

2015年の日本によるミナミマグロ耳石収集および年齢査定活動
ならびに年齢データの分析
Activities of southern bluefin tuna otolith collection and age
estimation and analysis of the age data by Japan in 2015

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要約

日本は2015年にミナミマグロ耳石を794個体から収集した。2015年に漁獲されたミナミマグロ210個体の年齢を査定し、2016年にデータをCCSBT事務局へ提出した。4512個体の年齢データを分析し、尾叉長と年齢との関係を示した。

Summary

Japan collected otoliths from 794 SBT individuals in 2015. Ages were estimated from 210 SBT individuals which were caught in 2015. The data were submitted to the CCSBT Secretariat in 2016. Age data of 4512 SBT individuals were analyzed to show relationships between fork length and age estimated.

1. Activities of otolith collection and age estimation

1) Otolith Collection:

In 2015, Japan collected otoliths from a total of 794 southern bluefin tuna *Thunnus maccoyii* (SBT) individuals. The number of otolith samples had been from 300 to more than 500 in early to mid2000s, however it had been kept less than 300 from late 2000s to early 2010s. Number of otolith samples had exceeded more than 500 again in 2014, and this has been same in 2015, too. All of them came from commercial longline vessels through the scientific observer program (Yamasaki et al. CCSBT- ESC/1609/20). These fish were caught from March to September 2015, and fork length of them were 87 to 185 cm.

2) Age estimation:

Ages of 210 individuals were estimated using otoliths following to the CCSBT manual (Anon. 2002), “A manual for age determination of southern bluefin tuna *Thunnus maccoyii*.” Each of two staff members in Marino-Research Cooperation, who did the same work for years, estimated the age once respectively and independently. Then, one of them determined the final estimated age with referring to their previous estimation.

The data of age estimated with capture information were sent to the CCSBT Secretariat in 2016. The number of individuals by year caught and CCSBT area in the 2016 data is shown in Table 1. Number of individuals by year caught and at fork length class in the 2016 data is shown in Table 2. The range of age estimated was from 2 to 29.

2. Analysis of age data

The aging data for 210 individuals which estimated in 2015 were added into accumulated aging dataset to apply the analysis. The sampling period of Japan starts from 1997, and total number of aging data reached 4512 individuals by 2015 (Table 3). Table 4 shows frequency of reliability of age estimation by fork length class, twenty-six otoliths out of 4538 individuals (0.57%) were not able to be estimated its ages (readability is 0). No otolith was assigned to readability 5 (no doubt). These age data have been submitted to CCSBT from 2005.

Statistical values of 4512 individuals that analyzed are shown for age estimated by 5 cm fork length class (Table 4) and fork length by age estimated (Table 5).

Relationships between fork length and age estimated are shown in Fig. 1 and Fig. 2. While there are a few outliers, majority of plots seems to be appropriate. Parameters of von Bertalanffy growth equation were estimated by the least square method as follows.

$L_{inf} = 181.6$ cm, $K = 0.167$, $t_0 = -1.567$ (year)

The length at age relationship used in CCSBT (mean length at age for 2005 catch) is corresponded well with the von Bertalanffy growth curve by the otolith data (Fig. 3).

References

- Anon. 2002. Report of the Direct Age Estimation Workshop. Victoria, Australia. 11-14 June 2002.
- Izumi, Y., T. Itoh, K. Oshima and H. Matsunaga. 2015. Report of Japanese scientific observer activities for southern bluefin tuna fishery in 2014 and 2015. CCSBT-ESC/1609/20.

Table 1 Number of otoliths, by year caught and CCSBT area, which were analyzed and submitted its data to CCSBT in 2016. The otolith samples had been analyzed in 2015 were taken from the fish which had been caught in 2014.

Area	Year		Total
	2014		
2	2	2	2
7	74	74	74
8	37	37	37
9	97	97	97
Total	210	210	210

Table 2 Number of otoliths which were analyzed and submitted its data to CCSBT in 2016 by year caught and at fork length class

Size	Year		Total
	2014		
80	1	1	1
90	1	1	1
100	5	5	5
110	20	20	20
120	23	23	23
130	23	23	23
140	51	51	51
150	53	53	53
160	16	16	16
170	15	15	15
180	2	2	2
Total	210	210	210

Table 3 Total number of otoliths, by year of catch and CCSBT statistical area, which have been analyzed and submitted its data to CCSBT since 2005.

Year	Area								Total
	Area1	Area2	Area4	Area5	Area7	Area8	Area9	Area11	
1997	14	10				33			57
1998			25			204	20		249
1999	1		73		144	334	36		588
2000		13	24		37	96	110		280
2001	13				71	57	208		349
2002	15		6		47	28	159		255
2003			60		42	78	302		482
2004	21	2	43		31	93	157		347
2005		29	46		5	83	251		414
2006		1	6			17	84		108
2007		1				194	104		299
2008			5		33	106	93		237
2009			7			141	77		225
2010		5	12			57		6	80
2011		10	5	18		26	39	3	101
2012			2		5	46	55		108
2014		2	1		222	37	97		359
Total	64	73	315	18	637	1630	1792	9	4538

Table 4 Statistical values of fork length and age estimated at 5 cm fork length class in age estimated data by Japan.

