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CATCH AND TRADE OF WEST AFRICAN SEAHORSES

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CATCH AND TRADE OF WEST AFRICAN SEAHORSES

FIELD DATA FROM SENEGAL (2012 TO 2013)
OFFICIAL DATA FOR SENEGAL AND GUINEA (1998-2016)

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ABSTRACT

The Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) restricts trade in all seahorses (*Hippocampus* spp.) among 184 countries to levels that do not damage wild populations. Seahorses are among the first marine fishes to be regulated by CITES and repeatedly set precedent for guidelines on sharks, rays and other fishes. As conservation concern emerged for populations of seahorses in Southeast Asia–the epicentre for the trade in dried seahorses–West Africa emerged as a new source. Management challenges meant that CITES suspended imports of the dominant species (*Hippocampus algiricus*) from Senegal and Guinea in January 2016. To provide support for remedial management, we analyse the trade in seahorses in West Africa, reporting (i) on field surveys conducted in 2012 and 2013 and (ii) on formal records held by CITES and key importers. As in many other countries, we found that seahorses in Senegal and Guinea were obtained in non-selective gear (rather than being targeted) and that few are encountered by individual fishers or fishing vessels. However, the huge number of vessels results in an estimated capture of more than 370,000 seahorses per annum, of which 50% were reportedly retained for trade; this is higher than mean annual exports reported in CITES and Customs data. Fishers reported declines in number and size in their catch, raising conservation concerns. CITES and national Authorities need to be much more vigilant in moving towards sustainable, legal exports, in ways that prioritize 1) regulating catches, 2) establishing marine protected areas where seahorses live, and 3) monitoring and evaluation of landings (catch per unit effort), allowing an index of population numbers and trends.

INTRODUCTION

In 1996, the first IUCN Red List conservation assessments for marine fishes played an important role in prompting resource managers to consider these animals as wildlife in addition to being economic commodities (Hudson & Mace, 1996; Vincent & Hall, 1996). Since that change, there has been a growing recognition that marine fish populations and species can be—and have been—damaged by human activity, sometimes perhaps irreversibly (Dulvy et al., 2004; Halpern et al., 2008; Sguotti et al., 2019). While marine fisheries remain central to national economic interests and human food security, management increasingly involves limits to exploitation (e.g. Spalding et al., 2013). The challenge is to retain the consumptive value of marine fishes while also preserving their marine biodiversity and ecological integrity for future generations. Many organizations and agencies now profess goals centred on sustainable use, to a greater extent than ever before (Griggs, 2018; UN Global Compact, 2019).

It was notable when, in 2002, the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES; *www.cites.org*) began regulating export of the first marine fishes including all seahorses (*Hippocampus* spp.), whale shark (*Rhincodon typus*) and basking shark (*Cetorhinus maximus*). Their addition to Appendix II of CITES meant that exports must be limited to sustainable levels that would not damage wild populations. Even though such restrictions are similar with fisheries management objectives, the debate about whether CITES should engage with marine fishes had raged for decades, and the 2002 decisions were highly controversial (Vincent et al., 2014). It was in a similarly contentious climate that CITES added a further four marine fish taxa to Appendix II by 2013, most by very slim margins. Many CITES Parties (member countries) remained unconvinced about the value of CITES' engagement with marine fishes, even though it is—or perhaps because it is—the only multinational environmental agreement with enforcement capacity (Vincent et al., 2014). That said, there was a sea change in 2016 when many more marine fish taxa were added to CITES Appendix II (Vincent et al., 2022). Yet more additions followed in 2019 and 2022, with limited controversy and debate, and there is now widespread acceptance that marine fishes do indeed fall within the purview of CITES.

In April 2008, CITES embarked on a process to ensure that the Convention was achieving its objectives for marine fishes (for the first time), by scrutinising how Parties were justifying seahorse exports. This aspect of the Convention—dubbed a review of significant trade (RST)—is part of what confers strength to CITES (Foster & Vincent, 2021,

CITES, n.d.). At the end of this lengthy RST process, CITES could recommend suspending exports of particular taxon from one or more Parties, giving CITES more teeth than most multilateral environmental agreements enjoy (Foster & Vincent, 2021, CITES, n.d.). Eight species of seahorse were the first marine fishes through the RST, with the end result being trade suspensions for most historically important source Parties (Foster & Vincent, 2021, CITES, n.d.). Rather than ending trade, however, large numbers of seahorses now move across borders illegally and without oversight (Vincent et al., 2022, CITES, n.d.). Embarking on the first RST for a marine fish helped inform CITES considerations and controversies related to listing such animals, which involves both ecological uncertainties and potential social impacts (Vincent et al., 2014).

CITES began paying particular attention to exports of the West African seahorse (*Hippocampus algiricus*) in 2011 upon realizing that there was notable trade in this unstudied species (Foster, 2016). At the time, it was inferred that this was the only species found in the region. Government trade records in Hong Kong Special Administrative Region of China (SAR) had begun recording seahorse imports from the region in 1998. CITES records dating from 2004 indicated enough trade in the species to encourage CITES scrutiny of the sustainability of exports, and of the likely ensuing damage to wild populations. Concern was heightened by the then total absence of publications on the biology, ecology or distribution of this species. By 2012, CITES had decided to initiate an RST for this species, which included the two dominant Parties for exports, Guinea and Senegal (Foster, 2016).

