

# ***Jiangsu Doulong Crayfish Fishery Management Plan***



# Doulong River crayfish trap fishery

11<sup>th</sup> December 2019

## Names / Logos of key FMP proponents

Crayfish Production and Marketing Cooperation Project Team

China Aquatic Products Processing and Marketing Association (CAPPMA)

Dafeng Fisheries Technical Extension Station

Marine Stewardship Council (MSC)

Jiangsu Baolong Group

Lyons Seafood Group

## FMP Version number

Version number	Date published	Key contributors	Description of key changes
1.0	20 March	Zhu Yaping Zhang Linlin Yu Xiaotong Xie Guoxing Cheng Xiaogang Yangping Tim Huntington	Draft of FMP
2.0	30 September, 2019	Zhu Yaping Zhang Linlin Yu Xiaotong Xie Guoxing Cheng Xiaogang Tim	FMP with new template
3.0	11 December, 2019	Zhu Yaping Zhang Linlin Yu Xiaotong Xie Guoxing Cheng Xiaogang, Robyn Cloake, Tim Huntington, Paul Medley.	Fishery description, fishery management structure, Trap Identification, HCR, HS update. stock assessments, compliance and monitoring
4.0			

<It is good practice to provide numbers to record the version number of the management plan e.g. Version 1.0 for the initial approved version, together with other information to provide transparency on the plan's development>

## Contents

<b>1.</b>	<b>IDENTIFICATION AND DESCRIPTION OF THE FISHERY.....</b>	<b>7</b>
1.1	FISHERY TO WHICH THIS PLAN APPLIES .....	8
1.2	DESCRIPTION OF THE FISHERY.....	9
<b>2.</b>	<b>GOALS AND OBJECTIVES.....</b>	<b>18</b>
2.1	GOVERNANCE AND POLICY.....	18
2.2	FISHERIES-SPECIFIC MANAGEMENT OBJECTIVES .....	20
<b>3.</b>	<b>FISHERIES MANAGEMENT STRUCTURE .....</b>	<b>22</b>
3.1	LEGAL FRAMEWORK .....	22
3.2	INSTITUTIONAL ARRANGEMENTS.....	23
3.3	CONSULTATION AND CO-MANAGEMENT ARRANGEMENTS .....	27
3.4	ALLOCATION OF RESOURCES .....	27
<b>4.</b>	<b>HARVEST STRATEGY AND CONTROL RULES .....</b>	<b>28</b>
4.1	HARVEST STRATEGY.....	28
4.2	HARVEST CONTROL RULES.....	31
4.3	DECISION-MAKING FRAMEWORKS.....	36
<b>5.</b>	<b>ECOSYSTEM MANAGEMENT STRATEGIES.....</b>	<b>40</b>
5.1	PRIMARY AND SECONDARY SPECIES.....	40
5.2	ENDANGERED, THREATENED AND PROTECTED SPECIES (ETP) .....	42
5.3	HABITATS.....	43
5.4	ECOSYSTEM.....	44
<b>6.</b>	<b>STOCK ASSESSMENT, FISHERY MONITORING AND RESEARCH.....</b>	<b>46</b>
6.1	STOCK ASSESSMENTS .....	46
6.2	FISHERIES-DEPENDENT MONITORING AND REPORTING .....	47
6.3	BYCATCH, ETP SPECIES AND OTHER SURVEYS .....	48
6.4	OTHER RELEVANT RESEARCH .....	48
<b>7.</b>	<b>COMPLIANCE AND MONITORING .....</b>	<b>49</b>
7.1	OBJECTIVES AND APPROACH .....	49
7.2	PLANNING.....	49
7.3	ROLES AND RESPONSIBILITIES IN COMPLIANCE .....	54
<b>8.</b>	<b>FISHERY PERFORMANCE EVALUATION.....</b>	<b>56</b>
8.1	MEASURABLE PERFORMANCE INDICATORS .....	56
8.2	REVIEW PROCESS .....	57
8.3	FISHERIES MANAGEMENT PLAN REVISION AND UPDATE .....	58
<b>9.</b>	<b>RESOURCES REQUIRED TO IMPLEMENT THE PLAN .....</b>	<b>59</b>
9.1	APPROACH.....	59
9.2	COST SHARING AND RECOVERY .....	60

## Appendices

APPENDIX A: REFERENCES.....	60
APPENDIX B: GLOSSARY.....	61

## Acronyms used

B.....	Biomass
BoF.....	Bureau of fisheries, China
BMT.....	Benchmarking and Tracking Tool
CAS.....	Consequence Spatial Analysis
Cat.....	Category
CBD.....	Convention on Biological Diversity
cm.....	centimetre
CHN.....	China
CoP.....	Code of Practise
CPUE.....	Catch per Unit Effort
DCFA .....	Dafeng Crayfish Fishery Association
EAF.....	ecosystem approach to fisheries
EC .....	European Commission
ERA .....	Ecological Risk Assessment
ETP.....	Endangered, Threatened and Protected
EU.....	European Union
EUR.....	Euro
F.....	Fishing mortality
FAO.....	Food and Agriculture Organization of the United Nations
FIP.....	Fishery Improvement Project
FMSY.....	Fishing mortality rate that would give maximum sustainable yield
FPA.....	Fisheries Partnership Agreement
GT.....	Gross Tonnes
ISBF.....	Introduced Species Based Fisheries (MSC term)
IUU.....	Illegal Unreported and Unregulated (fishing)
LME.....	Large Marine Ecosystem
m.....	metre(s)
MCS.....	Monitoring, Control and Surveillance
MoA.....	Ministry of Agriculture
MPA .....	Marine Protected Area

MSC.....Marine Stewardship Council  
MSY.....Maximum Sustainable Yield  
mt.....Metric tonnes  
mu..... Chinese measurement of water where 1mu = (1 / 15 of a hectare)  
N.....No (in relevant MSC scoring tables)  
N/A.....not applicable or not available  
Na (or na).....not applicable  
NGO.....non-governmental organisation  
nm.....nautical mile  
PCM.....Post-capture mortality  
PRC.....People's Republic of China  
PSA.....Productivity Susceptibility Analysis  
RBF.....Risk-Based Framework  
SB.....Spawning Biomass  
SFPA.....Sustainable Fisheries Partnership Agreement  
SICA.....ScaleIntensity Consequence Analysis  
SPR..... Spawning biomass per recruit  
t.....tonne(s)  
UoA.....Unit of Assessment  
UoC.....Unit of Certification  
USD..... Unite States dollar  
Y.....yes (in relevant MSC scoring tables)

# 1. Identification and Description of the Fishery

## Guidance for completing Section 1 – Identification and Description of the Fishery

Section 1 should set out:

- The (i) location and nature of the fishery in terms of the target stocks covered, its location, fishing methods and (ii) the time period covered by the plan and the revision dates if known.
- A description of the fishery, including its history, the nature of the target species(s), the environment and socio-economic characteristics.

The purpose is to provide readers with a broad understanding of the fishery and its main characteristics.

The Jiangsu Yancheng Dafeng Crayfish Fishery Improvement Project (FIP) encompasses that of the Doulong river and associated waterway network in Jiangsu Province Dafeng City. The Unit of Assessment is near the Jiangsu Yancheng Wetland National Nature Reserve which borders the Rare Bird and UNESCO Yancheng World Biosphere Reserve. Crayfish in the Dafeng region are fished using fixed cages and shrimping (Fyke type) nets, with a minimum mesh size of 2 cm. No bait is used in the fishery. The planned duration of FIP is three years; starting from 26 April 2017 and ending on the 31<sup>st</sup> March 2020.

This FIP is expected to assess the sustainable utilization of resources of wild crayfish in Doulong River in Dafeng District, Yancheng City, Jiangsu Province, according to the standards of the Marine Stewardship Council (MSC). With the joint participation of the local governments, research institutes, fishery enterprise (Jiangsu Baolong Group) and fishermen and the China Aquatic Products Processing and Marketing Association (CAPPMA) as the major executive, this Project aims to promote the local red swamp crayfish fishery to obtain and maintain the MSC Sustainable Fisheries Standard.

Starting in January 2018, the executive party of Project took part in the China Aquatic Products Processing and Marketing Association Crayfish Branch (CAPPMA Crayfish Branch). The CAPPMA Crayfish Branch established the crayfish production and marketing cooperation project team (Project Team) of in Dafeng District. The Project Team is mainly responsible for 1) formulating the management methods of the wild crayfish resources of Doulong River in Dafeng District, Yancheng City 2) establishing decision-making mechanism and daily supervision and management, and 3) carrying out sustainable assessment of crayfish fishery resources and improvement of fishery. The specific contents include: regular communication with local fishery authorities, annual data collection, fishermen's capacity building and training on laws and regulations, analysis and


coordinating experts for scientific monitoring.

In order to better implement the Project, according to the actual situation of Yancheng, Dafeng District, the Project Team has developed a management plan for the crayfish fishery in the Doulong River water system in Dafeng District, which serves as the guidelines for the Project Team members and local fishermen to manage the crayfish production activities.

### 1.1 Fishery to which this plan applies

<b>Fishery name:</b>	Doulong River crayfish trap fishery
<b>Species covered:</b>	<i>Procambarus clarkii</i> (red swamp crayfish)
<b>Fishery location:</b>	<p>Geographical range (as shown in Figure 1): within the South of Xichao River (inclusive), West of Dafeng Seawall, North of the Wanggang River (inclusive) and East of Tongyu River (inclusive) which Includes the Doulong River and the Dafenggan River basins and excluding the rare birds nature reserve.</p> <p><b>Figure 1 – Geographical Range of the Crayfish fishery</b></p>



<p><b>Fishing method(s)</b> :</p>	<div style="display: flex; justify-content: space-around;">   </div> <p><b>Figure 2 left - Crayfish fishing gear (地笼 or Ground cage). Figure 3 right: Typical Crayfish fishing boat. source: Lyons seafood RSS level1, September 14.</b></p> <p><i>Procambarus clarkii</i> in Dafeng District are caught using fixed traps consisting of long bag nets called 地笼 or directly translated as a ground cage. The length of the Reap is between 3-5meters long per net with a diameter of 30 -50 cm and the fishing regulations clearly stipulate that the minimum mesh size should not be less than 2 cm, (Figure1). A 2019 inspection conducted by the BoF China saw that the mesh size for all traps assessed were 3cm in diameter (above the stipulated 2cm). The crayfish fishing process does not use bait and the fishing device needs to be placed for 24 hours (the water temperature is high in summer, the crayfish are more active for feeding, so the placement time is shortened) and will be placed in the water again after the net is closed. These fishing devices are usually tied to wooden stakes on river beds, and fishing is carried out by one or two fishermen on small wooden boats less than 5 metres in length (Figure2). Boats are propelled using a pole to push the craft through the water. Where the traps are laid in shallow sections of the river, fishermen will wade into the water to collect the catch.</p>
<p><b>Term of plan:</b></p>	<ol style="list-style-type: none"> <li>1. Based on a MSC pre-assessment;</li> <li>2. Have an agreed Action Plan with measurable indicators and an associated budget;</li> <li>3. Involve a FIP ‘Partnership’ with a secretariat, a coordinator and technical facilitators;</li> <li>4. Have a final goal of MSC certification.</li> </ol>

<b>Date of next review:</b>	March 2025
<b>Key authors:</b>	Crayfish Production and Marketing Cooperation Project Team China Aquatic Products Processing and Marketing Association (CAPPMA) Dafeng Fisheries Technical Extension Station Marine Stewardship Council (MSC) Jiangsu Baolong Group Lyons Seafood Responsible Sourcing Group

## 1.2 Description of the Fishery

### 1.2.1 Historical Overview

<Brief history of the development of the fishery, including catch and effort trends, any key events (e.g. closures) and a chronology of management e.g. key legislation and the institutions involved>

Whilst native to South Central America, *Procambarus clarkii* was introduced to China in 1929 where the species thrived and later became an invasive pest to the indigenous ecosystem due to its high adaptability, high fecundity and aggressive nature. During the 1980s, interest in cultivation was stimulated by the development of the national and international markets for crayfish, leading to the establishment of processing plants. Since then *P. clarkii* has been farmed on a relatively small scale, but over a large geographical range. The red swamp Crayfish is now considered as a naturalized species in a number of regions of China and is described as both socially and economically accepted and important. Eradication of the species could potentially lead to greater negative environmental impacts. Although wild caught crayfish account for a small portion of the total Chinese production; 50,000 tonnes caught compared with 569,661 tonnes farmed in 2014, (FAO,2017), the Fishery plays an important economic staple in the local freshwater fishing industry and many local Chinese families or Riverfolk who live in dwellings next to the river are dependent on the fishery for food, income and livelihoods.

The majority of crayfish production is reported to occur in the lower regions of the Yangtze River, mostly in the Jiangsu Province. Dafang City catch records show that total regional landings in 2015

were around 12,000 t, of which around 4,000 t was purchased by Baolong itself, with the rest going to local sales.

Management of the fisheries in China fall under the responsibility of the Ministry of Agriculture (MoA) via the Bureau of Fisheries (BoF) and scientific support is provided primarily by the Chinese Academy of Fishery Sciences. Currently Article 22 of the Fisheries Law 2004 states that “total fishing quotas shall be allocated in adherence to the principles of fairness and impartiality. The means and results of allocation shall be made known to the public and shall be subject to supervision”. Fisheries regulations also require the engagement of researchers, fishers, production managers and other stakeholders to ensure they understand regulations and operate within the legal framework. Local government and fishery management authority in Dafeng announce and ask for opinions before making rules and regulations for crayfish management.

At the time of writing, there is currently no stock-specific management framework or management plan in place for the crayfish stock. There is no evidence of the implementation of highly conservative management measures. Catches are recorded by the fishers and are collected and audited routinely by the local fishery management agency, but no evidence of this data is provided.

Jiangsu Doulong Crayfish FIP started in 2017 by the lead of CAPPMA. The FIP is mainly based on the standards of Marine Stewardship Council (MSC) for the assessment of the sustainable use of fishery resources in the process of crayfish catches in the Doulong River in Dafeng County, Yancheng City, Jiangsu Province. The project was undertaken by means of organizing local government and fishery enterprises (Jiangsu Baolong Company), as well as other relevant parties such as fishermen to participate in the project. China Aquatic Products Processing and Marketing Alliance was the main executor to promote the process of local crayfish fishery achieving MSC sustainable fishery certification.

### **1.2.2 Biology of the Target Stocks**

<For each species / stock complex to be included in the plan (see Section 1.1 above), provide a brief description of its *main characteristics* (e.g. distribution, known stocks) *life cycle*, *inter-species relationships* (e.g. its major predators and prey) and *critical habitats* (associations with different habitats, in particular vulnerable marine ecosystems (VMEs)>

#### **1.2.2.1 Morphological characteristics**

The adult body of *Procambarus clarkii* ranges from 70-130mm long, measured from the forehead to the tail fan, reaching sizes in excess of 50g in 3-5 months. Body colour varies with age, from dark yellow to deep red with larvae generally being lighter in colour and shrimps darker and Juveniles not exhibiting a red carapace until maturation. The body is divided into two parts, the chest and the abdomen. There are 5 pairs of appendages in the head, of which the first 2 pairs are more developed,

the chest has 8 pairs of appendages, the last 5 pairs are step feet, and the first 3 pairs are all chelation feet (chelating limbs). The abdomen is relatively short, with 6 pairs of appendages. The first 5 pairs are swimming limbs, the last 1 pair is combined with the tail section to synthesize the tail fan, and the tail fan is developed.

### **1.2.2.2 Habitat and Biology**

Crayfish are highly adapted to digging burrows with their front limbs. These established burrows mitigate the crayfish against drought or cold periods and aid in predatory evasion. Studies have shown that boring preference is relatively loose with loam of certain hardness. *P.clarkii* is not adapted to swimming well and generally inhabit the bottom of the watercourse, confirmed by studies which found that crayfish prefer to live in ponds with static water. Habitat selection is based on hiding in structures and water bodies which admit low levels of light such as cracks in the masonry, under vegetation (acting as both food and habitat) or in caves. waterbodies with poor aquatic plants have very little distribution of crayfish. *Procambarus clarkii* has a wide water temperature tolerance of 5-38 ° C. Optimum habitat water pH for *P.clarkii* is 7.5-8.5, with the dissolved oxygen content of 2 mg/l or more. The Crayfish show high adaptability to changes of low salinity water bodies within a short time frame and is exhibits strong resistance to disease and pollution. Field investigations of Doulong Port, Tributary of Doulong Port and Artificial Canal indicate that the water depths of the three rivers above are mainly between 1 and 4 meters, and the water flow is mainly maintained at 0.019 to 0.045 m/s with vegetation such as Reeds, Scarps and duckweed distributed on both sides of the river bank.

*P. clarkii* displays territorial behaviour and is aggressive to its own species when competing for food or burrows. Larval and Juvenile stages have a strong self-cutting and regenerative ability and is a protective adaptation shared by crustaceans.

As an omnivorous predator, it is located in the second and third trophic levels of the native ecosystem, feeding on aquatic plants, animal and plant debris, aquatic attachment organisms, plankton, aquatic invertebrates, larvae and eggs of amphibians, adhesive sticky eggs of fish. Once established, the crayfish become a keystone species and a primary contributor to the ecosystem it inhabits. Reports show that aquatic insect larvae are a major component of their stomach contents when other food species are insufficient. Larvae tend to be carnivorous, and later larval stages tend to be more omnivorous or herbivorous. However, when the food is insufficient, the adult is opportunistic and will feed on the animal protein, even reverting to cannibalistic tendencies. It has been reported that crayfish feed on the lumps of fertilized eggs produced by frogs. It has also been observed in a study that crayfish feed on the viscous fertilized eggs attached to the aquatic plants by the economically important fish carp. In the same study, it was observed that the biomass of the

economically important fish carp and carp in the local natural waters decreased in biomass when the crayfish population was the highest in 1985.

