(*English only / en inglés únicamente / Seulement en anglais*)

CONVENTION ON INTERNATIONAL TRADE IN ENDANGERED SPECIES
OF WILD FAUNA AND FLORA

Nineteenth meeting of the Conference of the Parties
Panama City (Panama), 14 – 25 November 2022

TRACKING SEAHORSE (*HIPPOCAMPUS* SPP.) ILLEGAL WILDLIFE TRADE THROUGH SEIZURES REPORTED ONLINE

1. This document has been submitted by the United States of America on behalf of the IUCN, in relation to agenda item 69 on Seahorses (*Hippocampus* spp.).[1]

2. CoP19 Doc. 69.2 "NEXT STEPS TOWARD SUCCESSFUL IMPLEMENTATION OF APPENDIX-II LISTING OF SEAHORSES" submitted by the Maldives, Monaco, Nigeria, Peru, Senegal, Sri Lanka, Togo, the United Kingdom of Great Britain and Northern Ireland and the United States of America, proposes a set of draft Decisions to improve the conservation prospects for seahorses.

3. Draft Decision 19.AA, in CoP19 Doc. 69.2, directs the Secretariat to a) "…collaborate with Parties and species experts to prepare a report on the global illegal trade in seahorses, for consideration by the Standing Committee…" and b) "report on implementation of paragraph a) of the current Decision 19.AA to the Standing Committee at its 77th and 78th meeting."

4. Project Seahorse, which hosts the IUCN SSC Seahorse, Pipefish & Seadragon Specialist Group (SPS SG), has been collaborating with Oceans Asia on a study to document the illegal trade in seahorses through online reports of seizures. Data from Google searches were augmented by data already held by Project Seahorse, Oceans Asia and TRAFFIC.

5. We here present a first draft of the rationale, methods and results of this study in support of draft Decision 19.AA in CoP19 Doc. 69.2. **Our intent is to indicate the feasibility of this draft Decision by highlighting that relevant studies are already underway**. The study will be submitted for peer review once the results have been expanded and the discussion and recommendations section has been drafted. The authors welcome input or comments on the study thus far.

The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the CITES Secretariat (or the United Nations Environment Programme) concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries. The responsibility for the contents of the document rests exclusively with its author.

Tracking seahorse (*Hippocampus* spp.) illegal wildlife trade through seizures reported online

Sarah J. Foster,[1,2] Sydney Ascione,[1] Francesca Santaniello[3] and Teale Phelps Bondaroff[3]
[1]Project Seahorse, The University of British Columbia (projectseahorse.org)
[2] IUCN SSC Seahorse, Pipefish and Seadragon Specialist Group (iucn-seahorse.org)
[3]Oceans Asia (oceansasia.org)

Contact: s.foster@oceans.ubc.ca

Introduction and rationale:

Developing an understanding of the scope and scale of the illegal trade in fishes is challenged by the ongoing perception that fish are not wildlife (Vincent et al., 2014), and a consequent lack of formal record keeping and analyses of their illegal trade. For example, of the 14 taxon specific case studies included in the 2016 UNODC World Wildlife Crime Report, the only fish related topics were sturgeon caviar and glass eels, neither of which is fully marine (UNODC, 2016). European glass eels were again the only fish related case study in the 2020 report, which explored the illegal wildlife trade for seven taxon groups (UNODC, 2020). These reports are based on the World WISE database, which itself is "rooted in data submitted by the Parties to the Convention on International Trade in Endangered Species of Wild Fauna and Flora, known as CITES" (UNODC, 2016). In 2016, just 6% of World WISE records involved bony fish (the 2020 report did not include this breakdown). This suggests potential underreporting of fish in the annual illegal trade reports that Parties are required to submit to CITES. But fish are wildlife too – and as such illegal wildlife trade (IWT) includes fish.

In lieu of formal record keeping and transparency, we need to turn to alternative data sources to understand and raise awareness of the illegal international trade in fishes. Online records of wildlife seizures are an important source of information where formal records are lacking or inaccessible. Seizures of wildlife specimens typically take place when there are reasonable grounds to suspect that the specimens are being traded or used in a manner than contravenes national laws. For CITES listed species, this usually means the specimens were being traded internationally without valid export and/or import permits. CITES Parties can also enact stricter domestic legislation than the CITES framework requires, such that even exploitation and/or domestic trade is restricted for some CITES listed species. In such cases, wildlife specimens may be seized by Authorities without the need for international trade. Analysis of seizure data is frequently used to understand the dynamics of illegal wildlife trade, but care is needed to ensure data are interpreted properly (Challender et al., 2022). Wildlife seizures are the result of actions by law enforcement Authorities – whether targeted or opportunistic – and as such, patterns in seizures data may reflect varying levels of enforcement efforts and/or reporting instead of patterns in illegal trade (Underwood et al., 2013). It is therefore important to regard seizures data objectively, as one source of information on illegal trade. Nonetheless, experts agree seizure data can be used to: (i) estimate the minimum number of individual animals or plants in illegal trade, (ii) estimate minimum volumes over a defined period, and (iii) characterize spatial trafficking patterns (e.g., countries of origin, export, transit, and destination) based on reported seizures (Challender et al., 2022).

Analyses of online seizure records are available for a variety of terrestrial taxa, for example pangolin in China (Cheng et al., 2017), birds in Indonesia (Indraswari et al., 2020), White-rumped Shama (a

bird) in South-East Asia (Leupen et al., 2018), tigers from 13 range States (Stoner et al., 2016), tortoises and freshwater turtles from India (Mendiratta et al., 2017), and Siamese rosewood in Thailand (Siriwat & Nijman, 2018). In contrast, there are no such analyses for marine fishes and comparatively few even for marine species. The marine taxa we encountered included marine turtle products in China and Japan (Lam et al., 2011), marine mollusc shells in and from Indonesia (Nijman et al., 2015), and sea cucumbers in India, Sri Lanka and Mexico (Bondaroff et al., 2022; Bondaroff, 2021). This taxonomic bias is supported by the findings from a web crawling surveillance system developed to monitor reports on illegally traded wildlife (Sonricker Hansen et al., 2012). The system primarily found data for terrestrial wildlife, including elephants, rhinoceros, tigers, leopards and pangolins. They attributed this bias in part to a preference for "newsworthy" stories, such as those concerning particularly large seizures or that focus on charismatic megafauna.

Seahorses (*Hippocampus* spp.) provide an important case study for illegal wildlife trade in fishes as a set of charismatic marine species with a vast illegal trade that is poorly documented and largely unaddressed. They are among the most threatened marine species, partly as a consequence of international trade, with more than 30 species traded among more than 80 countries (Foster et al., 2016). The vast majority of seahorses in trade are sourced from the wild then dried to supply demands for traditional Chinese medicine (TCM; Vincent et al., 2011; Vincent, 1996). Much smaller numbers of seahorses are sourced from the wild or tank-reared then traded live for aquarium display (Foster et al., 2022; Vincent et al., 2011). Approximately 98% of the 5.7 million individual seahorses reported in the CITES trade database from 2004 to 2011 consisted of dried specimens, with 93% reportedly imported by China, including Hong Kong SAR and Taiwan, Province of China (Foster et al., 2016).

International trade patterns for both live and dried seahorses have shifted since their listing on CITES Appendix II in 2004, and particularly since their first inclusion in the CITES Review of Significant Trade in 2009 (RST, a CITES compliance process; Foster et al., 2022; Foster & Vincent, 2021). For the live trade, reported volumes have decreased over time and declared sourcing has shifted from wild capture to captive breeding (Foster et al., 2022; Koning & Hoeksema, 2021). On the other hand, the dried trade has become increasingly illegal in nature, now essentially occurring outside CITES processes, and is therefore not reflected in CITES data (Foster et al., 2019; Foster & Vincent, 2021). Most jurisdictions that historically exported large numbers of seahorses now report having suspended exports for this taxon, yet high levels of illegal dried trade persist (Foster et al., 2019; Foster & Vincent, 2021; Governments of Maldives, Monaco, Sri Lanka, and the United States of America, 2018). As one key example, a survey carried out in Hong Kong SAR in 2016-17 revealed that 95% of imports by volume had come from countries with trade suspensions (Foster et al., 2019). However, a survey of historically important exporting countries for dried seahorses in Asia revealed deficiencies in formal record keeping of any seahorse seizures (Foster & Vincent, 2022). Seizures were either not recorded or, when recorded, respondents noted challenges in passing seizure data from local/regional enforcement bodies up to national CITES Authorities, as well as a lack of onward reporting in the Parties' CITES annual illegal trade reports. There is an urgent need to raise awareness of and address such smuggling.