In May 2014, a CITES technical meeting (27th meeting of the Animals Committee) decided that the export of *H. algiricus* from Guinea and Senegal raised Urgent Concern (Foster, 2016). As a consequence, CITES asked both Parties to meet a series of recommendations to ensure their exports do not harm wild populations (i.e make non-detriment findings, NDFs). These included the requirements that Guinea and Senegal explain the basis for allowing existing levels of exports, provide information for protected area planning, monitor seahorse landings, and implement fishing restrictions to help support wild populations (CITES, 2014). Neither country responded to these obligations, with the result that CITES decided in January 2016 to recommend all Parties suspend trade in *H. algiricus* from Guinea and Senegal until such time as these countries could fulfil the recommendations (CITES, 2016).

It has become important to report publicly on any knowledge about trade of *H. algiricus* in the region, as a complement to the first-ever paper on the biology of the species (Cisneros-Montemayor et al.,

2015). In 2012 and 2013, we conducted field research to estimate, analyze and understand the trade in *H. algiricus* in Senegal. Prior to this research, the only available data referred to the numbers of seahorses reported in international trade, with no information on extraction or domestic trade, and thus offered little guidance on sustainable use. We set out to understand the fisheries and trades that involved seahorses, with a view to guiding government approaches to implementing the Appendix II listing. We now report on this research to help guide research, management and policy in trade relating to seahorses and other marine species from Senegal.

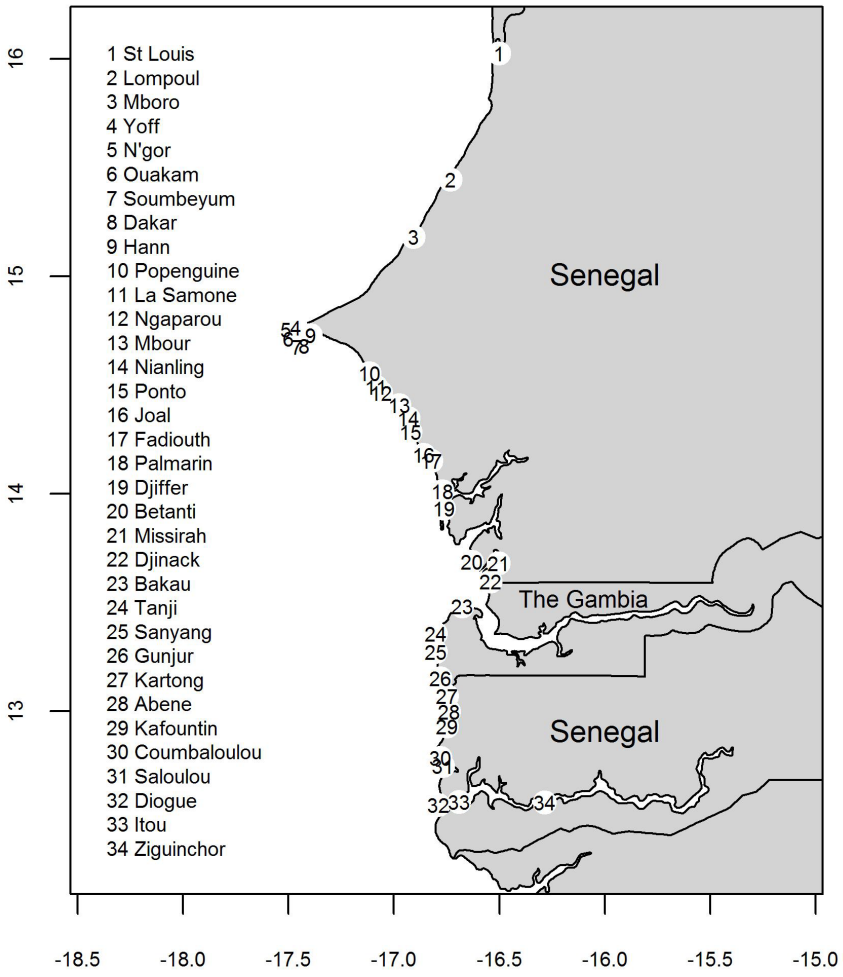

Figure 1. Study area with research and survey sites. Distance between degrees of latitude is 111 km.

STUDY AREA

The coastline of Senegal is dominated by tropical, shallow marine habitats including mangroves and mud/sand flats, rock and algal shelves and few rocky outcroppings. The Cap-Vert Peninsula, Senegal, clearly divides the marine geography of this coastline (Figure 1), with a steeper continental slope to the north and a shallower slope to the south (Guilcher, 2010). Ecosystems south of Dakar, Senegal, are furthermore influenced by the Saloum River and delta, with large areas of mangrove and seagrasses. Study sites were selected based on this geography and previous anecdotal reports of relative seahorse abundance, attempting to sample all representative habitats while focusing efforts in regions where fishers report encountering seahorses regularly (Figure. 1). Dakar is one of the largest ports in Africa, and the entry and exit point for international trade, trans-Atlantic and commercial fishing in the northern West Africa region (SIM Senegal, 2012).

METHODS

All research was covered by approvals from The University of British Columbia's Animal Care Committee (A13-0088) and Human Behavioural Research Ethics Board (H13-00819). We collaborated with Senegal's Department of Water, Forestry, Hunting and Soils (Direction des Eaux et Forêts, Chasses et de la Conservation des Sols; henceforth DEFCCS) throughout the research. We also consulted with local research institutions, NGOs and, when appropriate, met with local chiefs before conducting interviews. Findings from this research were shared with local authorities, fishing industry representatives and researchers, including at a briefing meeting and workshop hosted by the DEFCCS (July 8, 2023).

