

Chinese Red Swimming Crab Fisheries Improvement Scoping Report

*Completed for National Fisheries Institute (NFI)
Crab Council's
China Red Crab Working Group*

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Executive summary

This report presents an analysis of the opportunities and approach for developing a fishery improvement project (FIP) for China's red swimming crab fisheries, which use trawl and pot gear in the Minnan-Taiwan Bank area in southern China's Zhangzhou region of Fujian Province. The analysis has been supported by a contract between NFI, on behalf of its Crab Council's Red Crab Subgroup, and Ocean Outcomes (O2), with the initial idea for the work beginning with discussions in 2015 and culminating in a project agreement in late November 2016. A key purpose for the work is to inform a final decision by NFI about whether or not to support launch and implementation of a FIP for this species.

The Zhangzhou region accounts for about 60% of China's total crabmeat exports to the US. The two primary target species in this fishery represent most of this production - red swimming crab (*Portunus haanii*) and three-spot (or red-spot) swimming crab (*Portunus sanguinolentus*). Dongshan County within Zhangzhou City is the main processing hub for these US crabmeat exports and ten processors in the region account for 80% of this export trade. The concentrated processing activity, combined with relatively consolidated fishery landing characteristics (direct sales to processors or well-defined middlemen-brokers), create attractive dynamics for exerting supply chain pressure for sustainability requirements for the fishery as well as for the logistics of implementing fishery improvements such as effective catch monitoring and biological sampling of fishery landings.

Other positive enabling conditions for a successful fishery improvement effort include a network of committed local stakeholders such as the Chinese Aquatic Products Processing and Marketing Association (CAPPMA), which has existing MOUs with NFI and O2, and its provincial and local affiliates in Fujian (FAPPMA) and Zhangzhou (ZAPPMA), respectively. They comprise a strong organization of Chinese processing interests essential to the project and who have the means and motivation to influence relevant government organizations to actively support the improvement effort as a strategy to effectively market Chinese fishery products to a global market with sustainable sourcing requirements.

Incentives for government investment could be even further enhanced if Zhangzhou red swimming crab is chosen as a pilot demonstration fishery for Fujian Province to implement China's recent national policy to adopt broad management system reform. While demonstration projects under this policy have been coined total allowable catch (TAC) pilots as shorthand, we believe their purpose is to trial a suite of fishery management measures that can achieve maximum sustainable yield (MSY) outcomes. Since the red swimming crab project has great potential to accomplish this objective and to leverage key government investment, O2 has been actively working with CAPPMA and a key policy advisor from Shanghai Ocean University in an effort to positively influence this pilot fishery selection decision for Fujian Province.

Broad support for the project was clearly demonstrated at the inaugural red swimming crab stakeholder workshop in Dongshan in July 2016. Convened by CAPPMA, ZAPPMA, NFI and O2, participating stakeholders also included municipal government and county government officials, NFI Red Crab Group members, over 20 Zhangzhou processors, ten leading



representatives of local crab fishermen and MSC. There was a strong consensus on the necessity and urgency to improve the management of the swimming crab resource in Minnan-Taiwan Bank. And local representatives indicated strong support for the idea that the red swimming crab fishery should be chosen as a fishery management reform pilot under China's new national policy. They also showed strong intent to generally advocate for essential government involvement in the project. The workshop served to begin building a strong foundation of relationships among the involved stakeholders ultimately necessary for project success.

While the enabling conditions for the FIP are extremely encouraging, the challenges of tackling sustainability issues in the fishery, specifically, and in China, generally, should not be understated. While necessary structure and authorities for fisheries regulation exist in China at relevant government levels, the fishery management system is not well formed or functioning from a sustainability perspective. With respect to this particular fishery the report summarizes results from two recent MSC pre-assessments that suggest improvements are needed for 75% of MSC's performance indicators in order for the fishery to achieve a level of performance consistent with an unconditional pass of MSC's standard. We identify likely improvement needs in the fishery, which we believe are accomplishable given the enabling conditions described above. These include the FIP implementation expertise that O2 has to contribute, strong stakeholder commitments and relationships, and our deep, practical understanding of the Chinese management system and culture. The extent of improvements required will have a consequence for the time required to complete a FIP, which we believe may be 10 years to fully accomplish, though with significant sustainability outcomes expected within the first 5-yr phase. We provide a draft summary work plan for this first phase of the project, which outlines suggested performance goals and improvement actions.

We provide a very rough preliminary estimate of annual budget requirements for project management and on-the-water implementation actions, the totals for which we expect will range from \$131,000 - \$206,000 per year. Of this total, we have projected the need for total annual budget contributions from NFI on the order of \$81,000 - \$106,000. We expect several funding sources to support these measures that will include Chinese government, Chinese industry, foundations and NFI, and expect that NFI's contribution will be an essential key to leveraging this funding. We propose that NFI and O2 collaborate on joint fundraising and suggest that an expanded ask for Moore OSMI funding would be a first, immediate priority.

Finally we outline several next step recommendations for advancing the FIP to formal launch and implementation by October 2017. A positive decision by NFI's Red Crab Subgroup to support the project is a necessary precursor to activate a suite of implementation commitments and agreements. When this occurs, we would propose to reach an agreement between NFI-O2 to initiate these subsequent steps. These include facilitating implementing MOUs/agreements, finalizing the detailed 5-yr work plan and budget with project partners, formalizing operating and oversight mechanisms, continuing to work w/ partners to influence selection of RSC FIP as Fujian Province's national fisheries reform pilot, developing a communication plan with NFI and other partners, and creating a near-term joint fundraising strategy.



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1. Background

1.1 Project genesis

Following a pre-assessment of Chinese swimming crab fisheries in 2013 commissioned by Newport International in accordance with the Marine Stewardship Council (MSC) standard, an ad hoc Red Crab Group within the National Fisheries Institute's (NFI's) Crab Council was formed around the strong interest of industry members to ensure a long-term, sustainable supply of red swimming crabmeat imports to the US market from China. The pre-assessment confirmed the need for substantial improvement in the fishery and identified a number of specific issues to be addressed, underscored by a significant lack of data to support basic assessment and fishery management activities.

In mid-2015, discussions among NFI staff and Red Crab Group members led to an effort to explore whether the necessary enabling conditions existed to form an improvement project for these fisheries and, if so, to map out a pathway. An industry fishery improvement project (FIP) coordinator in China was initially designated by NFI (Ian Chen), and Ocean Outcomes (O2) was solicited to advise and assist in the development of a Chinese Swimming Crab Fishery Improvement Project (FIP) in active collaboration with NFI's Crab Council, its Red Crab Group members and Chinese processors. Coincidentally, a second pre-assessment of the fishery was completed in December 2015 as part of a group of species-fisheries in the region, funded by a German development bank DEG and apparently co-sponsored by MSC and the China Aquatic Products Processing and Marketing Alliance (CAPPMA), in close coordination with one or more Dongshan area processors in Fujian Province.

In March 2016, Red Crab Group members met at the Seafood Expo North America in Boston and confirmed their strong interest in determining if an industry-led and funded FIP was feasible. At a follow-up meeting NFI Crab Council staff requested O2 to submit a proposal outlining activities to scope this effort, build necessary support among US and Chinese industry members for its launch and implementation, and facilitate a decision by NFI members by on whether or not to support launching a red swimming crab FIP, based on an evaluation of whether necessary conditions exist to reasonably ensure its success. As a result, in early April 2016, O2 submitted a proposal to (NFI) for a project to thoroughly scope the China red swimming crab fishery and prepare for the successful launch of a fisheries improvement project (FIP), with a sense of tremendous potential to both rebuild and maintain sustainable crab imports from China to the US. A contract between NFI and O2 for the project was ultimately finalized in late November 2016 after Red Crab group members reached final agreement on a funding mechanism. The report herein encompasses activities from mid-April 2016 when conceptual agreement was reached on the project's scope.

1.2 Scoping approach

The intent of this work has been to create a clear and effective pathway for NFI's Red Crab Group to catalyze a FIP on red swimming crab in China. The project's activities were designed to establish the enabling conditions for a successful improvement project, co-design an action plan with key stakeholders, develop solid commitments from involved stakeholders, develop an



agreed implementation strategy, and public launch a FIP. Originally the target date for the launch was envisioned as early as mid-April 2017 but some delay was encountered in accessing and gaining permission to reference the most recent, 2015 MSC pre-assessment, which finally occurred in early June 2017. Another important pre-completion step was an update presentation to NFI's Red Crab Group at the Seafood Expo North America in Boston in March 2017.

Building a strong foundation for the China red swimming crab FIP has been an overriding project goal - there are too many examples of failed improvement efforts that have not spent the necessary time developing partnerships, solid improvement strategies, and the incentives and commitments to implement them. A key objective has been to ensure that Chinese industry, especially Chinese processors, play a strong role in any FIP, including working closely with government to invest in the fisheries management reform ultimately needed. This group will 'be there' for the long run and has keen insight into the way the fishery works and its problems.

The scoping project approach included stakeholder and supply chain mapping, engaging with strategic project partners, forming a dialogue among stakeholders, ensuring existence of a strong local processing organization and developing a strategy to address key issues in the fishery, including potential responsibilities. The initial FIP work plan and implementation strategy presented in this report represents the culmination of those efforts, which were organized around the following activities:

1. Finalize scoping project proposal, roles and agreement
2. Complete supply chain mapping and stakeholder
3. Conduct initial issue scoping and stakeholder workshop
4. Complete gap analysis and scoping doc preparation
5. Draft initial improvement work plan framework and outline steps for launch

2. Fishery and stock description

2.1 Species

The two most economically important Chinese crab species harvested off Fujian Province for the US export market are red swimming crab (*Portunus haanii*) and three-spot (or red-spot) swimming crab¹ (*Portunus sanguinolentus*) (Fig. 1), which are estimated to account for the majority of crab landed and processed primarily in the Zhangzhou City area. Until the mid- to late 1980s these species were of lesser importance with red swimming crab and smaller specimens of three-spot reportedly being used for feed and fertilizer while larger specimens of three-spot and the larger species of *Portunus pelagicus* (blue swimming crab), *Charybdis feriatus* (crucifix crab) and *Portunus trituberculatus* (Gazami crab) were dominant and primary fishery targets, mainly supplying the domestic seafood market. It is believed that fishery impacts to crab habitat and populations in recent decades led to resources decline of larger specimens

¹ We have tried to use current FAO common names for the various Portunid crab species but recognize there can be confusing overlap across geographies.



of crabs, with red swimming crab becoming ecologically dominant during the 1990s and eventually forming the basis for the US export market from Zhangzhou, though other crab species are still caught as secondarily in the fishery.



