Strengthening CITES implementation in Central America and the Caribbean

Species reviews

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Strengthening CITES implementation in Central America and the Caribbean: Species Reviews

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Executive Summary

In March 2019, Guatemala's National Council of Protected Areas (CONAP), with support from the Wildlife Conservation Society and UNEP-WCMC, hosted a workshop titled '*Exchange of experiences, guides and good practices in the preparation of non-detriment findings for CITES species'*. The workshop was held from the 5th to the 7th March 2019 in Guatemala City, and was attended by representatives of the CITES Scientific Authorities of Belize, the Dominican Republic, El Salvador, Guatemala, Honduras, Mexico, and Panama. It had three principal objectives:

(1) To develop regional capacity for the production of CITES non-detriment findings (NDFs);

(2) To provide a regional forum for CITES Scientific Authorities to exchange information, experiences and lessons learned in relation to the implementation of CITES, and

(3) To present in-depth reviews, carried out by UNEP-WCMC, of three specific taxa that are currently in international trade, which were highlighted by the CITES Authorities of the Central American region as taxa for which additional information would assist them with their CITES non-detriment findings.

The taxa chosen were a rosewood timber tree, *Dalbergia stevensonii* (Honduras rosewood), and two marine taxa: *Strombus gigas* (queen conch), and three species of the genus *Sphyrna* (hammerhead sharks). A draft report outlining aspects relevant to NDFs for each taxon (e.g. species biology, distribution, population status and trends, threats, trade levels and management actions within the respective range States) was submitted to the workshop with a view to making further progress on NDFs for these taxa. This report presents the final reviews conducted by UNEP-WCMC, which also incorporate information provided by the range States either prior to the workshop, during workshop discussion, or was submitted by countries for inclusion in the report shortly afterwards. Recommendations for further action are provided on a country basis where this is possible, or alternatively on a regional basis. It was noted by some range States that a lack of financial resources may prevent them from fully implementing all recommendations.

Summary of the status of taxa and key recommendations

Dalbergia stevensonii is a valuable rosewood and tonewood timber tree. It is restricted to Belize, Guatemala and Mexico, with the majority of the global population occurring in the Toledo District of Belize. The species' biological characteristics (slow growth, high levels of seed abortion, and habitat specificity), make it vulnerable to overexploitation, and it is threatened by habitat loss and illegal logging. Recent exports have been reported from Belize and Guatemala. The trade is largely wild-sourced; plantations exist in Guatemala, but the species grows very slowly in monoculture. In 2000-2014, increased international demand caused a significant reduction in commercial stocks, particularly in Belize. In response, Belize imposed a moratorium on logging and export in 2012 which was lifted in 2016 to allow tightly controlled harvest. In Guatemala, a population and abundance survey was conducted 2014-2016 and harvest follows broad government guidelines. Published information on population size and trends in Mexico are lacking, though the national population status was assessed in 2016-2018. The species has not been assessed by the IUCN.

Individual concessions are subject to management measures in Belize (mainly in community forests) and Guatemala, and regular monitoring to ensure compliance with management objectives is recommended. Non-detriment findings for individual concessions could be shared to assist with improving regional capacity to manage the species. Across the range, further enforcement efforts may be needed to address illegal trade in this species, and where government capabilities are stretched, community led enforcement mechanisms may be needed. Specific recommendations to range States are provided on pages 8-12.

Sphyrna lewini*, *S. mokarran* and *S. zygaena (scalloped hammerhead, great hammerhead, and smooth hammerhead shark) are widely distributed across warm temperate and tropical seas and have complex, coastal-pelagic life histories that vary by sex and developmental stage. Like many large sharks they are characterised by slow growth rates, low fecundity, and long lifespans; factors which combine to make all three

species highly vulnerable to overexploitation. Fishing is considered to be the primary threat to all three species, which are currently classified as Endangered (*S. lewini* and *S. mokarran*) or Vulnerable (*S. zygaena*) by the IUCN.

In Central America and the Caribbean, most sharks are captured either directly or indirectly by local artisanal small-scale fisheries. Many of these fisheries operate in nursery areas, and principally catch juveniles. Although principally targeted for their meat, exports of *Sphyrna* spp. from Central America consist predominantly of fins, with Hong Kong (Special Administrative Region of China) being the major importer. Management of shark fisheries is challenging, both as a result of the complex migratory patterns of many of the species involved, and a historical lack of species-specific data. A number of important steps have recently been taken to address these issues, including regional co-ordination of action plans and the implementation of harmonised data collection systems. Significant progress has also been made on designing a robust process for the realisation of non-detriment findings, with a number of guidelines now available to Parties wishing to export shark products. Nevertheless, significant challenges remain, including the absence of regional stock assessments, patchy implementation of protection measures such as closed seasons and minimum size requirements, and challenges relating to the high at-vessel mortality rates of all three species. Improvements in terms of data collection (species-specific catch data, catch per unit effort and conversion factors) are suggested, as well as strengthened management, including monitoring programmes that cover industrial and artisanal fleets, increased capacity for species identification, engagement with the CMS sharks MoU, stock assessments that use productivity and susceptibility analysis, prohibitions and enforcement. Detailed recommendations for range States of the Central American region are found on pages 32-37.

Strombus gigas (queen conch) occurs widely in the Caribbean Sea and Gulf of Mexico. The species is naturally vulnerable to harvesting due to slow growth, late maturation and aggregation in shallow waters for spawning. Populations have declined throughout the species' range as a result of overfishing and illegal harvesting. The key exporters in Central America are Belize, Honduras and Nicaragua. These countries have made progress towards implementing the Regional Queen Conch Management and Conservation Plan, which outlines multiple management measures.

It is recommended that countries publish results of their stock assessments and methodologies used to calculate quotas to improve transparency and regional capacity to manage *S. gigas*. In some cases, management actions are needed (e.g. harvest restrictions or plans for recovery of the species). Further collaborative efforts are also needed to coordinate enforcement challenges across the region. Specific recommendations are found on pages 92-97.

Overall, the CITES Authorities present at the workshop in March 2019 in Guatemala City showed a strong collaborative spirit, and the sharing of experiences including challenges and successes will help focus efforts to improve non-detriment findings for these taxa within the Central American region.

Introduction

This report provides in depth reviews of three taxa selected by the CITES Authorities of the Central American region for which it was noted that additional information would assist them with their CITES non-detriment findings (NDFs). The NDF process is a key science-based assessment to determine whether trade levels for CITES-listed species are sustainable. NDFs are required under Articles III and IV of the CITES Convention, which state that Parties shall only export Appendix II listed specimens (or Appendix I specimens for non-commercial purposes) when the CITES Scientific Authority of the State of export has advised that such export will not be detrimental to the survival of that species.

There is no "one size fits all" approach to NDFs, and different taxa have individual characteristics that present varying challenges for conducting these assessments. Undertaking NDFs in data poor environments can be challenging, particularly in situations where population trends are not well characterised, where species have complex life histories, or where species are highly migratory and move through areas under the jurisdiction of multiples Parties.

This report contributes to a wider project implemented by the Wildlife Conservation Society (WCS) that aims to strengthen CITES implementation in Central America and the Caribbean. WCS contacted the CITES Scientific Authorities of the nine focal countries (Mexico, Guatemala, Belize, El Salvador, Honduras, Nicaragua, Costa Rica, Panama and the Dominican Republic) requesting suggestions on priority CITES-listed taxa for review to assist with the development of scientifically robust NDFs. Three taxa that both occur within the region and are currently in international trade were selected for in depth review based on the country responses: *Dalbergia stevensonii* (Honduras rosewood), the genus *Sphyrna* spp. (hammerhead sharks), and *Strombus gigas* (queen conch).

Methods

Each taxon review provides the following information: biological characteristics, distribution, population status and trends, threats, trade (including CITES trade data and evidence of illegal trade) and management actions within the respective range States. These aspects are all relevant to the making of non-detriment findings. UNEP-WCMC consulted with focal countries to obtain specific information, and where responses were received they were included within the reviews. Management information (such as management plans etc.) were not available in all cases.

CITES Trade data are provided for a 10 year period, either 2007-2016, or 2008-2017 where 2017 data is available. Data were downloaded on 09/10/2018 and 27/01/2019. Trade tables all include direct trade (i.e. excluding re-export data), and trade volumes are reported by both exporters and importers. Recent biennial reports to CITES from the nine focal countries were consulted for any information on significant confiscations/seizures. Recommendations for further action are provided on a country basis where this is possible, or alternatively on a regional basis. Existing guidelines for making NDFs for queen conch, sharks and timber are also considered in the context of further action.

Dalbergia stevensonii

A. Summary and Recommendations

	Species characteristics summary: Biologically vulnerable to overexploitation (slow growing, few seeds successfully germinate) with distribution limited to a particular ecoregion.	**RECOMMENDATIONS**
BELIZE	Occurs in Toledo District, in the south eastern lowlands and the north western mountain highlands. Estimated population size in 2016 was 1.3 million individuals of ≥5 cm DBH, including 153 786 commercial-sized (>30 cm DBH) lowland individuals. The commercial subsector of the lowland population declined by approx. 50% 2008-2013 due to uncontrolled logging (reductions in the less-accessible mountain population were negligible over this period). However, high numbers of individuals in small size classes have been recorded. Main threats are habitat loss and illegal logging. Belize reported a decline in *D. stevensonii* direct exports of ~91% between 2013 (517.32 m^3) and 2015 (49.31 m^3), as a result of a harvest moratorium imposed 2012-2016. The moratorium was followed by restricted permits in 2016-2017. Belize has not yet submitted CITES annual reports for 2016-2017, but importers reported trade totals of 23.7 m^3 in 2016 and 18.02 m^3 in 2017 from Belize, showing a decline in direct trade of ~96% 2013-2017. Management involves tightly restricted numbers of logging permits for sustained-yield selective logging. Long-term forestry licenses have been granted; three are found in and around indigenous communities. Individual management plans were reported to be in place, with cutting cyles from 20-25 years. It is unclear whether 20 years is sufficient to allow maturation to commercial size between cycles, given slow growth rates. Key sustainability criteria in place for harvests are in place (e.g. trees of DBH 35-70 only; residual stocks of 50 trees/100 ha), and pre- and post-harvest monitoring is conducted by the Forestry Department. Protected areas cover approx. 42% of the species' range.	**NDFs:** Engagement with community-level groups should be continued, with regular monitoring conducted to check management objectives on an individual concession basis. The species status assessment should be repeated to assess population recovery on a national scale. Non-detriment findings for individual concessions could be shared to assist with improving regional capacity to manage the species. **ENFORCEMENT:** Strengthening enforcement checks on forest operations to help combat illegal harvesting and stockpile leakage. Where the species' range overlaps with community lands, subsistence use of the species by local communities should be defined.

GUATEMALA	Occurs in Alta Verapaz, El Quiché, Izabal and Petén Departments in scattered locations. Classified as Endangered in the country, with large trees (>40 cm DBH) reported to be scarce, indicating possible negative impacts of harvest. Some plantations are reported to occur, but growth is slow and majority of trade is wild-sourced. Average basal area was estimated at 0.1387-0.3153 m^2 per hectare in 2016. Main threats are exploitation, including illegal logging, damage by insects and phytopathogens, lack of a scientifically-established minimum cutting diameter, and habitat loss. Direct trade peaked in 2015 with a total of 220.9 m^3 sawn wood and logs reported by Guatemala and 212.67 m^3 reported by importers for this year. Harvest management plans are based on field inventories, and cutting intensity and minimum cutting diameters are determined individually for each forest stand based on general guidelines provided by INAB and CONAP. Cutting cycles are set at a minimum of 20 years, however, it is unclear whether this time scale is sufficient to allow maturation to commercial size between cycles, given slow growth rates. The species occurs in multiple protected areas. Enforcement includes government and community patrols and a newly-established forensic laboratory for wood identification.	**NDFs:** Comprehensive, species-specific management guidelines should be established. Robust assessments of population status (including growth rates) and harvest impacts should be completed. Measures to be developed include a scientifically-based minimum cutting diameter, annual allowable cut, and review of whether the cutting cycle is effective for this species. Regular monitoring should be conducted to check management objectives. Non-detriment findings for individual concessions could be shared to assist with improving regional capacity to manage the species. **ENFORCEMENT:** Strengthening patrolling and enforcement of forestry regulations would help combat illegal harvesting. This should include prohibiting extraction of stumps, as this precludes re-sprouting of felled trees.

MEXICO	Occurs in Chiapas State. No information on population size, but range was estimated at 3600 hectares. Main threats are habitat loss and degradation, followed by illegal logging. Virtually no trade in the species 2013-2017. The species was listed as Endangered in the country in 2018, which requires management and conservation plans to be developed before exploitation may be authorised. CONABIO (2018) reported that projects are currently underway to characterise the demographic and reproductive parameters of Mexican species of *Dalbergia*, with the aim of evaluating their conservation status and to develop an NDF for some species. No outcomes have yet been made available. The species also occurs in the Montes Azules Biosphere Reserve, which is subject to varying levels of protection.	**NDFs:** International trade is not currently anticipated. However if harvest or trade were to resume, improvement in knowledge and management of the species at the national level would be needed to support an NDF. Location and extent of stands should be verified. A population density survey should be conducted to ascertain the status of the population (including growth rates), with future monitoring to assess population trends. Following this, a comprehensive management plan should be developed. Robust assessment of harvest impacts should be completed. Measures to be developed could include a scientifically-based, species-specific minimum cutting diameter, cutting/logging/rotation cycle, and annual allowable cut. Regular monitoring conducted to check management objectives. **ENFORCEMENT:** Where the species' range overlaps with community lands, work with communities to ensure adequate management and conservation, and promote activities for the successful recovery of the species. Patrols could be strengthened to help combat illegal harvesting.

B. NDF guidelines and challenges in Central America

Non-detriment findings (NDFs) specifically for trees were first considered in depth at an NDF Workshop held in Mexico in 2008. Additional guidance has subsequently been developed, including the "nine-step" NDF process developed by Wolf *et al.* (2018). The "nine-step" guidance document provides a step-wise framework for determining whether a detailed NDF is needed, evaluating conservation concern and biological risk in the context of harvest and trade, and evaluating the impacts of trade and the efficacy of the management measures in place to mitigate concerns. Users can add data to an MS Excel spreadsheet to assist with the determination of an NDF based on low/medium or high risk factors. It is not clear if this guidance has previously been used by Belize or Guatemala in the context of *Dalbergia stevensonii*, or by other Parties in the region that export timber species, but it provides one useful approach to support CITES Scientific Authorities in the making of NDFs for timber. In Mexico the guidance was reported to have been used as a basis in the

evaluation process for the development of NDFs for all timber species, but current practices were reported to have moved beyond the process outlined in the guide (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019). If trade *in D. stevensonii* from Mexico were to be reopened, the CITES SA of Mexico noted that the "nine-step" guidance document would form part of the process employed for the development of NDFs (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019).

Challenges to NDFs specifically highlighted in this report include:

- ***Harvest:*** Official minimum cutting diameters are not reported from Guatemala, where they were reportedly determined on a case-by-case basis for each forest stand under harvest (INAB and CONAP, 2007). In Belize, a "self-imposed" minimum cutting diameter of >30 cm DBH was noted by Cho (2016), and in community-based forestry groups, a minimum and maximum cutting diameters of 35 cm and 70 cm DBH respectively was reported (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019). In Mexico, the minimum cutting diameter for the species is 35 cm DBH (J. Noguez *in litt.* to UNEP-WCMC, 2019). Selection and enforcement of official minimum cutting diameters should bear in mind the high degree of wastage inherent in harvesting heartwood of *D. stevensonii* (CoP 16 Prop. 62), as well as the importance of maintaining some large, mature seed trees for recruitment and population persistence (Gutierrez, 2016).

Other relevant issues identified:

- ***Wood identification:*** All *Dalbergia* species, including look-alikes of *D. stevensonii*, have recently been listed on CITES Appendix II, but implementation of CITES regulations requires timber traceability and wood identification capabilities to species level. *D. stevensonii* timber is known to be very similar in appearance to *D. tucurensis*, another Central American rosewood species (Wiemann and Ruffinatto, 2012). The two species can be differentiated based on wood density, but the samples being tested must be of equal moisture content to accurately differentiate in this way (Wiemann and Ruffinatto, 2012). Guatemala's recently established forensic laboratory for timber identification and accompanying technical manual present opportunities for regional information sharing and capacity building in wood identification.

- ***Pre-Convention stockpiles:*** Due to the risk of leakage from pre-Convention stockpiles of *D. stevensonii* timber in Belize, the Environmental Investigation Agency (2014) recommends adoption of a transparent process for inventorying stockpiles.

- ***Enforcement:*** Illegal logging is a persistent threat to *D. stevensonii* in all range States. Where government enforcement capabilities cannot be strengthened, community-led enforcement mechanisms, such as the Sarstoon Temash Institute for Indigenous Management cross-border collaboration (SATIIM, 2016), should be supported throughout the species' range.

Other initiatives supporting NDFs for timber species:

The ITTO-CITES programme on tree species, a collaboration between the International Tropical Timber Organization (ITTO) and the CITES Secretariat, aims to ensure that international trade in CITES-listed timber species remains consistent with their conservation and sustainable management[1]. In particular, the programme supports range State capacity building activities focussing on NDFs, national legislation and enforcement to ensure effective CITES implementation for Appendix II-listed timbers. The programme launched in 2007 and, from 2014-2016, supported the Government of Guatemala and partners in the implementation of a national population and abundance survey for *D. stevensonii* and the establishment of a forensic laboratory for timber identification (ITTO-CITES, 2015; Fundacion Naturaleza para la Vida, 2016a).

[1] https://www.cites.org/eng/prog/itto.php

A further project, the CITES Tree Species Programme (2017-2021) aims to financially support CITES Parties in ensuring that their trade in CITES-listed timber species is "sustainable, legal and traceable" (PC24 Doc. 9.2). A regional meeting for the Central and South American region was held in Argentina in September 2018, however, no published outcomes are yet available.

C. Species characteristics

Biology: *Dalbergia stevensonii* is a medium sized, tropical hardwood tree restricted to broadleaf forest habitats in Belize, Guatemala and Mexico (PC19 Doc. 16.1.3). It is typically restricted to moist to wet forest on non-calcareous acidic soils (Cho, 2016). This forest type appears to be characteristic of the Petén-Veracruz moist forest ecoregion of Central America (Mendelssohn *et al*., 2017), which occurs only in Belize, Guatemala and Mexico (Sarkar *et al*., 2009). The ecoregion extends from south east Mexico (southern Veracruz and northern Chiapas States) across northern Guatemala and Belize (Mendelssohn *et al*., 2017), and thus appears to limit the potential global distribution of *D. stevensonii* to this area.

D. stevensonii can attain a height of 15-30 m and a diameter of 91 cm, and individuals commonly have fluted trunks that fork approximately 6-8 m from the ground (Chudnoff, 1984). The dense heartwood is pinkish brown to purple in colour with irregular black markings, surrounded by a 3-5 cm thick layer of whitish-yellow sapwood (Longwood, 1962).

D. stevensonii individuals can live for over 200 years (Cho, 2016). Individuals are slow growing (Jenkins *et al.*, 2012), but experience intermittent faster growth spurts assumed to correspond to periods of increased resource availability (Cho, 2016). Cho (2016) reported that "the age or size at which the species reaches reproductive maturity is not well known" but stated that 20 cm diameter at breast height (DBH) was accepted as the minimum reproductive size for silviculture. A three-year study of 100 individuals within the Golden Stream Corridor Preserve, Belize, reported an average annual diametric increase of 0.32 cm, and estimated that an average sapling of 5 cm DBH would take approximately 115 years to reach a diameter of 45 cm (Gutierrez and Dorgay, 2017). Another study, using 30 census measurements from 48 individuals from lowland Toledo, Belize, calculated an average diametric increase of 0.40 cm per year and determined that annual diametric growth increased with size class: slowest at size classes <10 cm DBH, increasing rapidly at size classes between 25-40 cm DBH, and fastest in individuals of ~40 cm DBH (Cho, 2016). The authors remarked that growth appeared to "slow dramatically" once individuals surpassed 40 cm DBH, but stated that this could not be confirmed due to a scarcity of estimates from large individuals, which are "naturally very rare" (Cho, 2016). Gutierrez and Dorgay (2017) also reported that *D. stevensonii* has the ability to re-sprout from stumps, though they noted that further monitoring is needed to determine heartwood regeneration time.

D. stevensonii is monoecious (de Stefano *et al.*, 2016). Although the species' pollination mechanism is not fully understood, it is not known to be adapted to a specialist pollinator species, and may exhibit similar mechanisms to other Central and South American *Dalbergia* tree species (PC19 Doc. 16.1.3). *D. nigra* and *D. retusa* are pollinated by bees (PC19 Doc. 16.1.3). *D. stevensonii* seeds are wind-dispersed (de Stefano *et al.*, 2016).

The species exhibits a high degree of seed abortion (Jenkins *et al.*, 2012; Gutierrez, 2016) and Smith (2016) observed that, although *D. stevensonii* produces flowers and seed in abundance, very few seeds successfully germinate. Cho (2016) noted that the seeds are likely to require high light conditions for successful germination, indicative of a "pulse recruitment strategy" in which a species displays long periods of low recruitment interspersed with shorter periods of high recruitment triggered by severe canopy disturbance, such as that caused by hurricanes. It is suggested that *D. stevensonii* seed health and recruitment may also be negatively affected by insects (Herrera *et al.*, 2016). Gutierrez (2016) observed that the proportion of trees in reproductive condition increases with size class, and emphasised the importance of larger trees for seed production. Gutierrez (2016) also suggested that changes in weather patterns from year to year may influence the species' reproductive timing and success, a problem likely to be exacerbated by climate change.

Distribution: *D. stevensonii* is restricted to latitudes between 16-17° N (UNEP-WCMC, 1998). The species occurs in Central America in the regions of Toledo in Belize, Alta Verapaz, El Quiché, Izabal and Petén in Guatemala, and Chiapas in Mexico (Gill *et al.*, 2013).

Although the species has also been reported from Honduras, this is likely to be an error resulting from use of the common name "Honduras rosewood", which refers to Belize, formerly British Honduras (Gill *et al.*, 2013). Pinelo (2012 in Gill *et al.*, 2013) stated that there is no suitable habitat for the species in Honduras.

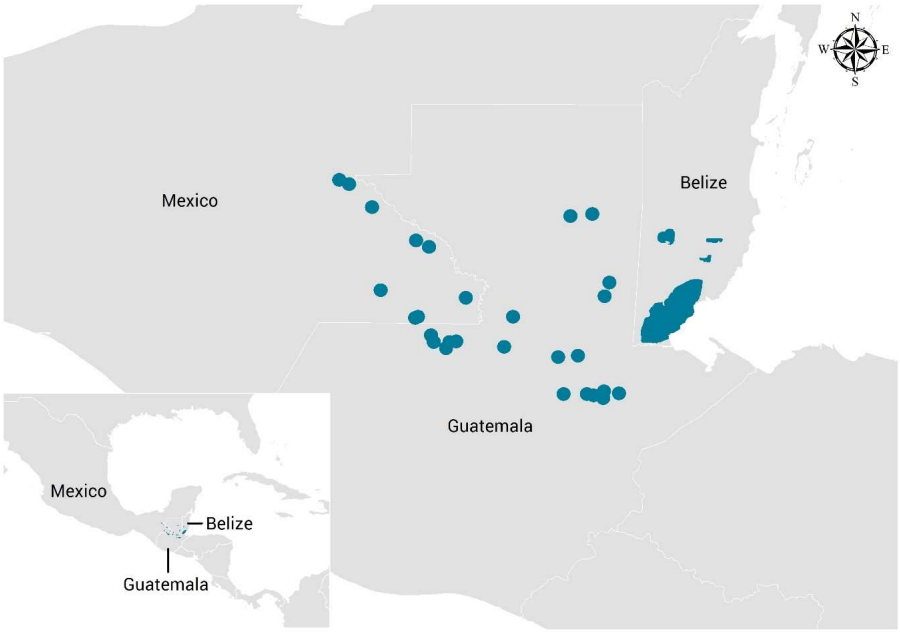

Figure 1: Distribution of *Dalbergia stevensonii*

Source: Belize Dalbergia stevensonii *population density data digitised from Cho (2016); Guatemala* D. stevensonii *occurrence data digitised from Fundacion Naturaleza para la Vida (2016b); Mexico* D. stevensonii *occurrence data digitised from CONABIO (2015 in de Stefano* et al*., 2016).*

Population status and trends: The majority of the global population of *D. stevensonii* occurs in the Toledo District of southern Belize (Gill *et al.*, 2013). Recent density estimates ranged from ~7 individuals per hectare (≥5 cm DBH) in Belize (Cho, 2016), to 4.52 individuals per hectare (>10 cm DBH) in Guatemala (ITTO-CITES, 2015). No population estimates were available for the species in Mexico at the time of writing.

D. stevensonii has not yet been assessed by the IUCN Red List of Threatened Species (IUCN, 2019), however, (Vivero *et al.*, 2006) proposed a global Red List category of Vulnerable.

Threats: Deforestation and degradation caused by agricultural expansion, livestock ranching, and human population growth is considered the main threat to *D. stevensonii* across its range (CoP 16 Prop. 62). These pressures are compounded by habitat specificity and the limited extent of remaining habitat in all range countries (CoP 16 Prop. 62).

The species is also harvested as a valuable rosewood and tonewood timber tree (Jenkins *et al.*, 2012; Environmental Investigation Agency, 2016). Although now of limited availability in international trade (Gill *et*

al., 2013), the species has been traded commercially, mainly from Belize, since the 1800s (Heinzman *et al.*, 2015). Over the period 2000-2014, harvest for the decorative furniture trade accelerated (Treanor, 2015), significantly reducing commercial stocks (Cho, 2016). Illegal logging of *D. stevensonii* has been reported in Belize (Environmental Investigation Agency, 2014), Guatemala (TRAFFIC, 2018) and Mexico (de Stefano *et al.*, 2016). Ongoing demand for *D. stevensonii* timber puts additional pressure on remaining wild stands (CoP 14 Prop. 32).

D. stevensonii resilience and recovery is impeded by intrinsic life history characteristics; the species is slow growing and prone to high levels of seed abortion (Jenkins *et al.*, 2012). Developing fruits and seeds are susceptible to insect and phytopathogen damage (Herrera *et al.*, 2016). Furthermore, the species' seasonal phenology is sensitive to changes in climate and unseasonal weather events, indicating that climate change is likely to adversely impact recruitment (Gutierrez and Dorgay, 2017).

Overview of trade and management:

Historic trade

The commercially valuable heartwood of *D. stevensonii* has been prized in international trade for its colouration, density and tonal qualities since the 1800s (Heinzman *et al.*, 2015). In 2012, Jenkins *et al.* reported that the species had an average market value of 11 004 USD per cubic metre sawn wood and 77 471 USD per cubic metre instrument blanks[2].

Removal of the low-value sapwood causes a high degree of wastage from cut lumber, and preference for the straightest grain, particularly for the manufacture of xylophones and marimbas, can cause wastage of up to 80% (CoP 16 Prop. 62). At the time of writing, no conversion factors could be found for the species.

The species is often traded under the common name "Honduras Rosewood", referring to Belize (formerly British Honduras) historically dominating the international trade in *D. stevensonii* (Wainwright and Zempel, 2018). Demand for *D. stevensonii* as a hongmu ("red wood") furniture species has increased significantly in recent years (Treanor, 2015; Environmental Investigation Agency, 2016), leading to the loss of approximately 50% of commercial stocks in Belize from 2008 to 2012 (Cho, 2016). *D. stevensonii* was additionally recommended by several guitar manufacturers as a substitute for *D. nigra* in these instruments, after the latter species' listing in CITES Appendix I (CoP 16 Prop. 62).

Listing in CITES

D. stevensonii was listed in CITES Appendix II on 12th June 2013, with the listing applying to logs, sawn wood, veneer sheets and plywood. Prior to this, the population of Guatemala was listed on Appendix III on 12th February 2008. The genus *Dalbergia* was listed in Appendix II (except for *Dalbergia* spp. listed in Appendix I) on 2nd January 2017[3]. There are currently no CITES quotas or suspensions in place for the species.

D. stevensonii had been previously proposed for listing in Appendix II at CITES CoP14 in 2007. However, the proposal was withdrawn and range and import states were recommended to increase information sharing on the species' population status, trends, and trade (Gill *et al.*, 2013).

Analysis of trade in *D. stevensonii*, post-listing

According to the CITES Trade Database, global direct exports in *D. stevensonii* for the period 2013-2017 consisted primarily of wild-sourced sawn wood exported from Guatemala (a total of 736.38 m^3 reported by exporters and 364.26 m^3 reported by importers) for commercial purposes, and pre-Convention logs and timber, also for commercial purposes, exported from Belize (a total of 576.96 m^3 reported by Belize and 425.87 m^3 reported by importers) (Fig. 2). Over the same time period, Mexico did not report any exports,

[2] Sawn wood for use in making instruments

[3] CoP17 Annotation #15 adds: "All parts and derivatives are included, except a) Leaves, flowers, pollen, fruits, and seeds; b) Non-commercial exports of a maximum total weight of 10 kg per shipment; c) Parts and derivatives of *Dalbergia cochinchinensis*, which are covered by Annotation # 4; d) Parts and derivatives of *Dalbergia* spp. originating and exported from Mexico, which are covered by Annotation # 6"

though the United States of America (hereafter United States) reported the import of a single, wild-sourced specimen (no unit of measurement given) from Mexico for scientific purposes.

During 2013-2017, according to exporters, the majority (93.4%) of direct exports of wild-sourced *D. stevensonii* was exported by Guatemala (736.38 m^3 sawn wood and 60 m^3 of logs), with exports peaking in 2015. The remaining 6.6% of wild-sourced direct trade reported in cubic metres originated in Belize (56.35 m^3 of timber). Belize, however, reported the export of large quantities of pre-Convention wood (617.46 m^3 of timber and sawn wood, presumably originating from the wild as Belize has no *D. stevensonii* plantations). The majority of the pre-Convention timber (76.5%) and all of the pre-Convention sawn wood was exported in 2013, with volumes of pre-Convention timber declining steeply thereafter (Fig. 3). Guatemala and Mexico did not report any pre-Convention exports.

China imported the highest quantities of wild-sourced *D. stevensonii* during the period 2013-2017, followed by the United States and Germany, as reported by both exporters and importers.

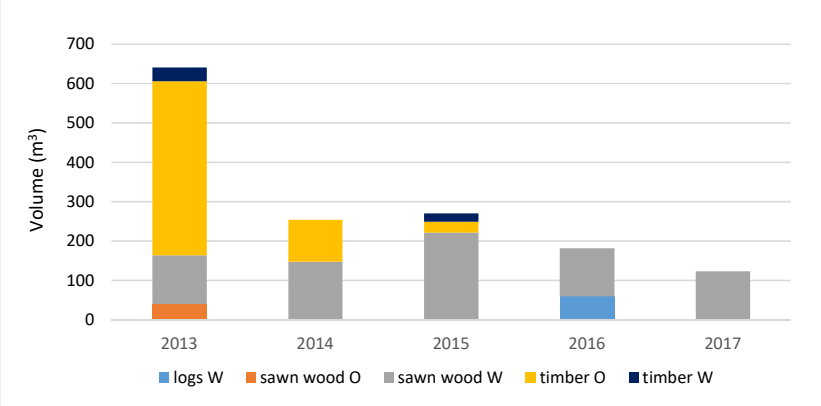

Figure 2: Direct exports of wild-sourced (W) and pre-Convention (O) *Dalbergia stevensonii* wood for commercial purposes from Belize, Guatemala and Mexico, 2013-2017, as reported by exporters. Belize has not submitted annual reports for the years 2016-2017, and Mexico has not submitted an annual report for 2017.

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 10/12/2018

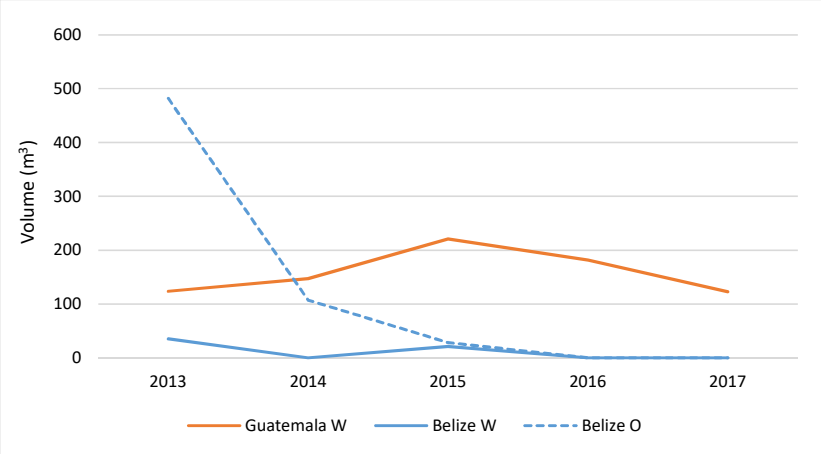

Figure 3: Direct exports of wild-sourced (W) and pre-Convention (O) *Dalbergia stevensonii* for commercial purposes from Belize and Guatemala, 2013-2017, as reported by exporters. Belize has not submitted annual reports for the years 2016-2017.

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 10/12/2018

D. Country reviews

Belize

Distribution: It has been suggested that *D. stevensonii* was once locally common throughout Belize (Environmental Investigation Agency, 2016), but by the early 20th Century the population was reported to be "confined to Toledo" (Standley and Record, 1936). The species' current population is concentrated within Toledo District in the south of the country (Gill *et al.*, 2013). The broadleaf forest type preferred by the species covers approximately 423 000 hectares of Toledo, half located in wet to moist lowland broadleaf forests in the south eastern part of the district and half in the drier mountain highlands to the north west of the district (Cho, 2016). Chudnoff (1984) reported that the species occurred in "fairly large patches along rivers but also on inter-riverine and drier areas; mostly between Sarstoon and Monkey Rivers".

Population status and trends: Belize is home to 10 species of *Dalbergia* (according to Species+[4]), and has the largest known population of *D. stevensonii* in the world (Gill *et al.*, 2013). Recently, the Belize Forest Department recognized the need for a scientific non-detriment finding for *D. stevensonii* and, as a result, a Darwin Initiative project co-led by the University of Oxford, the Belize Forest Department and the University of Belize was conducted from June 2014 to March 2017 (Cho, 2015). As part of this project, a comprehensive population survey was conducted 2014-2016 by the Belize Forest Department (Cho, 2016), covering 173 766 hectares of forest. The species population within the survey area was estimated to comprise approximately 1.3 million individuals of ≥5 cm DBH (approximately seven per hectare). As the survey area

[4] UNEP 2019. The Species+ Website. Nairobi, Kenya. Compiled by UNEP-WCMC, Cambridge, UK. Available at: www.speciesplus.net. [Accessed: 29/01/2019].

represents approximately half of the estimated habitat available for the species in Toledo, the national population is therefore likely to be larger than 1.3 million individuals.

The 2014-2016 survey incorporated datasets from pre-existing permanent sample plots, forest inventory plots assessed in 2008 and 2011-2014, historic logging records from extraction areas dating from the 1920s, and botanical records from protected areas (Cho, 2016). These datasets were then supplemented with population surveys from 272 sample plots (136 hectares of forest) representing a sampling intensity of 0.113%; based on previous forest inventories in Belize; this proportion was deemed sufficient to produce a reliable estimate of population density per hectare (Cho, 2016). Placement of the 272 sample plots within the species' estimated range prioritised sustainably-managed lowland areas where the species is harvested for export and, secondarily, areas where the species is subject to non-sustained selective logging (Cho, 2016). Lowland populations in these two land-management categories were considered a higher priority than the equivalent mountain populations, as lowland forest is more easily accessible and less well-protected than mountain areas in Toledo District (Cho, 2016).

The lowland population in Toledo was reported to have suffered a reduction of approximately 17.3% "in recent years" as a result of unsustainable and illegal logging 2008-2013 (Cho, 2016). Cho (2016) noted that this reduction predominantly affected the "merchantable subsector" of the population, which declined by approximately 50%, falling from ~318 017 individuals (1.8 per hectare) pre-2008 to ~153 786 individuals (0.9 per hectare) in 2016. Individuals of below-commercial size (<30 cm DBH) in the lowlands were reported to have declined by approximately 5.8% over the same time period, from ~953 161 individuals (5.5 per hectare) to ~900 000 individuals (5.2 per hectare), due to uncontrolled cutting for fence posts or small exportable lumber (Cho, 2016). Despite the substantial decline in the merchantable subsector of the lowland population of *D. stevensonii*, the relatively high numbers of individuals in smaller size classes indicated high potential for recruitment, with overall lowland population structure showing a typical reverse-J shaped curve of size classes (see Fig. 4) (Cho, 2016). The mountain population was deemed to have suffered only "negligible reductions in the merchantable subsector" during the period 2008-2013 (Cho, 2016). The Belize Forest Department (CITES SA of Belize *in litt*. to UNEP-WCMC, 2019) noted that healthy populations were found in and around indigenous communities.

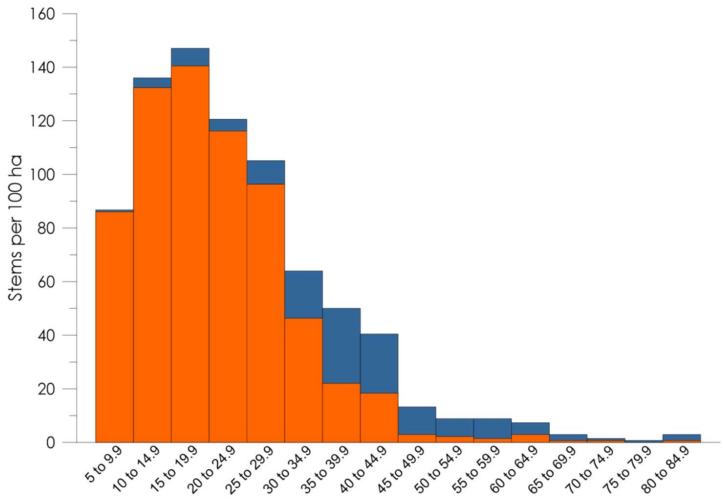

Figure 4: Lowland population structure of *Dalbergia stevensonii* in an average 100 hectares of forest in Toledo, Belize prior to uncontrolled logging circa 2008 (blue), and after uncontrolled logging ceased in 2013 (orange).

Source: Cho (2016) (permission pending)

Prior to the 2014-2016 survey, Belize's proposal to list the species on CITES Appendix II cited an estimate (methodology unknown) from 2012 that put the commercially-viable standing stock in Toledo District at 140 000 m^3, believed to represent a 13% decrease since 2009/2010 (Gill *et al.*, 2013).

Threats: In 2011, the total forested area in Belize was reported to be 1 393 000 ha, of which 599 000 ha was primary forest, with a deforestation rate of 0.68% 2005-2010 (Blaser *et al.*, 2011). Toledo District was reported to be losing approximately 2020 ha of forest annually (Environmental Investigation Agency, 2014). The high rate of human population growth and an expanding road network in the district improved access to forested areas, which were reported to be under increased pressure from settlements and agricultural expansion (Gill *et al.*, 2013).

The main threat to *D. stevensonii* in Belize was considered to be land conversion in areas of the species range that are neither sustainably managed for timber production nor protected (Cho, 2016). However, the Ya'axché Conservation Trust reported Guatemalan incursions across the western border of Columbia River Forest Reserve 2013-2015 resulting in continuous cutting of "small clearings" for farming, cattle ranching and marijuana production, indicating that protected areas in Toledo are also subject to some land use change (Gutierrez, 2016).

In addition to land use change, selective logging is recognised as a long-term threat to *D. stevensonii* in Belize, and was considered the greatest threat to the species 2007-2012, when unsustainable logging peaked in the country (Gill *et al.*, 2013). Gill (*in litt*., 2012 in CoP 16 Prop. 62) further noted that a "high number" of large, seed-bearing trees had been extracted during this period. The Belize Forest Department (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019) noted that during previous unsustainable harvesting, a large proportion of the tree had been typically left in the forest after conversion to flitches (squared, de-barked logs) and a conversion efficiency (tree to flitch) of 24% was estimated. In 2011, the Belize Forest Department declined a request for permission to uproot stumps of logged *D. stevensonii* for export (Gill *et al.*, 2013). Although the reason for the refusal is unclear, it may possibly have been because the species is known to re-sprout from stumps.

Belizean *D. stevensonii* has been an important commercial export since the early 19th Century (Gill *et al.*, 2013) and was the primary tonewood species for various percussion instruments including xylophones (PC18 Doc. 16.1.3.). From the 1930s onwards, the species was exported as a decorative hardwood (Heinzman *et al.*, 2015). An inventory in 1978 revealed that the majority of *D. stevensonii* stocks in Columbia River Forest Reserve in the Toledo District had been extracted (Gill *et al.*, 2013).

D. stevensonii is also increasingly sought after for rosewood furniture as an official hongmu species recognised by China's National Hongmu Standard (Treanor, 2015). Wainwright and Zempel (2018) stated that the harvesting boom was driven by a reduction in rosewood stock from Southeast Asia, coupled with a "change in tariff policy" making rosewood from outside Southeast Asia more competitive. Extraction of the species from Toledo increased steadily from 2007 onwards, peaking in February 2012 (Gill *et al.*, 2013). Much of the harvest was fuelled by Asian demand for rosewood timber (Jenkins *et al.*, 2012; Environmental Investigation Agency, 2014). Gill *et al.* (2013) reported Chinese imports of >6000 m^3 of Belizean rosewood of unspecified species in 2010-2012.

Although the species is now of limited availability in international trade (see *Trade* and *Management* sections), illegal harvest for the Chinese market (Environmental Investigation Agency, 2016) was reported to pose a threat to *D. stevensonii* in Belize. Cross border incursions by illegal loggers from Guatemala have been reported from Chiquibul and Columbia River Forest Reserve (Ministry of Agriculture, Forestry, Fisheries, the Environment and Sustainable Development, 2016). Jenkins *et al.* (2012) reported that, in July 2011, the Maya Leaders Alliance had registered concern about illegal logging in Toledo and had stated that they were aware of three active rosewood collection/buying sites in the district. Multiple instances of illegal rosewood logging were reported 2012-2013 by residents of Golden Stream, Toledo (Maya Leaders Alliance and Cultural Survival, 2013). A "lack of traceability for species cut outside of protected areas and a lack of definition of subsistence traditional use by indigenous communities" also pose threats to *D. stevensonii* in Belize, according to Lee Mcloughlin of Wildlife Conservation Society-Belize (Mcloughlin, L., pers. comm. 23rd November 2018). Mcloughlin added that there is "significant" abuse of the petty permit system (see *Management*).

The completion of the Southern Highway in 2009 made the forests of Toledo more accessible and transporting timber from point of harvest to point of export is now "considerably easier" (CoP 16 Prop. 62). Additionally, the Environmental Investigation Agency (2014) voiced concerns that the country's export quota for pre-Convention stocks, set at 400 000 board feet, posed a "major loophole in the CITES listing" as stockpiles were not secure and were subject to leakage and replacement with newly-cut timber.

Trade: Belize has submitted CITES annual reports for the years 2013-2015 but reports for 2016 and 2017 have not yet been received. Belize has never published export quotas for *D. stevensonii*.

According to the CITES Trade Database, direct trade in *D. stevensonii* from Belize 2013-2017 predominantly consisted of pre-Convention logs, timber and sawn wood (a total of 617.46 m^3 reported by Belize and 453.85 m^3 reported by importers) (see Table 1). Wild-sourced exports comprised relatively smaller quantities of timber, logs and sawn wood (56.35 m^3 reported by Belize and 173.88 m^3 reported by importers).

Overall, the majority of direct trade took place in 2013 (517.32 m^3 reported by Belize and 463.22 m^3 reported by importers). Although Belize has not yet submitted annual reports for 2016-2017, importer-reported trade showed a decline of ~96% between 2013 (463.22 m^3) and 2017 (18.02 m^3). Belize's own reports showed a decline of ~91% between 2013 (517.32 m^3) and 2015 (49.31 m^3). All trade in *D. stevensonii* was for commercial purposes.

China was the main importer 2013-2014, whereas all trade 2015-2017 was to the European Union (hereafter EU) (Netherlands and Spain) and the United States. The majority of trade that took place during Belize's harvest and export moratorium 2013-2016 was in pre-Convention items; however, the United States reported an import of 14 m^3 wild-sourced sawn wood in 2014 and Belize reported exporting 21.01 m^3 of wild-sourced timber to Spain in 2015, and it is unclear whether these permits were issued before or during the moratorium.

The majority of indirect trade in *D. stevensonii* originating in Belize consisted of wild-sourced carvings, for commercial purposes, re-exported in 2017 by Germany to the United States (1129.84 kg reported by Germany and 1130 kg by the United States).

Previously, (1999-2012), Belize exported approximately 26 000 m^3 of rosewood, the majority of which was thought to be *D. stevensonii* (Gill *et al.*, 2013).

Table 1: Direct exports of *Dalbergia stevensonii* from Belize for the years 2013-2017. Belize has not yet submitted annual reports for the years 2016-2017. [Key to source codes: 'O' = Pre-Convention; 'W' = wild-sourced; 'I' = seized or confiscated. All units are in cubic metres, and purpose code is 'T' (commercial purposes) for all shipments.]

Importer	Term	Source	Reporter	2013	2014	2015	2016	2017	Total
China	logs	O	Importer	335.07	90.8				**425.87**
			Exporter						
		W	Importer	94.5					**94.5**
			Exporter						
	sawn wood	O	Importer						
			Exporter	40.5					**40.5**
	timber	O	Importer						
			Exporter	428.25	56				**484.25**
		W	Importer	0.3					**0.3**
			Exporter	2.16					**2.16**
Germany	sawn wood	W	Importer	13.35					**13.35**
			Exporter						
	timber	O	Importer						
			Exporter	13.22					**13.22**
Netherlands	sawn wood	O	Importer			27.98			**27.98**
			Exporter						
		W	Importer				8.7	17.97	**26.68**
			Exporter						

	timber	O	Importer						
			Exporter		51.1	28.29			**79.39**
Spain	timber	W	Importer						
			Exporter			21.01			**21.01**
USA	sawn wood	I	Importer	10					**10**
			Exporter						
		W	Importer	10	14		15	0.05	**39.05**
			Exporter						
	timber	O	Importer						
			Exporter	0.01	0.09	0.01			**0.10**
		W	Importer						
			Exporter	33.18					**33.18**

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 05/12/2018

Management:

Previous species management

Belize banned roundwood exports of *D. stevensonii* in 1992 under Statutory Instrument No. 87 after a rapid decline in stocks, but the ban was lifted in 1996 (Environmental Investigation Agency, 2014).

