CLP FINAL REPORT

Marine Conservation: Research on seahorse trade and exploitation status in Con Dao

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Summary

The report recaps my internship program over 6 months hosted by Fauna & Flora International (FFI) – Vietnam Programme, with overall objective is to assess impacts and potential conservation solutions in Con Dao. As referring to works of literature and former outcomes of marine projects in Con Dao, I engaged in specific seahorse research as a key output for my internship, since Vietnam is one of the major markets of seahorse trade and export, but a limited number of research and concern posing on. The internship period happened to aim at conducting a study at the extent of seahorse trade and exploitation, by accomplishing a survey in Con Dao district, allocated to four different groups (Fisher, Trader, Local, and Tourist) in order to gain reflections on seahorse trade and catch activities. Two common trading and catching seahorse species, the mean volume and mean price, drivers that affect seahorse price, and its future volume trends are recognized by respondents in the results. Insufficient respondents' knowledge of legal conduct is expressed as a key finding. Eventually, the need of Con Dao authorities and agencies in raising awareness for local residents is proposed in the study for future marine projects.

1. Introduction

Vietnam is one of the top five seahorse-exporting nations in the world (Vincent, 1996); (Giles et al., 2006). Unregulated (by)catch and export of seahorses was previously reported for Vietnam, though such data rarely showed up in official Customs records of the main dried seahorses importing nations (Vincent, 1996). Most seahorse species are listed in CITES - Appendix II, and some are in Decree 26/2019 – Appendix II, with the aim of catching, trading and exporting restrictions. However, this enforcement still faced a number of challenges, most notably in capacity and knowledge (Foster et al., 2017). As FFI is currently commencing marine conservation work in Vietnam's Con Dao archipelago, the intern is supposed to support baseline data collection for key threats in the islands, focusing on intensifying challenges yet to receive conservation attention, such as the seafood trade. The preliminary survey from FFI –in 2018 recorded that seahorses happened to enter the market in Con Dao, while previous study and research of seahorses were mainly conducted on the coastal mainland, whereas island district such as Con Dao is a potential market of collection and purchase in quantity. Therefore, during the internship period, the proposed research on "Seahorse trade and exploitation in Con Dao" has been carried out with approval from Ba Ria – Vung Tau provincial authorities and Con Dao People's Committee, and the support from Con Dao National Park, governmental agencies and local volunteers.

The objectives of the internship are included as (1) Recognize issue(s) and support data collection, concentrating on the particular threat(s) which should obtain additional attention; (2) Prioritize interventions which FFI might undertake to address recognized threats in order to promote sustainable development of the Con Dao islands. The research of seahorse trade and exploitation in Con Dao specifically aimed at (1') Quantity and value estimation of seahorse volume; (2') Market chain and actor relationship determination; (3') Current Status and future trend of seahorse volume; (4') Proposed interventions in management and conservation.

2. Methods and activities

Desk research: Prior to the intended survey, preliminary research has been taken place at the office in order to perceive the objectives and contents of the marine conservation project commencing in Vietnam. As marine conservation is in its infancy in Vietnam, collected former projects were valuable for references. Meanwhile, based on the objectives of the FFI marine conservation project and its scoping research, seahorse and endangered marine species could be an initial start, which also relatively matched the intern background, which has been done in species conservation. Orientational discussions carried out with a technical supervisor for assessing the feasibility of ideas and research. Then, when the topic was determined, specific research timelines were scheduled to undertake the scientific survey and research. And the prominent activity of the internship is determined as "Seahorse Study".

Data collection: The research was taken place in Con Dao district, Ba Ria-Vung Tau province, concentrated on Con Son island, in 2 main locations which were Con Son town, and Ben Dam port. There are three field trips in total, in which the first and the third (in October and January) were for the meetings with Con Dao authorities and partner agencies, with the aim of FFI's marine project introduction, and information sharing. The main field trip was the interviews which occurred for 10 days, from November 17 – 27. There was a total of 47 answers collected after the survey, distributed to 4 different targeted groups: Fisher, Trader, Local resident, and Tourist. The method of choosing interviewees was based on the Snowball Sampling method (Goodman, 1961). The interview was conducted and collected answers based on a designed semi-structured questionnaire, questions depending on each group. The interview was performed as a casual conversation, which aimed at creating a comfortable atmosphere for the participants revealing their known knowledge. All recorded information was committed to serve for scientific study purpose solely, and participant's personal identity would have stayed anonymous in the report or any publications.

Data analysis and reports: Quantitative data was entered into a designed Excel table. Due to the relatively small number of samples, the results would be presented under percentage or stayed as the number of answers. Results and outputs were scientifically presented and interpreted in the report, with the comparison and reflection of previous studies in order to deliver objective discussion and to propose proper recommendations.

Logistics and budget hold: Besides the main task of conducting the survey and research, the intern was also responsible for field trip arrangement and spending (including transportation, accommodation, meals and beverage, etc. for FFI's participants). Mission/ Back term of reference (MtoR/ BtoR), and Field trip Advance /Claim were obliged to be prepared on some trips (depending on trip's purposes). Associated meetings/ conferences were proposed to engage in for a prospect of marine conservation in the future.

3. Results and Outputs

Thanks to the support from supervisors, interview has performed fluently which reached a total of 57 answers collected, in which Fisher (n=10), Trader (n=23), Other local resident (n=14), and Tourist (n=10). Identified issues are including the incidental catch from all recorded trawling boats (which takes up 6/10 surveyed fishers). Besides some common caught fishes and aquatic crabs, shrimps, squids, etc., seahorses are affirmed to be regularly caught and traded by participated interviewees. Two common seahorse species are recorded being caught and traded the most, namely hedgehog seahorse (*Hippocampus spinosissimus),* three-spot seahorse *(H. trimaculatus*), and great seahorse *(H. kelloggi)* . The mean of retailer sector is calculated as 4.21 ± 4.10 (kg/year). The mean price is 806.13 ± 261.11 (USD/kg), and this price can vary depending on seahorse size, and hugely on the price that wholesalers in China impose.

In addition, the study found that social status and connections of participants in the market also affect their seahorse reserve volume. Respondents' knowledge is insufficient in legal conduct regarding seahorse trade and catch, while they are well aware of laws for sea turtles, dugongs, and even of foreign legislation. Interventions in communication and campaign for public awareness raising of legal seahorse trading regulations, aligning with the Con Dao authority should be one of the primary activities that FFI should involve in.

Seahorse results were disclosed to the Con Dao national park and partner agencies, with an expectation of providing a scientific foundation for the local decision-making in species conservation and fisheries management.

4. Achievements and Impacts

Personally, the internship has equipped first-hand participant with intensive and practical skills and experience, where I had opportunity working in an actual project, and observing and dealing with the reality. That has taught me considerably with problem-solving and self-management. To work in conservation requires multiple and flexible skills, as well as environment adaptive, thus, the internship opportunity has better prepared intern for that. Further, it is building capacity and independent characteristics by sending me in a professional organization to work and learn from. Therefore, I acknowledged that is the biggest treasure that I have been received during the internship time, as well as the leading mission that the programme desire to orient.

One scientific report is proposed to deliver after the six-month internship, which accumulates data baseline and fundamental results for further marine project performance. The seahorse research is supposed to contribute to the knowledge and awareness of local administrative officials in a vulnerable species status that are still under concerned, and advocate for strengthening the conservation and management. The study also expressed that local people still lacked awareness of restricted trading and catching species, that provoked more plans and strategies of local communication. The activity could take time and effort due to various factors from the authorities, however, it is expected that the FFI will cooperate with local partners and other concerned agencies, to facilitate a strategy for consistent communication in order for a gradual change in knowledge and behavior. Even though, seahorse conservation and

seahorse market intervention play proportionally small in the multi-dimensions of the marine project, I believe the conservation is possible to take advantage of a complete marine conservation plan, to benefit seahorse conservation objective.

5. Limitations and Conclusions

Although the study and the internship as a whole have delivered certain results and outputs, in terms of practical contribution and personal improvement. There are still some shortcomings that influence the intended achievements. The survey embraced collecting various information regarding seahorse trading and networks, some of the required information was fairly sensitive to the participants, as they rejected to disclose. The survey also encountered several rejections to any interviewing participation. As I anticipated some unexpected situations, and adjusted ways of approach to earn necessary information, the expected answers could not entirely achieved and could result in some incomplete findings for the research. The skills and experience of intern in communicating with high-profiled traders are still in short, hence, it is necessary to approach the interviewers in an indirect ways and perhaps, more time consuming with support from local people.

