

2011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 2011

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## 要約

日本は 2011 年にミナミマグロ耳石を 422 個体から収集した。2006-2009 年に漁獲されたミナミマグロ 152 個体の年齢を査定し、2012 年にデータを CCSBT 事務局へ提出した。3806 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 422 SBT individuals in 2011. Ages were estimated from 152 SBT individuals which were caught between 2006 and 2009. The data were submitted to the CCSBT Secretariat in 2012. Age data of 3806 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 2011, Japan collected otoliths from a total of 422 southern bluefin tuna *Thunnus maccoyii* (SBT) individuals. 200 of them came from commercial longline vessels through the scientific observer program (Sakai et al. CCSBT- ESC/1208/27). These fish which were caught by longline were relatively large in size. Remaining 222 of them came from the trolling survey in January-February 2011. These fish were small in size presumably age 0-2 (CCSBT-ESC/1107/29).

### 2) Age estimation:

Ages of 152 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 2012. The number of individuals by year caught and CCSBT area in the 2012 data is shown in Table 1. Number of individuals by year caught and at fork length class in the 2012 data is shown in Table 2. Fork length of fish ranged from 80 to 201 cm. The range of age estimated was from 2 to 21. One otolith was not determined its age due to low readability of the otolith.

## 2. Analysis of age data

All age data which were submitted to the CCSBT by Japan from 2005 to 2012 were analyzed. The data includes 3806 individuals (Table 3). There are more than 200 individuals of age data in every year between 1998 and 2005, 2007 and 2008.

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 3806 individuals (0.71%) 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.

$L_{inf} = 182.5$  cm,  $K = 0.168$ ,  $t_0 = -1.493$  (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., K. Fujioka and O. Sakai. 2011. Report of the piston-line trolling survey for the age-1 southern bluefin tuna recruitment index in 2011/2012. CCSBT-ESC/1107/29.

Sakai, O., D. Tokuda, T. Itoh, Y. Akatsuka, and O. Abe. 2011. Report of Japanese scientific observer activities for southern bluefin tuna fishery in 2011. CCSBT-ESC/1208/27.

Table 1 Number of otoliths, by year caught and CCSBT area, which were analyzed and submitted its data to CCSBT in 2012

Area	Year				Total
	2006	2007	2008	2009	
8	10	21	35	27	93
9	7	52			59
Total	17	73	35	27	152

Table 2 Number of otoliths which were analyzed and submitted its data to CCSBT in 2012 by year caught and at fork length class

Size	Year				Total
	2006	2007	2008	2009	
70-79cm					0
80-89cm			9	4	13
90-99cm			8	2	10
100-109cm	1	2		4	7
110-119cm	1	4			5
120-129cm	1	5	3		9
130-139cm	1	1	1		3
140-149cm	1	4	8	2	15
150-159cm	3	15	4	5	27
160-169cm	5	17	5	5	32
170-179cm	3	5	12	3	23
180-189cm	1	2	2	2	7
190-199cm					0
200-209cm		1			1
Total	17	73	35	27	152

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	Area7	Area8	Area9	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			193	98	292
2008			5	33	102	93	233
2009			5		138	9	152
Total	64	56	293	410	1456	1527	3806

