

# **Update of the Japanese catch and length-frequency data for Pacific blue marlin (*Makaira nigricans*) from 1971 to 2024**

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## Abstract

This working paper documents the update of Japanese catch and size composition data for Pacific blue marlin (*Makaira nigricans*) in preparation for the upcoming stock assessment. The analysis covers the period from 1971 to 2024 and categorizes fisheries into six fleets: early and late offshore & distant-water (ODW) longline, coastal longline, driftnet, bait fishing, and others. Catch estimation methods largely follow protocols established in previous assessments, with a refinement for the coastal longline fleet (F3), where logbook data were supplemented with ratio-adjusted yearbook statistics since 2008. The updated catch time series confirms a historical peak in the mid-1980s followed by a decline to stabilized low levels in recent years. Size composition analysis of the ODW fleet reveals a stable long-term size structure dominated by immature fish, though clear spatiotemporal heterogeneity and sexual dimorphism are evident.

## Introduction

The International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean (ISC) Billfish Working Group (BILLWG) is scheduled to conduct a benchmark stock assessment for Pacific blue marlin in 2026. Japanese fisheries historically account for a significant proportion of the total Pacific catch, making accurate temporal and biological data from these fleets critical for model performance. This paper updates the Japanese catch and size composition statistics through 2024, employing methodology consistent with previous analyses (Ijima 2020; Kimoto and Yokawa, 2013) while incorporating minimal refinements to improve data quality.

## Methods

### *Catch Data and Processing*

This study updates the Japanese catch statistics for Pacific blue marlin following the fleet definitions established in the 2016 stock assessment (ISC, 2016). The fisheries are categorized into six fleets: early and late offshore & distant-water longline (F1 JPNEarlyLL and F2 JPNLateLL), coastal longline (F3 JPNCLL), driftnet (F4 JPNDRIFT), baitfish (F5 JPNBait), and other fisheries (F6 JPNOth). Data were compiled from two primary sources: 1) the Japanese longline logbook database, which provides high spatiotemporal resolution, and 2) the National Yearbook of Fisheries Statistics, which provides aggregated annual estimates.

### *Offshore & distant-water (ODW) longline (F1 and F2)*

The ODW longline fleet is the primary source of blue marlin catch. Catch data were derived from the

logbook database (resolution 5°×5°), covering the period 1971–2024. While commercial vessels have reported catch in body mass since 1971, public (training) vessels reported only catch in numbers between 1973 and 1993. To maintain consistency in units (metric tons), the catch mass for public vessels during this period was estimated. We calculated a quarterly mean body mass (MBM) using catch numbers and catch mass data from commercial vessels operating in the same year and quarter. This quarterly MBM was then applied to the public vessel catch numbers to estimate their catch mass. The observed commercial catch mass and estimated public vessel catch mass were summed to produce the final quarterly time series.

It is worth noting a methodological refinement in converting catch number to catch mass for public vessels (1973–1993). While the previous analysis (Ijima, 2020) stratified the MBM calculation by quarter and four spatial quadrants, we applied a Pacific-wide quarterly MBM. Given the single-stock assumption for Pacific blue marlin and the lack of distinct biological boundaries defining these quadrants, a spatially aggregated approach was deemed more appropriate and robust to potential data sparsity in specific areas. This methodological change resulted in only minor adjustments to the ODW longline catches; the mean absolute relative difference was 0.43% (range: 0–1.53%) compared to the time series used in the 2021 stock assessment (ISC, 2021).

#### *Coastal longline (F3)*

The catch time series for the coastal longline fleet was constructed using a hybrid approach to address changes in data availability. For the historical period (1971–1993), annual catches were extracted from the National Yearbook. Since yearbook records historically combined blue and black marlin (*Istiompax indica*) into a single category, a species composition ratio was calculated using coastal logbook data from the initial years of availability (1994–1998). Catch masses of blue and black marlin were summed from the logbooks, and the mean ratio of blue marlin (0.9730) was applied to the yearbook data to exclude black marlin. For the early period (1971–1993) when only annual estimates were available, the catch was allocated equally across four quarters.

