

Fishery Management Plan
of the
Doulong River crayfish trap fishery,
Jiangsu Yancheng Province, Dafeng District



Doulong River crayfish trap fishery,

Jiangsu Yancheng Province, Dafeng District

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

Jiangsu Baolong Group

Lyons Seafood Group

FMP Version number

Version number	Date published	Key contributors	Description of key changes
1.0	20 March 2019	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,	FMP with new template
3.0	Jan, 2020	Zhu Yaping, Zhang Linlin, Yu Xiaotong, Xie Guoxing, Cheng Xiaogang, Robyn Cloake	Trap Identification, description of HCR, HS,
4.0	March, 2020	Tim Huntington, Robyn Cloake, Clarus Chu, Paul Medley	Management/ groups, spelling and Grammar/ references and appendices
5.0	May, 2020	Tim Huntingdon, Robyn Cloake, Xiaotong YU	Clarification of compliance, enforcement mechanisms, dispute mechanisms and roles and responsibilities.

Contents

ACRONYMS USED	V
IDENTIFICATION AND DESCRIPTION OF THE FISHERY.....	77
1.1 FISHERY TO WHICH THIS PLAN APPLIES	78
1.2 DESCRIPTION OF THE FISHERY.....	9
2. GOALS AND OBJECTIVES.....	18
2.1 GOVERNANCE AND POLICY.....	18
2.2 FISHERIES-SPECIFIC MANAGEMENT OBJECTIVES	18
3. FISHERIES MANAGEMENT STRUCTURE	1920
3.1 LEGAL FRAMEWORK	20
3.2 INSTITUTIONAL ARRANGEMENTS.....	23
3.3 CONSULTATION AND CO-MANAGEMENT ARRANGEMENTS	25
3.4 ALLOCATION OF RESOURCES	26
4. HARVEST STRATEGY AND CONTROL RULES	27
4.1 HARVEST STRATEGY.....	27
4.2 HARVEST CONTROL RULES.....	2828
4.3 DECISION-MAKING FRAMEWORKS.....	34
5. ECOSYSTEM MANAGEMENT STRATEGIES.....	37
5.1 PRIMARY AND SECONDARY SPECIES.....	37
5.2 ENDANGERED, THREATENED AND PROTECTED SPECIES (ETP)	38
5.3 HABITATS.....	39
5.4 ECOSYSTEM.....	40
6. STOCK ASSESSMENT, FISHERY MONITORING AND RESEARCH.....	4141
6.1 STOCK ASSESSMENTS	41
6.2 FISHERIES-DEPENDENT MONITORING AND REPORTING	4242
6.3 BYCATCH, ETP SPECIES AND OTHER SURVEYS	4242
6.4 OTHER RELEVANT RESEARCH	42
7. COMPLIANCE AND MONITORING	4444
7.1 OBJECTIVES AND APPROACH	44
7.2 PLANNING.....	44
7.3 ROLES AND RESPONSIBILITIES IN COMPLIANCE	4848
8. FISHERY PERFORMANCE EVALUATION.....	5050
8.1 MEASURABLE PERFORMANCE INDICATORS	5050
8.2 REVIEW PROCESS	5050
8.3 FISHERIES MANAGEMENT PLAN REVISION AND UPDATE	5151
9. RESOURCES REQUIRED TO IMPLEMENT THE PLAN	52
9.1 APPROACH.....	52

9.2 COST SHARING AND RECOVERY 52

Appendices

APPENDIX A: REFERENCES 53

APPENDIX B: HARVEST STRATEGY AND CONTROL RULE: A SUMMARY OF PERFORMANCE RELATIVE TO THE MSC REQUIREMENTS BASED ON WORK COMPLETED 55

APPENDIX C: PRODUCTIVITY - SUSCEPTIBILITY ANALYSIS (SECONDARY SPECIES) 60

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 1 mu = 1/15 of a hectare
N	No (in relevant MSC scoring tables)
N/A	Not applicable or not available
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 Scale Intensity Consequence Analysis
SPR Spawning Biomass per Recruit
t tonne(s)
UoA..... Unit of Assessment
UoC..... Unit of Certification
USD..... United States dollar
Y..... Yes (in relevant MSC scoring tables)

Identification and Description of the Fishery

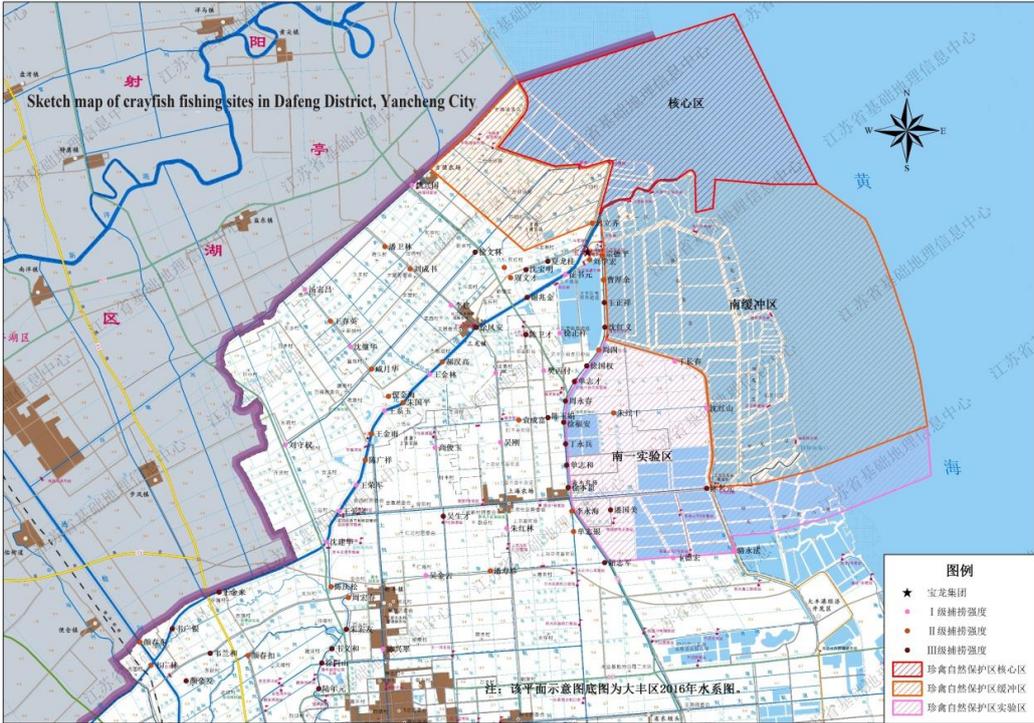
The Doulong River crayfish trap fishery of the Jiangsu Yancheng Province, Dafeng District is an artisanal fishery which encompasses that of the Doulong river and associated waterway network in Jiangsu Province Dafeng City. The Unit of Assessment is near the Jiangsu Yancheng Wetland National Nature Reserve 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 March 2020.

This FIP aim to improve the sustainable utilization of wild crayfish resources in Doulong River in Dafeng District, Yancheng City, Jiangsu Province, to meet the standards of the Marine Stewardship Council (MSC) through the joint participation of the local governments, research institutes, fishery enterprise (Jiangsu Baolong Group), processors (Labeyrie/Lyons Seafood and Bakkavor) and fishers. The China Aquatic Products Processing and Marketing Association (CAPPMA) has been main project executive to support the local crayfish fishery to achieve the MSC sustainable fisheries standard.

In January 2018, the local implementation team (Baolong) of the FIP joined the Crayfish Branch of the CAPPMA to establish the local FIP project team (Project Team) in Dafeng District. The Project Team is mainly responsible for 1) formulating the management systems of wild crayfish resources , 2) establishing decision-making mechanism and day-to-day supervision and management, and 3) carrying out sustainability assessment of crayfish fishery resources and improvement of fishery in Doulong River, Dafeng District, Yancheng City. Specific work tasks included regular communications 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, the Project Team has developed a management plan for the crayfish fishery in the Doulong River water system in Dafeng District that adapts to the real local situation, which serves as the guidelines for the Project Team members and local fishermen to manage the crayfish fishing activities.