The internship was surrounded by "Seahorse trade and exploitation in Con Dao", even though the study's objectives have not been entirely exposed, the sampling data indicates that the topic should not be underrated for the seahorse conservation and fisheries management as a whole. The Con Dao market is considered small-scale but it revealed some dominant actors in the market chain, which play a significant role in speculation and distribution of certain seahorse volumes inside and outside local market. According to the perceptions of surveyed participants, we can conclude that seahorses are facing major threats, along with other vulnerable species, if not receiving adequate concerns and awareness from the public, and continuing unregulated catching and trading activities. Prospect of sustainable fisheries management should be planned, accompanied with a complete strategy of the district development, therefore, the cooperation of Con Dao authorities and associated agencies, with the agreement of local residents, is optimal. In the next coming months, with an intention of pursuing seahorses for a complete study in Con Dao. I expect to support FFI's project to fulfill some shortages of data, namely the number of middlemen actors, and their prominent volumes. Also, the idea of communication of public awareness to vulnerable species in legal documents will be initiated with the accompaniment of the Con Dao national park, and other partner agencies. Meetings and communication among local residents, particularly seafood businesses and fishers are expected to strengthen.

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APPENDIX

Report on “Seahorse research and exploitation in Con Dao”

FINAL REPORT:

Research on Seahorse trade and exploitation

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Abstract

As seahorse is a flagship species and is facing major threats of being over-caught and overexploited worldwide. The understanding of the public in their vulnerable status has not been properly sufficient, or usually neglected. Following a scoping research in 2018 in Con Dao district, this study was conducted with the aim of assessment at the extent of seahorse trade and exploitation, by accomplishing a survey on 47 respondents, allocated to four different groups (Fisher, Trader, Local, and Tourist) in order to gain reflections on seahorse trade and catch. Incidental seahorse catch is recognized by a humble sample size of Fisher, but affirmed by all recorded fishers and other Trader and Local groups. Three common seahorse species are recorded being caught and traded the most, namely *Hippocampus spinosissimus, H. Trimaculatus*, and *H. Kelloggi* and agreed with former research findings. The mean volume of retailer sector in Con Dao is estimated as 4.21 ± 4.10 (kg/year). The mean price is 806.13 ± 261.11 (USD/kg), and this price can vary depending on seahorse size, and hugely on the price that wholesalers in China impose. The social status and connections of participants in the market also affect their seahorse reserve volume. Respondents' knowledge is insufficient in legal conduct regarding seahorse trade and catch, while they are well aware of ones for sea turtles, dugongs, and even of foreign legality. However, the need of Con Dao authorities and agencies in raising awareness for local residents is proposed in the study, as well as to strengthen their enforcement in fisheries market management.

1. Introduction

1.1 Seahorse rationale

Seahorses (Hippocampus Rafinesque 1810 spp.) and their relatives in the family Syngnathidae (pipefishes, seadragons and pipehorses) have life histories and behaviours that might make them vulnerable to population decline (Foster & Vincent, 2004). Syngnathidae are important in ecological, economical, medicinal and cultural terms (Bologna, 2007). They live in corals, seagrasses, macroalgae, mangroves, estuaries, lagoons and open bottom habitats and can be important predators on bottom-dwelling organisms (Tipton & Bell, 1988), (Bologna, 2007). Seahorses (genus Hippocampus) are rarely subject to fisheries management or monitoring, despite an international trade that consumes millions of these fishes, dried for use in traditional medicine (TM) and as curios, and live for display in aquaria (Vincent, 1996). They are caught, directly or indirectly, in fisheries around the world, ranging from small-scale hand collectors to bycatch in commercial shrimp trawlers (Vincent, 1996). Roughly 15-20 million of these fishes enter international trade, which involves at least 87 countries (Foster et al., 2014). The trade, therefore, is often diffuse and difficult to track, involving many participants over many regions (Giles et al., 2006). Moreover, these fisheries are often considered small-scale, both in terms of catch volumes and economic value, and are rarely of concern to traditional fisheries management bodies (Giles et al., 2006). Official statistics and trade surveys have highlighted an increased pressure on global seahorse populations. The global trade in seahorses increased from the 1980s, in part due to increased demand created by economic growth in Asia, and in part due to increased supply of seahorses

from bycatch in the world's growing trawl fisheries (Vincent, 1996). Most seahorses were thought to be exported, generally through unofficial and unregulated channels across the northern border into Guangxi province of China (Giles et al., 2006). Surveys of fishers have suggested that seahorse populations have declined during this time in at least some areas of the world (Vincent, 1996).

Seahorses are excellent examples of fishes that have been ignored by traditional fisheries management in the past but have recently attracted considerable conservation attention (Stocks, 2015). Despite global efforts to study and protect seahorses, they are still under threat (Stocks, 2015). The majority of seahorses are listed as Vulnerable or Data Deficient on the IUCN Red List of Threatened Species (IUCN, 2015). Signatories to the convention are now compelled to monitor international trade and source countries will need to ensure that exports are non-detrimental to the long-term persistence of wild populations (Giles et al., 2006). Many of the countries involved in seahorse fisheries and trade lack sufficient information (whether biological, fisheries, or trade related) to prove the sustainability of these activities (Stocks, 2015). Fishers across the globe reporting declines in seahorse catch even in studies in which effort was controlled (Giles et al., 2006), (Vincent et al., 2007). They are vulnerable species because of their habitat degradation(Vincent et al., 2011); (Harasti, 2016). Seahorses are likely to be particularly vulnerable to capture in shrimp trawls because they are similarly sized to target organisms (shrimp), demersal and slow swimming (Meeuwig et al., 2006). In addition, these fishes are threatened by degradation of their sensitive coral, seagrass and mangrove habitats (Hodgson, 1999). In total 11 countries–Australia, Brazil, Hong Kong, Ireland, Mexico, New

Caledonia, New Zealand, Sri Lanka, UK, USA and Viet Nam–were recorded as the source of captive-bred seahorses (Koldewey & Martin-Smith, 2010).

Vietnam is reportedly a supplier of dried seahorses, although little is known about the nature and size of the trade, or the status of its seahorse populations (Giles et al., 2006). Vietnam is also one of the top five seahorse-exporting nations in the world, along with India, Indonesia, Mexico and Thailand (Vincent, 1996); (Giles et al., 2006). According to CITES official data, reported Viet Nam as exporting a minimum of hundreds of thousands of seahorses per annum(Foster et al., 2016). This number is full of incompetency, since the reports from interviews with buyers and exporters in Viet Nam in the late 1990s estimated annual catches at over two million seahorses a year (Meeuwig et al., 2006) (Giles et al., 2006), with exports at a similar scale, which is approximately 6.5 tons, primarily to China (Giles et al., 2006). Unregulated (by)catch and export of seahorses was previously reported for Vietnam, though such data rarely showed up in official Customs records of the main dried seahorses importing nations (Vincent, 1996). Past surveys suggested most of the trade went unrecorded across the northern border into China (Vincent, 1996). Viet Nam expressed keen interest in establishing export levels that do not threaten wild populations, in a bid to lift the trade suspension imposed by CITES (Foster et al., 2017). It faced a number of challenges, however, most notably in capacity and knowledge (Foster et al., 2017). Additionally, coastal fisheries have expanded considerably in Vietnam with an increase from ~28,000 motorized vessels with an average horsepower of 19.8 in 1980 to ~72,000 vessels with an average horsepower of

26.2 in 1998 (Garces et al., 2003), which is perhaps an indicator of enormous pressure on fisheries resource these days.

There are seven species of seahorses known from Vietnam's waters, based on the recently revised morphological and genetic taxonomy of Vietnamese seahorses (LOURIE et al., 1999), which may still not be definitive (Giles et al., 2006). All seahorse species were marketable but here the focus is on the three species that were most widely encountered in trade; *Hippocampus spinosissimus*, *H. trimaculatus* and *H. kuda*. (Giles et al., 2006)(Stocks, 2015)(Foster et al., 2017)). The Red Data Book lists two seahorse species as Endangered (EN) in Vietnam (*H. trimaculatus*, *H. kuda*); and one species as Vulnerable (VU) (*H. histrix)* (Ministry of Science, Technology, and Environment 2007).

1.2 Background of study site

The Con Dao archipelago lies in the South China Sea, 185km from Vung Tau city of Ba Ria-Vung Tau province in South Vietnam. The total area of the terrestrial part of the island district is about 7,600ha, including 16 islands. In 1984, the government paid attention to the conservation of natural resources and biodiversity in this archipelago and established the protected area of Con Dao directly under the special zone of Vung Tau-Con Dao. In 1993, the Prime Minister issued Decision No. 135 / TTg to establish Con Dao National Park (CDNP) on the basis of the protected area of Con Dao. CDNP has an area of 19,990.7 ha, of which the area of forest conservation is 5,990.7 ha (accounting for 80% of the total natural area of the terrestrial part of the island district); the area of marine conservation is 14,000 ha; In addition, there is a sea buffer surrounded by 20,500 ha. Con Dao waters consists of 3 main ecosystems:

mangrove ecosystem has an area of 32ha, seagrass ecosystem has an area of about 600ha, ecosystem of coral reefs has an area of about 1,000 ha. The marine biota has listed 1,735 species, of which: 46 species of mangrove, 133 species of seaweed, 11 species of seagrass, 226 species of phytoplankton, 143 species of zooplankton, 360 species of coral, 187 species of molluscs, 215 species of coral reef fishes, 116 species of crustaceans, 115 species of echinoderms, 130 species of polychaete worms, 9 species of sea reptiles, 37 species of seabirds, 7 species of marine mammals.