The purpose of this study is to contribute information on the illegal wildlife trade in seahorses, using online reports of seizures in lieu of formal tracking. More specifically, we wanted to understand the scale and scope of any illegal trade in seahorses (e.g. trade routes, volumes, values, use), the nature

of the seizures (who was involved and what happened). Our intention is to suggest ways forward for improving the legality of the international trade. In so doing, we hope to provoke more analyses and improved record keeping for trade in marine fishes and, indeed, other marine species.

Methods

FINDING RELEVANT ARTICLES

We undertook eight approaches to finding relevant online postings about seahorse seizures (summarized below). The initial searches (approaches 1-3) were done in English, which is the most used language in global business, communications and global media (Bhutada, 2021; Neeley, 2012). We then wanted to see what further information could be obtained by searching in Simplified and Traditional Chinese (approaches 4-7), because the main destination market for dried seahorses, comprising 98% of global reported imports – is China (including Hong Kong SAR and Taiwan, Province of China; Foster et al., 2016). The postings from these searches were supplemented with existing information held by Project Seahorse, Oceans Asia and TRAFFIC (approach 8).

All searches were carried out in Google Chrome, using the Google advanced search option (https://www.google.ca/advanced_search) and Google News (news.google.com). The Chinese articles were automatically translated by Google Chrome. We set the study as encompassing seizures that were known or inferred to occur from 1 January 2010 – 29 April 2021.

We employed a minimum information approach when deciding whether to include a posting in our dataset. To be retained a posting needed to include information on:

- the location where the seizure occurred;
- the year the seizure occurred; and
- the volume, *or*
- the source or destination location of the seized seahorses.

We applied two rules with respect to the year of seizure. First, we used the year of the posting as the year of the seizure in cases where a posting failed to specify the date of the seizure but indicated it happened "recently". Second, we included a posting in our dataset but indicated the year as “ND” (no date) when a vague timing reference (e.g., "a couple years ago", “last year”) suggested the seizure took place within the timeframe of this study.

We sometimes encountered more than one online posting about the same seizure event. In most cases the information was complimentary, with one posting providing information that another did not. In such cases we retained the information from both postings in our database. However, in some cases the information was conflicting; most often this was in the form of differences in reported volumes. We applied the following rules, based on our expert understanding of the international trade in seahorses, to determine which information we retained in our database:

- Information from government sources was used over news articles or NGO reports.
- More precise numbers were used over numbers that appeared to be rounded/estimates.
- More probable values were used based off of correlated numbers (e.g. determining the number of seahorses based on price/weight), or pictures of the seizure.

The following eight approaches were used to finding relevant online postings covering the time period 1 January 2010 to 29 April 2021. All pages of all search results were reviewed for relevant content. A detailed explanation of each approach, including all relevant search settings, can be found as supplemental material.

Google searches

English

1. **We used the Google advanced search option and a suite of search terms to search for relevant news items.** Using the advanced search option, we searched for the following terms: *All these words:* seahorses; *Any of these words:* seize OR seized OR seizure OR trafficked OR trafficking OR traffickers OR smuggle OR smuggled OR smuggling OR smugglers OR crime OR criminal OR confiscate OR confiscated OR arrested OR arrest OR illegal. Then, from the results page, we chose "News" to narrow the search results to news items. We retained 32 seizures from this search for our database (Table 1).

2. **We used the Google advanced search option and a suite of search terms – but did not narrow to news.** We used the same search terms as per 1, but retained the default setting "All" instead of narrowing by "News". This search, carried out on 18 April 2021, resulted in the addition of 1 relevant seizure that was not discovered using search approach 1 (Table 1).

3. **We used the Google advanced search option and pairs of search terms to search for relevant news items**. Using the advanced search option we searched "seahorses" paired with one of the additional search terms listed in approach 1. This approach, carried out on 22 April 2021, resulted in the addition of 3 relevant seizures that were not discovered using search approaches 1 and 2 (Table 1).

Chinese

4. **Simplified Chinese (mainland China): We used the Google advanced search option and pairs of search terms to search for relevant news items.** Using the advanced search option, we searched for 海马 (hǎimǎ / seahorse(s)) combined with each of the following terms: 查获 (cháhuò / seized); 截获 (jiéhuò / intercepted/seizure); 运输 (yùnshū / transported); 商贩 (shāngfàn / vendor); 走私 (zǒusī / smuggling); 犯罪 (fànzuì / crime); 罪犯 (zuìfàn / criminal); 没收 (mòshōu / confiscation); 查没 (chá mò / found); 逮捕 (dàibǔ / arrested); 抓捕 (zhuā bǔ / catch); 非法 (fēifǎ / illegal). We consulted several colleagues fluent in Simplified Chinese, and with extensive experience in wildlife trade, to determine the search terms we should use. They derived the terms from the English language list used for approach 1, above. From the results page, we chose "News" to narrow the search results to news/media postings. This search, carried out on 27 April 2021, resulted in the addition of 16 relevant seizures that were not uncovered using the English language search (Table 1).

5. **We used the Google advanced search option and pairs of search terms in Simplified Chinese, but this time we did not narrow to news items.** We used the same search terms as per 4, but did not narrow by "News". This search, carried out on 28 April 2021, resulted in the addition of 33 relevant seizures that were not uncovered using approaches 1-4 (Table 1).

6. **Traditional Chinese (Hong Kong SAR, Macao SAR and and Taiwan, Province of China): We used the Google advanced search option and pairs of search terms to search for relevant news items.** Using the advanced search option, we searched for 海馬 (hǎimǎ / seahorse(s)) combined with each of the following terms: 查獲 (cháhuò / seized); 截獲 (jiéhuò / intercepted/seizure); 運輸 (yùnshū / transported); 商販 (shāngfàn / vendor); 走私 (zǒusī / smuggling); 犯罪 (fànzuì / crime); 罪犯 (zuìfàn / criminal); 沒收 (mòshōu / confiscation); 查沒 (chá mò / found); 逮捕 (dàibǔ / arrested); 抓捕 (zhuā bǔ / catch); 非法 (fēifǎ / illegal). We consulted a colleague fluent in Traditional Chinese to determine the search terms we should use. They derived the terms from the Simplified Chinese language list used for approach 4, above. The Traditional Chinese terms were also cross checked using multiple online translation resources. From the results page, we chose "News" to narrow the search results to news postings. This search, carried out on 27 June 2022, resulted in the addition of 2 relevant seizures that were not uncovered using approaches 1-5 (Table 1).

7. **We used the Google advanced search option and pairs of search terms – but this time we did not narrow to news postings.** We used the same search terms as per 6, but did not narrow by "News". This search, carried out on 28 June 2022, resulted in the addition of 3 relevant seizures that were not uncovered using approaches 1-6 (Table 1).

<u>Existing data</u>

8. **Project Seahorse, Oceans Asia and TRAFFIC had existing datasets on seahorse seizures which we incorporated into our findings** in order to ensure the most comprehensive information possible. We embraced any online postings found in these three databases that had not been uncovered using approaches 1-7, above, as long as they fell within the dates 1 Jan 2010 – 29 April 2021.
   8.1. **Project Seahorse dataset** – this dataset had been compiled haphazardly over about 5 years (from 2018-2022) from a variety of sources including Google news alerts, social media posts, emails sent to us from concerned individuals, etc. The Project Seahorse dataset had 60 relevant seizures that were not uncovered using approaches 1-7 (Table 1).
   8.2. **Oceans Asia dataset** – this exploratory dataset was compiled in January 2020 by searching for "seahorse smuggling" in Google images, in each of Arabic (تهريب فرس البحر), Simplified Chinese (海马走私), English, Italian (contrabbando di cavallucci marini) and Spanish (contrabando de caballitos de mar; translations were carried out in Google Translate). The researcher examined the information associated with any images that were of dried seahorses or related to a seahorse seizure. The Oceans Asia dataset contained 36 relevant seizures that were not uncovered using approaches 1-7 and that were also not in the Project Seahorse dataset (approach 8.1; Table 1).
   8.3. **TRAFFIC dataset** – TRAFFIC maintains the Wildlife Trade Portal (www.wildlifetradeportal.org), "the most comprehensive open-access repository of wildlife seizure data." TRAFFIC sent Project Seahorse a subset of the data containing all seizures involving the seahorse taxonomic family Syngnathidae as of 19 April 2022. The dataset contained 307 records covering the years 2003 through 2022. The data were filtered by sorting out: (i) incidents that fell outside the study dates of the dates 1 Jan 2010 – 29 April 2021; (ii) all pipefish seizures; (iii) records for which there was no publicly accessible link; and (iv) any records we already had in our database. This resulted in 107 new relevant seizures not uncovered using approaches 1 - 8.2 (Table 1).