1.1 Fishery to which this plan applies

Fishery name:	Doulong River crayfish trap fishery	
Species covered:	<i>Procambarus clarkii</i> (Red Swamp Crayfish)	
Fishery location:	<p>Geographical range (as shown in the map below, unshaded areas are part of the UoA): 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 but excluding the rare birds nature reserve.</p> 	
Fishing method:	 <p>Figure 2: Crayfish fishing gear (地笼 or Ground cage).</p>	 <p>Figure 3: Typical Crayfish fishing boat</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 trap is between 3-5 metres 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. 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 (Figure 2). 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>
Term of plan:	initially drafted in Year 2 (May 2018 – April 2019) of the FIP and finalised in April 2020. The FMP has a term of five year, during which it will be updated as required before being subject to an external review after five years.
Date of next review:	March 2025
Key authors:	<p>Crayfish Production and Marketing Cooperation Project Team</p> <p>China Aquatic Products Processing and Marketing Association (CAPPMA)</p> <p>Dafeng Fisheries Technical Extension Station</p> <p>Jiangsu Baolong Group</p> <p>Bakkavor</p> <p>Lyons Seafood Responsible Sourcing Group</p>

1.2 Description of the Fishery

1.2.1 Historical Overview

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, Wang et al. (2018) Eradication of the species could potentially lead to greater negative environmental impacts and would have severe economic consequences. A Third party assessment conducted in 2014, showed that the Crayfish is now fully integrated and self-sustaining component of the Doulong native ecosystem and that the introduction is now irreversible

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. A pre assessment conducted for the purpose of this FIP concluded that Dafeng City catch records from 2012, 12,000 metric tonnes were landed by this fishery, of which the majority went to Baolong.

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.

Prior to the implementation of the FIP, the Doulong fishery had the following management, control and enforcement system in place:

- Spatial, temporal and catch size limits
- Marketing controls,
- Harvesting licences
- Rights based management (user rights)
- Part of a protected ecosystem (National park)

There are no inputs into production such as feed, biotics or stock enhancement. This means that none of the crayfish are farmed and all crayfish is harvested from natural stocks (wild).

Jiangsu Doulong Crayfish FIP started in 2017 by the lead of CAPPMA. The FIP aims to align itself to 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. CAPPMA has been the main project executor to promote the process of local crayfish fishery achieving MSC sustainable fishery certification.

1.2.2 Biology of the Target Stocks

1.2.2.1 Morphological characteristics

The adult body size of *Procambarus clarkii* ranges from 70-130 mm, measured from the cephalothorax/carapace to the tail fan, reaching sizes in excess of 50 g in 3-5 months. Body colour varies with age, from dark yellow to deep red with larvae generally being lighter in colour and adult is darker. Juveniles not exhibiting a red carapace until maturation. The body is divided into two parts, the cephalothorax and the abdomen. There are 5 pairs of appendages in the carapace, 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 protect the crayfish against drought or cold periods and aid in predatory evasion (Haubrock *et al.*, 2019). Therefore crayfish prefer appropriate soft-bottom habitat to make burrows, but are otherwise able to tolerate a wide range of soil softness. *P. clarkii* is not adapted to swimming well and generally inhabit the bottom of the water course, and 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. *P. clarkii* 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, 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 an important component of 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 limited, the adult is opportunistic and will feed on the animal protein, even reverting to cannibalistic tendencies, Safra *et al.*, (1999), Barnes (1974). Loureiro *et al.*, (2019) report 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 therefore it has been 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 as well as in directed fisheries.

1.2.2.3 Reproduction

Their breeding strategy is that of an r-selected 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 *P. clarkii* was first introduced, crayfish generally enter the breeding season in mid-June and **peak** in October 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 swimmerets 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

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 metres. The amount of water transit is about 2.5 billion cubic metres. 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 Project Team showed substrate types 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).

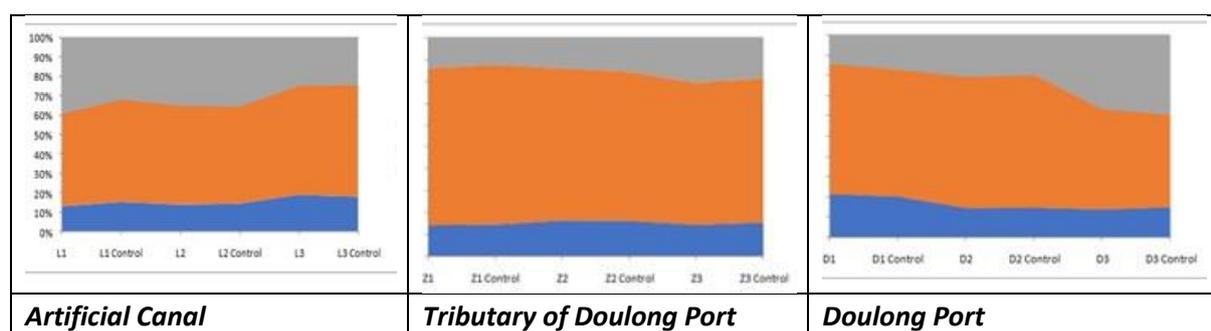


Figure 4: Distribution of substrate within the UoA

Note: (Presumably) grey=clay, orange=silt, blue=sand??

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. Table? Describes the output of flow rates, temperature, PH, flow rate and direction.

Table 1: Characteristics of the hydrological environment of Doulong Port, Tributary Doulong Port and Artificial canal

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

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 11,955m section used in the habitat investigations.

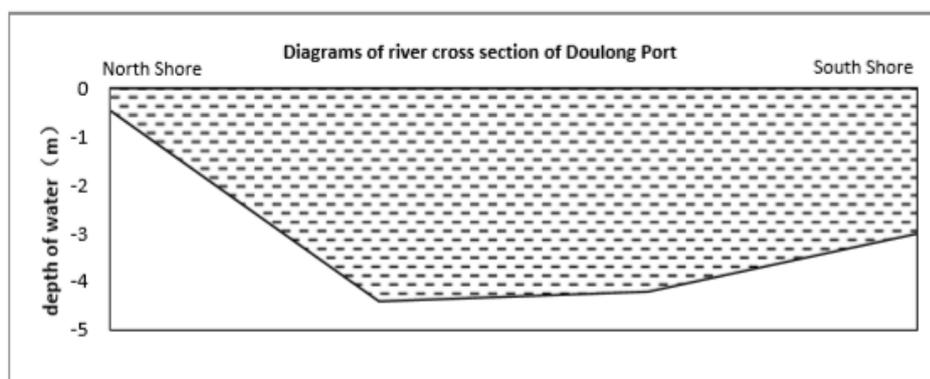


Figure 5: Cross section profile of the Doulong port sampled in the Habitat research report, by the East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences. August, 2018.

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

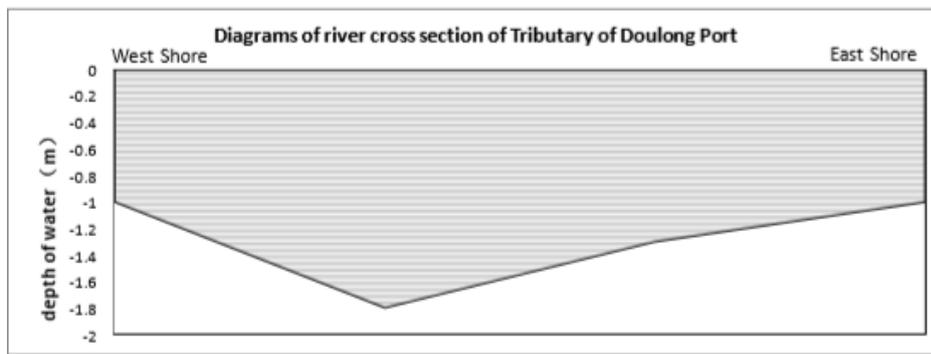


Figure 6 Cross section profile of the Artificial canal sampled in the Habitat research report, by the East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences. August, 2018.

Figure ? 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

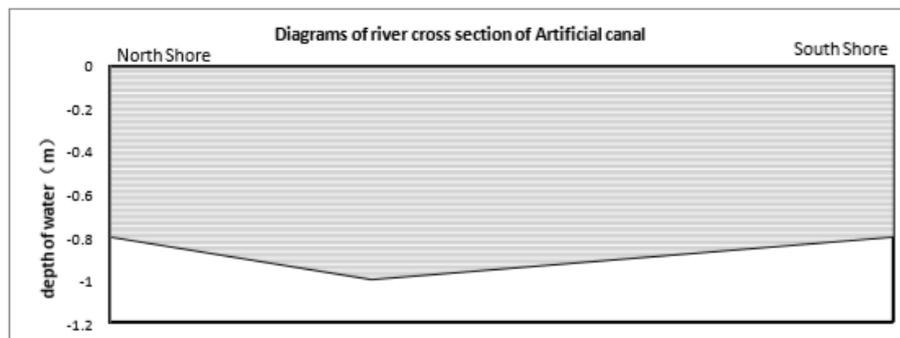


Figure 7 - Cross section profile of the Artificial canal sampled in the Habitat research report, by the East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences. August, 2018.

