2013 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 2013

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要約

　日本は 2013 年にミナミマグロ耳石を 275 個体から収集した。2011-2012 年に漁獲されたミナミマグロ 109 個体の年齢を査定し、2014 年にデータを CCSBT 事務局へ提出した。4159 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 275 SBT individuals in 2013. Ages were estimated from 109 SBT individuals which were caught between 2011 and 2012. The data were submitted to the CCSBT Secretariat in 2014. Age data of 4159 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 2013, Japan collected otoliths from a total of 275 southern bluefin tuna *Thunnus maccoyii* (SBT) individuals. 159 of them came from commercial longline vessels through the scientific observer program (Sakai et al. CCSBT- ESC/1409/29). These fish caught by longline were relatively large in size. Remaining 116 of them came from the trolling survey in January-February 2013. These fish were small in size presumably age 0-2 (CCSBT-ESC/1309/27).

2) Age estimation:

Ages of 109 individuals were estimated using otoliths following to the CCSBT manual, "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 2014. The number of individuals by year caught and CCSBT area in the 2014 data is shown in Table 1. Number of individuals by year caught and at fork length class in the 2014 data is shown in Table 2. Fork length of fish ranged from 87 to 182 cm. The range of age estimated was from 1 to 27.

2. Analysis of age data

All age data which were submitted to the CCSBT by Japan from 2005 to 2014 were analyzed. The data includes 4159 individuals (Table 3). More than 200 individuals of age data were produced in every year between 1998 and 2005, but decreased to around 100 individuals in recent few years.

Statistical values are shown for age estimated by 5 cm fork length class (Table 4) and fork length by age estimated (Table 5). Twenty six otoliths out of 4185 individuals (0.62%) were not able to be estimated its ages (readabilities are 0 or 1). No otolith was assigned to readability 5 (no doubt).

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 = 181.6 cm, K = 0.169, t0 = -1.517 (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.

Itoh, T., O. Sakai, and D. Tokuda. 2013. Report of the piston-line trolling survey for the age-1 southern bluefin tuna recruitment index in 2012/2013. CCSBT-ESC/1309/27.

Sakai, O., T. Itoh, H. Minami, and O. Abe. 2014. Report of Japanese scientific observer activities for southern bluefin tuna fishery in 2012 and 2013. CCSBT-ESC/1409/29.

Table 1   Number of otoliths, by year caught and CCSBT area, which were analyzed and submitted its data to CCSBT in 2014

| | Year | | |
Area	2011	2012	Total
2	1		1
4		2	2
7		5	5
8		46	46
9		55	55
Total	1	108	109

Table 2   Number of otoliths which were analyzed and submitted its data to CCSBT in 2014 by year caught and at fork length class

| | Year | | |
Size	2011	2012	Total
70-79cm			0
80-89cm		1	1
90-99cm			0
100-109cm		3	3
110-119cm		13	13
120-129cm	1	14	15
130-139cm		20	20
140-149cm		16	16
150-159cm		8	8
160-169cm		14	14
170-179cm		16	16
180-189cm		3	3
190-199cm			0
200-209cm			0
Total	1	108	109

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
Total	64	71	314	18	415	1599	1695	9	4185