During two field study periods, from May-June 2012 and June-July 2013, we conducted research at 29 sites in Senegal, including interviews with 262 people including 170 fishers, 43 traders, 25 government officials and 24 scientists, conservationists and members of civil society and. Study sites mainly consisted of fishing villages and/or landing sites, in addition to larger markets and processing facilities in Dakar. Senegalese assistants conducted interviews in Wolof, Fulah (or Fulani), French, English or Spanish as necessary. Interviews were semi-structured, in the form of a discussion or conversation including open-ended questions asked in the most natural order possible; these focused on seahorse biology and ecology, gear uses, estimated volume of seahorse catch, value, and past and present trade and market structure. We also asked questions on the habitat in which seahorses were most often caught, the depth at which they were caught, the size of seahorses and the seasonality of the catch. Information was cross-checked during interviews by rephrasing the same questions at different stages during the interview, in a form of triangulation. Data were recorded in the units given by respondents and later standardized for ease of comparison (e.g. fathoms to meters).

Throughout the interviews and research, the key issue addressed was the yearly catch and retention of seahorses by fishing vessels, including artisanal pirogues and industrial trawlers. As fishers generally recalled seahorse catch in number of individuals per day, week or month, we scaled up to yearly values based on their responses about the number of working days in a year and the difference in relative seahorse catch among seasons. The total number of individual seahorses was subsequently converted to weight units assuming 189 dried seahorses per kilogram, based on the mean dry weight of samples collected at study sites (5.3 g; Cisneros-Montemayor et al., 2015). We distinguished between total seahorses caught and the proportion retained for sale. Almost all artisanal fishers reported releasing

seahorses that were too small and therefore of low value. In contrast, fishers on industrial vessels reported that all seahorse catch was kept.

Total seahorse catch per province was estimated using per-vessel catch and the number of official vessels reported by the Direction des Pêches Maritimes[1] (2011). Based on in-site pirogue counts and interviews, we applied a correction factor to total vessel data to account for vessels that, because of their fishing gear, would not be expected to catch seahorses. For example, if a site had a total of 100 pirogues, but 25 used gears that do not catch seahorses (e.g. hook and line), an effective total of only 75 pirogues would be used to scale-up from per-vessel seahorse catch to total catch. Using both the official total vessels and our lower effective total vessel numbers, we provide a range of estimates of total seahorse catch.

Fishers who worked or had worked aboard industrial trawlers reported catch per trip (usually lasting 1-2 weeks), which we standardized to catch per boat per year. The industrial fishing fleet in Senegal was relatively small, with only 91 registered industrial trawlers, including foreign vessels, in 2011 (the most recent year of available data; Direction des Pêches Maritimes, 2011). It is highly likely that foreign vessels operating illegally in the region (Pauly et al., 2014; Standing, 2015) also caught seahorses, but we did not address this issue in our estimates.

Participants in the seahorse trade were categorized into levels, from fishers (level 1) to buyers (level 2) to consolidators (level 3) and on to exporters (level 4). Individuals may have worked at multiple levels, e.g. a seahorse fisher who also bought from other fishers would operate at both levels 1 and 2. The level of an individual depended on how many people had previously handled the seahorse and not on the person's perceived role or job description. At each trade level, if respondents were willing to share information, we noted selling and buying price data for seahorses (either individuals or per kg.

In addition to estimating current yearly seahorse catch, we asked questions to help make inferences on historical trends in catch. Based on the IUCN Red List criteria, declines in population sizes were calculated across a 10-year period or three generations (whichever is longer) (IUCN, 2001). Information needed to assess the exact generation time, prescribed by the IUCN (2017) was unavailable for *H. algiricus* (Pollom, 2017a).

[1]Direction des Pêches Maritimes (https://www.dpm.gouv.sn) is Senegal's Department of Marine Fisheries (within the Ministere de l'Economie Maritime, de la Pêches & des Transports Maritimes). It is responsible for the implementation of the Senegal's maritime fisheries policy.

Therefore, a 10-year time period was chosen as default. To assist recall and gauge change over time, fishers were helped to identify a significant point of reference 10 years ago, such as the creation of an MPA, a drought period or the birth of a child. This type of anchoring is useful for aiding recall over time (Means & Loftus, 1991; O'Donnell et al., 2010) but clearly varied by individual.

The number of responses for historic years was low (*n*= 1-7 per year). Fishing days per week was standardized as 6 days, as all fishermen reported increasing effort in recent years. Historic data on artisanal boat numbers was taken from official registers of licensed boats (Direction des Pêches Maritimes, 2012). The median catch per fisher per year was multiplied by the average number of pirogues for that year to get an estimate of the historical volume of seahorse catch. There were not enough historical catch data from industrial fishers to estimate historical industrial catch volumes.

In addition to our own surveys, we also accessed data on exports of seahorses originating in Senegal and Guinea from two other sources, to allow for comparison and cross-verification. First, records from the CITES Trade Database were analysed for all seahorse exports originating in Senegal and Guinea from 2004 to 2016, as per Foster et al., 2016. The CITES Trade Database consists of data reported by exporters and importers (UNEP-WCMC, 2016). Data were downloaded on October 19, 2018 – and contained 13 reported exports from Guinea and 35 from Senegal. Second, we accessed a second database maintained by the Hong Kong Special Administrative Region of China (SAR) (HK CSD, 2016), which is a key destination for seahorses from West Africa. Its seahorse entries in the Census and Statistics Data (HK CSD) date from 1998 and include year, country of origin, quantity and value for both live and dry seahorse imports; it included 16 records for Guinea and 16 records for Senegal through 2015. We converted CITES and CSD data (recorded in kg) to number of individual seahorses using the same 189 seahorses per kg, as explained above. A third potential source of export data for West Africa, a database maintained by Taiwan Province of China, since 1982, contained only a single export from Senegal in 2008 of 16 kg (or 3024 individual seahorses) and so we have not analysed it here.