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)					SD	
		0	1	2	3	4	5	N	mean	median	min		max
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-	101	1		63	37			100	3.6	4.0	2	11	1.13
100-	159	2	3	104	47	3		157	3.8	4.0	2	7	0.87
105-	210	2	7	130	67	4		208	4.1	4.0	2	7	0.95
110-	149		1	90	57	1		149	4.6	5.0	2	9	1.11
115-	181		9	98	73	1		181	5.1	5.0	3	11	1.15
120-	160		3	86	70	1		160	5.3	5.0	3	10	1.13
125-	132		2	58	66	6		132	5.8	6.0	4	9	1.09
130-	144		4	66	70	4		144	6.2	6.0	4	10	1.17
135-	158		4	77	74	3		158	6.9	7.0	4	13	1.36
140-	187	2	2	85	90	8		185	7.6	8.0	4	11	1.41
145-	235	1	6	114	108	6		234	8.3	8.0	4	16	1.63
150-	321	4	9	168	135	5		317	9.4	9.0	5	16	1.93
155-	302		9	170	111	12		302	10.1	10.0	6	17	2.02
160-	316	3	13	177	117	6		313	11.4	11.0	6	20	2.54
165-	237	2	15	133	81	6		235	12.9	12.0	4	31	3.42
170-	245	4	28	121	86	6		241	15.4	15.0	8	28	3.75
175-	136	1	17	67	51			135	17.1	16.0	7	36	5.17
180-	100	1	13	52	33	1		99	19.1	18.0	9	32	4.63
185-	40		7	23	10			40	20.0	19.0	12	35	5.85
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	3806	26	164	2061	1482	73	0	3780					

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	262	100.3	101.0	80.0	124.0	9.15
4	342	108.8	108.0	84.0	165.0	10.90
5	397	118.4	118.0	92.0	154.0	10.92
6	305	128.2	128.0	88.0	169.0	12.55
7	320	139.8	140.0	103.0	175.0	11.95
8	305	147.4	147.0	116.0	176.0	9.65
9	322	152.9	153.0	112.0	180.0	8.85
10	248	156.5	156.0	123.0	182.0	8.71
11	198	159.7	160.0	96.0	195.0	9.64
12	184	162.5	162.0	145.0	188.0	7.85
13	117	166.5	166.0	138.0	188.0	8.26
14	111	166.6	167.0	146.0	186.0	8.12
15	92	170.3	171.0	151.0	187.0	7.47
16	93	172.0	173.0	148.0	190.0	8.27
17	49	172.3	173.0	159.0	184.0	6.54
18	56	175.2	174.5	163.0	195.0	8.42
19	45	176.0	175.0	163.0	191.0	6.88
20	24	176.7	175.5	164.0	201.0	7.82
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	16	179.6	174.0	168.0	200.0	11.04
24	11	183.0	180.0	174.0	207.0	9.13
25	5	180.2	184.0	167.0	191.0	10.62
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	

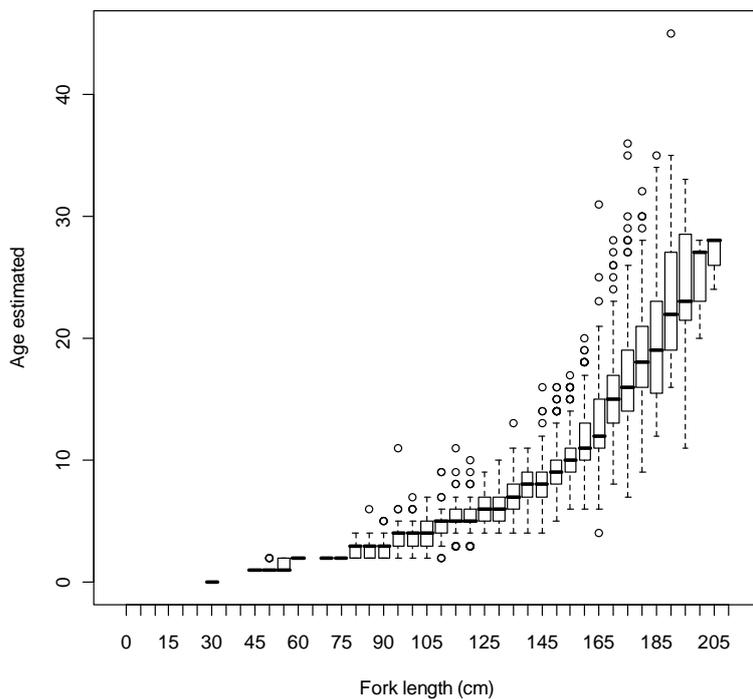


Fig. 1 Box plot of age estimated at fork length in 5 cm class in Japanese age estimated data

