# Activities of otolith collection and age estimation and analysis of the age data by Japan in 2005

# 2005年の日本による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

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## 要約

耳石は2005年に1340個体分を収集した。2004年までに漁獲された802個体の年齢を査定し、CCSBT事務局へ提出した。

## Summary

Otoliths were collected from 1340 individuals in 2005. Ages were estimated for 802 and its data were submitted to CCSBT Secretariat.

## 1. Activities of otolith collection and age estimation

Japan collected otoliths from a total of 1340 SBT individuals. 522 were from commercial longline vessels through scientific observer program. 90 were form a survey for archival tagging using a commercial longline vessel. 728 were from small fish presumably age 0-2 by surveys of the recruitment monitoring program including the acoustic survey and the piston-line trolling survey.

Ages of otoliths from 802 individuals were estimated up to April 2006 according to the CCSBT manual, "A manual for age determination of southern bluefin tuna *Thunnus maccoyii*. Two staff in Marino-Research Cooperation, same as last year, estimated the age once respectively and independently. Then, one of the staff determine the estimated age with refer to previous estimation of the two staff.

The data of age estimated with capture information were send to CCSBT Secretariat in April 2006. The number of individuals by year and CCSBT area in the data 2006 is shown in Table 1. Number of individuals by year and at fork length class in the data 2006 is shown in Table 2. The range of age estimated was 0 to 45 (Fig. 1). Six out of 802 individuals (0.7%) were not able to estimate its age.

## 2. Analysis of age data

Age data from Japan, submitted in both 2005 and 2006, were analyzed. Fig. 2 shows plots of fork length at age estimated. While several outliers were seen, majority of plots seems appropriate.

Statistical values of fork length and age estimated at 5 cm fork length class, as well as of age estimated, are shown in Table 3 and Table 4. Fig. 3 shows mean age estimated at fork length and Fig. 4 shows mean fork length at age estimated with standard deviations.

Parameters of von Bertalanffy growth equation were estimated by the least square method. Because treatment of the time lag between outermost increment deposited and capture of the fish (otolith margin) has not decided in CCSBT(CCSBT-ESC/0506/12, Anon. 2005), three cases were assumed; age+0.0, age + 0.5 and age+1.0. The results are shown in Table 5 and Fig. 5. The length at age relationship used for OM in CCSBT is correspond well with the von Bertalanffy growth curve by data of age+0.0.

## References

Anon. 2002. Report of the Direct Age Estimation Workshop. Victoria, Australia. 11-14 June 2002.

Anon. 2005. Report of the Extended Scientific Committee for the Tenth Meeting of the Scientific Committee. Taipei, Taiwan. 5-8 September 2005.

Krusic - Golub, K. Catch at age of Southern bluefin tuna in the New Zealand longline fishery, 2001 - 2004. CCSBT - ESC/0509/12

Table 1 Number of otoliths, by year and CCSBT area, of which were analyzed and submitted its data to CCSBT in 2006

| Year | 1998 | 2001 | 2002 | 2003 | 2004 | Total |
|---|---|---|---|---|---|---|
| Area1 | | | | | 21 | 21 |
| Area4 | | | 6 | 60 | | 66 |
| Area7 | | 15 | 47 | 42 | | 104 |
| Area8 | 1 | 33 | 28 | 78 | | 140 |
| Area9 | | 60 | 156 | 255 | | 471 |
| Total | 1 | 108 | 237 | 435 | 21 | 802 |

Table 2 Number of otoliths of which were analyzed and submitted its data to CCSBT in 2006 by year and at fork length class

