STATUS REPORT

Chaceon erytheiae

Common Name: Deep-sea red crab

FAO-ASFIS Code: GER

2018

Updated: 23 November 2018

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1. Description of the fishery

1.1 Description of fishing vessels and fishing gear

In 2018 a single vessel, *FV Crab Queen 1*, a Namibian vessel fished for a period of three months (April to June) and landed 173 tons of deep-sea red crab from a total of 177 sets. Whereas in 2017 two vessels *MFV Noordburg Kalapuse* and *FV Seiryo Maru* fished in Division B1 of the SEAFO CA and landed a total of 147 tons. *MFV Noordburg Kalapuse*, fished in the CA for a period of 14 days but only recorded a total of 4 fishing days in which it landed 7 tonnes of crab. Being new to the area the data seem to indicate that the vessel experienced severe weather (or other operational) problems in that it lost fishing gear on two separate occasions (days)during the fishing trip and, according to the Observer Report, spent a considerable amount of time trying to recover this gear with no success. This may be the reason why the vessel only managed to record such a low catch for the period of time it was in the SEAFO CA. A second vessel, *FV Seiryo Maru*, fished for almost 3 months (May to July) during 2017 and landed a total of 140 tonnes of crab from 135 sets.

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 average1200 traps (i.e. three sets with 400 traps each) per day. *MFV Noordburg Kalapuse*, with a holding capacity of 633m^3 and fishing gear capacity of 1397 pots deployed on 4 sets/lines.

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 (design& set deployment) 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.

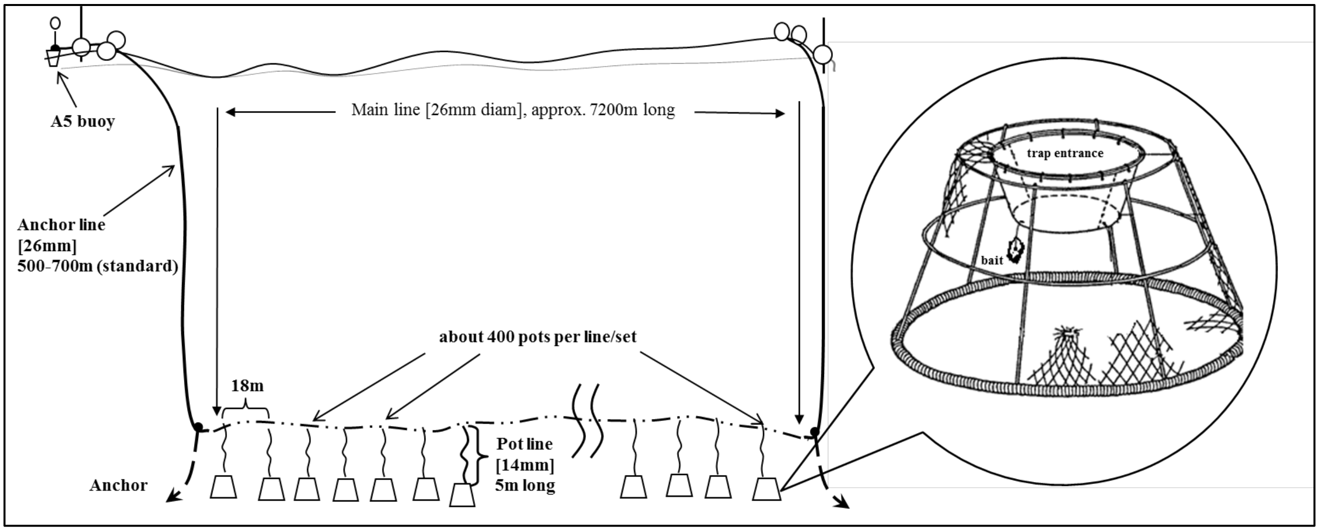

Figure 1: Deep-sea red crab fishing gear setup (set deployment and design) and illustration of a Japanese beehive pot (shown in enlarged form on the right).

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. 400 pots 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. 2-9). This seamount is located in DivisionB1 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 2010-2018.

2010	2011	2012	2013	2014	2015	2017	2018
181	133	129	103	107	73	145	177

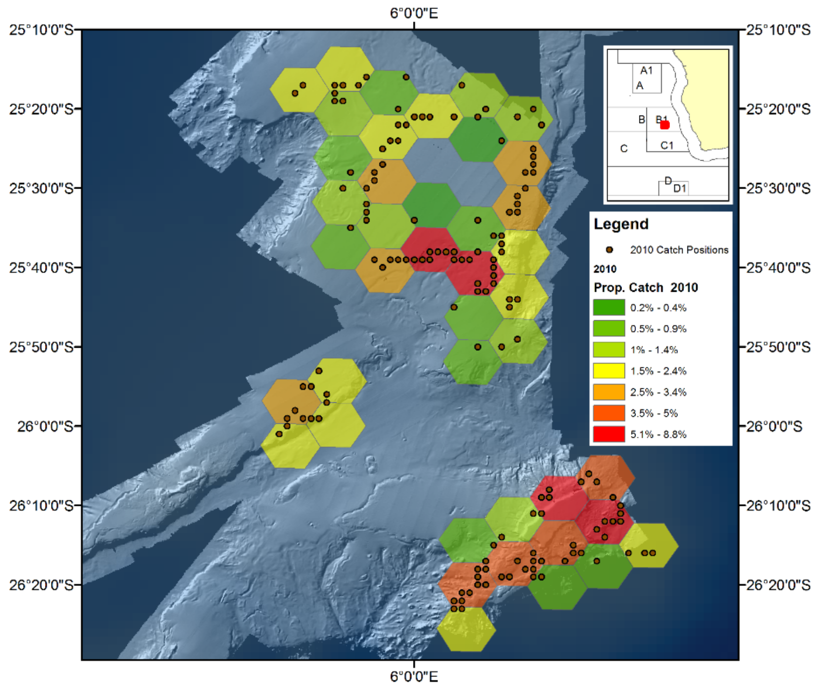

Figure 2: The 2010 catch distributions for deep-sea red crab in Division B1 aggregated to a 10 km^2 hexagonal area.