In Kenya, researchers have observed that crayfish feed on the intermediate host of human schistosomiasis and is used as a biological control. In Portugal, researchers have also observed that crayfish feed on invertebrates and it can account for more than 85% of the crayfish food composition. Account by Hobbs and Whiteman, 1991 suggest that *P. clarkii* is a serious threat to the survival of indigenous crayfish by competing with and often outcompeting local crawfish for food, habitat and other resources (especially habitats). Predators of the Crayfish in its larval and Juvenile stages are that of larger fish species and wading birds and In adult form, otters and other opportunistic land mammals.

### 1.2.2.3 Reproduction

Their breeding strategy is that of an r-type species with a short developmental period and low investment in offspring rearing but higher investment in that of other crustacean species. Under certain conditions including that of sufficient food, it can mature in one month. In the Yangtze River basin of China where where *P. clarkii* was first introduced, crayfish generally enter the breeding season in mid-June and **peak** in November each year. In the Dafeng District of Yancheng, Jiangsu, breeding occurs June to December.

In mature females, egg development begins prior to burrowing and maturation of eggs occurs inside the burrow. Once matured the eggs are expelled through oviducts and externally fertilized with sperm stored in the female seminal receptacle ( post interaction from mature males) and are then attached to the swimmerettes used to waft water over the berried mass to oxygenate them. The size and condition of the female determine the egg production and typically ranges from 200 – 500 eggs. Once hatched, the larval stages one and two remain attached to the abdomen until their third moult when they become free and can forage.

### 1.2.3 Ecosystem and Habitat

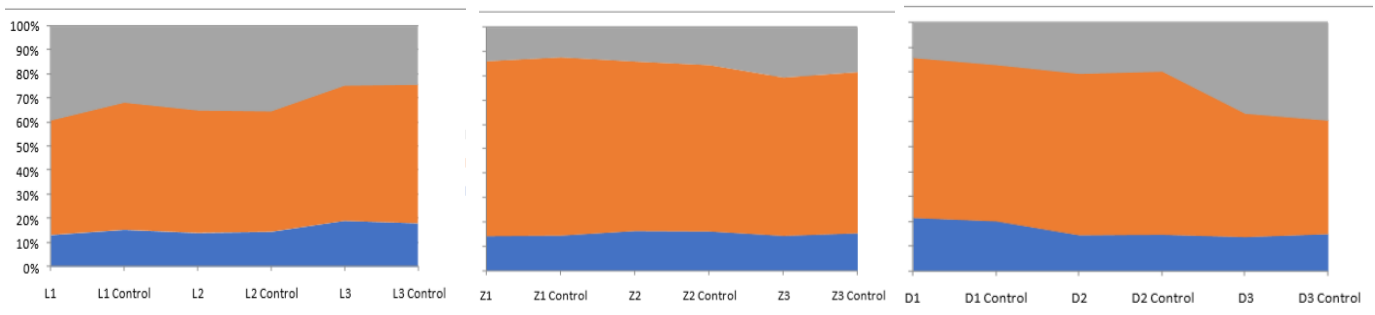
<Description of the *physical ecosystem* (depth, currents, substrate types & coastlines) and *biological environment* e.g. nutrient status, primary production, main trophic constituents, main habitat distribution, presence of vulnerable marine ecosystems (VMEs) and any interactions with other non-target bycatch, including endangered, threatened or protected (ETP) species.>

#### 1.2.3.1 Physical Ecosystem

The annual natural precipitation in Dafeng District is above 1000 mm, ranging between 2000 mm per year and the low flow years of 500 mm. Along the 112Km coastline rivers such as Chuandong Port, Jiangjie River, Wanggang River, Ermaoyou River, Simaoyou River, Doulong Port, Xichao River, Dafenggan River flow into the yellow sea. with an average annual runoff of 510 million cubic meters.

The amount of water transit is about 2.5 billion cubic meters. The underground freshwater resources are abundant. Dafeng District has the climatic characteristics of the transition from the north subtropical zone to the warm temperate zone. Its geographical advantages are conducive to various kinds of biological diversity and high fertility. The dominant species of the investigation included insects *Chironomus flaviplumus* and *Glyptotendipes tokunagai*.

A research report conducted by the PT showed substrate types of of Doulong Port, Tributary of Doulong Port and Artificial Canal were mainly composed of silt which accounted for more than 50%, while clay and sand were relatively little. The distribution of substrate types along with the three river courses was relatively uniform. The type and distribution of the substrate at investigation sites were similar to their corresponding control, which was of no significant difference, (Figure 4)



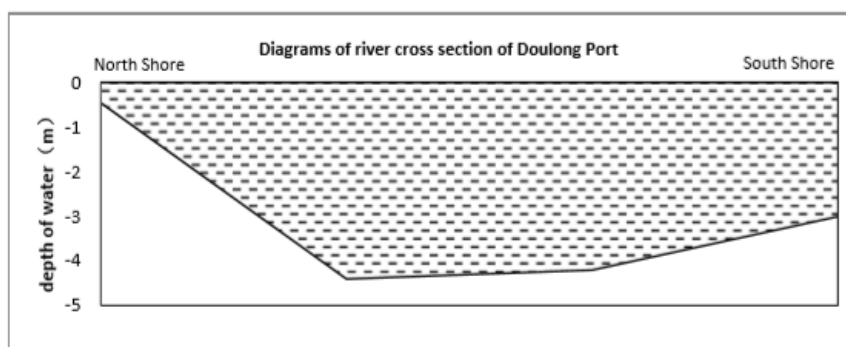
**Figure 4 -Distribution of substrate types (left to right) along Artificial Canal, Tributary of Doulong Port and Doulong Port.**

Between the three different sites sampled during the habitat investigation for Crayfish in Yancheng city, Doulong port shows a slightly lower average water temperature and PH when compared with the tributary of port and the artificial canal. The flow rate at the port sites were consistency higher Flow rate is higher also in the Doulong Port and the flow directions vary from west to east. Table1 Describes the output of flow rates, temperature, PH, flow rate and direction.

Section name	Water temperature (°C)	pH	flow rate (m/s)	flow direction
Doulong Port 1	30.2	8.29	0.046	west→east
Doulong Port 2	30.2	8.29	0.043	west→east
Doulong Port 3	30.2	8.28	0.044	west→east
Doulong Port 4	30.2	8.29	0.048	west→east
Average	30.2	8.29	0.045	west→east
Tributary of Doulong Port 1	30.3	8.49	0.035	South→North
Tributary of Doulong Port 2	30.3	8.50	0.036	South→North
Tributary of Doulong Port 3	30.3	8.50	0.042	South→North
Tributary of Doulong Port 4	30.3	8.51	0.034	South→North
Average	30.3	8.50	0.037	South→North
Artificial Canal 1	31.5	8.64	0.018	west→east
Artificial Canal 2	31.5	8.63	0.019	west→east
Artificial Canal 3	31.5	8.62	0.019	west→east
Artificial Canal 4	31.6	8.63	0.020	west→east
Average	31.5	8.63	0.019	west→east

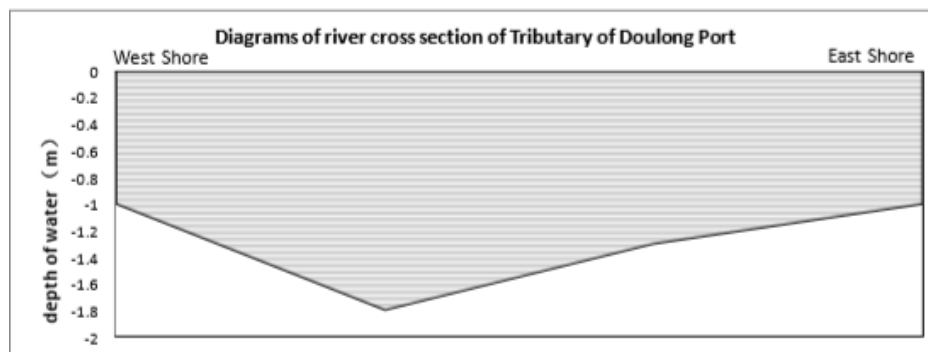
**Table1- Characteristics of the hydrological environment of Doulong Port, Tributary Doulong Port and Artificial canal. Source: Investigation and Assessment on the Habitat of Crayfish in Yancheng City, Jiangsu Province RESEARCH REPORT by the East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences . August, 2018.**

The north bank of Doulong port slopes down sharply to the bottom of the river; while the south bank slopes down to the central bottom of the river gently. The depth of the south bank is higher than that of the north bank. Figure 5 shows the 11955m section used in the habitat investigation



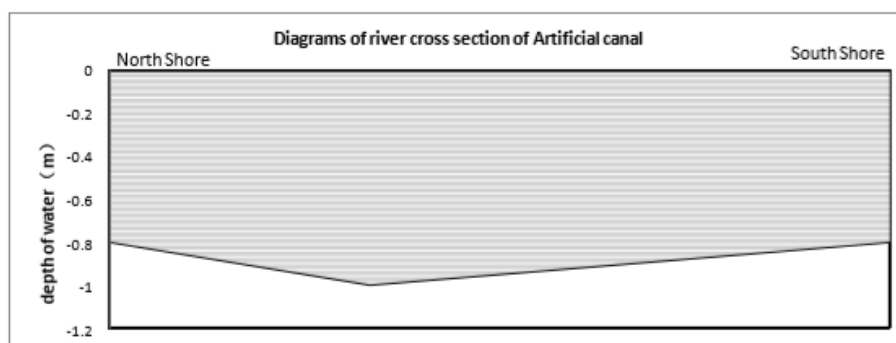
**Figure 5: Cross section profile of the Doulong port sampled in the Habitat research report, by the East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences. August, 2018.**

Figure 6 Shows the width of section investigation site in Artificial Canal was 26.46 m. The north bank sloped down sharply to the bottom of the river, while the central bottom of and the river rise up to the south bank gradually. The depths of the south bank and the north bank were at the same level



**Figure 6- Cross section profile of the Artificial canal sampled in the Habitat research report, by the East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences. August, 2018.**

Figure 7 Shows the width of section investigation site in Artificial Canal was 26.46 m. The north bank sloped down sharply to the bottom of the river, while the central bottom of and the river rise up to the south bank gradually. The depths of the south bank and the north bank were at the same level



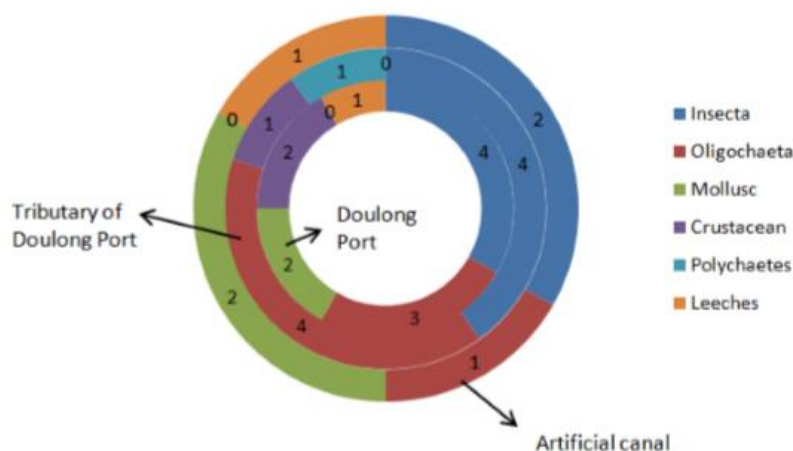
**Figure 7 - Cross section profile of the Artificial canal sampled in the Habitat research report, by the East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences. August, 2018.**

### 1.2.3.2 Biological environment

During a species investigation of Doulong port water substrate of the Crayfish habitat, 11 species of Benthic Organism, including 4 insect species, 3 Oligochaetes, 2 crustacean and 1 mollusc and 1 mite. The average population density of benthic organisms in Doulong Port was averaged at 221.333 ind./m<sup>2</sup> (48~592 ind./m<sup>2</sup>). By comparison (figure?), Tributary of Doulong port showed 10 species of Benthic Organism including 4 species of insects in which Chironomid larva had the largest proportion, 4 species of oligochaetes, 1 species of hairy and 1 species of crustaceans. At the artificial canal 6 species of Benthic Organism were detected in Tributary of Doulong Port, including 2 species of



insects in which Chironomid larva had the largest proportion, 2 species of mollusks, 1 species of oligochaetes and 1 species of mites.



**Figure 8 - Comparison of benthic organisms sampled in Doulong Port, Tributary of Doulong Port and Artificial Canal. Source: *Habitat research report, by the East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences. August, 2018.***

Further studies conducted on the Dougong crayfish habitat showed a higher average population density and average species diversity index in the port itself and the least biologically diverse areas assessed were that of the artificial canal. However Crustaceans average biomass (including that of *P.Clarkii*) was found within the tributary of Doulong Port. Table 1 shows the highlighted averages from the site.

	Average population density ind./m2	Average biomass g/m2	Average biodiversity index	Average richness index	Average evenness index
<b>Doulong port</b>	221.333 (48~592)	15.85 (0.11~56.63)	1.55 (1.15~1.82)	0.70 (0.49~0.90)	0.52 (0.34~0.64),
<b>Tributary of Doulong port</b>	101.33 (40~264)	0.25 (0.12~0.65)	1.54 (1.07~1.92)	0.80 (0.47~0.96)	0.46 (0.16~0.75)
<b>Artificial canal</b>	41.44 (32~96)	15.48 (0.65~28.9)	0.79 (0.51~0.92)	0.79 (0.56~0.94)	0.23 (0.00~0.61)

**Table 2: Doulong port, Tributary of Doulong Port and Artificial canal indices of biodiversity. Diversity index (Shannon-Weiner Biodiverstiy Index).Source: *Habitat research report, by the East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences. August, 2018.***

Reports of bycatch species conducted by the PT, within the fishery include Chinese mitten-hand crab *Eriocheir sinensis*, the oriental river prawn *Macrobrachium nipponense*, Vivipara and certain mixed species of fish. Observer data of bycatch species shows that the fishery occasionally catches and releases swamp eels, mud fish, Stone Moorokos, purple diced fish, Chinese bitterlin, leeches, sleepers, minnows, leeches and snakeheads.

#### 1.2.4 Economic and Social Characteristics

<Description, supported by maps and tables where appropriate, of the main landing locations, annual volume of catches, fishery seasonality, number of people involved *directly* and *indirectly*, brief summary of downstream value chain and the socio-economic dependencies of the fishery location>

Crayfish are collected live from three registered collection sites : Long feng, Sun Long da Qiao and Doulong Tiaojie Zha; sourcing from the harvesting locations (the three swamps and the river system)

Data on total landings are collected and aggregated by region and are sent to the commodity inspection Bureau and State Administration of Taxation of China. Catch weights are collected by fishers themselves, but also recorded in the sales number. Crayfish can only be sold at permitted markets. From the information available, no fishery independent data are collected. Only Fishermen carrying an approved licence from the BoF China, can catch Crayfish from the Dafeng region.

And the registered fishermen, water area of capture, trap type and number of traps per fishermen are monitored and retained each year. Table 2 below highlight the main characteristics of the 2018 fishing fleet.

Table 2		Allocated areas of water per fishermen	Number of traps per allocated per fishermen
<b>Doulong River</b>	25 fishermen Registered	Between 80 – 400 acres each	Between 80-300 Traps each (地笼)
<b>Dafeng main river</b>	17 fishermen Registered	Between 100 – 280 acres each used to fish	Between 60 – 300 Traps each (地笼)
<b>Man made river</b>	58 fishermen Registered	Between 60 – 800 acres each used to fish	Between 60 – 300 Traps each (地笼)

**Table 2: Registered fishermen information of the Defeng Crayfish fisheries. Taken from fishery register BoF, China, 2018.**

Regional fishery scientists conduct annual assessments to analyse the status of the resource with the objective of ensuring the long term preservation of both Crayfish and the broader environment. Additionally, large-scale (i.e. covering all fishery resources) projects are carried out every ten years.

In recent years, with the consumer's gradual understanding of the original crayfish shrimp and the extensive publicity of the media, the domestic consumption of the original crayfish is becoming more and more popular, accompanying with short supplement in the market and rising sale prices. Crayfish fresh muscle protein content is as high as 16-20%, and the dry muscle protein content is as high as 50%, which is higher than the protein content of common fish and eggs. The content of trace elements such as iodine, zinc and selenium in the original crayfish shrimp meat is also higher than other similar foods, and the muscle fibre of the original crayfish is delicate, the taste is lubricated, and it is easy to digest and absorb, especially the liver of the original crayfish, which weighs about 5% of body weight is rich in unsaturated fatty acids, proteins, free amino acids, vitamins and trace elements, and is of great medicinal value. In addition, the raw crayfish has a meat yield of up to 20%, so it can be used to process shrimp and shrimp tails. The shrimp shell of crayfish accounts for about 50-60% of its body weight. Its main component is chitin. Chitin is a natural biomacromolecule compound and the second largest renewable resource in the world after cellulose. And it is the only natural alkaline polysaccharide that has been discovered so far, so it has a very high deep processing value. In addition, chitin, chitin and chitosan extracted from the crustacean crustaceans can be used as industrial raw materials and widely used in agriculture, food, medicine, tobacco, paper, printing and dyeing, etc. In the field, the crayfish has a very high processing value-added potential.

According to the statistics of the China Chamber of Commerce for Import and Export of Food, Livestock and Animals, in 2008, China's exports of *Procambarus clarkii* products totalled 24,000 tons, and the total foreign exchange earned by exports was about 150 million US dollars. The annual consumption of the country totals about 300,000 tons, and the consumer groups are still expanding. "Spicy Crayfish" is well known throughout the country.

## 2. Goals and Objectives

### Guidance for completing Section 1 – Goals and Objectives

Section 2 should set out:

- The wider governance and policy environment in which the fishery operates, both in terms of the long-term objectives outside of the fishery and the policies that give rise to these.
- The long and short-term management objectives of the fishery itself.

