North Pacific Fisheries Commission

NPFC-2022-SC07-WP08

Species Summary

NPFC Japanese Sardine Small Working Group

2022-11-30

Japanese sardine (*Sardinops melanostictus*)

Common names:

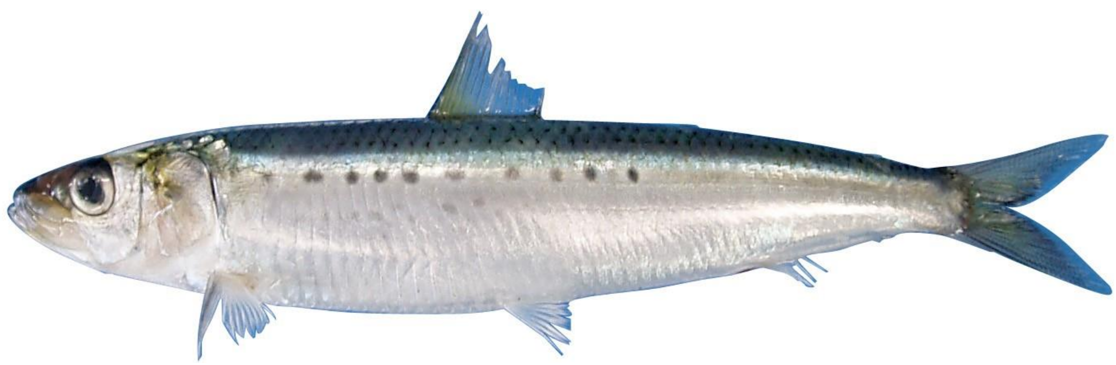
拟沙丁鱼, Ni Sha Ding Yu (China)

マイワシ, Maiwashi (Japan)

정어리, Jeong-eoli (Korea)

Дальневосточная сардина (Russia)

遠東擬沙丁魚, Yuan-Dong-Ni-Sha-Ding-Yu (Chinese Taipei)



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Management

Active NPFC Management Measures

The following NPFC conservation and mangement measure (CMM) pertains to this species:

- CMM 2021-11 For Japanese Sardine, Neon Flying Squid and Japanese Flying Squid

Available from https://www.npfc.int/active-conservation-and-management-measures

Management Summary

The current management measure for Japanese Sardine does not specify catch or effort limits. The CMM states that Members and Cooperating non-Contracting Parties currently harvesting Japanese Sardine should refrain from expansion of the number of fishing vessels authorized to fish Japanese Sardine in the Convention Area. New harvest capacity should also be avoided until as stock assessment has been completed.

A stock assessment for Japanese Sardine is conducted by Japan within their EEZ and used for management of the domestic fishery.

Table 1:Current status of management measures

Convention or Managment Principle	Status	Comment or Consideration
Biological reference point(s)	Not accomplished	Not established
Stock status	Unknown	Status determination criteria not established
Catch limit	Intermediate	Recommended catch, effort limits
Harvest control rule	Not accomplished	Not established
Other	Intermediate	No expansion of fishing beyond established areas

Assessment

There is currently no stock assessment for Japanese Sardine conducted by NPFC for the Convention Area.

Japan conducts an assessment of the Japanese Sardine stock using VPA and a number of data sources described below (Hiroshi and Nishida 2005).

Data

Surveys

Japan conducts three surveys that estimate recruitment for a number of pelagic species, including Japanese Sardine (Table 2). The surveys target pre-recruits and juveniles to determine an index of recruitment. Japan also conducts a monthly egg and larval survey that is used to estimate spawning stock biomass. Surveys are conducted in spring (1995-2020), summer (2001-2020) and fall (2005-2020) at 30-80 stations per year. The survey protocol can be found at (Oozeki et al. 2007). Russia has conducted a summertime acoustic-trawl survey since 2010 that examines mid-water and upper epipelagic species including Japanese Sardine.

Fishery

China, Japan and Russia catch Japanese sardine. China does not target the species, but it is captured as bycatch in other fisheries (e.g. chub mackerel). Catches are primarily by purse seine, with a smaller component of the catch taken by pelagic trawl. China's catch of Japanese Sardine is taken exclusively from the Convention Area from April to December. China's existing catch records are from 2016 to 2020 and show increasing catches during that time period as the stock may have been increasing. The historical catches (prior to 2016) are unknown, thought to be low and likely need to be confirmed.

