<u>STATUS REPORT</u>

Chaceon erytheiae

Common Name: Deep-sea red crab

FAO-ASFIS Code: GER

2015

Updated: 30-Sep-15

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1. Description of the fishery

1.1 Description of fishing vessels and fishing gear

Data within the SEAFO database indicate that the deep-sea red crab (DSRC) resource has been utilized by two nations primarily, Namibia and Japan. The Namibian-flagged vessel, *FV Crab Queen 1*, known to fish crab in the SEAFO CA is a 49.61m, 1989-built steel vessel with an onboard holding capacity of 610m^3. The vessel can process on average 1200 traps (i.e. three sets with 400 traps each) per day.

During 2005 an older Japanese-flagged vessel, *FV Kinpo Maru no. 58*, conducted crab fishing activities in the SEAFO CA. This vessel was built in 1986, is 62.60m in length and has an onboard holding capacity of 648m^3. The *Kinpo Maru*, however, was replaced by the *FV Seiryo Maru* which is 37.06m in length, was built in 1987 and has an on-board holding capacity of 289 m^3.

The Namibian and Japanese vessels' gear setup (set deployment & design) are very similar. Both vessels use the same type of fishing gear – known as Japanese beehive pots (Fig. 1). The beehive pots are conical metal frames covered in fishing net with an inlet shoot (trap entrance – Fig. 1) on the upper side of the structure and a catch retention bag on its underside. When settled on the seabed the upper side of the trap are roughly 50cm above the ground ensuring easy access to the entrance of the trap. The trap entrance leads to the kitchen area of the trap – which is sealed off by a plastic shoot that ensures all crabs end up in the bottom of the trap.

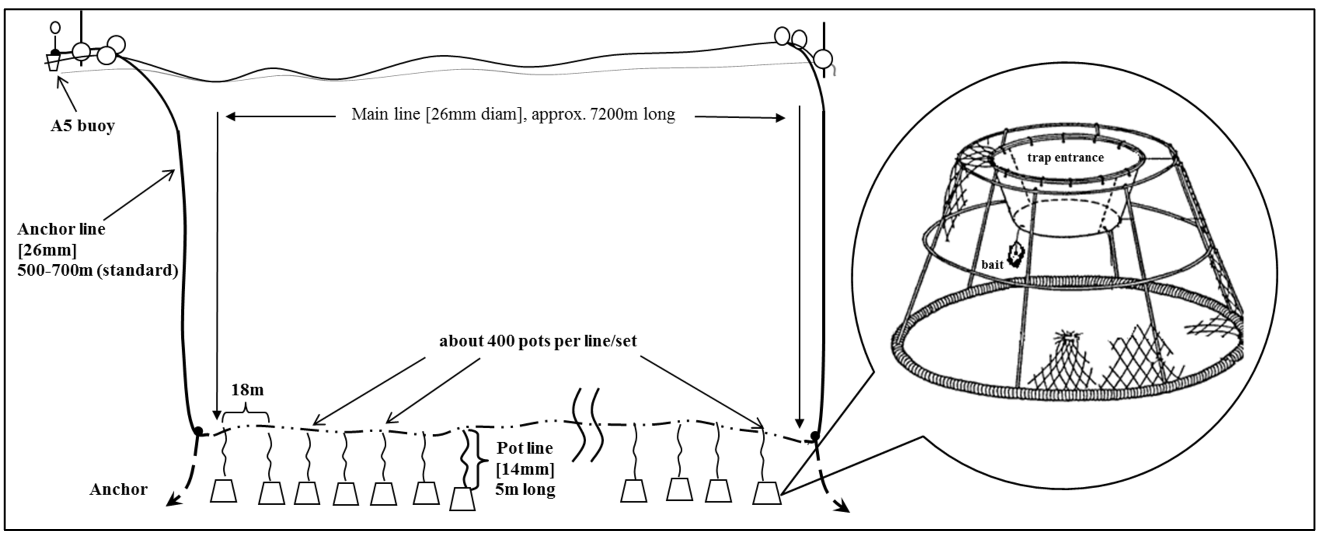

Figure 1: Deep-sea red crab fishing gear setup (set deployment and design) and illustration of a Japanese beehive pot (shown in enlarged form on the right).

One set or pot line consists of about 200-400 beehive pots, spaced roughly 18m apart, on a float line attached to two (start & end) anchors for keeping the gear in place on the seabed (Fig. 1). The start & end points of a set are clearly marked on the surface of the water with floats and one A5 buoy that denotes the start of a line. Under this setup (i.e. 400pots at 18m intervals) one crab fishing line covers a distance of roughly 7.2km (3.9nm) on the sea floor and sea surface.

1.2 Spatial and temporal distribution of fishing

In the SEAFO Convention Area fishing for deep-sea red crab is focussed mainly on *Chaceon erytheiae* on Valdivia Bank – a fairly extensive seamount that forms part of the Walvis Ridge (Fig. 2-6). This seamount is located in Division B1 of the SEAFO CA and has been the main fishing area of the crab fishery since 2005 when the resource was accessed by Japan. Records from the SEAFO database indicate that fishing for crab in this area occurred over a depth range of 280-1150m.

Table 1: The total number of sets from which deep-sea red crab catches were derived for the period 2010-2015.

2010	2011	2012	2013	2014	2015
181	133	129	103	107	73

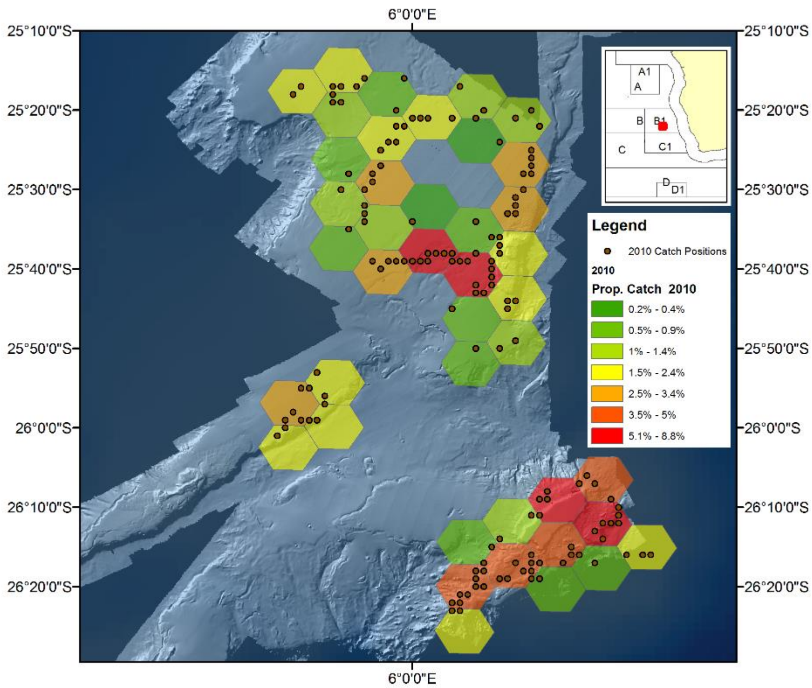

Figure 2: The 2010 catch distributions for deep-sea red crab in Division B1 aggregated to a 10 km^2 hexagonal area.

