# Japanese idea for the AHL of 2000 in CBS

1. Japan tried to calculate the amount of AHL in CBS for the year 2000 in case of which the pollock biomass in Bogoslof Area is estimated even less than one million ton.

2. The estimated values of AHL are as follows;

   I : 5.3 thousand ton
   when recruitment of 27 thousand ton(average value of 1995-99) will be expected.

   II : 9.7 thousand ton
   when recruitment of 104 thousand ton(average value of 1997-99) will be expected.

3. Base of estimation of AHL

   ① Operational Definition, Summary of the Bering Sea and Aleutian Islands Groundfish Fishery Management Plan 1997, published by North Pacific Fishery Management Council.

   ② Tier 3(b) used to determine the ABC as U.S. uses this category for estimating the ABC for the Bogoslof region.

   ③"FABC" is calculated in accordance with Tier 3(b)

   $F_{ABC} = F_{40\%}(B_{2000}/B_{40\%} - 0.05))/(1-0.05)$

   "FABC" means the fishing mortality rate for ABC.

   "F40%" means the fishing mortality rate that reduces spawning biomass per recruit to 40% of its unfished value.

   "B40%" refers to the long-term average biomass that would be expected under average recruitment and F=F40%

   "F40%" and "B40%" were estimated by SSC and are 0.27 and 200 million ton respectively.

   ④ Recruitment should be included to estimate the biomass of the beginning of the next year. Therefore we tried to modify the U.S. method partially at the calculation for AHL in CBS.

4. This level of AHL mentioned above, under the best available scientific information, shall be recognized as being safe enough to maintain the sustainable yields even in the recent level of biomass.

Japanese idea for the establishment of AHL for the year 2000 in CBS

1. Japan tried to calculate the amount of AHL in CBS for the year 2000 in case of which the pollock biomass in Bogoslof Area is estimated even less than one million ton.

2. US estimates the Acceptable Biological Catch(ABC) for pollock in Aleutian Basin-Bogoslof Island Area on the basis of biomass in these Area.

We understand that US, at least, makes these estimation in recognition of which the level of these biomass are enough to maintain their sustainable yields.

3. We tried to calculate the ABC in the Convention area taking into consideration the provisions of the Annex part I(b) of the Convention that the pollock biomass for the Specific Area shall be deemed to represent 60% of the Aleutian Basin biomass.

4. We understand that the recruitment should be included in the biomass of next year. Therefore we tried to modify the U.S. method * partially and used this modified US method at the calculation for AHL in CBS.

* : US method is mentioned in Tier 3(b), Operational Definition, Summary of the Bering Sea and Aleutian Islands Groundfish Fishery Management Plan 1997, published by North Pacific Fishery Management Council.

5. AHL calculation formula

①How to estimate the biomass(B) of 2000

$B2000=R2000+B1999 \cdot e^{(-Z)}$

" B2000 ", "R" and "Z" mean the "biomass", "recruitment" and "total mortality" respectively.

Numerals show calendar year.

Fishing mortality is equal to zero, as fishing has been moratorium since 1984 and, therefore, $Z=F+M=M$

"M=0.2" was determined by SSC(Scientific and Statistic Committee in NPFMC)

②How to estimate the recruitment

$R = Bt+1 - Bt \cdot e^{(-M)}$ (see table 1 in appendix)

"t" means the year. The figures of estimated recruitment are shown in table in Appendix.

③"FABC" is calculated in accordance with Tier 3(b)

FABC = F40%(B2000/B40%−0.05))/(1-0.05)

"FABC" means the fishing mortality rate for ABC.

"F40%" means the fishing mortality rate that reduces spawning biomass per recruit to 40% of its unfished value.

"B40%" refers to the long-term average biomass that would be expected under average recruitment and F=F40%

"F40%" and "B40%" were estimated by SSC and are 0.27 and 200 million ton respectively.

④How to calculate the exploitation rate (E)

$E = 1 - e^{(FABC)}$

⑤ABC in the Specific Area is calculated as follows;

ABC = E · B2000

⑥AHL in the Convention Area is estimated as follows;

AHL = ABC/0.6/3 = 0.55 * ABC

ABC in Bogoslof Area is equal to ABC in the Specific Area and it is deemed to represent 60% biomass in the Aleutian Basin Area. This Area includes US EEZ, Russian EEZ and CBS and, therefore, AHL in CBS is calculated by dividing ABC in the Aleutian Basin Area into three portions equally.