EXTRACTING INFORMATION

Each posting was reviewed and relevant information was extracted into an Excel database with three broad topic areas: 1) shipment details, 2) trade routes and 3) seizure details (Table 2).

Reported weight of seized seahorse shipments were converted into number of animals using the commonly-applied conversion of 2.69 grams per dried seahorse (Foster et al., 2016).

Reported values were first converted to nominal USD according to the date of posting using xe.com/currencytables. The nominal USD prices were then converted to 2021 real USD prices according to the year of posting and the annual average CPIs retrieved from https://data.bls.gov/timeseries/CUUR0000SA0 (2021 real USD = (nominal USD/ nominal year CPI) * 2021 CPI). This calculation adjusts for inflation and thus the result is real USD, using 2021 as a base year.

Geographic disclaimer: We use the term 'jurisdiction' to refer to CITES Parties and regions. The geographical designations employed in this document do not imply the expression of any opinion whatsoever on the part of the authors concerning the legal status of any country, territory, or area, or concerning the delimitation of its frontiers or boundaries.
We separate China, Hong Kong SAR and Macao SAR in our analysis of jurisdictions. Hong Kong SAR and Macao SAR of China have their own implementing CITES Authorities that are designated by China (CITES, 2022). China, as a Party to CITES, has not designated a separate Management Authority in its Taiwan Province.

Results

Our final dataset contained 293 unique seahorse seizures, which were first encountered in one of nine languages: English (n = 178), Chinese (Simplified n = 66; Traditional n = 4); Arabic (n = 18); Spanish (n = 16); Bahasa Indonesian (n = 4); Italian (n = 3); French (n = 2); Portuguese (n = 1); and Vietnamese (n = 1).

Outlets reporting seizures

Information came from 194 unique online outlets. The number of unique seizures reported by an outlet ranged from 1 to 68, with a mean $\pm$ sd of 2 $\pm$ 7 seizures per outlet and median of one seizure per outlet. Most online outlets only produced one or two relevant seizures (n = 147 and 27 outlets, respectively).

The outlets were produced by one of three stakeholder groups – news/media, NGOs, and government/law enforcement. News outlets provided the largest number of seizures for our database – reporting on 249 unique seizures over the time frame of this study. This was followed by NGOs, which reported on 116 seizures, and government/law enforcement which reported 102 seizures.

The specific outlets that produced the most information in our database were "On the Trail" (a report on animal poaching and smuggling produced by the French NGO Robin des Bois, https://robindesbois.org/en/a-la-trace-bulletin-dinformation-et-danalyses-sur-le-braconnage-et-la-

contrebande/), TRAFFIC (an international NGO specializing in global wildlife trade, www.traffic.org), the government of Belgium (through its CITES biennial reports), and the government of China (through its General Administration of Customs) (n = 68, 43, 38 and 25 seizures, respectively).

Number of seizures by year

Information on year of seizure was available for all but one seizure in our dataset (n = 292). As the end date of our study period was 29 April 2021, data for 2021 are incomplete and excluded from any temporal analysis (total n from 2010-2020 = 279).

Overall, our dataset contained a mean $\pm$ sd of 25 $\pm$ 11, and median (range) of 25 (7-44), seizures taking place each year across 2010-2020. The number of seizures increased over time (Figure 1). The fewest seizures were found for the first two years of our study (2010 and 2011; mean $\pm$ sd = 10 $\pm$ 4 seizures per year), and the most seizures were recorded for the last three full years (2018-2020; mean $\pm$ sd = 38 $\pm$ 5 seizures per year). The number of seizures across the remaining years (2012-2017) was relatively constant (mean $\pm$ sd = 24 $\pm$ 3, median (range) = 25 (21-28) seizures per year).

Information obtained

Extracted information on each seizure fell into three broad topic areas: 1) shipment details, 2) trade routes and 3) seizure details (Table 2). Some information was available for >80% of documented seizures: the form of seahorses in trade (e.g. live, dead-dried, dead-wet, dead-unspecified, prepared medicine); specific information on the location of seizure (e.g. city, airport name, etc.); the method of shipment/place of seizure (e.g. airport, seaport, retail venue etc.); and the seizing body (e.g. customs, police, etc.). In contrast, other information was available for only <10% of documented seizures: species name (common name or Latin name); the declared use of the seahorses that were seized (though many media outlets speculated their use to be for traditional Chinese medicine - TCM); and whether any legal action was taken/sections imposed as a consequence of the seizure. All other types of information were available for between 11 and 73% of documented seizures.

Trade form and use

Only three seizures were reported to be of live seahorses and the rest were reportedly of dead animals. The three seizures of live seahorses were reportedly destined for a "fish market", for aquarium display (inferred as the destination country was the United Kingdom – a key consumer market for live seahorses) or seized from a fishing boat. Of the dead seahorse seizures, 61% were specified to be of dried whole seahorses (n = 176/290) and a further 2% were reported as "wet" whole animals (6/290). Seahorses were also reportedly seized in the form of prepared medicines (e.g. pills or packets, n = 12/293). The exact form was not specified for 33% (n = 96/290) of the dead seizures.

Available information suggested that seized seahorses were destined for human consumption, either as a medicine or tonic food. Only 12 seizures declared a use for the seahorses; these included personal consumption (n = 3); decoration (n = 2); and cooking, food, infusions, wine, medicine, souvenir and "Viagra" (n = 1 each).

Species in trade

Information on species Latin or common name was available for just 17 seizures (n = 11 and 6, respectively; Table 3). We used our expert understanding to infer Latin names from common names,

where reported. Overall, we inferred that 14 species were reported across the dataset. The most frequently reported were *H. spinossissimus* and *H. ingens* (n = 4 seizures each), followed by *H. guttulatus* and *H. trimaculatus* (n = 2 seizures each).

Geographic aspects of seizures

Overall, 62 jurisdictions were implicated in the illegal trade of seahorses – as a location of a seizure, and/or a reported source, transit or destination jurisdiction: 17 in the African region, 19 in the Asian region, 14 in Europe, 10 in Central and South America and the Caribbean, and two in North America.

Location of seizures

Seizures reportedly took place in 39 jurisdictions – 5 in Africa, 11 in Asia, 13 in Europe, 8 in Central and South America and the Caribbean and 2 in North America. The mean $\pm$ sd number of unique seizures intercepted per jurisdiction was 8 $\pm$ 15, and the median (range) was 2 (1-86).

Asia was the most commonly reported location of seizures – accounting for just over half of total seizures in our database (n = 154; Figure 2). This was followed by Europe (n = 80), Africa (n = 24), North America (n = 18) and Central and South America and the Caribbean (n = 17) (Figure 2).

Within Asia, China, including Hong Kong SAR, was the reported location of 70% of seizures (n = 106/154), and just over one-third of all seizures (n = 106/293; Table 4). India was another notable location of seizures within Asia, accounting for 14% of seizures within Asia and 7% overall (n = 21/154 and 293, respectively).

Belgium dominated as a location of documented seizures in the European region, accounting for 56% of seizures (n = 45/80) within the region and 15% overall (n = 45/293; Table 4).

Within Africa, Egypt dominated as a location of documented seizures, accounting for three-quarters of seizures within the region (n = 18/24) and 6% overall (n = 18/293; Table 4).

Mexico was the location of the most seizures within North America; it was the location of two-thirds of seizures with the region and 4% of all seizures in our database (n = 12/293; Table 4).

