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Global Standard for Responsible Supply of Marine Ingredients
Fishery Assessment Methodology and Template Report V2.0

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of Marine Ingredients

Fishery Under Assessment	Japanese pilchard *Sardinops sagax* FAO 67, 77 (West Coast USA)
Date	May 2019
Assessor	Jim Daly

Application details and summary of the assessment outcome	
Name: T.C. Union Agrotech Co. Ltd	
Address:	
Country: Thailand	Zip:
Tel. No.:	Fax. No.:
Email address:	Applicant Code
Key Contact:	Title:

Certification Body Details				
Name of Certification Body:	SAI Global Ltd			
Assessor Name	Peer Reviewer	Assessment Days	Initial/Surveillance/Re-approval	Whole fish/ By-product
Jim Daly	Virginia Polonio	0.5	Re-approval	By-product
Assessment Period	2018			

Scope Details	
Management Authority (Country/State)	USA/Mexico
Main Species	*Sardinops sagax*
Fishery Location	FAO 67, 77
Gear Type(s)	Purse seine
Outcome of Assessment	
Overall Outcome: Northern Stock (Baja California to Alaska)	FAIL
Clauses Failed: Northern Stock (Baja California to Alaska)	C1.2
Overall Outcome: Gulf of California Stock:	PASS
Peer Review Evaluation:	Agree with the overall outcome of the assessment
Recommendation	

Assessment Determination

This species is known under a variety of common names. Off the West coast of North America the species is more commonly known as the Pacific sardine, Monterrey sardine or Californian sardine.

Three subpopulations are found off the West coast of North America (FAO 67, 77): Northern Baja California to Alaska (FAO 67); Central and Southern Baja California and the Gulf of California (FAO 77). The fishery and this assessment is mainly concentrated on the Northern and Gulf of California subpopulations (**Figure 1).**

Both the Northern and Gulf of California subpopulations are subject to species-specific management and are therefore assessed under clause C of this report. In both subpopulations fishery removals are included in the stock assessment process. The Northern subpopulation is considered, in its most recent stock assessment, to have a biomass below proxy limit reference point and removals from the fishery are not considered negligible. Management advice for the northern population for the 2017 and 2018 fishing season was zero catch. This subpopulation fails clause C.

The Gulf of California subpopulation is considered, in its most recent stock assessment, to have a biomass above limit proxy reference point so the subpopulation passes clause C.

Japanese /South American Pilchard (*Sardinops sagax*) is classed as of least concern on the IUCN Red List of Threatened Species and is not listed on the CITES list of endangered species (accessed 13.05.19).

The Gulf of California subpopulation of *Sardinops sagax* in the assessment area is recommended for approval as by-product material under the IFFO RS Standard. The Northern subpopulation of *Sardinops sagax* is not recommended for approval.

Peer Review Comments

Notes for On-site Auditor

Ensure separation of Northern subpopulation of *Sardinops sagax* from other IFFO-RS approved material.

Species-Specific Results

Category	Species	% landings	Outcome (Pass/Fail)	
Category A			A1	
			A2	
			A3	
			A4	
Category B				
Category C	*Sardinops sagax*	N/A	Pass: Gulf of California stock.	
Category C	*Sardinops sagax*	N/A	Fail: Northern subpopulation.	
Category D				

[List all Category A and B species. List approximate total %age of landings which are Category C and D species; these do not need to be individually named here]

HOW TO COMPLETE THIS ASSESSMENT REPORT

This assessment template uses a modular approach to assessing fisheries against the IFFO RS standard.

Whole Fish

The process for completing the template for a **whole fish** assessment is as follows:

1. ALL ASSESSMENTS: Complete the Species Characterisation table, to determine which categories of species are present in the fishery.
2. ALL ASSESSMENTS: Complete clauses M1, M2, M3: Management.
3. IF THERE ARE CATEGORY A SPECIES IN THE FISHERY: Complete clauses A1, A2, A3, A4 for **each** Category A species.
4. IF THERE ARE CATEGORY B SPECIES IN THE FISHERY: Complete the Section B risk assessment for **each** Category B species.
5. IF THERE ARE CATEGORY C SPECIES IN THE FISHERY: Complete clause C1 for **each** Category C species.
6. IF THERE ARE CATEGORY D SPECIES IN THE FISHERY: Complete Section D.
7. ALL ASSESSMENTS: Complete clauses F1, F2, F3: Further Impacts.