Figure 1. The two most commercially important crab species of Fujian Province, China red swimming crab (*Portunus haanii* - left) and three-spot (or red spot) swimming crab (*Portunus sanguinolentus* - right).

Crucifix crab is reported to be the third most economically important crab species currently caught in the area, but its market is apparently domestic because of its high local value. Other minor crab species landed in the fishery include *Charybdis natator* (ridged swimming crab) and *Charybdis japonica* (Japanese swimming crab, or Asian paddle crab). Interviews conducted during the project indicate that the local proportion of blue swimming crab in Zhangzhou landings may have increased in recent years, with some recent processing and product development occurring for this species.

2.2 Fishery summary

2.2.1 Location

These red swimming crab fisheries take place in the southern portion of the Taiwan Strait, in the northern South China Sea, off the southern area in Fujian Province (Fig. 2). These species also are found in offshore area of Shantou city of Guangdong from late spring to early summer but rarely found in the area north of 24°30'N or south of 22°00'N. They reproduce, forage and overwinter mainly in this ocean area of Yuedong- Minnan-Taiwan Bank fishing grounds. In terms of localized distributions, during the first half of the year, the crab are mainly found in the central portion of Taiwan Bank, but during the second half of the year, their distribution center gradually moves to the western part of Minnan-Taiwan Bank fishing ground and the inside part of the Taiwan Strait mid-line, with a relatively broader range but also population density is higher.

According to reports from fishing vessels, the harvest quantity is higher from August to November (peak in October) and lowest in May, also mirroring highest fishing effort during fall-winter. The fishery is subject to the standard summer closure from May to mid-August, while from January to May, spring festival holidays and strong northeast monsoons significantly dampen fishing activity during some portions of that time.

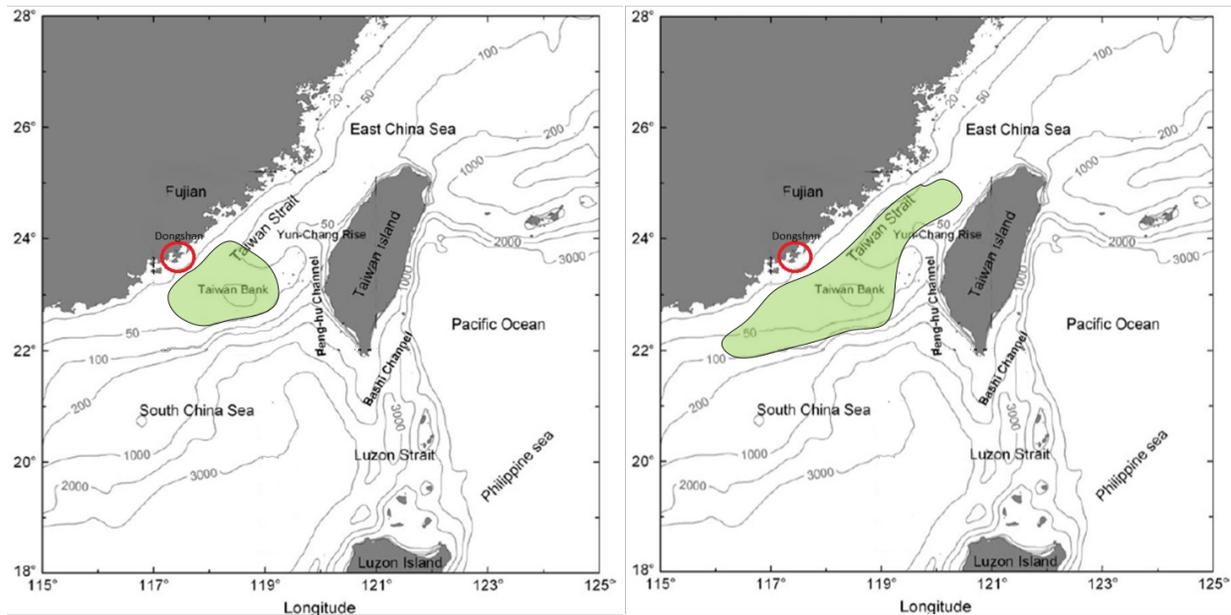


Figure 2. Main fishing grounds (in green) for the crab-directed bottom trap fishery (left) and bottom trawl fishery (right) with red-circled area noting primary processing hub of Dongshan (from Poseidon 2015).

2.2.2 Gear, vessels and harvest characteristics

The primary gear types targeting crab in this area are single vessel bottom trawls (Fig. 3) and crab pots/traps (Fig. 4). Although gillnets and stow nets are sometimes used to catch crab, quantities are comparatively small.



Figure 3. Typical trawl vessel (from Poseidon 2015) and mesh size in Chinese red swimming crab fishery.



Figure 4. Typical trap pot vessel (left) and pots (right) in Chinese red swimming crab fishery.

Trawls are dragged along the ocean bottom with two otter boards holding the wings of the trawl open. The ground rope has rubber discs and spacers intended to hold the bottom margin of the net above off the substrate, and the cod end has a minimum mesh size of 55 mm. Crab traps are small, cylindrical pots with iron frames and enclosed by nets with mesh size of 30 mm. Each fishing vessel carries several hundred to a few thousand pots and lays them in 60-80 m of water. The pots are baited, for example, with chopped sardines. The pots typically soak for 1-2 hours and each can catch about 2.5 to 10 kg of crabs.

Trawls are non-selective; according to interviews with fishermen, crabs comprise about 12-17% of trawl catches annually.² The remaining bycatch³ may include a variety of species such as Round sardinella (*Sardinella aurita*), Pacific chub mackerel (*Scomber japonicus*), Striped bonito (*Sarda orientalis*), mitre (or common Chinese) squid (*Uroteuthis chinensis*), and Neon flying squid (*Ommastrephes bartramii*).⁴ Traps are much more selective for crab, with bycatch mostly consisting of other crab species such as ridged swimming crab.

Endangered, threatened and endangered (ETP) species interactions are anecdotally suggested (based on local interviews with fishers and management officials) to be low, but interactions with trawl gear in particular are possible. The Law of the People's Republic of China on the Protection of Wildlife has detailed requirements on the protection of ETP species, including all fisheries adhering to no fishing areas, requiring ETP species to be released unharmed. However, there is no documentation currently on encounters, even though considered to be uncommon. Turtle exclusion devices (TEDs) are not required in the crab trawl fishery, though turtle encounters are not reportedly a significant management issue. During pre-assessment interviews fishermen reported that any turtles encountered are released at the point of capture. Nevertheless the lack of data collection, verification and documentation is considered to be a performance area in the fishery that needs attention.

² Investigation and analysis of the otter board trawl fishery in Minnan-Taiwan shallow fishing ground by Shen Chang-chun (Fisheries Research Institute of Fujian, China) Journal of Fujian Fisheries Aug, 2012.

³ The term bycatch is used here to mean non-target catch since all fish are typically retained in Chinese fisheries.

⁴ Poseidon Aquatic Resource Management, Ltd. 2015. MSC Pre-assessment of Dongshan fisheries.



Both trap and trawl fisheries primarily operate on the same distribution of red swimming crab around Minnan-Taiwan Bank, with trawls being used over a wider area (Fig. 2). The peak fishing seasons are from August to October for trawlers, and from October to November for traps. There is a fishing moratorium in place from May to August.

Commercial fishing vessels in China are licensed through localized registration. Crab fishing vessels operating in Minnan-Taiwan Bank fishing ground are mainly from Zhangzhou City, of which 83% are registered in three of Zhangzhou's nine counties - Dongshan, Zhao'an and Longhai⁵ (Fig. 5). Dongshan is the most important fishing port and registration jurisdiction, and it also is home to the primary landing sites and the processing companies. The fishing vessels registered in Zhao'an and Longhai counties also land crab catch in Dongshan port.

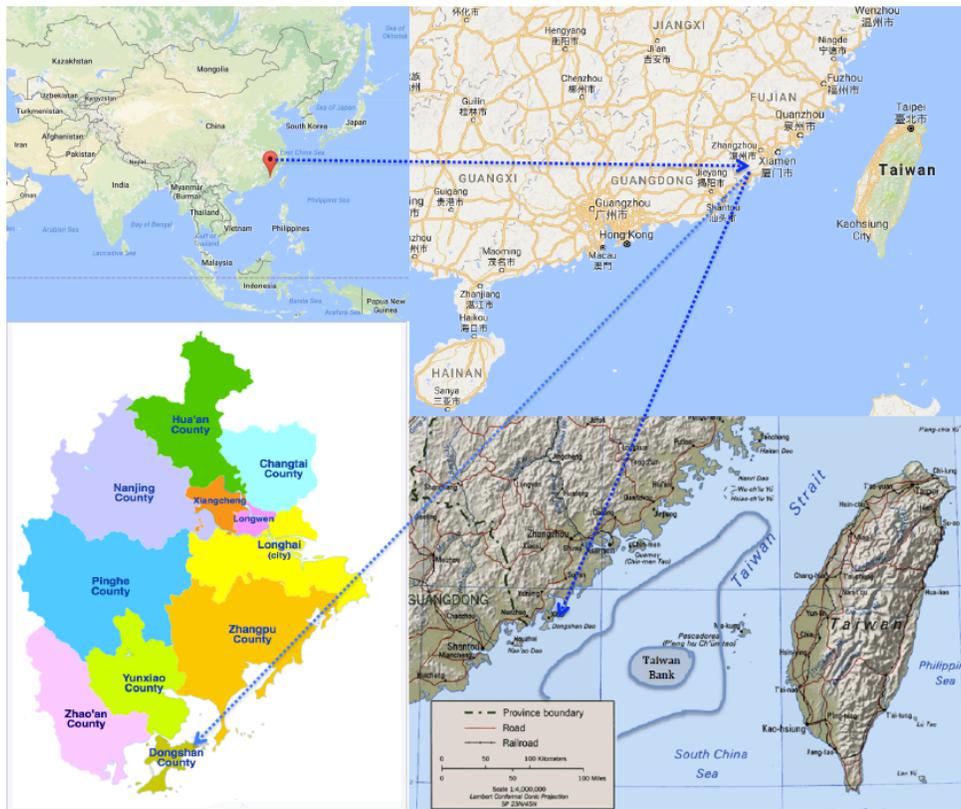


Figure 5. Location of Zhangzhou City in Fujian Province (upper panels) and its nine counties (lower left). Arrows point to the foremost red crab landing and processing center of Dongshan County while the circled area in Taiwan Strait is the center of red crab fishing activity (lower right).