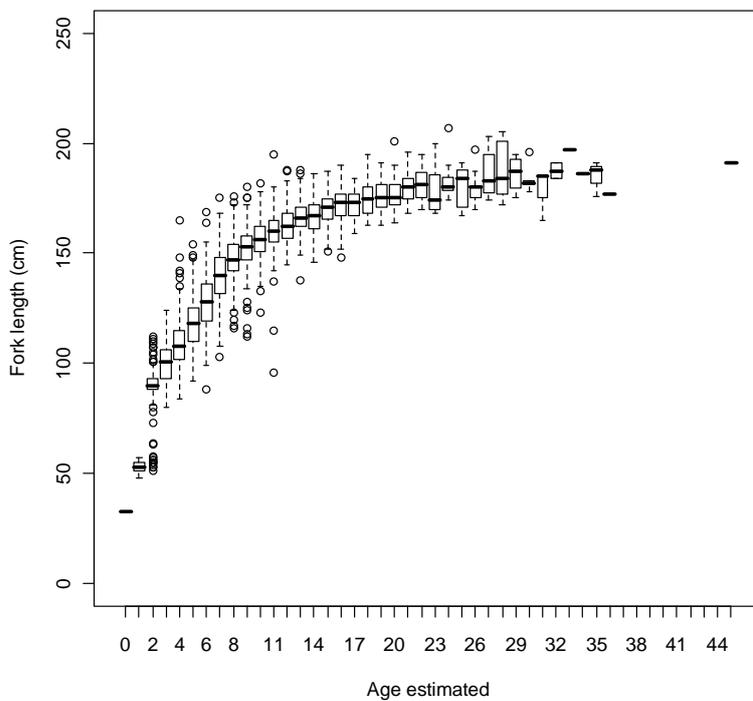


Fig. 2 Box plot of fork length at age estimated in Japanese age estimated data.

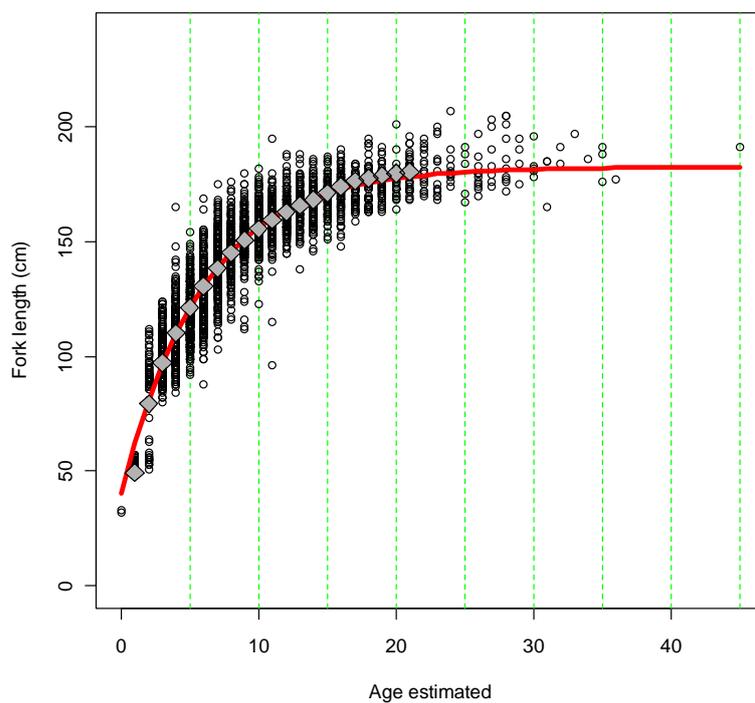


Fig. 3 von Bertalanffy curve and length plots for Japanese age estimated data. Diamonds are length-at-age used in CCSBT.