

Activities of southern bluefin tuna otolith collection and age  
estimation and analysis of the age data by Japan in 2017

2017年の日本によるミナミマグロ耳石収集と  
年齢査定活動並びに年齢データの分析

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## 要約

日本は2017年にミナミマグロ耳石を301個体から収集した。2016年に漁獲されたミナミマグロ198個体の年齢を査定し、2018年にデータをCCSBT事務局へ提出した。日本は合計4907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 301 southern bluefin tuna *Thunnus maccoyii* (SBT) individuals in 2017. Ages were estimated from 198 SBT in individuals which were caught in 2016. The data were submitted to the CCSBT Secretariat in 2018. Age data in a total of 4907 SBT individuals by Japan were analyzed to show relationships between fork length and age estimated.

### 1. Activities of otolith collection

In 2017, Japan collected otoliths from a total of 301 southern bluefin tuna *Thunnus Maccoyii* (SBT) individuals. 251 out of 301 otoliths came from commercial longline vessels through the scientific observer program (Itoh et al., CCSBT-ESC/1809/23). These fish were caught from April to August 2016, and fork length of them was 90 to 193cm. In addition, 55 out of 301 otoliths were collected from the trolling survey in 2018 (Tsuda and Itoh, CCSBT-ESC/1809/26).

### 2. Age estimation of 2016 data

Ages of 198 individuals which were caught in 2016 were estimated in 2017 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 Corporation, who did the same work for years, estimated the age once respectively and independently. Then, one of them determined the final estimated age referring to their previous estimation.

The number of individuals by the CCSBT area in the 2016 data is shown in Table 1. Number of individuals and at fork length class in the 2016 data is shown in Table 2. The range of age estimated was from 4 to 23. The data of age estimated with capture information were sent to the CCSBT Secretariat in 2018.

### 3. Analysis of accumulated age dataset

The age data for 198 individuals which estimated in 2017 were added into the accumulated age dataset since 1997 to apply the analysis. The total number of otolith which was analyzed for age estimation reached 4924 individuals by 2016 (Table 3). Table 4 shows the frequency of reliability of age estimation by fork length class, seventy otoliths out of 4924 individuals (0.34%) 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 4907 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, the majority of plots seems to be appropriate. Parameters of von Bertalanffy growth equation were estimated by the least square method as follows.

$$L_{inf} = 181.5 \text{ cm}, K = 0.166, t_0 = -1.619 \text{ (year)}$$

## References

- Anon (2002) Report of the Direct Age Estimation Workshop. Victoria, Australia. 11-14 June 2002.
- Itoh, T., Tsuda, Y., Inoue, Y., Semba, Y. and Oshima, K. (2018) Report of Japanese scientific observer activities for southern bluefin tuna fishery in 2017. CCSBT-ESC/1809/23.
- Tsuda, Y., and Itoh, T. (2018) Report of the piston-line trolling monitoring survey for the age-1 southern bluefin tuna recruitment index in 2017/2018. CCSBT-ESC/1809/26.

Table 1 Number of otoliths, by year caught and CCSBT area, that were analyzed and submitted its data to CCSBT in 2018. The otolith samples had been analyzed in 2017 were taken from the fish which had been caught in 2016.

Area	Year
	2016
7	44
9	154
Total	198

Table 2 Number of otoliths that were analyzed and submitted its data to CCSBT in 2018 by year caught and at fork length class.

Size	Year
	2016
100-109cm	1
110-119cm	
120-129cm	7
130-139cm	46
140-149cm	49
150-159cm	51
160-169cm	28
170-179cm	9
180-199cm	6
200-219cm	1
Total	198

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				32			56
1998			25			203	20	1	249
1999	1		73		144	332	36		586
2000		13	24		37	94	110		278
2001	13				70	56	206		345
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
2015			32	1		41	123		197
2016					44		154		198
Total	64	73	347	19	680	1664	2067	10	4924