The purpose is to provide readers with a broad understanding of what management of the fishery is trying to achieve, both at fishery and wider levels.

### 2.1 Governance and Policy

#### 2.1.1 Long-term Objectives

<Provide a brief description of the objective(s) contained in high level of broader government policy. Typically management decisions are taken in the context of broader pre-stated objectives and the success of management decisions is therefore judged against how well those decisions deliver against objectives. To ensure clear strategic direction, government policy and laws should provide management with a clear set of objectives to guide decision-making. Fishery-specific management policy (such as an FMP) will be developed in the context of these high level, long term objectives, demonstrating how these will be met – See Section below>

#### Meet the requirements of the Marine Stewardship Council Certification Standards.

<Describe how the objective will be achieved. Include how the FMP will comply with higher-level policy (fisheries, environment, food security, etc). Note that the precautionary approach should be explicit in the long-term objectives>

#### 2.1.2 Key Policy Linkages

<List or describe linkages with high-level policy and legislation (International, regional, national and local)>

The Fishery Law of the People's Republic of China	The <i>Fishery Law of the People's Republic of China</i> in 2004 is the most important and its main purposes are to strengthen the protection, increase, development and rational use of fishery resources. Chapter IV, Increase and Protection of Fishery Resources, lists some of the goals related to sustainable development, including: the establishment of aquatic nature reserve (fishing activities shall not be carried out without the approval of the competent fishery administration department); the use of explosives, poisons,
---------------------------------------------------	-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------

	electricity and any other means in fishing that impairs the fishery resources is prohibited; catching fry and fingerling of aquatic animals of important economic value is prohibited; protection of habitat ecosystems and endangered species.
Provisions on the Administration of Fishery Licensing	In order to protect and reasonably utilize the fishery resources, control the fishery intensity, maintain the fishery production order and safeguard the legitimate rights and interests of the fishery producers, the Provisions are formulated in accordance with <i>the Fishery Law of the People's Republic of China</i> .
The Law of the People's Republic of China on the Protection of Wildlife	This Law is enacted for the purposes of conserving wild animals, saving rare and endangered species of wild animals, maintaining biological diversity and ecological balance, and advancing ecological civilization.
Outline of Action for Conservation of Aquatic Biological Resources in China	In order to implement the scientific concept of development in an all-round way, strengthen the national ecological construction, protect and rationally utilize aquatic biological resources according to law, and implement the strategy of sustainable development, this Outline is formulated in accordance with the requirements of the conservation and management of aquatic biological resources in a new stage, new period and the market economy.
The 13 <sup>th</sup> Five-Year Plan for National Economic and Social Development of Dafeng district, Yancheng City	Firmly establish the concept of green GDP for the ecological district strategy, raise the awareness of ecological civilization, and make full use of the advantages of the ecological environment to build a beautiful and abundant Dafeng. Beautify urban and rural landscape, vigorously promote the construction of an ecological civilization demonstration area. Strengthen the protection and control of the ecology and comprehensively prevent and control pollution. Develop a low-carbon circular economy, advocate the renewable use of resources, promote clean energy alternatives and efficient recycling, raise the level of the development of ecological economy, and achieve a coordinated and sustainable development of the economy, society and the ecological environment.
Regulations on Fisheries Management in Jiangsu	In order to strengthen the protection, increase, development and rational use of fishery resources, protect the ecological environment

Province	of fishery, safeguard the legitimate rights and interests of fishery producers, and promote the sustainable development of fishery, these Regulations are formulated in accordance with the provisions of the <i>Fishery Law of the People's Republic of China</i> and the realities of Jiangsu Province.
Regulations of Jiangsu Province on the Protection of Wildlife	In order to conserve wild animals, save rare and endangered species of wild animals, protect, develop and rationally use wild animal resources, protect wildlife habitats and maintain ecological balance, according to the <i>Law of the People's Republic of China on the Protection of Wildlife</i> , the <i>Regulations for the Implementation of the People's Republic of China on the Protection of Terrestrial Wildlife</i> , the <i>Regulations for the Implementation of the People's Republic of China on the Protection of Aquatic Wildlife</i> , and other relevant laws and administrative regulations, these Regulations are formulated in conjunction with the actual conditions of Jiangsu Province.
The 13 <sup>th</sup> Five-Year Plan for Fishery Development in Dafeng District	In order to facilitate the development and protection of suitable fishery resources in Dafeng District, guide the fishery development scientifically and macroscopically, enhance the development of modern fishery industry, promote the sustainable development of fishery, it aims to achieve fishery production and management according to law and scientific and proper development of fishery resources, so as to realize the effective allocation of fishery resources and the coordinated development of fishery industry to enhance the sustainable development and utilization of fishery resources, the Plan is formulated in accordance with the Fishery Law of the People's Republic of China, the Regulations of the People's Republic of China on Nature Reserves, the Regulations on the Protection of Basic Farmlands and other laws and regulations, as well as the natural attributes of the tidal flat waters in Dafeng District, and in combination with social needs.
Crayfish Production and Marketing Cooperation Project Team – Fishery Management Plan	Based on the actual situation of Dafeng District and referring to the second edition of MSC standards, the Project Team prepared a management plan for the crayfish fishery in the Doulong River water system in Dafeng District, with reference to the second edition of the MSC Standard, as a member of the Project Team and local fishermen

	to manage crayfish and Guidelines for production activities.
--	--------------------------------------------------------------

## 2.2 Fisheries-Specific Management Objectives

### 2.2.1 Long-term Objectives

<Provide a brief description of the *long-term* objectives of the fishery covered by this plan. Long-term means at least over the term of the plan (and beyond) and if the plan is open-ended, over at least five years. For fisheries in a FIP, ideally these will be based upon the FIP Improvement Action Plan.

Fishery-specific objectives (or operational objectives) provide direction for management measures or regulations and are designed around the overarching national, international or regional goals and/or policies set by governments for their fishery sector (see Section 2.1.1 above). These may be as simple as a series of bullet points or might be expanded to provide more detail.

<Note that the short and long term objectives should be consistent with achieving the outcomes expressed by MSC's Principles 1 and 2 and are explicit within the FMP.>

<Describe how the long-term objectives will be achieved. If possible, each management objective should be examined individually and the management measures that are designed to help achieve that objective should be identified and explained.>

<For more complex fisheries, the plan could be more specific on how objectives and measures link up and which performance indicators are going to be used to measure the achievement of management objectives. This must be done by structuring the plan in a way that requires the development of performance indicators. The indicators must cover all objectives of the plan so in general there will be indicators of the biological status of the stock but also social and economic indicators of the health of the fishery.>

*The long-term objectives of crayfish management in Dafeng District are to:*

- To ensure a long-term, stable and sustainable development of crayfish fishery
- To ensure stable and controllable yields of crayfish (*P.clarkii*) stock
- To minimize the ecological impact on the Doulong River water environment, surrounding protected areas and new "World Natural Heritage" Yancheng Wetland from the fishing practices of the *P.clarkii*
- To ensure the maintenance of effective management and enforcement of the crayfish fishery.
- To strengthen the controlled conservation of crayfish fishery resources, enhance the ecological economy, and achieve a coordinated and sustainable development of economy, society and ecological environment.
- To ensure that the rights of any group that are dependent on the fishery for food and/or livelihood are and remain protected. These include the Riverfolk who reside next to the river and who are deemed eligible for permit by the BoF China

## 2.2.2 Short-term Objectives

<Provide a brief description of the *short-term* objectives of the fishery covered by this plan. Short-term means objectives that need to be achieved within the life of the plan and if the plan is open-ended, within five years or less. In many cases short-term objectives reflect urgent management priorities and may include re-building the fishery. These may be as simple as a series of bullet points or might be expanded to provide more detail>

<Describe how the short-term objectives will be achieved. See Section 2.2.1 above>

- To define clear the roles and responsibilities of stakeholders involved in the Project Team
- To ensure that the fishery complies with the laws, rules and regulations at all levels.
- To apply a precautionary approach to decision-making.
- To improve fishing practices and activities if and when necessary.
- To ensure responsible operations that will maintain habitats (and nearby nature reserves) and protect endangered, threatened or protected (ETP) species.
- To minimize and monitor the following:
  - Catching and discarding of small-size crayfish under the MLS of 5cm
  - Catching and discarding of non-target species and bycatch species in a way which maximises their chance of survival.
  - Impact on endangered, threatened and protected species
  - Impact on sensitive habitats.
- To ensure that key stakeholders in fishery management have clear communication, cooperation and consultation mechanisms and are integrated into the fisheries management strategy.
- To ensure timely implementation of management measures, which are routinely monitored and reviewed.

Timely implementation of management measures for supervision and review

In order to achieve the above objectives, a series of measures are defined in the Plan to manage crayfish fishing. The CAPPMA Crayfish Branch shall regularly review and discuss these objectives to provide suggestions on improvement in management actions in the annual meeting of the project group. Meetings should be held following the data collection



after the closure of the fishery, and updates made available for the December of that same year, made ready for the new fishing season. 56)

## 3. Fisheries Management Structure

### Guidance for completing Section 1 – Fishery Management Structure

Section 3 should set out:

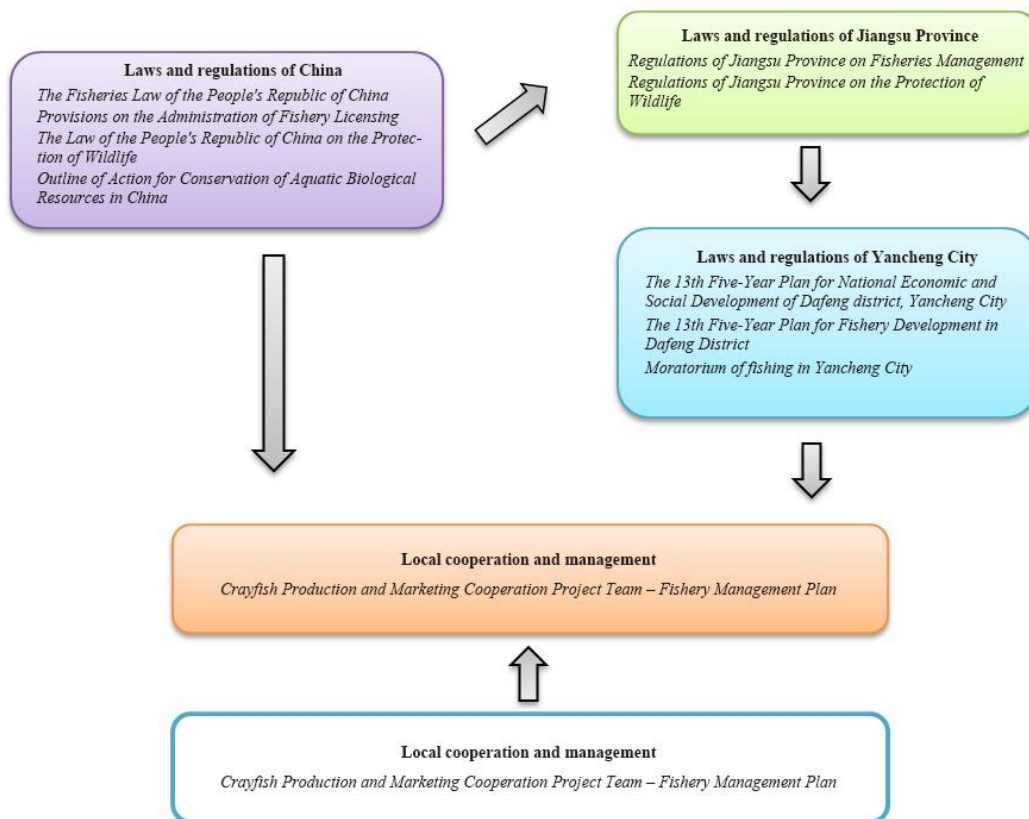
- The legal framework within which the fishery operates.
- The institutional arrangements for managing the fishery.
- The co-management arrangements for sharing management with fishery participants and other stakeholders.
- The consultation processes that the fishery should undertake to ensure participatory management.
- The principles and means for sharing the fishery's resources in an equitable fashion.

The purpose is to provide readers with an understanding of how the fishery is managed and who is involved.

### 3.1 Legal Framework

<Description of the legal and/or customary framework that ensures the fishery is sustainably managed, resources equitably allocated and allows for disputes to be resolved. This might include (i) fishery and relevant environmental legislation (Policies, Acts, Regulations) at all relevant jurisdictions – regional, national, international; (ii) relevant international instruments and evidence of domestic implementation and (iii) Regional Fishery Management Organisations (RFMO) conservation and management measures>

The Project Team is managed according to laws and regulations at the national, provincial and local levels, as shown in Figure 9 below. For details of laws, regulations, programmes and plans at all levels.

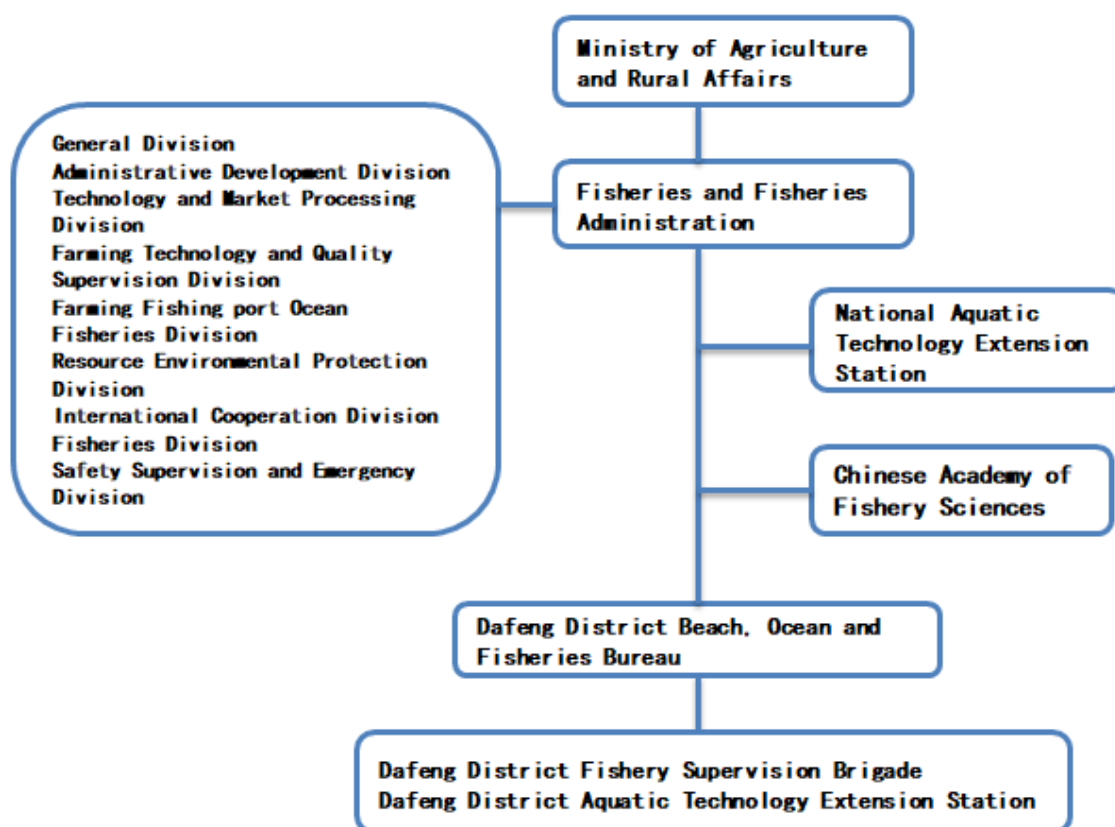


**Figure 9 - Crayfish fishery management structure**

### 3.2 Institutional Arrangements

<Description of the different institutions, organisations and other bodies involved in the management of the fishery, including statutory management organisations,, those responsible for monitoring, control and surveillance (MCS), fisher and producer organisations and non-statutory bodies that play a recognised role in managing the fishery. This could be provided as an organisational diagram, and supported by description of the key bodies outlining their roles and responsibilities>

The ultimate responsibility of China's fishery administration falls in the Ministry of Agriculture and Rural Affairs (MARA), including a series of specialized regional institutions such as the Bureau of Fisheries (BoF). Under the MARA, there is BoF, which has branches of the Yellow Sea and Bohai Sea, the East China Sea and the South China Sea. Relevant organizations and institutions established under the MARA include National Fisheries Technical Extension Center and Chinese Academy of Fishery Sciences. The organizational structure of the fishery administration units at national level is shown in Figure 10.