In 2001, the northern population of *D. stevensonii* in Toledo sustained damage from Hurricane Iris and in the aftermath the Belize Forestry Department is reported to have granted salvage logging permits without restriction on the size or number of individuals that could be harvested (Fauna and Flora International, 2007 in Gill *et al.*, 2013).

D. stevensonii was listed in the First Schedule of the Belize Forests Act 2003, requiring a licence to cut the species within forest reserves, national land and private lands encompassed by the Act (CoP 16 Prop. 62). However, Gill (*in litt*., 2012 in CoP 16 Prop. 62) reported that harvest from community lands was mainly conducted under short term licences or petty permits that were "notoriously difficult to monitor or manage", and that "in 2011-12 there seems to have been a free-for-all to extract as much rosewood as possible and monitoring this seems to have been beyond the capacity of the Forestry Department".

In March 2012, the Minister of Forestry, Fisheries and Sustainable Development enacted a moratorium on harvest and export of *D. stevensonii*, overriding all pre-existing licenses to harvest the species (Gill *et al.*, 2013). Exports were permitted to continue for a brief period after the moratorium was announced, and a reported 1378 m^3 was exported February-July 2012 with the last legal export dated 24th August 2012 (Gill *et al.*, 2013). Gill *et al.* (2013) projected that, had harvest been allowed to continue at pre-moratorium rates, the species would have become commercially extinct in Belize by 2033.

Belize proposed listing *D. stevensonii* in CITES Appendix II at the 16th Conference of the Parties in March 2013, and the listing came into force for logs, sawn wood, veneer sheets and plywood on 12th June 2013.

Current species management

The moratorium on harvest and export of *D. stevensonii* was lifted in 2016 to allow restricted international trade in timber harvested under long-term forest licences (Mcloughlin, L., pers. comm. 23rd November 2018). Licenses have since been issued which allow for 40 years of forestry activity (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019). Mcloughlin stated that "legal international trade of rosewood, which is sourced from long term forest licences… is well managed given the tight restrictions after the 2016 lifting of the moratorium put in place in 2012", but also noted that there is "an undetermined amount of domestic illegal trade, which may

cross borders, especially in the south where enforcement is limited" (Mcloughlin, L., pers. comm. 23rd November 2018).

Logging was also previously permitted under one-year licences and petty permits allowing extraction of timber up to the value of $50 Bze for sale or domestic use (Martinez, 2012). However, Belize's 2016-2020 National Biodiversity Action Plan stated an intention to reduce or phase out short term forest licenses and petty permits, citing "limited human and financial resources for monitoring" and limited incentives for concession holders "to not take short cuts", leading to unsustainable practices (Ministry of Agriculture, Forestry, Fisheries, the Environment and Sustainable Development, 2016).

A draft NDF for *D. stevensonii* was conducted by Cho (2016) as part of a UK Darwin Initiative funded project, which is now being used by the Belize Management Authority. The draft NDF contained a review of the population status of *D. stevensonii* in Belize, including population density estimates, population distribution, land use including designation of commercial production and protection forests, and threats to the species (Cho, 2016). However, the NDF was noted to be incomplete, with some aspects, including an assessment of the species' management including a sustained yield model and cutting cycle, represented by headings only (Cho, 2016). Cho (2016) reported that 32% of the species' range in Toledo is in areas designated for sustained-yield timber production and that loggers select individuals for harvest based on a "self-determined" minimum cutting size of 30 cm DBH due to the favourable ratio of heartwood to sapwood at this girth. Cho (2016) noted that enforcement of the minimum cutting size was lacking.

Cho (2016) stated that 26% of the species' range is at risk of land conversion in areas of private and community tenure forest that are not managed by the government or conservation NGOs. Accordingly, the Belize Forest Department reported that it was working with three community-based foresty groups (Conejo Creek, Santa Teresa and Boom Creek) as well as the Chiquibul Forest Reserve, to provide technical capacity to assist with sustainable management at community level (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019). Long-term forestry licences have been granted with 20-40 year cutting cycles in these four areas, where numerical sustainability critera are used (e.g. minimum and maximum cutting diameters are 35 cm dbh and 70 cm dbh respectively, mortality rate is 20 seed trees per 100 ha, residual stocks must be 50 trees/100 ha that are 25 cm DBH or more) (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019). These criteria were developed using data from permanent sample plots monitored since 1993 (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019).

In pre-harvest censuses, trees are documented, mapped and tagged, then designated into one of five "functional categories": future trees, seed trees, reserve trees (in buffer zones, not harvested), preserve trees (>70cm) and crop trees (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019). The CITES SA of Belize (*in litt.* to UNEP-WCMC, 2019) noted that at the community level, the management system includes growth, mortality and yield modelling [the yield model provided by the CITES SA of Belize indicated a minimum cutting diameter of 40 cm for rosewood]. The harvest quota is based on actual accruement of yield over the cutting cycle, then an export quota is set at 10% lower to account for some timber of poorer quality (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019).

A forest ranger is assigned to each concessionaire for the season, with every tree for harvest being verified against an approved list, and a penalty is in place for extraction of a "reserve tree" (equating to three times the equivalent volume subtracted from the export quota) (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019). Post-harvest audits take place within two months after logging to assess compliance with conditions set in the plan of operations and assess damage caused by logging operations in a sample area (e.g. felling techniques, size of canopy openings) (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019).

Traceability systems for monitoring harvested timber was noted to be in place as part of the annual operation plan to track "from stump to port", whereby trees are tracked from the stump to sawmill, with documentation passed on at the point of sale. Shipments are inspected three times to 1) verify the product form, species and quality, 2) verify it against packing lists and seal it temporarily in containers, and 3) verify the permits, and release it at the port inspection (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019).

The Sarstoon Temash Institute for Indigenous Management (SATIIM), a cross border collaboration between Belizean and Guatemalan communities, has recently partnered with Global Forest Watch (GFW) to create a community-led forest monitoring and patrol network in the Sarstoon Temash river basin and surrounding area that will collect data on disturbance events such as illegal logging, document forest change, and provide updates to the Belize Forestry Department and GFW (SATIIM, 2016).A management plan was noted to exist for the Conejo Creek Community (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019), which was produced by STIIM. According to the STIIM website, the Conejo Community Forest Sustainable Management Plan has a 20 year cycle, whilst the Santa Teresa has a 25 years cycle (STIIM, 2019).

The Ya'axché Conservation Trust and Fauna and Flora International are also reportedly working in partnership with local communities in Toledo District to promote sustainable development and a reduction in damaging land practices (Gutierrez and Dorgay, 2017).

An estimated 42% of the range of *D. stevensonii* in Toledo occurs in protected areas where resource extraction is prohibited (Cho, 2016). The species is known to occur in Golden Stream Corridor Preserve, Bladen Nature Reserve, Sarstoon Temash National Park, Cockscomb Basin Wildlife Sanctuary, Deep River Reserve, Maya Mountain North Forest Reserve, and Columbia River Forest Reserve (CoP 14 Prop. 32). Both Golden Stream Corridor Preserve and Cockscomb Basin Wildlife Sanctuary were reported to be under a high level of protection (CoP 14 Prop. 32). The eastern side of Bladen Nature Reserve was considered well-protected, while the western side was reported to be subject to cross border illegal logging incursions (Gill *et al.*, 2013).

Currently, there are no *D. stevensonii* plantations in Belize, and all harvest is from wild populations (Cho, 2016). Following Hurricane Iris in 2001, the Ya'axché Conservation Trust established a planting scheme using harvested seed, with little success (Gill *et al.*, 2013), however, the Trust continues to conduct research into *D. stevensonii* ecology in the Golden Stream Corridor Preserve (Gutierrez and Dorgay, 2017).

Guatemala

Distribution: *D. stevensonii* is listed as a principal forest species of Guatemala (INAB, 2006), and occurs in the departments of Alta Verapaz, El Quiché, Izabal and Petén (Gill *et al.*, 2013).

In Petén, *D. stevensonii* was recorded at altitudes of 120-580 metres above sea level, in subtropical and very humid subtropical forest types (Fundacion Naturaleza para la Vida, 2016b). The species was reported to be commonly found in primary and secondary forest, but also in livestock pastures and agricultural areas (Fundacion Naturaleza para la Vida, 2016b). The species is known to occur in the Maya Biosphere Reserve in Petén (CoP 16 Prop. 62).

In the Franja Trasversal del Norte (FTN) region (incorporating Alta Verapaz and Izabal), the species was found to inhabit marshy evergreen lowland forest that was seasonally or permanently flooded, at altitudes of 0-850 metres above sea level (Fundacion Naturaleza para la Vida, 2016b). Herrera *et al.* (2016) stated that the species grows on karst soils in Petén and the FTN at altitudes of 50-350 metres above sea level. Herrera *et al.* (2016) additionally reported that the largest populations of the species in the FTN were located in the Laguna Lachuá National Park in Cobán, Alta Verapaz.

In response to CITES Notification to the Parties No. 2010/27, the CITES Scientific Authority of Guatemala reported single-species and mixed plantations of *D. stevensonii*, but gave no information on stand volume (PC19 Doc. 16.1 (Rev. 1)). Herrera *et al.* (2016) specified that these plantations occur in Petén and Alta Verapaz but added that, as the growth of the species in monoculture is "extremely slow", commercial timber "mainly comes from natural populations".

Population status and trends: *D. stevensonii* is one of 16 species of *Dalbergia* occurring in Guatemala (according to Species+). In 2015, representatives of the Department of Forest Management and Wildlife informed the CITES Administrative Authority of Guatemala that the genus *Dalbergia* was in decline in the country due to unsustainable agriculture, forest fires, illegal logging and human population growth (SRG 73/7/3d). They added that, before 2012, the genus had not been studied at the species population level, and that *D. stevensonii* was the only *Dalbergia* species present at "colony level" in Guatemala (SRG 73/7/3d).

Based on GIS analysis, Fundacion Naturaleza para la Vida (FNPV) (2016) reported that the native range of *Dalbergia* spp. in Guatemala had declined by 60-80% between 1991-2012, and the native range of *D. stevensonii* had declined by 27.48% from 1 099 313 hectares in 1991 to 797 256 hectares in 2012.

Four populations of *D. stevensonii* have been reported from the FTN region, ranging from 44-800 individuals, only 5% of which had a DBH of 60-100 cm (FAUSAC-FNPV, 2015 in CoP 17 Prop. 55). Herrera *et al.* (2016) reported that, in general, wild *D. stevensonii* populations in Petén and the FTN exist as small forests or as scattered trees on cattle ranches or cardamom plantations. However, the authors also noted some wild populations of *D. stevensonii* that numbered >100 individuals occurring on farms in these regions (Herrera *et al.*, 2016).

In May 2014, following the listing of *D. stevensonii* in CITES Appendix II, FNPV in collaboration with Consejo Nacional de Áreas Protegidas (CONAP) and with funding from the ITTO-CITES Programme, commenced a project entitled: *Population and abundance survey for* Dalbergia retusa *and* D. stevensonii *species in their natural range areas in Guatemala*, which aimed to collect quantitative data sufficient to inform sustainable forest management and conservation of the two species (Fundacion Naturaleza para la Vida, 2016b). The project involved measuring individuals >10 cm DBH in 101 sampling plots of one hectare, each divided into four cardinal 20 by 50 m sub-plots (Government of Guatemala, 2014). In February 2016, preliminary results from 65 sampling plots reported an estimated *D. stevensonii* population density of 4.52 individuals per hectare, and indicated that large individuals of >40 cm DBH were scarce (0.16 individuals per hectare) (ITTO-CITES, 2015). This scarcity of large individuals may have implications for recruitment, as Gutierrez (2016) observed that the proportion of *D. stevensonii* trees in reproductive condition increases with size class, and emphasised the importance of larger trees for seed production.

The final FNPV project report, using results from 101 sampling plots, stated the average basal area of *D. stevensonii* as 0.1387-0.3153 m^2 per hectare, with a basal area sampling error of 38.9% (Fundacion Naturaleza para la Vida, 2016b). Additionally, the project established nine permanent monitoring plots for *D. stevensonii*, *D. retusa* and *D. tucurensis* for long-term assessment of species growth rate, phenology, pathology and adaptability (ITTO-CITES, 2016).

D. stevensonii is categorised as Endangered (EN ab(ii, iii)) on the Red List of Trees of Guatemala, using IUCN Red List Categories and Criteria version 3.1 (Vivero *et al.*, 2006). The species is also listed in CONAP Category 2, which includes species restricted to a single habitat type (CONAP, 2009). Commercial use of CONAP Category 2 species requires a technical management plan that will only be approved if it guarantees the species' survival (CONAP, 2009). Exploitation of Category 2 species within protected areas requires an additional environmental impact assessment (CONAP, 2009).

Threats: Herrera *et al.* (2016) described the situation of *D. stevensonii* in Guatemala as "critical", and listed the following threats to the species in Petén and the FTN:

1) Exploitation, including illegal logging and extraction of the stumps and roots of harvested trees, precluding re-sprouting from stumps;
2) Insect damage to fruits and seeds, affecting germination;
3) Adverse climatic conditions, exacerbated by climate change, causing decreased flowering and impeding healthy formation of fruits and seeds;
4) Phytopathogen damage to leaves and flowers;
5) Lack of a scientifically-established minimum cutting diameter to inform harvest practices.

Forest degradation and conversion is a major threat (see *Population status and trends* above). Forest cover in Guatemala was reported to have declined from 38% in 2001 to 35.5% in 2006 as a result of intense logging, the majority in native ranges of *Dalbergia* spp., including *D. stevensonii*, in Petén and Izabal (Hernandez Lopez, 2016).

Slash and burn agriculture and cattle ranching were reported as drivers of deforestation in Petén (CoP 16 Prop. 62). Allen (2012 in Gill *et al.*, 2013) reported that threats to *D. stevensonii* within the Maya Biosphere Reserve, Petén, also included encroachment by organised illegal logging groups and deforestation for the construction of airstrips to transport drugs.

Illegal harvest, mainly destined for Asian markets, is noted as an ongoing threat to wild populations of *D. stevensonii* in Guatemala (CoP 17 Prop. 55; TRAFFIC, 2018). Over the period 2011-2014, 38 shipments and truckloads totalling 906 m^3 of trunks, flitches (squared, de-barked logs) and tables of *D. stevensonii*, *D. retusa* and unidentified *Dalbergia* spp., under the common name "rosul", were confiscated in Guatemala (CoP 17 Prop. 55). More recently, 29 tonnes of Guatemalan rosewood, suspected to be *D. stevensonii*, were confiscated in January 2018 by Hong Kong customs officials (TRAFFIC, 2018). CONAP collaborates with the National Institute of Forestry, the Public Prosecutor's Office and the Nature Protection Division of the National Civil Police to conduct enforcement activities and illegal timber seizure operations (SRG 73/7/3d).

Trade: Trade from Guatemala was analysed for the years 2008-2017, as the *D. stevensonii* population of Guatemala was listed on CITES Appendix III in 2008. Guatemala has submitted annual reports for all years 2008-2017. The country has never published export quotas for *D. stevensonii*.

According to the CITES Trade Database, direct trade in *D. stevensonii* from Guatemala 2008-2017 mainly comprised wild-sourced sawn wood and logs for commercial purposes (a total of 1057.88 m^3 reported by Guatemala and 812.76 m^3 reported by importers).

The majority of direct trade 2008-2017 consisted of wild-sourced sawn wood and logs exported to China for commercial purposes (620.77 m^3 reported by Guatemala and 344.15 m^3 reported by China). China additionally reported importing 59.7 m^3 of artificially-propagated (plantation) logs in 2016. Overall, direct trade was variable across the study period, but peaked in 2015, when 220.9 m^3 was reported by Guatemala and 212.67 m^3 reported by importers) (see Table 2).

The majority of indirect trade 2008-2017 in *D. stevensonii* originating from Guatemala consisted of wild-sourced carvings for commercial purposes re-exported from Germany to the United States in 2017 (30 403 kg reported by the United States and 2032.6 kg reported by Germany), and sawn wood re-exported from Germany to Japan 2008-2011 for commercial purposes (38 775 kg reported by Japan and 28 377 kg reported by Germany).

D. stevensonii is also harvested in Guatemala for domestic use (e.g. furniture and boards for houses and fences (Fundacion Naturaleza para la Vida, 2016b).

Table 2: Direct exports of *Dalbergia stevensonii* from Guatemala, 2008-2017. [Key to source codes: 'A' = artificially propagated; 'W' = wild-sourced. All units are in cubic metres.

Importer	Term	Source	Purpose	Reporter	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
Belize	sawn wood	W	T	Importer											
				Exporter									15.6		**15.6**
China	logs	A	T	Importer									59.72		**59.72**
				Exporter											
		W		Importer							19.91	33.19	35		**88.10**
				Exporter									60		**60**
				Importer										61.97	**61.97**
				Exporter											
	sawn wood	W	T	Importer						11	18.24	144.94	19.9		**194.08**
				Exporter			40.5	87.63		71.79	127.41	151.38	20.09	61.97	**560.77**
Dominican Republic	sawn wood	W	T	Importer											
				Exporter							17.22				**17.22**
France	sawn wood	W	T	Importer									11.26		**11.26**
				Exporter			6						11.26		**17.26**
Germany	sawn wood	W	T	Importer	57.55	41.8	16.51		22.48	8.59	11.02	24.88	33.8	25.3	**241.93**
				Exporter			16.51	9.43		9.14	1.98	34.68	36	12.77	**120.51**
Japan	sawn wood	W	-	Importer	8										**8**
				Exporter											
			T	Importer					37.15	6.64		9.18	6.44		**59.41**
				Exporter						6.65		9.2	6.44		**22.29**
Netherlands	sawn wood	W	T	Importer										22.9	**22.9**
				Exporter										24.55	**24.55**
Spain	sawn wood	W	T	Importer	5	2.27	9								**16.27**
				Exporter			9								**9**
USA	sawn wood	W	T	Importer	19	2.00	21	25.36	31.31	1	0.47	0.49		8.21	**108.84**
				Exporter			14.97	77.46		36.19	0.5	25.64	32.33	23.59	**210.68**

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 06/12/2018

Management: Harvest management of *Dalbergia* tree species follows standard guidelines for broadleaf forest in Guatemala, as specified in a 2007 technical manual produced by Instituto Nacional de Bosques (INAB) and CONAP (INAB and CONAP, 2007). The guidelines specify a minimum cutting cycle of 20 years in broadleaf forest, although it is unclear whether this timescale is sufficient to allow *D. stevensonii* individuals to reach a commercial size. The manual lists the following requirements for determining harvest intensity:

- For 'precious species' in higher commercial demand, cutting intensity must not exceed 80% of available basal area, taking into account the number of individuals remaining for future harvest.
- For species with significant populations of very large individuals (>90 cm DBH), 65% of the available basal area may be cut.
- When the proportion of recoverable basal area for a second cutting cycle is low, ≤20% of non-recoverable basal area may be cut, assuming the total allowable harvest (80% of basal area) is not exceeded, and as long as "other mechanisms" ensure the sustainability and recovery of the forest.
- When determining cutting intensity, reference values on diametric increase and mortality should be taken from local research plot studies recognised by INAB and CONAP or, where this is not possible, from other valid regional research.
- Proportion of recoverable basal area must be determined according to formulae produced by INAB and CONAP, as defined in the diametric distribution curve of the forest under management (INAB and CONAP, 2007).

The minimum cutting diameter used must allow species regeneration, and take into account size at "optimum maturity" and favourable phytosanitary status (INAB and CONAP, 2007).

In 2011, the CITES Working Group on Bigleaf Mahogany and Neotropical Trees reported that management plans for *D. stevensonii* timber harvest in Guatemala covered a period of 30-40 years, with no specified minimum cutting diameter (PC19 Doc. 16.1 (Rev. 1)).

According to Adrian Josué Gálvez Morales, CITES Scientific Authority for timber species at CONAP, harvest quotas, cutting cycles and cutting intensity for hardwood species were reported to be established on an individual basis for each forest stand or block, according to the characteristics of the individual harvest populations, following a forest inventory and commercial census (Galvez Morales, A., pers. comm. 12th December 2018). Quotas are authorised by exploitation licenses issued by INAB in state forests and plantations outside of protected areas and by CONAP within protected areas (Galvez Morales, A., pers. comm. 12th December 2018). For CITES listed species, INAB and CONAP additionally conduct evaluations of in-the-field compliance with legality and sustainability guidelines (Galvez Morales, A., pers. comm. 12th December 2018). No specific management plans for individual forest stands could be located.

From May 2014 to October 2016, following the listing of *D. stevensonii* on CITES Appendix II, as well as a 2013 workshop on the ITTO-CITES Programme for Implementing CITES Listings of Tropical Timber Species, Guatemala implemented two projects: 1) *Population and abundance survey for* Dalbergia retusa *and* D. stevensonii *species in their natural range areas in Guatemala* and 2) *Establishment of a forensic laboratory for timber identification and description in the implementation of legal proceedings and traceability systems for CITES listed products* (ITTO-CITES, 2015; Fundacion Naturaleza para la Vida, 2016a). The first project produced density estimates and a distribution map of *D. stevensonii* in Guatemala (see *Distribution* and *Population status and trends* sections above), and the second established a wood identification laboratory and a technical reference manual to support legal processes, enable timber traceability, and combat illegal logging for CITES-listed species including *D. stevensonii* (Fundacion Naturaleza para la Vida, 2016a, 2016b).

CONAP is currently reported to be working towards establishing specific forest management guidelines for *Dalbergia* species in natural forests, plantations and agroforestry systems, as part of a CITES project *Generation of technical management capacities and guidelines to prepare non-detriment findings oriented to the species of the genus* Dalbergia *in Guatemala, El Salvador and Nicaragua,* which will commence in 2019 (Galvez Morales, A., pers. comm. 12th December 2018).

One *D. stevensonii* plantation in Guatemala from which exports of sawn wood (exported using source code W) have been imported into the EU was reported to use coppicing rather than felling (Scientific Authority of Germany, pers. comm. to UNEP-WCMC, 2019).

Herrera et al. (2016) noted that where wild populations of *D. stevensonii* occurred on farms in Petén and the FTN (see *Population status and trends* above), farm owners "were generally requesting permission to harvest due to the value of the wood" and added that such populations "were subject to theft and illegal logging".

D. stevensonii is known to occur in the Maya Biosphere Reserve (CoP 16 Prop. 62) and the Laguna Lachuá National Park (Herrera *et al.*, 2016). However, in the Maya Biosphere Reserve the species is at risk from encroaching illegal logging and land conversion (CoP 16 Prop. 62). Extraction zoning is reportedly determined by protected area category; harvest is permitted outside protected areas with type I and II management categories and inside core zones of protected areas with management category type VI (CoP 16 Prop. 62). Herrera *et al.* (2016) recommended that the Laguna Lachuá National Park should be a focal area for conservation of the species in Guatemala.

Mexico

Distribution: *D. stevensonii* is considered to be naturally scarce in Mexico, where it is restricted to tropical evergreen forest in the state of Chiapas, 152-495 metres above sea level (de Stefano *et al.*, 2016). De Stefano *et al.* (2016) reported that the species is known from only eight localities, and estimated its national range to total only 3600 hectares. The species was recorded in the municipalities of Benemérito de las Américas and Ocosingo, as well as the Montes Azules Biosphere Reserve in the Selva Lacandona (de Stefano *et al.*, 2016).

Population status and trends: Twenty-four, twenty-two and twenty species of *Dalbergia* are native to Mexico, according to Species+, CONABIO's national registry (CONABIO, 2019) and Cervantes *et al.* (2019) respectively. Information on *D. stevensonii* population size, density and trends is currently lacking for Mexico (de Stefano *et al.*, 2016), though de Stefano *et al.* (2016) stated that the high rates of deforestation and selective logging in Chiapas imply that the species is in decline.

In 2015, the CITES Scientific Authority of Mexico (CONABIO) held a workshop to evaluate the risk to *Dalbergia* timber species at the national level according to the methods and criteria of the country's official list of endangered species (NOM-059-SEMARNAT-2010) (PC22 Doc. 22.4). The workshop recommended that *D. stevensonii* be listed as Endangered (Category P) (de Stefano *et al.*, 2016), and the listing was adopted in August 2018 (Ministry of the Environment and Natural Resources of Mexico, 2018).

There are no plantations of *D. stevensonii* in Mexico, however the species has been proposed for "in situ" forest plantations and projects to promote the natural regeneration of the species within its area of distribution as part of the federal project "Sowing Life" (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019).

Threats: Cervantes *et al*. (2019) stated that the Mexican populations of the genus *Dalbergia* have been "severely diminished" due to overexploitation, illegal trade, and fragmentation and loss of forest habitat. Due to the restricted distribution and limited available habitat for *D.stevensonii*, deforestation is considered to be the main threat to the species in Mexico (de Stefano *et al.*, 2016). Between 1960 and 2005, the deforestation rate in the State of Chiapas was reported to be higher than in the rest of the country (González-Espinosa, 2005). Between 1978-2000, annual deforestation in south eastern Mexico was estimated at 190 000 hectares, and in 2010 the remaining forest was reported to be a mosaic of primary and secondary forest fragments interspersed with areas of livestock pasture and slash and burn agriculture (Díaz-Gallegos *et al.*, 2010). Global Forest Watch (2014) reported that Chiapas lost 520 000 hectares of tree cover, an 11% decrease, over the period 2001-2017 (though note that this dataset does not distinguish tree cover type). The Sustainable Tropics Alliance (2018) reported that subsidies to increase agricultural productivity were 70% greater than incentives for conservation and sustainable production in the region. Only 33% of the country's tropical evergreen forest remains (Challenger and Dirzo, 2009 in de Stefano *et al.*, 2016). Soto-Pinto *et al.* (2012) reported that the Selva Lacandona has suffered severe deforestation since the 1970s. Rapid human population growth and

consequent pressure from agricultural expansion have resulted in conversion of an estimated two thirds of the Selva Lacandona to low-productivity farmland (Natura Mexicana, 2018).

In addition to land conversion, the Montes Azules Biosphere Reserve is also threatened by sporadic settlements, forest fires, and selective logging (Carabias-Lilo *et al.*, 2000 in de Stefano *et al.*, 2016) The species is subject to limited legal harvest from the wild, and is threatened by illegal logging throughout its range (de Stefano *et al.*, 2016).

Quantitative data on the impact of illegal exploitation on the Mexican population of *D. stevensonii* are lacking (Jenkins *et al.*, 2012). De Stefano *et al.*, (2016) reported that the difficulty of ensuring legal, sustainable trade in *D. stevensonii* is compounded by the difficulty of identifying rosewood lumber to species level. In their biennial CITES implementation report for 2013-2014, Mexico reported the confiscation of 93 m^3 of *Dalbergia* wood under the trade name "granadillo" at the ports of Lázaro Cárdenas in Michoacán and Puerto Progreso in Yucatán, which had been intended for export to China and Taiwan. Although the confiscated wood was not identified to species level, it was described as having "brown to reddish-purple heartwood with blackish streaks, and yellowish sapwood", which could describe *D. stevensonii* or *D. granadillo*.

Trade: Mexico has, at the time of writing, submitted annual reports for the years 2013-2016. Mexico has never published export quotas for *D. stevensonii.*

According to the CITES Trade Database, direct trade in *D. stevensonii* from Mexico 2013-2017 consisted of one wild-sourced specimen (no units given), for scientific purposes, imported by the United States in 2014.

According to the CITES Trade Database, the majority of indirect trade 2013-2017 in *D. stevensonii* originating in Mexico took place in 2017, with only 0.17 m^3 sawn wood traded in 2013 and no indirect trade taking place 2014-2016. This trade predominantly consisted of pre-Convention wood products (no units given) for commercial purposes, re-exported by Japan to the UK, Taiwan, the Republic of Korea, Australia, and the Netherlands.

Management: Management and exploitation of nationally endangered species listed on NOM-059-SEMARNAT-2010 may only be carried out in accordance with the General Wildlife Law and the General Law of Ecological Balance and Environmental Protection (Ministry of the Environment and Natural Resources of Mexico, 2018). In summary, Articles 85 and 87 of the General Wildlife Law state, respectively, that the exploitation of at-risk species may be authorised only when "priority is given to collection and capture for activities of restoration, repopulation, reintroduction and scientific research", and when measures have been taken to counteract declines, and both a management plan and population study containing estimates of birth and death rates have been endorsed by an expert (The Government of Mexico, 2000). Article 87 of the General Law of Ecological Balance and Environmental Protection states that economic use of wild fauna and flora is authorised only when "individuals guarantee their controlled reproduction or development in captivity or semi-captivity or when the exploitation rate is lower than that of natural renewal of populations" (The Government of Mexico, 1988).

Prior to the listing of *D. stevensonii* on the NOM-059-SEMARNAT-2010, the species' harvest in Mexico was regulated by the General Law of Sustainable Forest and Soil Development, which established guidelines for forest management programmes (FMPs), specifying that FMPs must contain information, verified prior to harvest authorisation, on the species, sampling methods, estimation of harvest rates subject to actual reported stocks, management measures, and any silviculture treatments used (CONABIO, 2018).

CONABIO (2018) identified the following steps for *D. stevensonii* in Mexico:

1) Validate herbarium records with experts to verify the location of *D. stevensonii* populations;
2) Conduct a survey of population density and of habitat structure and composition;
3) Commence long-term population monitoring to determine growth rates, recruitment, and natural regeneration.

Additionally, as of 2016, CONABIO was reported to be coordinating an ongoing project entitled *Analysis of the populations and significant aspects of the pollination of* Dalbergia granadillo *and* Dalbergia stevensonii, which aims to provide information of the species' populations to support decision-making processes related to their sustainable use for timber and the implementation of CITES in Mexico (Camarena, 2016). CONABIO stated their involvement in three ongoing projects focussing on *D. stevensonii* in Mexico:

1) A three-phased study of population status and pollination mechanisms of *D. granadillo* and *D. stevensonii.* Project results delivered in September 2016 (phase 1), May 2017 (phase 2), and November 2018 (phase 3).
2) A publication (publication date as yet undetermined) entitled: *The genus* Dalbergia *in Mexico: challenges and opportunities for conservation.*
3) Compiling information to improve the development of protocols for NDF formulation for priority tree species of the genera *Dalbergia* and *Swietenia*. Project results expected in January 2019.

In 2019, Cervantes *et al.* published an updated checklist of Mexican *Dalbergia* species, to aid conservation. The authors stated that the absence of such a checklist had previously "stalled regulation and management" of *Dalbergia* species in Mexico (Cervantes *et al.*, 2019).

D. stevensonii has been recorded in Montes Azules Biosphere Reserve, a protected area covering 331 300 hectares of moist tropical forest; although the Reserve is under legal protection, it is also subject to some disturbance (see *Threats* above) (ParksWatch, 2004). The wider region has been the focus of the Mexico Mesoamerican Biological Corridor Sustainable Rural Development Program since 2008 (The World Bank, 2010). The program, coordinated by the Government of Chiapas, the Ministry of Agriculture, Livestock, Rural Development, Fisheries and Food (SAGARPA), the Ministry of Environment and Natural Resources (SEMARNAT), and the CITES Scientific Authority of Mexico (CONABIO), operates over ~120 400 hectares in three focal areas, including Benemérito de las Américas and Ocosingo where *D. stevensonii* is known to occur, working towards sustainable land use with local *ejido* communities who own collective land rights (The World Bank, 2010). As of 2010, The World Bank reported results including the "stabilization" of 20 000 hectares under land use promoting conservation and biological connectivity and 422 hectares of farmland under sustainable, high yield maize production without use of slash and burn or land rotation. Additionally, from 2008-2013 Natura Mexicana ran a payment for ecosystem services (PES) scheme with *ejido* communities in the area, protecting 14 000 hectares of forest from deforestation for five years, with the majority of community members choosing to renew their PES contracts in 2013-2014 (Cameron, 2015).

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Sphyrna spp.

A. Summary and Recommendations

Species characteristics

Sphyrna lewini, *Sphyrna mokarran* and *Sphyrna zygaena* were listed in Appendix II of CITES in 2013, with a delayed entry into effect of 18 months. The listings came into force on 14/09/2014. All three species have a circumglobal distribution and a complex, coastal-pelagic life history, with juveniles being found in inshore habitats and adults being found in deeper waters. The stock structure for all three species is poorly defined, but molecular data suggests that while females may show site fidelity to particular coastlines or archipelagos, males travel long distances and facilitate gene flow across oceanic expanses. All three species are characterised by slow growth, low fecundity, and long lifespans, though these parameters vary according to the population sampled.

S. lewini, *S. mokarran* and *S. zygaena* are highly susceptible to overexploitation and are vulnerable to a wide range of fishing gears (including trawls, purse seines, gillnets and longlines). The species are caught in both target and non-target fisheries, and all three have a very high at-vessel mortality rate (over 90% in several studies). Like other elasmobranchs, data on declines and landings for the three species is lacking, principally because (a) until recently, shark catches have tended not to be reported to species level and (b) species that are caught as bycatch tend to be underreported. *S. lewini* is the species for which most data are available, and the majority of studies indicate that it has suffered considerable declines in both the North West Atlantic and the Eastern Pacific.

In Central America and the Caribbean, most sharks are captured either directly or indirectly by local artisanal small-scale fisheries. Many of these fisheries operate in what are thought to be nursery areas, and principally catch juveniles. Within the region, Costa Rica and Panama have been reported to be the most important countries in terms of the volume of shark landings and fleet size; however, according to the CITES Trade Database, only Costa Rica, El Salvador, Nicaragua and Mexico exported *Sphyrna* spp. products in any substantial numbers from 2014 to 2016.

Guidelines, challenges and recommendations

The listing of shark species in the CITES appendices is a relatively recent development, and there has been much discussion regarding best practice for the development of NDFs for species that are commonly highly migratory, may use waters that are under the jurisdiction of multiple Parties, and may be harvested in areas beyond national jurisdiction, such as the high seas. In addition, data on marine species is frequently poor, and may vary across populations of widely-distributed species.

A number of guidance documents have been published to help Parties conduct robust NDFs for shark species (e.g. García Núñez, 2008; Mundy-Taylor *et al.*, 2014; Fisheries Agency of Japan, n.d.). An electronic worksheet to assist CITES Management and Scientific Authorities in developing NDFs for CITES-listed shark and ray species was also launched at the 70th Meeting of the CITES Standing Committee in October 2018, and is intended to be rolled out in 2019. The worksheet is based on Mundy-Taylor *et al.*, (2014)'s Non-detriment Findings Guidance for Shark Species and can be used to develop NDFs for CITES Appendix II-listed specimens caught in (a) a State's territorial waters and/or EEZ, and (b) the high seas. It helps Parties to make an assessment by guiding them through the specific aspects of a species' life history parameters, population data and management measures that should be considered when completing an NDF, and includes a step-wise process for deciding whether a positive NDF can be made. The guidance also includes collections of useful resources, as well as default species-specific biological data which can be used if no location-specific data are available. Regional workshops of OSPESCA member countries selected Mundy Taylor *et al.*, (2014) as the guidance that had a better foundation for the elements needed to make NDFs for shark species (CRACCITES - Costa Rica, 2017). In

2016, Simpfendorfer and Rigby (2016a) published a template following the Mundy-Taylor et al. (2014)'s NDF guidance for *Sphyrna lewini* in the Pacific Ocean. The template includes suggestions of sources that can be used to calculate intrinsic biological capability as well as global and regional management measures; however, the studies cited are principally focused on Indo-Pacific rather than Eastern Pacific populations. The forthcoming electronic NDF worksheet for sharks and rays will populate region-specific life history characteristics taken from the scientific literature automatically.

NDFs should be dynamic, and updated as new data becomes available. According to Mundy-Taylor *et al*.'s (2014), robust NDFs are made when:

(1) There is good communication between Fisheries Authorities and CITES Authorities within and between Parties.
(2) There is international cooperation, which includes the development of joint NDFs for shared stocks.
(3) There is collaborative development of stock assessments and NDFs for high seas shark stocks through membership of RFBs.
(4) Parties adopt standard approaches that allow NDFs to be equivalent and comparable, and actively encourage peer review and sharing of NDF methodologies.

The following table outlines the general challenges to making NDFs that have been noted to be present in the region covered by this review, steps that have been taken to address them to date, and where further efforts appear to be needed.

DATA	
Life history parameters	Life history parameters (used in stock assessments as well as the NDF process to determine intrinsic biological vulnerability) for *S. lewini,* including growth rates and reproductive periodicity, are known to vary upon the population sampled. Although Mundy-Taylor et al. (2014)'s NDF guidance includes default species-specific biological data, these may not reflect local stock characteristics. It is important, where possible, to base calculations on data collected from populations that are most relevant to Central American and Caribbean countries; however, a lack of estimates for important life history parameters for *S. mokarran* and *S. zygaena* remains a barrier to understanding the population dynamics for these species. The forthcoming electronic NDF worksheet for sharks and rays will populate region-specific life history characteristics taken from the scientific literature automatically, but important data gaps remain.
Catch estimates	Assessing the severity of fishing pressure on the stocks of particular species is an essential step necessary to conduct robust NDFs. However, accurate estimates of total shark catches (landed, released, and discarded at sea) in both target and non-target fisheries are currently lacking, and tend not to be species-specific. From the countries included in this report, only Belize and Costa Rica were reported to hold historic species-specific data for shark catches by their industrial fleets, and only Guatemala and Nicaragua were reported to hold historic species-specific catch data for their artisanal fleets (Siu and Aires-da-Silva, 2016). Monitoring programs should ideally cover both industrial and artisanal fleets if fishing pressure on *Sphyrna* spp. in the region is to be fully understood. Observers must also have the ability to distinguish between *Sphyrna* species. Limited capacity regarding the ability to identify sharks in the field has been raised by a number of countries in this report as an issue that must be urgently addressed (AC28 Inf. 12; Belize High Seas Fisheries Unit, 2015; FAO, 2018). One of the methods of assuring reliable species ID that has been suggested is to implement measures for hammerheads to be landed with their cephalofoils still attached (Anon., 2014).

Effort monitoring	Although population trends can be evaluated by Parties completing an NDF in a number of ways, inferences based on measures that include catch per unit effort (CPUE) are generally considered to be more robust than landings data alone. Some measures of effort, however, are considered to be better than others; for example, in purse seine fisheries, the length and soaking time of nets is considered to be a much better measure of effort than days fishing (FAO, 2018). Countries should ensure that, wherever possible, future stock assessments are underpinned by measures of CPUE that are most closely thought to reflect the status of the populations being fished.
Standardisation	Standardised data and processes for making NDFs will allow for better comparison of landings and abundance data between countries. Holdings of these data will increase as OSPESCA members (**Belize, Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua** & **Panama**) harmonise data collection forms for landings and biological sampling, and efforts to harmonise NDF procedures are already underway. In January 2015, for example, a Workshop on the Harmonisation of NDF Procedures for Shark and Ray Species on Appendix II of CITES in SICA countries was held in Guatemala City (AC28 Inf. 12). Standardised data collection forms as well as centralised data holdings (such as those currently being developed by OSPESCA countries) also have the potential to help countries (such as **Belize**) whose data holdings on shark catches were reported to be limited by vessels discharging catches at foreign ports.
Conversion Factors	Improving the use of reliable conversion factors between live weight, landed dead weight and weight of traded products is highlighted by Mundy-Taylor *et al.* (2014) as something that would assist authorities in more accurately evaluating the pressures exerted by trade on shark stocks, and are also a key aspect of ensuring traceability. They may be required, for example, to verify that reported amounts of parts or derivatives correspond to the number of individuals allocated in quotas or total allowable catches, or to verify that dried fins for export correspond to fresh product purchased. The use of uniform conversion factors across regions is a key component of the management of other marine species (such as *Strombus gigas*, see Prada *et al.*, 2017), and the same principles should apply to shark parts and derivatives; however, little information could be found on conversion factors currently used by countries included in this review, the methodologies being used to develop them, and whether regional standardisation efforts are underway. The size difference between the three listed species of *Sphyrna* spp. also highlights the need for some conversion factors (such as the average weight of fins, for example) to be species-specific. **Mexico** uses conversion factors as a traceability measure along its shark fin production lines (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2018) and has undertaken studies to identify fin drying times and conversion factors between derivatives, prioritising studies that are region-specific and have large sample sizes (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019). Any methodologies used to calculate these factors as well as any lessons learned could be shared.
MANAGEMENT	
Sharks MoU	The CMS sharks MoU contains a conservation plan that aims to achieve and maintain a favourable conservation status for migratory sharks. Although **Costa Rica, the Dominican Republic, Honduras** and **Panama** are CMS Parties, only Costa Rica is a signatory of the sharks MoU. The Dominican Republic, Honduras and Panama could consider becoming signatories to enhance coordinated conservation action across the species range.
Shared stocks	Where species occur within the waters of more than one State and/or the high seas (which is the case for *S. lewini*, *S. mokarran* and *S. zygaena*), NDFs can be developed and issued at a regional level, with an appropriate RFB (such

	as an RFMO) acting as an international Scientific Authority for stocks in the high seas (Mundy-Taylor *et al.*, 2014). Such an RFB could, for example, undertake a stock assessment and/or establish an NDF for stock under its remit, and set an Annual Total Allowable Catch (TAC) to be allocated in the form of quotas to its CPCs (Mundy-Taylor *et al.*, 2014). In 2009, the FAO Expert Advisory Panel for the Assessment of Proposals to Amend Appendices I and II of CITES Commercially-exploited Aquatic Species noted that, for the North West Atlantic, NDFs for *S. lewini* could be based on Hayes *et al.*, (2009) and Jiao *et al.*, (2009)'s assessments of the species (these assessments, however, are now 9 years old). Mundy-Taylor *et al.* (2014) recommend that Scientific Authorities check with the relevant RFB to see if a Regional NDF has been agreed – where one has not, they are recommended to seek scientific advice from that RFB in developing a State-based NDF. Where an RFB is not yet addressing shark management issues, Mundy-Taylor *et al.* (2014) suggest that Parties (in their capacity as RFB CPCs) could consider requesting that they now do so.
Management units	Although *S. lewini*, *S. mokarran* and *S. zygaena* have similar life history parameters in that they are generally long-lived, slow-growing, slow-reproducing species, differences in life history parameters and behaviour (such as schooling) between the three species means that each one will have a different population vulnerability and susceptibility to different gears (Abercrombie *et al.*, 2005). Management as a combined group is considered by some authors to not adequately take into account these differences (Abercrombie *et al.*, 2005). Similarly, connectivity between different populations of the same species has important implications for the estimation of population trends as well as sustainable levels of take. Daly-Engel et al. (2012) particularly note that, while a focus on mtDNA data from females supports an argument for conservative management units along coastlines, males may be being fished far from their location of origin and at both ends of a single migratory circuit. Single marker assays using either only female or biparentally inherited loci alone may give a misleading picture of management units, so it is important that multi-locus studies are used, where possible, to identify the origin of specimens (Daly-Engel *et al.*, 2012). It is also important to more fully define the stock structure of each species (particularly *S. mokarran* in the Eastern Pacific) to ensure that assessments are being conducted at the correct scale. Japan's NDF Guidelines for Aquatic Species recommend that NDFs should be completed, as far as possible, for each genetically independent stock (Fisheries Agency of Japan, n.d.). Costa Rica has noted that an evaluation of the population status of the CITES-listed hammerheads would be best conducted under the framework of IATTC (CRACCITES - Costa Rica, 2017).
Stock assessments	As a result of poor reporting as well as non-species specific records, data on population trends for *Sphyrna* spp. is scarce. As standardised reporting and species-specific data becomes more readily available (for example, through use of OSPESCA's reporting forms) future stock assessments will have more robust underpinnings; however, until such a time (information needed for formal stock assessment methods was estimated to be a minimum of 15-20 years), Scientific Authorities developing NDFs have been encouraged to adopt a precautionary approach under Principle 15 of the Rio Declaration on Environment and Development and according to the conclusions of the FAO/CITES Genazzano workshop (Mundy-Taylor *et al.*, 2014).

	In the absence of long-term datasets, **Mexico** and **Costa Rica** have used Productivity and Susceptibility Analysis (see Ocean Science Trust, 2017), in combination with a management risk assessment following the methodology of Lack *et al.* (2014), as a rapid method with which to assess the vulnerability of particular stocks (Benítez *et al.*, 2015; CITES SA of Costa Rica, 2018). **El Salvador** has conducted these assessments for *Carcharhinus falciformis*, *Alopias pelagicus* and *A. superciliosus*, but it is unclear whether they have been conducted for *S. lewini*. As the other two regional exporters of shark products according to the CITES Database, **Nicaragua** and **El Salvador** could consider conducting a similar analysis to underpin their NDFs for hammerhead sharks.
Prohibitions	The making of positive or positive conditional NDFs require Parties to ensure that appropriate management measures are in place to mitigate pressures affecting species stocks. The draft regional plan of action for the conservation and management of sharks in the WECAFC area (*inter alia* **Belize, Costa Rica, the Dominican Republic, Guatemala, Honduras, Mexico, Nicaragua, Panama**) has identified several management measures for sharks that could be implemented without the need for stock assessments. These include: ○ Catch limits for *S. zygaena,* and prohibitions on the catching, keeping on board, landing and commercialisation of *S. lewini* and *S. mokarran* (such a prohibition is already in place for Members of ICCAT (**Belize, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama**)) ○ Closed seasons for shark fishing during times when most species give birth (May-August). These are already in place in **Mexico** and **El Salvador**, but could also be considered by **Nicaragua**. ○ Establishment of minimum sizes specifically targeted at preventing the capture of new-born and early juveniles while they live in coastal nursery areas (minimum size restrictions are already in place in **Costa Rica**, but do not appear to be in place in **Mexico** and **Nicaragua**) ○ The prohibition of wire traces in longline and hook and line fisheries. It is unclear what monitoring methods are currently in place to evaluate the effectiveness of these measures in the countries in which they are implemented; however, long-term monitoring (preferably using fisheries-independent measures) will be essential in order to implement adaptive management of stocks.
At-vessel mortality	The high at-vessel mortality rates for all three species mean that hammerheads captured on longlines are unlikely to be able to be released alive. Management measures, as well as assessments of each species' vulnerability, should take this into account. The US responded to this issue by linking hammerhead shark quotas with "large coastal shark" (LCS) quotas (which include bull sharks and lemon sharks), and closing both quotas when one of them is reached (Anon., 2014). Gulak *et al.* (2015) suggested that a limitation on gear soak time could possibly help improve hammerhead shark survivorship in fisheries where they are not a target species; but also noted that achieving this may result in an unacceptable reduction in yield. Further research is needed to calculate whether limitations such as these could be financially viable in the region's fisheries, taking into account median hooking time for the target species.
Enforcement	Illegal, unreported and unregulated (IUU) fishing has been noted to occur in waters across the range of the three *Sphyrna* species considered in this review, including in some protected areas, though the scale of this activity is

	unclear. International trade from **Panama** was reported, despite no CITES exports permits being issued. One of the management measures required to be assessed in Mundy-Taylor *et al.* (2014)'s NDF guidance relates to the level of relevant compliance measures in place. Some countries included in this review were noted to be struggling to be able to implement effective enforcement of fishery regulations and further commitments to strengthen enforcement capacity in order to effectively implement these measures may be needed.
Traceability	CITES Authorities must be confident that specimens for which permits are being sought for have been correctly identified. In order for this requirement to be met when exporting products that have undergone processing (and are therefore subject to a number of identification issues discussed in this report), Parties must have robust systems of traceability/chains of custody in place. Although little information could be found regarding traceability systems for *Sphyrna* spp. that are currently in place in countries considered in this review, we highlight a report by Lehr (2016) on the traceability of CITES-listed shark products in **Costa Rica**, commissioned by the CITES Secretariat. Lehr (2016) reported that current control procedures for the medium and large size longline fleet were considered to fully implement the traceability recommendations of a report on shark traceability. Parties are encouraged to consider the report, which includes a series of recommendations concerning traceability, when implementing/designing their own systems.