Within Central and South America and the Caribbean, Peru dominated as a location of documented seizures, accounting for 40% of seizures within the region (n = 7/17) and 4% overall (n = 7/293; Table 4).

Other locations of note (n > 2 seizure events, which was the calculated median number per jurisdiction) were: Indonesia, the Philippines and Viet Nam in Asia; and France, Germany, Italy, Netherlands, Spain and the United Kingdom (UK) in Europe (Table 4).

Seahorses were reportedly intercepted most often in locations of transit, followed by destination and source. More than three-quarters of seizures (79%), for which we had information on both transit and seizure locations, reported the seahorses were intercepted in transit (n = 62/78 seizures), of which 38 involved Belgium as the transit location. More than half of seizures, for which we had information on both destination and seizure locations, reported the seahorses were intercepted at the destination (n

= 125/215 seizures), 70 of which involved China, including Hong Kong SAR. And finally, one-third of seizures, for which we had information on both source and seizure locations, reported the seahorses were intercepted at the source (n = 60/184 seizures).

Declared and inferred sources

Thirty-six (36) jurisdictions were the reported source of seized seahorses in our dataset – 17 in Africa, 12 in Asia, 1 in Europe, 4 in Central and South America and the Caribbean and 2 in North America. The mean number of seizures (± sd) reportedly sourced in a single jurisdiction was 5 ± 7, and the median (range) was 2 (1-31).

Africa and Asia were together reported as the source of 83% of recorded seizures for which a source was reported (Africa n = 80/184; Asia n = 74/184), followed by Central and South America and the Caribbean (n = 22), North America (n = 6) and Europe (n = 2; Figure 2).

Guinea and Egypt were the reported source of 65% of African seizures for which a source was reported (39 and 26%, n = 31 and 21/80, respectively; Table 4), and over one-quarter (28%) of seizures overall (n = 52/184).

China, India and Indonesia were the reported source of over half (57%; n = 42/74) of Asian seizures for which a source was reported (20, 20 and 16%, n = 15, 15 and 12/184; respectively; Table 4), and one-quarter (23%) overall.

Although the Central and South America and the Caribbean region was only reported as a source of seized seahorses in 12% of all seizures for which a source was reported, Peru accounted for 86% of seizures reportedly to be source in the region (n = 19/22; Table 4) and 10% of seizures overall (n = 19/184).

Other reported source jurisdictions of note (n > 2 seizures, which was the median number per jurisdiction) included: Africa – Madagascar, Mozambique, Senegal and Sierra Leone; Asia – Hong Kong SAR, the Philippines, Thailand and Viet Nam; Europe – none; and North America – Mexico (Table 4).

Transit

Information on transit locations (jurisdictions through which trade passes en route from the source and destination locations) was reported for only one-quarter of seizures in our database, so the data was patchy at best (Table 2). That being said, 24 jurisdictions were the reported locations of transit for seized seahorse shipments in our dataset: 3 in Africa, 12 in Asia, 6 in Europe, 2 in Central and South America and the Caribbean and 1 in North America. The mean number of seizures (± sd) that reportedly transited in a single jurisdiction was 6 ± 7, and the median (range) was 1 (1-38).

Europe was reported as the location of transit in about two-thirds (n = 50/78) of seizures that reported a transit location, followed by Asia (n = 18), Central and South America and the Caribbean (n = 5), Africa (n = 3) and North America (n = 2; Figure 2).

The location reported as the transit jurisdiction most often was Belgium (Table 4) – the jurisdiction accounted for 76% of seizures for which a transit location was reported in Europe (n = 38/50), and about half of all seizures for which a transit location was declared (n = 38/78).

Other locations of note (n > 2 seizures, which was the median number per jurisdiction) included: Asia – Hong Kong SAR, India; Europe – France, Netherlands; and Central and South America and the Caribbean – Bolivia (Table 4).

Declared and inferred destinations

Thirty-four (34) jurisdictions were the reported destination of seized seahorses in our dataset: 2 in Africa, 15 in Asia, 10 in Europe and 5 in Central and South America and the Caribbean and 2 in North America. The mean number of seizures ($\pm$ sd) that were reportedly destined to a single jurisdiction was 6 ± 21, and the median (range) was 2 (1-122).

Asia was the reported destination of seized seahorses for the vast majority the seizures for which a destination was reported (n = 174/215 seizures), followed by Europe (n = 25), North America (n = 8), Central and South America and the Caribbean (n = 6) and Africa (n = 2; Figure 2).

The jurisdiction reported as the destination the greatest number of times was China – it accounted for 70% of seizures with a destination location reported in Asia (n = 122/174) and over half of all seizures for which a destination was declared (n =122/215; Table 4). Next was Hong Kong SAR, which accounted for 10% of seizures for which a destination location was reported in Asia (n = 17/174) and 14% of all seizures for which a destination was declared (n =17/215; Table 4).

Other locations of note (n > 2 seizures, which was the median number per jurisdiction) included: Asia – India, the Philippines, Thailand, United Arab Emirates and Viet Nam; Europe – Belgium, Italy, Spain and the UK; North America – Mexico and the US (Table 4).

Seizure settings

Seizures were reported to take place at diverse settings such as airports, seaports, properties (retail venues, warehouses, homes), fishing vessels, vehicles of some kind, and in the mail (Table 5). Airports were the most reported setting – as the location for 122 seizures (of which 2 were in conjunction with other settings). The remaining 171 seizures were evenly spread among the other settings.

Most seizures were reportedly associated with passenger baggage, which accounted for over one third of all seizures (n = 109/293). This was particularly true of airports – passenger luggage accounting for 70% of seizures that involved an airport (n = 86/122). Cargo and passenger baggage on boats or ferries also dominated seizures involving seaports (n = 18 and 12/37, respectively).

For seizures involving properties, about half happened at points of retail (markets/shops, n = 20/37). There were no patterns of note for seizures that involved other settings.

Associated products

Information on other products that were seized alongside seahorses was available for just over one-quarter of seizures (n = 83/293; Table 6). Most seahorses were reportedly seized along with other wildlife products (n = 74), but some were found with non-wildlife items (e.g. electronics, wine, clothes, food, cosmetic, money, pharmaceuticals; n = 15).

Of the associated wildlife products, other marine wildlife was reportedly found with the seahorses in 42 seizures, followed by terrestrial wildlife in 39 seizures. Among marine wildlife, the most commonly reported products seized alongside seahorses were sea cucumbers, shark fins, other syngnathids (pipefish) and fish swim bladders (totoaba and unspecified; Table 6). Among terrestrial wildlife, ivory was the most frequently reported commodity seized alongside seahorses, only one of which specified the ivory to be from an elephant (Table 6). Ivory was followed closely by pangolin products. Tortoise/turtle and crocodile products also ranked high – but it is unknown whether these were of marine or terrestrial origin (Table 6).

Volumes of seized seahorses

Information on volumes of seized seahorses was available for 257 seizures; weight was reported for 138 seizures and number of individuals for 171 seizures – among these were 52 seizures for which both weight and number were reported. For comparability, we standardized all postings into number of seahorses seized (see methods), then rounded to nearest 1000. We excluded 12 seizures of medicinal products as the amounts of seahorse contained in each product were not reported.

For seizures with information on both number and weight, the number reported was greater than the number we calculated from standard conversions for 25 seizures, and smaller for 27 seizures. Two seizures had a very large discrepancy between reported number of individuals and that calculated from weight. Online postings related to one seizure reported volumes of 12.3 million individuals and 1043 kg, which converted to ~390,000 individuals. Online postings related to a separate seizure reported volumes of 8 million individuals and 648 kg, which converted to ~240,000 individuals. We employed a conservative approach and used the lower number of individuals we calculated from reported weight instead of the number of individuals reported for these two seizures.

The mean volume of seahorses per seizure was higher when we used the converted number of individuals from weight instead of the reported number of individuals where both were reported – but the median values were the same (Table 7). The mean volumes were as much as 20 times the median, reflecting the patchy data.

Values of seized seahorses

Information on the value of seized seahorses was reported for only 33 seizures in our database, of which a range of values was reported for six seizures, whereas only one estimate was found for the other 27.