Con Dao fishers employ small-scale fishing methods, including hookah diving, hand-lining for cuttlefish, using single-layered gillnets and three-layer driftnets, and longlining for tuna (Johns et al., 2008) (Khuu et al., 2020). The growth in the number of offshore fishing boats, which often employ damaging methods like bottom trawling and purse seine with strong lights of over 2000 Watts, has increasingly threatened CDNP's conservation features (Khuu et al., 2020). The opening of Ben Dam port in 2001, a fishing and service centre that can accommodate vessels of 2000 DWT [2], was one of the main causes of the expansion. (Khuu et al., 2020). Between 2004 and 2005, about 6,000 to 7,000 offshore fishing boats anchored in Ben Dam port [3]. According to the preliminary survey in Con Dao from FFI – Vietnam Programme, during the storm season, 130-180 trawlers shelter in the port; the season when the sea is calm, most ships and boats are anchored off shore and only 5-7 trawlers in port (Nguyen et al., 2018). These boats often dock at Ben Dam where they unload their catch and recharge with fuel and ice, and the number has increased recently because of displacement of fishing efforts driven by the nationwide depletion of fish stocks

(Khuu et al., 2020). Under such circumstances, local fisheries statistics are lacking and unreliable; Data from offshore fishing boats, catch from angling, spear fishing in coral reefs by tourists and gleaning of limpets and cockles in rocky shores by local people are frequently neglected by Con Dao district government (Khuu et al., 2020). The preliminary survey also recorded that seahorses are being sold commonly and publicly in the market in Con Dao. However, besides the immense advocacy and communication from non-profit organizations aligning with CDNP on sea turtle protection and anti-poaching; conservation, exploitation and consumption of seahorses as well as other endangered marine species keeps underestimated. Previous study and research of seahorses were mainly conducted on coastal mainland, whereas island district such as Con Dao is a potential market of collection and purchase in quantity. Therefore, the research on "Seahorse trade and exploitation in Con Dao" has been conducted with the expectation to fulfill the shortage in seahorse species concern and conservation.

2. Goal and Objectives

Goal: To assess the seahorse trade and exploitation status in Con Dao district, Ba Ria-Vung Tau.

Objectives:

- Estimate the volume quantity and value of trading seahorses in Con Dao
- Determine the market chain and actors and the relationships between the actors.
- Access the status of seahorse exploitation, and to anticipate the trend of seahorse trade and exploitation in Con Dao in the future.
- Propose some recommendations to Con Dao district authorities of pathways in seahorse conservation and management.

3. Methods

3.1 Data collection

The research was taken place in Con Dao district, Ba Ria- Vung Tau province, concentrated on Con Son island, in 2 main locations which were Con Son town, and Ben Dam port. While Con Son town is the main residential and tourist concentration, the number of locals, traders and tourists locate here, and Ben Dam port is the primary port of Con Dao district, so the number of fishers and middlemen were accessible. Also, few answers were collected randomly in some spots around the island, as long as people were capable of joining the interview.

The first survey lasted for 10 days, from November 17 – 27, and the complementary survey occurred from March 27 – April 1. There were total of 57 answers collected after the survey, distributed to 4 different targeted groups: Fishers (n=10), Traders (n=23), Other local residents (n=14), and Tourists (n=10). In terms of Traders, Te There are 2 major actors operating the seahorse market in Con Dao, namely Middlemen and Retailers. Furthermore, "Retailers" has been broken down into 3 sub-groups (according to the title that respondents have called themselves), which includes kiosk stands, seafood stores, and restaurants. The definition of each actor, and sub-group will be determined as following

Middleman: An intermediary in seahorse collection from fishers, transaction and logistics to other middlemen and/or consumers. Middlemen in Con Dao are divided as upper-level middlemen and lower-level middlemen

- Upper-level middleman: Owns large quantity stock of seahorses (in unit of a hundred kilograms to ton), who have strong and solid trading networks with the mainland intermediaries, and supply from fishing trawls for seahorse sources.

- Lower-level middleman: Holds small quantity stock of seahorses (in unit of grams to kilograms) and limited number of trading networks, or target market is local intermediaries and/or consumers. They also work as a logistican to provide upper-level middlemen or retailers.

Retailer: An intermediary who directly involve in local transaction to consumers. They own small quantity stock of seahorses (in unit of grams to kilograms).

Some prominent forms of retailers in Con Dao are seafood stores, market kiosks, and restaurants. Based on the fact and functions of retailers in Con Dao, some forms of retailers can be defined as:

- Seafood store: Locating around Con Son town, where storing and selling various types from frozen and dried seafood, the consumers are tourists, and from the mainland. They could serve big seafood types such as squids, mackerels, etc.

-Market kiosk: Small stores locating in mainly the Con Dao market, dried seafood are prominent, coupling with other specialties. They mainly serve locals and tourists.

-Restaurant : Mainly serving fresh seafood, but they can contact other intermediaries for providing seahorses if being requested by customers. This

group is capable of participating in seahorse trading, but is difficult to determine as they barely own quantity stock of seahorses.

The method of choosing interviewees was based on Snowball Sampling method (Goodman, 1961), in which surveyors received recommendations from local connections, and previous interviewees would suggest his/her fellows who were supposed to provide additional information regarding the interview's purposes.

The interview was conducted and collected answers based on a designed semi-structured questionnaire (Appendix 1)**.** Questions and hints would depend on different groups of participants, some sets of questions were consistent among all 4 groups. The participation of the interviewees is voluntary and anonymous, which their personal information was secured. The interview was performed as a casual conversation, which aimed at creating a comfortable atmosphere for the participants revealing their -knowledge, as we made them clear that the answers we were collecting only served for scientific research purposes. At their convenience, information was either noted down immediately during the conversations or later summarised after finishing the interview, to ensure the fluency of conversations and the comfort of participants.

Regarding fishers, some common fishing habits were collected such as capacity, length and registration of boats. Fishing gear types, length of catching time, and catching peaks were also noted. Both fishers and traders were asked about seahorse species that they could recognize, and other seafood species they are fishing/ trading. Regarding seahorses, information of origins, trading routes, methods of fishing/ trading should be highly focused on. Photo records of seahorses and other valuable seafood species, if possible, were taken and saved

for later species identification. Catching/ trading rate (kg per week/month/season) was asked to estimate the amount or number of seahorses would be caught/ traded in a period of time, and then estimated the total value. Additionally, past and present catch/trading rates would be accessed to anticipate the trends of seahorse catching/ trading. This is an open question, depending on the interviewee's knowledge. Some seahorse values at medicinal, food and cultural were collected from all participants.

To identify the seahorse species, prior to the field trip, references of common fished and traded seahorses were used to learn about morphological characteristics, by using a guideline of "A guide to the identification of seahorses" (Lourie et al., 2004). A shortcut of this guideline which recapped and described noticeable morphologies of 8 common seahorse species in Southeast Asia (Lourie et al., 2004), was applied to participants to help them easily recognize the species they happen to or usually see, as they could not identify by scientific names. All information was recorded (photo records, notes of morphological characteristics, and species identification from interviewees).

Some demographic related questions were considered to be collected, including age, sex, native/immigrants, number of years of doing fishing/ seafood trading, number of family members participating in doing fishing/ seafood trading, etc.

3.2 Data analysis

Quantitative data was entered in a designed Excel table, along with qualitative data. Due to relative small number of samples, the results would be presented under percentage or number of answers (n). Variables such as seahorse price,

volume would be analysed by a descriptive statistic table to find out the mean, minimum, maximum and standard deviation. Price was recorded in Vietnam dong (VND), however, in the report, prices would be converted into US dollar and reported in USD. 1 USD is equivalent to 23,104 VND (www.exchange-rates) Volume of dried seahorses is computed as the multiplication of average volume of a single shop/store/ restaurant or individual, and the total of dealers in the whole market. The estimation will relatively reflect the size of the market rather than the actual volume in Con Dao, as multiple levels of dealers participate in the market with a relatively differentiated difference in available and trading volume.

