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Update standardized CPUE for North Pacific albacore caught by the Japanese pole and line from 1972 to 2021[1]

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Summary

This document describes the spatial changes in the Japanese pole-and-line (JPPL) fishery location and standardized CPUE. CPUE were calculated by updated data including 2021 as same methodologies as the 2020 albacore tuna stock assessment for the analysis of Standardized CPUE. Fishery locations have been decreasing year by year, especially in 2010s. Recent Standardized CPUE (2019-2021) were highly fluctuated, and historical low level in 2019 and 2021.

Introduction

At the last ISC Albacore Working Group Assessment Improvement Meeting on May 9-13, 2022, we gave the presentation on the overview of JPPL fishery and the CPUE calculated by the previous method (Matsubara et al. 2020). The previous method was a standardized CPUE in GLM using delta-log normal to deal with zero catch data, however there are some problems that the vessel effect and the spatial effect were treated as a fixed effect, therefore we proposed a new Geostatistical CPUE was proposed as a future plan. During this meeting, the working group proposed to present the changes of the fishery location and to prepare the backup plan for submitting CPUE.

In this study, we describe (1) each decadal changes in the fishery location of JPPL fishery, and (2) updated CPUE by the same way as the previous stock assessment method.

Data and Methods

Logbook data for JPPL fishery were included daily catch of albacore, gross register tonnage (GRT), fishery locations (Latitude and Longitude), effort (number of poles), vessel ID from 1972-2021. We removed the data that the approximate weight contained blank data (i.e., “NA”) from the calculation. Subsequently, total catch was calculated in each grid (1 by 1), in order to confirm the spatial change of fishery locations with all available Japanese distant water pole-and-line data.

CPUE standardization

Data process and model for CPUE standardization (Tables 1 and 2) was the same as previous JPPL CPUE in the last stock assessment (Matsubara et al. 2020). Filtering process and calculation steps including formula for standardization are described below.

DWPL for CPUE data was extracted by

- Gross register tonnage (>199 t) and types of fishery (“Enyo”) for extracting DWPL
- Vessels that has searching devices (bait tank, NOAA receiver, bird radar)
- Operational areas (5°× 5° in 30-45N, 140-180E)
- Operational seasons (quarters 2 and 3)
- Sufficient operational days (>10 days in each year) AND operational years (>five years)

Model descriptions for CPUE standardization were delta-lognormal model (Lo et al. 1992). Standard error was derived from the method described by Shono (2008).

log(albacore catch rate)=year + latlong +Vessel ID ~binominal

log(CPUE) = year + latlong + Vessel ID ~ gaussian

all covariates were cosideerd as fixed effect.

Nominal CPUE was also provided as comparisons.

Nominal CPUE = catch (albacore) / effort (poles)

Results and Discussion

Albacore fishery location by distant water pole-and-line

The JPPL fishery location has been shrinking over years, and especially in the last decade the fishery location is historical low level (**Fig. 1**). In particular, there has been a decline in operations beyond 180°E from the 1980s to the 1990s. Also, the fishery location from south of 35°N to north of 40°N have been shrinking from the 1990s to 2010s. In recent years, in the 2010s, most of the fishing has been conducted west of 160°E and south of 40°N, and the fishery location over 1,000 (tons) albacore catch has been gradually decreasing.

CPUE trends

We successfully calculated update CPUE for JPPL(**Tables 2**, **3** and **4**). Update CPUE showed similar trend from previous standardized CPUE and drastically fluctuated in the long-term (yellow line in **Fig. 2**). The CPUE were varied within a range of 0.4-1.0 in 1972-1992, but it shifted toward high and stayed at a level from around 0.8-2.9 in 1993-2003.After 2004, CPUE were decreased to the low level again within a range of 0.5-1.5. The recent years (2019-2021) of CPUE were also highly fluctuated and corresponded to the historically low level in 2019 and 2021.

Reference

Lo, N. C.-h., Jacobson, L. D. and Squire, J. L. (1992) Indices of relative abundance from fish spotter data based on Delta-Lognormal Models. Can. J. Fish. Aquat. Sci., 49: 2515-2526.

Matsubara, N., Aoki, Y. and Kiyofuji,H. (2020) Standardized CPUE for North Pacific albacore caught by the Japanese pole and line from 1972 to 2018. ISC/20/ALBWG-01/02.