RESULTS

Seahorse ecology

Both species previously documented to occur in Senegal were identified during this study; most individuals were *Hippocampus algiricus* (*n*= 205) but we also found some *H. hippocampus* (*n*= 14). Seahorses occurred along the entire coast of Senegal, with fishers in all survey villages reporting at least some seahorses in local waters. Fishers and traders were generally not aware of the difference between species or familiar with seahorse reproductive biology, although they recognized pregnant individuals—which many inferred to be females (when they are actually males)—and occasionally reported releasing these individuals or attempting to "squeeze" the embryos out into the water.

Fishers reported catching seahorses most often on seagrass, rocks and silt with algae (Table 1). In all villages north of Dakar, fishers reported finding seahorses in rocky or silty habitats with algae in shallow waters (<10 m). However, reports of finding seahorses at greater depths came from fishers in two of these villages: Mboro (20-55 m; *n*=5) and Lompoul (20-50 m; *n*= 3). South of Dakar, fishers reported finding seahorses primarily in sand, rocks and seagrass beds and cited depth ranges that were generally shallower (0-30 m).

Thirteen fishers indicated higher catch of seahorses in the wet season (June-October) with seven additional fishers indicating higher catch in rough seas, which also tend to be in the wet season. Only eight fishers reported catching more seahorses in the dry season, two of these due to gear changes between seasons. Five fishers reported no seasonal difference in seahorse catch.

Table 1. Main habitat and mean depth at which seahorses were reportedly found at Senegal survey sites (from North to South). Source is given either as reported by respondent (Rep) or observed and confirmed in the field by the authors (Obs).

Site	Main Habitat	Mean Depth (m)	Source
St. Louis	Silt/algae	10-13	Rep
Lompoul	Silt/algae	20-50	Rep
Mboro	Rocks/algae	20-55	Rep
Yoff	Rocks/algae	3-10	Obs
N'gor	Sand/seagrass	2-3	Obs
Ouakam	Sand	5-12	Obs
Popenguine	Sand	6-12	Rep
La Samone	Rocks	10-55	Rep
Ngaparou	Sand	12-18	Rep
Mbour	Rocks/algae	0.5-2	Obs
Palmarin	Sand/rocks/algae	1-2	Rep
Nianling	Rocks/sand	15	Rep
Joal	Rocks/algae/seagrass	2-20	Rep
Fadiouth	Silt/algae	0.5	Obs
Djiffer	Seagrass	2-27	Rep
Missirah	Silt/algae	0.5-2	Obs
Betanti	Sand/algae/seagrass	1.2-1.7	Obs
Sanyang	Silt	2	Rep
Kartong	Silt/sand/algae	1	Rep
Kafountine	Sand/shells	7-8	Rep
Ziguinchor	Clay	2-15	Rep

Seahorse catch

All seahorses were reportedly obtained as bycatch in artisanal or industrial fisheries in Senegal, with no indication of a target fishery for seahorses. Artisanal fishers at all survey sites along the coast of Senegal reported encountering seahorses at least occasionally, though reported catch rates differed significantly between the coastal areas north (St. Louis, Louga, Dakar) and south (Thies, Fatick, Ziguinchor) of the Cap-Vert Peninsula (mean of 91 and 304 seahorses per vessel/year, respectively; p=0.03).

The most common fishing methods observed and reported by artisanal fishers, in order of most likely to catch seahorses, were seine nets, bottom-trawls, set gillnets, traps (mainly targeting cuttlefish), cast nets, spearfishing gear and hand lines. Because of the quite shallow coastal zone, seine nets were often deployed from the beach or standing in the water by groups of fishers, in addition to being deployed by circling out from a pirogue.

Most of those interviewed reported throwing some seahorses, often the smallest ones, back into the ocean (n=31 of 53). Of those that reported keeping the seahorses, most later sold (see below) or occasionally gave the seahorses away to friends.

Some fishers in sites in Louga and St. Louis (furthest provinces north of Dakar: see Figure 1) and Ziguinchor (furthest province south of Dakar) were not aware of the commercial value of seahorses and either threw the seahorses back or kept them for decorations only. All respondents in Fatick and most in Thies (see Figure 1) were aware of the seahorse market and kept more of them for sale. Once landed, most seahorses were dried in a well-ventilated area, preferably away from direct sunlight, until their sale. Three respondents noted that they did not let the seahorses dry completely before selling them, as they would get a higher price for damper seahorses (which were heavier) if they were sold by weight. Industrial fishers either dried the seahorses on board or at port but one fisher also reported selling the seahorses frozen.

Using data on per-vessel seahorse catch as reported in interviews, together with in-site vessel surveys and official data, we estimated the total catch and landings of seahorses per year in Senegal (Table 2). These results suggest that, yearly in 2012-2013, a total of 371,000 individual seahorses were caught, and 184,000 retained, for total landings of around 980 kg (Table 2).