B. Species characteristics

Taxonomic note

According to the *Catalog of Fishes* (the standard CITES reference for all fish except *Hippocampus*) the genus *Sphyrna* comprises nine species (Eschmeyer *et al.*, 2018). *S. lewini*, *S. mokarran*, and *S. zygaena* are the only species of Sphyrnidae listed in the CITES appendices.

Sphyrna lewini

Biology: *S. lewini* (scalloped hammerhead) is a large hammerhead shark, thought to be the most abundant species of the Sphyrnidae (Ebert and Stehmann, 2013). It is a coastal-pelagic species found in warm-temperate and tropical seas, and is notable for forming large true schools at different stages of its life history (Ebert and Stehmann, 2013). *S. lewini* is considered to be a generalist and opportunistic top predator, mainly feeding on cephalopods, teleosts (Torres-Rojas *et al.*, 2006; Ebert and Stehmann, 2013) and other elasmobranchs such as stingrays (*Dasyatis* spp.) (Baum *et al.*, 2007a). Juveniles have a similar diet, feeding mainly on crustaceans, cephalopods, and small teleosts such as gobies (Bush, 2003; Torres-Rojas *et al.*, 2010).

S. lewini is viviparous (Compagno, 1984), with estimates of the length of gestation ranging from 8 to 12 months (Hazin *et al.*, 2001; White *et al.*, 2008). Information on the reproductive periodicity of the species is conflicting, with some studies reporting that *S. lewini* females give birth every year (Cortés *et al.*, 2010), and others estimating that females give birth every two years (Hazin *et al.*, 2001; White *et al.*, 2008). Other life history data for the species (including those needed to assess its intrinsic biological vulnerability such as the age and size at which individuals reach maturity, the average litter size, and the species' natural mortality rate), vary depending upon the population sampled. The growth rate of *S. lewini* in the Western North Atlantic, for example, appears to be slower than that of Pacific Ocean populations (Ebert and Stehmann, 2013). Table 1.1 gives a summary of the range of life history parameters that have been calculated for the species, highlighting (in grey) those that are estimated from populations in waters most relevant to this review. In

general, *S. lewini* is a long-lived, relatively slow-growing, and slow-reproducing species (Piercy *et al.,* 2007; White *et al.*, 2008), parameters which make it intrinsically vulnerable to overexploitation (Maguire *et al.*, 2006; Baum *et al.*, 2007a; White *et al.,* 2008). A number of sources have placed the species within the FAO's low productivity category (<0.14/ yr) (CoP 16 Prop. 43; Cortes *et al.*, 2015). Species with these attributes, as well as complex spatial structures (see *Distribution* section), also have a low stock-recruitment relationship and long stock recovery times when overfished (Belize High Seas Fisheries Unit, 2015).

Table 1.1: Summary of life history parameters for *S. lewini.* TL = total length, F = female, M = male.

Life history parameter	*Value*	*Location*	*Source*
Growth rate (von Bertalanffy *k*)[5]	0.16 cm/yr F 0.13 cm/yr M (Assumes biannual growth band deposition)	Michoacán, Mexico (Eastern Pacific)	Anislado-Tolentino and Robinson-Mendoza, 2001
	0.10 cm/yr F 0.12 cm/yr M (Assumes biannual growth band deposition)	Southern Coast of Sinaloa, Mexico (Eastern Pacific)	Anislado-Tolentino *et al.*, 2008
	0.09 cm/yr F 0.13 cm/yr M (Assumes annual growth band deposition)	Gulf of Mexico and NW Atlantic	Piercy *et al.*, 2007
	0.05 cm/yr F 0.05 cm/yr M (Assumes annual growth band deposition)	Southern Brazilian coast (South Atlantic)	Kotas *et al.*, 2011
	0.25 cm/yr F 0.22 cm/yr M (Assumes biannual growth band deposition)	Northeastern Taiwan, Province of China[6]	Chen *et al.*, 1990
Size at maturity	223 cm TL F 170 cm TL M	Michoacán, Mexico (Eastern Pacific)	Anislado-Tolentino and Robinson-Mendoza, 2001
	220 cm TL F 180 cm TL M	Gulf of Tehuantepec, Mexico (Eastern Pacific)	Bejarano-Alvarez *et al.*, 2011a
	250 cm TL F 180 cm TL M	Gulf of Mexico	Branstetter, 1987
	240 cm TL F 180-200 cm TL M	Northeastern Brazil and SW equatorial Atlantic	Hazin *et al.*, 2001
	210 cm TL F 198 cm TL M	Northeastern Taiwan POC	Chen *et al.*, 1988 *in* Hazin *et al.*, 2001
	228.5 cm TL F 175.6 cm TL M	Indonesia	White *et al.*, 2008
	200 cm TL F 140-160 cm TL M	Northern Australia	Stevens and Lyle, 1989

[5] The most commonly used method to calculate a shark's age is to look at band pairs in an individual's vertebrae. While some studies assume that *S. lewini* puts down two band pairs per year (e.g. Chen *et al.*, 1990), the majority of studies calculate growth rates on the assumption that one band is put down per year (e.g. Piercy *et al.*, 2007; Kotas *et al.*, 2011)). Assuming annual ring growth rather than biannual ring growth results in (a) slower growth estimates and (b) higher estimates for the species' age at maturity.

[6] Hereafter referred to as Taiwan POC.

Life history parameter	*Value*	*Location*	*Source*
Age at maturity	5.8 years F 4.3 years M	Michoacán, Mexico (Eastern Pacific)	Anislado-Tolentino and Robinson-Mendoza, 2001b
	17 years F 10 years M	Gulf of Mexico	Branstetter, 1987
Observed longevity	18.6 years F (335.6cm TL) 8.8 years M (244.3cm TL)	Michoacán, Mexico (Eastern Pacific)	Anislado-Tolentino and Robinson-Mendoza, 2001
	30.5 years F (234cm FL) 30.5 years M (241cm FL)	Gulf of Mexico and NW Atlantic	Piercy *et al.*, 2007
	31.5 years F (217cm TL) 29.5 years M (234cm TL)	Southern Brazilian coast	Kotas *et al.*, 2011
	14 years F (331cm TL) 10.6 years M (301cm TL)	Northeastern Taiwan POC	Chen *et al.*, 1990
Litter size	14-40	Gulf of Tehuantepec, Mexico (Eastern Pacific)	Bejarano-Alvarez *et al.*, 2011a
	>30	Gulf of Mexico	Branstetter, 1987
	2-25	Eastern Pacific of Colombia	Tapiero, 1997
	2-21	Northeastern Brazil and SW equatorial Atlantic	Hazin *et al.*, 2001
	14-41 (mean = 25)	Indonesia	White *et al.*, 2008
	12-38	Northeastern Taiwan POC	Chen *et al.*, 1988 *in* Hazin *et al.*, 2001
	13-23	Northern Australia	Stevens and Lyle, 1989

S. lewini's natural mortality rate has been estimated at 0.107/year for the population of the Gulf of Mexico (using Branstetter (1987)'s estimate of the species growth rate) (Chen and Yuan, 2006), and 0.126/year for the population off the coast of Australia (Harry, 2011). The latter estimate used Jensen (1996)'s formula of *Natural Mortality = 1.6k*, where *k* is the von Bertalanffy growth completion rate. Both estimates assume that *S. lewini* puts down one band pair per year. Chen and Yuan (2006) calculated the species' intrinsic rate of population increase in the Gulf of Mexico to be 0.086/year. Estimates of this parameter from Taiwan POC, based on two band pairs per year, yielded a higher rate of 0.205/year (Liu and Tsai, 2011).

Distribution and Stock Structure: *S. lewini* has a circumglobal distribution in coastal warm temperate and tropical seas between 46°N and 36°S (Figure 1) (Compagno, 1984). It occurs over continental and insular shelves and in adjacent deep waters, from intertidal and surface waters to depths of 275m, and has been observed entering enclosed bays and estuaries (Compagno, 1984). Some adult populations are known to form large aggregations at sea mounts (Ebert and Stehmann, 2013).

Figure 1: Distribution of *S. lewini*. Source: International Union for the Conservation of Nature (IUCN), (Baum *et al.*, 2007a)

According to the IUCN's assessment of the species, *S. lewini* occurs in Belize, Costa Rica, the Dominican Republic, El Salvador, Honduras, Mexico, Nicaragua, and Panama, but not Guatemala (Baum *et al.*, 2007a). However, Central America's RPOA Sharks (see *Management* section) considers the species' range to include Guatemala (OSPESCA, 2011a), and there are records of *S. lewini* being caught by the country's artisanal fishery (Ruano and Ixquiac, 2007). Known *S. lewini* pupping and nursery areas include (but are not limited to) coastal waters off Oaxaca (Eastern Pacific) (Bejarano-Alvarez *et al.*, 2011), Bull's Bay (Northwest Atlantic) (Castro, 1993), Florida's Atlantic Coast (Adams and Paperno, 2007), the northern Gulf of California, and Bahia Almejas on the pacific coast of Baja California Sur (Baum *et al.*, 2007a). The Gulf of Tehantepec (Pacific) is considered to be an aggregation site for gravid females (CONAPESCA-INP, 2004); these are also commonly caught in spring/summer in Kino Bay, off the coast of Sonora (CONAPESCA-INP, 2004).

S. lewini is generally considered to be a highly mobile species (Compagno, 1984), but molecular studies have shown that males are much more mobile than females (Daly-Engel *et al.*, 2012). Male *S. lewini* do not show any genetic population differences either between or within ocean basins, and as such are thought to travel long distances and facilitate gene flow across oceanic expanses (Daly-Engel *et al.*, 2012). The frequency of these migrations, however, is unknown (Daly-Engel *et al.*, 2012); and despite evidence that they occur, Daly-Engel *et al.* (2012) found some genetic differentiation to be present between *S. lewini* populations in the Gulf of Mexico and the Western Atlantic.

In contrast, female *S. lewini* are thought to show site fidelity to single coastlines, archipelagos, or individual nursery areas (Daly-Engel *et al.*, 2012). The species' IUCN assessment noted that at least five genetically distinct populations of *S. lewini* had been identified: Northwest Atlantic, Caribbean Sea, Southwest Atlantic, Eastern Atlantic, and Indo-West Pacific (D. Chapman and M. Shivji, Nova Southeastern University unpublished data in Baum *et al.*, 2007a). At the time the species' IUCN assessment was published, boundaries between each population had not been fully defined, and further sampling in the Caribbean Sea was considered to be needed (Baum *et al.*, 2007a). The boundary between the Gulf of Mexico and Caribbean populations was estimated to lie somewhere between Texas and northern Belize (D. Chapman and M. Shivji, Nova Southeastern University unpublished data in Baum *et al.*, 2007a). NOAA recognised six distinct population segments for *S. lewini* in 2013: Northwest Atlantic and Gulf of Mexico; Central and Southwest Atlantic; Indo-West Pacific; Central Pacific; and Eastern Pacific (NOAA, 2013) (Figure 2).

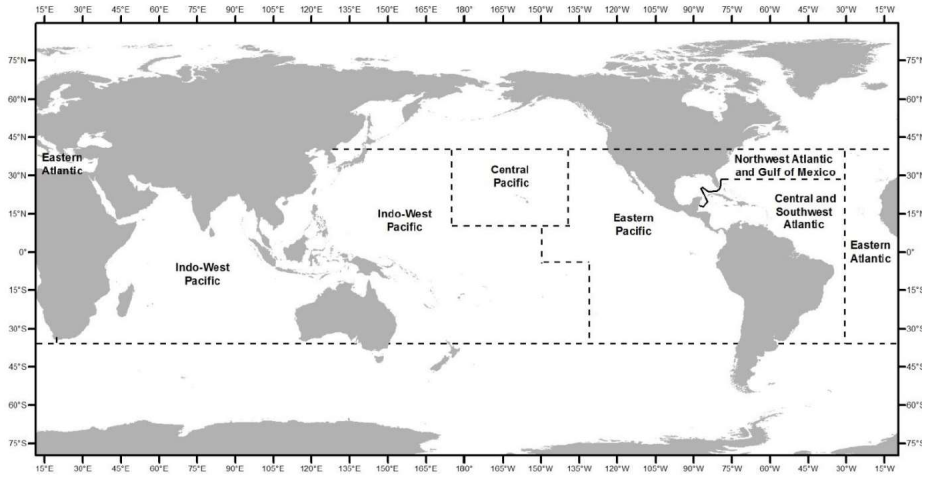

Figure 2: Summary of *S. lewini* distinct population segment boundaries as reported by NOAA, 2013 (reproduced with permission)

As well as these sex differences, *S. lewini* show different levels of mobility depending on whether they are juveniles or adults. Juvenile *S. lewini* are found in coastal habitats, where they remain resident for a number of years before moving offshore as they grow (Compagno, 1984; Hoyos-Padilla *et al.*, 2014). Natural predation of juveniles (by other carcharhinids as well as *S. lewini* adults) is high (Baum *et al.*, 2007a).

Population status and trends:

S. lewini was classified as Endangered, with an unknown population trend, in a 2007 IUCN assessment that is listed as needing updating (Baum *et al.*, 2007a). The assessment was made on the basis of major declines reported in many areas of the species' range, increased targeting for its high value fins, the species' low resilience to exploitation, and largely unregulated, continuing fishing pressure from both inshore and offshore fisheries (Baum *et al.*, 2007a). *S. lewini* has also been assessed at the level of individual subpopulations. Those of (1) the Northwest and Western Central Atlantic and (2) Eastern Central and Southeast Pacific, as the subpopulations most relevant to the region covered by this review, are classified as Endangered on the basis of continued high fishing pressure as well as observed and inferred declines (Baum *et al.*, 2007b, 2007c). Nance *et al.* (2011) used microsatellite data to estimate a historic effective population size in the Eastern Pacific of 34,995-43,551 *S. lewini* individuals, whereas Hayes *et al.* (2009) calculated a virgin, unfished population size (in 1981) for the northwestern Atlantic and Gulf of Mexico population of 142 000-169 000 individuals. In contrast, Hayes *et al.* (2009) estimated that this latter population had fallen to ~25,000 – 28,000 individuals in 2005. Duncan *et al.* (2006) also used molecular data to calculate global effective female population size estimates for *S. lewini*, which Miller *et al.* (2014) transformed to total effective population

estimates by assuming a 1:1 sex ratio and multiplying Duncan *et al.*'s (2006) estimates by two. As noted by the authors, these are intended to be qualitative indicators rather than precise estimates, and are based on low sample sizes for certain populations. The global effective population size of *S. lewini* was estimated to be 94 000 individuals (assuming a generation time of 16.7 years), and 280 000 individuals (assuming a generation time of 5.7 years).

Table 1.2 summarises available population and abundance trend data for *S. lewini* based on non-molecular data, particularly focusing on trends observed in the Northwest Atlantic, Central Atlantic, and Eastern Pacific. Because of difficulties in differentiating between *Sphyrna* species in the field (Baum *et al.*, 2007d), as well as historic non-species specific reporting, many of these estimates are for the genus *Sphyrna* and are therefore relevant to *S. mokarran* and *S. zygaena* as well. The majority of estimates agree that catches of *S. lewini* declined substantially between the 1980s and mid 2000s. For example, Hayes *et al*. (2009) found that some years in the early 1980s had maximum catches of 40 000 individuals in the NW Atlantic and Gulf of Mexico; this declined to 2600-6000 in 2002-2005 (FAO, 2010). However, in response to CoP 16 Prop. 43, the FAO Ad Hoc Expert Advisory Panel for Assessment of Proposals noted that recent harvest levels had been affected by increasingly stringent management measures, and should not be considered a reliable measure of abundance (FAO, 2010).

Whilst there are a number of estimates of population trends within the NW Atlantic, coverage of fishing areas relevant to the countries in this review is considered to be limited (FAO, 2018). There are also significant data gaps on population trends in the Eastern Pacific (FAO, 2010).

Table 1.2: Population trend data for *Sphyrna* spp. and for *S. lewini* in the Northwest, Central and Southwest Atlantic, as well as the Eastern and Southern Pacific Oceans.

Year	Location	Species	Data	Trend	Source
NW Atlantic					
1972-2003	NW Atlantic (coast off North Carolina)	*S. lewini*	Fishery independent survey (UNC research survey) (Catch per Unit Effort (CPUE))	98% decline*	Myers *et al.*, 2007
1986-2000	NW Atlantic	Hammerheads (primarily *S. lewini*)	Logbook data for US pelagic longline fleets targeting swordfish and tunas (CPUE)	89% decline*	Baum *et al.*, 2003[7]
			Observer data for US pelagic longline fleets targeting swordfish and tunas (CPUE)	76% decline*	Camhi *et al.*, 2009
1981-2005	NW Atlantic and Gulf of Mexico	*S. lewini*	Annual catch data recorded by National Marine Fisheries Service (surplus production model)	83% decline (however, the assessment indicated that numbers were increasing 1995-2005)	Hayes *et al.*, 2009[8]
1980-2005	NW Atlantic and Gulf of Mexico	Hammerhead shark complex (consisting of *S. lewini*, *S.*	Surplus production model	91-93% decline	Jiao *et al.*, 2009

[7] Conclusions from this study have been noted to be contentions, because the assessment "*only used a single relative abundance index (the pelagic longline logbooks), ignored data sets that would have produced different conclusions, and disregarded factors that possibly biased results*" (Hayes *et al.*, 2009)

[8] This was considered by the FAO Ad Hoc Expert Advisory Panel for Assessment of Proposals to CITES to be the most robust estimate for the NW Atlantic (FAO, 2010)

Year	Location	Species	Data	Trend	Source
		mokarran, and *S. zygaena*)			
Eastern Pacific					
1992-2002	Eastern Pacific (protected area near the Cocos Islands)	*S. lewini*	Diver visual sightings	71% decline	FAO, 2010
1993-2013	Eastern Pacific (protected area near the Cocos Islands)	*S. lewini*	Diver visual sightings	45% decline	White *et al.*, 2015
SW Atlantic					
2000-2008	SW Atlantic (off the coast of Brazil)	*S. lewini*	Surface gillnet CPUE (unstandardized) Bottom gillnet CPUE (unstandardized)	>80% decline >80% decline	FAO, 2010
2000-2008	SW Atlantic (off the coast of Brazil)	*S. lewini*	Surface longline CPUE (unstandardized)	No trend This fishery closed subsequent to 2008 because low abundance of targeted hammerhead sharks no longer justified fishing (FAO, 2010)	FAO, 2010
1992-2002	SW Atlantic (off the coast of Brazil)	*S. lewini* & *S. zygaena* (pooled)	Gillnet fisheries CPUE (unstandardized) Longline fisheries CPUE (unstandardized) Recreational fisheries CPUE (unstandardized)	No trend Increase from 1993-2000, decline from 2000-2002 No trend	Vooren *et al.*, 2005

Threats: Fishing is the main threat to the species. *S. lewini* co-exists with other high-value pelagic species (FAO, 2010), and is taken as both catch and bycatch within Exclusive Economic Zones (EEZs) as well as on the high seas.

The species is known to be susceptible to multiple different fishing gears including trawls, purse-seines and gillnets (Hayes *et al.*, 2009; Hazin *et al.*, 2001; Baum *et al.*, 2007a); however, it is considered to be most susceptible to fixed bottom and pelagic longlines (Belize High Seas Fisheries Unit, 2015; Queiroz *et al.*, 2016). The susceptibility of individuals to different fisheries changes as they mature; many juveniles are caught in coastal artisanal shark fisheries which tend to concentrate on nursery areas (Castillo-Géniz *et al.*, 1998; Ebert and Stehmann, 2013; Ruiz Alvarado and Mijangos López, 1998), whereas larger adults are caught as bycatch in pelagic fisheries for tuna and swordfish (Castillo-Géniz *et al.*, 1998; Ebert and Stehmann, 2013; Ruiz Alvarado and Mijangos López, 1998; White *et al.*, 2008; Ebert and Stehmann, 2013). Sex disequilibrium in catches has also been observed, probably as a result of the species' complex spatial dynamics (see *Distribution* section) (Tavares and Arocha, 2008; Hazin *et al.*, 2001; Branstetter, 1987; CONAPESCA-INP, 2004). *S. lewini*'s schooling

habit makes the species vulnerable to capture in large numbers; and can make the species appear to be more abundant in landings data (Baum *et al.*, 2007a).

Small hammerheads caught in artisanal fisheries appear to be principally caught for their meat, which was considered to taste better and to be easier to dress and conserve for later consumption than meat from larger individuals (Ministry of the Environment of Panama, 2017). Most shark meat in Central America tends to be consumed locally (FAO, 2018). Large *S. lewini,* on the other hand, are valued for their large fins, which have a high fin needle count (an indicator of quality in the shark fin market (Marshall and Barone, 2016)) (Abercrombie *et al.*, 2005; Baum *et al.*, 2007a). Fins are principally exported to Asia, where they are traded and consumed as a luxury seafood (Shea and To, 2017; FAO, 2010). Other parts and derivatives of hammerheads include leather and liver oil (Camhi *et al.*, 2009).

One of the largest trade hubs for the global shark fin trade is Hong Kong Special Administrative Region of China[9] (Fields *et al.*, 2018), where two detailed analyses of the species composition of fins on the market have shown which species are most commonly traded., Clarke *et al.* (2006) estimated that between 1.3 and 2.7 million *S. zygaena* and *S. lewini* were present in the shark fin trade each year, based on auction data from 1999-2001. A more recent study found that in 2014-2015 the fin trade volume in Hong Kong SAR markets had dropped by c. 30-50% since this last study; however, *S. lewini* and *S. zygaena* remained among the most common species traded (Fields *et al.*, 2018). *S. lewini*, *S. zygaena*, and *S. mokarran* accounted for 4.08%, 3.44% and 0.85% of 3943 samples analysed respectively (Fields *et al.*, 2018). The geographic origin of the samples was unknown; however, Fields *et al.* (2018) considered it possible that the maintenance of such high levels of hammerheads in the market had been enabled by shifts in the geographical sources of fins, or the expansion of fishing areas.

S. lewini has a very high at-vessel mortality rate: over 91% according to a study of US bottom longline vessels (70% young, 95.2% juvenile, 90.9% adult, N=455 individuals) (Morgan and Burgess, 2007), 62.9% according to Gulak *et al.* (2015)'s study of bottom longlines in the same region, and 100% in bottom-longline fishing experiments off Brazil (Afonso *et al.*, 2011 *in* Gulak *et al.*, 2015). Gulak *et al.* (2015) found that the most important variable determining the rate of hooking mortality for the species was time on the hook, with models predicting a mortality of 50% in <4h. Fishing depth was also discussed as a factor that could lead to increased mortality, but the study did not find a significant effect. Similarly, though hook type has previously been suggested to influence the mortality rates of sharks in commercial fisheries (Godin *et al.*'s (2012) meta-analysis on the subject found some evidence to suggest that, for shark species overall, circle hooks may reduce at-vessel mortality compared to J hooks), Gulak *et al.* (2015) did not find hook type to be a significant covariate in their models.

In 2015, *S. lewini* was included in an ecological risk assessment of pelagic sharks caught in Atlantic longline fisheries (Cortes *et al.*, 2015). The assessment calculated the vulnerability of the species (i.e. the extent to which the impact of a fishery on one species will exceed its biological ability to renew itself) based on measures of its productivity (in terms of the intrinsic rate of population increase) and susceptibility (the product of how likely a stock is to be encountered, how likely it is to be captured by the fishing gear, and post-capture mortality). Out of 20 species assessed, *S. lewini* was calculated to have the second lowest vulnerability; however, it should be noted that each risk assessment only applies to a particular fishery in a particular location, and that sharks generally are considered to be much more vulnerable than other target species with faster growth rates and higher fecundity. The study also did not take into account the species' high at-vessel and post-release mortality rates (Gallagher and Klimley, 2018). Other assessments, such as that conducted by the CITES SA of Costa Rica as part of its NDF for the species and the country's medium and large-sized fleet, placed *S. lewini* in a high risk category (CITES SA of Costa Rica, 2018).

Illegal, unreported and unregulated (IUU) fishing of *Sphyrna* spp. has been noted to occur in waters across the range, including around the Galapagos (Carr *et al.*, 2013), northern Australia, the western Indian Ocean (Baum

[9] Hereafter referred to as Hong Kong SAR

et al., 2007a) and the eastern tropical Pacific (Miller *et al.*, 2014; Benítez *et al.*, 2015), including in protected areas such as Cocos Island MPA in Costa Rica (White *et al.*, 2015). Miller *et al.* (2014) noted that with limited regulatory measures in the Eastern Pacific, threats from IUU fishing were expected to increase.

In addition to the effects of direct exploitation, poorly controlled development of coastal and marine habitats has been noted to be a threat to chondrichthyan nursey sites (CZMAI, 2014).

Sphyrna mokarran

Biology: *S. mokarran* (great hammerhead) is the largest of the hammerhead sharks (Last and Stevens, 2009 *in* Simpfendorfer, 2014), with mature adults commonly measuring around 4 m (Ebert and Stehmann, 2013). It is a coastal-pelagic species, occurring in both inshore as well as offshore areas, typically at depths of c. 1-80 m (Ebert and Stehmann, 2013). *S. mokarran* favours continental and insular coral reefs (Ebert and Stehmann, 2013), but tracking studies have shown that individuals will travel at least 1,200km offshore (Hammerschlag *et al.*, 2011). The species is thought to be more solitary than *S. lewini* and *S. zygaena* (Abercrombie *et al.*, 2005).

There are considerably fewer estimates of the life history parameters of *S. mokarran* compared to *S. lewini*, but available data indicate that the species has a faster growth rate and matures at an earlier age than other *Sphyrna* species (Ebert and Stehmann, 2013). Like other hammerheads, *S. mokarran* also has a relatively high fecundity compared to other sharks (Baum *et al.*, 2007a), with a mean litter size of 15 pups (Cortes *et al.*, 2015). In general, however, *S. mokarran* remains a slow-growing, slow-reproducing, long-lived species, which make it vulnerable to overexploitation. Its intrinsic rate of population increase is assumed to be low, and probably similar to that of *S. lewini* (Simpfendorfer and Rigby, 2016b), but there are currently no species-specific estimates.

Male *S. mokarran* are thought to grow faster and to reach sexual maturity at smaller sizes than females (Ebert and Stehmann, 2013; Stevens and Lyle, 1989). Like *S. lewini*, *S. mokarran* is viviparous (Ebert and Stehmann, 2013) and breeds once every two years, with a gestation period of 10-11 months (Stevens and Lyle, 1989). Litter size ranges from 6 to 42 pups (Ebert and Stehmann, 2013). Growth rates (von Bertalanffy *k*) for the species in the Gulf of Mexico and NW Atlantic have been estimated at 0.11 cm/year for females and 0.16 cm/year for males, assuming annual band deposition (Piercy *et al.*, 2010). Table 1.3 summarises estimates of the size and age at which males and females reach maturity.

Table 1.3: Size and age at maturity estimates for *S. mokarran.*

Life history parameter	*Value*	*Location*	*Source*
Size at maturity	210 cm TL F 225 cm TL M	Northern Australia	Stevens and Lyle, 1989
	250-300 cm TL F 234-269 cm TL M	Unspecified	Ebert and Stehmann, 2013
	227.9cm L_{ST}[10] M 227.9cm L_{ST} M	Eastern Australia	Harry, 2011
Age at maturity	5-6 years (median)	Unspecified	Ebert and Stehmann, 2013
	20 (median)	Unspecified	Cortes *et al.*, 2015

[10] L_{ST} = stretched total length

The oldest *S. mokarran* individual caught in the Gulf of California and Central Mexican Pacific measured 424 cm TL, and was estimated to be 45 years old (Tovar-Ávila and Gallegos-Camacho, 2014).

The only estimate of natural mortality rate that could be found for *S. mokarran* was calculated from data from the Queensland East Coast Inshore Finfish Fishery (Harry, 2011). It was calculated using Jensen (1996)'s formula of *Natural Mortality = 1.6k*, where *k* is the von Bertelanffy growth completion rate. The same is true for the only estimate of the species' intrinsic rebound potential that could be found, which was 0.043 /year (Harry, 2011).

Distribution and Stock Structure: *S. mokarran* is a coastal-pelagic species with a circumtropical distribution (Compagno, 1984) between latitudes 40N and 35S (Denham *et al.*, 2007) (Figure 3). They are most commonly found on the continental shelf and are thought to only rarely enter estuaries and the open ocean (Simpfendorfer, 2014). The IUCN assessment for the species lists all countries in this review except Mexico as countries of occurrence (Denham *et al.*, 2007); however, *S. mokarran* has been recorded in several Mexican fisheries areas (Benítez *et al.*, 2015), and Mexico's EEZ features prominently in the assessment's range map for the species.

Figure 3: Distribution of *S. mokarran.* Source: International Union for the Conservation of Nature (IUCN), Denham *et al.*, 2007.

S. mokarran is migratory, with some populations following warm water currents to move poleward in the summer (Ebert and Stehmann, 2013; Denham *et al.*, 2007). However, there is little published information regarding any detailed aspect of its movements (Denham *et al.*, 2007). Known nursery areas include a coastal mangrove estuarine area off southern Belize (Denham *et al.*, 2007).

Analysis of mitochondrial and nuclear DNA found that the populations of *S. mokarran* in Australia (Indo-Pacific) and the western Atlantic were genetically distinct, but samples from the eastern Atlantic, central Pacific and eastern Pacific were not included in the study (Testerman, 2014). Similar to *S. lewini*, differences in population

structure of *S. mokarran* from analyses of mitochondrial and nuclear DNA has been suggested to be evidence of male-mediated dispersal (Testerman, 2014). Sex-disequilibrium in catches has also been recorded (Harry, 2011).

Global population status and trends: A 2007 IUCN assessment (annotated as needing updating) categorised *S. mokarran* as Endangered, with a decreasing population trend, (Denham *et al.*, 2007), based on declines of >50% estimated by available studies. *S. mokarran* suffers from the same issues of under- and non-species specific reporting as *S. lewini,* and may often be grouped in with *S. lewini* in fisheries data as a result of misidentification (Denham *et al.*, 2007). There are therefore very few estimates of species-specific trends.

Data from the US pelagic fishery logbook estimated a decline of *S. mokarran* of over 90% between 1992 and 2000; however, this dataset has been criticised for inaccurate data reporting (Denham *et al.*, 2007). Dudley and Simpfendorfer's (2006) study of *S. mokarran* caught in shark nets off Kwa-Zulu Natal (a fishery independent monitoring method) estimated that between 1978 and 2003 the species declined by 79%. Other than these estimates, population trends for *S. mokarran* have to be inferred from estimates for the genus *Sphyrna*, which are outlined in the *Global population status and trends* section for *S. lewini*. Based on comparisons of fishery and non-fishery dependent surveys and records from ichthyological collections, Perez-Jimenez (2014) argued that the species may have been extirpated from the Gulf of California.

Threats: As the largest of the hammerhead sharks, *S. mokarran* is a favoured target species because of their large fins (which, like *S. lewini*, have a large number of fin needles) (Denham *et al.*, 2007). In 2007, fin prices for the species in Guatemala were reported to be USD50 per lb, and were considered to have risen as a result of Asian buyers (Denham *et al.*, 2007). *S. mokarran* meat is considered to be less desirable compared to that of other hammerheads (Ebert and Stehmann, 2013).

S. mokarran is not directly targeted in the NW Atlantic, but is still frequently taken as bycatch in pelagic longline, bottom longline, and net fisheries in the NW Atlantic and Gulf of Mexico (Ebert and Stehmann, 2013; Denham *et al.*, 2007). In the Pacific, the species is caught as bycatch in longline fisheries (Denham *et al.*, 2007). *S. mokarran* also has one of the highest at-vessel mortality rates of any shark species (over 90% according to US bottom longline fishery data (Morgan and Burgess, 2007), 56% according to Gulak *et al.* (2015)'s study of bottom longlines in the same region, and 100% in a study of Australian commercial longline fisheries (Butcher *et al.*, 2015)). Gulak *et al.* (2015) found that, like with *S. lewini*, time spent on the hook was a significant factor affecting mortality rates of *S. mokarran.* The authors also highlighted the role of ganglion length in influencing mortality rates, with their models predicting that mortality would occur earlier when longer ganglions are used (possibly because it increases the potential for entanglement or provides the shark with a greater distance to run and fight the longline, thus increasing stress) (Gulak *et al.*, 2015). However, it was noted that the low number of *S. mokarran* individuals included in the study could have resulted in a false positive for this relationship (Gulak *et al.*, 2015).

Sphyrna zygaena

Biology: *S. zygaena* is the second largest hammerhead shark after *S. mokarran* (Testerman, 2014), with individuals reaching a maximum total length of c. 370-400cm (Ebert and Stehmann, 2013). Like *S. lewini* and *S. mokarran* it is generalist predator, whose diet consists principally of cephalopods and teleosts (though larger individuals are known to take other small sharks such as shortnose spurdogs (*Squalus megalops*)) (Smale, 1991). The species tends to be found at or near the surface in relatively shallow waters, in contrast to *S. lewini* and *S. mokarran* who will range into greater depths (Ebert and Stehmann, 2013).

There are fewer estimates of the life history parameters of *S. zygaena* than there are for *S. lewini* (Rosa *et al.*, 2017), and the need for better data to make stock assessments has been highlighted (Coelho *et al.*, 2011). The species is also viviparous, and is thought to have a reproductive periodicity of 1 year (Cortes *et al.*, 2015). Mean litter size has been estimated to be higher than that of *S. lewini* and *S. mokarran*, at 33.5 pups (Cortes *et al.*, 2015). A study of *S. zygaena* caught by longliners in the Eastern Equatorial Pacific Ocean estimated a growth rate of k=0.06 cm/year for males, and k=0.07cm/year for females (Coelho *et al.*, 2011). Rosa (2017) estimated the growth rate to be k=0.09/year for both males and females from the Atlantic Ocean.

Similar to *S. lewini*, *S. zygaena* grows at a faster rate during the first four years of its life, after which the growth rate slows (Coelho *et al.*, 2011). Males are thought to mature at c. 210-240 cm, whereas females are thought to mature at a minimum of 304 cm (Ebert and Stehmann, 2013). In an ecological risk assessment of pelagic sharks caught in Atlantic longline fisheries, Cortés (2015) used an estimate of 9 years for the species' median age of maturity.

No estimates of the natural mortality or rate of population increase of *S. zygaena* could be found.

Distribution and Stock Structure: *S. zygaena* is a coastal-pelagic and semi-oceanic species (Compagno, 1984), found in temperate and subtropical oceans worldwide (Simpfendorfer and Rigby, 2016b) (Figure 4). It is generally considered to have a more temperate distribution than *S. lewini* and *S. mokarran* (Simpfendorfer and Rigby, 2016b). Reports of the species in tropical waters exist but are patchy, probably as a result of confusion with *S. lewini*, and the species' occurrence in these waters needs to be further clarified (Compagno, 1984; Simpfendorfer and Rigby, 2016b). *S. zygaena* is most commonly found in inshore, shallow waters over continental and insular shelves, but is also found offshore at depths of at least 200 m (Ebert and Stehmann, 2013).

Of the countries addressed in this review, only Mexico is listed as a country of occurrence by IUCN (Casper *et al.*, 2005).

Figure 4: Distribution of *S. zygaena.* Source: International Union for the Conservation of Nature (IUCN), Casper *et al.*, 2005.

Testerman (2014) found evidence of strong genetic differences between *S. zygaena* populations in the Atlantic and Indo-Pacific, and also evidence of matrilineal genetic structuring within eight ocean basins (Western North Atlantic, Western South Atlantic, Western Indian Ocean, Western South Pacific, Western North Pacific, Eastern North Pacific, Eastern Tropical Pacific, and Eastern South Pacific). This suggests that females are less mobile than males, and that the species may have similar sex-specific migration patterns to *S. lewini.* Testerman (2014) argued that all eight populations should be considered distinct management units for conservation and fisheries management purposes, but also noted that targeted genetic studies with animals of known gender and age class were needed to fully delineate genetic structure in the eastern and Western Atlantic. Limited dispersal is also supported by tagging studies of *S. zygaena* off the coast of southern Africa, which found that most movements were relatively short and restricted to the continental shelf (Diemer *et al.*, 2011).

Like *S. lewini* and *S. mokarran*, juvenile *S. zygaena* are thought to remain resident for a number of years in nursery areas, moving offshore as they mature.

Global population status and trends: *S. zygaena* is categorised by the IUCN as Vulnerable with a decreasing population trend, in an assessment noted as needing updating (Casper *et al.*, 2005). It was noted that further investigation into threats, population trends, catches and life-history parameters throughout its range was required to determine whether it may warrant a higher category in the future. Few species-specific data on population trends are available for reasons described in the *S. lewini* and *S. mokarran* sections of this report; in particular, however, *S. zygaena* is thought to be commonly confused with *S. lewini* (Casper *et al.*, 2005; Diemer *et al.*, 2011; Camhi *et al.*, 2009).

Declines of *S. zygaena* have been inferred from Baum *et al.* (2003)'s estimate of a decline in abundance of *Sphyrna* spp. (*S. lewini*, *S. mokarran* and *S. zygaena*) of 89% between 1986 and 2000. Based on standardised

CPUE data from a UNC research survey in the NW Atlantic, Myers *et al.* (2007) calculated that the species had declined by 99% between 1972 and 2003.

No assessments of long-term trends specific to *S. zygaena* could be found for the Eastern Pacific.

Threats: Like *S. lewini* and *S. mokarran*, *S. zygaena* has large, valuable fins that are sought after by Asian shark fin markets (Abercrombie *et al.*, 2005). It is also caught by target and non-target fisheries, and is vulnerable to a wide range of gears including pelagic longlines, handlines, gillnets, purse seines and pelagic and bottom trawls (Casper *et al.*, 2005). As would be expected by their movement patterns, juveniles mainly tend to be caught in near-shore fisheries, whereas adults tend to be caught by pelagic fisheries (Testerman, 2014).

At-vessel mortality of *S. zygaena* in a study of Australian commercial longline fisheries was calculated to be 100% (Butcher *et al.*, 2015).

C. Global trade

Global and regional landings and trade

Data on trade and landings of sharks and rays are generally poor. This is due to a variety of reasons, but some of the principal ones include:

(i) the fact that sharks are commonly caught as bycatch, and bycatch is rarely recorded at the species level in fishery statistics (Clarke *et al.*, 2006; Oliver *et al.*, 2015),

(ii) the capacity for species identification is generally poor, so the composition of landings has tended to be reported at a high taxonomic level (ICES, 2017),

(iii) many shark species lack their own customs code under systems in international use (FAO, 2010), and

(iv) data from vessels landing their catch in foreign ports may not be shared with their country of origin (Belize High Seas Fisheries Unit, 2015).

As a result, production data for *S. lewini, S. mokarran* and *S. zygaena* are commonly hidden among non-species-specific estimates, and even these may be affected by problems of under-reporting. Though members of the Sphyrnidae are can be readily separated from other shark taxa by their distinctive cephalofoils, difficulties with species identification commonly result in all hammerheads being aggregated into a single category, commonly reported as *Sphyrna* spp. or simply 'hammerheads'.

This section gives an overview of capture production and trade data for *S. lewini*, *S. mokarran* and *S. zygaena* at a global and regional scale (country-specific CITES trade data are outlined in *Section 3*). Where possible, the report discusses species-specific data; but in recognition of the high likelihood that some landings are being reported at high taxonomic levels, we also discuss landings reported as '*Sphyrna* spp.' and 'hammerheads'. We also discuss identification issues, as well as the need to establish robust conversion factors in order to have an accurate understanding of the number of individuals represented by measures of their parts and derivatives.

FAO Global Capture Production

FAO global capture production (i.e. the volume of fish catches landed) for hammerhead sharks is shown in Figure 5. These data indicate that the Atlantic was the largest source ocean of hammerhead catches 1997-2016 (Figure 4). Between 2007-2016, the three countries reporting the largest catches of Sphyrnidae (at the family level) were Indonesia (24 457 t), Senegal (10 576 t), and Mexico (10 664 t).

However, it is important to note that these figures are considered to be significant underestimates because (a) many countries have only recently started to report hammerhead shark catch data and (b) due to ongoing under-reporting of shark species in general and particularly of individuals taken as bycatch (Simpfendorfer and Rigby, 2016b; Oliver *et al.*, 2015; Clarke *et al.*, 2006). Furthermore, there are substantial discrepancies between FAO figures and shark fin trade data derived from markets. For example, Clarke *et al.*'s (2006) study of the biomass of sharks caught worldwide for the shark fin trade (derived from market data) estimated that, between 1996 and 2000, 49 000-90 000 tonnes of hammerhead sharks were taken for the fin trade each year. This is over an order of magnitude higher than the average annual global catch for hammerheads over the same time period according to FAO data (3508t) (Simpfendorfer and Rigby, 2016b).

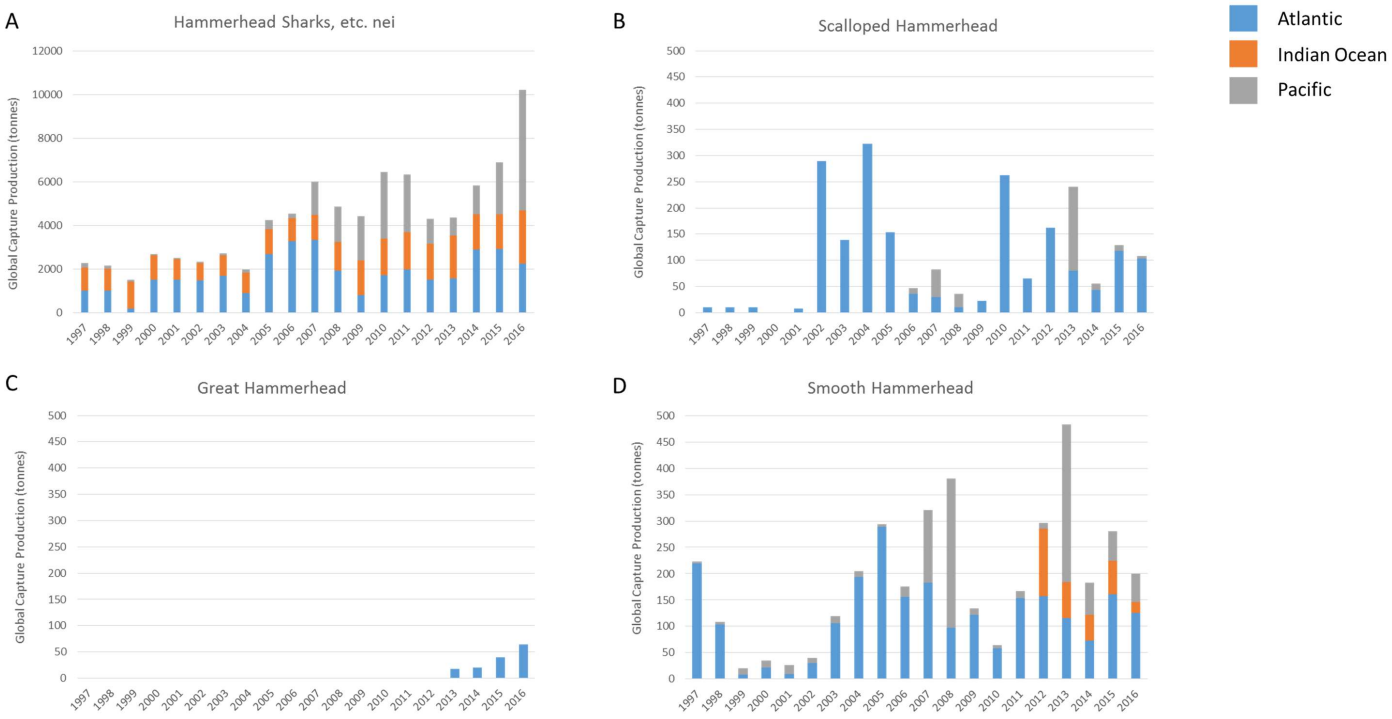

Figure 5: FAO global capture production for catches reported as 'Hammerhead sharks etc. nei[11]', 'scalloped hammerheads' (presumed to be *S. lewini*), 'great hammerheads' (presumed to be *S. mokarran*), and 'smooth hammerheads' (presumed to be *S. zygaena*).

[11] nei- not elsewhere included

CITES Trade Database

Whilst *S. lewini* was listed in Appendix III by Costa Rica on 25/09/2012, *S. lewini, S. mokarran* and *S. zygaena* were only listed in Appendix II in September 2014. Accordingly, only four years of trade data (2014-2017) and two complete years of data are available, as data for 2017 was not complete at the time of writing. According to the CITES Trade Database, global exports of wild-sourced *Sphyrna* spp. for commercial purposes 2014-2017 comprised fins and meat reported by weight (fins: 79 012 kg reported by exporters and 53 626 kg reported by importers). Hong Kong SAR was the largest importers of *Sphyrna* spp. globally 2014-2017. Costa Rica, El Salvador, Mexico and Nicaragua were the only countries covered by this review that reported direct exports of *Sphyrna* spp. for commercial purposes. Figure 5 shows the weight of *Sphyrna* fins directly exported by these four Parties, as reported by exporters. Mexico is the main exporter of *Sphyrna* spp. within Central America. Based on only two complete years of CITES trade data, it is not possible to infer any trends in exports.