The total volumes are essential to convert into the number of seahorses, according to experienced dealers, we credited and assumed that 100 gram of dried seahorses is equivalent to an averagely of 30 seahorses in small and medium-size. The conversion is applied in the report to visualize the number of individuals being traded and caught, and perhaps provide indicators of seahorse population loss due to the trading and exploiting activities. Hence, an estimation of the total value in USD is calculated, by the multiplication of the total volume of dried seahorses, and the price of dried seahorses per kg. Even though the profits of seahorse trading will not be compared with other seafood trading in the study, the total value is helpful in determining how much benefits the seahorse trading market would bring to dealers, and statistics for further studies in seahorses.

4. Results

4.1 Demographic summary

The interview conducted and received 57 answers: in which, Fishers (n=10), Traders (n= 23), Other local residents (n=14), and Tourists (n=10). According to a scoping research from FFI staff in 2018, there is an estimation of approximately 130 -180 off-shore boats in the port during storm season (Nguyen et al., 2018), so our surveyed number of off-shore boats at the time represents only 3.33 – 4.61% of total active boats (both on-shore and off-shore boats) ; among traders, the number of surveyed traders which ascertained to own and trade seahorses represents for roughly 44.74% of total seahorse-suspected traders in Con Dao, as a quick survey had been done in the second field trip to deliver an estimation of the number of seafood stores, market stands, and restaurants in Con Dao which are suspected to trade seahorses, via the adverstising boards, and secondary information from other fellow traders. Age of respondents distribute from 23 to 88 (45.2 ± 15.84 years, n=25). 59.57 % of interviewees (n= 37, tourists excluded) are immigrants which come from the mainland and other provinces. 8.51% of them are native which they were born and raised in Con Dao, and the rest of 10.64% are fishers who temporarily stayed while refueling their boats. Over half of them come from the Southern provinces which takes up 60%, namely Ho Chi Minh city, Vung Tau, Kien Giang, Can Tho, etc., the rest of 40% is from central north such as Thanh Hoa, Hai Phong, Nam Dinh, etc.

4.2 Catching and trading species

There are 21 responses for a list of some species which they are catching/trading or observing of being caught/traded. In which, fishes, namely grouper, mackerel, and cobia are recorded the most fishing and consuming species, agreed by all participated groups. The same result goes for squid, shrimp and other

commercial species. Seahorses are recognized by three groups but barely by Tourist, . Sea turtle and corals are barely caught –and traded, but fishers confessed that they could incidentally trapped by trawling nets occasionally, however, they will more likely be release if staying alive (Fig. 1).

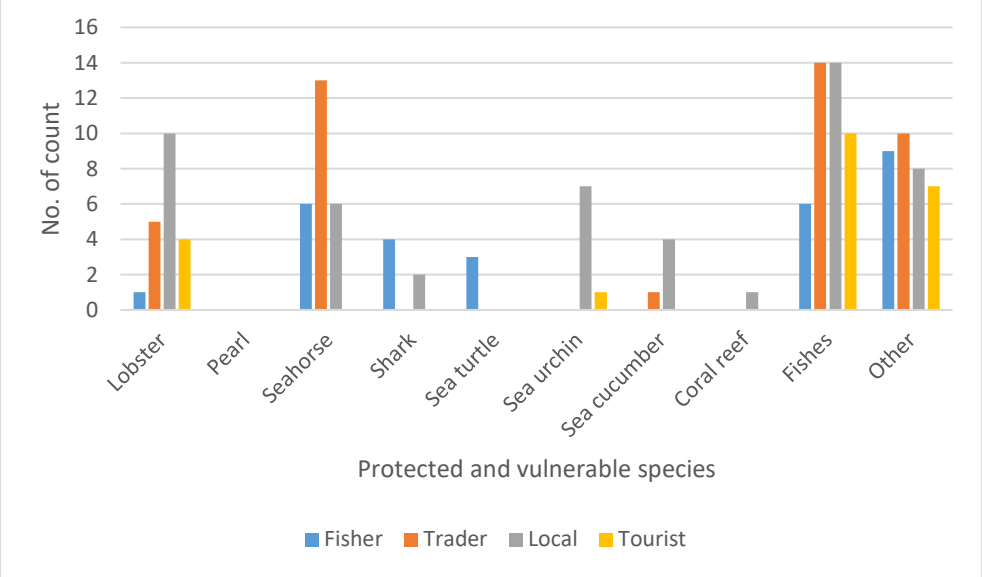

Figure 1: Catching and trading of some concerned marine species by groups of respondents

Regarding seahorses specifically, all traders and fishers are capable of seahorse identification (based on size, color and basic morphology), while few local people could recognize species, while nearly no tourists were able to– identify different species. Among the answers, –some people stated that there are 2 types of seahorses including Vietnamese and Indonesian. But 3 types of seahorses, which are spiny, smoothly and Indonesian are largely recognized by respondents. Some respondents recognized seahorses by its colors, including black, red, yellow. According to experience of most Traders, Vietnamese types are relatively small, around ring or little finger- sized, and Indonesian seahorses are usually

bigger, of around big toe-sized. By photos, people could visually relate to familiar seahorse species that they usually encountered, hence three-spot seahorse *Hippocampus trimaculatus* and spiny seahorse *H. spinosissimus* are the two species that popularly recognized by respondents (in 42.86% and 33.33% respectively). By observation in photographs, there were 9 shops and 1 trawling boat in which seahorses were available for photo recording. Collected photos of seahorses were sent to an expert in the Oceanography institute of Nha Trang – who has researched seahorse conservation for years, helped to identify seahorse species, which are *Hippocampus trimaculatus, H. spinosissimus,* and *H. kelloggi* (Appendix 2)

Among 10 boats that participated in the survey, 6/10 were off-shore trawling boats, 1 was a diving boat, and other 3 were near-shore boats. All surveyed off-shore boats utilized trawl gear type, with multiple used of sized-net (2cm is the minimum recorded mesh size). Besides, fishers also added that they did have targeted-species such as squid, fish, but did not reject incidental bycatch of other species. All trawling boats agreed that they caught seahorses incidentally during their journeys.

4.3 Seahorse volume

Available capacity of Traders varied, 23 were interviewed, including 4 upper-level middlemen, 2 lower-level middlemen, and 17 retailers (namely seafood stores, market kiosks, and restaurants) the average capacity of seahorses they own per year is vary depending on the level of traders.

Regarding retailers, the average capacity of seahorses is estimated 4.21 ± 4.10 (kg/year), as the standard deviation is quite large,–the difference of capacity among retailers is significant, hence, some retailers should have considerable transaction with multiple types of consumers. 4 interviewed upper-middlemen, however, are less likely to disclose an average estimation of the amount they trade per year.

We estimated the total volume of retailers in Con Dao, the number is relatively accurate for retailers, but not middlemen, because of 2 reasons. First, the number of collector interviews was small, and the number of estimated middlemen in Con Dao has not determined yet. Second, the volume of seahorse stock they own was considered relatively large that they rejected to give a concrete number of available quantity during the interview, then to do an estimation can lead to a significant error.

There are total 38 businesses which are suspected to trade seahorses in Con Dao, including seafood stores, kiosks in the market, and restaurants. hence, the estimation of the total volume of seahorses among retailers could be calculated as: 4.21 (kg) x 38 = 159.98 (kg/year).

According to an estimation from traders, the equivalence of 1kg of dried seahorses depends on the size, species. We learned from Mr. B – a professional former seahorse fisher, he has shown the approximate weight of each seahorse species, based on their living habitats. From the surveys, and recorded photos (Appendix 2)**,** traders provide medium and small seahorse sizes. Based on trader experience, we assumed that 100 gr of seahorse is equivalent to 30 individuals (which is a mix of medium and small sized seahorses, medium size is agreed to

be similar to thumb-sized), the number is utilized to estimate the total number of individuals of seahorses being traded in the retailer sector as 47,994 individuals/ year.

4.4 Seahorse price and estimated value

Respondents reported price they knew, we acknowledged all price they had given regardless of seahorse origin, size and reported time. However, the most recent prices were noted for consideration (preferably the prices within 2020). The reported prices by fishers and traders were considered for an average estimation, the report from local people and tourists were used as reflection to the fishers and traders' report. In fact, the survey revealed that local people barely caught up with the latest price of seahorses, and tourists who did not intend to consume seahorses, were unable to report the price.

The calculated mean price is 806.13 ± 261.11 (USD/kg). The minimum and maximum prices are 432.83 USD/kg and 1731.30 USD/kg respectively. Since the current price is applying to all surveyed groups, the sum of seahorse value among retailers can be determined by multiplying mean price and the total estimated amount of seahorses in retailer group, which is: 159.98 x 806.13 = 128,964.68. USD.

4.5 Trend of seahorse volume and price

20 respondents who are fishers and traders gave their opinions of seahorse volume compared to previous 5 years. Among them, 75 % agreed that the volume of seahorses has been decreasing, 10% claimed that it has actually been increasing, the same percentage goes for blank answer which they had no idea

the fluctuation of seahorse volume since 2015. And 5% said there is no change of seahorse volume in the past 5 years.

