REPORT OF THE TENTH ANNUAL CONFERENCE OF THE PARTIES TO THE CONVENTION ON THE CONSERVATION AND MANAGEMENT OF POLLOCK RESOURCES IN THE CENTRAL BERING SEA

September 6-9, 2005
Busan, Korea

1. Opening of the Conference

The provisional Chair, Mr. Ki Hiok BARNG, Director-General for International Cooperation Office (Korea), welcomed the delegations of the Parties to the Convention on The Conservation and Management of Pollock Resources in the Central Bering Sea to the Tenth Annual Conference. He invited the representatives of People's Republic of China (China), Japan, Poland, the Russian Federation (Russia), the United States of America (US), and the Republic of Korea (Korea) to present opening statements.

2. Welcome Address and Statements of the Delegates

Opening statements provided by the Parties are included in Appendix 1. A list of the participants is presented in Appendix 2.

3. Election

3.1. Chair

Mr. Ki Hiok BARNG, Director-General for International Cooperation Office Ministry of Maritime Affairs and Fisheries (Korea), was elected as Chair of the Tenth Annual Conference.

3.2. Vice-Chair

Mr. Leszek Dybiec, Deputy Director Fishery Department, Ministry of Agriculture and Rural Development (Poland) was elected Vice Chair.

3.3. Chair of Scientific and Technical Committee

Patricia Livingston (US) was elected the Chair of the Scientific and Technical Committee.

3.4. Rapporteur

The Chairman proposed two different rapporteurs, one from the US and one from another country. The Parties agreed that Mr. Stetson Tinkham (US) would serve as lead rapporteur with assistance from each of the member countries desiring to participate.

4. Adoption of the Agenda

The Agenda was adopted (Appendix 3).

5. Report of the Scientific and Technical Committee

The Chair of the Scientific and Technical (S&T) Committee reported on the results of the S&T Committee meeting of September 6-8, 2005 in Busan, Korea. The resulting report was distributed to the Parties (Appendix 4). The Chair summarized the S&T Committee discussions as follows:

5.1. Update catch and effort statistics

5.1.1. Tables of historical catch and effort statistics on pollock catch in the Bering Sea were updated and included in the final S&T report (Appendix 4).

5.2. Review results of trial fishing

5.2.1. No trial fishing occurred in 2005.

5.3. Review results of research cruises

5.3.1. The US reviewed results of the 2005 Bogoslof survey, described plans for the 2006 Bogoslof survey, and reported preliminary results of research conducted in 2004.

5.3.2. Russia reported on the results of the Western Bering Sea (WBS) pollock research cruises.

5.4. Review the status of Aleutian Basin pollock stocks

5.4.1. The US stated that recent studies indicate that the pollock stock in the Central Bering Sea is low. It was further noted that there was no comprehensive survey that could be used to determine the status of the Aleutian Basin stock. Detailed information is included in the S&T report. (Appendix 4)

5.5. Factors affecting recovery of the stocks

5.5.1. A lengthy discussion on this topic took place. It was acknowledged that numerous factors ranging from climate change to predation could affect pollock abundance. No one factor was identified as being solely responsible for the lack of recovery of pollock in the Convention Area.

5.6. The effects of the moratorium and its continuation

5.6.1. The US noted there has been continued improvement of the pollock stocks on the eastern Bering Sea shelf, but that this improvement does not seem to have affected Aleutian Basin pollock stock levels, despite many years of the moratorium. The US recommended continuation of the moratorium.

5.6.2. Japan and Korea noted that the moratorium has been in place for more than 12 years with no sign of recovery of pollock stocks in the Convention Area, and reminded the Parties that the objectives of the Convention are the conservation, management and utilization of pollock. Japan requested that additional methods be considered to fulfill the objectives of the Convention and stated that even if there is no fishing, an Allowable Harvest Level (AHL) should be set. China stressed that their fishermen have suffered huge economic costs in complying with the moratorium, but the stock level is still low. The Chinese Government is very concerned about the situation, and hopes additional research can be done to obtain more information.

5.7. Methodologies to determine Allowable Biological Catch (ABC) and AHL and Recommendation on AHL

5.7.1. Consensus was not reached on how to set an AHL.

5.8. Other matters and recommendations of the S&T Committee

5.8.1. Korea introduced a proposal for trial fishing in the Convention Area in 2006. (Appendix 4)

5.8.2. Russia introduced a proposal for the BAPIS program to further research and gather data on pollock stocks in the Aleutian Basin. All parties expressed support for the Russian proposal, but requested the proposal in writing. Russia subsequently distributed written copies of the proposal in English to the S&T. (Appendix 4)

6. Action Items

6.1. The review of scientific data and conservation measures of the Coastal States related to pollock fishing in the Bering Sea

6.1.1. The US and Russia submitted commercial catch statistics to the S&T, which were included in the S&T report. (Appendix 4)

6.1.2. Russia submitted its domestic management regulations in a past Annual Conference and reported that no changes have been made since the last Conference.

6.1.3 The US also updated the Parties on the limited fishery conducted near Adak in 2005 which was presented to the Parties at the Ninth Annual Conference. 1402 metric tons were harvested in 2005, which was below the Total Allowable Catch of 19,000 metric tons. No fish were harvested in the Bogoslof area or the Convention Area. A decision on whether to allow the fishery to continue in 2006 will not be made until the US domestic management council meeting in December 2005.

6.2. The establishment of a plan of work for the Scientific and Technical Committee

6.2.1 The US endorsed the S&T recommendation to convene a follow-on workshop to the Yokahama workshop on stock genetics. Japan expressed support for convening the workshop, but noted that it will be unable to host the meeting.

6.2.2. Korea proposed that the workshop include research into changing pollock migration patterns, and the US supported the Korean proposal. Dr. Nishimura of Japan will contact other parties to determine the date and location of the meeting.

6.3. The establishment of the Allowable Harvest Level

6.3.1. Poland referred to the calculated ABC and article VII paragraph 1, and proposed setting the AHL at a small level, 3000 metric tons that is about 33% of ABC. China supported the Polish proposal. China stated that with the 3000 metric ton AHL, the exploitation ratio is 0.7% of total Aleutian Basin biomass, and that this presents no danger to the resource.

6.3.2 Japan agreed with Poland that an AHL should be established for 2006. Japan stated that consideration should be given to the effects of the moratorium on the Parties' fishing industries. Japan reiterated its position that, from a scientific point of view, ABC could be established and, therefore, it should be possible to derive an AHL from ABC. Japan also expressed support for Russia's Bering-Aleutian Pollock International Survey(BAPIS) proposal.

6.3.3 Korea noted that the Parties reached consensus on an ABC of 9168 metric tons and that, because the majority of Parties believe AHL should be equal to ABC, AHL should be set at 9168.

6.3.4 The US referred to the Annex, Part I, paragraph (c), and noted that basin biomass is near historical low levels and is significantly below the level at which AHL could be set under the Convention. The US also noted that all Parties seemed to agree that the present biomass level has not reached 1.67 million metric tons. Therefore, the US stated that because biomass has not yet reached the biomass target stated in the Convention, AHL should be set at zero. More compelling scientific evidence would be needed before deviating from the Convention provisions.

6.3.5 Russia stated that there was insufficient information to deviate from Convention provisions, and therefore the AHL should be set at zero. Russia stated it is unfortunate that the stocks remain at low levels, but propose that the BAPIS program may help provide answers to the questions that surround the continued low levels of the Aleutian Basin pollock stocks.

6.3.6 The Chair summarized the situation, stating that the Parties basically had three different positions: Poland and China supported setting the AHL at 3000 metric tons; Japan and Korea supported setting AHL equal to ABC; and the US and Russia supported setting AHL at zero. The Chair stated that because consensus was not reached, there was no choice but to set AHL according to Convention Article VII, which refers to the procedure outlined in Annex Part I, paragraph (c).

6.3.7 Japan stated for the record that: Allowable Biological Catch (ABC) for Aleutian Basin Pollock has been set and it is based on scientific rationale. From the position that pollock preservation, management and optimum exploitation should be pursued in a rational manner and should be based on ABC and that all Parties should continue cooperation in order to achieve objectives of the Convention, our country kept submitting proposals to determine as AHL (ABC=AHL) a certain volume deemed reasonable from scientific standpoint by consensus stipulated in the Convention, article 7 paragraph 1. Japan believes that AHL should be set, even if the amount is very low and would not result in reopening fishing operations.

6.3.8 Korea stated that AHL should be set by consensus stipulated in the Convention, Article VII, paragraph 1 and the Parties should continue to make efforts to set AHL in following years. The US stated that it would continue research programs on pollock to achieve the Convention's objectives.

6.4. The establishment of the Individual National Quotas

6.4.1. The Chair stated that since AHL could not be established, no individual national quotas could be established.

6.5. The adoption of appropriate conservation and management measures based upon the advice of the Scientific and Technical Committee

6.5.1. No new advice from the S&T Committee was provided to the Parties and no recommendations for new conservation and management measures were made by the Parties.

6.6. The establishment of the terms and conditions for trial fishing in 2006

6.6.1 All Parties supported the Korean proposal for trial fishing in 2006 and Russia reaffirmed that all species caught during trial fishing cruises should be recorded.

6.7. Trial fishing plans

6.7.1. Korea circulated to the Parties a detailed plan to conduct trial fishing. (Appendix 6)

6.7.2 Japan supported the Korean proposal, stating that it would lead to better results in determining the stock levels in the Aleutian Basin.

6.7.3 US questioned how the trial vessels will report any product onboard prior to entering the Convention Area. Korea indicated the vessels would not have any product onboard prior to beginning trial fishing. The US then expressed its support for the proposal and indicated it could provide technical support to the Korean efforts, including through the use of acoustic data logging systems. The US offered to transfer its trial fishing rights for two vessels for two months to Korea pending examination of the US domestic legal and regulatory framework.[1]

6.7.4 China, Russia, and Poland expressed support for the Korean proposal.

[1] Subsequently to the meeting Poland agreed to transfer trial fishing rights of two vessels to Korea in 2006.

6.7.5 Korea stated that it will provide all valuable data to the other Parties and the Annual Conference.

6.7.6 China indicated they will provide trial fishing plans to the Parties if and when it develops them for 2006.

6.7.7 The Parties reaffirmed that any Party wishing to conduct trial fishing will abide by the Convention provisions and previously adopted terms and conditions adopted in 1999 regarding trial fishing.

<u>6.8. Reception of reports relating to measures taken to investigate and penalize violations of the Convention</u>

6.8.1. No actions were taken in 2005.

<u>6.9. The consideration of matters related to the conservation and management of living marine resources other than pollock in the Convention Area</u>

6.9.1. The US requested that vessels conducting trial fishing collect information on all living marine resources and that such information be provided to the Parties.

<u>6.10. Meeting Observers</u>

6.10.1. The Parties agreed to the same observer rules for 2006 that have been in use since 1998 (recorded in the Report of the Second Annual Conference, 1997, Part 6.J.10).

7. Eleventh Annual Conference

<u>7.1. Time and Location</u>

7.1.1 China stated that it will not be able to host the 2006 Annual Conference and expressed its hope that Poland would be able to host the Eleventh Annual Conference. China stated that it would host the Twelfth Annual Conference in 2007 possibly in Beijing.

7.1.2. Poland provisionally agreed to host the Eleventh Annual Conference. Poland will provide the date and location of the Conference pending consultations after the 2005 Polish elections.

7.1.3 The US, Russia, Japan, and Korea requested the Conference be held in early September to avoid conflicts with other international fisheries meetings.

<u>7.2. Election of Chair and Vice-Chair</u>

7.2.1 Poland was unable to nominate a chair for the Eleventh Annual Conference, but will provide a nomination in October 2005.

7.2.2 The chair suggested Ms. Baoying Zhu, head delegate of China, to serve as the vice chair for the Eleventh Annual Conference. China will confirm the nomination at a later date.

8. Other Business

8.1. Frequency of the Conference

8.1.1. At the Ninth Annual Meeting, the US agreed to look into the possibility of convening virtual meetings. Based on its research, the US proposed to continue annual face-to-face conferences.

9. Closing Statements

The closing statements of the Parties are provided in Appendix 7.

Appendices:

1. Opening Statements.
2. Delegation List
3. Plenary Agenda.
4. Report of the Scientific and Technical Committee.
5. Results of the Central Bering Sea Pollock Workshop on Allowable Harvest Level and Stock Identification held June 6-9, 2005 Seattle, Washington USA.
6. Trial Fishing Proposal by Korea.
7. Closing Statements Provided by the Parties.

OPENING STATEMENT BY DELEGATION OF JAPAN

Mr. Chairman, Distinguished Delegates. My name is Iwamoto and I have great honour to greet all of you on behalf of Japanese Delegation.

I am very glad to meet you all again at the 10^{th} Annual Conference and I would like to express my sincere gratitude to Korean government for organizing this meeting.

It is already more than 10 years since we have applied moratorium as the most severe conservation measures in the area of Bearing See, although the research results still show the decrease in Pollock stock. I think that this proves that although the moratorium has contributed to the prevention of the depletion of fish catches in the Bering Sea, it has not resulted in stock recovery.

The objective of this Convention is conservation, management and optimum utilization of Pollock resources.
Our country is of the opinion that, even if it is set at a very low level, an AHL should be set at a level deemed reasonable from the scientific standpoint.
At this Annual Conference, building up on considerations of Seattle Workshop, we should deepen cooperation in research activities aiming at collecting scientific data necessary for establishment of AHL and working together with all the Parties to the Convention make effort to set AHL.

Finally I would like to express our expectations to achieve meaningful and productive results at this Annual Session.

Now let me introduce members of our delegation.
…

That is all. Mr. Chair, thank you very much.

Opening Statement of China

Good Morning.
Mr. Chairman, distinguished delegates, Ladies and Gentlemen,

It's a great honor for us to be here in Busan for the 10th Central Bering Sea Pollock Conference. On behalf of my delegation, I'd like to express our sincere appreciation to the Government of Korea for providing the excellent facility to hold this conference, also I'd like to extend my thanks to Korean people for the hospitality we received in this beautiful city.

In the past ten years, we have discussed Pollock resources in the Central Bering Sea in many respects since we have voluntarily agreed and established a moratorium in 1993 for the Pollock resource recovery. But 12 years have past, even we have managed to maintain a minimum level of fishing effort in this area, unfortunately we are still failed to see any signs of recovery for the Pollock resource in the Convention area. Now, it was acknowledged that number of factors could affect Pollock abundance. However, no one factor was identified as sole responsible for the delay of stock recovery in the Central Bering Sea. So we need further research and continuously exchange information, so as to attain better understanding on this issue.

I regret that China could not attend last two years annual conference for some reason, but today we are here, and we are willing to cooperate with other countries to make better results. Mr. Chairman, I do hope with all the delegations' efforts and contributions on this meeting, we can achieve fruitful outcomes so that we can persuade our fishermen to keep hopeful and patient for the re-opening of the fishery in the near future.

Thank you.

THE TENTH ANNUAL CONFERENCE OF THE PARTIES TO THE CONVENTION ON THE CONSERVATION AND MANAGEMENT OF POLLOCK RESOURCES IN THE CENTRAL BERING SEA

September 6-9, 2005, Busan, Republic of Korea

Opening Statement of the Republic of Korea

Mr. Chairman, Distinguished delegates, Ladies and Gentleman!

Korean delegation is pleased to host the 10th Annual Conference in Busan where the 4th Annual Conference was held in 1999. On behalf of Korean delegation, I would like to extend my heartfelt welcome to all delegations to this Conference.

Twelve years have passed since fishing operations have been suspended in the Central Bering Sea in 1993. In the meantime, Korean fishermen have provided their cooperation in the all-out effort to conserve and manage Pollock resources, patiently awaiting their recovery so as to resume fishing operation. However, recovery rate during the last twelve years has been seriously disappointing. There is no clear evidence that Pollock resources in the Central Bering Sea will reach 1.67 million metric ton level as determined in the Conference. As well, the Annual Conference has not provided a clear vision for resuming fishing operations.

Therefore, the Koran fishermen have been seriously concerned about whether the moratorium is in fact contributing to recovery of Pollock resource, or whether the 1.67 million metric tons determined in the Convention is too ideal.

Under such circumstances, if the Annual Conference cannot provide or suggest any prospects or visions for resuming fishing operations, it will be difficult to request the Korean fishermen to continue to be patient. Therefore, at the 10th Annual Conference here, the Korean delegation would like to propose two prominent issues among agenda items before us.

Firstly, an AHL should be set on consensus in accordance with Article 7 of the Convention, even if the biomass does not reach the 1.67 million metric ton level. As you are aware, at the Workshop on AHL held in Seattle in June this year, issue on an AHL was deeply discussed and productive outcome was created. Setting a token AHL must be helpful for the Government of Parties to persuade their fishermen to be more patient for the time being.

Secondly, trial fishing should be conducted by more fishing vessels. Korean proposal for trial fishing was already circulated to all Parties in advance of this meeting. Korea conducted trial fishing two times with two fishing vessels in 2000 and 2003 respectively, but failed to collect valuable data. It is because two vessels are not enough to keep track of fish stocks in the vast Central Bering Sea. Therefore, Korea is planning to dispatch four fishing vessels in 2006. Other parties are also kindly requested to join trial fishing with Korea in order to collect wide and valuable data.

I hope that all delegates may reach satisfactory consensus on two major issues proposed by Korea at this meeting. I am sure that these proposals can greatly contribute to conservation and management of fish stocks as well as providing credibility for fishermen.

In closing, I would highly expect fruitful outcomes during this meeting and would like to reiterate Korea's commitment to work closely with all Parties to the Convention.

Thank you.

Let me introduce Korean delegation.

On my right hand

- Chiguk Ahn, Deputy Director, Ministry of Maritime Affairs and Fisheries
- Oh-Seung Kwon, Assistant Director, Ministry of Maritime Affairs and Fisheries
- Won-Seok Yang, Senior scientist, National Fisheries Research and Development Institute
- Seok-Gwan Choi, Scientist, National Fisheries Research and Development Institute

On my left hand

- Dae-Won Kim, Director, Korea Deep Sea Fisheries Association
- Soo-Yong Jeon, President, Han Sung Enterprise Co.
- Seong-Joon Lee, Kwan Sung Co.
- Chang-Soon Lee, Managing Director, Keukdong Fisheries Co.
- Yong-Tae Choi, President, Mambuk Fisheries Co.
- In Yeop Moon, General Manager, Sajo Industries Co.
- Young-Taek Cho, President, Wonil Fisheries Co.
- Goo-Young Kim, Director, Oyang Corporation

Poland Opening Statement

Mr. Chairman, Distinguished Delegates, Ladies and Gentlemen

It is a great honor for the Polish delegation to participate in the Tenth Annual Conference of the Parties to the Convetion on the Conservation and Management of Pollock Resources in the Central Bering Sea. I would like to express my gratitude to Government of Republic of Korea for organizing and hosting this meeting.

Many things have changed in Poland and in the Polish fishery since the Convention is in force. Ten years ago three fishing companies existed in Poland and about 20 vessels operated on fishing grounds of North Pacific. The condition of long-distance fleet which depends on this fishing grounds were getting worse year by year, to certain extent as a consequence of the closure of the Central Bering Sea fishery. Since 2002 there is no Polish fishing vessels on the fishing grounds of North Pacific.

Many scientific efforts were taken during last years and the many discussions were taken during the meetings of Scientific and Technical Committee and other symposia and workshops. All Parties cooperated in the researches to determine the status of pollock stock and the reason why the pollock stock haven't recovered after many years. Moratorium on fishing pollock in Central Bering Sea has continued over ten years and there is no indication of improving the state of Aleutian Basin pollock stock.

There are no Polish vessels in the area of the Convention now, but we expect that an AHL will be established at a level corresponding to actual Aleutian Basin pollock biomass and precautionary rate of exploitation.

Thank you for your attention.

TENTH ANNUAL CONFERENCE
OF THE PARTIES TO THE CONVENTION
ON CONSERVATION AND MANAGEMENT OF POLLOCK
RESOURCES IN THE CENTRAL BERING SEA

SEPTEMBER 06-09, 2005, BUSAN, REPUBLIC OF KOREA

OPENING STATEMENT
BY THE RUSSIAN FEDERATION

Mr. Chairman, Ladies and gentlemen,

It is a great honor for the Russian Delegation to participate in the Central Bering Sea Pollock Convention Tenth Annual Conference. On behalf of the Russian Federation delegation I would like to extend our appreciation to the Government of Republic of Korea for hosting this meeting.

This is a jubilee conference: it is the tenth one. That is why we should attempt to use the four forthcoming days for summarizing the results of investigations of the last decade. During the ensuing ten year period of the Convention we are to reach the next stage of research so that more ample information on pollock of the Central Bering Sea is obtained. In my view, the CBS workshop on allowable harvest level and stock identification held in Seattle last June was very efficient. It was suggested by the Russian Delegation at the workshop to draw up and fulfil an integrated pollock research program named BAPIS. The experience of implementation of a similar program on salmon showed that it is exactly such a program that all the Convention member nations could join their effort for in order to obtain reliable data on the status of nekton including pollock, in the Central Bering Sea, and forecast the interannual biomass and abundance dynamics of fishing species. I expect that we shall have a constructive discussion of each Party’s proposals on further research plans which are to be set on a radically new level in the upcoming decade of the Convention.

Thank you.

May I now introduce members of the Russian Delegation.

TENTH ANNUAL CONFERENCE OF THE PARTIES TO THE CONVENTION ON THE CONSERVATION AND MANAGEMENT OF POLLOCK RESOURCES IN THE CENTRAL BERING SEA

OPENING STATEMENT

UNITED STATES DELEGATION

Mr. Chairman, distinguished delegates, ladies and gentlemen; the United States Party appreciates the expressions of sympathy of the Chair to the people of the United States of America for the calamities that have befallen upon parts of the Gulf Coast region. It has indeed been a sad week for America as Hurricane Katrina has brought in untold miseries to the lives of so many people in the region and the Nation.

As the Gulf Coast region heals, the United States Delegation here has important responsibilities to perform -- to provide wise stewardship of pollock fisheries at this Annual Conference of the Parties to the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea. We are honored here to be guests of the Republic of Korea, and to be meeting in such an important port city, Busan.

It is as important to the United States Party, as it is to all Parties here, to ensure that pollock resources are well managed to achieve high biomass levels. We wish for this Convention to provide speedy recovery of Pollock resources to an abundant state in a healthy ecosystem; but it appears that recovery will take time.

In June this year, the United States Party was honored to conduct two technical workshops to address important questions of the Parties with regard to scientific factors that should be considered in determining Allowable Harvest Levels and advancing stock identification research. We anticipate that advances made at the Workshop will contribute substantially to the deliberations of the Scientific and Technical Committee. We look forward to the advice of the Committee to help us make proper management decisions for the central Bering Sea pollock stock.

Fellow Delegates, the United States delegation is here this week to further the objectives of the Convention. I will now have the United States delegation members introduce themselves.

Scientific and Technical Committee

Provisional List of Participants

CBSPC

6 - 7 September 2005

Busan, Republic of Korea

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Proposed Agenda for the Tenth Annual Conference

TENTH ANNUAL CONFERENCE OF THE PARTIES TO THE CONVENTION ON THE CONSERVATION AND MANAGEMENT OF POLLOCK RESOURCES IN THE CENTRAL BERING SEA
September 5-9, 2005. Busan, Korea

1. Opening of the Conference

2. Welcome Addresses and Opening Statements of the Delegates

3. Election (Chair, Vice-Chair, Chair of Scientific & Technical Committee, and Rapporteur)

4. Adoption of the Agenda

5. Report of the Scientific and Technical Committee

6. Action Items
    - 6.1. The review of scientific data and conservation measures of the Coastal States related to pollock fishing in the Bering Sea
    - 6.2. The establishment of a Plan of Work for the Scientific and Technical Committee
    - 6.3. The establishment of the Allowable Harvest Level
    - 6.4. The establishment of the Individual National Quotas
    - 6.5. The adoption of appropriate conservation and management measures based upon the advice of the Scientific and Technical Committee
    - 6.6. The establishment of the Terms and Conditions for Trial Fishing in 2006
    - 6.7. Trial Fishing Plans in 2006
    - 6.8. Reception of reports relating to measures taken to investigate and penalize violations of the Convention
    - 6.9. The consideration of matters related to the conservation and management of living marines resources other than pollock in the Convention area
    - 6.10. Meeting Observers

7. Eleventh Annual Conference
    - 7.1. Time and Location
    - 7.2. Election of Chair and Vice-Chair

8. Other Business

9. Closing Statements

10th ANNUAL CONFERENCE OF THE PARTIES TO THE CONVENTION ON THE CONSERVATION AND MANAGEMENT OF POLLOCK RESOURCES IN THE CENTRAL BERING SEA

REPORT OF THE MEETING OF THE SCIENTIFIC AND TECHNICAL COMMITTEE

6-8 September 2005 – Busan, Korea

Final: 08 September 2005

Delegations from Japan, People's Republic of China, Poland, the Republic of Korea (Korea), the Russian Federation (Russia), and the United States (US) participated in a meeting of the Scientific and Technical (S&T) Committee in conjunction with the 10th Annual Conference of the Parties to the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea in Busan, Korea.

1. Opening remarks

Patricia Livingston (US), Chair of the Scientific and Technical Committee, opened the meeting at 13:30, 6 September 2005. A list of the participants is provided (attachment 1).

2. Appointment of Rapporteur

Mr. Steven Barbeaux (US) was appointed as lead rapporteur. Each delegation agreed to select rapporteurs to aide Mr. Barbeaux with this function.

3. Adoption of Agenda

3.1 The Korean delegations proposed a new agenda item to discuss the future research plans for the US research vessel R/V Oscar Dyson.

3.2. The Russian delegation proposed a new agenda item to discuss proposal of a joint Bering Sea pollock research program, preliminarily named BAPIS. This should be agenda item 6.2.

3.3 Japan proposed a new agenda item to discuss recommendations for ABC and AHL. Agenda item 5.7.

3.4 The new agenda for the meeting was adopted (attachment 2).

4. Report of the June 6-9, 2005 Pollock Workshop In Seattle

4.1 Dr. Loh Lee-Low (US) provided a synopsis of the workshop held in Seattle. Documents are available at http://www.afsc.noaa.gov/refm/cbs/convention_workshop.htm. The S&T made the recommendation that a group led by Dr. Nishimura (Japan) and consisting of members from each delegation (Korea: Dr. Soon-Song Kim, Russia: Dr. Alexander Glubokov, Poland: Dr. Jerezy Janusz, US: Dr. Mike Canino, China: Mr. Liu, Xiaobing) should be organized to discuss the planning of a workshop on pollock genetics similar to that convened in Yokohama, Japan. This workshop should use the recommendations from the Seattle workshop as a basis for their agenda. The genetics workshop plan will be discussed and decided upon by the S&T delegates at the next annual meeting.

5. Discussion of Science Issues

5.1. Update catch and effort statistics

5.1.1. Dr. Loh Lee-Low (US) provided the latest catch statistics for the North Pacific Pollock fisheries in a handout (attachment 3: Table 1 and Table 2).

5.1.2. Dr. Stepanenko (Russia) presented a review of the pollock fisheries in the Western Bering Sea (attachment 4). The Russian delegation reported that in 2004 the 1999-2001 year classes predominated in pollock catch in the Navarin area. The CPUE in 2004 increased roughly by 19% compared with 2003, reflecting an increasing abundance of pollock in the Northwestern Bering Sea. The Russian delegation also reported that the Navarin catch for 2005 provided by Dr. Low in attachment 3 Table 2 should be updated to 246,800 t for catch through August 31, 2005.

5.1.3. The Japanese delegation expressed deep concern about the volume of 1 and 2 year-old pollock in the Russian commercial catch (attachment 4 Table 5) and recommended that the Russian fisheries attempt to limit these catches. The Russian delegation replied that the level was dependent on recruitment and oceanic conditions (warm years tend to have more juveniles on the shelf), and unavoidably high concentration of young fish in the summer fisheries.

5.2. Review results of trial fishing

There was no trial fishing reported by the member nations for 2005.

5.3. Review results of research cruises

5.3.1. Ms. Taina Honkalehto (US) provided a review of the 2005 Bogoslof survey, described plans for the 2006 Bogoslof survey, provided preliminary plans for other 2006 surveys, and reported results of research cruise in 2004 (attachment 5).

5.3.2. The US presented a review of the results of the 5-13 March 2005 echo-integration-trawl survey of pollock in the southeastern Aleutian Basin near Bogoslof Island by the R/V MILLER FREEMAN. The cruise was able to complete acoustic data collection and completed 19 trawl hauls. The pollock biomass estimate for the Bogoslof Island area was 253,000 t.

5.3.3. The next survey is planned for 4-12 March 2006, with similar tracklines as 2005 (attachment 5.3.3). R/V OSCAR DYSON will shadow R/V MILLER FREEMAN. The US extended an invitation to all convention parties to participate in the planned 2006 research survey. The US requested as much notice as possible (minimum of two months) to include visiting scientists on planned research cruises. Korea indicated that it would like to have one scientist participate in the Bogoslof survey on board the R/V Oscar Dyson.

5.3.4. United States provided results of R/V MILLER FREEMAN 2004 Eastern Bering Sea survey from Bristol Bay to Cape Navarin, including Russian waters. 154 hauls were completed, including some experimental hauls with an opening-closing mid-water trawl net. Four Russian scientists participated. Approximately 90 percent of pollock were in the US zone and 10 percent were in the Russian zone.

5.3.5. The Russian delegation stated that they would like to have two scientists participate in the 2006 summer EIT shelf survey, both on the R/V Oscar Dyson.

5.3.6. Dr. Stepenenko (Russia) provided a detailed report on research in the Western Bering Sea in 2005 and presented the preliminary data of EIT Midwater Survey conducted by TINRO in July 2005. Pollock biomass was estimated at about 499,000 t, an increase from 80,000 t from previous survey. The 2001-2002 year classes predominated in the Navarin area in the summer of 2005. Abundance of the 2003 year class was estimated to be relatively low.

5.4. Review the status of Aleutian Basin pollock stocks

5.4.1. Dr. Loh Lee-Low (US) presented the stock assessment for the Eastern Bering Sea pollock stock (attachment 6). The latest Eastern Bering Sea stock assessment can be found at http://www.afsc.noaa.gov/refm/stocks/assessments.htm.

5.4.2. Mr. Steven Barbeaux (US) presented on the 2004 Aleutian Islands pollock stock assessment (attachment 7). The latest Aleutian Island pollock stock assessment can be found at http://www.afsc.noaa.gov/refm/stocks/assessments.htm.

5.4.3. There is no comprehensive survey at this time that could be used to determine the status of Aleutian Basin pollock stock.

5.4.4. Ms. Taina Honkelehto (US) presented on survey effort and biomass estimates in the Bogoslof Island and basin areas (attachment 8) from 1983-2005.

5.4.5. Mr. Steve Barbeaux (US) delegation provided a table on the effort and catch in the Convention area trial fisheries from 1993-2003 (attachment 9).

5.5. Factors affecting recovery of the stocks

5.5.1. The Korean delegation expressed concerns about the impact of marine mammal populations on the recovery of the convention area pollock stock. The US delegation reported on status of the marine mammal population in the Bogoslof Area. The Steller sea lion and northern fur seal populations remain at low levels in the Eastern Bering Sea. The US stated that they thought it was doubtful that the marine mammals are significantly affecting the recruitment of pollock to the Donut hole.

5.5.2. The Japanese delegation wanted to stress the importance of conserving juvenile pollock. The US delegation stated that there are no specific rules for protecting juvenile fish, but that there is significant economic incentives for the industry to avoid small fish which are not marketable. The other aspect they wished the S&T to consider is that the US has 100 % observer coverage and that their management is based on the size of fish caught. If the industry catches too many young fish, the quota is effectively reduced in the following years. The US delegation stated that they have two observers on every boat. Observers measure the size composition of the catch. The US conservation goals are on female spawning biomass, they have very strict quota regulations, when the quota is reached the fishery is closed. Pollock caught in other fisheries are also counted against this quota and can be restrictive.

5.5.3. The Korean delegation inquired as to the location of spawning aggregations in the Bering sea and how these are protected. The US delegation stated that there is no directed pollock fishery in the Bogoslof region (which was closed by the North Pacific Fishery Management Council's (NPFMC) in 1993). Furthermore, the Eastern Bering Sea shelf region has seasonal restrictions such that only 40% of the annual quota can be taken during the spawning season.

5.5.4. A map of spawning aggregation sites (attachment 10) was presented and Dr. Stepanenko of the Russian delegation was asked to provide a synopsis of his research in producing this map. He reviewed the previous years' research data on pollock reproduction in the shelf and deep water areas throughout the Bering Sea. Since 2000, the magnitude of the pre-spawning pollock migration from the shelf into the adjacent deep waters has apparently increased. The Russian delegation believes that may improve recruitment to the Aleutian basin pollock.

5.5.5. The Russian delegation proposed that it is necessary to unite research efforts of all convention nations and increase the study of Bering Sea pollock reproduction and subpopulation structure for a better understanding of factors affecting the recovery of the Aleutian basin stocks.

5.5.6. Mr. Kanto (Japan) discussed the history of the 60%-40% split of the Aleutian Basin pollock stock between US origin and Russian origin, concluding that it was a political compromise between the parties. Poland provided some additional background stating that the alternative was a range from 60%-80% in the Bogoslof region.

5.5.7. The Korean delegation pointed out that pollock resources in the Central Bering Sea have declined even though fishing has been suspended in the Central Bering Sea and Bogoslof Island area and they suggested that pollock migration routes might have changed in recent years, and this may also be a factor in the poor recovery of the Aleutian basin stock. The US stated that there is insufficient data at this time to assess this and supported further research on this issue.

5.5.8. The meeting concluded that numerous factors influence basin pollock stock recovery. The factors discussed included climate change, predation, and possible changes in migration route. No one factor was identified as being solely responsible for the lack of biomass recovery.

The parties agreed that continued research is required.

5.6. The effects of the moratorium and its continuation

5.6.1. The Korean and Japanese delegations voiced their concerns that after 12 years of moratorium the stock has not appeared to recover and that perhaps the parties should consider other management options. The Korean delegation stated that they were finding it increasingly difficult to communicate the reasoning behind the moratorium to their fishermen as there have been no positive results to date.

5.6.2. The Chinese delegation stated that according to the scientific data the resource status is very low in the convention area and that the twelve year moratorium has had little effect. They stated that there probably was no other choice but to continue the moratorium. They would like to stress that their fishermen have already paid a lot to comply with the moratorium. The Chinese government is very concerned about the pollock stock status and they hope all the delegations can do more research and obtain more information concerning this issue.

5.7. Methodologies to determine Allowable Biological Catch (ABC) and Allowable Harvest Level (AHL)

5.7.1. The US stated that the NPFMC has not yet met to determine ABC for Bogoslof area pollock for 2006. Dr. Low illustrated the Council's SSC process and a typical calculation was provided. The US delegation stated that they could not predict what the NPFMC would do but that it was most likely that the ABC for the Bogoslof region will be set using the most conservative measure of the three methods outlined in the 2005 Seattle workshop. This would result in an ABC for the Bogoslof area of 5501 t.

5.7.2. Japan delegation proposed that the S&T use this figure, 5501 t, as a basis for setting ABC in the Convention area.

5.7.3. Taking the method defined in the Convention, whereby the winter survey estimate from the Bogoslof region represents 60% of the Aleutian Basin, the meeting noted that an ABC for the convention area would be 9168 t. All parties agreed to this methodology and ABC level.

5.7.4. For determining AHL, the discussion turned to how ABC and AHL should be related. The Japanese delegation proposed that AHL should be equal to ABC. The Korean delegation agreed with the Japanese proposal. The US delegation proposed that AHL be equal to or less than ABC.

5.7.5. The US delegation believes that the ABC estimation should concern scientific issues related to the biology of the stock and that the AHL could take other factors into consideration. The US wishes to maintain a separation between ABC and AHL and prefers to defer the discussion of AHL to the annual meeting.

5.7.6. There was significant discussion on the subject of how to derive AHL. In summary the

Chinese delegation stated that they would prefer that AHL be equal to ABC but in order to reach consensus would agree to an AHL being less than ABC. The Polish delegation prefer that the AHL be equal to ABC, but to easily reach agreement Poland proposed that the AHL be set equal to 33% of the ABC. The Russian delegation proposed that due to scientific uncertainty the AHL be set to 0.

5.7.7. Japan requested the Russian delegation to clarify the scientific base for AHL being set at the zero level. Russia provided additional information concerning scientific uncertainty for the estimation of AHL more than 0. Japan declared that the ABC was determined at a very conservative level, moreover present estimation of Bogoslof Island biomass shows a figure for larger than minimum stock level (B_{ban}=120,000 t). Under such circumstances AHL can be set. Japan stated that they saw no rationale obstacles for setting AHL.

5.7.8. Consensus was not reached on how to determine AHL .

5.8. Recommendation on AHL

5.8.1. Discussions were covered in section 5.7.

5.8.2. As consensus on how to determine AHL was not reached, the proposals submitted by the delegations would be reported to the Annual conference.

6. Discussion of Enforcement and Management Issues

6.1. Trial fishing terms and conditions for 2005

6.1.1. The US Coast Guard reported that there was no trial fishing in 2005 and therefore no enforcement action this year.

6.1.2. Korean party presented on a proposed change to the trial fishing terms and conditions that would allow countries to donate the allocation of trial fishing vessels to another convention nation (attachment 11).

6.1.3. The Japanese supported this proposal, but wished to limit it to a single year as a provisional measure. The Chinese supported this proposal as long as the total number of fishing vessels was limited to current restrictions. Poland supported the Korean position with the Japanese suggestion that it be limited to one year. The US delegation wished further elaboration on the trial fishery plans proposed by the Korean party. The Korean delegation accepted the comments of the other parties. A meeting was convened outside the regular S&T meeting to discuss specific details on trial fishing involving Korea, US, Japan, and China. In this meeting all parties agreed to report the Korean proposal on trial fishing to the 10th Annual Conference. A separate report detailing this agreement is attached (attachment 12).

6.2. Discussion of BAPIS

6.2.1. Dr. Glubokov (Russia) presented a Russian proposal for a comprehensive research plan to create the Bering-Aleutian pollock International Survey Program. For their part the Russians would be willing to conduct an annual bottom and mid-water trawl survey in conjunction with ichthyoplankton collections and a hydroacoustic survey of pollock stocks in their EEZ. The meeting requested more details of their proposal (in English). This is provided in attachment 13.

6.2.2. All parties agreed that they support the idea of such a program, but would like to review a written proposal. The Russians will provide a copy of the proposal in English to the S&T for consideration.

6.3. Components and Recommendations

6.3.1. No further components or recommendations were discussed.

7. Other Matters and Recommendations

7.1. No other matters or recommendations were discussed.

8. Report to the Annual Conference

8.1. The Chair of the S&T gave the S&T report to the Annual Conference.

9. Closing Remarks

9.1. The Chair thanked all the participants of the S&T for their thoughtful discussions, and thanked the rapporteurs for compiling the written report. With that, the Chair closed the S&T meeting at approximately 6 pm on Wednesday, September 7, 2005.