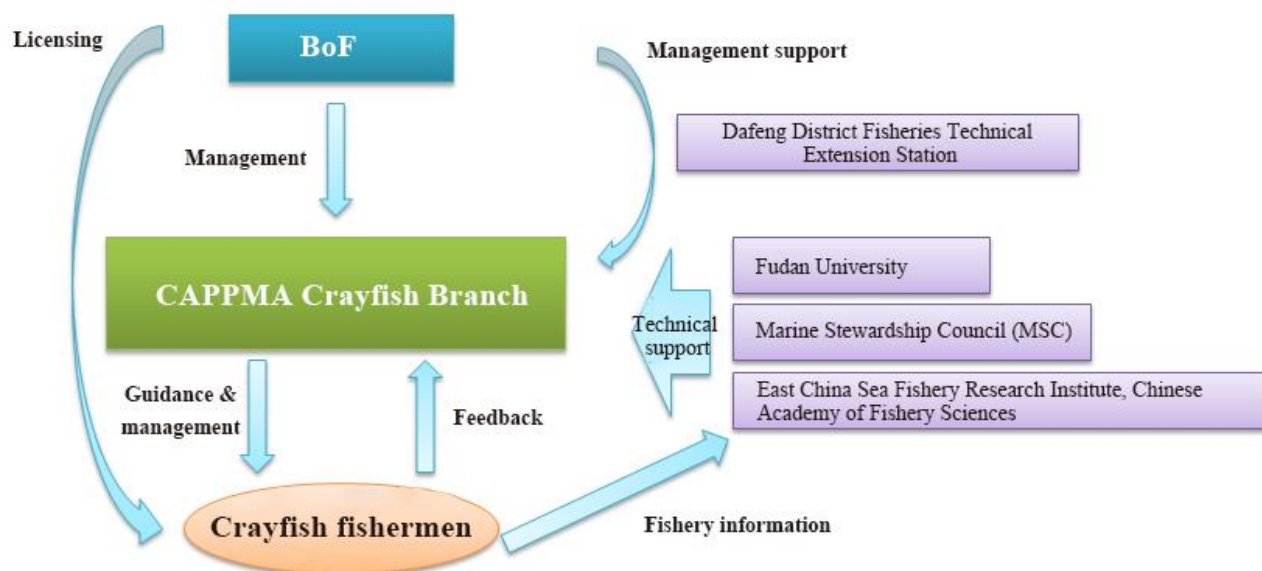
**Figure 10: The organizational structure of the fishery administration units at national level**

The Project Team, in charge of the management and implementation of the crayfish fishery improvement, is mainly responsible for the regular communication with local fisheries authorities, regular data collection every year, capacity-building and training of fishermen on laws and regulations, analysis of data and information collected, regular supervision and review of the management system and liaison and reporting with CAPPMA Crayfish Branch.

The representatives of the Project Team include Jiangsu Baolong Group, the Fisheries Technical Extension Station, Dafeng District Marine and Fishery Bureau and other organizations at the local level, as well as research institutions such as Fudan University and the East China Sea Fishery Research Institute of Chinese Academy of Fishery Sciences, with the participation of CAPPMA, MSC, WWF and other non-profit organizations, and the guidance of some independent foreign experts. Structure of the management is seen in Figure 11.

The management structure of the Project Team is shown as follows:

## Stakeholders



**Figure 11: Project Team management structure**

### Stakeholders and their responsibilities

MARA	Conduct overall research and organize the implementation of strategic plans and policies for agriculture, rural areas and farmers; supervise and administer planting, animal husbandry, fishery, reclamation, mechanization and the quality and safety of agricultural products; in charge of investment in agriculture.
Bureau of Fisheries	Its tasks include the development of fishery administration plans, strategies, norms and laws, the administration of fishery departments, planning, selection and management of related fisheries research, maintaining and publishing fishery statistics, and monitoring and enforcement of fisheries administration.
Fisheries Technical	Centering on the work of fisheries, strengthen the function of

Extension Station	public welfare, innovate the system and mechanism, improve the service ability, and play an important role in ensuring the safe and effective supply of aquatic products, promoting fishermen's income and promoting the construction of modern fishery.
East China Sea Fishery Research Institute, Chinese Academy of Fishery Sciences	Provide technical guidance for benthic risk assessment and monitoring, help prepare a fishery improvement plan and participate in making improvements.
China Aquatic Products Processing and Marketing Association (CAPPMA)	Taking the lead leading in the Project, CAPPMA is responsible for the connection with stakeholders in the process of fishery improvement, and provides help and a platform for the processing, marketing and publicity of the crayfish downstream production chain.
Crayfish Production and Marketing Cooperation Project Team:	Principal of local fishery management
Marine Stewardship Council (MSC)	Provide technical support such as MSC standards interpretation and capacity building
Dafeng Fishery Administration Brigade:	Supervise and manage crayfish fishing operations in accordance with laws and regulations
Dafeng Fisheries Technical Extension Station:	Local primary provider of basic information and technical support.
World Wide Fund for Nature (WWF)	Technical support provider
Independent expert	Participate as a stock assessment expert, providing fishing management strategies and advices
Independent consultancy	A foreign consulting company which provides action plan and guidance, provides a framework for fisheries improvement plan and participates in its modification
Lyons seafoods	A foreign purchaser and sponsor

Bakkavo Company	A foreign purchaser and sponsor
Jiangsu Baolong Group	The leading enterprise of the local crayfish processing industry, the major operator of the MSC fishery improvement plan, and the key leader of the crayfish production and marketing cooperative organization.
Fudan University	Provide technical guidance for ecological risk assessment and monitoring

### 3.2.1 Dispute Settlements

< Description of an explicit and well-described dispute resolution process. This should include the process (e.g. how all stakeholders can raise an issue with the fishery management team), time limits for response from both parties and third-party arbitration where necessary. >

When a dispute arises in the project team, there are the following four methods of settlement: (a) reconciliation (b) mediation (c) arbitration (d) litigation

(A) Reconciliation. The parties negotiate and resolve it by themselves. The parties are the subjects of civil disputes, and they have full disposition power over the disputed matters. The dispute settlement panel does not intervene. Whether to exercise the disposition power, when to exercise the disposition power, and how to exercise the disposition power is at the discretion of the parties.

(2) Mediation. A third party other than the parties to the dispute communicates information between the parties to the dispute in accordance with certain social norms (customs, ethics, laws, etc.), makes the facts clear, and promotes mutual understanding and compromise between the parties to the dispute, so as to reach a consensus on the final settlement of the dispute . The third party here is the People's Mediation Committee. In addition, there are mediations among agencies, enterprises and institutions, and citizens.

(3) Arbitration. The so-called arbitration refers to the method of mediating a civil dispute and making certain legal documents to calm the conflict under the auspices of the arbitral tribunal and with the participation of the parties to the civil dispute. Arbitration is civil. The basis of arbitration is the agreement of the parties. In other words, the submission of arbitration must be based on the consent of the parties, otherwise, the arbitration procedure cannot be initiated. Under normal circumstances, members of the arbitral tribunal are also elected by the parties.

(5) Litigation. Civil lawsuits are what people call "civil lawsuits." Compared to people's mediation, parties' self-reconciliation, unit (or department, community) handling and arbitration mechanisms, civil litigation is a typical form of public power relief. The greatest feature of this public relief is its special legal coercion. Civil litigation is also the most effective and last resort for the country to handle civil disputes. Therefore, the state often must make strict regulations on the subject, procedure and system of the lawsuit.

**From the time that the formalised dispute has been made the dispute must be addressed by two months after the date of the submission and resolved within 6 months.**

### 3.3 Consultation and Co-management Arrangements

<Description of the processes and arrangement that allow non-statutory bodies, and where appropriate individuals, to contribute to fishery management planning>

In order to promote the legal, compliance and sustainable development of the freshwater fishing industry in the region, and to protect and scientifically develop and utilize fishery resources, a management plan is formulated by Fisheries Law Enforcement Brigade. Although freshwater crayfish are invasive alien species, they have been well integrated into the local ecosystem for many years due to legal, rational management and scientific development and utilization. As an important fishery resource, they have provided rich ingredients for the economic and social development of our district. And industrial raw materials. The law enforcement management of freshwater crayfish capture fisheries combines with the overall management of fishery administration in freshwater fishing, and implements risk management methods to achieve the management objectives of healthy and sustainable development and utilization of fishery resources.

### 3.4 Allocation of Resources

#### 3.4.1 Basic Principles

<List or description of the basic principles of how fishery resources are allocated to different participants>

#### 3.4.2 Specific Mechanisms

<Description of the different mechanisms by which fishery resources are allocated, how these allocations are managed, how they can be transferred and cancelled. This section should be harmonised with the harvest strategy and control rules in the next section>



## 4. Harvest Strategy and Control Rules

### Guidance for completing Section 4 – Harvest strategy and control rules

Section 4 should set out:

- The strategy by which the fishery will be harvested.
- The Harvest Control Rules (HCRs) that will be used to implement the harvest strategy.
- The decision-making frameworks that will be used to design, develop and review the harvest strategy and its control rules.

The purpose is to provide explicit statements on the approach to managing sustainable harvesting of fishery resources and how the control rules will ensure that the fishery is adaptive and response to changes in stock condition.

### 4.1 Harvest Strategy

#### 4.1.1 Description

<A description of the approach taken to manage the fishery and make sure it is responsive to the target stock status. For instance a harvest strategy may decide whether *input controls* (e.g. methods to limit fishing effort) or *output controls* (e.g. methods to limit fishing mortality) or a combination of both are used. In some cases this strategy may be transitional e.g. moving from one approach to another, in which case the timescale needs to be mentioned. Additional detail may be provided in terms of the initial design and provide justification why a particular strategy has been adopted. It should be noted that the harvest strategy should be designed to achieve the fishery-specific objectives stated in Section 2.2.>

<The harvest strategy should also include strategies for (i) minimising unwanted catches of target, primary and secondary species, (ii) minimising interactions with ETP species and (iii) ensuring that habitat and ecosystem impacts are within acceptable levels>

In general, it is believed that about 20000t of wild caught crayfish are caught in the region per year, with around 18000t in the Doulong river basin and around 6000t purchased by the Baolong plant (i.e. around 30%). However, the Baolong plant purchases the majority of the catch in the Dafeng district around Yancheng. River connectivity between Dafeng and other districts is well-defined and limited to various canals and rivers. For the purposes of the current stock assessment, Baolong purchases will be treated as the total catch for this management unit.

In 2019, whether Baolong provide sufficient coverage was put in doubt because fishing continued after Baolong had stopped purchases. Recording these additional catches will be necessary not only for using the total catch in the stock assessment, but also to evaluate the effectiveness of the HCR.

Based on the 2018 stock assessment, the stock is not overfished and overfishing did not occur in 2018. This is likely to remain the case unless the fishery changes significantly.

The following is an outline of a harvest strategy being developed for the Dafeng crayfish fishery for the Baolong Group processor near Yancheng. The strategy is based on a stock assessment being conducted data collected during the 2018 season.

The estimated fishing mortality (exploitation rate) during the season was compared to the constant fishing mortality which would produce 40% unexploited SSB (MSY target) or 20% unexploited SSB (PRI limit) to determine whether overfishing was occurring. The estimated SSB and fishing mortality relative to these reference points was used to determine the trigger point used in the harvest control rule.

Effort or catch controls (e.g. TACs) are not an option at this stage and may never be appropriate. Varying the length of the season is the best option at present. Implementation at this stage would depend upon Baolong limiting the date of purchase to an earlier time, if that was found to be necessary. It is important to note that with current controls the fishery is subject to, effectively, a fixed harvest rate policy. This is because the numbers and distribution of traps remains fixed. Agreeing to maintain this harvest policy will form an important part of the HCR. It may be possible that a stock assessment will make **recommendations on this target harvest rate, but this is not likely to be the case from the first assessment. Nevertheless, it is important to be aware that if the current harvest rate exceeds the  $SPR_{20\%}$ , it may be difficult to justify against MSC requirements and the first assessment may indicate a reduction in harvest rate is necessary.**

As well as a current harvest rate, the HCR will define a trigger point when further harvest reduction would be required. Hopefully, this reduction would only **be required in unusual circumstances, and the HCR would not affect the normal operation of the fishery. A trigger point should be determined based on some measure of abundance. For the preliminary HCR, the trigger point would be determined by the catch rate.** In future as more data become available, a more sophisticated approach could be developed. Effectively the fishery would be closed (Baolong cease purchases) in the week following the point when average catch rates have fallen below some value determined from the stock assessment.

#### **4.1.2 Monitoring, Review and Evaluation of the Harvest Strategy**

<A brief description of the main mechanisms to monitor the fishery (see also Section 5: Ecosystem Management Strategies

### **Guidance for completing Section 5 – Ecosystem management strategies**

Section 5 should set out:

- The strategies by which non-target species, endangered, threatened or protected (ETP) species, habitats and ecosystem structure and functioning will be managed.

The purpose is to provide explicit statements on the approach to managing the non-target

elements of the aquatic ecosystem related to the fishery.

## 4.2 Primary and Secondary Species

Under the MSC standard, the assessment must ensure that the fishery does not impair the recruitment of non-target bycatch (e.g. those species not being included in the Unit of Assessment). Such species are categorised as primary (e.g. usually managed with set reference points) or secondary (unmanaged). This latter category also includes an assessment of species outside the scope of MSC certification e.g. seabirds and marine mammals. Primary and secondary species are further sub-classified as *main* (e.g. more than 5% by weight of the total of all catches in the UoA or where it is less resilient and makes up >2% of the catch) or *minor*.

### 4.2.1 Management strategy

<Brief description of the approach to which a fishery will ensure that they will not hinder the rebuilding of the main primary and secondary species at/to levels which are highly likely to be above the point of reproductive impairment (PRI). This should provide at least a partial strategy for their management>

The target species of this FMP is red swamp crayfish. In order to reduce the impact on other bycatch species, the following management measures shall be adopted:

- All non-commercial bycatch shall be immediately released back into the aquatic environment in a manner that maximizes its survival.
- All commercial bycatch that is not suitable for markets, e.g. is undersize or otherwise ineligible, shall be immediately released back into the aquatic environment in a manner that maximizes its survival.
- If bycatch levels increase, fishermen should move gear to another location at least 50m away.
- Fishermen will assist the CAPPMA Crayfish Branch to monitor the quantity and quality of bycatch when requested.

### 4.2.2 Other considerations

<Provide supporting evidence that the management strategy above is likely to work, based upon information about the fishery or the species involved. Include evidence that the measures and partial strategy are being implemented successfully. In the case of sharks, provide evidence that it is highly likely shark finning is not taking place>.

<Provide evidence that there is a regular review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main primary species and they are implemented as appropriate>.

- The Project Team will review the level of retained catch annually to monitor and record the risk level of bycatch. The quantity of discarded non-target bycatch needs to be fully documented:
  1. If necessary (based on the available data from observers), an observer survey is required to quantify the weight and proportion of discarded non-target bycatch. The scope of survey should be defined and approved by CAPPMA Crayfish Branch.
  2. The Project Team will periodically review the above monitoring objectives and assess the applicability to the management of non-target populations based on the best available scientific data.
  3. The Project Team will periodically review alternatives to minimize bycatch and, if necessary, provide the most effective scientific data and commission a research to support management decisions.
  4. The bycatch data can be collected from the same crayfish sampling sites.
  5. The data recorded by observer include: the name of bycatch, the total weight and quantity of bycatch, the maximum and minimum length of bycatch.
  6. Data and information will be summarized monthly.
  7. A written report is required after the end of the fishing season each year.
- During the annual fishing season, based on the fact-sampling data of the observers, a CPUE curve for the first-level bycatch species is produced.

## 4.3 Endangered, Threatened and Protected Species (ETP)

### 4.3.1 Management strategy

<Brief description of the approach to which a fishery will manage the fishery's impact on ETP species, including measures to minimise mortality, which is designed to be highly likely to achieve national and international requirements for the protection of ETP species>.

According to local fishery management records and scientific investigation reports, there is very little interaction with ETP species in crayfish fisheries, and it is generally not easy to capture aquatic or wild animals that are under national or provincial protection. However the following highlights the management plan and measures in place to prevent a rare interaction with ETP species:

1. If there is any trace of otters within 50 meters around the traps, the traps shall be relocated away from the otter home range.
2. All turtles (except snapping turtles) and frogs, regardless of species, shall be unconditionally released back into the aquatic environment.
3. Chinese suckers and Chinese giant salamanders shall be immediately released back into the aquatic environment, and Dafeng Fishery Administration Brigade shall be informed of.

The assessment unit area we have identified this time is adjacent to the World Natural Heritage-Yancheng Wetland. It is not excluded that during the rainy season or when flooding, there are occasional national or provincial key protected wild animals misplaced in the assessment unit, and the country or province should be identified and properly handled in time. The level of protected wild animals, usually birds or leeches. According to the Law of the People's Republic of China on the Protection of Wild Animals, the Regulations on the Implementation of the Protection of Terrestrial Wild Animals of the People's Republic of China, the Regulations on the Implementation of the Protection of Aquatic Wild Animals of the People's Republic of China, and the Regulations on the Protection of Wild Animals in Jiangsu Province, especially the Yancheng Wetland After the World Natural Heritage, the Regulations on the Protection of Yanhai Yellow Sea Wetland was approved by the Tenth Session of the Standing Committee of the 13th National People's Congress of Jiangsu Province and was implemented on September 1, 2019. The aim is to strengthen the protection of the world's natural heritage "Yancheng Yellow Sea Wetland", maintain the ecological functional integrity and biodiversity of wetlands, and promote the sustainable use of wetland resources.

#### 4.3.2 Other considerations

<Provide supporting evidence that the management strategy above is likely to work, based upon information about the fishery or the species involved. Include evidence that the measures and partial strategy are being implemented successfully>.

<Provide evidence that there is a regular review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ETP species and they are implemented as appropriate>.

The following management measures shall be adopted:

- The “Regulations” propose: setting protection landmarks with the name of the wetland, the level of protection, the scope of protection, the management unit and its contact information. Establish and improve the Yellow River Wetland Key Protected Wildlife Rescue Linkage Mechanism, promptly accept relevant ambulance reports, and take emergency ambulance measures for injured or trapped key protected wild animals.
- No fishing will be undertaken in nature reserves or other environmentally sensitive areas.
- All ETP species captured must be released back into the aquatic environment as quickly and carefully as possible, to maximise survival chances and the local fishery management department authorities be reported to of its capture at the earliest opportunity.
- Fishermen will respect the sensitivity of ETP species to disturbance, and will amend their catching activities to ensure that noise and other intrusion will be kept to a minimum, especially during nesting, feeding, migration and other sensitive periods.
- Any interactions with ETP species will be recorded and immediately reported to the local fishery management department.
- CAPPMA Crayfish Branch actively organizes trainings for fishermen to learn the laws and regulations involving nature reserves and make them take initiative to report. Fishermen will be instructed on ETP sensitive areas and sensitive periods of time to minimise ETP species capture.
- For illegal activities, a penalty ranging from 200 to 2,000 RMB Yuan will be given. Suspension?
- The reporting and processing procedures are as follows:
  1. Observers will record the type, quantity, time and location of ETP species found. If no ETP species is found, a record of 0 should be performed.