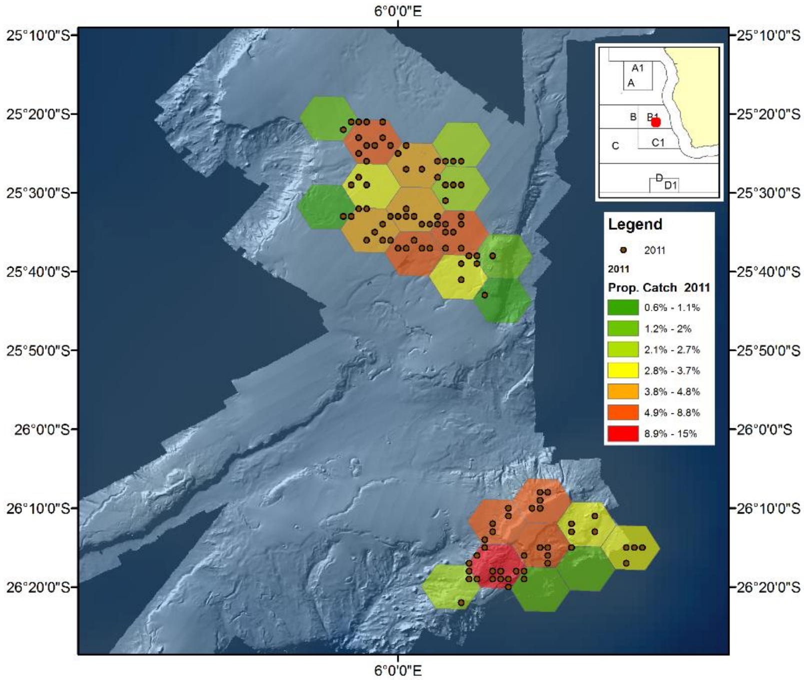

Figure 3: The 2011 catch distributions for deep-sea red crab in Division B1 aggregated to a 10 km^2 hexagonal area.

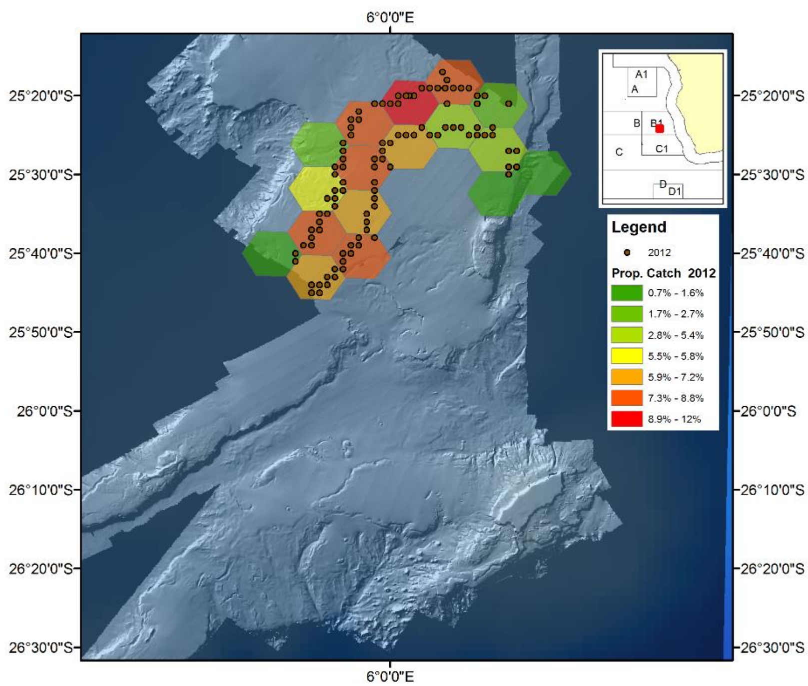

Figure 4: The 2012 catch distributions for deep-sea red crab in Division B1 aggregated to a 10 km^2 hexagonal area.

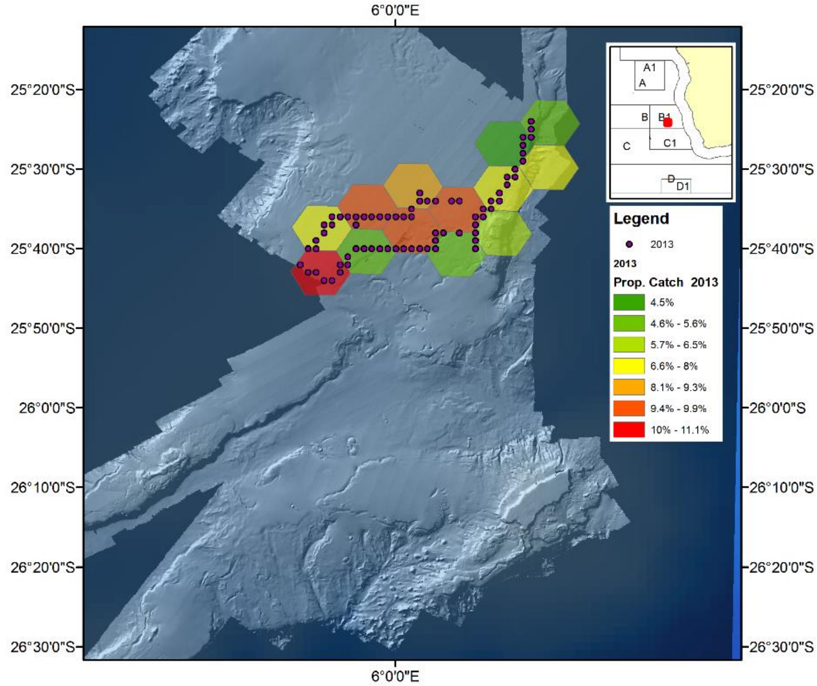

Figure 5: The 2013 catch distributions for deep-sea red crab in Division B1 aggregated to a 10 km^2 hexagonal area.

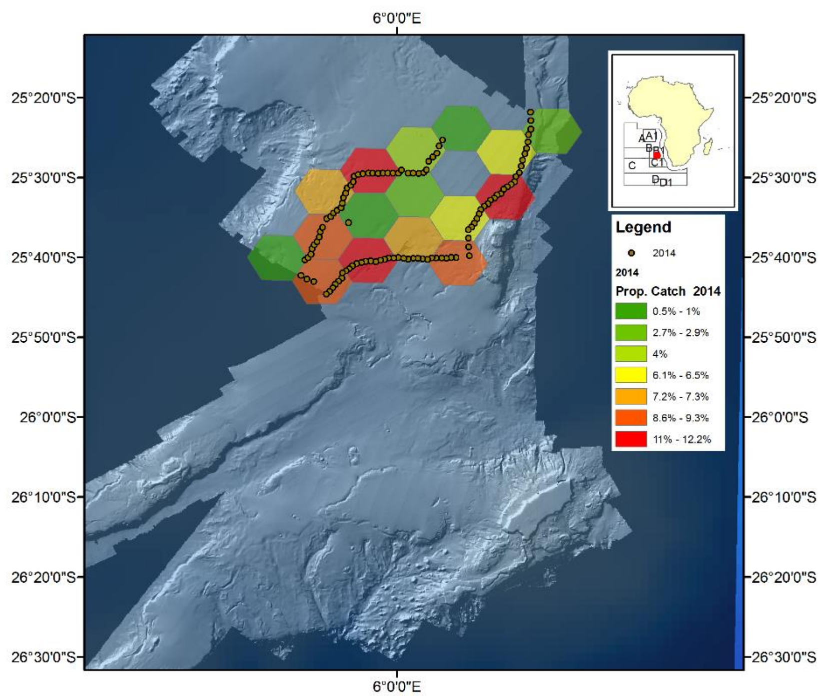

Figure 6: The 2014 catch distributions for deep-sea red crab in Division B1 aggregated to a 10 km^2 hexagonal area.