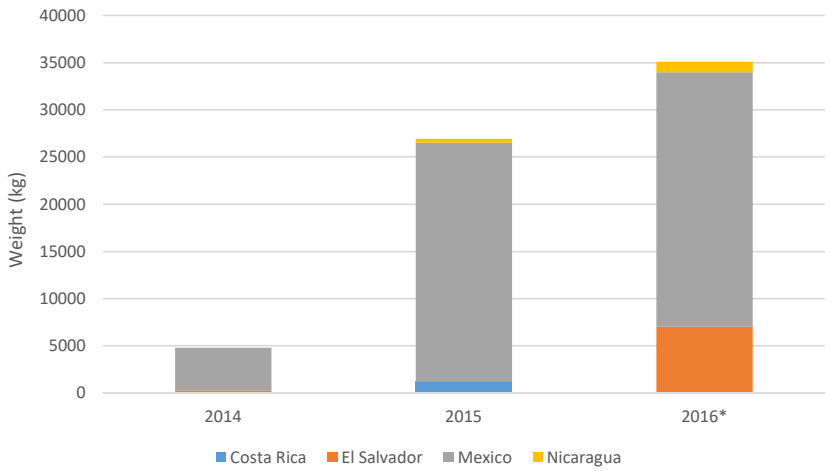

Figure 6: Estimated weight of wild-sourced *Sphyrna* spp. fins exported 2014-2016 for commercial purposes from CITES Parties included in this review, as reported by exporters. * denotes years for which trade data is incomplete; at the time of writing (January 2019) Belize had not yet submitted CITES Annual Reports for 2016. Total weight shown includes data from three conversions of fins that were reported as the number of units traded into kilograms (434 *S. lewini* fins exported from El Salvador in 2014, and 50 *S. lewini* and 50 *S. mokarran* fins exported from Nicaragua in 2016). We based the conversions on the average weight of *S. lewini* fins reported in Kim *et al.*, (2007) which was calculated as 0.69 kg. Estimates of the average weight of fins could not be found for *S. mokarran,* so the same estimate of average fin weight was used; it should be noted, however, that it is likely to be an underestimate for this larger species.

IATTC Data

As members of IATTC (Inter-American Tropical Tuna Commission) (see *Management* section), Belize, El Salvador, Guatemala, Honduras, Mexico, Nicaragua and Panama are required to submit annual reports for catches, effort by gear type, landing and trade of sharks by species (IATTC, 2005). Figure 7 shows Eastern Pacific Ocean (EPO) hammerhead bycatch data for purse seines fishers, obtained from IATTC's public domain data library for the last ten years (2008-2017). Panama and Mexico reported the highest number of *Sphyrna* landings over this time period (a total of 936 and 923 individuals respectively), whereas Nicaragua reported landing 129 *Sphyrna* individuals. There were no reported data for the time period specified for Belize, Honduras, El Salvador, and Guatemala.

Reporting data for hammerheads retained by longline vessels in the EPO is similarly patchy. Only Belize and Panama have reported catches of hammerheads; Belize reported zero hammerheads retained by industrial longline vessels in the EPO 2009-2017. There is no data reported for Panama 2008-2015, but zero catches were reported in 2016, and 11.03Mt hammerheads were retained in 2017.

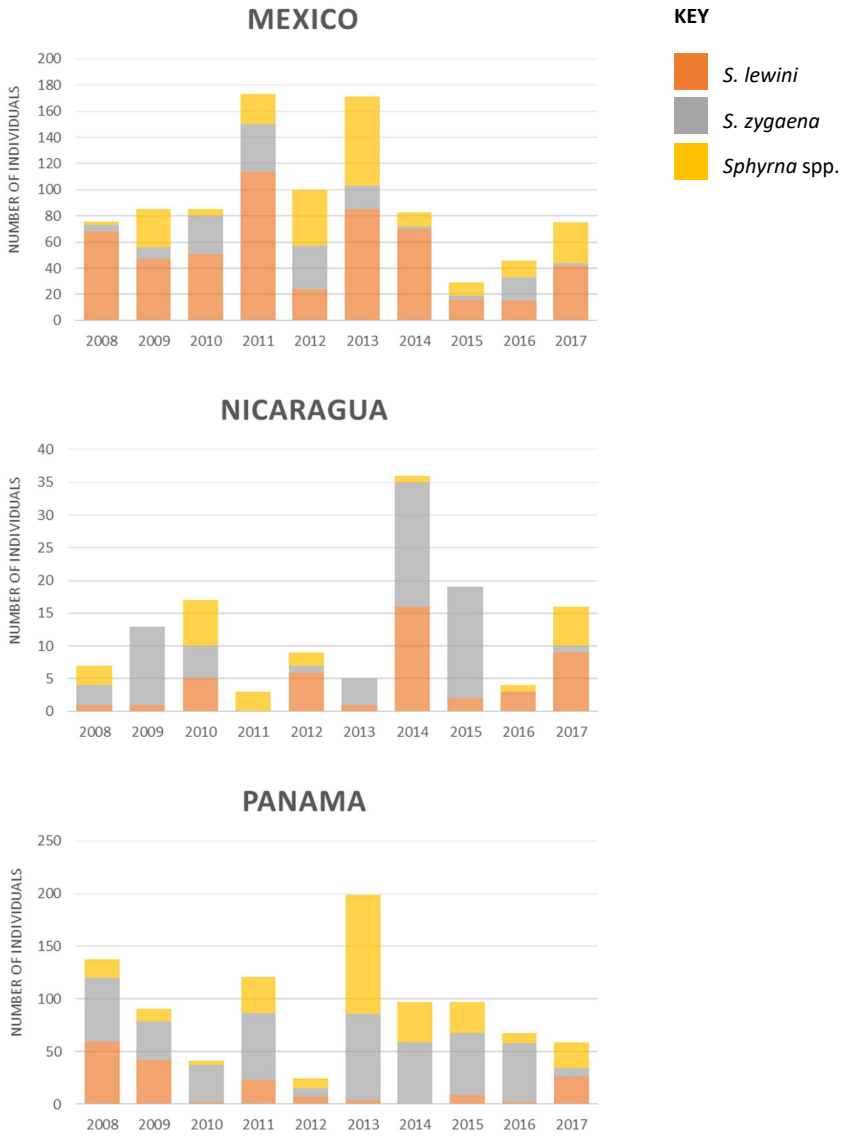

Figure 7: Data provided by IATTC members included in this review on hammerhead bycatch by purse seine vessels in the EPO, 2008-2017. Hammerhead catches may potentially be reported at species level (*S. lewini* and *S. zygaena*), at genus level (*Sphyrna* spp.) or at a higher 'various sharks level'. Data from this latter level are excluded, so the totals may not be fully representative of the total number of *Sphyrna* spp. caught.

Identification

S. lewini, *S. mokarran* and *S. zygaena* are considered by Ebert and Stehmann (2013) and Pérez-Jiménez (2014) to be identifiable to species level from their morphology. The anterior edge of the cephalophoil of *S. lewini,* for example, has a prominent indentation at the midline which is unique to the species (CEC, 2017). However, it is difficult to identify individuals to species in the field (ICES, 2017), and confusion between *S. lewini*, *S. mokarran*, *S. zygaena*, and other *Sphyrna* and *Eusphyra* species has been noted to be common (Mundy-Taylor and Crook, 2013; Simpfendorfer and Rigby, 2016b; Casper *et al.*, 2005; Tavares and Arocha, 2008; Diemer *et al.*, 2011).

Identification additionally becomes much harder when the full organism is no longer available, and a decision has to be made for parts and derivatives such as fins and meat (Mundy-Taylor and Crook, 2013; CEC, 2017). Dried fins in particular are considered to present difficulties (Mundy-Taylor and Crook, 2013), though traders in China and Hong Kong SAR have been noted to be able to reliably identify fins in trade to small species groups (including a mixed group of *S. lewini* and *S. zygaena*) (Clarke *et al.*, 2005). Visual guides have been created to help address this problem (e.g. Castellanos Betancourt *et al.* 2013; Marshall and Barone, 2016; Abercrombie and Hernandez, 2017), and in 2014 FAO launched iSharkFin; a free app that uses machine learning to identify fins from photographs (Marshall and Barone, 2016).

There is no easy way for border enforcement authorities to visually identify meat and cartilage to species level (CEC, 2017); however, Cardeñosa *et al.* (2018) recently published a field-based, fast (<4hours) multiplex real-time PCR protocol for identifying CITES-listed shark species (including all three listed species of *Sphyrna*) from tissue samples, at a cost of USD 0.94 per sample. These sorts of resources will help build capacity in this area, which was noted to be an urgent need in several Central American countries' NPOA-Sharks (Comisión Nacional para la Conservación y Ordenación de los Tiburones, 2010; Belize High Seas Fisheries Unit, 2015).

Nevertheless, look-alike issues between CITES and non-CITES listed *Sphyrna* derivatives have been noted to be such that some authors have suggested the Appendix II listing be expanded to include all members of the genus *Sphyrna* and *Eusphyrna,* under Criterion A in Annex 2b (the look-alike clause) of Resolution Conf. 9.24 (Rev. CoP14) (AC30 Inf. 14).

Conversion Factors

Shark products are often traded in parts, such as fins and meat, and accordingly it is difficult to equate the number of these body parts in trade to the number of sharks harvested. Calculating this requires the use of a conversion factor, which requires assumptions to be made about (a) whether all fins of the shark were used, (b) the average body weight of the species, (c) the ratio of fin mass to body mass, and (d) the amount of mass that is lost due to processing. Lehr (2015) noted that conversion factors will need to be set by scientific authorities, ideally in coordination with other Parties. Costa Rica's NDF for *Sphyrna* spp. stipulates that a wet-fin weight to dry fin weight conversion factor of 38% is used to verify that dried fins for export corresponded to fresh product purchased; an important part of the traceability measures outlined in its NDF for *Sphyrna* (CRACCITES - Costa Rica, 2017). Mexico has also undertaken studies to identify fin drying times and conversion factors between derivatives, prioritising studies that are region-specific and have large sample sizes (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019). The country uses the following conversion factors for *Sphyrna* spp. derivatives:

Table 1.4: Conversion factors used by Mexico for *Sphyrna* spp. (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019)

Species	*% WFW:DW*	*% WFW:RC*	*% WFW:DW*	*Source*
Sphyrna lewini	2.85	1.66	40 (NMFS, 1993 in Biery & Pauly 2012)	Cortés & Neer (2006)
Sphyrna mokarran	2.94	1.96		Cortés & Neer (2006) and Biery & Pauly (2012)
Sphyrna zygaena	8.79	5.77		Neves dos Santos and García (2008)

WFW: wet fin weight, DFW: dry fin weight, DW: dressed carcass weight, RC: round carcass

Information regarding the conversion factors used by other focal countries could not be located.

Management

As a set of species with a circumglobal distribution, the ranges of *S. lewini*, *S. mokarran* and *S. zygaena* include areas under the management of national, regional and international treaties and legislation. There may be also be areas where the three species occur that are not under the jurisdiction of either national, regional or international governance (such as certain areas of the high seas).

Each State included in the review will have an EEZ up to 200 nautical miles (370 km) off its coast, within which the State assumes jurisdiction over the exploration and exploitation of marine resources. In addition, States may be members of RFBs such as RFMOs. The countries that are members to these international bodies share a practical or financial interest in conserving fish stocks in a particular region. RFMOs can cover large geographical areas; and as partially migratory species, *S. lewini*, *S. mokarran* and *S. zygaena* come under the remit of some of the so-called tuna RFMOs, whose areas cover 91% of the world's oceans (Pew Trusts, 2012). States may additionally be signatories of fisheries management organisations that are not RFMOs; the majority of States reviewed in this document, for example, are members of the Central America Fisheries and Aquaculture Organization (OSPESCA).

This section gives an overview of relevant legislation and treaties that operate at a regional and international level. Outlines of national legislation can be found in *Country Reviews* section. A summary of which States included in this review are subject to each treaty discussed in this section is included in Annex 1.

International Management

United Nations Convention for the Law of the Sea (UNCLOS)

UNCLOS is considered to be the principal framework convention for the management of the world's oceans (Fischer *et al.*, 2012). The family Sphyrnidae is listed under Annex I (as highly migratory species) (United Nations General Assembly, 1982).

Under UNCLOS, coastal States and other States whose nationals fish in the region for listed species should cooperate directly or through appropriate international organizations with a view to ensuring conservation and promoting the objective of optimum utilization of such species throughout the region, both within and beyond the EEZ (United Nations General Assembly, 1982). Where no appropriate international organization exists, the coastal State and other States whose nationals harvest these species in the region area are asked to cooperate to establish such an organization and participate in its work (United Nations General Assembly, 1982).

Convention on Migratory Species of Wild Animals (CMS)

S. lewini and *S. mokarran* were listed in Appendix II of CMS in 2014. The Convention encourages range States of Appendix II-listed species to conclude global or regional Agreements for the conservation and management of individual species or groups of related species. To this end, *S. lewini* and *S. mokarran* (and, as of December 2018, *S. zygaena*) are covered by the CMS Memorandum of Understanding (MoU) on the Conservation of Migratory Sharks (CMS, 2016). Though non-binding, the MoU contains a conservation plan that aims to achieve and maintain a favourable conservation status for migratory sharks. Although Honduras, Costa Rica, Panama and the Dominican Republic are Parties to CMS, only Costa Rica is a signatory of the sharks MoU.

FAO International Plan of Action for the Conservation and Management of Sharks (IPOA-Sharks)

IPOA-SHARKS was adopted in 1999 under the auspices of the FAO Code of Conduct for Responsible Fisheries (Fischer *et al.*, 2012). Its aim is to ensure the conservation and management of sharks and their long-term sustainable use, with particular emphasis on improving species-specific catch and landings data collection and the monitoring and management of shark fisheries (Fischer *et al.*, 2012). The plan applies to coastal States where sharks are caught in their waters, and to flag States whose vessels catch sharks on the high seas. IPOA-Sharks encourages States to develop and implement National Plans for Action for the conservation and management of sharks (NPOA-Sharks), and suggests how these plans should be structured as well as what they should include. Implementation of IPOA-Sharks is voluntary; however, all countries in this review have developed NPOA-Sharks (FAO, 2018), and a Regional Plan of Action for the Conservation and Management of Sharks (RPOA-Sharks) has also been published for Central America.

Regional Management

Regional Fisheries Management Organisations (RFMOs)

Table 2.1 lists the RFMOs where a country reviewed in this report is either a contracting party or a cooperating non-contracting party (referred to collectively as CPCs), and gives an overview of any stock assessments for the three *Sphyrna* species considered in this report. It additionally outlines any relevant measures outlined in each RFMO's resolutions and recommendations.

The three RFMOs most relevant to hammerhead fisheries in this review's target countries are the International Commission for the Conservation of Atlantic Tunas (ICCAT), Inter-American Tropical Tuna Commission (IATTC) and Western Central Atlantic Fishery Commission (WECAFC). All three have implemented some sort of finning ban that is intended to require fishermen to fully utilise their entire catches of sharks, but the form of finning ban in place in the ICCAT and IATTC RFMOs has come under criticism for its inclusion of loopholes which are argued to have facilitated illegal finning. The bans themselves stipulate that CPCs should "*not have onboard fins that total more than 5% of the weight of sharks onboard up to the first point of landing*"; however, the text does not specify whether this limit applies to the weight of whole or processed sharks, and wet or dry fins (OCEANA, 2013). It also allows fins and carcases to be landed separately, which is considered to make enforcement "practically impossible" (OCEANA, 2013). Several NGOs have argued that stronger bans are those that require sharks to be landed with their fins naturally attached (OCEANA, 2013); bans of this form have been adopted by WECAFC and all members of OSPESCA.

Table 2.1: Summary of RFMO measures relevant to the sustainable use of *Sphyrna* spp.

RFMO	*Countries*	*Stock status of* Sphyrna spp.	*Measures*
International Commission for the Conservation of Atlantic Tunas (**ICCAT**)	**Members:** Belize, El Salvador, Guatemala, Honduras, Mexico, Nicaragua, Panama **Cooperators:** Costa Rica	Status unknown; no stock assessment (ICES, 2017)	***Prohibitions:*** The retention on board, transhipping, landing, storing, selling, or offering for sale of any part or whole carcass of sharks of the family Sphyrnidae is prohibited (except for *Sphyrna tiburo*) (ICCAT, 2010). Hammerheads caught by vessels must be promptly released unharmed, to the extent practicable, when they are brought alongside the vessel. Hammerheads caught by developing coastal CPCs[12] for local consumption are exempt provided these CPCs provide Task I and Task II data (ICCAT, 2010). ***Shark fin measures:*** CPCs should take necessary measures to require fishermen to fully use their entire catches of sharks (ICCAT, 2004). Full utilization is defined as retention by the fishing vessel of all parts of the shark excepting head, guts and skins, to the point of first landing (ICCAT, 2004). Vessels must not have onboard fins that total more than 5% of the weight of sharks onboard, up to the first point of landing (ICCAT, 2004). ***Bycatch:*** The release of live sharks (especially juveniles) that are caught incidentally and are not used for food/subsistence is encouraged (ICCAT, 2004). ***Reporting:*** CPCs are required to report the number of discards and releases of hammerheads, with an indication of status (dead or alive) in accordance with ICCAT data reporting requirements. ***IPOA Sharks:*** ICCAT members must fully implement NPOA Sharks (ICCAT, 2003). ***Data collection and research:*** CPCs are encouraged to, where possible, undertake research to identify ways to make fishing gears more selective and identify shark nursery areas (ICCAT, 2010).
Western and Central Pacific Fisheries	**Cooperating Non-contracting Parties:** El Salvador, Mexico,	Unknown, no stock assessment	***Shark fin measures:*** Commission Members, Cooperating non-Members, and participating territories (CCMs) should take measures necessary to require

[12] Parties and co-operating non-parties, co-operating fishing entities or regional economic integration organizations

RFMO	*Countries*	*Stock status of* Sphyrna spp.	*Measures*
Commission (**WCPFC**)	Panama		that their fishers fully use any retained catches of sharks (WCPFC, 2010). Full utilization is defined as retention by the fishing vessel of all parts of the shark excepting head, guts, and skins, to the point of first landing or transshipment. Vessels are required to have on board fins that total no more that 5% of the weight of sharks on board up to the first point of landing. CCMs that currently do not require fins and carcasses to be offloaded together at the point of first landing should take the necessary measures to ensure compliance with the 5% ratio through certification, monitoring by an observer, or other appropriate measures. CCMs may alternatively require that their vessels land sharks with fins attached to the carcass or that fins not be landed without the corresponding carcass. ***Bycatch:*** NPOA Sharks must include measures to minimize waste and discards from shark catches and encourage the live release of incidental catches of sharks (WCPFC, 2010). In fisheries for tunas and tuna-like species that are not directed at sharks, the live release of incidentally caught sharks is encouraged (WCPFC, 2010). ***Reporting:*** CCMs must report annual catch and fishing effort statistics on hammerheads (among other species) by gear type, including available historical data (WCPFC, 2010). ***IPOA Sharks:*** CCMs must implement IPOA Sharks, and report to the Commission on their implementation of IPOA Sharks and NPOA Sharks (WCPFC, 2010). ***Data collection and research:*** CCMs are encouraged to support research and development of strategies for the avoidance of unwanted shark captures (e.g. chemical, magnetic and rare earth metal shark deterrents) (WCPFC, 2010).
Inter-American Tropical Tuna Commission (**IATTC**)	**Members:** Belize, Costa Rica, El Salvador, Guatemala, Mexico, Nicaragua, Panama	Unknown status, no stock assessment	***Prohibitions:*** CPCs should prohibit longline vessels flying their flag that fish for tuna or swordfish in the Convention Area from using “shark lines” (individual lines attached to the line of floats or directly to the floats and used to fish for sharks) (IATTC, 2016).

RFMO	*Countries*	*Stock status of* Sphyrna spp.	*Measures*
	Cooperating Non Members: Honduras		***Shark fin measures:*** CPCs should take necessary measures to require their fishers to fully use any retained catches of sharks. Full utilization is defined as retention by the fishing vessel of all parts of the shark excepting head, guts, and skins, to the point of first landing (IATTC, 2005). Vessels must not have onboard fins that total more than 5% of the weight of sharks onboard, up to the first point of landing (IATTC, 2005). CPCs that currently do not require fins and carcasses to be offloaded together at the point of first landing should take the necessary measures to ensure compliance with the 5% ratio through certification, monitoring by an observer, or other appropriate measures (IATTC, 2005). ***Bycatch:*** The release of live sharks (especially juveniles) that are caught incidentally and are not used for food/subsistence is encouraged (IATTC, 2005), and should be done in the manner described in Resolution C-16-05 (IATTC, 2016). ***Reporting:*** CPCs are required to submit annual reports for catches, effort by gear type, landing and trade of sharks by species (IATTC, 2005). ***IPOA Sharks:*** IATTC requires CPCs to establish and implement NPOA-Sharks (IATTC, 2005). ***Data collection and research:*** CPCs are encouraged to, where possible, undertake research to identify ways to make fishing gears more selective and identify shark nursery areas (IATTC, 2005). In 2006, the IATTC, in cooperation with scientists of CPCs and, if possible, the Western and Central Pacific Fisheries Commission, agreed to provide preliminary advice on the stock status of key shark species (IATTC, 2005). Resolution C-16-05 on the management of shark species called for, *inter alia*, the scientific staff of the IATTC to develop a work plan to complete a population assessment of *S. lewini*, *S. zygaena* and *S. mokarran* (IATTC, 2016).
Western Central Atlantic Fishery	Belize, Costa Rica, Dominican Republic, Guatemala, Honduras,	The US, through NOAA, is the only WECAFC member to have carried out a stock assessment	The 8th Session of the WECAFC Scientific Advisory Group was held in November 2017. During the meeting, the following relevant

RFMO	*Countries*	*Stock status of* Sphyrna spp.	*Measures*
Commission (**WECAFC**)	Mexico, Nicaragua, Panama (Members)	of *S. lewini* within part of the WECAFC area (FAO, 2018). The assessment concluded that in the case of the NW Atlantic and the Gulf of Mexico, high at-vessel fishing mortality was the most serious threat, with overutilization by industrial/commercial and recreational fisheries as moderate risks (Miller *et al.*, 2014). In the Eastern Pacific, overutilization by industrial/commercial and artisanal fisheries, as well as the impact of IUU fishing, high at-vessel fishing mortality and schooling behaviour of the species were ranked as high risks, with the lack of current adequate regulatory mechanisms ranked as a moderate risk (Miller *et al.*, 2014). The NW Atlantic and Gulf of Mexico population was considered to be at a low risk of extinction now and in the foreseeable future, whereas the Eastern Pacific population was considered to be at high risk of extinction now and in	recommendations from the WECAFC working groups were discussed, for final review and endorsement by WECAFC 17 in 2018. ***(1) Recommendation WECAFC/17/2018/6*** *"on the fisheries management and conservation of sharks and rays in the WECAFC area"* includes recommendations for members of WECAFC to*, inter alia:* • Implement the endorsed ""Regional Plan of Action for the Conservation and Management of Sharks and Rays in the WECAFC Area" as appropriate • Prepare their NPOA-Sharks in line with the IPOA-Sharks • Undertake research to identify ways to make fishing gears more selective • Conduct research on key biological/ ecological parameters, life history and behavioural traits, migration patterns, as well as on the identification of potential mating, pupping and nursery grounds of the most common shark species in the WECAFC area. The recommendation additionally calls for members of WECAFC that are non-contracting parties to ICCAT provide their estimates of landings and of live and dead discards of sharks and all other available data (including observer data) annually to WECAFC ***(2) Recommendation WECAFC/17/2018/7*** *"on the removal of fins of sharks on board by vessels fishing in the WECAFC area"* includes recommendations for members to*, inter alia:* • Prohibit the removal of shark fins at sea, and require that all sharks be landed with their fins naturally attached through the point of first landing of the sharks. Shark fins may be partially cut from the body and folded against the carcass, but should not be removed • Encourage the release of live sharks that are caught incidentally and are not used for food and/or subsistence **(3)** ***Recommendation WECAFC/17/2018/8*** *"on applying a precautionary approach to fishing of threatened species of sharks and rays in the WECAFC area"* includes recommendations for members to, *inter alia*:

RFMO	*Countries*	*Stock status of* Sphyrna spp.	*Measures*
		the foreseeable future (Miller *et al.*, 2014).	• Restrict vessels flying their flag from directed fishing of the family Sphyrnidae (except *Sphyrna tiburo*)
IOTC	Belize	*S. lewini:* 2017 stock status was determined to be uncertain (IOTC, 2017b). The IOTC was recommended to take a cautious approach by implementing some management actions for S. lewini, and to encourage CPCs to comply with their recording requirements (IOTC, 2017b).	***Shark fin measures:*** CPCs should take necessary measures to require their fishers to fully use any retained catches of sharks (IOTC, 2017a). Full utilization is defined as retention by the fishing vessel of all parts of the shark excepting head, guts and skins, to the point of first landing (IOTC, 2017a). If sharks are landed fresh, CPCs should prohibit the removal of shark fins on board vessels (IOTC, 2017a). If sharks are landed frozen, CPCs should require their vessels to not have on board fins that total more than 5% of the weight of sharks on board, up to the first point of landing (IOTC, 2017a). CPCs that currently do not require fins and carcasses to be offloaded together at the point of first landing should take the necessary measures to ensure compliance with the 5 % ratio through certification, monitoring by an observer, or other appropriate measures (IOTC, 2017a). Shark fins may be partially sliced through and folded against the shark carcass (IOTC, 2017a). ***Bycatch:*** The release of live sharks (especially juveniles and pregnant females) that are caught incidentally and are not used for food/subsistence is encouraged (IOTC, 2017a). ***Reporting:*** CPCs are required to submit annual reports for shark catches, including all available historical data, estimates and life status of discards (dead or alive) and size frequencies (IOTC, 2017a). ***Data collection and research:*** CPCs should undertake research to: a) identify ways to make fishing gears more selective, b) improve knowledge on key biological/ecological parameters, life-history and behavioural traits, migration patterns of key shark species; c) identify key shark mating, pupping and nursery areas; and d) improve handling practices for live sharks to maximise post-release survival (IOTC, 2017a). The IOTC Scientific Committee should annually review the information provided by CPCs, and, as necessary, provide recommendations to the Commission on ways to strengthen the conservation and management of sharks within IOTC fisheries (IOTC, 2017a).

OSPESCA (Central American Integration System (SICA)'s Fisheries and Aquaculture Sector Organisation of the Central American Isthmus)

Belize, Costa Rica, El Salvador, Panama, Guatemala, Honduras and Nicaragua are all members of OSPESCA, a regional fisheries body whose area of competence extends to the national waters, inland waters and EEZs of its Member States. It has adopted a number of regulations relevant to the management of sharks and published an RPOA-Sharks in 2011.

RPOA-Sharks: Plan de Acción Regional para la Ordenación y Conservación de los Tiburones en Centroamérica (PAR-TIBURON)

PAR-TIBURON aims to guarantee the sustainable management of sharks in the Central American region by having the entire region adopt common strategic objectives (OSPESCA, 2011a). The plan outlines the eight avenues through which this could be achieved, and for each one outlines the principal objective, activities that will be carried out and indicators of success. The eight avenues are:

- Research
- Monitoring and control
- Capacity building
- Information sharing
- Intergovernmental coordination
- Legislation
- Utilisation and trade
- Financial management

The plan notes that, *inter alia*:

(1) The execution of the RPOA-Sharks must bear in mind the fishing contexts of the Pacific and the Central American Caribbean, which belong to different ecosystems with different attributes;

(2) The region should consider the creation or remodelling of a Regional Center for Research and Training in Fishery Resources, which would have the capacity to supervise all actions related to regional issues of sharks and other fisheries;

(3) The region should consider forming a group of technicians who specialize in the evaluation and monitoring of fisheries for sharks and highly migratory species;

(4) Available data on catches and effort in shark fisheries are insufficient in the majority of fisheries. There is a lack of landing information in properly controlled ports, and efforts must be made to limit this;

(5) There remains a lack of data on fishing effort and specific allocation of catch, as well as records of the sex, length and age composition of catches;

(6) Knowledge of catches in coastal areas is generally scarce, including in critical shark nursery habitats associated with gulfs such as the Gulf of Fonseca, Gulf of Honduras, Gulf of Nicoya, Golfo Dulce, Gulf of Panamá and Gulf of San Miguel;

(7) Coordinating the collection of information on transboundary species especially in international waters remains difficult, and there is a need for coordinated work with the IATTC;

(8) Co-management of the shark populations of El Salvador, Honduras and Nicaragua in the Gulf of Fonseca is recommended; as well as co-management between Belize, Guatemala and Honduras in the Gulf of Honduras;

(9) In almost all countries, economic funds for shark monitoring, research and management are scarce; alternative funding alternatives should therefore be sought.

In addition, the report highlights the need to increase capacity of personnel across the region as one of the most urgent actions required (OSPESCA, 2011a). In terms of developing robust NDFs for *Sphyrna* spp., measures ensuring coordinated and standardised data collection, measures to increase species-specific data, measures to adequately protect nursery areas, and the principle of co-management of shared stocks are the most important.

Finning: OSPESCA adopted Regulation OSP-05-11 in November 2011, which is legally binding and banned shark finning outright (OSPESCA, 2011b). Importantly, the regulation stipulates that sharks must be landed while their fins are still naturally attached to the whole body or a portion of the shark body. This is considered to be a more easily implemented system than the fin to bodyweight ratio requirements implemented by some RFMOs, and is considered by many countries to be the target standard for how to enforce bans on shark finning (Marshall and Barone, 2016).

Monitoring and Research: Since 2012, OSPESCA members have worked to harmonize data collection forms for landings and biological sampling (FAO, 2018). A capacity building programme on CITES non-detriment findings procedures for sharks listed in Appendix II, with U.S. Department of the Interior support, has also been implemented (FAO, 2018). At a recent meeting of the WECAFC/OSPESCA/CRFM/CITES/CFMC working group on shark conservation and management, OSPESCA noted that only limited shark research had been carried out in Central America, with different catch and effort data quality levels and coverage among countries. Shark stock assessments, as well as standard definitions for different types of fishing fleet (artisanal, small scale, industrial) were noted to be critically needed (FAO, 2018).

Enforcement and Traceability: In recognition of a need to intensify and fortify efforts to tackle IUU fishing, in 2010, OSPESCA members adopted regulation OSP 03-10 for the creation and gradual implementation of a regional system for satellite monitoring and control of fishing vessels (OSPESCA 2010). Total implementation was expected to be achieved within six months of the regulation's adoption (OSPESCA 2010).

Action Plan for North America: Sustainable Trade in Sharks

In 2017, the Commission for Environmental Cooperation (CEC) published an action plan for eight priority shark species that were native to North America and were traded by more than one of the three North America countries (CEC, 2017). The document includes seven recommended actions for promoting the conservation of priority shark species in Mexico and ensuring their legal, sustainable trade throughout North America, developed through a consultative process with stakeholders as well as the CITES Authorities of Canada, Mexico and the United States (CEC, 2017).. Details of these recommendations that are most relevant to the development of NDFs are outlined in the Mexico *Country Review* Section.

WECAFC RPOA-Sharks

In 2017, a draft regional management plan for sharks and rays was published for countries in the WECAFC area (FAO, 2018), which includes all countries in this review except El Salvador.

Protocol Concerning Specially Protected Areas and Wildlife (SPAW Protocol)

Belize, the Dominican Republic and Panama are contracting Parties to the SPAW protocol, under which Parties are required to take measures to protect, preserve and sustainably manage areas and species which are listed under the SPAW Protocol's Annexes. *S. lewini, S. mokarran* and *S. zygaena* are listed under Annex III; these are species for which exploitation is allowed, but must be regulated "so as to ensure and maintain the population at an optimal level". The Dominican Republic cites the SPAW protocol in the preamble of its indefinite ban on the capture and commercial trade of all species of sharks and rays within waters under its jurisdiction (see *Country Reviews* Section), noting that article 10 of the protocol establishes a duty to regulate and if necessary

prohibit the capture, retention or death, trade and disturbance of these species (Resolution 023/2017) (Ministerio de Medio Ambiente y Recursos Naturales, 2017).

D. Country Reviews Overview

In Central America and the Caribbean, most sharks are captured either directly or indirectly by local artisanal small-scale fisheries, where they are an important economic resource (Comisión Nacional para la Conservación y Ordenación de los Tiburones, 2010; CoP17 Inf. 84). A 2010 survey of the Central American artisanal fishery found that this activity was more prevalent in the Pacific Ocean than in the Caribbean Sea and continental waters (OSPESCA, 2011a). Third-party countries also operate industrial fishing in some countries in the region (OSPESCA, 2011a).

Juvenile and neonate *S. lewini* are particularly heavily exploited in directed fisheries in the Eastern Central and Southeast Pacific (Miller *et al.*, 2014) (for example, in waters around Costa Rica's Cocos Island in the Eastern Pacific (Baum *et al.*, 2007a) as well as the Gulf of Mexico (Castillo-Géniz *et al.*, 1998)). They are taken both in targeted fisheries and as bycatch in shrimp trawlers and coastal fisheries targeting teleosts (Baum *et al.*, 2007a). Pressure on these populations was considered to have increased as traditional coastal fisheries in Central America become depleted (Baum *et al.*, 2007a).

Costa Rica and Panama were reported to be the most important countries in terms of the volume of shark landings and fleet size (FAO, 2018). Most shark meat tends to be eaten locally, whereas fins are mostly exported (FAO, 2018).

Please note that within each country review, the threats section focuses only on the fishery impacts in that country.

Belize

Population status and trends: No specific information on the status of the species/ trends in shark fishery catches in Belize was located, however the species are globally Endangered (*S. lewini* and *S. mokarran*) or Vulnerable with a declining population trend (*S. zygaena*).

Threats: Belize's shark fishery was reported to be mainly artisanal and to be based in coastal waters, inland waters of the barrier reef lagoon, and around three of the country's atolls (Anon, 2014).Sharks in general were reported to have grown in commercial value over the past few years, and were targeted for their meat, skin, cartilage, teeth, fins, jaws and other organs (Belize High Seas Fisheries Unit, 2015). In 2007, market demand for shark products was noted to have increased in the neighbouring countries of Guatemala, Honduras, and Mexico as well as Asia; this, in combination with a lack of shark specific regulations, is reported to have led to population declines and distribution shifts of the country's shark species (Graham, 2007 in CZMAI, 2014). Fishers originating from Guatemala, Honduras and Mexico were also reported to regularly fish in Belizean waters, concentrating on sharks before the Lenten season (CZMAI, 2014). Little shark meat is thought to be consumed in Belize itself; instead, a large proportion of the country's shark catch is thought to be smuggled illegally to neighbouring countries (Anon, 2014).

The principal gears used in the country's small scale fisheries are trammel nets and hand lines (Anon, 2014). Belize's Fisheries Department has identified five major landings sites for sharks caught in national waters: Robinson Point, Colson Point, Scipio Caye and Rocky Point (Belize Fisheries Department, 2017). In general however, landings of sharks caught in national waters have tended to be dispersed, making them difficult to quantify (Belize Fisheries Department, 2017). According to the Fisheries Department, 24 383lb (c. 11 250kg) of shark meat was landed in 2016 (Belize Fisheries Department, 2017). Of these landings, 10.9% were *S. lewini*,

and 7% were *S. mokarran* (Belize Fisheries Department, 2017). In terms of the number of fishers, the country's artisanal shark fishery is much smaller than those for lobster and conch; in 2017, 65 permits were issued with landings concentrated into five export permits (Belize Fisheries Department, 2017).

Belize also has a high seas fishery that was principally located in the Eastern Pacific, where the majority of vessels were reported to harvest sharks as their target species (Belize High Seas Fisheries Unit, 2015 (Belize Fisheries Department, 2017). Data from this area for 2001-2013 shows that hammerheads were not among the most important species caught; the only records of hammerhead landings in the area were 17t in 2007, and 3t in 2008 (Belize High Seas Fisheries Unit, 2015). Harvests from this fishery, however, are considered to have declined since Belize adopted strict management policies for its longline fleet (FAO, 2018). In 2017, the specific targeting of sharks was reported to have ceased (FAO, 2018).

Poor data, as well as a lack of independent personnel with knowledge and training in shark species identification, were noted to have led to a poor state of knowledge of Belize's domestic and high seas shark fishery (Belize High Seas Fisheries Unit, 2015). One of the main reasons for this was that vessels of the country's fishery did not discharge at local ports, so data on catches, landing and effort of this fleet was inadequate (Belize High Seas Fisheries Unit, 2015, Belize Fisheries Department, 2017). Instead, the country relies heavily on other States to obtain and provide this information.

Trade: According to the CITES Trade Database, there has been no direct or indirect trade of *Sphyrna* spp. for commercial purposes from Belize 2014-2016. Low numbers of wild-sourced specimens were exported to the US for scientific purposes in 2015 (16 specimens of *S. lewini* and five specimens of *S. mokarran*, according to Belize). The US reported imports of 29 600kg source I (confiscated or seized) fins from Belize in 2014 (Table 3.1), suggesting recent and substantial illegal trade from the country.

Table 3.1: Direct exports of *Sphyrna* spp. from Belize, 2014-2016. At the time of writing (January 2019) annual reports had not yet been received from Belize for 2016 and 2017.

Taxon	Importer	Term	Unit	Purpose	Source	Reported by	2014	2015	2016	Total
Sphyrna lewini	United States	fins	kg	T	I	Exporter			-	
						Importer	29600			**29600**
		specimens	-	S	I	Exporter			-	
						Importer		6		**6**
					W	Exporter		16	-	**16**
						Importer				
Sphyrna mokarran	United States	specimens	-	S	I	Exporter			-	
						Importer		2		**2**
					W	Exporter		5	-	**5**
						Importer				

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 06/11/2018

Management: Within its territorial waters, Belize's domestic shark fisheries are managed by the Belize Fisheries Department (under the Ministry of Forestry, Fisheries and Sustainable Development), whereas fishing on the high seas is managed by the Belize High Seas Fisheries Unit (Ministry of Finance) under the High Seas Fishing Act 2013.

Prohibitions: Belize established a closed season for shark fishing between 1st August and 31st October (Belize Fisheries Department, 2017).

NPOA-Sharks: Belize published a draft NPOA-Sharks in 2015, and issued an updated version in 2017 (Belize High Seas Fisheries Unit, 2015; Belize Fisheries Department, 2017), which set out legal requirements for its fishing fleet and is fully embedded in its national legislation (FAO, 2018). The plan identifies a number of key areas that need to be addressed in order to maintain a sustainable shark fishery, namely:

(1) The development of a standard identification/field guide, to increase basic knowledge, capacity and skills to identify shark catches to species level

(2) The development of data collection and monitoring protocols
(3) Better training and equipment for personnel on data collection and monitoring techniques.

In 2016, the country's National Shark Working Group was reactivated and given responsibility for revising an updating Belize's NPOA-Sharks (Nunez, 2017). The updated plan was finalized in December 2018, but has not yet been published (R. Graham *in litt.* to UNEP-WCMC, 2019).

Finning: As a member of OSPESCA, shark finning in Belize was banned by Regulation OSP-05-11, which stipulates that sharks must be landed while their fins are still naturally attached.

Monitoring: Fisheries monitoring of high seas catches in Belize is carried out in accordance with Monitoring, Control and Surveillance Regulation S.I. No. 39 of 2014. The country's observer program was reported to cover a minimum of 5% of the fleet annually. All catches (including shark discards) must be reported via longline logbooks and Belize's approved e-log system, the latter of which is intended to allow for daily submission of a vessel's catches in real time (Belize High Seas Fisheries Unit, 2015). Inspections of shark landings are achieved through a combination of appointed Inspectors in some ports, and the establishment of an MoU for Fisheries Cooperation with competent Fisheries Authorities in other states (Belize High Seas Fisheries Unit, 2015). All licenced high seas vessels must have an operational mobile transceiver unit installed (Belize Fisheries Department, 2017).

Since 2013, the Belize Fisheries Department has also collected biological/morphometric catch and effort data from a number of landing sites and fishing cooperatives (Belize Fisheries Department, 2017).

Protected areas: The Belize Fisheries Department has designated Marine Protected Areas (MPAs) and Shark Protected Areas (SPAs) to protect vulnerable species (Belize High Seas Fisheries Unit, 2015). Longlines and nets within the country's network of MPAs is banned (CZMAI, 2014). In 2014 marine reserve staff were reported to be struggling to deliver effective enforcement of fishery regulations in MPAs, with netting and longlining by fishers in neighbouring countries reported to be taking place within MPA boundaries (CZMAI, 2014).

Other measures: Belize operates a licencing system for fishing in national waters as well as the high seas that applies to both small scale and industrial fishers (Belize Fisheries Department, 2017). These licences restrict the number and type of vessels, areas of operation, and species that are allowed to be targeted, and are issued subject to conditions including the submission of catch reports and compliance with national regulations ((Belize High Seas Fisheries Unit, 2015; Belize Fisheries Department, 2017). The country additionally has a Fleet Policy Plan, which does not allow for any further expansion of its fisheries where sharks are either directly or indirectly caught (Belize High Seas Fisheries Unit, 2015). The high seas fishing fleet is limited to 75 vessels operating in the Atlantic and Eastern Pacific, and only those engaged in long line fisheries can obtain a permit to harvest sharks (FAO, 2018). However, the High Seas Fisheries Act 2013 was reported to contain no specific regulations pertaining to the management of sharks on the high seas other than those adopted by RFMOs to which Belize is a Party, and the Party's requirements under CITES (Belize High Seas Fisheries Unit, 2015).

Since the listing of *Sphyrna* spp. came into effect, enforcement of shark fishery related laws was reported to have increased (Anon, 2014). Belize was additionally reported to be increasing its capacity with regard to species identification, and its Fisheries Administration was reported to be working closely with scientists to assess shark population statuses (Anon, 2014).

Non-detriment findings: In October 2017, Belize's Fisheries Department convened a National Sharks Workshop, whose aims included the preparation an NDF for *S. lewini* and *S. mokarran* (Belize High Seas Fisheries Unit, 2017). An NDF has not yet been completed.

Costa Rica

Hammerheads principally occur in three gulfs in Costa Rica: the Gulf of Nicoya, Gulf of Papagayo, and the Golfo Dulce (Anon, 2014). Costa Rica listed *S. lewini* on CITES Appendix III on 25/09/2012.

Population status and trends: Standardised catch rates of sharks in Costa Rica's EEZ 1991-2000 showed a decrease of 60% (Arauz *et al.*, 2004 *in* Baum *et al.*, 2007a), but no species-specific trends data for *Sphyrna* spp. could be found. All species are however globally threated (see above).

Threats: Costa Rica's shark fishery principally operates from ports on the country's Pacific coast (Siu and Aires-da-Silva, 2016; CRACCITES - Costa Rica, 2017). In 2015, Siu and Aires-da-Silva (2016) reported the fleet size to be 6579 boats, of which 6100 were small-scale or artisanal vessels (Siu and Aires-da-Silva, 2016); however, Costa Rica's 2017 NDF for *Sphyrna* spp. states there are considerably fewer (less than 2500 vessels). In 2014 the country reported 68% of its fishing fleet to be small scale, 23% medium scale, 6% advanced, and 3% semi-industrial (Anon, 2014).

The country's 443 longliners principally target large pelagic fish in the eastern Pacific; 70% of the weight of incidental captures from 2009-2012 was accounted for by sharks (Cubero-Pardo and Martínez-Cascante, 2013). The principal fishing gears of the country's medium and large- sized fleet principally are surface longlines and trammel nets (Anon, 2014; CRACCITES - Costa Rica, 2017), whereas the principal gears of Costa Rica's artisanal fleet are trammel nets and gillnets (Anon, 2014).

Sharks also make up a large percentage of the country's artisanal fleet catches in both the North Atlantic (Villalobos-Rojas *et al.*, 2014) and the Eastern Pacific. A study of shark and ray landings from the artisanal fishery of Tárcoles, at the mouth of the Gulf of Nicoya, for example, found that *S. lewini* accounted for 6.1% of shark and ray landings (Lopez-Garro *et al.*, 2009). Many of the country's identified nursery grounds (such as Peñón, in the Gulf of Nicoya) are popular elasmobranch fishing grounds, and are heavily fished by gillnets *(*Zanella *et al.*, 2009; Miller *et al.*, 2014). Important known nursery areas include the mouth of the River Tárcoles, the Térraba-Sierpe National Wetland, and the Golfo Dulce (CRACCITES - Costa Rica, 2017). In Tárcoles, *S. lewini* is captured year-round, with a peak in captures between April and May which consists solely of neonates.

The proportion of shark catches that are *S. lewini* increases between March and May, presumably in synchrony with the species' pupping season (CRACCITES - Costa Rica, 2017). The main fishing gears of the artisanal fleet were reported to be hand ropes, gillnets and bottom and surface longlines (CRACCITES - Costa Rica, 2017).

In addition to its national fleet, Costa Rica previously had a relatively large number of foreign longliners landing their catches in the country. An average of 36 foreign longline vessels landed their catches 2004-2010; most (81%) belonged to Belize, followed by Taiwan POC, Cambodia, and Indonesia (Siu and Aires-da-Silva, 2016). Since 2010 the number of ships has declined as a result of declining prices for fins in Asian markets, changes to legislation regarding finning (see *Management* section), increases in fuel costs, and stricter national measures controlling the activities of these vessels (Siu and Aires-da-Silva, 2016; CRACCITES - Costa Rica, 2017). In 2015, there were reported to be no foreign longliners landing their catches in the country (Siu and Aires-da-Silva, 2016).

Trade: According to the CITES Trade Database, direct trade in *Sphyrna* spp. from Costa Rica 2014-2017 principally comprised fins and specimens of *S. lewini* and *S. zygaena*, exported to Hong Kong SAR for commercial purposes in 2014 and 2015 (Table 3.2). No trade in *S. lewini* was reported whilst the species was listed in Appendix III. In 2015, trade in *Sphyrna* spp. fins for commercial purposes totalled 1200 kg according to exporters and 946 kg according to importers. No commercial trade was reported in 2016 or 2017, and no indirect trade of *Sphyrna* spp. originating in Costa Rica was reported 2014-2017.

Table 3.2: Direct exports of Sphyrna spp. from Costa Rica, 2014-2016. Costa Rica has submitted all annual reports for 2014-2017.

