2014 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 2014

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要約

日本は 2014 年にミナミマグロ耳石を 435 個体から収集した。2014 年に漁獲されたミナミマグロ 149 個体の年齢を査定し、2015 年にデータを CCSBT 事務局へ提出した。4308 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 435 SBT individuals in 2014. Ages were estimated from 149 SBT individuals which were caught in 2014. The data were submitted to the CCSBT Secretariat in 2015. Age data of 4308 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 2014, Japan collected otoliths from a total of 435 southern bluefin tuna *Thunnus maccoyii* (SBT) individuals. Although the number of otolith samples had decreased in recent years compared to that of in the late 1990s to early 2000s, it increased remarkably in 2014. All of them came from commercial longline vessels through the scientific observer program (Yamasaki et al. CCSBT- ESC/1509/27). These fish were caught from March to September 2014, and fork length of them were 105 to 190 cm.

2) Age estimation:

Ages of 149 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 2015. The number of individuals by year caught and CCSBT area in the 2015 data is shown in Table 1. Number of individuals by year caught and at fork length class in the 2015 data is shown in Table 2. The range of age estimated was from 3 to 27.

2. Analysis of age data

The aging data for 149 individuals which estimated in 2014 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 4334 individuals by 2014 (Table 3). Aging analysis to the individuals caught in 2014 was conducted in advance of the analysis of those caught in 2013, because the otolith specimens derived from the individuals caught in 2014 reached to NRIFSF earlier than those caught in 2013. Twenty six otoliths out of 4334 individuals (0.60%) 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 4308 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.

Linf = 181.7 cm, K = 0.168, t0 = -1.539 (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, H. Minami, and H. Matsunaga. 2015. Report of Japanese scientific observer activities for southern bluefin tuna fishery in 2013 and 2014. CCSBT-ESC/1509/27.

Table 1 Number of otoliths, by year caught and CCSBT area, which were analyzed and submitted its data to CCSBT in 2015

	Year	
Area	2014	Total
4	1	1
7	148	148
Total	149	149

Table 2 Number of otoliths which were analyzed and submitted its data to CCSBT in 2015 by year caught and at fork length class

	Year	
Size	2014	Total
100-109cm	3	3
110-119cm	7	7
120-129cm	26	26
130-139cm	28	28
140-149cm	22	22
150-159cm	42	42
160-169cm	10	10
170-179cm	7	7
180-190cm	4	4
Total	149	149

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	Area1	Area2	Area4	Area5	Area7	Area8	Area9	Other	Total
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	108	93		239
2009			7			141	77		225
2010		5	12			57		6	80
2011		10	5	18		30	39	3	105
2012			2		5	46	55		108
2014	2	140	7						149
Total	66	211	321	18	415	1599	1695	9	4334

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	N_Readability						Age estimated (readability 1-5)					
		0	1	2	3	4	5	N	mean	median	min	max	SD
25-	0												
30-	2			2				2	0.00	0.00	0	0	0.00
35-	0												
40-	0												
45-	6				6			6	1.00	1.00	1	1	0.00
50-	43			12	31			43	1.09	1.00	1	2	0.29
55-	27	1		13	13			26	1.27	1.00	1	2	0.45
60-	2			2				2	2.00	2.00	2	2	0.00
65-	0												
70-	1			1				1	2.00	2.00	2	2	
75-	1			1				1	2.00	2.00	2	2	
80-	9	1		8				8	2.75	3.00	2	4	0.71
85-	68		1	52	15			68	2.68	3.00	2	6	0.74
90-	96		4	69	23			96	2.82	3.00	2	5	0.78
95-	103	1		65	37			102	3.62	4.00	2	11	1.14
100-	164	2	3	109	47	3		162	3.77	4.00	1	7	0.91
105-	220	2	7	139	68	4		218	4.16	4.00	2	7	0.96
110-	171		1	111	58	1		171	4.63	5.00	2	9	1.09
115-	197		10	113	73	1		197	5.14	5.00	2	11	1.15
120-	189		5	112	71	1		189	5.41	5.00	3	12	1.24
125-	174		4	96	68	6		174	6.06	6.00	4	10	1.21
130-	184		4	101	75	4		184	6.30	6.00	4	10	1.13
135-	206		5	117	81	3		206	7.09	7.00	4	13	1.54
140-	247	2	4	138	95	8		245	7.73	8.00	4	13	1.50
145-	273	1	7	147	112	6		272	8.47	8.00	4	19	1.91
150-	372	4	11	214	138	5		368	9.36	9.00	5	16	1.95
155-	341		10	206	113	12		341	10.18	10.00	6	19	2.06
160-	357	3	14	214	120	6		354	11.43	11.00	6	24	2.66
165-	261	2	15	157	81	6		259	12.86	12.00	4	31	3.48
170-	273	4	29	148	86	6		269	15.28	15.00	6	28	3.81
175-	154	1	19	82	52			153	16.92	16.00	7	36	5.34
180-	108	1	16	57	33	1		107	19.21	19.00	9	32	4.63
185-	45		7	28	10			45	19.53	19.00	8	35	6.13
190-	21	1	6	10	4			20					
195-	11		1	5	5			11	24.00	23.00	11	33	6.18
200-	5		1	3	1			5	25.00	27.00	20	28	3.39
205-	3			2	1			3	26.67	28.00	24	28	2.31
210-	0												
Total	4334	26	184	2534	1517	73		4308					

