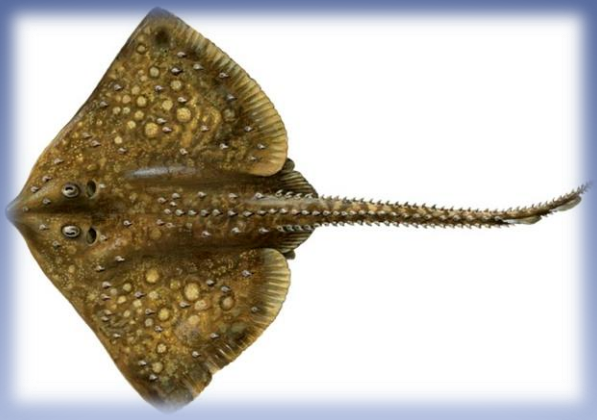


Stock Assessment Form

Raja clavata (RJC)

Reference year: 2021

Reporting year: 2022

Raja clavata is the most widespread and landed skate species in Cyprus with relatively low value and insignificant contribution in Cypriot demersal fisheries catches. The stock is exploited from all fleet segments as well as recreational fishery boats using reels, handlines and longlines. Due to identification issues species was declared in landings, at various irregular configurations constituting the production figures as unreliable for the purposes of a stock assessment. Moreover catch data from recreational fishery are absent. To this end alternative length and survey based approached were exploited. Data from Cyprus official statistics were compiled, under the R language environment, into a Bayesian data limited model (AMSY) that estimates fisheries reference points from survey CPUE and resilience. Abundance index derived from biomass estimates of MEDITS Trawl survey. The BCrumb state space model was employed to interpolate the missing survey year of the timeseries (2014). As an auxiliary exercise an Empirical Indicator derived from the length trend of the 95th percentile of the larger individuals of RJC in MEDITS data series. Results indicate a sustainable exploitation. The AMSY shows clear consistent signals of population dynamics for the species but due to the inherent capabilities of the methodology the assessment was validated as qualitative suggesting that the stock seems to be in sustainable exploitation (F/Fmsy = 0.15) with relatively high biomass trajectory (B/Bmsy = 1.91).

Stock Assessment Form version 2.0 (March 2022)

Uploader: *Ioannis Thasitis*

Stock assessment form

Basic Identification Data

Scientific name:	Common name:	ISCAAP Group:
Serranus cabrilla	Comber	CBR
1st Geographical sub-area:	**2nd Geographical sub-area:**	**3rd Geographical sub-area:**
[GSA_25]		
4th Geographical sub-area:	**5th Geographical sub-area:**	**6th Geographical sub-area:**
1st Country	**2nd Country**	**3rd Country**
Cyprus		
4th Country	**5th Country**	**6th Country**
Stock assessment method: (direct, indirect, combined, none)		
AMSY and an Empirical Length Indicator		
Authors:		
Ioannis Thasitis, Charis Charilaou		
Affiliation:		
Department of Fisheries and Marine Research, Cyprus		

The ISSCAAP code is assigned according to the FAO 'International Standard Statistical Classification for Aquatic Animals and Plants' (ISSCAAP) which divides commercial species into 50 groups on the basis of their taxonomic, ecological and economic characteristics. This can be provided by the GFCM secretariat if needed. A list of groups can be found here:

http://www.fao.org/fishery/collection/asfis/en

Direct methods (you can choose more than one):

- Acoustics survey
- Egg production survey
- Trawl survey
- SURBA
- Other (please specify)

Indirect method (you can choose more than one):

- ICA

- VPA
- LCA
- AMCI
- XSA
- Biomass models
- Length based models
- Other (please specify)

Combined method: you can choose both a direct and an indirect method and the name of the combined method (please specify)

1 Stock identification and biological information

The assessment covers the area under the effective control of Cyprus Republic; it is assumed that the stock limits of the assessed *Raja clavata* are in agreement with the limits of GSA 25 (Figure 2.1-1).

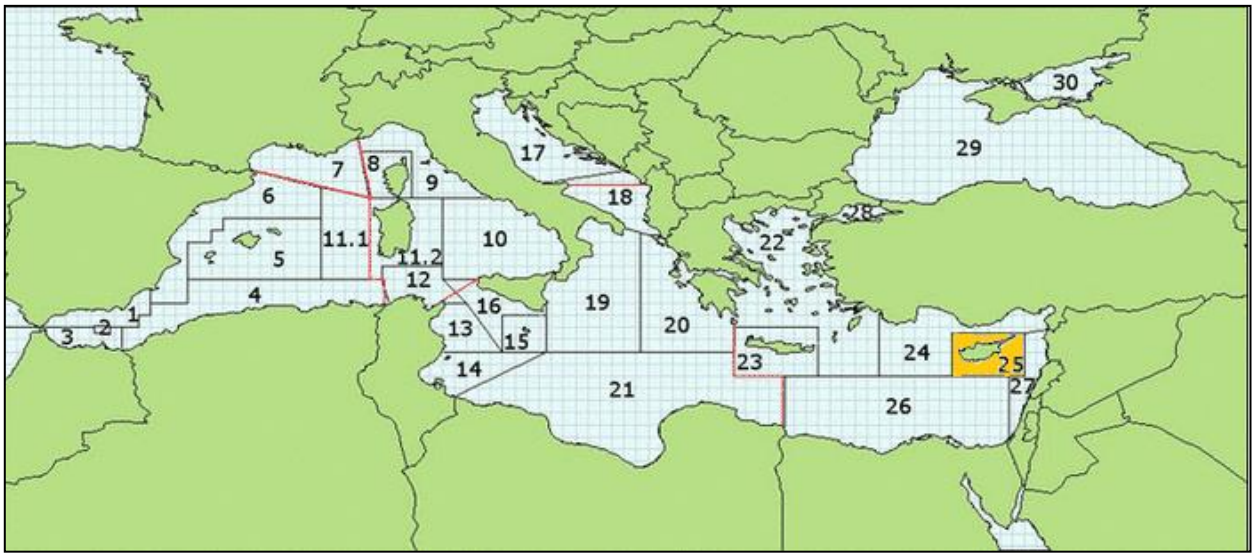


Figure 2.1-1: Geographical location of GSA25.