| Year | 1998 | 2001 | 2002 | 2003 | 2004 | Total |
|---|---|---|---|---|---|---|
| 30-39cm | | | | 2 | | 2 |
| 40-49cm | | | | 6 | | 6 |
| 50-59cm | | | | 60 | | 60 |
| 60-69cm | | | | 2 | | 2 |
| 70-79cm | | | | 1 | | 1 |
| 80-89cm | | | 2 | 6 | | 8 |
| 90-99cm | | 1 | 9 | 22 | | 32 |
| 100-109cm | | 4 | 51 | 35 | | 90 |
| 110-119cm | | 10 | 56 | 63 | | 129 |
| 120-129cm | | 9 | 29 | 61 | | 99 |
| 130-139cm | | 12 | 17 | 30 | | 59 |
| 140-149cm | | 14 | 15 | 32 | | 61 |
| 150-159cm | 1 | 21 | 27 | 37 | 5 | 91 |
| 160-169cm | | 16 | 21 | 36 | 7 | 80 |
| 170-179cm | | 12 | 5 | 24 | 4 | 45 |
| 180-189cm | | 7 | 5 | 15 | 2 | 29 |
| 190-199cm | | 2 | | 1 | 3 | 6 |
| 200-209cm | | | | 2 | | 2 |
| Total | 1 | 108 | 237 | 435 | 21 | 802 |

Table 3 Statistical values of fork length and age estimated at 5 cm fork length class in age estimated data by Japan.

| Fork length | Fork length | | | | | | Age estimated | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Class | N | mean | median | min | max | SD | N | mean | median | min | max | SD |
| 25– | 0 | | | | | | | | | | | |
| 30– | 2 | 32.6 | 32.6 | 32.2 | 33.0 | 0.57 | 2 | 0.0 | 0.0 | 0 | 0 | |
| 35– | 0 | | | | | | | | | | | |
| 40– | 0 | | | | | | | | | | | |
| 45– | 6 | 48.5 | 48.5 | 48.0 | 49.0 | 0.55 | 6 | 1.0 | 1.0 | 1 | 1 | 0.00 |
| 50– | 43 | 52.4 | 53.0 | 50.0 | 54.8 | 1.40 | 43 | 1.1 | 1.0 | 1 | 2 | 0.29 |
| 55– | 27 | 55.9 | 56.0 | 55.0 | 58.0 | 0.93 | 26 | 1.3 | 1.0 | 1 | 2 | 0.45 |
| 60– | 2 | 63.5 | 63.5 | 63.0 | 64.0 | 0.71 | 2 | 2.0 | 2.0 | 2 | 2 | 0.00 |
| 65– | 0 | | | | | | | | | | | |
| 70– | 1 | 73.0 | 73.0 | 73.0 | 73.0 | | 1 | 2.0 | 2.0 | 2 | 2 | |
| 75– | 0 | | | | | | | | | | | |
| 80– | 3 | 83.0 | 83.0 | 82.0 | 84.0 | 1.00 | 2 | 3.5 | 3.5 | 3 | 4 | 0.71 |
| 85– | 35 | 88.3 | 89.0 | 85.0 | 89.0 | 1.04 | 35 | 3.0 | 3.0 | 2 | 6 | 0.82 |
| 90– | 57 | 92.0 | 92.0 | 90.0 | 94.0 | 1.35 | 57 | 3.1 | 3.0 | 2 | 5 | 0.85 |
| 95– | 74 | 97.2 | 97.0 | 95.0 | 99.0 | 1.44 | 73 | 3.8 | 4.0 | 2 | 11 | 1.19 |