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

Age class	N	mean	median	min	max	SD
0	2	32.6	32.6	32.2	33.0	0.57
1	65	53.8	53.0	48.0	103.0	6.66
2	109	88.2	90.0	51.0	118.0	13.70
3	269	100.6	101.0	80.0	124.0	9.15
4	360	109.3	108.0	84.0	165.0	11.05
5	438	118.5	118.0	92.0	154.0	10.94
6	382	128.9	128.0	88.0	171.0	12.64
7	400	139.8	140.0	103.0	176.0	11.98
8	379	146.6	147.0	116.0	185.0	10.42
9	373	152.6	153.0	112.0	185.0	9.19
10	288	156.3	156.0	123.0	182.0	9.02
11	228	159.4	160.0	96.0	195.0	9.59
12	204	161.5	162.0	124.0	188.0	9.16
13	136	165.5	166.0	138.0	188.0	8.69
14	124	166.6	167.0	146.0	187.0	8.37
15	99	169.6	170.0	149.0	187.0	7.94
16	105	171.7	172.0	148.0	190.0	8.00
17	56	171.9	172.5	159.0	184.0	6.31
18	60	175.4	175.0	163.0	195.0	8.23
19	50	174.0	174.5	145.0	191.0	9.39
20	27	176.8	176.0	164.0	201.0	7.49
21	36	180.0	180.0	168.0	196.0	6.96
22	21	180.3	180.0	170.0	195.0	7.62
23	19	180.0	175.0	168.0	200.0	10.94
24	16	181.3	180.0	162.0	207.0	9.33
25	7	179.9	184.0	167.0	191.0	9.15
26	14	179.2	179.0	170.0	197.0	6.70
27	9	184.8	181.0	174.0	203.0	10.58
28	10	187.7	184.0	172.0	205.0	12.72
29	4	186.0	187.0	175.0	195.0	8.60
30	5	184.0	182.0	178.0	196.0	6.96
31	3	178.3	185.0	165.0	185.0	11.55
32	2	187.5	187.5	184.0	191.0	4.95
33	1	197.0	197.0	197.0	197.0	
34	1	186.0	186.0	186.0	186.0	
35	3	185.0	188.0	176.0	191.0	7.94
36	1	177.0	177.0	177.0	177.0	
37						
38						
39						
40						
41						
42						
43						
44						
45	1	191.0	191.0	191.0	191.0	