1.1 Stock unit

1.2 Growth and maturity

Table 1.2-1: Maximum size, size at first maturity and size at recruitment.

Somatic magnitude measured (LT, LC, etc)				**Units**	cm
Sex	**Fem**	**Mal**	**Combined**	**Reproduction season**	
Maximum size observed			98 DW	**Recruitment season**	
Size at first maturity				**Spawning area**	Shelf
Recruitment size to the fishery				**Nursery area**	Shelf

Table 1-2.2: M vector and proportion of matures by size or age (Males)

Size/Age	Natural mortality	Proportion of matures
…	…	…

Table 1-2.3: M vector and proportion of matures by size or age (Females)

Size/Age	Natural mortality	Proportion of matures
…	…	…

Table 1-3: Growth and length weight model parameters

			Sex			
		Units	female	male	Combined	Years
Growth model	**L_∞**					
	K					
	t_0					
	Data source					
Length weight relationship	**a**					
	b					
	M (scalar)					
	sex ratio (% females/total)					

2 Fisheries information

2.1 Description of the fleet

As indicated in Table 3.1-1, the stock is exploited by different Operational Units.

The small scale artisanal fleet operates mainly with bottom set nets and bottom longlines. Vessels under this fleet represent the large majority of the fishing vessels in the Cyprus Fleet Register (96%). Most vessels have length 6-<12m and are allowed to operate every day all year round with a number of restriction measures on the use of fishing gears and minimum landing sizes, according to the national and community law (see Section 3.3). Since 2016 there are 325 licensed vessels (28 with length 0-<6m, 297 with length 6-<12m).

Polyvalent vessels over 12m can also catch RJC using nets and bottom longlines in times they are not involved in the large pelagic fishery which is their main activity.

For bottom trawlers RJC is always present as bycatch at varying quantities. Operation occurs in territorial waters at depth up to 200m. Since 2012 the trawlers operating in territorial waters are limited to two. Further information on the restrictions applied on this fleet are provided in Section 3.3.

As shown in Table 3.1-2, *Raja clavata* in GSA25 is exploited with a number of other demersal species for all operational units.

Table 2-1: Description of operational units exploiting the stock

	Country	GSA	Fleet Segment	Fishing Gear Class	Group of Target Species	Species
Operational Unit 1	CYP	GSA25	C-Polyvalent small-scale vessels with engine (6-12 metres)	07 – Gillnets, Entangling Nets, Long-lines	33 – Demersal shelf species	
Operational Unit 2	CYP	GSA25	B – Polyvalent small-scale vessels with engine (<6 metres)	07 – Gillnets, Entangling Nets, Long-lines	33 – Demersal shelf species	
Operational Unit 3	CYP	GSA25	M – Polyvalent vessels (>12 metres)	07 – Gillnets and Entangling Nets	33 – Demersal shelf species	
Operational Unit 4	CYP	GSA25	Recreational Fisheries	07 – Hand line and Long-lines	33 – Demersal shelf species	
Operational Unit 5	CYP	GSA25	F – Trawlers (>24 metres)	03 - Trawls	33 – Demersal shelf species	

Table 2.1-2: Catch, bycatch, discards and effort by operational unit in the reference year

Operational Units*	Fleet (n° of boats)*	Catch (T or kg of the species assessed)	Other species caught (names and weight)	Discards (species assessed)	Discards (other species caught)	Effort (units)
Polyvalent small-scale vessels (6-12 metres)	297		*Boobs boops , Mullus barbatus, Pagellus erythrinus , Sparisoma cretense , Pagellus acarne, Siganus rivulatus, Spicara maena, Serranus cabrilla, Diplodus sargus, Spicara smaris, Octopus vulgaris, Sepia officinalis, Loligo vulgaris*	No discards	*Lagocephalus* spp.	
Polyvalent small-scale vessels (0-6m)	28		*Boobs boops , Mullus barbatus, Pagellus erythrinus , Sparisoma cretense , Pagellus acarne, Siganus rivulatus, Spicara maena, Serranus cabrilla, Diplodus sargus, Spicara smaris, Octopus vulgaris, Sepia officinalis, Loligo vulgaris*	No discards	*Lagocephalus* spp.	
Polyvalent vessels (>12 metres)	34		*Boobs boops, Mullus barbatus, Spicara smaris*	No discards	*Lagocephalus* spp.	
Recreational Fisheries	2500			No discards		
Trawlers	2		*Boobs boops , Mullus barbatus, Pagellus erythrinus , Sparisoma cretense , Pagellus acarne, Siganus*	No discards	*Boops boops, Mullus barbatus, Pagellus erythrinus, P. acarne, Spicara*	

Operational Units*	Fleet (n° of boats)*	Catch (T or kg of the species assessed)	Other species caught (names and weight)	Discards (species assessed)	Discards (other species caught)	Effort (units)
			rivulatus, Spicara maena, Serranus cabrilla, Diplodus sargus, Spicara smaris, Octopus vulgaris, Sepia officinalis, Loligo vulgaris		*smaris, Serranus cabrilla, Merluccius merluccius*	
Total						

2.2 Historical trends

Landings data records start in 1975 but due to identification issues the species was mixing at various irregular configurations during landing declarations. In general Raja clavate was registered together with a number of skate and shark under the code SKX which normally corresponds to Elasmobranchii group and STT which corresponds to Dasyatidae family. As a result landing data cannot utilised in stock assessment as no reliable estimations can be extracted

Information on the length distribution of the species is limited. Figure 3.2-4 provides the effort exerted for the period 2005 – 2020 for the two main fleets: nets and the 2 bottom trawlers operating in Cyprus territorial waters.