Japan's fishery for Japanese Sardine occurs inside their EEZ and is mostly conducted by large purse seine vessels (>90% of the catch). Additional components of the fishery include set nets, dip nets and other gears. The fishery experienced very high catches in the 1980's and early 1990's, a decline to very low catches from 1995 to ~2010 and has been recovering since then. The fishery is conducted year round, but mainly during the summer season.

The Russian fishery occurs inside their EEZ and is prosecuted primarily by pelagic trawling (>90% of the catch), with a smaller component of the catch coming from purse seines. The success of Russian fishery depends on the migration patterns and overall abundance of Japanese Sardine, as the sardine move into Russian waters when their abundance is high. For this reason, there was no catch from 1994-2011 when the stock abundance was low, but in recent years (since 2016) as the stock has recovered and water temperatures have been warm there have been increasing catches in Russia. The Russian fishery occurs primarily from June to November.

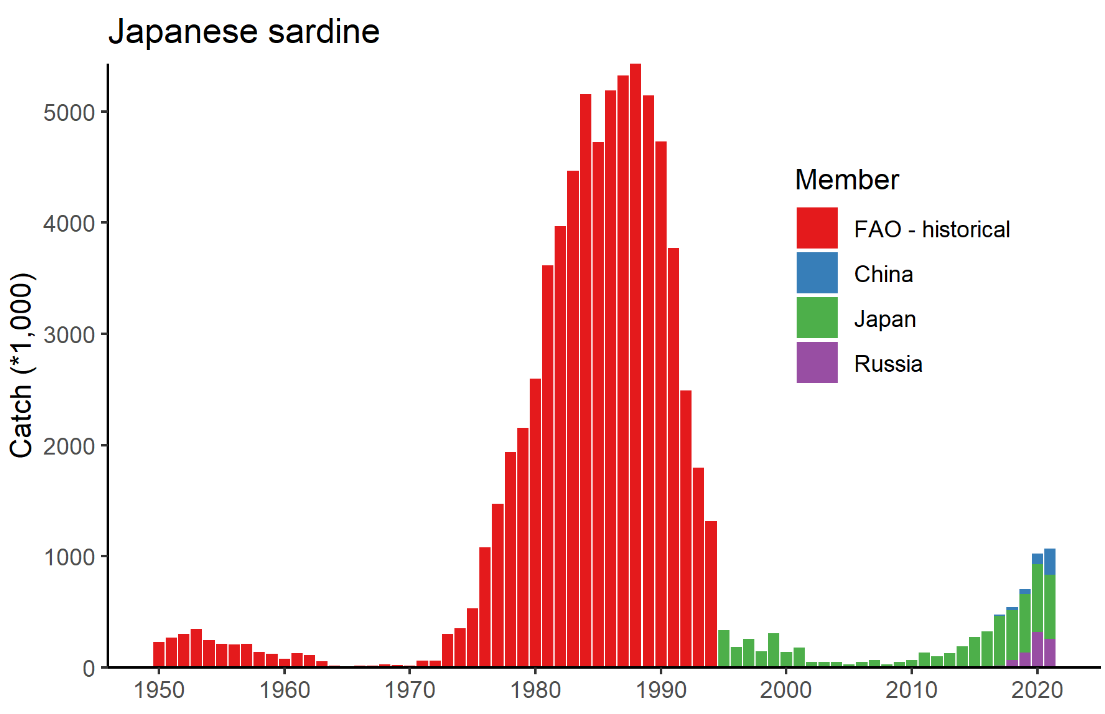

Figure 2. Historical catch of Japanese Sardine.

Other NPFC Members (Canada, Korea, Chinese Taipei, USA and Vanuatu) do not target Japanese Sardine. Chinese Taipei has some historical records of Japanese Sardine bycatch in the Pacific Saury fishery (~100 mt) and Korea has a small amount of historical bycatch data from the bottom trawl fishery. Vanuatu, USA and Canada have no record of Japanese Sardine catches.