There are 1406 medium-sized larger trawler vessels (length > 12 meters) and 582 pot trap vessels based in Zhangzhou City, with the latter fishing an estimated 380,000 pots.⁶ Trawlers

⁵ The administrative hierarchy in China's provinces is comprised of counties that lie within broader city jurisdictions.

⁶ Qing, Fang and Wang, Songlin. 2017. Supply chain survey for Red Swimming Crab industry in Zhangzhou area (Dongshan Island).



reportedly vary their mesh size according to the season and the size of the targeted crabs. It has been noted that cages are often lost, usually due to trawlers slicing through the lines, which inevitably leads to the potential for ghost fishing (i.e. pots continuing to fish after they are lost).

The Chinese government does not record detailed official catch statistics by species or gear, but the total annual crab harvest from Zhangzhou's vessels is estimated to be about 55-60 kilotonnes (kt), of which 40-50 kt belong to the genus *Portunus*. Most of the *Portunus* catch is red swimming crab, followed by three-spot swimming crab. According to one survey, catch composition for Minnan-Taiwan Bank crab fisheries is roughly 70% and 15% of each species, respectively, with the remainder consisting of the crab species note earlier.

Assuming that 14% of the trawl harvest is comprised of crabs², Qing and Wang⁶ estimated and compiled total crab harvest statistics for Zhangzhou City and that portion of the total landed and processed in Dongshan County (Tables 1 and 2). From 2009 to 2014, the average crab harvest was about 29,900 mt for trawls and 37,100 mt for traps in Zhangzhou City, and of that total, 13,200 mt for trawls and 9,300 mt for traps landed in Dongshan County. These rough estimates suggest that the respective catch proportions for trawls and traps are 45% and 55 in Zhangzhou City, while landings in Dongshan are weighted more heavily to trawl than trap - 59% and 41%.

Given the difference in vessel numbers, it appears that trap pot vessels may have considerably more catch efficiency.

| Zhangzhou City total crab fishing catch | crabs harvest | | | | | Fishing catch quantity by gear | | | |
|---|-------------------|----------------|-------------------|------------------|-------------|--|---|---------------------------|--|
| | Sub-total (crabs) | Species items | | | | Total Harvest from Trawl (All fishing species) | Estimated crab harvest from Trawl (14% of Harvest from Trawl) | Pot trap Harvest quantity | Estimated crab harvest from trawl and pot trap |
| | | 梭子蟹 Portunidae | 青蟹 Scylla serrata | 蟳 Hairy sea crab | other crabs | | | | |
| Year-2009 | 56,260 | 41,555 | 930 | 1,320 | 12,455 | 211,275 | 29,579 | 34,845 | 64,424 |
| Year-2010 | 56,655 | 41,189 | 979 | 1,369 | 13,118 | 211,807 | 29,653 | 34,773 | 64,426 |
| Year-2011 | 57,809 | 41,571 | 1,012 | 1,374 | 13,852 | 216,097 | 30,254 | 35,766 | 66,020 |
| Year-2012 | 59,781 | 46,857 | 1,220 | 1,493 | 10,211 | 210,928 | 29,530 | 38,168 | 67,698 |
| Year-2013 | 59,915 | 46,696 | 1,258 | 1,534 | 10,427 | 211,467 | 29,605 | 39,627 | 69,232 |
| Year-2014 | 64,374 | 49,937 | 1,334 | 2,236 | 10,867 | 217,899 | 30,506 | 39,255 | 69,761 |

| Dongshan county fishing vessel report harvest | crabs | | | | | Fishing catch quantity by gear | | | |
|---|-------------------|----------------|-------------------|------------------|-------------|--|---|---------------------------|--|
| | Sub-total (crabs) | Species items | | | | Total Harvest from Trawl (All fishing species) | Estimated crab harvest from Trawl (14% of Harvest from Trawl) | Pot trap Harvest quantity | Estimated crab harvest from trawl and pot trap |
| | | 梭子蟹 Portunidae | 青蟹 Scylla serrata | 蟳 Hairy sea crab | other crabs | | | | |
| Year-2009 | 20,867 | 12,971 | 33 | 0 | 7,863 | 97,457 | 13,644 | 9,179 | 22,823 |
| Year-2010 | 20,520 | 12,456 | 33 | 0 | 8,031 | 95,934 | 13,431 | 7,991 | 21,422 |
| Year-2011 | 21,484 | 12,559 | 50 | 0 | 8,875 | 93,811 | 13,134 | 9,275 | 22,409 |
| Year-2012 | 22,551 | 17,324 | 45 | 0 | 5,182 | 92,664 | 12,973 | 8,668 | 21,641 |
| Year-2013 | 22,685 | 17,141 | 47 | 0 | 5,497 | 92,716 | 12,980 | 10,620 | 23,600 |
| Year-2014 | 24,682 | 18,028 | 48 | 0 | 6,606 | 93,289 | 13,060 | 10,170 | 23,230 |



3. Supply chain characteristics

3.1 Vessel to first receiver

The two final destinations for crab catch in the Zhangzhou area are either the local fresh seafood market or processing enterprises. The fresh market relies on wholesalers, while the latter involves processors directly purchasing product from fishermen or using middlemen (brokers) for centralized purchasing. *Portunus haanii* and *Portunus sanguinolentus* are destined mainly for processing and the export market and are typically delivered with ice to maintain freshness (Fig. 6).



Figure 6. Live *Portunus haanii* just landed – packed with ice to maintain condition.

Direct purchasing entails an export processing enterprise establishing a representative office at the fishing port for buying crab. The fishermen will report the quantity, species, and size of the catch from the fishing trip, and negotiate the price via radio, for example, during their backhaul (trawl). The vessel lands the catch directly to the representative (usually a freezer truck waiting at port) at the end of a fishing trip or to runner boats that service fishing vessels during extended trips by receiving their catch and delivering ice and other supplies. This sales path requires a good relationship between the enterprises and vessel owners, and once established, it tends to be reliable. Many processing enterprises like to maintain steady, cooperative relationships with fishing vessels by providing cash advances for financing or operational costs. These relationships can be mutually beneficial - safe and stable raw material supplies for processors and cash advances to cover fisheries production costs for vessel owners. In that arrangement the parties typically negotiate a bilateral protective price before the vessel begins fishing, which allows fishermen to avoid the risk of large price and catch fluctuations. These arrangements require local interpersonal connections and locational advantage, and the majority occur between enterprises on Dongshan Island, the major landing and processing center.

The other sales path is centralized purchasing using middlemen, where vessel owners habitually sell their catch to brokers with whom they have a history of long-term cooperation. Middlemen sort different species after collecting catch from several fishing vessels, and for



example, the catch of crabs will be simply sorted by species and size directly at the port. Those materials will be priced between processors and middlemen, and then sent to processors. The reason middlemen exist is that many fishing vessels in China's coastal fishery are small, usually with catch levels from of 1-5 tons for each fishing trip. Those vessels are not part of a consolidated business organization, so processing enterprises would spend too much time and money on management and transportation for individual vessel purchases in order to meet their supply demands. So middlemen alleviate this potential workload and cost. In Dongshan, processors outside the island (though still in Zhangzhou City) rely primarily on middlemen for their procurement. In this arrangement, the key decision maker with the processor on purchase price is this middleman-broker, so fluctuation in price is common, and a stable, 'negotiated price' for the fishermen is typically not possible.

Crab 'materials' also are sometimes traded among different processing plants to meet fluctuating market and supply demands. The simplified supply chain structure of crabs in Zhangzhou City is shown in Fig. 7.

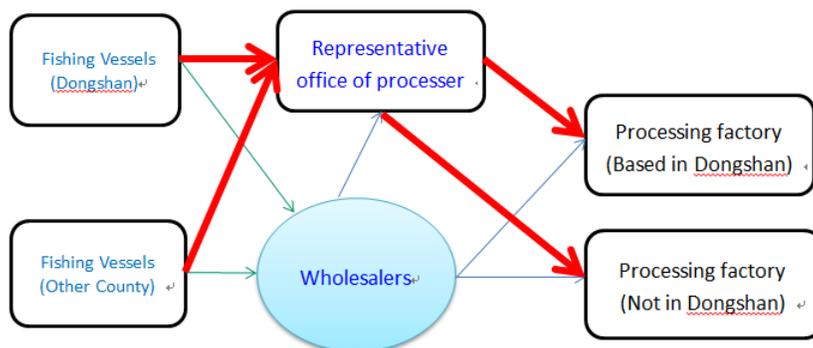


Figure 7. Local Zhangzhou City crab supply chain schematic.

3.2 Processing and export of crab products in Zhangzhou

Zhangzhou region is China's largest center for exported crab products, with red swimming and three-spot swimming crab (*Portunus haanii* and *P. sanguinolentus*) providing high value-added export products. The US is the main export market.

3.2.1 *Portunus haanii* and *P. sanguinolentus* export products

Portunus haanii is shelled after cooking to create two types of crabmeat products: quick-frozen boiled crab (soft packing seal) (Fig. 8) and canned frozen crabmeat. Canned frozen crabmeat is also classified into two specifications, according to the size and integrity of the crabmeat block. Crabmeat pieces $\geq 8\text{mm}$ are called canned circle center crabmeat, or big white 8mm (Fig. 9),



and those < 8 mm are called common canned crabmeat, or small white (Fig 10). The main markets are Taiwan region and the US.



Figure 8. Quick-frozen Zhangzhou crabmeat, typically destined for the Asian market.



Figure 9. Examples of Zhangzhou canned circle center crabmeat and 'big white'.



Figure 10. Examples of Zhangzhou common canned crabmeat and 'small white'.