A fishery must score a pass in **all applicable clauses** before approval may be recommended. To achieve a pass in a clause, the fishery/species must meet **all** of the minimum requirements.

By-products

The process for completing the template for **by-product raw material** is as follows:

1. ALL ASSESSMENTS: Complete the Species Characterisation table with the names of the by-product species and stocks under assessment. The '% landings' column can be left empty; all by-products are considered as Category C and D.
2. IF THERE ARE CATEGORY C BYPRODUCTS UNDER ASSESSMENT: Complete clause C1 for **each** Category C by-product.
3. IF THERE ARE CATEGORY D BYPRODUCTS UNDER ASSESSMENT: Complete Section D.
4. ALL OTHER SECTIONS CAN BE DELETED. Clauses M1 - M3, F1 - F3, and Sections A and B do not need to be completed for a by-product assessment.

By-product approval is awarded on a species-by-species basis. Each by-product species scoring a pass under the appropriate section may be approved against the IFFO RS Standard.

SPECIES CATEGORISATION

The following table should be completed as fully as the available information permits. Any species representing more than 0.1% of the annual catch should be listed, along with an estimate of the proportion of the catch each species represents. The species should then be divided into Type 1 and Type 2 as follows:

- **Type 1 Species** can be considered the 'target' or 'main' species in the fishery. They make up the bulk of annual landings and are subjected to a detailed assessment.
- **Type 2 Species** can be considered the 'bycatch' or 'minor' species in the fishery. They make up a small proportion of the annual landings and are subjected to relatively high-level assessment.

Type 1 Species must represent 95% of the total annual catch. Type 2 Species may represent a maximum of 5% of the annual catch (see Appendix B).

Species which make up less than 0.1% of landings do not need to be listed (NOTE: ETP species are considered separately). The table should be extended if more space is needed. Discarded species should be included when known.

The 'stock' column should be used to differentiate when there are multiple biological or management stocks of one species captured by the fishery. The 'management' column should be used to indicate whether there is an adequate management regime specifically aimed at the individual species/stock. In some cases it will be

immediately clear whether there is a species-specific management regime in place (for example, if there is an annual TAC). In less clear circumstances, the rule of thumb should be that if the species meets the minimum requirements of clauses A1-A4, an adequate species-specific management regime is in place.

NOTE: If any species is categorised as Endangered or Critically Endangered on the IUCN Red List, or if it appears in the CITES appendices, it **cannot** be approved for use as an IFFO RS raw material. This applied to whole fish as well as by-products.

TYPE 1 SPECIES (Representing 95% of the catch or more)
Category A: Species-specific management regime in place.
Category B: No species-specific management regime in place.

TYPE 2 SPECIES (Representing 5% OF THE CATCH OR LESS)
Category C: Species-specific management regime in place.
Category D: No species-specific management regime in place.

Common name	Latin name	Stock	% of landings	Management	Category
Japanese pilchard/ California sardine/ Monterrey sardine/ Pacific sardine	*Sardinops sagax*	Northern subpopulation	N/A	Species-specific management (USA)	C
		Gulf of California	N/A	Species-specific management (Mexico)	C

CATEGORY C SPECIES

In a whole fish assessment, Category C species are those which make up less than 5% of landings, but which are subject to a species-specific management regime. In most cases this will be because they are a commercial target in a fishery other than the one under assessment. In a by-product assessment, Category C species are those which are subject to a species-specific management regime, and are usually targeted species in fisheries for human consumption.

Clause C1 should be completed for **each** Category C species. If there are no Category C species in the fishery under assessment, this section can be deleted. A Category C species does not meet the minimum requirements of clause C1 should be re-assessed as a Category D species.

Species Name		Pacific /Monterrey Sardine; Japanese pilchard Sardinops sagax	
C1	**Category C Stock Status - Minimum Requirements**		
	C1.1	Fishery removals of the species in the fishery under assessment are included in the stock assessment process, OR are considered by scientific authorities to be negligible. Northern subpopulation: Gulf of California:	**PASS (for both stocks)**
	C1.2	The species is considered, in its most recent stock assessment, to have a biomass above the limit reference point (or proxy), OR removals by the fishery under assessment are considered by scientific authorities to be negligible: Northern subpopulation: Gulf of California:	**FAIL-Northern Subpopulation** **PASS- Gulf of California Subpopulation**
Clause outcome:			**Pass for Northern Subpopulation** **Fail for Gulf of California Subpopulation**

Evidence:

Three sub-populations occur off the West Coast of North America: Northern Baja California to Alaska (Northern subpopulation); Central and Southern Baja California and the Gulf of California. The fishery and this assessment is concentrated on the Northern subpopulation and Gulf of California stocks (**Figure 1**).