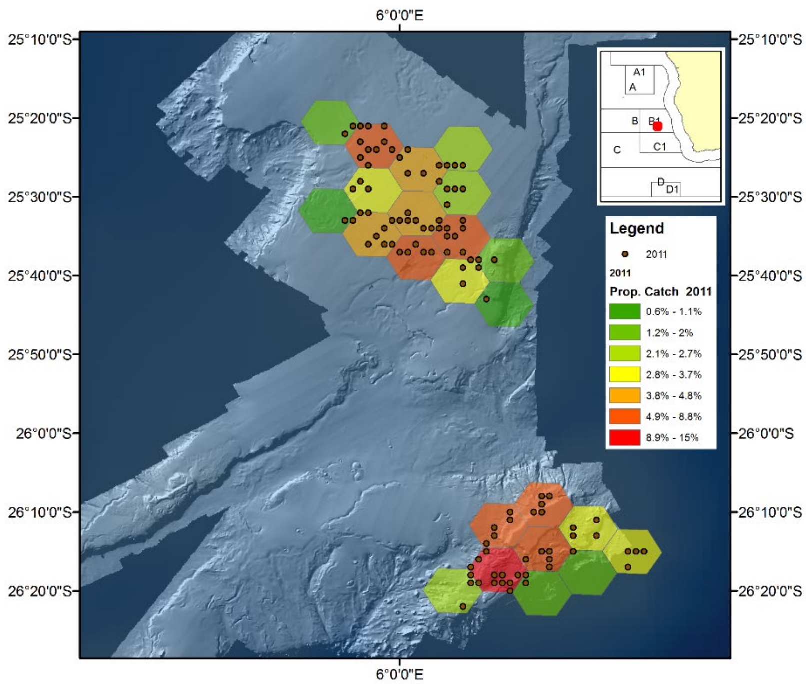

Figure 3: The 2011 catch distributions for deep-sea red crab in Division B1 aggregated to a 10 km^2 hexagonal area.

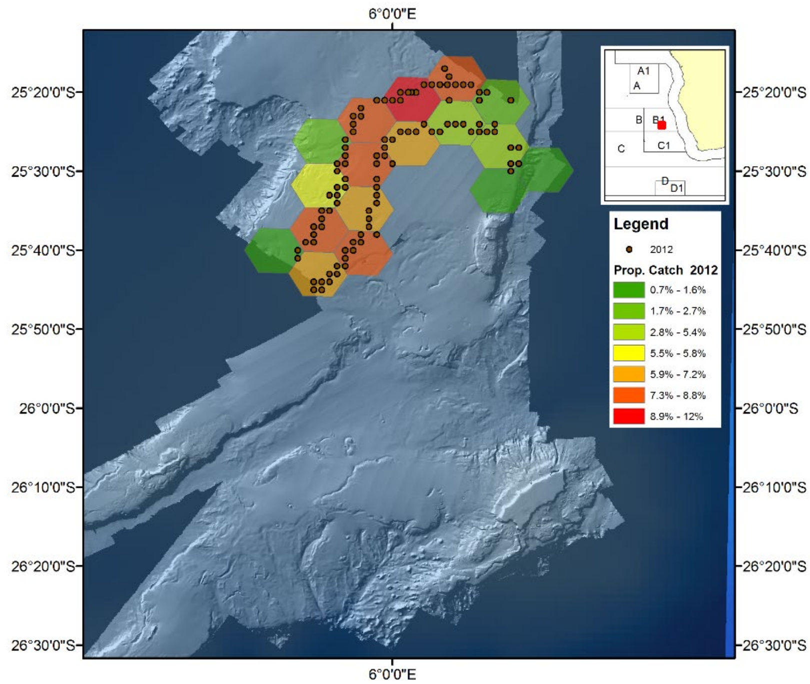

Figure 4: The 2012 catch distributions for deep-sea red crab in Division B1 aggregated to a 10 km^2 hexagonal area.

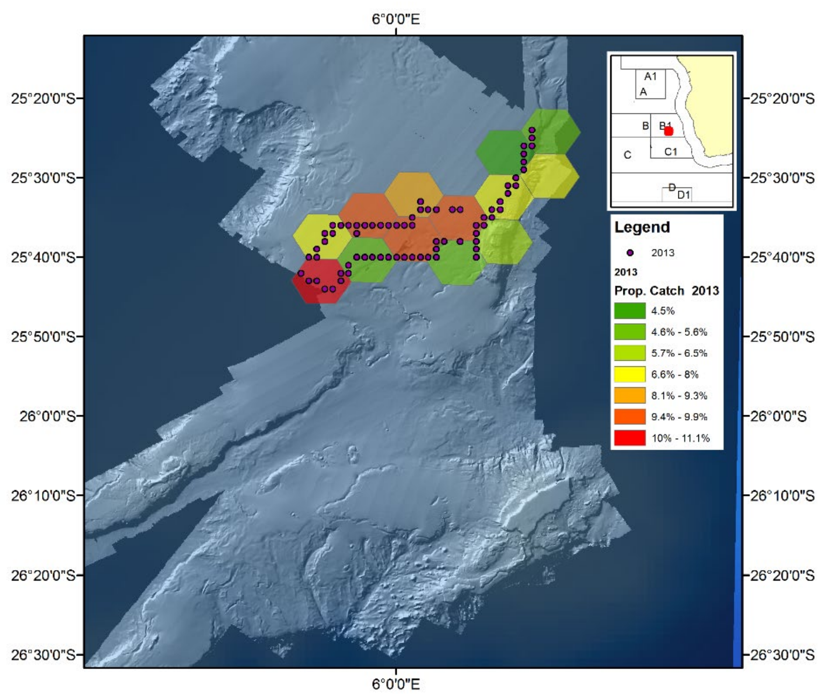

Figure 5: The 2013 catch distributions for deep-sea red crab in Division B1 aggregated to a 10 km^2 hexagonal area.

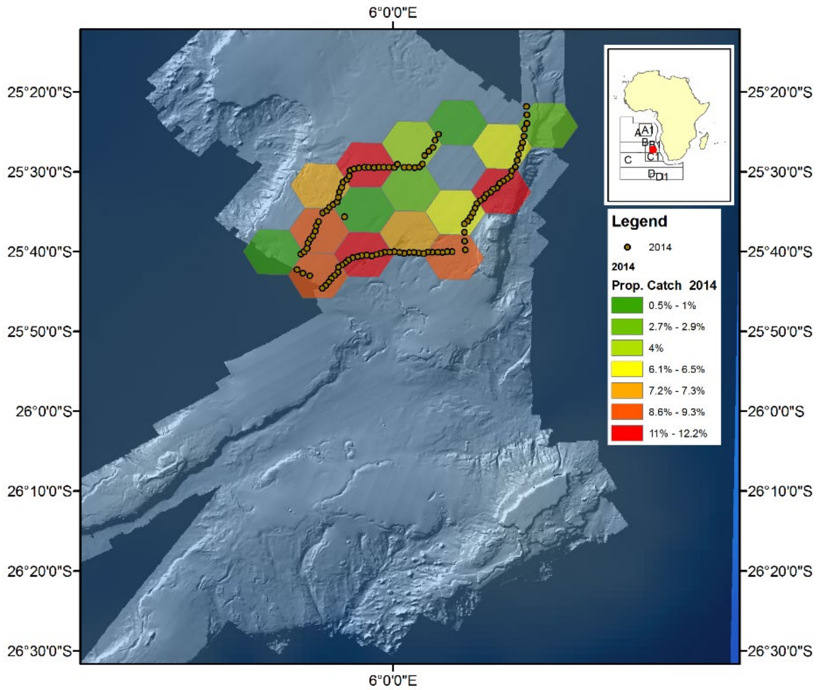

Figure 6: The 2014 catch distributions for deep-sea red crab in Division B1 aggregated to a 10 km^2 hexagonal area.