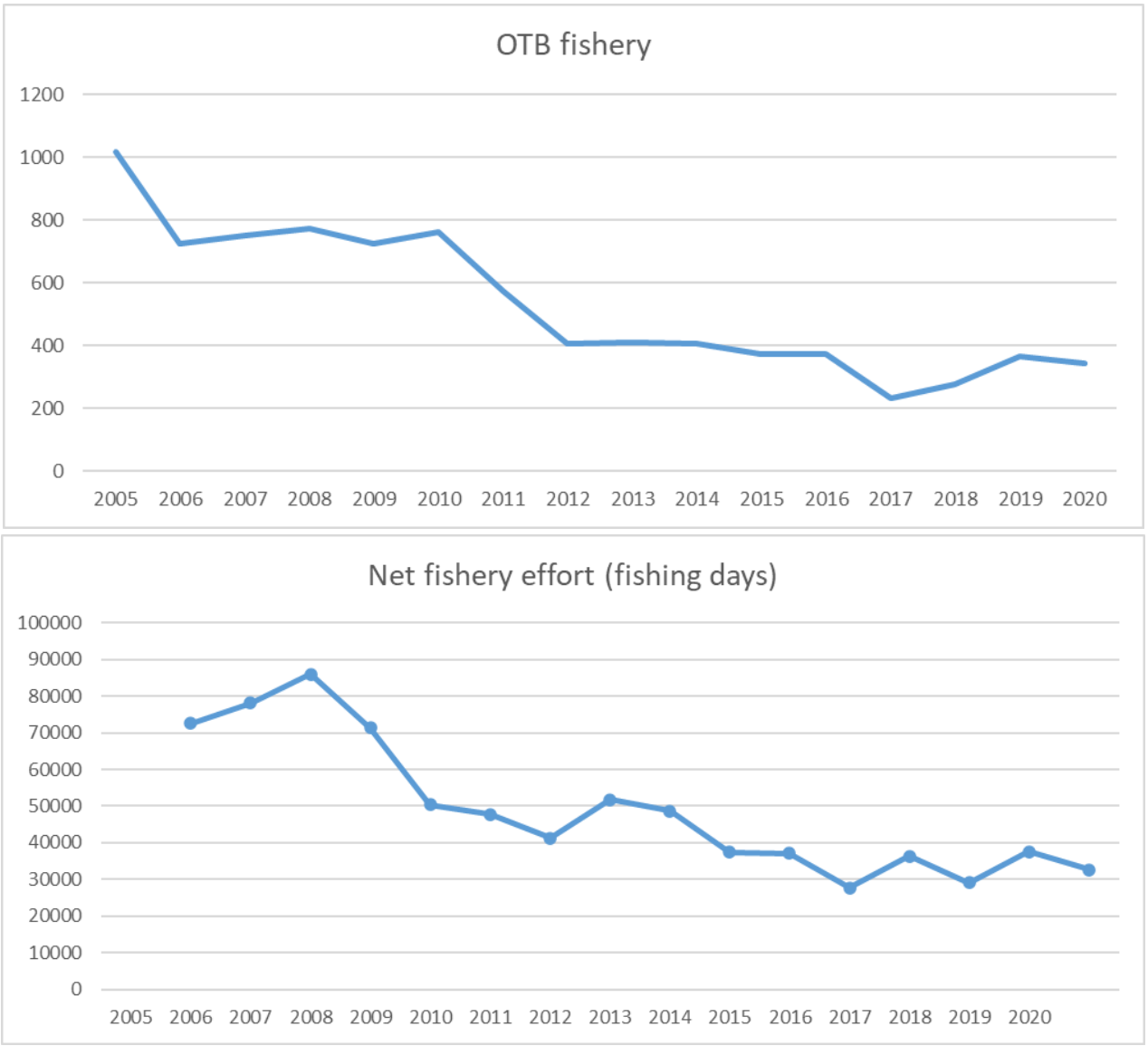


Figure 3.2-4: *Commercial fishing effort for the period 2005-2020 per fleet*.

2.3 Management regulations

Current and past management regulations:

1. Polyvalent small-scale vessels (0-6m, 6-12m)

- Restriction of the maximum number of licenses.

  Small scale inshore vessel licenses (Category A&B) are restricted to 500 by legislation; however, the maximum number is further reduced in accordance with the number of vessels that are permanently removed from the fleet through adjustment schemes.

  During 2013, 107 vessels were scrapped with public aid, in accordance with an effort adjustment plan based on Article 21 (a) of Regulation (EC) 1198/2006 on the *European Fisheries Fund* –EFF. In 2014 the maximum number of licenses was reduced accordingly to 393 licenses. During 2015 additional 66 vessels were scrapped with public aid, under the Operational Programme 2014-2020 of the European Marine and Fisheries Fund. Therefore, from 2016 the maximum number of licenses has been reduced to 327 licenses.

- Restrictions on the use of fishing gears depending on the fishing license category.