Northern subpopulation (FAO 67):
C1.1:
The northern subpopulation of *Sardinops sagax* is assessed by the US National Marine Fisheries Service (NMFS), part of NOAA (R2). The stock extends from Northern Baja California, Mexico to British Columbia, Canada and also up to 300nm offshore.

The latest stock assessment (Hill K.T. *et al*, 2017, R2) used two approaches, a survey-based approach (AT) and a model-based assessment (ALT). The model is an integrated assessment model developed using Stock Synthesis (SS version 3.24aa), and includes fishery and survey data collected from mid-2005 through 2016. Input data / specifications include catch data and a July-June biological year with two semesters (S1=July-Dec and S2=Jan-Jun). The current Stock Synthesis model aggregates regional fisheries into a southern 'MEXCAL' fleet and a Northern 'PNW' fleet (**Figure 1**).

Fishery removals of the species in the fishery under assessment are included in the stock assessment process.

Northern subpopulation (FAO 67)

C1.2:

Based on model ALT estimates, the U.S. exploitation rate (defined as the Calendar year catch/Total mid-year biomass) has averaged about 11% since 2005, peaking at 33% in 2013. The U.S. and total exploitation rates were <1% in 2016. Recent catch limits and landings are shown in **Figure 2**; exploitation rates estimated by the ALT model in **Figure 3.**

Stock biomass, used for calculating annual harvest specifications, is defined as the sum of the biomass for sardine ages one and older (age 1+) at the start of the management year. Time series of estimated stock biomass from model ALT and the AT survey are shown in Figure 4. A trend of declining stock biomass has been observed since 2005-06, peaking at 1.8 mmt in 2006, and plateauing at recent historical low levels since 2014. Model ALT stock biomass is projected to be 86,586 mt in July 2017 (**Figure 4**)

It was recommended that management advice for the 2017-2018 fishing year be based upon the model due to forecasting issues. The model estimated stock biomass of *Sardinops sagax* to be below the CUTOFF threshold (150,000mt), the lowest level of biomass for which directed harvest is allowed, and consequently the harvest guideline for directed fisheries in 2017-2018 is 0 mt (Hill *et al*, 2017).

2019 UPDATE:

Commercial fishing for Pacific sardines is prohibited because the population is estimated to be below the precautionary level set by managers. A precautionary measure is built into sardine management to stop directed fishing when the population falls below 150,000 metric tons. The latest population estimate is below that level, and managers have closed the fishery.

Fishery removals of the northern subpopulation are included in the stock assessment process and the subpopulation is considered, in its most recent stock assessment, to have a biomass below the proxy limit reference point**.** The Northern Subpopulation fails clause C 1.2.