List of Attachments:

1. S&T Committee Participants for 2005
2. S&T Agenda for 2005

The following attachments will be made available on the Convention website:

3. Information Submitted to the Scientific and Technical Committee by the United States for the 10th Annual Conference of the Parties to the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea, with amended tables
4. Russian report on western Bering Sea pollock catch and Fishery Data
5. Results of Research Cruises – USA
6. 2004 Eastern Bering Sea pollock stock assessment summary
7. 2004 Aleutian Islands pollock stock assessment summary
8. Compilation of the survey effort and biomass estimates in the Bogoslof Island and basin areas

9. Summary of the effort, catch, and track lines in the Convention area trial fisheries from 1993-2003
10. A map of spawning aggregation sites compiled by Dr. Stepenenko
11. Korean party proposal to change the trial fishing terms and conditions
12. Agreement among parties on Korean proposal to change in trial fishing terms and conditions
13. Russian party BAPIS research plan proposal

Scientific and Technical Committee

Provisional List of Participants

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6 - 7 September 2005

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Attachment 2

10th ANNUAL CONFERENCE OF THE PARTIES TO THE CONVENTION ON THE CONSERVATION AND MANAGEMENT OF POLLOCK RESOURCES IN THE CENTRAL BERING SEA

AGENDA OF THE MEETING OF THE SCIENTIFIC AND TECHNICAL COMMITTEE

5-8 September 2005 – Busan, Korea

1. **Opening remarks**

2. **Appointment of Rapporteur**

3. **Adoption of Agenda**

4. **Report of the June 6-8, 2005 Pollock Workshop in Seattle**

5. **Discussion of Science Issues**
   - 5.1. Update catch and effort statistics
   - 5.2. Review results of trial fishing
   - 5.3. Review results of research cruises
   - 5.4. Review the status of Aleutian Basin pollock stocks
   - 5.5. Factors affecting recovery of the stocks
   - 5.6. The effects of the moratorium and its continuation
   - 5.7. Methodologies to determine Allowable Biological Catch (ABC) and Allowable Harvest Level (AHL)
   - 5.8. Recommendation on AHL

6. **Discussion of Enforcement and Management Issues**
   - 6.1. Trial fishing terms and conditions for 2005
   - 6.2. Discussion of BAPIS
   - 6.3. Components and Recommendations

7. **Other Matters and Recommendations**

8. **Report to the Annual Conference**

9. **Closing Remarks**

Table 1. United States Pollock Catches in metric tons, 1993-2005

Year	E. Bering Sea	Aleutians	Bogoslof	Gulf of Alaska
1993	1,198,790	54,074	885	108,066
1994	1,197,224	53,224	556	110,890
1995	1,169,614	60,184	264	73,248
1996	1,102,579	26,597	389	37,106
1997	1,036,789	24,721	163	89,893
1998	1,058,288	22,053	8	123,805
1999	889,561	965	1	93,422
2000	1,019,067	1,174	29	23,643
2001	1,247,305	788	61	70,485
2002	1,331,416	1,134	22	50,712
2003	1,491,356	1,653	24	48,573
2004	1,493,394	1,150	50	60,929
(thru 30 July) 2005	999,021	1,408	0	45,268

Note: (Data from http://www.fakr.noaa.gov/sustainablefisheries/catchstats.htm)

Table 2. Historical catch of pollock from the Bering Sea, in metric tons, 1977-2005

Year	Olyotorskiy-Karagin (W of 170W)	Navarin Region (E of 170W)	Donut Hole	Bogoslof	Aleutian Region	Eastern Bering Sea	Total Bering Sea
1977	265000				7625	978370	1,250,995
1978	417000				6282	979431	1,402,713
1979	546,000				9,504	935,714	1,491,218
1980	825,000				58,156	958,280	1,841,436
1981	1,133,000				55,516	973,502	2,162,018
1982	976,000				57,978	955,964	1,989,942
1983	1,006,000				59,026	981,450	2,046,476
1984	252,000	503,000	181,200		81,834	1,092,055	2,110,089
1985	134,000	488,000	363,400		58,730	1,139,676	2,183,806
1986	297,000	570,000	1,039,800		46,641	1,141,993	3,095,434
1987	349,000	463,000	1,326,300	377,436	28,720	859,416	3,403,872
1988	475,000	852,000	1,395,900	87,813	30,000	1,228,721	4,069,434
1989	345,000	684,000	1,447,600	36,073	15,531	1,229,600	3,757,804
1990	582,000	232,000	917,400	151,672	79,025	1,455,193	3,417,290
1991	326,000	178,000	293,400	264,760	78,649	1,217,301	2,358,110
1992	282,000	315,000	10,000	160	48,745	1,164,440	1,820,345
1993	288,000	389,000	1,957	885	54,074	1,198,790	1,932,706
1994	204,000	288,900	NA	556	53,224	1,197,224	1,743,904
1995	79,000	427,300	Trace	264	60,184	1,169,614	1,736,362
1996	34,000	753,000	Trace	389	26,597	1,102,579	1,916,565
1997	30,000	735,000	Trace	163	24,721	1,036,789	1,826,673
1998	25,000	719,000	Trace	8	22,053	1,058,288	1,824,349
1999	46,000	639,000	Trace	1	965	889,561	1,575,527
2000	15,000	507,000	Trace	29	1,174	1,019,067	1,542,270
2001	25,000	526,000	Trace	61	788	1,247,305	1,799,154
2002	8,000	370,000	Trace	22	1,134	1,331,416	1,710,572
2003	14,600	411,200	Trace	24	1,653	1,491,356	1,918,833
2004	6,200	427,600	Trace	0	1,150	1,493,394	1,928,344
2005*	?	191,040	Trace	0	1,408	999,021	1,191,469

* U.S. data for 2005 is through July 30, Russian data is through August 10.

Sources of Data

U.S. Data, 1979-1992 from Pollock stock assessment document at 7th Annual Conference
1993-2004 data from web site: www.fakr.noaa.gov
Navarin Data, 1994-2001 (from Russian pollock stock assessment document presented by the Russian Party at the 6th annual conference in Poland)
Navarin Data, 1984-1993 (from The Aleutian Basin Pollock Stock in 2001 written by TINRO and presented at 6th annual conference)

Attachment 4

Federal Agency of Fisheries Russian Federation

Pacific Research Fisheries Centre (TINRO-centre)

WESTERN BERING SEA POLLOCK CATCH AND FISHERY DATA

(document submitted for Tenth Annual Conference Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea)

By
Stepanenko M.A., Gritsay E.V.

2005

In 2004 pattern pollock fisheries in the western Bering Sea shows concentrations of catch basically at outer shelf placed between Cape Navarin and Convention line and at shallow waters of Anadyr Bay (Fig. 1).

The Navarin area (Western Bering Sea placed to east from 174^0 00 E) pollock catch was significant and CPUE stable in period from 1980 until 1989. The catch has declined rapidly in 1990-1995, again grew in 1996-1999 and interannual variations were related basically with fishing activity (Fig. 2). The CPUE has declined sharply in 1998-2001 and has historical minimum in 2001 (42.4 t/day) but began stable increasing since 2002.

Historically directed pollock fisheries in the Bering Sea began by the end of 1950-s. Pollock were harvested basically in the eastern Bering Sea. Catch increased rapidly and reached a peak in 1972 (about 2.0 mln.t).

Pollock fisheries in the western Bering Sea began early 1970-s at first in the Olutorskiy and Karaginskiy Bays. Since the advent the EEZs in 1977, pollock fisheries extended into northern Bering Sea. Pollock fishing in the Olutorskiy and Karaginskiy Bays were relatively stable in period between 1976-1994 with peaks in 1976 (549 ths.t) and in 1988 (408 ths.t) and in 1995 catch was 62-73 % less than the catch in 1993-1994 and fishing moratorium was enacted since 2002.

Pollock catch in the Bering Sea reached maximum in 1988, about 4.07 mln.t including in the US waters 33.1%, in the Russian EEZ 32.6% (Navarin area 20.9%) and in the Aleutian Basin (donut hole) 34.3% (Fig. 3).

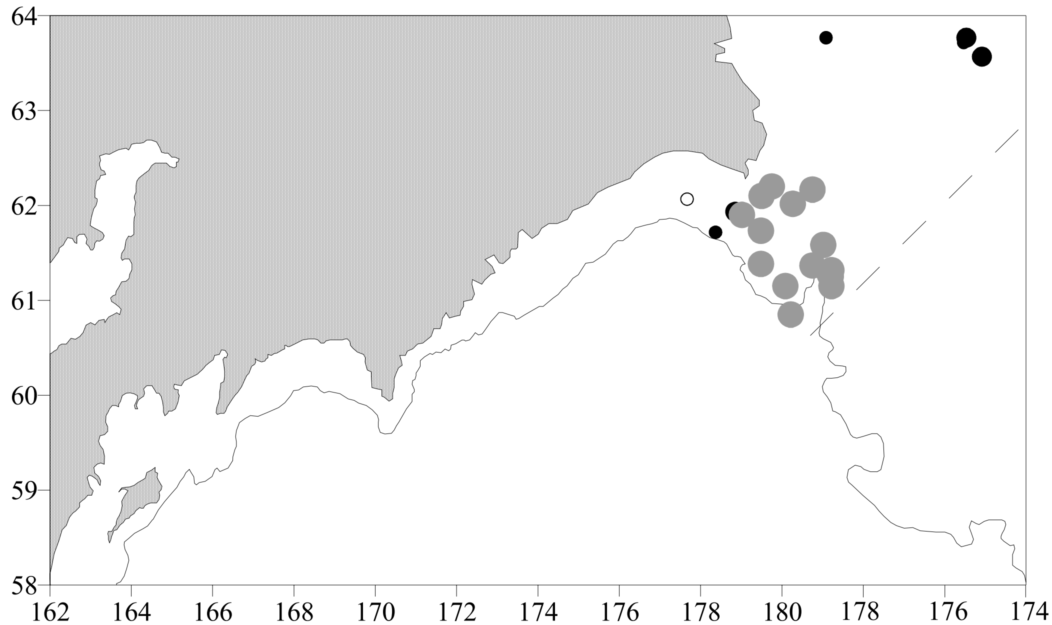
Pollock fishing in the central Bering Sea began in the middle 1980–s and harvested basically extremely abundant 1978 year class. By 1992 the central Bering Sea pollock catch declined at 10.0 ths.t and moratorium was enacted in 1993.

The pattern of modern pollock factory trawlers fisheries in the Navarin area in 2000-2004 has been in winter (January-February) and postspawning time (May 15-December) and CPUE have maximum in winter period (Fig. 4a), fishing activity (Fig. 4б) and catch (Fig. 4в) in June-October.

Seasonal variation of pollock CPUE and catch in the Navarin area depends from seasonal migrations, abundance and distribution of pollock in the northwestern Bering Sea.

The length frequency data for 2004 shows high mode of fish at 31-34 cm, 37-42 cm. This is indications of the 2001 year class (50.2%), 2000 year class (23.5%) and 1999 year class (11.5%). The 1999-2001 year classes predominated in catch in the 2004. The 2002 year class consisted just 2.3% of the total catch.

The average pollock CPUE in 2004 was at 18.9% higher compare 2003 and it reflects increasing scale of distribution pollock into northwestern Bering Sea and higher abundance of pollock in the Navarin area in feeding period.



Условные обозначения: ○ - 0,1 - 10; ● - 10 - 25;
● - 25 - 50; ● - 50 - 150 т на с/с лова

Fig. 1. Concentrations of pollock fishery 2004, May-December on the northwestern Bering Sea.

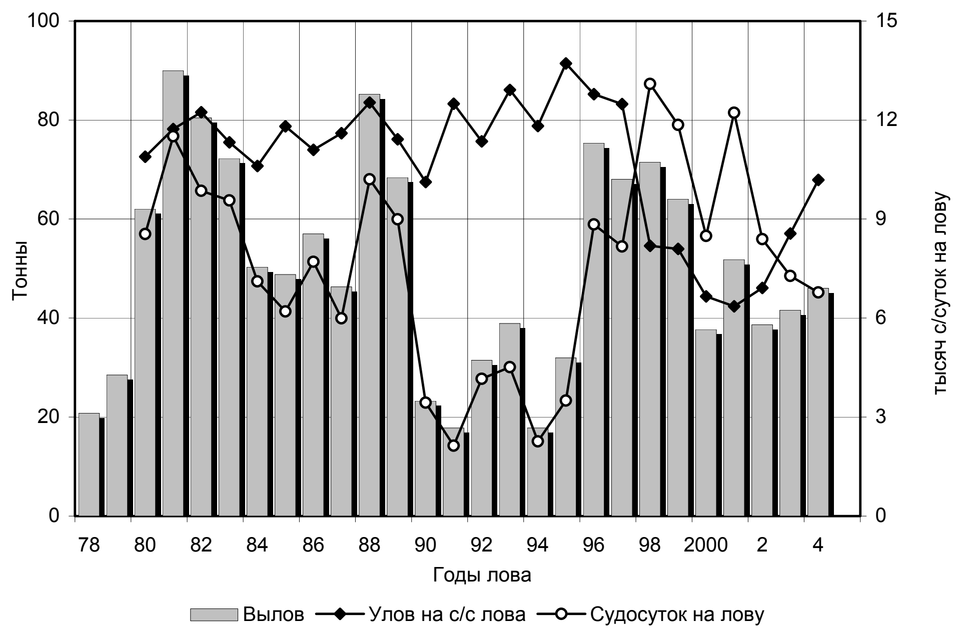


Fig. 2. Pollock catch (x 10^4 t) CPUE and number of days (ths.) used for active fishing in the Navarin area in 2004

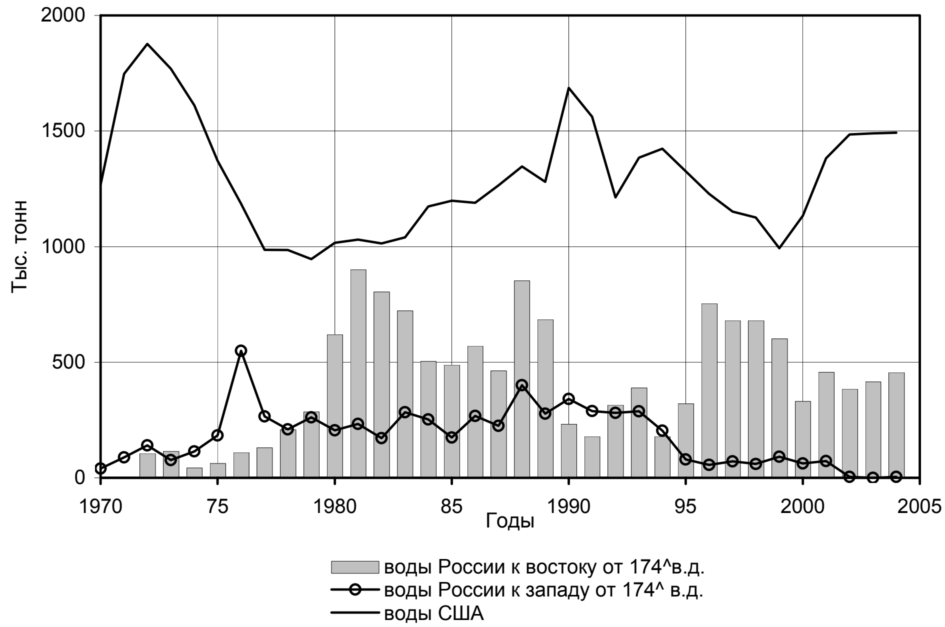


Fig. 3. Pollock catch in the western Bering Sea (Russian EEZ, areas to east and to west from 174^0 00 E) and in the eastern Bering Sea (US EEZ)

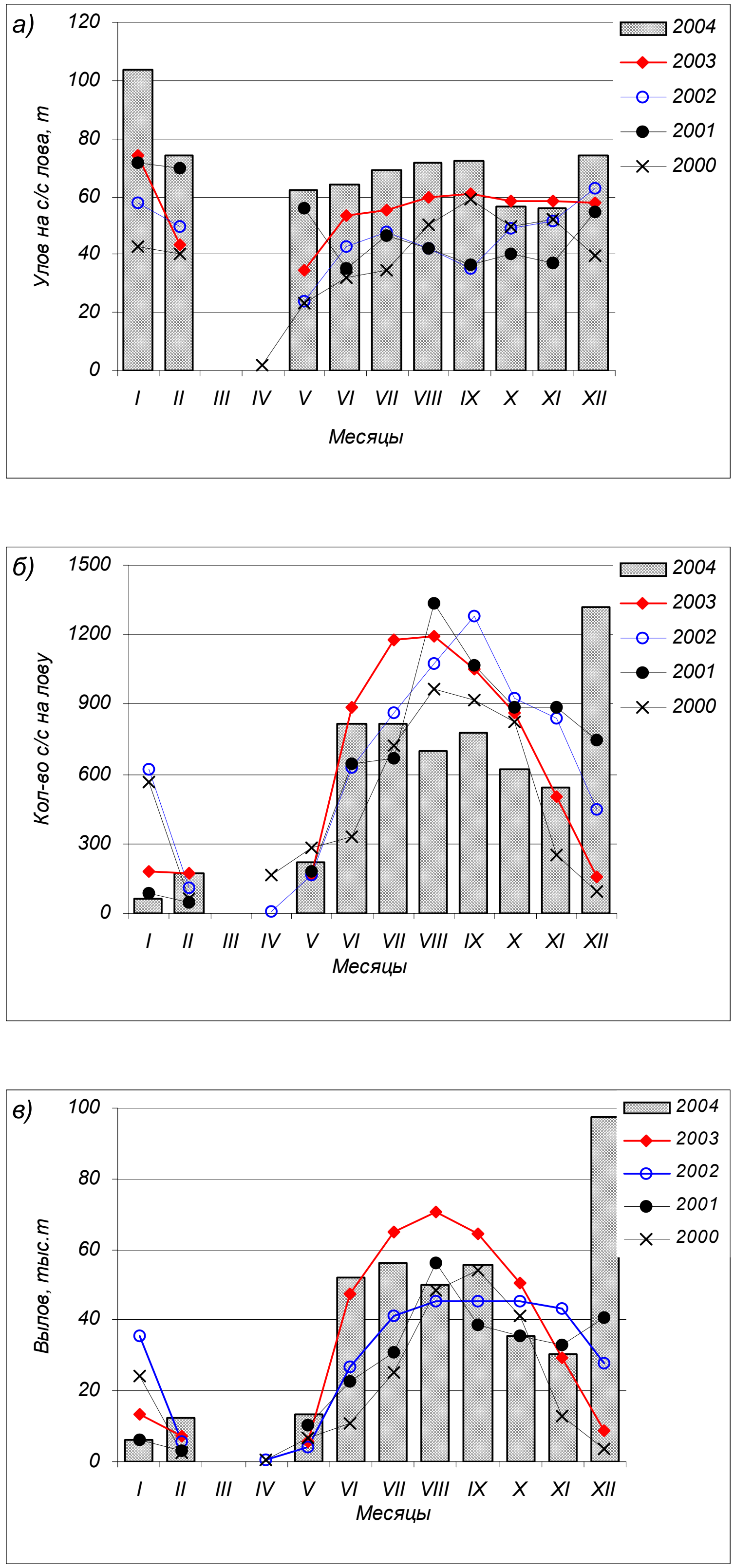


Fig. 4. Pollock CPUE (a), number of days used for active fishing (б) and estimated catch at month (в) of Russian factory trawlers in the Navarin area in 2000-2004

Results of research cruises – U.S.A.

Bogoslof 2005 review with ages

Plans for 2006 Bogoslof survey

Summer 2004 Bering Sea shelf final results

Taina Honkalehto
Alaska Fisheries Science Center
NOAA, NMFS
Seattle WA USA

Results of the 2005 Bogoslof EIT pollock survey

March 7 –13, 2005
RV *Miller Freeman*

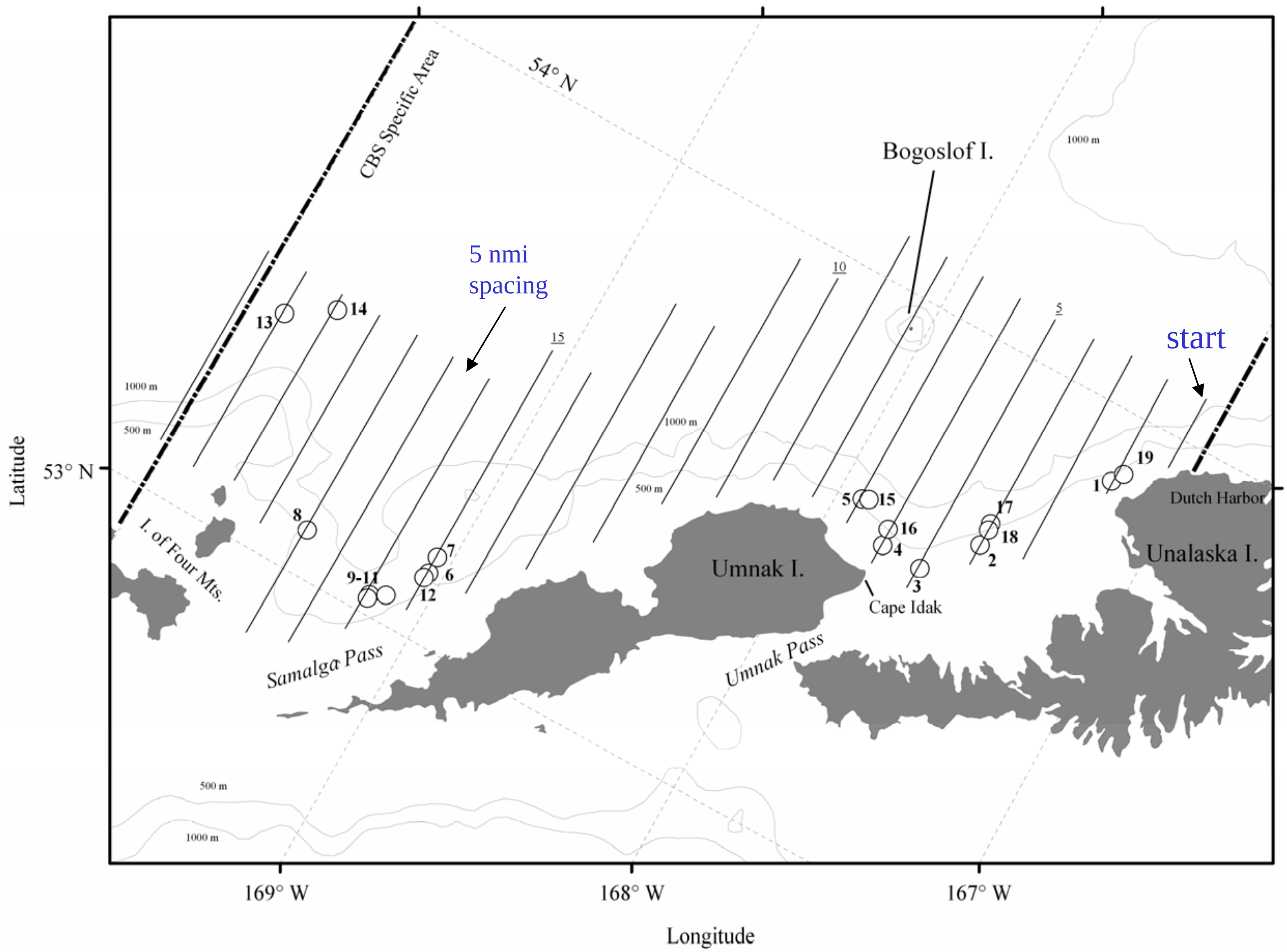


Figure 1. Trackline (22) and haul location (19 circles) from the winter 2005 echo integration-trawl survey in the Bogoslof Island area. Transect numbers are underlined. The dash-dotted line indicates the NPFMC Area 518/Central Bering Sea Specific Area.

Table 1.--Catch by primary species from 19 midwater trawl hauls during the winter 2005 echo integration-trawl survey of walleye pollock in the Bogoslof Island area.

Species Name	Scientific Name	Weight (kg)	Percent by weight	Numbers
walleye pollock	***Theragra chalcogramma***	**14,489.28**	**94.3**	**12,009**
Pacific ocean perch	*Sebastes alutus*	616.51	4.0	625
*other		255.45	1.7	13,137
		15361.24		25,771

* mostly lanternfish

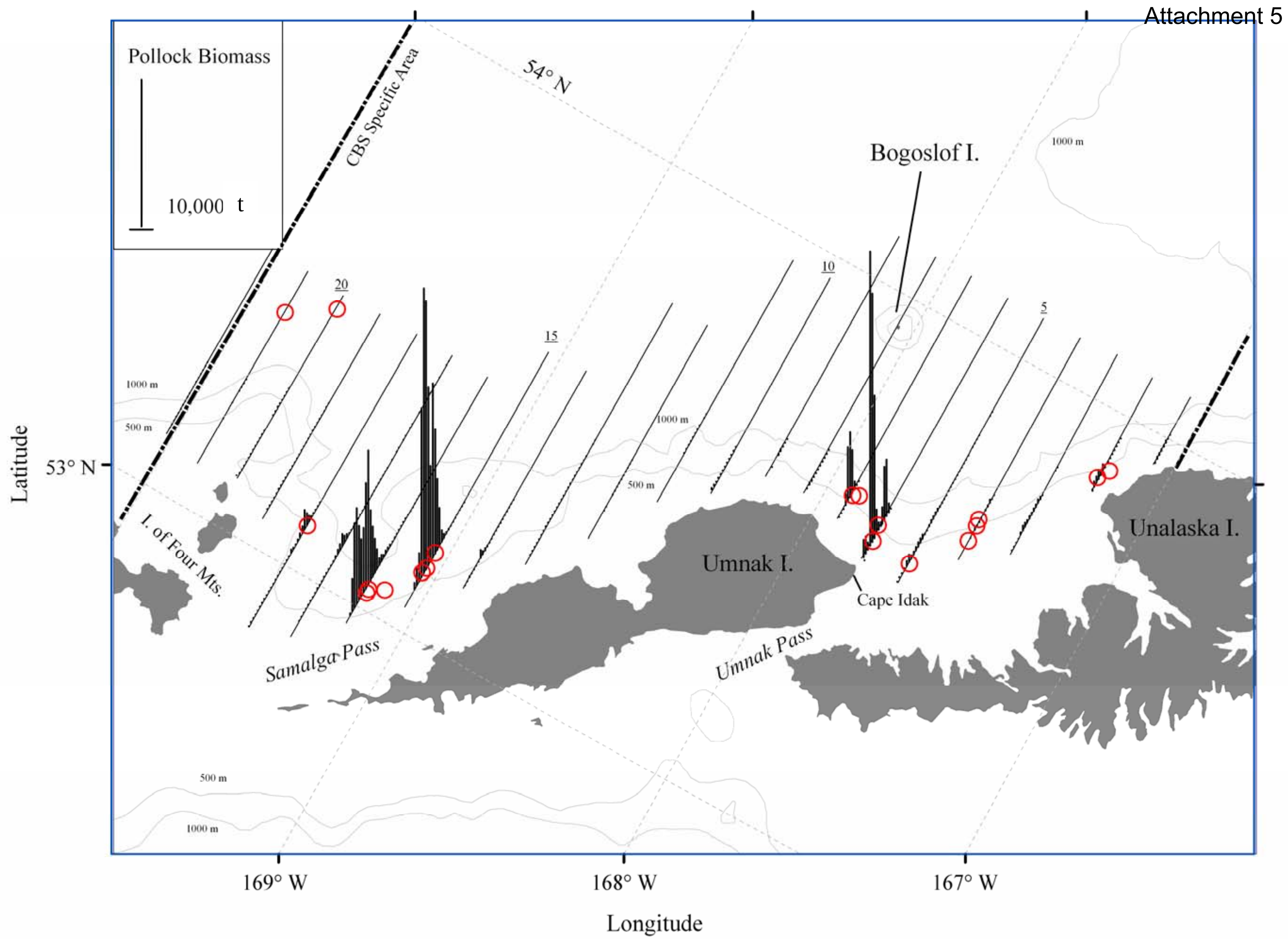


Figure 2. Trawl haul location (circles) and biomass (metric tons) attributed to pollock observed during the winter 2005 echo integration-trawl survey in the Bogoslof Island area.

Echogram of transect 15, Samalga Pass region

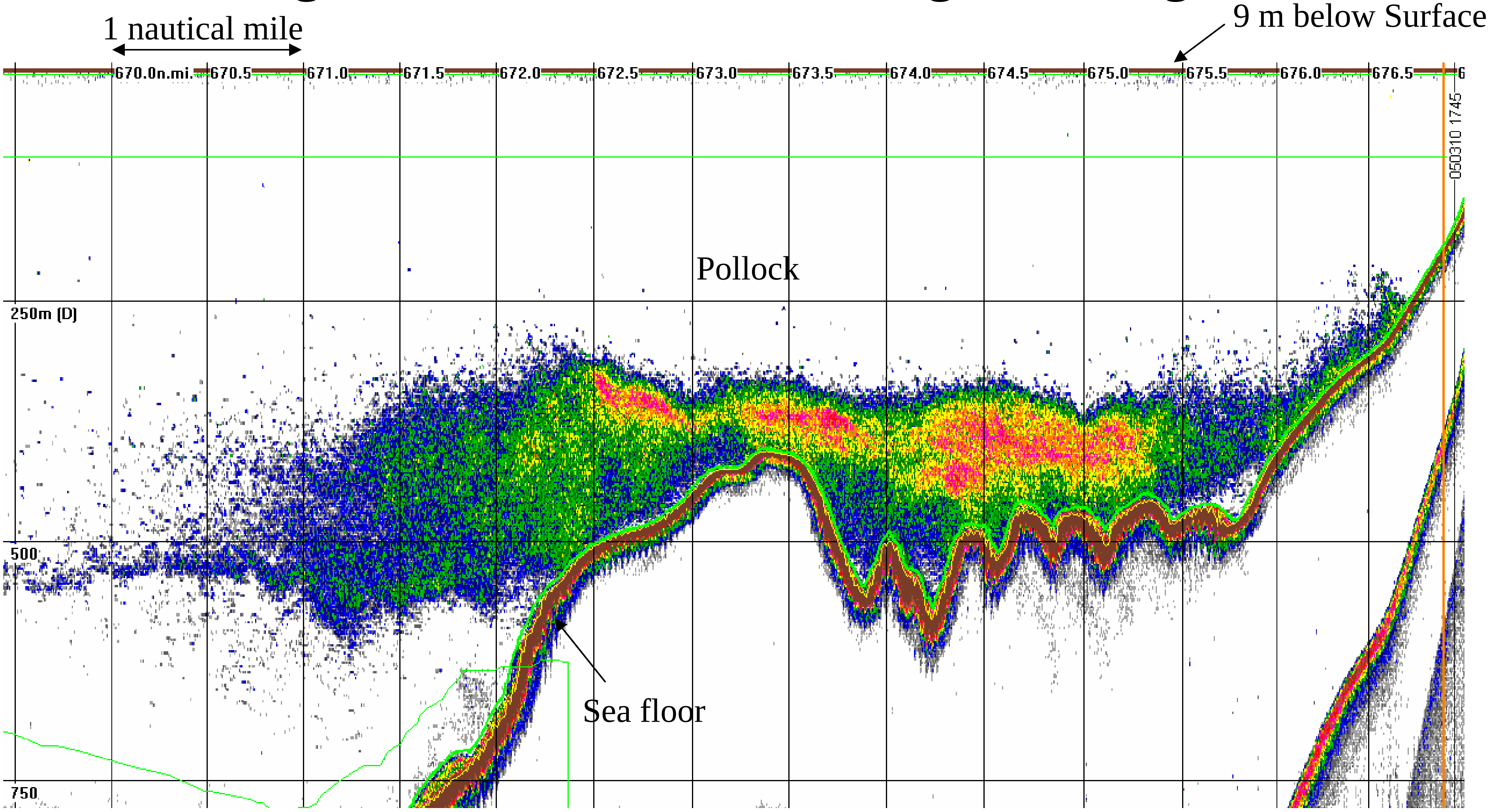


Figure 3. Pollock backscatter along transect 15, Samalga Pass region, where 3 trawl hauls were conducted.

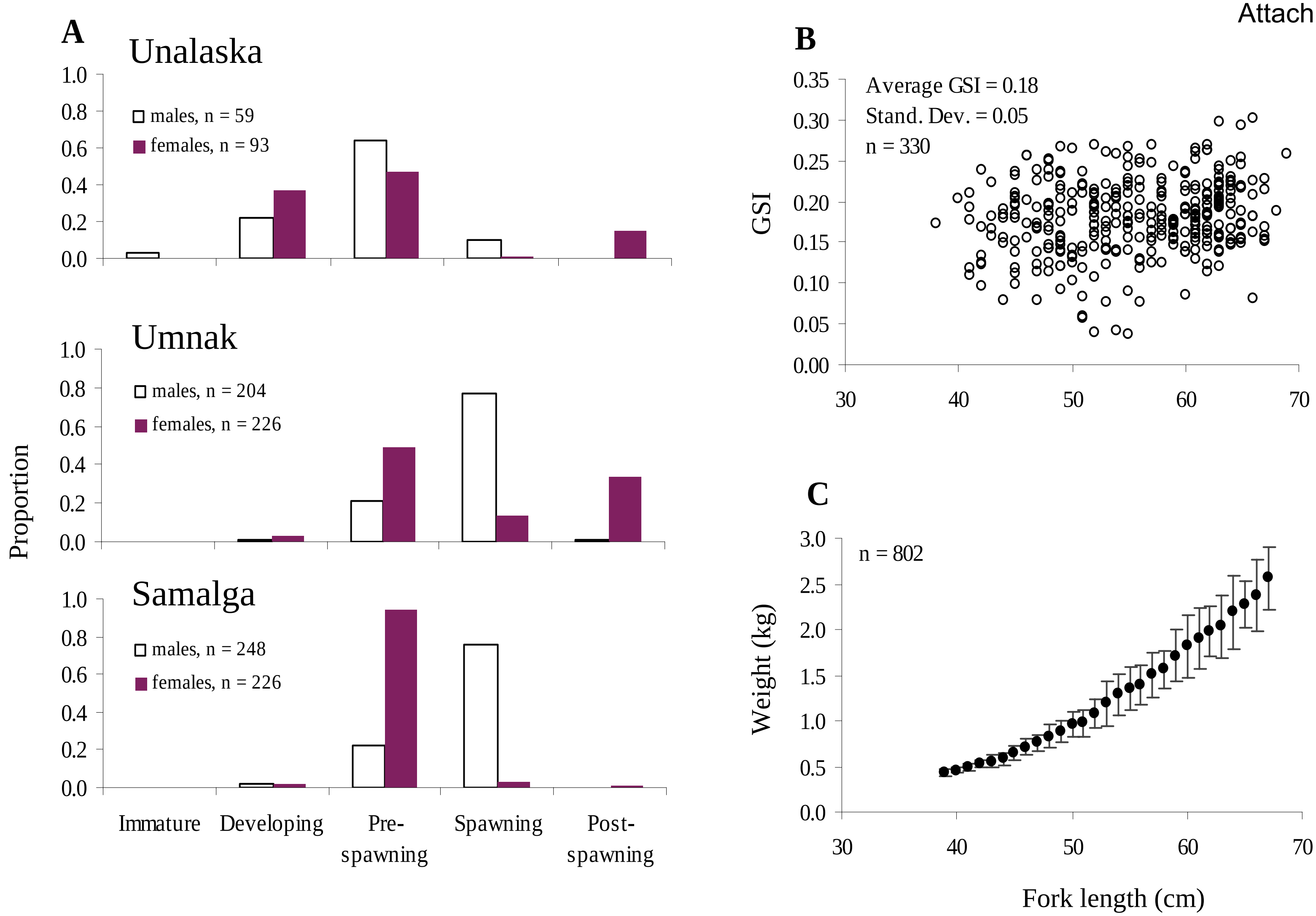
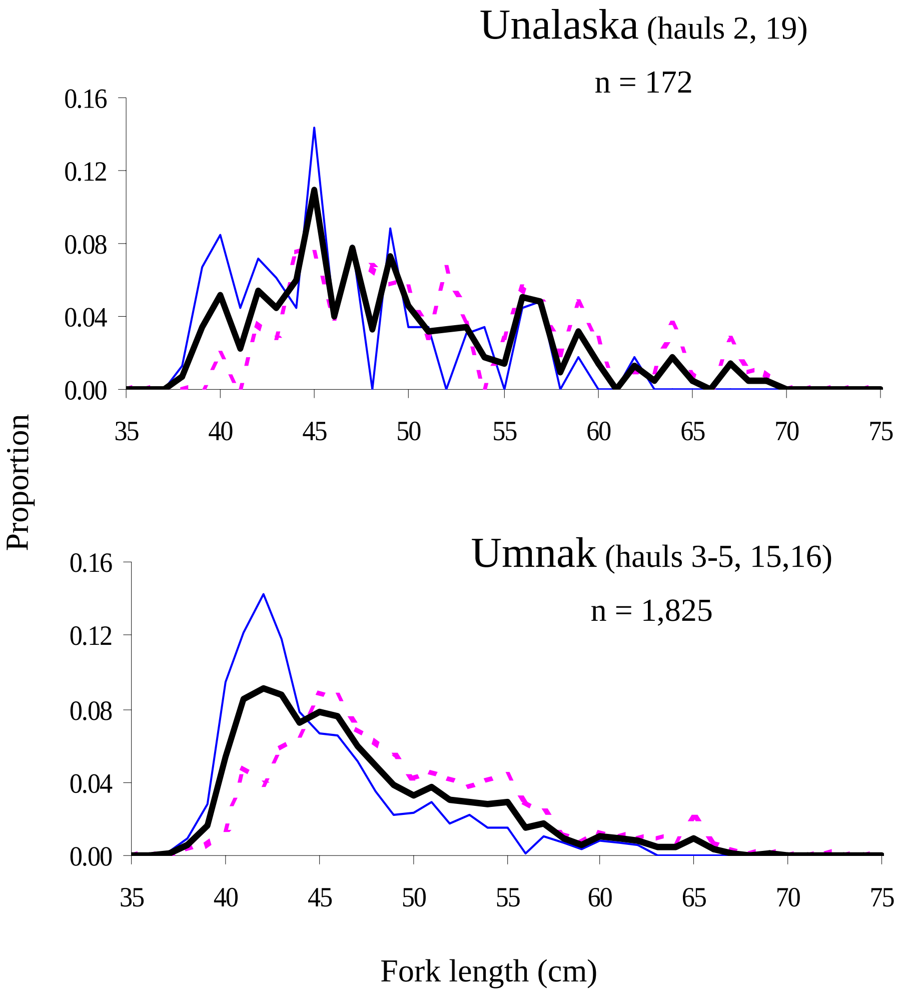


Figure 4. Pollock maturity stages for 3 length strata (A), gonado-somatic index (GSI) for pre-spawning females as a function of fork length (cm) (B), and mean weight at length, where at least 5 fish were measured (sexes combined) (C). Vertical bars indicate one standard deviation.



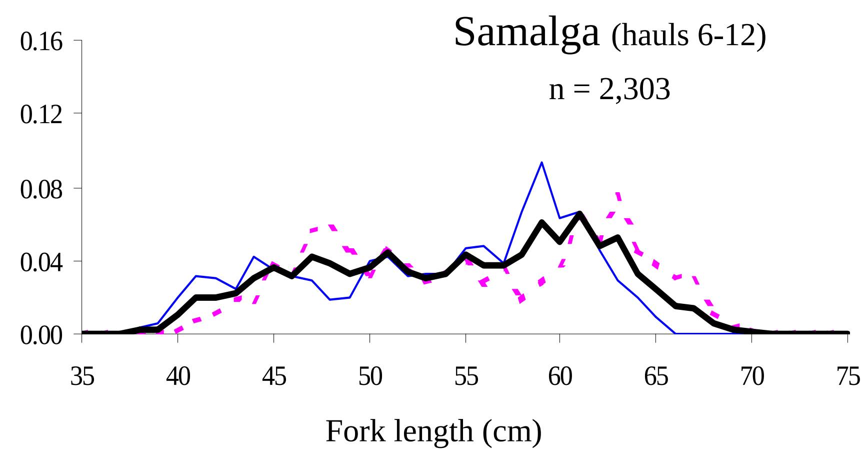


Figure 5. Pollock proportion-at-length for 3 length strata (sexes combined: bold line, males: medium line, females: dashed line)

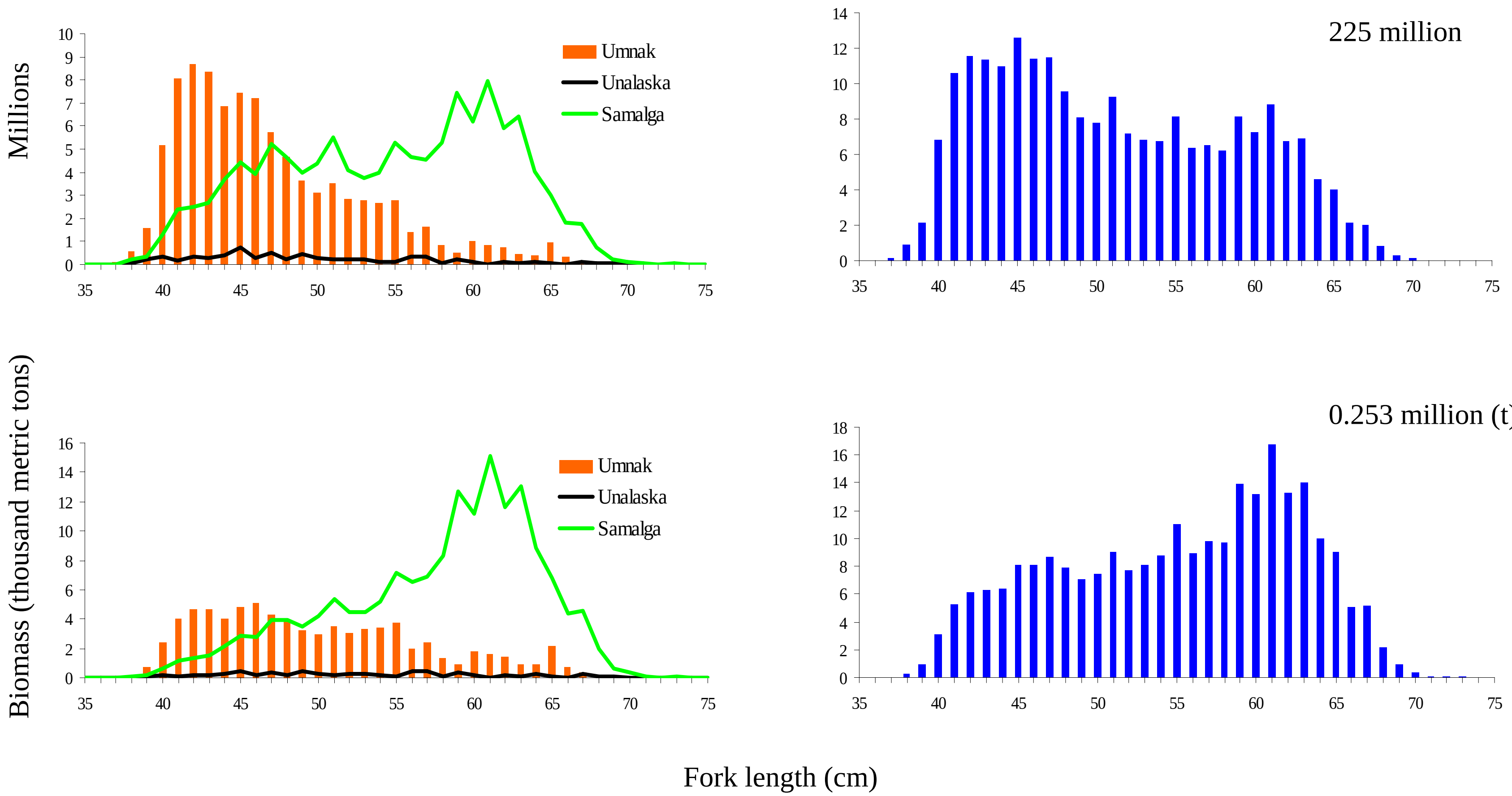


Figure 6. Population-at-length (top) and biomass-at-length (bottom) estimates from the winter 2005 echo integration-trawl survey of walleye pollock in the Bogoslof Island area.

