ASC SHRIMP STANDARD REVISION

Freshwater Crustacean Species – Metric Revision
Metric Analysis

March 2020

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Purpose

The purpose of this document is to present the acquired data for the revision of the ASC Shrimp Standard v.1.1. in order to include freshwater crustaceans within the Standard. This document will be used for the decision-making process within the revision of the metric performance indicators, and where relevant to propose species specific metrics.

Background

The ASC Shrimp Standard v.1.1 is based on the anterior work of the Shrimp Aquaculture Dialogue (ShAD) and sets requirements that define what has been deemed 'acceptable' levels as regards the major social and environmental impacts of saltwater shrimp farming. The purpose of the ASC Shrimp Standard was and is to provide means to measurably improve the environmental and social performance of shrimp aquaculture operations worldwide. The Standard currently covers species under the genus *Penaeus*[1] and is oriented towards the production of *P. vannamei*[2] and *P. monodon.*

A Gap Analysis was conducted by the ASC in order to assess the possibility of adding freshwater crustaceans to the ASC Shrimp Standard within the scope of the Shrimp revision process. As a result of the gap analysis and further discussion with stakeholders, it was decided to add the crayfish species *Cherax spp., Procambarus spp., Astacus spp.;* and the freshwater shrimp *Macrobrachium spp.* to the standard.

Producer Countries and Volumes

The information in this section is based on the FAO Fishery and Aquaculture Statistics 2016 (FAO, 2018a) and species factsheets for *Cherax quadricarinatus* (FAO, 2016a)*, Procambarus clarkii* (FAO, 2016b) and *Macrobrachium rosenbergii* (FAO, 2016c). This provides background information as to why the inclusion of these freshwater crustaceans is of relevance to the ASC. A more detailed analysis can be found in the Gap Analysis referred to above.

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[1]The ASC's Technical Advisory Group (TAG) supported in November 2019 the proposal that based on recent research re. phylogenetic analyses of several shrimp within the family Penaidae, the *Penaeus* genus should be used to define all potential new saltwater shrimp species. This also means that from the Shrimp Standard Review's public consultation of March 2020, references to the 'Litopenaeus' genus will be removed and replaced by 'Penaeus', and/or used interchangeably. Notably, the Whiteleg shrimp *may* be referred to by ASC as 'Penaeus (Litopenaeus) vannamei' – or 'P. vannamei' – and if so: this latter species refers to the same as the one listed in the scope of the Shrimp Standard v1.1 as 'Litopenaeus vannamei' or 'L. vannamei'.

[2] Ibid.

The FAO production statistics are shown in Figure 1. The production of *Cherax quadricarinatus* is highly fluctuating and estimated to currently be 305 tonnes per annum with the main producer country being Australia. The main producers of *Procambarus clarkii* are the United States, China and Italy with a total production volume in 2016 of 919,887 tonnes. *Astacus spp.* are so far produced only in very few countries, with a total yearly production volume of 144 tonnes. However, the interest in the latter species is increasing, especially by RAS[3] farms in Europe, where the species is considered endangered (Seemann et al., 2015).

The production of *Macrobrachium rosenbergii* has been fluctuating slightly in the last 15 years with currently 233,898 tonnes production volume. Main producer countries are, China, Bangladesh, Thailand and Myanmar. Production volumes for *Macrobrachium nipponense* are within the same order of magnitude, with 272,592 tonnes produced in 2016 (mainly in China). Other species of the same genera are produced in low in production volumes, but steadily increasing.