For the modern period (1994–2024), direct quarterly catch masses were available from the logbook database. However, a reclassification of coastal longline vessels took place in the 2000s. The old classification recognized “small-form certified” (Jap. 小型承認, *kogata-shōnin*) and “small-form registered” (Jap. 小型届出, *kogata-todokede*) vessels, whereas the new classification recognizes only “new small-form” (Jap. 新小型, *shin-kogata*) vessels. The size of all these vessels is typically <20 mt, but prior to the reclassification they differed in logbook reporting duties (obligatory for small-form certified, voluntary for small-form registered). After the reclassification, much of the fleet was consolidated under uniform logbook reporting requirements. Catches for vessels not classified as new small-form are available through yearbook records. Therefore, from 2008 (when the records for new small-form vessels start) until 2024, the logbook data were supplemented with ratio-adjusted

yearbook catches to ensure complete coverage of the fishery. The impact of this supplementation on the catch time series is described in the Results section.

#### *Driftnet (F4), baitfish (F5), and other fisheries (F6)*

Catch estimation for the driftnet, baitfish, and other fisheries fleets relied exclusively on the National Yearbook of Fisheries Statistics. Similar to the historical coastal data, these records do not distinguish between blue and black marlin. Following the methodology of Kimoto and Yokawa (2013), a fixed ratio derived from the Research of Japanese Bluefin Tuna (RJB) records (0.9838) was applied to the total annual catch to estimate the blue marlin component. The "other" fleet (F6) was compiled by aggregating miscellaneous gear types, including minor longline categories not classified as the ODW or coastal, trap nets, and squid drift nets (discontinued by the end of 1992). Annual catch estimates were divided equally among four quarters for input into the seasonal assessment model.

#### *Length-Frequency Data and Processing*

##### *Offshore & distant-water (ODW) longline (F1 and F2)*

Size composition data for the ODW longline fleet were derived from the Japanese longline logbook database, encompassing measurements collected by commercial and public training vessels. The primary metric recorded was Eye-Fork Length (EFL) in centimeters. For the construction of length-frequency distributions, data were aggregated into 5 cm bins, with values falling exactly on a bin boundary assigned to the lower bin. Of note is that the raw data included records at varying spatial resolutions (typically 1°×1° or 5°×5° grids), but for spatial visualizations, mean lengths were aggregated into 5°×5° grid cells to match the resolution of the catch maps.

##### *Driftnet (F4)*

Size data for the driftnet fishery were sourced from the same database but filtered specifically for large-mesh driftnet gear. Unlike the longline fleet, the primary size metric available for this fishery is whole body mass in kilograms. Body mass measurements were aggregated into 5 kg bins using a parallel binning logic to the length data. The available time series for this fleet is intermittent, covering the historical period 1977–1998.

## **Results**

### *Catch Trends and Spatiotemporal Distribution*

The total annual catch mass of Pacific blue marlin by Japanese fisheries displays distinct historical phases, characterized by a peak in the mid-1980s followed by a significant reduction in fishing pressure (Figure 1). Catches gradually increased to a peak of approximately 14,000 mt in 1985. Following a temporary decline in the late 1980s and a brief recovery in the mid-1990s, a substantial

drop occurred in 1996. Subsequently, the total catch mass has continued a slow decline, stabilizing at historical lows below 1,500 mt in recent years (2020–2024). Historically, the ODW longline fleet accounted for the vast majority of the catch. However, as ODW fishing effort decreased, the relative contribution of the coastal longline fleet has grown, representing a significant proportion of the total catch in the last decade.