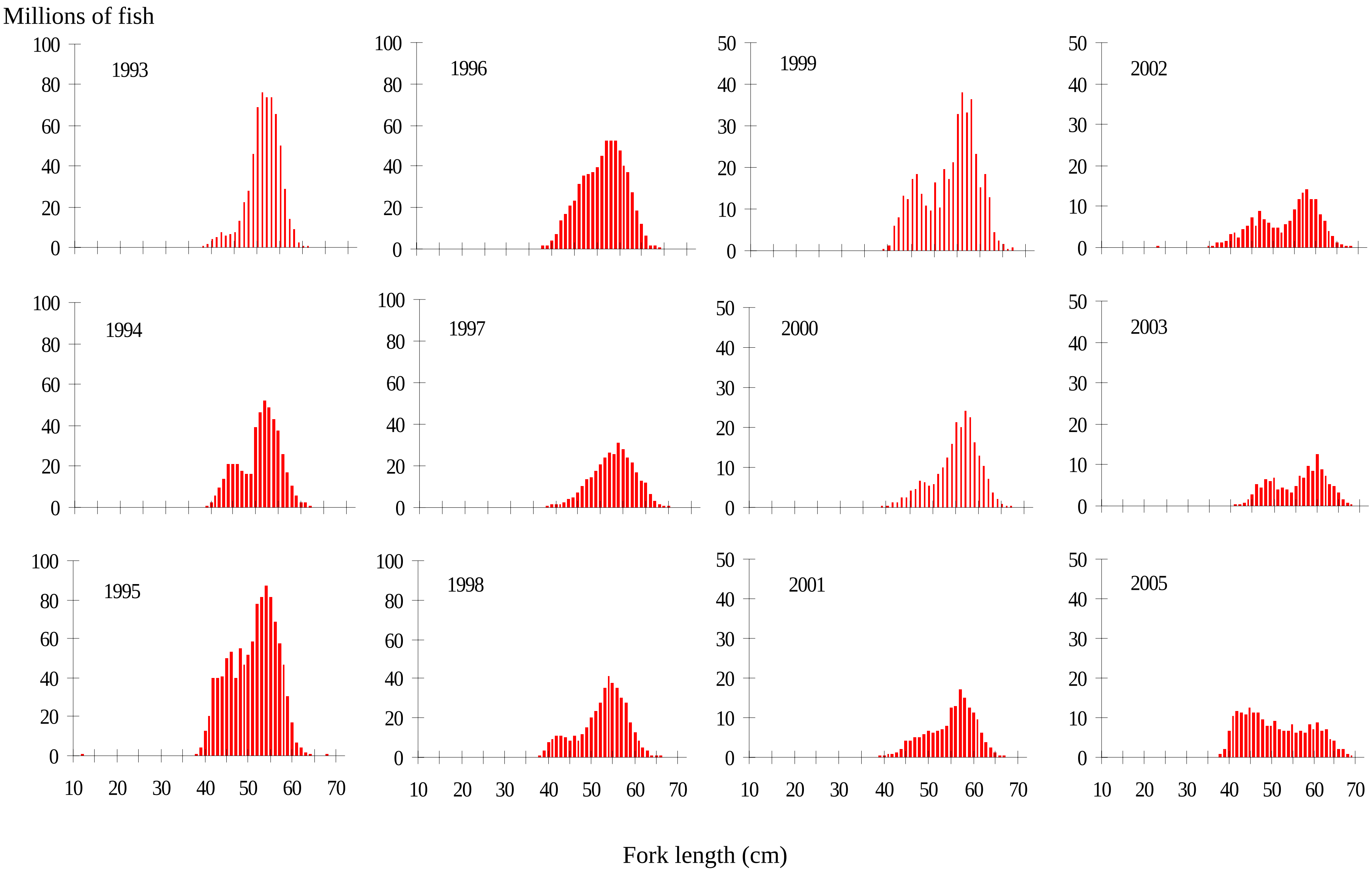
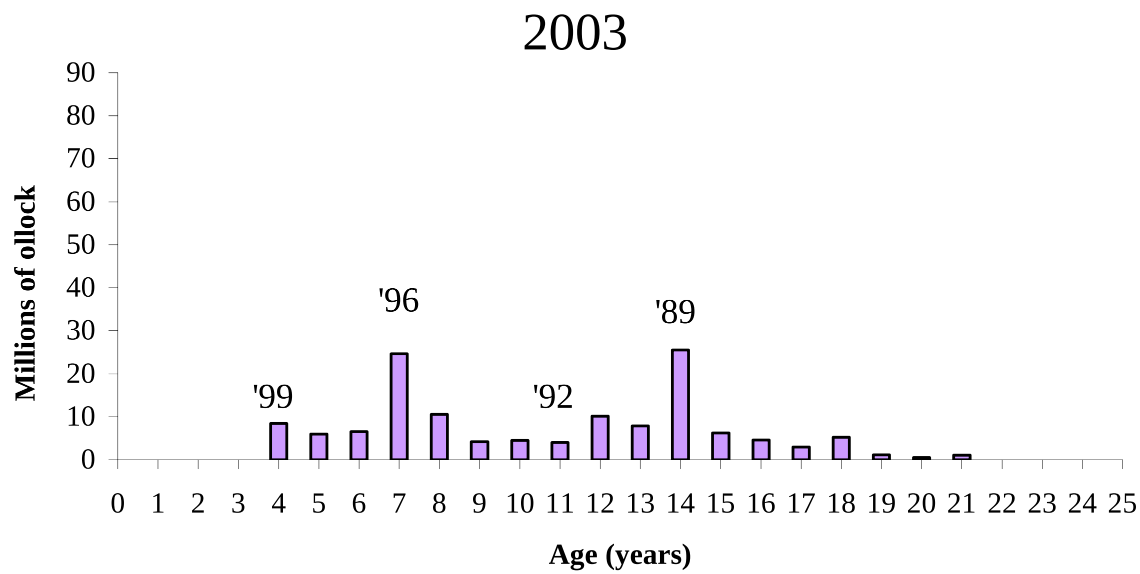


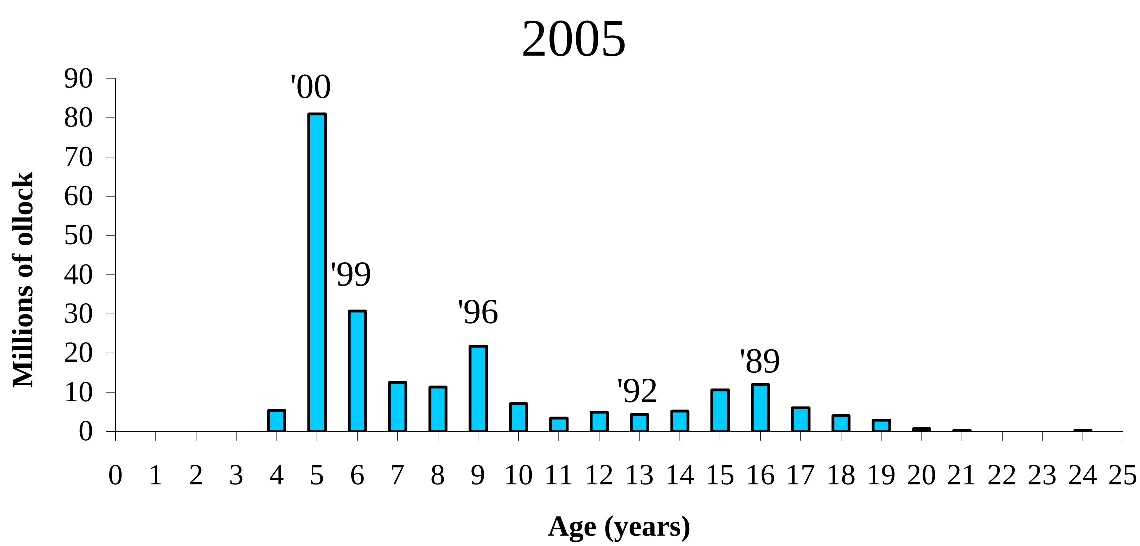
Figure 7. Numbers-at-length estimates (millions) from echo integration-trawl surveys of spawning pollock near Bogoslof Island in winter 1993-2005. The United States conducted all but the 1999 survey, which was conducted by Japan. Note y-axis scales differ.

Bogoslof EIT Numbers at age estimates (millions)

Major year classes are highlighted

Age	2003 Millions	2004 (No survey)	2005 Millions
0	0.00	-	0.00
1	0.00	-	0.00
2	0.00	-	0.00
3	0.02	-	0.00
4	8.41	-	5.38
5	5.96	-	80.99
6	6.54	-	30.73
7	24.66	-	12.52
8	10.59	-	11.32
9	4.14	-	21.78
10	4.53	-	7.14
11	4.02	-	3.42
12	10.12	-	4.95
13	7.87	-	4.35
14	25.54	-	5.25
15	6.23	-	10.63
16	4.60	-	11.96
17	2.96	-	5.99
18	5.25	-	4.07
19	1.18	-	2.83
20	0.46	-	0.75
21	1.10	-	0.23
22	0.00	-	0.00
23	0.00	-	0.00
24	0.00	-	0.26
25	0.00	-	0.00
Totals	134.19	-	224.53





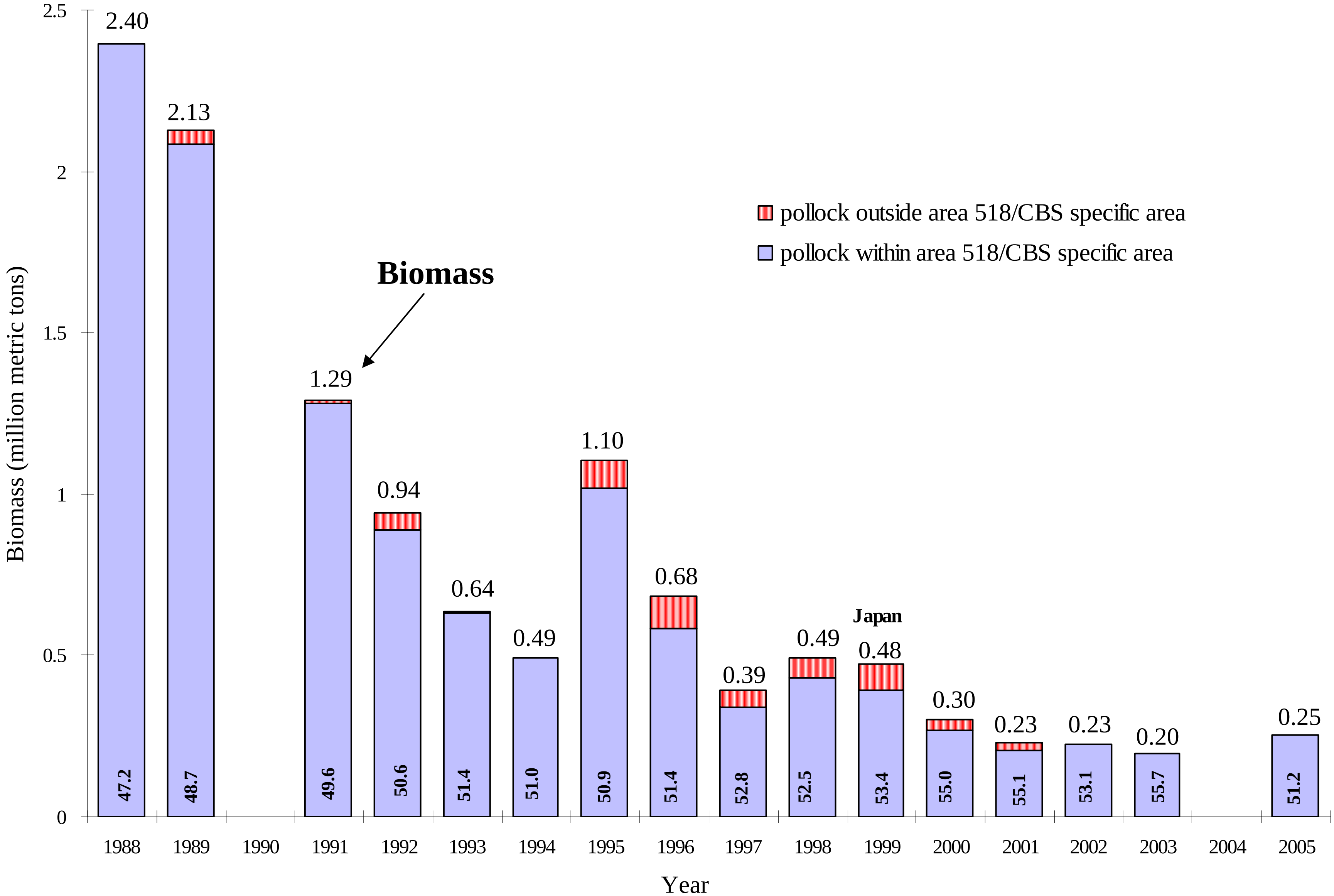
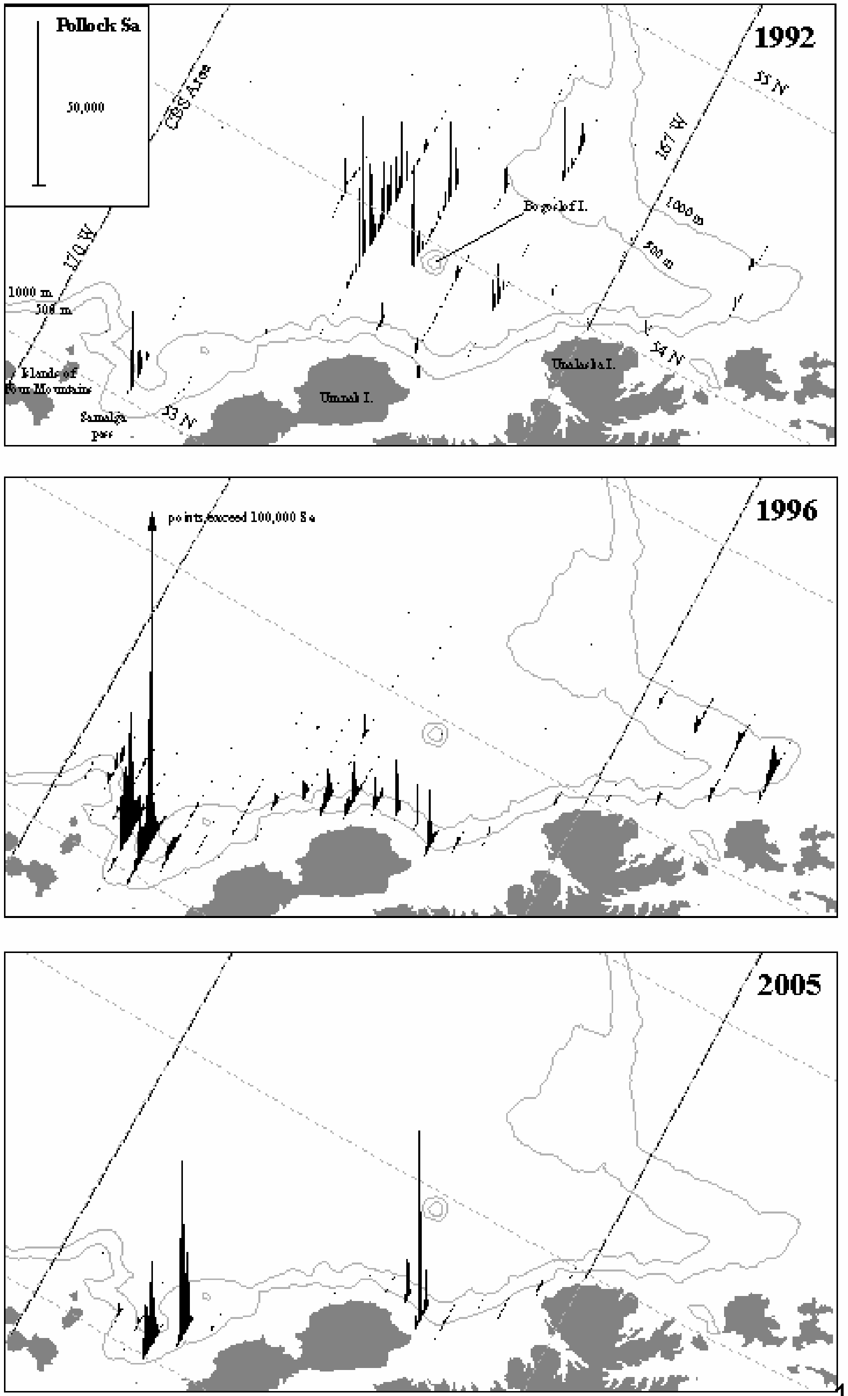


Figure 8. Biomass estimates (top of each bar) and average fork lengths (cm) (inside bar) obtained during winter echo integration-trawl surveys for walleye pollock in the Bogoslof Island area, 1988-2005. The U.S. conducted all but the 1999 survey, which was conducted by Japan.

3 Periods of Bogoslof pollock



1988 – 1993

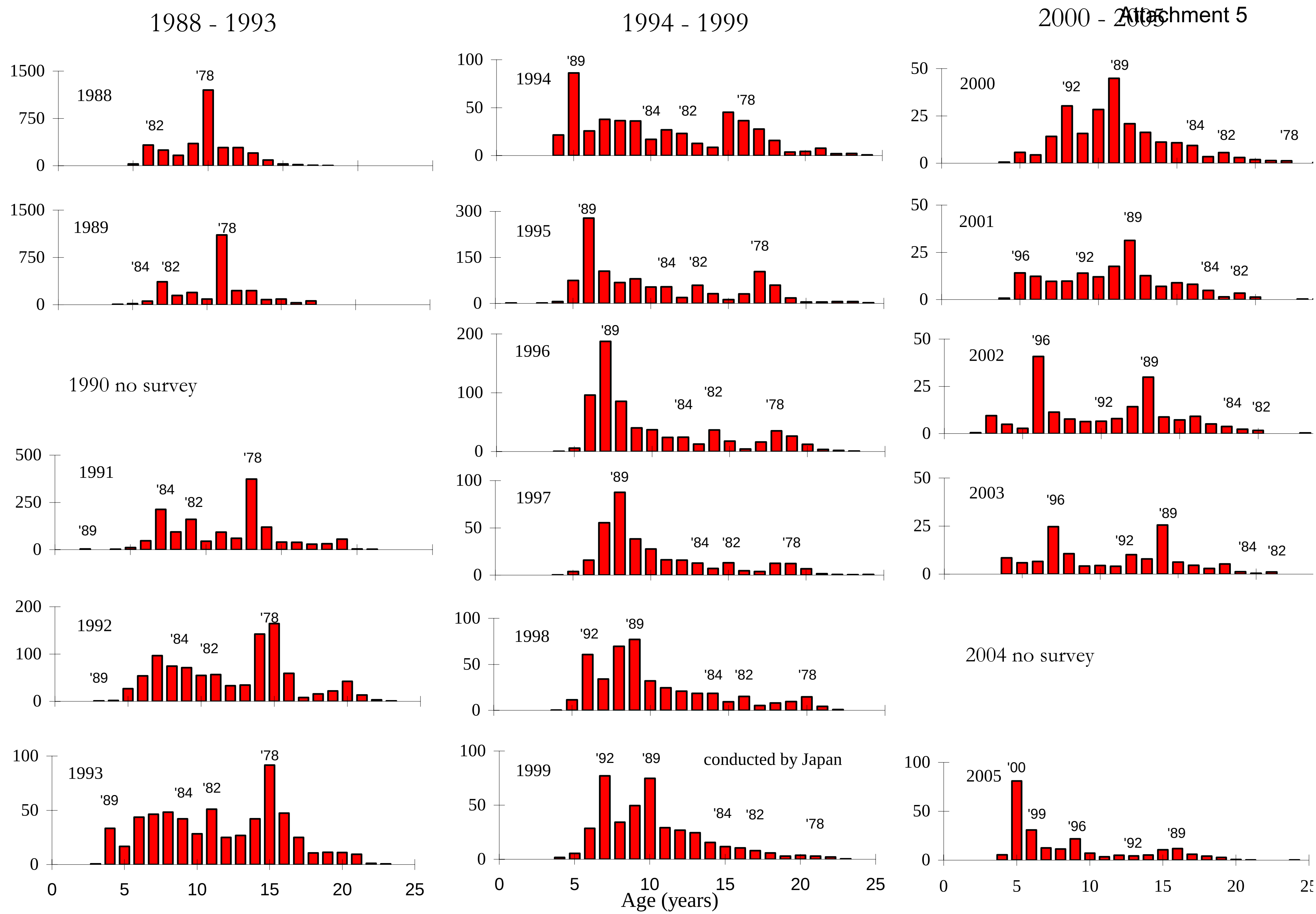
Surrounded Bogoslof Island
1978 year class dominated
Avg est. biomass 1.456 million t

1994 – 1999

Samalga Pass and N Aleutian Is.
1989 year class dominated (1992)
Avg est. biomass 0.543 million t

2000 – present

Samalga Pass and NE Umnak
1989 alternates w/ 1996
2000 and 1999 y.c. in 2005
Avg est. biomass 0.231 million t



Numbers-at-age estimates (millions) from EIT surveys of pollock near Bogoslof Island.
Major year classes on the EBS shelf are indicated. Y-axes differ.

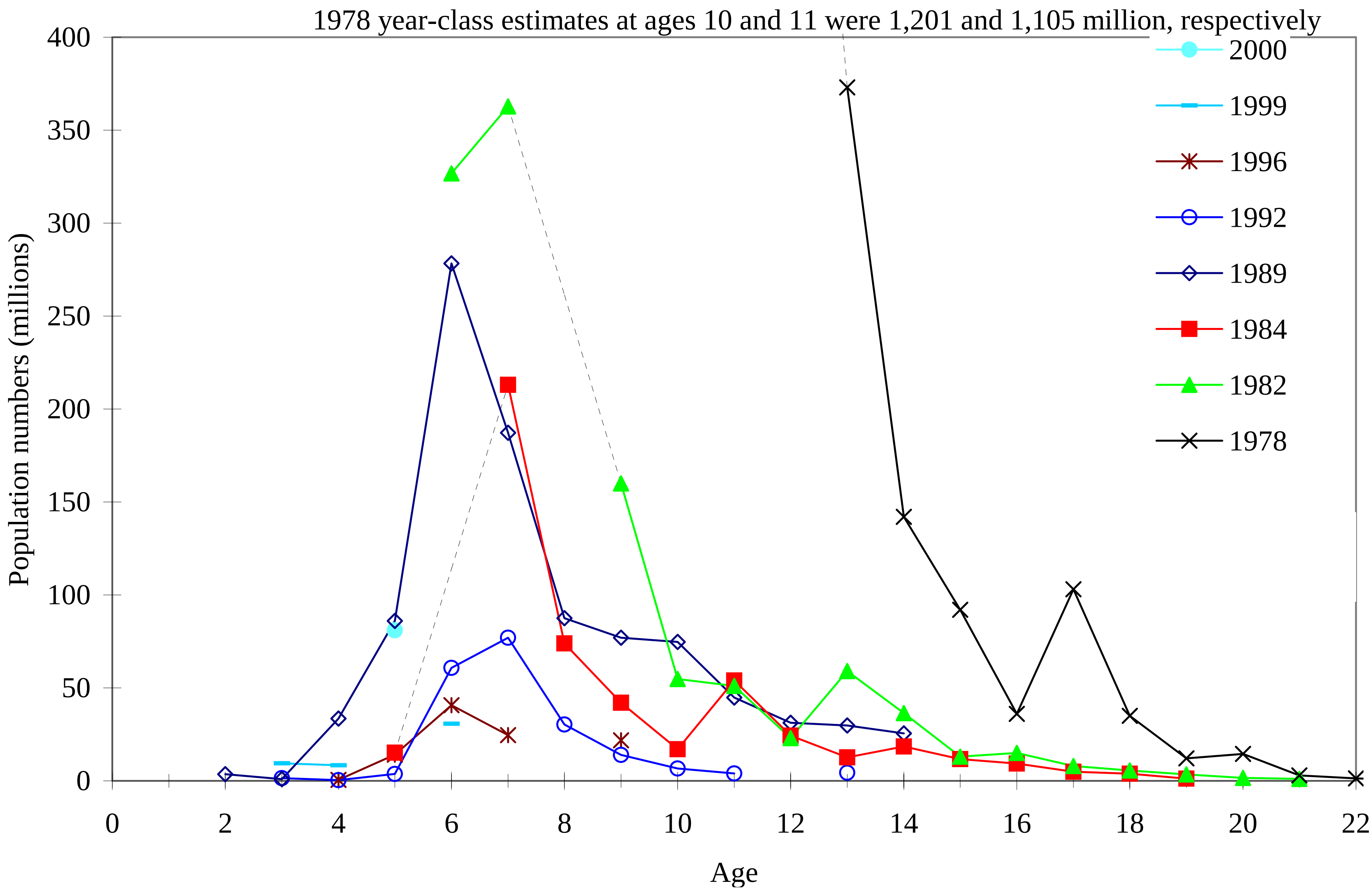


Figure 13.--Estimated population numbers at age for dominant year classes from EIT surveys of Bogoslof Island pollock between 1988 and 2005. The 1999 survey was conducted by Japan. No surveys were conducted in 1990 (dashed lines) or 2004.

Attachment 5

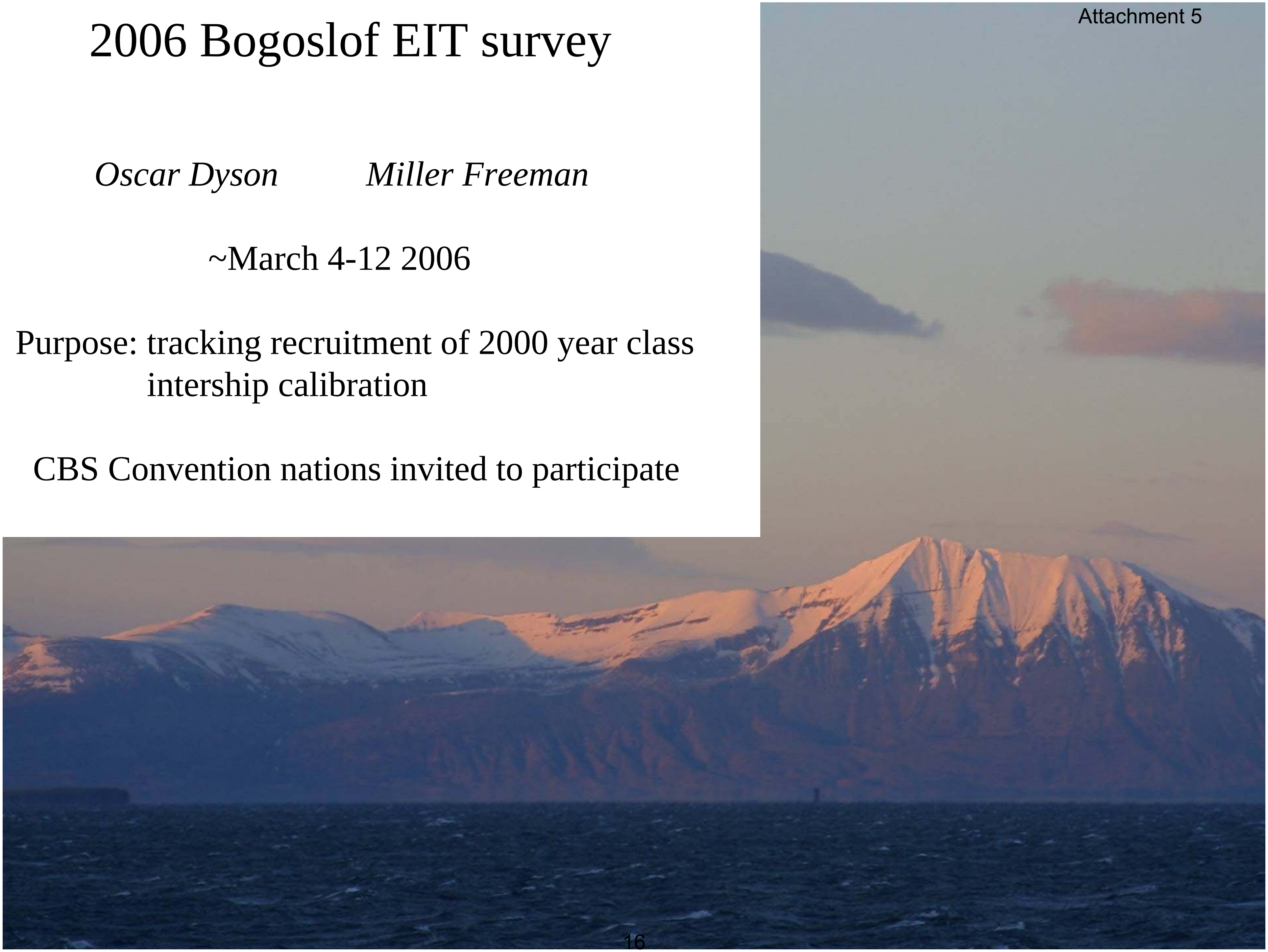
2006 Bogoslof EIT survey

Oscar Dyson *Miller Freeman*

~March 4-12 2006

Purpose: tracking recruitment of 2000 year class
intership calibration

CBS Convention nations invited to participate



Results from the 2004 summer Bering Sea shelf pollock EIT survey

Transect lines and trawl haul stations for the summer 2004 Bering Sea shelf pollock EIT survey.

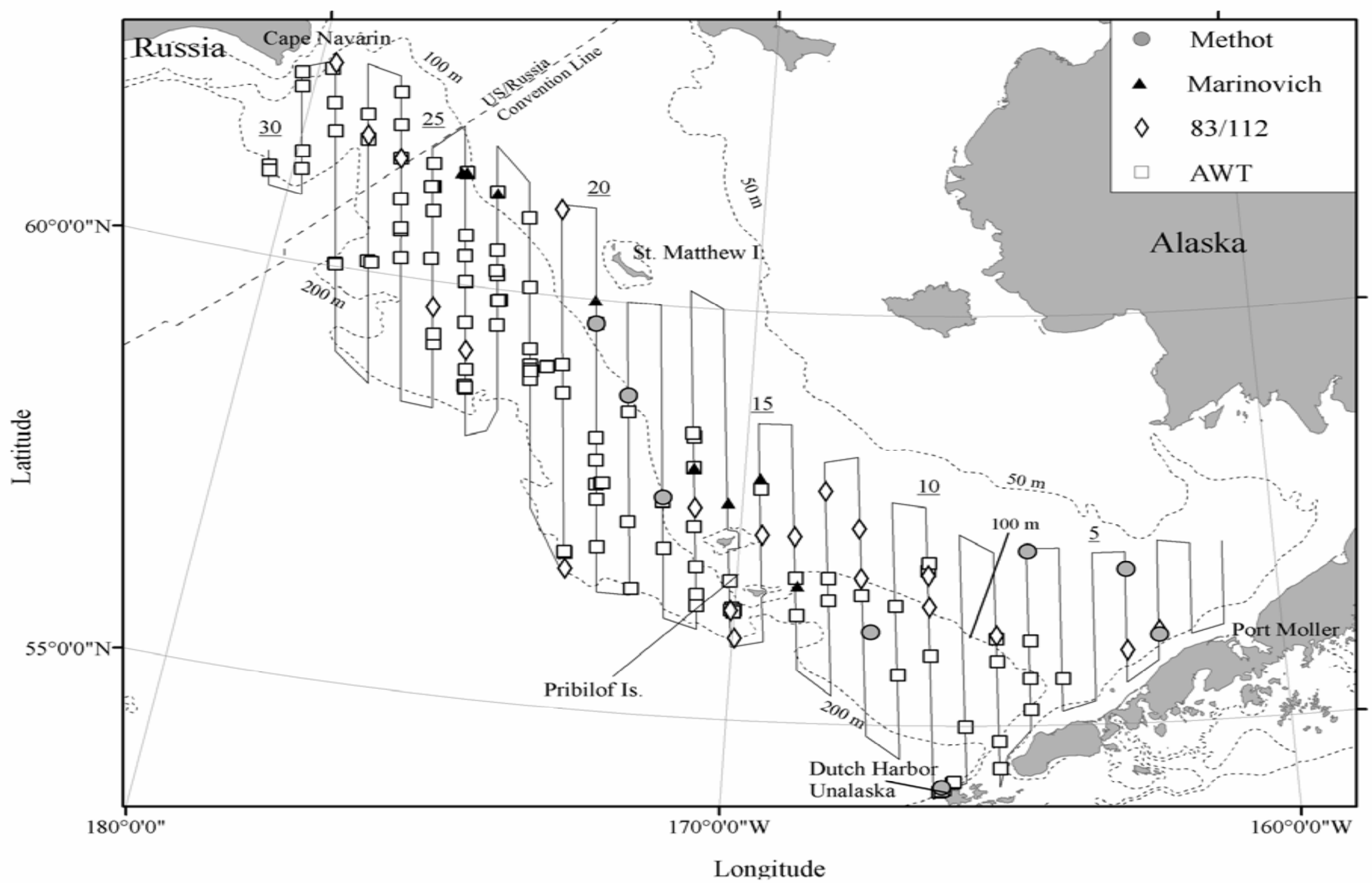
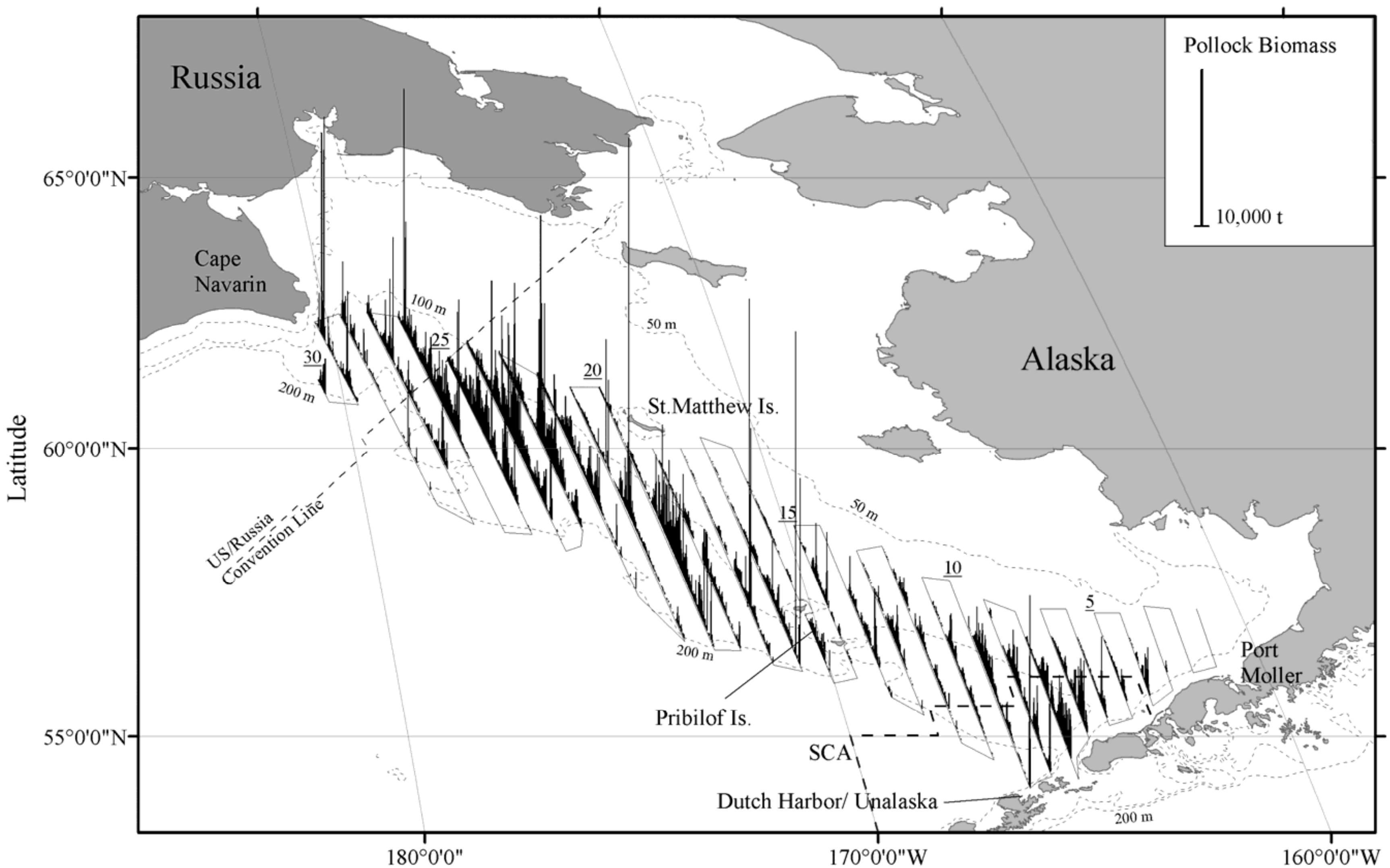
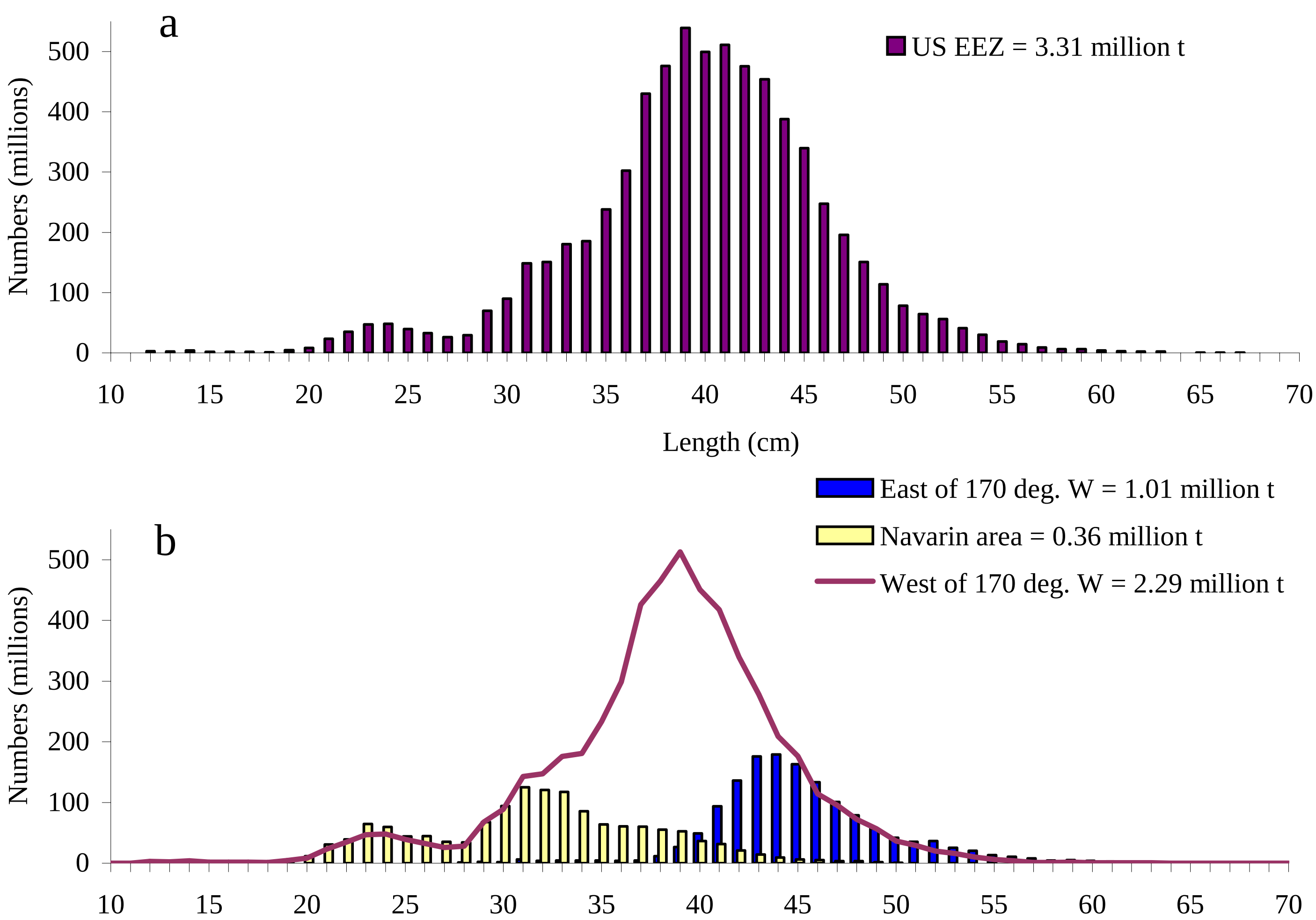


Figure 1. Transect lines with locations of midwater (Aleutian wing trawl), bottom (83/112), Marinovich, and Methot trawl hauls during the summer 2004, echo integration-trawl survey of pollock on the Bering sea shelf, MF2004-08. Transect numbers are underlined.