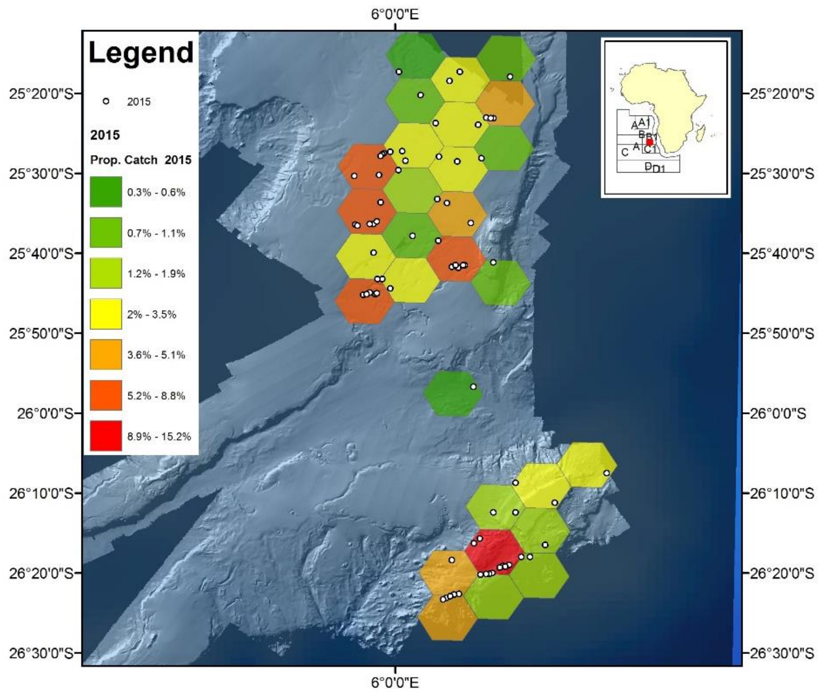

Figure 7: The 2015 catch distributions for deep-sea red crab in Division B1 aggregated to a 10 km^2 hexagonal area.

1.3 Reported landings and discards

Reported landings (Table 2) comprise catches made by Japanese, Namibian, Spanish, Portuguese and Korean-flagged vessels over the period 2001-2015. As is evident from Table 2 the two main players in the SEAFO crab fishery are Japan and Namibia, respectively, with Spanish and Portuguese vessels having only sporadically fished for crab in the SEAFO CA over the period 2003 to 2007. Spanish-flagged vessels actively fished for crab in the SEAFO CA during 2003 and 2004, whereas Portuguese-flagged vessels only fished for crab once during the 2007 season (Table 2).

Table 2: Catches (tonnes) of deep-sea red crab (*Chaceon spp*. – considered to be mostly *Chaceon erytheiae*).

Nation	**Japan**		**Korea**		**Namibia**		**Spain**		**Portugal**	
Fishing method	**Pots**		**Pots**		**Pots**		**Pots**		**Pots**	
Management Area	**B1**		**B1**		**B1**		**UNK**		**A**	
Catch details (t)	**Ret.**	**Disc.**	**Ret.**	**Disc.**	**Ret.**	**Disc.**	**Ret.**	**Disc.**	**Ret.**	**Disc.**
2001			N/F	N/F			<1			
2002			N/F	N/F						
2003			N/F	N/F			5			
2004			N/F	N/F			24			
2005	253	0	N/F	N/F	54					
2006	389		N/F	N/F						
2007	770		N/F	N/F	3	0			35	
2008	39		N/F	N/F						
2009	196		N/F	N/F	N/F	N/F	N/F	N/F	N/F	N/F

2010	200	0	N/F	N/F			N/F			
2011	N/F	N/F	N/F	N/F	175	0	N/F	N/F	N/F	N/F
2012	N/F	N/F	N/F	N/F	198	0	N/F	N/F	N/F	N/F
2013	N/F	N/F	N/F	N/F	196	0	N/F	N/F	N/F	N/F
2014	N/F	N/F	N/F	N/F	135	0	N/F	N/F	N/F	N/F
2015*	N/F	N/F	104	0	N/F	N/F	N/F	N/F	N/F	N/F

* Provisional (September 2015) Ret. = Retained Disc. = Discarded
N/F = No Fishing.
Blank fields = No data available.
UNK = Unknown.

Being a pot fishery, the deep-sea red crab fishery has an almost negligible bycatch impact. To date only 5kg of teleost (Marine nei and European sprat) fish discards have been recorded, during 2010, from this fishery. As of 2010, however, minimal to moderate bycatches of king crabs have also been recorded from this fishery (see Section 5.3 for additional information).

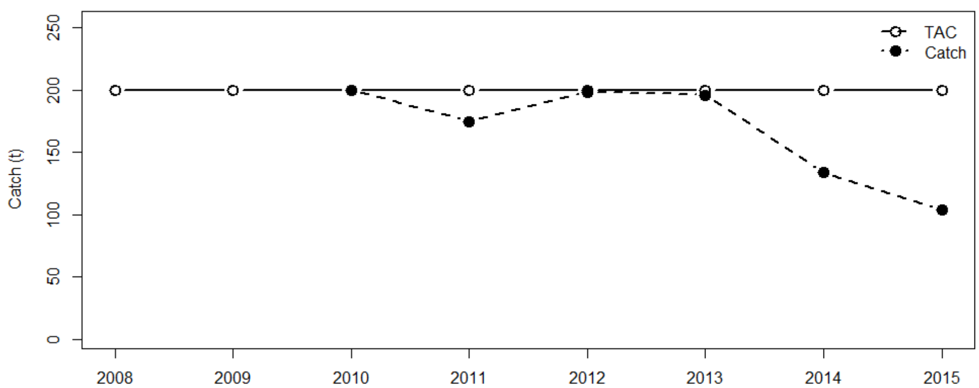

Figure 8: Annual catches in relation to TAC for Deep-Sea Red Crab in Division B1. No catches were taken elsewhere in the SEAFO CA.

1.4 IUU catch

IUU fishing activity in the SEAFO CA has been reported to the Secretariat latest in 2012, but the extent of IUU fishing is at present unknown.

2. Stock distribution and identity

One species of deep-sea red crab has been recorded in Division B1, namely *Chaceon erytheiae* (López-Abellán *et al*. 2008), and is thus considered the target species of this fishery. Aside from the areas recorded in catch records the overall distribution of *Chaceon erytheiae* within the SEAFO CA is still unknown. Further encounter records documented through video footage during the 2015 FAO-Nansen VME survey in the SEAFO CA indicate that deep-sea red crab are distributed across a major part of the Valdivia seamount range, as well as the Ewing and Vema seamounts (DOC/SC/22/2015).

Preliminary results from genetics studies, based on Mitochondrial DNA, indicate that the deep-sea red crab targeted by the pot fishery on the Valdivia Bank is confirmed as *C. erytheiae* (López-Abellán *pers. comm.*).

3. Data available for assessments, life history parameters and other population information

3.1 Fisheries and surveys data

Fishery-dependent data exist only for more recent years (2010-2014) of the SEAFO deep-sea red crab fishery (Fig. 7). Biological data from the fishery comprise gender-specific length-frequency, weight-at-length, female maturity and berry state data (Table 3).

Table3: Illustration of sampling frequencies (2010-2015) from the deep-sea red crab commercial fleet within the SEAFO CA.

	2010	**2011**	**2012**	**2013**	**2014**	**2015**
Total Number of Sets	181	133	120	103	107	74
Crabs Sampled per Set	30	30	30	30	100	136
Total Crabs Sampled	5430	3990	3600	3077	10654	32500

Very limited fisheries-independent data on deep-sea red crabs exists for the SEAFO CA. A total of 479 deep-sea red crabs were sampled during the 2008 Spanish-Namibia survey on Valdivia Bank. The data was collected over a depth range of 867-1660m. Additionally 127 deep-sea red crab samples were collected onboard the *RV Fridtjof Nansen* during the SEAFO VME mapping survey conducted at the start of 2015 (DOC/SC/22/2015).