Shono, H. (2008) Confidence interval estimation of CPUE year trend in delta-type two-step model. Fish. Sci., 74: 712-717.

Table 1. Summary of data for analysis of CPUE standardization

	Data for ISC DataPrep in 2022
Period (whole)	1972–2021
Region	see Figure 1
Model	delta-lognormal (no update)
Vessel ID	(Kinoshita et al. 2017, no update)

Table 2. Definition of explanatory variables included in the model

Variable	**Data type**	**Description**
year	Categorical	unique year (1972–2021)
latlong	Categorical	5°× 5°
vessel ID	Categorical	unique vessel identification

Table 3. ANOVA (1st step (a)) and TYPE III ANOVA (2nd step (b)).

Variable	***df***	**Chisq** (χ^2)	***p*** (> Chi)
year	49	17068.119	< 2.2e-16 ***
latlong	15	6063.048	< 2.2e-16 ***
Vessel ID	203	4881.505	< 2.2e-16 ***

(b) 2nd step

Variable	**TYPE III SS**	***Df***	***F***	***p*** (> *F*)
year	5670.204	49	96.478	< 2.2e-16 ***
latlong	1065.050	14	63.425	< 2.2e-16 ***
Vessel ID	1605.764	203	6.595	< 2.2e-16 ***

Table 4. Abundance indices for NPALB caught by the JPN DWPL

Year	qtr	non-zero rate		positive catch			Relative	by Shono (2008)	
		estimat	SE	estimat	SE	adjusted	abundance Index	σ[CPUE]	σ[logCPUE]
1972	2-3	0.47184	0.0318	0.14062	0.0498	0.140798	0.67615065	0.00444	0.18198058
1973	2-3	0.60359	0.0292	0.18566	0.0454	0.185861	1.14177576	0.0056	0.2469772
1974	2-3	0.64570	0.0277	0.21390	0.0457	0.214133	1.40723839	0.00656	0.27016085
1975	2-3	0.67370	0.0266	0.16944	0.0483	0.169640	1.16318409	0.00551	0.28648109
1976	2-3	0.71036	0.0244	0.17508	0.0564	0.175360	1.26783719	0.0067	0.30930489
1977	2-3	0.73763	0.0232	0.09628	0.0822	0.096612	0.72530823	0.00538	0.33110191
1978	2-3	0.79694	0.0195	0.14445	0.0411	0.144572	1.1726428	0.00414	0.36051073
1979	2-3	0.59788	0.0287	0.12906	0.0442	0.129190	0.78613763	0.00378	0.24368217
1980	2-3	0.61200	0.0284	0.13538	0.0500	0.135556	0.84434283	0.00448	0.2523785
1981	2-3	0.41260	0.0316	0.03946	0.0539	0.039523	0.16597534	0.00132	0.15696685
1982	2-3	0.32636	0.0292	0.08289	0.0825	0.083182	0.27630081	0.00402	0.13768696
1983	2-3	0.41702	0.0319	0.08200	0.0582	0.082148	0.34866033	0.00295	0.16035157
1984	2-3	0.40433	0.0305	0.14467	0.0563	0.144902	0.59630271	0.00501	0.15434675
1985	2-3	0.62567	0.0341	0.15758	0.0772	0.158060	1.00650773	0.00803	0.26641
1986	2-3	0.37179	0.0305	0.16487	0.0573	0.165151	0.62493447	0.00573	0.1415059
1987	2-3	0.29459	0.0353	0.21688	0.1366	0.218917	0.65638124	0.01709	0.16782271
1988	2-3	0.28365	0.0526	0.17148	0.2439	0.176664	0.51002054	0.02397	0.26111163