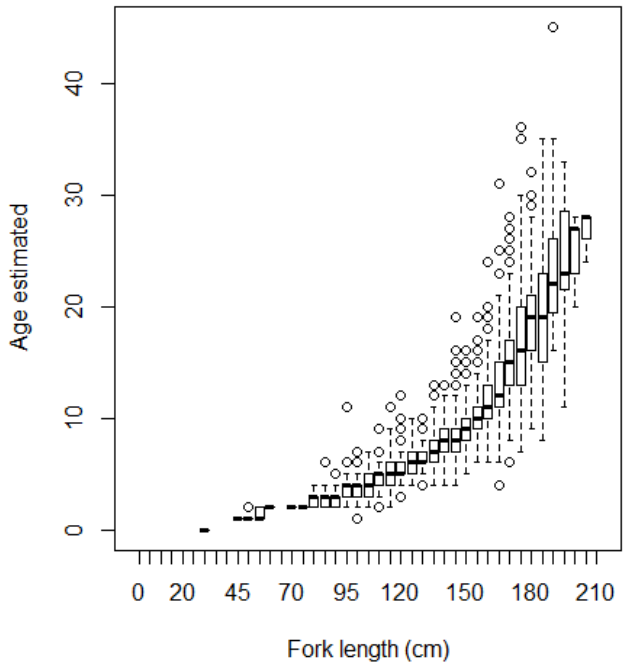

Fig. 1 Box plot of age estimated at fork length in 5 cm class in Japanese age estimated data

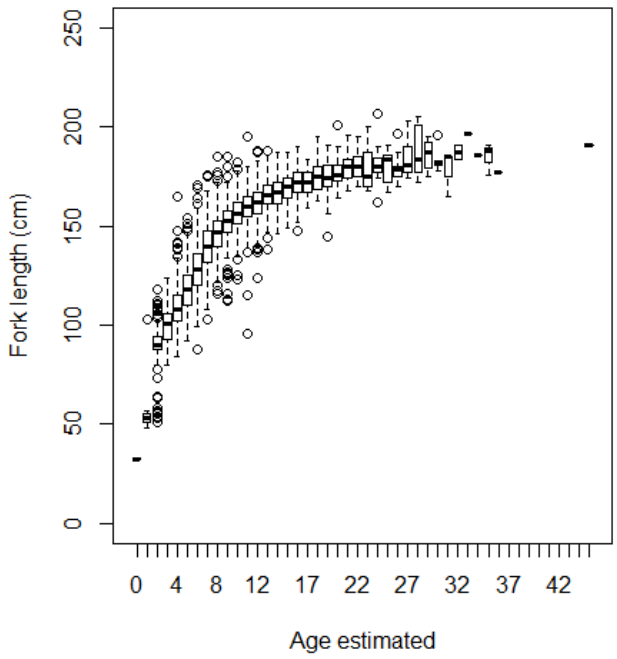

Fig. 2 Box plot of fork length at age estimated in Japanese age estimated data.

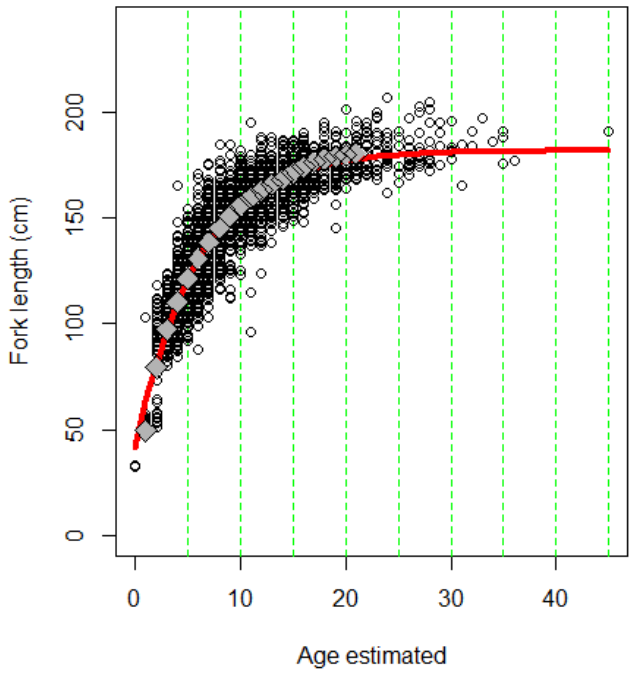

Fig. 3 von Bertalanffy curve and length plots for Japanese age estimated data. Diamonds are length-at-age used in CCSBT.