Table 2. Estimated annual seahorse catch and landings in Senegal for 2012-2013. Vessel numbers (artisanal pirogues and industrial bottom trawlers) are from Direction des Pêches Maritimes (2011). Effective vessels (those using gear that could potentially catch seahorses), median catch of seahorses per vessel, and retention rates by region are from in-site surveys and interviews. We assumed 5.3 g mean dry weight per individual seahorse, from our own field observations (Cisneros-Montemayor et al., 2015.). Landings range is from use of estimated effective vessels and official vessel numbers (in brackets). Median catch in Dakar region was zero, so the mean was used.

Province	Vessels	Effective Vessels	Median Catch p.a. (no. seahorses)	Total Catch (no. seahorses)	Retention Rate	Landings (Individuals)	Landings (Kg)
St. Louis	1,009	787	18	14,088	5%	704	4 (5)
Louga	144	112	16	1,752	5%	88	0 (1)
Thies	2,960	2,308	9	21,703	32%	6,888	37 (47)
Dakar	2,921	1,051	16	17,320	<1%	104	1 (2)
Fatick	1,305	913	85	77,648	50%	38,953	206 (295)
Kaolack	107	75	60	4,494	19%	867	5 (7)
Zinguinchor	2,009	2,009	60	120,540	19%	23,247	123 (123)
Artisanal	10,455	7,257	-	257,544	28%	70,851	376 (478)
Industrial	91	91	1,253	114,023	100%	114,023	604 (604)
Total	**10,546**	**7,348**	**-**	**371,567**	**50%**	**184,874**	**980 (1,083)**

It is important to note that some fishers (particularly in southern Senegal) reported taking longer trips south towards Guinea and Guinea-Bissau. These groups of fishers operated aboard larger artisanal pirogues (>20 m length) in which they might travel up to two weeks at a time before returning to land their catch in Senegal.

It is possible that some seahorses might have been caught in these waters, but our data come from smaller pirogues that operated in the coastal waters close to surveyed sites.

Seahorse catch trends

Most Senegalese fishers who reported on the change in size of seahorses over their fishing career (2 to 40 years), reported a decrease in the size of seahorses (*n*=11 of 16) with the rest reporting that seahorse size had stayed the same. All four fishers who commented on changes in the ease of finding seahorses over the duration of their fishing career (16-40 years) reported a decrease in seahorse availability.

Trade structure and routes

The majority of fishers (trade level 1) sold to buyers (level 2) who bought from multiple fishers at a given site, paying between USD 0.70-2.00 per individual seahorse (then equal to about USD 255/kg; range USD 70 to 300/kg) depending on size and colour. These buyers most often reported being contacted by Senegalese secondary buyers (level 3), or occasionally by Asian buyers (level 3-4), who travelled along the coast obtaining seahorses to take to Dakar. Once in Dakar, these level 3 traders reported selling their seahorses (by the kg) mainly to Senegalese exporters (level 4), or occasionally directly to Asian buyers (level 3-4) who would export them.

While there were many fishers in Senegal (official estimate of about 58,000; Direction des Pêches Maritimes, 2011), everybody we interviewed reported a small number of level 2 (2-3 per site) and level 3 buyers (number unknown). According to official records kept by the Senegal CITES Authority, there was only one active export company that had shipped to three importers (in Mainland China, Hong Kong SAR of China, Taiwan Province of China) in one year (2011-2012).

Other trade data sources

CITES Data

All trade reported to CITES as coming from Guinea and Senegal was of dried, wild seahorses for commercial purposes (+99% of reported exports by volume from each Party). The remainder was made up of single reported export of 425 live wild seahorses from Guinea for commercial purposes in 2004, 20 live wild seahorses from Senegal in 2007 for aquarium display, and a total of about 46 dried seahorses from Senegal for scientific purposes in 2004, 2012 and 2013.

Almost all reported exports were of one species, *H. algiricus* – including 98% of reported exports from Guinea and all exports from Senegal, by volume. It is likely, however, that exports included a small percentage of *H. hippocampus*. The remaining exports purportedly from Guinea were not identified to the species level (reported as *Hippocampus* spp.).

Reported exports from Guinea in the CITES database totalled ~1.5 million individuals from 2004-2012, with an annual average of ~188,000 individuals across the nine years (Figure 2). Guinea's seahorses were reportedly imported into Hong Kong (75% by volume) and China (25% by volume). Guinea's reported seahorse exports reportedly peaked in 2005 (at ~435,000 individuals), remained relatively stable from 2006-2009, followed by few to no reported exports from 2010-2016 (Figure 2). About half of Guinean seahorse exports by volume reported in the CITES data in 2004 and 2005 were reported by importing Parties (57 and 48%, respectively), with the other half reported by Guinea; most if not all reported exports form Guinea were reported by importing Parties only in the remaining years.

Reported exports from Senegal in the CITES database totalled ~966,000 individuals, with an annual average of ~74,400 individuals across 2004-2016 (Figure 2). Senegal's seahorses reported sending seahorses to six Parties: Hong Kong (79% by volume), China (18% by volume), Taiwan Province of China (3% by volume), Canada, France and the UK (each <0.1% by volume). Senegal's purported export volumes were steady from 2004-2008, at or above 100,000 individuals per year, declined to very low volumes in 2009 and 2010, and then increased again in 2011 and have remained highly variable over time (Figure 2). About three quarters (72%) of exports from Senegal reported in the CITES data were reported by importing Parties across 2004-2013, with the other quarter of exports by volume reported by Senegal.