  Until March 2011 minimum mesh size of nets was set at 32mm (open mesh size). From March 2011 minimum mesh size of nets is set at 38mm (open mesh size).
  Maximum length of nets: For boats with license A is 5000m, for boats with license B is 3000m.
  Maximum height of nets: 4m.
  Restrictions on the time and duration of fishing, depending on mesh sizes.
  Additional restrictions on the use of monofilament nets (mesh sizes, length of nets).

2. Bottom Trawlers in territorial waters

- Restriction of the maximum number of licenses. Before 2006 the maximum number of licenses was restricted to 8, while from 2006 until 2011 the maximum number was reduced to 4. From November 2011 maximum number of licenses is restricted to 2.
- Minimum mesh size: From June 2010 the 40mm diamond shape trawl net has been replaced by a diamond meshed net of 50mm at the cod-end. From November 2011 minimum mesh size of 50mm diamond in any part of the net.
- Depth and distance from the cost restrictions: Prohibition of bottom trawling at depths less than 50m and at distances less than 0.7 nautical miles off the coast.
- Seasonal and Area restrictions:
  - Closed trawling period in territorial waters from 1st of June until the 7th of November (in force since the mid '80s).
  - Prohibition of bottom trawling in the Zygi coastal area, at a distance of 3 nautical miles from the coast.
  - Restriction of 2 areas from fishing with trawl nets, on a rotational basis (northwest part of Cyprus from 8 November – 15 February, southeastern part from 16 February – 31 May every year). Applied from November 2011.

2.4 Reference points

Table 2.3-1: List of reference points and empirical reference values previously agreed (if any)

Indicator	Limit Reference point/empirical reference value	Value	Target Reference point/empirical reference value	Value	Comments
B					
SSB					
F					
Y					
CPUE					
Index of Biomass at sea					

3 Fisheries independent information

In the absence of reliable landings, length and growth parameters data, the method used for delivering the stock assessment of the species was a Bayesian Abundance Maximum Sustainable Yield method (AMSY) which made use of the Biomass Index coming from the MEDITS trawl survey (Figure 4.1-1). This is the only fisheries independent information available for the species. In 2014 due to administrative issues the survey was not performed. The BCrumb state space model was used to interpolate the missing year data as AMSY cannot accommodate data gaps in time series of index.

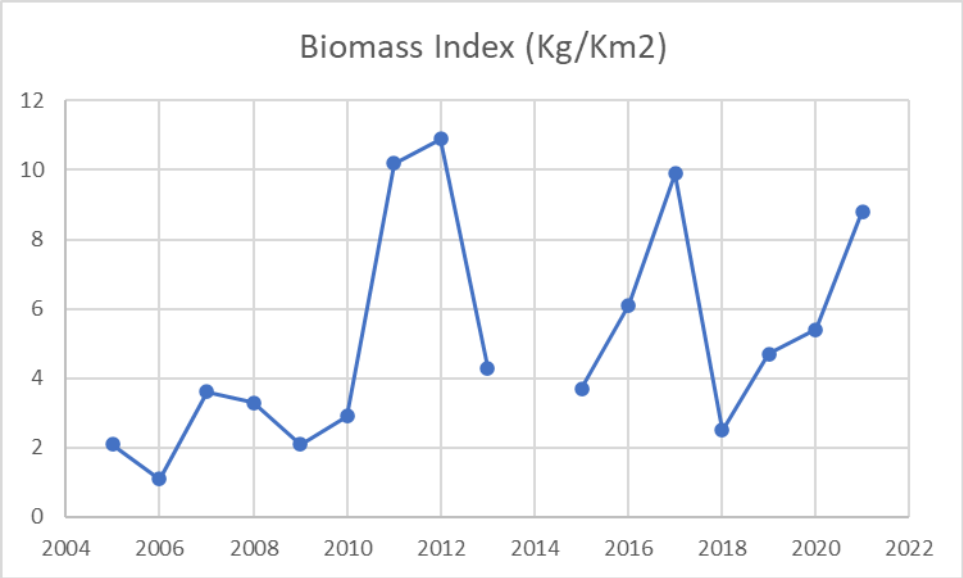


Figure 4.1-1: Raja clavata MEDITS Biomass index (Kg/m^2) for the years 2005 - 2021.

4 Ecological information

4.1 Protected species potentially affected by the fisheries

The protected species that are potentially affected by the fisheries are the two turtle species (*Chelonia mydas*, *Caretta caretta)* encountered in Cyprus waters, and cetaceans (*Tursiops truncatus).* The interaction of the net fisheries with cetaceans involves mostly the damage of fishing gear and caught fish eaten by the dolphins.

4.2 *In general, the catch of protected species (shark species, turtles, monk seal, cetaceans) is prohibited in accordance with international obligations (including relevant GFCM recommendations), and data on incidental catches are collected.* Environmental indexes

No environmental indices are used in the assessment.

5 Stock Assessment

5.1 Abundance Maximum Sustainable Yield- AMSY

AMSY (Froese et al. 2019) Bayesian methodology was developed as a measure to assess stocks in cases that analytic data for running full stock assessments are missing but standardized CPUE or other reliable abundance indices are available. Combined with resilience data prior that can be derived from either Fishbase or Length Based Bayesian Biomass Estimator (LBB) estimates the relative population size and delivers key fisheries reference points (Fmsy, F/Fmsy, B/Bmsy). In addition to CPUE and resilience AMSY requires a prior range as a ballpark estimation for the relative stock size for one year in the timeseries.

AMSY takes all the above information (CPUE, resilience prior, biomass prior) and tests it over a high number of productivity combinations of the maximum intrinsic rate of population increase (r) and the unexploited stock size (k) for their compatibility with these inputs. In this manner r-k pairs that would predict negative catches or catches higher than the available biomass can be considered as incompatible with the inputs and can be excluded from the analysis. Diagnostics plots and presentation of the outcomes are given as outputs together with assessment results and managerial related plots.