| 100– | 106 | 102.3 | 102.5 | 100.0 | 104.0 | 1.39 | 105 | 4.0 | 4.0 | 3 | 7 | 0.85 |
| 105– | 158 | 107.1 | 107.0 | 105.0 | 109.0 | 1.47 | 156 | 4.3 | 4.0 | 2 | 7 | 0.92 |
| 110– | 117 | 111.9 | 112.0 | 110.0 | 114.0 | 1.49 | 117 | 4.8 | 5.0 | 3 | 9 | 1.05 |
| 115– | 132 | 117.2 | 117.0 | 115.0 | 119.0 | 1.46 | 132 | 5.4 | 5.0 | 3 | 11 | 1.08 |
| 120– | 106 | 121.9 | 122.0 | 120.0 | 124.0 | 1.52 | 106 | 5.5 | 5.0 | 3 | 10 | 1.03 |
| 125– | 85 | 127.0 | 127.0 | 125.0 | 129.0 | 1.46 | 85 | 6.0 | 6.0 | 4 | 9 | 1.03 |
| 130– | 90 | 131.9 | 132.0 | 130.0 | 134.0 | 1.48 | 90 | 6.5 | 7.0 | 4 | 10 | 1.03 |
| 135– | 81 | 136.9 | 137.0 | 135.0 | 139.0 | 1.43 | 81 | 7.3 | 7.0 | 5 | 13 | 1.46 |
| 140– | 103 | 142.2 | 142.0 | 140.0 | 144.0 | 1.33 | 102 | 7.9 | 8.0 | 5 | 11 | 1.37 |
| 145– | 128 | 146.8 | 147.0 | 145.0 | 149.0 | 1.31 | 128 | 8.8 | 9.0 | 6 | 16 | 1.70 |
| 150– | 163 | 151.9 | 152.0 | 150.0 | 154.0 | 1.32 | 162 | 9.6 | 10.0 | 6 | 16 | 1.77 |
| 155– | 147 | 156.7 | 157.0 | 155.0 | 159.0 | 1.33 | 147 | 10.4 | 10.0 | 6 | 17 | 2.14 |
| 160– | 157 | 162.1 | 162.0 | 160.0 | 164.0 | 1.43 | 154 | 11.3 | 11.0 | 7 | 19 | 2.44 |
| 165– | 97 | 166.7 | 167.0 | 165.0 | 169.0 | 1.43 | 96 | 13.1 | 13.0 | 4 | 31 | 4.04 |
| 170– | 99 | 171.8 | 172.0 | 170.0 | 174.0 | 1.46 | 98 | 16.2 | 15.0 | 8 | 28 | 4.17 |
| 175– | 74 | 176.6 | 176.0 | 175.0 | 179.0 | 1.38 | 73 | 18.5 | 18.0 | 7 | 36 | 5.98 |
| 180– | 51 | 181.8 | 182.0 | 180.0 | 184.0 | 1.43 | 50 | 19.9 | 20.0 | 9 | 32 | 4.83 |
| 185– | 20 | 186.4 | 186.0 | 185.0 | 189.0 | 1.39 | 20 | 21.9 | 21.0 | 12 | 35 | 6.07 |
| 190– | 11 | 191.0 | 191.0 | 190.0 | 193.0 | 1.10 | 10 | 26.6 | 23.5 | 16 | 45 | 8.80 |
| 195– | 10 | 195.8 | 195.5 | 195.0 | 197.0 | 0.92 | 10 | 24.1 | 24.5 | 11 | 33 | 6.51 |
| 200– | 2 | 202.0 | 202.0 | 201.0 | 203.0 | 1.41 | 2 | 27.5 | 27.5 | 27 | 28 | 0.71 |
| 205– | 3 | 205.7 | 205.0 | 205.0 | 207.0 | 1.15 | 3 | 26.7 | 28.0 | 24 | 28 | 2.31 |
| 210– | 0 | | | | | | | | | | | |