Fork Length class	N_readability							Age estimated (readability 1-5)					
	N	0	1	2	3	4	5	N	mean	median	min	max	SD
30-	2			2				2	0.0	0	0	0	0.00
35-	0												
40-	0												
45-	6					6		6	1.0	1	1	1	0.00
50-	43			12	31			43	1.1	1	1	2	0.29
55-	27	1		13	13			26	1.3	1	1	2	0.45
60-	2			2				2	2.0	2	2	2	0.00
65-	0												
70-	1			1				1	2.0	2	2	2	
75-	1			1				1	2.0	2	2	2	
80-	9	1		8				8	2.8	3	2	4	0.71
85-	69		1	53	15			69	2.7	3	2	6	0.74
90-	96		4	69	23			96	2.8	3	2	5	0.78
95-	104	1		66	37			103	3.6	4	2	11	1.14
100-	166	2	3	111	47	3		164	3.8	4	1	7	0.91
105-	223	2	7	142	68	4		221	4.2	4	2	7	0.98
110-	177		1	117	58	1		177	4.7	5	2	9	1.09
115-	211		10	127	73	1		211	5.2	5	2	11	1.16
120-	200		5	123	71	1		200	5.5	5	3	12	1.27
125-	186		4	108	68	6		186	6.1	6	4	10	1.22
130-	197		4	114	75	4		197	6.3	6	4	10	1.11
135-	215		6	126	80	3		215	7.1	7	4	13	1.52
140-	261	2	4	152	95	8		259	7.8	8	4	13	1.51
145-	309	1	7	182	113	6		308	8.5	8	4	19	1.78
150-	407	4	11	248	139	5		403	9.4	9	5	17	1.98
155-	359		10	224	113	12		359	10.2	10	6	19	2.03
160-	364	3	14	221	120	6		361	11.5	11	6	24	2.68
165-	270	2	15	166	81	6		268	13.0	12	4	31	3.60
170-	283	4	29	157	87	6		279	15.4	15	6	29	3.91
175-	156	1	20	82	53			155	17.0	16	7	36	5.26
180-	108	1	15	58	33	1		107	19.2	19	9	32	4.63
185-	46		7	29	10			46	19.6	19	8	35	6.09
190-	21	1	6	10	4			20					
195-	11		1	5	5			11	24.0	23	11	33	6.18
200-	5		1	3	1			5	25.0	27	20	28	3.39
205-	3			2	1			3	26.7	28	24	28	2.31
Total	4538	26	185	2734	1520	73	0	4512					

Table 5 Statistical values of fork length at age in age estimated data by Japan.

Age	N	mean	median	min	max	SD
0	2	32.6	32.6	32.2	33	0.57
1	65	53.8	53	48	103	6.66
2	110	88.2	90	51	118	13.64
3	271	100.6	101	80	124	9.12
4	366	109.4	108	84	165	11.02
5	450	118.6	118	92	154	10.86
6	407	128.6	128	88	171	12.58
7	428	139.4	139	103	176	11.84
8	405	146.4	147	116	185	10.54
9	399	152.3	152	112	185	9.00
10	309	155.9	156	121	182	9.13
11	246	158.9	159	96	195	9.59
12	216	161.2	162	124	188	9.22
13	139	165.3	166	138	188	8.68
14	126	166.5	167	146	187	8.36
15	102	169.4	170	149	187	8.02
16	108	171.6	172	148	190	7.93
17	60	171.5	172	152	184	6.63
18	61	175.2	175	163	195	8.22
19	52	174.4	175	145	191	8.42
20	29	176.4	175	164	201	7.34
21	38	179.4	179.5	167	196	7.26
22	22	179.9	178.5	170	195	7.70
23	20	179.6	174	168	200	10.80
24	17	181.5	180	162	207	9.08
25	7	179.9	184	167	191	9.15
26	15	178.3	178	165	197	7.43
27	9	184.8	181	174	203	10.58
28	10	187.7	184	172	205	12.72
29	5	183.2	184	172	195	9.73
30	5	184.0	182	178	196	6.96
31	3	178.3	185	165	185	11.55
32	2	187.5	187.5	184	191	4.95
33	1	197.0	197	197	197	
34	1	186.0	186	186	186	
35	3	185.0	188	176	191	7.94
36	1	177.0	177	177	177	
37						
38						
39						
40						
41						
42						
43						
44						
45	1	191.0	191	191	191	