3.2 Length data and frequency distribution

Available length-frequency data for crabs caught in the SEAFO CA over the period 2010-2014 are presented in Figure 8. Length-frequency data from all areas sampled in Division B1 were pooled as no significant differences were detected between areas.

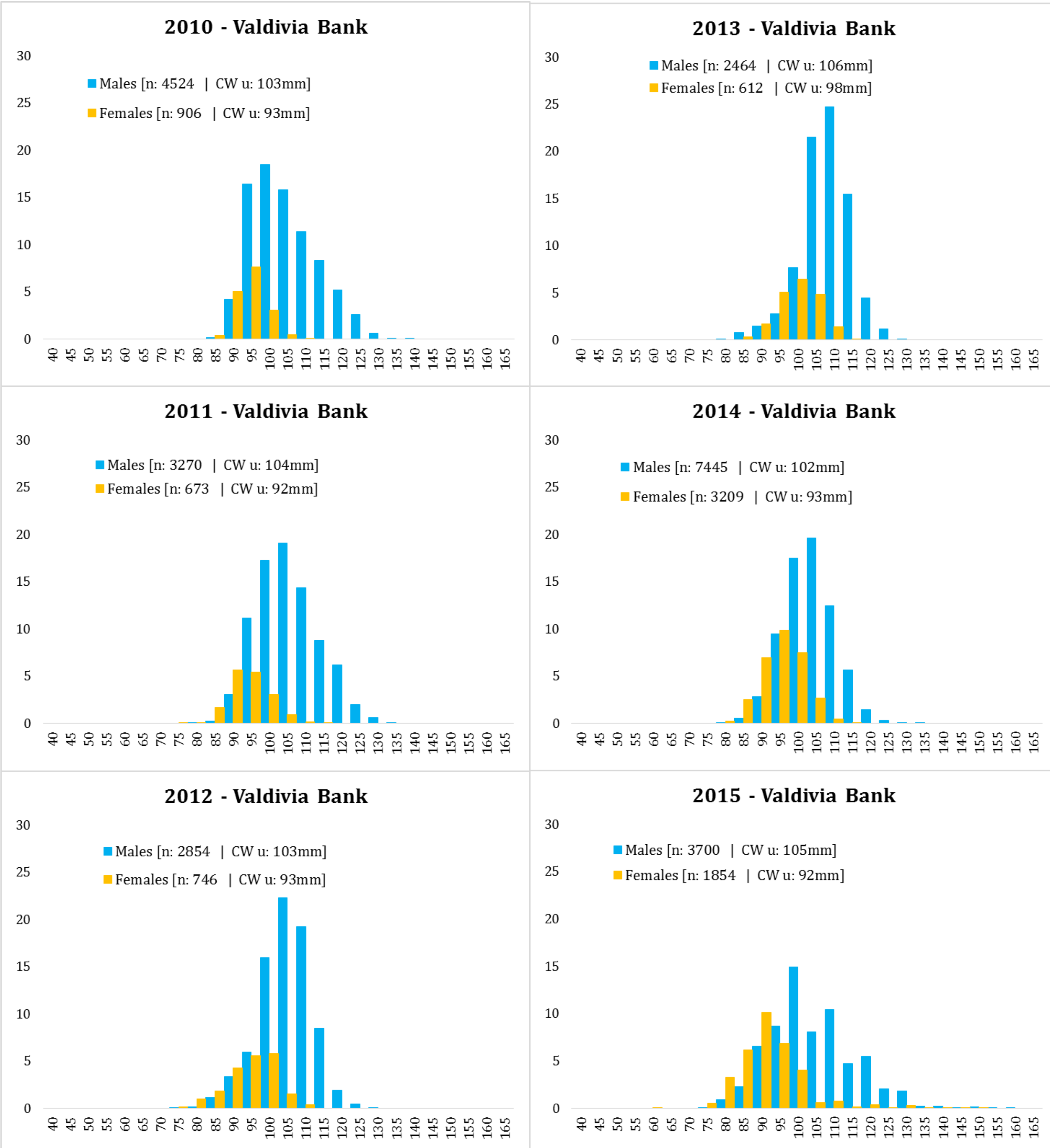

Figure 8: Carapace width (mm) frequencies (in percentages) of crabs sampled from commercial catches [2010-2015]. Notes: "n" refers to sample size; "u" refers to the carapace width arithmetic mean for each sample as indicated.

For the period 2010-2014 there have been no significant changes in the female crab size distribution (Fig. 8). The male crab size distribution changed from a wider size distribution in 2010 and 2011, where larger male crabs were recorded, to a slightly narrowed size distribution in 2012-2014 of smaller crabs. During 2015 a lot more female crabs larger than 110mm were recorded than any preceding years since 2010 (Fig. 8). Sex ratio from crab commercial samples fluctuated around 4:1 in favour of male crabs – a well-known bias of the commercial traps used in this fishery.

3.3 Length-weight relationships

Length-weight relationship derived from catches on Valdivia Bank reveal the gender-specific growth disparity (Fig. 9). Male crabs grow at a faster rate than females and thus attain much larger sizes than female crabs. This species attribute, however, is not unique to *Chaceon erytheiae* and has been recorded for other crab species in the *Chaceon* genus (Le Roux 1997). Data from the 2008 survey show a much more coherent length-weight relation for both male and female crabs (Fig. 10).

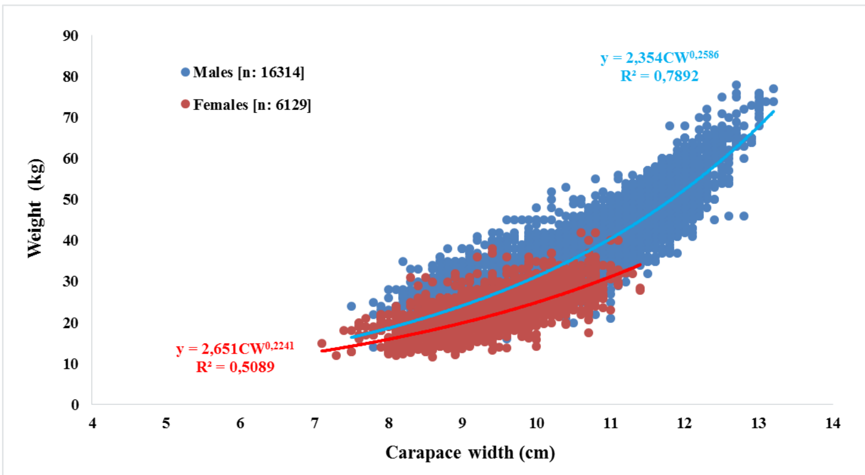

Figure 9: Length-at-weight data for *Chaceon erytheiae* as recorded from catches on Valdivia Bank (2008-2015). Red text show female length-weight relationship, blue text show male length-weight relationship.