Three-spot swimming crab (*Portunus sanguinolentus*) is processed into frozen raw crab block, packed in color boxes and exported to US, European and South Korean markets (Fig. 11).



Figure 11. Zhangzhou frozen raw crab block.

According to interviews with processing enterprises, purchases of *Portunus haanii* outpace *Portunus sanguinolentus* by about 10:1, depending on annual fishery status. The yield of crabmeat from *Portunus haanii* is reported to be about 16%, and that from *Portunus sanguinolentus* is about 35%.

3.2.2 Status of crab products export from Zhangzhou to the US

In 2014, total crabmeat products exported from China globally was 74.7 kt, of which Zhangzhou exported 29.2 kt tons, or 39%. Also in 2014 crabmeat products exported from China to the US was 13.3 kt, of which Zhangzhou accounted for 8.2 kt, or 61%.⁷ As noted above Zhangzhou is one of the core regions for crabmeat export trade from China (Fig. 12). Considering that *Portunus haanii* and *P. sanguinolentus* fisheries in China are almost only in the Minnan-Taiwan bank ocean area, and Dongshan is the backbone production base, it is clear that Dongshan plays a key role in crabmeat products trade between China and the US.

In 2014, there were a total of 23 companies in the Zhangzhou region recording crab product exports to the US. Of these the top 10 accounted for about 80% of the exports while 14 accounted for over 90% (Table 3). Processors interviewed indicated that, in their business with the US market, they primarily export directly to US trading companies, with almost no links directly with US retailers. To keep business confidential, interviewees did not disclose their US buyers. Crabmeat processing enterprises in Zhangzhou, although they have begun to develop their own crabmeat product brands, typically export canned crabmeat to the US with packaging that utilizes the customer's brand.

As already noted Dongshan County is the crabmeat processing hub for Zhangzhou and of central importance to the regional aquatic product processing industry. At present, there are 11 processing factories engaged in crabmeat processing and export business in Dongshan, with about 20,000 workers in this industry. While there are also other crabmeat processing and export factories in Zhangzhou City's other counties, most purchase crab materials from the Dongshan fishing port.

⁷ Data from Chinese customs



Table 3. Amount of crab products (t) exported from Zhangzhou to the US.

| Company | Year | | | | |
|----------------|------|-------|-------|-------|-------|
| | 2010 | 2011 | 2012 | 2013 | 2014 |
| 1 ⁸ | 497 | 464 | 428 | 857 | 1,357 |
| 2 | 442 | 733 | 630 | 600 | 925 |
| 3 | 409 | 670 | 560 | 459 | 606 |
| 4 | 896 | 1,278 | 1,124 | 1,133 | 587 |
| 5 | 904 | 691 | 53 | 98 | 534 |
| 6 | 354 | 549 | 227 | 332 | 532 |
| 7 | 424 | 804 | 694 | 418 | 528 |
| 8 | 340 | 224 | 215 | 479 | 510 |
| 9 | 436 | 477 | 378 | 415 | 499 |
| 10 | 107. | 231 | 231 | 361 | 421 |
| 11 | 187 | 170 | 140 | 141 | 282 |
| 12 | 574 | 82 | 208 | 81 | 270 |
| 13 | 225 | 215 | 222 | 145 | 177 |
| 14 | 268 | 211 | 132 | 203 | 158 |
| 15 | | 0 | 135 | 176 | 150 |
| 16 | | 0 | 97 | 17 | 121 |
| 17 | | 0 | 86 | 89 | 98 |
| 18 | | | | 52 | 98 |
| 19 | | 280 | 125 | 93 | 93 |
| 20 | | | | 100 | 80 |
| 21 | | | | 0 | 54 |
| 22 | 9 | 36 | 89 | 39 | 23 |
| 23 | 263 | 145 | 235 | 39 | 0 |

⁸ The company names have not been included to respect information that might be considered confidential.



A point of interest noted in our survey of Dongshan processors was that due to the rise in price of China's crab product (mainly due to rising labor costs and price of crab raw materials), some foreign buyers have looked to the Indonesia region for possible procurement of *Portunus haanii* canned products. In Indonesia, the processing industry for *Portunus haanii* is under development, but speculatively could perhaps become a new region of competition with the Zhangzhou crab processing industry at some future time.



Figure 12. Example of Zhangzhou processing plants – canning crabmeat shown in right panel.

4. China red swimming crab fishery performance gap analysis

Two MSC pre-assessments have been conducted that are relevant to this fishery:

1. *2013 crab pre-assessment by Intertek Moody Marine*

Target crab species, gear types, and areas:

- Red swimming crab (*Portunus haanii*), trawl and cage, Taiwan Strait in East China Sea
- Sand crab (*Ovalipes punctatus*), trawl, East China Sea off Shanghai City

2. *2015 Dongshan fisheries pre-assessment by Poseidon Aquatic Resources Management Ltd.* - This was a multi-species assessment, which included (among others) two crab target species in two of the Units of Assessment (UoAs).

Target crab species, gear types and areas:

- Red swimming crab (*Portunus haanii*), bottom trap and bottom trawl, Taiwan Strait and East and South China Sea off Dongshan County
- Three-spot (or red spot) swimming crab (*Portunus sanguinolentus*), bottom trap and bottom trawl, Taiwan Strait and East and South China Sea off Dongshan County

The 2013 pre-assessment is based on an older version of the MSC fisheries standard (v. 1.3), whereas the 2015 pre-assessment is based on the current standard (v. 2.0). In addition to being



more recent and current, the 2015 pre-assessment generally has more detailed information. Thus we primarily have based our recommendations on the 2015 pre-assessment (see Table 1 for scores) and used the 2013 pre-assessment as a supplement. The fisheries are significantly data deficient and both pre-assessments relied heavily upon MSC's Risk Based Framework (RBF) to diagnose performance.

4.1 Overview of pre-assessment results and major gaps

A summary of pre-assessment results is shown in Table 4. Our gap analysis indicates that 75% of MSC performance indicators likely would require some form of improvement action in order to meet an unconditional pass of the MSC standard. There are some differences between trawl and trap-pot gear primarily related to potential impacts on ETP species. While the specific assessment results are further outlined in the next section, it's useful to remember that potential deficiencies could be resolved by gathering information to better assess performance. Conversely, more data collected from the fishery could identify issues not highlighted in the pre-assessments. Nevertheless, both pre-assessments identified the following key deficiencies:

- There is a lack of monitoring and current biological data for these crab stocks, and no stock assessments are conducted.
- There is a lack of a harvest strategy and harvest control rules, for both target species and retained non-target species.
- Fishery interactions with ETP (endangered, threatened or protected) species are reported to be rare, but documentation and verification are minimal.
- Impacts on non-target and ETP species are a particular concern for trawls, which are not as selective as traps.
- There are no fishery-specific management plans.
- Decision-making processes are not responsive to issues identified in relevant research. I.e., science is not effectively used to inform management.

Table 4. Summary of likely scoring category outcomes for Chinese red and three spot crab fisheries in 2015 Poseidon pre-assessment (see further discussion below about caveated category).

| Gear Type | Total MSC Performance Indicators | Scoring Category | | | |
|--------------|----------------------------------|---------------------------------|------|--------------------------------------|--------------------|
| | | Not Scored, Unknown or Caveated | Fail | Conditional pass (needs improvement) | Unconditional Pass |
| Bottom trawl | 28 | 4 | 6 | 13 | 5 |
| Pot (cage) | 28 | 4 | 4 | 15 | 5 |



4.2 Gap analysis of MSC performance indicators

The likely scoring results for the Chinese red swimming crab fishery against MSC performance indicators (PIs) based on the Poseidon's 2015 pre-assessment are summarized in Table 5. One item worth noting is the high scores (≥ 80) assigned to stock status of the target species in both pre-assessments. Due to the lack of stock assessments for swimming crabs, MSC's risk-based framework (RBF) was used to evaluate risk of fishing activities on stock status. In a full MSC assessment, the RBF requires that two analyses are applied to target species: a productivity susceptibility analysis (PSA) and a consequence analysis (CA). Both analyses evaluate risk, with the PSA being based on a species' biological attributes and susceptibility to fishing mortality, and the CA relying on expert judgment from stakeholders.

Neither pre-assessment fully applied both a PSA and CA, which is not unusual for a pre-assessment. The 2013 pre-assessment described likely PSA and CA scoring but did not compute scores, while the 2015 pre-assessment conducted the PSA but not the CA. For the PSA, red swimming crab and three-spot swimming crab were both evaluated as being at low risk despite high susceptibility to fishing mortality because the species are highly productive. However, we expect that a CA would identify additional risks to the stocks, particularly in terms of size structure. Fishers and processors have made a strong point regarding decline in crab sizes particularly for three-spot and blue swimming crab, which suggests that fishing may be impacting recruitment. Additional historical information about the decline and loss of economically significant abundance of blue swimming and Gazami crab from the same fishing grounds by the 1990s also raises significant question about the fishery's potential impact on stock status. In the absence of stock status surveys or assessments, conducting an actual CA and obtaining stakeholder input may highlight stock status concerns that were not clearly identified in the pre-assessments.

As a result we have highlighted the results for PI 1.1.1 Stock Status in orange in Table 5 to reflect a significant potential for a basic performance issue in this key area and the intent to co-design improvement actions with the fishery clients. Similarly we also have highlighted PI 1.2.4 Assessment of Stock Status in orange. Under MSC's risk based methodology if PI 1.1.1 scores ≥ 80 , then PI 1.2.4 is automatically assigned passing score of 80. In this case some assessment of abundance or population status characteristics will be necessary to resolve basic questions about the potential impact of the fishery on meeting MSY abundance levels, or their surrogates.