Figure 1. Distribution of Pacific sardine, primary commercial fishing areas and modelled fleets. Source: Hill *et al*, 2017 R2
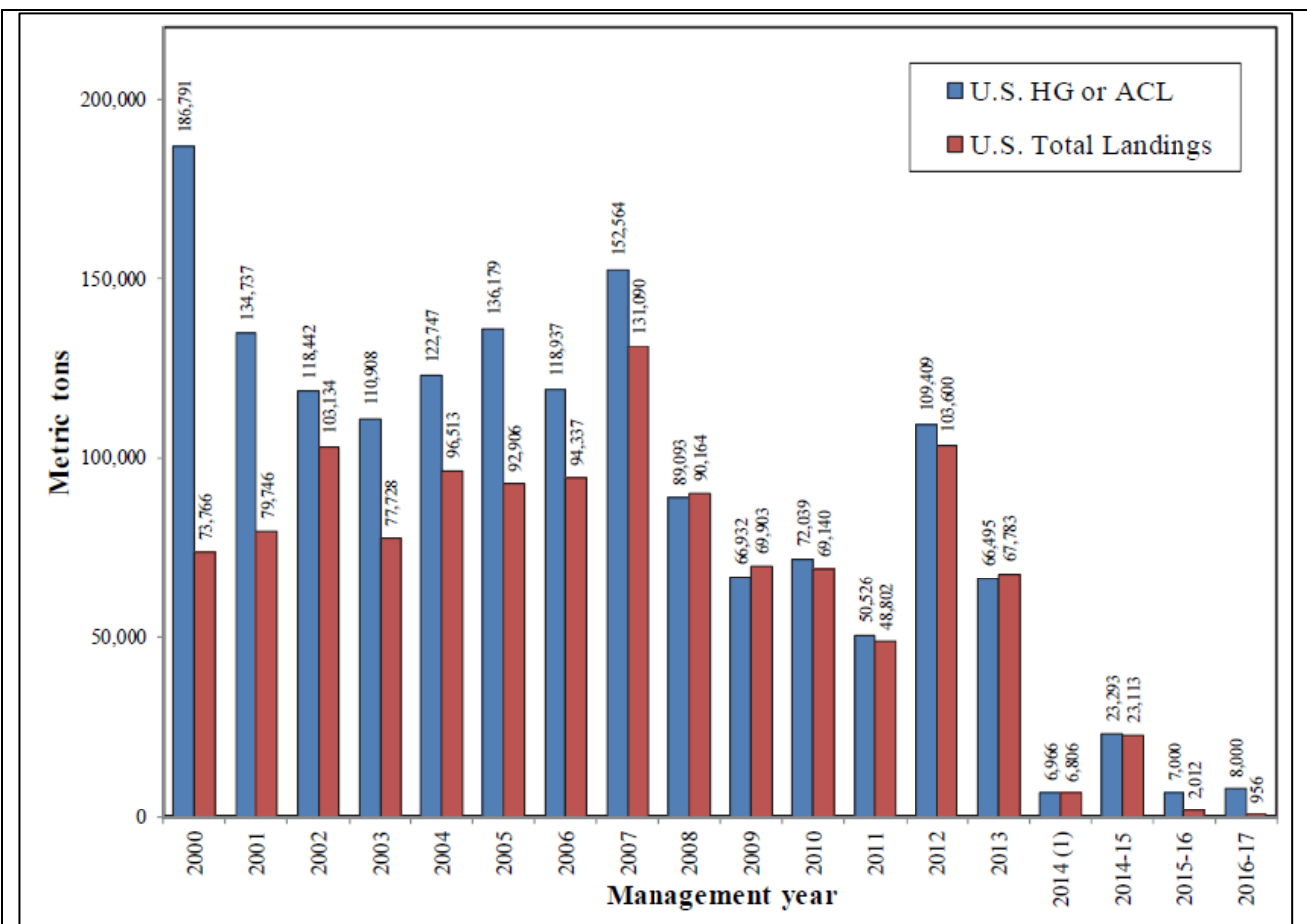
Figure 2. US *Sardinops sagax* harvest guidelines (HG) or acceptable catch limits (ACL) and landings since onset of federal management. Source: Hill K.T. *et al*, 2017. R2

Calendar Year	USA	Total
2005	4.4%	5.4%
2006	4.3%	5.0%
2007	7.0%	8.7%
2008	7.1%	9.9%
2009	7.9%	12.2%
2010	8.8%	14.7%
2011	7.6%	16.5%
2012	26.2%	34.1%
2013	33.1%	40.1%
2014	24.0%	24.4%
2015	4.0%	4.0%
2016	0.4%	0.4%