Biological environment

During a species investigation of Doulong port water substrate of the crayfish habitat, 11 species of benthic organisms including 4 insects, 3 oligochaetes, 2 crustaceans, 1 molluscs and 1 mite species. The average population density of benthic organisms in Doulong Port was averaged at 221.333 ind./m² (48~592 ind./m²). 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 insect in which Chironomid larva had the largest proportion, 2 species of mollusc, 1 species of oligochaete and 1 species of mite.

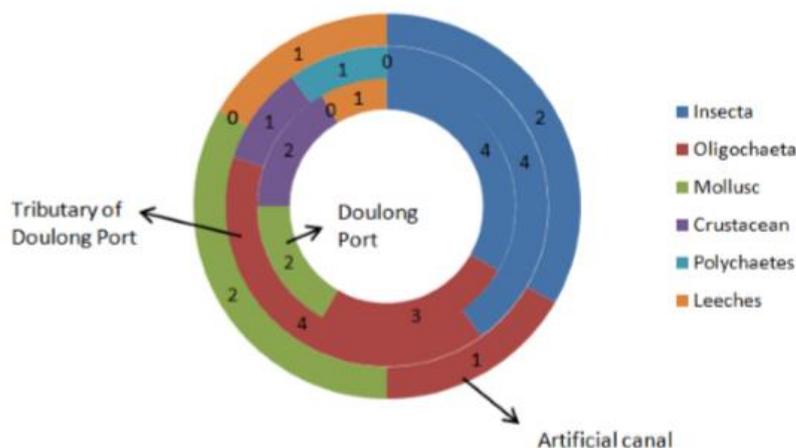


Figure 8 Comparison of benthic organisms sampled in Doulong Port, Tributary of Doulong Port and Artificial Canal. Source: *Habitat research report, by the East China Sea Fisheries Research Institute, Chinese Academy of Fishery Sciences. August, 2018.*

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 Crustacea’s average biomass (including that of *P. Clarkii*) was found within the tributary of Doulong Port. Table 1 shows the highlighted averages from the site.

Table 2: Doulong port, Tributary of Doulong Port and Artificial canal indices of biodiversity. Diversity index (Shannon-Weiner Biodiversity Index)

Water section	Average population density ind./m ²	Average biomass g/m ²	Average biodiversity index	Average richness index	Average evenness index
Doulong port	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)
Tributary of Doulong port	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)
Artificial canal	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)

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 Project Team 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

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.

A Local group known as the “River Folk” (translated from Chinese) are who are as dependent on the fishery for Livelihood/subsistence as well as direct consumption. Their rights to access the fishery should be maintained at all times. According to the BoF, “river folk” constitute the majority of all the registered fishermen in the UoA.

The registered fishermen, water area of capture, trap type and number of traps per fishermen are monitored and retained each year. Table 3 below highlight the main characteristics of the 2018 fishing fleet.

Table 3: Registered fishermen information of the Doulong Crayfish fisheries

Component	No. of registered fishers	Allocated areas of water per fishermen	Number of traps per allocated per fishermen
Doulong River	25 Registered fishermen	Between 80 – 400 acres each	Between 80-300 Traps each (地笼)
Dafeng main river	17 Registered fishermen	Between 100 – 280 acres each used to fish	Between 60 – 300 Traps each (地笼)
Artificial canal??	58 Registered fishermen	Between 60 – 800 acres each used to fish	Between 60 – 300 Traps each (地笼)

Source: Fishery register BoF, China, 2018.

Regional fishery scientists conduct annual assessments to analyse the status of the crayfish 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 awareness of crayfish resources and the extensive publicity from the media, the domestic consumption of the original crayfish is becoming more and more important resulting in shortage of supply to the market and rising sale prices.

Crayfish fresh muscle protein content can be up to 16-20%, and the dry muscle protein content can reach 50%, which is higher than the protein content of 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. The muscle fibre of the original crayfish is delicate, the taste is pleasant and it is easy to digest and absorb, especially the liver of the original crayfish, which weighs about 5% of body weight and is rich in unsaturated fatty acids, proteins, free amino acids, vitamins and trace elements, and is of great medicinal value. In addition, raw crawfish has a meat yield of up to 20% which is ideal for processing as meat and tails. The crayfish shell accounts for about 50-60% of its body weight. Its main component is chitin, which is a natural biomacromolecule compound and the second largest renewable resource

in the world after cellulose. It is the only natural alkaline polysaccharide and has a very valuable processing value. Chitin and chitosan extracted from the crustacean crustaceans could be used as industrial raw materials and has been widely used in agriculture, food, medicine, tobacco, paper, printing and dyeing, etc.

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 crayfish products totalled 24,000 tons, and the total foreign exchange earned was about 150 million US dollars. The annual national consumption of crayfish in China is about 300,000 tons, and the consumer groups are still expanding. "Spicy Crayfish" is well known throughout the country.

2. Goals and Objectives

2.1 Governance and Policy

The overarching Long term objective of the Fishery is to achieve an effectively managed, suitable fishery. This will be done primarily by adopting an adaptable management strategy. The management strategy has been designed to include precautionary harvest control rules which intend to manage the MSY of the target species. A precautionary approach is necessary to the HCRs, as the target species (*Procambrus clarkii*) is recognised as an introduced and invasive species. On this premise, the long-term management will aim to achieve a well-balanced ecosystem. The

Maybe add details e.g. intent to manage to MSY and to adopt the precautionary principle, but recognise it is based on an introduced animal, therefore is designed to ensure that a well-balanced ecosystem is the main objective. Try to link to the Fishery Law of the People's Republic of China (2004, see next section) Fisheries-Specific Management Objectives

2.1.1 Long-term Objectives

- To ensure a long-term, stable and sustainable development of crayfish fishery
- To ensure stable and controllable yields of crayfish (*P. clarkii*) stock
- The **long-term objectives** of crayfish management in Dafeng District are to:
- 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 control and 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 fishers who reside next to the river and who are deemed eligible for permit by the BoF China

2.1.2 Short-term Objectives

The **short-term objectives** are:

- To clearly define 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 the decision-making process.
- To improve fishing practices and activities where necessary.
- To ensure responsible operations that will maintain the conditions of habitats (and including nearby nature reserves) and to protect endangered, threatened or protected (ETP) species.

- To minimize and monitor the following:
 - Catching and discarding of small-size crayfish under the MLS of 5 cm
 - 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 urgent management measures for supervision and review

In order to achieve the above objectives, a series of measures are defined in this Plan to manage crayfish fishery. The CAPPMA Crayfish Branch will regularly review and discuss these objectives to provide suggestions on improvement in management actions at least every five years or less if required. Define the period of review i.e.. after every fishing season?

3. Fisheries Management Structure

3.1 Legal Framework

The Fishery is managed according to laws and regulations at the national, provincial and local levels, as shown in Figure 1 below. For details of laws, regulations, programmes and plans at all levels.