Table 5. Likely Performance Indicator (PI) scores from the 2015 pre-assessment for Dongshan bottom trap and trawl fisheries (see text following-4 table for important qualifications).

| Principle | Component | Performance Indicator | Likely scoring Trap | Likely scoring Trawl |
|-------------------|------------|---------------------------------------|---------------------|----------------------|
| 1 | Outcome | 1.1.1 Stock status | ≥80 ⁹ | ≥80 ⁸ |
| | | 1.1.2 Stock rebuilding | n/a | n/a |
| | Management | 1.2.1 Harvest strategy | <60 | <60 |
| | | 1.2.2 Harvest control rules and tools | <60 | <60 |
| | | 1.2.3 Information and monitoring | <60 | <60 |
| | | 1.2.4 Assessment of stock status | 80 ⁹ | 80 ⁹ |
| | 2 | Primary species | 2.1.1 Outcome | 100 |
| 2.1.2 Management | | | 80 | 80 |
| 2.1.3 Information | | | 80 | 80 |
| Secondary species | | 2.2.1 Outcome | ≥80 | ≥80 |
| | | 2.2.2 Management | 60-79 | 60-79 |
| | | 2.2.3 Information | 60-79 | 60-79 |
| ETP species | | 2.3.1 Outcome | ? | ? |
| | | 2.3.2 Management | 60-79 | <60 |
| | | 2.3.3 Information | 60-79 | <60 |

⁹ See discussion on risk factors above.



| | | | | |
|---|------------------------------------|--|-------|-------|
| | Habitats | 2.4.1 Outcome | 60-79 | 60-79 |
| | | 2.4.2 Management | 60-79 | 60-79 |
| | | 2.4.3 Information | 60-79 | 60-79 |
| | Ecosystem | 2.5.1 Outcome | 60-79 | 60-79 |
| | | 2.5.2 Management | 60-79 | 60-79 |
| | | 2.5.3 Information | 60-79 | 60-79 |
| 3 | Governance & policy | 3.1.1 Legal and customary framework | 60-79 | 60-79 |
| | | 3.1.2 Consultation, roles and responsibilities | ≥80 | ≥80 |
| | | 3.1.3 Long term objectives | 60-79 | 60-79 |
| | Fishery specific management system | 3.2.1 Fishery specific objectives | 60-79 | 60-79 |
| | | 3.2.2 Decision making processes | <60 | <60 |
| | | 3.2.3 Compliance and enforcement | 60-79 | 60-79 |
| | | 3.2.4 Management performance evaluation | 60-79 | 60-79 |

4.3 Likely improvement needs

We have examined pre-assessment scoring for each MSC v. 2.0 performance indicator (PI) and suggest the following improvements to increase scores for PIs that fall below the 80 scoring level. It is important to note these recommendations are not intended to constitute an action plan but rather highlight issues needing to be addressed to meet the MSC standard of performance. The anticipated approach to developing a fishery improvement work plan would be one of active engagement and co-design with involved stakeholders. There are also a number of cases where additional information may be needed to verify or clarify current performance, which also would help inform subsequent improvement steps.



4.3.1 PI 1.1.1 – Stock status

This PI is intended to verify whether the fishery’s target stock status is maintained above a level that may correspond to recruitment impairment and at or above a level that corresponds with achieving a maximum sustained yield goal. As noted above, although the pre-assessments suggested that the fishery could possibly be achieving pass performance for this indicator, that possibility was based on a risk assessment that relied completely on the red swimming crab’s life history characteristics and high productivity. Ancillary information from fishers and processors provide a strong indication that average size in the population has been decreasing and there is previous history that indicates likely overfishing of other swimming crab species that were previously targeted in the fishery. We recommend that a some more comprehensive risk assessment be conducted and/or a direct assessment of stock size against desired reference abundance levels in the fishery.

4.3.2 PI 1.2.1 - Harvest strategy

The goal of this PI is to show that there is a robust and precautionary harvest strategy in place. Because there are no specific harvest strategies for these crab fisheries, we recommend working with stakeholders to develop a harvest strategy that is responsive to the status of crab stocks.

4.3.3 PI 1.2.2 - Harvest control rules

When developing the harvest strategy, harvest control rules (HCRs) should be defined. HCRs are a pre-agreed upon set of rules used to determine management actions that will be taken in response to changes in stock status. Although there are some controls in place such as licensing restrictions and a closed season, and a minimum carapace size, these are not HCRs. Once HCRs are in place, their efficacy will need to be evaluated.

4.3.4 PI 1.2.3 - Information and monitoring

To fully support the harvest strategy and HCRs, regular monitoring of stock abundance and harvests (from all sources of fishing mortality) is needed. In the longer term, we suggest working with the fishery management system to initiate a robust monitoring system. In the shorter term, the fishery can contribute to the larger effort by monitoring its own catches.

4.3.5 PI 1.2.4 – Assessment of stock status

Following the discussion of PI 1.1.1 we recommend that a some more comprehensive risk assessment be conducted and/or a direct assessment of stock size against desired reference abundance levels in the fishery.

4.3.6 PI 2.2.2 - Secondary species management strategy

MSC defines secondary species as “species in the catch that are within the scope of the MSC program but are not considered primary or ETP species.” Essentially, these are species that do not have management tools and measures in place, and are also not known to be threatened.



For the bottom trap fishery, one main secondary species was identified in the 2015 pre-assessment: ridged swimming crab (*Charybdis natator*). For the bottom trawl fishery, no main and six minor secondary species were identified: Round sardinella (*Sardinella aurita*), Pacific chub mackerel (*Scomber japonicus*), Striped bonito (*Sarda orientalis*), mitre squid (*Uroteuthis chinensis*), and Neon flying squid (*Ommastrephes bartramii*). MSC has more stringent requirements for main species (generally > 5% of the catch) than for minor species (generally < 5% of the catch).

For the bottom trap fishery, a partial management strategy needs to be developed for ridged swimming crab that includes at least one measure that is expected to maintain species abundance and that can be revised as needed. The controls that are currently in place, such as licensing restrictions, a closed season, and minimum carapace size do not constitute an adequate strategy because they are not specifically designed for these fisheries.

For the bottom trawl fishery, no main secondary species were identified in the pre-assessment. MSC does not require partial management strategies for minor secondary species to achieve an 80 score, although the presence of strategies can improve scoring.

4.3.7 PI 2.2.3 - Secondary species information

This PI relates to the presence and quality of information available for informing management of secondary species. Because biological data are limited, we recommend collecting quantitative information on main secondary species that can be used to support relevant management strategies.

4.3.8 PI 2.3.1 - ETP species outcome

The 2015 pre-assessment lists ETP species that the crab fisheries may encounter. However, there is no formal reporting of ETP species interactions, nor is there much evidence of measures taken to minimize bycatch of ETP species. Both pre-assessments noted the lack of information for evaluating this PI, and only the 2013 pre-assessment provided a score (60-79). We suggest gathering more information from researchers or other organizations to narrow down the list of ETP species that are at particular risk of being impacted by these fisheries, and then conducting productivity susceptibility analyses on these species or evaluating impacts more directly where possible.

4.3.9 PI 2.3.2 - ETP species management strategy

According to China's regulations, ETP species cannot be caught, or if caught, they must be released alive. However, these regulations do not comprise an adequate management strategy because review of management measures and their efficacy is lacking. We recommend identifying specific risks to ETP species from these fisheries, and then developing and implementing a strategy with measures to address these risks. Performance of the management strategy should be reviewed periodically and revised as needed.



4.3.10 PI 2.3.3 - ETP species information

Information for assessing ETP species impacts and supporting an ETP species management strategy is lacking. A system for monitoring fishery impacts on ETP species should be implemented, and the collected information should be used to evaluate the management strategy.

4.3.11 PI 2.4.1 - Habitats outcome

Both the trap and trawl fisheries are operated on sandy bottom habitats, and reef and island areas are typically protected from fishing. Thus habitats are expected to recover quickly from fishing disturbances. However, more evidence is needed to demonstrate that fishing gear is highly unlikely to cause irreversible harm to commonly encountered and vulnerable habitats. We recommend conducting a scientific assessment to show that gear is highly unlikely to harm bottom habitat, and that vulnerable habitats such as reefs are not impacted.

4.3.12 PI 2.4.2 - Habitats management strategy

China adopted relatively recent regulations to establish and manage '[Aquatic Germplasm Resources Conservation Zones](#)', which are major areas where aquatic germplasm resources have high value for economics, hereditary and breeding, in order to strengthen protection of these resources and their associated environments. In addition, under a separate mandate to conserve ecosystems, 59 marine protected areas established by the State Oceanic Administration (SOA) Department for Marine Resources and Environmental Protection (DMREP). These protected areas cover islands, coral reefs, mangrove swamps, key turtle and horseshoe crab beaches, and other habitat types. In addition to these protected areas, regulations prohibit trawling within a specified onshore zone, though artisanal fishing can take place within the zone. The SOA is currently reviewing spatial protection and management.

The above information indicates that a partial management strategy exists, but there is no clear evidence that strategy's measures are working. Such evidence should be gathered, for instance by collecting vessel monitoring data to show that fishing does not occur in protected areas.

4.3.13 PI 2.4.3 - Habitats information

Types and distribution of habitats are generally known. However, the degree of contact between fishing gears and the sea bottom has not been well quantified. We recommend collecting information on the frequency and extent of contact between gear and the sea bottom, to better determine habitat impacts. Monitoring of impacts should be ongoing to track habitat risks over time.

4.3.14 PI 2.5.1 - Ecosystem outcomes

The crab trap fishery affects local ecosystems through removal of targeted crab species and harvest of fish resources for bait. Crab and bait species removals are thought to be at acceptable levels, but supporting evidence is limited. We suggest collecting information relating to potential impacts of crab and bait species removal, possibly by consulting experts. Another suggestion is to conduct a Scale Intensity Consequence Analysis (SICA), which involves



convening stakeholders, identifying the most vulnerable subcomponent of the ecosystem, and then assessing the consequence of the fishery on this subcomponent.

Another potential issue in the trap fishery has been the report of lost gear and the possible impact from ghost fishing. Additional information and/or risk analysis is needed to help assess the extent and consequence of derelict gear from the fishery.¹⁰

In the trawl fishery, heavy fishing mortality on high-value demersal stocks has led to a shift in the ecosystem and harvest toward faster-growing, smaller species such as shrimp. Furthermore, the lack of gear selectivity may hinder recovery of depleted stocks. A SICA will likely be needed, with the ecosystem subcomponent of species composition being a probable concern.

4.3.15 PI 2.5.2 - Ecosystem management strategy

Effects of crab removal on the ecosystem are not taken into account in management, and the annual summer fishery closure in the Minnan-Taiwan Bank area from 1 May through 15 August is the primary measure expected to restrain fishery impacts on the ecosystem. We recommend developing a fishery-specific strategy with at least one measure for limiting negative ecosystem impacts, which can be revised as needed. It will also be important to collect evidence that measures are implemented and enforced. The potential issue of ghost gear should be included in these considerations.