Taxon	Importer	Term	Unit	Purpose	Source	Reported by	2014	2015	2016	2017	Total
Sphyrna lewini	Colombia	specimens	-	S	W	Exporter	8				**8**
						Importer					
	El Salvador	specimens	kg	S	W	Exporter				0.02	**0.02**
						Importer					
	Hong Kong SAR	fins	kg	T	W	Exporter		342.05			**342.05**
						Importer		297.83			**297.83**
		specimens	kg	T	W	Exporter	167.85				**167.85**
						Importer					
	Peru	fins	-	E	W	Exporter					
						Importer			5		**5**
Sphyrna zygaena	Hong Kong SAR	fins	kg	T	W	Exporter		858.1			**858.1**
						Importer		648.22			**648.22**
		specimens	kg	T	W	Exporter	323.2				**323.2**
						Importer					
	Peru	fins	-	E	W	Exporter					
						Importer			10		**10**
	United States	fins	-	S	W	Exporter		6			**6**
						Importer					

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 06/11/2018

According to data from wholesalers in Costa Rica's National Supply Centre, around 2% of the weight shark products traded "over the past 6 years" (presumed to be 2010-2016) was accounted for by hammerheads (CRACCITES - Costa Rica, 2017). Species-specific data on shark exports prior to the listing of *Sphyrna* spp. on the CITES appendices is not available; however, exports of shark bodies declined from a peak of over 8000 metric tonnes of meat in 2003 to under 1000 tonnes in 2014 (CRACCITES - Costa Rica, 2017). Exports of shark fin, on the other hand, have fluctuated (see Figure 9).

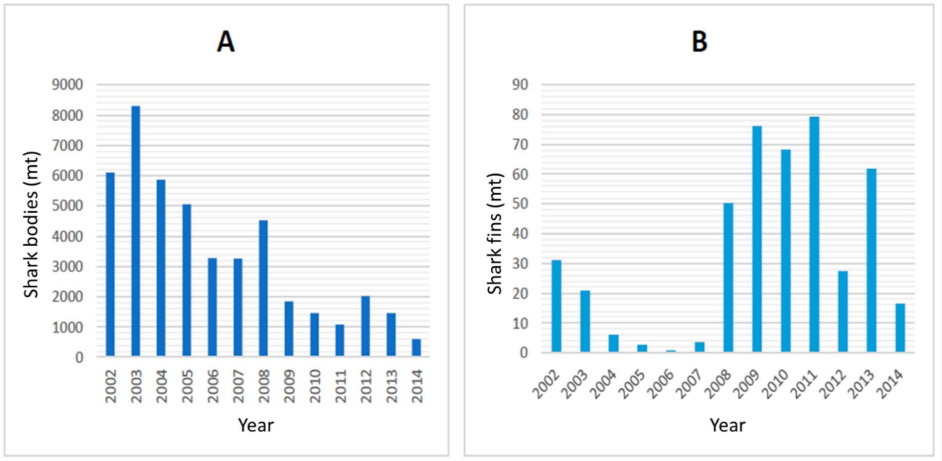

Figure 9: Shark exports (all species) from Costa Rica 2002-2014, according to data submitted to INCOPESCA and the Costa Rican Central Bank. Source: CRACCITES - Costa Rica, 2017 (permission pending).

Management: Costa Rica's fisheries are managed by INCOPESCA (Siu and Aires-da-Silva, 2016).

NPOA-Sharks: Costa Rica adopted its NPOA sharks in 2010, to be implemented within a 5 year period (Comisión Nacional para la Conservación y Ordenación de los Tiburones, 2010). The plan has six strategic objectives, which are:

(1) To promote responsible fishing habits and practices that support sustainable fishing, conservation and use of shark species.

(2) Undertake scientific research to improve knowledge on the biology, ecology and fishery statistics of the shark populations

(3) Improve the coordination and effectiveness of management between different actors involved in the harvesting and conservation of sharks

(4) To adjust the existing legal framework according to the needs sustainable use and conservation

(5) To develop an international coordination platform for shark harvesting and conservation, with a regional and ecosystem focus

(6) To prioritize, improve and expand, through effective coordination between the institutions involved, compliance, control and surveillance of fisheries regulation and the utilization of sharks and their habitats.

Finning: As a member of OSPESCA, shark finning in Costa Rica was banned by Regulation OSP-05-11, which stipulates that sharks must be landed while their fins are still naturally attached. Shark finning had previously been regulated by a series of pieces of national legislation, with the most recent (AJDIP139-2008) requiring fishers to land sharks with their fins intact and naturally attached.

Monitoring: Since 2004, Costa Rica has monitored landings from medium and large longliners as well as foreign longliners, in the country's four principal shark-landing ports, as per the terms of Regulation 415/2003 (Siu and Aires-da-Silva, 2016). Prior to 2004, landings were registered generically as "sharks", but since 2004 they have been classified by species (Siu and Aires-da-Silva, 2016). In 2012, Costa Rica's fisheries inspectors switched to the inspection forms of OSPESCA, which facilitate the registration of landings by species and by the flag of the vessel (Siu and Aires-da-Silva, 2016). Historical landings data has been transferred to a shared database developed by IATTC and OSPESCA (Siu and Aires-da-Silva, 2016). Since 2015, length and sex of shark landings in Puntaneras have additionally been recorded and added to the INCOPESCA's central database (Siu and Aires-da-Silva, 2016). Costa Rica's NPOA-Sharks notes that it has achieved 100% inspection rates for vessels landing sharks (Comisión Nacional para la Conservación y Ordenación de los Tiburones, 2010).

In 2016, Lehr (2016) undertook a study on the implementation of the OSPESCA Catch Documentation Scheme, and traceability of CITES-listed shark products in Costa Rica. Current control procedures for the medium and large size longline fleet were considered to fully implement the traceability recommendations of a report on shark traceability (Lehr, 2016) presented to the 69th Meeting of the CITES Standing Committee (SC69 Doc. 50). For the country's artisanal fleet, the report suggests that comprehensive sales documentation on "sharks" in general needs to be complemented by a sample-based study of catch composition, ideally by catch-region, in order to gauge the impact of that fleet on the shark population. Based on this data, Costa Rica may then wish to decide if and what kind of traceability system is needed in with the light of that impact (Lehr, 2016).

Protected areas: Decree No. 41056 established the "Golfo Dulce sanctuary for hammerhead sharks", in which the fishing, capture, use, transfer, transport and sale of hammerhead sharks is prohibited. Fishing for commercial purposes is also prohibited in national parks, natural monuments and biological reserves (Government of Costa Rica, 2005).

Other measures: AJDIP/105-2013 established a catch size limit for *Sphyrna lewini* based on the size of first maturity (this is defined as the minimum size at which at 50% of individuals have achieved maturity) (INCOPESCA, 2013), however the actual size limit is not explicitly clear.

***Non-detriment findings*:** Costa Rica has published NDFs for *S. lewini*, *S. mokarran* and *S. zygaena*; in 2015, 2017 and 2018 (CRACCITES- Costa Rica, 2015, 2017; CITES SA of Costa Rica, 2018). All three of these NDFs were negative, meaning that trade would not be in accordance with Article IV of the Convention. The 2018 NDF noted, *inter alia*, that a high percentage of Costa Rica's *Sphyrna* landings consisted of juveniles and that there were currently no closed seasons to protect the species except in certain areas of the Golfo Dulce (CITES SA of Costa Rica, 2018). It was also noted that an ecological risk assessment conducted for hammerheads concluded that all species, but particularly *S. lewini*, were at high risk of overexploitation (CITES SA of Costa Rica, 2018).

Each NDF also included recommendations of actions to be achieved before a positive or positive conditional NDF can be put in place. Although substantial progress has been achieved, the 2018-2019 NDFs recommendations highlighted a number of areas that required further attention (CITES SA of Costa Rica, 2018). These were:

(1) The need to adopt the IATTC standardised biological sampling form in order to have the necessary information to establish regional and national management measures.

(2) For INCOPESCA to continue with their monitoring program for pelagic species

(3) For the Government of Costa Rica to continue with efforts to implement its on-board observer program

(4) For INCOPESCA to review its NPOA-Sharks, giving priority to CITES-listed species

(5) For INCOPESCA to declare closed seasons and other restrictions in key areas and at key times for the species' reproduction, including a prohibition on the use of bottom longlines. Zanella *et al.* (2009) recommended restriction the use of gillnets and bottom longlines in the region of Peñón, whereas Zanella & López-Garro (2015) recommended implementing a closed season from June to August in Pique Fijo, Los Bajos y La Ciénaga (Golfo Dulce) to coincide with the peak pupping season.

(6) In light of observations of a decrease in landings, the need for a historical analysis of the number of national fishing vessels fishing and landing catches in Costa Rica.

(7) The need for INCOPESCA to conduct an inventory of *Sphyrna* spp. fin stockpiles, and to control the market at a national level.

(8) The need to reinforce capacity building efforts for fisheries inspectors, particularly those relating to species identification and legal minimum size limits for catches.

(9) For the country's Scientific Authority to carry out the necessary informatics systems upgrades that will allow it to digitise information contained in fishing logbooks.

Dominican Republic

Population status and trends: No specific information on the status of the species/ trends in shark fishery catches in the Dominican Republic was located, however the species are globally Endangered (*S. lewini* and *S. mokarran*) or Vulnerable with a declining population trend (*S. zygaena*).

Threats: The Dominican Republic is reported not to have a targeted shark fishery, but sharks are generally caught as bycatch in small-scale artisanal fisheries (Anon., 2014).

Trade: The Dominican Republic has submitted all annual reports for 2014-2017. According to the CITES Trade Database, there was no direct trade of *Sphyrna* spp. from the Dominican Republic reported 2014-2017. No indirect trade in *Sphyrna* spp. originating in Dominican Republic was reported 2014-2017.

Management: The country's shark fishery is regulated by the Dominican Council for Fisheries and Aquaculture (CODOPESCA).

NPOA-Sharks: According to the report of the first meeting of the WECAFC/OSPESCA/CRFM/CITES/CRMC working group on shark conservation and management, all members of OSPESCA prepared NPOA-Sharks between 2005 and 2008 (FAO, 2018); however, no national plan for Dominican Republic could be found. In 2014 the country noted that it had adopted several initiatives from OSPESCA's RPOA-Sharks, such as its finning ban and its establishment of protected areas (Anon, 2014).

Prohibitions: In 2017, the Dominican Republic banned indefinitely the capture and commercial trade of all species of sharks and rays within waters under its jurisdiction (Resolution 023/2017) (Ministerio de Medio Ambiente y Recursos Naturales, 2017). The ban includes the retention of sharks accidentally caught, and also covers exports and imports of all parts and derivatives (Ministerio de Medio Ambiente y Recursos Naturales, 2017).

Finning: As a member of OSPESCA, shark finning in the Dominican Repbulic was banned by Regulation OSP-05-11, which stipulates that sharks must be landed while their fins are still naturally attached (OSPESCA, 2011b).

Non-detriment findings: According to the CITES Trade Database, there has been no trade in Sphyrna spp. from the Dominican Republic. However, the report of the first meeting of the WECAFC/OSPESCA/CRFM/CITES/CRMC working group on shark conservation and management noted that a working group of the CITES Management and Scientific Authorities considered there to be enough information to make a conditional NDF for the species (with recommendations to improve information and management (Anon, 2014)).

El Salvador

Population status and trends: No specific information on the status of the species/ trends in shark fishery catches in El Salvador was located, however the species are globally Endangered (*S. lewini* and *S. mokarran*) or Vulnerable with a declining population trend (*S. zygaena*).

Threats: In 2014, El Salvador's industrial fishing fleet was reported to consist of four tuna vessels, four longliners and 46 shrimp vessels, whereas its artisanal fishing fleet was reported to consist of 8300 vessels (Anon, 2014). The principal gears used by the coastal artisanal fleet were reported to be trammel nets and surface longlines (CITES SA of El Salvador *in litt.* to UNEP-WCMC, 2019). Fishing vessels operating more than 40 miles from the coast were reported to principally use surface longlines, with Sphyrnidae among the principal target families (CITES SA of El Salvador *in litt.* to UNEP-WCMC, 2019). Sharks in El Salvador are landed at seven principal ports: El Tamarindo (La Unión), Puerto El Triunfo (Usulután), San Luís La Herradura, Isla Tasajera (La Paz), Puerto de la Libertad (La Libertad) Puerto Artesanal de Acajutla (Sonsonate) and Garita Palmera (Ahuachapán) (CoP17 Inf. 84).

Sphyrna spp. are caught by both the industrial and artisanal fleets in targeted as well as non-targeted fisheries (CoP17 Inf. 84; CITES SA of El Salvador *in litt.* to UNEP-WCMC, 2019). *Sphyrna* spp. were reported to account for 2% of industrial captures (Anon, 2014), whereas *S. lewini* alone was reported to account for 12% of artisanal captures (Anon, 2014).

The country has been noted to have the largest volume of captures of juvenile *S. lewini* in the region (CRACCITES - Costa Rica, 2017). Peak captures of *Sphyrna* spp. occur from April to June, which coincides with the pupping season on the Salvadorean coast (CoP17 Inf. 84).

Trade: According to the CITES Trade Database, direct exports of *Sphyrna* spp. from El Salvador principally comprised fins of *S. lewini* exported to Hong Kong SAR, for commercial purposes (Table 3.3). The amount of fins exported peaked in 2016 as reported by El Salvador (7039 kg) and in 2017 as reported by Hong Kong, SAR (1687 kg). Exports was also reported at the genus level by El Salvador in 2015.

No indirect trade in *Sphyrna* spp. originating in El Salvador was reported 2014-2017.

Table 3.3: Direct exports of *Sphyrna* spp. from El Salvador 2014-2017. El Salvador has submitted all annual reports for 2014-2017.

Taxon	Importer	Term	Unit	Purpose	Source	Reported by	2014	2015	2016	2017	Total
Sphyrna lewini	Hong Kong SAR	fins	kg	T	W	Exporter			7039.21	675.95	**7715.16**
						Importer		402.88	1109.71	1686.7	**2796.41**
			-	T	W	Exporter	434				**434**
						Importer					
		live	kg	T	W	Exporter		1024.7			**1024.7**
						Importer					
		tails	-	T	W	Exporter	108				**108**
						Importer					
Sphyrna mokarran	Hong Kong, SAR	fins	kg	T	W	Exporter					
						Importer				65.9	**65.9**
Sphyrna spp.	Hong Kong SAR	live	kg	T	W	Exporter		58.27			**58.27**
						Importer					

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 21/11/2018

Management:

NPOA-Sharks: El Salvador produced an NPOA-Sharks in 2008 and updated it in 2012 (Anon, 2014). However, the document does not appear to be publically available.

Prohibitions: Resolution No. 11 Vol. 402, published in 2014, introduced temporary closed seasons spanning from mid-May to Mid-July, in order to provide protection to *Sphyrna* spp. neonates (CoP17 Inf. 84).

Monitoring: As a member of OSPESCA, El Salvador is using the region's protocol for data gathering and monitoring (Anon, 2014). The country is working with a consultant to develop tariff codes relating to sharks to replace its current ones, which only refer to sharks as a general group (Anon, 2014).

Finning: As a member of OSPESCA, shark finning in El Salvador was banned by Regulation OSP-05-11, which stipulates that sharks must be landed while their fins are still naturally attached (OSPESCA, 2011b). Nationally, finning is banned by Decree No. 199, which states that the separation of fins from bodies is banned in all forms up to the point of first landing (Asamblea Legislativa de la Republica de El Salvador, 2012). Exports and imports of shark fins are banned, unless a certificate has been issued by the country of origin to confirm that fins are not a product of the practice of finning (Asamblea Legislativa de la Republica de El Salvador, 2012).

Non-detriment findings: A representative of CENDEPESCA noted that El Salvador believed it had enough information available to establish a total allowable catch for *Sphyrna* spp. (Anon, 2014). El Salvador made a positive conditional non-detriment finding for *S. lewini*, *S. mokarran* and *S. zygaena* in 2017 (CRACCITES - Costa Rica, 2017), however the document could not be accessed, so it is not possible to outline the scientific justification for the NDF. In 2017 the country used productivity and susceptibility analysis to inform risk levels outlined in its positive conditional NDF for *Carcharhinus falciformis* (silky shark), *Alopias superciliosis* and

A. vulpinus (thresher sharks) (CITES SA of El Salvador *in litt.* to UNEP-WCMC, 2019). The positive conditional NDFs (valid for 18 months) for *C. falciformis*, *Alopias superciliosis* and *A. vulpinus* included the following recommendations for the country's shark fisheries in general (CITES SA of El Salvador *in litt.* to UNEP-WCMC, 2019):

(1) Improve communication between authorities and academia to enable available information to be shared.

(2) Look for strategies which will allow the systematic analysis of information available from artisanal logbooks.

(3) Increase capacity and procide incentives for the delivery of fully complete landings forms (which species-level identification.

(4) Develop internal agreements to facilitate the flow of information between government agencies and enable traceability and sustainability analyses.

(5) Increase the number of staff at MARN and regional fisheries offices, in order to promote compliance with regulations.

(6) Consider the development of indicators that would establish baselines and allow the impact of measures, such as closed seasons, to be evaluated.

(7) Consider implementing measures such as quotas, minimum sizes and no-fishing zones.

(8) Monitor the implementation of measures that limit finning and fishing of juveniles/neonates

(9) Undertake training and dissemination campaigns to promote the implementation of the above measures.

A lack of capacity to conduct NDFs was highlighted to be an ongoing issue in the country (CITES SA of El Salvador pers. comm. 2019).

Guatemala

Population status and trends: No specific information on the status of the species/ trends in shark fishery catches in Guatemala was located, however the species are globally Endangered (*S. lewini* and *S. mokarran*) or Vulnerable with a declining population trend (*S. zygaena*). A 2015 report on updating the management plan of the Punta de Manabique Wildlife Refuge recommended that all three species of CITES listed hammerhead shark be added to CONAP's list of endangered species (Alianza de Derecho Ambiental y Agua, 2015); but it is unclear whether this has taken place.

Threats: In 2016, Guatemala's fishing fleet in the Eastern Pacific was reported to consist of 31 medium- and large-scale shrimp vessels, three large-scale tuna purse seiners, 18 medium-scale longliners, five small-scale longline/gillnet vessels, and 4 860 small-scale artisanal boats (Siu and Aires-da-Silva, 2016). Within the Guatemalan EEZ sharks were reported to be principally caught by artisanal longliners and by small-scale vessels that direct their efforts at them (Siu and Aires-da-Silva, 2016). Since 2005, sharks have also been targeted by medium-sized industrial longliners (Siu and Aires-da-Silva, 2016); a large number of sharks are also caught as bycatch in artisanal gillnet fisheries (Siu and Aires-da-Silva, 2016).

Guatemala's shark fisheries in the Pacific Ocean and Caribbean Sea have different scales and are characterised by different fishing gears (C. Avalos *pers. comm.* 2019). In the Pacific Ocean, the country allows the operation of small, medium and large scale vessels, and the principal gear type is longlines (C. Avalos *pers. comm.* 2019). In contrast, only small-scale and artisanal fishers are allowed to operate in the Caribbean Sea (C. Avalos *pers. comm.* 2019). While the principal fishing year used by small-scale fishers off the Caribbean coast is also longlines, the principal gears of artisanal fishers are gill- and trammel nets (C. Avalos *pers. comm.* 2019).

A project undertaken by the NGO Fundación Mundo Azul, aiming to characterise the country's landings of chondrichthyans, has been in place since 2015 and remains ongoing (C. Avalos *pers. comm.* 2019). Preliminary results from two communities on Guatemala's Caribbean coast found that *S. lewini* was the second most common shark species caught in fisheries that principally used surface longlines, bottom longlines, and trammel nets (C. Avalos *pers. comm.* 2019). *S. mokarran* was also captured, but at much lower volumes (C. Avalos *pers. comm.* 2019). The project has also been monitoring chondrichthyan landings at two communities on the Pacific coast since 2017. *S. lewini* was the most common shark species incidentally caught at the two communities sampled, accounting for 291 of the 1596 individuals recorded; however, there is still a lack of data concerning the most common species caught by communities who actively target chondrichthyans (C. Avalos *pers. comm.* 2019). A large proportion of *S. lewini* caught off both coasts were neonates and juveniles (76% of males and 96% of females in the two communities sampled on the Caribbean coast, and 95% of individuals caught in the two communities sampled on the Pacific coast), indicating that the fishery appears to be based in nursery areas for the species (C. Avalos *pers. comm.* 2019). This preliminary data is in-line with previous published work, which found that *S. lewini* was one of the five main species caught by the Guatemalan fisheries in the Eastern Pacific from 1997-1998 (Ruiz Alvarado and Mijangos López, 1998). Peak captures of the species were noted to occur from May to July (Ruiz Alvarado and Mijangos López, 1998) and May to August (C. Avalos *pers. comm.* 2019).

Trade: According to the CITES Trade Database, there was no direct or indirect trade of *Sphyrna* spp. from Guatemala 2014-2017. Guatemala has submitted all annual reports for 2014-2017.

Management: Guatemala's fisheries are managed by the Directorate for Fisheries and Aquaculture Standards (DIPESCA).

NPOA-Sharks: Guatemala has produced an NPOA-Sharks, however the document does not appear to be publically available.

Prohibitions: Closed seasons are in place for the country's Caribbean coast (Government of Guatemala, 2019). 2019's closed season for shark fishing will run from the 15th August to the 15th September (Government of Guatemala, 2019).

Monitoring: DIPESCA has collected data on landings by species and longliner effort from medium- and small-sized longliners in several of the country's main shark landing ports. Before 2015, effort was measured in terms of fishing days, whereas it is currently measured in terms of the number of hooks deployed (Siu and Aires-da-Silva, 2016). OSPESCA's forms have been used since 2014, which facilitate the registration of landings by species and by the flag of the vessel (Siu and Aires-da-Silva, 2016). Although inspection coverage of the country's medium-sized longline fleet was considered to be high, coverage of landings from small-scale and artisanal vessels was reported to be opportunistic; there is therefore no consistent long term data series for shark landings from these fisheries (Siu and Aires-da-Silva, 2016). Other than landings data, DIPESCA does not have any other programs to monitor fisheries and/or the biology of sharks (Siu and Aires-da-Silva, 2016), however a recent project undertaken by the NGO Fundación Mundo Azul aims to characterise the country's landings of chondrichthyans. A large amount of data was also reported to have been accumulated through collaborative programs with universities (Siu and Aires-da-Silva, 2016).

Finning: As a member of OSPESCA, shark finning in Guatemala was banned by Regulation OSP-05-11, which stipulates that sharks must be landed while their fins are still naturally attached (OSPESCA, 2011b).

Other measures: Governmental Agreement No. 223-2005 prohibited commercial fishing in the Pacific Ocean up to 20 nautical miles from Guatemala's coastline, and restricted the gear types and number of hooks that can be used for commercial shark fisheries. Shark fishing requires a licence, the requirements for which are outlined in Article 55 of Decree No. 08-2002 (General Law of Fishing and Aquaculture).

Honduras

Population status and trends: No specific information on the status of the species/ trends in shark fishery catches in Honduras was located, however the species are globally Endangered (*S. lewini* and *S. mokarran*) or Vulnerable with a declining population trend (*S. zygaena*).

Threats: Honduras has not historically had a directed shark fishery (Anon, 2014). Between 1997 and 2007, a number of permits were issued for international and domestic commercialisation of sharks, principally for export to Hong Kong SAR and China (Anon, 2014). Prior to the country's declaration of its territorial waters as a shark sanctuary (see Management), 98% of domestic trade in sharks was accounted for by *Carcharhinus limbatus*.

Trade: According to the CITES Trade Database, there was no direct or indirect trade of *Sphyrna* spp. from Honduras 2014-2017. Honduras has submitted all annual reports for 2014-2017.

Illegal trade of products and derivatives has been reported to occur (Anon, 2014).

Management:

NPOA-Sharks: Honduras produced an NPOA-Sharks in 2005 (Anon, 2014), however the document does not appear to be publically available. The CITES SA Honduras indicated that their NPOA-Sharks was planned to be revised and updated in 2019 (CITES SA of Honduras pers. comm, 2019).

Prohibitions: In June 2011 Honduras declared its territorial waters a shark sanctuary, and banned all targeted shark fishing in waters under its jurisdiction (Decree No. 107/2011 (Republica de Honduras, 2011)). In 2016 the law was updated to note that sharks caught accidentally may still be used, but that their capture must be reported to relevant authorities, which have a duty to investigate (Decree No. 26/2016 (Republica de Honduras, 2016)). Agreement 001-15 confirmed the indefinite ban on fishing for all shark species, further noting that capture, possession, national commercialization and export of all parts and derivatives is prohibited, as is the import of any shark species regardless of its country of origin (Secretaria de Estado en los Despachos de Agricultura y Ganaderia, 2015).

Despite this legislation, there are reports that targeted shark fishing remains ongoing off the coast of La Mosquitia, especially from January to March (Carrere, 2018). The meat appears to be solely sold domestically, but no monitoring or quota system for incidental catches appears to be in place (Carrere, 2018).

Finning: As a member of OSPESCA, shark finning in Honduras was banned by Regulation OSP-05-11, which stipulates that sharks must be landed while their fins are still naturally attached (OSPESCA, 2011b).

Mexico

Population status and trends: A workshop conducted in 2015 on Evaluating the Productivity, Susceptibility and Management of Mexican Sharks Listed in CITES Appendix II noted that the status of all three *Sphyrna* species in Mexico was uncertain (Benítez *et al.*, 2015). *S. lewini* was noted to be potentially overexploited in fishing areas off the coast of Jalisco to the end of the Guerrero coastline, as the few available data and anecdotal information from fishermen implied decreasing trends in captures. Information available from INAPESCA's research program in Puerto Chiapas from 1996-2010 also indicated declines in *S. lewini* captures off the coast of Oaxaca and Chiapas (Benítez *et al.*, 2015).

Threats: Mexico's shark fishery can be divided into three sectors: (1) an artisanal fishery comprising boats less than 10.5m in length, which in 2006 accounted for c. 40% of national production, (2) a medium-sized boat fishery consisting of vessels between 10-27m in length fishing principally in the coastal waters of Tamaulipas and Veracruz, Sonda de Campeche and Quintana Roo, in the Gulf of California and the Gulf of Tehuantepec, and the Pacific Ocean coastline, and (3) a deep-sea fishery, consisting of vessels >27m, operating in coastal waters and oceanic waters within Mexico's Pacific EEZ (Secretaria de Agricultura ganaderia desarollo rural pesca y alimentacion, 2007). In 2006, the latter two fisheries were reported to account for c. 60% of national shark production (Secretaria de Agricultura ganaderia desarollo rural pesca y alimentacion, 2007). An estimated 62% of production came from the Pacific Ocean, with the remainder coming from the Gulf of Mexico and the Caribbean Sea (Secretaria de Agricultura ganaderia desarollo rural pesca y alimentacion, 2007).

Sphyrna spp. are known to be among the most common species caught in multiple regions, and Sphyrnidae are one of the two most commercially important shark families for the country's fisheries (CONAPESCA-INP, 2004). In 2004, 90% of the national production of elasmobranchs was used for human consumption, whereas the principal products exported were fins and skins (CONAPESCA-INP, 2004). Artisanal fishery catches of *S. lewini* are predominately of juveniles (Pérez-Jiménez *et al.*, 2005; Bizzarro *et al.*, 2009; Miller *et al.*, 2014).

Sphyrna spp. are among the principal species caught in:

- The Gulf of California, including waters off Sonora, Sinaloa, and Nayarit (*S. lewini* and *S. zygaena*) (CONAPESCA-INP, 2004)
- The western coast of Baja California (*S. lewini*) (CONAPESCA-INP, 2004)
- Waters off the Jalisco-Colima-Manzanillo coastline, in the central Pacific (*S. lewini* and *S. zygaena*) (CONAPESCA-INP, 2004)
- The Gulf of Tehuantepec (historical landings data from 1996-1998 from *S. lewini* was the second most important shark caught in the artisanal shark fishery, accounting of 36% of the study's sample catch) (Soriano-Velassquez *et al.*, 2002 *in* Baum *et al.*, 2007a)
- Non-coastal pacific waters (*S. lewini* and *S. zygaena*) (CONAPESCA-INP, 2004)
- The Gulf of Mexico (*S. lewini* and *S. mokarran*), particularly waters off Tamaulipas, Tabasco, Campeche and Quintana Roo (CONAPESCA-INP, 2004).

National production of elasmobranchs 1978-2002 was an average of 27 314.7t per year (CONAPESCA-INP, 2004). Historical effort data are not available, and the use of non-species specific groupings like "sharks" means that there is little data on species specific changes in abundance in Mexican waters (CONAPESCA-INP, 2004). In addition, Saldaña-Ruiz *et al.* (*under review*, in CEC, 2017) have noted discrepancies between shark landings according to FAO data and those they estimated using a literature review, with FAO data providing a substantial underestimate of landings (CEC, 2017).

In 2015, the CITES SA of Mexico conducted an analysis of productivity and susceptibility for all three hammerhead species in six different fishing zones (Benítez *et al.*, 2015). In general, *S. mokarran* was the species most susceptible to both small- and medium-sized vessels in the Atlantic (Benítez *et al.*, 2015). In the Pacific, *S. mokarran* was reported to be the species most vulnerable to the large-sized fishing fleet, and *S. zygaena* was reported to be the most vulnerable to the small-sized fishing fleet (Benítez *et al.*, 2015).

Trade: According to the CITES Trade Database, direct exports of *Sphyrna* spp. 2014-2017 principally comprised wild-sourced fins traded for commercial purposes (95 143 kg kg according Mexico, and 42 745 kg according to importers) (Table 3.4). The major importers were China according to data reported by Mexico, and Hong Kong SAR according to importer-reported data; a permit analysis suggests that much of this is likely to be the same trade. Mexico reported exports of fins to unknown importers within their 2016 and 2017 annual report, making trade patterns more difficult to interpret; however a permit analysis indicated that at least 7844 kg *S. lewini* fins and 13 677 kg of *S. zygaena* fins exported by Mexico to an unknown destination were reported on permit numbers which were also reported as imports by Hong Kong, SAR.

Table 3.4: Direct exports of *Sphyrna* spp. from Mexico, 2014-2017. Mexico has submitted all annual reports for 2014-2017. All quantities rounded to whole numbers, where applicable.

Taxon	Importer	Term	Unit	Purpose	Source	Reported by	2014	2015	2016	2017	Total
Sphyrna lewini	China	fins	kg	T	W	Importer					
						Exporter	4244	5230			9474
	Hong Kong, SAR	fins	kg	T	W	Importer		6507	6403	3503	16412
						Exporter		73			73
	United States of America	skulls	-	P	I	Importer		3			3
						Exporter					
	Unknown	fins	kg	H	W	Importer					
						Exporter				296	296
				T	W	Importer					
						Exporter			6720	12522	19242
Sphyrna mokarran	China	fins	kg	T	W	Importer					
						Exporter	250	8898			9148
	Hong Kong, SAR	fins	kg	T	W	Importer		3261			3261
						Exporter					
	Unknown	fins	kg	T	W	Importer					
						Exporter			141	141	282
Sphyrna zygaena	Chile	fins	kg	T	W	Importer					
						Exporter		878			878
	China	fins	kg	T	O	Importer					
						Exporter	340				340
					W	Importer					
						Exporter		3639			3639
	Hong Kong, SAR	fins	kg	T	W	Importer		6670	10425	5978	23073
						Exporter		6604			6604
	United States of America	bodies	-	P	I	Importer		1			1
						Exporter					
		bones	-	P	I	Importer				1	1
						Exporter					
		medicine	-	P	I	Importer			2		2
						Exporter					
		skulls	-	P	I	Importer		2			2
						Exporter					
	Unknown	fins	kg	T	W	Importer					
						Exporter			19299	26503	45802

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 16/05/2019

No indirect trade in *Sphyrna* spp. originating in Mexico was reported 2014-2017.

Data from Mexico's CITES law enforcement authority (PROFEPA) shows the trade volumes for each species authorised via CITES permits from 2014 to May 2018 (Table 3.5). Discrepancies between the two data sets may be a result of some permits not being used in their entirety, or being cancelled by holders after authorisation, i.e. not everything authorised by CITES permits being exported. Mexico may provide their reports on the basis of permits issued. Whilst no trade in *S. mokarran* was reported by PROFEPA since 2015, exports of 141.12 kg was reported according to the CITES Trade Database in 2016.

Table 3.5: Exports of dried shark fin (kg) according to border verification data from Mexico's CITES Law Enforcement Authority (PROFEPA). Data for 2018 is from January-May. Source: CITES SA of Mexico *in litt.* to UNEP-WCMC, 2018.

Species	2014	2015	2016	2017	2018	Sum	Annual mean*
Sphyrna lewini	2747.0	5092.9	5053.6	3758.1	759.1	17410.6	3482.1
Sphyrna mokarran	0.0	3355.8	0.0	0.0	0.0	3355.8	671.2
Sphyrna zygaena	0.0	7842.2	7805.4	10623.4	1688.0	27959.0	5591.8

Management: The agency responsible for the management, monitoring and enforcement of Mexico's fisheries in the Comisión Nacional de Acuacultura y Pesca (National Comission of Aquaculture and Fisheries, CONAPESCA) (Fischer *et al.*, 2012). Mexican aquatic resources are regulated by the General Law of Sustainable Fisheries and Aquaculture (Mexico, 2007). There are no species-specific management measures in place, but there are a number of management measures for sharks in general (Benítez *et al.*, 2015). Management risks for sharks are considered to be higher for the country's small sized fleet than its large-sized fleet (Benítez *et al.*, 2015).

NPOA -Sharks: Mexico published its NPOA Sharks in 2004 (CONAPESCA-INP, 2004). Its objectives are to:

(1) Ensure that catches of sharks and rays are sustainable

(2) Identify threats to elasmobranch populations

(3) Identify and protect critical habitats, as well as species which are particularly vulnerable or threatened

(4) Identify and develop effective frameworks for research, management and education among all stakeholders

(5) Minimize the bycatch of sharks, rays and tuna-like species in other fisheries, as well as capture waste and discards.

(6) Promote full utilization.

(7) Contribute to the protection of biological diversity and the structure and function of the ecosystem

(8) Improve the biological information of shark species, as well as information on catches, effort, landings and trade by species

(9) Establish an information system.

Additionally, in 2017, the Commission for Environmental Cooperation (in partnership with the governments of the United States of America, Canada, and Mexico and their respective CITES Authorities), published a plan of action for the sustainable trade of sharks listed on Appendix II of CITES (CEC, 2017). The plan outlines 17 actions that need to be prioritised in order to ensure that trade in shark species is sustainable in Central America. These include, *inter alia*:

(1) Capacity building in the Mexican fisheries sector, with the aim of improving species identification and species-specific reporting;

(2) Improving systems for fisheries data compilation;

(3) Carrying out trade-chain analyses;

(4) Supporting the development of species-specific Harmonised Commodity Description codes;

(5) Updating Mexico's NPOA-Sharks (published in 2004) to include relevant measures from IATTC and ICCAT;

(6) Evaluating the effectiveness of closed seasons that are currently in place, and, if necessary, modify them. Additionally evaluate the potential of other management measures, such as total allowable catches and size limits, as well as closures of areas that are essential habitats.

(7) Updating Mexico's National Fishing Chart to include *Sphyrna* as a separate group.

(8) Finalising management plans for elasmobranch fisheries in the Pacific Ocean, Gulf of Mexico and Caribbean Sea.

Prohibitions: Regulation NOM-029-PESC-2006 stipulates that the Secretariat of Agriculture, Livestock, Rural Development, Fishing and Food will establish area-based closed seasons for taking sharks and rays during the principal periods of reproduction, birth and growth of these species (Secretaria de Agricultura ganaderia desarollo rural pesca y alimentacion, 2007). The process for setting closed seasons was originally outlined in Regulation NOM-029-PESC-1993 (Secretaría de Pesca, 1994), which has since been amended multiple times to modify spatial closures for shark fisheries along both the Pacific coat and the Gulf of Mexico. Shark fishing is currently prohibited in the Pacific from the 1st May to the 31st of July, and in the Gulf of Mexico and Caribbean Sea from the 1st May to the 30th June (CEC, 2017). Shark fishing is additionally prohibited in Tabasco, Campeche and Yucatán from the 1st- 29th August (CEC, 2017).

Finning: Regulation NOM-029-PESC-2006 prohibits the exclusive use of fins and the landing of fins without bodies on board (Secretaria de Agricultura ganaderia desarollo rural pesca y alimentacion, 2007).

Monitoring: Regulation NOM-PESC-029-2006 requires all vessels to report catch and effort data to INAPESCA (Secretaria de Agricultura ganaderia desarollo rural pesca y alimentacion, 2007); however, at the time of writing landings of *Sphyrna* spp. appeared to be reported at the genus level (CEC, 2017). Mexico is currently carrying out a "Compilation of Species-Specific Information on Catch and Fishing Effort with Emphasis on CITES-listed Shark Species" (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2018), whose objectives are to 1) compile data at the species-specific level, 2) conduct an analysis of challenges and opportunities, and 3) develop a capacity building strategy. Upon the project's completion in mid-2019, a proposal for the standardization of fishery production statistics generated by CONAPESCA at species level is expected to be presented (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2018). The CITES SA of Mexico, in collaboration with shark experts from government, academia and NGOs, has also established Fishing Zones off the Pacific and Atlantic coasts of the country which aim to analyse available information on fisheries utilization and management for the formulation of NDFs. Conversion calculations are also used to determine whether the volumes of fins exported are in line with the volume of sharks landed and at each stage of the production chain (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2018).

Other measures: Shark fishing requires a licence (Secretaria de Agricultura, Ganaderia, Desarollo Rural, Pesca y Alimentacion 2007), with the number of licences available remaining constant (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019).

Mexico has also set a maximum bycatch volume for vessels participating in targeted shark and ray fishery in Pacific waters under its jurisdiction. Vessels may not land a bycatch (i.e. non-target species such as tuna and dorado) volume greater than 30% of the total catch (Secretaría de Agricultura, Ganadería, Desarrollo Rural, 2008).

Non-detriment findings: Mexico's non-detriment finding process was reported to involve progressing through a workflow that takes into consideration (1) whether the items for export are legal and traceable, (2) whether sufficient management measures are in place given the species' vulnerability as calculated by productivity and susceptibility (PSA) analysis as well as management risk assessment following the methodology of Lack *et al.* (2014), and (3) whether the volume of items for export is consistent with the number of sharks reported in arrival notices, using the conversion factors listed in the Global Trade section of this report (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019). There is a database to track how many NDFs are issued, the decisions made of

each application, and the reasons given in cases where applications were denied (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019).

Nicaragua

Population status and trends: No specific information on the status of the species/ trends in shark fishery catches in Nicaragua was located, however the species are globally Endangered (*S. lewini* and *S. mokarran*) or Vulnerable with a declining population trend (*S. zygaena*).

Threats: In 2015, Nicaragua's fleet consisted of c. 4330 artisanal vessels which mainly used gill nets (36%), followed by handlines (20%), cast nets (15%) and longlines (7%) and an industrial fleet of 50 vessels (Siu and Aires-da-Silva, 2016). Sharks are the main target of both the artisanal and industrial fleets; however, the diversity and proportions of species captured is poorly known because (a) the country's landings inspection system for the industrial fleet does not register shark landings at species level, and (b) there are no studies of shark fisheries in Nicaragua (Siu and Aires-da-Silva, 2016). The country's shark fishery is considered to be less economically important than other fisheries, such as those for shrimp and lobster (Siu and Aires-da-Silva, 2016). In 2015, Nicaragua noted that a fall in the price of fins had caused targeted fishing of sharks to considerably decrease (AC28 Inf. 12.)

Landings of sharks off the country's Caribbean coast from 1992-2005 were below 100 million lb annually (~45.3 million kg), except for 1995 (293 million lb (~132.9 million kg)), 2001 (134 million lb (~60.8 million kg)) and 2005 (129 million lb (~58.5 million kg)) (Zarate and Hearn, 2008). In the Pacific, landings of shark over this period have fluctuated, but have remained over 100 million lb (~45.3 million kg) per year annually (Zarate and Hearn, 2008). The contribution of hammerheads to these figures is unknown, however, Zarate and Hearn (2008) noted that shark fisheries tended to be directed towards Carcharhinidae, and a document submitted to the CITES Animals Committee in 2015 noted that none of the species currently listed in CITES Appendix II were fished by Nicaraguan fishermen (AC28 Inf. 12).

Trade: According to the CITES Trade Database, direct trade in *Sphyrna* spp. from Nicaragua 2014-2017 comprised *S. lewini*, *S. mokarran*, and *Sphyrna* spp. fins, exported to Hong Kong SAR for commercial purposes (Table 3.6). According to Nicaragua, this consisted of a total of 398kg of *Sphyrna* fins exported to Hong Kong SAR in 2015 (294kg as reported by importers), 1039kg and 100 fins reported as units exported in 2016 (564kg and no fins as reported by importers), and 62kg of fins in 2017 (62kg as reported by importers). There was no indirect trade of *Sphyrna* spp. originating in Nicaragua 2014-2017.

Table 3.6: Direct exports of *Sphyrna* spp. from Nicaragua, 2014-2017. Nicaragua has submitted all annual reports 2014-2017.

Taxon	Importer	Term	Unit	Purpose	Source	Reported by	2014	2015	2016	2017	Total
Sphyrna lewini	Hong Kong SAR	fins	kg	T	W	Exporter		217.27	953.41		**1170.68**
						Importer		294.34	387.41		**681.75**
			-	T	W	Exporter			50		**50**
						Importer					
Sphyrna mokarran	Hong Kong SAR	fins	kg	T	W	Exporter			86	62.16	**148.16**
						Importer			177	62.16	**239.16**
			-	T	W	Exporter			50		**50**
						Importer					
Sphyrna spp.	Hong Kong SAR	fins	kg	T	W	Exporter		180.43			**180.43**
						Importer					

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 06/11/2018

Management: Nicaragua's shark fisheries are managed by the Nicaraguan Institute of Fisheries and Agriculture (INPESCA) (Siu and Aires-da-Silva, 2016).

NPOA-Sharks: According to the report of the first meeting of the WECAFC/OSPESCA/CRFM/CITES/CRMC working group on shark conservation and management, all members of OSPESCA prepared NPOA-Sharks between 2005 and 2008 (FAO, 2018); however, a copy of Nicaragua's NPOA-Sharks could not be located.

Finning: As a member of SICA, shark finning in Panama was banned by Regulation OSP-05-11, which stipulates that sharks must be landed while their fins are still naturally attached.

Monitoring: INPESCA regularly collect landings data from the country's principal shark landing sites, using the Central American standardised forms for landings inspections (AC28 Inf. 12). Since 2005, INPESCA's landings database has recorded shark landings by species for the artisanal fleet; however, landings from industrial vessels are still classified at the generic level of "sharks" (Siu and Aires-da-Silva, 2016).

Non-detriment findings: No specific information on non-detriment findings for export could be located.

Panama

Population status and trends: Although insufficient data has been a persistent barrier to conducting stock assessment, since 2009 a number of studies (as well as anecdotal evidence from fishermen) have concluded that *Sphyrna* spp. in Panamanian waters are overexploited (Anon., 2014). In particular, an absence of adults has been noted alongside decreases in the number of neonates and juveniles (Anon., 2014).

Threats: Panama's intensive shark fishery began in the 1980s, but it wasn't until the 1990s that both artisanal and industrial fisheries began capturing sharks in large numbers (Ministry of the Environment of Panama, 2017). Information regarding the production and effort for shark fisheries is still considered to remain unspecific and scarce, but a survey of the country's shark fishing fleet was expected for 2018 (FAO, 2018). *Sphyrna* spp. are the most common species of shark caught as bycatch in the country's artisanal fishery (FAO, 2018). Studies have found that *S. lewini* accounted for 49% of individuals caught in the David mangroves on the country's Pacific coast, for 57% of individuals caught in a study of the Gulf of Chiriquí, and 68% of catches in a study of the principal ports on Panama's Pacific coast (Ministry of the Environment of Panama, 2017). *S. lewini* accounted for c.13% of Panama's industrial fishing fleet shark catches (Harper *et al.*, 2014).

The country's hammerhead fishery is predominantly focused on juveniles and neonates (Arriati, 2011 *in* Miller *et al.*, 2014; Anon., 2014). Smaller sharks are considered to have better-tasting meat, which can be easily conserved and sold quickly; large individuals, on the other hand, are principally retained for the high value of their fins (Ministry of the Environment of Panama, 2017). Shark fins were reported to be incidentally sold, and all other shark products were reported to be sold only rarely (FAO, 2018).

Between 2007 and 2011, the amount of sharks caught by Panama's industrial fisheries declined dramatically (Table 3.7). Landings data for artisanal fisheries does not include a separate category for elasmobranchs, and as such they are lumped into an 'other species' category. Data on the amount of meat and fins exported is scarce; however, Panama is considered to be one of Latin America and the Caribbean's major processing hubs for shark products (Mundy-Taylor and Crook, 2013).

Table 3.7: Amount of sharks landed by the Panamanian industrial fishing fleet, 2007-2011 (t)

2007	2008	2009	2010	2011
2777	3655	5403	591	411

Trade: According to the CITES Trade Database, there was no direct or indirect trade of *Sphyrna* spp. from

Panama 2014-2016; Panama's annual report for 2017 had not been received at the time of writing (January 2019). However, according to a workshop of CITES Authorities it was reported that the country exports dry shark fins to at least 15 countries, including Hong Kong SAR, Taiwan POC and the United States (Anon., 2014). At least one company was reported to export bodies to Africa (Anon., 2014).

Management:

NPOA-Sharks: Panama published its first NPOA-Sharks in 2010, and released an updated version in 2017 (Ministry of the Environment of Panama, 2017). Implementation of the plan is required by Law 9 of 16th March 2006, which also stipulates that the plan must be revised every four years. The current plan has five objectives:

(1) To encourage and facilitate processes for the development of knowledge, research and monitoring of the sharks and rays, their critical habitats, and their fishery

(2) Strengthen regulatory, management and management capacity to ensure the sustainable use and conservation of sharks and rays in Panama. This includes reviewing the current legislative framework for shark fisheries and to consider the implementation of minimum size captures, temporal or spatial closed seasons, and total allowable catches based on the precautionary principle.

(3) Have in place a programme of control and surveillance aimed at ensuring compliance with regulations and existing regulations to decrease illegality

(4) Ensure that information on initiatives for the conservation and sustainable use of sharks and rays reach the general population, with an emphasis on the government and fishing sectors

(5) To achieve the necessary financing and institutional strengthening for the execution of the projects and activities of the country's NPOA-Sharks.