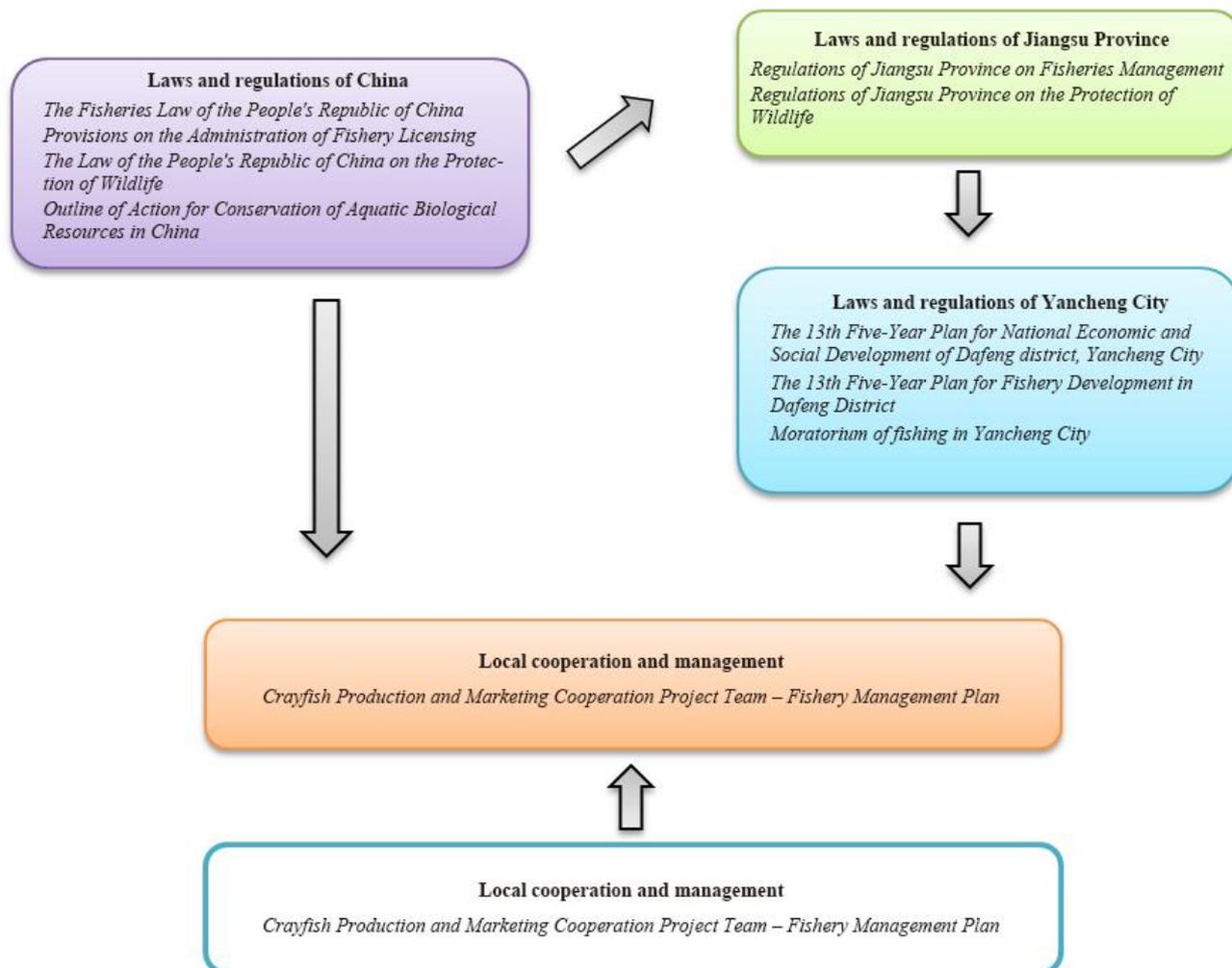


Figure 9: Crayfish fishery management structure

Table 4: Relevant laws and regulations governing the crayfish fishery

Law	Relevance to the crayfish fishery
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 national fisheries regulation and its main purposes are to strengthen the protection, increase production, development and rational use of fishery resources. In Chapter IV 'Increase and Protection of Fishery Resources', it 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); prohibition on the use of explosives, poisons, electricity and any other means in fishing that impairs the fishery resources; prohibition of catching fry and fingerling of aquatic animals of important economic value; 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 13th 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 district. 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 Province	In order to strengthen the protection, increase production, development and optimise the utilisation of fishery resources, protect the ecological environment of fishery, safeguard the legitimate rights and interests of fishery producers, and promote the sustainable development of fishery,

Law	Relevance to the crayfish fishery
	these Regulations are formulated based on the provisions of the <i>Fishery Law of the People's Republic of China</i> with the consideration of the actual conditions in 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 <i>the Law of the People's Republic of China on the Protection of Wildlife, the Regulations for the Implementation of the People's Republic of China on the Protection of Terrestrial Wildlife, the 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 13th 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 referencing the MSC standards (version 2.0), the Project Team prepared a management plan for the crayfish fishery in the Doulong River water system in Dafeng District which will function as guidelines for the Project Team and local fishermen to manage fishing and production activities of crayfish.

3.2 Institutional Arrangements

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 Centre and Chinese Academy of Fishery Sciences. The organizational structure of the fishery administration units at national level is shown in Figure 2.

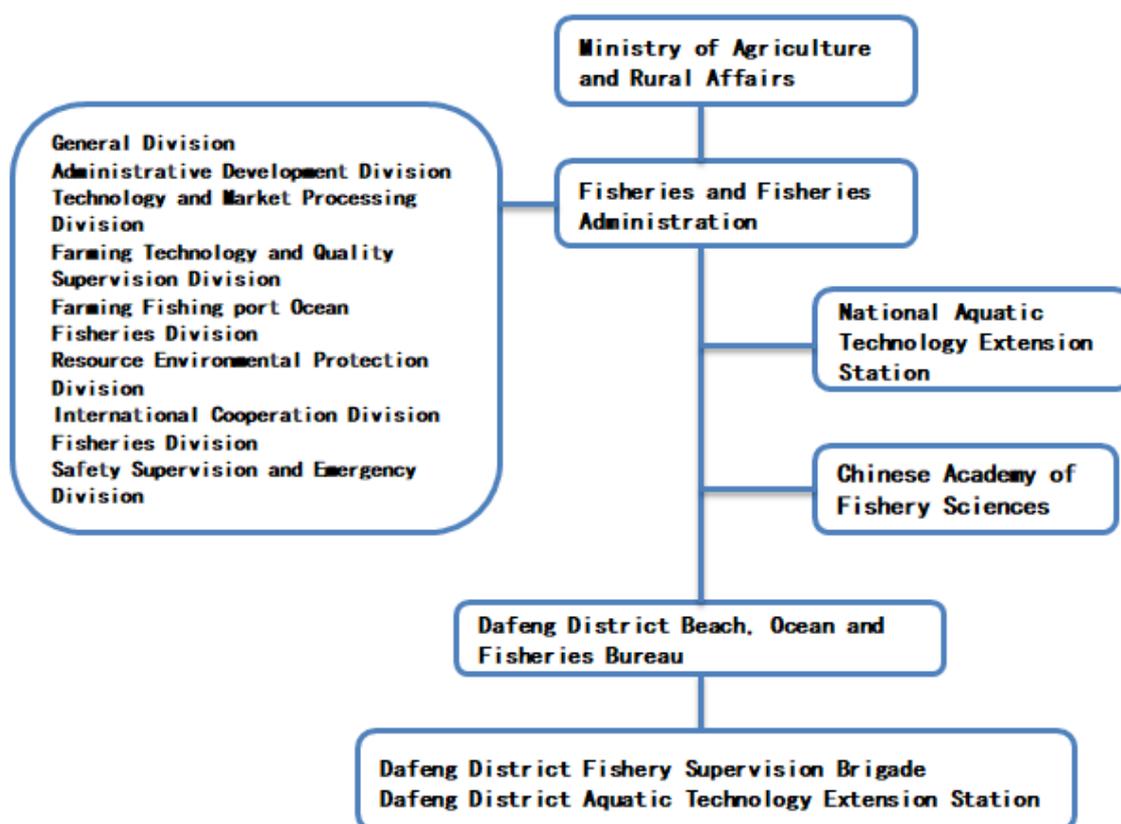


Figure 10: The organizational structure of the fishery administration units at national level

Management and implementation of the crayfish fishery improvement, is mainly responsible for the regular communication with local fisheries authorities, regular annual data collection, capacity-building and training of fishers on laws and regulations, analysis of data and information gathered, 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 local organizations. It also includes research institutions such as Fudan University and the East China Sea Fishery Research Institute of Chinese Academy of Fishery Sciences and the participation of CAPPMA, MSC, WWF, other non-profit organizations and the guidance of some independent overseas experts.