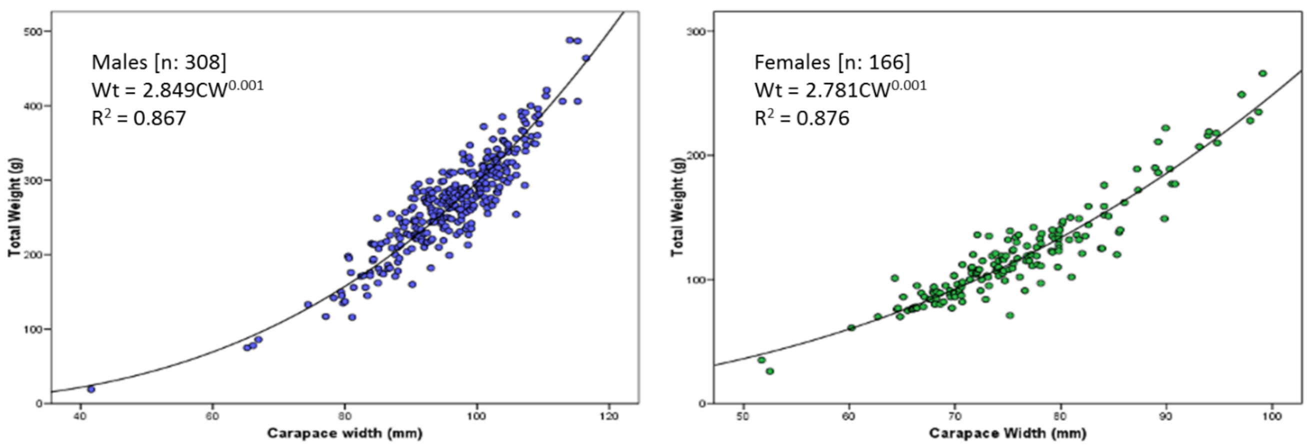

Figure 10: Length-at-weight data for *Chaceonerytheiae* as recorded from the 2008 Spain-Namibia survey (López-Abellán *et al*. 2008).

3.4 Age data and growth parameters

No information exists on the age and growth attributes of *Chaceon erytheiae*.

3.5 Reproductive parameters

Very limited reproductive data exist for *Chaceon erytheiae* from commercial samples. This dataset constitute female maturity and berry data collected during 2010-2015. However, the mating and spawning seasons for *C. erytheiae* within the SEAFO CA are still unknown.

3.6 Natural mortality

No natural mortality data exist for *Chaceon erytheiae*.

3.7 Feeding and trophic relationships (including species interaction)

No data exist for *Chaceon erytheiae*.

3.8 Tagging and migration

No data on migration exist for *Chaceon erytheiae* in the SEAFO CA.

4. Stock assessment status

4.1 Available abundance indices and estimates of biomass

Currently the only data available for the assessment for *C. erytheiae* abundance within the SEAFO CA are the catch and effort data from which a limited catch-per-unit effort (CPUE) series can be constructed.

4.2 Data used

The available SEAFO data (2005-2014) for purposes of considering possible assessment strategies are presented in Table 4.

Table 4: Description of the entire deep-sea red crab database highlighting important datasets.

Year	Flag State	Data Type - Source	Brief Description [NB Data Groups only]
2005	JPN	Catch Data – Observer Report	Set-by-Set data (vessel ID, set-haul positions & dates), Depth, Catch, Effort - (157 records).
2007	NAM	Catch Data – Observer Report	Set-by-Set data (vessel ID, set-haul positions & dates), Depth, Catch, Effort - (10 records - sets).
2010	JPN	Catch & Biological Data – Observer Report	Set data (vessel ID, set-haul positions & dates), Depth, Length, Weight, Catch, Effort - (Catch: 181 records, Biological: 5430 records).
2011	NAM	Catch & Biol. Data – Observer Report	Set-by-Set data (vessel ID, set-haul positions & dates), Depth, Length, Weight, Catch, Effort - (Catch: 133 records, Biological: 3990 records).
2012	NAM	Catch & Biol. Data – Obs. Report & Captain's Logbook [log sheet data]	Set-by-Set data (vessel ID, set-haul positions & dates), Depth, Length, Weight, Catch, Effort - (Catch: 129 records, Biological: 3600 records).

2013	NAM	Catch Data – Captain's Logbook [log sheet data]	Set-by-Set data (vessel ID, set-haul positions & dates), Depth, Catch, Effort - (Catch: 103 records, Biological: 3090 records).
2014	NAM	Catch Data – Captain's Logbook [log sheet data]	Set-by-Set data (vessel ID, set-haul positions and dates), Depth, Length, Weight, Catch, Effort – (Catch: 107 records, Biological: 10660 records)
2015	KOR	Catch Data – Fishing Logbook data	Set-by-Set data (vessel ID, set-haul positions and dates), Depth, Length, Weight, Catch, Effort – (Catch: 73 records, Biological: 5554 records)

4.3 Methods used

CPUE Standardization:

As part of the annual updating of the deep-sea red crab abundance index another attempt was made during 2015 at standardizing the CPUE index. With the agreement made in 2014 to use all available catch and effort data in the CPUE model, a problem was encountered with the soak time data recorded during 2015. Prior to 2015 the duration of time for which baited crab pots were left in the water during fishing operations (i.e. soaking time of baited crab pots), ranged between 11.7 and 99.5 hours with a mean of 25.1 hours (Table 5). However, during 2015 the soak time of baited traps during fishing operations changed drastically to a range of 93.7 and 233.5 hours with a mean of 120.8 hours. Out of the 73 sets recorded for 2015 only one set had a soak time of 93.5 hours, while 88% of the sets had soak times ranging between 100 and 117 hours; and the remaining 11% recorded soak times greater than 200 hours. This increase in the soak time during 2015 greatly reduces the annual CPUE when compared with other years as illustrated in Figure 11.

Table5: Comparison of "Soak Time" in hours as reported from the deep-sea red crab fishery for the period 2010 to 2015.

	2010-2014	**2015**
Minimum	11.7	93.7
1st Quantile	22.3	105.0
Median	23.0	108.3
Mean	25.1	120.8
3rd Quantile	23.6	113.5
Maximum	99.5	233.5

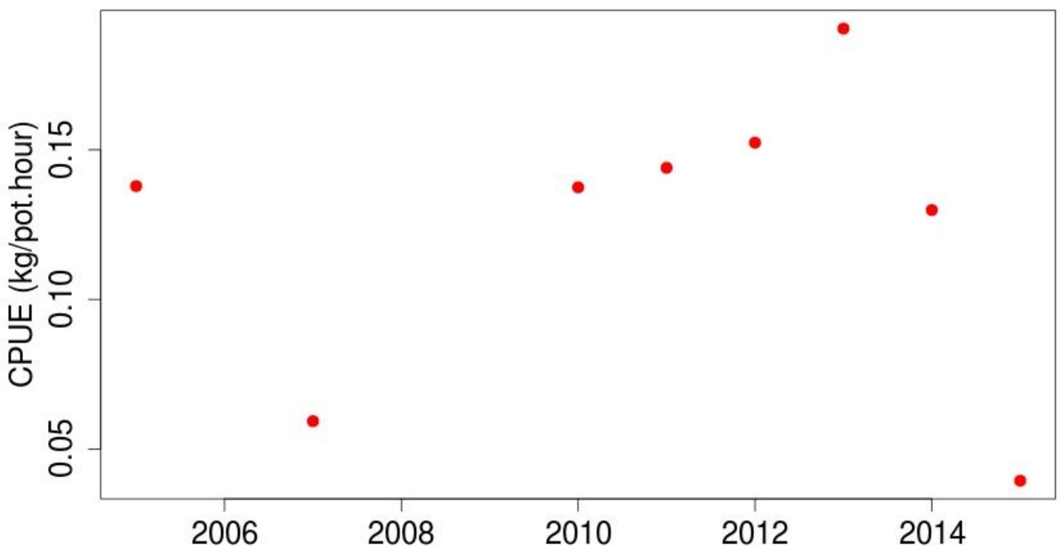

Figure 11: Nominal CPUE (base on "Soak Time") from the SEAFO deep-sea red fishery for the period 2005 to 2015.