Similarly, regarding the question for the anticipated trend of seahorse volume in the next 5 years, 19 interviewees gave their answers, in which most people still believe that the volume of seahorses will be decreasing dramatically (accounts for 68.42%), 10.53 % believed the volume will be increased, 5.26% thought it will stay the same, and 15.79% had no answers for this question.

4.6 Awareness of seahorse trade and exploitation

Regarding the knowledge of surveyed groups on the legal decision on seahorse trade and exploitation, in the decree 26/2019, there are 3 seahorse species which are listed in the group II, appendix II and being restricted to caught at certain time and size, and 1 seahorse species listed in the group I, appendix II. 68.42% of people (n=57) answered the question and said “No” as they have not ever heard about the decree and they believed there is no decision in any of such legal documents. We asked them an additional question, that whether or not they know any marine species which are being restricted or banned for catching, and trading in Con Dao, 78.72% of them said “Yes”, and they could give some examples such as Green turtles, corals, Dugong, and small giant clams. Interestingly, the information most of them perceived comes from communication from national parks and Con Dao authority (takes up 65.71%), following media and verbal conveyors (as 31.43% and 22.86% respectively). This can refer that Con Dao authorities have done successful work in communicating with local residents of endangered marine species, however, there are still under

concerned species such as seahorses that have not been properly recognized by people.

28.95% and 7.89% of the answers agreed and strongly agreed that seahorses should be legally protected, (among total number of 38 respondents), 10.53% said they did not agree to legally protect the seahorses. The reason they gave for this answer was because their livelihoods are dependent on these fisheries resources, if not catching them, they would not sustain their lives. 47.37% were unsure for the answers. The percentage is proportionally large, due to number of the answers come from local people. And as they did not take considerate concern about seafood and fisheries resources, it is understandable that they had limited knowledge to give the opinion.

4.7 Seahorse market chain

Fishers play the prominent role of harvesting seahorses, although, according to them, seahorses are incidental species being trapped on the route of their trawling. As the amount they harvest after a journey may vary, depending highly on the area they are going to catch fish, fishers are still the main source to provide seahorses to the Con Dao market, and to export to the mainland. The interview results have not recorded any information of seahorses being transported from the mainland to Con Dao.

Intermediaries which have been identified in Con Dao are middlemen and retailers. In overall, middlemen are collecting a large quantity of seahorses and transport them to the mainland, or distribute to other lower-level middlemen or retailers, while retailers are capable of owning small limited amount and serve

mainly local consumption. The level of the two groups can be distinguished by the size of collection and the networks with fishers. We recognized that local middlemen will locate near the Ben Dam port, for conveniently receiving seafood from the trawls and sending back to the mainland. The middlemen are capable of trading various types of seafood, but more specialized in few types with large quantity, and focusing on the mainland market. We approached 4 medium upper-level middlemen, whom 2 are specialized in seahorses and 2 others are in dried squids, and seahorses. They gave hint of average amount of seahorses being transported to the mainland per journey can be from tens to hundreds kilograms. However, they considered themselves as medium upper-level middlemen, as the biggest middlemen in Con Dao being indicated, owns and transports estimatedly ton in unit of dried seahorses and also the largest quantity of dried seafood.

To the mainland middlemen, they have close and reliable relationship with the upper-middlemen in Con Dao. Among 4 survey upper-middlemen, 3 revealed that the mainland middlemen are members of their families, and 1 said that the mainland middlemen are his senior friends. The transportation of seahorses after the mainland arrival was barely disclosed, theses local middlemen simply stated that the quantity is still going to be collected and then export to China.

Although the mainland is the dominant market of the upper-level middlemen in Con Dao, they can occasionally do retail to tourists, as long as the profit they earn from an unit of seahorses to tourists is higher than the mainland middlemen. However, the small and unstable number of purchase from tourists,

in addition to large quantity stock of seahorses, mainland market is still the target place to the upper-level middlemen.

Lower-level middlemen are playing as a collector and logistican, who visits trawlers anchoring or resting near Con Dao waters, or have connections with some trawlers to collect seafood. This group is less likely to be specialized in some types of seafood, small or no quantity stock and more focused on local market in Con Dao, which are seafood stores, market stands, restaurants and other forms of retailers.

Retailers in Con Dao distribute mainly in the centre of Con Son town, targeting to tourists. In spite of small quantity stock of seahorses due to low demand and high cost comparing to other seafood, these retailers still remain various seafood types as one of the ways to raise their seafood reputation in the market.

Market actors and their connections are going to present in the diagram below (Figure 2):

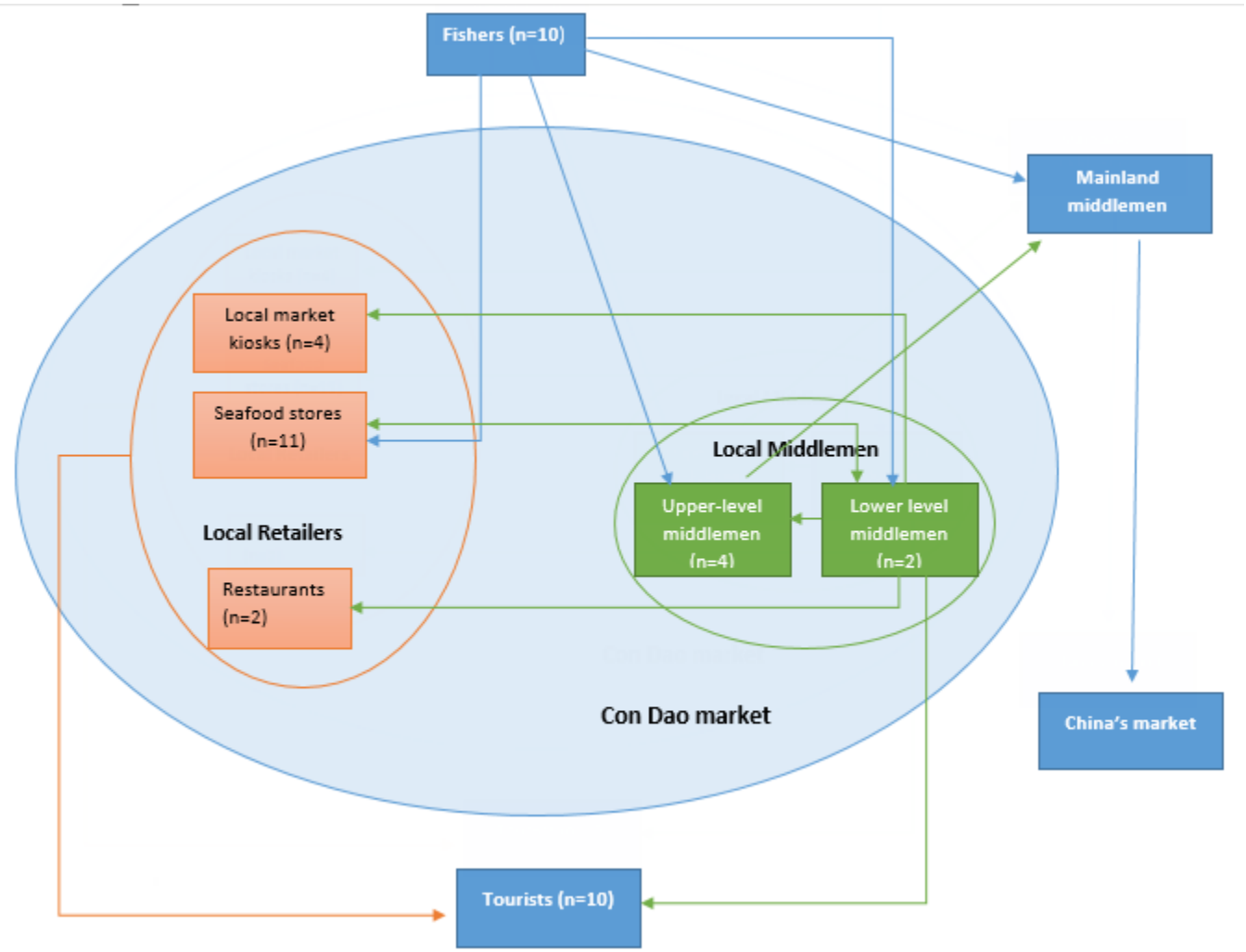

Figure 2 : Market chain of seahorse trading in Con Dao

5. Discussion and Recommendations

5.1 Discussion

The result of the study in Con Dao presented three seahorse species, which are *Hippocampus trimaculatus, H. spinosissimus,* and *H. kelloggi* . As trawlers in most ports in southern and central Vietnam, operating in the South China Sea or Gulf of Thailand, identified *H. trimaculatus* as the most commonly caught seahorse (Meeuwig et al., 2006), followed by *H. spinosissimus* (Giles et al., 2006), it is understandable that the reported results agreed with the previous findings. However, the species identification was limited by observation and experience of traders and fishers primarily, recorded photos have not been used in order to analysing morphological characteristics. In the research in Con Dao, the ability of seahorse identification is appropriate to traders and fishers who usually encounter seahorses, however, local people and tourists barely distinguish between the species, as they have not regularly observed.