We calculated the minimum and maximum value estimates in 2021 real USD. Where only one value was reported it was used as both the minimum and maximum value for that seizure. The largest reported value across all seizures was 12 million Chinese Yuan which converted into 18.2 million USD. We calculated the values with and without this record (Table 6). It is notable that while there is a large discrepancy between mean and median values (as with volumes), the median per seizure value was estimate to be between 85,000 and 96,000 USD (Table 6). The mean values were reported to be almost 15 times higher than the median with the outlier value, and almost 10 times higher without it.

As seizures varied in size, it is meaningful to consider the value of a single dried seahorses. We did this calculation using the minimum reported values for the six seizures with a range. The mean values per seahorses were similar whether we used the number of individuals calculated from weight or the

reported number of individuals where both were found for a single seizure (Table 6). The median values were the same between these two datasets, and were about 4 times lower than the median values (Table 7).

People involved

Seizing agency: Information on the seizing agency was available for 253 seizures in our database. Among them, 67% reported Customs (n = 170), 12% reported Police (n = 30), 11% reported the presence of more than one enforcement body (n = 28), and 2% reported the marines (n = 5).

***Number of people implicated in offense*:** Most seizures reportedly involved very few offenders. Information on the number of people implicated in the seizure was available for just over half of the seizures in our database (n = 151). The mean (± sd) number of people per seizure was calculated to be 3 ± 9, and the median (range) as 1 (1 to 100). Indeed, only one person was implicated in over half the seizures in our database (57%, n = 86), whereas 2-4 people were implicated in another one-third of seizures (n = 49).

Consequences

Information regarding enforcement action taken at the time of the seizure was available for almost one-third (31%) of seizures (Table 2). The most common action at the time of seizure was detention (arrest) of people involved – this was reported to happen in 88% of such records (n = 80/91).

Very little information was available on legal action resulting from the seizures – this was reported for just 6% of seizures in our database (Table 2). In seven cases the perpetrators were issued fines. Also in seven cases offenders were jailed. Other legal actions reportedly taken included probation (n = 3), community service (n = 1) and the requirement to attend environmental presentations and workshop (n = 1). Offenders were reportedly released without punishment in two cases.

References

Bhutada, G. (2021). *Visualizing the Most Used Languages on the Internet*. Visual Capitalist & Business Insider. https://markets.businessinsider.com/news/stocks/the-most-used-languages-on-the-internet-1030251593

Bondaroff, T. N. P., Morrow, F., Bennett, A., Pedroza-Gutiérrez, C., Gore, M. L., & López-Rocha, J. A. (2022). Characterising changes in a decade of Mexican sea cucumber crime (2011–2021) using media reports. *SPC Beche-de-mer Information Bulletin*, *42*, 11-35.

Bondaroff, T. P. (2021). Sea cucumber crime in India and Sri Lanka during the period 2015–2020. *SPC Beche-de-mer Information Bulletin*, *41*, 55-65.

Challender, D. W. S., Brockington, D., Hinsley, A., Hoffmann, M., Kolby, J. E., Massé, F., Natusch, D. J. D., Oldfield, T. E. E., Outhwaite, W., 't Sas-Rolfes, M., & Milner-Gulland, E. J. (2022). Mischaracterizing wildlife trade and its impacts may mislead policy processes. *Conservation Letters*, *15*(1), e12832. https://doi.org/https://doi.org/10.1111/conl.12832

Cheng, W., Xing, S., & Bonebrake, T. C. (2017). Recent Pangolin Seizures in China Reveal Priority Areas for Intervention. *Conservation Letters*, *10*(6), 757-764. https://doi.org/10.1111/conl.12339

CITES. (2022). *National CITES Authorities*. CITES. https://cites.org/eng/parties/country-profiles/national-authorities

Foster, S., Wiswedel, S., & Vincent, A. (2016). Opportunities and challenges for analysis of wildlife trade using CITES data - seahorses as a case study. *Aquatic Conservation: Marine and Freshwater Ecosystems*, *26*(1), 154-172. https://doi.org/10.1002/aqc.2493

Foster, S. J., Justason, T., Magera, A. M., & Vincent, A. C. J. (2022). *Changes in the international trade in live seahorses (Hippocampus spp.) after their listing on CITES Appendix II. SC74 Doc. 70.1 Annex 1*. https://cites.org/sites/default/files/eng/com/sc/74/E-SC74-70-01.pdf

Foster, S. J., Kuo, T.-C., Wan, A. K. Y., & Vincent, A. C. J. (2019). Global seahorse trade defies export bans under CITES action and national legislation. *Marine Policy*, *103*, 33-41. https://doi.org/10.1016/j.marpol.2019.01.014

Foster, S. J., & Vincent, A. C. J. (2021). Holding governments accountable for their commitments: CITES Review of Significant Trade for a very high-volume taxon. *Global Ecology and Conservation*, *27*. https://doi.org/10.1016/j.gecco.2021.e01572

Foster, S. J., & Vincent, A. C. J. (2022). *Implementation of CITES Appendix II listing for seahorses in the context of export bans and suspensions. SC74 Doc. 70.1. Annex 2*. CITES. https://cites.org/sites/default/files/eng/com/sc/74/E-SC74-70-01.pdf

Governments of Maldives, Monaco, Sri Lanka, and the United States of America. (2018). *Seahorses (Hippocampus spp) on CITES – a roadmap to success. CoP18 Doc. 72 – p. 1* (1858500982). https://cites.org/sites/default/files/eng/cop/18/doc/E-CoP18-072.pdf

Indraswari, K., Friedman, R. S., Noske, R., Shepherd, C. R., Biggs, D., Susilawati, C., & Wilson, C. (2020). It's in the news: Characterising Indonesia's wild bird trade network from media-reported seizure incidents. *Biological Conservation*, *243*, 108431. https://doi.org/10.1016/j.biocon.2020.108431

Koning, S., & Hoeksema, B. W. (2021). Diversity of Seahorse Species (*Hippocampus* spp.) in the International Aquarium Trade. *Diversity*, *13*(5). https://doi.org/10.3390/d13050187

Lam, T., Ling, X., Takahashi, S., & Burgess, E. A. (2011). Market Forces: An Examination of Marine Turtle Trade in China and Japan. *TRAFFIC*. https://www.traffic.org/site/assets/files/2601/marine_turtle_trade_china_japan.pdf

Leupen, B. T., Krishnasamy, K., Shepherd, C. R., Chng, S. C., Bergin, D., Eaton, J. A., Yukin, D. A., Hue, S. K. P., Miller, A., & Nekaris, K. A.-I. (2018). Trade in White-rumped Shamas Kittacincla malabarica demands strong national and international responses. *Forktail*, *34*, 1-8. https://doi.org/DOI: 10.13140/RG.2.2.17829.04320

Mendiratta, U., Sheel, V., & Singh, S. (2017). Enforcement seizures reveal large-scale illegal trade in India's tortoises and freshwater turtles. *Biological Conservation*, *207*, 100-105. https://doi.org/https://doi.org/10.1016/j.biocon.2017.01.023

Neeley, T. (2012). *Global Business Speaks English*. Harvard Business Review. https://hbr.org/2012/05/global-business-speaks-english

Nijman, V., Spaan, D., & Nekaris, K. A.-I. (2015). Large-Scale Trade in Legally Protected Marine Mollusc Shells from Java and Bali, Indonesia. *PLOS ONE*, *10*(12), e0140593. https://doi.org/10.1371/journal.pone.0140593

Siriwat, P., & Nijman, V. (2018). Using online media-sourced seizure data to assess the illegal wildlife trade in Siamese rosewood. *Environmental Conservation*, *45*(4), 352-360. https://doi.org/10.1017/s037689291800005x

Sonricker Hansen, A. L., Li, A., Joly, D., Mekaru, S., & Brownstein, J. S. (2012). Digital Surveillance: A Novel Approach to Monitoring the Illegal Wildlife Trade. *PLOS ONE*, *7*(12), e51156. https://doi.org/10.1371/journal.pone.0051156

Stoner, S., Krishnasamy, K., Wittmann, T., Delean, S., & Cassey, P. (2016). Reduced to skin and bones re-examined: Full analysis. An analysis of Tiger seizures from 13 range countries from 2000-2015. *TRAFFIC*. https://portals.iucn.org/library/sites/library/files/documents/Traf-140.pdf

Underwood, F. M., Burn, R. W., & Milliken, T. (2013). Dissecting the Illegal Ivory Trade: An Analysis of Ivory Seizures Data. *PLOS ONE*, *8*(10), e76539. https://doi.org/10.1371/journal.pone.0076539

UNODC. (2016). *World Wildlife Crime Report: Trafficking in Protected Species.* U. Nations. https://www.unodc.org/documents/data-and-analysis/wildlife/World_Wildlife_Crime_Report_2016_final.pdf

UNODC. (2020). *World Wildlife Crime Report 2020: Trafficking in Protected Species*. https://www.unodc.org/documents/data-and-analysis/wildlife/2020/World_Wildlife_Report_2020_9July.pdf

Vincent, A. C., Foster, S. J., & Koldewey, H. J. (2011). Conservation and management of seahorses and other Syngnathidae. *J Fish Biol*, *78*(6), 1681-1724. https://doi.org/10.1111/j.1095-8649.2011.03003.x

Vincent, A. C. J. (1996). The international trade in seahorses. *TRAFFIC INTERNATIONAL, CAMBRIDGE(UK). 1996.*, vii + 163-vii + 163.