Table 4 Statistical value 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
30-35-	2			2				2	0.0	0	0	0	0.00
40-45-	6				6			6	1.0	1	1	1	0.00
50-55-	42			12	30			42	1.1	1	1	2	0.30
60-65-	28	1		13	14			27	1.3	1	1	2	0.45
70-75-	2			2				2	2.0	2	2	2	0.00
80-85-	1			1				1	2.0	2	2	2	
90-95-	1			1				1	2.0	2	2	2	
100-105-	8			8				8	2.8	3	2	4	0.71
110-115-	69		1	53	15			69	2.7	3	2	6	0.74
120-125-	98		4	71	23			98	2.8	3	2	5	0.77
130-135-	110			73	37			110	3.6	4	2	11	1.12
140-145-	171	1	3	117	47	3		170	3.8	4	1	7	0.93
150-155-	223		7	144	68	4		223	4.2	4	2	7	0.97
160-165-	180		1	120	58	1		180	4.7	5	2	9	1.09
170-175-	213		10	129	73	1		213	5.2	5	2	11	1.16
180-185-	214		6	136	71	1		214	5.5	5	3	12	1.31
190-195-	203		4	124	69	6		203	6.1	6	4	10	1.25
200-205-	232		4	147	77	4		232	6.4	7	4	11	1.16
210-215-	253		6	164	80	3		253	7.2	7	4	13	1.47
220-225-	299	1	5	187	98	8		298	7.8	8	4	13	1.48
230-235-	363		9	233	114	6		362	8.6	9	4	19	1.78
240-245-	471	3	19	304	140	5		468	9.5	9	5	17	1.94
250-255-	404		11	268	113	12		404	10.2	10	6	19	1.97
260-265-	392	3	17	246	120	6		389	11.5	11	6	24	2.63
270-275-	286	2	18	178	82	6		284	13.0	13	4	31	3.61
280-285-	289	4	31	161	87	6		285	15.4	15	6	29	3.89
290-295-	165	1	20	91	53			164	17.1	16	7	36	5.18
300-305-	110		15	61	33	1		110	19.1	18	9	32	4.64
310-315-	49		7	32	10			49	19.5	19	8	35	5.94
320-325-	21		6	11	4			21					
330-335-	11		1	5	5			11	24.0	23	11	33	6.18
340-345-	5		1	3	1			5	25.0	27	20	28	3.39
350-355-	3			2	1			3	26.7	28	24	28	2.31
Total	4924	17	206	3099	1529	73		4907					

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	32.5	32.5	32	33	0.71
1	65	53.8	53.0	48	103	6.66
2	110	88.2	90.0	51	118	13.64
3	277	100.5	101.0	80	124	9.05
4	374	109.3	108.0	84	165	11.02
5	460	118.6	118.0	92	154	10.89
6	437	128.6	128.0	88	171	12.51
7	481	138.9	138.0	103	176	11.55
8	469	145.8	146.0	116	185	10.49
9	461	151.7	152.0	112	185	8.96
10	361	155.1	155.0	121	182	9.11
11	285	158.2	158.0	96	195	9.34
12	236	161.0	161.0	124	188	9.09
13	158	164.7	165.0	138	188	8.71
14	131	166.4	167.0	146	187	8.31
15	110	169.3	170.0	149	187	7.89
16	114	171.7	172.0	148	190	8.26
17	62	171.7	172.0	152	184	6.65
18	62	175.1	174.5	163	195	8.19
19	56	174.8	175.0	145	191	8.39
20	32	176.6	175.0	164	201	7.15
21	38	179.4	179.5	167	196	7.26
22	22	179.9	178.5	170	195	7.70
23	22	179.4	175.5	168	200	10.31
24	18	180.7	180.0	162	207	9.36
25	7	179.9	184.0	167	191	9.15
26	15	178.3	178.0	165	197	7.43
27	9	184.8	181.0	174	203	10.58
28	10	187.7	184.0	172	205	12.72
29	5	183.2	184.0	172	195	9.73
30	5	184.0	182.0	178	196	6.96
31	3	178.3	185.0	165	185	11.55
32	2	187.5	187.5	184	191	4.95
33	1	197.0	197.0	197	197	
34	1	186.0	186.0	186	186	
35	3	185.0	188.0	176	191	7.94
36	1	177.0	177.0	177	177	
37						
38						
39						
40						
41						
42						
43						
44						
45	1	191.0	191.0	191	191	