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

| Age Class | Age estimate N | Fork length N | mean | median | min | max | SD |
|---|---|---|---|---|---|---|---|
| 0 | 2 | 2 | 32.6 | 32.6 | 32.2 | 33.0 | 0.57 |
| 1 | 64 | 64 | 53.1 | 53.0 | 48.0 | 57.0 | 2.48 |
| 2 | 45 | 45 | 81.3 | 89.0 | 51.0 | 105.0 | 16.88 |
| 3 | 141 | 139 | 98.9 | 100.0 | 82.0 | 120.0 | 7.77 |
| 4 | 242 | 237 | 106.4 | 106.0 | 84.0 | 165.0 | 9.51 |
| 5 | 289 | 287 | 115.8 | 115.0 | 92.0 | 143.0 | 9.90 |
| 6 | 201 | 200 | 124.2 | 124.0 | 88.0 | 169.0 | 11.53 |
| 7 | 192 | 188 | 136.7 | 136.0 | 103.0 | 175.0 | 12.32 |
| 8 | 161 | 159 | 146.4 | 146.0 | 117.0 | 176.0 | 9.63 |
| 9 | 163 | 163 | 151.0 | 152.0 | 112.0 | 180.0 | 9.95 |
| 10 | 146 | 146 | 155.0 | 154.0 | 123.0 | 182.0 | 9.14 |
| 11 | 101 | 100 | 158.1 | 159.0 | 96.0 | 195.0 | 11.57 |
| 12 | 90 | 89 | 160.1 | 160.0 | 145.0 | 187.0 | 7.62 |
| 13 | 54 | 53 | 165.7 | 166.0 | 138.0 | 179.0 | 8.06 |
| 14 | 51 | 51 | 164.5 | 165.0 | 146.0 | 182.0 | 8.58 |
| 15 | 37 | 36 | 169.2 | 170.5 | 154.0 | 185.0 | 6.89 |
| 16 | 41 | 38 | 172.1 | 173.5 | 148.0 | 190.0 | 10.23 |
| 17 | 17 | 15 | 171.6 | 173.0 | 159.0 | 183.0 | 6.70 |
| 18 | 24 | 23 | 174.9 | 174.0 | 163.0 | 195.0 | 9.05 |
| 19 | 24 | 22 | 175.1 | 175.0 | 163.0 | 188.0 | 6.89 |
| 20 | 13 | 13 | 175.6 | 175.0 | 168.0 | 184.0 | 4.89 |
| 21 | 27 | 27 | 179.8 | 180.0 | 168.0 | 196.0 | 6.63 |
| 22 | 16 | 16 | 180.6 | 178.5 | 170.0 | 195.0 | 8.25 |
| 23 | 13 | 12 | 176.6 | 173.0 | 168.0 | 197.0 | 8.69 |
| 24 | 7 | 7 | 182.3 | 179.0 | 174.0 | 207.0 | 11.25 |
| 25 | 5 | 4 | 182.5 | 186.0 | 167.0 | 191.0 | 10.72 |
| 26 | 9 | 8 | 181.1 | 179.0 | 173.0 | 197.0 | 7.85 |
| 27 | 5 | 4 | 185.3 | 181.0 | 176.0 | 203.0 | 12.18 |
| 28 | 9 | 8 | 188.6 | 186.5 | 172.0 | 205.0 | 14.21 |
| 29 | 3 | 3 | 186.7 | 190.0 | 175.0 | 195.0 | 10.41 |
| 30 | 4 | 4 | 185.5 | 182.5 | 181.0 | 196.0 | 7.05 |
| 31 | 2 | 2 | 175.0 | 175.0 | 165.0 | 185.0 | 14.14 |
| 32 | 2 | 2 | 187.5 | 187.5 | 184.0 | 191.0 | 4.95 |
| 33 | 1 | 1 | 197.0 | 197.0 | 197.0 | 197.0 | |
| 34 | 1 | 1 | 186.0 | 186.0 | 186.0 | 186.0 | |
| 35 | 3 | 3 | 185.0 | 188.0 | 176.0 | 191.0 | 7.94 |
| 36 | 1 | 1 | 177.0 | 177.0 | 177.0 | 177.0 | |
| 37 | 0 | | | | | | |
| 38 | 0 | | | | | | |
| 39 | 0 | | | | | | |
| 40 | 0 | | | | | | |
| 41 | 0 | | | | | | |
| 42 | 0 | | | | | | |
| 43 | 0 | | | | | | |
| 44 | 1 | | | | | | |
| 45 | 2 | 1 | 191.0 | 191.0 | 191.0 | 191.0 | |

Table 5　Estimated parameters of von Bertalanffy growth equation in three cases.

| | Linf | k | $t_0$ |
|---|---|---|---|
| Age estimated+0.0 | 183.1539 | 0.162325 | −1.36677 |
| Age estimated+0.5 | 183.1541 | 0.162324 | −0.86679 |
| Age estimated+1.0 | 183.1543 | 0.162324 | −0.36681 |