1989	2-3	0.08582	0.0155	0.21165	0.1370	0.213653	0.18663268	0.01515	0.1392116
1990	2-3	0.19904	0.0240	0.20501	0.0770	0.205620	0.41654243	0.00877	0.09867954
1991	2-3	0.23960	0.0272	0.45177	0.0811	0.453263	1.10533413	0.02074	0.11140196
1992	2-3	0.15913	0.0216	0.47883	0.0929	0.480906	0.77886572	0.02416	0.10458706
1993	2-3	0.27176	0.0277	0.41134	0.0688	0.412319	1.14045516	0.01632	0.112116
1994	2-3	0.49665	0.0321	0.47297	0.0512	0.473594	2.39391725	0.01549	0.19401174
1995	2-3	0.44746	0.0313	0.39610	0.0477	0.396559	1.80597343	0.01191	0.17027974
1996	2-3	0.62745	0.0304	0.25673	0.0496	0.257054	1.64156017	0.00851	0.26073592
1997	2-3	0.66662	0.0271	0.29018	0.0402	0.290421	1.97042214	0.00791	0.28115588
1998	2-3	0.53094	0.0310	0.32287	0.0488	0.323264	1.74683627	0.01021	0.2100966
1999	2-3	0.68644	0.0263	0.33800	0.0389	0.338263	2.36323596	0.00899	0.29245998
2000	2-3	0.50016	0.0307	0.18875	0.0413	0.188920	0.96170083	0.00504	0.1933217
2001	2-3	0.68090	0.0265	0.22018	0.0384	0.220346	1.52700417	0.00576	0.28915242
2002	2-3	0.72600	0.0245	0.36945	0.0386	0.369728	2.73194912	0.00982	0.31595282
2003	2-3	0.66904	0.0270	0.25421	0.0415	0.254434	1.73251375	0.00715	0.28272895
2004	2-3	0.57695	0.0314	0.28165	0.0486	0.281985	1.65582028	0.00900	0.23346752
2005	2-3	0.46429	0.0309	0.15528	0.0408	0.155412	0.7343933	0.00406	0.17621877
2006	2-3	0.36903	0.0301	0.16116	0.0472	0.161342	0.60599137	0.00465	0.13658989
2007	2-3	0.51950	0.0318	0.23685	0.0480	0.237130	1.25379286	0.00735	0.20424791
2008	2-3	0.32073	0.0289	0.21027	0.0521	0.210560	0.68733741	0.00653	0.11984532
2009	2-3	0.36223	0.0309	0.30049	0.0579	0.300997	1.1097009	0.01051	0.13800007
2010	2-3	0.36400	0.0302	0.27043	0.0493	0.270760	1.00309032	0.00812	0.13533599
2011	2-3	0.22431	0.0252	0.31097	0.0671	0.311671	0.71154212	0.01176	0.09748697
2012	2-3	0.49742	0.0321	0.24705	0.0467	0.247327	1.25211861	0.00742	0.19323897
2013	2-3	0.35967	0.0304	0.22693	0.0503	0.227218	0.8317644	0.00693	0.13395434
2014	2-3	0.37346	0.0322	0.23898	0.0654	0.239494	0.91032411	0.00945	0.14561696
2015	2-3	0.30720	0.0286	0.16638	0.0536	0.166628	0.52098475	0.00528	0.11563737
2016	2-3	0.29839	0.0286	0.14406	0.0584	0.144308	0.43825743	0.00494	0.1148956
2017	2-3	0.22479	0.0255	0.18751	0.0691	0.187963	0.43003647	0.00731	0.09903877
2018	2-3	0.14077	0.0197	0.15102	0.0886	0.151622	0.21724505	0.00720	0.09801581
2019	2-3	0.10131	0.0158	0.09786	0.0982	0.098336	0.10139609	0.00506	0.10250559
2020	2-3	0.26778	0.0278	0.49318	0.0674	0.494302	1.34719729	0.01913	0.11002264
2021	2-3	0.21528	0.0243	0.14410	0.0626	0.144389	0.31636331	0.00507	0.0920454

