# **Terms of Reference**

# **Stock Assessment (WP 1-1)**

## **Introduction**

Red swamp crayfish harvested from the Doulong River in the Dafeng District supply Bakkavor and Lyons Seafood via local processor, Baolong. All wish to ensure supplies achieve the Marine Stewardship Council (MSC) sustainability standard.

A Fisheries Improvement Plan (FIP) has been developed (Poseidon, 2017) to address the shortcomings in information and management that were identified in pre-assessments undertaken in recent years (MRAG, 2016, SAI Global, 2014). The FIP includes the design and implementation of a stock assessment, supported by the necessary data collection, to inform the management of the fishery.

## **Objective**

The objective is to design, test and undertake an appropriate stock assessment for the Red Swamp Crayfish Fishery in Dafeng District that will meet or exceed the MSC Principle 1 standard requirements[[1]](#footnote-1).

## **Background**

Red swamp crayfish (*Procambarus clarkii*) was introduced in China in 1929. Since then, it has been farmed on a relatively small scale, as the species was treated as an invasive species and pest. 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. In many regions crayfish are cultured using a crayfish-crop rotation strategy.

Most crayfish production is reported to occur in the lower regions of the Yangtze River, mostly in the Jiangsu Province. Wild caught crayfish account for a small portion of the total Chinese production. Each year, approximately 50,000 t of wild-caught crayfish is produced. By way of comparison, in 2014 the total production of farmed crayfish in China was 569,661 t (FAO, 2017). Dafeng City catch records show that total regional landings in 2015 were around 12,000 t, of which around 4,000 t was purchased by Baolong itself, with the rest going to local sales. Dafeng District production comes from 500 licensed fishermen operating in the Doulong River and associated channels. Around 10% of fishermen supply Baolong.

Crayfish in the Dafeng region are fished using fixed cages and shrimping (Fyke type) nets and the regulations specify a minimum mesh size of 2 cm. No bait is used in the fishery. Gear is typically fished for 24 hours (less often in summer when the water temperature is higher and the crayfish actively foraging for food) and retrieved before re-setting. These are often tied to stakes to the riverbed and fished from small wooden one or two person-operated boats.

Red swamp crayfish can now be considered a naturalized species in a number of regions of China (Li et al, 2012) and is now described as both economically and socially accepted or indeed, important (as a food and for export revenue). Eradication is not an option and could potentially lead to greater negative environmental impacts.

## **MSC Standard for Introduced Species**

As red swamp crayfish is an introduced species MSC’s Annex SD: Introduced Species Based Fisheries (ISBF) – Normative in the Fisheries Certification Methodology version 2 (MSC, 2014). The key elements to note here are:

* It is important to consider the ecological role of this introduced species in the assessment (and therefore this Action plan)
* It is possible to make modifications to the scoring issues at PI 1.1.1 for fisheries that include setting target reference points at levels which may be lower than Maximum Sustainable Yield (MSY) as a deliberate measure to allow for reduced biodiversity impact. This said, it is not possible to accept limit reference points set at levels below which there is an appreciable risk of impairing reproductive capacity.
* It may be necessary to put measures in place in the fishery to prevent further ecosystem impacts that may have occurred as a result of the introduction of red swamp crayfish under the Ecosystem component of Principle 2. These might include:
  + Setting target reference points at levels that allow for recovery of species impacted by the introduction,
  + Containment measures such as fishing down at the boundaries of the stock to prevent further spread,
  + Protection and/or creation of faunal refugia,
  + Provisions in legislation to prohibit further introductions of any other alien species.
  + Other relevant mechanisms.
* It may be necessary to define a corresponding Ecosystem Information scoring issue that addresses the collection of information important to understanding and preventing further progression of impact of the introduced species on biodiversity.

## **Specific Requirements**

The specific requirements under this contract are to:

**a. Review Available Data**

Conduct a review of the detailed data with the objective of ensuring the data are suitable for stock assessment. The review should check for errors and ensure appropriate patterns are present that indicate the data are suitable for stock assessment. The review should consider whether any estimates of total are valid, whether the data are suitable for estimating an abundance index and estimating stock structure (age, size, sex). The review should identify appropriate stock assessment models that can be used for analyses.

The consultant will review the fishery monitoring programme in place in the fishery to ensure it is fit for purpose in delivering data to inform stock assessment on an ongoing basis.

Prepare graphs and simple analyses to report on the available information. It is expected that the assessment will be based on fishery-dependent data. The report should recommend further data collection if necessary.

1. **Define the stock unit for assessment.**

Based on a review of available information from earlier reports and MSC standard requirements, propose the most suitable stock unit for the assessment giving clear justification for the unit proposed. Assess how complimentary this stock unit is to the management unit (the Dafeng District Crayfish Fishery, the currently proposed Unit of Assessment) and identify any implications for management and data collection.

1. **Undertake a stock assessment**

Based on the data review above, use identified stock assessment methods to derive determine stock status based on well-defined target and limit reference points for the stock unit. This must meet the MSC standards for stock assessment (achieving SG80 for 1.2.4). The assessment model should be able to test different HCR through simulation.

1. **Test proposed Harvest Control Rules and tools**

Harvest Control Rules (HCRs) and tools should be identified by the stakeholders that are appropriate to the fishery, i.e. are effective, workable and enforceable. The HCRs are likely to relate to a management of effort to influence Catch Per Unit Effort (CPUE).

HCRs will be discussed and proposed by fishery stakeholders.

The agreed HCRs should then be evaluated to confirm that they are appropriate to the Harvest Strategy, i.e. that they will enable the fishery to meet the target reference points.

1. **HCR and data collection capacity building**

*[additional component – costs to be presented separately to other components]*

The intention is for a robust stock assessment process to be developed and implemented in the fishery. Capacity building may be required to maintain adequate data collection activities in future years.

If the selected consultant is external to the regional scientific advisors, they are asked to provide a costing for the training of local scientists in the stock assessment model used and required data collection. This will ensure local scientists can conduct annual assessments by using the model and provide the necessary advice to fishery managers.

## **Outputs**

The required outputs are:

* a final report describing the rationale for stock unit, reference point and assessment model choices. It will provide clear and concise Harvest strategy, HCRs and fishery monitoring for inclusion in the Crayfish Fishery Management Plan.
* A functioning stock assessment model in R

## **Timescale**

The final outputs are to be delivered within five months of contract award.

## **Resource Needs and Budget**

Consultant profile: An experienced international stock assessment specialist with experience of assessing water crustacean species, especially in fresh waters.

Provisional budget:

1 days fees @ £600/day £10,200

International travel £2,000

Overnight costs (Shanghai) 3 nights @ £125 £375

Overnight costs (Dafeng) 5 nights @ £40 £200

Translation £400

**TOTAL £13,175**

1. See MSC Fisheries Standard Requirements v2.0, October 2014. [↑](#footnote-ref-1)