[3] **RAS**: Recirculating aquaculture systems

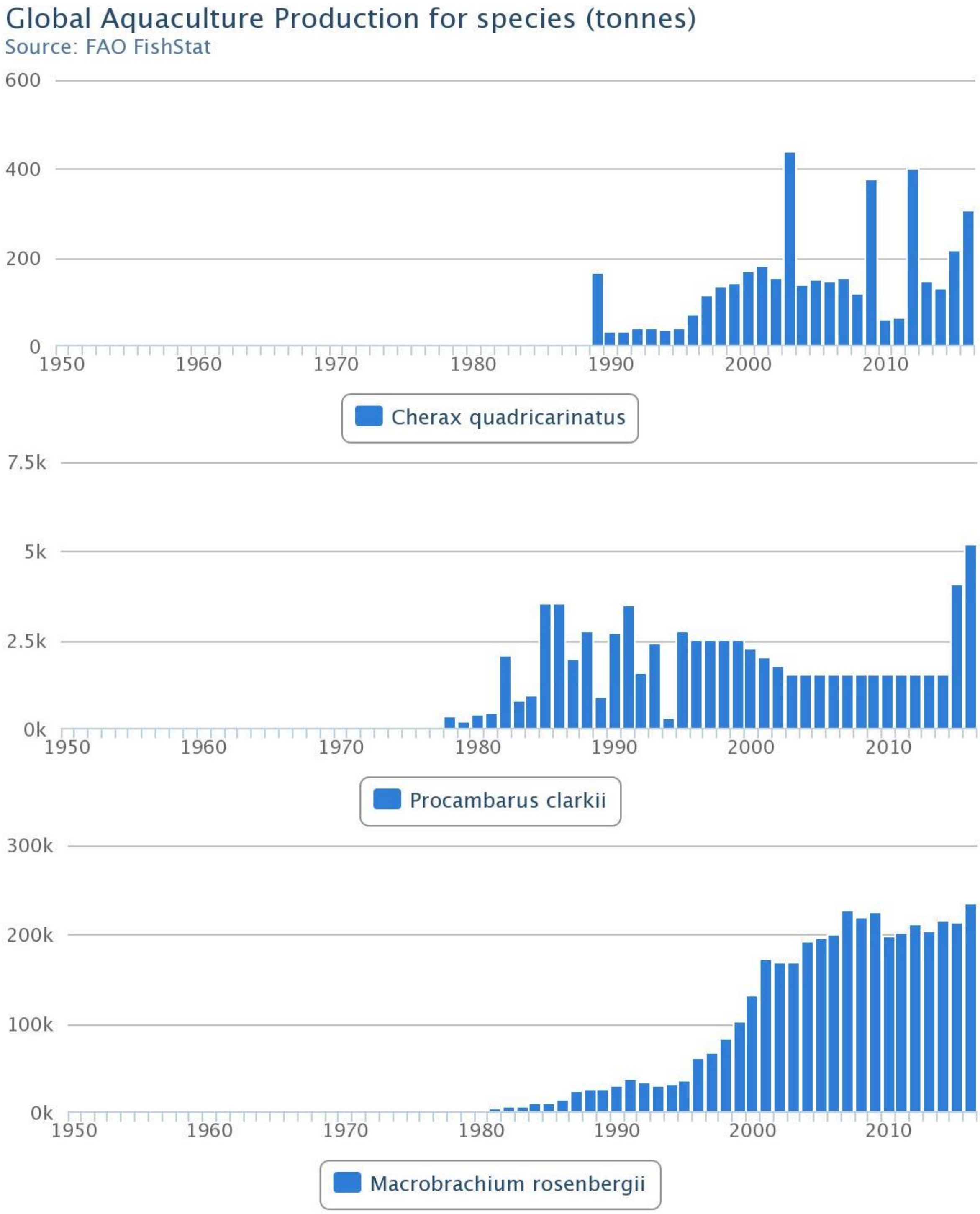

Figure 1: Global Aquaculture Production of *Cherax quadricarinatus, Procambarus clarkii* and *Macrobrachium rosenbergii*

Corresponding Metrics

The ASC Shrimp Standard covers seven principles regarding legal regulations, environmentally suitable sighting and operation, community interactions, responsible operation practices, shrimp health management, stock management and resources use.

Principles are then divided into different criteria and indicators, each with qualitative or quantitative requirements. Indicators with a corresponding metric requirement are listed in Table 1 below. Indicators relating to feed use (origin of fishmeal, fish oil and non-marine ingredients) are excluded from Table 1 as they will be/are covered in the forthcoming ASC Feed Standard.

Table 1: Species specific indicators within the ASC Shrimp Standard v.1.1

Indicator	Requirement	Metric	Additional Information
2.5.3	Water-specific conductance or chloride concentration in concentration in freshwater wells used by the farm or located on adjacent properties	< 1,500 mhos (conductance) Or < 300 mg/L chloride	For all freshwater wells
5.1.3	Annual average farm survival rate (SR) 1) unfed and non-permanently aerated pond 2) fed but non-permanently aerated pond 3) fed and permanently aerated pond	1)>25% 2)>45% 3)>60%	
5.1.4	Percent of stocked lost larvae that are specific pathogen free (SPF) of specific pathogen resistant (SPR) for all important pathogens	100%	If commercially available
6.2.2	Percent of total post larvae from closed loop hatchery	100%	Reachable within 6 years after publication of the ASC Shrimp Standard **(2020)**
7.4.1	Feed Fish Equivalence Ratio (FFER)	1.35:1 1.9:1	*P. vannamei* *P. monodon*
7.4.2 a	Economic feed conversion ratio (eFCR)		Records available
7.4.2 b	Protein retention efficiency (PRE)		Records available
7.5.1	Nitrogen effluent per tonne of shrimp produced over a 12-month period	<25.2 kg/T <32.4 kg/T	*P. vannamei* *P. monodon*
7.5.2	Phosphorous effluent per tonne of shrimp produced over a 12-month period	<3.9 kg/T <5.4 kg/T	*P. vannamei* *P. monodon*
7.5.4	Treatment of effluent water from permanently aerated ponds; concentration of settleable solids	<3.3 mL/L	Evidence that discharge water goes through a treatment system
7.5.5	Percentage change in diurnal DO relative to DO at saturation in receiving water body for the water's specific salinity and temperature	<65%	