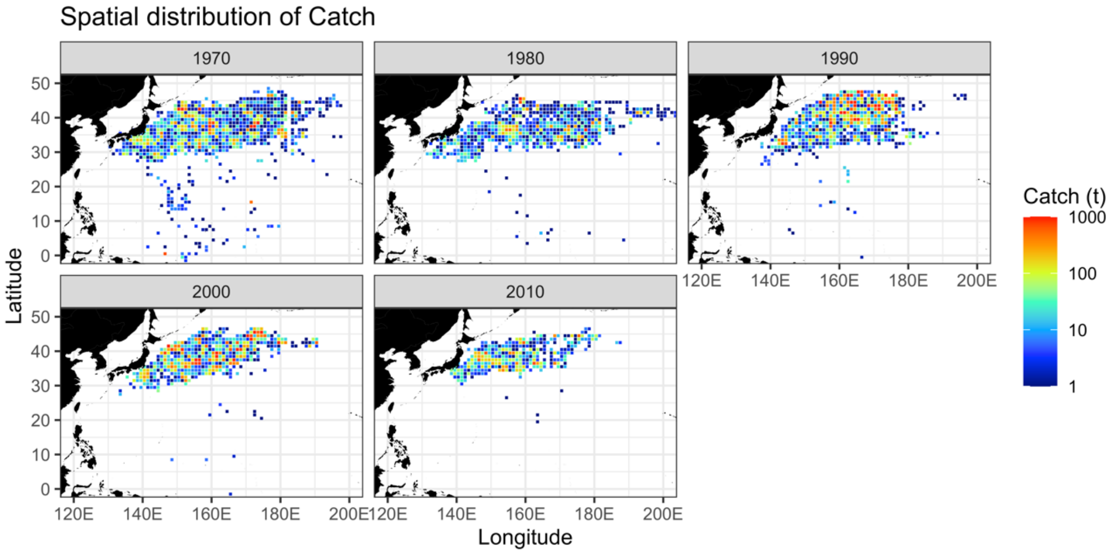

Figure 1. Decadal spatial distribution of albacore caught by Japanese distant water pole and line.

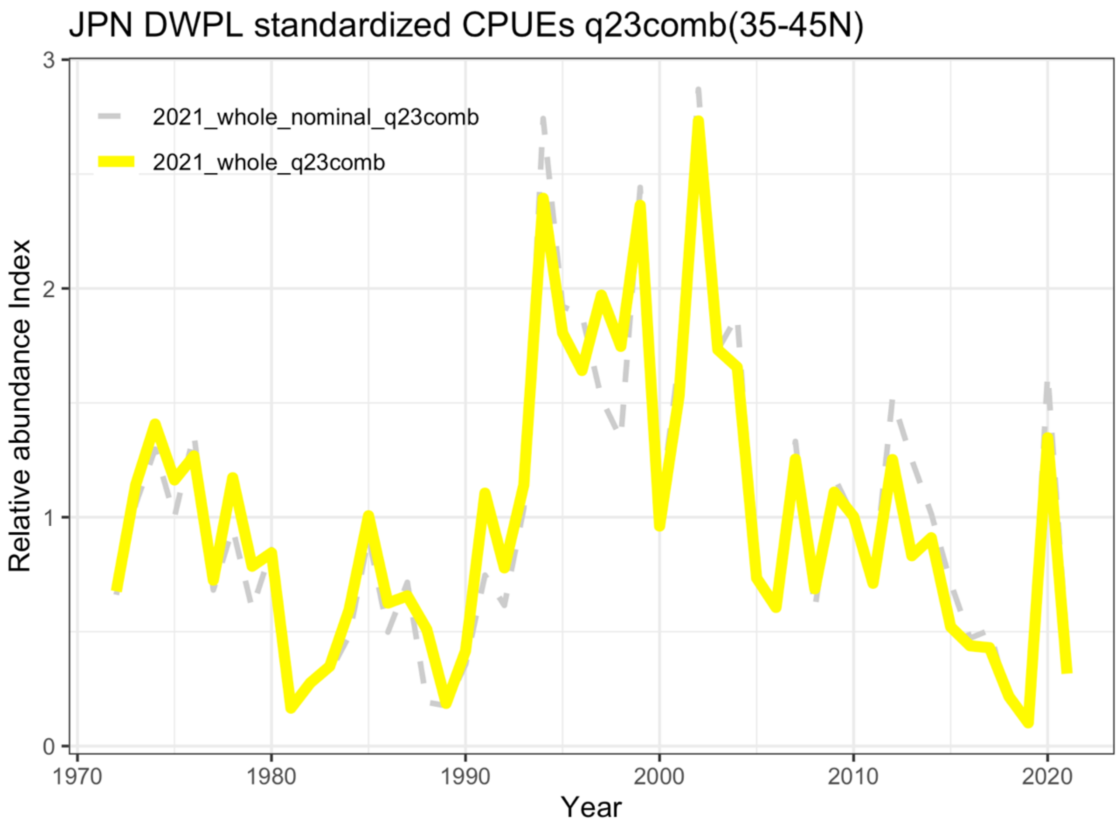

Figure 2. Relative abundance index of NPALB caught by Japanese distant water pole and line (JP DWPL) from 1972 to 2021. Dashed grey line showed nominal CPUE.