Finning: As a member of SICA, shark finning in Panama was banned by Regulation OSP-05-11, which stipulates that sharks must be landed while their fins are still naturally attached. Previously, Law 9 prohibited finning in waters under the jurisdiction of Panama. Artisanal boats with outboard motors of up to 70 horsepower were permitted to transport fins separated from bodies as long as they corresponded to 5% or under of the weight of shark meat landed. According to Law 9 (Article 6), imports of shark fins that are not partially naturally attached require a certificate from the relevant competent authority of the country of origin that confirms that they are not the product of finning.

Monitoring: Panama has c. 350 landing ports, of which 95% are on the country's Pacific coast (Anon., 2014). In 2014, the country noted that it has insufficient personnel to adequately monitor all of these areas (Anon., 2014).

Other measures: Law 9 stipulates that fishing effort for sharks must not be increased, and prohibits the issuance of new shark fishing licences or the authorisation of new boats, except in cases of over-production of sharks (Article 7). In 2010, Decree No. 486 prohibited the use of all types of longlines by commercial and industrial vessels in waters under the jurisdiction of Panama. Use of longlines was limited to vessels with a gross registered tonnage of under 6 t, which had received authorisation from the Authority for Aquatic Resources of Panama.

Non-detriment finding: Panama made a negative non-detriment finding for *S. lewini*, *S. mokarran* and *S. zygaena* in October 2015 (CRACCITES - Costa Rica, 2017). We were unable to access the document.

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Strombus gigas

A. Summary and Recommendations

	Species characteristics summary: vulnerable to overfishing due to slow growth, sedentary nature, late maturation and aggregation in shallow waters for spawning. **RST:** All countries included in this assessment are not currently included in the CITES Review of Significant Trade process.	**RECOMMENDATIONS**
REGION-WIDE		- To increase transparency of non-detriment findings (NDFs), it is recommended that range States publish stock assessments and methodologies used to calculate stock biomass, sustainable yields and export quotas, and share their NDFs to assist with improving regional capacity to manage the species. To inform NDFs, long-term population monitoring should be implemented. - It is recommended that range States for *S. gigas* make use of CITES Decision 17.287 (if taken forward by CoP18), which specified that, "*if requested by a range State, the Animals Committee shall provide advice regarding NDFs for trade in S. gigas, research in support of sustainable queen conch fishery and trade, and other technical matters*". - If such requests are made, the Animals Committee could review the information available relating to criticial thresholds for ensuring reproduction of the species at the national or regional level, and make recommendations on the use of such thresholds in the non-detriment findings process. A guideline threshold in the current NDF guidelines for queen conch is not accepted by range States. - It is recommended that range States consider use of harvest thresholds related to shell lip thickness (e.g. > 10-15 mm) to ensure that juveniles are protected and spawning stocks are secure, in conjunction with other measures such as market clean weight. - Further collaborative enforcement efforts to address cross-border illegal trade in *S. gigas* appear to be needed in the region; joint patrols and a shared system of surveillance (satellite tracking) were suggested by the CITES SA of Honduras. - Additional research (e.g. population genetics of stocks, population connectivity and dispersal) may also be beneficial to management of stocks across the region.

BELIZE	Occurs throughout the entire length of the Belize reef and three offshore atolls. Stock assessments across the reef in 2012 show densities of 337 individuals/ha, with an increasing abundance trend, but in 2018 the average density had decreased to 248.5 indivuals/ha. Whilst one expert considered that juveniles were being harvested in Belize, the country refered to individuals harvested as "subadults". Other studies suggested a population decline in one marine reserve with a low percentage of adults, and a decline in median conch size in some fished areas, suggesting some impacts of trade. Illegal harvesting by national and foreign vessels (apparently including use of undersized meats of <85g), was noted to be a general problem. Direct exports 2008-2017 consisted predominantly of meat (2.8 million kg) as reported by Belize. No export quotas are published. Conversion factors have been developed. Management measures include: preliminary development of a network of marine reserves with no-take zones, legislation prohibiting harvest during closed seasons and in no-take zones, banning fishing with scuba diving gear, licencing of fishers (in a maximum of two areas), implementing national catch and quotas for general-use zones, minimum size and weight restrictions (of 17.8 cm shell length or market clean meat weight of 3oz (85g)) and collection of landing catch statistics. No-take zones were reported to have had a limited effect in one reserve. An NDF was under development.	Publish full stock assessments for 2014, 2016 and 2018 to allow trends in population status to be assessed over time, including the methodologies used for the surveys. Continue bi-annual monitoring. Assess time series of catch and effort data as well as fisheries independent surveys. Consider submitted an annual export quota for the species for publication on the CITES website. Attempt to quantify harvest levels for national consumption. Develop recovery plans for any overfished areas (possibly including Sapodilla Cayes Marine Reserve and Glovers Reef Reserve). Enforcement: Combat illegal harvesting through possible measures including strengthening patrolling (e.g. targeting known sites of illegal fishing such as Sapodilla Cayes), and requiring *S. gigas* fishing vessels > 10 m be fitted with Vessel Monitoring Systems. The national management plan or NDF has not been seen. Once developed, Belize is encouraged to share their NDF, e.g. on the CITES website.
COSTA RICA	Occurs off the eastern coast. Limited information available on the population status, which has previously declined. No information on current threats, but illegal fishing was reported in the past. No direct exports were reported 2008-2017. A permanent closed season has been implemented, and capture and sale are prohibited.	International trade is not currently anticipated. However if harvest or trade were to resume, comprehensive abundance and distribution surveys should be designed and implemented to inform a potential NDF. A long-term national population monitoring programme should be established. It is unclear if illegal trade continues, but if so, strengthened enforcement measures may also be needed.

DOMINICAN REPUBLIC	Occurs in the northern and southern coastal and offshore areas. No recent abundance or density data is available; density estimates in Jaragua National Park in 1997 were low (4.3 adults and 53 juveniles per ha) and had also declined to low levels in Parque Nacional del Este (0.6 adults and 14.4 juveniles per ha) in 2000. Reported historical declines have been attributed to overexploitation (a key threat), with a low percentage of adults in some areas. Illegal harvesting and pollution are other threats. Direct trade in *S. gigas* products, 2008-2017 comprised only two wild-sourced shells, with importers reporting a higher quantity of confiscated carvings (1542) from the country. The species is mainly harvested for domestic use. Conversion factors have been developed. Management measures include a prohibition on harvest of juveniles or reproductively-active individuals, minimum size and weight restrictions (of 20 cm or clean weight of 227g), and a closed season with a ban on movement, trade or export of meat at this time. It is unclear if a management plan exists. Compressor fishing methods are permitted except in reserves with fishing zones. One assessment noted that compliance with fishery regulations was previously limited. No NDF in place, as there is insufficient population data available to calculate sustainable catches.	International trade is not currently anticipated. However if harvest or trade were to resume, comprehensive abundance and distribution surveys should be designed and implemented to include reliable estimates of adult and juveniles densities within commercial fishing areas. These should be regularly repeated. Consider implementing a harvest restriction related to minimum-lip thickness (e.g. ≥ 10-15 mm). Consider banning fishing with scuba diving gear. Development of a national species management plan. Develop recovery plans for any overfished areas (possibly including the Parque Nacional del Este and Parque Nacional Jarangua). Enforcement: Combat illegal harvesting through possible measures including strengthening patrolling, requiring *S. gigas* fishing vessels > 10 m be fitted with Vessel Monitoring Systems.
GUATEMALA	Occurs off the Atlantic coast. No recent surveys, but one survey in 2010 revealed low densities juveniles and a complete absence of adults. Illegal fishing is a key threat, with one author claiming illegal commercial export (without CITES permits) to Belize had occurred. Direct exports of shells and carvings 2008-2017 were very low (<20). The species is occasionally harvested for domestic use. No species-specific management measures have been implemented.	Abundance and distribution surveys should be designed and implemented to include reliable estimates of adult and juveniles densities within artisanal fishing areas. Enforcement: Combat illegal harvesting through possible measures including strengthening patrolling, requiring *S. gigas* fishing vessels > 10 m be fitted with Vessel Monitoring Systems.

HONDURAS	Occurs throughout several marine banks off coast in the north. Past overexploitation has affected the population; however, the 2017 NDF provides a figure of 192 adults/ha. A study in 2017-2018 also recorded an average age of 3.5-4 years (adult stage) in fishing areas. Illegal trade may be a threat. Direct exports 2008-2017 predominantly consisted of wild-sourced meat (1.48 million kg reported by Honduras and 1.31 million reported by importers). An annual export quota of 210 000 kg was published 2008-2016, with the quota being exceeded in 2011 and 2016. The export quota increased to 360 000 kg in 2017, with an additional 59 000 kg for domestic use. Conversion factors have been developed. Management measures have included a previous moratorium on trade, implementation of abundance surveys, development of a management plan (which uses survey data to conclude the species is not over-exploited), licenced fishing vessels that must have a satellite monitoring system with an on-board inspector to monitor record CPUE data and limited number of divers, CPUE measures in place (weight per dive per vessel), minimum size and weight restrictions (21 cm or clean weight of 125 g) as well as lip thickness restriction of 18mm, authorised processing plants which must report regularly, closed seasons, and a ban on fishing in some areas. Honduras has produced an NDF based on the Guidelines adopted by the 2nd technical conch working group. Key risk factors included a lack of MPAs and the prevalence of IUU fishing.	Designation of additional no take zones was identified by Honduras as an aim to protect 20% of critical habitat. Export quota compliance measures may be needed. Sharing of experience in implementing a lip thickness size restriction. Scope ideas for setting harvest quotas for individuals, not meat. Annual surveys should be continued to assess the species density and assess impacts of harvests. Additional engagement with stakeholders (e.g fishing cooperatives) with the aim of improving effectiveness of management interventions. Closure of fisheries between June and September to harmonise closures across the region. Honduras also identified the need to improve administrative procedures, such as logbook registrations for fishermen, as well as outreach, including capacity building of both ship owners and captains. Enforcement: strengthen patrolling to address illegal trade threats, including collaboration with neighbouring countries to address cross border illegal activities. Further capacity needs for inspectors were also identified by Honduras. Addressing these factors would enable Honduras to work towards a more robust NDF assessment.

MEXICO	Occurs in segregated populations off the eastern coast with fisheries noted in the Quintana Roo and Yucatan States. Continual surveys from 1989 to 2018 in Banco Chinchorro showed fluctuating densities, but all were higher than the 100 indiv/ha required for ensuring reproduction, with a 2018 density of 0.042 indiv/m^2. Populations in Quintana Roo have shown signs of recovery. Over-fishing has been the key historical threat, with illegal harvest also reported. Direct exports 2008-2017 predominantly consisted of 40 640 shells. The meat is consumed locally. Conversion factors have been developed. Management measures include the total closure of fisheries off the coasts of Yucatán and closures subject to annual biomass assessments issued by INAPESCA in Quintana Roo, and minimum size (20 cm) and clean weight (125 g) restrictions. In Banco Chinchorro, harvests are subject to a 15mm lip thickness requirement. A national workflow for producing an NDF for the species has been developed.	Implement standardised abundance and distribution monitoring surveys across sites in the country to allow comparability of density data. These should be completed annually and include reliable estimates of adult and juveniles densities within commercial fishing areas. Develop recovery plans for any overfished areas (including Banco Chinchorro). Sharing of experience in implementing a lip thickness size restriction.Consider banning fishing with scuba diving gear. Development of a national species management plan. Enforcement: Combat illegal harvesting through possible measures including strengthening patrolling, requiring *S. gigas* fishing vessels > 10 m be fitted with Vessel Monitoring Systems.

NICARAGUA	Occurs off the eastern coast. Survey data from 2009 revealed moderately high densities (176-267 indiv/ha), with high juvenile densities (1715 indiv/ha). No evidence of overfishing was reported from one study in 2015. Nicaragua is the main exporter in the region. Direct exports 2008-2017 were predominantly wild-sourced meat, accounting for 4.67 million kg. The export quota of 589 670 kg in 2013-2016 was exceeded in all years; whilst the 2017 quota was increased to 635 035 kg, it was also exceeded. Illegal harvest and trade was reported a problem. Conversion factors have been developed. Management measures include: a national management plan with aims to collect CPUE data and assessment of stocks, licensing for fishing of *S. gigas*, closed seasons during which time capture, process and storage are not permitted, and minimum size (20 cm), clean weight (172g processed meat) and lip thickness (9.5 mm) restrictions. Vessel based satellite monitoring systems were also reported to exist.	Export quota management measures are needed to avoid quota non-compliance. Comprehensive abundance and distribution surveys should be continued to include reliable estimates of adult and juveniles densities within commercial fishing areas. These should be regularly repeated. Consider banning fishing with scuba diving gear. Sharing of experience in implementing a lip thickness size restriction. Scope ideas for setting harvest quotas for individuals, not meat. It is not clear if an NDF document exists (it has not been seen). Once developed, Nicaragua is encouraged to share their NDF, e.g. on the CITES website. Nicaragua could then work towards a more robust assessment based on existing NDF guidance (e.g. by including mortality factors, influence of regional connectivity and population abundance, migration, habitat quality changes etc.) Enforcement: Combat illegal harvesting through possible measures including strengthening patrolling and enforcement of fishery regulations.
PANAMA	Occurs off the eastern coast. Limited information available on the population status, but overexploitationwas considered to have led to some of the lowest population densities recorded in the region Very low densities of 1.43 individuals/ha reported at one site in 2010 with 80% being juveniles. Panama noted that there have been no signs of population recovery to date. No direct exports from Panama 2008-2017, and only 555 derivatives reported imported in 2010 from Panama. A permanent closed season for the species was reported to be in place, although it is unclear when this came into force. A general ban on harvesting marine resources with diving equipment also exists, and protected areas are either no-take or reserves with closed seasons.	International trade is not currently anticipated. However if harvest or trade were to resume, comprehensive abundance and distribution surveys should be designed and implemented to inform a potential NDF. A long-term national population monitoring programme should be established.

B. Species characteristics

Taxonomic note: The systematics of the family *Strombidae* has undergone several relatively recent taxonomic revisions based on morphological analyses (Simone, 2005) and genetic analyses (Latiolais *et al.*, 2006). Landau *et al.* (2008) proposed *Strombus gigas* be included in the genus *Lobatus,* a revision followed in MolluscaBase (2018). There is currently no CITES standard nomenclature for this species, and this genus change is not proposed to CITES CoP18 (Notification 2018/100). MolluscaBase (2018a) considers *Eustrombus gigas* to be an additional synonym of *L. gigas*.

Biology: *S. gigas* is a large mollusc of maximum length 30.4 cm (García-sais *et al.*, 2012), occurring in shallow seagrass and sandy habitats across the Greater Caribbean region (Prada *et al.*, 2009). It is characterized by its large, whorl-shaped shell with multiple spines at the shell's apex (Appeldoorn and Baker, 2013) as well as a robust shell lip in mature individuals. *S. gigas*' diet consists of different species of epiphytes on sea grass and algae, with juveniles feeding on various types of plant detritus including *Thalassia testudinum* (Stoner and Waite, 1991). Adults are also known to feed on different types of filamentous algae (Creswell, 1994 in Appeldoorn and Baker, 2013; Ray and Stoner, 1995). The species' habitat preference was reported to vary according to its life-history stage with adult conch generally occurring in deeper water (Appeldoorn and Baker, 2013). *S. gigas* has two life stages; an initial planktonic stage characterised by microscopic free-swimming larvae, and a benthic stage associated with the seafloor (Prada *et al.*, 2017).

Mating in *S. gigas* is affected by a number of environmental variables, including photoperiod, wave surge, habitat features such as sediment grain-size and bed forms (Stoner and Ray-Culp, 2000; Aranda *et al.* 2014), and water temperature (Randall, 1964). Spawning typically occurs between April and October, but periods vary according to geographical location (Appeldoorn and Baker, 2013). Females store eggs for several weeks before laying individual egg masses (averaging 400 000 [Davis, 2005] to 750 000 eggs [Appeldoorn, 1997]) in clean, coarse-sand flats (Randall, 1964). Reproductively active females can lay between 7 and 13 egg masses per season (Prada *et al.*, 2017). Eggs hatch after three to five days (Davis, 1998 in Prada *et al.*, 2017) and remain in the planktonic stage typically for 14-28 days, or a maximum 60 days (D'Asaro, 1965). The longevity of *S. gigas* was estimated to exceed 20 years (Appeldoorn, 1994 in Appeldoorn and Baker, 2013). Natural mortality was noted to be much higher in juveniles than adults, with the size of the shell an important part of this species' defence (Appeldoorn and Baker, 2013).

Importantly, *S. gigas* populations are thought not to spawn or reproduce it the population density of adult individuals is below a critical density. In 1995, a study of *S. gigas* at two locations in the Exuma Cays, Bahamas, found that no mating occurred when adult densities were less than 56 individuals per ha and spawning did not occur when adult densities were below 48 individuals per ha (Stoner and Ray Culp, 2000). Reproduction was then found to increase proportionally with density until reaching an asymptote at c. 200 individuals/ha (Stoner and Ray Culp, 2000). Later studies have noted that the critical threshold for reproduction varies across space and time. Stoner *et al.* (2012a) reported that the lowest density at which mating was observed at Exuma Cays in 2011 was 74 mature adults per ha, whereas at Berry Islands and Andros Island (also in the Bahamas), the critical thresholds below which mating was not observed to occur were 47 and 64 mature adults per ha respectively (Stoner *et al.* 2012a).

Growth in the shell of *S. gigas* has two phases, with individuals reaching maximum shell length before maturation, followed by the thickening of the shell as individuals become mature adults (Appeldoorn 1988; Stoner *et al.*, 2012).

Juveniles of *S. gigas* were noted to have very specific habitat requirements, typically in areas with medium seagrass density at depths of less than 15 m (Appeldoorn and Baker, 2013). In contrast, adults were noted to prefer sand or algal flats and hard bottom substrate such as coral rubble and can tolerate a wider range of environmental conditions than juveniles (Appeldoorn and Baker, 2013). Adults have typically been recorded in depths of up to 30 m (Appeldoorn, 1988), but have been observed at a depth of 59 m (Appeldoorn and Baker, 2013). Home range size in *S. gigas* varies with age and geographical location, and has been measured at 0.0027

hectares (ha) in Florida (Delgado and Glazer, 2007), 0.15-0.5 ha in the Turks and Caicos Islands (Hesse, 1979) and 0.6-1.2 ha in Barbados (Phillips *et al.*, 2010).

Individuals reach sexual maturity at around three and a half to four years (Appeldoorn and Baker, 2013; Prada *et al.*, 2017). As individuals begin to mature, the lip of the shell develops a flare which becomes fully formed after three months, with maturity recorded in individuals with shell lip thickness of 8 – 26 mm (Stoner *et al.*, 2012; Prada *et al.*, 2017).

Based on the biological characteristics, the species is considered to be particularly vulnerable to overfishing because of their slow growth, their occurrence in shallow waters, their late maturation and the tendency to aggregate in shallow waters for spawning (Theile, 2005).

Distribution: *S. gigas* occurs throughout the Caribbean Sea and the Gulf of Mexico with its distribution extending from Bermuda and the United States (Florida Keys and Flower Garden Banks, Texas) south throughout the Caribbean islands and the Caribbean coasts of Central and South America to Venezuela (Fig. 1). This species had been noted to occur off the coast of Brazil (Theile, 2001); however, no further information regarding its occurrence or population status in Brazil, Guyana, French Guyana and Suriname was found and its status in these countries requires validation (National Marine Fisheries Service, 2014).

Figure 1. Distribution of *Strombus gigas*

Source: National Marine Fisheries Service 2014. Queen Conch, Strombus gigas (Linnaeus 1758) Status Report.

Population status and trends: In 1994, the IUCN assessed the species as Commercially Threatened, a category no longer used, and it has not been subsequently assessed (AC26/PC 20 Doc. 7). In 2003, it was reported that intensive fishing pressure had resulted in population declines and stock collapses, resulting in the total or temporary closure of the *S. gigas* fishery in a number of locations (including Mexico; AC19 Doc. 8.3). Despite its listing in Appendix II in 1992, it was noted that the majority of *S. gigas* populations continued to decline and some local populations were at risk of recruitment failure (including in parts of Belize,

the Dominican Republic, Honduras and Panama; AC19 Doc. 8.3). Increasing pressure from commercial and domestic fishing was also noted to have reduced *S. gigas* stocks throughout much of its range, resulting in declining annual harvests in the Caribbean (Fanning *et al.*, 2011). Recovery of *S. gigas* populations, following harvesting to below critical thresholds for reproduction (56 individuals/ha; Stoner and Ray-Culp, 2000), was found to be very slow in Florida and other Caribbean regions (SC66 Doc. 31 Annex 2). The release of hatchery-reared *S. gigas* in Florida, Mexico, Puerto Rico and the Bahamas were not found to be successful in rebuilding stocks (Stoner *et al.*, 2011).

Recent estimates of *S. gigas* densities were taken from twelve range States across the range; densities ranged from 1.4 adults per ha in Barbados (recorded in 2010) and Panama, to 242.9 adults per ha in Saint Lucia, recorded in 2008 (Prada *et al.*, 2017). Juvenile density estimates ranged from 3.7 individuals per ha in Antigua and Barbuda, recorded in 2002, to 254.4 individuals in Saint Vincent and the Grenadines, recorded in 2013 (Prada *et al.*, 2017).

Throughout this species' range, population connectivity, dispersal and recruitment of larvae is driven by hydrodynamics and current patterns (Appeldoorn and Baker, 2013). Larval transport reported to occur via immigration from upstream areas (Posada *et al.*, 1997 in National Marine Fisheries Service, 2014) and local recruitment (Appeldoorn, 1997). Deep-water stocks of adult populations were reported to provide important recruitment to shallow-water stocks and considered critical to spawning stock refugia (Appeldoorn, 1997). However, there is little documentation of such deep-water stocks. Populations in Barbados, Bermuda and Florida at the geographic limit of this species' range, have low reproductive stock and were noted to be potentially isolated from any upstream larval source (Appeldoorn and Baker, 2013).

Prada and Appeldoorn (2014) noted that due to the biological complexity of the species, the lack of time series of catch and effort data, the lack of regular species surveys and illegal fishing, the status of *S. gigas* at the regional level could not be effectively estimated.

Threats: Unsustainable fishing of *S. gigas* is the most prominent threat to this species throughout its range (Theile, 2001; National Marine Fisheries Service, 2014). From the 1980's, commercial fishing of *S. gigas* increased rapidly (Paris *et al.*, 2008), driven by the increasing demand for conch meat and pearls by the international market (Fanning *et al.*, 2011). Whilst it is harvested primarily for meat, shells are used for jewellery and tourist curios (TRAFFIC Europe and IUCN, 2003). There is also a small trade in S. *gigas* pearls (TRAFFIC Europe and IUCN, 2003) and, more recently, the conch opercula, which is largely imported by China and is believed to be used in traditional Chinese medicine (Prada and Appeldoorn, 2014).

Other threats to *S. gigas* include various types of habitat degradation, such as the indirect effect of reduced seagrass cover, which often acts as important nursey areas for *S. gigas* (National Marine Fisheries Service, 2014). Seagrass habitats were noted to be reduced by several factors, including algal blooms caused by eutrophication, hurricanes, recreational or commercial boat traffic and groundings and coastal developments such as dredging (National Marine Fisheries Service, 2014). Increased sedimentation caused by coastal influxes threaten *S. gigas* by altering the preferred substrate structure (National Marine Fisheries Service, 2014). Ocean acidification was also reported to threaten shell-builders such as *S. gigas*, particularly affecting the deep-water populations (Doney, 2006).

High levels of allegedly illegally harvested and traded *S. gigas* meat has been noted (Theile, 2005) with large numbers of *S. gigas* reported to be lost to poachers annually (FAO, 2007). Illegal harvesting of *S. gigas* has been recorded in Belize (Chan *et al.*, 2013), Costa Rica (Anon., 1996 in AC19 Doc 8.3), Guatemala (Gonzalez-Bernat and Clifton, 2017), Honduras (Prada *et al.*, 2009) and Nicaragua (Prada *et al.*, 2009).

Despite conservation actions and international management policies, a number of countries have reported that *S. gigas* populations have shown poor recovery (Paris *et al.*, 2008). This poor recovery has been attributed to reduced densities of adults (i.e spawning stock) which limits *S. gigas* reproduction (FAO, 2007). This implies that once *S. gigas* densities reach such critical low levels, conservation actions may be insufficient to promote recovery.

Overview of trade: *S. gigas* was listed in CITES Appendix II on 11/06/1992. According to the CITES Trade Database, trade in *S. gigas,* 2008-2017, was predominantly in wild-sourced meat for commercial purposes. Direct exports of *S. gigas* meat reported by weight during this period, amounted to 15.3 million kg, as reported by exporting countries. Equivalent trade as reported by importers amounted to 18.7 million kg. *S. gigas* shells represented the highest exports reported by number, with 1.8 million as reported by exporter countries and 0.7 million as reported by importers. During this period, Belize, Honduras and Nicaragua exported the highest quantities of wild-sourced meat. Exports from Belize, Honduras and Nicaragua varied throughout this time, with trade showing an overall increasing trend, particularly from Nicaragua (Fig. 2).

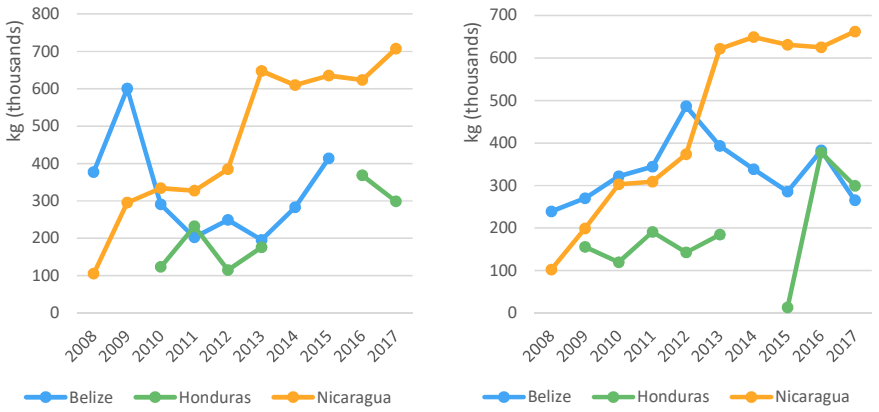


Figure 2: Direct trade in wild-sourced *Strombus gigas* meat exported for commercial purposes (including trade reported without a purpose or source code specified), 2008-2017, as reported by Belize, Honduras and Nicaragua (left) and reported by importers (right).

Fishing of *S. gigas* was reported to be predominantly carried out by industrial and artisanal fleets (Fanning *et al.*, 2011). Industrial fleets have been reported to operate out of Jamaica, Honduras, Nicaragua, Colombia and the Dominican Republic (Fanning *et al.*, 2011), and artisanal fleets from Jamaica, Colombia, Cuba, Honduras, Nicaragua, Belize, Turks and Caicos, and the Bahamas (Appeldoorn and Baker, 2013). The principal exported product derived from *S. gigas* is white meat, followed by shells and pearls (Prada *et al.*, 2017).

It was reported that in the past there have been difficulties matching national trade quotas to available stocks in range countries (Appeldoorn and Baker, 2013). However, most areas were noted to now have systematic monitoring of either stock density and/or catch effort (Appeldoorn and Baker, 2013). Fanning *et al.* (2011) noted that density was one of the most important criteria affecting *S. gigas* productivity, and a crucial ecosystem-based management objective was the maintenance of adult densities at a level that ensured successful reproduction. Following a *S. gigas* expert workshop in 2012, a precautionary density value of 100 adults per hectare within the spawning area was recommended for successful reproduction (Prada and Appeldoorn, 2014), although such densities can only be determined if surveys take place at the time of spawning aggregations.

Other important ecosystem-based management recommendations include the maintenance of nursery areas and areas with high-quality water and habitat (Fanning *et al.*, 2011). The larviculture, nursery culture and brood-stock maintenance of *S. gigas* was noted to be well established (Lovatelli and Sarkis, 2011). *S. gigas* were noted to have been grown to market size out of land-based ponds and cage structures in 20 months (Lovatelli and Sarkis, 2011). However, prior to 2011, no large-scale reseeding efforts with hatchery reared *S.*

gigas had been carried out due to the high hatchery-production costs (e.g., 0.20 USD for a 2 cm seed to 0.75 USD for a 7–9 cm seed; Lovatelli and Sarkis, 2011).

Overview of management guidelines and recommendations:

This section provides on overview of discussions of *S. gigas* in the CITES context, and progress made though the Queen Conch Working Group. Specific management measures are outlined in the various country reports, but regulatory measures and sustainable management of *S. gigas* fisheries have varied considerably throughout the range and have been successful in varying degrees in terms of implementation, compliance and follow up (according to AC28 Inf. 30). They include:

- Permanent or temporal closed seasons;
- Minimum shell length and/or flared lip thickness;
- Minimum clean or unclean meat weight;
- Establishment of sanctuaries / Marine Protected Areas (MPAs);
- Catch quotas by area or in time;
- Export quotas and prohibition of exports;
- Species-specific license systems for fishers and vessels;
- Prohibition or limitation on fishing methods or gears (scuba, hookah):
- Individual non-transferable quotas for industrial vessels that are based on robust assessments of stock, catch and effort;
- Exclusive zones for artisanal fishers.

Given that shell length does not correlate with maturity, it was considered that a minimum shell length for harvest was not a good management measure to avoid harvest of juveniles; lip thickness was considered a preferential indicator of an individual's maturity (Stoner *et al.*, 2012; Foley and Takahashi, 2017). The relationship between lip thickness, age and maturity was considered to vary between geopgraphic locatations, but in the Caribbean, Stoner *et al.* (2012) also suggested that changes to harvest criteria for the species were urgently needed, with a minimum lip thickness of no less than 15 mm proposed. A minimum lip thickness of ≥ 15 mm was also suggested by Peel *et al.* (2014) and Boman *et al.* (2018); Foley and Takahashi (2017) recommended a minimum lip thickness of 16 mm.

One of the disadvantages of implementing a lip-thickness size limit is that compliance is difficult to monitor as shells are usually discarded at sea. Foley and Takahashi (2017) found that market clean weight of female *S. gigas* (something can that be measured after individuals have been landed) was significantly correlated to an individual's gonadosomatic index (a measure of sexual maturity), and suggested using market clean weight in conjunction with lip thickness as a measure to inform management. Their sample of *S. gigas* from the Port Honduras Marine Reserve, Belize, found that the market clean weight at which 50% of females were mature was 199g (Foley and Takahashi 2017). The authors recommended a size limit of 150g market clean weight be initially applied, which could then be altered as part of adaptive management plans.

The management of *S. gigas* in each of the countries reviewed is subject to a number of international conventions and agreements, as well as, regulations set by Regional Fishery Bodies (RFBs) and Regional Fisheries Management Organisations (RFMOs). These are detailed below in Table 1.

Table 1: Summary of review countries membership to international conventions and RFMOs relevant to the sustainable use of *S. gigas*.

Convention	Countries
CITES[13] - Appendix II	**Members:** Belize, Costa Rica, Dominican Republic, Guatemala, Honduras, Mexico, Nicaragua, Panama
Cartagena Convention's Land-based Sources and Activities Protocol[14]	**Members:** Belize, Dominican Republic, Honduras and Panama
Cartagena Convention's Oil Spills Protocol[14]	**Members:** Belize, Costa Rica, Dominican Republic, Guatemala, Honduras and Panama
Cartagena Convention's Specially Protected Areas and Wildlife (SPAW) Protocol[14] - Annex III	**Members:** Belize, Dominican Republic, Honduras, Mexico, Nicaragua and Panama
RFMO	
Central America Fisheries and Aquaculture Organization (OSPESCA)[15]	**Members:** Belize, Costa Rica, Dominican Republic, Guatemala, Honduras, Nicaragua and Panama
Caribbean Regional Fisheries Mechanism (CRFM)[16]	**Members:** Belize **Partner**: Dominican Republic
Western Central Atlantic Fishery Commission (WECAFC)[17]	**Members:** Belize, Costa Rica, Dominican Republic, Guatemala, Honduras, Mexico, Nicaragua and Panama

CITES history

The Animals Committee included S. *gigas* in the Review of Significant Trade (RST) process in 1994 noting that harvesting and international trade in this species had been responsible for local populations becoming severely depleted (AC12 Summary Record). It was again selected at AC17 in 2001 for all range States.

At AC19 trade in *S. gigas* from 21 range States (among them Costa Rica, Guatemala, Mexico, and Panama) was categorised as 'least concern', and these range States were removed from the review (AC19 Summary Record). It was concluded that trade was 'of urgent concern' for Dominican Republic, Haiti and Honduras and 'of possible concern' in a further 13 range States, including Belize and Nicaragua, (AC19 Summary Record) and recommendations were directed to these countries. Following non-compliance with these, Notification 2003/057 advised that the SC a recommended a trade suspension for Haiti, while the Dominican Republic and Honduras had agreed to suspend the issuance of export permits for *S. gigas* from 29 September 2003. Belize, Dominican Republic, Honduras and Nicaragua were removed from the process in 2006, and a recommendation to suspend trade was made for Grenada (Notification 2006/034). The suspensions for Grenada and Haiti remain in place.

Following CoP17, *S. gigas* was selected as meeting the "high volume" criterion for the Review of Significant Trade Process (AC29 Doc. 13.3 Annex 2 (Rev.1)), however the species was not selected by the AC for inclusion in the process.

[13] CITES 2019. List of contracting Parties. Available at: https://cites.org/eng/disc/parties/chronolo.php. [Accessed: 28/01/2019].
[14] Caribbean Environment Programme and United Nations Environment Programme 2019. Cartagena Convention and its Protocols. Available at: http://www.cep.unep.org/cartagena-convention. [Accessed: 28/01/2019].
[15] OSPESCA 2019. Central American Fisheries and Aquaculture Organization (Organización del Sector Pesquero y Acuícola del Istmo Centroamericano, OSPESCA). Available at: http://www.fao.org/fishery/rfb/ospesca/en. [Accessed: 28/01/2019].
[16] CRFM 2019. Caribbean Regional Fisheries Mechanism. Available at: http://www.crfm.int/index.php?option=com_content&view=article&id=3&Itemid=101. [Accessed: 28/01/2019].
[17] WECAFC 2019. Western Central Atlantic Fishery Commission (WECAFC). Available at: http://www.fao.org/fishery/rfb/wecafc/en. [Accessed: 28/01/2019].

Queen Conch Working Group and related CITES CoP Decisions

In recognition of the need for coordinated management of the queen conch (*S. gigas*) by fisheries scientists and managers, three meetings of the WECAFC/CFMC/OSPESCA/CRFM working group have been held (e.g., October 2012, November 2014 and October-November, 2018.).

The first meeting of the Queen Conch Working Group (Miami, United States of America, 22-24 May 2012), provided recommendations to support the development of a regional plan for the management and conservation of *S. gigas* (CFMC[18]/OSPESCA/WECAFC/CRFM Working Group on Conch Queen, 2012). It was also recommended that *S. gigas* range States, CITES and FAO work closely to improve and standardize trade data and statistics, such as the use of regionally accepted conversion factors for *S. gigas* meat and derivatives (e.g., pearls, shells and opercula; CFMC/OSPESCA/WECAFC/CRFM Working Group on Conch Queen, 2012).

In 2013, at CoP16, a range of inter-related decisions (Decisions 16.141- 16.148) regarding the regional cooperation on the management and trade of *S. gigas* were adopted. Range States were inter alia, directed to adopt, where possible, recommendations made by the Miami Working Group on Queen Conch (QCWG) as revised by CFMC/OSPESCA/WECAFC/CRFM (2012), participate in the development of national, sub-regional and regional plans for the management and conservation of the species and share information on NDF practises and enforcement issues, explore ways to enhance the traceability of the species in trade and collaborate in developing and implementing joint research programmes at the sub-regional level to support the making of non-detriment findings, and develop and apply conversion factors .

Documents AC28 Doc. 19 and CoP17 Doc. 72 report on regional progress made towards achieving the CoP16 Decisions. In terms of developing national, sub-regional and regional plans (in accordance with Decision 16.142), the inclusion of sustainability criteria was recommended, as was the need for licenses for artisanal fishermen, and increasing the frequency of free-diving and adopt strict regulations for independent diving techniques. Related to Decision 16.144 on exploring traceability options, it was recognised that all of the constituents of the value chain should be known to enable tracking of the entire product process, and certification stamps was highlighted as they guaranteeing product sustainability, as well as the need for pilot projects. The need for guidelines for the making of non-detriment findings was also highlighted (AC28 Doc. 19).

The second meeting of the Queen Conch Working Group was held in Panama City (18 to 20 November 2014) and focused on further developing the Regional Queen Conch Fisheries Management and Conservation Plan (CFMC/OSPESCA/WECAFC/CRFM Working Group on Conch Queen, 2014). AC28 Inf. 30 notes that it was agreed that that the measures in the draft Queen Conch management and conservation plan that would most effectively contribute to sustainability were:

- A complete regional ban between the months of June and September.
- Restrictions on the possession of Queen Conch during the ban
- Improvement of catch and effort monitoring programmes
- Limiting the minimum shell size
- Granting of licences to fisherman, processors and exporters
- Adoption of a regulation for independent diving and promotion of the use of free diving
- Prohibition of the use of destructive fishing methods
- Organization of surveillance patrols
- Use of satellite monitoring systems (suggested for boats >10m)
- Development of education and awareness-raising programmes for different users
- Adoption of mechanisms and protocols at the sub-regional level to assess the Queen Conch.
- Identification and protection of breeding and growing areas
- Limiting catching through areas established by national governments, and management and conservation plans at the national level
- Definition of value chains

[18] Caribbean Fisheries Management Council (CFMC)

- Development and implementation of a digital system for the entering of catch and effort data
- Progressively incorporate co-management strategies.

It was also agreed to use regional harmonized conversion factors that had been developed by FAO (in accordance with Decision 16.143). However, CoP17 Doc. 72 noted that "Countries and territories that had already established their national conversion factor should continue to apply them in order to calculate the live weight", and that range States of *S. gigas* are invited to consider developing their own conversion factor because of the spatial variability and characteristics of the species. The use of a standardized template for non-detriment findings (CoP17 Doc. 72) was also agreed and later endorsed by OSPESCA and CRFM and is now included on the CITES website. The meeting agreed that WECAFC members should prepare and share their NDFs as well as implement the reginal plan. CoP17 concluded that the next step would be the effective national and sub-regional implementation of measures on conversion factors, NDFs national plans of action for the management and conservation of queen conch, in which sustainability criteria are included, and more comprehensive education and outreach programmes aimed at queen conch consumers, focusing on responsible catch, trade and consumption, as well as increasing traceability (CoP17 Doc. 72).

Regional Queen Conch Fisheries Management and Conservation Plan

The regional plan was adopted by WECAFC at its 16th session in 2016 (Western Central Atlantic Fishery Commission, 2016). It outlined a total of fourteen short-term, mid-term and long-term management measures for regional-level intervention or harmonization (Prada et al., 2017).

Short-term management measures included:

- Harmonized and simplified categories of queen conch meat conversion factors. To implement this, firstly, all *S. gigas* catch data should be reported in live/nominal weight (i.e., animal with shell). Secondly, in the absence of national conversion factors, the following regional conversion factors have been proposed by the FAO: Dirty meat (i.e., animal without shell) 5.3, 50% clean (i.e., removal of operculum and visceral bag) 7.9, and 100% clean (only white meat) 13.2 (Prada et al., 2017).
- Improvement of catch and effort data collection and processing, as well as monitoring programmes by establishing a regional advisory group tasked with analysing catch and effort data. Also, through the design of effective *S. gigas* surveys, improve fisheries reporting mechanisms, compile historical *S. gigas* fishery data, apply conversion factors and determine quantities of locally consumed *S. gigas* products, assess changes to fishery techniques and efficiency of catch effort and improve existing national and sub-regional digital databases.
- A synchronized regional closed season (1 June to 30 September) for *S. gigas*.
- Non-Detriment Finding (NDF) for export of queen conch meat and its by-products. A standardised NDF guideline was accepted at a Regional Queen Conch Group meeting in 2014 (Queen Conch Working Group, 2014).
- Licensing of all queen conch fishers, processors and exporters.
- Adoption of stricter regulations on autonomous diving techniques.
- Organized patrolling through the establishment of bilateral and multilateral agreements between range states and at the sub-regional level.
- Extended use of satellite-based Vessel Monitoring Systems (VMS) systems for boats with a length exceeding 10 metres.
- Continuous education and outreach programmes for stakeholders.

Mid-term management measures included:

- Development of national level queen conch conservation and management plans, focusing on an ecosystem approach to fisheries and following guidelines of the Regional Queen Conch Fisheries Management and Conservation Plan.
- Traceability of queen conch throughout the value chain.
- Develop collaborative arrangements needed to generate habitat maps at the scale needed for better fisheries management.

- Adoption of sub-regional mechanisms to evaluate the fishery potential of queen conch using fishery dependent and independent factors.

Long-term management measure:

- Progressive inclusion of co-management strategies by defining a legal framework for co-management of fisheries.

At CoP17, a range of further decisions were adopted (Decisions 17.285- 17.290) directing range States to collaborate on implementing the regional plan, develop national management plans, organize national level consultations, build awareness, increase buy-in of all stakeholders for implementing the measures, and contribute to future national, sub-regional and regional compliance. Further collection of data on weight of *S. gigas* by processing grade to improve conversion factors was requested, as well as exploring ways to enhance traceability (e.g. catch certificates, labelling systems and the application of genetic techniques). Joint research programmes at sub-regional or regional level to support the making of non-detriment findings were promoted. The Animals Committee was requested to provide advice regarding NDFs and review the process for setting "scientific" quotas.

At AC29 the issue of "Scientific" quotas that had been published by Honduras (reflecting scientific catch obtained in monitoring and stock assessment) was considered. Export of these catches was expected to cover the costs of the research and analysis relating to stock status (AC29. Doc. 26). The AC concluded that there are no such things as "scientific" quotas, and that all export quotas for wild specimens of Appendix II species (as is the case of *S. gigas*) should be supported by an NDF. At SC70, it was decided that Decision 17.286 relating to traceability and Decision 17.289, directing the Secretariat to collaborate with FAO, CFMC, OSPESCA, WECAFC, and CRFM to enhance Parties capacity to implement the Regional Queen Conch Fisheries Management and Conservation Plan and apply the NDF guidance should be taken forward and considered to CoP18.

The third meeting of the CFMC/OSPESCA/WECAFC/CRFM working group was convened to further the implementation of the Regional Queen Conch Fisheries Management and Conservation Plan (CFMC/OSPESCA/WECAFC/CRFM Working Group on Conch Queen, 2018). This took place on 30th October – 1st November 2018 in Panama City, Panama (SC70 Doc. 60).

Specific objectives included:

- Review the implementation of the Regional Queen Conch Fisheries Management and Conservation Plan by *S. gigas* range states and identify any challenges or actions required to advance the plan.
- Further assess the status of their national fisheries and review other developments relevant to the management of *S. gigas* such as: application of conversion factors for standardized data reporting.
- Review research programs in support of making NDFs and the exchange of information on enforcement issues and regional/bilateral collaboration in fighting Illegal, Unreported and Unregulated (IUU) fishing of *S. gigas*.
- Development of tools to assess traceability of *S. gigas*. Decide upon the terms of reference and a revised work plan to guide future activities of the working group and help ensure achievement of its goal.

The outcomes of the meeting were to report on progress with the implementation of relevant CITES and WECAF decisions at future meetings including, the WECAFC Scientific Advisory Group (SAG; November 2018), 17th session of WECAFC (April/May 2019), CoP18 (May/June 2019) and at AC31 (January 2020). A workshop report was not available at the time of writing.

Guidance on Non-detriment findings

Van Eijs (2015) first developed NDF guidelines for *S. gigas* (AC28 Inf. 30 Annex 6), as presented to the 2nd technical conch working group. The guidelines are presented as a table for SA's to complete during the NDF process. The guidance is structured into 10 categories (e.g. life history and biological characteristics and resilience, national status, management of the resource and harvesting impacts to provide an overview of where better information is required, trade and market forces, legal framework). Further sub-categories

closely follow the IUCN checklist but are also aligned with issues that have directly or indirectly a bearing on the sustainable exploitation of the species. It is intended the information generated in the table by SAs will be expressed as a number of indicators, that can be obtained from scientific research or elsewhere, which can inform management decisions and actions (e.g. more research and improved monitoring, a control and feedback system, which, in turn, will be reflected in more robust management). Where information may be lacking, the specific information categories deemed most important for a quick and/or early risk assessment are as follows: species ID, data accuracy, population density and adults per ha, national distribution, national abundance, export volume, social impact of resource exploitation, management plan, management measures, confidence in fishery management effectiveness, catch quotas, IUU fishing, confidence in monitoring (AC28 Inf. 30 Annex 6).

Critical density thresholds

Whether Stoner and Ray-Culp (2000)'s threshold of 56 adult individuals/ha should be used as a critical point above which *S. gigas* stocks should be maintained remains subject to debate. AC19 Doc. 8.3 (Rev 1) notes that Stoner and Ray-Culp (2000)'s work "highlights the importance of maintaining stock density above this critical level to prevent recruitment failure".AC28 Inf. 30 (draft report of the CFMC/OSPESCA/WECAFC/CRFM working group on queen conch) provides draft guidelines for non-detriment findings, and as an indicator for "population density and adults per hectare", notes that 56 adults/ha is the "CITES minimum benchmark". However, it should be noted that these guidelines including the density threshold have not been accepted by all range States (CITES SA of Belize pers comm. 2019; CITES SA of Mexico pers. comm. 2019) and they are not endorsed by the Convention. Other benchmarks have been recommended, including one of 100 adult individuals/ha in the queen conch experts working group report (held in Miami in 2012) (CFMC, 2012); however countries were noted to have raised objections (CFMC, 2012; CITES SA of Belize pers comm. 2019; CITES SA of Mexico pers. comm. 2019). Instead, some countries were noted to have argued that thresholds should be set by each range state (CITES SA of Belize pers comm. 2019; CITES SA of Mexico pers. comm. 2019).

Minimum thresholds for reproduction to occur are known to be variable (see Stoner *et al.* 2012a), and represent only the absolute minima that is needed for reproduction to occur at all. The point at which the relationship between density and reproductive rates levels off also varies geographically (Stoner *et al.* 2012a), highlighting the need for magement to be context specific. Nevertheless, broad-brush benchmarks may be useful in situations where historical data is absent or where there are not enough resources to implement in depth monitoring measures. Further studies to characterise the variability of critical thresholds for reproduction across *S. gigas'* range are needed.

