2012 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 2012

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要約

日本は 2012 年にミナミマグロ耳石を 209 個体から収集した。2007-2011 年に漁獲されたミナミマグロ 270 個体の年齢を査定し、2013 年にデータを CCSBT 事務局へ提出した。4050 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 209 SBT individuals in 2012. Ages were estimated from 270 SBT individuals which were caught between 2007 and 2011. The data were submitted to the CCSBT Secretariat in 2013. Age data of 4050 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 2012, Japan collected otoliths from a total of 209 southern bluefin tuna *Thunnus maccoyii* (SBT) individuals. 121 of them came from commercial longline vessels through the scientific observer program (Sakai et al. CCSBT- ESC/1309/22). These fish caught by longline were relatively large in size. Remaining 98 of them came from the trolling survey in January-February 2012. These fish were small in size presumably age 0-2 (CCSBT-ESC/1208/33).

2) Age estimation:

Ages of 270 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 2013. The number of individuals by year caught and CCSBT area in the 2013 data is shown in Table 1. Number of individuals by year caught and at fork length class in the 2013 data is shown in Table 2. Fork length of fish ranged from 98 to 189 201 cm. The range of age estimated was from 3 to 25.

2. Analysis of age data

All age data which were submitted to the CCSBT by Japan from 2005 to 2013 were analyzed. The data includes 4050 individuals (Table 3). There are more than 200 individuals of age data in every year between 1998 and 2005, and between 2007 and 2009.

Statistical values are shown for age estimated by 5 cm fork length class (Table 4) and fork length by age estimated (Table 5). Twenty seven otoliths out of 4076 individuals (0.66%) 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 = 0.170, t0 = -1.469 (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. 2012. Report of the piston-line trolling survey for the age-1 southern bluefin tuna recruitment index in 2011/2012. CCSBT-ESC/1208/33.

Sakai, O., D. Tokuda, T. Itoh, H. Minami, and O. Abe. 2013. Report of Japanese scientific observer activities for southern bluefin tuna fishery in 2011 and 2012. CCSBT-ESC/1309/22.

Table 1 Number of otoliths, by year caught and CCSBT area, which were analyzed and submitted its data to CCSBT in 2013

	Year					
Area	2007	2008	2009	2010	2011	Total
2				5	9	14
4			2	12	5	19
5					18	18
8	1	6	3	57	30	97
9	6		68		39	113
11				6	3	9
Total	7	6	73	80	104	270

Table 2 Number of otoliths which were analyzed and submitted its data to CCSBT in 2013 by year caught and at fork length class

	Year					
Size	2007	2008	2009	2010	2011	Total
70-79cm						0
80-89cm						0
90-99cm					2	2
100-109cm				2	4	3	9
110-119cm				5	6	7	18
120-129cm		1		9	7	13	30
130-139cm			3	10	9	18	40
140-149cm		3		13	17	27	60
150-159cm				15	11	14	40
160-169cm		3		14	14	10	41
170-179cm			3	5	9	6	23
180-189cm					3	4	7
190-199cm							0
200-209cm							0
Total		7	6	73	80	104	270

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		9	5	18		30	39	3	104
Total	64	70	312	18	410	1553	1640	9	4076

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

Fork length	N_readability							Age estimated (readability 1-5)					
Class	N	0	1	2	3	4	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-	67			52	15			67	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-	162	2	3	107	47	3		160	3.8	4.0	2	7	0.88
105-	216	2	7	135	68	4		214	4.2	4.0	2	7	0.96
110-	162		1	102	58	1		162	4.7	5.0	2	9	1.09
115-	186		9	103	73	1		186	5.2	5.0	3	11	1.14
120-	172		4	96	71	1		172	5.4	5.0	3	12	1.24
125-	150		3	74	67	6		150	6.0	6.0	4	10	1.24
130-	162		4	82	72	4		162	6.3	6.0	4	10	1.17
135-	180		4	94	79	3		180	7.1	7.0	4	13	1.54
140-	226	2	3	119	94	8		224	7.7	8.0	4	13	1.49
145-	256	1	6	133	110	6		255	8.5	8.0	4	19	1.94
150-	344	4	11	187	137	5		340	9.4	9.0	5	16	1.99
155-	319		10	185	112	12		319	10.2	10.0	6	19	2.11
160-	340	3	14	199	118	6		337	11.4	11.0	6	24	2.68
165-	254	2	15	150	81	6		252	12.8	12.0	4	31	3.49
170-	261	4	29	136	86	6		257	15.2	15.0	6	28	3.81
175-	143	1	17	74	51			142	16.8	16.0	7	36	5.33
180-	103	1	15	53	33	1		102	19.2	19.0	9	32	4.65
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	4076	26	174	2300	1503	73	0	4050					