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

Stakeholders

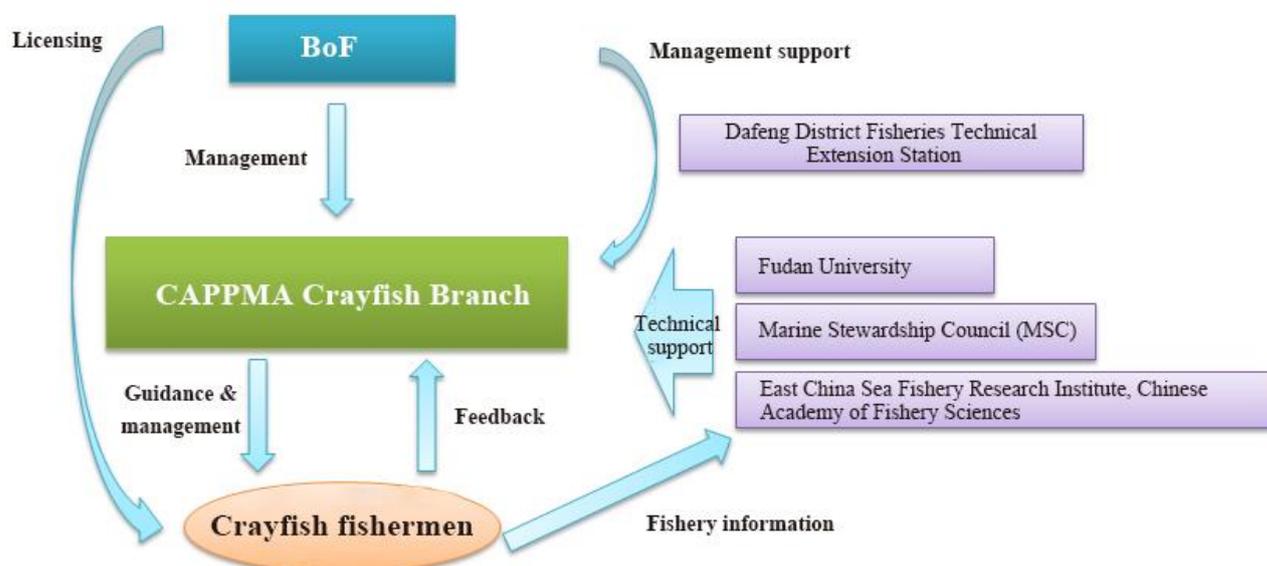


Figure 11: Project Team management structure

Stakeholders and their responsibilities

Stakeholder	Description
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	Centring 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.
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	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

Stakeholder	Description
Association (CAPPMA)	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 fisheries science expert	Participate as a stock assessment expert, providing fishing management strategies and advice
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
Bakkavor 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
IKEA	A foreign purchaser and sponsor

3.3 Consultation and Co-management Arrangements

Due to Chinese law and traditions, the Chinese government will not sign a MoU with any company or association to co-manage a fishery as it is seen that they have a duty to manage the fishery according to the law of nation. However, the Crayfish Fishery management strategy is more detailed than the current law or regulation in place and therefore the crayfish fishery Cooperation team will manage the crayfish fishery according to the current fisheries management plan (FMP). The Crayfish Cooperation team and fishery enforcement governor have a Co-management agreement (see appendix E for the 2019 management plan) Further evidence of the co-management can be seen in the governor made plan (created in the beginning of the year and a summary at the end of the fishing season), The plan followed the same work as the Crayfish FMP and therefore this work has become part of the government management work.

In order to promote the legal, complied and sustainable development of the freshwater fishery in the region, and to protect and science-based utilisation of 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 become important food sources and industrial raw materials to support the economic and social development of the district. 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.

There is a formalised system for legal disputes that a fisherman may undertake if they are unhappy with a penalty decision, Summarised in the 2019 Annual Work Summary of Fishery Administration Management on Freshwater Crayfish Fishery in Dafeng District, Yancheng City,

Article 38 from the Annual work summary:

“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.”

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

4.1 Harvest Strategy

4.1.1 Description

In general, it is believed that about 20,000 tonnes of wild caught crayfish are caught in the region per year, with around 18,000 tonnes in the Doulong river basin and around 6,000 tonnes purchased by the Baolong plant (i.e. around 30%). However, it is also believed that the Baolong plant purchases by far the majority of the catch in the Dafeng district around Yancheng although this needs to be verified. 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 have been treated as the total catch for this management unit.

Based on the 2018 stock assessment, the stock is not overfished and overfishing did not occur. 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 Doulong crayfish fishery for the Baolong Group 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. However, the precautionary rule has been based on very limited information and may therefore need to be changed significantly as better information becomes available.

Direct effort or catch controls (e.g. TACs) are not an option at this stage and may never be appropriate due to difficulties with implementation. Varying the length of the season is the most practical 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 due to the limited data. Nevertheless, it is important to be aware that if future stock assessments suggest that the current harvest rate is exceeding the $SPR_{20\%}$, this may indicate a long term reduction in harvest rate is necessary.

4.1.2 Monitoring, Review and Evaluation of the Harvest Strategy

Weekly monitoring data will be collected by designated observers throughout the season. This is based on observing three traps at sampling sites and recording the numbers and size composition of the crayfish landed as was done in 2018. All purchases by Baolong group are recorded and are now computerised. Select fishers are also asked to complete logbooks recording their catch and effort on a voluntary basis and moving to mandatory at the start of the fishing season in 2025. Purchase records and log book data from Baolong will also contribute to the mechanisms used to monitor the fishery, specifically providing information on the total catch.

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. **As a result of the review, for the 2020 season another question will be collected 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.** This will be evaluated in 2020 to see whether it can be used to provide a better estimate of the total catch each week.

Stock Assessment

An age specific depletion model was fitted to the available purchase and observer data. For the 2018 assessment, the data appeared to have captured the changes in the population well, but model fitted the 2019 less well, partly because there was no clear depletion evident in the abundance index.

The stock assessment estimated the exploitation rate and the number of females reaching maturity. Because it is only a few years' 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 next seasons.

Reference points

Reference points for the fishery will likely be proposed as spawning biomass -per-recruit at 40% (SPR_{40%} target) and 20% (SPR_{20%} limit). Spawner-per-recruit calculations have been possible with outputs from the stock assessment. However, reference points for the HCR will still need to 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 in future when more information is available. Reference points were not updated from the 2018 season because the lack of consistency of the data.

It should also be noted that the target could be set lower than the precautionary SPR_{40%} 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, their interpretation and the ecological role of the species. If the stock status can be estimated and the ecological role of the species in the ecosystem can be determined more precisely in future, a lower target (SPR_{30%}) may be considered more suitable.

4.2 Harvest Control Rules

4.2.1 Description of the Harvest Control Rules

The proposed harvest control rule will have several parts. The first part would be a fixed fishing effort level will maintain a fixed proportion of the stock (i.e. fishing mortality) being captured each year. A

second part will reduce fishing effort if there are indications that stock is at risk of being reduced below the point where recruitment might be impaired.

As well as a current harvest rate, the HCR will define a trigger point when further temporary 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 has been determined based on some measure of abundance that seeks to decrease harvest rate before there is a significant risk of the stock falling below the point where recruitment begins to reduce by a substantial amount. For the preliminary HCR, the trigger point** has been 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.

Fixed Harvest Rate policy

Harvest within the management unit will be limited to the number registered permit holders, The number of traps which each permit holder uses, the size of their designated harvest areas and the standardization of their traps

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. 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 is 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 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, (Figure1). 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 3 right: Typical Crayfish fishing net. source: BoF, 2018

Further Harvest Reduction

The HCR will define a trigger point when further harvest reduction would be required. Reducing harvest by varying the length of the season is the best option at present. Crayfish are inactive earlier in the season, so earlier start than customarily applied is not a threat to the fishery. Earlier closure of the season should reduce harvest and can be implemented quickly in any year and would form the HCR intervention if required. Implementation at this stage would depend upon Baolong limiting the date of purchase to an earlier time, if that was found to be necessary.

A trigger point has been established as a precautionary measure based on the catch-per-trap, so the season will close early if catch rates fall below this level. The available data are limited so this may be subject to further changes as more data become available.

Initial evaluation of the fishery suggests the earlier closure of the fishery (Baolong ceases to purchase crayfish) would only be required in unusual circumstances, and the HCR would most likely not affect the normal operation of the fishery.

Direct effort or catch controls (e.g. TACs) are not an option at this stage and may never be appropriate, given the size of the fishery and the way it operates.

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 possible significant data gap is the total catch indicated in the 2019 stock assessment. This is being corrected by adding additional questions to the logbooks to ensure complete data collection during the 2020 season. The full report can be viewed in appendices NUMBER>>>>>>)

Therefore 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.

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. Table 6 Consolidates these rules, reference points, justification for the rule and the key uncertainties it addresses.

Table 6 – precautionary Harvest control rule consolidation.