Figure 3. US and total exploitation rates for the Northern subpopulation, calculated from model ALT. Source: Hill K.T. et al, 2017. R2
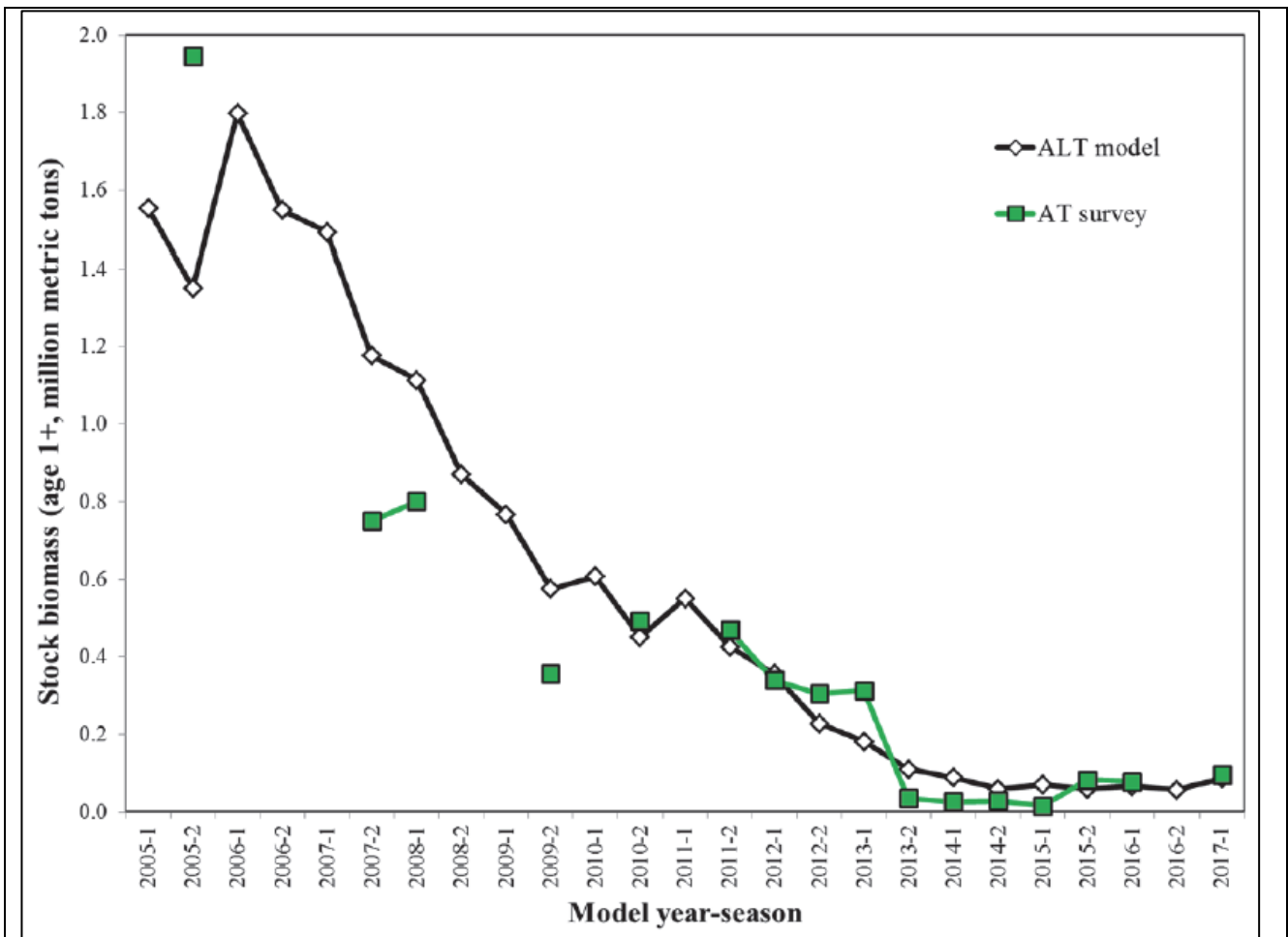
Figure 4. Time series of estimates stock biomass (mmt) from model. ALT and AT survey. Source: Hill K.T. *et al*, 2017. **R2**

Gulf of California subpopulation (FAO 77):
C1.1:

Scientific research and advice in support of the management of Mexican fisheries is provided by the National Fisheries Institute (INAPESCA). A stock assessment of *Sardinops sagax* is conducted annually, and considers all fishery removals and the biological characteristics of the species. Stock assessments use regular Virtual Population Analysis, length based (Jones') VPA and statistical catch at age using the Age Structured Assessment Program (ASAP) using catch and effort data from the fleet. The most recent assessment in 2016 used auxiliary information including; a series of CPUE values from scientific cruises, the indices of abundance from acoustic surveys, an index of egg and larvae, an index representing spawning probability and the proportion of sardines in the diet of seabirds.

Fishery removals of the species in the fishery under assessment are included in the stock assessment process; the stock passes Clause C1.1.

Gulf of California subpopulation (FAO 77):
C1.2:

In recent years the status of the *Sardinops sagax* Gulf of California stock (Pacific or Monterrey sardine) has been of concern due to a sharp decline in catches from a historic high of around half a million tons in seasons 2007/08 and 2008/09 down to 3,571 tons in season 2013/14 and 4,455 tons in season 2014/15 (**Figure 5**). Although these catches were obtained in seasons when the fleet agreed to suspend effort on Pacific sardine, the records represent historic lows for the fishery. The stock assessments concluded that recruitment is highly