To solve this problem one option would be to keep the range of soak times the same as that recorded during the pre-2015 years, which means removing all sets with soak times greater than 100 hours from the 2015 dataset. This option, however, was not feasible as it would mean removing 99% of the 2015 CPUE data – since all but one set had a soak time less than 100 hours. The second option was to define a normal distribution of soak times on the average soak time for which bait used in the fishery remains viable (i.e. the average amount of time bait remains in the trap before being consumed and/or disintegrating). From other crustacean fisheries it is known that bait usually only last for roughly 24 hours, and thus the defined soak time distribution would be similar to that recorded from the SEAFO crab fishery during the pre-2015 years. The final option was to exclude soak time from the calculation of CPUE, and to only consider the number of pots used during fishing operations. This was the approach used during the 2015 standardization of the annual CPUE from the SEAFO deep-sea red crab fishery.

Table 6: Description of the sets for which catch and effort data are available for the CPUE standardization.

2005	**2007**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**
157	10	181	133	129	103	107	73

The records from 2007 were excluded from the analysis as they were derived from an area not exploited in the remaining years and, constituting only 10 sets, were not comparable to datasets from the rest of the data series.

<u>The following variables from each record were considered in the model</u>:

Year - A 12-month period – explanatory variable (covariate).
Semester - A calendar semester in a fishing year – explanatory variable (covariate).
VesselID - Identification code for a participating vessel – explanatory variable (covariate).
Zone - Identification code for a fishing area – explanatory variable (covariate). Co-ordinates where categorized into three smaller fishing zones reflecting the fishing records within Division B1.
Depth - Fishing depth – explanatory variable (covariate). Depth was categorized into 50 metre intervals covering the entire range of depths recorded by the fishery.

Pots - The number of baited pots used per set during fishing operations – explanatory variable (co-variate).

CPUE - Catch/number of pots – response variable.

4.4 Results

Results from the CPUE standardization are presented below to illustrate some of the more important outputs and methods applied.

The maximum set of model parameters offered to the stepwise selection procedure was:

$$CPUE = \beta_0 + \beta_1 \text{ Year} + \beta_2 \text{ VesselID} + \beta_3 \text{ Depth} + \beta_4 \text{ Zone} + \beta_5 \text{ Semester} + \beta_6 \text{Pots} + \varepsilon$$

A stepwise backward model selection procedure was deployed in selecting the covariates, to the model. The model with lowest Akaike value (AIC - Akaike Information Criterion) was selected as the best model, since it has a better predictive power. The best model (outlined below) was then used for further analysis.

$$CPUE = \beta_0 + \beta_1 \text{ Year} + \beta_3 \text{ Depth} + \beta_4 \text{ Zone} + \beta_5 \text{ Semester} + \beta_6 \text{Pots} + \varepsilon$$

Table 7 presents the estimates of the coefficients, standard error and *t* values for different levels of the factors entered into the selected model. Model, covariate year, depth, semester and pots are very significant with p-values of $2.2*10^{-16}$, $1.546*10^{-9}$,$4.831*10^{-4}$and $4.138*10^{-8}$indicating strong covariance with deep-sea red crab catch rates. Zone, as a covariate, was also significant but to a lesser degree than the aforementioned variables.

Table 7: ANOVA results for the CPUE model.

Covariates	Df	Deviance	Residual Df	Residual Deviance	Pr(>Chi)
NULL			859	913.42	
Year	6	277.864	853	635.56	< 2.2e-16 ***
Depth	16	48.552	837	587.01	1.546e-09 ***
Zone	2	3.980	835	587.03	0.0470093 *
as.factor(SEMESTER)	1	7.928	834	575.10	0.0004831 ***
Pots	15	42.000	819	533.10	4.138e-08 ***

Signif. codes: 0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1

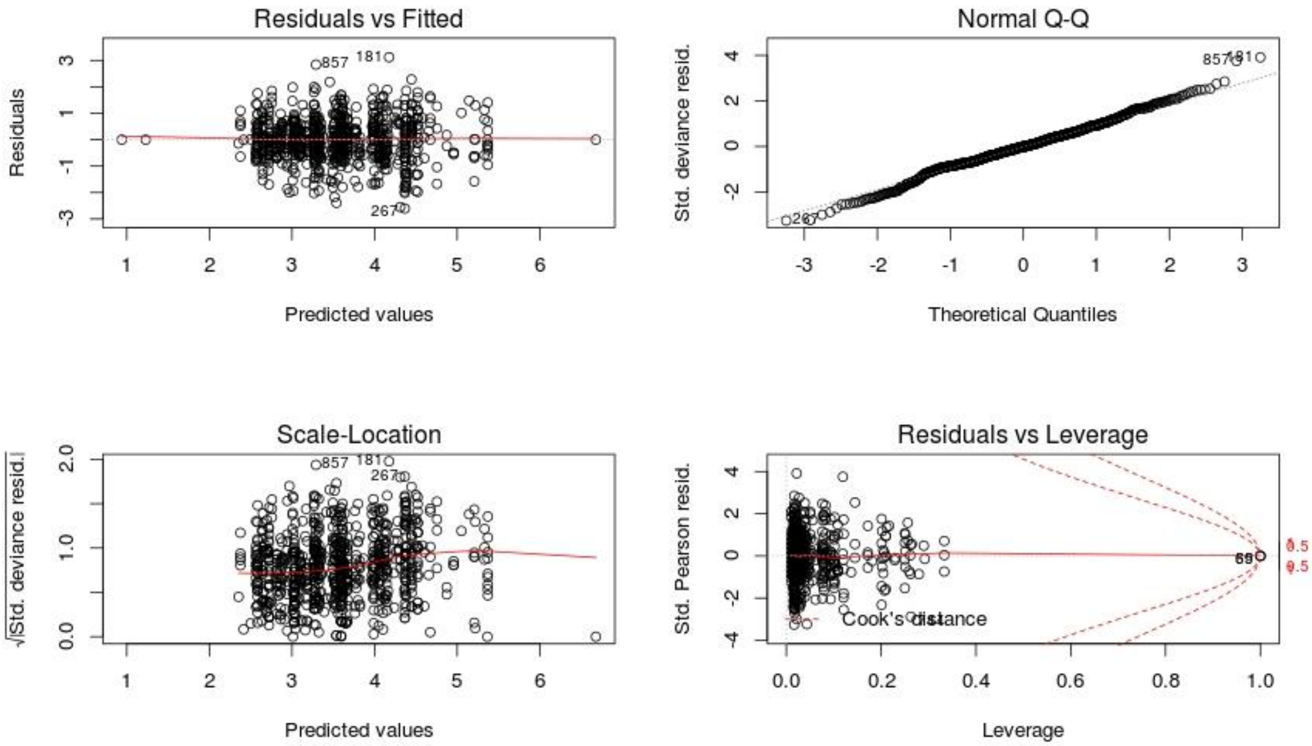

Figure 12: QQ and studentized residual plots of the best lognormal fit model for retained catch CPUE (kg/pot).

Model diagnostics of the best model were assessed. This involved checking for normality of the residuals and the spread of the residuals across the fitted values. A total of 23 outliers were removed (out of a total of 883 data points – i.e. outliers removed equates to 2.7% of entire dataset) on the basis of residual skewness and Cook's Distance disparity. After the removal of the outliers diagnostic plots revealed improve distributions thus indicating that model assumptions were not violated. QQplots of the residuals indicated that the model residuals were well within the excepted limits for data skewness (Fig. 12). Plots of the residuals versus fitted values indicated evenly distributed data points, no overridingly skewed patterns in the plot (Fig. 12). Therefore there is no evidence of non-constant error variance in the residual plot and independence assumption also appeared reasonable.