Most respondents affirmed that trawlers in off-shore waters are more likely to encounter and catch seahorses than small boats in near-shore areas. A former professional seahorse fisher who had shifted his job from manual seahorse catching to seahorse trading, ascertained that the population of seahorses near-shore has dropped dramatically over the 5 years (some even/or gave for 10 years). The statement is also approved by other interviewers, as not only seahorses, other sea animals have marked a plunge during the period. According to fishers, as trawlers are getting equipped and more advanced, which facilitates the temporal length and capacity of fishing activities, however, the activities of trawlers have increasingly posed into incidental catch. As fishers were

ambiguous about the depth of their fishing areas, and bottom trawl fishing is more likely to be applied in fishing for optimal benefits. Fishing activities in Con Dao waters have not been appropriately controlled. Since the recorded number of trawling boats anchored in Con Dao in a certain period of time (e.g. week, month) has not been conducted systematically and completely by the official authorities, hence, the surveyed result has not represented entirely the fact of fishing activities in Con Dao waters.

Retailers constitute the majority of trader report results in terms of seahorse volume availability. The fluctuation of seahorse volume on traders could indicate the variety of seahorse capacity owned by individual trader. Noticeably from the survey, some retailers who reported of selling 1-3 kg/ year while others could do with 7 -10 kg/ year. . The capability of storing a higher quantity of seahorse reserves could also be associated with the strong connection of certain retailers to middlemen , as seahorses kept high trading price but low consumption in the local market, .

The estimated amount of seahorse volume in the retail sector is based on trader report, and stated to be served for tourists who are domestic consumers. Comparing to the research in 2006, the volume exceeds the total domestic sales of dried seahorses based on surveys of retailers located in four major markets in Vietnam (ca. 103 – 121 kg/ year) (Giles et al., 2006). The estimated amount of dried seahorse, based on a sample of retailers in Con Dao in 2020 is 1.43 -1.67 times more than four major markets 14 years ago, which apparently can be seen that the market of seahorses marks the growth over the years. However, by the survey, dealers attained that majority of seahorses will be collected and

transported to the mainland for export, the trading data on middlemen and wholesalers is inadequate to state that seahorses are more in favor of local consumption or mainland transport.

The reports from respondents on seahorse decline in a period of 5 - 10 years, however, should be considered as an indirect indicator of a decline in seahorse population, rather than direct evidence, as the study has not conducted a specific research to quantify or to access directly the seahorse population over the time. Majority of the answers simply stated that over-exploitation is the role key of the plunge, this should be regarded as a lack of information. While an array of other threats including habitat destruction and pollution, over-exploitation along with habitat loss, was frequently cited for similar declines reported by fishers in other parts of Asia (Vincent, 1996). Hence, from the respondent's perspectives, these threats would be still less likely to be confirmed.

The final channel where seahorses are reported in trade is China's market, according to the knowledge of retailers, and confirmation by middlemen in Con Dao. From the information that all traders have given, during the Covid-19 pandemic, trading between Vietnam and China was suspended, which resulted in the delay of seahorse transactions and the price of seahorses dropped. Currently, by the time we did the second survey in late March 2021, the middlemen said that when the trade between the two countries was gradually recovered, the seahorse price continuing marking its higher value. One senior middleman agreed that the seahorse market in Con Dao is driven by the mainland market which is also driven dramatically by China's market. However, price is not the sole factor that every trader applied, particularly high-profiled

traders such as upper-level middlemen, as transactions are based on long-lasting connections and trust, in which the price will be less likely to be fluctuated.

Generally, awareness of all surveyed respondents regarding legal documents of seahorses is deficient, as seahorses are barely recognized in the public as legally restricted of being caught and traded at certain time and at specific minimum size. Interestingly, some respondents affirmed the deficiency of Vietnam's legal documents by giving similar examples of Indonesia's and Thailand's acts, which defined that the fishing activities have to last for only 6 months in a year, another 6 months for refreshment of fisheries resources. They emphasized that the enactment and performance are valid without tolerance of any violations. This probably could demonstrate the lack of communication and performance in legal documents of administrative officials, when people are better aware of foreign acts and penalties than their national ones.

5.2 Recommendations

Seahorses are recorded being caught by trawl boats, and confirmed by traders, local residents and authorities. The method of management and controlling is challenging as majority of trawl boats are from mainland provinces. Hence, the cooperation among local agencies and counsel with provincial and central governments in patrolling the quantity and activities of boats on and near Con Dao waters should be strictly enforced. As violations in Con Dao district are addressed by different agencies (e.g Fisheries Resource Surveillance Unit (FRSU) is in charge of addressing offences related to fishing equipment, border guard for human-related offences, and rangers of Con Dao National Park (CDNP) for

endangered species offences), hence, to tackle with violations demands the fluent collaboration among these agencies, both in sea patrolling and violations addressing. However, in reality, sea patrolling in Con Dao is mainly conducted by national park rangers, while border guard is supposed to assist FRSU and CDNP where necessary (Khuu et al., 2020). The issue complicatedly comes from the conflicts between authorities, resulted in poor cooperation and law enforcement among agencies (Khuu et al., 2020). Still, the idea of collaboration should be initiated for both short and long term action, and demands advocacy from multiple levels of authorities for speeding the enforcement.

To a larger extent, the district government, aligning with CDNP, should report and counsel the provincial government of tightening and statistically controlling the current and new operational trawling boats registered in Ba Ria – Vung Tau. The exchange of this information between the district and the provincial levels is essential for regulating legal operational boats. Also locally, the recorded statistics of boats anchoring in Con Dao waters, offences in catching endangered or legally protected species, and violations in boat registration, boat size or net size, should be tolerantly shared with concerned agencies, in a proper way without any threat of confidential revealing.

As seahorses are less likely to gain significant concern as other endangered species are in Con Dao (e.g sea turtles, dugongs, giant clams), conservation targeted on seahorse species specifically seems not to be feasible at the time. Rather, to make progress in conserving seahorses, it needs to pay attention to their fisheries, trades and conservation (Foster et al., 2017). Hence, fisheries management could be an indirect pathway to regulate not only seahorse

catching, but also other incidental bycatch species. In which case, management of bycatch activities of off-shore boats should be highly accelerated. The legal fundamental was promulgated in Fisheries Law 2017, and associated degrees and circulars, which already covered the abandonment of bottom trawls, and defined net size for target species, etc. At the same time, enforcement and compliance of responsible agencies should be stimulated for effective performance of fisheries resource management.

Besides, the Con Dao seahorse market is potentially anticipated to be expanded in the next period of 5 years, thus, the regulation and intervention should be approached presently. First off, a wider survey on retail and intermediate businesses should be initiated to figure out the concrete number of seahorse trading participants, and precisely estimate the total volume of seahorses in Con Dao. As the current research approached mainly retailers, and in short of middlemen and fishers, the estimation of total volume may not represent the actual figure. Meanwhile, communication should be combined with the survey in order to deliver the information on the legal conducts of seahorse fishing and trading. As a many people surveyed have not been aware of the status of seahorse conservation by Degree 26/2019 and the CITES list, this work should be gradually practiced and campaigned, with the aim of facilitating the voluntary elimination of seahorse trading on the site from dealers. The fact is that local residents are well aware of some prominent protected species and associated penalty, this is a good example to facilitate CDNP to strengthen their campaign and communication in raising the knowledge of protected species and specifically seahorses. The work might be feasible towards retailers, since seahorses

contribute proportionally small profit to their total income, and account for high seeding capital.

The long term communication is necessary to comprehensively change the local public's perceptions and behaviors on seahorse (and other vulnerable and protected marine species) dealing and consumption. The belief of seahorse application on traditional medicine has embedded in respondents' mindset, hence, consistency and completeness of communication and campaign should be planned by the CDNP with support from the district agencies. In fact, it is possible to take advantage of the participation of government and non-government organizations, and sustainable committed businesses, who are establishing their projects or investment in Con Dao, for the aid of message expansion.