Pollock biomass along tracklines from the summer 2004 Bering Sea shelf pollock EIT survey.



Estimated pollock length composition in a) the US EEZ and b) east and west of 170 W and in the Cape Navarin area during the summer 2004 EIT survey of the Bering Sea shelf.

Table 8.--Abundance of pollock by area from summer echo integration-trawl surveys on the U.S. EEZ portion of the Bering Sea shelf, 1994-2004. Data are estimated pollock biomass between near surface and 3 m off bottom. Relative estimation error for the acoustic data is indicated.

Date		**Area** (nmi)^2	**Biomass (million metric tons, top) and percent of total (bottom)**			**Total Biomass (million metric tons)**	**Relative estimation error**
			SCA	**E170-SCA**	**W170**		
Summer 1994	9 Jul-19 Aug	78,251	0.312 10.8	0.399 13.8	2.18 75.4	2.89	0.047
Summer 1996	20 Jul-30 Aug	93,810	0.215 9.3	0.269 11.7	1.83 79.0	2.31	0.039
Summer 1997	17 Jul-4 Sept	102,770	0.246 9.5	0.527 20.3	1.82 70.2	2.59	0.037
Summer 1999	7 Jun-5 Aug	103,670	0.299 9.1	0.579 17.6	2.41 73.2	3.29	0.055
Summer 2000	7 Jun-2 Aug	106,140	0.393 12.9	0.498 16.3	2.16 70.8	3.05	0.032
Summer 2002	4 Jun -30 Jul	99,526	0.647 17.9	0.797 22.0	2.18 60.1	3.62	0.031
Summer 2004	4 Jun -29 Jul	99,659	0.498 15.1	0.516 15.6	2.29 69.3	3.31	0.037

SCA = Sea lion Conservation Area
E170 - SCA = East of 170°W minus SCA
W170 = West of 170°W

RV *Oscar Dyson*

Update on the status of Eastern Bering Sea pollock

James Ianelli
AFSC NMFS/NOAA
Seattle WA 98115

The following is largely extracted from Ianelli et al. (2004). See http://www.afsc.noaa.gov/refm/docs/2004/EBSpollock.pdf for further details.

The pollock fishery in the EBS is the largest single-species fishery in the US and catches in the past few years have been at the highest levels in recent history, approaching 1.5 million t.

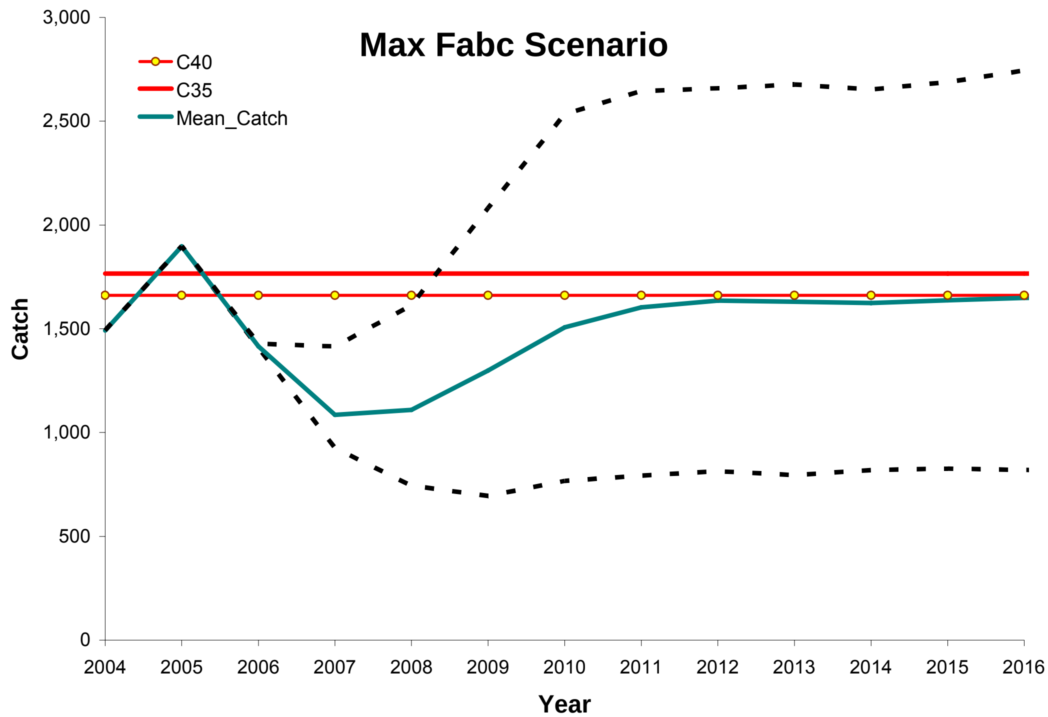
Bottom trawl and echo-integration trawl surveys where conducted in summer 2004 in the eastern Bering Sea. The biomass estimate from the 2004 NMFS summer bottom-trawl survey was 3.75 million tons, a substantial drop from the value of 8.14 million tons estimated in 2003. The biomass estimate from echo-integration trawl survey was 3.31 million tons, down from 3.6 million tons estimated in 2002 but close to the average estimated by this survey since 1982 (3.36 million tons). Stock levels for EBS pollock appear to be lower overall than estimated in 2003 and the projected 2005 biomass is the lowest estimated since 1992. The 2000 year class appears to be above average and the main age group available to the fishery. Subsequent year classes are currently estimated to be below average and will result in further short-term declines in abundance. Projections (based on Tier 3 harvest levels) indicate the ABC could be below 1.1 million t by 2007 (Fig. 1). However, since in the BSAI region there is a cap on the total groundfish TAC of 2 million tons, the catch of pollock is unlikely to exceed 1.5 million t. Hence, projections using alternative constant catch scenarios may be more realistic for projection purposes (e.g., Fig. 2). While current stock levels are quite high, given the expected recruitment and array of year-classes available to this fishery, the stock is expected to decline in the next few years to near or below target levels.

ABC setting process for EBS pollock

The stock assessment for EBS pollock is considered by the NPFMC SSC to have reliable estimates of uncertainty in F_{msy} and SSB and therefore maximum permissible ABC and OFL are derived from Tier 1 of the amended FMP (see WP-7 of this meeting). As with all NPFMC groundfish species, the recommended ABC can be set below the maximum permissible ABC level. In practice, this is done for various conservation reasons including ecosystem concerns, stock status uncertainty, and analyses on risk aversion. The Tier 1 calculations are derived from a risk averse analysis and have the basic property that the greater the uncertainty (in F_{msy} and current stock size), the lower the maximum permissible ABC. For 2005, the maximum permissible ABC was 1.962 million tons, based on the harmonic mean value of F_{msy}. The OFL level was specified at 2.104 million tons corresponding to the arithmetic mean of F_{msy}. The TAC was set to 1.478 million t due to constraints imposed by having the sum of all groundfish TACs be no greater than 2.0 million t.

The 2005 Fishery

Preliminary results for the first half of the 2005 fishery indicate that production rates were similar to recent years (Fig. 3). The distribution of the catch has varied in this period but generally progresses from heavy concentrations of removals north of Unimak Island and extending north and west of this area along the 200 m isobath as the season develops (Fig. 4). A clearer picture emerges on catch-location variability if the spatial aspect of the fishery is plotted each year against some average catch level. This was done for the period 2000-2005 for the first months of the winter fishery (Fig. 5).



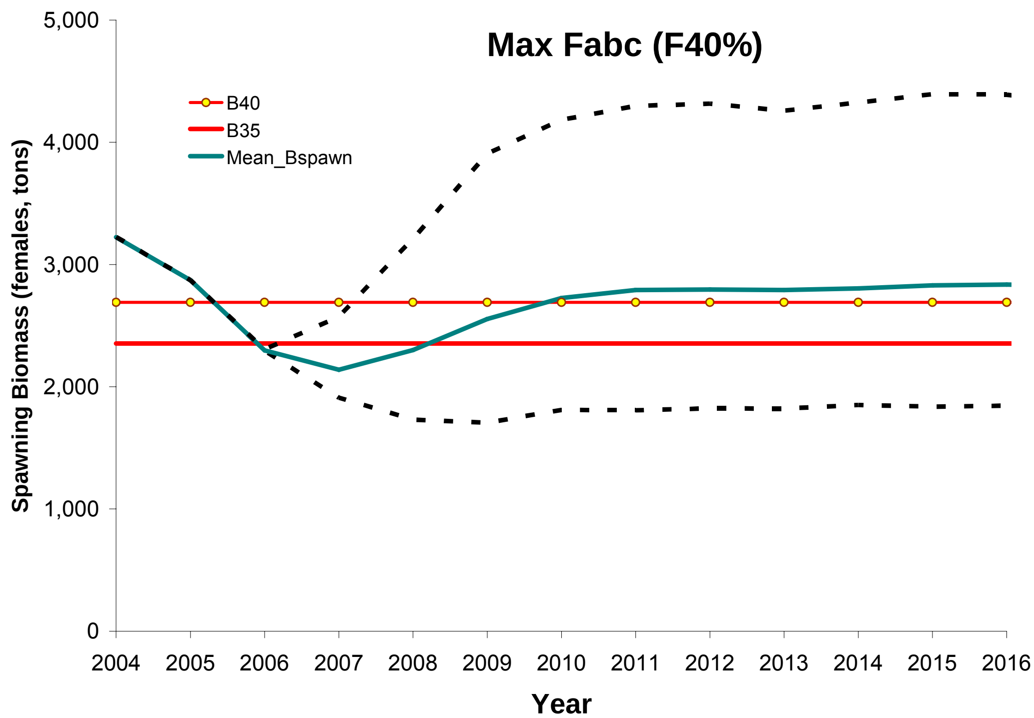


Figure 1. Projected EBS walleye pollock **yield** (top) and **Female spawning biomass** (bottom) relative to the long-term expected values under $F_{35\%}$ and $F_{40\%}$ (horizontal lines) for Model 1. $B_{40\%}$ is computed from average recruitment from 1978-2004. Future harvest rates follow the guidelines specified under Scenario 1, max F_{ABC} assuming $F_{ABC} = F_{40\%}$.

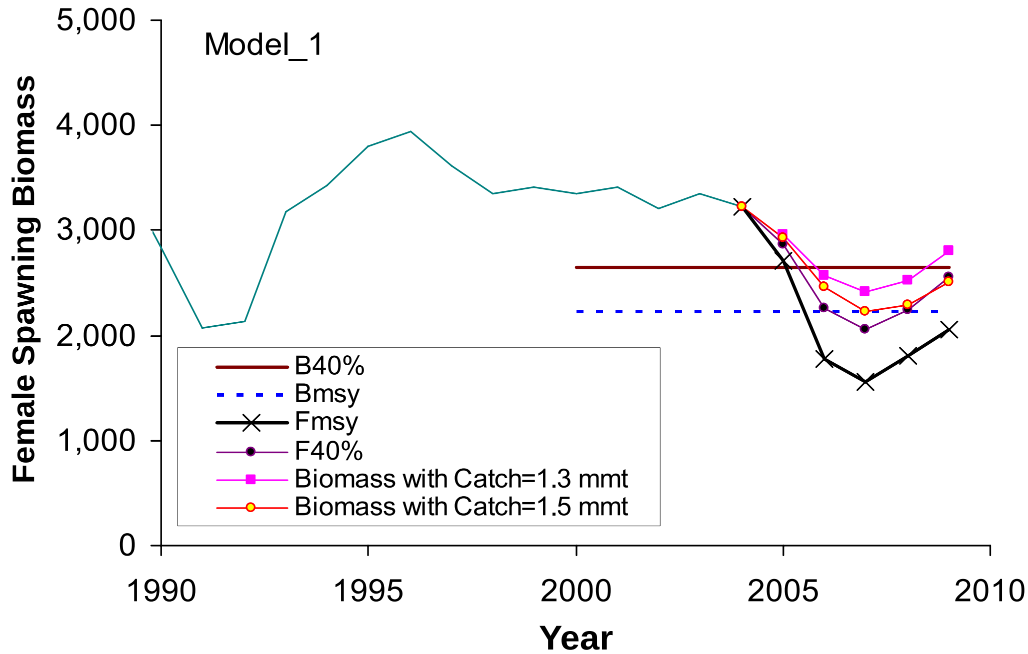


Figure 2. EBS walleye pollock female spawning biomass abundance trends, 1990-2009 as estimated by Ianelli et al., 2004 under different 2005-2009 harvest levels. Note that the F_{msy} and $F_{40\%}$ catch levels are unadjusted arithmetic mean fishing mortality rates. Horizontal solid and dashed lines represent the B_{msy}, and $B_{40\%}$ levels, respectively.

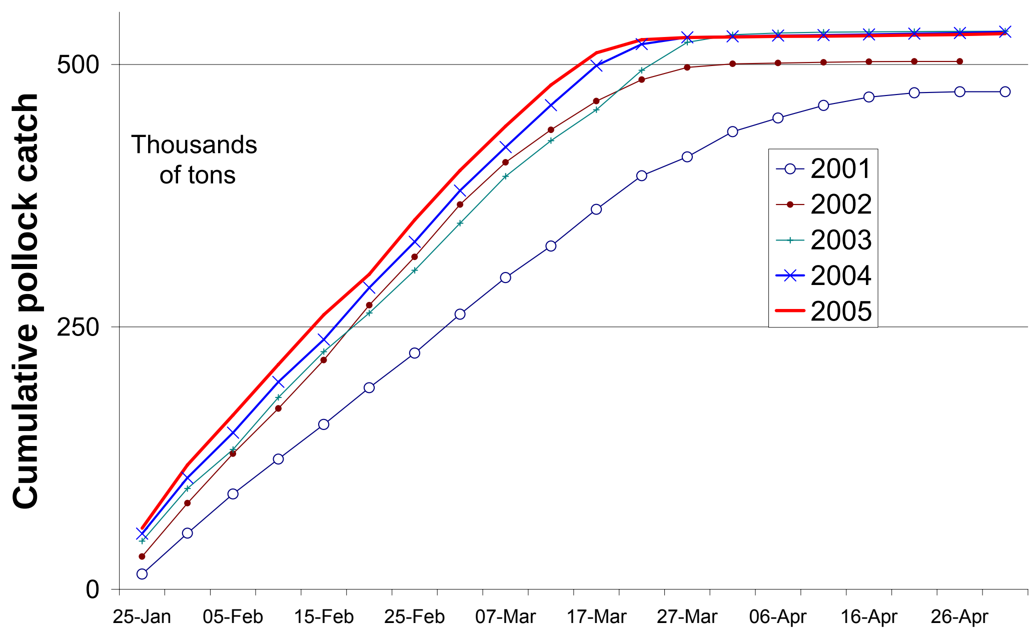


Figure 3. Cumulative catch levels for 2005 compared to recent years for the first season (winter) based on observer data.

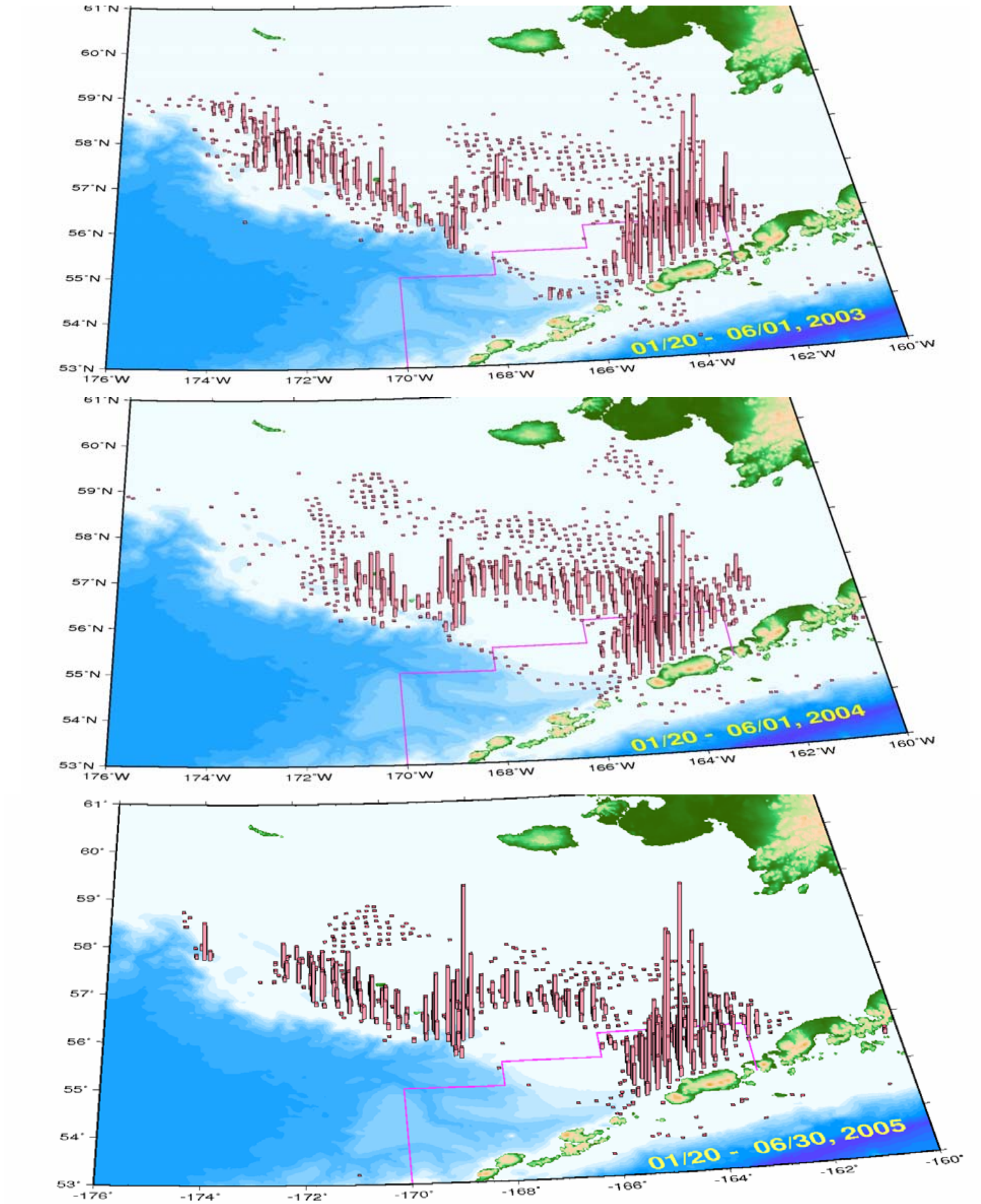


Figure 4. Concentrations of the pollock fishery 2003-2005, January - June on the EBS shelf. Line delineates SCA (sea lion conservation area). The column height represents relative removal on the same scale in all years.

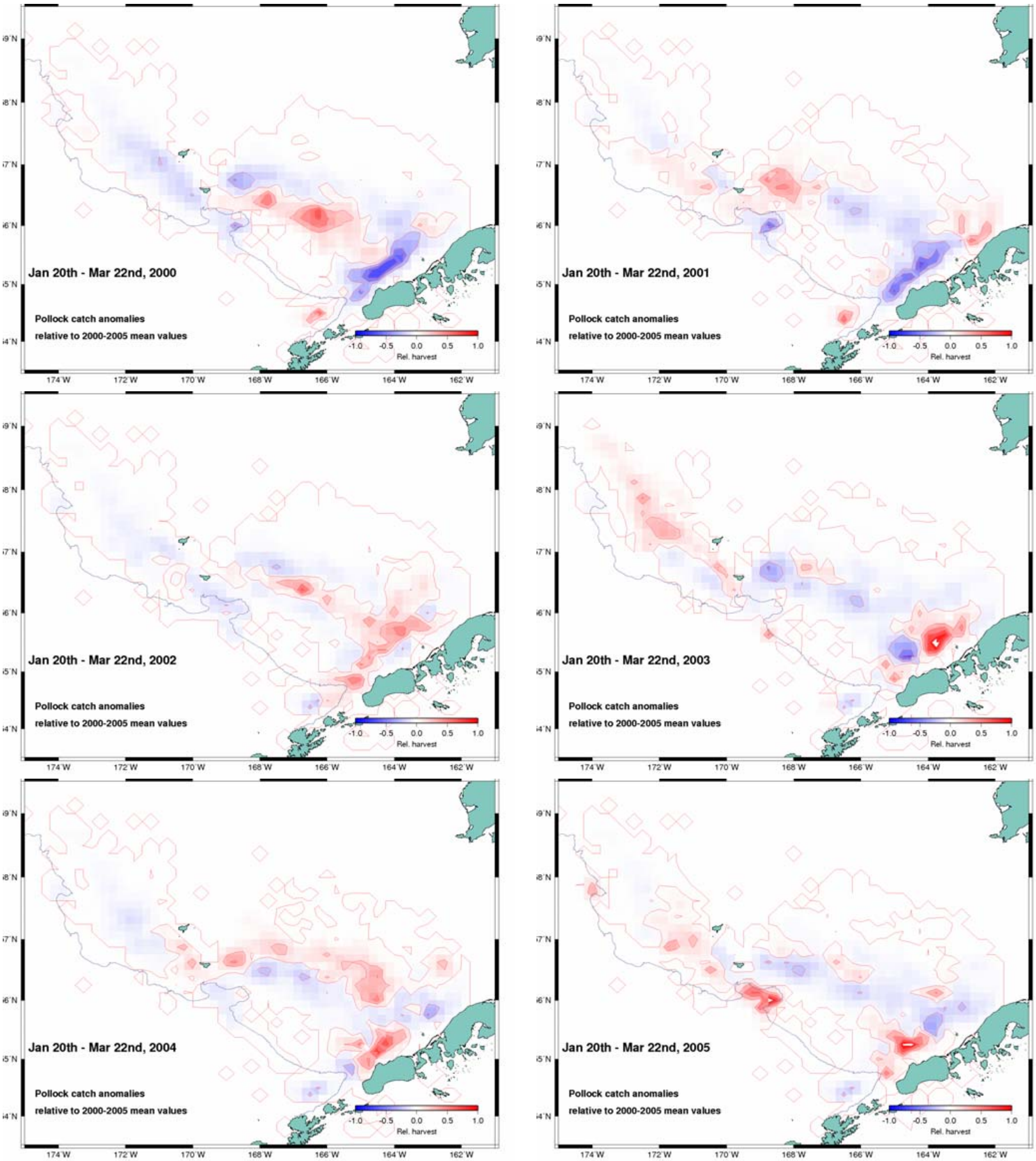


Figure 5. Geographic anomalies of catch for the period Jan 20th – March 22nd by year relative to the average catch over 2000-2005.

Recent research activities and stock assessment approaches for the Aleutian Islands region

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The following is largely extracted from Barbeaux et al. (2004). See http://www.afsc.noaa.gov/refm/docs/2004/AIpollock.pdf for further details.

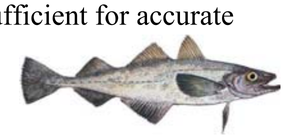
Walleye pollock are distributed throughout the Aleutian Islands with concentrations in areas and depths dependent on season. Generally, larger pollock occur in spawning aggregations during February – April. Three stocks of pollock are identified in the U.S. portion of the Bering Sea for management purposes. These are: eastern Bering Sea which consists of pollock occurring on the eastern Bering Sea shelf from Unimak Pass to the U.S.-Russia Convention line; the Aleutian Islands Region encompassing the Aleutian Islands shelf region from 170°W to the U.S.-Russia Convention line; and the Central Bering Sea—Bogoslof Island pollock. These three management stocks probably have some degree of exchange. The Bogoslof stock is a group that forms a distinct spawning aggregation that has some connection with the deep water region of the Aleutian Basin. Bailey et al. (1999) present a thorough review of population structure of pollock throughout the north Pacific region. Recent genetic studies using mitochondrial DNA methods have found the largest differences to be between pollock from the eastern and western sides of the north Pacific.

Previously, Ianelli et al. (1997) developed a model for Aleutian Islands pollock and concluded that the spatial overlap and the nature of the fisheries precluded a clearly defined "stock" since much of the catch was removed very close to the eastern edge of the region and appeared continuous with catch further to the east. In some years a large portion of the pollock removed in the Aleutian Islands Region was from deep-water regions and appear to be most aptly assigned as "Basin" pollock. This problem was confirmed and can be seen in the spatial distribution of historical catch patterns (Fig. 1). Hence, the data used here are organized to cover a region that is more consistent with survey observations and historical fishing patterns (Fig. 2).

The nature of the pollock fishery in the Aleutian Islands Region has varied considerably since 1977 due to changes in the fleet makeup and in regulations. During the late 1970s through the 1980s the fishing fleet was primarily foreign. In 1989, the domestic fleet began operating in earnest and has continued in the Aleutian Islands Region until 1999 when the North Pacific Fishery Management Council (NPFMC) recommended closing this region for directed pollock fishing due to concerns for Steller sea lion recovery. Length frequency data shows rather distinct characteristics when broken out by regions over this period (Fig. 3). There are notable similarities to the patterns over time for data from the eastern portion of the Aleutian Islands. This can also be seen from the mean-length of fish observed in the catch by these regions (Fig. 4). Another characteristic of the Aleutian Islands pollock is that mean length at age has changed substantially over time (Fig. 5). This pattern reflects the areas that are fished during these periods rather that actual changes in growth. I.e., during the early period, most of the pollock were caught towards the eastern edge of the Aleutian Islands region whereas the more recent period the pollock were from catch broadly distributed throughout the region.

The summer bottom trawl survey showed highly variable success in finding pollock in recent years, often with considerable concentrations toward the eastern edge (Fig. 6).

The R/V Kaiyo Maru conducted a survey between 170°W and 178°W longitude in the winter of 2002 after completing a survey of the Bogoslof region (Nishimura et al 2002; Fig. 7). Due to difficulties in operating their large mid-water trawl on the steep slope area they felt their catches in this area were insufficient for accurate



species identification and biomass estimation. They did however come up with some preliminary biomass estimations. For the entire area from 170°W and 178°W longitudes they estimated a biomass of 93,000 mt of spawning pollock biomass with between 61,000 mt estimated in the NRA east of 173°W and 32,000 mt in the remainder of the survey area to 178°W longitude. The largest aggregations in the NRA area were observed at 174°W longitude north of Atka Island. Most of the pollock echo sign was observed along the slope of the Aleutian Islands relatively near shore.

Process for setting ABC in Aleutian Islands

For many years, the Aleutian Islands pollock stock has lacked an age-structured model and the SSC has determined that the stock qualified for management under Tier 5 (see section below). In last year's assessment, preliminary explorations of several age-structured models were provided, all of which focused on the portion of the stock to the west of 174°W. For the 2004 management cycle, five alternative age-structured models were developed and evaluated. The 2004 assessment focused on two of those models, one of which (Model 1) uses data only from the portion of the stock to the west of 174°W, and the other of which (Model 1B) includes survey data from the entire Aleutian Islands management area. The Plan Team recommended the use of Model 1B, but due to the uncertainty in the survey catchability coefficient recommended setting the ABC below the maximum permissible level. The Plan Team, in their review of the assessment recommended setting the 2005 ABC at the equilibrium level associated with an $F_{40\%}$ harvest rate, which was 43,200 t.

The SSC determined that the Aleutian pollock stock did not qualify for management under Tier 3 and the stock remained at Tier 5. This was largely for concerns about conservation and acknowledged uncertainty that interacts with stock structure uncertainties and a reliable survey (summer bottom-trawl surveys done every other year are currently undertaken). The SSC therefore recommended a maximum permissible ABC for 2005 was computed as the product of the most recent survey biomass estimate (130,451 t) and 75% of the natural mortality rate (0.30), resulting in an ABC of 29,400 t, and an OFL of 39,100 t . The actual TAC was specified this year by congressional mandate at no more than 19,000 t. Under Tier 5, the stock is technically not evaluated for overfished determinations nor whether it is approaching an overfished condition. Nonetheless, based on the best available information the stock is not considered overfished nor is it approaching an overfished condition.

The 2005 Fishery

The directed Aleutian pollock fishery started in March, but little pollock was harvested. From 20 January – 15 April a total of 2,661 t of pollock were harvested in the Aleutian area out of the total 9,250 t first-season TAC. Preliminary reports from fishermen indicate that there was not adequate pollock sign outside of designated Steller sea lion critical habitat closure areas to justify continuation of the fishery in the first season. Also reported was large quantities of Pacific ocean perch in both the echosign and bycatch in the areas that vessels were allowed to fish. Since this was intended as primarily a roe-fishery, it is expected that much of the 2005 second-season TAC of 9,250 t will not be caught.

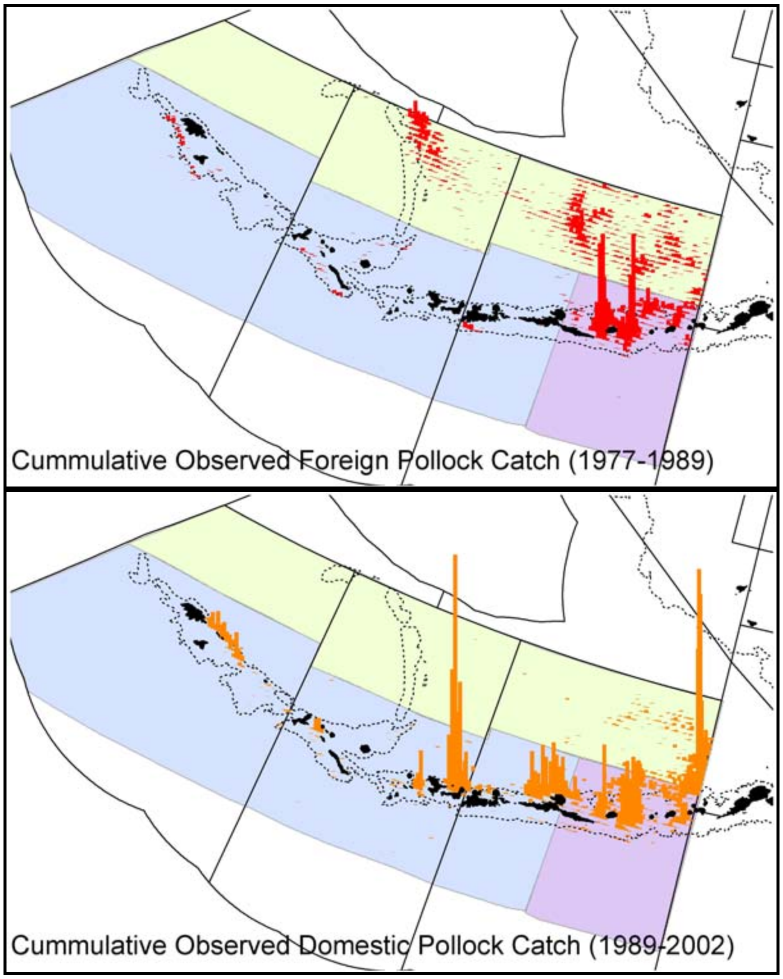


Figure 1. Observed foreign and J.V. (1978-1989), and domestic (1989-2002) pollock catch in the Aleutian Islands Area summed over all years and 10 minute latitude and longitude blocks. Both maps use the same scale (maximum observed catch per 10 minute block: foreign and J.V. 8,000 t and Domestic 19,000 t). Catches of less than 1 t were excluded from cumulative totals.

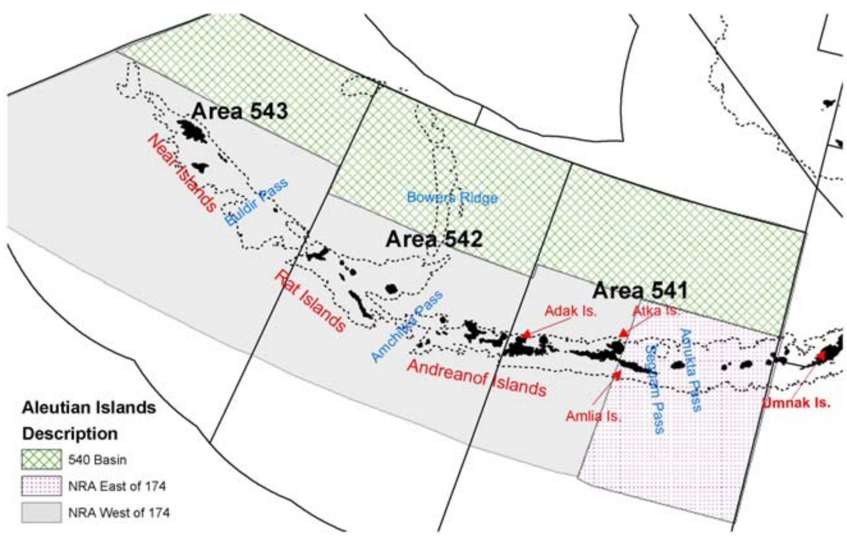


Figure 2. Regions defined for consideration of alternative data partitions for Aleutian Islands Region pollock. The abbreviation "NRA" represents the Near, Rat, and Andreanof Island groups.

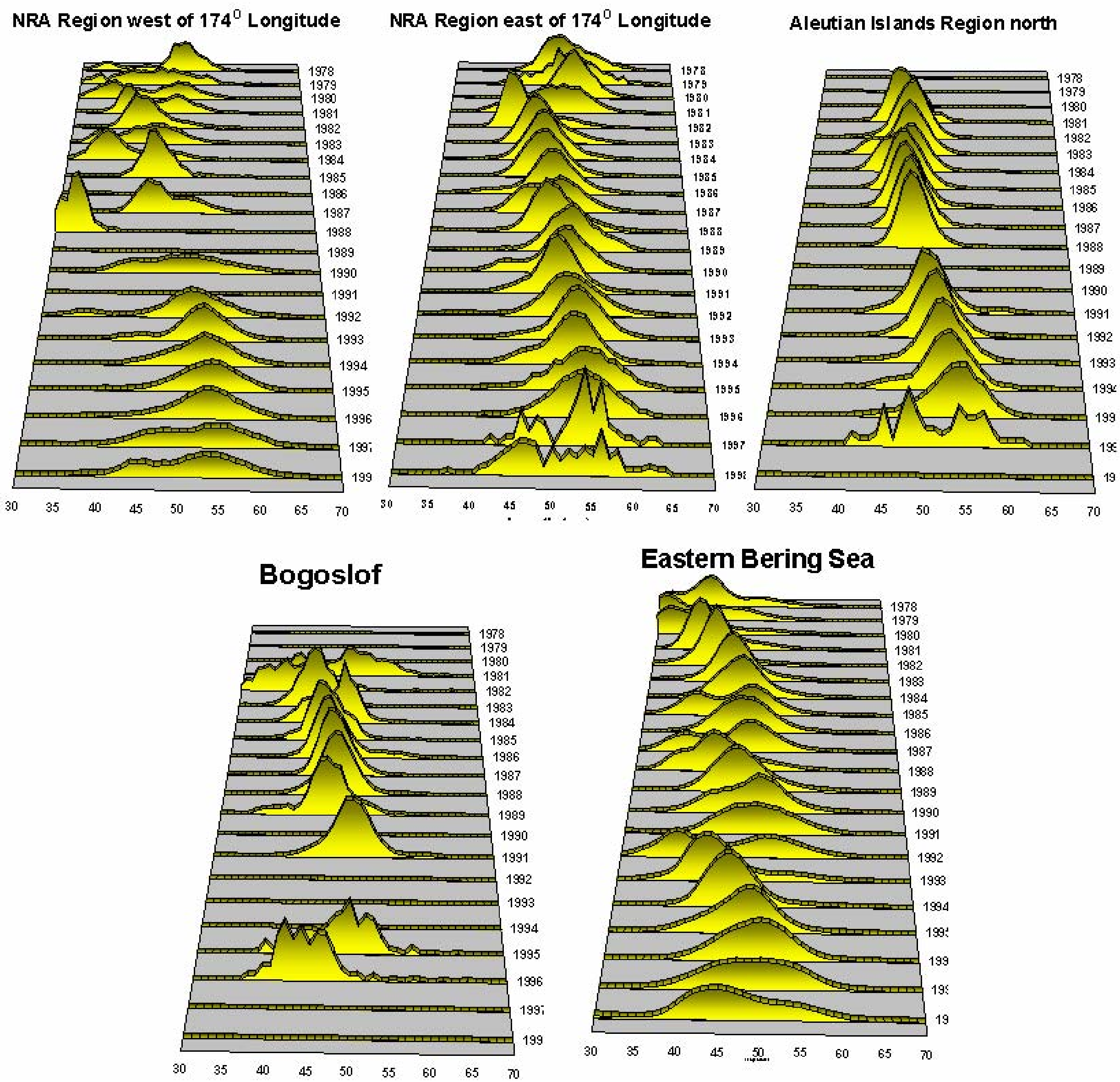


Figure 3. Pollock length frequency distributions by region.

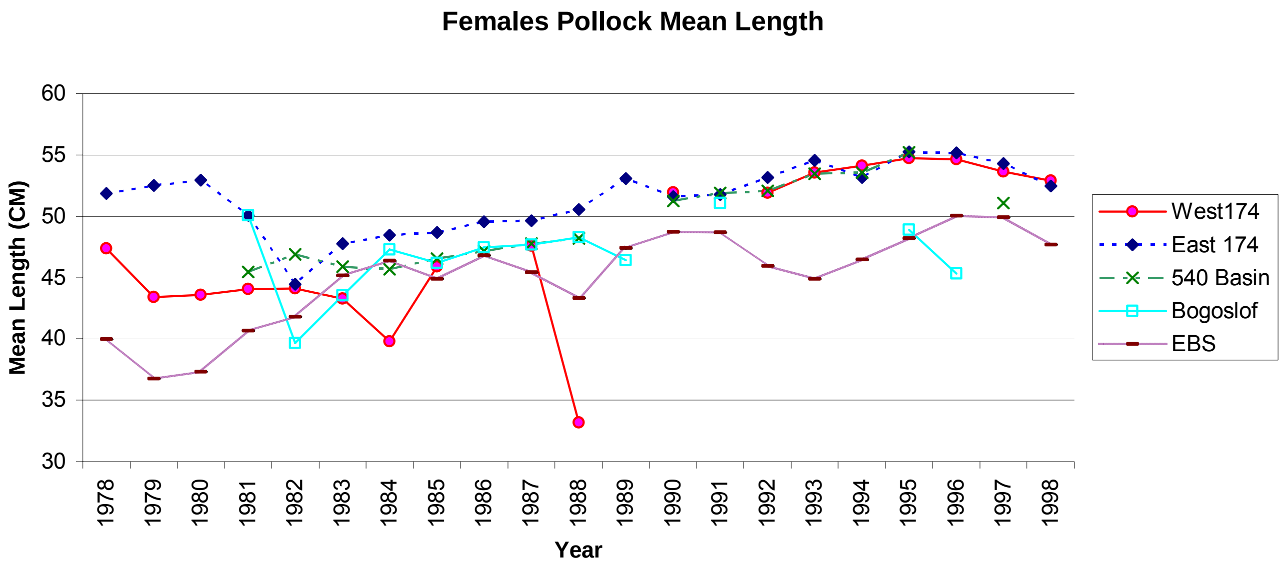


Figure 4. Mean length of female pollock in the catch from various areas based on observer data.

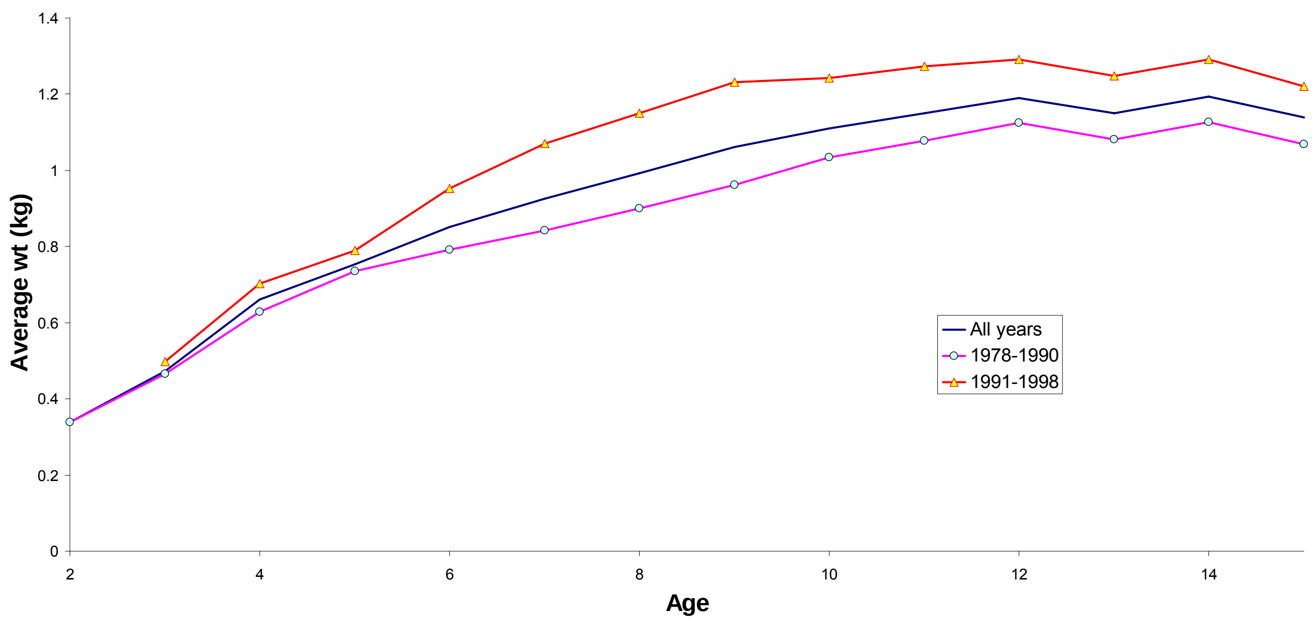


Figure 5. Average weight-at-age for Aleutian Islands pollock for all years combined, 1978-1990, and 1991-1998.