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 0	1	2	3	4	5	Age estimated (readability 1-5) N	mean	median	min	max	SD
25-	0												
30-	2			2				2	0.0	0.0	0	0	0.00
35-	0												
40-	0												
45-	6				6			6	1.0	1.0	1	1	0.00
50-	43			12	31			43	1.1	1.0	1	2	0.29
55-	27	1		13	13			26	1.3	1.0	1	2	0.45
60-	2			2				2	2.0	2.0	2	2	0.00
65-	0												
70-	1			1				1	2.0	2.0	2	2	
75-	1			1				1	2.0	2.0	2	2	
80-	9	1		8				8	2.8	3.0	2	4	0.71
85-	68		1	52	15			68	2.7	3.0	2	6	0.74
90-	96		4	69	23			96	2.8	3.0	2	5	0.78
95-	103	1		65	37			102	3.6	4.0	2	11	1.14
100-	164	2	3	109	47	3		162	3.8	4.0	1	7	0.91
105-	217	2	7	136	68	4		215	4.2	4.0	2	7	0.96
110-	169		1	109	58	1		169	4.6	5.0	2	9	1.10
115-	192		10	108	73	1		192	5.1	5.0	2	11	1.15
120-	178		5	101	71	1		178	5.4	5.0	3	12	1.23
125-	159		4	81	68	6		159	6.0	6.0	4	10	1.22
130-	163		4	83	72	4		163	6.3	6.0	4	10	1.17
135-	199		5	112	79	3		199	7.1	7.0	4	13	1.56
140-	236	2	4	127	95	8		234	7.7	8.0	4	13	1.53
145-	262	1	7	137	111	6		261	8.5	8.0	4	19	1.94
150-	346	4	11	189	137	5		342	9.4	9.0	5	16	1.98
155-	325		10	190	113	12		325	10.2	10.0	6	19	2.10
160-	348	3	14	205	120	6		345	11.4	11.0	6	24	2.67
165-	260	2	15	156	81	6		258	12.9	12.0	4	31	3.49
170-	271	4	29	146	86	6		267	15.3	15.0	6	28	3.82
175-	149	1	17	79	52			148	17.0	16.0	7	36	5.38
180-	106	1	16	55	33	1		105	19.1	18.0	9	32	4.61
185-	44		7	27	10			44	19.4	19.0	8	35	6.16
190-	20	1	6	9	4			19					
195-	11		1	5	5			11	24.0	23.0	11	33	6.18
200-	5		1	3	1			5	25.0	27.0	20	28	3.39
205-	3			2	1			3	26.7	28.0	24	28	2.31
210-	0												
Total	4185	26	182	2394	1510	73	0	4159					