The ASC Shrimp Standard does not yet provide a threshold for eFCR and the protein retention efficiency (PRE) but requires the farmer to provide the records for the data within the audit. The Rationale of Criterion 7.4 states that the PRE "*is a relatively undocumented parameter in the field*, [thus] *the ShAD has preferred not to set a requirement at this stage. This is a starting point on a critical issue and ASC will be able to set a requirement as information is collected and if it proves to be a useful indicator of responsible shrimp production"*. The PRE or PPV (protein productive value) evaluates the conversion efficiency of protein in the feed into body protein.

Data Collection – Sample Size

Within the revision of the ASC Shrimp Standard v1.1 data from non-certified farms as well as literature data will be taken into account. The data obtained will then be compared and used to set the new metric requirements within the revised standard. In order to determine the correct sample size a power analysis[4] was undertaken for the metric revision of the saltwater shrimp species based on the knowledge from ASC certified farm data and a first literature review.

The power analysis and sample size determination has been conducted using R. Standard deviation within samples was estimated using data from the ASC certified farms. Standard deviation between samples was estimated based on the average of ASC certified farms and the average in the literature, based on an initial literature review. Significance level (type I error (α)) was set to 0.05 and the power (type II error (β)) was set to 80% based on the suggestions by Cohen (1992).

The full results can be found in the Data Overview report for the metric revision of the saltwater shrimp species *P. vannamei* and *P. monodon*. As a result, the sample size was set at n = 40 per indicator with a minimum sample size of n = 10 per specific species. Data collection should be equally spread among the main producer countries.

Non-certified Farms

In order to set metric performance limits for freshwater crustacean species within the ASC Shrimp Standard, it is crucial to check the performance of non-certified farms. A request for data from non-certified farms has been published on the website and social media and send to stakeholders via email in December 2019.

No datasets have been received so far but work is ongoing, and this section (Table 2) will be filled-in as soon as data becomes available.

[4] Power analysis is described in more detail by Cohen (1992).

Table 2: Data from non-certified farms.

Indicator	Requirement	Value	Sample Size	Remarks
2.5.3	Water-specific conductance (< 1,500 mhos)			
	Chloride concentration (< 300 mg/L)			
5.1.3	Annual average farm survival rate unfed and non-permanently aerated pond (>25%) fed but non-permanently aerated pond (>45%) fed and permanently aerated pond (>60%)			
5.1.4	SPF or SPR larvae (100%)			
6.2.2	PL from closed loop hatchery (100%)			
7.4.1	Feed Fish Equivalence Ratio (FFER)			
	(*Cherax spp.*)			
	(*Procambarus spp.*)			
	(*Astacus spp.*)			
	(*Macrobrachium spp.*)			
7.4.2 a	eFCR (*Cherax spp.*) (*Procambarus spp.*)			
	(*Astacus spp.*)			
	(*Macrobrachium spp.*)			
7.4.2 b	Protein Retention Efficiency (PRE) (*Cherax spp.*)			
	(*Procambarus spp.*)			
	(*Astacus spp.*)			
	(*Macrobrachium sp.p*)			
7.5.1	Nitrogen effluent (*Cherax spp.*) (*Procambarus spp.*)			
	(*Astacus spp.*)			
	(*Macrobrachium spp.*)			
7.5.2	Phosphorous effluent (*Cherax spp.*) (*Procambarus spp.*)			
	(*Astacus spp.*)			
	(*Macrobrachium spp.*)			
7.5.4	Concentration of settleable solids (<3.3 mL/L)			
7.5.5	Percentage change in diurnal DO (<65%)			

Literature Research

The global (all species) aquaculture production has risen continuously in the last decades and was at a total of 80.031 million tonnes in 2016 with about 7.862 million tonnes of crustaceans (FAO, 2018b). In 2016 about 72,000t of shrimp were certified under the ASC Shrimp Standard. The amount tripled to about 224,500t as of February 2020[5].