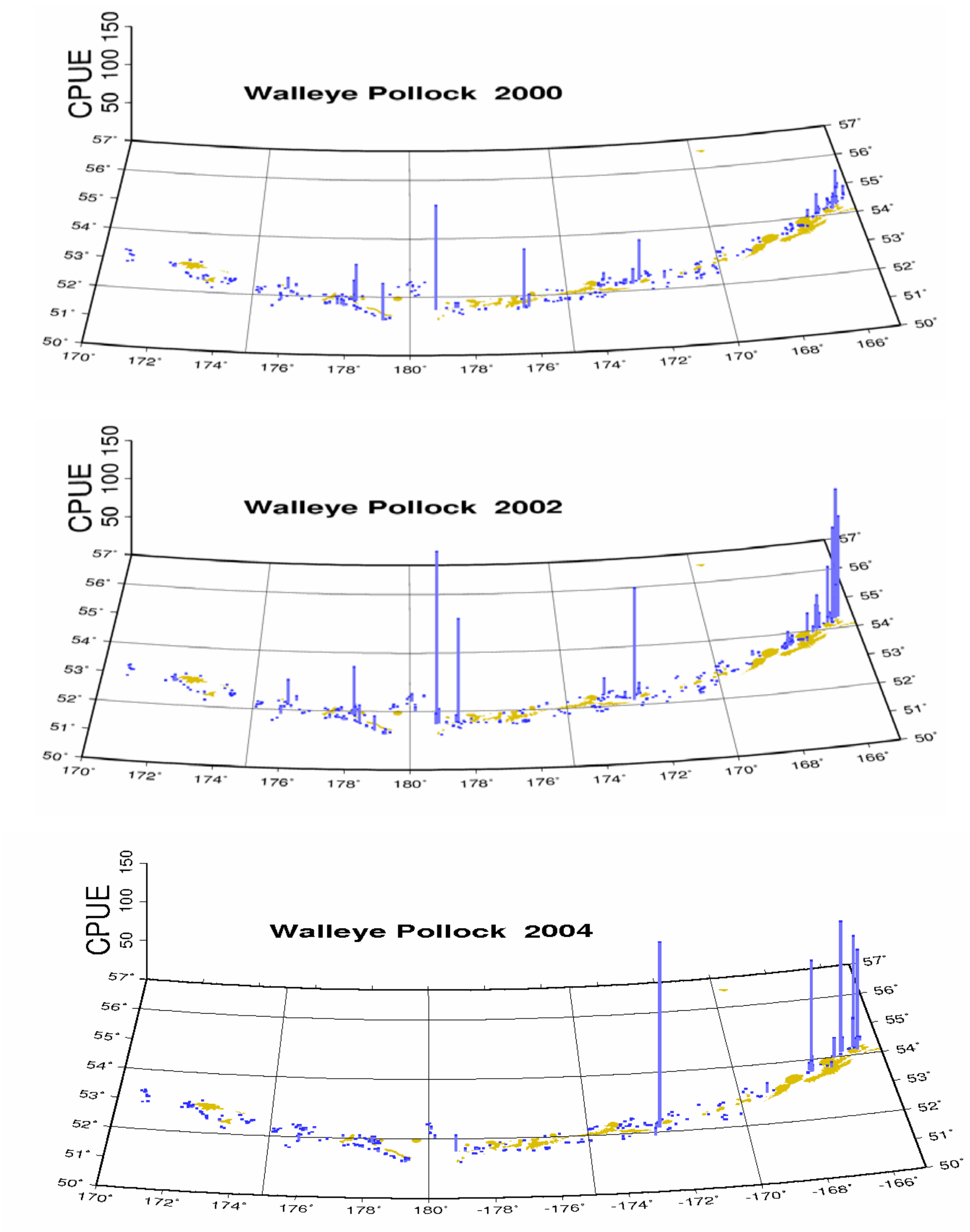


Figure 6. Catch per tow of pollock in the Aleutian Islands Region and east of 170°W during summer months from bottom-trawl surveys, 2000-2004.

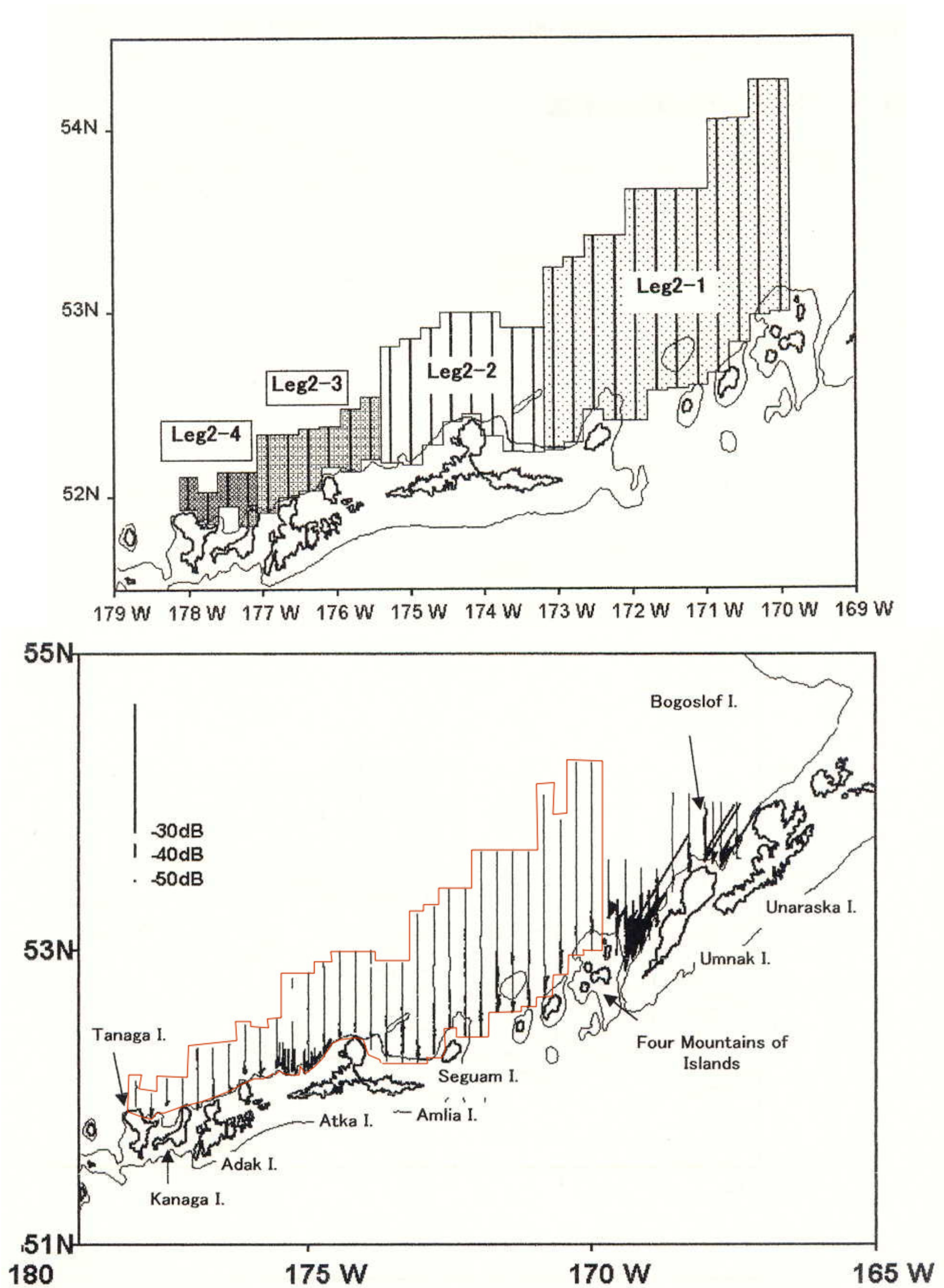


Figure 7. R/V Kaiyo Maru 2002 echo integration-trawl survey (above) strata for leg2 and below observed S_A in both legs. Please note that in the bottom picture the encircled area is leg 2.

Table 5.--Estimates of walleye pollock biomass (in metric tons (t)) by survey area and management area from February-March echo integration-trawl surveys in the Bogoslof Island area between 1988 and 2005.

	Bogoslof Survey Area			**Central Bering Sea Specific Area**	
Year	**Biomass (million t)**	**Area nmi^2**	**Relative estimation error (%)**	**Biomass (million t)**	**Relative estimation error (%)**
1988	2.396	--	--	2.396	--
1989	2.126	--	--	2.084	--
1990	--	No survey	--	--	--
1991	1.289	8,411	11.7	1.283	--
1992	0.940	8,794	20.4	0.888	--
1993	0.635	7,743	9.2	0.631	--
1994	0.490	6,412	11.6	0.490	--
1995	1.104	7,781	10.7	1.020	--
1996	0.682	7,898	19.6	0.582	--
1997	0.392	8,321	14.0	0.342	--
1998	0.492	8,796	19.0	0.432	19.0
1999	0.475	Conducted by Japan Fisheries Agency		0.393	--
2000	0.301	7,863	14.3	0.270	12.7
2001	0.232	5,573	10.2	0.208	11.8
2002	0.227	2,903	12.2	0.227	12.2
2003	0.198	2,993	21.5	0.198	21.5
2004	--	No survey	--	--	--
2005	0.253	3,112	16.7	0.253	16.7

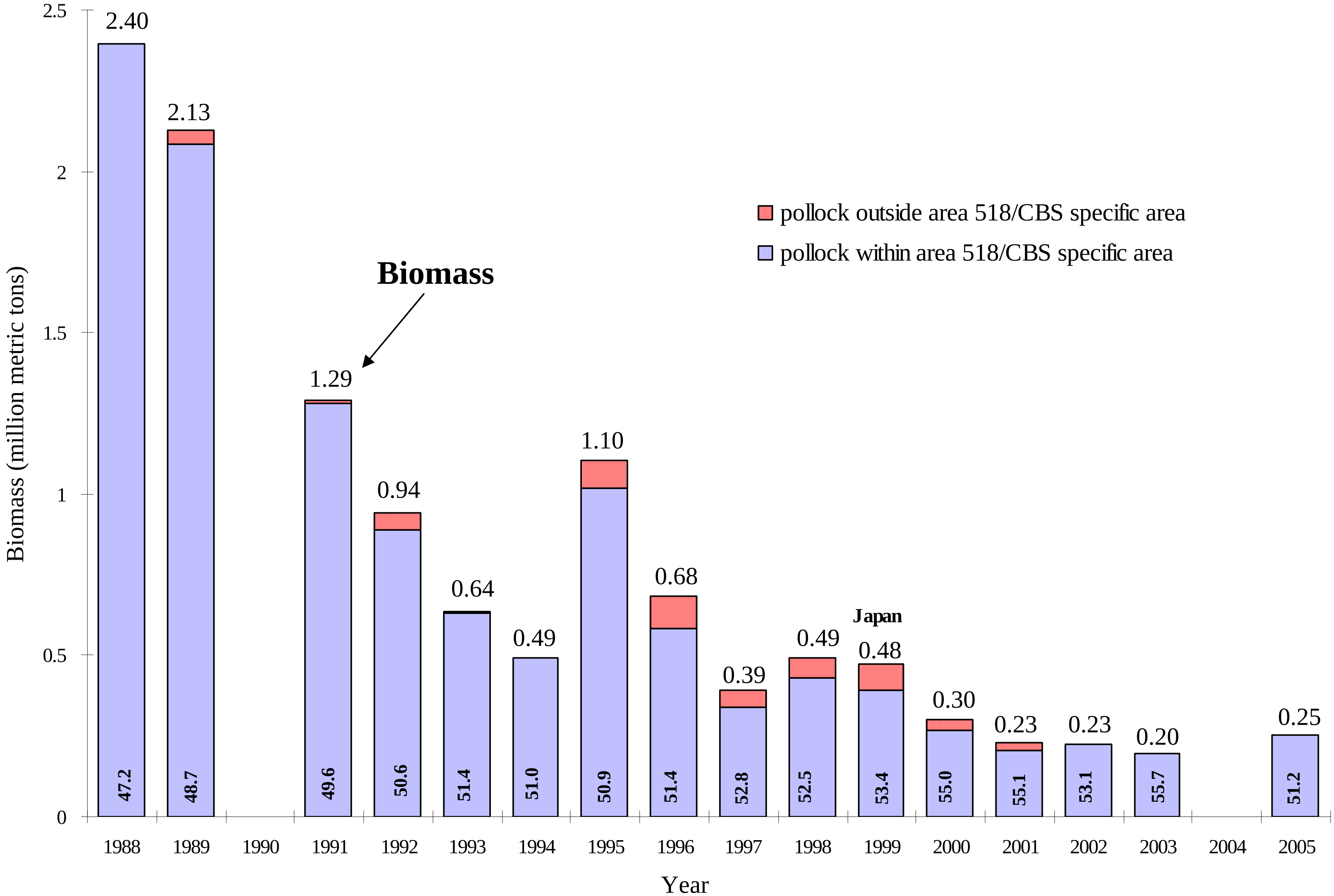


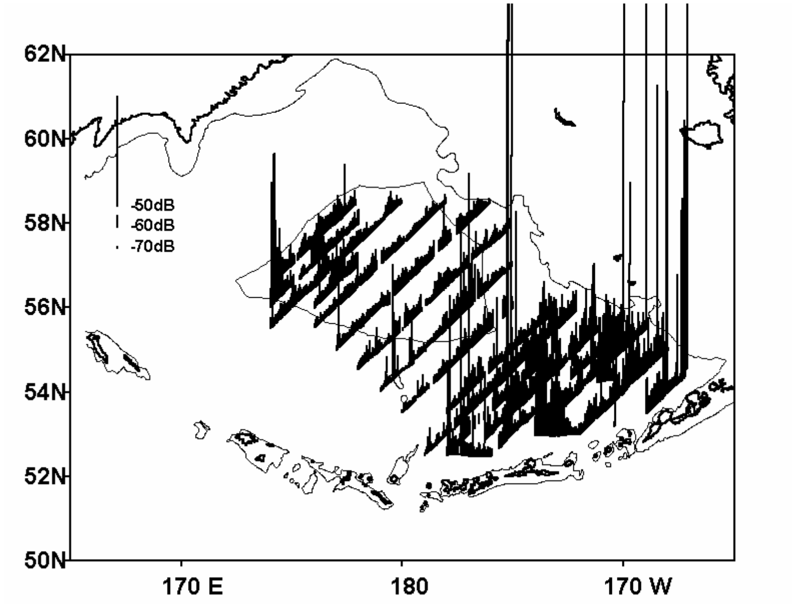
Figure 8. Biomass estimates (top of each bar) and average fork lengths (cm) (inside bar) obtained during winter echo integration-trawl surveys for walleye pollock in the Bogoslof Island area, 1988-2005. The U.S. conducted all but the 1999 survey, which was conducted by Japan.

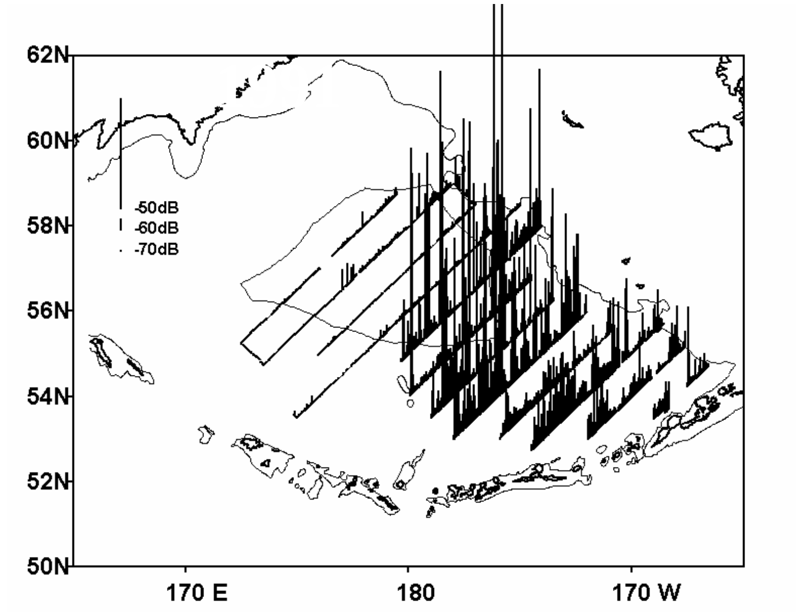
Biomass estimates from Aleutian Basin/Bogoslof EIT surveys between 1983 and 2005

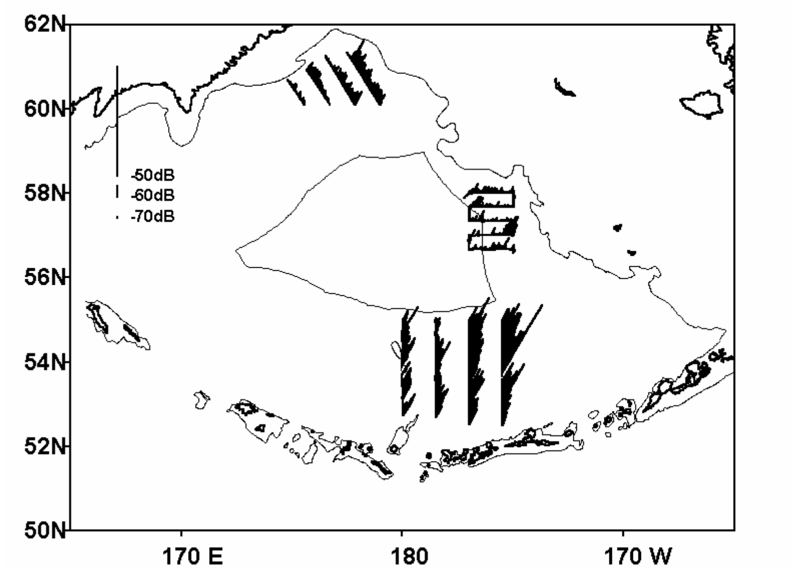
Attachment 8

Year	Dates	Nation	Region	Area (nmi^2)	Biomass (metric tons (t)) Bogoslof[1]	Aleutian Basin	Between	Comments
1983	Jan-Mar	Japan	Aleutian Basin			1,269,000 - 5,442,000		Okada 1986
1988	Feb 2-11, 12 -Mar 4	USA	Bogoslof/Aleutian Basin		2,396,000	not estimated		no signif. echosign in basin
1988	Aug 14-Oct 12	Japan	Aleutian Basin	133,480		995,000		JFA 1992 Coop Rept
1989	Mar 1-7, Jan 20-Feb 8	USA	Bogoslof/Aleutian Basin		2,084,000	not estimated		no signif. echosign in basin
1989	Dec 8 (88)-Feb 26	Japan	Bogoslof/Aleutian Basin	6,799 149,928	1,155,000	1,103,000		Total-Bogoslof, 1996 WG doc
								Includes a little EBS shelf.
1989	Jul 7 - Oct 16	Japan	Aleutian Basin	39,606		182,000		May 1992 INPFC WG doc J-2
1990	Aug 26 - Sep 26	Japan	Aleutian Basin			113,000		
1991	Feb 23-Mar 3, 7-10	USA	Bogoslof		1,283,000			
1991	Jun 28 - Aug 24	Japan	Aleutian Basin	144,264		765,000		Preliminary results in 1994
								Tokyo WG meeting
1992	Feb 28-Mar 8	USA	Bogoslof		888,000			
1993	Jan 3 - Mar 24	Japan	eastern/western Aleutian Basin			not estimated		no significant pollock
1993	Feb 5-9, Feb 27-Mar 5	USA	Bogoslof		631,000			
1993	Jun 28 - Aug 2	China	Donut Hole	37,880		52,541		Third International Stock
								assessment workshop
1994	Feb 27-Mar 9	USA	Bogoslof		490,000			
1994	Jul 3-28	Korea	Bogoslof, Donut Hole, Between	6,650 38,595 26,500	22,980	2,290	18,930	
1994	Aug 2 - Sep 20	Japan	Aleutian Basin 175-180 W, 52.5-55 N	29,427		155,000		STC Seattle October 1995,
								north of Aleutian chain
1994			Aleutian Basin 174-179 E, 60-62 N	7,626		14,000		Navarin basin
1994			Kamchatka Basin			no fish sign		
1995	Feb 25- Mar 8	USA	Bogoslof		1,020,000			
1995	Jul 9-31	Korea	Bogoslof, Donut Hole, Between	11,800 64,800 42,900	36,450	--	3,380	
1996	Feb 13-24, Mar 6-12	Japan	Bogoslof/Aleutian Basin		439,000	80,199		Basin west of 169 W
1996	Feb 27-Mar 7	USA	Bogoslof		582,000			
1996	May 13-31	Korea	Bogoslof, Donut Hole, Between	14,100 72,000 47,580	44,070	1,600	11,680	
1996	Nov 1 - 24	Japan	Donut Hole			no fish sign		1998 CBS conference
1997	Mar 1-10	USA	Bogoslof		342,000			
1997	May 17 - Jun 12	Korea	Bogoslof, Donut Hole, Between	8,885 57,392 31,842	13,274	12,096	17,795	STC 1997 / 2nd Annual Conf
1998	Jan 4 -13	Japan	Donut Hole			no fish sign		1998 CBS conference
1998	Mar 2-9	USA	Bogoslof		432,000			
1998	Sep 19-23	Russia	Donut Hole			no fish sign		no pollock caught in 3 hauls
1999	Jan 21 - Mar 19	Japan	Bogoslof		393,000			
1999	May 23 - Jun 17	Korea	Bogoslof, Donut Hole, Between	8,875 79,250	84,600	--		4th annual conference papers
2000	Mar 2-12	USA	Bogoslof		270,000			
2000	Mar 6-27	Korea	Bogoslof (518), Donut Hole, Between	699 56,002	257,000	32,000	--	Basin, but some shelf pollock
2001	Mar 5-11	USA	Bogoslof		208,000			
2002	Feb 2 - Mar 20	Japan	Bogoslof/Aleutian Basin west of 170 W	2,409 12,768	180,000	92,000		2002 7th Annual Conf.;
2002	Mar 5-10	USA	Bogoslof		227,000			basin W of Specific area, N of
2003	Mar 7-13	USA	Bogoslof		198,000			Aleutians (not Donut Hole)
2005	Mar 7-13	USA	Bogoslof (518)	3,112	253,000			
	International zone area	205,311 km2 = 59,859 nmi2		[1] USA, 1999 Japan, 2000		Korea estimates = Specific area		spawning surveys

Horizontal SA distribution (summer)







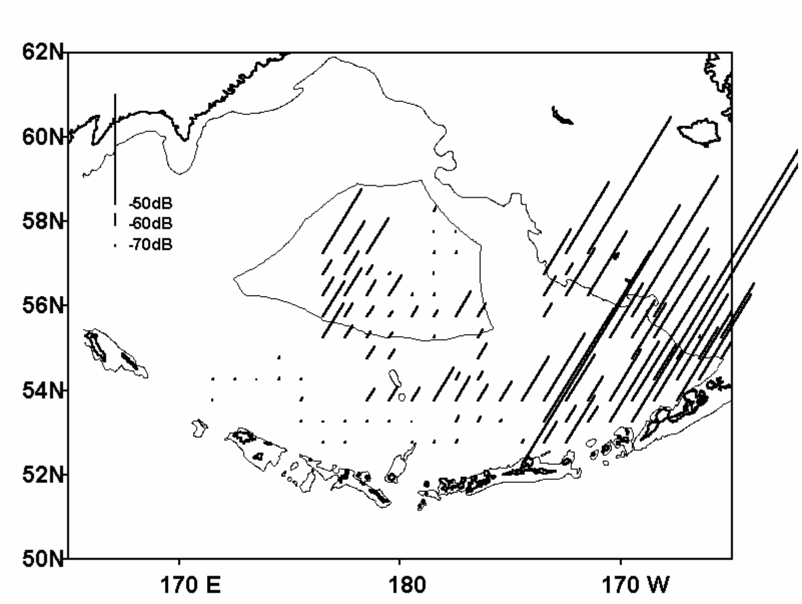
Biomass estimates:

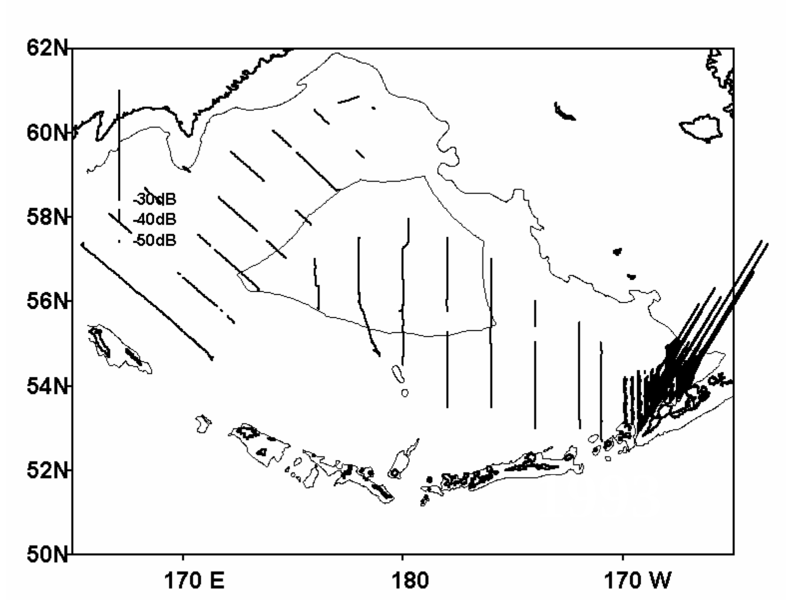
1988: 1.00 million tons

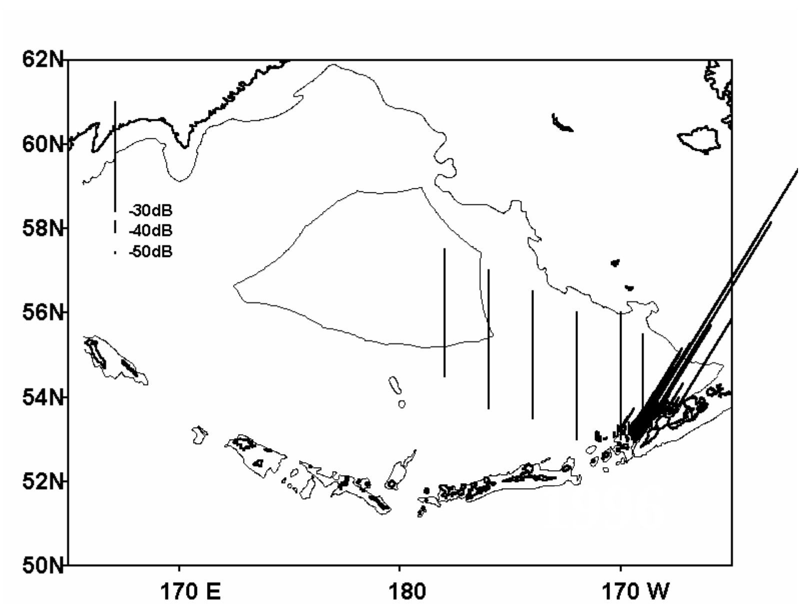
1991: 0.77 million tons

1994: 0.17 million tons

Horizontal SA distribution (Winter)







Biomass estimates:

1988-1989: 3.29 million tons

1.16million tons in Bogoslof

1.10million tons out of Bogoslof

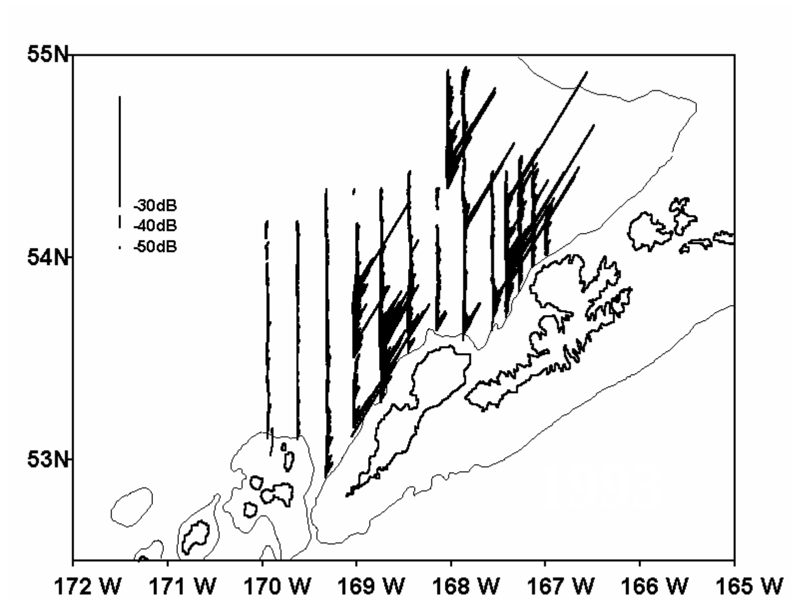
1993: ** million tons

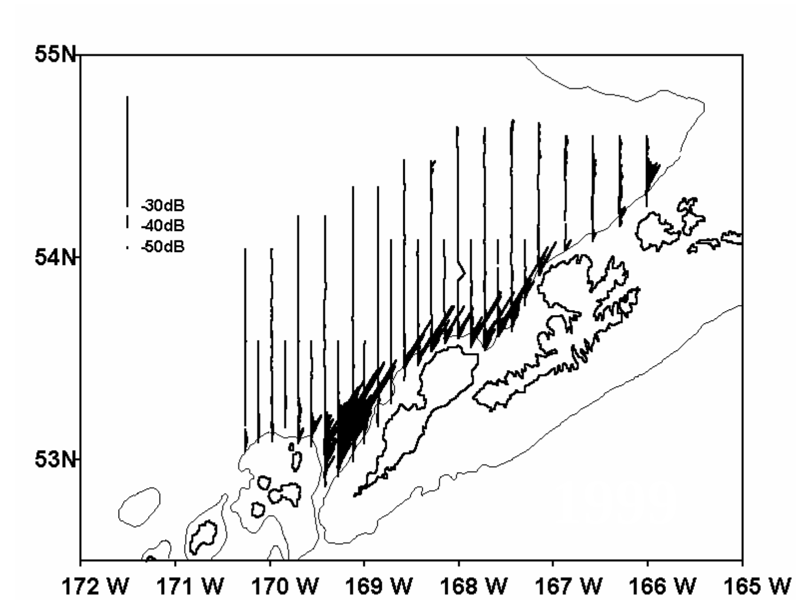
1996: 0.52 million tons

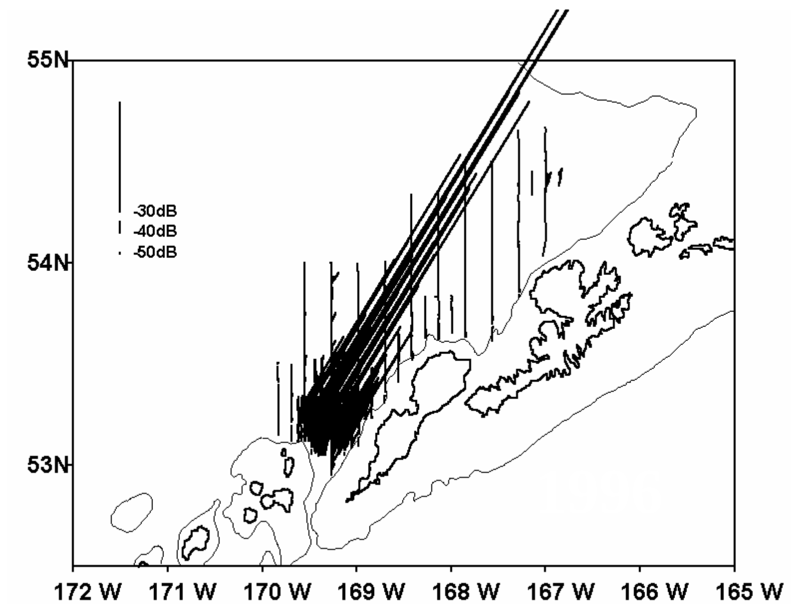
0.44million tons in Bogoslof

0.08million tons out of Bogoslof

Horizontal SA distribution (winter Bogoslof)







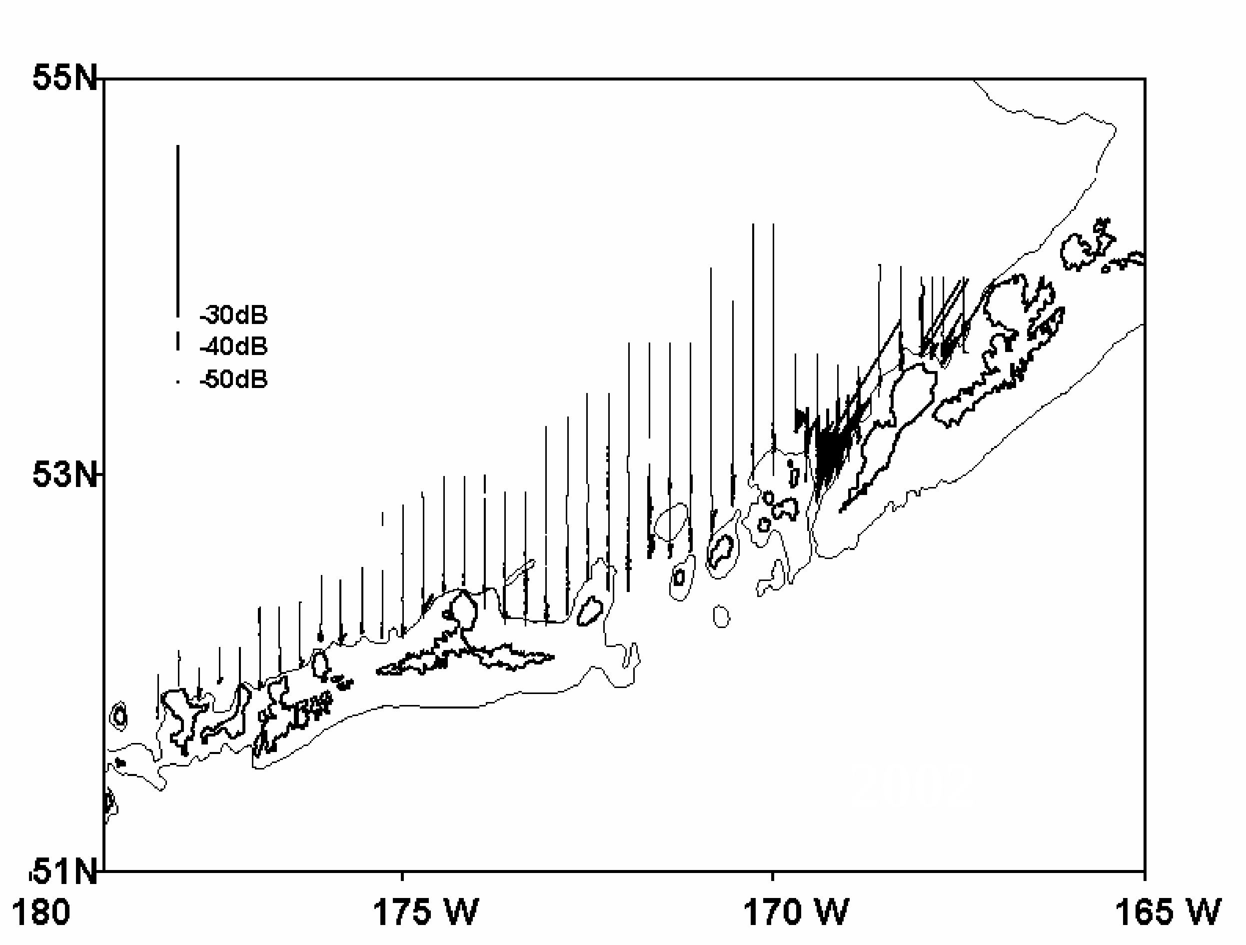
Biomass estimates:

1993: ** million tons

1996: 0.44million tons

1999: 0.48 million tons

Horizontal SA distribution (winter)



Biomass estimates:

1996: 0.52 million tons

0.18million tons in Bogoslof

0.09million tons out of Bogoslof

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2001	Mar 5-11	USA	Bogoslof		208,000			
2002	Feb 2 - Mar 20	Japan	Bogoslof/Aleutian Basin west of 170 W	2,409 12,768	180,000	92,000		2002 7th Annual Conf.;
2002	Mar 5-10	USA	Bogoslof		227,000			basin W of Specific area, N of
2003	Mar 7-13	USA	Bogoslof		198,000			Aleutians (not Donut Hole)
2005	Mar 7-13	USA	Bogoslof (518)	3,112	253,000			
	International zone area	205,311 km2 = 59,859 nmi2		[1] USA, 1999 Japan, 2000	Korea estimates = Specific area			spawning surveys

Attachment 9

Table. Summary of Trial Fisheries on Pollock in the Central Bering Sea Donut Hole Area

Dates	Year	Nation	No. Vessels	Vessel Name	Vessel Days	Data Source (Annual Conference Report)	Catch (KG)	Catch Number
Mar 12-26	2003	Korea	2	Man Jeck No. 21, O Yang Ho - 2	27	9th	2.6	2
Oct - Nov	2003	Korea	1	O-Ryong 503	15	9th	0.0	0
Nov 15-25	2003	Russia	1	Pioner Nikolayeva	11	9th	1.6	1
Nov 11-14	2001	China	2	Ming Zhu, Kai Feng	8	7th	0.0	0
Jun 7 - Jul 14	2001	China	1	Kai Tuo	38	6th	~24.0	16
Jan 12 - Feb 3	2000	Korea	1	Oriental Discoverer	23	5th	0.0	0
May 11-20	2000	Korea	1	Oriental Angel	10	5th	0.0	0
May 20 - Jun 28	2000	China	1	Kai Chuang	40	5th	~64.5	43
Aug 17-30	1999	Poland	1	Homar	14	5th	2.3	2
Apr 29 - May 3	1999	Poland	1	Acamar	5	4th	2.9	2
Sep 3-8	1998	Poland	1	Acamar	6	4th	3.3	2
Oct 12-15	1997	Poland	1	Acamar	4	STC, Sep. 1998	0.0	0
Aug 16-19	1997	Russia	1	Vigo	4	2nd	0.0	0
Jun & Aug	1997	China	2	?	8	2nd	< 900.0	< 600
?	1996	China	1	?	?	2nd	?	?
Sep 1-11	1996	Poland	1	Acamar	11	2nd	244.2	184
Oct 18 - Nov 12	1995	Poland	2	Homar, Acamar	54	1st	40.3	31
Jul 2 - Sep 4	1993	Poland	1	Adm. Arciszewski	63	Bull. SFI. 2(138) 1996	627,500.0	570,454

Red indicates unknown
Orange are non-reported estimated numbers

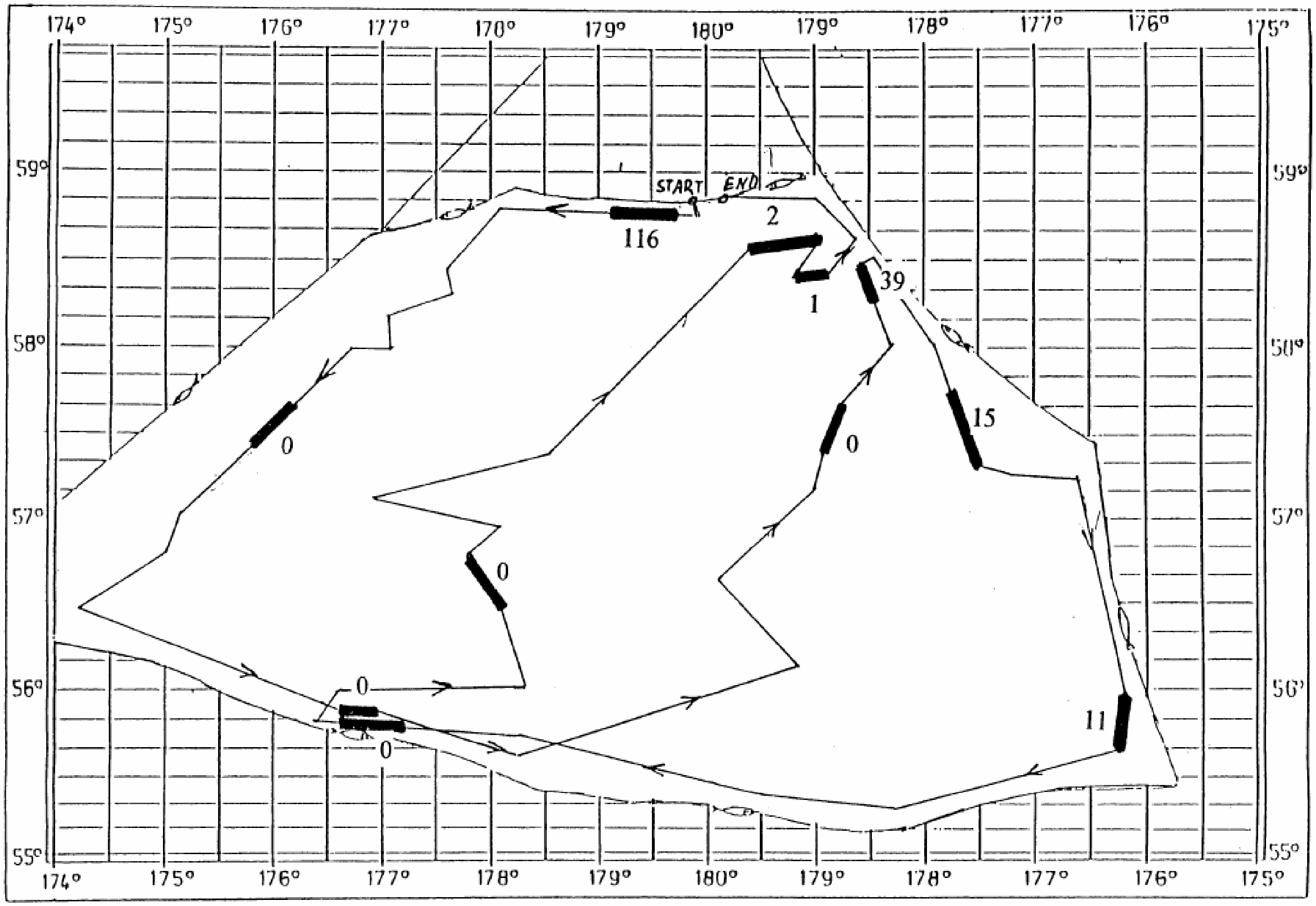


Fig. 1 Hydroacoustic trackline and hauls (solid lines) conducted during trial fishing of Polish vessel m/t "ACAMAR" in the international waters of the Bering Sea in September 1996. Figures indicate the number of pollock (individuals) in each haul.