6. Conclusion

Seahorse trade and exploitation in Con Dao has not been entirely exposed in the research, however, the sampling data indicate that the topic should not be underrated for the seahorse conservation and fisheries management as a whole. The Con Dao market is considered small-scale but it revealed some dominant actors in the market chain, which play a significant role in speculation and distribution of certain seahorse volumes inside and outside local market. According to the perceptions of surveyed participants, we can conclude that seahorses are facing major threats, along with other vulnerable species, if not receiving adequate concerns and awareness from the public, and continuing

multiple types of unregulated catching and trading activities. Prospect of sustainable fisheries management should be planned, accompanied with a complete strategy of the district development, therefore, the cooperation of Con Dao authorities and associated agencies, with the agreement of local residents, is optimal. Although some limitations are tangible during this research processes, further seahorse study is recommended to carry out, but should pay more attention on trade and exploitation, and apply intensive technical methods, in order to facilitate large-scale conservation of the species.

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APPENDICES

APPENDIX 1

QUESTIONNAIRE FOR SEAHORSE SURVEY

Pre-questionnaire statement:

My name is….. and I work in the Vietnam marine programme of Fauna & Flora International, an organization that works with communities to achieve wildlife conservation. The aim of this survey is to learn more about seahorses, fisheries livelihoods and the seafood trade in Con Dao, and we would like to ask you about these topics.

Your participation in this survey is voluntary and confidential. We will not save your name or other personal information without permission. Individual answers will be collected and reported as grouped answers only, and we will not share your individual answers beyond the staff involved in the research. You may choose not to answer any of the questions, and you may stop the survey at any time. The whole interview is expected to last for 30-40 minutes.

Do you agree to participate in the interview? *Yes* *No*

For Fishers

A. General questions of fishing habit

1. Where do you fish?

a. On-shore
b. In-shore
c. Off-shore

2. What is the capacity of your boat vessel?

a. Motorized vessel over 90 CV (HP)
b. Motorized vessel from 20 - 90 CV (HP)
c. Motorized vessel below 20 CV (HP)
d. Small or manual boat active nearshore with unlimited capacity

3. What is the length of your vessel?

a. Over 24 m
b. Between 15 - 24m
c. Between 12 - 15m
d. Below 12 m

4. What depth do you fish at?.....

5. What is/ are the fishing gears that you use? (Single Trawl, Pair trawl, Seine nets, Diving, Crab net, Electric shock, others)

6. Why have you chosen to do fishing? .....

7. Has your boat registered a permission for fishing?

a. Yes
b. Yes, but on process or extension
c. No

7.1 If no, why didn't you register?

8. When is the high season and low season for fishing?

High season .....
Low season .....

9. For each journey, how many days is your average fishing trip? .....

10. What species do you catch? (Fishes, Giant squid, Lobster, Shark, Seahorse, Sea turtle, Pearl, Coral reef, Sea cucumber, Sea urchin, others)

B. Questions about seahorse and/or other seafood fishing

If seahorse is selected in above question, continue answering from q. 10 - q. 31

11 What species do you catch on target? .....

12. What species are not caught on target? .....

13. How many seahorses do you know? .....

14. What are the species that you can identify? Photos available

15. What species do traders and consumers prefer? .....

16. How financially important is seahorse trading for your livelihood (Very important, Important, Relatively important, Very less important; Not important)?

Or using scale: 9 - 10 points: Very important; 7-8 points: Important; 5-6 points: Relatively important; 3-4 points: Very less important; 0-2 points: Not important)

17. What months do you catch seahorses? .....

18. A. How many kilograms of seahorses do you catch averagely per journey/ season? ……..

B. How many journeys do you catch seahorses?

……..

19. A. What are the prices of 1 kg/ couple/ individual of seahorses?

Species	**State**		
	Dried	**Fresh dead**	**Fresh live**

B. Are there any differences in selling seahorses in the market? (if yes, please clarify) ……

C. Are the any differences in selling seahorses and other marine species? (If yes, please clarify) ……

20. How does the seahorse price currently differ from previous 5 years? (Increased Decreased, Remained, Do not know)
21. What does productivity of seahorses compare to previous 5 years? (Increased Decreased, Remained, Do not know)
22. If the seahorse catching rate is increasing/ decreasing. In your point of view, what are the factors leading to the fluctuation (decreased/ increased)?

a. Local/state legislations (is nearshore fishing allowed? Do the district authorities support fishers in terms of permission papers, bank loan opportunities, etc. ?)

b. Available resource varieties (number and area of catching sites, possibility of encountering seahorses/ marine species changing?)

c. Change of Weather/ Seasons/ Climate (sunny, windy, more/less calamities)

d. Marine environment (has it been saved or polluted? do you see any environmental problems?)

e. Fishing equipment ((in)applicable fishing gears, boat vessel size and capacity?)

f. Competitive market (number of fishers, traders changed? conflicts between stakeholders?)

g. Others

h. Do not know

23. What do you think you will do if seahorse productivity decreases?

……

24. Do you think that the seahorse fishing rate will fluctuate in the future? Why?

……

25. How profitable is seahorse fishing compared to other seafood?

a. Significantly more profitable
b. Slightly more profitable
c. The same
d. Slightly less profitable
e. Significantly less profitable

26. What purpose do you have in catching seahorses?

a. For use
b. For trade

26.1 If for use, why do you use seahorses? ……

26.2 If for trade, who do you sell seahorses to? And from where?

27. Do you know what purposes that people consume seahorses? If selecting any options, please specify. ……

28. A. Have you been aware that there are some seahorse and/or other marine species that are legally protected (by Decree 26/2019)?

a. Yes
b. No

B. Do you know any marine species which are being restricted or banned for catching/ trading/ exporting in Con Dao?

c. Yes (Please give details)
d. No

28.1 If yes (any of above question), by what means do you know?

a. Media (Social platforms, television, etc)
b. Verbal conveyors (other fishers, traders, etc.)
c. Communication from district authorities, local officers, etc.
d. Self-study on legal documents, regulations, decrees, etc.
e. Others……..

29. At what extent do you agree that seahorses should be protected?

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree
f. Not sure

30. What is your age? ……

31. Biological sex? ……

32. Are you native or immigrant?

a. Native
b. Immigrant (How long have been residing here?)
c. Others

32.1 If you are an immigrant, why did you move to Con Dao?

……

33. How long have you been fishing seahorses/ seafood?

34. Have you ever shifted your means of living?

a. Yes
b. No

c. Prefer not to say

34.1. If yes, why did you shift your means of living, how has it been after shifting?

……

35 Are your family members participating/ involved in fishing/ trading seafood? If yes, how many?

a. Yes. Doing fishing (Specify number….)
b. Yes. Doing trade (Specify number….)
c. Yes. Doing both (Specify number….)
d. None

36. Have you ever had a conflict with other fishermen regarding fishing areas, fishing profits, etc? If yes, could you give details. If no, do you know any conflicts that ever happened?

For traders (Wholesalers, middlemen and retailers in the port and the market)

1. Are you a…?
a. Wholesaler
b. Middleman
c. Retailer
d. Shop owner/ restaurant owner
e. Others (please specify…)
2. What species do you trade? (Fishes, Giant squid, Lobster, Shark, Seahorse, Sea turtle, Pearl, Coral reef, Sea cucumber, Sea urchin, others)

If seahorses are included, continue the following questions

3. What are seahorse species that you are trading? Photos available
4. What species that buyers prefer?
5. How important seahorse trading is in your business (Very important, Important, Relatively important, Very less important; Not important)?

Or using scale: 9 - 10 points: Very important; 7-8 points: Important; 5-6 points: Relatively important; 3-4 points: Very less important; 0-2 points: Not important)

6. What is the high season for seahorse trading? ……
7. What the sources/ providers do you get seahorses?

	Subjects	Local	Mainland	Abroad
a.	Fishers			……
b.	Wholesalers			……

c.	Middlemen			.....
d.	Retailers			.....
e.	Souvenir shops/ restaurants			.....
f.	Local residents			.....
g	Tourists			
h.	Khác			.....

8. What state of seahorse do you trade?
    1. Dried
    2. Dead fresh
    3. Live fresh
9. How much/ how many seahorses do you trade averagely per month?

.....

10. What is the price of seahorse per kg?

Species	**State**		
	Dried	**Fresh dead**	**Fresh live**

11. How does the seahorse trading rate currently differ from previous 5 years? (Increased, Decreased, Remained, Do not know)
12. In your point of view, what is/are the reasons leading to the fluctuation (if decreased/ increased)? For each option selected, please give details.
    a. Local/state legislations (procedures of registering a permission, or legal support from the district authorities for traders in Con dao)

b. Available resource varieties (how is local/ mainland/foreign source availability?)
c. Change of Weather/ Seasons/ Climate (sunny, windy, more/less calamities)
d. Marine environment (has the environment been saved or polluted? do you see any environmental problems?)
e. Competitive market (number of fishers, traders changed? conflicts between stakeholders?)
f. Others….
g. Do not know

13. What would you do if seahorse availability decreases? ……

14. Do you think that the seahorse trading rate will fluctuate in the future? Why? …….

15. Who are regular buyers that you sell seahorses?

	Subjects	Local	Mainland	Abroad
a.	Fishers			.....
b.	Wholesalers			.....
c.	Middlemen			.....
d.	Retailers			.....
e.	Souvenir shops/ restaurants			.....
f.	Local residents			.....
g	Tourists			
h.	Khác			.....