C. Country reviews

Belize

Distribution: *S. gigas* was reported to occur along the entire length of the 250 km Belize reef system (Finch *et al.*, 2008; Azueta, 2012 in Appeldoorn and Baker, 2013) and at Glover's Atoll (Tewfik *et al.*, 2017), Lighthouse Atoll (Truelove *et al.*, 2017) and Turneffe Atoll (Jagbir, 2015).

Population status and trends: In 2003, *S. gigas* population densities in Belize were reported to be severely depleted due to overfishing, with progressively smaller individuals being harvested despite national size restrictions (AC19 Doc. 8.3 (Rev. 1)). Overexploitation in the past was noted to have markedly reduced *S. gigas* populations (Appeldoorn and Baker, 2013; MRAG, 2013). Surveys from 2006 to 2008 suggested *S. gigas* had been locally extirpated through severe overfishing fishing from the Northeast Caye (Cigliano and Kliman, 2014) an area within the Belize Barrier Reef Reserve System.

The Belize Fisheries Department carry out a national conch survey every two years to assess the natural populations of *S. gigas* (MRAG, 2013). Stock assessments are obtained through line-transect surveys conducted along the entire length of Belize Barrier Reef and extrapolated to known fishing grounds, determined by BFD (MRAG, 2013). Surveys focus on primary conch fishing areas and are carried out both within and outside eight marine reserves in Belize (MRAG, 2013). Surveys of *S. gigas* densities between 1996 and 2010 reported notable increases, with individuals per ha recorded at 14.3 in 1996, 38.9 in 2003, 44.0 in 2004, 109.6 in 2006, 88.3 in 2008, 332 in 2010 (MRAG, 2013) and 337 in 2012, with populations considered "healthy and robust" (Belize Fisheries Department, 2013). In 2018, the mean density of conch/ha was nationally estimated to be 248.51 individuals/ ha (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019) (no figures were provided for mean conch densities in 2014 and 2016). Densities in 2018 were highly variable across the areas sampled, ranging from 18.7 individuals/ha reported from area "five" off the country's southern coast (which includes Punta Ycacos, Middle Snake Key, South Snake Caye, and Stuart Cay), to 526.4 individuals/ha reported from in area "one" off Belize's northern coast (which includes Caye Cauker, Caye Chapel, Punta Azul and San Juan) (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019). Three out of the eight areas sampled had conch/ha densities below 88 individuals /ha (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019).

Belize reported that its harvest was based on collecting subadults (CITES SA of Belize pers. comm. 2019). In 2018, 8% of the country's *S. gigas* population was estimated to be aged one year, 35% aged two years, 40% aged three years, and 17% aged 4+ years (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019). Mean shell length 2006-2018 was reported to have remained relatively stable, ranging from 133.5-158.7 mm (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019). Based on these parameters, the CITES SA of Belize considered its conch fishery to remain strong and viable (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019); however, Tewfik (pers. comm. to UNEP-WCMC, 2019) has argued that the current shell length based size limits used by Belize promoted growth and recruitment overfishing.

Surveys in 2003 and 2004 confirmed the presence of unexploited, reproductively active, deep-water *S. gigas* stocks in Belize and high recruitment back into reef areas (CRFM, 2007). These stocks were thought to have promoted the recovery of stocks observed from 2003-2004 via the provision of large annual recruitments of *S. gigas* to Belize from upstream source populations occurring in the deep water areas off the coast of Belize and Honduras (Mitton *et al.*, 1989 in Appeldoorn and Baker, 2013). However, documentation of such deep-water stocks of *S. gigas* in Belize remains elusive and their support to recruitment of the shallow water fishery was reported to have been exaggerated (Tewfik, pers. comm. to UNEP-WCMC, 2019).

It was reported that surveys in MPAs take place every year, before and after fishing is opened (MRAG, 2013). Details of specific MPA surveys are available from scientific literature.

A survey of the Sapodilla Cayes Marine Reserve (SCMR), at the southern end of the Belize Barrier Reef, was conducted from 2006-2008 across eight shallow-water (<5 m) sites (five in conservation zones and three in general-use zones; Cigliano and Kliman, 2014). A total of 1778 individuals (1.4% adults, 5.6% sub-adults and 93.0% juveniles) were recorded, and the densities of *S. gigas* in the different age groups varied from 0-75 adults per ha and 0-214 sub-adults per ha, to 0-3785 juveniles per ha (Cigliano and Kliman, 2014). Adult aggregations were recorded at six of the eight sites in 2006, but were absent in 2008, whilst only one site showed the opposite pattern gaining adults from an initial absence (Cigliano and Kliman, 2014). The declining trend, contrasting with the Belize Fisheries Department data, was attributed to increased harvesting within the SCMR area (Cigliano and Kliman, 2014). A survey of the SCMR in 2009 observed 693 *S. gigas* individuals across an area of 7 200 square metres (equivalent to 962.5 individuals per ha; Chan *et al.*, 2013). Chan *et al.* (2013) noted that the density was 3.9 times higher in the conservation zone (287.5 adult and 2 012.5 juvenile per ha) than in the general use zone (58.3 adult and 529.2 juvenile per ha). Densities were also higher in dense seagrasses and on sand flats than sparse seagrass habitats (Chan *et al.*, 2013). Over 85% and 90% of the *S. gigas* individuals recorded across the three zones in the SCMR were juveniles, as recorded by Cigliano and Kliman (2014) and Chan *et al.*(2013) respectively. During surveys at Northeast Caye from 2006-2008, *S. gigas* was noted to have been locally extirpated through severe overfishing fishing (Cigliano and Kliman, 2014). However, no evidence of stock declines were reported to have occurred in Belize since 2006 (BCFU [2010] in SOFRECO [2013] in AC28 Inf. 30).

Surveys were undertaken four times a year in the Laughing Bird Caye National Park (LBCNP), Gladden Spit and Silk Cayes Marine and Reserve (GSSCMR) and Sapodilla Cayes Marine Reserve (SCMR) between 2008 and 2011 (Hagan, 2012). Significantly higher encounter rates of *S. gigas* were found in totally protected LBCNP compared to outside reserve, although in GSSCMR densities declined over years in the no-take zone and remained constant in the general-use zone, with a marked decline noted in the SCMR (which also has use zones), between 2008-2009 (Hagan, 2012).

Surveys of *S. gigas* were carried out in Glover's Reef from 2007 to 2013 and revealed density and biomass increased in the reserve zone but no significant trend was noted in the general use zone (Tewfik *et al.*, 2017). However, lip thickness of mature conch decreased over time in both zones, immature conch decreased in density and biomass over time, and average shell length decreased over time (Tewfik *et al.*, 2017) and may indicate overfishing. Declines in mean shell lengths of mature, lipped adults (2004-2018) was also reported to be a cause for concern, as this will likely impact adult fecundity and recruitment especially in light of low adult densities (Tewfik *et al.*, in press).

Threats: Tewflik et al. (in press) reported the main threat to *S. gigas* in Belize to be the overharvesting of juveniles due to low shell length and market clean mass size limits, as opposed to lip thickness and associated mass over the last 40 years. Historical overfishing of *S. gigas* prior to 1977, by both industrial and extensive artisanal fisheries (Appeldoorn and Baker, 2013) led to the depletion of stocks and high quantities (70%; Gibson *et al.* [1983]) of legal catches consisting of juveniles (Appeldoorn and Baker, 2013). Landings data collected from 1995-2015 showed that capture production gradually increased to reach a peak of 1.1 million pounds (c. 499 000kg) in 2012. Illegal harvesting driven predominantly by foreign vessels during closed seasons was noted to threaten *S. gigas* populations in Belize (Ministry of Agriculture Forestry Fisheries the Environment and Sustainable Development, 2016). Illegal harvesting of *S. gigas* within marine protected areas was also reported to be a general problem (Chan *et al.*, 2013), and was noted in the SCMR (Hagan, 2012). Although there is no data on the extent of IUU fishing, it was not considered to be significant (MRAG, 2013).

Increased ocean acidification and declining reef health have also been noted as key threats to *S. gigas* (Ministry of Agriculture Forestry Fisheries the Environment and Sustainable Development, 2016). Seagrass beds were reportedly being impacted by dredging, siltation and nutrient enrichment from agriculture (Gillet, 2003). Offshore oil drilling has also been highlighted as a potential threat to *S. gigas* and its associated habitats (Palomares and Pauly, 2011); however, a moratorium on oil exploration and other petroleum operations in the entire maritime zone of Belize was established through the 2017 Petroleum Operations (Maritime Zone Moratorium) Act (UNESCO World Heritage Convention, 2019).

Trade: Belize has submitted CITES annual reports for the years 2007-2015, but not yet for 2016-2017 at the time of writing (January 2019). Belize has never publised annual export quotas for *S. gigas*.

According to the CITES Trade Database, direct exports of *S. gigas* from Belize, 2008-2017, predominately consisted of wild-sourced meat for commercial purposes, with 2.8 million kg reported by Belize and 3.2 million kg reported by importers (Table 2). Trade in wild-sourced meat for commercial purposes peaked in 2009 according to Belize (Fig. 3) and in 2012 according to importers (Fig. 4). The United States was the predominant importer of wild-sourced meat for commercial purposes, accounting for 92% of trade as reported by Belize (Fig. 3), and 99% of trade as reported by importers (Fig. 4). Relatively high levels of trade were also reported in wild-sourced shells, with considerably more reported by Belize (104 983) than by importers (14 551).

Indirect trade in *S. gigas* originating in Belize predominantly comprised wild-sourced meat and shells for commercial purposes.

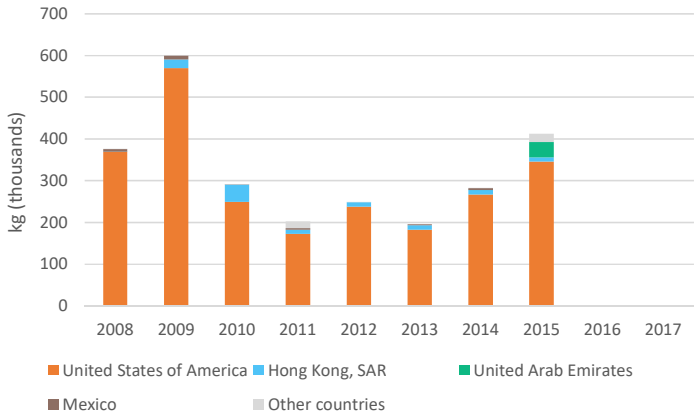


Figure 3: Direct exports of wild-sourced *Strombus gigas* meat for commercial purposes from Belize by country of destination, 2008-2017, as reported by Belize.

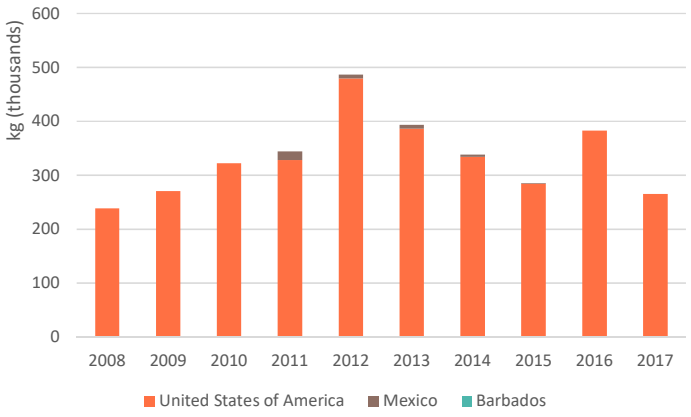


Figure 4: Direct imports of wild-sourced *Strombus gigas* meat for commercial purposes from Belize, by country of import, 2008-2017, as reported by importers.

Commercial exploitation of *S. gigas* in Belize began in the early 1960's (Gongora, 2006). Since then, *S. gigas* has become one of Belize's largest overall exports (Chan *et al.*, 2013) and in 2017 was worth >4.2 million USD (>7.3 million Belizean dollars; The Statistical Institute of Belize, 2018). In 2017, Belize was estimated to have approximately 800 small boats and 2000-2759 fishers using only free diving fishing methods to harvest *S. gigas* (Prada *et al.*, 2017). Annual production of *S. gigas* meat in 2013 was estimated at 439 tons (85% clean), equating to 5.5 million USD, with 98% of this exported by the country (Prada *et al.*, 2017). It was reported that within Belize 90 – 95% of the *S. gigas* catch was delivered to fishery cooperatives and the amount of unreported catch was likely to be small (Azueta, 2012 in Appeldoorn and Baker, 2013; MRAG, 2013).

Table 2: Direct exports of *Strombus gigas* from Belize, 2008-2017. Belize has not submitted annual reports for 2016 and 2017 at the time of writing (January 2019). Low levels of trade in powder and jewellery, and trade for scientific (S), personal (P) and circuses and travelling exhibitions (Q) purposes have been excluded from the table. Quantities have been rounded to whole numbers, where applicable.

Term	Unit	Purpose	Source	Reported by	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
bodies	kg	T	W	Exporter	1		2						-	-	3
				Importer											
	-	T	W	Exporter	1644								-	-	1644
				Importer											
carvings	-	T	I	Exporter									-	-	
				Importer	800										800
			W	Exporter									-	-	
				Importer	579	38	35		196	258	932				2038
derivatives	-	T	W	Exporter	42		1634	1002	1791				-	-	4469
				Importer	773	1176	2796	166	104	1496	1603	2947			11061
			-	Exporter			188						-	-	188
				Importer											
		-	W	Exporter			554						-	-	554
				Importer											
meat	kg	T	D	Exporter									-	-	
				Importer										2295	2295
			I	Exporter									-	-	
				Importer	4568	31080	9307	2				111		10149	55217
			O	Exporter									-	-	
				Importer				3632							3632
			W	Exporter	377015	600294	281839	202403	249306	195809	283304	413324	-	-	2603293
				Importer	238929	270236	321950	344355	486524	393152	338494	285605	382712	265378	3327334
			-	Exporter	2		9082						-	-	9085
				Importer											
		-	W	Exporter								2	-	-	2
				Importer											
			-	Exporter	4							2	-	-	6
				Importer				2							2
meat (cont.)	-	T	I	Exporter									-	-	
				Importer							3		12		15

Term	Unit	Purpose	Source	Reported by	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
			W	Exporter	29000	1217	382	492	57		8866	16838	-	-	56852
				Importer	20										20
pearl	-	T	W	Exporter						3156	2373		-	-	5529
				Importer								27	1704	2186	3917
shells	kg	T	W	Exporter									-	-	
				Importer			43493								43493
	-	T	I	Exporter									-	-	
				Importer	100		64	43	7	6000					6214
			W	Exporter	24		111		5500	12000		87348	-	-	104983
				Importer	142		116	2643	2360	8241	44	70	912	23	14551
unspecified	kg	-	-	Exporter				13					-	-	13
				Importer											
	-	T	W	Exporter									-	-	
				Importer					94						94
		-	-	Exporter			2	9573					-	-	9575
				Importer											

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 27/01/2019

Management: Multiple aspects of Belize's fisheries are managed through the Fisheries Resource Bill, a revised version of which is proposed for enactment into law in 2019 (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019). The revised bill includes provisions for several regulatory measures that are relevant to the *S. gigas* fishery, including measures to facilitate surveillance and enforcement, provisions for the co-mangement of fisheries areas, and requirements for the definition of fisheries management plans (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019).

Belize first established a management plan to combat the unsustainable harvesting of *S. gigas* in 1977, which has led to a gradual increase in population densities (MRAG, 2013). The latest comprehensive national management plan for the species was published in 2014, with the aim of achieving sustainable use (CITES SA of Belize *in litt.* to UNEP-WCMC 2019). Adaptive management takes place through the adjustment of harvest regulations in response to a number of indicators, including (1) the average shell length compared to the 10-year average, (2) conch density, with a limit reference of 88 conch/ha, (3) the total reported catch of the previous season compared to the 10 year average, and (4) early season CPUE, late season CPUE, and the ratio between the two (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019). Specific management measures implemented in the country are outlined below.

***Quotas*:** The 2005 Fishing Regulation states that the catch quota shall not exceed 70% of the MSY, and exports shall not exceed 95% of the quota (MRAG, 2013).

The *S. gigas* meat allocation quota in Belize is calculated using historical production volume, membership of fishing cooperatives, and processing and storage capacity of individual fishermen in four cooperative zones (Northern, National, Placencia and Rio Grande) (Belize Fisheries Department, 2013). Based on abundance by site, the national conch biomass is estimated (in 2010 as 4 079 834 lbs), with MSY as 1 019 959 lbs), and precautionary exploitable biomass (75% of MSY) as 764 969 lbs (MRAG, 2013). Major extrapolation of density by area is involed in the calculation of absolute abundance and thus MSY (MRAG, 2013).

The overall *S. gigas* quota to the four registered and functional fishermen cooperatives in the 2012-2013 season amounted to ~ 726 000 kg (1.06 million pounds; Belize Fisheries Department, 2013). Since 2005, the total allowable catch was divided between the fishing cooperatives across a nine month period (MRAG, 2013). The Belize Fisheries Department was reported to have very good relationships with the conch fishing cooperatives (MRAG, 2013). MRAG (2013) suggested that a system to equitably allocate quotas be introduced (e.g. based on historical production, time of membership, participation in monitoring and history of compliance). Belize noted that catch limits based on the results of monitoring took into account FAO precautionary principles (AC28 Doc 19). MRAG (2013) considered the catch quota set on conch abundance was efficient, but noted problems with the illegal catch.

Tewfik (pers. comm. to UNEP-WCMC, 2019) noted some concern in relation to the specific methodologies used to calculate standing stock biomass and sustainable yields which were discussed and reviewed with the CITES Management Authority of Belize during a workshop organised by the Fisheries Department in 2018.

***Monitoring*:** National abundance surveys have been conducted biannually from 1996 onward and used for stock assessments (MRAG, 2013). The methodology involves conducting a visual diving census (a fisheries independent measure) along two 100 m linear transects at each sampling station. All *S. gigas* found on transects are measured individually (conch size) (CoP17 Inf. 19). Data from these transects are then sent to the Fisheries Department of Belize, which conduct analyses to establish the population structure according to size class, the biomass density, and the abundance of Belize's *S. gigas* stocks (CoP17 Inf. 19). MRAG (2013) suggested that the survey design could be reviewed to include shorter transects with a greater coverage of habitats, depths and the entire stock, including deep water adults, with analyses of abundance and age structure among habitats and depths to better understand stock in fished and unfished areas and effectiveness of marine reserves.

Although landings data have been available since 1977, CPUE measures are only available from 2009 (CoP17 Inf. 19). Landings data are collected from two fishing cooperatives with headquarters in Belize City, which between them account for 95% of the national production of *S. gigas* meat (CoP17 Inf. 19). Although CPUE fluctuates through the fishing season (starting with an average value of 30 pounds/day/fisherman in October

before gradually decreasing to 10-15 pounds/day at the end of the fishing season in May/June), Belize reported that data from 2009-2016 showed that CPUE had remained consistent (CoP17 Inf. 19). MRAG (2013) suggested that effort could be improved to reflect actual number of fisherment that harvested the reported catch. Sustainability is also assessed via measurement of the average weight of meat at 85% clean (i.e., market clean meat mass), which is recorded by the Belize Fisheries Department (CoP17 Inf. 19). Data from 2012 to 2015 indicated a relatively constant average weight of 113g – 142g per individual over the four years, which was suggested demonstrated that stocks were not being overexploited (CoP17 Inf. 19). Tewfik *et al*. (*in press*) recommends a 192 g meat mass using 50% maturity level which is associated with a 10 mm lipped conch.

According to the Belize Fisheries Department (Belize Fisheries Department, 2019a, b, d, e, f) monitoring of conch has been noted to occur in the Caye Caulker Marine and Forest Reserve, Bacalar Chico Marine Reserve, Glover's Reef, South Water Caye and Sapodilla Caye.

***Traceability*:** AC28 Doc. 19 noted that progress had been made in the traceability of meat though the establishment of catch quotas for fishing cooperatives, which are required to report details of catches and landings per fisherman to the Belize Fisheries Department for processing and analysis. Accordingly, the Department has collected sufficient information to link catch areas and the fisherman using them. Possible future action on traceability under consideration in Belize was a stamp indicating the date and area in which the conch was caught on the packaging of the meat (AC28 Doc. 19). MRAG (2013) suggested data management practises (for catches, exports, licensing and registration) in Belize could be improved so data is available in real-time rather than collecting data during visits to plants.

Conversion factors: Belize has clearly defined criteria for each processing stage of *S. gigas*. Unprocessed conch is defined as conch that has been removed from the shell with all organs attached, and has a minimum weight of 213g (7.5 oz) (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019). Partially processed conch (market clean conch) is defined as conch that has been removed from the shell and from which the operculum, intestines, proboscis, head, eye stalks, ventral portion of mantle tissue and some thick-darkened skin on the foot have been removed, and has a minimum weight of 85g (3oz) (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019). Fully processed conch (conch fillet) is defined as conch that has been removed from the shell and from which all body organs have been totally removed from the foot, and has a minimum weight of 78g (2 ¾ oz) (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019).

***Minimum harvest measurements*:** Both minimum size and weight restrictions are in place (Government of Belize, 2003; CoP17 Inf. 19). It is prohibited to harvest *S. gigas* with an overall shell length of less than seven inches (17.8 cm), an unprocessed weight of 213g, an 85% processed weight of 85g (i.e., market clean meat mass) or a 100% clean meat-only weight of 78g (CoP17 Inf. 19). FAO (2015) noted that this size limit (which targets the sub-adult population) had been evaluated as effective (AC28 Inf.30), but Tewfik (pers. comm. to UNEP-WCMC, 2019) noted that the current shell length based size limits promoted growth and recruitment overfishing. Other control measures include the prohibition of possession or sale of diced conch meat in Belize (AC28 Inf. 30; CITES SA of Belize *in litt.* to UNEP-WCMC, 2019), which discourages harvesting of undersized conch.

***Zoning and closed seasons*:** The annual closed season for *S. gigas* runs from 1st July to 30th September (Government of Belize, 2003; CoP17 Inf. 19; CITES SA of Belize *in litt.* to UNEP-WCMC, 2019), or at the point at which the national conch quota is realised (CITES SA of Belize *in litt*. to UNEP-WCMC, 2019). Belize operates a spatial approach to fisheries known as Territorial Use Rights for Fishing (TURF) (CoP17 Inf. 19). The country has designated nine multi-use marine reserves, each of which is split into a general use area (80%), conservation area (15%) and preservation area (5%) (Atlas of Marine Protection, 2019). Within reserves, commercial fishing may only be carried out in a general use zone; extraction from conservation and preservation areas is prohibited (Chan *et al.*, 2013). Out of the eight managed access areas (which may include a marine reserve and imbedded no-take area), fishermen may choose two to use as their principal harvest area (CoP17 Inf. 19); a further deepwater managed access area (Area 9) is open to all fishers with a commercial licence (Tewfik *et al.*, in press). The approach was first trialled at the Puerto Honduras and Glover's Reef marine reserves in July 2011, after which it was expanded to cover all of Belize's waters in 2016 (CoP17 Inf. 19). A proposal to expand

no-take zones to 10% of the reserve's area is currently under consideration (CITES SA of Belize *in litt.* to UNEP-WCMC, 2019).

Within the system of nine marine reserves, no-take zones were reportedly having a positive effect on *S. gigas* stock, with densities increasing from 88.3 individuals per ha in 2008 to 337 individuals per ha in 2012 (Belize Fisheries Department, 2013). Surveys between 2003 and 2010 found that *S. gigas* densities were higher in no-take and deep-water areas compared with shallow-water fished areas (MRAG, 2013), which suggested that no-take areas were indeed functioning as a conservation tool. Tewfik (pers. comm. to UNEP-WCMC, 2019) noted that reserves do function in terms of spillover and recruitment, however, high fishing effort especially at reserve boundaries and poaching in no-take areas were noted to have severe negative impacts on the effectiveness of no take areas. Similarly, Foster *et al.* (2016) noted that *S. gigas* population data from a general-use zone and no-take zones in the Port Honduras Marine Reserve showed that no-take zones were having a limited effect on enhancing these fisheries.

Acosta *et al.* (2018) reported that catch-per-unit-effort (CPUE) was higher in protected areas than fished zones, but no significant change was detected in CPUE or conch size after 15 years of marine protected areas from 2001-2016. Tewfik (pers. comm. to UNEP-WCMC, 2019) noted that CPUE may provide limited understanding on the effect of harvesting on the populations given the multi-species nature of harvest by many Belizean fishers. It was suggested that the monitoring of the biomass (market clean meat mass) of individual harvested conch and the proportion of mature (lipped conch) in fishing areas may provides a better measure (i.e indicator) for assessing effectiveness of management measures.

***Fishing gears*:** Belize's Fisheries Regulation prohibits fishing of *S. gigas* through the use of scuba diving equipment (Government of Belize, 2003). This was considered to be successful as a means of reducing fishing mortality on spawners in deeper waters (AC28 Inf. 30). However, Tewfik (pers. comm. to UNEP-WCMC, 2019) noted that free divers were able to harvest *S. gigas* at depths of greater than 18 m and ambigutiy remains as to the definition of deep-water stocks. In addition, illegal use of SCUBA was reported to have been observed harvesting of mature conch on the fore-reef in some areas (Tewfik, pers. comm. to UNEP-WCMC, 2019).

Protected areas: Of Belize's marine reserves that protect *S. gigas*, five are under State control (MRAG, 2013). Legislation is in place to prohibit the extraction of any marine organisms from conservation areas or no-take zones (Chan *et al.*, 2013). Marine reserves that are important for *S. gigas* include the SCMR (which was established in 1996 principally to protect the *S. gigas* fishery in southern Belize, and is noted to be a significant nursery for this species (Cigliano and Kliman, 2014)), the Gladden Spit and Silk Cayes Marine Reserve, the Caye Caulker Marine and Forest Reserve and the Turneffe Atoll Marine Reserve, which has been noted to be an important nursery ground for the species (Belize Fisheries Department, 2019g). In two reserves (Glovers Reef and Port Honduras) a pilot project to grant fishermen strewardship rights had reportedly reduced illegal fishing (Belize Fisheries Department, 2013).

Three MPAs are managed by an NGO 'Southern Environmental Association' (SEA) - Laughing Bird Caye National Park (LBCNP) which is co-managed with the Belize Forestry Department, and Gladden Spit and Silk Cayes Marine and Reserve (GSSCMR) and Sapodilla Cayes Marine Reserve (SCMR), which are co-managed with the Belize Fisheries Department (Hagan, 2012). The LBCNP of 4095 ha is entirely no take, and it was suggested that based on conch encounters, the effective enforcement of the LBCNP provides for larval dispersal to adjacent reserves providing a 'spill-over' effect, but that this effect was considerably less at GSSCMR where less than 2% of the reserve is a no-take zone.

Access to the fishery: According to MRAG (2013), the 2007 Management Plan proposed that there would be access and effort control, with a maximum of 2000 fishers participating in the conch fishery and a maximum of 800 boats. However, open access fisheries still exist in Belize, with no restrictions on the number of people allowed to fish (Foley, 2012; Ministry of Agriculture, 2016).

***Enforcement*:** In 2003, the Government of Belize amended its Fisheries Regulation, first published in 1977, detailing the regulatory criteria for *S. gigas* (Government of Belize, 2003). All Belizean fishing vessels fishing commercially for *S. gigas* require licences (CoP17 Inf. 19), which must be renewed annually (CoP17 Inf. 19). Patrols within the Caye Caulker Marine and Forest Reserve were noted to increase during closed seasons

(Belize Fisheries Department, 2019c). Within the Belize Fisheries Department the Conservation Compliance Unit (CCU) is responsible for law enforcement and carries out routine inspections of boats, fishers and business establishments (MRAG, 2013). The Capture Fisheries Unit (CFU) of the Belize Fisheries Department inspect conch exports through random selection of 5 to 10% of boxes (containing ~ 4.5 – 22.7 kg of conch meat; MRAG, 2013). The possession of conch meat below the specified legal limits results in a fine of ~ 10-15 USD (20-30 Belizean dollars; FAO, 2007). Fisheries officers are also posted to coopertaives during grinding of conch to ensure compliance with the minimum size regulations (MRAG, 2013). Whilst it was noted that activities such as illegal, unreported and unregulated fishing were being controlled, Belize noted additional resources were needed to continue fighting these activities (AC28 Doc 19).

SEA emply park rangers to patrol twice a day in reserves and an enforcement team to combat illegal fishing activities day and night both in the reserves and the buffer zones between them (Hagan, 2012).

***NDF*:** While Belize noted that an NDF had not been fully completed, the elements of the bi-annual underwater surveys and methodology used for establishment of a TAC were considered consistent with guidelines for the development of a NDF, and the country expected to develop its first NDF for the 2018/19 Queen conch fishing season (AC30 Doc. 22 Annex 1).

Costa Rica

Distribution: In Costa Rica, *S. gigas* occurs off the country's eastern coast, with specific locations including the Cahuita National Park (Robinson, 1987) and between the coasts off Cahuita and Gandoca (Espinosa and Ortea, 2014).

Population status and trends: It was reported that limited information was available on the population status of *S. gigas* in Costa Rica (National Marine Fisheries Service, 2014). Prior to 2003, the population of *S. gigas* in Costa Rica was noted to be declining (AC19 Doc. 8.3 (Rev. 1)); however, according to the 2014 National Marine Fisheries Service report no population surveys had been undertaken.

Threats: Small quantities of illegal subsistence fishing of *S. gigas* were reported to occur in Costa Rica (Anon., 1996 in AC19 Doc. 8.3 (Rev. 1)).

Trade: Costa Rica has submitted annual reports for all years 2008-2017; the country has never published CITES export quotas for *S. gigas.*

No direct or indirect exports of *S. gigas* from or originating in Costa Rica were reported 2008-2017.

Management: In 1989, the Government of Costa Rica introduced regulatory measures (Decree No. 19. 203 MAG, Article 1; Government of Costa Rica, 1989) to permanently prohibit the harvest and export of *S. gigas*. This was ratified in 2000 to include the prohibition of the capture and sale of any *S. gigas* in territorial waters (The Government of Costa Rica, 2000). It has been reported that *S. gigas* collected as bycatch can be used for personal consumption but not sold (Mora, 2012 in National Marine Fisheries Service, 2014). Costa Rica has several marine protected areas off its Atlantic coast (UNEP-WCMC, 2019b) with *S. gigas* reported within the Cahuita National Park (Robinson, 1987).

Dominican Republic

Distribution: *S. gigas* occurs in southern and northern coastal and offshore areas in the Dominican Republic. Specific locations in southern and south-western locations include Alto Bello, Pedernales, around

Beata Island, Jaragua National Park and Parque del Este National Park in the southeast (MRAG, 2013). Northern locations including the Silver and Navidad Banks (Appeldoorn and Baker, 2013).

Population status and trends: Abundance surveys have not been conducted regularly in the Dominican Republic, with no time series density information to assess trends over time (MRAG, 2013). A survey of the Parque Nacional del Este, conducted from 1996 to 1997, revealed that both juvenile and adult *S. gigas* populations had declined by an order of magnitude with 4.5 adults and 282 juveniles per ha recorded in 1996, falling to 1.6 adults and 22.5 juveniles per ha in 1997 (Delgado *et al.*, 1998). Densities in the same location further reduced in 2000, with 0.6 adults and 14.4 juveniles recorded per ha (Torres and Sullivan Sealey, 2002). Density surveys carried out within the Jaragua National Park, in 1997, revealed 89% of the observed conch were juveniles with an overall density of 4.3 adults and 53 juveniles per ha (Posada *et al.*, 2000).

In 2003, *S. gigas* population densities in the Dominican Republic were reported to be so low that local fisheries were reported to be at risk of recruitment failure (AC 19 Doc. 8.3 (Rev. 1)).

Threats: It was reported that early commercial fisheries in the Dominican Republic, 1955-1970, were not sustainable (Appeldoorn and Baker, 2013). Industrial fishing in the Dominican Republic first focused on the offshore Silver and Navidad Banks (Appeldoorn and Baker, 2013) and extremely high landing volumes were recorded between 1992 and 2005 (e.g., a peak of 3140 metric tons of unprocessed meat was reported in 1992; Mateo and Tejeda, 2008). Posada *et al.* (1999) noted the age structure of *S. gigas* in the Jaragua National Park reflected one of high fishing pressure (i.e., high percentages of juveniles and low percentage of adults observed in shallow waters). Posada *et al.* (1999) noted the density of adults found in deeper waters (i.e., 53 per ha) was close the minimum level required for successful reproduction (described as 56 individuals/ha by Stoner and Ray-Culp [2000]).

IUU fishing was reported to be probably high (MRAG, 2013), with the CITES Scientific Authority noting there have been issues with IUU fishing from the Turks and Caicos islands (CITES SA of the Dominican Republic pers. comm. 2019). *S. gigas* populations in Parque del Este were noted to have been decimated by sewage discharge, tourism and the high discharge of phosphates and sulphates from golf courses (MRAG, 2013).

Most *S. gigas* in the Dominican Republic was noted to be consumed locally or exported illegally (MRAG, 2013). National demand was noted to be increasing alongside increases in tourism (CITES SA of the Dominican Republic pers. comm. 2019).

Trade: The Dominican Republic has submitted annual reports for the years 2008-2017; the country has never published CITES export quotas for *S. gigas.*

According to the CITES Trade Database, trade in *S. gigas* from the Dominican Republic, 2008-2017, predominately consisted of 1542 source I (seized/confiscated) carvings for commercial purposes, as reported by the importer, the United States, only (Table 3). The only exports reported by the Dominican Republic 2008-2017 comprised two wild-sourced shells for personal purposes exported to Switzerland in 2012.

Indirect trade in *S. gigas* originating in Dominican Republic 2008-2017 solely comprised two kilogrammes of source 'I' (seized/confiscated) meat re-exported via Haiti, as reported by the United States, the sole importer, in 2013.

Table 3: Direct exports of *Strombus gigas* from Dominican Republic, 2008-2017. All quantities have been rounded to whole numbers, where applicable.

Term	Unit	Purpose	Source	Reported by	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
carvings	kg	T	I	Exporter											
				Importer				2							**2**
	-	Q	O	Exporter											
				Importer					4						**4**
		T	I	Exporter											
				Importer	246	1241	55								**1542**
meat	kg	P	I	Exporter											
				Importer				7	<1		93	1		1	**103**
		T	I	Exporter											
				Importer	109					113	1				**223**
shells	-	P	I	Exporter											
				Importer			5			42	1	2	18		**68**
			U	Exporter											
				Importer			4								**4**
			W	Exporter					2						**2**
				Importer								1			**1**
		T	I	Exporter											
				Importer			10		10		4				**24**
		-	I	Exporter											
				Importer	11	16									**27**

Source: *CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 27/01/2019*

Prior to 2000, *S. gigas* represented the most important fishery resource in the Dominican Republic, being exploited for both local consumption and export (Perez, 2004). Traditionally, the main *S. gigas* fisheries were in the south around Beata Island and the Canal of Catuano located between Saona Island and the mainland, but as these fisheries were depleted, fishing spread to the north and northeast coasts of the country (Mateo and Tejeda, 2008). As industrial fishing caused *S. gigas* stocks to diminish, Dominican Republic vessels were reportedly observed fishing in other states (Appeldoorn and Baker, 2013).

Following the closure of Jamaica's fishery in 2001-2002, landings in the Dominican Republic markedly increased (AC26/PC20 Doc. 7).

Annual production of clean *S. gigas* meat, in 2011, was estimated at 355 tons (Prada et al., 2017).

Management: Following inclusion of the Dominican Republic in the CITES RST process, the country suspended trade in *S. gigas*. The suspension was lifted in 2006. It was reported in 2015 that the Dominican Republic was not undertaking international trade (AC28 Doc 19).

NDF: The CITES SA of the Dominican Republic reported that it was not yet possible to conduct an NDF for *S. gigas* because there is not enough population data to allow sustainable catch levels to be set (CITES SA of the Dominican Republic, pers. comm. 2019).

Quotas: In 2006, the Dominican Republic implemented a zero quota for *S. gigas* meat.

***Monitoring and traceability*:** In 2004, the Government of the Dominican Republic passed a law (No. 307-04) establishing the Dominican Council for Fisheries and Aquaculture (CODEPESCA; The Government of the Dominican Republic, 2004). In 2017, the Dominican Republic was estimated to have approximately 247 small and 40 industrial boats and 1680-2018 fishers, with compressor fishing methods used to harvest *S. gigas* (Prada *et al.*, 2017). AC28 Doc. 19 noted that CODOPESCA carries out control, monitoring and surveillance activities through experts and inspectors, who complete the landing registers in the different fishing areas for the species. MRAG (2013) noted that short and long-term monitoring of the fishery had been difficult to implement based on limited financial and human resources and no reliable data on catches or fishing effort was available.

***Minimum harvest measurements*:** The 2004 law (No. 307-04) prohibits the capture of juvenile *S. gigas* (The Government of the Dominican Republic, 2004). The law prohibits possessing, processing and marketing *S. gigas* with a weight of less than 227 grams (g) of meat (0.5 pounds) and / or less than 20 cm shell length (i.e., from the apex to the siphonal channel of its shell; Article 59). It also prohibits the capture of reproductive individuals, with eggs attached, or during the spawning season (Article 61).

***Zoning and closed seasons*:** In 1999, through CITES recommendations regarding the sustainable harvest of *S. gigas* (see Notification to the Parties No. 1999/50), the Government of the Dominican Republic established a closed season from 1st July – 31st October each year, and banned the trade in meat of this species during this period (Decree No. 269-99; Perez, 2004). The decree prohibited the transportation, sale or export of *S. gigas* meat during the closed season and the permanent prohibition of capture from critical habitats, including the Catuano Channel, between Punta Aljibe and Punta Balajú in the Este National Park and within the southeast coast of Beata Island (Perez, 2004).

***Fishing gears*:** The 2004 law (No. 307-04) prohibits the use of compressors to harvest fisheries and dive fishing at night in the fishery reserve areas (Law No. 307-04, Article 64; The Government of the Dominican Republic, 2004).

***Protected areas*:** The Dominican Republic has multiple marine protected areas (UNEP-WCMC, 2019c), with *S. gigas* noted to occur in the Jaragua National Park and Parque del Este National Park in the southeast (MRAG, 2013).

***Enforcement*:** Mateo and Tejeda (2008) noted that there was limited compliance with fishery regulations in the Dominican Republic and that these regulations were poorly enforced. Mateo and Tejeda (2008) provided recommendations for strengthening the *S. gigas* resource in the Dominican Republic to include:

- conducting full assessments of *S. gigas* populations and fisheries
- establishing a permanent system for monitoring catch and effort data in the main fishing areas, and validated with independent data
- ensuring fishery data collection are those required for the implementation of the Dominican Republic's fishery policy
- applying a standardized index of capture effort per unit across fisheries
- establishing a recovery plan for overfished areas
- use of a fisheries database that is compatible with other regional or national databases

Guatemala

Distribution: This species occurs off the Atlantic coast of Guatemala, specifically recorded from the western end of the Punta de Manabique Peninsula to the mouth of the Motagua River on the border with Honduras (Reyes, 2010).

Population status and trends: A survey of *S. gigas,* conducted in 2010, recorded a total of 395 juveniles (between 4.5 and 7.0 cm total length) within 43 sites across a 34,027 hectare area, at depths of 0-30 m (Reyes, 2010). No adults were observed, and the highest number of juveniles were recorded in mud flats and to a lesser extent in coral, sandy and seagrass areas (Reyes, 2010).

Threats: Illegal fishing of *S. gigas* in Guatemala was noted to be caused by poor regulation of the fishery resource (Gonzalez-Bernat and Clifton, 2017).

Trade: Guatemala has submitted annual reports for all years 2008-2017; the country has never published CITES export quotas for *S. gigas.*

According to the CITES Trade Database, direct exports of *S. gigas* from Guatemala, 2008-2017, consisted of low levels of shells and carvings, primarily for non-commercial purposes (Table 4). Shells were mainly exported to France and the United States, while all carvings were exported to the United States.

Indirect trade in *S. gigas* originating in Guatemala 2008-2017 comprised very low levels of wild-sourced and pre-Convention shells for exhibitions and commercial purposes reported in 2011.

Table 4: Direct exports of *Strombus gigas* from Guatemala, 2008-2017. All trade was reported by number.

Term	Purpose	Source	Reported by	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
carvings	E	W	Exporter			3								**3**
			Importer											
shells	P	W	Exporter	1	6			3						**10**
			Importer											
	Q	C	Exporter											
			Importer			3								**3**
		O	Exporter											
			Importer										2	**2**
	S	O	Exporter											
			Importer				2							**2**
	T	W	Exporter				2						2	**4**
			Importer											

Source: *CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 27/01/2019*

Management: Ministerial Agreement No. 52-2019 set a closed season for *S. gigas* off the Caribbean coast from the 1st July to the 30th September (Government of Guatemala, 2019).

Theile (2005) noted that *S. gigas* was only occasionally harvested by artisanal fishermen in Guatemala and was not exported from the country. However, according to Reyes (2010) *S. gigas* was largely commercially traded with Belize, during both closed and open seasons in Belize, from the Guatemalan port of Puerto Barrios. Guatemala has multiple marine protected areas off its Atlantic coast (UNEP-WCMC, 2019d), however it is unknown whether *S. gigas* occurs within these areas.

Due to minimal levels of *S. gigas* fishing, no size restrictions were reported to have been implemented by Guatemala (Perez, 2009).

Honduras

Distribution: *S. gigas* is reported to be distributed throughout several marine banks off the coast of Honduras, including the fishing banks of Alagardo Reef, Gorda, Middle, Misteriosa, Oneida, Parche de Coral, Rosalinda, Rosario and Vivorios (AC30 Inf. 10). Additional localities include the banks of Thunder Knoll, Media Luna, Arrecife Lagarto and Cayos Vivorillos (AC19 Doc. 8.3 (Rev. 1)).

Population status and trends: When *Strombus gigas* was selected for the RST in 2003 (AC19 Doc. 8.3 (Rev. 1)), it was noted that information on its population in Honduras was limited to a single stock assessment study undertaken in 1996 in Cayos Cochinos (Tewfik *et al.,* 1998); an area which had never been targeted by industrial *S. gigas* fishery and had been declared a Biological Reserve in 1993. Even so, Tewflik *et al*. (1998) reported an overall density of 14.6 individuals per ha over the 15 330 ha study area; well below the minimum density thought to be required for reproduction (56 individuals/ha; Stoner and Ray-Culp [2000]). At the time, there was no information available for banks that were used by the commercial *S. gigas* fishery

(AC19 Doc. 8.3 (Rev. 1)). It was considered that the *S. gigas* population density in Honduras was so low that local fisheries were at risk of recruitment failure (AC19 Doc. 8.3 (Rev. 1)).

Ehrhardt and Galo (2005) surveyed *S. gigas* density in the fishing banks of Rosalinda and Gorda (thought to be the most representative of the *S. gigas* fishing areas in Honduras) from November 2003 to May 2004. Densities in shallow areas (54-80 feet [16.5-24.4 m] below sea level) ranged between 100-200 individuals per ha and between 400-450 individuals per ha in areas at depths greater than 80 feet (>24.4 m) below sea level (Ehrhardt and Galo, 2005).

Green *et al.* (2001) re-surveyed the Cayos Cochinos MPA (Green *et al.*, 2011), but did not use data collected to calculate a mean number of individuals/ha to allow for direct comparison. Surveys from 2009 to 2011, using three 50 m transects found mean numbers of conch encountered varied between 0.0-9.0 individuals/transect in 2009, 0-13.0 individuals/transect in 2010 and 0-13.3 individuals/transect in 2011 but densities varied across sites within the MPA (Green *et al.*, 2011).

Surveys from 2005 to 2017 revealed *S. gigas* densities in Gorda, Oneida and Rosalinda fishing banks increased from 2005 to 2012 and declined from 2015 to 2016 across all sites (Dirección General de Pesca / Secretaria de Agricultura y Ganadería Gobierno de Honduras, 2018). Surveys in Middle Bank, Misteriosa, and Rosario, from 2015 to 2018, revealed mixed trends with densities increasing in Rosario, highest density in Misteriosa in 2016 and lowest density in 2016 for Middle Bank (Dirección General de Pesca / Secretaria de Agricultura y Ganadería Gobierno de Honduras, 2018). Honduras's 2017 NDF noted a [presumably average] density of 192 adult individuals/ha.

According to a 4 month survey, 2017-2018, *S. gigas* populations in Honduras fishing banks were reported to average between 3.5 years to 4 years old and were in their adult stage (Dirección General de Pesca / Secretaria de Agricultura y Ganadería Gobierno de Honduras, 2018).

Honduras's NDF report noted a national average of 192 adult individuals per ha where transects undertaken every three nautical miles for the national abundance analysis (SA of Honduras, 2017).

Threats: Historical exploitation of *S. gigas* in Honduras has been high; exports peaked in the late 1990's and early 2000's (DIGEPESCA, 2017). Annual exports reached over 1000 metric tons in 2003 (AC30 Inf. 10), indicating that the country had among the highest landings in the Caribbean region (AC19 Doc. 8.3 (Rev. 1)). Overexploitation by artisanal fisheries was noted by Tewfik *et al.* (1998) to be likely responsible for low densities of juvenile and adult *S. gigas* in the Cayos Cochinos area in 1996 (14.6 individuals/ha, SD = 36.15).; but the review found no information for the areas used by the commercial *S. gigas* fishery.

Illegal harvest and trade of *S. gigas* had been reported to be a significant problem in Honduras (Theile, 2005; Prada *et al.*, 2008), and confiscations continue (CITES SA of Honduras *in litt.* to UNEP-WCMC, 2019). Illegal fishing from Nicaragua in Honduran waters was also been noted to be an issue (CITES SA of Honduras *in litt.* to UNEP-WCMC, 2019).

Trade: Honduras has submitted all annual reports for the years 2008-2017. Honduras published an annual export quota of 210 000 kg of meat from 2008 to 2016, and 360 000 kg of meat in 2017 (Table 5); no export quota has been published for 2018. The quota appears to have been exceeded in 2011 by 22 366 kg, according to Honduras and in 2016, by 158 564 kg according to Honduras and by 167 649 kg according to importers. There is, however, a discrepancy between the quotas published on the CITES Secretariat and that reported to be in place by the CITES SA of Honduras in 2016. DIGEPESCA reported the 2016 export quota to be 310 tons (DIGEPESCA, 2017; AC30 Inf. 10).