Poland 1997

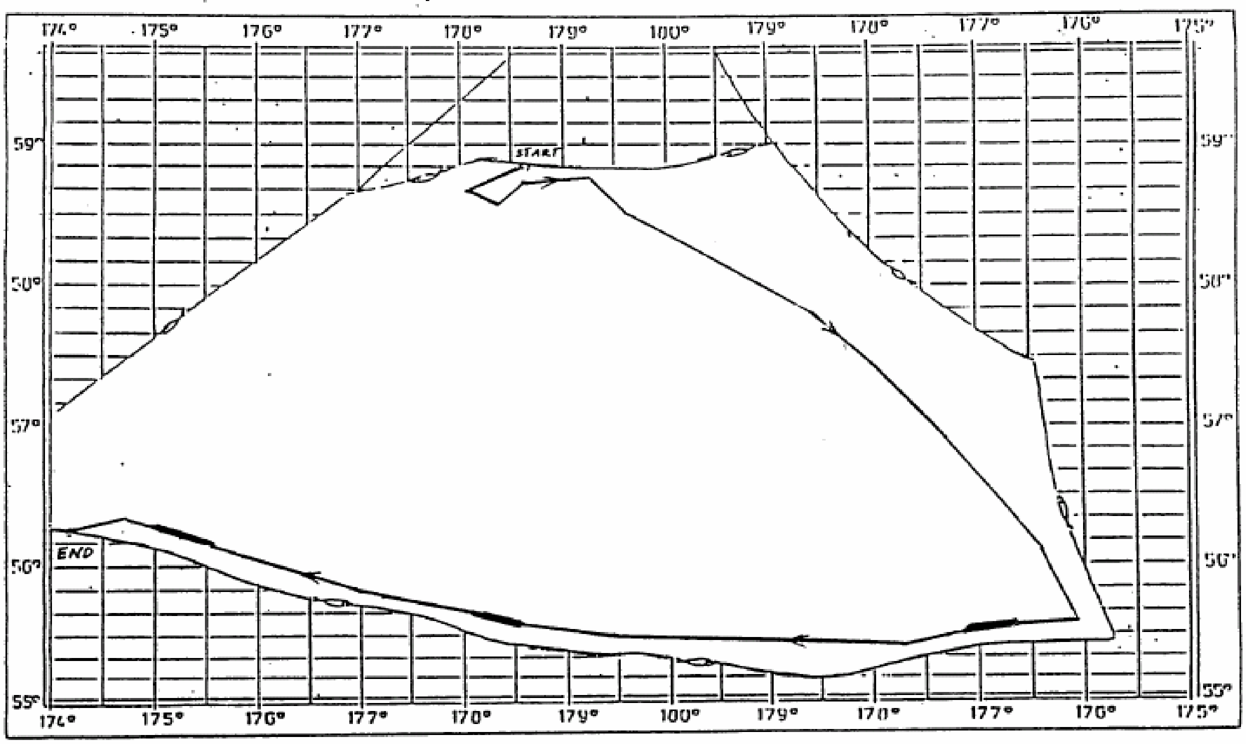


Fig. 1 Hydroacoustic trackline and hauls (solid lines) conducted during trial fishing of Polish vessel m/t ACAMAR in the intrnational waters of the

Poland 1998

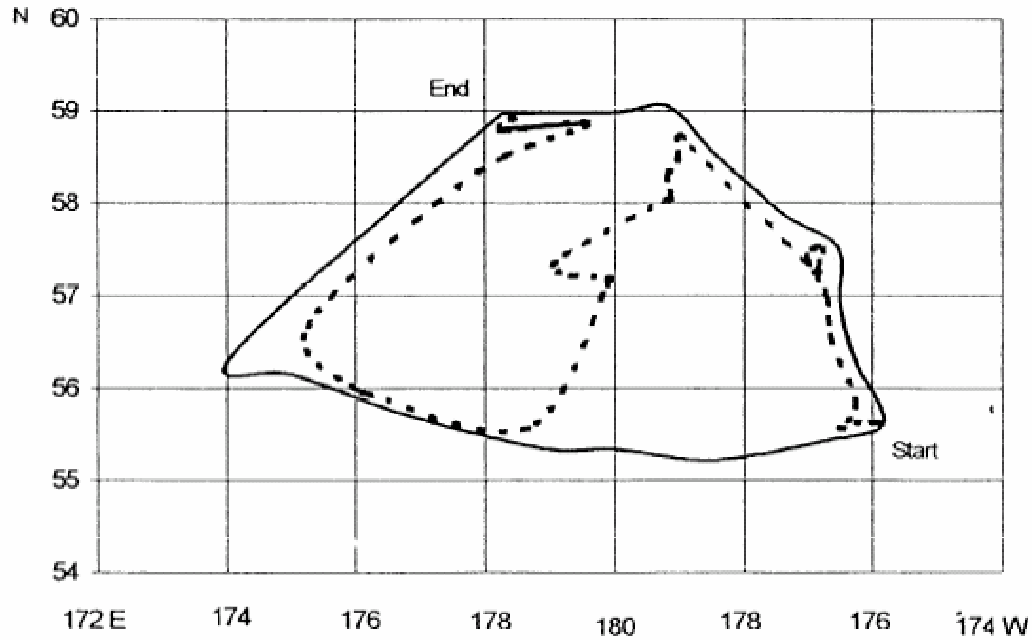


Fig. 1. Hydroacoustic trackline and the site of hauls (solid line) of m/t ACAMAR during trial fishing in Convention area of the Bering Sea in September 1998.

Poland 1999

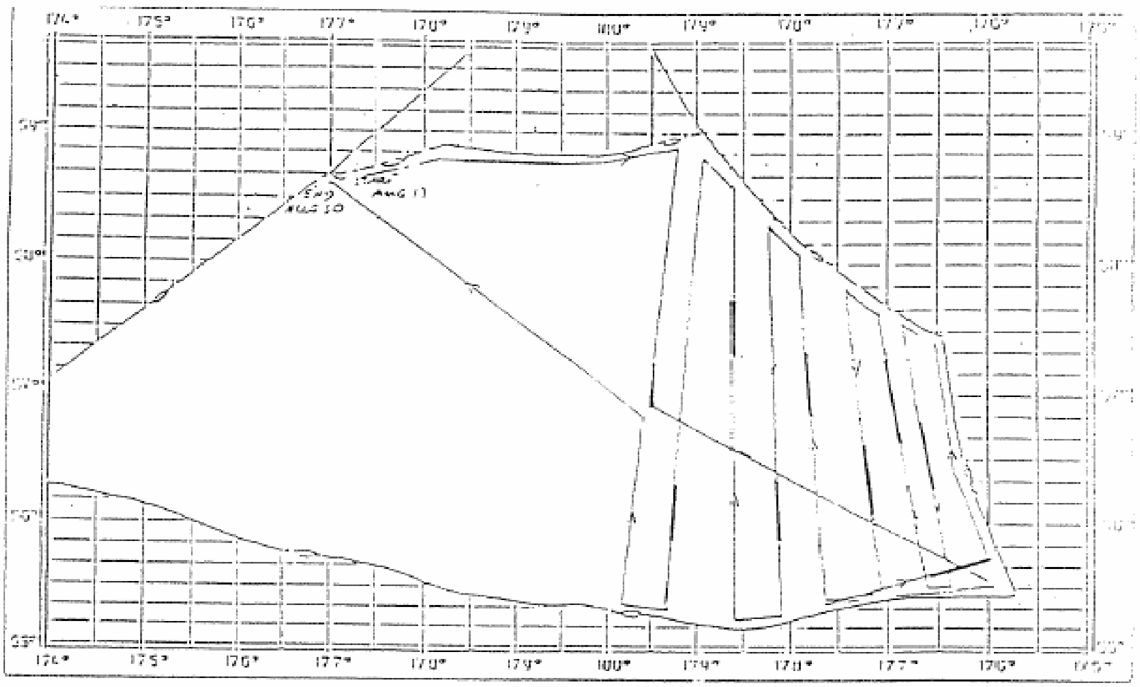


Fig. 1. Hydroacoustic trackline and the site of hauls (solid line) of m/t HOMAR During trial fishing i the Convention Area of Bering Sea (summer 1999)

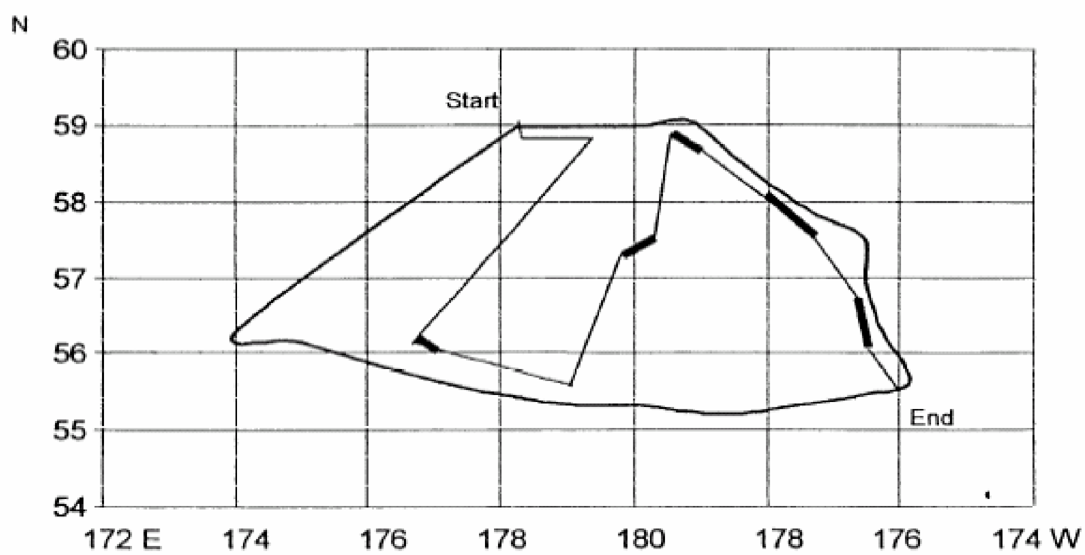
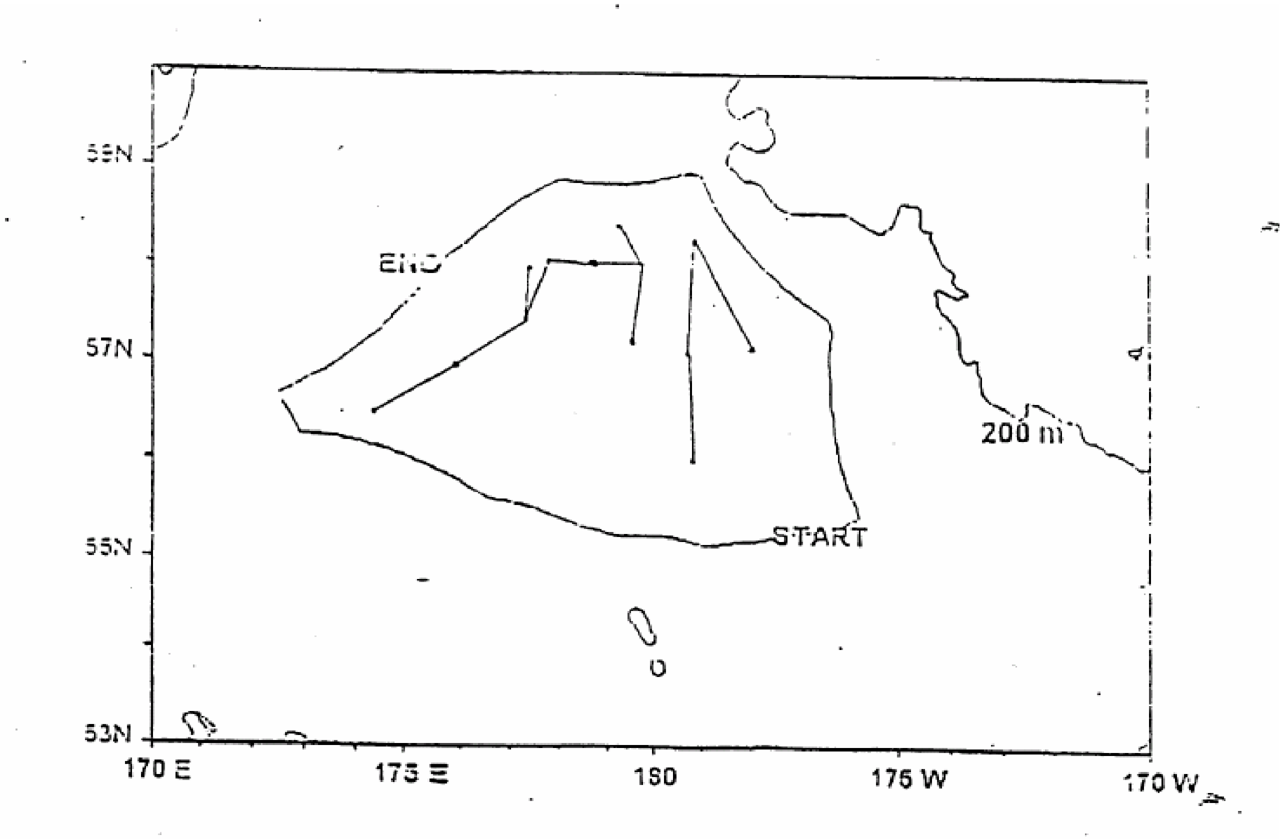
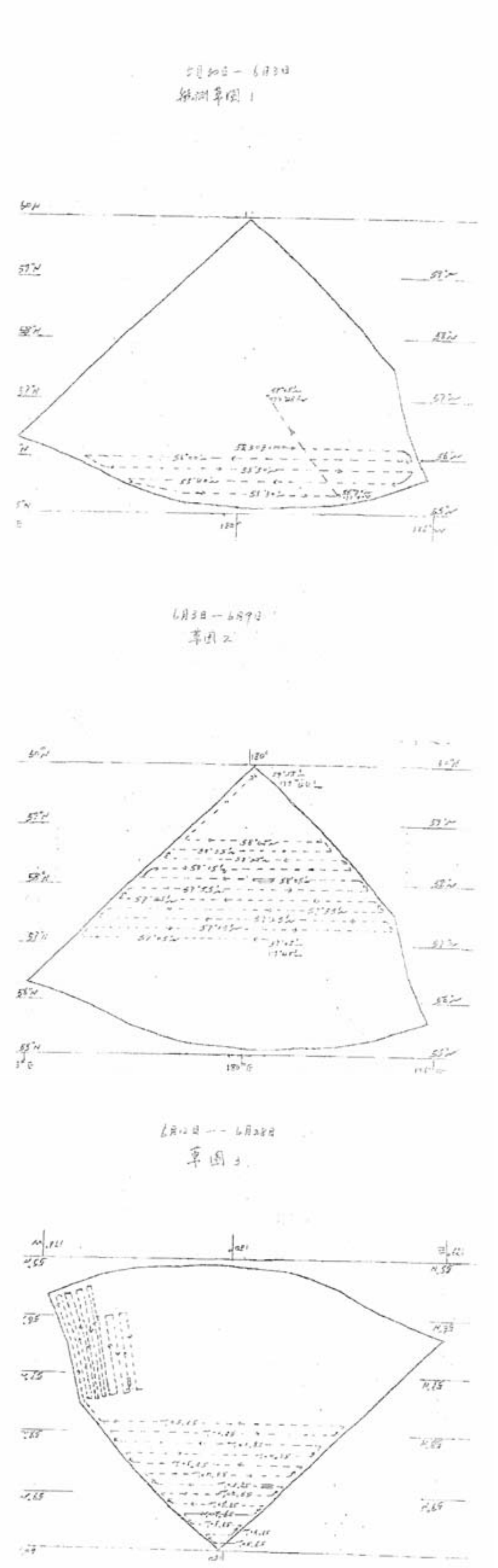


Fig.1. Hydroacoustic trackline and the site of hauls (solid line) of m/t ACAMAR during trial fishing in Convention Area of the Bering Sea (Spring 1999)

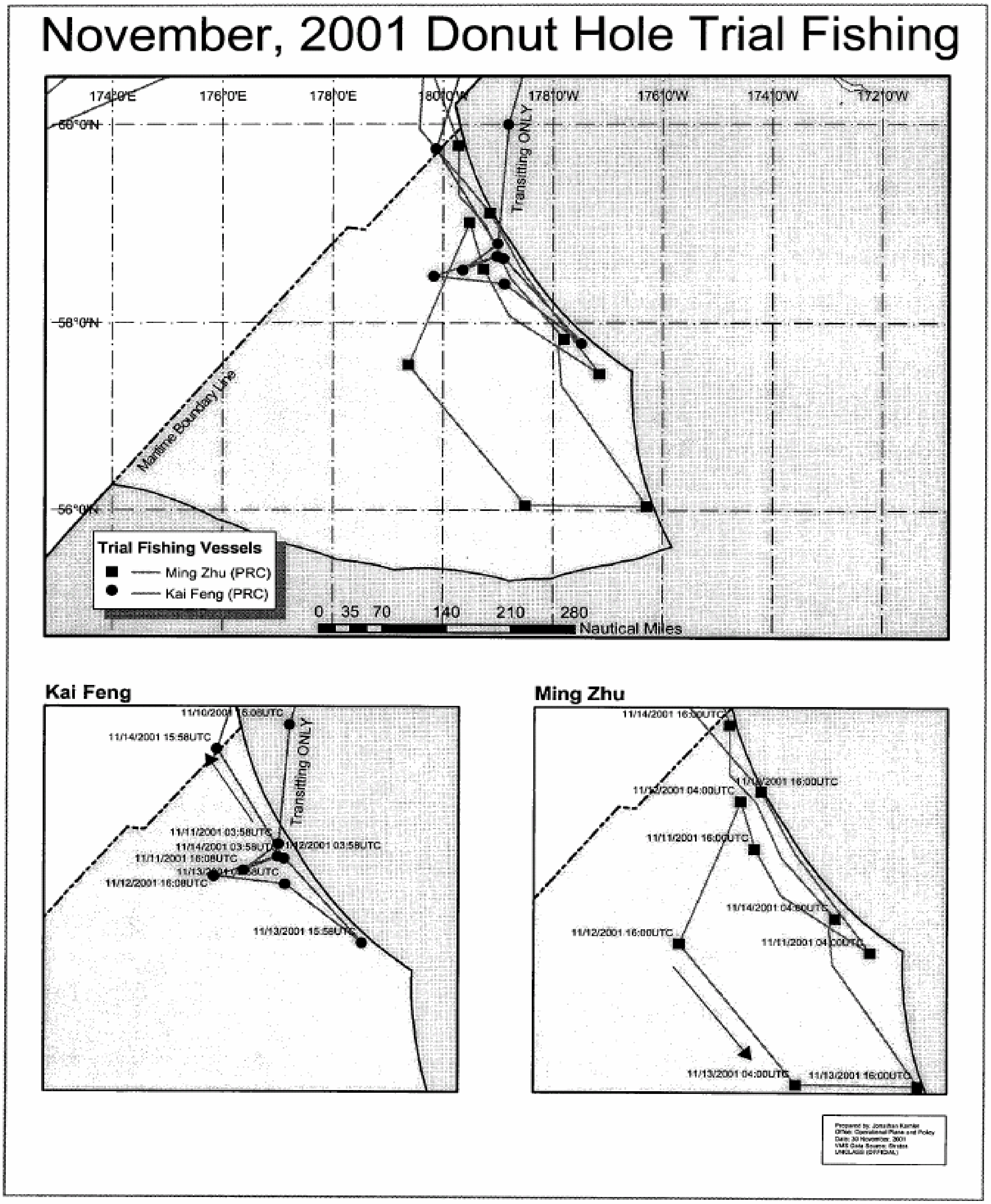
China 1997



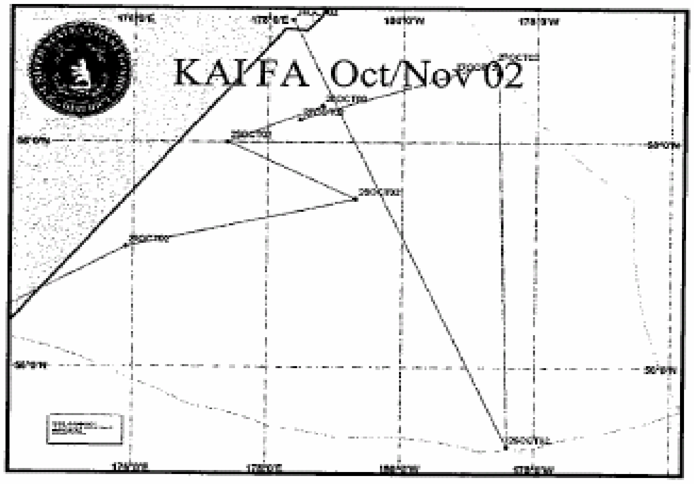
China 2000

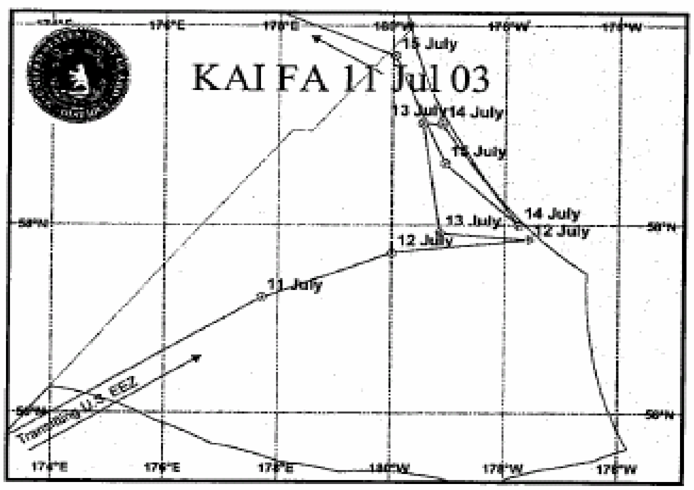


China 2001


November, 2001 Donut Hole Trial Fishing
174°0'E
176°0'E
178°0'E
180°0'W
178°0'W
176°0'W
174°0'W
172°0'W
60°0'N
58°0'N
56°0'N
Transitting ONLY
Maritime Boundary Line
Trial Fishing Vessels
Ming Zhu (PRC)
Kai Feng (PRC)
0 35 70 140 210 280
Nautical Miles
Kai Feng
11/14/2001 15:58UTC
Transitting ONLY
11/11/2001 03:58UTC
11/11/2001 16:08UTC
11/12/2001 16:08UTC
11/13/2001 15:58UTC
Ming Zhu
11/11/2001 16:00UTC
11/14/2001 04:00UTC
11/12/2001 16:00UTC
11/13/2001 04:00UTC
11/13/2001 16:00UTC

China 2002 and 2003





Korea 2000

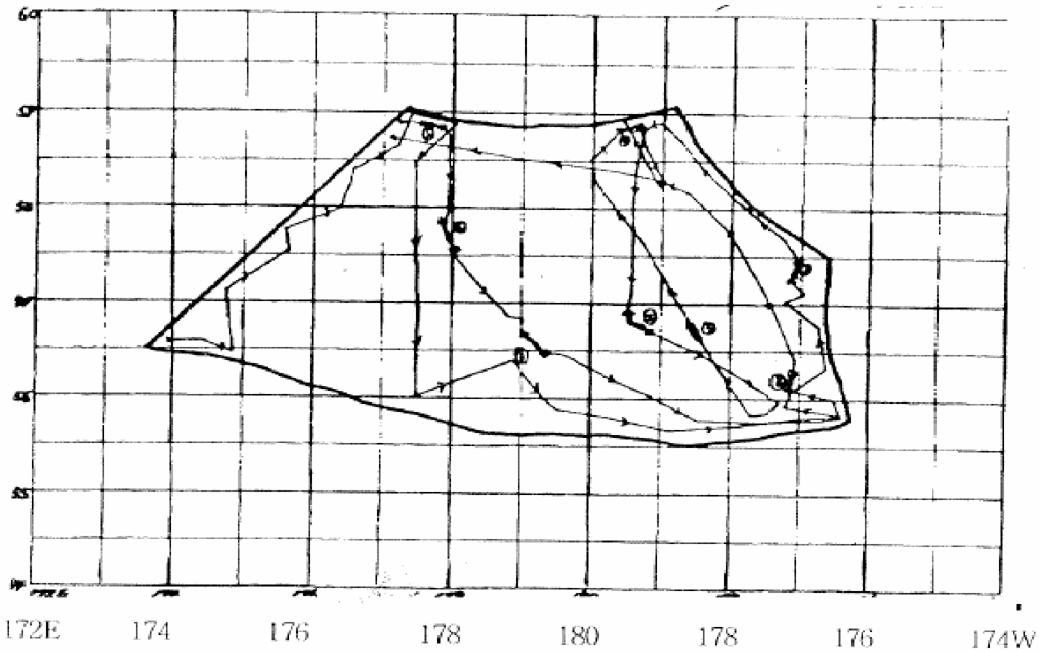


Fig. 1. Hydroacoustic trackline and haul positions (thick line) of M/T ORIENTAL DISCOVERER during trial fishing in Convention area in January.

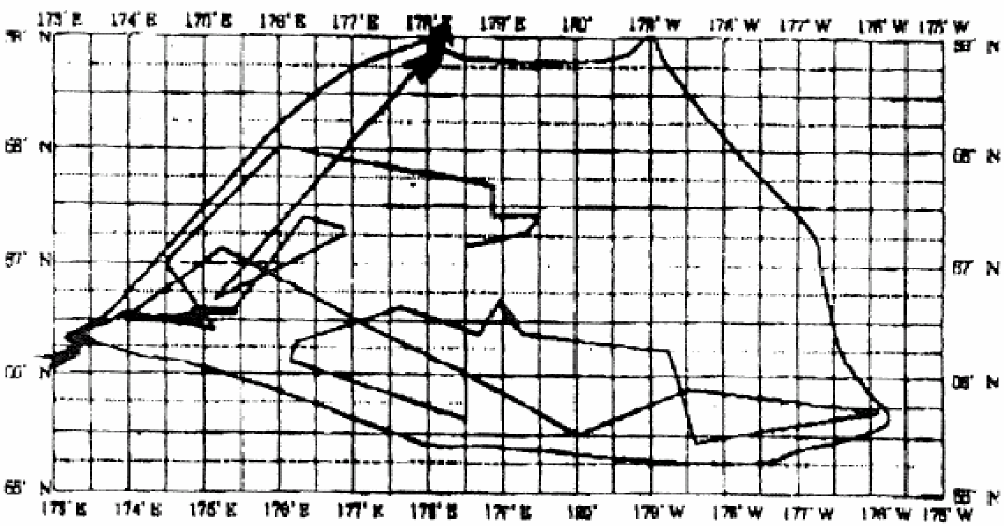


Fig. 2. Hydroacoustic trackline and haul positions (thick line) of M/T ORIENTAL ANGEL during trial fishing in Convention area in May.

Korea 2003

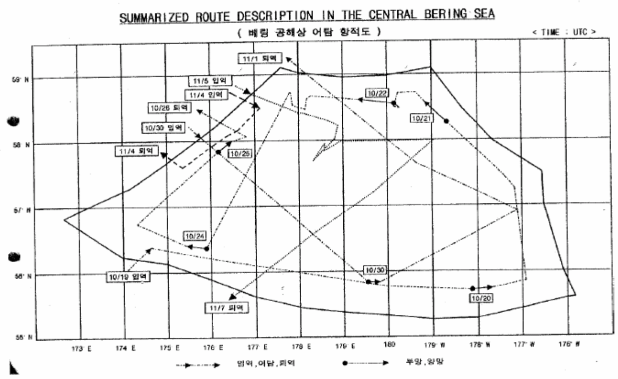


Fig. 1. Hydroacoustic trackline and haul positions of *O-RYONG 503* trial fishing in Convention area during 19 Oct. ~ 07 Nov. 2003.

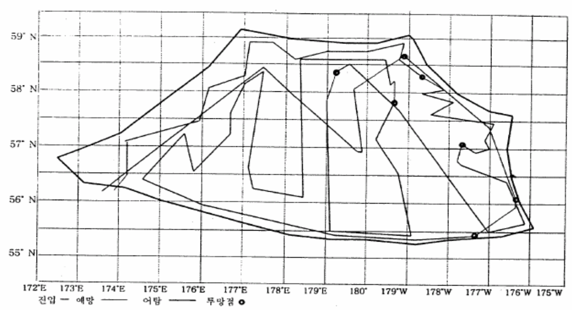
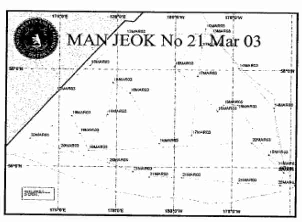
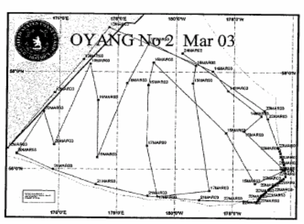
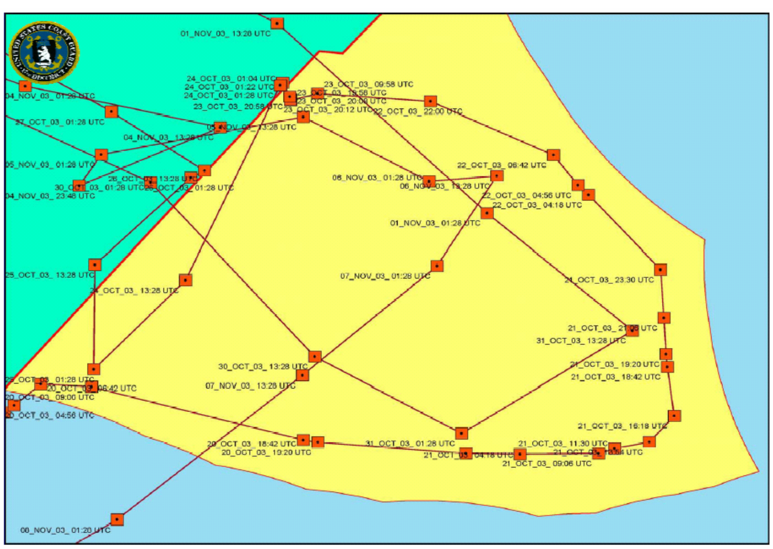


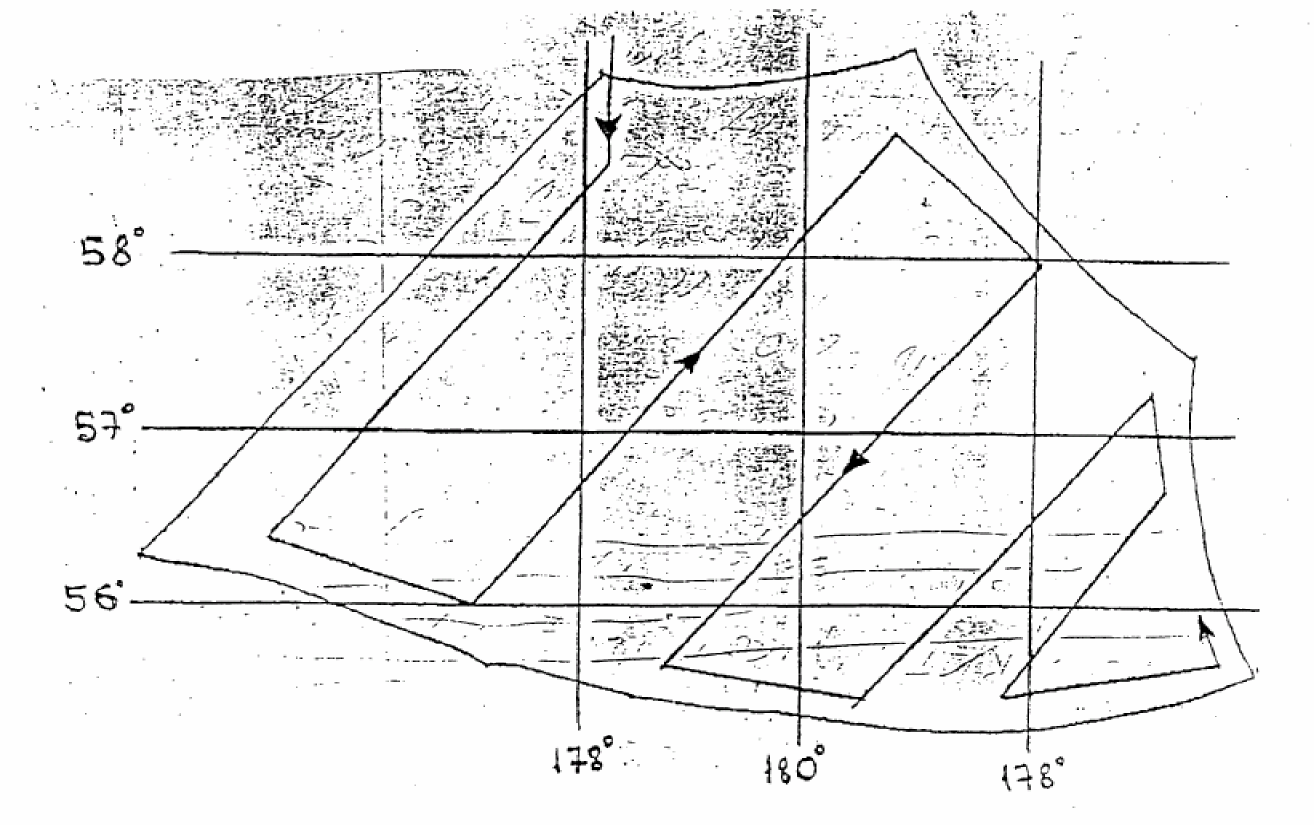
Fig. 2. Hydroacoustic trackline and haul positions (circle) of O YANG HO - 2 during trial fishing in Convention area in Mar. 2003.







Russia 1997



Russia 2003

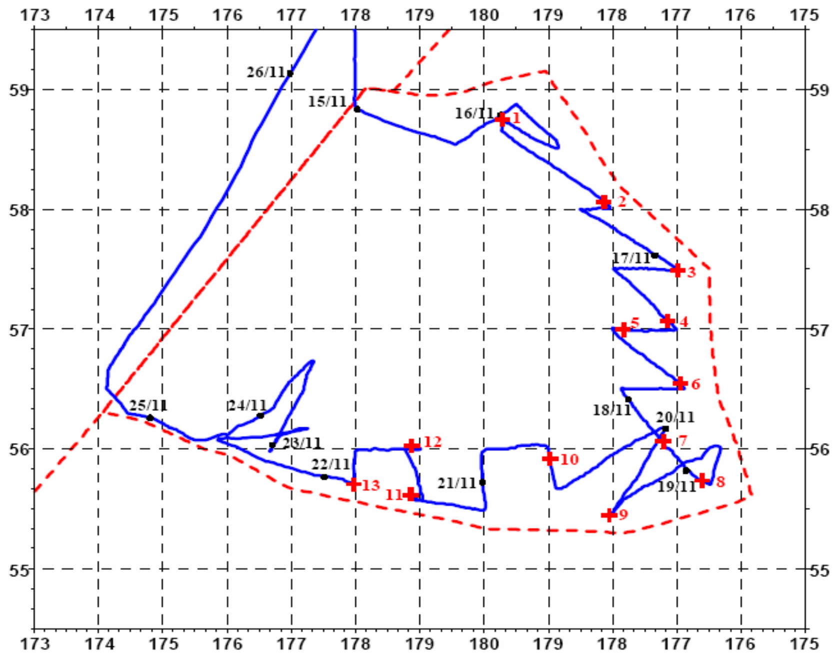
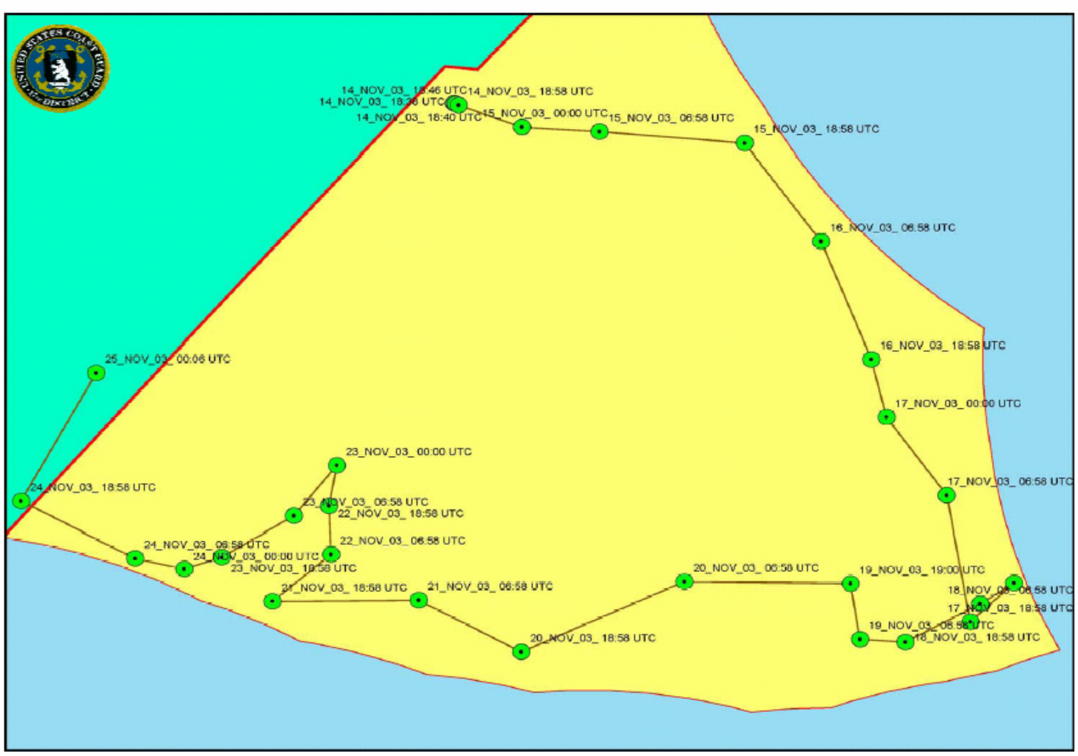
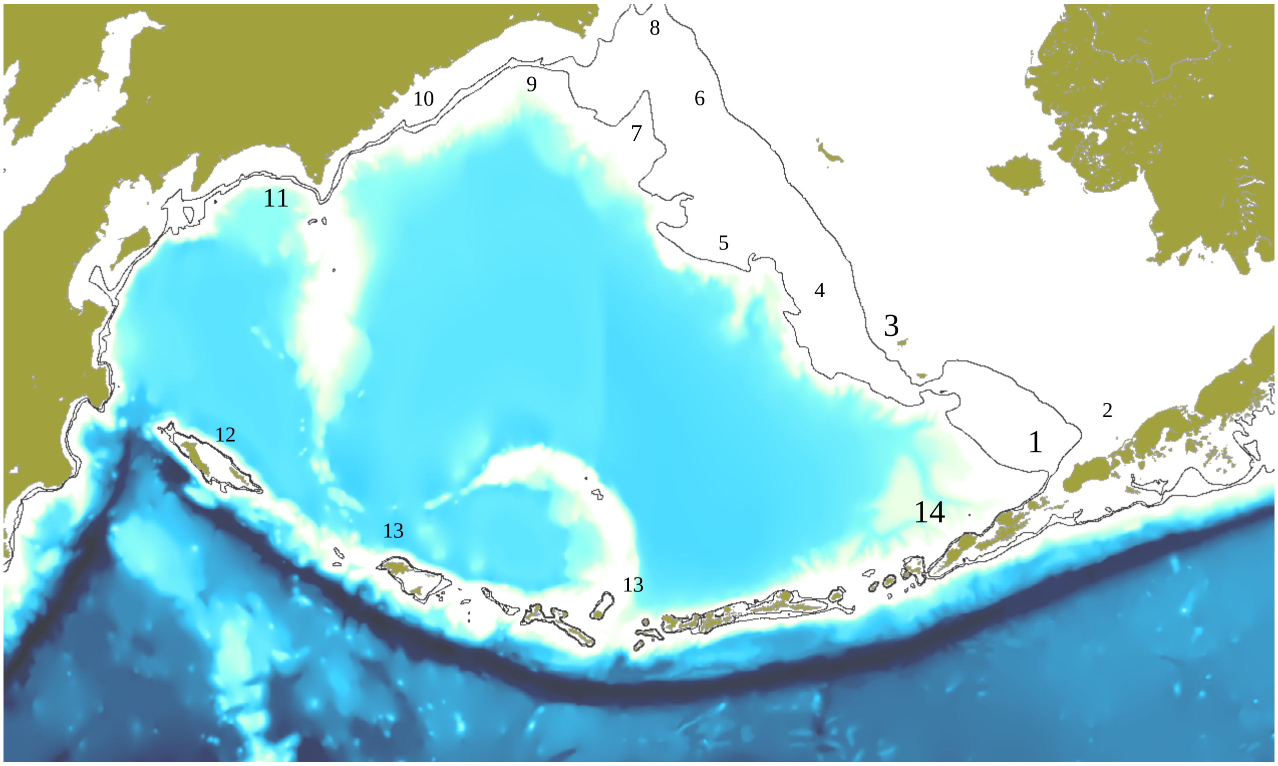


Figure 3. Map of tacks in the echointegration survey, and sites of trawlings in the Donut Hole and Aleutian Basin (haul sites marked red).