Shrimp and prawn farming has been identified as one of the aquaculture practices with the greatest environmental impact (Hall et al., 2011). It is thus paramount to drive the shrimp aquaculture industry towards more environmentally sustainable and responsible practices. Farming of freshwater crustaceans is often seen more positive as it does not cause salinisation of soil and water and is usually practiced extensively, thus having a reduced impact on the environment (Kutty, 2005). However, freshwater crustaceans are not covered under the scope of the ASC Shrimp Standard v1.1.

Literature is available on all species of interest. Survival rates being cited are often higher than those observed in the realm of commercial production for both crayfish and crawfish; this is probably due to the fact that they are often kept individually for research experimentation purposes.

[5] Based on ASC audit reports (asc-aqua.org). See ASC Certification Update February 2020: https://mailchi.mp/c8978ec37674/xr162vrjvq-2692789

Table 3: Data from scientific Literature

Indicator #	Requirement	Value	Sample Size	Remarks
2.5.3	Water-specific conductance	No data		
	Chloride concentration	No data		
5.1.3	Annual average farm survival rate *Cherax spp.*			
	A: unfed and non-permanently aerated pond	63.5 ± 7.8	n = 2	Only one study
	B: fed but non-permanently aerated pond	54.0 ± 21.9	n = 27	
	C: fed and permanently aerated pond	81.3 ± 10.2	n = 40	
	Annual average farm survival rate *Procambarus spp.*			
	A	No data		
	B	No data		
	C	89.7 ± 6.7	n = 32	
	Annual average farm survival rate *Astacus spp.*			
	A			
	B	79.7	n = 1	
	C	86.1 ± 27.8	n = 4	
	Annual average farm survival rate *Macrobrachium spp.*			
	A	No data		
	B	60.8 ± 11.0	n = 24	
	C	81.6 ± 13.4	n = 24	
5.1.4	SPF or SPR larvae (100%)	No info		
6.2.2	PL from closed loop hatchery (100%)	No info		
7.4.1	Feed Fish Equivalence Ratio (FFER)			
	(*Cherax spp.*)	3.4 ± 2.6	n = 49	Based on standard formula and provided FCR
	(*Procambarus spp.*)	2.1 ± 1.0	n = 12	
	(*Astacus spp.*)	No data		
	(*Macrobrachium spp*)	3.0 ± 1.4	n = 37	
7.4.2 a	eFCR			
	(*Cherax spp.*)	3.4 ± 2.2	n = 49	25th Percentile: 1.44
	(*Procambarus spp.*)	1.4 ± 0.2	n = 12	
	(*Astacus spp.*)	No data		
	(*Macrobrachium spp*)	3.0 ± 0.9	n = 37	
7.4.2 b	Nrotein retention efficiency (PRE)			
	(*Cherax spp.*)	No data		PER 2.3 ± 0.7
	(*Procambarus spp.*)	42.5 ± 2.5	n = 2	
	(*Astacus spp.*)	No data		
	(*Macrobrachium spp*)	16.9 ± 1.6	n = 5	PER 1.9 ± 1.0
7.5.1	Nitrogen effluent			
	(*Cherax spp.*)			
	(*Procambarus spp.*)			
	(*Macrobrachium spp*)			
	(*Astacus spp.*)			
7.5.2	Phosphorous effluent			
	(*Cherax spp.*)			
	(*Procambarus spp.*)			
	(*Astacus spp.*)			
	(*Macrobrachium spp*)			
7.5.4	Concentration of settleable solids			
7.5.5	Percentage change in diurnal DO	40.0 ± 21.1	n = 9	Data from *Macrobrachium*

The following articles and papers have been consulted in order to obtain the data cited above in Table 3. No paper provided information for all indicators in the ASC Shrimp Standard; and some did not yield any useful information. Data for *Cherax spp.* mainly came from Australia and the US, as well as Mexico, Ecuador and Israel. Data for *Procambarus spp.* was very limited and came mainly from China and Mexico with one study from the US. Only two helpful studies covering *Astacus spp.* were identified, focusing on RAS and pond farming in Germany and the Czech Republic. The main data source for *Macrobrachium spp.* was from Asia, mainly Bangladesh, India and few from Malaysia. Additional data came from Mexico and Egypt.

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Recommendations

As previously mentioned in the 'Corresponding Metrics' section, the inclusion of some of the indicators in the current Shrimp Standard revision has not been deemed relevant as they are currently covered by the (forthcoming) ASC Feed Standard (Re. indicators 7.2.1a, 7.2.1b, 7.2.2).