5.1.1 Model assumptions

AMSY estimates of exploitation come with wide margins of uncertainty, which hinder the suitability for management based on this metric. However, AMSY seems to estimate relatively well the productivity as well as relative stock size which aid in the management of data-poor or stocks or in cases that landings are not reliable.

5.1.2 Parametrization and Script Used

Resilience priors play an important role in Bayesian statistics as the reliability of the results depend solely on the use of an appropriate prior distribution (Myers et al. 2002). As the results of LBB model attempted (which can deliver informative priors coming from stock specific length measurements) were not considered reliable, resilience priors for RJC were obtained from the database of FishBase. A wide range of values were initially used for the exploitation of priors based on the information and status of Cyprus fisheries. The final model configuration and settings are provided bellow. All R scripts were uploaded at the dedicated folder of the GFCM WGSAD SharePoint.

CPUE_File	Stock	Name	EnglishName	ScientificName	StartYear	EndYear	Resilience	r.low	r.hi	Bk.yr	Bk.pr	Bk.pr.low	Bk.pr.hi	e.creep	Comment
CPUE.csv	RAJACLA_GSA25	Cyprus	NA	Raja clavata	2005	2021	Low		NA	NA	2005	About half	NA	NA	NA	

```
#---------------------------------------
# General R code settings for the analysis
#---------------------------------------
smooth.cpue  <- T # set to TRUE to apply ksmooth with minimum bandwidth
filter       <- TRUE # set to TRUE for Monte Carlo filtering
cor.log.rk   <- -0.607 empirical value of log r-k correlation
sigma.r      <- c(0.05,0.07,0.1,0.15) # overall process error for productivity or r
sigma.cpue   <- 0.10 # observation error for cpue
n.p          <- 50000 # number of r-kq pairs to be analysed;
n.trial      <- 30 # times each year is calculated with new random error terms for r and cpue
min.viable   <- 20 # minimum number of viable r-kq pairs to be accepted for analysis
max.viable   <- 5000 # maximum number of viable r-kq pairs to reduce processing time
creep.graph  <- T # plot graph for effort creep correction, if used
do.plots     <- TRUE # retrospective analysis does not work if FALSE
write.output <- T # set to TRUE if table with results in output file is wanted
kobe.plot    <- T # HW set to TRUE so produce additional kobe status plot
save.plots   <- T # set to TRUE to save graphs to JPEG files
close.plots  <- T # set to TRUE to close on-screen plots
retros       <- T # retrospective analysis, requires do.plots <- TRUE
```

5.1.3 Results

The assessment indicates that *Raja clavata* in GSA25 seems to be in sustainable exploitation (F/Fmsy = 0.15) with high biomass (B/Bmsy = 1.91).

The graphical representation of the model outcome is given in Figure 6.1.3-1. Focusing on the most important outcomes we see that the exploitation rate started at relatively high levels in 2005 and it was reduced to sustainable levels after 2007. Biomass levels (B/Bmsy) started at an intermediate level around 0.75 and overpassed the sustainable levels after 2009. The Kobe managerial plot is also presented in Figure 6.1.3.2 showing all the evolution of exploitation trajectory.