These are summarized in the figure and table below:



ID	*Location*	*Aggregation size*	*Depth*	*Timing*	*Age composition*
1	Unimak Island	Large	Shelf	March-May	Mixed
2	Amak Island	Small	Shelf	Feb-March	Oldest
3	Pribilof Island	Large	Shelf/coastal	March-May	Young/older
4	Zemchug Canyon	Small	Shelf	April-May	Mixed
5	Pervenetz Canyon	Small	Shelf	April-May	Mixed
6	Navarin shelf	Small	Shelf	April-May	Mixed
7	Navarin Canyon	Small/Medium	Shelf	May-June	Mixed
8	Anadyr Bay	Small	Shelf/coastal	July	Older
9	Koryak coast	Small	Shelf/coastal	April-May	Mixed
10	Koryak coast	Small	Shelf	April-May	Mixed
11	Olyutorskiy Bay	Large	Shelf	April-May	Mixed
12	Commander Isl.	Small	Slope	March-April	Mixed
13	Kanaga Pass	Small	Slope	March	Oldest
14	Bogoslof	Large	Deep/slope	March	Older

Attachment 11

해양수산부

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CIRCULAR COMMUNICATION TO THE DELEGATIONS OF THE TENTH CENTRAL BERING SEA POLLOCK CONFERENCE

September 6-9, 2005 Busan Korea

September 1, 2005

Re: Korean Proposal on the Terms and Conditions for Trial Fishing for Pollock in 2006

I, as head of the Korean delegation to the Tenth Central Bering Sea Pollock Conference, would like to submit the attached proposal on trial fishing in 2006 so that this issue will be discussed at the Annual Conference and Scientific and Technical Committee. Thank you.

Sincerely yours,

Joon-Suk Kang
Director of Distant Water Fishery
International Cooperation Office
Ministry of Maritime Affairs and Fisheries

"Attachment"

Korean Proposal on the Terms and Conditions for Trial Fishing for Pollock in 2006

1. Modification of measures for trial fishing

In accordance with the Convention Article Ⅹ, para 4 providing that “the terms and conditions for trial fishing shall be established by the Annual Conference,” Korea proposes to add following para (underlined bold) to Measures for Trial Fishing adopted pursuant to the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea, adopted at the 9th Annual Conference in 2004.

*“No more than 2 vessels from each Party to the Convention at any time may conduct trial fishing for pollock in the Convention Area. **Each Party can transfer its trial fishing rights to other Party.** Information on the vessels that will engage in the trial fishing will be provided to all parties at least two weeks prior to commencement of trial fishing. Such information will include vessel name, vessel type, vessels' international radio call sign(IRCS), vessel's satellite transmitter number, and the area and time of the trial fishing. Parties conducting trial fishing will notify the other Parties regarding the schedule of such trial fishing with sufficient notice to facilitate the embarkation and disembarkation of observers. Vessels engaged in trial fishing will have scientific observers of the flag-State on board and will accept at least one Scientific Observer of other Parties to the Convention, with the cost being paid by the requesting Party in accordance with arrangements to be made between the flag State of the vessel and the other Parties. All provisions of the Convention and all measures adopted by the annual conference regarding boarding and inspections, vessel monitoring systems, entry and transshipment notifications, safe boarding ladder standards, and shipboard logs and records will govern such trial fishing. Prior to the **11th** Annual Conference, Parties conducting trial fishing will submit to the other Parties a report of the trial fishing which provides the type of catch and distribution data as specified in the Central Bering Sea Observer Program Manual.”*

2. Background

Trial fishing in the Central Bering Sea was conducted two times by two Korean fishing vessels in 2000 and 2003 respectively. However, the trial fishing failed to collect detailed information because only two fishing vessels were not enough to detect fish stocks in the vast Central Bering Sea. Based on expert opinion recommending that more fishing vessels are needed for effective trial fishing, Korea proposed to conduct trial fishing with 5 fishing vessels at the 9th Annual Conference. As a result, the Conference agreed to submit a detailed trial fishing plan and rationale for using additional vessels in advance of the this Annual Conference. The U.S also agreed that the annual conference would review the recommendations of the Scientific and Technical Committee concerning the Korean trial fishing plan.

3. Need for using additional vessels

The Central Bering Sea is vast and the sonar used by most fishing vessels may only cover 700 - 1,000m wide. Therefore, only two fishing vessels could not keep track of fish stocks in the vast area and thus failed to collect valuable data. For effective trial fishing, the number of commercial trial fishing vessels should be increased to the utmost.

Korea plans to dispatch 4 trial fishing vessels (see Attachment). Vessels engaged in trial fishing will assess fish stocks at average speed of 7~8kt, in a 5-mile wide in 2006. Fishing method is to keep track of fish stocks with scientific echo-sounder such as sonar, taking into account water temperature and the divergence of planktons, and the net will be thrown when fish stocks are detected. The vessels should observe conservation measures adopted by the Convention. Collected data will be submitted to the next the Scientific and Technical Committee and Annual Conference.

As we are well aware, all Parties have implemented faithfully the Moratorium which have ceased fishing operations temporally for pollock in the open sea since 1993. All parties have been actively participating in concerted efforts to protect and manage the pollock resources in the Bering Sea, wishing that pollock resources will recover to sustainable level.

Even though 12 years have passed since the moratorium, however, the resources of the Central Bering Sea do not seem to recover, while the pollock resources in the waters of coastal states in the Bering Sea are recovering. The Korean fishermen have doubt about this situation. Therefore, this trial fishing may greatly contribute to conservation and management of the Pollock resources in the Central Bering Sea with valuable data collection as well as providing credibility to fishermen.

4. Trial Fishing Plan for 2006

See attachment.

Trial Fishing Plan for 2006

1. The Purposes of Trial Fishing

- To analyze the geographical distribution of Pollock in the Central Bering Sea.
- To estimate total weight and number of fish of Pollock and other fishes
- To collect biological data of Pollock and other fishes (length, sex, body, weight, maturity)

2. Fishing Company

Name of Company	Address	Tel/Fax
Keukdong Fisheries Co.,Ltd	45, Okeum-Dong, SongPa-Ku, Seoul, Korea	82+2+3402+0919 / 82+2+3402+0966
Nambuk Fisheries Co.,Ltd	654, Nambumin-Dong, Seo-Ku, Busan, Korea	82+51+467+1551 / 82+51+243+4211
HanSung Enterprise Co.,Ltd	71, Daekyo-Dong 1Ga, YoungDo-Ku, Busan, Korea	82+51+410+7100 / 82+2+732+5300
Oyang Corporation	76-3, Taepyung-Ro 1Ga, Joong-Ku, Seoul, Korea	82+2+3277+1600 / 82+2+313+8079

3. Descriptions of Trial Fishing Vessel

3-1. Keukdong Fisheries Co.,Ltd

Name of Vessel	Type	G/T	Call Sign
CLOVER Ho	Stern Trawler	997.02	6.S.W.N
Main Dimension			**INMARSAT-C No.**
Length	**Breadth**	**Depth**	
63.18	11.40	5.10	444047812

3-2. Nambuk Fisheries Co.,Ltd

Name of Vessel	Type	G/T	Call Sign
Nambuk Ho	Stern Trawler	5,549.02	6.M.X.T
Main Dimension			**INMARSAT-C No.**
Length	**Breadth**	**Depth**	
104.30	17.80	11.00	444048214

3-3. Han Sung Enterprise Co.,Ltd

Name of Vessel	Type	G/T	Call Sign
Joon Sung Ho	Stern Trawler	2,866	6.L.S.U
Main Dimension			**INMARSAT-C No.**
Length	**Breadth**	**Depth**	
84.91	15.00	9.55	444095484

3-4. Oyang Corporation

Name of Vessel	Type	G/T	Call Sign
2 Oyang Ho	Stern Trawler	3,527.33	6.M.M.E
Main Dimension			**INMARSAT-C No.**
Length	**Breadth**	**Depth**	
88.94	15.00	9.80	444047612

4. Research Area and Cruise Plan

Research area covers the contracting waters delimitated by the Convention. Vessels engaged in trial fishing should observe conservation measures adopted by the Convention. Trial fishing will be conducted for two months in Autumn with exception of movement of vessel between port and fishing ground.

Vessel	Cruise Plan
CLOVER Ho	Vessels engaged in trial fishing will assess fish stocks at average speed of 7~8kt, in a 5-mile in width. Fishing method is to keep track of fish stocks with scientific echo-sounder such as sonar, taking into account water temperature and the divergence of planktons, and the net will be thrown when fish stocks are detected.
NAMBUK Ho	
JOON SUNG Ho	
OYANG Ho	

5. Observer

One observer from Korea will be on board each vessel. One observer from other parties will be welcome on board in accordance with the terms and conditions on trial fishing on pollock in 2006. Cost for observer should be paid by the requesting party.

6. Report

The results of trial fishing will be submitted to the next the Scientific and Technical Committee, and Annual Conference and informed to other Parties, including the type of catch and distribution data as specified in the Central Bering Sea Observer Program Manual.

Korea's Proposal regarding the Terms and Conditions on Trial Fishing in 2006

(Agreed at the informal consultation between China, Japan, Korea, USA, held in the evening of September 7)

At the 10th Annual Conference, the Parties agreed that the Republic of Korea will be allowed to seek the trial fishing rights of two vessels from other Parties for two months for 2006.

May I now present the Russian proposals to BAPIS program designed pursuant to the Central Bering Sea pollock workshop on allowable harvest level and stock identification (para 12.2 of the Protocol) held last June in Seattle.

Goals and objectives

This study is aimed at assessing the Bering Sea pelagic concentrations of pollock, and the role of pollock within the currently existing ecosystems.

This is to be achieved through accomplishing some specific tasks as given below.

1. Assess the present biomass of pollock concentrations in the Aleutian and Commander Basins.
2. Measure up the polymorphism of genetic markers in pollock at different geographical sites of the Bering Sea.
3. Survey water circulation and dynamics in the Aleutian basin.
4. Use the confidence data on the population structure of the Bering Sea pollock, and on the importance of the coastal stocks for the formation of concentrations in the Aleutian Basin for annual evaluation of characteristics as given below (for each stock):
   - spawning intensity;
   - recruitment by year classes;
   - age/sex structure of the spawning and fishing stocks.

5. Assess the role of the Aleutian Basin pollock within the Bering Sea ecosystem

The activities which Russia could perform under the International Program BAPIS are follows.

Regular trawl surveys shall be conducted to collect biological, genetic and physiological data. Depending on the season and pollock distribution pattern this work is to be done using midwater and bottom trawls.

The grid of stations is shown in Figure 1. It was designed with due regard to the present day concept concerning the migratory routes of pollock within the Donut Hole and the adjacent waters of Bering Sea. In total, the trawl survey will include 67 stations of which 34 hauls will be made in the Convention Area (Donut Hole) of the Bering Sea. The range surveyed will cover the waters off Medny Island, Shirshov ridge area, the southern and northern parts of the Aleutian basin, and a part of the Navarin Region.

The ichthyoplankton survey shall be made in spring time once a year. Its specific timing is dependent on the ice conditions of the year and the expected time of spawning within the said time interval.

The survey will be done using a station grid shown in Figure 1. There will be 41 stations including 29 at the site between Medny Island and Olutor cape, 8 in the southeast of the Donut Hole, and 4 in Navarin Region. Should it be impossible to accomplish stations at the points shown in the grid because of heavy ice conditions the survey stations will have to be shifted most closely to the ice edge.

Ichthyoplankton samples will be collected with IKS-80 net according to the standard techniques. Vertical hauls between 500 m and surface will be made; at lesser depths it will be between the bottom and surface. The angle of line tilt will be accounted for so that the net is set to the desired stratum, or when the swept water volume is calculated.

The ichthyoplankton hauls shall be combined with hydrological stations. Remote sensing data show the actual submersion depth of the net.

The echointegration surveys are targeted at finding out the population attributes of bathymetric distribution and regularities in forming pelagic concentrations of pollock going out to the Aleutian and Commander Basins; another target is to evaluate the biomass of the pelagic and near-bottom concentrations of pollock in the Central Bering Sea and adjacent regions. Acoustic studies are made once in spring at the site between Medny Island and Olutor cape, and in Navarin Region. The overall length of the acoustic survey tacks in 651 nautical miles of which 571 mile portion is the stretch between Medny Island and Olutor cape.

Hydrometeorology is to be studied to track down the impact of habitat condition, and to identify the key factors which influence the formation of fishing concentrations and set up the spawning, feeding and wintering migration routes, and egg/larvae transport trajectories. Another objective is to monitor the hydrological characteristics of pollock biotopes at stages of their development on individual level. The hydrometeorology research includes gathering of data on the physical system of the sea.

This type of work is to be done concurrently with the trawl and ichthyoplankton surveys.

The 0-1500 m, or 0-bottom layer, are to be examined where temperature and salinity data from standard layers is to be collected.

The hydrology data obtained shall be entered in the computer database, primarily processed and mapped. The work in hydrology shall be done according to the existing guidelines.

Meteorology research will include daily observations at least once a day, as follows:

- analysis of the near earth weather maps;
- visual observations of the cloudiness and sea surface condition;
- recording of the air and sea surface temperature (SST), force and direction of winds, direction and velocity of currents by Doppler lag.

Fax and E-maps (land weather analysis, ten-day maps of water temperature and currents) shall be received by the radio operator of the vessel. Weather observations shall be made using one weather station on board, concurrently with visual observations.

In – between the specialized activities, i.e. trawl, ichthyoplankton, echointegration and hydrological surveys vessels operate in scientific and fish-finding regime in order to detect individual concentrations and find out position, and for monitoring of seasonal redistribution of pollock and other species. Trial and fishing hauls are made all across the range of research, depending on the actual situation. Similarly to trawl surveys, the catches are also analyzed which must involve ichthyological examination.

Specimens for genetic studies are selected once a year during spawning, or at the time closest to spawning. These specimens come from pollock taken in the region of Shirshov ridge, Medny Island, Donut Hole, and Navarin. Complete biological analysis must follow in respect of all individual pollock sampled for genetic analysis.

The study of pollock in the Central Bering Sea and adjacent waters will strengthen confidence of its stock condition assessment, and improve the quality of forecasts. The study of ecosystem restructuring and response of pollock to the climatic and oceanographic variability will make it possible to find out the long-range trends in the species' reproduction and abundance dynamics, and regularities in the formation of pelagic concentrations in the basins of the Bering Sea.

It is expected that the implementation of this program will enable us to obtain:

1. Actual status estimates for pelagic concentrations of pollock of the Aleutian basin and adjacent waters; short- and long-range trends in their abundance and density variations.
2. Data on seasonal distribution of the pelagic pollock concentrations, as dependent on various habitat parameters and the condition of inshore stocks.
3. Appraisal of the vectors of restructuring in the Bering Sea ecosystem, and of the species' response to the weather and ocean variability in the region.
4. Knowledge of the actual general pattern of the population (and, if possible, subpopulation) structure of pollock in the Bering Sea.
5. Information on the range of individual populations of pollock in the Bering Sea; direction and extent of the spawning, feeding and wintering migrations; timing of departure and entry of pollock to the Donut Hole.

Central Bering Sea Pollock Workshop on Allowable Harvest Level and Stock Identification

June 6-9, 2005 Seattle, Washington USA

Background: At the Ninth Annual Conference of the Parties to the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea held last September in Kushiro, Japan, the Parties agreed on a Scientific and Technical (S&T) Committee Work Plan for 2005. This Plan requires that two working groups be formed: 1) a genetics working group to address research on the composition of pollock stocks in the Bering Sea, and 2) a working group to identify scientific factors that should be considered in deriving an AHL (Acceptable Harvest Level) after the Allowable Biological Catch (ABC) is determined by the S&T Committee. The United States offered to host an AHL workshop in May-June 2005 at the NOAA Alaska Fisheries Science Center in Seattle, Washington, and suggested that the Parties consider holding a Genetics Workshop at the same time.

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1. Introductions and Election

1.1. The meeting nominated L. Low as meeting chair and J. Ianelli as head rapporteur with assistance from each delegation.

1.2. Individual opening statements and introductions were made. There was considerable discussion over the interpretation of the language under Agenda 5. The workshop noted that rather than spend too much time on the wording of this agenda and given that the agenda was already agreed upon by the Parties to the Convention, issues related to concern were better highlighted in this report.

1.3. The workshop reviewed the text of the convention specifically as relates to how the AHL is prescribed. It was agreed that the focus should be on the scientific aspects within the context of the convention. *The workshop adopted the agenda as it was drafted.*

2. Health, status, and trends of Aleutian Basin pollock stock

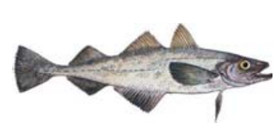
2.1. The workshop convened with a summary discussion on the status and trend of what is known about Aleutian Basin pollock. No new information was tabled specifically on survey or experimental fishing within the convention area. The subsequent agenda items present more detailed discussion on these aspects based on survey and other data from adjacent regions.

3. Present biomass level of stock

3.1. D. McKelvey (AFSC) presented survey results from the Bogoslof survey and this is included in WP-3.

3.2. The delegate from Korea asked about the presence of myctophids in the region and apparently they were not found close to pollock aggregations.

3.3. The Russian delegation requested information on the magnitude of observation errors in the survey estimate. The response was that the coefficient of variation was about 17%. They also suggested that a type of adaptive sampling strategy to focus on concentrations may be useful to improve estimation precision. Ms. McKelvey noted that these are areas of research that could lead to improvements. It was also noted that over time, the transect length into the basin and transect-spacing has changed.

3.4. The question arose about the age composition of the biomass. Based on preliminary examination of the age-data that was released early this week, the stock appears to consist mainly of the 2000 year-class, followed by the 1999 year-class (numerically).

3.5. An extensive discussion revolved around different characteristics between Samalga Pass fish compared to that of Umnak Island (which were much smaller). There was a suggestion that the 2000 year-class might be from Bogoslof spawning concentrations. It was pointed out that it would be important to have a survey in 2006 to see if this year-class continues to recruit.

3.6. In Russian waters (specifically, in the Sea of Okhotsk) survey data suggest that biomass estimates were highest during peak of spawning. Perhaps the timing issue may affect biomass estimates since the goal for the Bogoslof survey is to arrive prior to the peak of spawning. Also, it was also noted that younger pollock seem to reach peak spawning later in March with older pollock spawning first.

3.7. *Agenda items 3-8 were suspended temporarily so that presentations for Agenda item 9 could be heard for background purposes.*

3.8. The Chair resumed discussion with a review of the methods for arriving at biomass levels for the CBS region. Under the convention, the default formula for the Basin stock is to assume that the Bogoslof region (the convention's "Specific Area") stock represents 60% of the basin stock.

3.9. Since Bogoslof pollock spawn in deep-water, this is a characteristic that differentiates them from shelf area spawners and hence, these may truly have Aleutian Basin characteristics. It was also noted that this pattern of distribution (aggregations concentrated around Samalga pass and NE of Umnak Island) was very common in many surveys over the past several years.

3.10. Other issues that affected biomass level of the stock included the timing of the survey (i.e., there may be evidence that the survey occurs too early and higher concentrations are found during or slightly after spawning. Also, adaptive sampling of transect lines may provide better estimates (current CV of the 2005 biomass estimate is on the order of 17%).

3.11. The Russian delegation suggested that the proportion attributed to the basin as coming from the Bogoslof region has changed substantially. Russia suggested that there is evidence that the proportion of Basin pollock occurring in the Bogoslof Region is more than 60% now. They proposed that estimation of this proportion be estimated and that this be on the agenda for discussion at the next convention meeting.

3.12. The Russian delegation proposed that it is necessary to develop a comprehensive program for the Bering-Aleutian Pollock International Survey (BAPIS) which has as a main goal to study pollock biomass distributions between the Donut Hole and Bogoslof regions and include surveys from surrounding US and Russian zones. This should be carried out throughout the period of Bogoslof stock recovery. A plan with a budget should be formulated for presentation at the annual conference.

3.13. Japan noted that the current BASIS (Bering-Aleutian Salmon International Survey) program is for salmon which is a relatively large industry compared to the pollock fishery, especially in the Convention area. For that reason, presently it would be difficult to gain support for undertaking this type of research.

3.14. The Russian delegation commented that the cumulative total catch was 7 million tons in the Aleutian Basin. This is a large amount and survey work should be done according to this magnitude. The delegation proposed that such a survey program be carried out for one or two years by each member country and include ichthyoplankton surveys.

4. Safe exploitation rates on the stock

4.1. The US delegation presented WP-4 and WP-7. The use of SPR rates as done for domestic fisheries were presented along with the control rules for setting ABC. A specific application to the Bogoslof region was presented and three alternatives were given as examples. These were discussed in more detail under the next agenda item.

5. Anticipated exploitation rate of different AHLs on the stock

5.1. Exploitation rates under the three alternative approaches presented in WP-4 give:

Option	ABC approach	2006 ABC (Bogoslof fraction)	Exploitation rate (relative to Bogoslof survey estimate, 253,000 t)
1)	Tier 3 (with target 2 mt)	5,501 t	2.15%
2)	Simple rate of 75% of *M* (*M*=0.2)	37,950 t	15%
3)	Age-structured model (Tier 3 $F_{40\%}$ using NPFMC control rule)	Approximately 42,000 t	Approximately 16%

5.2. The meeting discussed factors that should be considered in choosing approaches for ABC and the above table is provided as background.

5.3. The workshop noted that the "target level" for rebuilding Bogoslof stock (and by extension, the Aleutian Basin pollock) may be affected by environmental change. The first option was considered appropriate given the current status (relatively low abundance levels). The target level of 2 million t was recognized to be very high. The target level and approach to estimating ABCs should be evaluated each year as new data become available.

5.4. The delegation from Japan proposed that for practical purposes of calculating Aleutian Basin ABC, the Bogoslof ABC value should be divided by 0.6 (as implied by the description in the Annex). They consider that the data are lacking to provide an alternative value other than that specified in the convention. The Russian delegation stated that they believe the pollock stock distribution between the Aleutian Basin and Bogoslof (i.e., the specific area detailed in the Convention) has changed. Therefore, the biomass of pollock in the Aleutian basin should be calculated accordingly. There was discussion about what evidence exists to estimate the current proportions. Dr. Stepanenko provided insight on direct observations from surveys in this region. Some participants noted that this highlights the need for a directed research program to evaluate pollock distribution patterns.

5.5. The delegate from Korea noted concerns on the assumption that fish migrate throughout the Basin. According to results from three years of hydroacoustic surveys (1996, 1997, and 1999) the echosign of pollock was present in 1996 and 1997, but not in 1999. Based on this, they thought that pollock appeared to be moving toward the east and west of Bogoslof region, not northward into the Basin. This may be due to environmental conditions. However, recent information is lacking (from their research) on the distribution and movement patterns of pollock in these regions.

5.6. The delegation from Japan proposed to set the AHL = ABC for the Aleutian Basin pollock.

5.7. The US delegation proposed that the level of AHL should be $\leq$ ABC, but that the degree of departure should be part of the Annual conference. They felt that the workshop should focus on the biological issues related to estimating pollock ABC.

6. Biological reference biomass levels for the stock; such as minimum biomass, $B_{40\%}$, B_{msy} and optimum biomass

6.1. These concepts were reviewed and presented under Agenda item 4, specific from working papers WP-4 and WP-7. The approach of computing the minimum-stock size threshold (MSST) was discussed and it was noted that the value most appropriate would be on the order of 120,000 t (compared to the current estimate of 253,000 t for the Bogoslof region). This takes the assumption that the proxy for B_{msy} is equal to $B_{35\%}$ as derived from the preliminary age-structured model presented in WP-4. It was noted in the presentation that this value ($0.5B_{msy}$) of MSST was imposed for Steller sea lion considerations under the domestic US pollock fisheries management.

7. Desirable rebuilding schedule of the stock

7.1. This topic was discussed under agenda item 5. Since there are concerns about the changed conditions and the impact of highly variable recruitment for Aleutian Basin pollock, the workshop recommended that the rebuilding level should be reevaluated as needed (see paragraph 5.3). An exact schedule for attaining high stock sizes is difficult to detail due to the unpredictability of year-class strength.

8. Effects of different levels of AHL on the rebuilding schedule of the stock

8.1. The US party proposes that for the purposes of having a reasonable expectation of recovering pollock within the convention area, having a rebuilding target set high (as in option 1, with a 2 million t biomass target) would provide the most likely scenario for achieving the levels of catches observed in the convention area during the 1980s. However, they note that there is a large degree of uncertainty in this rebuilding effort since anomalous year-classes such as the 1978 event are unpredictable and likely a consequence of complex ecosystem and environment interactions.

9. Biological relationships between the Aleutian Basin pollock stock and those in the adjacent waters

9.1. Steve Barbeaux presented WP-5 which provided background on recent developments on stock assessment modeling for the Aleutian Islands region. In this assessment, the authors recognized that many catches were outside of the coastal areas that were covered by the main summer-time bottom trawl surveys. Dr. Choi (ROK) noted that the research done by the RV Tamgu 1 covered areas in the Convention area in the late 1990s and found no echosign of pollock. This report was presented at the 2000 CBS workshop and is available online.

9.2. It was noted that in the early 1990s Japan conducted EIT surveys and found little pollock in the region south of Bowers Ridge. This suggests that the pollock found around the Bowers Ridge area is unlikely to be part of the Aleutian Islands group and may belong to the Aleutian Basin pollock stock.

9.3. Dr. Ianelli presented an overview of EBS pollock on the shelf with particular reference to current patterns in fishing concentrations by region and within seasons (WP-6).

9.4. Dr. Stepanenko presented survey results of pollock from the Eastern and Western Bering Sea shelf (WP-11). The abundance of young-of-year in Anadyr Bay are comparable to Bristol Bay in 2003 and that recruitment could be derived from these regions to respective areas. However, recognition of these potential components is not possible in 2004.

9.5. Dr. Vasilyev presented a stock assessment model for the Navarin area (separable cohort model, WP-12). This approach includes many sources of information (two young-fish surveys, age structure, two CPUE indices (partitioned by vessel size classes), catch-at-age, and an age-zero survey. The model was introduced at ICES and should be useful for any stock in the Bering Sea and an appendix detailing the model configuration was also provided to the workshop (appendix to WP-12). They are also doing joint-research with Norway in order to create a joint model for herring stock assessment, partially based on robust properties of the above model. Confidence bounds were computed based on bootstrap methodology.

9.6. In summary, the biological relationships between Aleutian Basin pollock and surrounding areas are not well understood. Pollock are known to be one of the main biological components of the ecosystem for these regions and that further study on potential impacts is warranted.

10. Effects of fishing outside the central Bering Sea Convention Area on the status, biomass, and trend of the Aleutian Basin stock

10.1. The Russian party noted that the "shelf" and "basin" (Bogoslof) pollock is thought to inhabit the shelf area as juveniles (prior to first maturation). The fisheries in these regions attempt to avoid these small immature fish since they are not marketable. Therefore the total catch of "Basin" pollock on the shelf is relatively low.

10.2. They further noted that if Bogoslof pollock abundance is high, the bycatch in shelf fisheries is unlikely to have a large influence. If Bogoslof abundance is low, the bycatch is likely to be low on the shelf and hence have minimal impact on the "Basin" stock. Some participants conclude that fishing effort outside of the Convention area have little impact on Aleutian Basin pollock.

10.3. The Japanese party expressed the opinion that the bycatch levels from adjacent fisheries may impact Aleutian Basin pollock and also that predation on pollock by other animals and competition for food should also be considered.

11. Other scientific factors that are considered relevant

11.1. No papers were presented under this topic. There was some discussion that addressing ecosystem effects (in particular, trophic interactions) in the Aleutian Basin region and surrounding areas would be useful. Environmental changes were also discussed as playing an important role.

12. Recommendations to the Scientific and Technical Committee on Determination of AHL

12.1. All parties reviewed methodologies for calculating AHL on the basis of ABC and agreed that the present procedure for calculating ABC used in the USA is appropriate and also should be applied to the Aleutian Basin pollock stock given its current condition.

12.2. Some parties proposed that in order to determine the transformation from ABC to AHL new information about the distribution of pollock in the Aleutian Basin is needed. The workshop recommends that the committee consider their proposals about possible approaches for collecting such information including the proposal of the Russian party for an international survey effort (BAPIS).

Workshop for Genetic Research on Pollock Resources in the Central Bering Sea June 6-9, 2005 Seattle, Washington USA

1. Introductions and Election of Meeting Officials

1.1. The meeting nominated L. Low as meeting chair and I. Spies as rapporteur with assistance from each party.

1.2. The agenda was agreed upon by all parties.

2. Review of Current Information and Research

2.1. M. Canino (AFSC) put together a list of studies on Pollock genetic stock structure (WP-8). Earlier studies using allozymes and mtDNA may represent mixed stocks because they were not taken during spawning season. Studies of Atlantic cod have shown considerable genetic differentiation between spawning groups, and thus it would be worth while to re-examine stock structure of other gadids. Russian party inquired how many samples were used in they study and where the NCBS sample was collected (in September by a US catcher-processor, slightly northwest of the donut hole).

2.2. The Russian party presented 'Microsatellite analysis of population structure of Bering Sea Pollock' (WP-10). They found weak but significant structuring, using nine microsatellite loci. The North Kuril grouping appears genetically distinct, as do the East Bering Sea samples. There was some discussion on sampling and analysis with U.S. party and Japanese party.

2.3. Dr. Canino discussed his work on gene frequency stability over time using work on both microsatellite and pantophysin. More discussion centered on the question of genetic differentiation between year classes.

2.4. The Japanese party presented work they had done on walleye pollock (WP-13) by mtDNA sequencing of the mitochondrial control region, plus mtDNA, RFLP, and SNP analysis of the Calmodulin gene. Sampling locations ranged from Japan to Shelikov Strait. The mtDNA analyses found an east-west split, between Japan and the Bering Sea. SNP analysis of the Calmodulin gene indicated three major clusters: EBS, Japan, and WBS/Russia. Questions centered on desire for larger sample sizes in the future and historical explanations for observed broad scale genetic differentiation. The question of future work was brought up in order to ascertain with statistical confidence the population structure of walleye pollock and use the data for fisheries management.

2.5. Further discussion centered on the accuracy of genetic analysis and the desire to ascertain discrete population structure of walleye pollock, which to date has not been possible given various limitations (i.e., sample size, marker selection, funding, etc.).

3. Research Planning, Specimen Collection and Exchanges

3.1. The workshop began discussion on this agenda by first reviewing existing samples. The US scientists noted that they have genetic samples from spawning pollock aggregates from various locations including the Bering Sea dating back to 1997. These samples are available to any interested parties. The Russian scientists stated they have samples from the Western and Northern part of the Bering Sea and from the areas listed in WP-10, and that they are open to sharing samples. It was noted that 50-100 individuals should be collected from each spawning aggregation (or sampling location), in order for them to be representative. Any tissue will be sufficient (muscle/bones/fin clip), but fish should be sampled within a half an hour or so of death.

3.2. Sample preservation in ethanol can last typically for 3-5 years, but in some cases as long as 30 years. Preservation of DNA is best done in -80°C freezer. It was noted that samples preserved for more than 5 years, can result in "noise" in the microsatellite loci. Some genetic research has been successful on herring scale samples that were in storage for about 30 years. Many times scales are stored dry and that this can degrade the sample quality. It was noted that properly preserved otoliths could be used for genetic analysis as long as there is sufficient tissue left on the otolith and that microsatellite analysis is more robust than allozyme analysis because the sampling requirements are not as stringent. Fin clips are easy to take in the field and are good for DNA extraction. SNPs should work the same as nuclear analysis. The Poland scientist noted that they have some otoliths from the past fishery operations on pollock in the CBS, EBS, Aleutian Islands, and GOA since 1978. Similar collections are also likely available from Korean research cruises. The US party noted that they have opportunities to collect fin clips from fisherman but that such cooperative agreements usually require producing results fairly quickly (within several years).

3.3. Ichthyoplankton surveys should be pursued as another source of DNA (ensuring that the eggs/juveniles are pollock). The BASIS surveys may be a possible source of samples. The Japanese scientists noted that they may have juvenile pollock samples collected in recent years.

3.4. The need for a definitive study on pollock was highlighted. It was noted that a definitive study would entail having 20 good microsatellite markers and multi-year samples from spawning pollock collected in all the main areas.

3.5. The issue of using of muscle tissue and more easily collected samples (e.g., fin clips) was discussed at length. The Japanese scientists stated that they had some difficulties extracting DNA from the fin clips they received from the AFSC. They had no problems extracting DNA from muscle and thus would prefer this type of sample. The main advantage for using fin-clips is the ease of collection. While both tissue types can be used, where possible the workshop felt that innovative sampling approaches (e.g., simply taking muscle tissue with each otolith collection) should be pursued.

3.6. The issue on the need to focus attention on developing better markers arose. WP-8 states that small sample sizes and samples from non-spawning individuals were possible issues related to the lack of differentiation between Bogoslof pollock and that from surrounding areas. The lack of sufficient markers was listed as another possible issue. This question of criteria to use to determine if different stocks exist was raised. Evidence for genetic differentiation implies a self recruiting, genetically distinct stock. If one is able to provide evidence that genetic differentiation is constant over time, then that is evidence of genetic differentiation. Typically, however, discrete boundaries do not exist in marine fishes. Instead, there is often isolation by distance and some sort of cline in genetic characteristics. As an example, the AFSC recently completed a genetic analysis of Atka mackerel in the Aleutian Islands using nine microsatellite loci. Four locations were sample with results of a high degree of correct classification to region (76-80% certainty location of origin). This study suggests that since similar methods are being used for pollock, the genetic markers that were used should be adequate.

3.7. The issue on the ability of genetic research to address questions on the degree to which the Bogoslof population represents the entire Aleutian Basin pollock was discussed. It was pointed out that distinguishing Aleutian Basin pollock from EBS and other areas is largely a different issue than understanding the relative abundance between the Aleutian Basin stock and the Bogoslof portion of that stock during the winter spawning aggregations. Analysis of historical collections may provide some new insights on genetic discretion of the Bogoslof region as compared to the pollock from the Aleutian Basin and other regions.

4. Recommendations to the Scientific and Technical Committee

4.1. *Historical specimen availability.* The workshop recommends that parties to the Convention develop an inventory of historical samples. It is envisioned that these data will be presented and updated eventually to be available on a website. The data should include basic information such as geographic position, the storage method, date collected, and availability of subsidiary data (e.g., age, length, sex, gonad maturity, etc.).

4.2. *Current and planned research.* The workshop recommends that parties present a report on the ongoing and planned activities on genetics research related to pollock. This should be broken into three main areas: current sample collection and processing efforts, historical sample analysis, and research on developing new markers or methods. This will help guide areas where research is lacking and inform on activities around the region.

4.3. *Development of baseline research.* The workshop encouraged member countries to pursue research on improving genetic markers for pollock. The use of alternative markers will help improve the understanding of how stocks are related.

4.4. *Sample exchange.* The workshop recommends that sample-exchange among member parties be facilitated.

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Agenda

Day 1 (June 6, 2005):

1. Introductions and Election of Meeting Officials
2. Health, status and trends of the Aleutian Basin pollock stock
3. Present biomass level of the stock
4. Safe exploitation rates on the stock
5. Anticipated exploitation rate of different AHLs on the stock
6. Biological reference biomass levels for the stock; such as minimum biomass, $B_{40\%}$, B_{msy} and optimum biomass

Day 2 (June 7, 2005):

7. Desirable rebuilding schedule of the stock;
8. Effects of different levels of AHL on the rebuilding schedule of the stock;
9. Biological relationships between the Aleutian Basin pollock stock and those in the adjacent waters;
10. Effects of fishing outside the central Bering Sea Convention Area on the status, biomass, and trend of the Aleutian Basin stock; and
11. Other scientific factors that are considered relevant

Day 3 (June 8, 2005, morning session)

12. Recommendations to the Scientific and Technical Committee on Determination of AHL
13. Summary Report of the Workshop

Workshop for Genetic Research on Pollock Resources in the Central Bering Sea

Day 3 (June 8, 2005, afternoon session):

1. Introductions and Election of Meeting Officials
2. Review of Current Information and Research

Day 4 (June 9, 2005):

3. Research Planning, Specimen Collection and Sample Exchanges
4. Recommendations to the Scientific and Technical Committee
5. Summary Report of the Workshop

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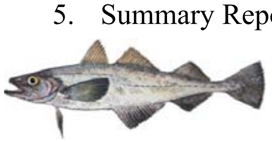
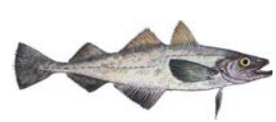


Final version

List of documents

AHL Meeting Report	AHL Meeting Report
Genetics Meeting Report	Genetics Meeting Report
Background and Draft Agenda	WP-1
List of documents	WP-2
Preliminary report on the 2005 Bogoslof EIT survey	WP-3
Approaches for setting ABC in the Bogoslof Region under US Fishery Management practices	WP-4
Recent research activities and stock assessment approaches for the Aleutian Islands region	WP-5
Update on the status of Eastern Bering Sea pollock	WP-6
Review of the NPFMC approach for setting ABC and OFL levels and levels set for 2005 and 2006	WP-7
Summary of genetic stock identification studies in the Bering Sea	WP-8
List of Participants	WP-9
Microsatellite analysis of the population structure of the Bering Sea pollock	WP-10
Status of stocks and reproduction of the Eastern Bering Sea pollock (*Theragra chalcogramma*) in 2003-2005	WP-11
Update of Navarin walleye pollock stock assessment (including an appendix of ISVPA model)	WP-12
Summary of DNA analyses of pollock by Japanese scientist 2005	WP-13



Preliminary results of the 2005 Bogoslof EIT pollock survey

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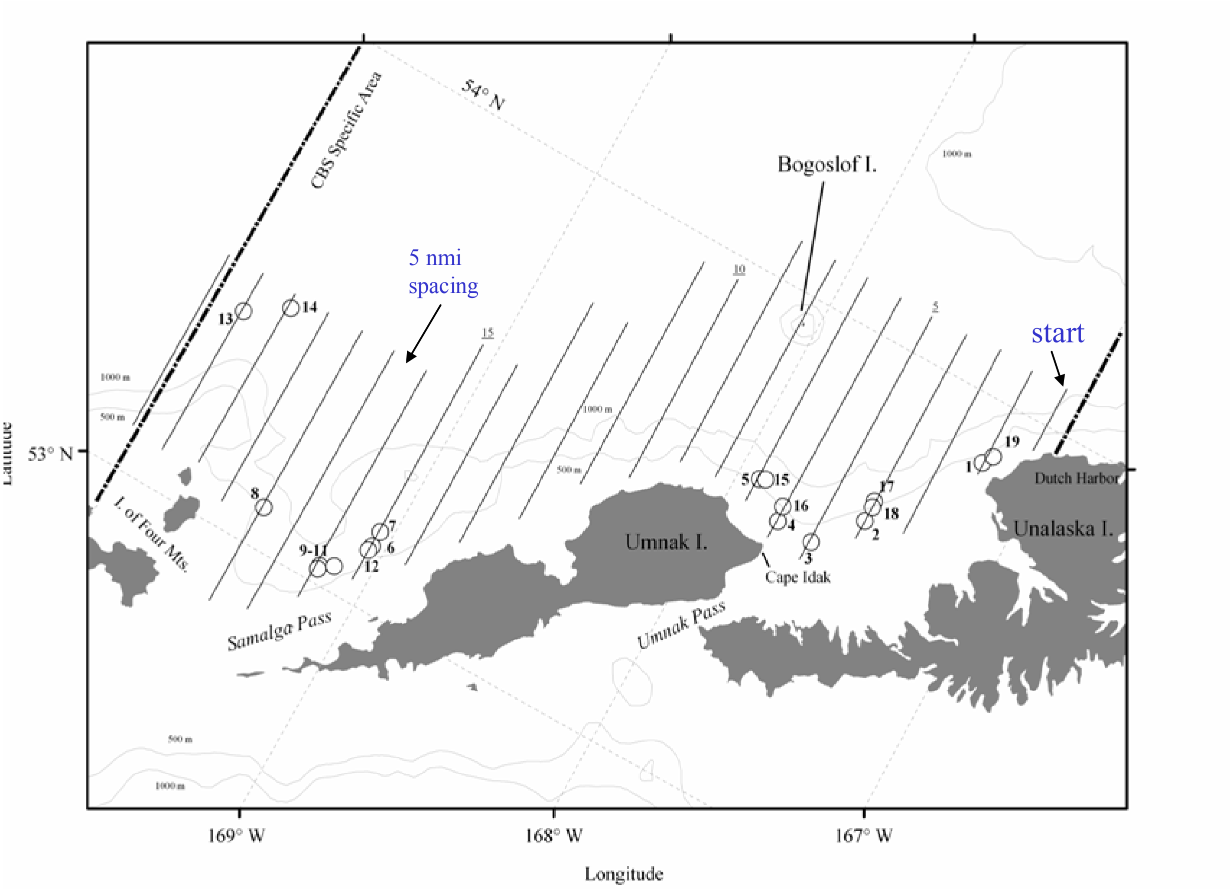

Figure 1. Trackline (22) and haul location (19 circles) from the winter 2005 echo integration-trawl survey in the Bogoslof Island area. Transect numbers are underlined. The dash-dotted line indicates the NPFMC Area 518/Central Bering Sea Specific Area.