2. For trapped and injured ETP species: Any unit or individual that finds an ETP aquatic wildlife injured, stranded, trapped or dead due to straying into a bay or river inlet shall promptly report to the local department of fishery administration or the fishery supervision and administration department, which will take emergency rescue measures, or require units nearby that have the necessary conditions for emergency rescue to take emergency measures and report to the competent department of fishery administration.
3. For dead aquatic wildlife: they will be properly handled with by the fishery administration.
4. For live aquatic wildlife or those that can return to their habitat: they shall be released immediately and unconditionally or in a way which maximises it's chance of survival upon release

## 4.4 Habitats

### 4.4.1 Management strategy

<Brief description of the approach to which a fishery will ensure it is highly unlikely to reduce structure and function of the both commonly encountered and vulnerable marine ecosystem (VME) habitats to a point where there would be serious or irreversible harm>.

In 2018, the unit of assessment (UoA) has been carried out for benthic risk assessment and ecosystem risk assessment by expert team of the East China Sea of the Chinese Academy of Fishery Sciences. The result shows that, for the change of benthic environment, the annual fishing equipment changes little, the fishing gear type is relatively stable, and the Doulong River water system is generally sandy, so the fishing has little effect on the substrate. For the monitoring of the benthic environment, it can be monitored every 3-5 years on the basis of certain management measures (the monitoring frequency can be adjusted according to the actual situation).

### 4.4.2 Other considerations

<Provide supporting evidence that the management strategy above is likely to work, based upon directly about the UoA and/or habitats involved. Include evidence that the measures and partial strategy are being implemented successfully>.

<Provide evidence that there is some quantitative evidence that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/ non-MSC fisheries, where relevant>.

In order to reduce the impact of the fishery and its related activities on habitats, the following management measures shall be adopted:

- Fishermen should set and haul traps in a manner that least disturbs the habitats.
- Fishermen should avoid setting fishing gear in habitats that might be sensitive to disturbance and their fishing activities.
- Assess and monitor the habitat assessment plan in conjunction with the relevant systems and management of the department of wildlife protection administration and other relevant departments.
- Establish and improve wildlife resources and habitat archives and monitoring mechanisms.

Conduct a field visit or fixed-point sampling of the UoA on a regular basis, and form an analysis report or meeting minutes.

## 4.5 Ecosystem

### 4.5.1 Management strategy

<Brief description of the approach to which a fishery will ensure that they will, if necessary, take into account available information and is expected to restrain impacts of the UoA on the ecosystem so that they are highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm. This should provide at least a partial strategy for ecosystem management>.

Knowing the fishery is targeted as an introduced species fishery the key ecosystem strategy is to make sure that *P.clarkii* population is kept at levels low enough to prevent any further ecosystem impacts associated with the Crayfish including habitat modification by burrowing and voracious predation of native species.

Based on the Ecosystem risk assessment conducted in 2018 by Fudan University, The harvest strategy will play a vital role in controlling and reducing environmental impact by association with Catch per unit effort (CPUE) of Crayfish.

- Due to the nature of the Crayfish and the impact of higher populations outlined in the ecosystem risk assessment, the CPUE of crayfish will be based at the maximum sustainable yield (MSY) or lower subject to review by the project team; based on data produced in the fishing season.

The annual review by the project team will be initiated after the closure of the fishing season and be revised and updated in the FMP in the December, before the new season begins.

Whilst it is recognized that this species is now irreversibly part of the local ecosystem, the fishery will take measures to prevent further ecosystem impacts that may have occurred as a result of the introduction of the species, especially in the neighbouring Yancheng Nature Reserve.



In order to reduce the impact of the fishery and its activities on the ecosystem, the following management measures shall be adopted:

- Non-native species shall not be introduced into the UoA without a strong and scientific environmental risk assessment.
- Baolong Group will summarize and feedback the annual monitoring situation in December each year.
- Compare the government's environmental monitoring results with the data of Baolong Group, and invite third-party representatives to supervise and make suggestions.
- Visit riverside households, hold forums to collect other environment-related information that cannot be covered by monitoring data, summarize the annual environmental monitoring situation, predict the follow-up environmental change trend, and discuss whether there are new risks.

#### 4.5.2 Other considerations

<Provide supporting evidence that the management strategy above is likely to work, based upon information about the fishery or the ecosystem involved. Include evidence that the measures and partial strategy are being implemented successfully>.

After monitoring data collection and convening stakeholder forums, Baolong Group will convene relevant experts to review and revise the monitoring and management plan, assess the effectiveness and accuracy of the management plan for the year, find out the omissions and shortcomings, and discuss and pass the environmental monitoring management plan for the coming year.

**Stock Assessment, Fishery Monitoring and Research** and how the results will be used to review and evaluate the harvest strategy and refine it over time. Such a review may include a periodic assessment of alternative measures to minimise unwanted catch of the target and non-target stocks>

Weekly monitoring data will be collected by designated observers throughout the season. This is based on observing three traps at each site and recording the numbers and size composition of the crayfish landed as was done in 2018. Purchase records and log book data from Baolong will also contribute to the mechanisms used to monitor the fishery

During the 2019 fishing season data collection, an overview on the effectiveness of each mechanism was assessed by a third party consultant who deemed:

**Observer Data:** The observer data have been found to be very high quality and will be critical for the stock assessment. Patterns in the data are consistent with the species biology and will allow key values to be estimated.

**Purchase Records:** Baolong Group purchase records do not incorporate any measure of fishing effort. Therefore, they are only suitable to calculating the total landings. This is however a very important statistic and will be critical for the stock assessment.

**Logbook Data:** The logbook data have not turned out to be so useful and may need to be re-evaluated. However, the data appeared to improve in 2019, and importantly may be the best way to estimate catches that are not being purchased by Baolong.

For the 2020 season another question will be inputted within the log books, asking where the remaining volumes not being sold to Baolong, will be going. This will give us an indication of overall fishery volumes being caught from the Doulong river.

### Stock Assessment

Based on the 2019 stock assessment, an age specific depletion model is being fitted to the available purchase and observer data. There is a high probability of success because the data have captured the changes in the population well. The stock assessment will estimate the exploitation rate and the number of females reaching maturity. Because it is only one year's data, it will not be able to estimate general productivity (e.g. average recruitment or the effect of temperature on production). However, it will be sufficient to propose and test through simulation an interim harvest control rule for the 2019 season.

### Reference points

Reference points for the fishery will likely be proposed as spawning biomass -per-recruit at 40% (SPR<sub>40%</sub> target) and 20% (SPR<sub>20%</sub> limit). Spawner-per-recruit calculations should be possible with outputs from the stock assessment. However, reference points for the HCR will likely be adjusted to the level of acceptable risk of 5%, 10% and 20% probability of the stock falling below the limit reference point and 50% probability being below the target. Reference points were not updated from the 2018 season because the lack of consistency of the data.

It should be noted that the target could be set lower than the precautionary SPR<sub>40%</sub> to account for the fact this is an introduced species and the fishery may be the main control on population size (MSC CR 2.0 SD2.1.1.2). It is recommended to keep the precautionary target for the moment however due to various uncertainties associated with the data and its interpretation. If the stock status can be estimated more precisely in future, a lower target (SPR<sub>30%</sub>) may be considered more suitable in this case.

## 4.6 Harvest Control Rules

### 4.6.1 Description of the Harvest Control Rules

<Provide a list of harvest control rules (HCRs) that have been agreed for the fishery. In general, HCRs should be economically sound, compliant with national regulations and/or international fishery agreements, based on relevant international experiences, supportive of ecosystem-based fisheries management, and compatible with the biology of target stocks. These HCRs should be well-defined e.g. detailing their purpose, mechanism, trigger points and performance indicators. If possible, they should also be considered in terms of their robustness to uncertainty.>

Effort or catch controls (e.g. TACs) are not an option at this stage and may never be appropriate. Varying the length of the season is the best option at present. Implementation at this stage would depend upon Baolong limiting the date of purchase to an earlier time, if that was found to be necessary. It is important to note that with current controls the fishery is subject to, effectively, a fixed harvest rate policy. This is because the numbers and distribution of traps remains fixed. Agreeing to maintain this harvest policy will form an important part of the HCR. It may be possible that a stock assessment will make recommendations on this target harvest rate, but this is not likely to be the case from the first assessment. Nevertheless, it is important to be aware that if the current harvest rate exceeds the  $SPR_{20\%}$ , it may be difficult to justify against MSC requirements and the first assessment may indicate a reduction in harvest rate is necessary.

As well as a current harvest rate, the HCR will define a trigger point when further harvest reduction would be required. Crayfish are inactive earlier in the season, so earlier start than customarily applied is not a threat to the fishery. Hopefully, this reduction would only be required in unusual circumstances, and the HCR would not affect the normal operation of the fishery. A trigger point should be determined based on some measure of abundance. For the preliminary HCR, the trigger point would be determined by the catch rate. In future as more data become available, a more sophisticated approach could be developed. Effectively the fishery would be closed (Baolong cease purchases) in the week following the point when average catch rates have fallen below some value determined from the stock assessment.

The proposed harvest control rule will have several parts:

#### Fixed Harvest Rate policy

Harvest within the management unit will be limited to registered permit holders with the current number of traps within their harvest areas.

Licences are permitted by the BoF, China and number of licences are currently being held at 550 licences, permitted in 2018 as a control to limit the number of fishermen and thus fishing pressure. For full details see Appendix 2. During 2018, licences were audited for fishermen interviewed on-site to check for their eligibility to catch and sell crayfish by the BoF. The registration of permit holders are irrespective of Baolong and must be agreed with the BoF China upon registration.

The licence states the maximum number of traps used per registered fishermen (up to a maximum of 300 nets per license) as well as the fees and legal requirements to be fulfilled, Figure1 shows a licence used within the Crayfish fishery. Licences will be made available to local management on request and accurately matches to the fishermen’s details.

The number of traps used per registered fishermen is limited by the number stated in the licence. The target trap density currently stands at (1 trap / 8 mu ~ 2 / hectare). The maximum number of traps is approximately 156 traps per 181 mu, which is 15 traps per hectare. A current stock assessment conducted in 2018 and 2019, shows that the current trap density is sustainable and therefore target trap density will be held at this and any alterations to trap density per mu will be notified and agreed by the management authority.



**Figure 12 – An Example of fishermen licences. Source: BoF, 2018**

### Standardization of traps

Fixed traps consisting of long bag nets called **地笼**) or directly translated as a ground cage,(Figure13), are the standardized trap to use in this fishery and the management authority will be notified of any proposed changes to gears or fishing operations. No changes to harvest practices should occur without their prior agreement. The length of the Reap is between 3-5meters long per net with a diameter of 30 -50 cm and the fishing regulations clearly stipulate that the minimum mesh size should not be less than 2 cm, (Figure 14). A 2019 inspection conducted by the BoF China saw that the mesh size for all traps assessed were 3cm in diameter, as seen in Figure 13 below (above the stipulated 2cm).



**Figure 13 left - Crayfish fishing gear (地笼 or Ground cage ). Figure 14 right: Typical Crayfish fishing net.**  
**source: BoF, 2018**

### Monitoring

The harvest control rule will require monitoring data. For the next 1-2 years, this will depend upon the observer data as were collected in 2018. It will need to be determined how monitoring will be conducted in the long term. The most cost-effective way would be to change either the logbook data or purchase records to obtain the required data for the HCR. A reduced observer programme could also be implemented in the long term, with the significant advantage that the sizes of crayfish would also be recorded.

A significant data gap is the total catch. 2019 was apparently an unusual year with a typhoon causing Baolong to end its purchases early. It was reported however that many fishers continue to collect and sell crayfish in other markets. This has two implications:

1. Catches not purchased by Baolong need to be estimated. Logbooks can be used for this, but the catches reported in logbooks will still need to be raised to the entire fishery. This might be done now by estimating the raising factor comparing logbook catch to total purchases by Baolong during the season. The validity of this approach will need to be discussed and/or verified. Other raising factors (e.g. number of registered traps) could also be used, and the best approach chosen through consultation.
2. When Baolong stopped purchases, the decrease in landings provides an indicator of the effectiveness of the HCR tools to reduce exploitation. Currently it is assumed that when Baolong ceases to purchase crayfish, this would act as a strong disincentive to continue catching crayfish. It is as yet unclear whether this was the case in 2019.

A priority for the 2020 season will be to make further improvements to the data collection system (summary of performance relative to the MSC requirements, appendix 1). Specifically, there is a

need to estimate total catches not purchased by Baolong and ensure that the observer data are collected throughout the season even if Baolong stops purchases, when fishing continues, or if Baolong delays starting purchases, but fishing has started. The logbooks seem the best way to provide information on catches sold to other buyers than Baolong, and it should be ensured that they capture this information.

It will be possible to conduct further stock assessment work which can be used to support the harvest strategy. Apart from improving the data collection as outlined above, the following tasks could be undertaken.

- Evaluate the use of alternate covariates in explaining catch rates. These would likely be temperature and water flow. Initial work on this could be carried out now, but it would likely be more productive to wait at least until after the 2020 season when another year's data would be available. This is important because catch rates are used to monitor abundance and are therefore used in the HCR. The reasons for changes in catch rates other than abundance need to be explored.
- Conduct a length-based assessment excluding catch and effort data. Using only the size composition, it should be possible to obtain an estimate of fishing mortality for comparison with  $SPR_{40\%}$ ,  $SPR_{30\%}$ , and  $SPR_{20\%}$  levels. Size composition data is the most reliable data available. If considered urgent (e.g. MSC full assessment is to take place before 2020), this could be carried out now, but may also be more likely to be successful if undertaken if necessary in 2020.

The existing fishing strategy is based on the results of the 2018 and 2019 stock assessment and reference to the existing actual fishing conditions. The crayfish fishery is managed through restrictive measures of input and output (the number of nets and seasonal fishing, etc.). The proposed harvest control rule will have several parts of which table.

Rule	Key uncertainty
------	-----------------

<p><b>Limitation of Fishing Season</b></p>	<p>The season will start in week 1: defined as</p> <p>Permissible harvest will start no earlier than the 27<sup>th</sup> of April each season and ending the season one week after the average capture per trap is 8 Crayfish or less.</p> <p>Harvest will cease either</p> <ol style="list-style-type: none"> <li>a) on or before the 14<sup>th</sup> August each season</li> <li>b) Harvest will cease within the season if the average catch rate determined each week falls below X kg/3 traps.</li> <li>c) Notice will be given in the following week when catch rates have fallen below the threshold, and the fishery will be closed the week after, when Baolong would cease any further purchases.</li> </ol> <p>Start date to be determined by Baolong on their custom practice.</p> <p>X needs to be estimated using stock assessment output. The practical implementation of any HCR (who carries out the monitoring, data processing, calculations etc.) will also need to be decided.</p> <p>Subject to annual review by the project team.</p> <p><b>Reference points:</b></p> <p><b>SPR 40% target reference point SPR 20 is the limit reference point should the management trigger be somewhere between the two?</b></p>
<p><b>Minimum landing size (MLS)</b></p>	<p><b>Rule</b></p> <p>Release of captured crayfish with a carapace length of 5cm long or less in a way that maximises their chance of survival.</p> <p><b>Reference points:</b></p> <p><b>SPR 40% target reference point SPR 20 is the limit reference point should the management trigger be somewhere between the two?</b></p>
<p><b>Maintaining a Fixed Harvest Rate Policy</b></p>	<p><b>Rule</b></p> <p>Harvest within the management unit will be limited to</p> <ol style="list-style-type: none"> <li>1) Registered permit holders only (550 total)</li> <li>2) The number of traps within their harvest areas as applied in 2018.</li> <li>3) Target trap density will be an average of 1 trap / 8 mu ~ 2 / hectare) per household.</li> </ol> <p><i>The registration of permit holders are irrespective of Baolong and must be agreed with the China Beuru of fisheries upon registration.</i></p>

Catches will be taken with standard traps: the management authority will be notified of any proposed changes to gears or fishing operations. No changes to harvest practices should occur without prior agreement.