4.3.16 PI 2.5.3 - Ecosystem information

Key elements of the ecosystem are broadly understood, but ecosystem impacts from the UoAs have not been studied. We suggest investigating these impacts by working with the research and academic community to identify and analyze ecosystem indicator data. Indicator data should be collected on an ongoing basis to allow for tracking of ecosystem changes.

4.3.17 PI 3.1.1 - Legal and customary framework

The management system generally follows local and national laws in accordance with MSC Principles 1 and 2. Procedures include a process for resolving disputes concerning effects of fishing activities, but it is unclear whether the resolution process is transparent and effective. We recommend making the dispute resolution process more transparent and collecting information to show that the process is effective.

4.3.18 PI 3.1.2 - Consultation, roles, and responsibilities

This PI scored ≥ 80 in the 2015 pre-assessment, but we believe more supporting evidence is needed. Evidence should be collected to show that fishery consultation processes are held regularly and are open to all stakeholders, and that stakeholder input is considered by the

¹⁰ The issue of ghost gear is referenced under ecosystem indicators here but MSC guidance requires that its potential impacts be considered in all areas of Principle 2 (Box GSA7: MSC Fisheries Standard and Guidance v2.0).



management system. Obtaining a more detailed description of consultation processes would be helpful.

4.3.19 PI 3.1.3 - Long term objectives

Long term objectives consistent with MSC Principles 1 and 2 are suggested in the overall fishery management system but are not explicit. We suggest reviewing high level management policies to confirm whether long objectives are explicitly mentioned. If they are not, the next step would be to work with the government to develop appropriate objectives and incorporate them into policy.

4.3.20 PI 3.2.1 - Fishery-specific objectives

These crab fisheries lack a species and/or fleet-specific management plan. Input controls such as the licensing system suggest some objectives, but they are not explicit. To address this deficiency, we recommend working with stakeholders to develop a fishery-specific management plan with clear objectives that are consistent with MSC principles.

4.3.21 PI 3.2.2 - Decision-making processes

Decision-making processes are in place, but they do not appear to respond to serious issues identified in relevant research and monitoring. There is a need to incorporate responsiveness and a precautionary approach into decision-making, including mechanisms to monitor the fishery and ensure that research/monitoring results are used to inform management in a timely, adaptive manner.

4.3.22 PI 3.2.3 - Compliance and enforcement

Monitoring, control, and surveillance mechanisms exist, and sanctions are applied to those who do not comply with regulations. Compliance is reportedly high, but evidence is lacking. Evidence of compliance (such as inspection reports and track records of individual violations) should be collected.

4.3.23 PI 3.2.4 - Management performance evaluation

Some parts of the management system are reviewed internally, but these may not be key parts (such as stock assessment and enforcement systems) where performance should be regularly evaluated. Additionally, the management system is not subject to comprehensive external review. We recommend examining the management review process, identifying the components that should be regularly reviewed, and developing proposals for conducting appropriate internal and external reviews.

4.4 Other information gaps and questions

The pre-assessments (particularly the 2013 report) acknowledged the limited availability of detailed fishery information. In addition to the potential improvement needs described above, we had questions about some aspects of the fishery that did not appear to be covered in the pre-assessments. Those questions are outlined below, though in some cases our additional,



ongoing research is providing some useful insights that will help shape additional information collection through fishery improvement efforts.

4.4.1 Stock structure and sources of fishing mortality

Biological data on red swimming crab are limited, and there was no discussion of stock structure in either pre-assessment. In addition, it was not clear whether all sources of fishing mortality on the stock were identified.

Questions for stakeholders:

- Have there been any attempts to determine stock structure? Are red swimming crab assumed to belong to a single stock within the assessed area?
- Do other gears, such as gillnets, harvest significant quantities of crab?
- Do artisanal fisheries harvest significant quantities of crab?
- Do other nations also exploit the stock(s)? If so, what are their approximate harvest volumes?

4.4.2 Management measures and compliance

The pre-assessments described various management measures including a vessel licensing system, seasonal closures, minimum crab carapace size of 100 mm, and protected areas. However, details about the measures and fishermen's compliance were lacking.

Questions for stakeholders:

- How was the minimum crab size determined and has it been fully implemented? Are undersized crabs incidentally caught in trawl fisheries? If so, are they discarded?
- Are there many vessels fishing without a license, or with an expired license?

4.4.3 Detailed catch information

The 2015 pre-assessment identifies main and minor non-target species for each UoA (Table 15) based on personal communication with the client. No details were provided about catch proportions and whether all captured species were identified, so additional catch information will be needed to confirm the pre-assessment results and contribute to work plan development. This need could be addressed by collecting and quantifying catch samples in the relevant fisheries.

Questions for stakeholders:

- Does catch composition vary substantially over the fishing season?
- Were all harvested species included in the pre-assessment, including those that are not economically valuable, rarely encountered and/or discarded?

4.5 Priority list of tasks for the fishery to implement

In order to achieve a level of performance consistent with an MSC minimum pass, each of the three MSC principles must score 80 or above, and no individual PIs can score less than 60. According to the 2015 pre-assessment, PIs 1.2.1, 1.2.2, 1.2.3, 3.2.2, will likely score below 60



for both trap and trawl fisheries (Table 5). In addition, PIs 2.3.2 and 2.3.3 will likely score below 60 for trawl fisheries specifically (Table 5). The deficiencies associated with these PIs were naturally highlighted as major issues in the pre-assessments, and actions for addressing them are worth prioritizing. Additionally, because fishery information is limited, the sooner the fishery can start monitoring abundance and catches, the better. Development of a fishery-specific management plan is another task that would be prudent to initiate in the early stages of the FIP.

4.5.1 Priority Task 1 - Implement a monitoring system for target stocks

Regular, accurate monitoring of stock abundance and catches (from all sources of fishing mortality) is needed to develop and support a harvest strategy and ensure sustainable management. Basic catch and biological monitoring and data collection systems need to be designed and implemented. Scientists and fishery managers should be consulted to design scientifically robust monitoring methods. One potential method for monitoring abundance is to conduct research surveys when the fishery is closed, which would require government approval. For example, traps with very small mesh sizes could be set during the summer fishery closure, to obtain an effort-based measure of crab abundance at all sizes. Obtaining accurate catch estimates is also necessary, at the very least for fisheries involved in the FIP.

4.5.2 Priority Task 2 - Determine risks to ETP species; develop relevant management measures

Fishery impacts on ETP species are reportedly minimal, but an improved understanding of risks is needed, especially for the trawl fishery. This may involve consultations with scientists and NGOs, as well as collection and verification of detailed catch data. After risks to ETP species have been better characterized, management measures for mitigating those risks can be developed, if needed, such as fishing behavior adjustments to better avoid ETP species, protocols for releasing incidentally captured animals, and excluder devices. These measures should be part of an ETP species management strategy that is subject to review and revision.

4.5.3 Priority Task 3 - Develop a harvest strategy and harvest control rules for target species

Development of a robust and precautionary harvest strategy involves multiple steps. The first step will be to work with stakeholders (government managers, fishermen, and other relevant parties) to identify management objectives. Then based on these objectives, management measures and harvest control rules can be developed. It is important that the strategy be clearly defined, responsive to stock abundance, and subject to periodic evaluation.

4.5.4 Priority Task 4 - Develop a fishery-specific management plan

The lack of fishery-specific management is a major deficiency that should be addressed at an early stage. Some of the other actions identified in other priority tasks, such as development of fishery objective and a harvest strategy, could naturally be incorporated into a management plan.



4.5.5 Priority Task 5 - Foster more precautionary decision-making informed by research

The current fishery management system does not appear to respond to serious issues identified in relevant research and monitoring, except for toxin screening. Thus there is a strong need to incorporate responsiveness and accountability into decision-making, by improving monitoring systems, regularly analyzing and publicizing research/monitoring results, and requiring transparency in the decision process. This task will require substantial engagement and cooperation with government agencies.

5. Stakeholder mapping and engagement

The fishery's sustainability challenges and improvement needs outlined in Section 4 cannot be overstated, and project planning to date has recognized an essential need to secure deep, active engagement of key stakeholders to motivate and support these efforts. This includes national, regional and local levels of Chinese government; university science institutes; national, regional and local associations of Chinese processors; NGO partners; and NFI.

5.1 Key government management authorities

While the Chinese fisheries management system is not well advanced in terms of producing sustainable resource outcomes, the levels of national, regional and local management authorities are well established. The main and highest administrative body is the Fisheries Bureau under the Ministry of Agriculture (农业部渔业局, FBMOA). This governmental branch is responsible for broad national policy and, on behalf of the Central Government, sets overarching fisheries goals and objectives every five years in the form of a Five-Year Plan. For instance, the thirteenth Five-Year Plan recently issued for the period 2016 to 2020 established the intent to adopt fisheries management system reforms. The implementing approach has been to select a pilot demonstration fishery in each of five provinces, including Fujian. While demonstration projects under this policy have been coined total allowable catch (TAC) pilots as shorthand, we believe their purpose is to trial a suite of fishery management measures that can achieve maximum sustainable yield (MSY) outcomes. In the case of red swimming crab, with a short life history and high reproductive potential, such a suite could logically include minimum catch size, protection of egg bearing females, seasonal or area closures, gear changes and threshold management triggers rather than setting annual TAC targets.

For the red swimming crab FIP it would be a key advantage for the fishery to be selected as the Fujian provincial management reform pilot because its implementation would be the responsibility of Fujian Province and its subordinate city and county governments. This would represent a government commitment at all levels and result in associated investment of resources, both of which would be extremely beneficial for successful implementation of fishery improvement actions. Nevertheless government engagement certainly can be enlisted without this pilot designation for the fishery. O2 has been opportunistic in the short-term by actively seeking support from key industry and science advisors to the pilot fishery selection process, which will be a bonus if achieved.

As noted above provincial, city, and county bodies operate under guidance of the FBMOA to



manage fisheries within their respective jurisdictions. The management of China's coastal fishing vessels occurs through localized management mechanisms, where all vessels are registered in the counties they originate from and are under management of the authority in their registered areas. The crab fishing ground on Minnan-Taiwan Bank is traditionally open for vessels from Zhangzhou, which means the city government undertakes direct management of fishing vessels on the water. The subordinate counties within Zhangzhou also have a potential role in response to illegal acts due to their role in vessel registration. The two most active regulatory mechanisms in the fishery - the Fishing Capacity Control System and Summer Fishing Closure, are implemented under city management authority.