The updated estimation methodology for the coastal longline fleet (F3 JPNCLL) resulted in notable differences compared to the 2020 stock assessment, particularly in the modern period (Figure 2). While estimates remain identical during the historical yearbook-dependent period (1971–1993), the inclusion of ratio-adjusted yearbook data to supplement logbooks generated higher catch mass estimates from 2008 to 2018. This divergence suggests that the previous assessment, which relied solely on logbooks for this period, likely under-represented catches from vessels affected by the “small-form” reclassification. Despite this upward revision in magnitude, the overall trajectory remains consistent, showing a decline from a local peak in 2010 to current levels.

Spatiotemporal analysis of the ODW longline fleet reveals a considerable contraction of fishing grounds over the decades (Figure 3). During the high-catch periods of the 1970s and 1980s, fishing effort and catch mass were broadly distributed across the Pacific, extending deep into the eastern Pacific Ocean (EPO). However, coinciding with the sharp decline in total catch mass in the mid-1990s, the fleet effectively withdrew from the EPO. By the most recent period (2011–2020), fishing activity has become largely concentrated in the western and central Pacific, primarily north of the equator, reflecting a fundamental shift in the operational footprint of the Japanese longline fishery.

### *Size Composition and Spatiotemporal Trends*

The length-frequency distributions for the offshore & distant-water (ODW) longline fleet exhibit a consistent unimodal structure centered on immature to young adult fish (Figure 4). For the early period (fleet F1; 1971–1993), the distribution and mean length ( $\mu=162.6$  cm) are identical to those reported in the previous assessment, confirming the consistency of the data extraction and processing protocols. In the late period (fleet F2; 1994–2024), the size structure remains a very similar ( $\mu=165.6$  cm). The inclusion of updated data from 2020 to 2024 slightly increased the sample size but did not alter the shape of the distribution, indicating that the overall size selectivity of the commercial fishery has remained stable in recent years.

Sexual dimorphism is clearly observable in the size data, with females ( $\mu=186.7$  cm) attaining considerably larger sizes than males ( $\mu=158.8$  cm) and dominating the size classes above 200 cm EFL (Figure 5). However, the dataset is heavily skewed towards unsexed individuals and males. The size distribution of the “unknown” sex category ( $\mu=164.0$  cm) closely tracks that of the male segment. This suggests that the unknown category predominantly consists of immature fish and small adults, that is, groups for which sex determination is often hampered by undeveloped gonads or precluded

by the removal of internal organs during commercial processing.

A distinct spatiotemporal structure in mean body size is evident across the Pacific (Figure 6). Smaller individuals (mean EFL < 160 cm) are consistently concentrated in tropical waters (approximately 10°S–20°N), particularly in the western and central Pacific. In contrast, larger individuals (mean EFL > 200 cm) occur at higher latitudes in both hemispheres and in the EPO. While the operational range of the fleet shifts seasonally, this underlying biological pattern remains stable throughout the year. Such spatial heterogeneity suggests that fishery selectivity is area-dependent, with the EPO and temperate grounds yielding larger fish than tropical nursery areas.

The temporal evolution of size composition within the ODW longline fleet reveals remarkable long-term stability in Quarters 1, 2, and 4 (Figure 7). For over five decades, the dominant mode has consistently remained within the 140–160 cm EFL range, indicating a persistent targeting of immature to young adult fish. In contrast, Quarter 3 exhibits a distinct deviation from this pattern, particularly between the late 1990s and the mid-2000s, when the distribution temporarily shifted towards larger individuals (>180 cm). While the underlying causes are unclear, this shift coincides with a period of high fishing effort in the EPO (Figure 3), where larger individuals reside (Figure 6). The subsequent disappearance of larger fish from the Quarter 3 catch aligns with the fleet's withdrawal from the EPO, suggesting that temporal variations in the mean size of caught fish reflect shifts in fishing grounds rather than changes in the underlying population structure.