Rule and Reference Points		Key uncertainty
Limitation of Fishing Season	<p>The season will start in week 1: Permissible harvest will start and end each season as determined by Baolong on their custom practice unless the average capture per trap falls below the trigger reference point, currently 24 crayfish / 3 traps. In this case, notice will be given immediately in the week following detection of low catch rates and Baolong will cease purchases in the following week. Therefore, the fishery will close at the start of the second week after the week when the catch per trap fell below 24 crayfish / 3 traps. This preliminary HCR will be subject to annual review by the project team.</p> <p>Reference points: The trigger reference point is precautionary based on estimation depletion in the 2018 assessment to reduce the chance of depletion below 20% stock size at the beginning of the season.</p>	<p>The trigger point will need to be re-estimated using stock assessments as more data become available. The practical implementation of any HCR (who carries out the monitoring, data processing, calculations etc.) will also need to be decided.</p>
Minimum landing size (MLS)	<p>Rule</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>Justification:</p> <p>Crayfish below the MLS are immature. Could impair recruitment if taken undersized.</p>	<p>Key uncertainty</p>
	<p>Rule</p> <p>Harvest within the management unit will be limited to</p> <p>1) Registered permit holders only (550 total)</p>	<p>Key uncertainty</p> <p>Stock assessments in 2018 and 2019 suggested that the fishing mortality was sustainable (fishing mortality at or above F_{MSY}). However, this determination was</p>

Maintaining a Fixed Harvest Rate Policy	<p>2) The number of traps within their harvest areas as applied in 2018.</p> <p>3) Target trap density will be an average of 1 trap / 8 mu ~ 2 / hectare) per household.</p> <p><i>The registration of permit holders are irrespective of Baolong and must be agreed with the China Bureau of Fisheries upon registration.</i></p> <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.</p>	based on very little data, and so remains highly uncertain.
	<p>Justification:</p> <p>Length based analysis conducted on the 2018 and 2019 stock assessment data concluded that</p>	
Monitoring	<p style="text-align: center;">Rule</p> <p>Monitoring is conducted by:</p> <ol style="list-style-type: none"> 1. Abundance index and size composition is obtained from 6 landings observers who monitor landings from 6 traps each, every week during the fishing season. 2. Total catches are monitored from Baolong purchase records. However, from 2020 onwards the log book questionnaire will include a question to determine where catches volumes not purchased by Baolong are going. 	<p style="text-align: center;">Key uncertainty</p> <p>uncertainty over total catch volumes</p>

<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>

4.2.2 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>

Annual data collection will take place during the fishing season and collated information on Catch landings will be added to the existing data collection system. The Fisheries management plan will then be updated with the agreement from stakeholders during the annual Crayfish workshop. A third party stock assessment expert will review the HCR (every year), and recommend options to improve it where appropriate. The third party review will take place at the end of every 5th fishing season (5 years).

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 be circulated to the fishermen before the new fishing season begins. A flow chart of this process is described below (Figure 14)



Figure 14 –time frame for review of harvest control rules

4.3 Decision-making Frameworks

Established in January 2018, the Project Team forms part of the Crayfish Branch in Dafeng District under CAPPMA. The FIP Project shall comply 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, evaluating and improvement of all parts of the management plan.

Decisions of the Project Team on this management plan and its measures require 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 ad hoc meetings as necessary.

The minutes of the Project Team meeting will be kept in electronic format as well as hard copy format.

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

The Project secretariat should provide support on organizing meetings and other agreed responsibilities.

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

- any change in shipping 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 management plan
- Any related scientific research
- Other activities that have an impact on the management of crayfish within specific areas.

The Crayfish Branch of CAPPMA provides a mechanism to support fishermen and stakeholders to raise and solve problems including feedback mechanisms such as symposiums and telephone calls. These activities will be conducted at the end of each year. Stakeholders can raise questions to the project team during 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: the Crayfish Branch of CAPPMA 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 Crayfish Branch of CAPPMA. 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	Individual private Businessman		Hold meeting and transform information in Group 1
4	Group leader of group 2	Wang Jinlai	Individual private Businessman		Hold meeting and transform information in Group 2
5	Group leader of group 3	Cao Houyu	Individual private businessman		Hold meeting and transform information in Group 3
6	Group leader of group 4	Zhou Yongchun	Individual private businessman		Hold meeting and transform information in Group 4
7	Group leader of group 5	Yuan Chengfu	Individual private businessman		Hold meeting and transform information in Group 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. It also includes the

participation of CAPPMA , 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

5.1 Non-target Species

Normal catch composition within the fishery in (excluding the target species of *Procambrus Clarkii*) consists of two invertebrate the oriental river prawn (*Macrobrachium nippor*) and the Chinese mitten crab (*Eriocheir sinensis*) and the Crucian carp (*Carassius carracius*). Appendix C includes the PSA results from the 2019 study of non-target species.

5.1.1 Management strategy

The target species of this FMP is 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. undersize or ineligible individuals 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 where is at least 50 m away from the original location.
- Fishermen will assist the CAPPMA Crayfish Branch to monitor the quantity and quality of bycatch when requested.
- To maximise quantifiable data, observers may request fishermen to provide detailed information such as weight or catch composition of discard bycatch. The Crayfish Branch of CAPPMA should define and approve the scope such activities.

5.1.2 Other considerations

The Project Team will review the level of retained catches 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.

5.2 Endangered, Threatened and Protected Species (ETP)

5.2.1 Management strategy

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 any unexpected 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 bird or mammals. 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

The following management measures shall be adopted to minimise the impacts on ETP species:

- The "Regulations **on the Protection of Yanhai Yellow Sea Wetland**" state: 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 rescue reports and take emergency rescue 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 alter 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 understand the laws and regulations involving nature reserves and encourage them to 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 imposed
- 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

5.3 Habitats

5.3.1 Management strategy

In 2018, A benthic risk assessment and ecosystem risk assessment were carried out for the unit of assessment (UoA) by an expert team of the East China Sea of the Chinese Academy of Fishery Sciences (2018). The result showed that, regarding any change of benthic environment, the annual fishing operation 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

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 produce an analysis report or capture results in meeting minutes.

5.4 Ecosystem

5.4.1 Management strategy

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 (ERA) conducted in 2018 by Fudan University (2018), 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

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

6.1 Stock assessments

6.1.1 Current status of target stock

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 or 2019. 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.

Uncertainties

In 2019, whether Baolong provide sufficient coverage was questioned because some unknown amount of fishing continued after Baolong had stopped purchases. In future it is planned to record these catches. 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.

6.1.2 Stock assessment methodologies

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

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 includes the date of sampling, weight of crayfish retained in the 3 traps of each fisherman, number of crayfish retained, weight and of number crayfish discarded.

An Observer's data record form is shown in .

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

The items to be recorded in the purchase record are:

- Date, fishing vessel number, weight and area information (Appendix D).
- 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

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

7.1 Objectives and Approach

In order to promote (i) legal compliance and sustainable development of the freshwater fishing industry in the region and (ii) 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.

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 amendments 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

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.

Table 5: Crayfish fishery risk management scoring sheet

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 fishing gears: 8 points	The quantity of nets of single vessel/household exceeding 300, 1 point to be deducted for one case until the points are completely deducted.	8
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

Specific management of the 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.

5. 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.

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.

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

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.

Table 6: Provisions for fines imposed concurrently or separately

S/N	Illegal act	Fine (¥)
1. Unauthorized fishing without a fishing license	Inland water non-motorized vessels	50-150
	Inland water motorized vessels and marine non-motorized vessels	100-500

S/N	Illegal act	Fine (¥)
	Marine water motorized vessels, with power less than 184 kW	200-2500
	184-440 kW	2500-6000
	Above 440 kW	6000-20000
2. Conducting fishing operations not according to the specified types, locations, time limits, fishing gears or licenses, and annual examinations	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	
3. Violating the regulations on closed fishing areas, closed fishing seasons, protected areas, aquatic animals that are prohibited for fishing, or bearing no licenses or acquiring the catches	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
	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
4. Using prohibited fishing gears and fishing methods	(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	
5. The amount of larvae exceeding the specified proportion	Inland waters	10-50
	Seas	50-500
6	Building fishing vessels without a construction permit	20-50% of the building cost
7	Sale, lease, alteration, illegal transfer of fishery licenses or permits	100-1000

S/N	Illegal act	Fine (¥)
8	Stealing, robbing aquatic products or destroying fishery water bodies and facilities, with minor behaviours	50-1000
9	Polluting fishery waters, causing losses to the fishery	20 per acre
10	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 fulfil 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

Organisation	Role
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.

Organisation	Role
Fisheries Technical Extension Station	Centring 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 Extension Station:	Local primary provider of basic information and technical support.