In the context of this fishery improvement effort, the associated regional-local bodies are the Fujian Provincial Ocean and Fishery Department, the Zhangzhou Municipal Ocean and Fishery Bureau, and primarily Dongshan County. As noted earlier, two other Zhangzhou counties have registered vessels participating in the fishery - Longhai and Zhao'an – but their numbers are small in comparison and many of their landings still occur in Dongshan. So the central organizing focus of the project currently lies in Dongshan, with the Ocean and Fishery Bureau of Zhangzhou City being the key authority for managing fishing vessel activities on the fishing grounds. At some point as the project progresses, it will be logical to engage other subordinate counties within Zhangzhou in the FIP as well as explore the participation of vessels from other completely separate jurisdictions such as Guangdong Province and even Taiwan, even though their current importance appears small in comparison.

5.2 Key Chinese seafood industry associations

The Chinese Aquatic Products Processing and Marketing Alliance (CAPPMA) is the national association umbrella of seafood processors, has a partnership MOU with each NFI and O2, and is a very important stakeholder for the red swimming crab project. As noted above CAPPMA is instrumental in advising national fisheries policy and Dr. Cui He, CAPPMA's current president, is already supporting the project by playing an active role to influence the decision on selecting it as the pilot demonstration fishery for Fujian Province. In 2016 CAPPMA also explored, with O2's assistance, the potential application for government funding support for the project's implementation actions. Finally CAPPMA is also taking a strong sustainability leadership role in influencing the positive involvement of CAPPMA's regional affiliate associations in the FIP, which in 2016 included Dr. Cui chairing the inaugural stakeholder workshop for the project in Dongshan

The Fujian Aquatic Products Processing and Marketing Association (FAPPMA) is the provincial association, with a goal of helping the seafood industry of Fujian Province to gain larger global seafood market share, business profits and more international recognition. The Zhangzhou Aquatic Products Processing and Marketing Association (ZAPPMA) is the city level affiliate in Zhangzhou, located on Dongshan Island. As the local organizations of the seafood processing industry, FAPPMA and ZAPPMA maintain good cooperative relationships with fishing cooperatives and important seafood processing enterprises, and also are an important communication bridge between local fishery departments and the seafood industry sector. Both associations have expressed their strong support for sustainable fishery development in



Dongshan Island, with the expectation that such efforts will bring real benefits to local fishermen and processing enterprises. Both organizations were actively involved in the inaugural 2016 red swimming crab fishery improvement workshop, both are advocating for selection of the fishery as the national management reform (AKA TAC) pilot for Fujian Province, and ZAPPMA has indicated an interest in playing the role of industry coordinator for the project's implementation. These active roles are pivotal given the organizations' close relationships with local governments, with a large ability to influence the decision-making process and information consultation with these fishery authorities.

5.3 Zhangzhou coastal crab fishery producers

The fishing vessels in Zhangzhou City are registered to vessel owners or fishermen. There are no vertically integrated companies that process crabs and own fishing vessels. Each fishing vessel can be considered as an independent business operation. There are three fishing organizations that use the title of 'fishery company' but they reflect group economic history, and currently act more like small-scale local fishermen's fellowships or fishing vessel associations. These companies don't have a legal infrastructure or own vessels, so they don't directly control catch.

Key crab fishermen/leaders from the fishery did participate in the inaugural fishery improvement workshop in 2016 in Dongshan and voiced their support for effort. However, given the large numbers of vessels registered in the fishery, some increased organization among fishermen would be beneficial to coordinate and support fishery improvement actions on the water. Our current assessment suggests that procurement policies of processing enterprises might not be expected to strongly influence the vessel owner's behavior in the immediate term, largely due to the large numbers of small vessels that do not have direct sales agreements with processors but use middlemen-brokers as discussed above. It is likely also impractical at present because market demand for red swimming crab is high so processors in the near-term may be reluctant to implement restrictive buying practices if they are not able to meet order volume needs.

These circumstances are expected to shift as the sustainability efforts progress in the fishery. In the meantime, because of the top down nature of government authority in China, government involvement and outreach to fishermen will likely be an important enabling and motivating factor for their organized involvement in the fishery, especially if we can successfully leverage government investments and incentives. One idea that we have discussed is a government led effort to help the fishing industry organize its role in fishery improvement efforts such as catch data collection, and believe that the processors' influence with the government to support such an idea could be an important motivating factor.

5.4 Science institutes

Science and research institutes have an important role to play in the project. Because much of their work is guided by government priorities and funding, a direct connection exists between leveraging government management commitment and the necessary science support to implement sustainability improvements. Our experience to date also suggests that university students may provide the most economical source of data collection in the initial stages of



improvement work, especially related to dockside catch monitoring or fishery observation. While these relationships will need further cultivation for the project, we do have good relationships currently with the Chinese Academy of Fisheries Sciences (CAFS) and Shanghai Ocean University (SHOU). While CAFS wouldn't play a direct role on the ground with action plan implementation, it could be an important partner in economically convening science workshops when useful and helping engage member research institutes in project activities.

Regarding Shanghai Ocean University Professor Yi Tang is currently an advisor to the selection of provincial fishery pilots to demonstrate national management reform and will be accompanying us on an upcoming site visit to Dongshan as part of our effort to advocate selection of red swimming crab as the Fujian pilot.

While O2 expects to bring its own science and fisheries management expertise to the project, one of its envisioned roles in assisting the project's management is to organize delivery of priority inputs from Chinese and international science and management experts necessary to implement the FIP action plan once finalized.

5.5 US red swimming crab importers

The Red Crab subgroup of NFI's Crab Council is clearly a motivating and enabling stakeholder for the project essential for the FIP's launch and progress. The key roles for NFI will continue to be:

- financial support for the project
- key local catalyst on the ground – industry leadership and coordination
- core partner organizing and leadership role with CAPPMA and O2
- supply chain demand for Chinese partners to meet FIP commitments, including engagement in annual stakeholder meetings
- joint fundraising with O2 and other project partners

NFI members are in an ideal position to request their Chinese crab processors and suppliers (mostly ZAPPMA members) to support efforts of crab stock/fishery monitoring and research efforts for the purpose of guiding the development of customized, sustainable management measures. Because of the Chinese industry's strong connection to government fisheries authorities, NFI's supply chain influence has an important link to influencing government investment in the project, including laws and regulations required for ultimate sustainability improvement outcomes. NFI's participation in and contribution to the annual all-stakeholder FIP workshop will be an important, visible indication of NFI's commitment. And sharing the NFI Crab Council's sustainability experience in SE Asia will contribute to effective development of the Zhangzhou RSC FIP.

In addition to these key roles, we would like to emphasize the extraordinary value that NFI's local industry coordinator, Ian Chen, has been playing on the ground in China. He has extremely strong relationships with seafood industry representatives in Dongshan and the broader region, which was demonstrated by his instrumental role in organizing the inaugural



stakeholder workshop for the project in 2016. His continued active role in collaborating with the project team will be extremely important for ensuring the FIPs successful implementation and progress.

5.6 O2

O2's key role in the developing improvement effort is underpinned by the organization's fishery management and sustainability improvement expertise, which is anchored by its experienced and knowledgeable staff in China. The latter includes the leadership of Songlin Wang, China Program Director, and the recent addition of Fenjie Chen, China Fisheries Program Manager, who has undergraduate and graduate fisheries training in both China and Japan, and before coming to O2, had practical experience on the ground with government fisheries institutes in China. Qing Fang, who has been serving as a part-time consultant for O2 with his uniquely rich work experience with CAPPMA, the Fishery Bureau of Ministry of Agriculture and MSC, has been contributing invaluable knowledge on the supply chain and insights about how to engage Chinese government and industry stakeholders. The China team has the key support of Dr. Jocelyn Drugan, O2's Analytics Team Director and Fishery Scientist, and Rich Lincoln, O2 Founder and Senior Advisor, who has over 40 years of relevant fisheries management experience. The involvement of these key staff reflect O2's deep commitment to the red swimming crab FIP's successful implementation and conduct.

Beyond this current scoping and project organizing effort, O2 envisions continuing to play a central role in FIP implementation through collaborative project management support locally with ZAPPMA, engagement with fishery participants, and coordination with other project partners and stakeholders. O2 would use its key relationships with government, industry and other stakeholders to help fundraise, leverage science and manage inputs to the project and work closely with project partners to help ensure accountability to improvement commitments.

5.7 Other NGOs

A variety of international and Chinese NGOs have useful enabling roles in the FIP moving forward. These involve helping support funding needs for implementation and also collaborating on fishery improvement needs within China that might cross species in order to gain efficiencies through aligned efforts. An example of the latter might include aligning red swimming crab and loligo squid efforts in Fujian Province to the extent that coordinated actions to build catch monitoring and data collection or changes in fisheries management systems might dovetail. O2 has had some initial discussions with SFP and China Blue about this idea. Also both WWF and MSC have a presence in China, and O2 would anticipate seeking their support of the FIPs implementation.



5.8 FIP implementing mechanisms

5.8.1 FIP management approach

Considering the key stakeholders and their important roles in the red swimming crab FIP described above, we envision a project management ‘structure’ with its relationships and interactions as pictured in Fig. 13. As part of an active project management and support role on the ground with ZAPPMA, O2 envisions a frequent presence locally and active, regular communications with key project partners and stakeholders.