For the large-mesh driftnet fishery (F4), the body mass-frequency distribution was compared with the previous assessment (Figure 8). The distribution for this historical fleet (1977–1998) remains identical to the previous analysis ( $\mu=117.8$  kg), confirming the reliability of the data recovery process. The substantially higher mean body mass compared to the longline fishery indicates that the driftnet gear has a distinct selectivity pattern, targeting significantly larger, mature individuals than the longline fleets.

## Discussion & Conclusions

This study updates the Japanese catch and size statistics for Pacific blue marlin through 2024, providing a consistent and reproducible dataset for the upcoming stock assessment. The close agreement with previous datasets during historical periods validates the data extraction and processing protocols. A key improvement in this update is the refined estimation methodology for the coastal longline fleet (F3). By supplementing logbook records with ratio-adjusted yearbook statistics, this analysis addresses potential underestimation of catches in the 2021 assessment, particularly during the fleet reclassification period (2008–2019). This hybrid approach offers a more robust representation of total removals, ensuring that the increasing relative contribution of the

coastal fishery in the modern era is accurately captured.

The analysis of spatiotemporal dynamics reveals a possible link between the contraction of ODW fishing grounds and observed changes in size composition. Specifically, the withdrawal of fishing effort from the EPO, a region characterized by larger mean body sizes, coincides with the disappearance of larger individuals from the Quarter 3 catch in the 2000s. This pattern suggests that temporal variations in size frequency are driven by shifts in the fleet's operational area rather than changes in the underlying population structure. The previous stock assessment addressed these dynamics by employing time-varying selectivity for the Late Longline fleet (F2). Given the clear spatial heterogeneity in fish size and historical shifts in fishing effort, we recommend continuing the use of time-varying selectivity to accurately account for these operational changes.

While sexual dimorphism is clearly evident in the available data, with females dominating the largest size classes, the utility of sex-specific data for the assessment is constrained by the high proportion of unsexed individuals. The size distribution of the "unknown" category closely mirrors that of males and smaller individuals, likely reflecting the difficulty of sex determination in immature fish and the rapid processing of smaller adults. Consequently, neither the unsexed nor the identified groups represent a random sample of the catch; the unsexed group is biased towards smaller size classes, while the female group is reciprocally biased towards large individuals. For this reason, we believe that fitting sex-specific selectivity functions is unadvisable, and that the length-frequency data should be used in the combined-sex format.

In summary, the updated catch and size datasets presented herein represent the best available scientific information for the Japanese fleets, and should therefore be suitable for use in the upcoming Pacific blue marlin stock assessment. Specifically, the updated coastal longline (F3) catch time series is an attempt to account more fully for historical catches past 2008. Furthermore, regarding size composition, the combined-sex format is recommended for model fitting. Aggregating males, females, and unsexed individuals into a single distribution mitigates the bias introduced by size-dependent sex determination, ensuring that the selectivity estimation reflects the true size structure of the total removals.

## References

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Kimoto, A. and Yokawa, K. 2013. Input data of blue marlin caught by Japanese Fisheries for the stock assessment in the Pacific Ocean. ISC/13/BILLWG-01/06.

## Tables

**Table 1.** Time series of quarterly Pacific blue marlin (*Makaria Nigricans*) catches (in metric tons) for six Japanese fleets: early offshore & distant-water longline (F1 JPNEarlyLL; 1971-1993), late offshore & distant-water longline (F2 JPNLateLL; 1994-2024), coastal longline (F3 JPNCLL; 1971-2024), driftnet (F4 JPNDRIFT; 1972-2023), baitfish (F5 JPNBait; 1971-2023), and other (F6 JPNOth; 1971-2023). The 2024 catches for driftnet, baitfish, and other fisheries are unavailable due to a delay in the collection of government statistics; as a standard practice, these catches are carried over from the previous year.