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	64	53.1	53.0	48.0	57.0	2.48
2	106	87.8	90.0	51.0	112.0	13.51
3	263	100.3	101.0	80.0	124.0	9.13
4	351	109.0	108.0	84.0	165.0	10.97
5	423	118.5	118.0	92.0	154.0	11.03
6	334	128.6	128.0	88.0	171.0	13.18
7	366	140.2	140.0	103.0	176.0	12.16
8	346	146.9	147.0	116.0	185.0	10.29
9	351	152.8	153.0	112.0	185.0	9.32
10	268	156.5	156.0	123.0	182.0	9.19
11	212	159.5	160.0	96.0	195.0	9.80
12	194	161.7	162.0	124.0	188.0	8.99
13	130	165.5	166.0	138.0	188.0	8.78
14	119	166.5	167.0	146.0	187.0	8.41
15	96	169.7	170.5	149.0	187.0	7.97
16	98	171.8	173.0	148.0	190.0	8.20
17	53	171.9	172.0	159.0	184.0	6.48
18	56	175.2	174.5	163.0	195.0	8.42
19	48	174.3	175.0	145.0	191.0	9.51
20	25	176.6	175.0	164.0	201.0	7.69
21	35	180.1	180.0	168.0	196.0	7.01
22	19	181.0	181.0	170.0	195.0	7.72
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	6	180.8	184.0	167.0	191.0	9.62
26	13	179.5	180.0	170.0	197.0	6.91
27	7	186.4	183.0	174.0	203.0	11.56
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	

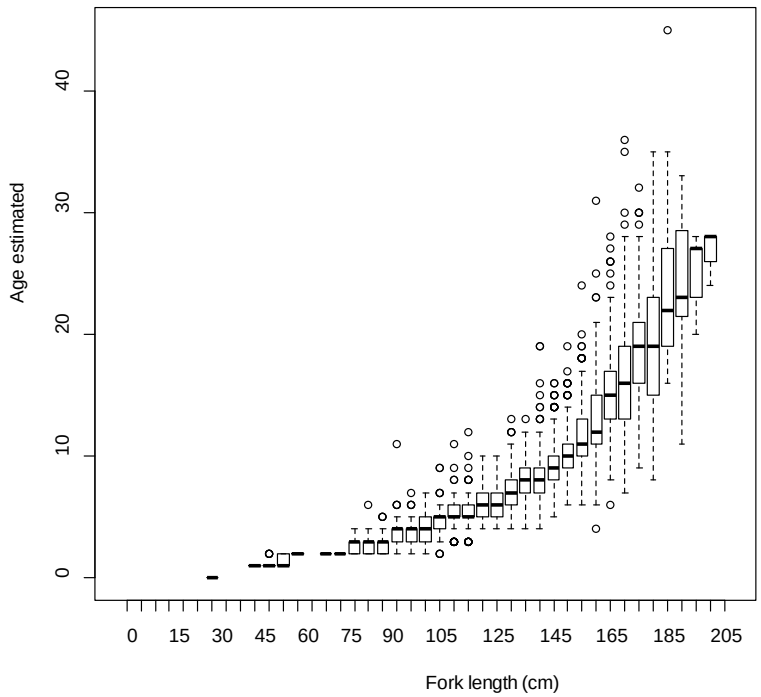

Fig. 1 Box plot of age estimated at fork length in 5 cm class in Japanese age estimated data