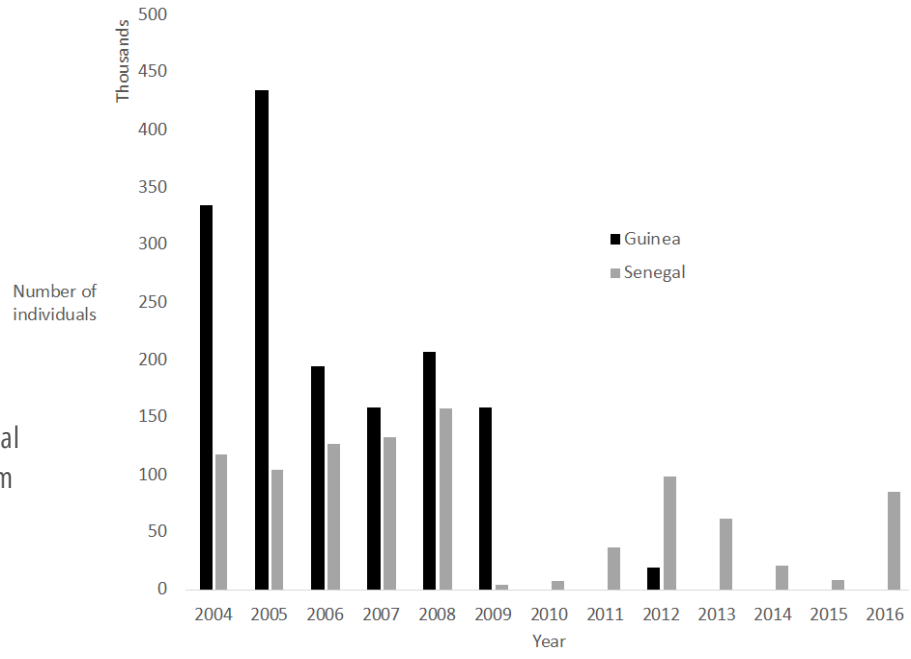

Figure 2. Reported seahorse exports from Guinea and Senegal in the CITES trade database from 2004-2016. The CITES seahorse listing only came into effect in 2004, and so that year may represent partial data.

Hong Kong Customs Data

Hong Kong's CSD data, which are reported only as *Hippocampus* spp., reported trade from Guinea in all years except 2011 and then 2013-2015, and from Senegal in all years except 2011-2015. HK CSD reported mean annual imports from Guinea of ~75,000 seahorses from 1998-2012, and Senegal of ~55,000 seahorses between from 1998-2010. Reported Guinean imports into Hong Kong were low from 1998-2003 (annual mean of ~12,000 individuals), increased substantially in 2004 (the year the CITES listing came into effect) through 2009 (annual mean of ~164,000 individuals), and then decreased to an annual mean of ~19,000 from 2010-2012 (Figure 3). There were no reported imports from Guinea after 2012. Senegalese imports into Hong Kong fluctuated between tens and hundreds of thousands of individuals between 1998 and 2007 (annual mean of ~70,000 individuals), but then decreased to an annual mean of ~5,000 from 2008-2010 (Figure 3). There were no reported imports from Senegal after 2010.

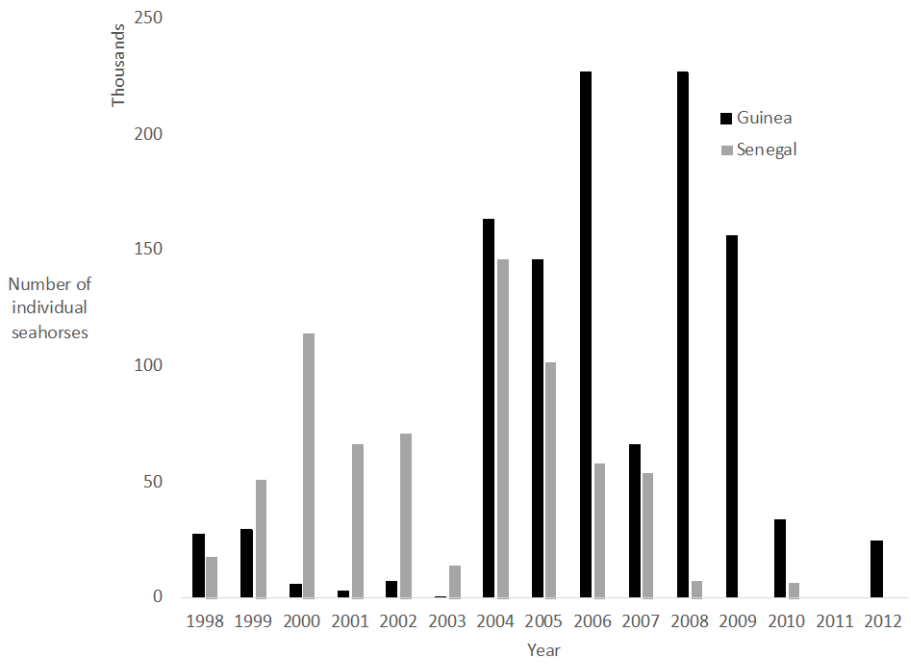

Figure 3. Reported seahorse exports from Guinea and Senegal in the HK CSD trade database from 1998-2012.