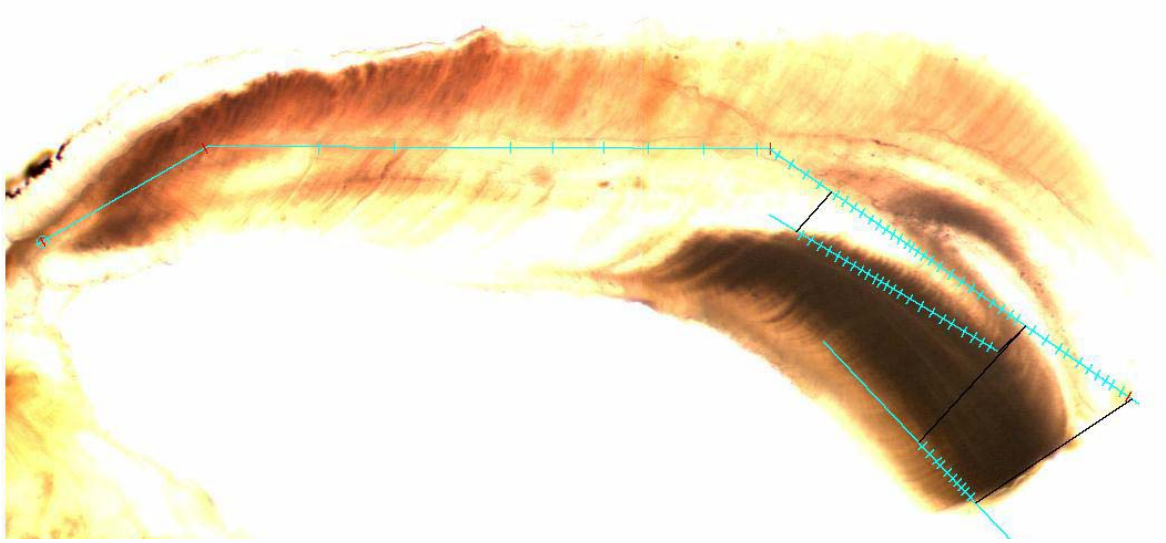

Fig.1　Photograph of otolith whose age was estimated as 45 years old.