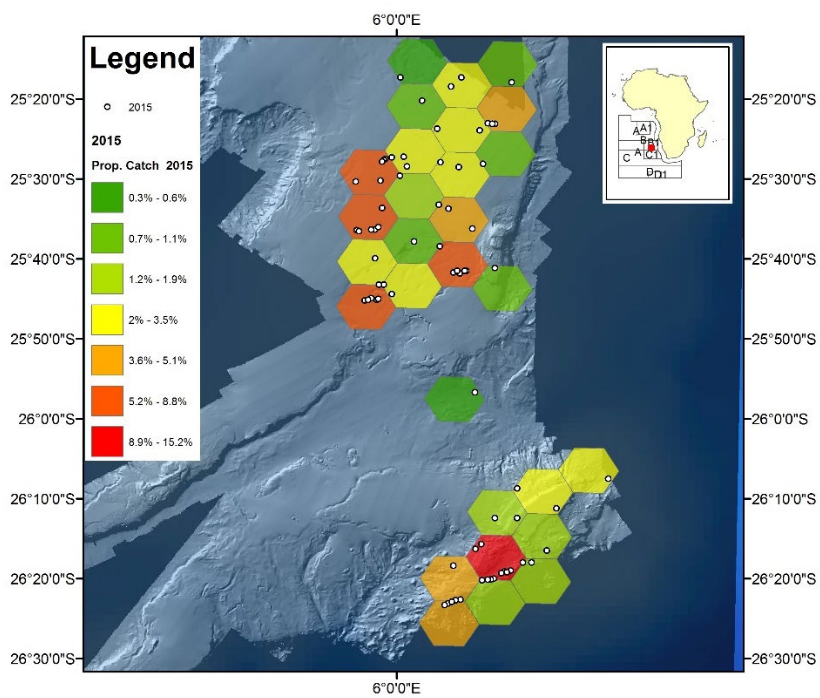

Figure 7: The 2015 catch distributions for deep-sea red crab in Division B1 aggregated to a 10 km^2 hexagonal area.

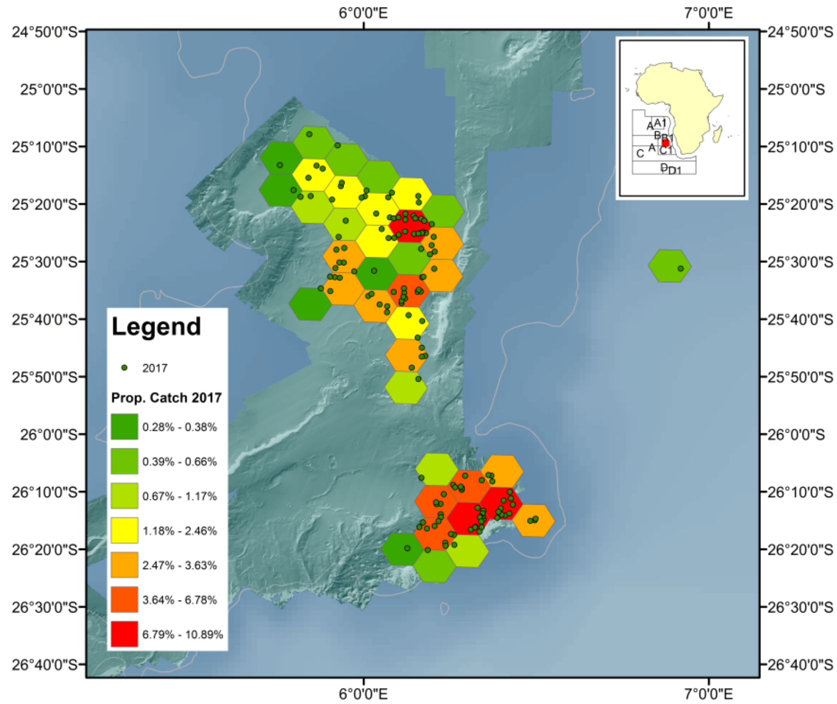

Figure 8: The 2017 catch distributions for deep-sea red crab in Division B1 aggregated to a 10 km^2 hexagonal area.

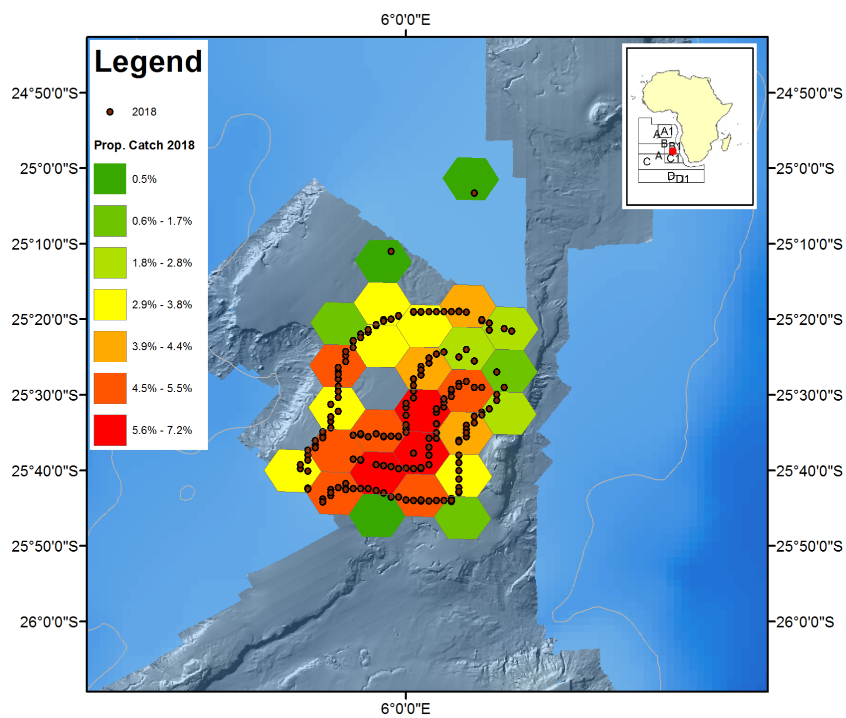

Figure 9: The 2018 catch distributions for deep-sea red crab in Division B1 aggregated to a 10 km^2 hexagonal area.