Table 5: CITES export quotas for *Strombus gigas* meat from Honduras 2008-2018 and global direct exports of wild-sourced[19] *S. gigas* meat reported by Honduras and countries of import 2008-2017. Quantities have been rounded to whole numbers, where applicable.

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017
Quota (meat in kg)	210 000	210 000	210 000	210 000	210 000	210 000	210 000	210 000	210 000[20]	360 000
Reported by Honduras			123 949	232 366	115 374	175 625			368 564	298 952
Reported by importers		155 683	119 203	190 678	142 487	184 482		13 154	377 649	299 484

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 27/01/2019

According to the CITES Trade Database, direct exports of *S. gigas* from Honduras 2008-2017, predominately consisted of meat, with 1.48 million kg reported by Honduras and 1.31 million kg reported by importers (Table 6). All trade reported by importers was wild-sourced for commercial purposes while 85% of trade reported by Honduras was reported without a purpose or source code specified. A permit analysis suggests that much of the meat reported by Honduras without a purpose or source code was exported on permits which were reported by importers as being wild-sourced for commercial purposes. In addition, Honduras reported exporting 56 778 kg of meat from captive-bred conches in 2010, however no details of captive-breeding facilities in the country were found. Virtually all *S. gigas* meat was imported by the United States (>95%; Fig. 5 and Fig. 6).

Exports were variable 2008-2017 and peaked at over 360 000 kg in 2016 according to both exporter and importers (Fig. 5 and Fig. 6). All trade 2008-2015 remained below 230 000 kg per year; Honduras did not report any exports in 2008, 2009, 2014 or 2015 while importers did not report trade in 2008 or 2014.

Honduras also reported exporting 185 706 kg of wild-sourced shells for commercial purposes in 2009 (Table 6), of which 83% was imported by the United States.

Indirect trade in *S. gigas* originating in Honduras 2008-2017 mainly comprised wild-sourced meat for commercial purposes, with 33255 kg reported by re-exporters and 29581 kg reported by importers.

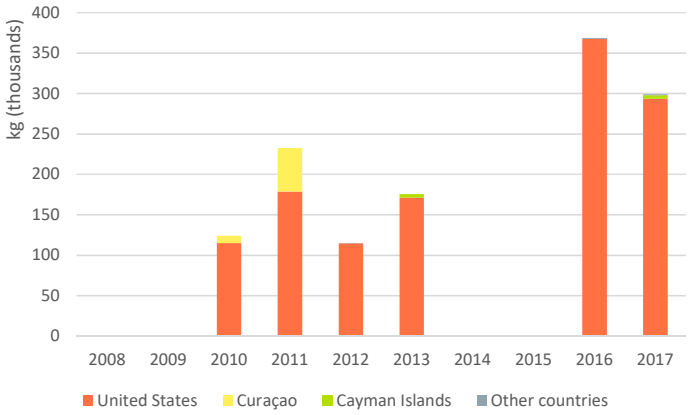


Figure 5: Direct exports of *Strombus gigas* wild-sourced meat for commercial purposes (including trade reported without a source or purpose code) from Honduras, 2008-2017, as reported by Honduras.

[19] includes trade reported without a source specified
[20] DIGEPESCA reported the 2016 export quota to be 310 tons (DIGEPESCA, 2017; AC30 Inf. 10).

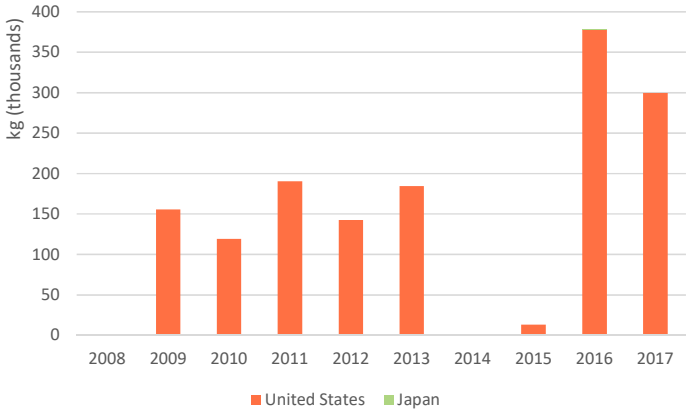


Figure 6: Direct imports of *Strombus gigas* wild-sourced meat for commercial purposes from Honduras, 2008-2017, as reported by importers.

Table 6: Direct exports of *Strombus* gigas from Honduras, 2008-2017. Quantities have been rounded to whole numbers, where applicable. Honduras noted that discrepancies between data reported by importers and data reported by exporters is partially explained by Honduras reporting approved vs. actual trade (CITES SA of Honduras, pers comm. 2019).

Term	Unit	Purpose	Source	Reported by	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
derivatives	kg	T	W	Exporter							977				**977**
				Importer											
		-	-	Exporter									247	2573	**2820**
				Importer											
live	kg	T	W	Exporter											
				Importer		11786									**11786**
meat	kg	P	I	Exporter											
				Importer			23						12		**35**
		T	C	Exporter			56778								**56778**
				Importer											
			I	Exporter											
				Importer		23443	17098		9231					21	**49793**
			W	Exporter			13636			175625					**189261**
				Importer		155683	119203	190678	142487	184482		13154	377649	299484	**1482819**
		-	-	Exporter			110312	232366	115374				368564	298952	**1125568**
				Importer											
	-	-	-	Exporter				22347					393		**22740**
				Importer											
shells	kg	T	W	Exporter		185706									**185706**
				Importer											
	-	P	I	Exporter											
				Importer	6		2				19				**27**
			W	Exporter											
				Importer			1								**1**
		T	W	Exporter	3000										**3000**
				Importer											
specimens	kg	S	W	Exporter						37					**37**
				Importer											
	-	S	W	Exporter	8										**8**
				Importer						316					**316**

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 27/01/2019

Management: Honduras has implemented several management measures to address harvest of *S. gigas*. Through the RST process, Honduras' population of *S. gigas* population was classified as 'urgent concern' in 2003, and a number of short-term actions were directed to be completed within six months, including: a voluntary moratorium, designation of commercial fishery areas, the need to undertake density studies of *S. gigas* in these areas, identify and analyse landing trends and establish minimum weights and establish cautious quotas (AC19 WG3 Doc, 1 Annex 1). Longer term actions included a fishery data collection programme (catch and effort data) and monitoring programme to provide reliable estimates of adult and juvenile densities.

Honduras established a moratorium on exports from the *S. gigas* commercial fishery (Ministerial Agreement 820-03; The Government of Honduras, 2003). In addition, it established a research plan based on scientific fisheries in order to address information gaps, the first results of which were published in Ehrhardt and Galo (2005) (see population and trends section). The study reported that, based on *S. gigas* clean weight data collected between November 2003 to May 2004, stocks were being harvested at approximately maximum sustainable levels (i.e., achieved when fishing mortality is similar to natural mortality) (Ehrhardt and Galo, 2005). Honduras was subsequently removed from the RST process in 2006.

Honduras has established a management plan for *S. gigas*, which states that data collected from 2006-2015 on the density and abundance of *S. gigas* supported the conclusion that the species is not overexploited. Reproductive capacity was also not thought to be affected by the species' population density, and captures were reported to consist entirely of adults. The management plan was reported to be adaptive, however it was noted that limited stakeholder involvement was a factor that could impact on the management plan effectiveness (SA of Honduras, 2017).

Although the moratorium remained in place until 2017 (CITES SA of Honduras pers comm. 2019), trade resumed in 2006 as part of the Government of Honduras' *Proyecto Caracol*, which was developed with CITES in order to provide insight into the status of *S. gigas* and improve the management of its fishery (DIGEPESCA, 2017). As part of *Proyecto Caracol,* annual 'scientific quotas' were set via which vessels could collect data on CPUE and *S. gigas* density and abundance (DIGEPESCA, 2017). The quotas were set annually by Ministerial Agreements, and shared out among a specified number of industrial fishing vessels (see *Quotas* section). Since 2018, 'scientific quotas' have been referred to as commercial export quotas (Government of Honduras, 2018), but they are still set via the same mechanism of Ministerial Agreements.

Ministerial Agreements also include requirements to implement management plans for S. *gigas*, and require these plans to bear in mind FAO recommendations regarding catch limits, the establishment of fishing zones, the regulation of approved harvesting sizes, closed seasons, and the application of conversion factors approved by WECAFC/CRFM. Relevant aspects of these regulations (alongside other relevant management measures) are detailed below.

***NDF*:** Honduras has completed a rapid NDF for export of the species**,** based on the guidelines agreed at the 2nd Conch Working Group. It was noted that the qualitative level of biological and ecological data in relation to the state of the resource was high (SA of Honduras, 2017). However, the NDF also noted that tenure agreements were not in place, and IUU fishing had a notable impact on the resource (SA of Honduras, 2017).

Quotas: Honduras has stated that its main objective of harvest quotas is to ensure that *S. gigas* harvests are both ecologically feasible and economically profitable without causing damage to *S. gigas* stocks (AC30 Doc. 22 Annex 1). Quotas were reported to be set considering relative abundances, densities, growth models and maximum sustainable yield (AC30 Doc. 22 Annex 1), though the exact methodology used to calculate them could not be located.

The country initially set a scientific quota for 210 metric tonnes (set in 2006) to be allocated to four industrial fishing vessels (AC30 Doc. 22 Annex 1); however, at the 2nd WECAFC meeting in 2014, it was agreed that Honduras would gradually increase its quota. In 2016, the country set a scientific quota for 310 metric tons of *S. gigas* for export and an additional commercial quota 90.9 metric tons for domestic trade and consumption (a total 400.9 metric tons). This latter quota was shared out between 12 vessels. In 2017, an additional vessel

was granted a conch licence and the quota was increased again to c.419 metric tons (AC30 Inf. 10), of which 360 metric tons were a scientific quota allocated for CITES certificates and c.59 metric tons were a commercial quota reserved for supplying the national markets (AC30 Inf. 10; AC30 Doc. 22 Annex 1). In 2018 Honduras set a commercial export quota for 360 metric tons, to be distributed between 13 vessels, and an additional 130 000 oz of 100% clean fillet for its national market (Government of Honduras 2018; Ministerial Agreement 139-2018). Vessels are allowed a maximum of five fishing trips to extract the total quota (Government of Honduras 2018; Ministerial Agreement 139-2018).

In light of growing markets for opercula and trimmings, Honduras was noted to be considering setting quotas for these derivatives (CITES SA of Honduras pers. comm. 2019).

Monitoring and traceability: Honduras began monitoring its *S. gigas* fishery upon the establishment of scientific quotas under *Proyecto Caracol.* The country's 2017 management plan (the latest that could be accessed) includes objectives to continue efforts to build upon its fisheries-independent data detailing densities and relative abundance of *S. gigas* population, morphometric relationships, and catch composition according to the sex, weight and size of individuals (DIGEPESCA, 2017). Actions include intentions to, *inter alia*, annually updating the program's monitoring methodology taking into account the development of the commercial fishery of *S. gigas*, and the establishment of a database to hold the program's findings (DIGEPESCA, 2017). Vessels which have been allocated an *S. gigas* quota must carry a Satellite Monitoring System in order to ensure traceability (DIGEPESCA, 2017) and each vessel must also have an on-board inspector to monitor its activity and record CPUE data (DIGEPESCA, 2017), who is able to take samples of whole conch to return to shore for biometric testing (Government of Honduras, 2018, CITES SA of Honduras pers. comm. 2019). Owners (or a representative of the owner) of vessels which have been allocated a quota must also send monthly production reports to the statistics unit of DIGEPESCA, indicating the name of the processing plants to which they have sold their product (DIGEPESCA, 2017). Monitoring programmes were reportedly undertaken, both in processing plants and at sea, to ensure the harvest of *S. gigas* is not detrimental or causes damage to the species (AC30 Doc. 22 Annex 1). Confidence in fishing data was reported to be high (SA of Honduras, 2017).

Restrictions are set out in the appropriate Ministerial Agreement. *S. gigas* products for both the international and domestic markets must only come from authorised processing plants that are registered with DIGEPESCA (DIGEPESCA, 2017). Processing plants have to provide monthly reports to DIGEPESCA detailing, *inter alia*, the amount of product sold, and identity of buyers, and the origin of the product (DIGEPESCA, 2017).

Conversion factors: Conversion factors to be used are specified by Ministerial Agreements relating to *S. gigas*; for example, Ministerial Agreement No. 933-16 set a conversion factor of 2.2046 lb clean meat per kg for the 2016-17 season (DIGEPESCA, 2017).

Data for establishing future conversion factors is collected during the *S. gigas* fishing process, which is limited to a four-day exploratory fishing stage followed by eleven days of commercial fishing as detailed by the relevant Ministerial Agreement. During the initial four days of exploratory fishing, a number of queen conch samples are brought to land to be analysed by technical exports who record the weight of samples when they are 50%, 65%, 85% and 100% clean (definitions for these percentages can be found in AC30 Inf. 10). In the 2017-2018 season, it was calculated that from a nominal average weight (e.g., shell and meat) of 2177.79 g, a 50% clean fillet equated to 203.20 g (conversion factor of 10.72) and a 100% clean fillet equated to 111.98 g (conversion factor of 19.45), representing just over 5% of the entire individual (AC30 Inf. 10).

Minimum harvest measurements: These are also set by Ministerial Agreements. The minimum capture size for the 2018-2019 season was a length of 210 mm, a lip thickness of 18 mm, and a 100% clean filleted meat weight of 118g (Government of Honduras 2018; Ministerial Agreement 139-2018). The harvest of juveniles is prohibited (Government of Honduras 2018; Ministerial Agreement 139-2018).

Zoning and closed seasons: Honduras' 2018 closed season for *S. gigas* fishing ran from 1st March to 30th June (Acuerdo No. 001-2018; The Government of Honduras, 2018). Ministerial Agreements define the areas where industrial fishing may occur (DIGEPESCA, 2017), and include temporary and permanent closures of particular zones to *S. gigas* fishing. For example, Ministerial Agreement 139-2018 imposed a temporary ban on fishing

within certain zones in Cayos de la Mosquitia in response to records of a low number of inviduals/ha. Cayo Gorda, a critical habitat for *S. gigas*, was designated as an area where all fishing is permanently prohibited and through which vessels may not travel (The Government of Honduras, 2018; Ministerial Agreement 139-2018). Agreement 139-2018 also stipulated that further no-take areas should be defined through a participative process, in order to reach a target of protecting 20% of critical habitat in Honduras' fishing grounds.

Fishing gears: The only approved fishing gear for *S. gigas* is manual collection by scuba diving (The Government of Honduras, 2018; Ministerial Agreement 139-2018). Vessels with a licence under Proyecto Caracol are also prohibited from having on board Sodium Bisulfate, nets, or other fishing gears unrelated to their activity (The Government of Honduras, 2018; Ministerial Agreement 139-2018). Vessels may also not have more than 30 divers and 30 'cayuqueros' (The Government of Honduras, 2018; Ministerial Agreement 139-2018).

Protected areas: Cayos Cochinos area was declared a biological reserve in 1993 and since then harvest of *S. gigas* has been banned (Tewfik *et al.*, 1998). Fishing in the Marine Reserve of Sandy Bay was also noted to be banned (Morales, *in litt* 2003 in AC19 Doc. 8.3 (Rev. 1)). In 2016, a fishing ban specifically to ensure the reproductive success of *S. gigas* was established in the Cayo Gorda protected area (Ministerial Agreement 933-16; Ministerial Agreement 139-2018). A lack of MPAs was noted in the NDF compiled by the SA of Honduras (2017).

Enforcement: The Secretaría de Agricultura y Ganadería (SAG; Secretariat of Agriculture and Livestock) of Honduras was noted to have developed a proposal for enforcing national law regarding CITES (AC22 Inf. 4). This proposal, in collaboration with the Navy and "Dirección de Marine Mercante Nacional", specifically focused on the regulation of Honduras' fishing fleets (AC22 Inf. 4). The CITES SA of Honduras noted that it was working towards establishing an inter-agency task force, including the police, the public prosecutor's office, DIGIPESCA and CITES, to improve controls and reduce the incidence of IUU fishing (CITES SA of Honduras *in litt.* to UNEP-WCMC, 2019).

Mexico

Distribution: *S. gigas* occurs off the eastern coast of Mexico, with fisheries noted off the Quintana Roo and Yucatan states (IUCN *et al.*, 1996). Specific locations include Alacranes Reef on the Campeche Bank in Yucatan State, Banco Chichorro Atoll, Cozumel Island and Xel-Ha (Peel *et al.*, 2014) in Quintana Roo state (Pérez-Enriquez *et al.*, 2011).

Population status and trends: Mexico was reported to have large *S. gigas* spawning stocks (Stoner, 1997). Paris *et al.* (2008) noted that *S. gigas* populations from the Mexican Caribbean and North Yucatan Peninsula were segregated, with populations on the Alacranes Reef being particularly isolated.

Densities of *S. gigas* have been continuously monitored from 1989 to 2018 in Banco Chinchorro, but while monitoring has been conducted in other fishing sites, varying methods and monitoring intervals mean the figures are not directly comparable (Mexican CITES Scientific Authority (SA), 2018). In Banco Chinchorro *S. gigas* densities (measured in individuals per m^2) have fluctuated over the last 29 years (Mexican CITES SA, 2018). From an initial density of 0.157 in 1989 they declined to 0.086 in 1996, then fell rapidly to 0.008 in 1997 and 0 in 2000 (Basurto *et al.*, 2011). From 2000 to 2005 they increased gradually to 0.070, then rose sharply in 2007 to 0.155, falling again to 0.011 in 2009. Densities increased to 0.073 in 2011 (Basurto *et al.*, 2011), decreased to 0.054 in 2015, and increased to 0.074 in 2016 (Mexican CITES SA , 2018).

Surveys of *S. gigas* in Cozumel, south-eastern Mexico, revealed densities of 89 individuals per ha in 1989, followed by 830 individuals per ha in 1995 (Martinez Vasquez, 1995 in Tewfik and Guzman, 2003). The abundance of *S. gigas* veligers (i.e., planktonic larvae) surveyed at Chinchorro Bank from August 1997 to July 1998, was found to be highest at Penelope (7.42 veligers / 10 m^3) and lowest at Lobos key (<0.01 veligers / 10 m^3; de Jesús-Navarrete, 2001). Peel *et al.* (2010) showed that the total abundance of *S. gigas* in the Xel-Ha

area increased four-fold during a period from 2004 to 2010, highlighting the areas´ importance for the rehabilitation of this species.

Threats: *S. gigas* stocks at Banco Chinchorro, Mexico, were noted to have been overexploited and at risk of collapsing (de Jesús-Navarrete, 2003). Fishermen who legally harvest this species in Mexico reported that illegal fishing poses a threat; however, there is no published data on illegal harvest volumes (Mexican CITES SA, 2018). The catch in Mexico was reported to be for national consumption, with the shells of individuals exported (AC28 Inf. 30).

Trade: Mexico has submitted all annual reports for the years 2008-2016, but had not yet submitted an annual report for 2017 at the time of writing (January 2019). Mexico has never published export quotas for *S. gigas* on the CITES website.

According to the CITES Trade Database, direct exports of *S. gigas* from Mexico, 2008-2017, predominately consisted of 40 640 wild-sourced shells for commercial purposes, as reported by Mexico (Table 7). Virtually all of this trade was exported to the United States in 2011 and 2012 (Fig. 7); the United States only reported importing wild-sourced 7845 shells in 2012, with a further 7845 source 'I' shells also reported in 2012. The Mexican CITES Scientific Authority (in litt. to UNEP-WCMC, 2018) reported that only one legal export of *S. gigas* from the wild has been made in the last 7 years (export of 3000 kg of pulp to the United States in 2018). Most *S. gigas* products are consumed nationally (Government of Mexico, 2016).

Indirect exports of *S. gigas* originating in Mexico 2008-2017 comprised very low levels of shells, carvings and derivatives.

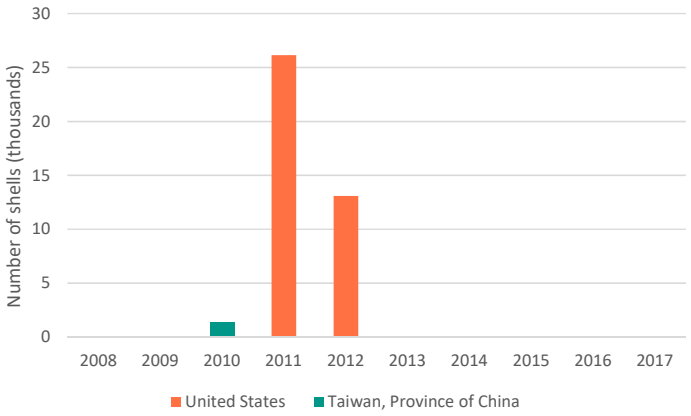


Figure 7: Direct exports of *Strombus gigas* wild-sourced shells for commercial purposes from Mexico, 2007-2016, as reported by Mexico.

Table 7: Direct exports of *Strombus gigas* from Mexico, 2008-2017. Quantities rounded to the nearest whole number, where applicable. Mexico has not yet submitted an annual report for 2017.

Term	Unit	Purpose	Source	Reported by	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
bodies	-	P	I	Exporter										-	
				Importer						1					1
carvings	-	E	O	Exporter					3			1		-	4
				Importer					3						3
		P	I	Exporter										-	
				Importer	1										1
		T	I	Exporter										-	
				Importer	29						24				53
jewellery	-	T	I	Exporter										-	
				Importer										2	2
meat	kg	P	I	Exporter										-	
				Importer										1	1
	-	P	I	Exporter										-	
				Importer						1					1
shells	-	E	O	Exporter	2	5		5		1				-	13
				Importer	2										2
		P	I	Exporter										-	
				Importer	6	16	24	43	15	18	68	19	10	34	253
		Q	O	Exporter					1					-	1
				Importer				5			1				6
			W	Exporter										-	
				Importer		5									5
		T	I	Exporter										-	
				Importer	95	3	20	3	7845			1			7967
			W	Exporter			1400	26160	13080					-	40640
				Importer					7845						7845

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 27/01/2019

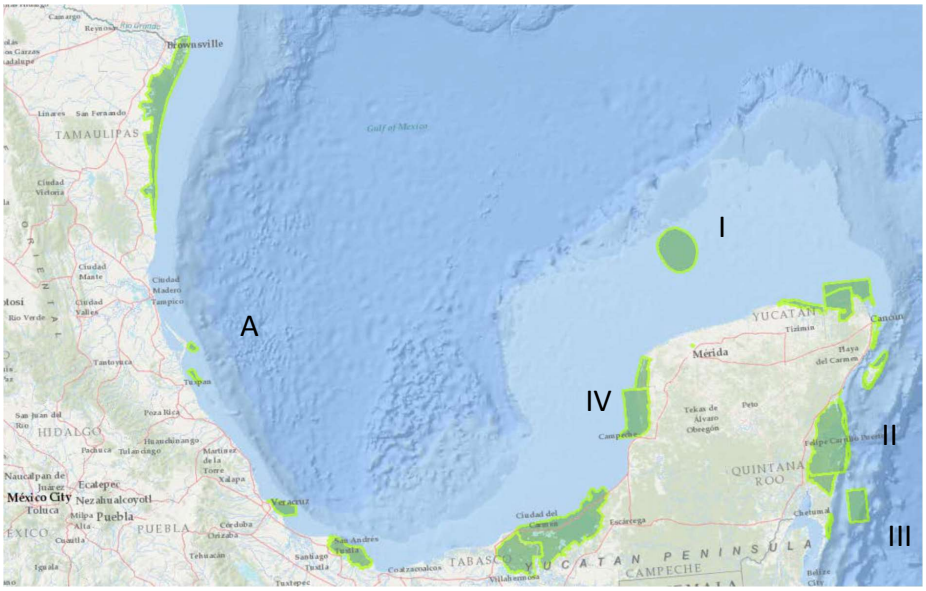
Management: In 2015, legislation was passed stating that in the technical opinion of the National Institute of Fisheries and Aquaculture (Technical Opinion No. RJL / INAPESCA / DGAIPP / 116/2017), some species of the genus *Strombus,* including *S. gigas,* were re-assigned to the genus *Lobatus* (The Government of Mexico, 2017). Mexico has implemented the following management measures for the species:

Quotas: In 1996, harvest quotas were established in Banco Chinchorro and Banco de Cozumel areas in the Quintana Roo state (AC26/PC20 Doc. 7, Annex 5).

Monitoring and traceability*:* Chávez and Constanza-Mora (2009) recommended that *S. gigas* densities should be assessed every year to provide advice to fishing authorities before opening each fishing season thereby applying the principles of adaptive management. INAPESCA monitors the density of *S. gigas* on the Chinchorro bank annually (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019). Preliminary densities for 2015, 2016 and 2018 were reported to be 0.054 individuals/m^2 (equivalent to 540 individuals/ha), 0.074 individuals/m^2 (740 individuals/ha), and 0.042 individuals/m^2 (420 individuals/ha) respectively (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019).

Minimum harvest measurements: In 1996, size limits (minimum shell length of 200 mm; Peel *et al.* 2014) were established in Banco Chinchorro and Banco de Cozumel areas in the Quintana Roo state (AC26/PC20 Doc. 7, Annex 5). In 2016, legislation establishing a minimum shell size harvest criteria of 20 cm was published (The Government of Mexico, 2016; AC30 Doc. 22 Annex 1). Harvests from Banco Chinchorro were additionally reported to be subject to a 1.5 cm minimum lip thickness requirement (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019).

Zoning and closed seasons: The following map shows the spatial and temporal restrictions in place for the harvest of *S. gigas* in Mexico (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019):



Key:

A. Tamaulipas, Veracruz and Tabasco. No information, but *S. gigas* is not considered to be very abundant

I. Yucatán. Permanent ban (The exploitation of *S. gigas* in coastal waters of the state of Yucatán was permantly banned in 1993 (Government of Mexico, 2016).

II. Quintana Roo. Annual seasonal closure from the 1st May to the 31st of October across the whole state

III. Banco Chinchorro. Permanent ban in place 2012-2017. In 2018, the permanent ban was lifted and a seasonal ban imposed throughout the month of February and from the 1st May to the 30th of November. Harvest is subject to increased restrictions in the "Barlovento" zone, which is a recruitement area for the species.

IV. Campeche. Seasonal closure from 1st January to 14th March, and 16th July to 31st December (still to be validated).

Figure 8: Spatial and temporal restrictions in place for the harvest of *S. gigas* in Mexico. Source: CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019

Protected areas: This species occurs in several marine protected areas off the Atlantic coast of Mexico (UNEP-WCMC, 2019e), including the Alacranes Reef National Park, the Banco Chinchorro Biosphere Reserve (Pérez-Enriquez *et al.*, 2011) and the Xel-Ha Natural Park (Peel *et al.*, 2010).

Enforcement: Fishing for *S. gigas* requires a permit (CITES SA of Mexico *in litt.* to UNEP-WCMC, 2019). Mexico's ban on *S. gigas* fishing at Alacran reef was noted to have led to increased illegal harvesting (Rodríguez-Gil pers. comm. in Chávez and Constanza-Mora, 2009).

NDF: Mexico reported that before harvesting *S. gigas,* and in the absence of an NDF, the National Fisheries Institute (INAPESCA) makes biomass recommendations based on the Regional Queen Conch Fisheries Management and Conservation Plan (AC30 Doc. 22 Annex 1). Mexico has produced a workflow for issuing NDFs for *S. gigas*, which includes steps to (1) verify the origin of the shipment, (2) review previous NDFs issued for the species, (3) review the quota, criteria and methods of extraction, (4) compile background information on the conservation and use of the species, including the species' conservation status and impacts from other threats, (5) take into account potential impacts of IUU fishing, (6) consider the quality of information, and, finally, (7) if necessary adjust harvested volumes and issue management recommendations. Step 3 (review of the quota, criteria and methods of extraction) includes verifying the following:

(i) That harvested specimens are adults (lip thickness is >8mm)

(ii) That the density of individuals in the area from which they were harvested is over 100 individuals/ha

(iii) That the volume extracted is below the maximum sustainable harvest, which is set at 8% of the population

(iv) That the harvest method was selective and minimally invasive (e.g free diving)

(v) That when the population trend is known, it is stable or increasing

(vi) To consider new and additional information regarding the harvest and biology of the species.

Nicaragua

Distribution: *S. gigas* occurs off the eastern coast of Nicaragua (Ehrhardt and Galo, 2005). Specific localities include: areas a few miles east of the Corn Islands and Little Corn Island, around the Miskito Keys and around the Pearl Keys (e.g., Askill, King and Man of War; Pérez, 2004).

Population status and trends: Population densities in Nicaragua were reported as 123 individuals per ha, in fishing banks on the Honduran-Nicaraguan continental shelf (Ehrhardt and Galo, 2005). Subsequent surveys were carried out in 2005, 2009, and 2011 (Navarro and Castellon, 2012). Results of the 2009 survey showed adult *S. gigas* densities ranged from 176 to 267 individuals per ha depending on the month (April, July, or November), location and depth (10-30 m; Navarro and Castellon, 2012). Juvenile densities in July were noted to be as high as 1715 individuals per ha (Navarro and Castellon, 2012).

Threats: Fisheries occur on the Honduran-Nicaraguan continental shelf (Ehrhardt and Galo, 2005). Illegal harvest and trade of *S. gigas* was reported to be a significant problem in Nicaragua, constituting an estimated 20% of legally reported trade (Prada *et al.*, 2009).

Trade: Nicaragua has submitted annual reports for the years 2008-2017. Nicaragua published annual export quotas for meat, opercula, shells and trimmings 2008-2017 (Table 8). No export quotas have been published for 2018.

The quota for meat appears to have been exceeded in 2009 and 2012 according to both Nicaragua and importers, in 2013 and 2017 according to Nicaragua only and in 2014 according to importers only (Table 8). Additional information provided in Nicaragua's annual reports suggested that some exports reported by Nicaragua in 2009 were from quotas in previous years (2007 and 2008). Furthermore, given the lack of trade reported as skins by importers, it is possible that importers are reporting such trade as meat, thereby causing the quantities of meat reported to be inflated. Quotas for shells, opercula and trimmings were not exceeded.

According to the CITES Trade Database, trade in *S. gigas* from Nicaragua, 2008-2017, predominately consisted of 4.66 million kg of wild-sourced meat for commercial purposes, as reported by Nicaragua and 4.47 million kg reported by importers (Table 9). The United States was the importer of more than 93% of this trade, as

reported by Nicaragua (Fig. 8), and all equivalent importer-reported trade (Fig. 9). Trade in wild-sourced meat for commercial purposes, as reported by both Nicaragua and importers, increased from 2008 to 2014 and remained relatively constant in subsequent years. In 2004, it was reported that the volume of *S. gigas* consumed domestically was unknown (Garcia, 2004).

Indirect exports of *S. gigas* originating in Nicaragua 2008-2017 mainly comprised meat 1143915 kg of meat reported without a purpose or source code, of which 98% was re-exported via Honduras to the United States, according to Honduras. In 2017, Honduras also reported 18 960 kg of meat originating from Nicaragua was in international transit to Nicaragua.

Table 8: CITES export quotas for *Strombus gigas* meat, opercula, shells and trimmings from Nicaragua 2007-2017 (including 'scientific' quotas) and global direct exports of *Strombus gigas* meat, opercula*, shells and trimmings*, as reported by Nicaragua and countries of import 2008-2017. All quantities have been rounded to the nearest whole number where applicable.

Quota	2008	2009	2010**	2011	2012**	2013	2014	2015	2016	2017
Meat (kg)	158757	158757	340194	385859	340194	635029	635029	635124	635029	680394
Reported by Nicaragua	105212	295173	334094	327502	389403	647714	609727	635036	623475	691407
Reported by Importers	102144	198745	302527	308859	373267	621669	649232	630644	625144	662024
Shells (#)	750000	1050000	2250000	2550000	2250000	4200000	4200000	3900000	3900000	4200000
Reported by Nicaragua	100	14020	6000	12000					7837	
Reported by Importers		20		12000				5		
Trimmings (kg)	71138	71138	150822	170931	150822	281534	281534	281576	281576	281539
Reported by Nicaragua	6033	5378	8233	7190	17645	57017	32474	47376	28604	18934
Reported by Importers										2040
Opercula (#)	750000	1050000	2250000	2550000	2250000	3900000	3900000	4200000	4200000	4200000
Reported by Nicaragua		35538								
Reported by Importers										
Opercula (kg)						300000	300000			
Reported by Nicaragua								343		
Reported by Importers										

*Trade reported by Nicaragua as 'claws' was assumed to be opercula and as 'skin' was assumed to be trimmings, based on additional information provided in Nicaragua's annual reports.
** Quota was not published on CITES website but was noted in supplementary information provided by Nicaragua in their annual report.
Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 27/01/2019

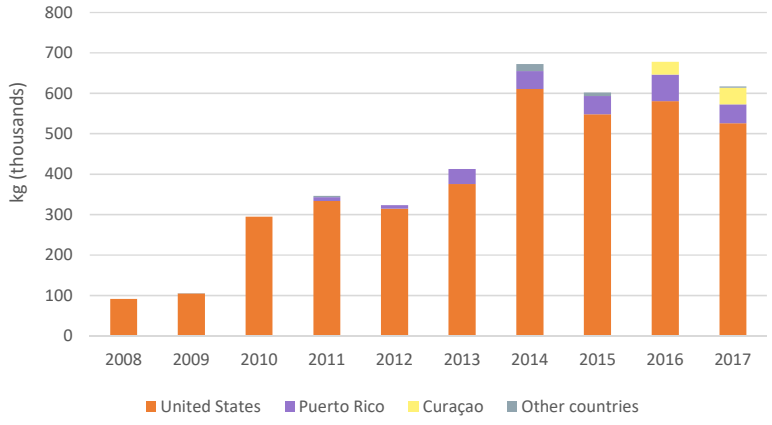


Figure 9: Direct exports of *Strombus gigas* wild-sourced meat for commercial purposes from Nicaragua, 2007-2016, as reported by Nicaragua.

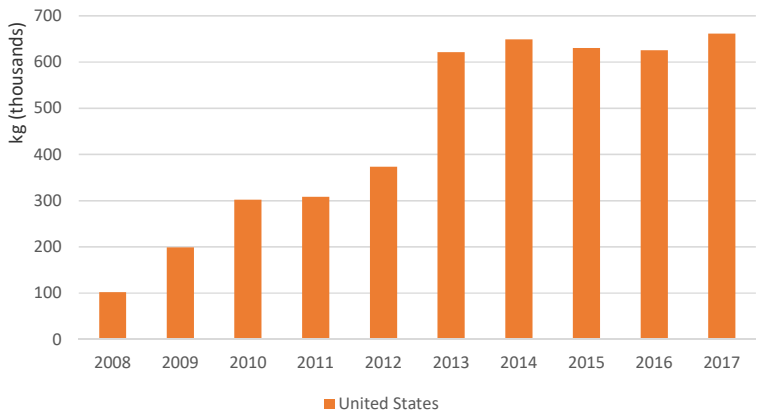


Figure 10: Direct exports of *Strombus gigas* wild-sourced meat for commercial purposes from Nicaragua, 2007-2016, as reported by importer.

Table 9: Direct exports of *Strombus gigas* from Nicaragua, 2008-2017. Low levels of trade in shells for personal use were excluded from the table. Quantities rounded to whole numbers, where applicable.

Term	Unit	Purpose	Source	Reported by	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
bodies	kg	T	W	Exporter											
				Importer					33566	36287					**69853**
claws	kg	T	W	Exporter								343		120	**463**
				Importer											
	-	T	W	Exporter		35538									**35538**
				Importer											
meat	kg	T	C	Exporter						28576					**28576**
				Importer											
			I	Exporter											
				Importer								327	11340		**11667**
			W	Exporter	105212	295173	334094	327502	389403	647714	609727	635036	623475	691407	**4658745**
				Importer	102144	198745	302527	308859	373267	621669	649232	630644	625144	662024	**4474254**
shells	kg	T	W	Exporter								2			**2**
				Importer		14000									**14000**
	-	T	U	Exporter											
				Importer			6000								**6000**
			W	Exporter	100	14020	6000	12000					7837		**39957**
				Importer		20		12000							**12020**
skins	kg	T	W	Exporter	6033	5378	8233	7190	17645	57017	32474	47376	28604	18934	**228883**
				Importer										2040	**2040**

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 24/01/2019

The *S. gigas* fishery in Nicaragua was reported to be the third most commercially important fishery in the country, with 6501 tonnes landed in 2011 recorded to be worth 4.8 million USD (Singh-Renton and McIvor, 2015). The country has both industrial and extensive artisanal fisheries aimed at exporting this species (Appeldoorn and Baker, 2013). In 2017, Nicaragua was estimated to have approximately 70 small and 22 industrial boats and 1650 fishers, with compressor fishing methods used to harvest *S. gigas* (Prada et al., 2017). Annual production of *S. gigas,* in 2013, was estimated at 640 tons with 90% of this exported by the country (Prada et al., 2017).

Management: Nicaragua published a national Action Plan for the management of *S. gigas* exploitation in 2004 (Perez and Barnutti, 2004), which came into effect in 2005 (Singh-Renton and McIvor, 2015). Following inclusion of Nicaragua in the CITES RST process, the country provided evidence that it had established an action plan for the management for queen conch, annual report quotas, legislation on minimum size and weight restrictions, and sampling of S. gigas (AC22 Inf. 4). Following this it was concluded that Nicaragua had taken adequate actions to implement the recommendations and was removed from the RST process (AC22 Inf. 4). In a more recent FAO report, Collado (2012) did not consider that S. gigas was being overfished, supported by no decrease in CPUE trends. Nicaragua have implemented several management measures:

Quotas*:* The Government of Nicaragua set annual harvesting quotas for *S. gigas,* and this is considered to be a precautionary measures (Collado, 2012).

Access to the fishery: Participatory controls via a licencing and limited entry were reported to be in place although without limited entry, and such measures were were considered to have the potential to improve stakeholder relationships in the long-term (Collado (2012). Vessel catch limits are also in place (Collado (2012).

Conversion Factors: Nicaragua has reported the following conversion factors: 5.5 for unprocessed "dirty" to live weight, 10.2 for 50% clean to live weight and 17.0 for 100% clean stages to live weight in 2007, calculated from a sample of 712 individuals (Navarro, 2007).

Monitoring and traceability*:* Nicaragua's 2004 Action Plan for the management of *S. gigas* exploitation included a proposal to develop two research programs: one to conduct an evaluation of *S. gigas* stocks through exploratory fishing, and one to collect CPUE statistics for directed fisheries and to undertake periodic monitoring of processing plants. Data available as part of this research program was noted to include the total volume of meat stored in processing plants as well as the weight of processed and exported meat (AC22 Inf. 22). In 2006, Nicaragua was noted to be planning to adopt a similar approach to measure densities and establish harvest and export quotas as that used by Honduras (AC22 Inf. 22). Surveys estimating *S. gigas* abundance have been conducted in 2002, 2004, 2005, 2009 and 2011 (Appeldoorn and Baker, 2013; Navarro 2012 in Appeldoorn and Baker, 2013) (see *Population Status and Trends* section). In 2012, it was reported that fishing effort had increased over the last ten years (Collado, 2012). The report also noted that vessel based satellite monitoring systems and on-board observers were used in commercial fisheries in order to support compliance (Collado, 2012).

Minimum harvest measurements*:* In 2004, the Government of Nicaragua introduced legislation prohibiting the capture, processing or storage of *S. gigas* with a shell size of less than 200 mm siphonal length, or a weight of less than 172 g of processed meat (Agreement No. 359/04, Article 28; The Government of Nicaragua, 2004). However, it was noted that no minimum-size restrictions were actually in place for *S. gigas* (Collado, 2012).

Zoning and closed seasons*:* In 2004, legislation established a closed season for *S. gigas* harvesting from 1st June to 30th September 2004. During the closed season, it is strictly prohibited to capture, process, store and commercially sell both juvenile and adult *S. gigas* (Agreement No. 359/04, Article 45; Prada *et al*., 2017). In 2015, an FAO report recorded the following management tools for Nicaragua's *S. gigas* fisheries: nursery area closures, temporary closures for specific purposes (e.g., spawning aggregations) and defined fishing seasons (Singh-Renton and McIvor, 2015).

Protected areas*:* Nicaragua has several marine protected areas off its Atlantic coast, with *S. gigas* populations noted within the vicinity of Cayos Miskitos y Franja Costera Inmediata Biological Reserve (UNEP-WCMC, 2019f). However, the presence of *S. gigas* within the protected area and details of its governance and

management plan requires validation. According to Collado (2012) there are no marine protected areas where fishing is prohibited.

Fishing gears: No gear type restrictions are in place (Collado, 2012).

Enforcement: Nicaragua's restrictions on minimal shell length and lip thickness were noted to be difficult to enforce because divers take conch meat out of the shell underwater (FAO, 2007). During the closed season, monitoring and surveillance was noted to be weak (FAO, 2007). According to Garcia (2004), Nicaragua did not have the capacity at that time to control the fishing and illegal traffic from both domestic and neighbouring countries. No recent information on enforcement challenges were located.

Panama

Distribution: *S. gigas* occurs off the eastern coast of Panama, with specific localities noted at Bocas del Toro in north-eastern Panama (Tewfik and Guzman, 2003).

Population status and trends: In Bocas del Toro, adult *S. gigas* densities were recorded at 1.43 individuals per ha, with surveys carried out over a 43.2 ha area of shallow water (<10 m) between February and September 2000 (Tewfik and Guzman, 2003). A total of 45 individuals were observed with 80% reported to be juveniles (Tewfik and Guzman, 2003). Low densities of *S. gigas* were reported to have persisted despite the the establishment of the prohibitions discussed in the *Management* section (CITES SA of Panama *in litt.* to UNEP-WCMC, 2019).

Threats: Overexploitation of *S. gigas* in Panama has led to some of the lowest population densities recorded in the region (Tewfik and Guzman, 2003). It was noted that *S. gigas* occurs alongside *S. costatus* (milk conch) in the Caribbean Sea (CITES SA of Panama *in litt.* to UNEP-WCMC, 2019). While both species are eaten domestically, processed meat from the two species cannot be distinguished (CITES SA of Panama *in litt.* to UNEP-WCMC, 2019).

Trade: Panama has submitted annual reports for the years 2008-2016, but has not yet submitted an annual report for 2017 at the time of writing (January 2019). Panama has never published CITES export quotas for *S. gigas.*

According to the CITES Trade Database, Panama did not report any direct exports of *S. gigas* 2008-2017. Importers reported low quantities of wild-sourced derivatives for commercial purposes in 2010 and source I (seized/confiscated) shells in 2008, 2012 and 2013 (Table 10). No indirect trade in *S. gigas* originating in Panama was reported 2008-2017.

Table 10: Direct exports of *Strombus gigas* from Panama, 2008-2017. All trade was reported by number.

Term	Purpose	Source	Reported by	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	Total
derivatives	P	W	Exporter											
			Importer			50								**50**
	T	W	Exporter											
			Importer			505								**505**
shells	P	I	Exporter											
			Importer					2	18					**20**
	-	I	Exporter											
			Importer	73										**73**

Source: CITES Trade Database, UNEP-WCMC, Cambridge, UK, downloaded on 27/01/2019

Management: Panama was noted to only have a small scale *S. gigas* fishery. The country closed its *S. gigas* fisheries between 2004 and 2009 (Appeldoorn and Baker, 2013), and in 2015 established another 5-year

moratorium which banned the fishing, posession or trade of the species (CITES SA of Panama *in litt.* to UNEP-WCMC, 2019). Fishing for *S. gigas* was reported to only be allowed for scientific purposes (CITES SA of Panama *in litt.* to UNEP-WCMC, 2019). In 2015 an FAO report recorded the following management tools for various species in Panama (including *S. gigas*): marine protected areas where fishing is prohibited, marine reserves where fishing is sometimes permitted, temporary closures for specific purposes (e.g., spawning aggregations), and gear restrictions on vessel size, engine size, gear size and gear type (Singh-Renton and McIvor, 2015). Panama has several Atlantic coast marine protected areas, with *S. gigas* populations noted within the vicinity of the Isla Bastimentos marine national park (UNEP-WCMC, 2019g). However, the presence of *S. gigas* within the protected area and details of its governance and management plan requires validation. A ban on scuba diving equipment for harvesting marine resources has been implemented (Georges and Oxenford, 2014).

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Annexes

Annex 1: *Sphyrna* spp.

Table 1: Summary of country memberships to RFBs and Multilateral Environmental Agreements. Countries marked as X may be members or cooperating non-members.

Country	RFMOs					CMS	CMS MoU Sharks	SPAW	OSPESCA
	ICCAT	WCPFC	IATTC	IOTC	WECAFC				
Belize	X		X	X	X	X			X
Costa Rica			X		X	X	X		X
Dominican Republic					X	X		X	X
El Salvador	X	X	X						X
Guatemala	X		X		X			X*	X
Honduras	X				X	X			X
Mexico	X	X	X		X			X	
Nicaragua	X		X		X				X
Panama	X	X	X		X	X		X	X

* Signatory but not ratified

Annex 2

Table 1: Purpose of trade

Code	Description
B	Breeding in captivity or artificial propagation
E	Educational
G	Botanical garden
H	Hunting trophies
L	Law enforcement / judicial / forensic
M	Medical (including bio-medical research)
N	Reintroduction or introduction into the wild
P	Personal
Q	Circus and travelling exhibitions
S	Scientific
T	Commercial
Z	Zoos

Table 2: Source of specimens

Code	Description
W	Specimens taken from the wild
R	Specimens originating from a ranching operation
D	Annex A animals bred in captivity for commercial purposes and Annex A plants artificially propagated for commercial purposes in accordance with Chapter XIII of Regulation (EC) No 865/2006, as well as parts and derivatives thereof
A	Annex A plants artificially propagated for non-commercial purposes and Annexes B and C plants artificially propagated in accordance with Chapter XIII of Regulation (EC) No 865/2006, as well as parts and derivatives thereof
C	Annex A animals bred in captivity for non-commercial purposes and Annexes B and C animals bred in captivity in accordance with Chapter XIII of Regulation (EC) No 865/2006, as well as parts and derivatives thereof
F	Animals born in captivity, but for which the criteria of Chapter XIII of Regulation (EC) No 865/2006 are not met, as well as parts and derivatives thereof
I	Confiscated or seized specimens (to be used only in conjunction with another source code)
O	Pre-Convention (to be used only in conjunction with another source code)
U	Source unknown (must be justified)
X	Specimens taken in “the marine environment not under the jurisdiction of any State”