**Reference points:**

**SPR 40% target reference point SPR 20 is the limit reference point should the management trigger be somewhere between the two?**

**Monitoring**

Log book questionnaire will include a question to determine where catches volumes not purchased by Baolong are going

**Reference points:**

**SPR 40% target reference point SPR 20 is the limit reference point should the management trigger be somewhere between the two?**

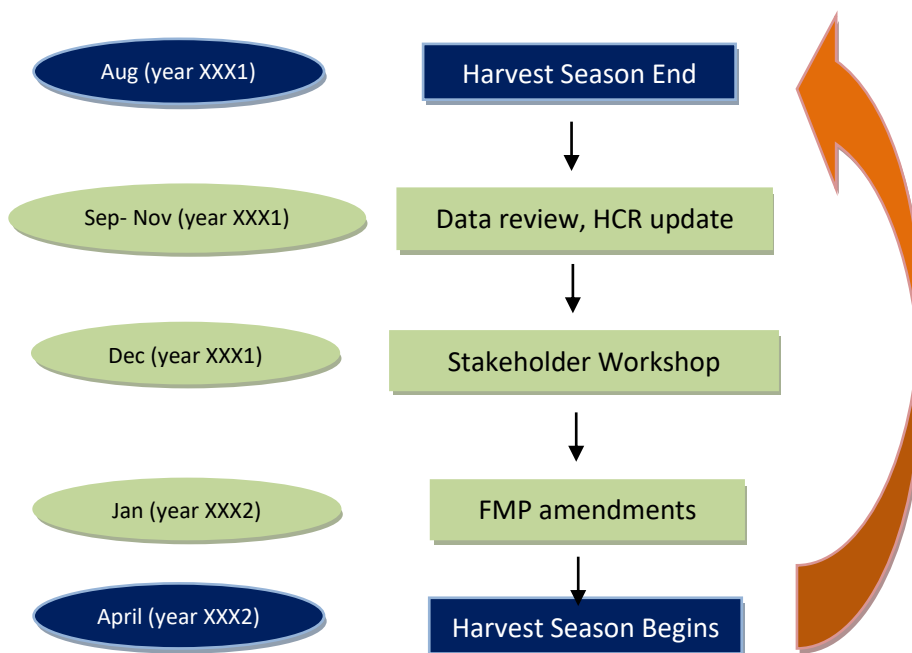


<In addition, HCRs or other mechanisms to minimise unwanted catches of target, primary and secondary species, (ii) interactions with ETP species and (iii) ensuring that habitat and ecosystem impacts are within acceptable levels could be included. An example of these could be move-on rules when a benthic impact trigger point is reached, such as a catch of VME indicator species>

#### 4.6.2 Review of the Harvest Control Rules

<A brief description of the main mechanisms to monitor the effectiveness of the HCRs in terms of how responsive they are to stock status and how effective they are in restoring the stock to target levels>

Every year will formulate new data for that fishing season and will be added to the previous years data collection. A third party stock expert will review, address and update of Harvest Control Rules where appropriate and the Fisheries management plan will be updated at the agreement from Stakeholders during the annual Crayfish workshop. The review of data will be organised to coincide within two months after the end of the fishing season September – November of that fishing year and the annual workshops will be held in the December following the third party assessment. The FMP will be updated within one month, and any modifications to the HC will circulated to the fishermen before the new fishing season begins. A flow chart of this process is described below (Figure14)



**Figure 14 – Flow chart of time frame for review of harvest control rules**

## 4.7 Decision-making Frameworks

<Building on Sections 4.1 and 4.6 above, provide a brief overview on the process to review and refine existing measures and strategies designed to achieve the fishery-specific objectives. This includes processes to review HCRs and to identify the need for new or modified HCRs. >

<Provide additional detail on the different processes needed to design, review and update management measures and strategies. Could be in the form of a flow diagram. Should mention the institutional responsibilities involved, timelines and consultation procedures>

<Describe how information is identified and used in decision-making processes, including how the precautionary approach is applied. It may also be appropriate to include an overview of how the outcomes of decision-making are made available to fishery stakeholders>

The Project Team, established in January 2018, is the sustainable fishery project team of CAPPMA Crayfish Branch in Dafeng District. The Project complies with the articles of association of CAPPMA, according to which:

In the Project Team, at least one member of each of the organizations listed in Appendix 2 shall be appointed.

The Project Team shall carry out regular inspection for the implementation, monitoring, assessment and improvement of all parts of the management plan.

The decision of the Project Team on this management plan and its measures shall be based on the approval of the majority of members, with at least 5 Project Team members (or assistants) coming to an agreement.

The Project Team will meet once every 6 months and hold additional meetings as necessary.

The meeting minutes of the Project Team will be kept in electronic form and on paper.

Other participants and stakeholders can be invited (or requested) to join the meeting and provide advices, information, or observations.

Organizing meetings and other agreed responsibilities should be supported by the Project secretariat.

The Project Team should review the fishery performance and any issues that arise, including non-compliance, changes in management policies, and new information that may affect the fishery and its objectives, including but not limited to:

- any change in ship activity, fishing gear type or fishery operations
- any change in fishery management or policy
- Activities of other ships or foreign vessels that may affect the fishery plan

- Related scientific research
- Other activities that have an impact on the management of crayfish in specific areas.
- The Crayfish Branch provides a mechanism for fishermen and stakeholders to propose and solve problems, including feedback mechanisms such as symposiums and telephone calls, which are conducted at the end of each year. Stakeholders can ask questions to the project team for a one-month feedback period. When necessary, the project team can help with the temporary resolution and arbitration of conflicts between fishermen and stakeholders. The response period for conflict resolution arbitration is one month.

#### **Decision mechanism and organizational structure**

Management and decision-making body: CAPPMA Crayfish Branch exercises management and decision-making power over the Project in accordance with its management rules. For specific decision-making processes and requirements, please refer to the Administrative Measures of CAPPMA Crayfish Branch. The secretariat of CAPPMA Crayfish Branch exercises specific management responsibilities for the Project in accordance with the resolutions of the Council.

Executive body: The Project sponsor, Jiangsu Baolong Group Co., Ltd., set up a project team to conduct project management and implementation. The members of the Project Team are as follows:

No.	Position in Project Team	Name	Organization	Title	Responsibility
1	Team leader	Wang Fengshu	Jiangsu Baolong Group Co., Ltd.	General Manager	Responsible for overall work of the Project Team
2	Executive vice leader	Cheng Xiaogang	Jiangsu Baolong Group Co., Ltd		Responsible for the coordination of between the Project Team and fishermen

3	Group leader of group 1	Xie Zhaojin	small private business		Hold meeting and transform information in Goup 1
4	Group leader of group 2	Wang Jinlai	small private business		Hold meeting and transform information in Goup 2
	Group leader of group 3	Cao Houyu	small private business		Hold meeting and transform information in Goup 3
	Group leader of group 4	Zhou Yongchun	small private business		Hold meeting and transform information in Goup 4
7	Group leader of group 5	Yuan Chengfu	small private business		Hold meeting and transform information in Goup 5

Supervisory body: The secretariat of CAPPMA Crayfish Branch designates a person to supervise the implementation and operation of the Project, who reports to the secretariat on a regular basis.

No.	Role	Name	Organization	Title	Responsibility
1	Project supervisor	Cai Jun	CAPPMA Crayfish Branch	Secretary General	Fishery organization management

Expert consultants: The consultants hired by the Project Team are from Dafeng District Fisheries Technical Extension Station, Dafeng District Marine and Fishery Bureau and other

organizations, as well as research institutions such as Fudan University and the East China Sea Fishery Research Institute of Chinese Academy of Fishery Sciences, with the participation of CAPPMA, MSC, WWF and other non-profit organizations, and the guidance of some independent foreign experts. See Appendix 3 for details of such consultants.

## 5. Ecosystem Management Strategies

### Guidance for completing Section 5 – Ecosystem management strategies

Section 5 should set out:

- The strategies by which non-target species, endangered, threatened or protected (ETP) species, habitats and ecosystem structure and functioning will be managed.

The purpose is to provide explicit statements on the approach to managing the non-target elements of the aquatic ecosystem related to the fishery.

### 5.1 Primary and Secondary Species

Under the MSC standard, the assessment must ensure that the fishery does not impair the recruitment of non-target bycatch (e.g. those species not being included in the Unit of Assessment). Such species are categorised as primary (e.g. usually managed with set reference points) or secondary (unmanaged). This latter category also includes an assessment of species outside the scope of MSC certification e.g. seabirds and marine mammals. Primary and secondary species are further sub-classified as *main* (e.g. more than 5% by weight of the total of all catches in the UoA or where it is less resilient and makes up >2% of the catch) or *minor*.

#### 5.1.1 Management strategy

<Brief description of the approach to which a fishery will ensure that they will not hinder the rebuilding of the main primary and secondary species at/to levels which are highly likely to be above the point of reproductive impairment (PRI). This should provide at least a partial strategy<sup>1</sup> for their management>

The target species of this FMP is red swamp crayfish. In order to reduce the impact on other bycatch species, the following management measures shall be adopted:

- All non-commercial bycatch shall be immediately released back into the aquatic environment in a manner that maximizes its survival.

---

<sup>1</sup> A 'partial strategy' represents a cohesive arrangement which may comprise one or more measures, an understanding of how it/they work to achieve an outcome and an awareness of the need to change the measures should they cease to be effective. It may not have been designed to manage the impact on that component specifically.

- All commercial bycatch that is not suitable for markets, e.g. is undersize or otherwise ineligible, shall be immediately released back into the aquatic environment in a manner that maximizes its survival.
- If bycatch levels increase, fishermen should move gear to another location at least 50m away.
- Fishermen will assist the CAPPMA Crayfish Branch to monitor the quantity and quality of bycatch when requested.

### 5.1.2 Other considerations

<Provide supporting evidence that the management strategy above is likely to work, based upon information about the fishery or the species involved. Include evidence that the measures and partial strategy are being implemented successfully. In the case of sharks, provide evidence that it is highly likely shark finning is not taking place>.

<Provide evidence that there is a regular review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of main primary species and they are implemented as appropriate>.

- The Project Team will review the level of retained catch annually to monitor and record the risk level of bycatch. The quantity of discarded non-target bycatch needs to be fully documented:
  8. If necessary (based on the available data from observers), an observer survey is required to quantify the weight and proportion of discarded non-target bycatch. The scope of survey should be defined and approved by CAPPMA Crayfish Branch.
  9. The Project Team will periodically review the above monitoring objectives and assess the applicability to the management of non-target populations based on the best available scientific data.
  10. The Project Team will periodically review alternatives to minimize bycatch and, if necessary, provide the most effective scientific data and commission a research to support management decisions.
  11. The bycatch data can be collected from the same crayfish sampling sites.
  12. The data recorded by observer include: the name of bycatch, the total weight and quantity of bycatch, the maximum and minimum length of bycatch.
  13. Data and information will be summarized monthly.
  14. A written report is required after the end of the fishing season each year.
- During the annual fishing season, based on the fact-sampling data of the observers, a CPUE curve for the first-level bycatch species is produced.

## 5.2 Endangered, Threatened and Protected Species (ETP)

### 5.2.1 Management strategy

<Brief description of the approach to which a fishery will manage the fishery's impact on ETP species, including measures to minimise mortality, which is designed to be highly likely to achieve national and international requirements for the protection of ETP species>.

According to local fishery management records and scientific investigation reports, there is very little interaction with ETP species in crayfish fisheries, and it is generally not easy to capture aquatic or wild animals that are under national or provincial protection. However the following highlights the management plan and measures in place to prevent a rare interaction with ETP species:

1. If there is any trace of otters within 50 meters around the traps, the traps shall be relocated away from the otter home range.
2. All turtles (except snapping turtles) and frogs, regardless of species, shall be unconditionally released back into the aquatic environment.
3. Chinese suckers and Chinese giant salamanders shall be immediately released back into the aquatic environment, and Dafeng Fishery Administration Brigade shall be informed of.

The assessment unit area we have identified this time is adjacent to the World Natural Heritage-Yancheng Wetland. It is not excluded that during the rainy season or when flooding, there are occasional national or provincial key protected wild animals misplaced in the assessment unit, and the country or province should be identified and properly handled in time. The level of protected wild animals, usually birds or leeches. According to the Law of the People's Republic of China on the Protection of Wild Animals, the Regulations on the Implementation of the Protection of Terrestrial Wild Animals of the People's Republic of China, the Regulations on the Implementation of the Protection of Aquatic Wild Animals of the People's Republic of China, and the Regulations on the Protection of Wild Animals in Jiangsu Province, especially the Yancheng Wetland After the World Natural Heritage, the Regulations on the Protection of Yanhai Yellow Sea Wetland was approved by the Tenth Session of the Standing Committee of the 13th National People's Congress of Jiangsu Province and was implemented on September 1, 2019. The aim is to strengthen the protection of the world's natural heritage "Yancheng Yellow Sea Wetland", maintain the ecological functional integrity and biodiversity of wetlands, and promote the sustainable use of wetland resources.



## 5.2.2 Other considerations

<Provide supporting evidence that the management strategy above is likely to work, based upon information about the fishery or the species involved. Include evidence that the measures and partial strategy are being implemented successfully>.

<Provide evidence that there is a regular review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of ETP species and they are implemented as appropriate>.

The following management measures shall be adopted:

- The “Regulations” propose: setting protection landmarks with the name of the wetland, the level of protection, the scope of protection, the management unit and its contact information. Establish and improve the Yellow River Wetland Key Protected Wildlife Rescue Linkage Mechanism, promptly accept relevant ambulance reports, and take emergency ambulance measures for injured or trapped key protected wild animals.
- No fishing will be undertaken in nature reserves or other environmentally sensitive areas.
- All ETP species captured must be released back into the aquatic environment as quickly and carefully as possible, to maximise survival chances and the local fishery management department authorities be reported to of its capture at the earliest opportunity.
- Fishermen will respect the sensitivity of ETP species to disturbance, and will amend their catching activities to ensure that noise and other intrusion will be kept to a minimum, especially during nesting, feeding, migration and other sensitive periods.
- Any interactions with ETP species will be recorded and immediately reported to the local fishery management department.
- CAPPMA Crayfish Branch actively organizes trainings for fishermen to learn the laws and regulations involving nature reserves and make them take initiative to report. Fishermen will be instructed on ETP sensitive areas and sensitive periods of time to minimise ETP species capture.
- For illegal activities, a penalty ranging from 200 to 2,000 RMB Yuan will be given. Suspension?
- The reporting and processing procedures are as follows:
  5. Observers will record the type, quantity, time and location of ETP species found. If no ETP species is found, a record of 0 should be performed.

6. For trapped and injured ETP species: Any unit or individual that finds an ETP aquatic wildlife injured, stranded, trapped or dead due to straying into a bay or river inlet shall promptly report to the local department of fishery administration or the fishery supervision and administration department, which will take emergency rescue measures, or require units nearby that have the necessary conditions for emergency rescue to take emergency measures and report to the competent department of fishery administration.
7. For dead aquatic wildlife: they will be properly handled with by the fishery administration.
8. For live aquatic wildlife or those that can return to their habitat: they shall be released immediately and unconditionally or in a way which maximises it's chance of survival upon release

## 5.3 Habitats

### 5.3.1 Management strategy

<Brief description of the approach to which a fishery will ensure it is highly unlikely to reduce structure and function of the both commonly encountered and vulnerable marine ecosystem (VME) habitats to a point where there would be serious or irreversible harm>.

In 2018, the unit of assessment (UoA) has been carried out for benthic risk assessment and ecosystem risk assessment by expert team of the East China Sea of the Chinese Academy of Fishery Sciences. The result shows that, for the change of benthic environment, the annual fishing equipment changes little, the fishing gear type is relatively stable, and the Doulong River water system is generally sandy, so the fishing has little effect on the substrate. For the monitoring of the benthic environment, it can be monitored every 3-5 years on the basis of certain management measures (the monitoring frequency can be adjusted according to the actual situation).

### 5.3.2 Other considerations

<Provide supporting evidence that the management strategy above is likely to work, based upon directly about the UoA and/or habitats involved. Include evidence that the measures and partial strategy are being implemented successfully>.

<Provide evidence that there is some quantitative evidence that the UoA complies with both its management requirements and with protection measures afforded to VMEs by other MSC UoAs/ non-MSC fisheries, where relevant>.

In order to reduce the impact of the fishery and its related activities on habitats, the following management measures shall be adopted:

- Fishermen should set and haul traps in a manner that least disturbs the habitats.
- Fishermen should avoid setting fishing gear in habitats that might be sensitive to disturbance and their fishing activities.
- Assess and monitor the habitat assessment plan in conjunction with the relevant systems and management of the department of wildlife protection administration and other relevant departments.
- Establish and improve wildlife resources and habitat archives and monitoring mechanisms.

Conduct a field visit or fixed-point sampling of the UoA on a regular basis, and form an analysis report or meeting minutes.

## 5.4 Ecosystem

### 5.4.1 Management strategy

<Brief description of the approach to which a fishery will ensure that they will, if necessary, take into account available information and is expected to restrain impacts of the UoA on the ecosystem so that they are highly unlikely to disrupt the key elements underlying ecosystem structure and function to a point where there would be a serious or irreversible harm. This should provide at least a partial strategy for ecosystem management>.

Knowing the fishery is targeted as an introduced species fishery the key ecosystem strategy is to make sure that *P.clarkii* population is kept at levels low enough to prevent any further ecosystem impacts associated with the Crayfish including habitat modification by burrowing and voracious predation of native species.

Based on the Ecosystem risk assessment conducted in 2018 by Fudan University, The harvest strategy will play a vital role in controlling and reducing environmental impact by association with Catch per unit effort (CPUE) of Crayfish.

- Due to the nature of the Crayfish and the impact of higher populations outlined in the ecosystem risk assessment, the CPUE of crayfish will be based at the maximum sustainable yield (MSY) or lower subject to review by the project team; based on data produced in the fishing season.

The annual review by the project team will be initiated after the closure of the fishing season and be revised and updated in the FMP in the December, before the new season begins.

Whilst it is recognized that this species is now irreversibly part of the local ecosystem, the fishery will take measures to prevent further ecosystem impacts that may have occurred as a result of the introduction of the species, especially in the neighbouring Yancheng Nature Reserve.

In order to reduce the impact of the fishery and its activities on the ecosystem, the following management measures shall be adopted:

- Non-native species shall not be introduced into the UoA without a strong and scientific environmental risk assessment.
- Baolong Group will summarize and feedback the annual monitoring situation in December each year.
- Compare the government's environmental monitoring results with the data of Baolong Group, and invite third-party representatives to supervise and make suggestions.
- Visit riverside households, hold forums to collect other environment-related information that cannot be covered by monitoring data, summarize the annual environmental monitoring situation, predict the follow-up environmental change trend, and discuss whether there are new risks.

#### **5.4.2 Other considerations**

<Provide supporting evidence that the management strategy above is likely to work, based upon information about the fishery or the ecosystem involved. Include evidence that the measures and partial strategy are being implemented successfully>.

After monitoring data collection and convening stakeholder forums, Baolong Group will convene relevant experts to review and revise the monitoring and management plan, assess the effectiveness and accuracy of the management plan for the year, find out the omissions and shortcomings, and discuss and pass the environmental monitoring management plan for the coming year.

## 6. Stock Assessment, Fishery Monitoring and Research

### Guidance for completing Section 6 – Stock Assessment, Fishery Monitoring and Research

Section 5 should set out:

- A description of the stock status and trend at the time of the plan, together with a description of the stock assessment methodologies, or other measures of stock levels
- Description of fisheries-dependent research and reporting.
- Description of other relevant research, including bycatch, ETP and habitat surveys.

The purpose is to set out mechanisms for monitoring key indicators relating to stock condition and environmental performance.