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 2001-2018. 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 2007(Table 2). Annual catches in relation to TAC for Deep-Sea Red Crab in Division B1 and the remaining SEAFO CA (Figure 10). The only reported catch outside B1 is that made by Portugal in Division A1 during 2007

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**	
Year	**Retain**	**Discard**	**Retain**	**Discard**	**Retain**	**Discard**	**Retain**	**Discard**	**Retain**	**Discard**
2001			-	-			<1			
2002			-	-						
2003			-	-			5			
2004			-	-			24			
2005	253	0	-	-	54					
2006	389		-	-						
2007	770		-	-	3	0			35	
2008	39		-	-						
2009	196		-	-	-	-	-	-	-	-
2010	200	0	-	-			-			
2011	-	-	-	-	175	0	-	-	-	-
2012	-	-	-	-	198	0	-	-	-	-
2013	-	-	-	-	196	0	-	-	-	-
2014	-	-	-	-	135	0	-	-	-	-
2015	-	-	104	0	-	-	-	-	-	-
2016	-	-	-	-	-	-	-	-	-	-
2017	140	0	-	-	7	0	-	-	-	-
2018	N/F	N/F	N/F	N/F	173	0	N/F	N/F	N/F	N/F

* Provisional (September 2018). Ret. = Retained Disc. = Discarded - = No Fishing.
Blank fields = No data available. UNK = Unknown.

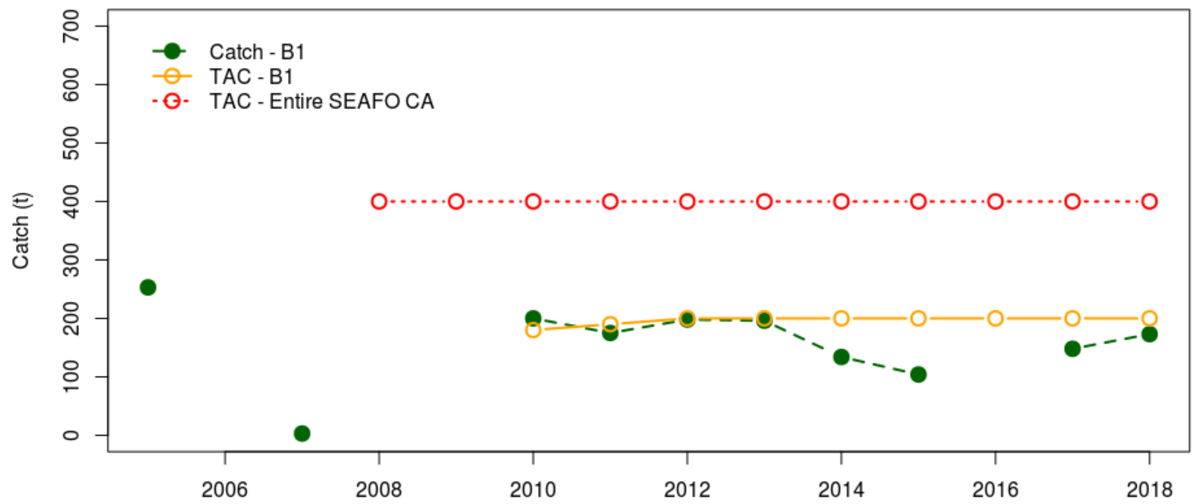

Figure 10: Annual catches in relation to TAC for Deep-Sea Red Crab in Division B1 and the remaining SEAFO CA. The only reported catch outside B1 is that made by Portugal in Division A1 during 2007 (see Table 2 for clarity).

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 in terms of the records from this fishery (see Section 5.3 for additional information).

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 (2010-2018) of the SEAFO deep-sea red crab fishery (Fig. 10). 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 (2010-2018) from the deep-sea red crab commercial fleet within the SEAFO CA.

	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2017**	**2018**
Total Number of Sets	181	133	129	103	107	73	145	177
Crabs Sampled per Set	30	30	30	30	100	136	100	100
Total Crabs Sampled	5430	3990	3600	3077	10654	32500	13500	17700

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 2010-2018 are presented in Figure11. Length-frequency data from all areas sampled in Division B1 were pooled as no significant differences were detected between areas.