Fishery catch data is available for Members from the NPFC website (https://www.npfc.int/system/files/2022-03/NPFC-2023-AR-Annual%20Summary%20Footprint%20-%20Japanese%20Sardine.xlsx) since 2001. Prior years fishery catch data was downloaded from FAO data collections at https://www.openfisheries.org using rfisheries package (Karthik Ram, Carl Boettiger, and Dyck 2013).

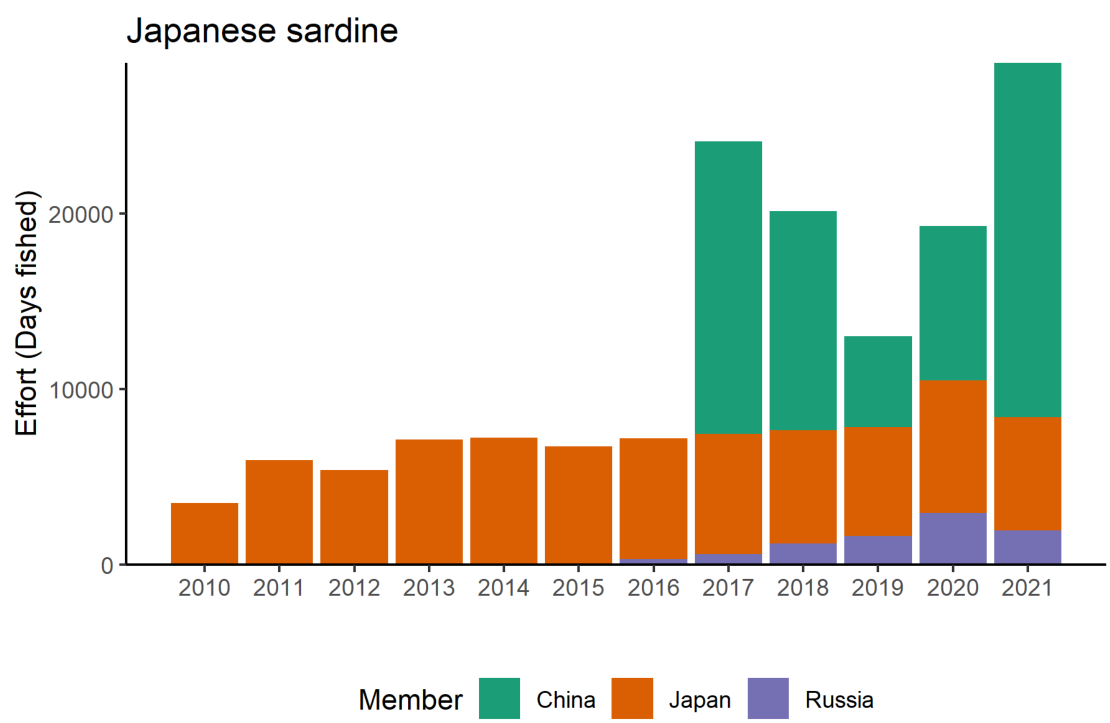

Figure 3. Historical fishing effort for Japanese Sardine.

Biological collections

China collected biological data from fishery catches of Japanese Sardine in 2020. These collections included length data as well as maturity and age structures.

Russia collects length and weight data, age structures (scales) and maturity data from both commercial catches and surveys.

Japan also collects length, weight, maturity and age data from the survey and fishery to support their stock assessment.

Table 2:Data availability from Members regarding Japanese sardine

Data	Source	Years	Comment

Data	Source	Years	Comment
Catch	China	2016-present	Catches from convention area
	Japan	1995-present	Historical catch data from 1968 available, catches in national waters
	Korea		Minor bycatch in bottom trawl fishery
	Russia	2016-present	Catches primarily in national waters, not convention area
	Chinese Taipei		Minor bycatch in Pacific saury fishery
CPUE			not developed
Survey	Japan		Pre-recruit survey
	Japan		Juvenile survey
	Japan		Monthly egg and larval survey
	Russia	2010-present	Acoustic-trawl survey
Age data	China	2020	Commercial catch
	Japan		Commercial and survey catches
	Russia		Commercial and survey catches
Length data	China	2020	Commercial catch
	Japan		Commercial and survey catches
	Russia		Commercial and survey catches
Maturity/fecundity	China	2020	Commercial catch
	Japan		Commercial and survey catches
	Russia		Commercial and survey catches

Special Comments

None

Biological Information

Distribution

Japanese sardine (*Sardinops melanostichtus*; Figure 1) are a pelagic species that occurs in large migratory schools in the coastal waters of China, Chinese Taipei, Japan, Korea and Russia (Figure 4, (Kaschner et al. 2019)). They generally migrate from the south to the north during summer, returning to inshore areas in the south to spawn in the winter. Japanese sardine feed mainly on zooplankton and phytoplankton.