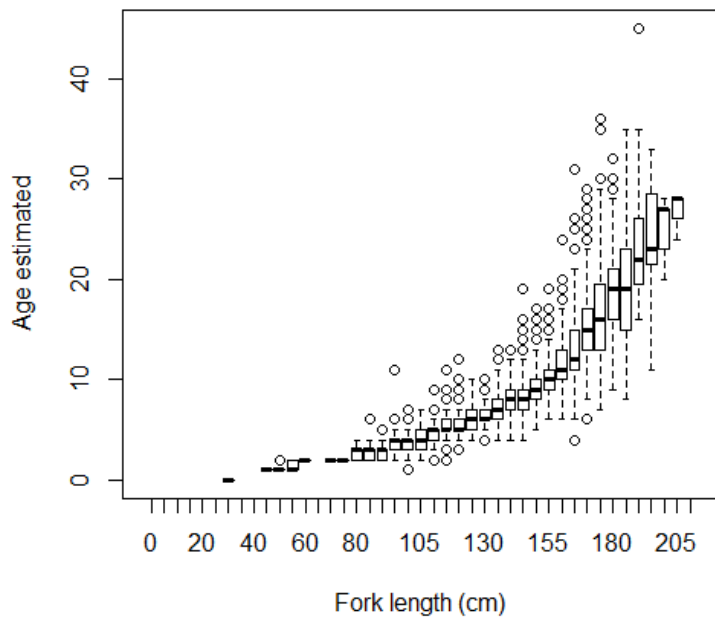


Fig. 1 Box plot of age estimated at fork length in 5 cm class in Japanese age estimated data

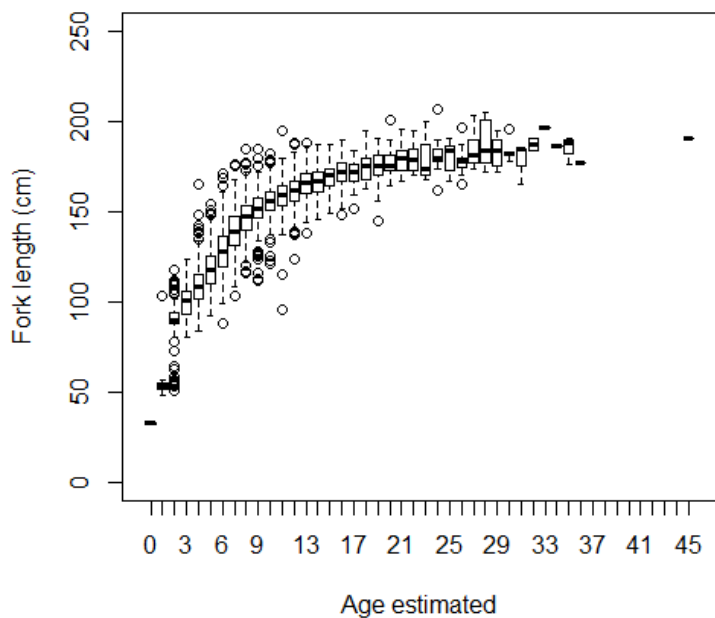


Fig. 2 Box plot of fork length at age estimated in Japanese age estimated data.

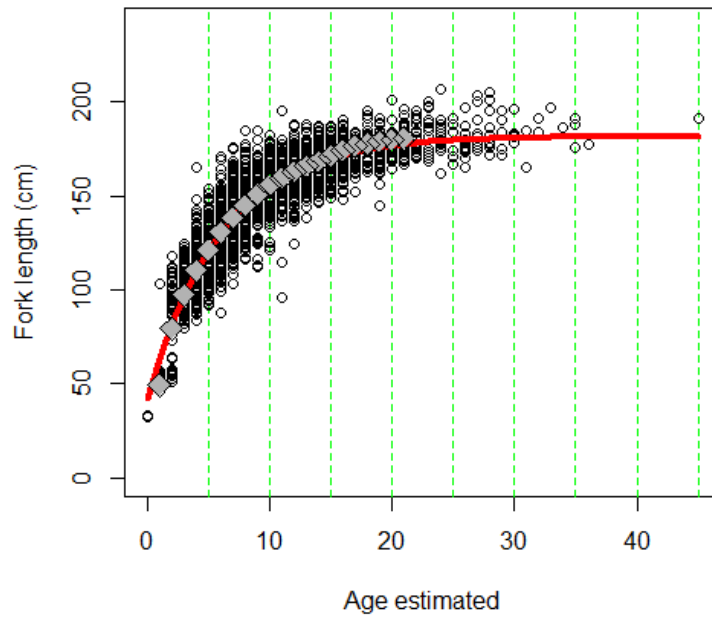


Fig. 3 von Bertalanffy curve and length plots for Japanese age estimated data. Diamonds are length-at-age used in CCSBT.