There was a fairly decent match between what Hong Kong reported to CITES and what was reported in the HK CSD data about imports to Hong Kong from Guinea from 2004 to 2012, except for 2007 when HK CSD reported volumes were much lower than those Hong Kong reported to CITES, and 2010 when only HK CSD data reported trade with Guinea (Figure 4). Hong Kong reported importing an annual average of ~127,000 seahorses from Guinea in the CITES database from 2004 to 2012, compared with ~116,000 seahorses reported in HK CSD data for the same time period. Almost all exports from Guinea to Hong Kong reported in the CITES database were reported by Hong Kong (+99% by volume). The total reported value of seahorse imports from Guinea into Hong Kong in HK CSD data was 3,842,000 HKD or 494,000 USD, or an annual average of 274,000 HKD or 35,000 USD. This translated into an average of 624 HKD or 80 USD per kg of dried seahorses.

Hong Kong CSD data showed a notable discrepancy between what HK reported to CITES as being imported from Senegal and what was reported in the HK CSD data for all years except 2005, 2006 and 2010 (Figure 4). In 2004, Hong Kong reported smaller volumes of Senegalese imports to CITES than were reported in HK CSD data, whereas the opposite was true in 2007-2009, and in 2011-2012 when only CITES data reported trade between HK and Senegal (Figure 4). Hong Kong reported importing an annual average of ~65,000 seahorses from Senegal in the CITES database from 2004 to 2010, compared with an average of ~53,000 seahorses reported per year in HK CSD data for the same time period. As with Guinea, most (+99% by volume) exports from Senegal to Hong Kong reported in the CITES database were reported by Hong Kong. The total reported value of seahorse imports from Senegal into Hong Kong in the HK CSD data was 3,394,000 HKD or 436,000 USD, or an annual average of 283,000 HKD or 36,000 USD. This translated into an average of 1,209 HKD or 155 USD per kg of dried seahorses.

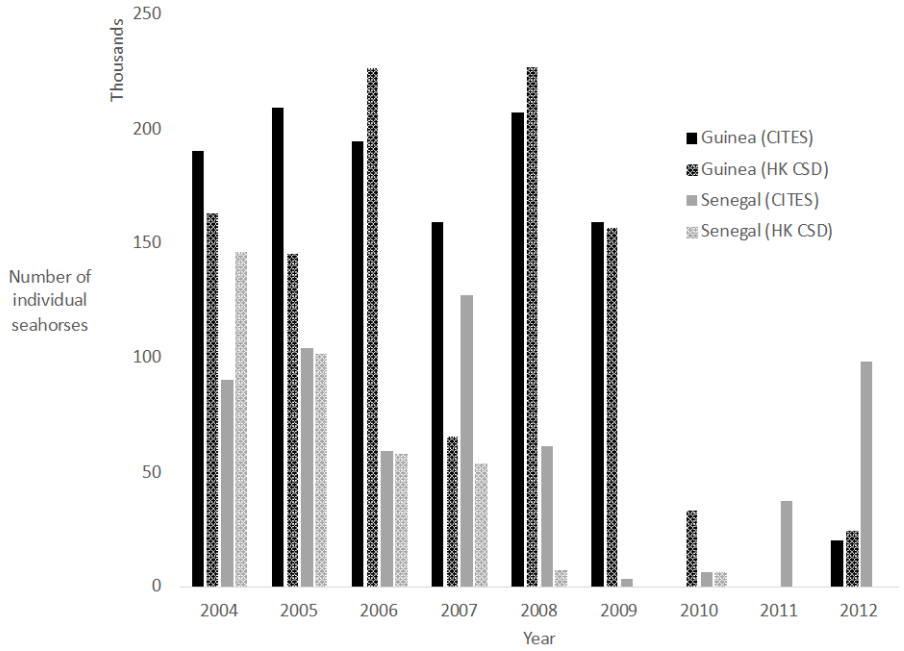

Figure 4. Comparing number of seahorses reportedly imported into Hong Kong from Guinea or Senegal, as reported in the CITES database or HK CSD data.

DISCUSSION

The substantial trade of seahorses in Senegal indicates the global scale of commerce in these fishes, and the difficulty in regulating their exports meaningfully. As supplies of seahorses have dwindled in southeast and southern Asia, traders have reached farther afield, aided by the expansion of China's economic interests. By 2004, they were extracting notable numbers of seahorses from West Africa (Foster et al., 2016), to a level that appeared to be damaging wild populations (Foster, 2016). Most seahorses are obtained as incidental capture, with fishers and traders appearing to earn little from their sale. On the one hand, then, there are few economic drivers to motivate management for sustainable trade. On the other hand, however, effective regulation should be possible without much economic penalty. The failure of CITES Authorities in Senegal and Guinea to respond to formal recommendations from the Convention – thus incurring an export suspension in 2016 – indicates that more must be done to generate political capacity.

Capture of seahorses in West Africa is similar to seahorse capture in many other regions: incidentally obtained in shallow water by non-selective gear, low catches per vessel, a large number of vessels creating high cumulative catches, and low values per

animal caught (Lawson et al., 2017). More of the catch was recorded from regions south of Cap-Vert (Dakar, Senegal), which was shallower than the north (Pelegri et al., 2017; Encyclopedia Britannica, n.d.). Most seahorses in West Africa (if not all) were caught unintentionally, primarily as bycatch in industrial trawlers and by artisanal seine nets, and to a lesser degree by hand collection. Yet, total seahorse landings in Senegal probably amounted to about 371,000 individuals (980 kg/year), with *H. algiricus* by far the most abundant species in the catch, supplemented by very few *H. hippocampus*. Even though each fisher or gear apparently caught relatively few seahorses, the large number of fishers or gears in the region results in a substantial national catch. Data suggest fishers earned at least USD 128,000 from the landed value of seahorses per year, which was not a major component of total landed value in Senegal (USD 646 million in 2010; www.seaaroundus.org), even though it contributed some useful income for fishers that encounter seahorses.