Results from the standardized CPUE exercise suggest that CPUE has fluctuated over a moderate range (of 0.248 and 5.108) during the period 2005 to 2015. However, the confidence margins are fairly wide for the main part of the CPUE series – which indicates that the CPUE hasn't change significantly over the period 2011-2015, with the exception of 2010 and 2014 undoubtedly (Fig. 13).

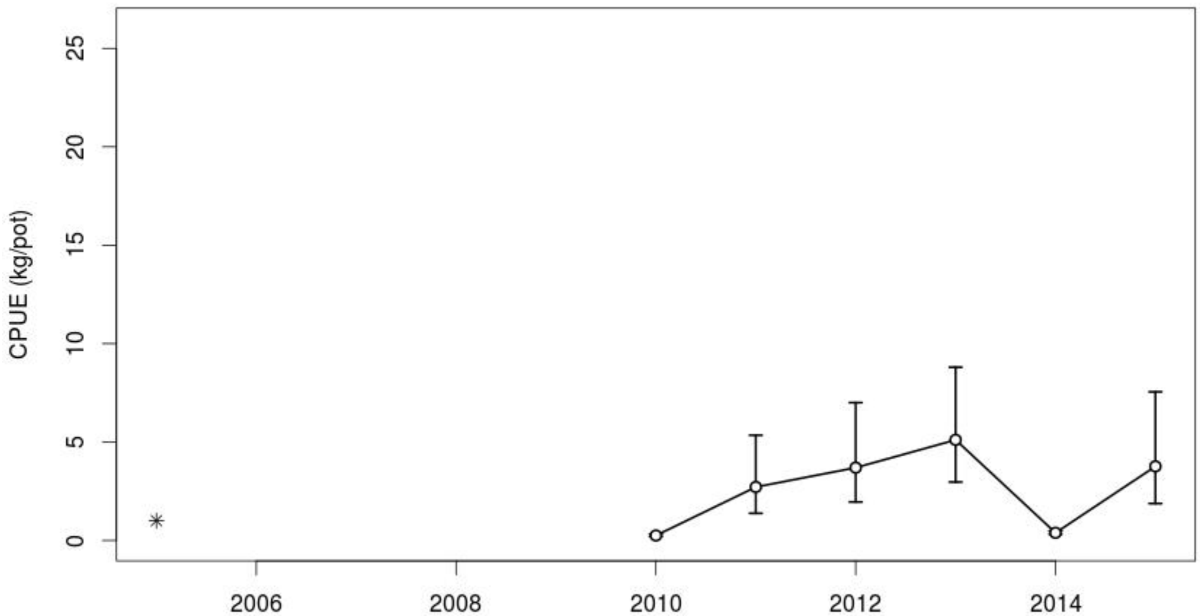

Figure 13: Trends in catch CPUE indexes for catches per pot-hour of crabs – with soak time as a categorical variable (factor). Standardized Index: black line with standard deviation (error bars).

4.5 Discussion

In light of new catch and effort data received from the deep-sea red crab fishery in 2015 another run on the standardization of crab CPUE series was conducted in 2015. In contrast to the CPUE standardization of 2014, soak time was not considered as a predictive variable or covariate in the GLM implemented during 2015. The reason for this were twofold:- firstly, the soak times recorded for the 2015 crab fishing operations were far in excess of those calculated for years prior to 2015; and secondly, there doesn't seem to be any correlation between the viability of bait and catch rates in the crab fishery that would necessitate the inclusion of soak time as a predictive variable in the CPUE standardization. For these reasons the CPUE calculated in 2015 for the crab fishery is referenced as "Kg/Pot" and not "Kg/Pot Hour" as was the case in 2014. The CPUE standardization revealed that, although the data series is very short, there was no severe changes in the CPUE trend since 2010 and that it is well within range of the 2005 CPUE.

In 2014 an exploratory Length Cohort Analysis (LCA) was conducted, and was found to be inconclusive but nevertheless indicated that the SEAFO deep-sea red crab resource is not in any risk of over-exploitation. This exploratory exercise was not repeated in 2015.

SC also noted that sampling on deep-sea red crab is quite good, but not all valuable data are available hence it is affecting our choice of an assessment method.

SC discussed in 2014 the possibility of applying the harvest rule and it was decided that the Greenland Halibut harvest control rule used in NAFO may be the most appropriate option for deep-sea red crab. This was adopted by the Commission in 2014.

In 2014 only near 50% of the TAC was caught. The reason for this is unknown to the SC.

4.6 Conclusion

The biological data series obtained from the SEAFO deep-sea red crab fishery, although short, is of relatively good quality. Nevertheless, important data such as growth parameter for the *C. erytheiae* stock, which will enhance the cohort analyses of the resource, was not available for the SEAFO CA and emphasis needs to be given in collecting this data for future assessments.

4.7 Biological reference points and harvest control rules

At this point in time it should be noted that no biological reference points exist for this stock in the SEAFO CA.

However, it is worthwhile to note that the *C. erytheiae* stock, based on the grounds of it being a long-lived and relatively stable stock, is a good candidate for an empirical Harvest Control Rule (HCR) similar to that applied to the Greenland halibut stock by the North Atlantic Fisheries Organization (NAFO). This is a simple HCR that merely considers that slope of an abundance index such as the CPUE and applies a catch limit to future years based in the current year's TAC. The concept is as follows:

$$TAC_{y+1} = \begin{cases} TAC_y \times \left(1 + \lambda_u \times slope\right) & if \quad slope \geq 0 \quad \textbf{...rule 1} \\ TAC_y \times \left(1 + \lambda_d \times slope\right) & if \quad slope < 0 \quad \textbf{...rule 2} \end{cases}$$

Slope: average slope of the Biomass Indicator (CPUE, Survey) in recent 5 years.

- λ_u :TAC control coefficient if slope > 0 (Stock seems to be growing) : λ_u=1
- λ_d :TAC control coefficient if slope < 0 (Stock seems to be decreasing) : λ_d=2
- TAC generated by the HCR is constrained to ± 5% of the TAC in the preceding year.

For the interim this is considered to be a fairly good starting point, given the current status of the *C. erytheiae* resource, until such time that additional data are available for more advance stock assessment approaches.

5. Incidental mortality and bycatch of fish and invertebrates

5.1 Incidental mortality (seabirds, mammals and turtles)

No incidental catches of seabirds, mammals and turtles have been recorded from the deep-sea red crab fishery to date.

5.2 Fish bycatch

Incidental and bycatch records from the deep-sea red crab fishery indicate that only one species is currently impacted by this fishery.

Table 6: Incidental (bycatch) catch from the deep-sea red crab fishery (kg).

	2009	2010	2011	2012
Species	**-**	**B1**	**-**	**-**
***MZZ**		5.23		

*** Marine Nei fishes (*Osteichthyes*)**

5.3 Invertebrate bycatch including VME taxa

Very limited bycatches of invertebrate and VME taxa have been reported from the SEAFO deep-sea red crab fishery. To date roughly 1343kg of King crab (*Lithodesferox* – KCA) bycatches been recorded from the deep-sea red crab fishery in Division B1 (Fig. 14). All these bycatches were made during 2015 only.