Requirements for SPF larvae and origin of PL (5.1.4, 6.2.2) should also stay at '100%'.

The new metric indicators for freshwater species within the revised ASC Shrimp Standard will be informed by Table 4, which provides a summary of available data; and shows the average and quartiles (Q[6]) (either Q_1 (lowest 25%) or Q_3 (highest 25%), depending on the requirement[7]).

Requirements for water specific conductance or chloride concentration in wells are not necessarily applicable for most freshwater crustacean farms, but when applicable should be audited similarly to saltwater species. Furthermore, the literature showed relatively high survival rates for all freshwater species for all production system types. It is thus recommended to set the same SR values for freshwater species as for the saltwater species.

Based on the similarities identified in the literature research and the Gap Analysis it is being proposed to use the same metrics for *Cherax spp., Procambarus spp.* and *Astacus spp.* This decision is not final and can be re-assessed on the basis of incoming data resulting from the public consultation. The decision should also be revisited with each metric Revision, as more data becomes available.

Limits on nitrogen and phosphorous effluents are calculated from the FFER using the same factor as for *P. vannamei* in the ASC Shrimp Standard v.1.1.

The protein retention efficiency (PRE) is a measure of the amount of protein provided in the feed that is retained in the harvested shrimp. The ASC Shrimp Standard v1.1 requires farmers to record PRE values and that those be made available for the ASC to collect data and potentially frame this into a new requirement within the remit of the Shrimp Standard revision. As PRE data availability for all above-mentioned species is currently scarce, it is being recommended to keep this as a "records are available" indicator/requirement for the freshwater shrimp species.

[6] **Q_1 = 1st Quartile, Q_3 = 3rd Quartile**; the first quartile is defined as the middle number between the median of the dataset and the smallest number, the third quartile is defined as the middle number between the median of the dataset and the highest number in the dataset.

[7] Indicators with a requirement above a certain metric limit (e.g. survival rate) show the data for the 3rd Quartile, whereas indicators with a requirement below a certain metric limit (e.g. FFER) show the data for the 1st Quartile.

Table 4: Summary of Data and Recommendation for new Metrics

Indicator #	Requirement	Non-certified Farm		Literature		Proposed Requirement
		Average	Q	Average	Q	
2.5.3	Water-specific conductance	No data				Same values as saltwater shrimp
	Chloride concentration	No data				
5.1.3	Annual average farm survival rate *Cherax spp.*					Same values as saltwater shrimp
	A			63.5 ± 7.8	66.3	
	B			54.0 ± 21.9	68.0	
	C			81.3 ± 10.2	85.7	
	Annual average farm survival rate *Procambarus spp.*					
	A			No data		
	B			No data		
	C			89.7 ± 6.7	99.3	
	Annual average farm survival rate *Astacus spp.*					
	A					
	B			79.7		
	C			86.1 ± 27.8		
	Annual average farm survival rate *Macrobrachium spp.*					
	A			No data		
	B			60.8 ± 11.0		
	C			81.6 ± 13.4		
7.4.1	Feed Fish Equivalence Ratio (FFER)					
	(*Cherax spp.*)			3.4 ± 2.6	1.4	1.4
	(*Procambarus spp.*)			2.1 ± 1.0	1.1	
	(*Astacus spp.*)			No data		
	(*Macrobrachium spp.*)			3.0 ± 1.4	2.1	2.1
7.4.2 a	eFCR					
	(*Cherax spp.*)			3.4 ± 2.2	1.4	Recording
	(*Procambarus spp.*)			1.4 ± 0.2	1.3	
	(*Astacus spp.*)			No data		
	(*Macrobrachium spp*)			3.0 ± 0.9	2.4	
7.4.2 b	Protein Retention Efficiency (PRE)					
	(*Cherax spp.*)			No data		Recording
	(*Procambarus spp.*)			42.5 ± 2.5	43.8	
	(*Astacus spp.*)			No data		
	(*Macrobrachium spp*)			16.9 ± 1.6		
7.5.1	Nitrogen effluent					
	(*Cherax spp.*)					26.1
	(*Procambarus spp.*)					
	(*Astacus spp.*)					
	(*Macrobrachium spp*)					39.2
7.5.2	Phosphorous effluent					4.0
	(*Cherax spp.*)					
	(*Procambarus spp.*)					
	(*Astacus spp.*)					
	(*Macrobrachium spp*)					6.1
7.5.4	Concentration of settleable solids					Same values as shrimp
7.5.5	Percentage change in diurnal DO			40.0 ± 21.1	21.6	Same values as shrimp

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