### 6.1 Stock assessments

#### 6.1.1 Current status of target stock(s)

<Brief summary of what is known about the stock, including historical trends if possible. Where appropriate, include summary graphs e.g. of spawning stock biomass, recruitment and fishing mortality where available. This text should be updated as and when a new stock assessment is conducted>

There is no well-defined stock. The population distribution is limited by physical boundaries and the Baolong plant purchases most of the catch in the Dafeng district around Yancheng. River connectivity between Dafeng and other districts is well-defined and limited to a small number of canals and rivers. Movement of crayfish between districts is unknown but also likely to be limited by the available connections. Therefore, for the purposes of this harvest strategy, Baolong purchases will be treated as the total catch from this management unit.

Stock Status

Based on the 2018 stock assessment, the stock is not overfished and overfishing did not occur in 2018. This is likely to remain the case unless the fishery changes significantly.

Reference Points

The reference points are based on the fished spawning stock biomass (SSB) compared to the unexploited SSB ( $SSB_0$ ) in the last four weeks of the season. A precautionary maximum sustainable yield (MSY) proxy was set at 40%  $SSB_0$  to determine if the stock was overexploited.

The SSB estimate is based on quantity of females present in the last four weeks of the season estimated by the stock assessment. By this point, catchability appeared to be decreasing, because, it was hypothesized, females would be increasingly retreating to burrows as they become berried.

The estimated fishing mortality (exploitation rate) during the season was compared to the constant fishing mortality which would produce 40% unexploited SSB (MSY target) or 20% unexploited SSB (PRI limit) to determine whether overfishing was occurring.

The estimated SSB and fishing mortality relative to these reference points was used to determine the trigger point used in the harvest control rule.

### **6.1.2 Stock assessment methodologies**

<Provide some details on the stock assessment methodologies used and why, and if possible identify uncertainties in the assessment process, or proxies to stock levels>

<Provide context on when the last stock assessment took place, the level of peer review and how the stock assessment process and methodologies are being improved as a result>

The population model is based on a single season depletion of a size structured population. The initial size structure is estimated using a spline function. This interpolates between fitted values, which allows the curve to be flexible without a function determining its shape. The spline curve was used because at this point there is no information on what the initial size composition might be like. More information might allow imposing some functional form.

The initial population size in each 1mm CL size bin was estimated using a spline curve which interpolates between fixed points. 8 points were defined 5mm apart across the size range. The abundance in each of these bins was estimated freely and abundance in the bins between them interpolated using the spline function.

Growth was modelled using a transition matrix. This calculates the proportion of each size bin either remaining in the bin or transferring to larger size bins on each time step. This is appropriate for short time series as it avoids the direct calculation of age, but is able to explain any change in size during the season.

Growth was assumed to be approximately linear during the season. Initially it was proposed to apply a von Bertalanffy growth curve, but sizes do not approach the maximum size suggested in the scientific literature (around 68mm), so the data are insufficient to estimate these parameters. Linear growth was a reasonable approximation over the short time period.

Selectivity can be included in the model, but again could not be estimated. It is not clear what if any fishing selectivity curve might apply. There is clear modal progression in the size composition. Given that the left-hand side of the frequency curve moves to the right, it is not likely that this is the result of minimum size selectivity function, but represents the abundance pattern in the population. Selectivity was therefore assumed to be flat over the available sizes 20-60mm CL.

## 6.2 Fisheries-dependent monitoring and reporting

<Provide details on what information is regularly and periodically collected from the fishery, including effort, catch and landings>

Observer's data collection:

- Observers' data collection should be carried out in the fishing season each year (generally from early April to the end of September every year).
- The data recorded by observer include: date of sampling, weight of crayfish retained in the 3 traps of each fisherman, number of crayfish retained, weight and of number crayfish discarded. Observer's data record form is shown in [Appendix 3](#).
- During the annual fishing season, the crayfish's CPUE curve is generated based on the observer's real-time sampling data.

## 6.3 Bycatch, ETP species and other surveys

<Provide details on regular and periodic surveys to collect data on (i) non-target catch, (ii) the interactions with endangered, threatened and protected (ETP) species and their consequences, (iii) habitat distribution and impact assessments and (iv) other surveys>

Monitoring measures for raw material purchase areas

- The items to be recorded in the purchase record are: date, fishing vessel number, weight and area information. See Appendix 4.
- Monitoring item: entry of purchase records
- Monitoring frequency: sampling once a month
- All purchase records should be filled in in detail and reviewed by qualified individuals.

- The test results will be reported in writing to the Enterprise Management Division and the Director's Office, and the original test records will be stored in the archives.
- The qualified raw materials will be recorded on the Company's freshwater crayfish raw materials acquisition account.
- The system of fishing closure and fishing off shall be strictly enforced, and it is forbidden to catch crayfish from November to March of the following year.

## 6.4 Other relevant research

<Provide details of any other research that is required or being carried out to support ensuring the sustainability of the fishery. This could include ecosystem and socio-economic themes. Where appropriate put these into context with wider national, regional or international research initiatives>

### Stock management assessment and monitoring

- Through CAPPMA Crayfish Branch, a team of expert consultants can be organized, and foreign experts in crayfish stock can be invited to participate in the annual forum by telephone or presence. At the forum, the results of stock data collection in the fishing season will be summarized and shared, and a data quality analysis will be given. At the same time, the stock data collection plan will be assessed to determine its practicability and deficiencies, and together with suggestions put forward by experts, the fishery management plan can be revised.
- The revised fishery management plan will be voted at the annual meeting of the Standing Council (before the fishing season).
- CAPPMA Crayfish Branch will monitor the data collection every month during the fishing season and record the results in written form every year for review.



## 7. Compliance and Monitoring

### Guidance for completing Section 7 – Compliance and Monitoring

Section 6 should set out:

- The overall objectives of monitoring, control and surveillance (MCS) efforts in the fishery.
- How MCS activities are planned.
- Roles and responsibilities in fisheries compliance.

The purpose is to provide readers with a broad understanding of how compliance in the fishery is monitored and what approaches are taken to deter non-compliance.

### 7.1 Objectives and Approach

<Brief summary of the main objectives of fisheries control, including linkages to any higher policy>

<General approach to MCS e.g. sea-based, port-based, self-regulation, fleet coverage of vessel monitoring systems (VMS), etc.>

In order to promote the legal, compliance and sustainable development of the freshwater fishing industry in the region, and to protect and scientifically develop and utilize fishery resources, the Dafeng Crayfish Production and Marketing Cooperation Project Team accepts the fishery management plan formulated by the Dafeng Fishery and Fishery Administration. Although freshwater crayfish are invasive alien species, they have been well integrated into the local ecosystem for many years due to legal, rational management and scientific development and utilization. As an important fishery resource, they have provided rich ingredients for the economic and social development of our district. And industrial raw materials. The law enforcement management of freshwater crayfish capture fisheries combines with the overall management of fishery administration in freshwater fishing, and implements risk management methods to achieve the management objectives of healthy and sustainable development and utilization of fishery resources. A brief annual control report will be prepared by the BoF in the December at the end of each fishing season which should include:

- 1) The number of inspections made
- 2) The level of non compliance detected
- 3) The sanctions imposed by the detected non compliances (If any)

On review of the annual control report by the project team, it will follow that the risk assessment be reviewed and revisions be made. Following the Risk assessment revision, the Annual control plan should be updated where necessary in the December after the seasonal closure of the fishery.

## 7.2 Planning

### 7.2.1 Risk assessment

<Description of the main risks of systematic non-compliance and how these are considered in the MCS planning process. This should focus on the main components of the fishery where non-compliance might occur e.g. non-, under and mis-reporting, illegal discarding, illegal transshipments, unlicensed vessels and fishing activities, fishing in no-take MPAs, etc.>

The crayfish fishery risk assessment uses a percent scoring method that combines periodic inspections and irregular surprise inspections to score each risk point. The scores of 80 points and above are “no risk”; 65 points (inclusive) to 80 points are “risk alert areas”; below 65 points are “existing risks”, and targeted management measures should be taken. In the implementation of the management plan, we will develop the next phase of management measures based on the scores of each inspection to promote the sustainable use of crayfish fisheries.

The 2019 Annual Work Summary of Fishery Administration Management on Freshwater Crayfish Fishery in Dafeng District, Yancheng City includes the annual Crayfish fishery risk management scoring sheet which assigns the score to each risk assessed for non- conformance within the Crayfish Fishery and the table of the list of penalties associated with non- compliancy (Appendix 2). This is to be reviewed annually by the BoF after the closure of the fishery (October -December) and documents including any amendments to the risk assessments and penalties to be made publicly available.

Table4 Crayfish fishery risk management scoring sheet created by the co management between the Crayfish cooperation team and the fishery enforcement governor (BoF,China):

Points	Penalty points	Score
Enforcement of laws and regulations 30 points	15 points. 1 point to be deducted for one case of unlicensed operation found in the main river and its tributaries, until the points are completely deducted.	9
	15 points. 1 point to be deducted for one case of set-net ground cage found in various river courses, until the points are completely deducted.	15
Quantity of	The quantity of nets of single vessel/household	8

fishing gears: 8 points	exceeding 300, 1 point to be deducted for one case until the points are completely deducted.	
Mesh size: 15 points	1 point to be deducted for one case of mesh size less than 2 cm, until the points are completely deducted.	12
Size of target catch: 12 points	1 point to be deducted for one household with the specifications of the captured crayfish less than 3 cm, until the points are completely deducted.	9
Fishing with storage battery or not: 6 points	If there is a case where electric pulse is used to drive the crayfish to the ground cage, 6 points is deducted in one time.	6
Trapping with baits: 10 points	1 point to be deducted for one case found, until the points are completely deducted.	6
The bycatch aquatic products failing to meet the selling specifications: 10 points	1 point to be deducted for one case found, until the points are completely deducted.	10
Wild protected animals being affected or not: 4 points	4 points to be deducted in one time for one case found	4
Catching the burrowing crayfish by excavation: 5 points	1 point to be deducted for one case found, until the points are completely deducted	4
Total score: 100 points		83

## 7.2.2 Recurrent planning

<Description of the recurrent planning processes (e.g. annual control planning), how these are designed, resourced and implemented. Should also include some details on how control efforts and impacts are monitored and used for recurrent planning processes>

Carry out the normal work of fisheries management

### (1) Special management of target species crayfish

1. Strictly implement the fishery fishing license system. The fishermen and fishing vessels that carry out freshwater fishing in the main rivers and their tributaries in the region are strictly enforced. The fishermen and fishing vessels that have not been illegally fished are confiscated their operating nets and ships, and are ordered to correct illegal operations.
2. It is forbidden to carry out fixed operation activities in various rivers and rivers in the whole district, and comprehensively eliminate the fixed-fishing fishing rods and fishing rods.
3. Regular inspections or irregular inspections to check fishing vessel power, mesh specifications and catch specifications. For licensed fishing vessels, operating methods and nets, the fishing vessel power, the number of nets, the size of the mesh and the minimum catch specifications of various types are strictly checked. In the management of freshwater crayfish fisheries, strict implementation: the minimum mesh size of the cage is 2 cm; the single-vehicle or single-family operation net is less than 300; the market transaction specifications of less than 3.0 cm are strictly prohibited; except for crayfish Other bycatch aquatic products are not subject to the provisions of the listing and trading regulations.
4. In conjunction with other related actions, organize regular inspections or irregular surprise inspections to prevent fishery fishing operations from capturing or affecting the behaviour of wild protected animals. Extensive publicity activities were carried out to inform all fishermen about national and provincial first- and second-level wild protected animals and “three-owned” protected animals that may appear in the waters of the region.

### (2) Management of non-ETP bycatch species

1. Analyse the catch of non-ETP species other than crayfish recorded by observer records, fixed-point fishing fishermen's production records and peacetime assault inspections, and analyse the effects of non-fixed crayfish operation cages on other species in the Doulong River Basin. Particular attention is paid to the effects of this method of operation on salmon, crab and shrimp.

2. Through the existing data, establish a trend chart of the variety and quantity of the single-catch catch of the by-catch species, and provide a timely and accurate decision-making basis for the fishery administration plan.

3. Non-ETP species that are not commercially traded should be immediately returned to the original water body and kept as viable as possible. In addition to the annual fishing from September 10 to December 30, the crabs will be released to the original water body at other times; the size of the squid should reach 100 grams or more, and the fish can be marketed; the size of the shrimp should be 100. The grain is marketed every 500 grams or more.

4. If the total weight of the three species of river crab, green prawn and squid, which are of particular concern, exceeds 10% or more of the total catch weight, the cage should be placed 50 meters above the original cage placement point, and the time should not be greater than one time. 8 hours.

### (III) Management of ETP species

1. If there is leeches activity within 50 meters of the crayfish fishing cage, the cage should be withdrawn and the cage should be relocated from the raft activity area.

2. All turtles (except for crocodile turtles) and frogs should be returned to the original water body unconditionally regardless of the species.

3, pharyngeal fish, Da Ni, etc. immediately returned to the original water body, while reporting to the district fishery government brigade.

### 7.2.3 Deterrence of non-compliance

<Description of the main mechanisms for deterrence against rule-breaking. This may include enforcement-based sanctions (both administrative and criminal) available for illegal, unreported and unregulated (IUU) fishing infringements, including details of penalty levels where possible, and also informal approaches, such as norm-based controls. >

Penalties for violations of relevant laws and regulations in the Measures for the Implementation of the Fisheries Law of the People's Republic of China in Jiangsu Province:

Article 36 For anyone who violates fishery laws and regulations, the catch and other illegal gains shall be confiscated, the losses caused shall be compensated, and criticism and education, fines (provisions are attached), confiscation of fishing gears, revocation of fishing licenses or farming licenses, and confiscation of fishing vessels will be imposed according the seriousness of the cases.

**Provisions for fines imposed concurrently or separately created by the BoF and Crayfish Cooperation:**

<b>S/N</b>	<b>Illegal act</b>	<b>Fine amount (Yuan)</b>
<b>1. Unauthorized fishing without a fishing license</b>	Inland water non-motorized vessels	50-150
	Inland water motorized vessels and marine non-motorized vessels	100-500
	Marine water motorized vessels, with power less than 184 kW	200-2500
	184-440 kW	2500-6000
	Above 440 kW	6000-20000
<b>2. Conducting fishing operations not according to the specified types, locations, time limits, fishing gears or licenses, and annual examinations</b>	Inland water non-motorized vessels	25-50
	Inland water motorized vessels and marine non-motorized vessels	50-100
	Marine water motorized vessels, with power less than 184 kW	50-750
	184-440 kW	750-1800
	Above 440 kW	1800-3000
	Offshore vessels entering the inland sea for fishing	
	440 kW or less	3000-7000
	Above 440 kW	7000-20000
	Failing to apply for permits or annual examinations according to the regulations	
	Inland waters	20-50
	Seas	50-500
<b>3. Violating the regulations on closed fishing areas, closed fishing seasons, protected</b>	Inland water non-motorized vessels	50-500
	Inland water motorized vessels and marine water non-motorized vessels	500-5000
	Marine water motorized vessels, with power less than 44 kW	500-5000
	44-184 kW	5000-15000

<b>areas, aquatic animals that are prohibited for fishing, or bearing no licenses or acquiring the catches</b>	184-440 kW	15000-30000
	Above 440 kW	30000-50000
	Illegal acquisition, trafficking or hiding of parents and seedlings of aquatic animals with important economic value	500-10000
<b>4. Using prohibited fishing gears and fishing methods</b>	(1) Fishing with explosives and poisons	
	Inland waters	50-500
	Seas	500-50000
	(2) Fishing with electricity	
	Inland waters	200-1000
	Seas	500-3000
	(3) Catching fish with ospreys not according to the regulations	50-200
	(4) Trapping fish by making knocking noise	
	Inland waters	1000-10000
	Seas	5000-50000
	(5) Using nets with undersized mesh	
	Inland waters	50-200
Seas	200-1000	
	(6)	100-1000
	(7) Using bamboo weirs and lift nets	50-200
	(8) Using multi-layer sac nets, water gate sleeve nets	50-1000
<b>5. The amount of larvae exceeding the specified proportion</b>	Inland waters	10-50
	Seas	50-500
<b>6</b>	Building fishing vessels without a construction permit	20-50% of the building

		cost
<b>7</b>	Sale, lease, alteration, illegal transfer of fishery licenses or permits	100-1000
<b>8</b>	Stealing, robbing aquatic products or destroying fishery water bodies and facilities, with minor behaviors	50-1000
<b>9</b>	Polluting fishery waters, causing losses to the fishery	20 per acre
<b>10</b>	If a fine is imposed, the captain or unit leader shall be imposed with a fine of	100-1000

Note: Units for measurement of fines: work unit shall be taken for measurement for vessel operations (main motor power of motorized vessels will be consolidated); and a single person shall be taken for measurement for non-vessel operations.

The compensation for loss of fishery resources shall be calculated on the basis of 0.5 to 3 times the resulting mortality of aquatic animals; Those who have their fishing licenses revoked may only reapply the license after one year, and those who have their aquaculture permits revoked may only reapply for it after six months.

Article 37 The administrative penalties prescribed in these measures shall be decided by the fishery administration authorities at or above the county level and the notice of a penalty decision shall be filled out and issued. Among them, the confiscation of non-motorized fishing vessels or motorized ones with power below 44 kW (60 hp) shall be decided by municipal fishery administration authority; the confiscation of motorized fishing vessels with power above 44 kW shall be decided by provincial fishery administration authority. In the execution of various penalties, separate vouchers shall be issued for fines, compensations and confiscated fishing gears and catches. A daily late fee of 1% of the total amount of the fine shall be added from the final date of the time limit for overdue payment of the fine.