Life history

Japanese sardine are short-lived and fast growing, maturing early at 2-years old. Their maximum length is ~24 cm and their maximum reported age is 25 years (Whitehead 1985). Their growth rates and spawning patterns are highly influenced by the environment (Niino et al. 2021)

Taxonomically, the Japanese sardine are closely related to other species around the globe including Sardinops from southern Africa, Australia, South America and California.

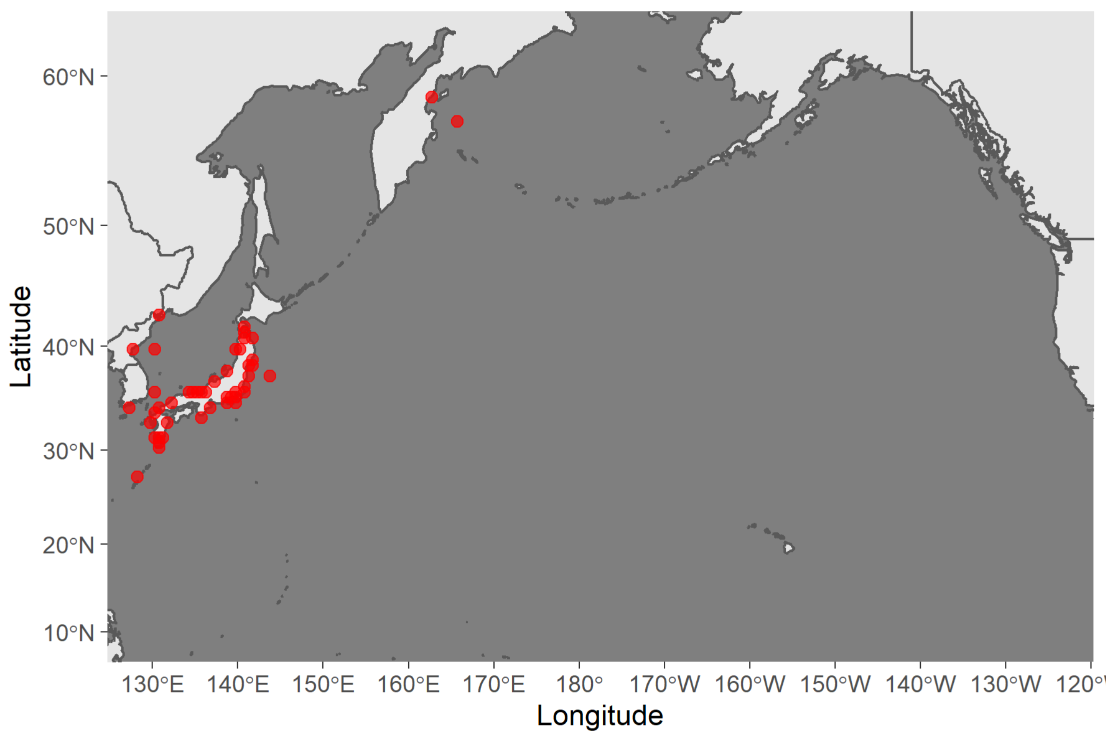

Figure 4. Map of distribution of Sardine species in the North Pacific.

Literature cited

Hiroshi, and Nishida. 2005. "Stock Assessment and ABC Calculation for Japanese Sardine (Sardinops Melanostictus) in the Northwestern Pacific Under Japanese TAC System." In.

Karthik Ram, Carl Boettiger, and Andrew Dyck. 2013. "Rfisheries: R Interface for Fisheries Data. R Package Version 0.1." 2013. http://CRAN.R-project.org/package=rfisheries.