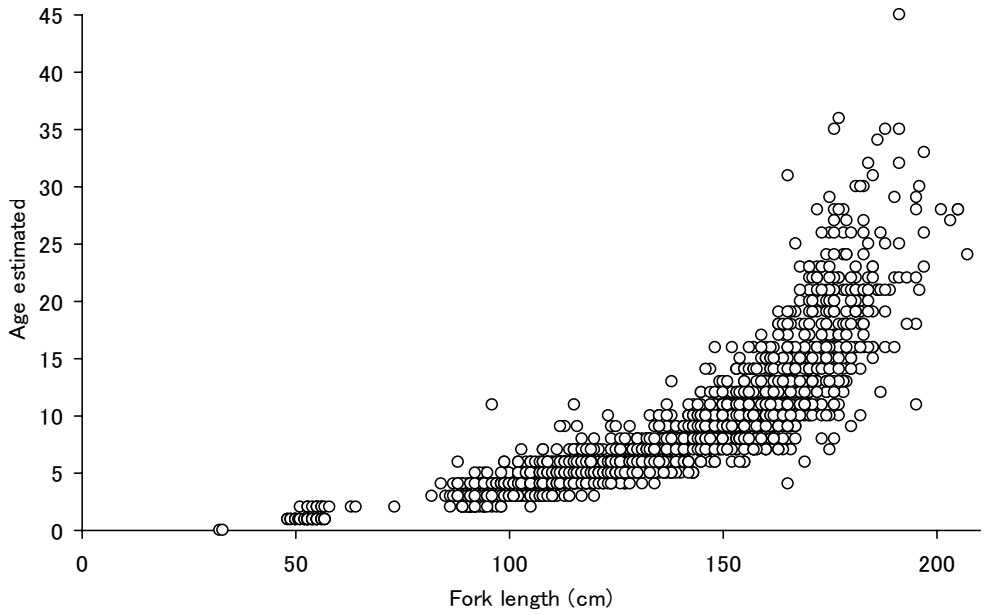


Fig.2　Plots of age estimated at length in Japanese age estimated data

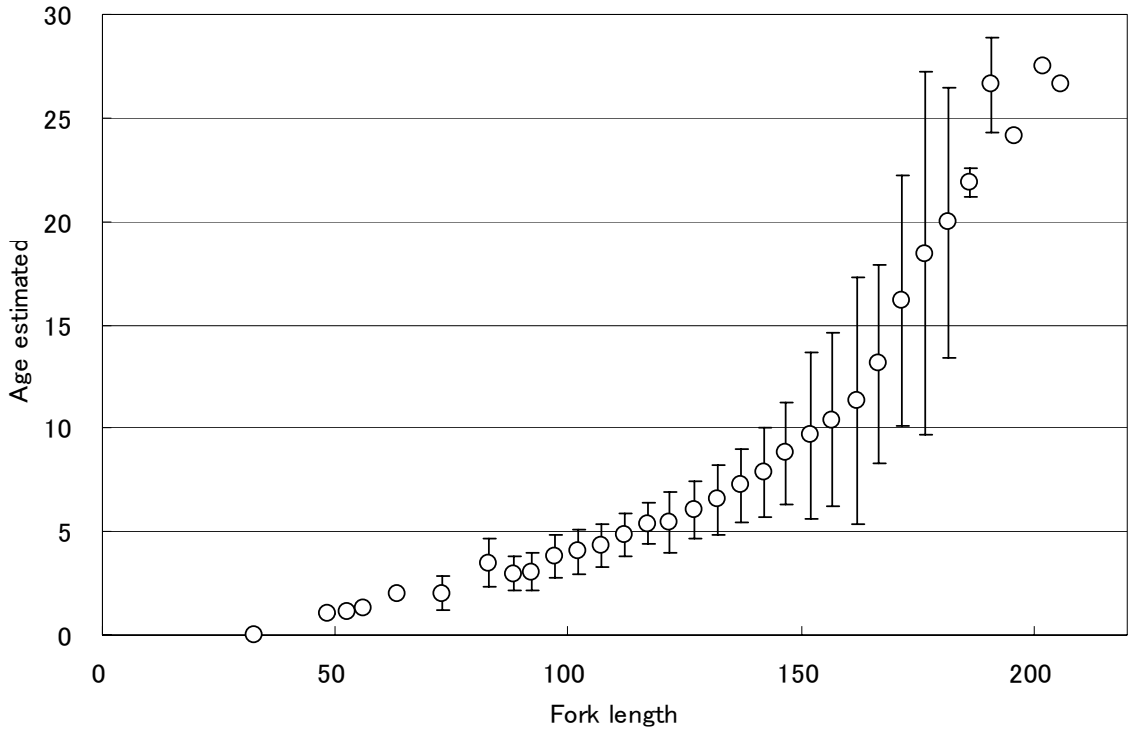


Fig. 3 Mean with SD of age estimated at fork length in 5 cm class in Japanese age estimated data