variable and suggested that environmental conditions, notably El Niño events, may play an important role in such variability. These assessments also indicate that total abundance closely follows the trend in recruitment (Alvarez et al, 2017. **R1**)
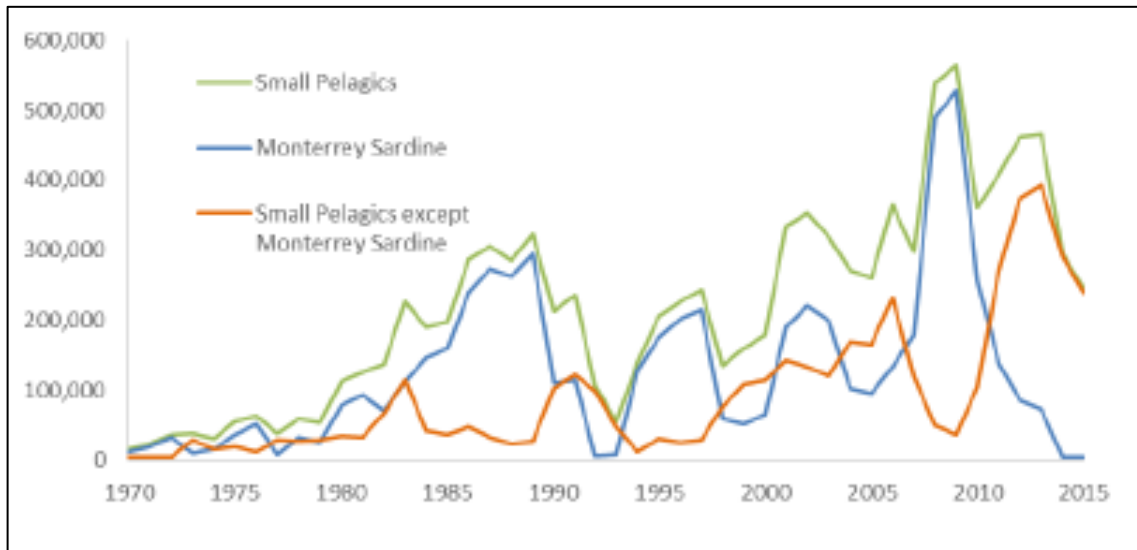

Figure 5. Comparative trends of catch history for *Sardinops sagax* (Monterrey sardine) vs all other small pelagic species in the fishery of the northern/central Gulf of California, Mexico. From data of Nevárez-Martínez et al. 2016a. Source: Alvarez *et al*, 2017.R1

However, Alvarez et al, 2017 refer to evidence that indicates overfishing may have played a role in the fall of the *Sardinops sagax* stock in the early 1990s (**Figure 6).** Comparison of the reported trend in the catch compared to the estimated historic values of the Biologically Acceptable Catch (BAC) shows that in the late 1980s and early 1990s, the actual catch may have been close to the BAC or exceeded it **R1**. A similar pattern appears more recently from around 2008 and overfishing may have taken place momentarily as a result of unfavourable environmental conditions not being accounted for in management.

[Note: Biologically Acceptable Catch = a prudent level of catch that can vary between 5 and 25% of the estimated biomass although fishing mortality rate producing MSY has been estimated in the most recent stock assessment at 0.29 (Nevarez-Martinez 2016, cited in Alvarez et al, 2017. R1)].
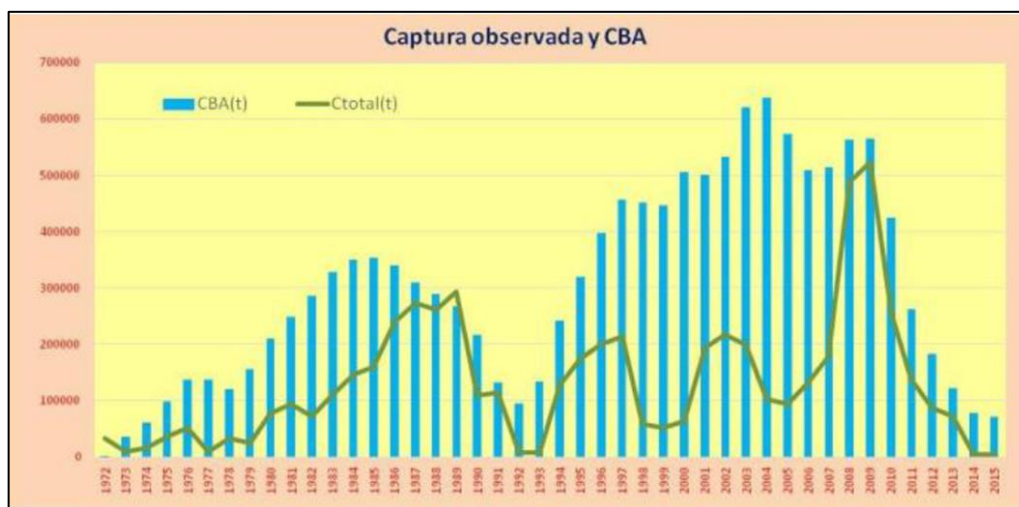