Vincent, A. C. J., Sadovy de Mitcheson, Y. J., Fowler, S. L., & Lieberman, S. (2014). The role of CITES in the conservation of marine fishes subject to international trade. *Fish and Fisheries*, *15*(4), 563-592. https://doi.org/10.1111/faf.12035

Table 1. Number of unique seahorse seizure records produced by each search procedure.

Procedure	**Relevant seizure records**
1. Google News, combined terms, English	32
2. Google All, combined terms, English	+1
3. Google News, pairs of terms, English	+3
4. Google News, pairs of terms, Simplified Chinese	+16
5. Google All, pairs of terms, Simplified Chinese	+33
6. Google News, pairs of terms, Traditional Chinese	+2
7. Google All, pairs of terms, Traditional Chinese	+3
8.1 Project Seahorse existing dataset	+60
8.2 Oceans Asia existing dataset	+36
8.3 TRAFFIC existing dataset	+107
Total	**293**

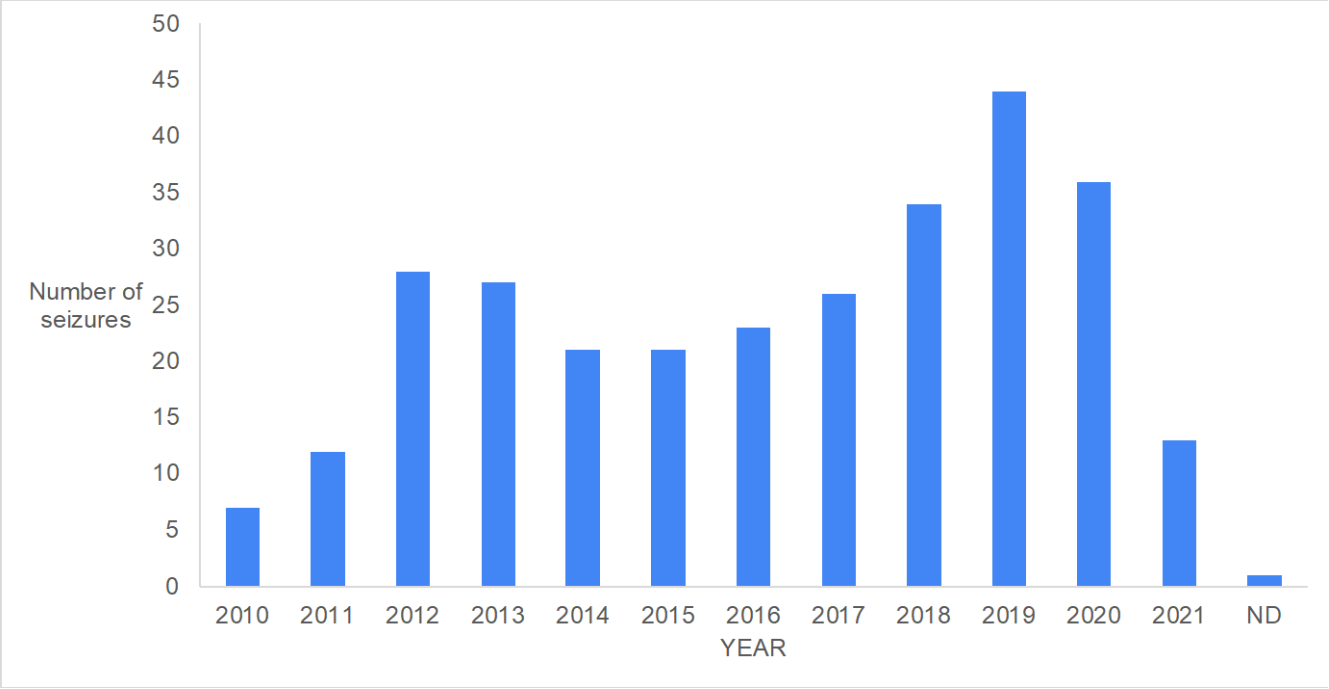

Figure 1. Number of unique seahorse seizures reported to take place in each year. ND = no date.

Table 2. Information on seahorse seizures made available in online postings.

Topic	Heading	Full dataset	Full dataset %
Shipment details	Seahorse form (live, dried, wet, prepared medicine)	293	100%
	Volume of seizure as weight (kg)	138	47%
	Volume of seizure as number of individuals	171	58%
	Associated commodities	83	28%
	Value of seizure	33	11%
	Declared use	12	4%
	Species (Latin or common name)	17	6%
Trade routes	Location of seizure - jurisdiction (CITES Party or region)	293	100%
	Location of seizure - specifics (e.g. city, airport name, etc.)	265	90%
	Method of shipment / place of seizure	258	88%
	Declared source jurisdiction	184	63%
	Declared source city	40	14%
	Declared destination jurisdiction	215	73%
	Declared destination city	63	22%
	Declared transit jurisdiction	78	27%
	Declared transit city	57	19%
Seizure details	Seizing agency	253	86%
	Number of people implicated in the offense	151	52%
	Number of people arrested	84	29%
	Enforcement action at the time of seizure	102	35%
	Legal action taken (actual punishment)	18	6%

Table 3. Information on seahorse species name reported in seizure records.

Reported species name	Inferred species name	Number of seizures
Hippocampus ingens	*Hippocampus ingens*	3
Hipocampus reidi	*Hipocampus reidi*	1
"West African Seahorse"	*Hippocampus algiricus*	1
"Bauer's seahorse, seahorse, spiny seahorse"	*Hippocampus barbouri, Hippocampus kelloggi & Hippocampus spinosissimus*	1
"brown seahorse"	*Hippocampus erectus*	1
Hippocampus guttulatus	*Hippocampus guttulatus*	1
Hippocampus ravulosus	*Hippocampus guttulatus*	1
Hippocampus hippocampus	*Hippocampus hippocampus*	1
"giant seahorse"	*Hippocampus ingens*	1
Kreb's seahorse	*Hippocampus kuda*	1
"Japanese seahorse" & "thorn seahorse"	*Hippocampus mohnikei & Hippocampus histrix*	1
Hippocampus patagonicus	*Hippocampus patagonicus*	1
Hippocampus spinosissimus	*Hippocampus spinosissimus*	1
Hippocampus spinosissimus & Hippocampus trimaculatus	*Hippocampus spinosissimus & Hippocampus trimaculatus*	1
Hippocampus spinosissimus + Hippocampus trimaculatus	*Hippocampus spinosissimus & Hippocampus trimaculatus*	1