As in so many other countries, accounts from West African fishers suggested we should be concerned about the conservation status of at least some seahorse populations in the region. Fishers and traders in many countries report declines in seahorse numbers (Lawson et al., 2017; Vincent et al., 2022), provoking Red List assessments that some species are threatened (eg. Lim, 2015; Pollom, 2017b). Indeed, in 2016, *H. algiricus* was assessed as Vulnerable due to decreasing population trends (Pollom, 2017a). In Senegal, fishers reported a decrease availability of seahorses, and also in the size of seahorses. In particular, there was a significant increase in reported seahorse catch in regions south compared to the north of Cap-Vert (Dakar, Senegal). These areas were shallower and dominated by rock and algal shelf and habitats associated with the Sine Saloum Delta. The nonselective gear that is the primary source of seahorses is likely to continue exerting pressure on seahorses, probably with growing intensity. Many countries are experiencing a move towards annihilation fishing, where trawlers and other gears no longer even direct their efforts at target species, instead seeking all forms of life indiscriminately (Ray & McCormick-Ray, 2014; Vincent & Harris, 2014). The fisheries operate without biological reference points that might limit their forays and then sell the undifferentiated biomass for animal feed, aquaculture feed, or low-grade surimi products (Karp et al., 2019).

Trade for seahorses in Senegal was also similar to that in many other countries globally, with a very broad base that narrows quickly (Vincent et al., 2011; Kuo et al., 2018). The trade is characterized by large numbers of artisanal fishers (~60,000 in Senegal alone) who sell to a very small number of intermediary traders, who in turn sell to a tiny

number of exporters; in theory they must meet export requirements under CITES. The price fishers were paid for seahorses in Senegal was higher than in other regions, where fishers are typically paid less than US$1 per dried seahorse (Vincent et al., 2011; Vincent, 1996). The value of Senegalese imports reported in Hong Kong Customs data warrants further investigation, as the price per kilogram was lower than reportedly paid to fishers, and much lower than retail prices in Hong Kong. Each dried individual retailed in Hong Kong for roughly US$3–5, or approximately US$1,000–1,600 per kilogram of dried individuals (Vincent et al., 2011; Vincent, 1996). It is also unclear why the value of the seahorses from Senegal in Hong Kong data was twice that reported for seahorse imports from Guinea. Apart from the export trade through Dakar, a small portion of seahorses was sold opportunistically and likely transported out of the country more immediately by Asian buyers or, in very small amounts, by tourists who obtained their seahorses at curio shops.

The fisheries of Senegal contributed to a global catch of about 37 million seahorses in one year, with analysis covering 22 countries and five gear types (Lawson et al., 2017). Moreover, Senegal and Guinea's exports of seahorses were large enough to place these countries in the top six export countries for seahorses from 2004-2011 (Foster et al., 2016). The numbers we deduced as entering trade (catches that were retained) were much higher than those reported to CITES or CSD. Such formal trade and/or Customs data provide valuable lower limits of seahorse catch but should be regarded warily as significant underestimates of true catch or trade: many seahorses are discarded (alive or dead) or are used locally, and never enter trade routes, while many more are certainly traded without documentation or regulation. Official data do, nevertheless, offer an indicator of where conservation action is needed.

Our findings can assist Senegal, in particular, in responding to the current export suspension for *H. algiricus* by moving towards management measures that might allow positive non-detriment findings (Foster & Vincent, 2016). [There are larger issues behind CITES' suspension of seahorse exports from Guinea; indeed, CITES suspended trade in all commercial species from Guinea in 2013; CITES, 2025]. CITES had asked both of these West African countries to explain the basis for allowing existing levels of exports, provide information for protected area planning, monitor seahorse landings, and implement fishing restrictions to help support wild populations (CITES, 2014). However, Senegal and Guinea's failure to reply to CITES Recommendations led to a formally imposed trade suspension in 2016 (Foster, 2016). Such suspensions can remove an income stream from artisanal fishers and traders and makes monitoring more difficult without

necessarily supporting seahorses, particular if illegal exports persist (Vaidyanathan & Vincent, 2021).

Since seahorse trade from Senegal is likely driven more by bycatch than by targeted capture, efforts to develop positive NDFs should focus on regulating take and finding a sustainable level of extraction and trade. Senegal can focus on reducing bycatch, by implementing its own fisheries management laws. For example, Senegal has established inshore exclusion zones (IEZs) to protect small-scale fisheries and marine ecosystems from the negative impacts of industrial fishing, particularly bottom trawling (EJF, 2023; TBT, 2025). However, ensuring compliance with IEZ regulations remains a challenge (EJF, 2023). Seahorse conservation and management would also be supported by establishing carefully managed protected areas. Zones with spatial and temporal bans on trawling may be particularly valuable, for seahorses (Vincent et al., 2022) but also for reducing conflict with fisheries based on selective / passive gear and for avoiding habitat damage and other damaging bycatch (EJF, 2023; TBT, 2025). All actions need to be accompanied by monitoring and evaluation of landings (catch per unit effort), allowing an index of population numbers and trends (Vincent et al., 2022). Systematic monitoring of landings will present an opportunity to understand how management measures are serving seahorses and what other efforts might be needed to ensure conservation of wild populations across species.

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