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	268	100.5	101.0	80.0	124.0	9.16
4	357	109.3	108.0	84.0	165.0	11.09
5	429	118.5	118.0	92.0	154.0	11.01
6	357	128.8	128.0	88.0	171.0	12.94
7	374	140.2	140.0	103.0	176.0	12.08
8	353	146.8	147.0	116.0	185.0	10.23
9	358	152.6	153.0	112.0	185.0	9.33
10	272	156.4	156.0	123.0	182.0	9.21
11	216	159.5	160.0	96.0	195.0	9.72
12	199	161.4	162.0	124.0	188.0	9.19
13	134	165.5	166.0	138.0	188.0	8.70
14	123	166.6	167.0	146.0	187.0	8.40
15	98	169.5	170.0	149.0	187.0	7.95
16	104	171.7	172.0	148.0	190.0	8.04
17	55	171.9	172.0	159.0	184.0	6.36
18	59	175.3	175.0	163.0	195.0	8.29
19	50	174.0	174.5	145.0	191.0	9.39
20	26	176.5	175.5	164.0	201.0	7.53
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	18	179.4	174.0	168.0	200.0	10.98
24	15	180.8	180.0	162.0	207.0	9.47
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	8	185.3	181.0	174.0	203.0	11.21
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	
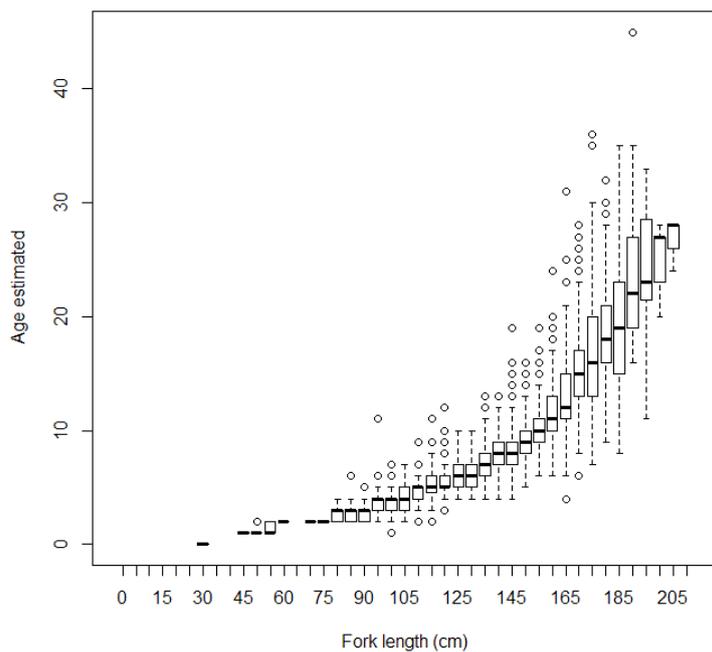
Fig. 1　Box plot of age estimated at fork length in 5 cm class in Japanese age estimated data
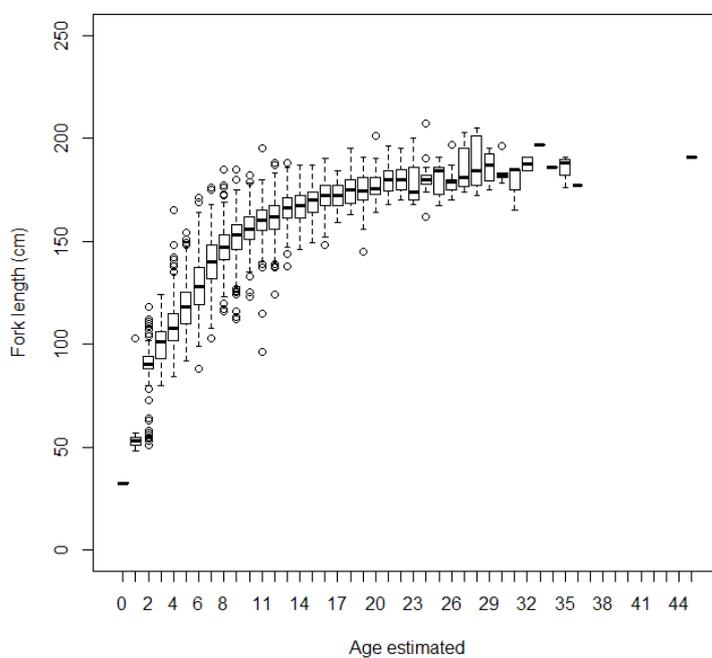

Fig. 2　Box plot of fork length at age estimated in Japanese age estimated data.
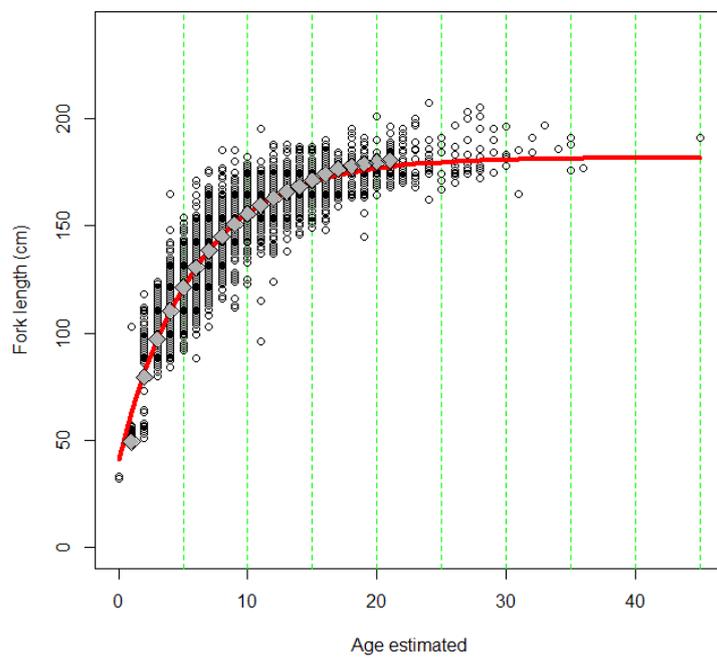
Fig. 3   von Bertalanffy curve and length plots for Japanese age estimated data. Diamonds are length-at-age used in CCSBT.