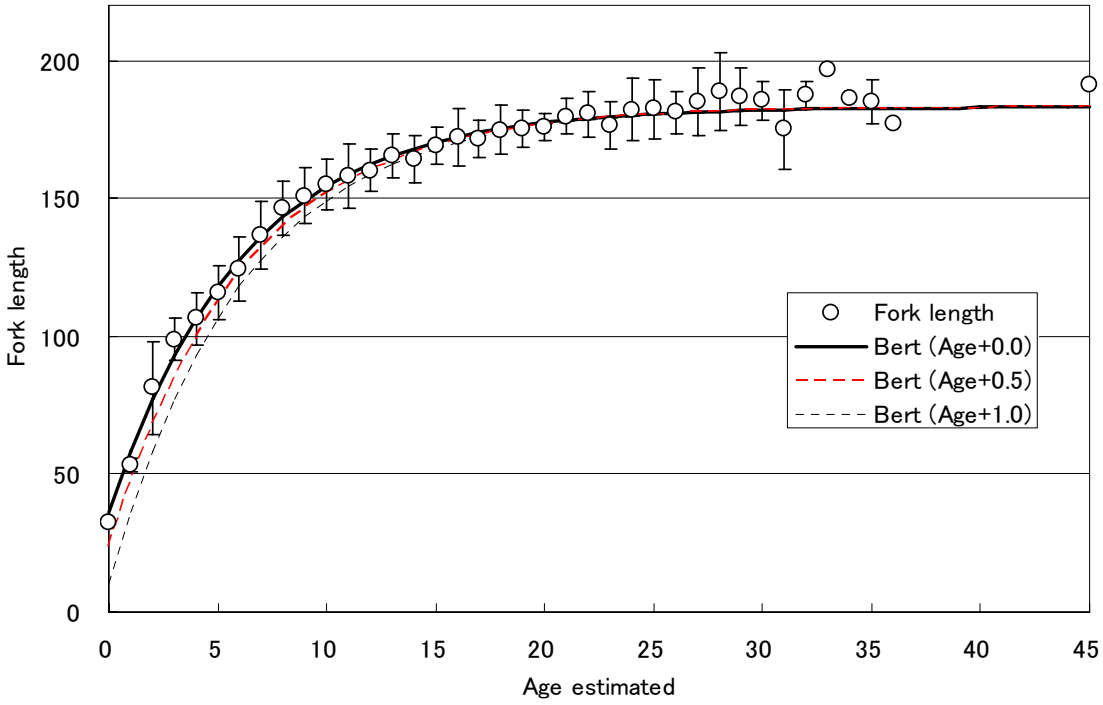


Fig. 4 Mean with SD of fork length at age estimated in Japanese age estimated data. Three von Bertalanffy curves, which assume decimal place of age in three cases (age + 0.0, +0.5, and +1.0) , are drown.

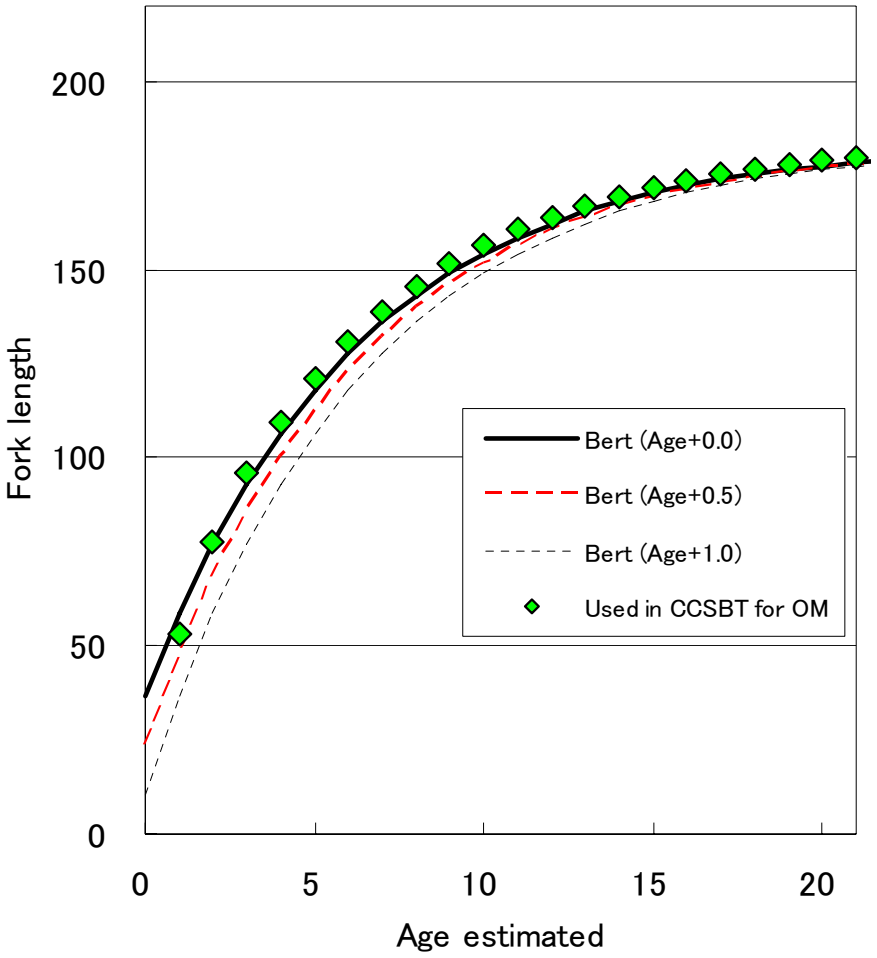


Fig. 5 Comparison between length at age of the von Bertalanffy curves from Japanese age estimated data and that used in CCSBT for OM.