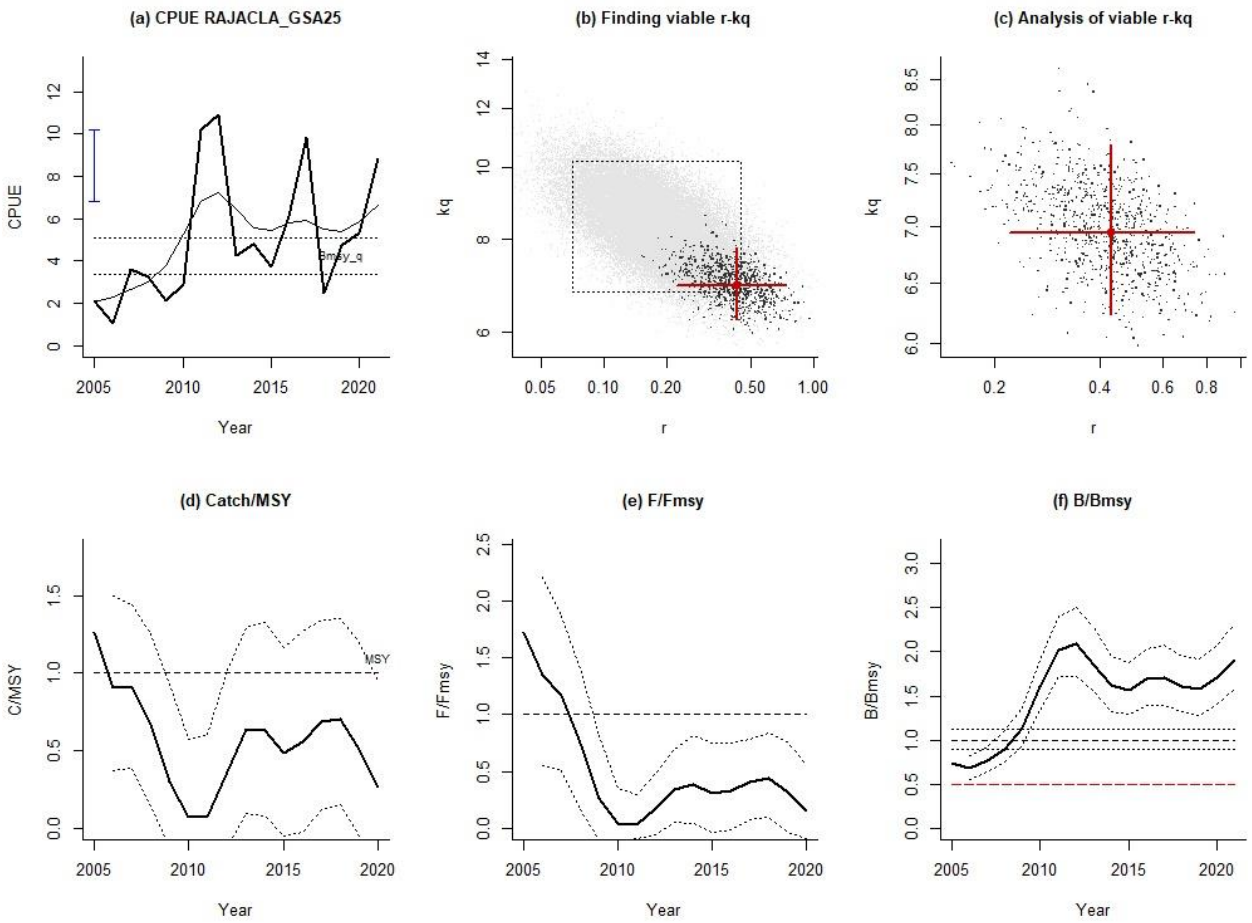


Fig. 6.1.3-1. *Stock assessment results for Raja clavata in GSA-25.* The bold curve in panel Figure 2a presents the time series of biomass index used in the analysis. The dotted horizontal lines indicate the prior bounds for the CPUE level that sets the area where B_{msy},. The blue vertical line on the left shows the prior stock size B/B0. Figure 2b indicates all the r-kq pairs that were tested by AMSY. The black dots represent 'viable' r-kq pairs. Figure 2c magnifies the area occupied by the viable *r-*k_q pairs. Figure 2d shows the time series of the median relative to catch predicted by AMSY. Figure 2e represents the time series of fishing pressure F/F_{msy} predicted by AMSY. Figure 2f shows the time series of CPUE expressed as B/B_{msy} in an MSY framework, as informed processed by the AMSY filters.

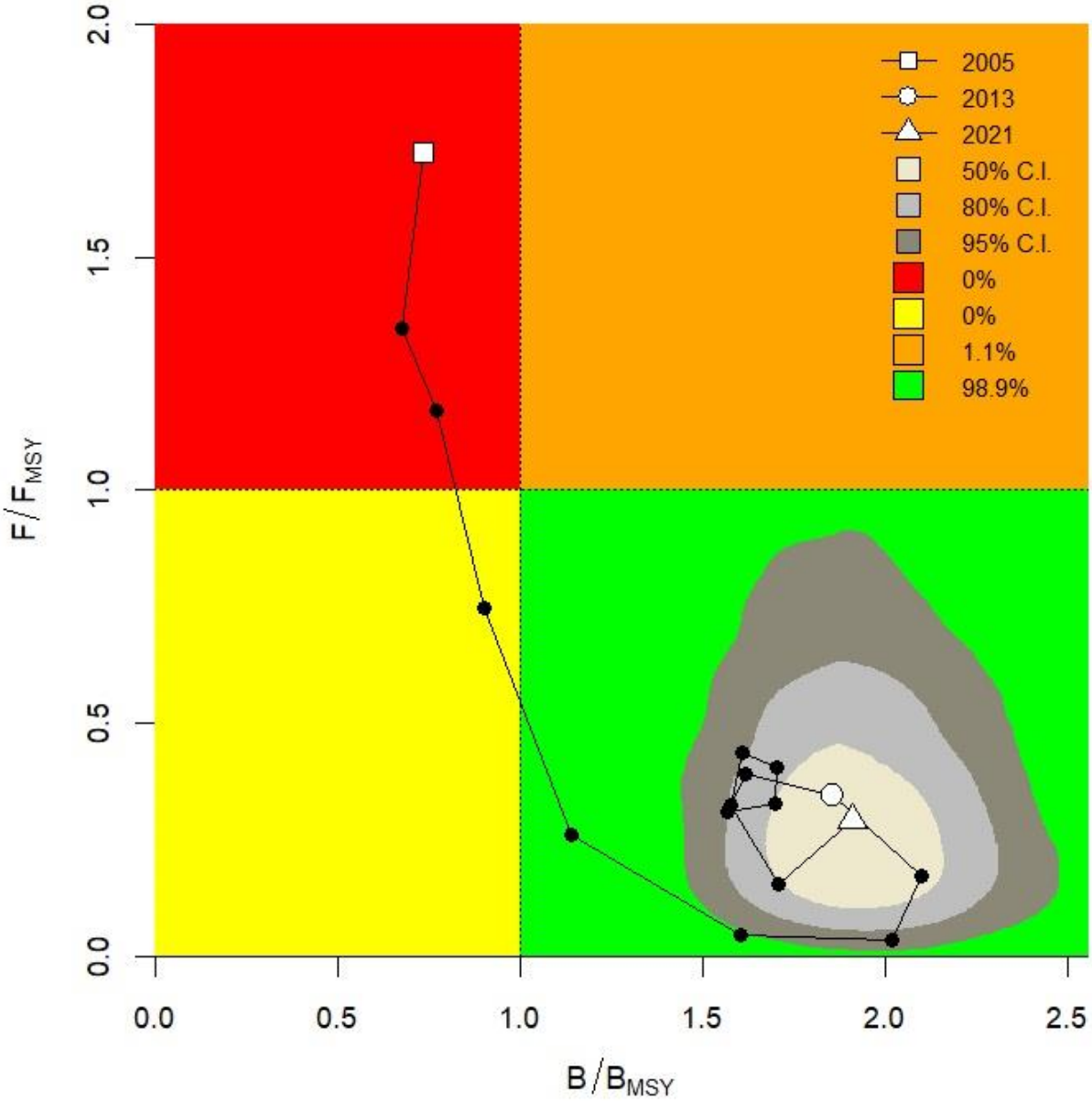


Fig. 6.1.3-2. *Kobe plot showing the timeseries of Exploitation (F/Fmsy) over Biomass (B/Bmsy).*