Year	JPNEarlyLL	JPNLateLL	JPNCLL	JPNDRIFT	JPNBait	JPNOth
1971	1897.7		28.2		1.5	12.3
	1667.4		28.2		1.5	12.3
	1894.5		28.2		1.5	12.3
	1404.1		28.2		1.5	12.3
1972	2546.8		52.8	2.0	1.7	13.0
	2241.3		52.8	2.0	1.7	13.0
	2123.2		52.8	2.0	1.7	13.0
	1581.5		52.8	2.0	1.7	13.0
1973	2863.0		52.8	65.9	5.7	33.5
	2607.8		52.8	65.9	5.7	33.5
	1659.4		52.8	65.9	5.7	33.5
	2001.1		52.8	65.9	5.7	33.5
1974	2495.4		45.2	56.6	15.2	13.0
	2084.3		45.2	56.6	15.2	13.0
	1739.4		45.2	56.6	15.2	13.0
	1748.8		45.2	56.6	15.2	13.0
1975	1586.1		116.0	195.5	36.4	20.4
	1269.3		116.0	195.5	36.4	20.4
	1608.6		116.0	195.5	36.4	20.4
	1187.2		116.0	195.5	36.4	20.4
1976	1472.4		106.1	142.9	49.9	80.7
	1820.2		106.1	142.9	49.9	80.7
	2050.3		106.1	142.9	49.9	80.7
	1808.7		106.1	142.9	49.9	80.7
1977	2104.7		129.2	245.5	47.7	38.6
	2031.8		129.2	245.5	47.7	38.6
	1833.2		129.2	245.5	47.7	38.6
	1877.8		129.2	245.5	47.7	38.6
1978	2341.0		206.5	217.4	49.2	98.4
	2628.8		206.5	217.4	49.2	98.4
	2122.6		206.5	217.4	49.2	98.4

1979	1707.8	206.5	217.4	49.2	98.4
	2274.5	186.8	126.2	41.3	66.4
	2767.5	186.8	126.2	41.3	66.4
	2148.7	186.8	126.2	41.3	66.4
1980	2195.3	186.8	126.2	41.3	66.4
	3425.0	170.8	213.5	34.4	29.5
	2774.2	170.8	213.5	34.4	29.5
	2151.6	170.8	213.5	34.4	29.5
1981	2086.8	170.8	213.5	34.4	29.5
	2796.6	199.5	286.5	46.2	36.2
	3101.4	199.5	286.5	46.2	36.2
	2287.1	199.5	286.5	46.2	36.2
1982	1959.1	199.5	286.5	46.2	36.2
	3083.6	175.6	234.9	42.3	61.7
	3171.7	175.6	234.9	42.3	61.7
	2543.9	175.6	234.9	42.3	61.7
1983	2056.4	175.6	234.9	42.3	61.7
	3010.1	257.4	229.0	56.8	109.9
	2758.6	257.4	229.0	56.8	109.9
	1927.6	257.4	229.0	56.8	109.9
1984	2144.7	257.4	229.0	56.8	109.9
	4000.3	317.7	59.8	45.7	107.0
	3318.3	317.7	59.8	45.7	107.0
	2549.2	317.7	59.8	45.7	107.0
1985	2473.7	317.7	59.8	45.7	107.0
	3216.6	252.2	98.6	74.5	90.8
	2738.6	252.2	98.6	74.5	90.8
	1666.5	252.2	98.6	74.5	90.8
1986	1766.3	252.2	98.6	74.5	90.8
	3386.6	218.4	43.3	91.5	38.4
	3646.7	218.4	43.3	91.5	38.4
	2306.1	218.4	43.3	91.5	38.4
1987	2081.1	218.4	43.3	91.5	38.4
	2765.4	371.2	63.0	70.3	32.0
	3545.8	371.2	63.0	70.3	32.0
	3164.0	371.2	63.0	70.3	32.0
1988	2331.8	371.2	63.0	70.3	32.0
	3827.0	353.7	89.3	57.3	37.6
	2909.8	353.7	89.3	57.3	37.6
	1956.5	353.7	89.3	57.3	37.6
1989	1489.8	353.7	89.3	57.3	37.6
	2289.1	306.7	72.1	97.2	33.2