If you export seahorses to other countries, how much do you export averagely per month?

…….

16. What factors influence the seahorse price?
    1. Size
    2. Color, gloss
    3. Species

4. State of seahorse (dried, live fresh, dead fresh)
5. Origin
6. Others

17. How profitable is seahorse trading compared to other seafood?
    1. Significantly more profitable
    2. Slightly more profitable
    3. The same
    4. Slightly less profitable
    5. Significantly less profitable
18. Do you know what purposes that people consume seahorses? please specify.

19. A. Have you been aware that there are some seahorse species that are legally protected (by Decree 26/2019)?
    1. Yes
    2. No

    B. Do you know any marine species which are being restricted or banned for catching/ trading/ exporting in Con Dao?
    a. Yes (Please give details)
    b. No

    19.1 If yes, by what means do you know?
        a. Media (Social platforms, television, etc)
        b. Verbal conveyors by other fishers, traders, etc.
        c. Communication from district authorities, local officers, etc.
        d. Self-study on legal documents, regulations, decrees, etc.
        e. Others
20. At what extent do you agree that seahorses should be protected?
    1. Strongly agree
    2. Agree
    3. Neutral
    4. Disagree
    5. Strongly disagree
21. What is your age?
22. Biological sex?
23. Are you native or immigrant?
    a. Native
    b. Immigrant (How long have you been residing in Con Dao?)
    c. Others

    23.1 If you are an immigrant, why did you move to Con Dao?
    .....
24. How long have you been trading seahorses/ seafood?
    .....
25. Have you ever shifted your means of living?
    1. Yes
    2. No

3. Prefer not to say

25.1 If yes, why did you shift your means of living, how has it been after shifting?

……

26. Are your family members participating/ involved in trading seafood? If yes, how many?

a. Yes. Doing fishing (Specify number….)
b. Yes. Doing trade (Specify number….)
c. Yes. Doing both (Specify number….)
d. None

27. Have you ever had a conflict with other traders regarding seahorse/ seafood providers, seahorse/ seafood benefits, etc? If yes, could you give details? If no, do you know any conflicts that ever happened?

For Consumers (Locals, Tourists)

Locals

1. What are the species fishers/ traders that you see being caught and traded in Con Dao? (Fishes, Giant squid, Lobster, Shark, Seahorse, Sea turtle, Pearl, Coral reef, Sea cucumber, Sea urchin, others)
2. What are the species which you see traders usually trade? (Fishes, Giant squid, Lobster, Shark, Seahorse, Sea turtle, Pearl, Coral reef, Sea cucumber, Sea urchin, others)
3. Do you buy and consume any of these species? What are your favorites?

……

4. Have you ever seen seahorses being traded in Con Dao yet?

a. Yes
b. No

4.1 If yes, what are the species that you can identify? Photos available

4.2 Do you know fishing gears that fishers use for catching seahorses?

4.3 Do you know where seahorses come from?

4.4 Do you know seahorses are sold to whom and where?

	Subjects	Local	Mainland	Abroad
a.	Fishers			…….
b.	Wholesalers			…….
c.	Middlemen			…….

d.	Retailers			.....
e.	Souvenir shops/ restaurants			.....
f.	Local residents			.....
g	Tourists			
h.	Khác			.....

4.5 Do you know the price of one kg/couple/ individual?

Species	**State**		
	Dried	**Fresh dead**	**Fresh live**

5. Have you ever bought seahorses?

a. Yes

b. No

5.1 If No, do you intend to buy seahorses? Why?

.....

5.2 How often do you buy seahorses?

a. Less than once per year

b. Once per year

c. 2-5 times per year

d. Once per month

e. More than once per month

f. Others (Please specify)

5.3 What seahorse species that you prefer? (Spiny seahorses, Indonesian seahorses, etc.)

5.4 For each time, how many seahorses do you usually buy?

.....

5.5 What state of seahorses do you prefer?

a. Dried
b. Dead fresh
c. Live fresh

5. For what purposes do you buy seahorses?

a. Food
b. Medicine
c. Ornament
d. Others (.....)

5.5. What factors of seahorses influence your decision of buying?

a. Size
b. Color, gloss
c. Species
d. State of seahorse (dried, live fresh, dead fresh)
e. Origin
f. Price
g. Others

6. A. Have you been aware that there are some seahorse species that are legally protected (by Decree 26/2019)?

a. Yes
b. No

B. Do you know any marine species which are being restricted or banned for catching/ trading/ exporting in Con Dao?

a. Yes (Please give details)
b. No

6.1 If yes, by what means do you know?

Media (Social platforms, television, etc)
Verbal conveyors by other fishers, traders, etc.
Communication from district authorities, local officers, etc.
Self-study on legal documents, regulations, decrees, etc.
Others

7 . At what extent do you agree that seahorses need to be legally protected?

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

9. What is your age?

10. Biological sex?

11. Are you native or immigrant?

d. Native
e. Immigrant (How long have you been residing in Con Dao?)

f. Others

11.1 If you are an immigrant, why did you move to Con Dao?

.....

Tourists

1. Where are you from?
2. What is your main purpose for visiting Con Dao?
   a. For casual amusement (beaches, resorts,etc)
   b. For spiritual visit (historical monuments)
   c. For ecological experience (natural forests, coral reefs, etc)
   d. For business (work, study, research, etc)
   e. Others
3. Do you plan to buy any seafood in Con Dao?
   a. Yes
   b. No
   c. Not sure
4. Have you tried seafood in Con Dao? How do you think?

.....

5. Do you know seahorses and how seahorses look like?
   a. Yes
   b. No

   5.1 If yes, did you see seahorses being sold in Con Dao market or any where in Con Dao?
   a. Yes
   b. No
6. What are the species that you have seen being traded/ caught in Con Dao?

.....

7. Have you ever bought or intended to buy seahorses? If yes or no, please give explanations

a. Yes
b. No

7.1 If yes, do usually ask for the origin of seahorses? If yes, where are they from?

.....

7.2 Have you ever bought seahorses from somewhere else?

.....

7.3 How often do you buy seahorses?
   a. Less than once per year
   b. Once per year
   c. 2-5 times per year
   d. Once per month
   e. More than once per month
   f. Others (Please specify)

7.4 What seahorse species that you prefer? (Spiny seahorses, Indonesian seahorses, etc.)

7.5 For each time, how many seahorses do you usually buy?

.....

7.6 What state of seahorses do you prefer?

a. Dried
b. Dead fresh
c. Live fresh

8. For what purposes do you buy seahorses?

a. Food
b. Medicine
c. Ornament
d. Others (.....)

5.5. What factors of seahorses influence your decision of buying?

a. Size
b. Color, gloss
c. Species
d. State of seahorse (dried, live fresh, dead fresh)
e. Origin
f. Price
g. Others

6. A. Have you been aware that there are some seahorse species that are legally protected (by Decree 26/2019)?

a. Yes
b. No

B. Do you know any marine species which are being restricted or banned for catching/ trading/ exporting in Con Dao?

a. Yes (Please give details)
b. No

6.1 If yes, by what means do you know?

a. Media (Social platforms, television, etc)
b. Verbal conveyors by other fishers, traders, etc.
c. Communication from district authorities, local officers, etc.
d. Self-study on legal documents, regulations, decrees, etc.
e. Others

7 . At what extent do you agree that seahorses need to be legally protected?

a. Strongly agree
b. Agree
c. Neutral
d. Disagree
e. Strongly disagree

9. What is your age?

10. Biological sex?

11. Are you native or immigrant?

g. Native

h. Immigrant (How long have you been residing in Con Dao?)

i. Others

11.1 If you are an immigrant, why did you move to Con Dao?

.....

APPENDIX 2

Image 1: Spiny seahorse (*Hippocampus spinosissimus)*

Image 2: Three-dotted seahorse (*Hippocampus trimaculatus)*

Image 3: A pair of Great seahorse (*Hippocampus kelloggi*)

Image 4: A bag of dried seahorses being sold in a seafood store

Image 5: A red seahorse *(H. spinosissimus)*, being so-called rare and expensive

Image 6: 2 red seahorses in a bag

Image 7: A small seahorse in size being caught and sold

Image 8: Seahorses according to size

Image 9: Seahorses are being caught and

Image 10: Seahorses are being preserved in

dried from a trawl white liquor and displayed in a seafood store

Image 11 & 12: A fussy jar preserving seahorses, sea dragrons, and earth ginseng

Image 13 & 14: A trawl and its fishing gear and net system which are supposed to be capable of regularly catching seahorses