8. Fishery Performance Evaluation

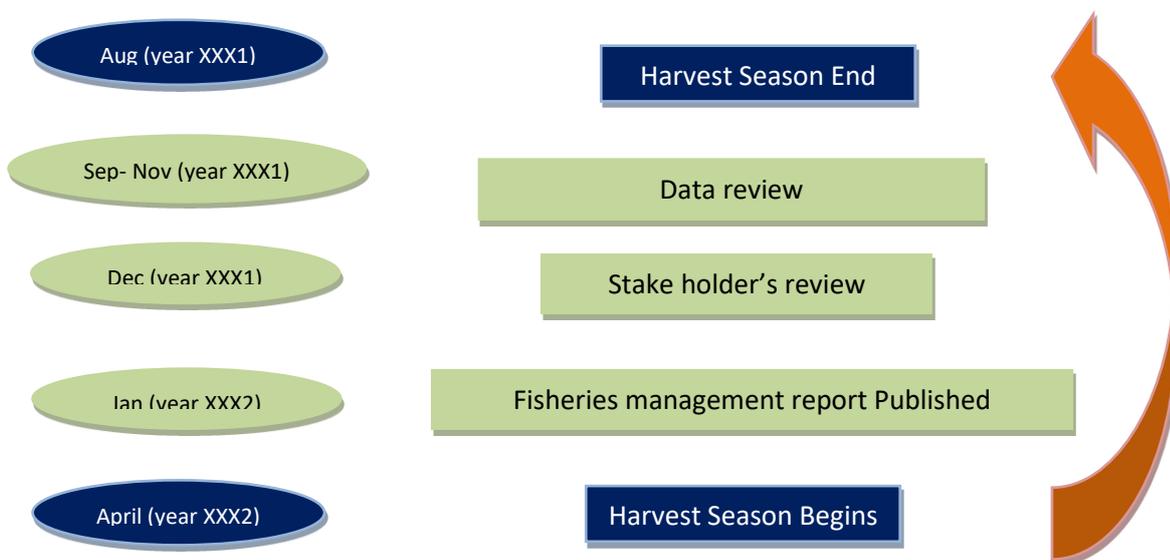
8.1 Review Process

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"

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.

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

9.1 Approach

9.1.1 Human Resources

XXXXXX

9.1.2 Financial Resources

XXXXXX

9.2 Cost sharing and recovery

XXXXXX

Appendix A: References

- Anon (2019).** Impact of crayfish fishing on local ecosystems. Unpublished report. 2 pp.
- Barnes, R. (1974).** Invertebrate Zoology. Philadelphia, PA: W.B. Saunders Company.
- Bureau of Fisheries (2019a).** Management Plan and Measures for Risk Assessment of Crawfish Fishery in Dafeng District, Yancheng in 2019. 5 pp.
- Bureau of Fisheries (2019b).** Annual Work Summary of Fishery Administration Management on Freshwater Crayfish Fishery in Dafeng District, Yancheng City, 2019. 7 pp
- 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
- Crayfish Production and Marketing Cooperative Project Team (2019).** Summary of crayfish production and Market Cooperative Project Team in 2019. 12.pp.
- East China Sea Fisheries Research Institute and the Chinese Academy of Fishery Sciences (2018).** Investigation and Assessment on the Habitat of Crayfish in Yancheng City, Jiangsu Province. Research Report prepared for the Dafeng Crayfish FIP. 42 pp.
- FAO (2019).** FAO of united nations, 23/10/19
http://www.fao.org/fishery/culturedspecies/Procambarus_clarkii/en
- Fudan University (2018).** Assessment Report on Ecological Risk of *Procambarus clarkii* in Doulong River, Dafeng District, Yancheng City, Jiangsu Province. Research Report produced by the Evaluation Agency: School of Life Sciences, Fudan University on August 22, 2018. 59 pp.
- Global Invasive species database .**<http://www.iucngisd.org/gisd/species.php?sc=608>. Visited 01/11/19.
- Haubrock, P., Mazza, G., Inghilesi., A.F., Bandoni., M., Solari, L., Tricarico, E. (2019).** ‘Burrowing activity of *Procambarus clarkii* on levees: analysing behaviour and burrow structure. Wetlands Ecology JOUR: Management’ Wetlands Ecology Management. PP. 497-511 .
- Huntington, T. and R. Cappell (2017).** Detailed Action for the Red Swamp Chinese Crayfish Fisheries Improvement Project. Report by Poseidon Aquatic Resource Management Ltd to Lyons Seafoods Ltd and Bakkavor Asia. Report reference 1329/R/01/B
- Loureiro, T.G., Anastácio, P.M., Bueno, L.,S., Timm-Wood., C. & Araujo., P.B. (2019).** Food matters: Trophodynamics and the role of diet in the invasion success of *Procambarus clarkii* in an Atlantic Forest conservation area. *Limnologica*. 79.
- Medley, Paul (2018).** Dafeng Crayfish Stock Assessment 2018. Unpublished report prepared for the Dafeng Crayfish FIP. 6 pp.
- Medley, Paul (2019).** Dafeng Crayfish Stock Assessment 2019. Unpublished report prepared for the Dafeng Crayfish FIP. 6 pp.
- Safra, J., C Yannias, J.Goulka (1999).** Encyclopedia Britannica. Chicago: Encylopedia Britannica Inc.
- Wang, Q., Ding, H., Tao, Z., Ma, D. (2018).** Crayfish (*Procambarus clarkii*) Cultivation in China: A Decade of Unprecedented Development. 10.1002/9781119120759.ch4_1.
- Xie Guoxing (2018).** Evaluation of the impact of crayfish fisheries on ETP species. Unpublished report prepared for the Dafeng Crayfish FIP. 14 pp.
- Zhu Yaping, Zhang Linlin, Yu Xiaotong, Xie Guoxing, Cheng Xiaogang & Robyn Cloake (2019).** Jiangsu Doulong Crayfish Fishery Management Plan. Unpublished document. Version 10.17 (ENG.). 72 pp.

Appendix B: 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 likely that the stock is above the point where recruitment would be impaired (PRI).	It is highly likely that the stock is above the PRI.	There is a high degree of certainty 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 high degree of certainty 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 expected 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 work together 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 designed 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.

ID	Name	SG60	SG80	SG100	Comments
121b	Harvest strategy evaluation	The harvest strategy is likely to work based on prior experience or plausible argument.	The harvest strategy may not have been fully tested but evidence exists that it is achieving its objectives.	The performance of the harvest strategy has been fully evaluated 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 regular 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 biannual 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.

ID	Name	SG60	SG80	SG100	Comments
122a	HCRs design and application	Generally understood HCRs are in place or available that are expected to reduce the exploitation rate as the point of recruitment impairment (PRI) is approached.	Well defined HCRs are in place that ensure that the exploitation rate is reduced as the PRI is approached, are expected to keep the stock fluctuating around 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 fluctuating at or above 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 wide range of uncertainties including the ecological role of the stock, and there is evidence 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 some evidence that tools used or available to implement HCRs are appropriate and effective in controlling exploitation.	Available evidence indicates that the tools in use are appropriate and effective in achieving the exploitation levels required under the HCRs.	Evidence clearly shows 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.

ID	Name	SG60	SG80	SG100	Comments
123a	Range of information	Some relevant information related to stock structure, stock productivity and fleet composition is available to support the harvest strategy.	Sufficient relevant information related to stock structure, stock productivity, fleet composition and other data are available to support the harvest strategy.	A comprehensive range 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 at least one indicator is available and monitored with sufficient frequency to support the harvest control rule.	Stock abundance and UoA removals are regularly monitored at a level of accuracy and coverage consistent with the harvest control rule , and one or more indicators are available and monitored with sufficient frequency to support the harvest control rule.	All information 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 uncertainties 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	The HCR is constructed to be consistent with the stock assessment and available data. However, recent testing suggests that further data

ID	Name	SG60	SG80	SG100	Comments
				species and the nature of the UoA.	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 identifies major sources of uncertainty.	The assessment takes uncertainty into account .	The assessment takes into account uncertainty and is evaluating stock status relative to reference points in a probabilistic 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 internally and externally peer reviewed.	The stock assessment has not been peer reviewed. recent testing suggests that it is not yet ready for review.