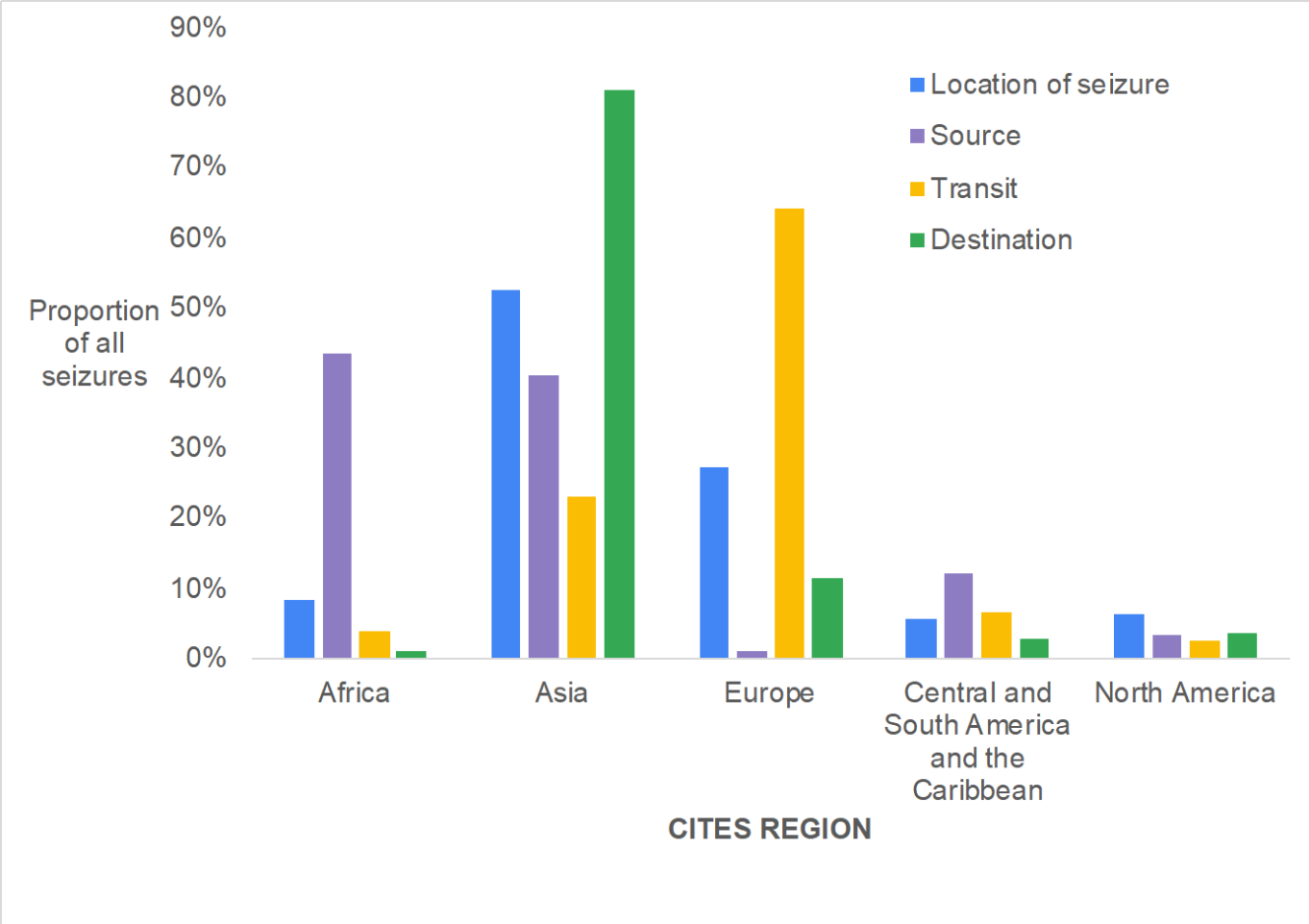

Figure 2. Representation of geographic regions as declared location of seizure or declared source, transit location or destination of seized seahorses.

Table 4. Top most reported locations of seahorse seizures, source of seizures, transit location of seizures or destination o seizures. Both number of seizures associated with each jurisdiction and its rank are indicated. Jurisdictions ranking in the top ten are reported for location and source of seizure, but only those ranking in top nine and seven are reported for transit and destination, respectively, because all other locations were associated with just one seizure each.

		Location of seizure		Reported source		Reported transit location		Reported destination	
Region	Jurisdiction	Number of seizures	Rank	Number of seizures	Rank	Number of seizures	Rank	Number of seizures	Rank
Africa	Egypt	18	5	21	2				
Africa	Guinea			31	1				
Africa	Madagascar			4	10				
Africa	Mozambique			4	10				
Africa	Senegal			4	10				
Asia	Cambodia							2	7
Asia	China	86	1	15	4			122	1
Asia	China (Hong Kong SAR)	20	4	6	8	3	4	17	2
Asia	India	21	3	15	5	5	2	5	4
Asia	Indonesia			12	6				
Asia	Malaysia							2	7
Asia	Philippines	9	7	6	8			7	3
Asia	Sri Lanka							2	7
Asia	Thailand			6	8			3	6
Asia	United Arab Emirates							4	5
Asia	Viet Nam			8	7			5	4
Europe	Belgium	45	2			38	1	5	4
Europe	Bolivia					3	4		
Europe	France					4	3		
Europe	Germany					2	5		
Europe	Italy							3	6
Europe	Netherlands					4	3		
Europe	Spain							3	6
Europe	Sweden							2	7
Europe	United Kingdom	8	8					7	3
Central and South America and the Caribbean	Brazil							2	7
Central and South America and the Caribbean	Peru	7	9	19	3	2	5		
North America	Mexico	12	6	5	9	2	5	3	6
North America	United States	6	10					5	4

Table 5. Settings for seahorse seizures – either mode of transport or location of seizure.

Method of transport/location of seizure	# seizures in full dataset
Passenger baggage - airplane	86
Unspecified	35
Mail (by post)	32
Airport	28
Market/Shop	20
Sea cargo	18
Passenger baggage - boat/ferry	12
Passenger baggage - bus	9
House	8
Car	7
Air cargo	6
Truck/Minivan	6
Warehouse	6
Fishing vessel	4
Passenger baggage	4
Boat	2
Land cargo	2
Passenger baggage - land	2
Abandoned Box	1
Air cargo, Truck/Minivan, House	1
Mail (by post), Car	1
Sea cargo, House	1
Train, Car	1
Warehouse. Air cargo	1

Table 6. Products reported to be associated with seized seahorses.

Product	# records mentioning product
Marine - animal	
Sea cucumbers	10
Shark fins	10
Syngnathids (pipefish/"sea dragons")	8
Sharks and rays (not fins)	4
Swim bladders (other)	4
Swim bladders (totoaba)	3
Coral	3
Shells (snails, bivalve, other)	3
Shells (Giant clam)	2
Shells Nautilus)	2
Abalone	2
Sea crabs / crustaceans	2
"fish"	1
Nudibranchs	1
Octopus	1
Sea moths	1
Seaweed	1
Marine/terrestrial - animal	
Tortoise / turtle (shell - raw and processed, whole, skulls)	9
Crocodile (bags, meat)	4
Terrestrial - animal	
Ivory (unspecified, raw or processed)	13
Ivory (elephant)	1
Pangolin (whole, scales, tablets)	11
Skins (cattle, horse, donkey, sheep, wet salted)	6
Deer (tails, tendons, penises, gall bladders, unspecified)	5
Tiger (bones, teeth, toes, gall)	4
Birds nest	3
Elephant (skin, bones, tail)	3
Lizards (geckos, monitor, iguana, chameleon)	3
Snakes (skin, galls)	3
Animal horns (rhino, antelope, unidentified)	2
Skins (leopard, panthera)	2
Bats (whole, skulls)	1
Feline skull	1
Frogs	1
Genitalia (unspecified)	1
Honey	1
Lion teeth	1
Mantasis	1
Scorpions	1
Terrestrial - plant	
Wood	2
Plant (*Cistanche deserticola*)	1
Plant (*Salacia reticulata*)	1
Ginseng	1
Anthropogenic	
Electronics	3
Wine	3
Clothes	2
Food	2
Cosmetics	1
Money	1
Pharmaceuticals	1

Table 7. Volumes and values associated with seahorse seizures. Volumes and per seahorse values were calculated assuming either the reported weight was correct or the reported number of individuals was correct, where both were reported for a single seizure event. Total values were calculated using all reported values, as well as with a single outlier (of 18.2 million USD) removed. Per seahorse values were calculated using the minimum values, with and without the outlier value.