1990	2461.8	306.7	72.1	97.2	33.2	
	2101.0	306.7	72.1	97.2	33.2	
	1937.1	306.7	72.1	97.2	33.2	
	2373.5	292.9	62.0	62.5	44.3	
	2191.3	292.9	62.0	62.5	44.3	
	1322.2	292.9	62.0	62.5	44.3	
1991	1873.3	292.9	62.0	62.5	44.3	
	2450.0	326.4	43.8	42.3	16.7	
	2691.4	326.4	43.8	42.3	16.7	
	1473.0	326.4	43.8	42.3	16.7	
1992	1785.2	326.4	43.8	42.3	16.7	
	2790.1	403.1	39.6	37.6	14.3	
	2785.9	403.1	39.6	37.6	14.3	
	1793.2	403.1	39.6	37.6	14.3	
1993	1601.0	403.1	39.6	37.6	14.3	
	2634.4	508.9	35.9	46.7	21.9	
	2729.4	508.9	35.9	46.7	21.9	
	2029.7	508.9	35.9	46.7	21.9	
1994	2118.4	508.9	35.9	46.7	21.9	
		3036.5	213.0	38.6	34.9	17.5
		3004.1	368.9	38.6	34.9	17.5
		2433.1	596.1	38.6	34.9	17.5
1995		2660.1	379.5	38.6	34.9	17.5
		2743.9	180.4	34.9	42.8	16.7
		2659.9	522.1	34.9	42.8	16.7
		2175.6	619.5	34.9	42.8	16.7
		1737.2	509.5	34.9	42.8	16.7
1996		1342.0	245.1	26.3	44.3	10.6
		1308.9	341.7	26.3	44.3	10.6
		1056.1	290.1	26.3	44.3	10.6
		951.5	265.7	26.3	44.3	10.6
1997		1207.9	179.7	18.7	58.3	8.6
		1615.1	263.5	18.7	58.3	8.6
		1679.5	294.8	18.7	58.3	8.6
		1642.9	263.7	18.7	58.3	8.6
1998		1609.2	147.8	13.5	70.6	7.1
		1487.6	427.7	13.5	70.6	7.1
		1257.3	339.6	13.5	70.6	7.1
		1067.8	304.3	13.5	70.6	7.1
1999		1167.4	239.6	18.9	42.6	3.0
		989.2	343.8	18.9	42.6	3.0
		997.0	272.9	18.9	42.6	3.0

2000	934.6	293.2	18.9	42.6	3.0
	1003.6	185.8	5.2	48.5	8.1
	797.1	433.3	5.2	48.5	8.1
	1198.4	345.2	5.2	48.5	8.1
2001	1025.0	286.0	5.2	48.5	8.1
	924.6	156.4	39.8	33.9	5.4
	991.1	466.9	39.8	33.9	5.4
	1091.7	290.5	39.8	33.9	5.4
2002	1054.1	275.1	39.8	33.9	5.4
	1098.6	155.0	26.1	37.1	6.9
	1036.7	356.1	26.1	37.1	6.9
	842.4	213.1	26.1	37.1	6.9
2003	811.7	154.4	26.1	37.1	6.9
	1235.8	161.1	9.1	43.8	5.2
	947.8	304.1	9.1	43.8	5.2
	712.4	286.4	9.1	43.8	5.2
2004	811.8	260.1	9.1	43.8	5.2
	1043.6	235.3	4.9	48.0	8.4
	747.1	409.1	4.9	48.0	8.4
	693.0	361.0	4.9	48.0	8.4
2005	911.5	166.9	4.9	48.0	8.4
	1111.7	113.6	9.1	48.0	5.9
	697.3	325.9	9.1	48.0	5.9
	639.7	307.7	9.1	48.0	5.9
2006	437.7	271.9	9.1	48.0	5.9
	589.7	139.2	7.9	34.7	5.4
	719.1	318.5	7.9	34.7	5.4
	600.2	318.2	7.9	34.7	5.4
2007	597.1	262.5	7.9	34.7	5.4
	786.9	167.5	18.7	39.8	8.1
	537.5	375.3	18.7	39.8	8.1
	452.4	287.5	18.7	39.8	8.1
2008	388.4	310.9	18.7	39.8	8.1
	513.8	235.9	7.9	49.9	11.8
	530.9	457.0	7.9	49.9	11.8
	435.5	493.4	7.9	49.9	11.8
2009	383.0	329.5	7.9	49.9	11.8
	551.5	281.3	14.3	39.4	8.6
	403.7	512.9	14.3	39.4	8.6
	406.1	385.3	14.3	39.4	8.6
2010	582.3	269.7	14.3	39.4	8.6
	705.7	194.4	23.4	55.6	8.4