Appendix C: Productivity - Susceptibility Analysis (Secondary species)

Only main species scored?		Yes						Productivity Scores [1-3]							Susceptibility Scores [1-3]				Cumulative only											
Scoring element	First of each scoring element	Species Grouping only ID 'At Risk' species by selecting associated species group	Species Grouping only Number of species in species group w hich this species represents (N2)	Family name	Scientific name	Common name	Species type	Fishery descriptor	Average age at maturity	Average max age	Fecundity	Average max size	Average size at Maturity	Reproductive strategy	Trophic level	Density Dependence	Total Productivity (average)	Availability	Encounterability	Selectivity	Post-capture mortality	Total (multiplicative)	PSA Score	Catch (tons)	Weighting	Weighted Total	Weighted PSA Score	MSC PSA-derived score	Risk Category Name	MSC scoring guidepost
1	First		1	Palaemonidae	Macrobrachium nipponense	Oriental river prawn	Invertebrate		1	1	1			1	1	2	1.17	2	2	1	1	1.08	1.59	500	1.00	1.59	1.59	100	Low	≥80
2	First		1	Varunidae	Eriocheir sinensis	Chinese Mitten Crab	Invertebrate		1	1	1			1	1	2	1.17	2	2	1	1	1.08	1.59	500	1.00	1.59	1.59	100	Low	≥80
3	First		1	Cyprinidae	Carassius carassius	Crucian carp	Non-invertebrate		1	2	1	1	1	2	2		1.43	2	2	1	1	1.08	1.79	500	1.00	1.79	1.79	99	Low	≥80

Appendix D: Observer Form page 1 of 2

Fishermen name		Number of traps in sample		Date (dd/mm/yy)	
		Location of sample	Name or code	Enumerator	

A. Target / Bycatch records

Species	Retained catch				Discarded catch			
	Total weight retained (kg)	Total number (n) retained	Min length (cm) in catch	Max length (cm) in catch	Total weight (g) discarded	Total number (n) discarded	Reason for discard (undersize / no market / other)	Condition of discarded animal (Alive / moribund / dead)
Crayfish								
Bycatch	Bycatch species 1							
	Bycatch species 2							
	Bycatch species 3							
	Bycatch species 4							
	Bycatch species 5							
	Bycatch species 6							
	Bycatch species 7							
	Bycatch species 8							
	Bycatch species 9							
	Bycatch species 10							

B. ETP observations

Appendix E: Observer Form page 2 of 2

ETP species	Interaction observed <i>If no observation, leave blank</i>	Likely frequency of interaction	Likely direct impact of interaction

Management Plan and Measures for Risk Assessment of Crawfish Fishery in Dafeng District, Yancheng in 2019

This management plan is formulated to promote the legal, compliant and sustainable development of the freshwater fishing in Dafeng District, and to protect, scientifically and rationally develop and utilize fishery resources. Although crayfish is an invasive species, over the years, due to legal and rational management and scientific development and utilization, it has been well got into the local ecosystem. As an important fishery resource, crayfish provides abundant food and industrial raw materials for the economic and social development of the District. Law enforcement and management of crayfish fishing should be combined with the overall management of freshwater fishing, and risk management should be implemented to achieve the goal of healthy and sustainable development and utilization of fishery resources.

I. Major risks of freshwater fishery resources including crayfish

As important renewable biological resources, the major risks of freshwater fishery resources are as follows:

1. Overexploitation; 2. The destruction of biodiversity in ecosystems due to human influence; 3. The structural imbalance of biological population with important economic value, and damage to the ecological balance; 4. The main biological resources cannot survive, grow and multiply in the destroyed habitats; 5. The protected aquatic wildlife living in the fresh water environment affected by the production and living of human beings.

II. Laws and regulations governing the management of crayfish and other freshwater fishery resources

Fisheries Law of the People's Republic of China;

Regulations for the Implementation of Fisheries Law of the People's Republic of China;

Regulations of Jiangsu Province on Fisheries Management;

The Law of the People's Republic of China on the Protection of Wildlife;

Regulations of the People's Republic of China on the Protection of Aquatic Wild Animals;

Water Pollution Prevention and Control Law of the People's Republic of China;

Provisions of Jiangsu Province on the Administration of Fishery Licensing.

III. Special campaigns related to fishery management led and participated by the fishery administration and law enforcement authority

1. Take the lead and coordinate with the authorities of water resources, environmental protection and housing and construction to thoroughly clean up the stationary fishing gears such as stationary lift net and bamboo fish trap in main rivers emptying into the sea and their tributaries and rural rivers. Reduce the intensity of fishing, including freshwater fishing, and provide basic guarantee for the recovery and growth of fishery resources.

2. Take an active part in the management of the "river chief system" led by the environmental protection authorities, control and rectify industrial pollution, agricultural non-point source pollution, pollution from aquaculture, livestock and poultry breeding, and urban water pollution, and comprehensively improve the water quality of rivers and river sections in the District.

3. Actively participate in the rural residential environment improvement program led by the agricultural administration and law enforcement authorities to improve the quality of rural rivers and water environment.

4. Launch a special campaign to crack down on illegal fishing activities using explosives, poisons, electricity and any other illegal means.

IV. Carry out regular work on fishery management

(1) Crayfish (target species)

1. Strictly enforce the system of fishery licensing. Strictly implement fishery licensing for fishermen and fishing vessels fishing in the main rivers emptying into the sea and their tributaries, confiscate the fishing nets and vessels of fishermen without a license, and order them to correct their illegal operations.

2. Prohibit to stationary fishing operations in all rivers in the whole District, and ban all stationary fishing gears such as stationary lift net and bamboo fish trap.

3. Carry out regular inspections or spot checks on the power of fishing vessels, mesh size and catch sizes. For the approved fishing vessels, fishing methods and fishing gears, strictly check the power of fishing vessels, number of fishing gears, mesh size and the minimum size of various catches. In the administration of crayfish fishery, the following shall be strictly implemented: the minimum mesh size of traps is 2 cm; the fishing gears on a fishing vessel or of a household shall be less than 300; it is strictly forbidden to catch crayfish under the commercial size of 3.0cm; all bycatch species under the commercial size shall be discarded.

4. Organize regular inspections or spot checks, in combination with other relevant campaigns, to prevent fishing operations from catching or affecting protected wildlife. Carry out a wide range of publicity activities to let all fishermen know the Class I and II wildlife species under state or provincial protection and terrestrial wildlife of important ecological, scientific and social values under state protection that may and often appear in the waters of the whole District.

(2) Non-ETP bycatch species

1. Analyze the effects of non-stationary crayfish traps on other species in the Doulong River basin, based on the catches of non-ETP species other than crayfish recorded by observers, fixed-point fishermen and spot check records, with special attention paid to the effects of this fishing method on Crucian carps, river crabs and freshwater shrimps.

2. Based on the existing data, create a change trend chart for species and quantity of bycatch caught per trap to provide timely and accurate decision-making basis for fishery administration plan.

3. Non-commercial non-ETP species shall be immediately released back into the aquatic environment in a manner that maximizes its survival. Except that river crabs can be caught from September 10 to December 30 every year, they shall be released back into the aquatic environment at all other times; Crucian carps shall not be caught until reaching 100 grams per piece; Freshwater shrimps shall not be harvested until reaching 500 grams per 100 pieces.

4. If the total weight of the 3 species of river crabs, freshwater shrimps and Crucian carps exceeds 10% or more of the total catches, the traps should be placed more than 50 meters away from the last place and shall not be greater than 8 hours one time.

(3) 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.

V. Crayfish fishery risk assessment

For the risk assessment of crayfish fishery, the 100-mark scoring system is adopted to assess various risk points in combination with regular inspections or spot checks. A score of 80 or above indicates "no risk"; a score of 65 to 79 indicates "risk warning"; a score below 65 indicates "at risk", and targeted management measures shall be taken. During the implementation of the management plan, targeted management measures for the next stage will be formulated according to the score of each inspection to promote the sustainable development of crayfish fishery.

Crayfish Fishery Risk Rating Scale

Item	Description	Score
Enforcement of laws and regulations: 30 points	15 points in total. 1 point will be deducted every time fishing without license is found in a main river or its tributary until 15 points are deducted.	
	15 points in total. 1 point will be deducted every time stationary traps are found in a river until 15 points are deducted.	
Quantity of fishing gears: 8 points	1 point will be deducted every time the fishing gears on a fishing vessel or of a household exceeding 300 are found until 8 points are deducted.	
Mesh size: 15 points	1 point will be deducted every time a trap with mesh size under 2 cm is found until 15 points are deducted.	
Size of target catch: 12 points	1 point will be deducted every time crayfish under 3 cm caught by a fisherman is found until 12 points are deducted.	
Whether electricity is used in fishing: 6 points	6 points will be deducted wholly in case of using electric pulse to drive crayfish into the traps	
Whether the traps are baited: 10 points	1 point will be deducted every time until 10 points are deducted.	
Bycatch species under the commercial size: 10 points	1 point will be deducted every time until 10 points are deducted.	
Whether it affects wildlife under protection: 4 points	4 points will be deducted wholly once found	
Digging for crawfish: 5 points	1 point will be deducted every time until 5 points are deducted.	
Total score: 100 points		