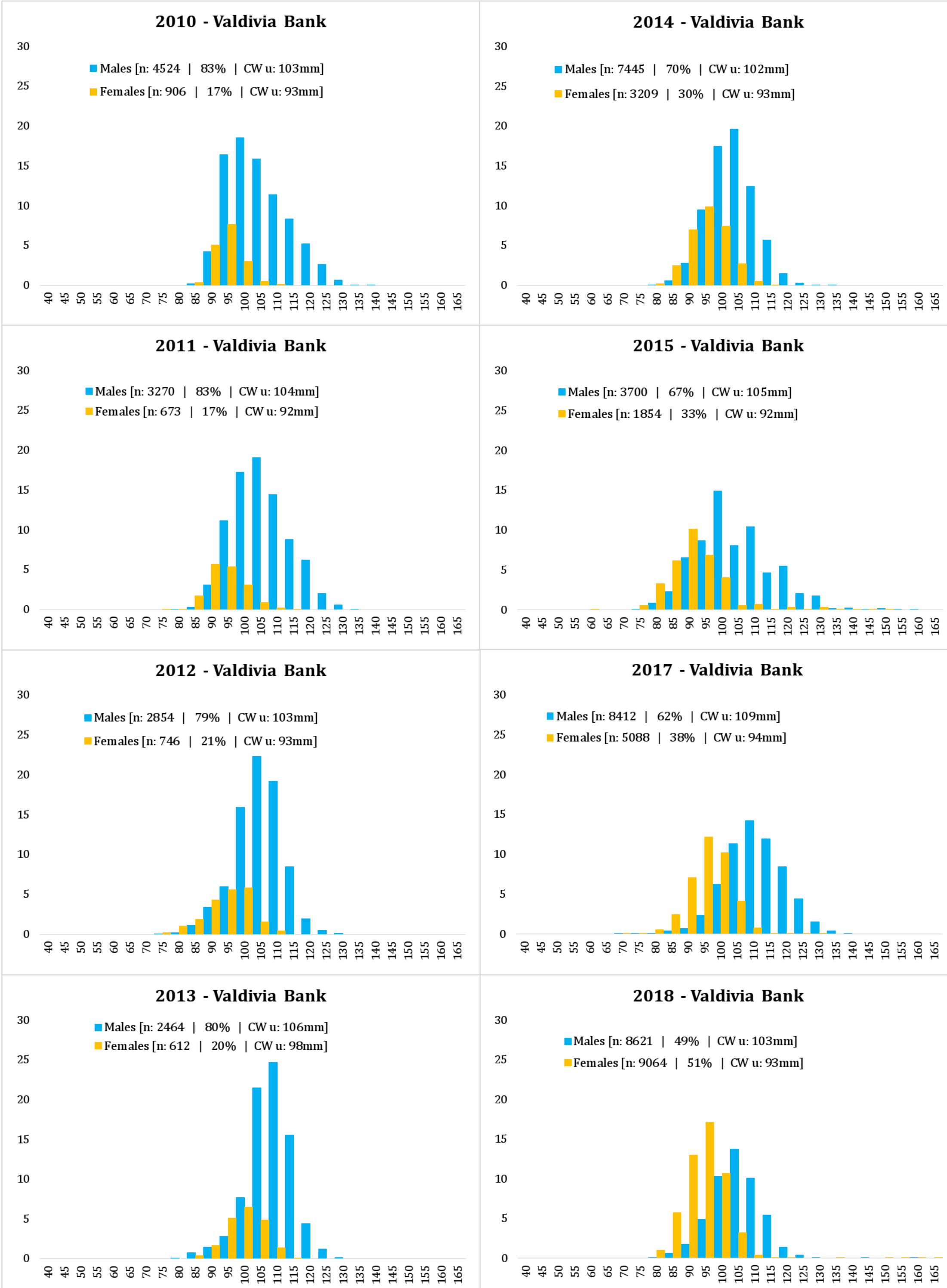

Figure 11: Carapace width frequencies (in percentages)of crabs sampled from commercial catches [2010-2015&2017-2018]. Notes: "n" refers to sample size; "u" refers to the carapace width mean for each sample as indicated.

For the period 2010-2018 there has been no significant changes in the female crab size distribution (Fig. 11). 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.

11). 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.

In 2018 the biological dataset was linked to some sampling issues. Upon initial queries the Secretariat was informed that no observer data had been collected as the observer deployed on the *FV Crab Queen 1* for the 2018 fishing trip was not a scientific observer. However, upon further queries a handwritten biological dataset appeared – seemingly recorded by the Captain of the vessel. On further investigation certain anomalies were detected with the 2018 dataset. The most obvious oddity was the sex ratio - which for the 2018 dataset was 1:1, whereas all datasets from previous years were all skewed towards male crabs (at a ratio of 2:1 or higher). The skew towards male crabs (of commercial crab pots) has already been confirmed on the basis that male crabs grow faster than females, attaining larger sizes, and as a result are retained at a much higher rate than female crabs under existing trap mesh size restrictions. Furthermore, the 2018 dataset had 3x as many large (i.e. >130mm CW) female crabs than that of the 2015 dataset (which was the only other dataset with female crabs larger than 130mm size) – this is only slight evident in Fig. 11. These observations raised some doubts about the integrity of the 2018 dataset, and will most certainly require better monitoring or controlling during future fishing activities.

3.3 Length-weight relationships

Length-weight relationship derived from catches on Valdivia Bank reveal the gender-specific growth disparity (Fig. 12). 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. 12).

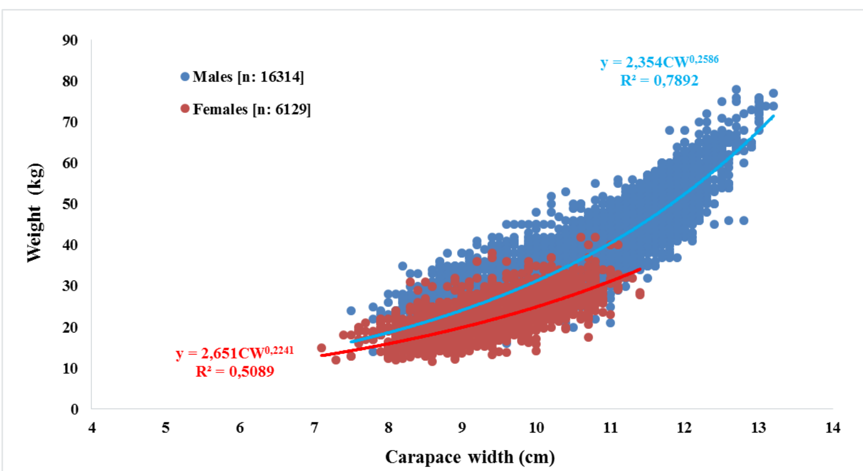

Figure 12: Length-at-weight data for *Chaceon erytheiae*as recorded from catches on Valdivia Bank (2008-2015). Red text show female length-weight relationship, blue text show male length-weight relationship.

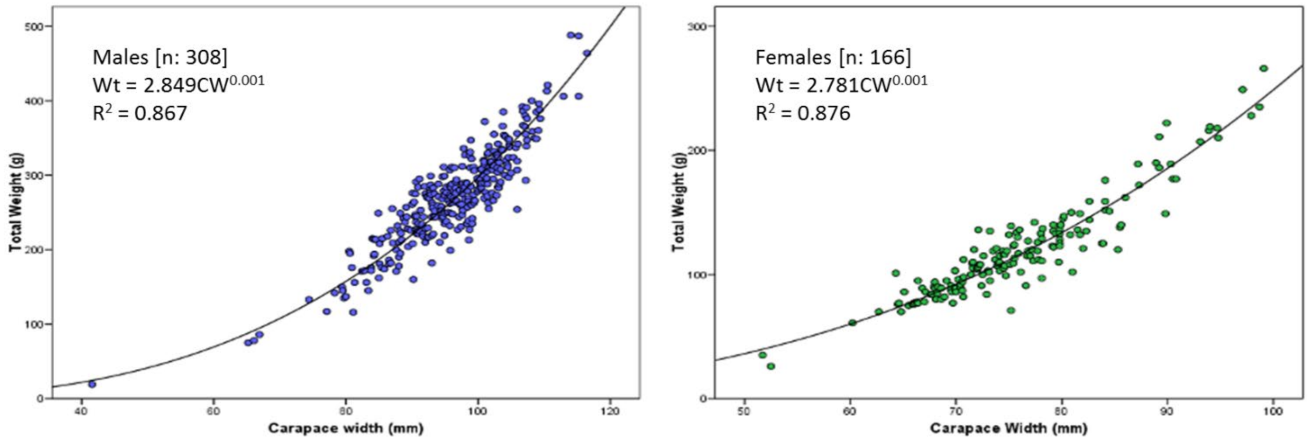

Figure 13: Length-at-weight data for *Chaceonerytheiae* as recorded from the 2008 Spain-Namibia survey (López-Abellán *et al*. 2008).

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 (2005-2018) 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)
2017	JPN & NAM	Catch Data – Fishing Logbook data	Set-by-Set data (vessel ID, set-haul positions and dates), Depth, Length, Weight, Catch, Effort – (Catch: 142 records, Biological: 5554 records)
2018	NAM	Catch Data – Fishing Logbook data& Biological Data (not from Observer Report)	Set-by-Set data (vessel ID, set-haul positions and dates), Depth, Length, Weight, Catch, Effort – (Catch: 177 records, Biological: 17700 records)

4.3 Methods used

<u>CPUE Standardization</u>:
As part of the annual updating of the deep-sea red crab abundance index another attempt was made during 2018 at standardizing the CPUE index. Following the outcomes of the 2015 assessment that revealed "SoakTime" as an unreliable factor for consideration in the CPUE standardization, "SoakTime" was again omitted from the 2018 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	2017	2018
157	10	181	133	129	103	107	73	142	177

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. In addition to this the 7 sets from a Namibian vessel that conducted some very uncharacteristic crab fishing operations during 2017 were also removed from the analysis as the data from this vessel was severely disparate (both in terms of total set number and catch) from all of the remaining data in the SEAFO database.