2011	662.9	652.8	23.4	55.6	8.4
	455.1	571.8	23.4	55.6	8.4
	421.0	364.5	23.4	55.6	8.4
	584.1	235.5	25.1	58.5	10.8
	564.4	566.2	25.1	58.5	10.8
	444.4	388.6	25.1	58.5	10.8
2012	370.1	282.2	25.1	58.5	10.8
	445.6	215.5	11.8	60.5	19.7
	458.4	453.5	11.8	60.5	19.7
	462.1	419.1	11.8	60.5	19.7
2013	471.5	233.3	11.8	60.5	19.7
	541.3	245.7	3.4	43.3	19.9
	532.1	546.2	3.4	43.3	19.9
	427.5	441.3	3.4	43.3	19.9
	288.0	278.9	3.4	43.3	19.9
2014	453.7	214.5	2.5	43.8	9.1
	492.9	397.9	2.5	43.8	9.1
	398.8	328.8	2.5	43.8	9.1
	350.7	160.8	2.5	43.8	9.1
	431.6	144.7	6.6	43.0	14.5
2015	403.7	304.2	6.6	43.0	14.5
	351.3	296.1	6.6	43.0	14.5
	334.2	208.1	6.6	43.0	14.5
	663.3	140.7	4.2	39.8	12.5
	476.9	407.8	4.2	39.8	12.5
2016	275.6	290.5	4.2	39.8	12.5
	303.9	234.6	4.2	39.8	12.5
	384.0	128.2	3.7	30.3	12.5
	366.2	204.6	3.7	30.3	12.5
	309.7	310.1	3.7	30.3	12.5
2017	237.2	226.7	3.7	30.3	12.5
	292.9	105.4	1.2	43.0	9.3
	309.9	284.1	1.2	43.0	9.3
	245.1	250.8	1.2	43.0	9.3
	179.1	209.3	1.2	43.0	9.3
2018	244.9	94.5	3.9	39.8	16.0
	308.6	289.8	3.9	39.8	16.0
	213.5	253.2	3.9	39.8	16.0
	137.2	182.4	3.9	39.8	16.0
2019	162.8	108.0	0.7	29.5	12.3
	172.6	212.5	0.7	29.5	12.3
	109.1	168.7	0.7	29.5	12.3

2021	106.1	109.1	0.7	29.5	12.3
	151.3	84.0	1.0	40.6	19.9
	168.9	209.6	1.0	40.6	19.9
	111.9	177.8	1.0	40.6	19.9
2022	110.9	107.5	1.0	40.6	19.9
	125.5	73.7	0.7	32.2	10.8
	154.8	227.8	0.7	32.2	10.8
	106.8	190.0	0.7	32.2	10.8
2023	128.5	99.3	0.7	32.2	10.8
	201.5	75.7	0.7	39.8	13.0
	166.2	187.7	0.7	39.8	13.0
	118.0	138.2	0.7	39.8	13.0
2024	186.1	107.5	0.7	39.8	13.0
	251.8	59.2			
	215.5	277.3			
	181.6	259.8			
	170.6	192.1			