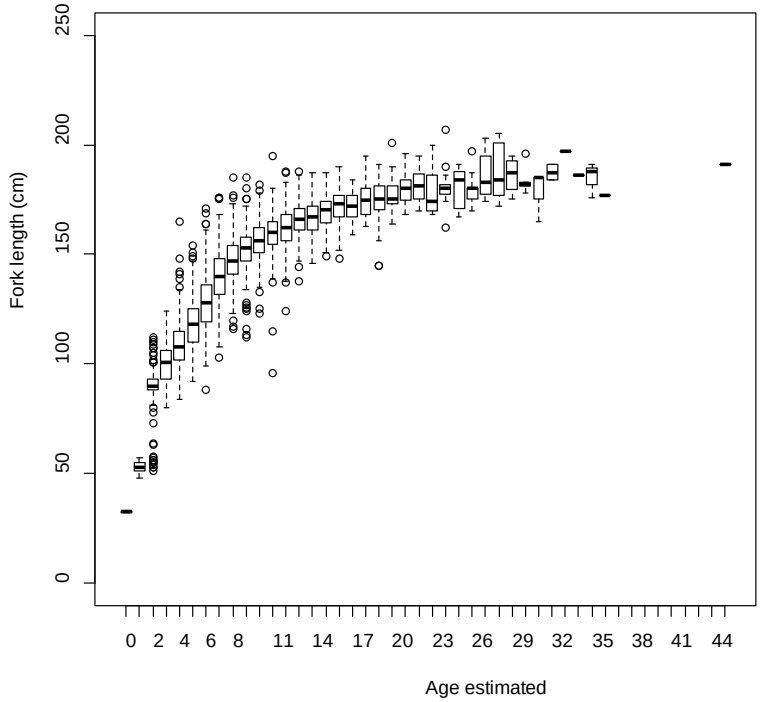

Fig. 2 Box plot of fork length at age estimated in Japanese age estimated data.

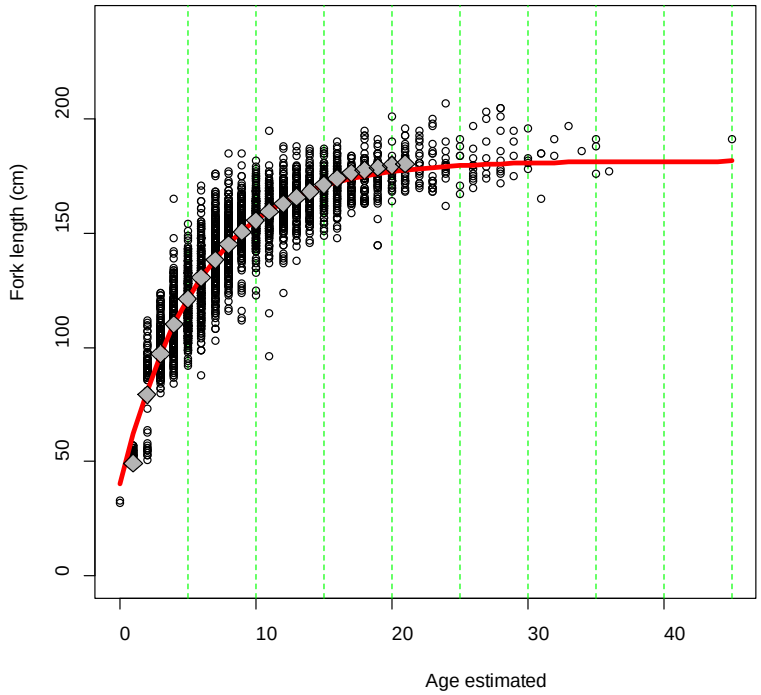

Fig. 3 von Bertalanffy curve and length plots for Japanese age estimated data. Diamonds are length-at-age used in CCSBT.