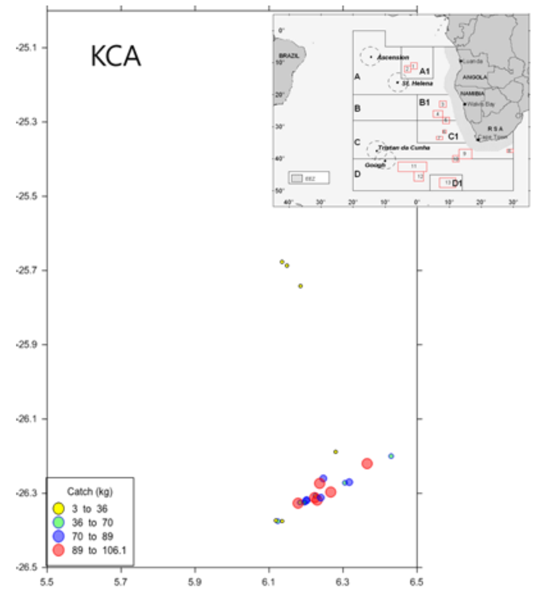

Figure 14: Spatial reference of King crab (*Lithodes ferox*) bycatches recorded from the deep-sea red crab fishery in Division B1 during 2015.

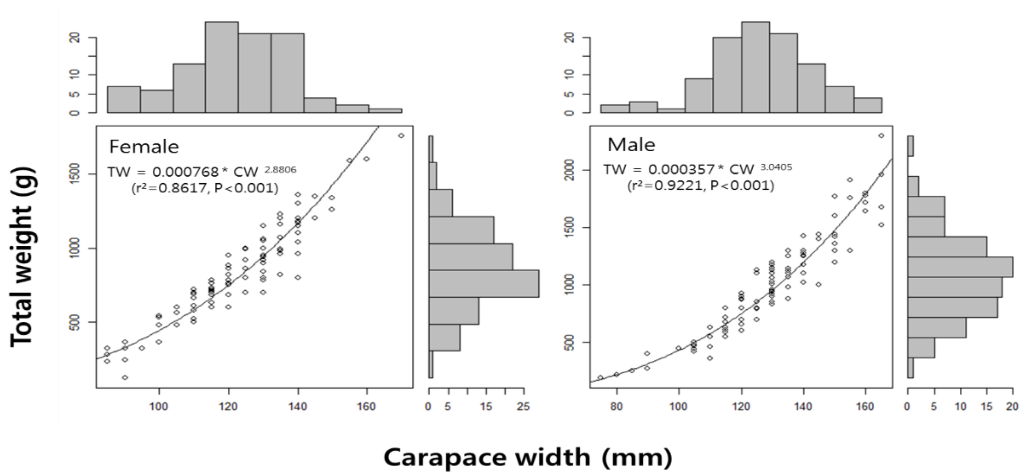

Figure 15: Sample statistics of King crab bycatches recorded by the deep-sea red crab fishery in Division B1 during 2015.

Incidental bycatches of VME indicator species have been minimal, and to date no bycatches exceeding the encounter thresholds have been recorded from the SEAFO deep-sea red crab fishery.

5.4 Incidental mortality and bycatch mitigation methods

There currently exist no incidental and bycatch mitigation measures for the deep-sea red crab fishery in the SEAFO CA.

5.5 Lost and abandoned gear

No lost and abandoned gear data have been reported for the deep-sea red crab fishery in the SEAFO CA.

5.6 Ecosystem implications and effects

The SEAFO deep-sea red crab fishery has very limited to no negative ecosystem impacts in terms of it temporal and spatial context.

6. Current conservation measures and management advice

Given that the TACs set for Deep-Sea Red Crab under CM 27/13 are up for review this year, SC implemented the HCR, as adopted by the Commission in 2014, for setting the 2016 TACs.

Under the rules of the HCR the abundance index available for the fishery (in this case CPUE) is used to gauge the trend of the catch rates over the last five years (Fig. 16). Considering the p-value of the slope, for the regression line fitted to the annual CPUEs for 2011 to 2015, it is clear that the slope is not significantly different from zero, however, the SC agreed to adopt the best estimate of the slope which is -0.1213. Under this scenario the HCR stipulates the use of “Rule 2” for setting the TAC.

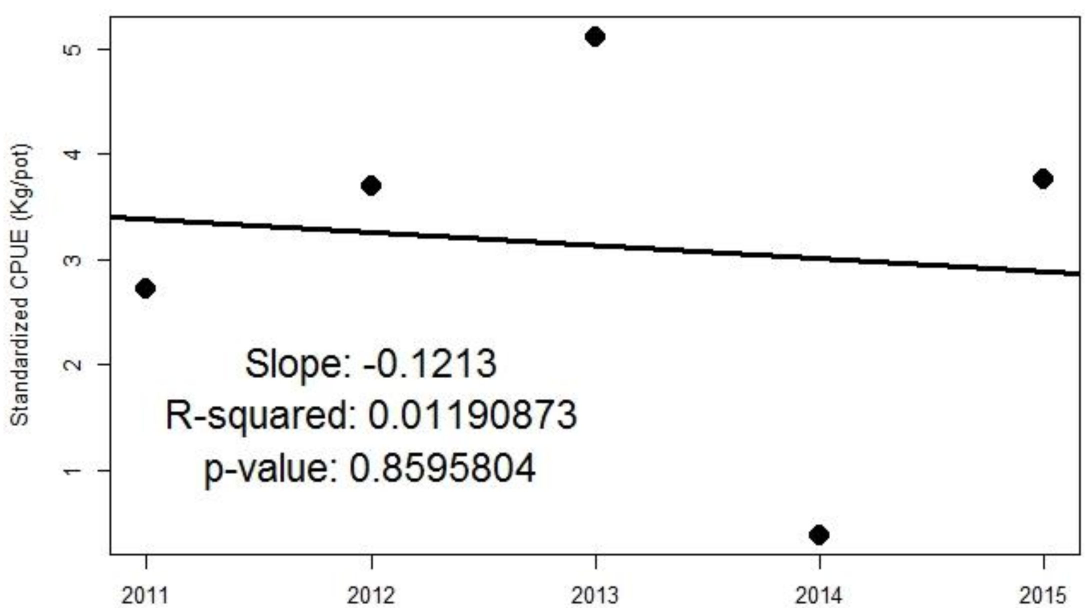

Figure 16: Regression line fitted to averaged annual CPUEs (2011-2015) for use in Harvest Control Rule.

Considering that no catches were recorded outside Division B1 the 2016 TAC recommendations are only applied to Division B1.

$$TAC_{2016} = TAC_{2015} * (1 + (2 * slope))$$

$$TAC_{2016} = 200 \text{ tons} * (1 + (2 * -0.1213))$$

$$TAC_{2016} = 152 \text{ tons}$$

However, the difference between the 2015 and proposed 2016 TAC is greater than the 5% limit stipulated by the HCR. **SC therefore recommends a TAC for 2016 be set at 190 tons for Division B1, and 200 tons for the remainder of the SEAFO CA.**

Table 7: Other Conservation Measures that are applicable to this fishery.

Conservation Measure 04/06	Conservation of sharks caught in association with fisheries managed by SEAFO.
Conservation Measure 14/09	Reduce sea turtle mortality in SEAFO fishing operations.
Conservation Measure 18/10	Management of vulnerable deep water habitats and ecosystems in the SEAFO Convention Area.
Conservation Measure 25/12	Reducing incidental bycatch of seabirds in the SEAFO Convention Area.
Conservation Measure 26/13	Bottom fishing activities in the SEAFO Convention Area.

7. References

Le Roux L. 1997 – Stock assessment and population dynamics of the deep-sea red crab *Chaceon maritae* (Brachyura, Geryonidae) off the Namibian Coast. M.Sc. thesis, University of Iceland, Department of Biology. 88 pp.

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