## Figures

**Figure 1.** Historical annual catch (in metric tons) of Pacific blue marlin (*Makaira nigricans*) by Japanese fisheries from 1971 through 2024. Catches are stratified by the fleet definitions used in the stock assessment: offshore & distant-water (ODW) longline (F1 & F2), coastal longline (F3), driftnet (F4), baitfish (F5), and other fisheries (F6). The time series integrates commercial logbook data, public vessel records, and national yearbook statistics. Note that 2024 data for driftnet, baitfish, and other fisheries are unavailable due to a delay in the collection of government statistics.

**Figure 2.** Comparison of annual catch estimates (in metric tons) for the Japanese Coastal Longline fleet (F3 JPNCLL) between the 2021 stock assessment (gray dashed line) and the current update (red solid line). The time series are identical during the historical yearbook-based period (1971–1993). The divergence observed from 1994 onwards, and particularly the higher estimates between 2008 and 2018, reflects the updated processing methodology, which utilizes direct quarterly logbook weights and supplements them with national yearbook statistics to ensure complete coverage of the coastal fleet.

**Figure 3.** Spatiotemporal distribution of Pacific blue marlin (*Makaira nigricans*) catch by the Japanese offshore & distant water (ODW) longline fleet (F1 & F2). Catches are aggregated into 5°×5° grid cells over five decadal periods from 1971 to 2020. The color scale represents the total accumulated catch in metric tons on a logarithmic scale. The maps illustrate the historical broad distribution of the fishery across the Pacific and the subsequent contraction of fishing grounds, particularly the reduction of fishing effort in the Eastern Pacific Ocean observed since the late 1990s.

**Figure 4.** Comparison of eye-fork length (EFL) frequency distributions (5 cm bin width) for Pacific blue marlin caught by the Japanese offshore & distant-water (ODW) longline fishery between the current update (grey bars) and the previous stock assessment (red line). The left panel shows the early longline fleet (F1; 1971–1993), and the right panel shows the late longline fleet (F2; 1994–2024). Sample sizes ( $N$ ) and mean lengths ( $\mu$ ) are provided for both datasets.

**Figure 5.** Sex-specific length frequency distributions (eye-fork length, EFL) of Pacific blue marlin caught by the Japanese offshore & distant-water (ODW) longline fishery. Distributions are shown as overlapping density histograms for females (red), males (blue), and individuals of unknown sex (grey). Dashed vertical lines indicate the mean length ( $\mu$ ) for each group. The sample size ( $N$ ) highlights the high proportion of unsexed individuals in the dataset.

**Figure 6.** Seasonal spatial distribution of mean eye-fork length (EFL, cm) for Pacific blue marlin caught by the Japanese offshore & distant-water (ODW) longline fishery. Data are aggregated into 5°×5° grid cells by quarter (Q1–Q4) for the entire study period (1971–2023). The color scale represents the mean length, with lighter colors (yellow) indicating smaller average sizes and darker colors (red/black) indicating larger average sizes.

**Figure 7.** Historical changes in eye-fork length (EFL) frequency distributions of Pacific blue marlin caught by the Japanese offshore & distant-water (ODW) longline fishery, stratified by quarter (1971–2024). The heatmap illustrates the density (proportion) of fish within 5 cm length bins for each year. Darker colors (red to black) indicate higher frequencies, while lighter colors (yellow to white) indicate lower frequencies.

**Figure 8.** Comparison of whole-body mass frequency distributions (5 kg bin width) for Pacific blue marlin caught by the Japanese large-mesh driftnet fishery (F4). The histogram compares the current data update (grey bars) with the dataset used in the previous stock assessment (red line). Data cover the historical period 1977–1998. Sample sizes ( $N$ ) and mean masses ( $\mu$ ) are provided for both datasets.