Article 38 If a party is not satisfied with the penalty decision of the fishery administration authority, he/she may appeal to the fishery administration authority of a higher level or directly file a suit with the people's court within 30 days after receiving the notice of a penalty decision. The higher-level fishery administration authority shall make a decision within 15 days after it receives the appeal. During the appeal and litigation, the execution of



the original penalty decision will not be stopped. If a party files no complaint or lawsuit within the time limit and refuses to fulfill the penalty decision, the authority that makes the penalty decision shall apply to the people’s court for compulsory execution

### 7.3 Roles and responsibilities in compliance

<Description of the main organisations responsible for fisheries monitoring, control and surveillance, including their jurisdictions and responsibilities>

MARA	Conduct overall research and organize the implementation of strategic plans and policies for agriculture, rural areas and farmers; supervise and administer planting, animal husbandry, fishery, reclamation, mechanization and the quality and safety of agricultural products; in charge of investment in agriculture.
Bureau of Fisheries	Its tasks include the development of fishery administration plans, strategies, norms and laws, the administration of fishery departments, planning, selection and management of related fisheries research, maintaining and publishing fishery statistics, and monitoring and enforcement of fisheries administration.
Fisheries Technical Extension Station	Centering on the work of fisheries, strengthen the function of public welfare, innovate the system and mechanism, improve the service ability, and play an important role in ensuring the safe and effective supply of aquatic products, promoting fishermen's income and promoting the construction of modern fishery.
Crayfish Production and Marketing Cooperation Project Team:	Principal of local fishery management
Dafeng Fishery Administration Brigade:	Supervise and manage crayfish fishing operations in accordance with laws and regulations
Dafeng Fisheries Technical	Local primary provider of basic information and technical

Extension Station:

support.

## 8. Fishery Performance Evaluation

### Guidance for completing Section – Fishery Performance Evaluation

Section 7 should set out:

- The main performance indicators that will be used to monitor how well the plan is being implemented and how effective it is being.
- The process by which fisheries management can be periodically reviewed and the FMP revised.

The purpose is to ensure that the FMP remains relevant to the on-going and emerging challenges to the sustainable management of the fishery.

The approach presented below presumes that the fishery is working to meet MSC's fishery standard requirements, mostly likely through a Fisheries Improvement Project (FIP), and has developed a time-bound Improvement Action Plan.

Once the fishery exits the FIP (e.g. becomes certified or otherwise leaves the MSC program), this section can be replaced with standard fishery performance monitoring and evaluation text. In this case they are directed towards more generic guidance on fisheries performance objective setting and evaluation, such as in Hindson *et al* (2005).

### 8.1 Measurable Performance Indicators

<Where the fishery is in a formal FIP<sup>2</sup>, MSC's Benchmarking and Tracking Tool (BMT) should be used here. The BMT provides a method for reporting the status of fisheries against the MSC Fisheries Standard and tracks the progress being made as fisheries improve towards sustainability and certification. MSC provides written guidance<sup>3</sup> and an Excel-based BMT tool<sup>4</sup> that allows users to benchmark the performance of a fishery or FIP against the MSC Fisheries Standard>

---

<sup>2</sup> See <https://www.msc.org/for-business/fisheries/developing-world-and-small-scale-fisheries/fips>

<sup>3</sup> [https://www.msc.org/docs/default-source/default-document-library/for-business/fishery-improvement-tools/benchmarking-and-tracking-tool--guidance-document.pdf?sfvrsn=840c1bb\\_20](https://www.msc.org/docs/default-source/default-document-library/for-business/fishery-improvement-tools/benchmarking-and-tracking-tool--guidance-document.pdf?sfvrsn=840c1bb_20)

<sup>4</sup> [https://www.msc.org/docs/default-source/default-document-library/for-business/fishery-improvement-tools/msc-benchmarking-and-tracking-tool-excel-spreadsheet-v2-1.xlsx?sfvrsn=76d27110\\_14](https://www.msc.org/docs/default-source/default-document-library/for-business/fishery-improvement-tools/msc-benchmarking-and-tracking-tool-excel-spreadsheet-v2-1.xlsx?sfvrsn=76d27110_14)

<Once the fishery has exited the FIP, SMART<sup>5</sup> indicators need to be developed to enable monitoring of the fishery against the long and short-term objectives outlined in **Section 2**. These indicators should be subject to periodic evaluation to ensure they remain relevant and useful>

---

<sup>5</sup> **Specific** – targets a specific area for improvement; **Measurable** – you can measure some indicator to check if you have achieved it; **Agreed** – by the appropriate stakeholders; **Realistic** – within your timescale and resources; **Time dependent** – it includes a stated timescale for achievement (adapted from Hindson *et al*, 2005)

## 8.2 Review Process

4. An internal review of the FIP Action Plan should be undertaken on an annual basis, with progress / outcomes noted against the individual actions in Table 3 of the Action Plan, and the BMT updated accordingly. The process and mechanism for review reviews should be recorded here, including any public consultation considered necessary.

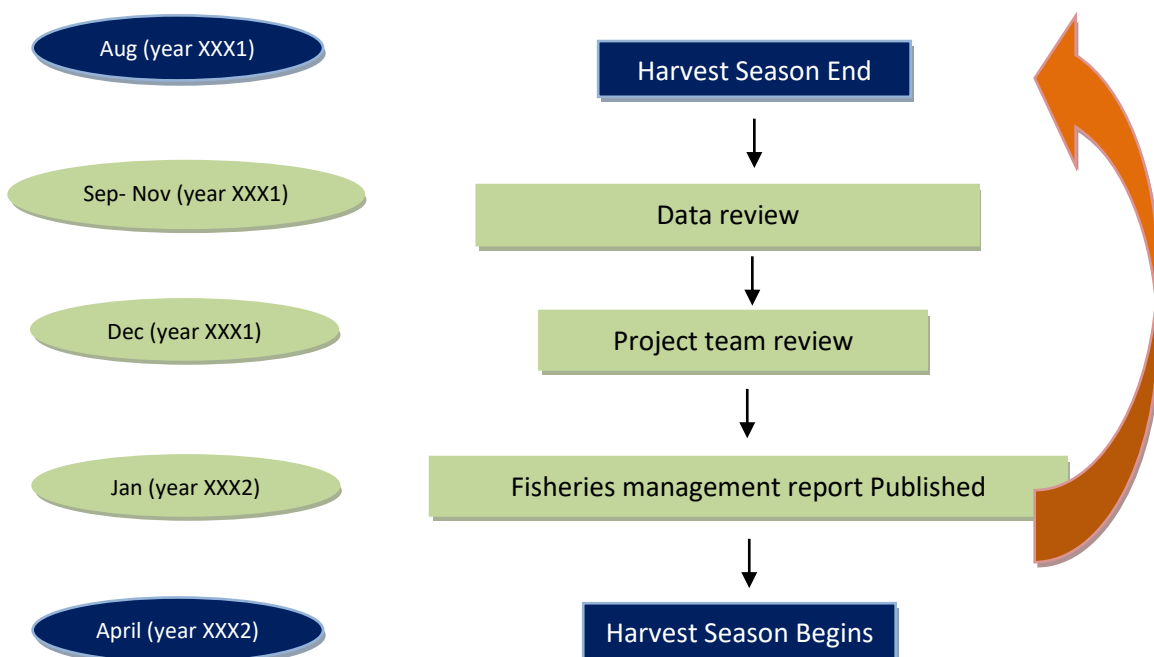
5. A periodic, external review of the FIP Action Plan should be undertaken on a periodic basis e.g. in the form of an independent pre-assessment for the initial design of the Action Plan and possibly a final independent review once the FIP has been completed to ensure that the fishery is ready to undergo full assessment. The process and mechanism for external reviews should be recorded here.

6. Once the fishery has exited the FIP, the FMP should be formally revised on an annual basis to reflect any changes to the fishery management, as well as any new information supporting this management e.g. new stock assessment results. We suggest that a more detailed evaluation, if possible with some external input, be conducted every five years to ensure the FMP remains relevant and robust.

The project team (and Its successors in the Client group) will prepare an annual and publicly available Fisheries Management Report of each fishing season from December 2019. The report will include:

- 1) Fishing effort and landings data for *P. clarkii* and the main primary and secondary species
- 2) Weekly CPUE data through the fishing season
- 3) Compliance and use of HCRs
- 4) Any ETP, habitat or ecosystem, events of interest CPUE data throughout the fishing season
- 5) A summary of the Bureau of fisheries “Control Report”
- 6) This report should be formally reviewed by the project team and the Fisheries management plan updated where necessary and include any recommendations for the fisheries management report.

A recommended timeframe of review and report is shown below:



The Fisheries management report should be scheduled for publication by the December in time for the new season.

Where deemed necessary an external review of the fishery should be commissioned every 5 years.

### **8.3 Fisheries Management Plan Revision and Update**

<A Fisheries Management Plan should be a living document that is adaptive to changing instances both within and outside the fishery. Based on the review processes earlier in this section, the FMP can be updated, and more detail added as it matures. This section should therefore describe the process by which the FMP will be revised e.g. at which periodicity, by who, and the degree of stakeholder participation and consultation involved. It is noted that some elements of the plan may need legislative changes e.g. some harvest control rules, and thus the processes and timescale to changes these needs to be reflected here>

## 9. Resources required to implement the Plan

### Guidance for completing Section 8 – Resources required to implement the Plan

Section 8 should set out:

- The approach to ensuring that sufficient human and financial resources are allocated to implement the plan.
- Approaches to share and / or recover costs from stakeholders.

The purpose is to formalise how the plan is to be supported and maintained.

### 9.1 Approach

#### 9.1.1 Human Resources

<Describe the approach to ensuring there are sufficient human resources to maintain, develop and when necessary, update the plan. If possible, identify the lead agency responsible and any key partners involved, detailing roles and responsibilities>

#### 9.1.2 Financial Resources

<Describe the approach to ensuring there are sufficient financial resources to maintain, develop and when necessary, update the plan. If possible, provide details of the budget involved and their source>

### 9.2 Cost sharing and recovery

<Describe any cost sharing or cost-recovery mechanisms>

## References

Correia A. M., Bandeira. N. & Anastacio, P.M. (2005) Predator–prey interactions of *Procambarus clarkii* with aquatic macroinvertebrates in single and multiple prey systems. *Acta Oecologica*, Volume 28, Issue 3. Pages 337- 343

Assessment report on Ecological Risk of *Procambarus clarkia* in Doulong River, defeng District, Yancheng City, Jiangsu province

FAO of united nations, 23/10/19

[http://www.fao.org/fishery/culturedspecies/Procambarus\\_clarkii/en](http://www.fao.org/fishery/culturedspecies/Procambarus_clarkii/en)

Website: Global Invasive species database .<http://www.iucngisd.org/gisd/species.php?sc=608>.

Visited 01/11/19.

Investigation and Assessment on the Habitat of Crayfish in Yancheng City, Jiangsu Province  
RESEARCH REPORT by the East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences. August, 2018





## 10. Appendix 1

Harvest strategy and control rule: a summary of performance relative to the MSC requirements based on work completed.

ID	Name	SG60	SG80	SG100	Comments
111a	Stock status relative to recruitment impairment.	It is <b>likely</b> that the stock is above the point where recruitment would be impaired (PRI).	It is <b>highly likely</b> that the stock is above the PRI.	There is a <b>high degree of certainty</b> that the stock is above the PRI.	There is currently no evidence that the stock is overfished. The apparent abundance was much higher in 2019 compared to 2018. It is highly likely that the stock is above its PRI.
111b	Stock status in relation to achievement of Maximum Sustainable Yield (MSY).		The stock is at or fluctuating around a level consistent with MSY.	There is a <b>high degree of certainty</b> that the stock has been fluctuating around a level consistent with MSY or has been above this level over recent years.	The target is not clearly defined yet, although the stock status appears with any candidate target reference points at this stage.
121a	Harvest strategy design	The harvest strategy is <b>expected</b> to achieve stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and the elements of the harvest strategy <b>work together</b> towards achieving stock management objectives reflected in PI 1.1.1 SG80.	The harvest strategy is responsive to the state of the stock and is <b>designed</b> to achieve stock management objectives reflected in PI 1.1.1 SG80.	With the monitoring programme in place, the harvest strategy is being evaluated. However, data are as yet insufficient to allow full evaluation. Elements are licensing system and limits on traps, opening and closing of season and Baolong purchasing arrangements. Furthermore, there is a well-defined rule that should reduce catches if the stock is determined too low. There are potential gaps in the system. Catches not sold to Baolong, and environmental effects undermining the HCR assumptions may prevent the strategy achieving

					PI 111 objectives.
121b	Harvest strategy evaluation	The harvest strategy is <b>likely</b> to work based on prior experience or plausible argument.	The harvest strategy may not have been fully <b>tested</b> but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been <b>fully evaluated</b> and evidence exists to show that it is achieving its objectives including being clearly able to maintain stocks at target levels.	Evidence is currently insufficient to show that the harvest strategy will work. See stock assessment report for suggestions on further actions that can be taken before 2020. Another year's data should help test the strategy.
121c	Harvest strategy monitoring	Monitoring is in place that is expected to determine whether the harvest strategy is working.			The current monitoring system should be adequate to evaluate the harvest strategy.
121d	Harvest strategy review			The harvest strategy is periodically reviewed and improved as necessary.	No review has been conducted as yet. A review could be completed alongside a technical review of the stock assessment.
121f	Review of alternative measures	There has been a review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock.	There is a <b>regular</b> review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock and they are implemented as appropriate.	There is a <b>biannual</b> review of the potential effectiveness and practicality of alternative measures to minimise UoA-related mortality of unwanted catch of the target stock, and they are implemented, as appropriate.	In general, crayfish are unharmed during capture. Undersized and berried crayfish are returned alive, otherwise crayfish are retained. It is unlikely that this PI will need to be evaluated.

122a	HCRs design and application	<b>Generally understood</b> HCRs are in place or <b>available</b> that are <b>expected</b> to reduce the exploitation rate as the point of recruitment impairment (PRI) is approached.	<b>Well defined</b> HCRs are <b>in place</b> that <b>ensure</b> that the exploitation rate is reduced as the PRI is approached, are expected to keep the stock <b>fluctuating around</b> a target level consistent with (or above) MSY, or for key LTL species a level consistent with ecosystem needs.	The HCRs are expected to keep the stock <b>fluctuating at or above</b> a target level consistent with MSY, or another more appropriate level taking into account the ecological role of the stock, most of the time.	The main task is to ensure the stock remains above its limit reference point, and the precautionary HCR should continue to ensure that this is the case. There is a strong environmental component affecting the population and the fishery. It may be argued that the target stock size should be lower than MSY since the species is introduced.
122b	HCRs robustness to uncertainty		The HCRs are likely to be robust to the main uncertainties.	The HCRs take account of a <b>wide</b> range of uncertainties including the ecological role of the stock, and there is <b>evidence</b> that the HCRs are robust to the main uncertainties.	The HCR has undergone preliminary tests using projections of the Bayesian stock assessment. These are probabilistic in nature and show the HCR should be robust in reducing exploitation levels if the stock size falls below a preliminary precautionary level.
122c	HCRs evaluation	There is <b>some evidence</b> that tools used or <b>available</b> to implement HCRs are appropriate and effective in controlling exploitation.	<b>Available evidence</b> indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs.	<b>Evidence clearly shows</b> that the tools in use are effective in achieving the exploitation levels required under the HCRs.	It is not clear yet that the tools in place are sufficient to reduce substantially the exploitation rate when required. Currently, it depends on plausible argument that catches will decrease when Baolong stops purchases. This still needs to be verified.

123a	Range of information	<b>Some</b> relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	<b>Sufficient</b> relevant information related to stock structure, stock productivity, fleet composition and other data are available to support the harvest strategy.	A <b>comprehensive range</b> of information (on stock structure, stock productivity, fleet composition, stock abundance, UoA removals and other information such as environmental information), including some that may not be directly relevant to the current harvest strategy, is available.	Information is sufficient to support a preliminary harvest strategy considering the size and scale of the fishery. Information is set to improve over time.
123b	Monitoring	Stock abundance and UoA removals are monitored and <b>at least one indicator</b> is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and UoA removals are <b>regularly monitored at a level of accuracy and coverage consistent with the harvest control rule</b> , and <b>one or more indicators</b> are available and monitored with sufficient frequency to support the harvest control rule.	<b>All information</b> required by the harvest control rule is monitored with high frequency and a high degree of certainty, and there is a good understanding of the inherent <b>uncertainties</b> in the information [data] and the robustness of assessment and management to this uncertainty.	Total catch, CPUE and size composition are collected through the season. These data should be sufficient to support an HCR.
123c	Comprehensiveness of information		There is good information on all other fishery removals from the stock.		Not all catches are estimated. Whereas in 2018 unrecorded catches were not considered significant, in 2019 they may have been.
124a	Appropriateness of assessment to stock under consideration		The assessment is appropriate for the stock and for the harvest control rule.	The assessment takes into account the major features relevant to the biology of the species and the nature of the UoA.	The HCR is constructed to be consistent with the stock assessment and available data. However, recent testing suggests that further data and development may be required

					due to inconsistent results between the 2018 and 2019 seasons.
124b	Assessment approach	The assessment estimates stock status relative to generic reference points appropriate to the species category.	The assessment estimates stock status relative to reference points that are appropriate to the stock and can be estimated.		The stock assessment evaluates stock status relative to reference points.
124c	Uncertainty in the assessment	The assessment <b>identifies major sources</b> of uncertainty.	The assessment takes <b>uncertainty into account</b> .	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a <b>probabilistic</b> way.	The stock assessment is using Bayesian model which is probabilistic.
124d	Evaluation of assessment			The assessment has been tested and shown to be robust. Alternative hypotheses and assessment approaches have been rigorously explored.	Although the stock assessment has been tested, it is not clear that it is robust. Significant uncertainty remains on environmental effects and how these might be accounted for.
124e	Peer review of assessment		The assessment of stock status is subject to peer review.	The assessment has been <b>internally and externally</b> peer reviewed.	The stock assessment has not been peer reviewed. recent testing suggests that it is not yet ready for review.

## 11. Appendix 2