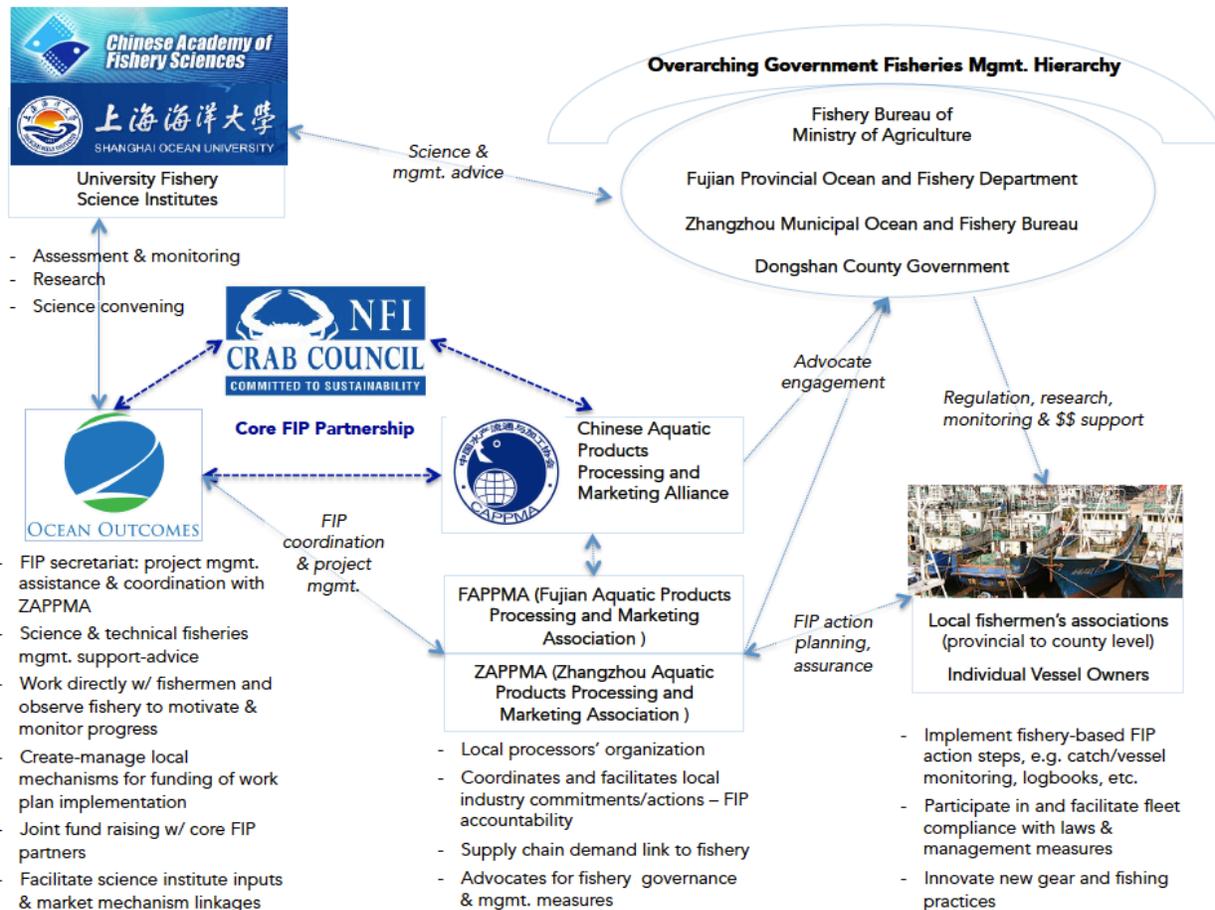


Figure 13. Zhangzhou red swimming crab fishery improvement stakeholders, roles and relationships.

5.8.2 Annual stakeholder convening

Besides the active project management and regular communications identified above, FIP implementation envisions key stakeholder workshops to be held annually in Zhangzhou to review progress, update plans, and ensure project commitments of key partners are discussed



and reinforced. The important inaugural stakeholder workshop was held in July 2016 and was instrumental in solidifying key understanding of the sustainability issues in the fishery and generating strong interest to initiate a FIP.

The workshop was the genesis for recommendations of project structure and stakeholder relationships recommended in Fig. 13. Convened by CAPPMA, ZAPPMA, NFI CC and O2, participating stakeholders also included municipal and county government officials, NFI Red Crab Group members, over 20 Zhangzhou processors, ten leading representatives of local crab fishermen and MSC (Fig. 14). There was a strong consensus on the necessity and urgency to improve the management of the swimming crab resource in Minnan-Taiwan Bank.



Figure 14. Inaugural, July 2016 red swimming crab FIP stakeholder workshop, Dongshan, China.

Local representatives indicated strong support for the idea that the red swimming crab FIP might be chosen as a pilot for implementing the new Chinese national policy to demonstrate fisheries management reform while also indicating an intent to solicit essential government involvement in the project. The industry expressed the belief that the FIP could help differentiate the sustainability leadership role of Dongshan fisheries.

With respect to respective implementation roles and responsibilities the idea for strong local leadership centered around a lead coordinating role for ZAPPMA and possibly a Council of leaders from different participating organizations to ensure careful planning, accountability and priority use of resources. Local stakeholders expressed an outstanding need for local, part-time technical project management support on the ground.

The inaugural workshop also explored financing future improvements after launch using a multi-prong funding approach that would include NFI, Chinese government, local processors, and



foundation sources. Following the workshop O2 helped Dr. Cui at CAPPMA construct a proposal for initial government seed funding in 2017 and beyond, but it was not immediately successful due to project's pre-implementation status and delays regarding decisions on a fishery demonstration pilot for Fujian Province.

6. Draft work plan and launch

6.1 Initial work plan framework

The gap analysis and fishery improvement needs assessment in Section 4 provide the basis for developing a FIP work plan for the project. We provide a preliminary summary draft of the first 5-yr, Phase 1 work plan in Appendix 1. This draft is consistent with the work plan concepts discussed at the July 2016 Dongshan stakeholder workshop, but provides more specificity on potential action steps and timelines. The purpose of this first draft is to create the basis for further planning and co-design with project partners in order to finalize a more detailed action plan, which if successfully implemented, would result in fishery performance that would be consistent with an unconditional pass of the MSC standard, which has been an essential goal identified by NFI. The work plan template in Appendix 1 also contains the more detailed structure that the final work plan will take, but that detailed step is being retained for the process of reaching final agreement among FIP partners once the decision to move to launch has been made.

6.2 Implementation strategy and approach

For the initial five years of the red swimming crab FIP, we have scoped a project implementation strategy and budget for two components: (1) day-to-day project management and (2) on-the-water improvement actions.

6.2.1 Annual implementation support and project oversight

Stakeholder workshop discussions in Dongshan indicated the need for on-the-ground technical support in the region to help design specific fisheries management components, manage the project, provide verification that work plan measures are being effectively implemented, and to ensure that work contributions by various parties are occurring as planned. Under this scenario ZAPPMA would be the responsible 'implementing authority' and would be an important conduit to the industry and government to ensure their support of action plan measures, as identified in Fig. 13, but also supported by CAPPMA and FAPPMA in these efforts. A technical support person would work closely with ZAPPMA and would represent an investment by US importers to ensure their project investments have a high probability of meeting expectations.

We have estimated a requirement of 0.4 FTE for this role given the size and complexity of the project. As noted above O2 recently has added Fenjie Chen to its team to provide this capacity and has the other 0.6 FTE of his position covered by an opportune arrangement for assessment work with Seafood Watch that is ideally compatible for this dual role. Besides the experience noted above Fenjie has had on-the-ground experience designing the Loligo squid FIP in Guangdong Province and is ideally suited for this position. Under this scenario this would be a cost shared O2 position supported by SWF and NFI .



Discussions in Dongshan also highlighted the need and value of project management/oversight from an international improvement organization with strong fisheries science and management expertise to ensure the FIP meets international standards and commands credibility in the marketplace. O2's key roles of this function, besides supervising on-the-ground technical implementation staff, would be fundraising, leveraging necessary scientific and government investment, guiding work plan modifications and updates, developing communication updates on the project to support marketing objectives, and coordinating annual project review meetings to evaluate progress towards performance objectives and make annual course corrections. The O2 inputs to this oversight function would primarily entail modest time from Songlin Wang and small contributions by Jocelyn Drugan and Rich Lincoln.

We would propose that NFI's Red Crab Group fund these combined implementation support and project oversight costs to ensure the effective implementation and ultimate success of the FIP, which we roughly estimate to be \$56,000 annually for at least the first 5-year implementation phase. This estimate, based on our assessment of first year costs, would be refined through completion of the detailed 5-yr work plan.

6.2.1 Annual action plan improvements: on-the-water

As noted above a detailed work plan of improvement actions will be further fleshed out using the summary outline in Appendix 1 through co-design with project partners once a decision is made to formally launch the project. As highlighted these will include activities such as fishery monitoring, catch data system development, stock assessment, gear-fishery modification testing, and harvest strategy evaluation. To be refined through detailed work planning and adaptive project management, we believe these action implementation costs likely will range from \$75,000 to \$150,000 annually and expect that funding sources for these measures will include Chinese government, Chinese industry, foundations and NFI's RCG. As discussed above current efforts to position the FIP as a demonstration pilot for the new national policy mandate would help facilitate direct government investment in both regulatory change and implementing improvement actions through its research institutes, fishery incentives and other monetary inputs. Our goal would be for the NFI's Red Crab Group's contribution to the FIP's action plan items to be relatively modest, e.g., in the \$25,000 to \$50,000 range for the initial implementation years, thus representing a total annual NFI investment of \$81,000 - \$106,000 when including the project management and technical support role outlined in the previous section.

6.3 Next steps to FIP launch

A positive decision by NFI's Red Crab Subgroup to support the project is a necessary precursor to activate a suite of implementation commitments and agreements. While local Chinese stakeholder interest and commitment to the FIP is strong, the US market demand for a sustainable supply of Chinese crabmeat, and a willingness of US buyers via NFI to invest in the project en this occurs, is a clear catalyst and essential enabling condition.



Presuming the NFI does reach a positive decision to move ahead we would propose NFI and O2 enter into a new agreement as soon as possible to initiate the subsequent steps to launch and implement the FIP. These include the following:

- facilitating implementing MOUs/agreements
- finalizing the detailed 5-yr work plan and budget with project partners
- formalizing operating and oversight mechanisms
- continuing to work w/ partners to influence selection of RSC FIP as Fujian Province's national fisheries management reform pilot
- developing a communication plan with NFI and other partners, and
- creating a near-term joint fundraising strategy.

We view the current July - August 2017 timeframe as ideal for maintaining momentum and moving to the next steps for advancing the project's implementation. We have at least one site visit planned to Dongshan during July and August and stakeholder availability is typically highest during summer fishery closure period. We believe that it would be feasible to formally launch the FIP in October 2017 if the necessary decisions and steps outlined above progress without undue delay.