Figure 6. Comparison of catch records (green line) of *Sardinops sagax* in the Gulf of California with the estimated Biologically Acceptable Catch (bars) obtained with the control rule in the Management Plan. Reproduced from Nevarez-Martinez et al. 2016. Source: Alvarez et al, 2017. R1

The occurrence of a strong El Niño event was confirmed in 2015. Under these oceanographic conditions INAPESCA consider that the best possible explanation for the recent low catches is that the stock has shifted distribution to the north of the Gulf, and to deeper waters making the fish unavailable to the fishery.

Fisheries independent cruises, with the ability to detect biomass to a depth of 250 m were conducted by INAPESCA in 2014 and showed that most small pelagic species, including the *Sardinops sagax*, were scattered and in low abundance which reflected the low availability to the fishery (operates between 40 and 100m). The expectation is for the abundance of *Sardinops sagax* to continue at low levels until the 2020s.

The most recent assessment by Nevarez-Martinez et al. (2016, cited in Alvarez et al, 2017. **R1**) estimated total biomass at nearly one million tonnes whereas adult biomass was estimated to be around 420,000 tonnes between 2013/14 and 2014/15. The biomass was estimated by acoustic methods, but Alvarez et al (2017) note expert advice that these are underestimates of true abundance as a result of technical issues with the survey.

The assessment estimated that F was, for most of the time series under 0.15 with the exception of the periods in the late 1980s/early 1990s and from 2008 to 2013. During these periods the harvest rate exceeded 0.18 which corresponds to 0.29, the ASAP estimate of the fishing mortality rate producing MSY (Fmsy). It is therefore estimated that except for these periods, the stock has not been through periods of overfishing and has been under the BAC (consistent with achieving MSY).

2019 Update:
The latest stock assessment reports indicate that the stock has been stable in the last 3 years with spawning stock biomas (SSB) around Bmsy (533,000 tonnes). Fishing mortality is considered to be very low, however peer review of the methodology detected methodological errors indicating that F values are underestimated. R4.

This fishery is regulated under the Norma Oficial Mexicana (NOM) 003-PESC-1993. R5.
A management plan in place has the following required actions/objectives:
- Minimum size limit for Pacific sardine of 150 mm.
- Area/Fishing closures during spawning periods (August-September).
- Port sampling programme to collect age and size data.
- Total catches for the fishery are documented through landing slips / fishing vessel for each trip.

Fishery removals of the Gulf of California subpopulation are included in the stock assessment process and the subpopulation is considered, in its most recent stock assessment, to have a biomass above the limit reference point (or proxy). The subpopulation passes clause C.

References
R1 Alvarez, C., Andraka, S., Anhalzer, G. and Morgan, S. (2017). Small Pelagics Fishery in Sonora, Gulf of California. MSC Fishery Assessment Report. December 19, 2017. SCS Global Services Ltd.
https://fisheries.msc.org/en/fisheries/small-pelagics-fishery-in-sonora-gulf-of-california/@@assessments

R2 Hill, K.T., P.R. Crone, J.P. Zwolinski, 2017. Assessment of the Pacific sardine resource in 2017 for U.S. management in 2017-18. US Department of Commerce. NOAA Tech. Memo. NMFS-SWFSC-576. 262 p.
http://www.pcouncil.org/wp-content/uploads/2017/05/Appendix-C-2017-sardine-assessment-NOAA-TM-NMFS-SWFSC-576.pdf

R3 Fishsource South American Pilchard *S.sagax*: https://www.fishsource.org/stock_page/1953

> **R4** SCS Global Services Report. 2018. Small Pelagics Fishery In Sonora, Gulf of California. MSC Fishery Assessment Report- Public Certification Report. 363 pp.
> https://cert.msc.org/FileLoader/FileLinkDownload.asmx/GetFile?encryptedKey=yHo1ADc6rEFZpAwyFhB061LIgQfRoY4i8/BFKvGIuXFlC5kCw6VCdStkyBvkF1X2
>
> **R5** Norma Oficial Mexicana (NOM) 003-PESC-1993:
> https://www.inapesca.gob.mx/portal/documentos/publicaciones/pelagicos/NOM003pesc1993SARDINA.pdf
>
> *Standard clauses 1.3.2.2*

SOCIAL CRITERION

In addition to the scored criteria listed above, applicants must commit to ensuring that vessels operating in the fishery adhere to internationally recognised guidance on human rights. They must also commit to ensuring there is no use of enforced or unpaid labour in the fleet(s) operating upon the resource.