	Volume (number of individuals)		Total values (2021 real USD)		Total values (2021 real USD) - outlier removed		Per seahorse value (2021 real USD)		Per seahorse value (2021 real USD) - outlier removed	
	Using weights	Using numbers	Minimum	Maximum	Minimum	Maximum	Using weights	Using numbers	Using weights	Using numbers
min	1	1	40	900	-	900	<1	<1	<1	<1
max	476,000	274,000	18.2 million	18.2 million	6.4 million	6.4 million	328	178	81	81
mean	20,000	14,000	1.2 million	1.4 million	661,000	845,000	24	19	14	14
stdev	57,000	37,000	3.4 million	3.5 million	1.5 million	1.8 million	60	37	23	23
median	1,000	1,000	88,000	96,000	85,000	92,000	5	5	4	5

Supplemental material

What follows is a detailed explanation of each approach used to find online postings about seahorse seizures.

English

1. **We used the Google advanced search option and a suite of search terms to search for relevant news items.**

1.1. We set our Google settings as follows:
Region: Canada
Private/personal results: Do not use private/personal results
Auto-complete with trending search: Do not show popular searches

1.2. Using the advanced search option, we searched for the following terms:
All these words: seahorses
Any of these words: seize OR seized OR seizure OR trafficked OR trafficking OR traffickers OR smuggle OR smuggled OR smuggling OR smugglers OR crime OR criminal OR confiscate OR confiscated OR arrested OR arrest OR illegal
Language: English
Region: Any Region
Last Update: Anytime

1.3. From the results page, we chose "News" to narrow the search results to news items.

1.4. We further narrowed the results using the "Tools" option as follows:
Time: from the 01/01/2010 to actual
Sorting: Sorted by date

1.5. Results: We retained 32 postings from this search for our analysis.

2. **We used the Google advanced search option and a suite of search terms – but did not narrow to news.**

2.1. As per 1.1

2.2. As per 1.2

2.3. We did not narrow by "News", but retained the default setting "All"

2.4. As per 1.4

2.5. This search, carried out on 18 April 2021, resulted in the addition of 1 relevant seizure that was not discovered using search approach 1.

3. **We used the Google advanced search option and pairs of search terms to search for relevant news items.**

3.1. As per 1.1.

3.2. Using the advanced search option and same advanced search settings as per 1.2, we searched for the following terms under ***All these words:***
Seahorses seize
Seahorses seized
Seahorses seizure
Seahorses trafficked
Seahorses trafficking
Seahorses traffickers
Seahorses smuggle
Seahorses smuggled
Seahorses smuggling
Seahorses smugglers
Seahorses crime
Seahorses criminal
Seahorses confiscate
Seahorses confiscated
Seahorses arrested
Seahorses arrest
Seahorses illegal

3.3. As per 1.3.

3.4. As per 1.4

3.5. Results: This approach, carried out on 22 April 2021, resulted in the addition of 3 relevant seizures that were not discovered using search approaches 1 and 2.

<u>Chinese</u>

4. **Simplified Chinese: We used the Google advanced search option and pairs of search terms to search for relevant news items.**

4.1. We set our search settings as per 1.1.

4.2. Using the advanced search option, we searched for 海马 (seahorse(s)) combined with each of the following terms:
查获 (seized)

截获 (intercepted/seizure)
运输 (transported)
商贩 (vendor)
走私 (smuggling)
犯罪 (crime)
罪犯 (criminal)
没收 (confiscation)
查没 (found)
逮捕 (arrested)
抓捕 (catch)
非法 (illegal)

The other advanced search options were set as:
Language: Chinese (Simplified)
Region: Any Region
Last Update: Anytime

We consulted several colleagues of Chinese nationality fluent in Simplified Chinese, and with extensive experience in wildlife trade, to determine the search terms we should use. They derived the terms from the English language list used for approach 1, above.

4.3. From the results page, we chose "News" to narrow the search results to news/media postings.

4.4. We further narrowed the results using the "Tools" option as follows:
Time: from the 01/01/2010 to actual
Sorting: Sorted by date

4.5. Results: This search, carried out on 27 April 2021, resulted in the addition of 16 relevant seizures that were not uncovered using the English language search.

5. **We used the Google advanced search option and pairs of search terms in Simplified Chinese, but this time we did not narrow to news items.**

5.1. As per 1.1

5.2. As per 4.2

5.3. We did not narrow by "News", but chose "All"

5.4. As per 4.4

5.5. This search, carried out on 28 April 2021, resulted in the addition of 33 relevant seizures that were not uncovered using approaches 1-4.

6. **Traditional Chinese: We used the Google advanced search option and pairs of search terms to search for relevant news items.**

6.1. As per 1.1.

6.2. Using the advanced search option, we searched for海馬 (seahorse(s)) combined with each of the following terms:
查獲 (seized).
截獲 (intercepted/seizure)
運輸 (transported)
商販 (vendor)
走私 (smuggling)
犯罪 (crime)
罪犯 (criminal)
沒收 (confiscation)
查沒 (found)
逮捕 (arrested)
抓捕 (catch)
非法 (illegal)

The other advanced search options were set as:
Language: Chinese (Traditional)
Region: Any Region
Last Update: Anytime

We consulted a colleague of Chinese nationality, fluent in both Simplified and Traditional Chinese, to determine the search terms we should use. They derived the terms from the Simplified Chinese language list used for approach 4, above. The Traditional Chinese terms were also cross checked using multiple online translation resources.

6.3. From the results page, we chose "News" to narrow the search results to news postings.

6.4. We further narrowed the results using the "Tools" option as follows:
Region: The web
Time: Custom range - 01 January 2010 – 29 April 2021
Sorting: sort by date
Duplicates: Hide Duplicates
NB: The "Tools" options changed in the time between our searches in English and Simplified Chinese and our search in Traditional Chinese, hence the difference in the specifications for approaches 1-5 versus 6

6.5. Results: This search, carried out on 27 June 2022, resulted in the addition of 2 relevant seizures that were not uncovered using approaches 1-5.

7. **We used the Google advanced search option and pairs of search terms – but this time we did not narrow to news postings.**

7.1. As per 1.1

7.2. As per 6.2

7.3. We did not narrow by "News", but chose "All"

7.4. We further narrowed the results using the "Tools" option as follows:
Country: Any Country
Time: Custom range - 01 January 2010 – 29 April 2021
Language: Custom
Results: All results

7.5. This search, carried out on 28 June 2022, resulted in the addition of 3 relevant seizures that were not uncovered using approaches 1-6.

<u>Additional postings</u>

8. **Project Seahorse, Oceans Asia and TRAFFIC had existing datasets on seahorse seizures which we incorporated into our findings in order to ensure the most comprehensive information possible**. To do this, we brought in any online postings that were not uncovered using approaches 1-7, above, covering the dates 1 Jan 2010 – 29 April 2021.

8.1. **Project Seahorse dataset** – this dataset had been compiled haphazardly over 5 years (2018-2020) from a variety of sources including Google news alerts, social media posts, emails sent to us from concerned individuals, etc. The Project Seahorse dataset had 60 relevant seizures that were not uncovered using approaches 1-7.

8.2. **Oceans Asia dataset** – this exploratory dataset was compiled in January 2020 by searching for "seahorse smuggling" in Google images, in each of Arabic (تهريب فرس البحر), Simplified Chinese (海马走私), English, Italian (contrabbando di cavallucci marini) and Spanish (contrabando de caballitos de mar; translations were carried out in Google Translate). The researcher examined the information associated with any images that were of dried seahorses or related to a seahorse seizure. The Oceans Asia dataset contained 36 relevant seizures that were not uncovered using approaches 1-7 and that were also not in the Project Seahorse dataset (approach 8.1).

8.3. **TRAFFIC dataset** – TRAFFIC maintains the Wildlife Trade Portal (www.wildlifetradeportal.org), "the most comprehensive open-access repository of wildlife seizure data." TRAFFIC sent Project Seahorse a subset of the data containing all syngnathid seizures as of 19 April 2022. The dataset contained 307 records covering the years 2003 through 2022. The data were filtered as follows:

- we sorted out incidents that fell outside the study dates of the dates 1 Jan 2010 – 29 April 2021;
- we sorted out all pipefish seizures;
- we sorted out records for which there was no publicly accessible link;
- we sorted out any records we already had in our database.

This resulted in 107 relevant seizures not uncovered using approaches 1 - 8.2.