6. Used parameters and data for AHL calculation

①The amount of average recruitment (see table 1 in appendix)

The amounts of average recruitment for recent three and five years are used, and they are 27 thousand ton and 104 thousand ton respectively.

②M=0.2

③Biomass of 1999 is estimated as 392 thousand ton from Kaiyo-maru survey in 1999.

④F40%=0.27

⑤B40%=2,000,000 ton

7. AHL calculation in the Convention Area

①Model Ⅰ : M=0.2 , "the value of recruitment "=27 thousand ton.

②Model Ⅱ : M=0.2 , "the value of recruitment" =104 thousand ton.

8. Most of juvenile fish in the Navarin Area is estimated to recruit in the Eastern Baring Sea as spawning adults stock.

However, the distribution of young fishes, which will spawn in the Bogoslof Area, and migration routes of adults, which will spawn in the Bogoslof Area, have not been clarified, and this made it quite difficult for us to study and predict recruitment so far.

We cannot help but consider our calculations of AHL using many hypothesis and we understand that clarification of these factors and further improvement of our calculation model are much required.

The calculation of AHL for the year of 2000

(1) Model Ⅰ : M=0.2, R=−5 thousand ton

Biomass of survival from 1999 is calculated as;

B1999 * e^(−0.2) =392 * 0.819=321

Estimated biomass for 2000 is calculated as;

B2000=B1999 * e^(−0.2) + R

=321−5=316

FABC = F40%(B2000 * e^(−M) + R) / B40%−0.05) / (1−0.05)

=0.27((321+(−5)) / 2000−0.05) / 0.95

=0.27 (316 / 2000−0.05) / 0.95

=0.0307

E = 1 −e^ (− FABC) = 1 −e^ (−0.0307)

= 1 −0.970=0.030

ABC for 2000 is 3.0% of biomass of 2000

ABC2000=316 * 0.030

=9.5 thousand ton

ABC in the Convention Area is calculated as;

ABC=9.5 / 0.6 / 3 = 5.3

AHL for the Convention area should be established as 5.3 thousand ton

(1) Model Ⅱ : M=0.2, R=86 thousand ton

Biomass of survival from 1999 is calculated as;

B1999 * e^(−0.2) =392 * 0.819=321

Estimated biomass for 2000 is calculated as;

B2000=B1999 * e^(−0.2) + R

=321+86=407

FABC= F40%(B2000 * e^(−M) + R) / B40%−0.05) / (1−0.05)

=0.27((321+86) / 2000−0.05) / 0.95

=0.27 (407 / 2000−0.05) / 0.95

=0.044

E = 1 −e^ (− FABC) = 1 −e^ (−0.044)

= 1 −0.957=0.043

ABC for 2000 is 4.3% of biomass of 2000

ＡＢＣ2000＝407＊0.043

＝17.5 thousand ton

ABC in the Convention Area is calculated as;

ＡＢＣ＝17.5／0.6／3 ＝ 9.7

AHL for the Convention area should be established as 9.7 thousand ton

APPENDIX TABLE 1

The amount of Recruitment

(Ten thousand ton)

| Year | Biomass | M=0.2 | M=0.3 |
|---|---|---|---|
| 1988 | 240 | | |
| 1989 | 213 | 16.44 | 35.16 |
| 1990 | | | |
| 1991 | 129 | | |
| 1992 | 94 | −11.65 | −1.59 |
| 1993 | 64 | −12.99 | −5.65 |
| 1994 | 54 | 1.58 | 6.58 |
| 1995 | 110 | 65.77 | 69.99 |
| 1996 | 68 | −22.09 | −13.51 |
| 1997 | 39 | −16.69 | −11.39 |
| 1998 | 49 | 17.06 | 20.10 |
| 1999 | 39 | −0.93 | 2.89 |
| 2000 | | | |
| AVERAGE (RECENT 5 YEARS : 1995-1999) | | 8.62 | 13.62 |
| AVERAGE (RECENT 3 YEARS : 1997-1999) | | −0.56 | 3.87 |