5.1.4 Robustness analysis

5.1.5 Retrospective analysis, comparison between model runs, sensitivity analysis, etc.

Retrospective analysis doesn't show a significant bias. The retrospective plots deviate slightly from the reference but the trajectory they follow is pointing to the reference direction (Fig. 6.1.5-1).

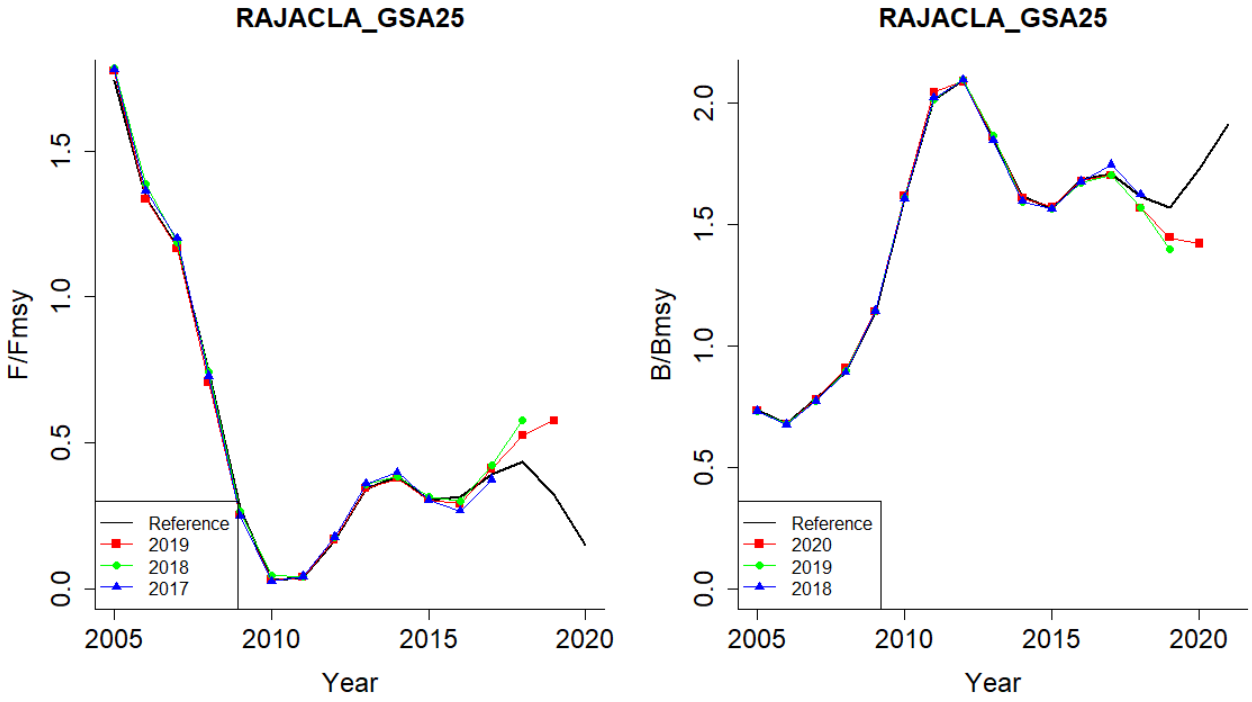
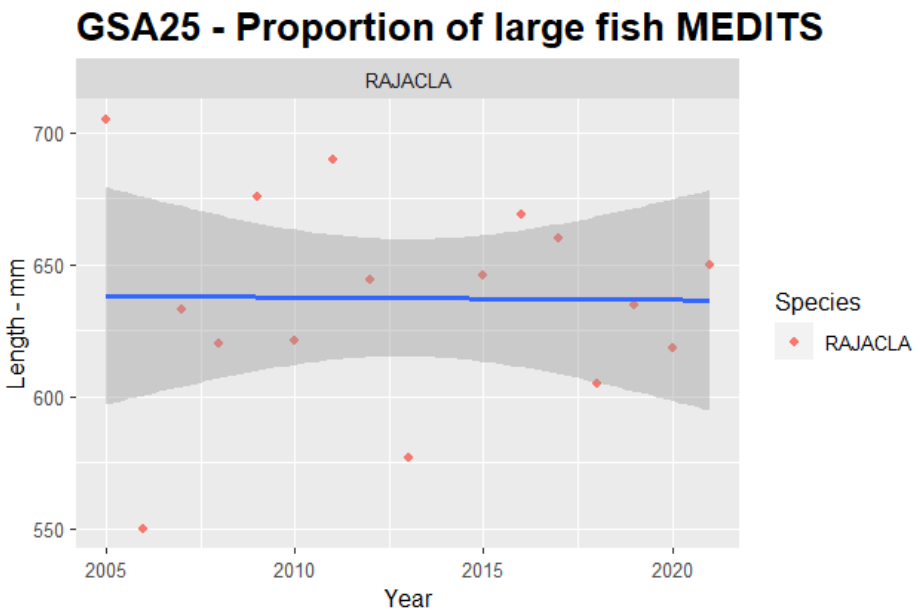


Fig. 6.1.5-1. *Raja clavata GSA25 AMSY retrospective analysis plots of F/Fmsy and B/Bmsy.*

5.1.6 Assessment quality

Based on the type of the model used and the fact that the resilience priors used are coming from FishBase rather than the LBB methodology which derives informed priors from direct length measurements of the stock the group felt more confident to validate the assessment as qualitative.