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

Year	-	A 12-month period – explanatory variable (covariate).
SEASON	-	The seasonal cycle – 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:

$$CPUE = \beta_0 + \beta_1\,Year + \beta_2\,VesselID + \beta_3\,Depth + \beta_4 Zone + \beta_5 Season + \beta_6 Pots + \varepsilon$$

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.

$$CPUE = \beta_0 + \beta_1\,Year + \beta_3\,Depth + \beta_4\,Zone + \beta_5\,Season + \beta_6 Pots + \varepsilon$$

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, covariates year, depth, zone, season and pots all had very significance with p-values of $2.2*10^{-16}$, $1.037*10^{-9}$,$3.766*10^{-4}$,$5.084*10^{-4}$ and $2.2*10^{-16}$ indicating strong covariance with deep-sea red crab catch rates.

Table 7: ANOVA results for the CPUE model.

Covariates	Df	Deviance	Residual Df	Residual Deviance	Pr(>Chi)
NULL			1115	1088.40	
Year	8	516.75	1107	571.64	< 2.2e-16 ***
Depth	13	30.79	1094	540.86	1.037e-09 ***
Zone	2	7.00	1092	533.86	0.0003766 ***
as.factor(SEASON)	3	7.85	1089	526.01	0.0005084***
Pots	10	47.34	1079	478.67	< 2.2e-16 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

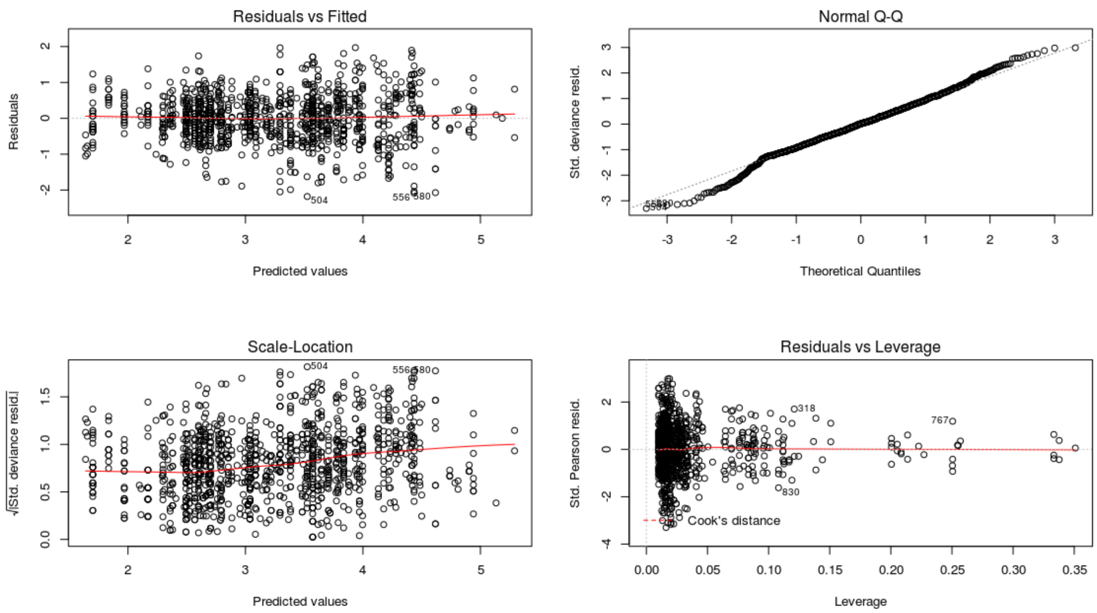

Figure 14: QQ and studentized residual plots of the best lognormal fit model for retained catch CPUE (kg/pot).

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 82 outliers were removed (out of a total of 1198 data points – i.e. outliers removed equates to 6.8% 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. 14). Plots of the residuals versus fitted values indicated evenly distributed data points, no overridingly skewed patterns in the plot (Fig. 14). 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 2018. 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, 2014, 2017 and 2018 where the CPUE was very close to zero(Fig. 15).

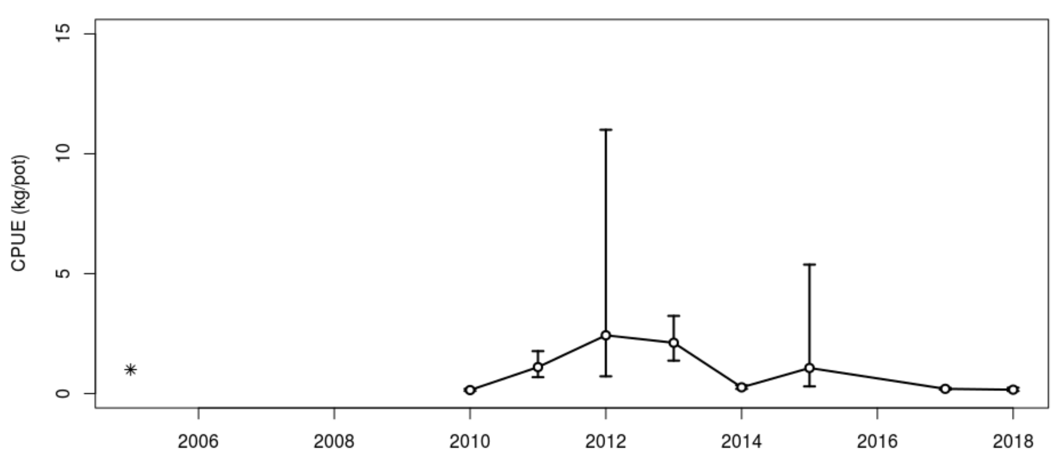

Figure 15: Trends in catch CPUE indexes for catches per pot-hour of crabs – with soak time as a categorical variable (factor)not included in the model. Standardized Index: black line with standard deviation (error bars).

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 were 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. At this point in time there are no indications for why the TACs was not landed fully during 2015 and 2017 (see Figure

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:

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

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 (*Lithodes ferox* – KCA) bycatches been recorded from the deep-sea red crab fishery in Division B1 (Fig. 16 & 17). All these bycatches were made during 2015 only.