Appendix A - Determining Resilience Ratings

The assessment of Category B species described in this assessment report template utilises a resilience rating system suggested by the American Fisheries Society. This approach was chosen because it is also used by FishBase, and so the resilience ratings for many thousands of species are freely available online. As described by FishBase, the following is the process used to arrive at the resilience ratings:

"*The American Fisheries Society (AFS) has suggested values for several biological parameters that allow classification of a fish population or species into categories of high, medium, low and very low resilience or productivity (Musick 1999). If no reliable estimate of r_m (see below) is available, the assignment is to the lowest category for which any of the available parameters fits. For each of these categories, AFS has suggested thresholds for decline over the longer of 10 years or three generations. If an observed decline measured in biomass or numbers of mature individuals exceeds the indicated threshold value, the population or species is considered vulnerable to extinction unless explicitly shown otherwise. If one sex strongly limits the reproductive capacity of the species or population, then only the decline in the limiting sex should be considered. We decided to restrict the automatic assignment of resilience categories in the Key Facts page to values of K, t_m and t_{max} and those records of fecundity estimates that referred to minimum number of eggs or pups per female per year, assuming that these were equivalent to average fecundity at first maturity (Musick 1999). Note that many small fishes may spawn several times per year (we exclude these for the time being) and large live bearers such as the coelacanth may have gestation periods of more than one year (we corrected fecundity estimates for those cases reported in the literature). Also, we excluded resilience estimates based on r_m (see below) as we are not yet confident with the reliability of the current method for estimating rm. If users have independent r_m or fecundity estimates, they can refer to Table 1 for using this information.*"

Parameter	High	Medium	Low	Very low
Threshold	0.99	0.95	0.85	0.70
r_{max} (1/year)	> 0.5	0.16 – 0.50	0.05 – 0.15	< 0.05
K (1/year)	> 0.3	0.16 – 0.30	0.05 – 0.15	< 0.05
Fecundity (1/year)	> 10,000	100 – 1000	10 – 100	< 10
t_m (years)	< 1	2 – 4	5 – 10	> 10
t_{max} (years)	1 - 3	4 – 10	11 – 30	> 30

Taken from the FishBase manual, "Estimation of Life-History Key Facts":
http://www.fishbase.us/manual/English/key%20facts.htm#resilience]

Appendix B – Background on the 5% catch rule

The proposed fishery assessment methodology uses a species categorisation approach to divide the catch in the assessment fishery into groups. These groups are:

- **Category A:** "Target" species with a species-specific management regime in place.
- **Category B:** "Target" species with no species-specific management regime in place.
- **Category C:** "Non-target" species with a species-specific management regime in place.
- **Category D:** "Non-target" species with no species-specific management regime in place

The distinction between 'target' and 'non-target' species is made to enable the assessment to consider the impact of the fishery on all the species caught regularly, without requiring a full assessment be conducted for each. Thus 'target' species are subjected to a more detailed assessment, while 'non-target' species are considered more briefly. For the purposes of the IFFO RS fishery assessment, 'target' and 'non-target' species are defined by their prevalence in the catch, by weight. Applicants must declare which species are considered 'target' species in the fishery, and the combined weight of these must be at least 95% of the annual catch. The remaining 5% can be made up of 'non-target' species. Note also that ETP species are considered separately, irrespective of their frequency of occurrence in the catch.

The proposed use of 5% as a limit for 'non-target' species is one area in which feedback is being sought via the public consultation. The decision to propose a value of 5% ensures consistency with other fishery assessment programmes, such as the MSC which uses 5% to distinguish between 'main' and 'minor' species (see MSC Standard, SA3.4 and GSA3.4.2); and Seafood Watch, which uses 5% when defining the 'main' species for the assessment (see Seafood Watch Standard, Criterion 2). The value is also consistent with the approached used in Version 1 of the IFFO RS Standard, in which up to 5% of the raw material could be comprised of 'unassessed' species.