5.1.7 Auxiliary methods



ICES CIEM Used when an index of abundance or biomass is available

Stock Categories: 3

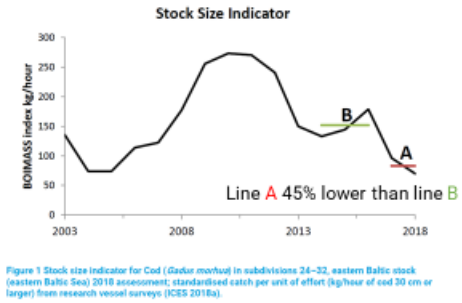
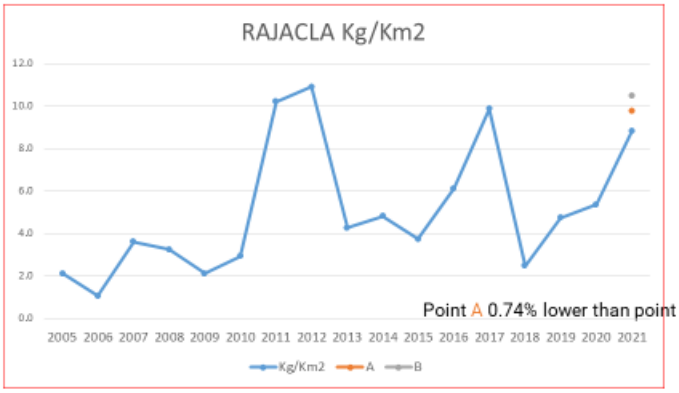


Figure 1 Stock size indicator for Cod (*Gadus morhua*) in subdivisions 24–32, eastern Baltic stock (eastern Baltic Sea) 2018 assessment; standardised catch per unit of effort (kg/hour of cod 30 cm or larger) from research vessel surveys (ICES 2018a).



Recent trend in biomass is assessed by calculating the mean biomass index in the last two survey years (index A) compared with the previous three (index B) years

6 Stock predictions

Draft scientific advice

Based on	Indicator	Analytic al reference point (name and value)	Current value from the analysis (name and value)	Empirical reference value (name and value)	Trend (time period)	Stock Status
Fishing mortality	Fishing mortality	F/F_{msy} : 0.154			D	S
	Fishing effort				D	
	Catch					
Stock abundance	Biomass	B/B_{msy}: 1.91			I	O_H
Recruitment						
Final Diagnosis		In sustainable exploitation with high biomass				

State the rationale behind that diagnoses, explaining if it is based on analytical or on empirical references

6.1 Explanation of codes

Trend categories

1) N - No trend
2) I - Increasing
3) D – Decreasing
4) C - Cyclic

Stock Status

Based on Fishing mortality related indicators

1) **N - Not known or uncertain** – Not much information is available to make a judgment;
2) **U - undeveloped or new fishery** - Believed to have a significant potential for expansion in total production;
3) **S - Sustainable exploitation**- fishing mortality or effort below an agreed fishing mortality or effort based Reference Point;
4) **IO –In Overfishing status**– fishing mortality or effort above the value of the agreed fishing mortality or effort based Reference Point. An agreed range of overfishing levels is provided;

Range of Overfishing levels based on fishery reference points

In order to assess the level of overfishing status when $F_{0.1}$ from a Y/R model is used as LRP, the following operational approach is proposed:

- If $Fc^*/F_{0.1}$ is below or equal to 1.33 the stock is in **(O_L): Low overfishing**
- If the $Fc/F_{0.1}$ is between 1.33 and 1.66 the stock is in **(O_I): Intermediate overfishing**
- If the $Fc/F_{0.1}$ is equal or above to 1.66 the stock is in **(O_H): High overfishing**

*Fc is current level of F

5) **C- Collapsed**- no or very few catches;

Based on Stock related indicators

1) **N - Not known or uncertain:** Not much information is available to make a judgment
2) **S - Sustainably exploited:** Standing stock above an agreed biomass based Reference Point;
3) **O - Overexploited**: Standing stock below the value of the agreed biomass based Reference Point. An agreed range of overexploited status is provided;

Empirical Reference framework for the relative level of stock biomass index

- **Relative low biomass:** Values lower than or equal to 33rd percentile of biomass index in the time series **(O_L)**
- **Relative intermediate biomass:** Values falling within this limit and 66th percentile **(O_I)**
- **Relative high biomass:** Values higher than the 66th percentile **(O_H)**

4) **D – Depleted**: Standing stock is at lowest historical levels, irrespective of the amount of fishing effort exerted;
5) **R –Recovering:** Biomass are increasing after having been depleted from a previous period;

Agreed definitions as per SAC Glossary

Overfished (or overexploited) *- A stock is considered to be overfished when its abundance is below an agreed biomass based reference target point, like B0.1 or BMSY. To apply this denomination, it should be assumed that the current state of the stock (in biomass) arises from the application of excessive fishing pressure in previous years. This classification is independent of the current level of fishing mortality.*

Stock subjected to overfishing (or overexploitation) *- A stock is subjected to overfishing if the fishing mortality applied to it exceeds the one it can sustainably stand, for a longer period. In other words, the current fishing mortality exceeds the fishing mortality that, if applied during a long period, under stable conditions, would lead the stock abundance to the reference point of the target abundance (either in terms of biomass or numbers)*