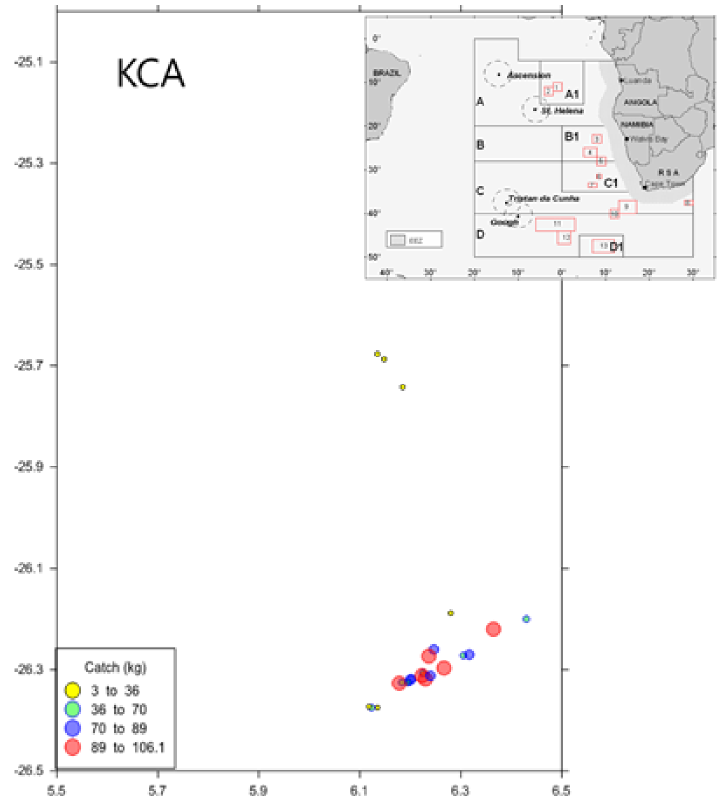

Figure 16: Spatial reference of King crab (*Lithodes ferox*) bycatches recorded from the deep-sea red crab fishery in Division B1 during 2015.

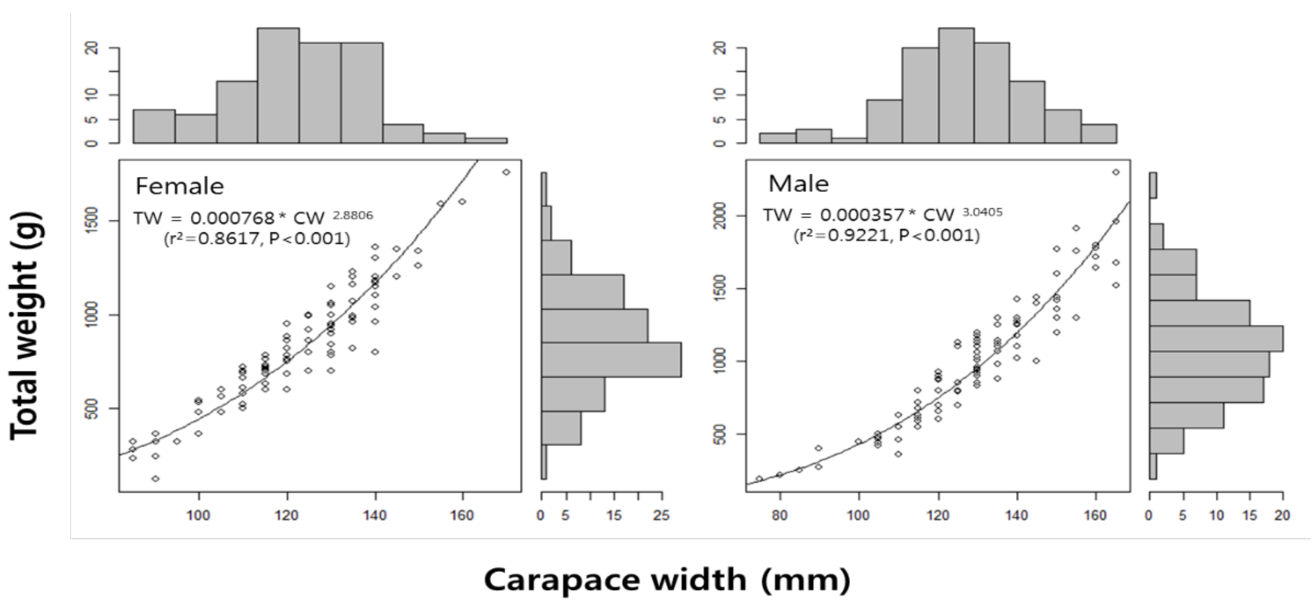

Figure 17: Sample statistics of King crab bycatches recorded by the deep-sea red crab fishery in Division B1 during 2015.

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

Two incidences of lost gear was report during 2017 for a new fishing vessel (*MFV Noordburg Kalapuse*– Call Sign: V5WO). The two incidents were report on 20 & 22 February 2017, the locations where the gear was lost are indicated in Figure18 and a description of the lost gear lost is outlined below:

Gear Type: Crab pots, search grabber, 4 line anchors,12 weight bars and 20 floats.
Quantity: 6 pots lost offline and 608 pots lost attached to the line. Search grabber, 4 anchor lines and 12 weight bars. Twenty floats attached to the lost line.

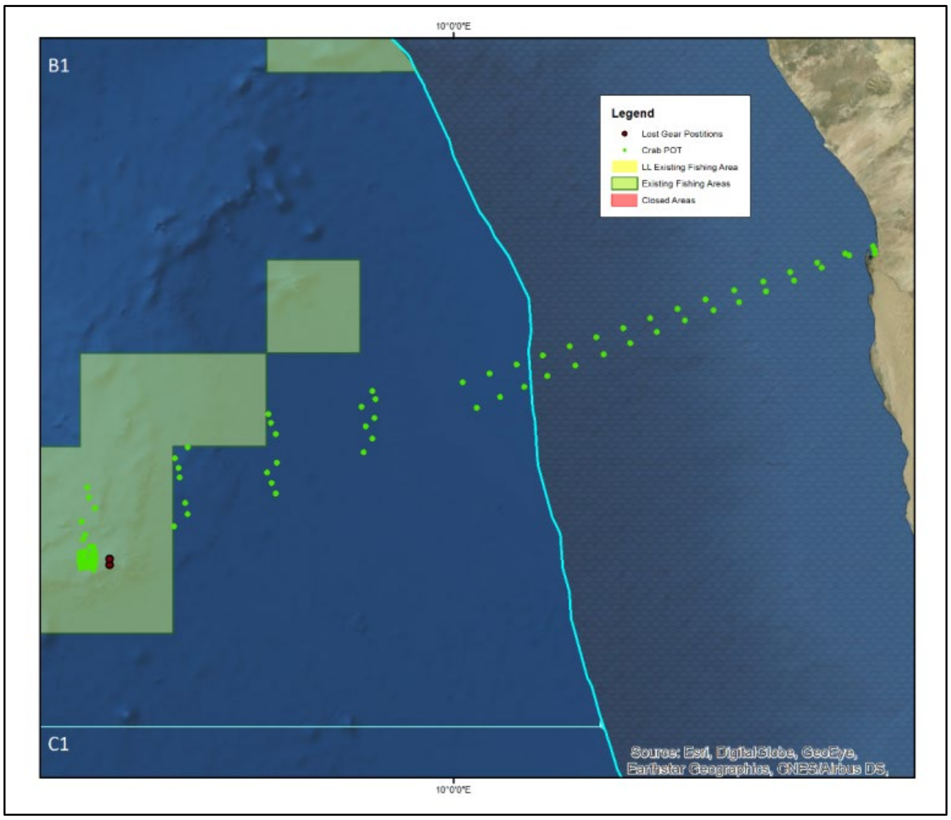

Figure 18: Positions of crab fishing gear lost by the MFV Noordburg Kalapuse 20 and 22 February 2017.