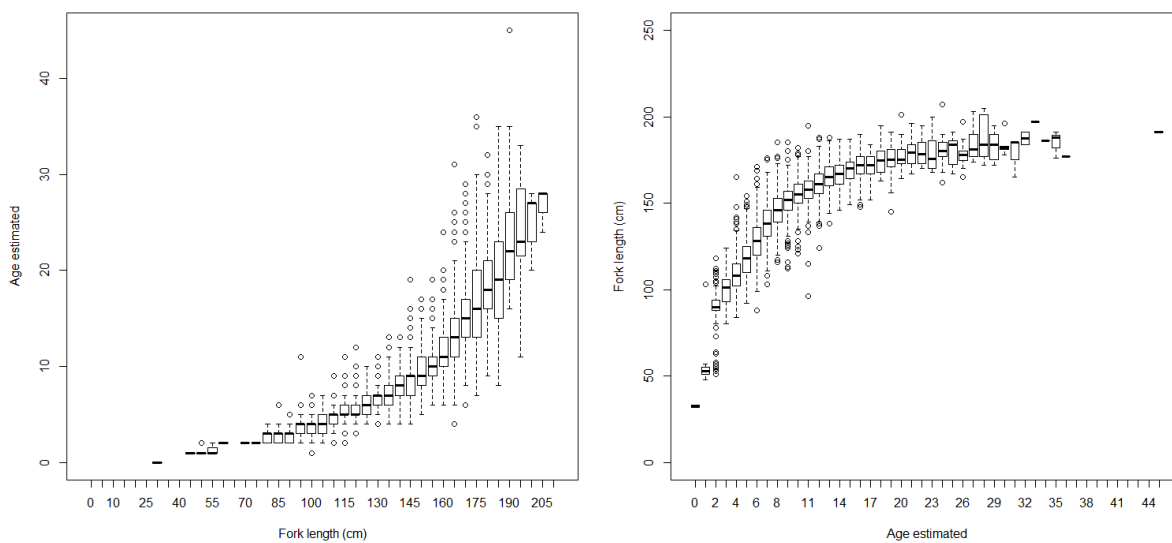


Fig. 1 (a) Boxplot of age estimated at fork length in 5 cm class in Japanese age estimated data. (b) Boxplot of fork length at age estimated in Japanese age estimated data.

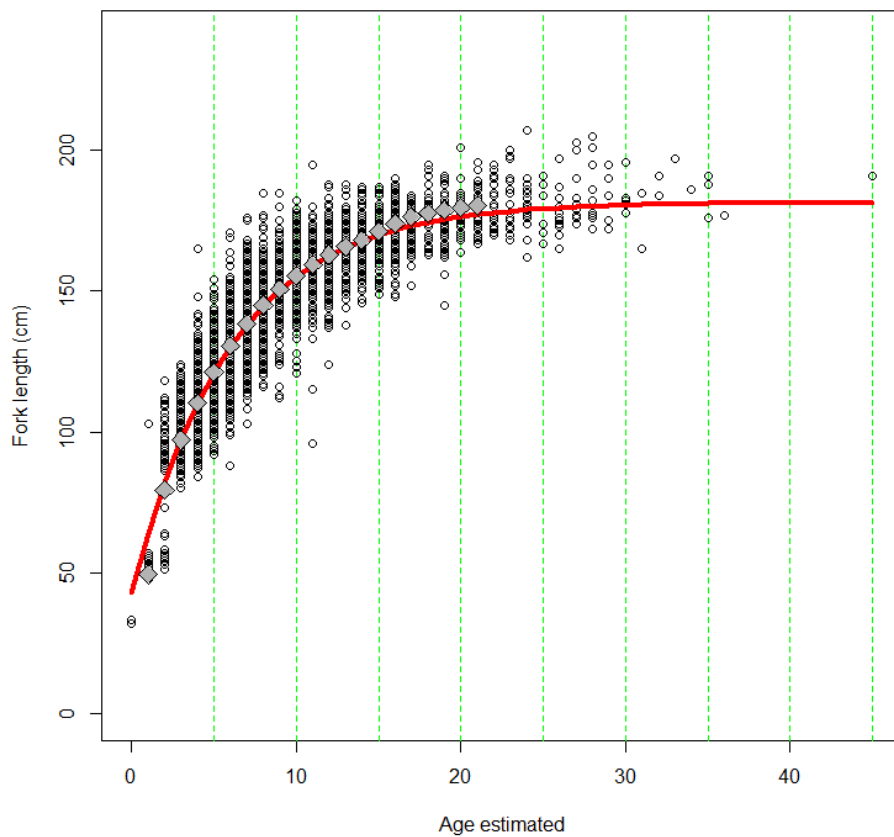


Fig. 2 von Bertalanffy curve and length plots for Japanese age estimated data. Diamonds are length-at age used in CCSBT.