Kaschner, K., Kesner-Reyes K., Garilao C., Segschneider J., J. Rius-Barile, Rees T., and R. Froese. 2019. "AquaMaps: Predicted Range Maps for Aquatic Species. Data Retrieved from Https://Www.aquamaps.org."

Niino, Yohei, Sho Furuichi, Yasuhiro Kamimura, and Ryuji Yukami. 2021. "Spatiotemporal spawning patterns and early growth of Japanese sardine in the western North Pacific during the recent stock increase." *Fisheries Oceanography*, no. April: 1–10. https://doi.org/10.1111/fog.12542.

Oozeki, Yoshioki, Akinori Takasuka, Hiroshi Kubota, and Manuel Barange. 2007. "Characterizing Spawning Habitats of Japanese Sardine (Sardinops Melanostictus), Japanese Anchovy (Engraulis Japonicus), and Pacific Round Herring (Etrumeus Teres) in the Northwestern Pacific." *CalCOFI Rep.* 48 (December).

Whitehead, Peter J. P. 1985. "FAO Species Catalogue. Vol. 7. Clupeoid Fishes of the World (Suborder Clupeoidei). An Annotated and Illustrated Catalogue of the Herrings, Sardines, Pilchards, Sprats, Shads, Anchovies and Wolf-Herrings." *FAO Fish. Synop.* 125(7/1): 1–303.

Appendix: Sardine and the environment

Table 3:Studies examining the relationship between Japanese sardine and the environment

Reference	Year	Type	Country	Ocean	Region	Species	Life stage	Parameter	Environmental variables	Effect	Method
Kodama, T, Wagawa T, Ohshimo S, Morimoto H, Iguchi N, Fukudome KI, Goto T, Takahashi T, Yasuda T. 2018. Improvement in Recruitment of Japanese Sardine with Delays of the Spring Phytoplankton Bloom in the Sea of Japan. Fisheries Oceanography 27 (4): 289–301. https://doi.org/10.1111/fog.12252.	2018	journal paper	Japan	Pacific	Sea of Japan	Japanese sardine	Larvae	Recruitment	Sea surface chlorophyl a	delay in start and end dates of spring bloom were positively correlated with recruitment	Correlation, empirical orthogonal function
Yasuda, Tohya, Satoshi Kitajima, Akira Hayashi, Motomitsu Takahashi, and Masa aki Fukuwaka. 2021. "Cold Offshore Area Provides a Favorable Feeding Ground with Lipid-Rich Foods for Juvenile Japanese Sardine." Fisheries Oceanography, no. January: 1–16. https://doi.org/10.1111/fog.12530.	2021	journal paper	Japan	Pacific	Sea of Japan	Japanese sardine	juvenile	Body condition	Prey species and temperature	higher condition in offshore distributed fish due to lower temperature and higher lipid content prey	correlation
Nishikawa, Haruka. 2019. "Relationship between Recruitment of Japanese Sardine (Sardinops Melanostictus) and Environment of Larval Habitat in the Low-Stock Period (1995–2010)." Fisheries Oceanography 28 (2): 131–42. https://doi.org/10.1111/fog.12397.	2019	journal paper	Japan	Pacific	Kuoshio current	Japanese sardine	Larvae	Recruitment	water temperature and larval drift	warmer temperature related to lower recruitment	correlation
Niino, Yohei, Sho Furuichi, Yasuhiro Kamimura, and Ryuji Yukami. 2021. "Spatiotemporal Spawning Patterns and Early Growth of Japanese Sardine in the Western North Pacific during the Recent Stock Increase." Fisheries Oceanography, no. April: 1–10. https://doi.org/10.1111/fog.12542.	2021	journal paper	Japan	Pacific	Kuoshio current	Japanese sardine	Larvae	growth	spawning distribution and timing (temperature)	early spawning in eastern area contributed to higher recruitment during time of increasing sardine biomass	correlation
Muko, Soyoka, Seiji Ohshimo, Hiroyuki Kurota, Tohya Yasuda, and Masa Aki Fukuwaka. 2018. "Long-Term Change in the Distribution of Japanese Sardine in the Sea of Japan during Population Fluctuations." Marine Ecology Progress Series 593: 141–54. https://doi.org/10.3354/meps12491.	2018	journal paper	Japan	Pacific	Sea of Japan	Japanese sardine	Adult	Distribution (SDM)	sea surface temperature	dome shaped relationship between sea surface temperature and the probability of presence, with peak between 10-20 C	generalized additive models
Sogawa, Sayaka, Kiyotaka Hidaka, Yasuhiro Kamimura, Masanori Takahashi, Hiroaki Saito, Yuji Okazaki, Yugo Shimizu, and Takashi Setou. 2019. "Environmental Characteristics of Spawning and Nursery Grounds of Japanese Sardine and Mackerels in the Kuroshio and Kuroshio Extension Area." Fisheries Oceanography 28 (4): 454–67. https://doi.org/10.1111/fog.12423.	2019	journal paper	Japan	Pacific	Kuoshio current	Japanese sardine	Egg	Distribution	water temperature, larval drift, zooplankton	little variability in environment where eggs were found, copepod community structure was important	correlation