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

Fishing activities in 2018 providing required catch and effort data to update the CPUE series which form the basis for the application of the HCR as adopted by the Commission in 2015.The SC applying the HCR based on CPUE trend (Figure 19).

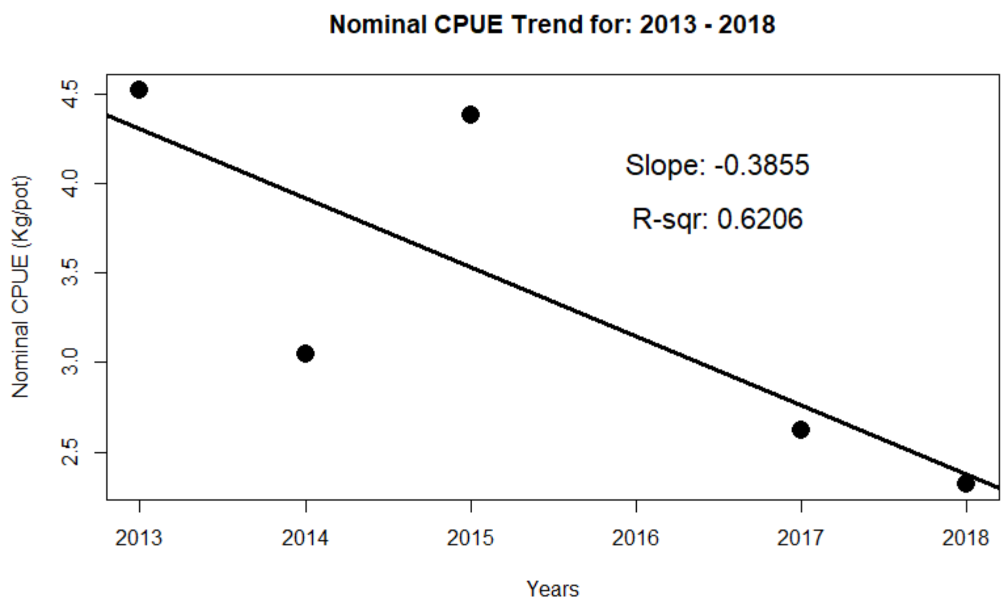

Figure 19: Regression line fitted to average annual CPUEs (2013-2018) for use in Harvest Control Rule.

Considering that no catches were recorded outside Division B1 the 2019 TAC recommendations are only applied to Division B1.

$$TAC_{2019} = TAC_{2018} * (1 + (2 * slope))$$

$$TAC_{2019} = 180 \text{ tons} * (1 + (2 * -0.3855))$$

$$TAC_{2019} = 41 \text{ tons}$$

The SC agreed to adopt the best estimate of the slope which is -0.3855. Under this scenario the HCR stipulates the use of “Rule 2” for setting the TAC.

The difference between the 2018 and proposed 2019 TAC is greater than the 5% limit stipulated by the HCR. **SC therefore recommends a TAC for 2019 and 2020 be set at 171 tons for Division B1, and 200 tons for the remainder of the SEAFO CA.**

Significant crab fisheries have been conducted in B1 since 2005, and at the start of the CPUE series (2013) the fishery was well established. This is thus not a new fishery where a strong decline in the CPUE might be expected. The perception in 2017 of a stable fishery with no significant negative trend was based on a CPUE series for the years 2010-2017 (but with 2016 missing). For the shorter but more reliable series from 2013-2018, the slope is negative and the CPUE level in 2018 is only about 50% of that in 2013. This suggests a fast declining abundance, i.e. a result in stark contrast to the perception last year. In addition, significant changes in the sex composition is observed during the time-series, with a decline in the proportion of males, and this larger individuals. The decline in CPUE and the sex composition/size composition change are worrying signs and creates uncertainty that requires cautious action.

The HCR was designed during a period when the crab fishery was perceived as relatively stable or varying without trend. It was not designed to handle a situation of strong and steady decline in CPUE as suggested by the 2013-2018 CPUE series. Using the HCR and the “Rule 2” produces a TAC=41 t. However, the TAC becomes 171 t when applying the 5% restriction on changes between years. This TAC is thus 4.2 times the figure suggested by the HCR, which does not appear as a precautionary option.

Japan expressed the following statement.

Based on the landing table (SEAFO, 2018), deep-sea red crab catch data by crab pot fisheries in SEAFO CA is available since 2001. According to the landing table, the high catch more than 300t was reported in 2005-2007 (307, 389, 818 t respectively). Afterwards, catch have been decreased to less than 200t (partially due to the TAC limit). The standardized CPUE has been declining since 2011. This is most probably caused by high catch in 2005-2007. Hence the CPUE (2018) is about a half of CPUE (2013), which is not a good situation for the stock.

However, the HCR will improve this situation by the self-control system, i.e., when the slope is the negative, precautionary λ=2 (instead of λ=1) is applied to reduce TAC much lower (note: λ: TAC control coefficient of slope). But ±5% (constraint of TAC change) limits the large reduction or increase of TAC. Thus, if HCR is used and when CPUE decease continuously, TAC will be reduced continuously to prevent the further reduction of CPUE. Although it is the slow process, the stock will be continuously protected in the long term. The same situation is applied for the case when CPUE increase very largely, i.e., HCR will prevent large increase of TAC by the +5% constraint. Therefore, as long as HCR is applied, the stock will be protected in an optimum way in a long term. Thus, HCR should be continuously used. It is noted that NAFO and CCSBT use the same HCR for 5-10 years without any problems. In SEAFO, HCR was just adopted in 2016 and it is too early to change to other methods without evaluating HCR.

Significant crab fisheries have been conducted in B1 since 2005, and at the start of the CPUE series (2013)

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.
Conservation Measure 32/16	On Total Allowable Catches and related conditions for Patagonian toothfish, orange roughy, Alfonsino and Deep-Sea Red Crab in the SEAFO Convention Area in 2016.

7. References

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