Reference	Year	Type	Country	Ocean	Region	Species	Life stage	Parameter	Environmental variables	Effect	Method
Kuroda, Hiroshi, Toshihiko Saito, Toshiki Kaga, Akinori Takasuka, Yasuhiro Kamimura, Sho Furuichi, and Takuya Nakanowatari. 2020. “Unconventional Sea Surface Temperature Regime Around Japan in the 2000s–2010s: Potential Influences on Major Fisheries Resources.” Frontiers in Marine Science 7 (October): 1–21. https://doi.org/10.3389/fmars.2020.574904.	2020	journal paper	Japan	Pacific	Pacific	Japanese sardine	Adult	Recruitment	PDO, SST	spawning was earlier during SST increases	correlation
Ma, Shuyang, Yongjun Tian, Caihong Fu, Haiqing Yu, Jianchao Li, Yang Liu, Jiahua Cheng, Rong Wan, and Yoshiro Watanabe. 2021. “Climate-Induced Nonlinearity in Pelagic Communities and Non-Stationary Relationships with Physical Drivers in the Kuroshio Ecosystem.” Fish and Fisheries 22 (1): 1–17. https://doi.org/10.1111/faf.12502.	2020	journal paper	China	Pacific	Kuoshio current	Japanese sardine	Adult	Abundance/Catch	Basin scale climate (ALPI, SST, Current patterns)	Climate variability introduced nonlinearity and nonstationarity to pelagic fish	time series analyses
Kurota, Hiroyuki, Cody S. Szuwalski, and Momoko Ichinokawa. 2020. “Drivers of Recruitment Dynamics in Japanese Major Fisheries Resources: Effects of Environmental Conditions and Spawner Abundance.” Fisheries Research 221 (September 2019): 105353. https://doi.org/10.1016/j.fishres.2019.105353.	2020	journal paper	Japan	Pacific	Pacific	Japanese sardine	Adult	Recruitment	"Environment" other than SSB	Regime shifts were detected in pelagic species	time series analyses, change point analysis
Furuichi, Sho, Tohya Yasuda, Hiroyuki Kurota, Mari Yoda, Kei Suzuki, Motomitsu Takahashi, and Masa Aki Fukuwaka. 2020. “Disentangling the Effects of Climate and Density-Dependent Factors on Spatiotemporal Dynamics of Japanese Sardine Spawning.” Marine Ecology Progress Series 633: 157–68. https://doi.org/10.3354/meps13169.	2020	journal paper	Japan	Pacific	Sea of Japan	Japanese sardine	Egg	Abundance and distribution	SST	Cold water led to decreased egg abundance over larger area, warm temperatures led to earlier spawning	correlation
Okazaki, Yuji, Kazuaki Tadokoro, Hiroshi Kubota, Yasuhiro Kamimura, and Kiyotaka Hidaka. 2019. “Dietary Overlap and Optimal Prey Environments of Larval and Juvenile Sardine and Anchovy in the Mixed Water Region of the Western North Pacific.” Marine Ecology Progress Series 630: 149–60. https://doi.org/10.3354/meps13124.	2019	journal paper	Japan	Pacific	Kuoshio current		larvae and juvenile	prey habits	SST	Temperature influences abundance of prey with effect on recruitment	correlation