Table 1.--Catch by primary species from 19 midwater trawl hauls during the winter 2005 echo integration-trawl survey of walleye pollock in the Bogoslof Island area.

Species Name	Scientific Name	Weight (kg)	Percent by weight	Numbers
walleye pollock	***Theragra chalcogramma***	**14,489.28**	**94.3**	**12,009**
Pacific ocean perch	*Sebastes alutus*	616.51	4.0	625
*other		255.45	1.7	13,137
		15361.24		25,771

* mostly lanternfish

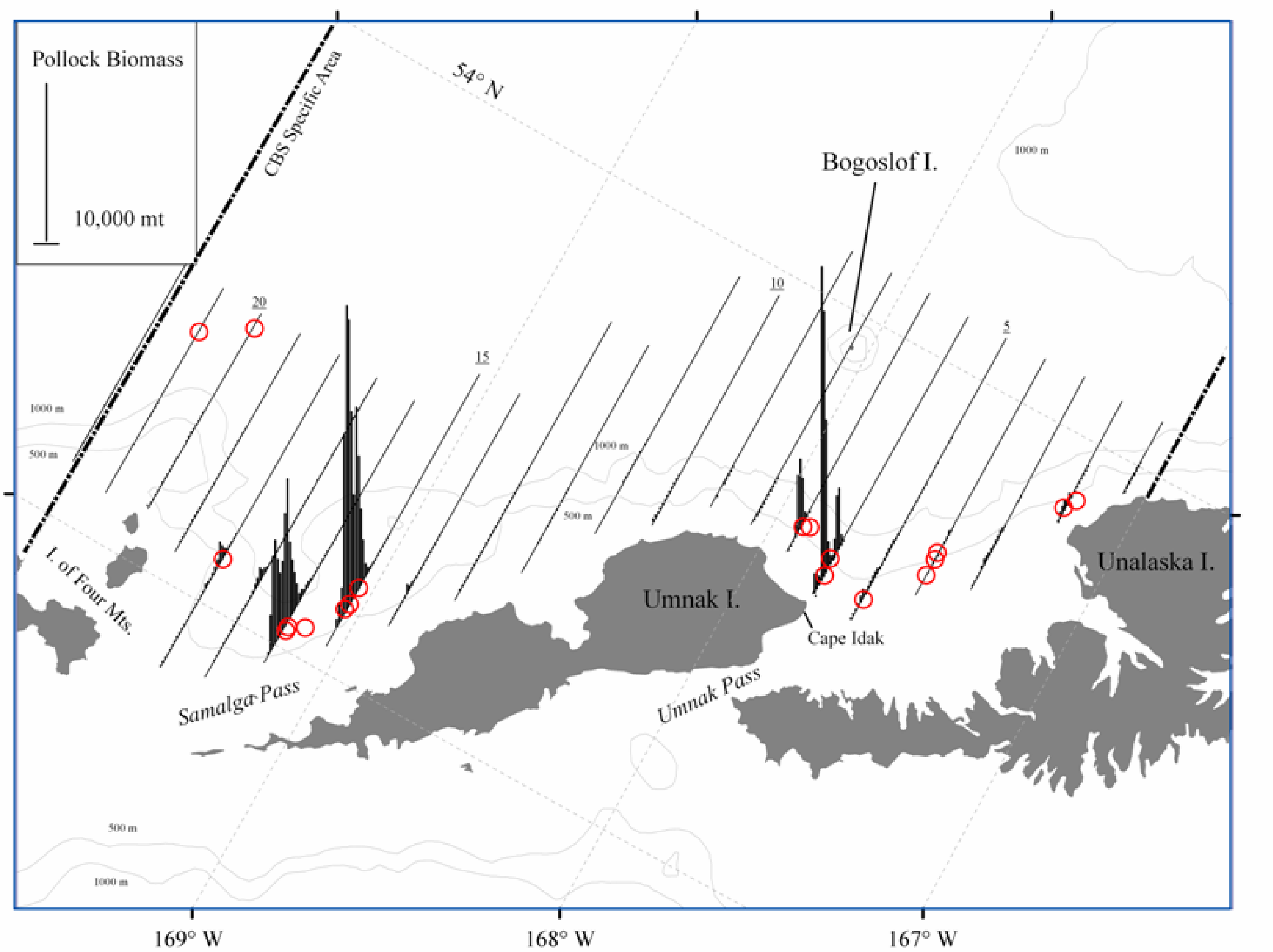

Figure 2. Trawl haul location (circles) and biomass (10,000 metric tons) attributed to pollock observed during the winter 2005 echo integration-trawl survey in the Bogoslof Island area.

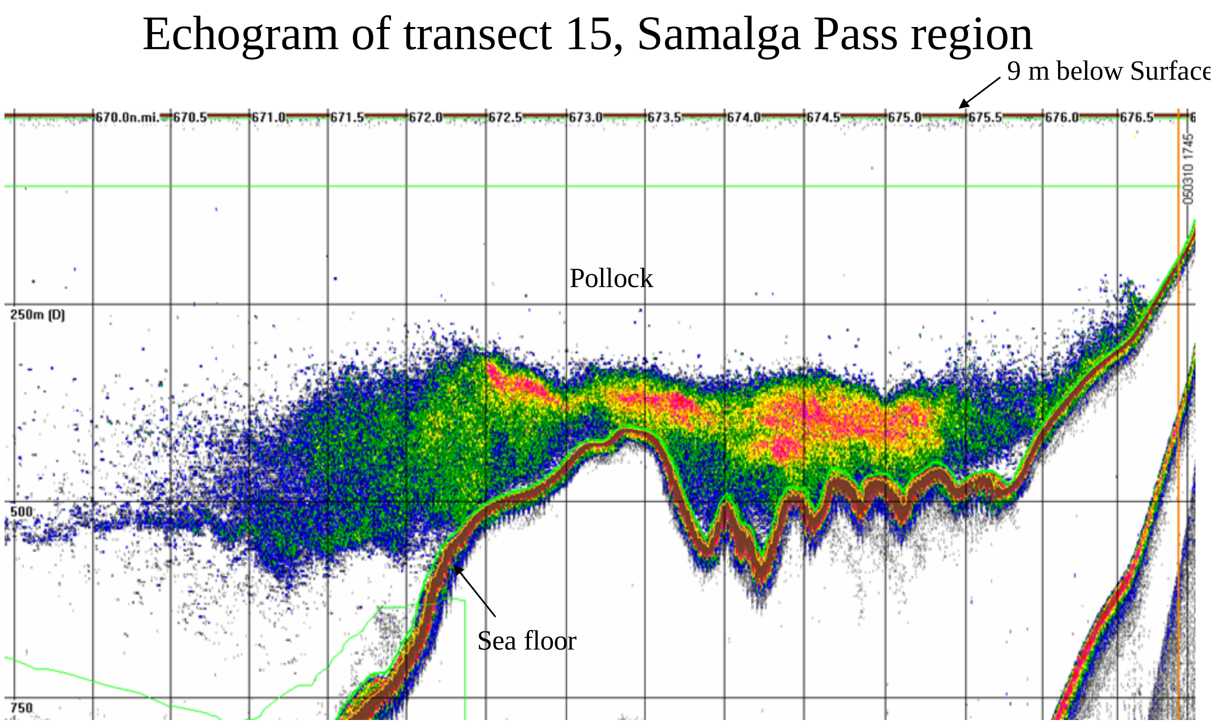

Figure 3. Pollock backscatter along transect 15, Samalga Pass region, where 3 trawl hauls were conducted.

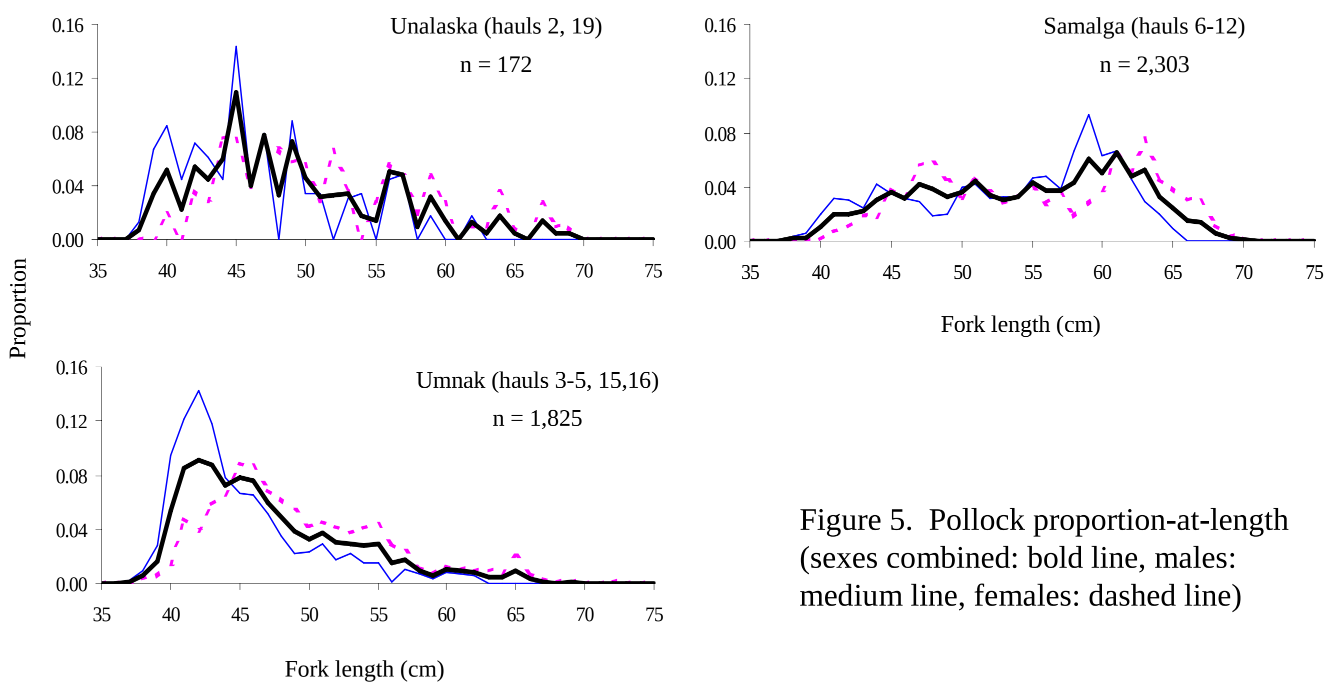

Figure 5. Pollock proportion-at-length (sexes combined: bold line, males: medium line, females: dashed line)

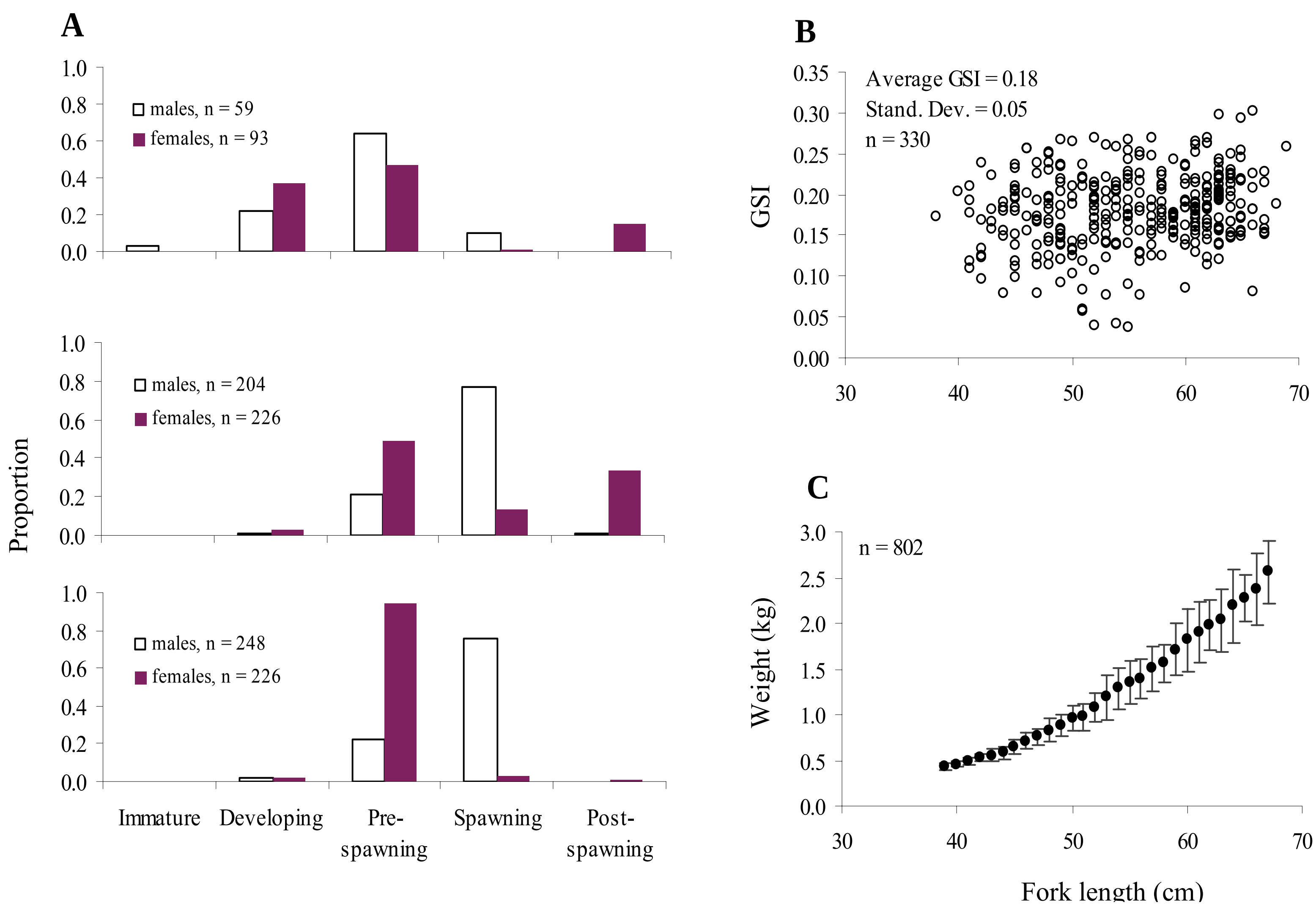

Figure 4. Pollock maturity stages for strata 1-3 (A), gonado-somatic index (GSI) for pre-spawning females as a function of fork length (cm) (B), and mean weight at length, where at least 5 fish were measured (sexes combined) (C). Vertical bars indicate one standard deviation.

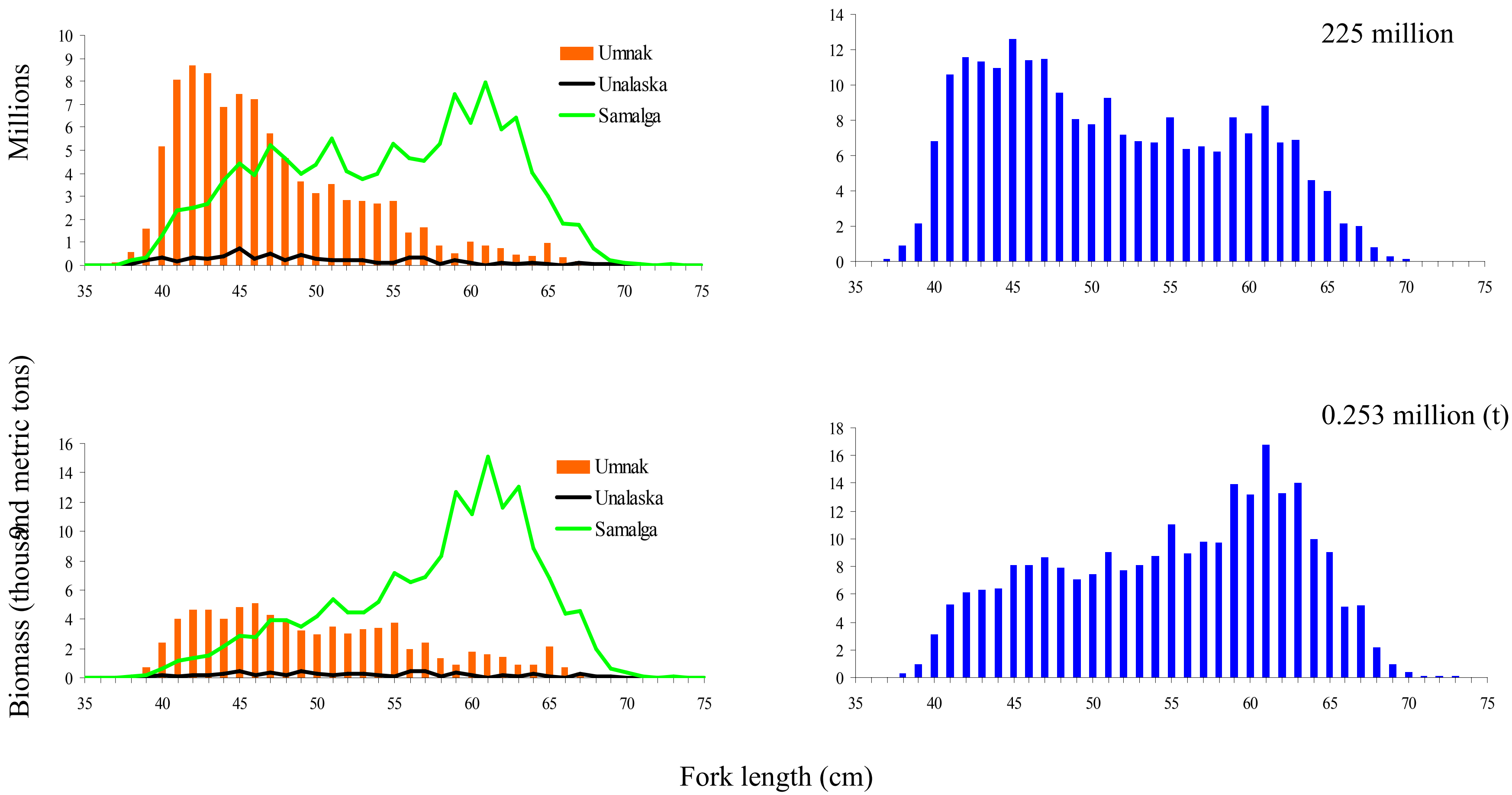

Figure 6. Population-at-length (top) and biomass-at-length (bottom) estimates from the winter 2005 echo integration-trawl survey of walleye pollock in the Bogoslof Island area.

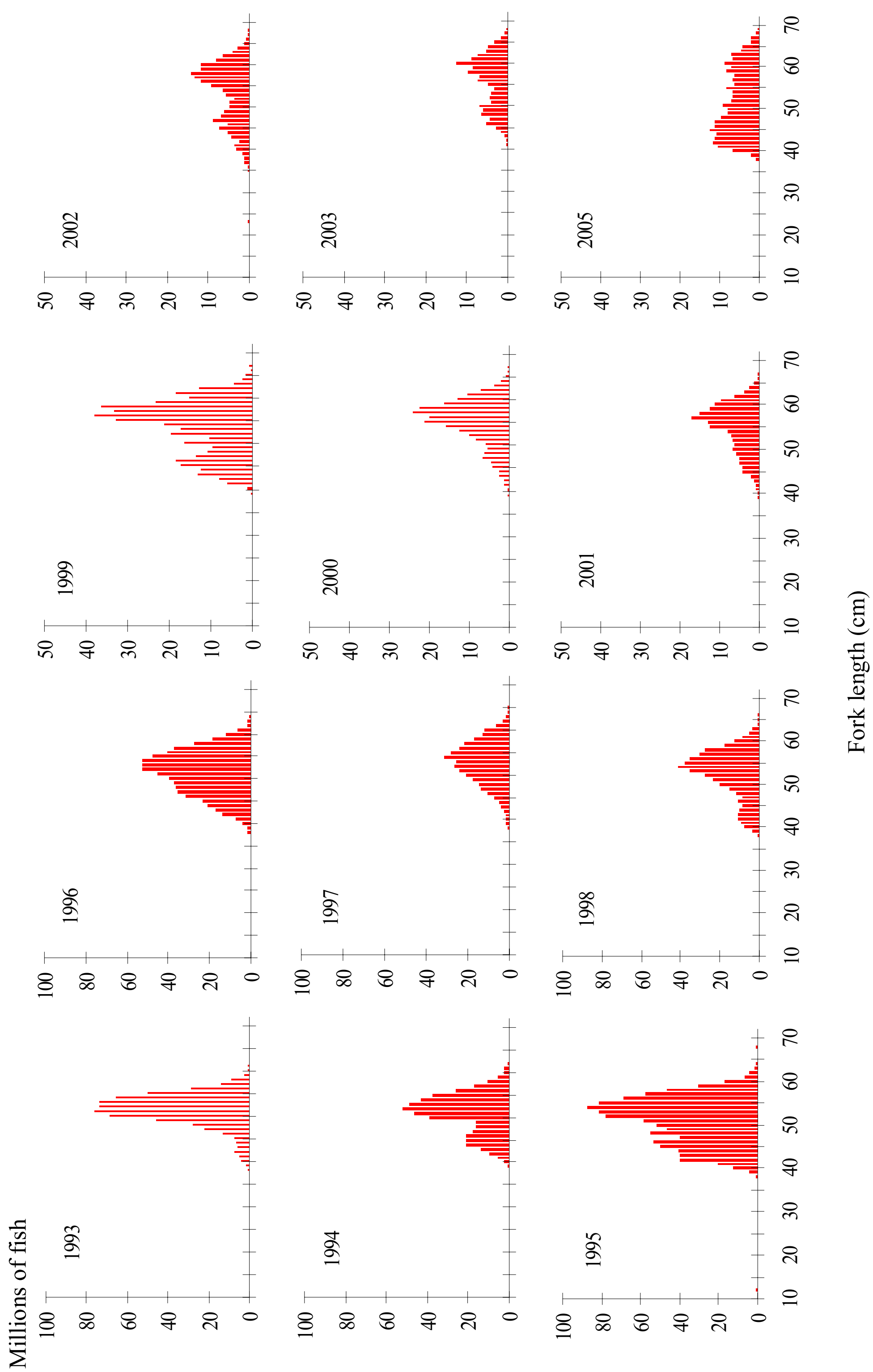

Figure 7. Numbers-at-length estimates (millions) from echo integration-trawl surveys of spawning pollock near Bogoslof Island in winter 1993-2005. The United States conducted all but the 1999 survey, which was conducted by Japan. Note y-axis scales differ.

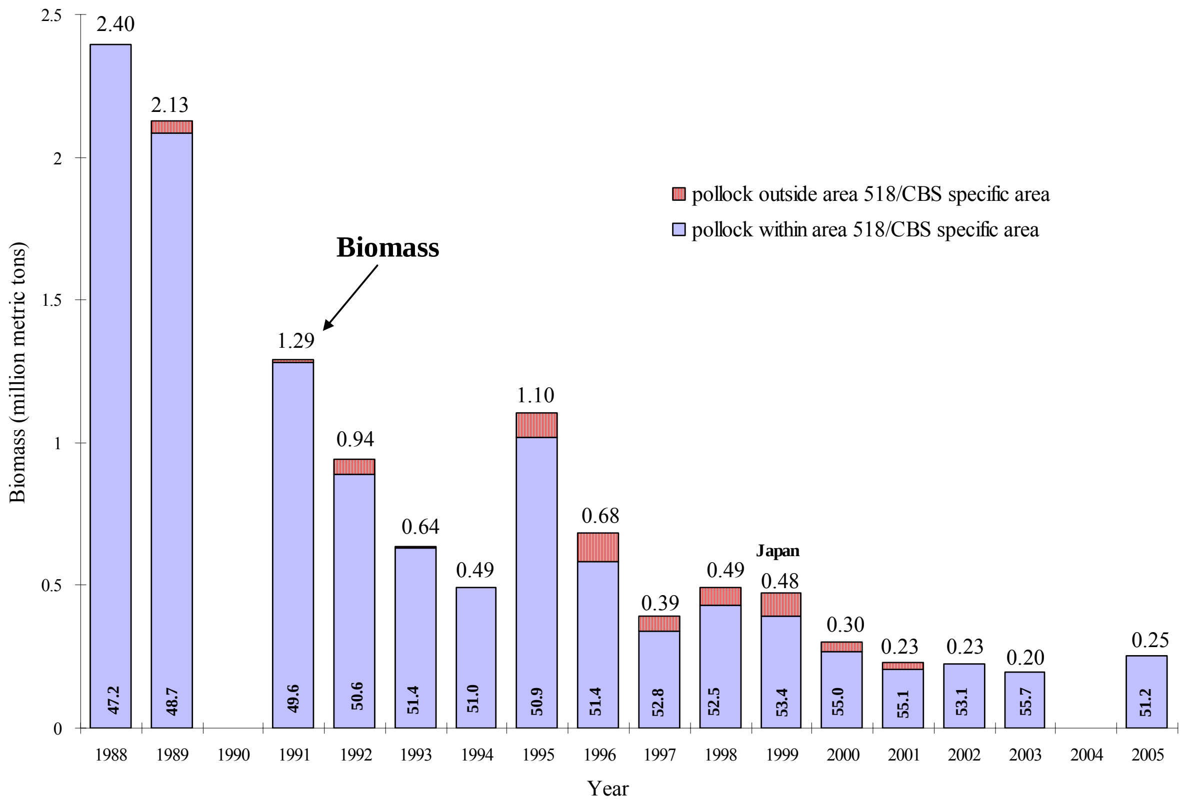

Figure 8. Biomass estimates (top of each bar) and average fork lengths (cm) (inside bar) obtained during winter echo integration-trawl surveys for walleye pollock in the Bogoslof Island area, 1988-2005. The U.S. conducted all but the 1999 survey, which was conducted by Japan.

Approaches for setting ABC in the Bogoslof Region under US Fishery Management practices

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Stock status summary

The National Marine Fisheries Service has conducted echo-integration-trawl (EIT) surveys for Aleutian Basin pollock spawning in the Bogoslof Island area annually since 1988, with three exceptions: a Bogoslof Island area EIT survey was not conducted in 1990, 2004 and in 1999 the survey was conducted by the Fisheries Agency of Japan. The annual Bogoslof Island area EIT survey results (Fig 1) show that population decline occurred between 1988 and 1994, was stable and variable then dropped again to the level it has maintained since 2000. The 2003 Bogoslof Island EIT survey results have been published as an AFSC Processed Report (McKelvey and Williamson 2003). The 1989 year class moved into the Bogoslof Island area and was partly responsible for the 1995 increase (Fig. 2), but the abundance of all ages increased between 1994 and 1995. The decrease between 1995 and 1996 was followed by a continued decline in 1997. This suggests that the 1995 estimate may have been over-estimated, or that conditions in that year affected the apparent abundance of pollock. The summary Bogoslof Island area EIT survey biomass estimates, 1988-2005, are shown in Table 1. The 1996 and 1999 year classes have thus far failed to materialized to any great extent in this region even though their abundance on the EBS shelf region is above average. The current population levels on the eastern Bering Sea shelf, and the absence of extremely large year classes, suggests that pollock distribution throughout the Bering Sea has shifted. The extent that this is due to environmental causes is unclear.

The information available for pollock in the Aleutian Basin and the Bogoslof Island area indicates that these fish belong to the same "stock". The pollock found in winter surveys are generally older than age 5 and are considered distinct from eastern Bering Sea pollock. Data on the age structure of Bogoslof-Basin pollock show that a majority of pollock in the Basin originated from year classes that were also strong on the shelf, 1972, 1978, 1982, 1984, 1989, 1992, and 1996 (Fig. 3). There has been some indication that there are strong year classes appearing on the shelf that have not been coincidentally as strong (in a relative sense) in the Bogoslof region (Ianelli et al., 2001). The conditions leading to strong year classes of pollock in the Basin appears to be density related and may be functionally related to abundance on the shelf. Additional information relating the total mortality of the 1992 cohort shows that the estimate is much higher than expected in the Bogoslof region compared to the EBS shelf (Fig. 4).

Differences in spawning time and fecundity have been documented between eastern Bering Sea pollock and Aleutian Basin pollock. Pollock harvested in the Bogoslof Island fishery (Area 518) have noticeably different age compositions than those taken on the eastern Bering Sea shelf. For example, the average number of age 15 and older pollock observed from the Bogoslof EIT survey since 1988 is 18% while for the same period in the EBS region, age 15 and older averages only 2% (by number for all fish older than age 7). Pollock in the northern shelf have a similar size at age as Aleutian Basin pollock although a very different age composition. However, Aleutian Basin pollock may not be an independent stock. Very few pollock younger than 5 years old have ever been found in the Aleutian Basin including the Russian portion. Recruits to the basin are coming from another area, most likely the surrounding shelves either in the US or Russian EEZ.

Computation of ABC and OFLs

Since 1999 the North Pacific Fishery Management Council (NPFMC) have generally been presented with a number of alternative methods for computing ABC values for the Bogoslof region. These have included:

1) Using a biomass-adjusted harvest rate rule (with 2,000,000 ton estimate as a target stock size) with an estimate of a F_{ABC} based on growth, natural mortality, and maturation rate.
2) Using a harvest rate as a simple fraction of natural mortality rate (e.g., F_{ABC} =0.75M) .
3) An approach using a simple age-structured model.

The NPFMC Science and Statistical Committee (SSC) considered the third approach using an age-structured model to be inappropriate since it covered only part of the stock. The approach 1) and 2) above are provided below for comparison (along with alternative assumptions about F_{ABC} level for 1). The section included in this document reviews the details of the current NPFMC's Tier system for setting ABCs and OFLs.

Using method 1) above and given the survey estimate of exploitable biomass of 0.253 million t and M = 0.2 and considering of a target stock size of 2 million tons, the F_{ABC} level is computed as:

$$F_{abc} \le F_{40\%} \bullet \left(\frac{B_{2005}}{B_{40\%}} - 0.05 \right) \Big/ \left(1 - 0.05\right) .$$

Assuming that $F_{40\%}$ = 0.27 (as in past assessments), this gives a fishing mortality rate of 0.0217 that translates to an exploitation rate of 0.0215. This value multiplied by 253,000 t, gives a **2006 ABC of 5,501 t for the Bogoslof region.** The value assumed for $F_{40\%}$ that is critical for this calculation was based on uncertain assumptions about selectivity, natural mortality, growth, and maturation. Some of these assumptions were reevaluated here using a simple knife-edged selectivity at age 4 and age 5. Female pollock were specified to be 50% mature by age 5 and immature for younger pollock and 100% mature for older pollock with a natural morality of 0.3. This results in an $F_{40\%}$ level of 0.22 for age-4 knife edge assumption and $F_{40\%}$ = 0.33 for the age-5 knife-edge assumption. These two scenarios provide ABCs for 2006 that would be 4,482 t or 6,723 t for the age-4 and age-5 knife edge assumptions, respectively. Clearly, these rules are sensitive to assumptions about expected selectivity, assumed growth, natural mortality, and maturation rates.

The approach for computing ABC levels under 2) above (a Tier 5 computation) simply uses the most recent survey biomass estimate applied to an adjusted natural mortality. Given a value of M=0.3 then the ABC level would be (2005 survey biomass $\times M \times$ 0.75) of **56,925 t** at a biomass of 253,000 t. With M = 0.2, the ABC would be 37,950 t.

Further work on developing a simple age-structured model tuned to the EIT winter survey data (Fig. 5) suggest that, by the same NPFMC rules used for setting groundfish ABCs, the current Bogoslof stock size is about 75% of the target level ($B_{40\%}$) and that the "unfished" level (given observed recruitment at age 6 to this region) is approximately 330,000 t (female spawning biomass). This is substantially lower than the 1 million t "target" currently in use. Forward simulations using this model result (and fishing using the maximum permissible ABC) shows that the 90 percentile range of female SSB is between about 50,000 t and 430,000 t while under a no-fishing scenario, this range increases to nearly 1 million t (Fig. 6). This reflects the main characteristic that seems to prevail for basin pollock: they are highly susceptible to year-class variability.

In summary, there is a range of ABC levels that have been calculated under the NPFMC guidelines. The second approach results in the highest ABC level since the levels are not adjusted by some perceived target level. The first approach results in ABC levels that are nearly an order of magnitude lower due to the built-in adjustment to recover stock sizes to a target level. This approach was sensitive to assumptions about selectivity (and maturation rates). The age-structured model, while not accepted by the SSC due to stock structure concerns, could be argued to represent an alternative method to set ABCs and subsequent TACs. In practice, all of these approaches undergo scientific review each year in light of available data. The NPFMC has a record of being very conservative and setting a low ABC level and NMFS has responded by prohibiting any directed pollock fishery in this region.

Literature cited

Ianelli, J.N., T. Buckley, T. Honkalehto, N. Williamson and G. Walters. 2001. Bering Sea-Aleutian Islands Walleye Pollock Assessment for 2002. *In*: Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands regions. North Pac. Fish. Mgmt. Council, Anchorage, AK, section 1:1-105.

Ianelli, J.N.,S. Barbeaux, G. Walters, T. Honkalehto, and N. Williamson. 2004. Bering Sea-Aleutian Islands Walleye Pollock Assessment for 2004. *In*: Stock assessment and fishery evaluation report for the groundfish resources of the Bering Sea/Aleutian Islands regions. North Pac. Fish. Mgmt. Council, Anchorage, AK, section 1:37-126. http://www.afsc.noaa.gov/refm/docs/2004/EBSpollock.pdf

Table 1. Biomass of pollock as surveyed in the Bogoslof region, 1988-2005. Note that in 1999 the Fishery Agency of Japan conducted the survey.

Biomass (millions of t)

Year: 1988	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
2.4	2.1	-	1.3	0.9	0.6	0.49	1.1	0.68

Year: 1997	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
0.39	0.49	0.48	0.30	0.23	0.23	0.20	-	0.253

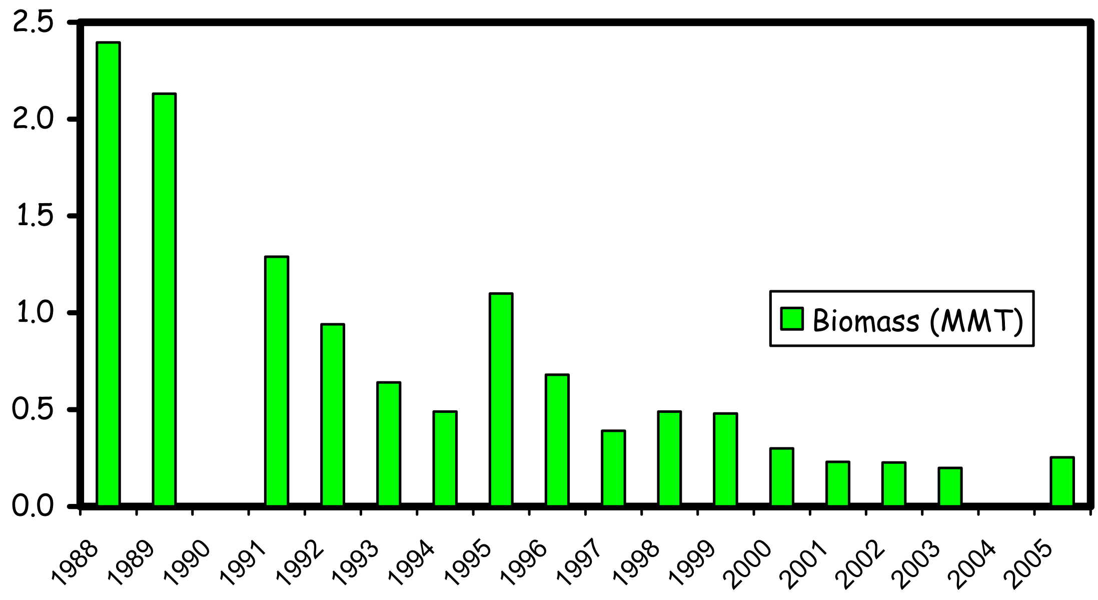

Figure 1. Pollock biomass estimates from the 1988-2005 Bogoslof Area EIT surveys in millions of tons. There were no surveys in 1990 and in 2004.

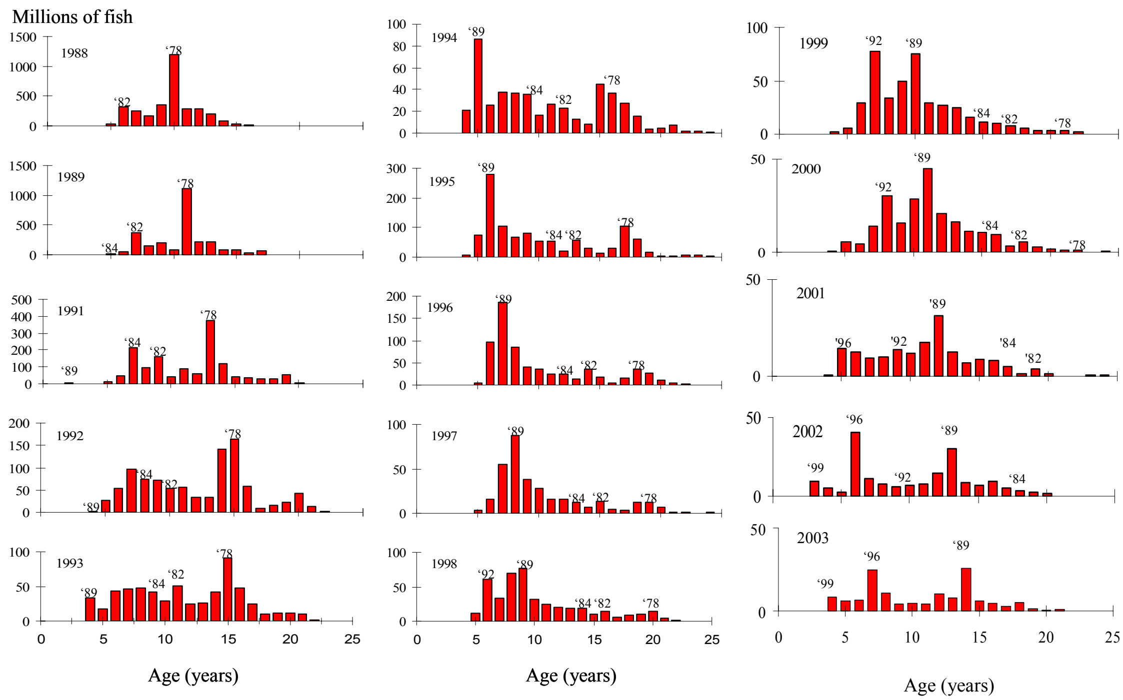

Figure 2. Numbers-at-age estimates (millions) obtained during echo integration-trawl surveys of walleye pollock near Bogoslof Island in winter 1988-2003. Major year classes are indicated. The United States conducted all but the 1999 survey (Japan). No survey was conducted in 1990. Note y-axis scales differ.

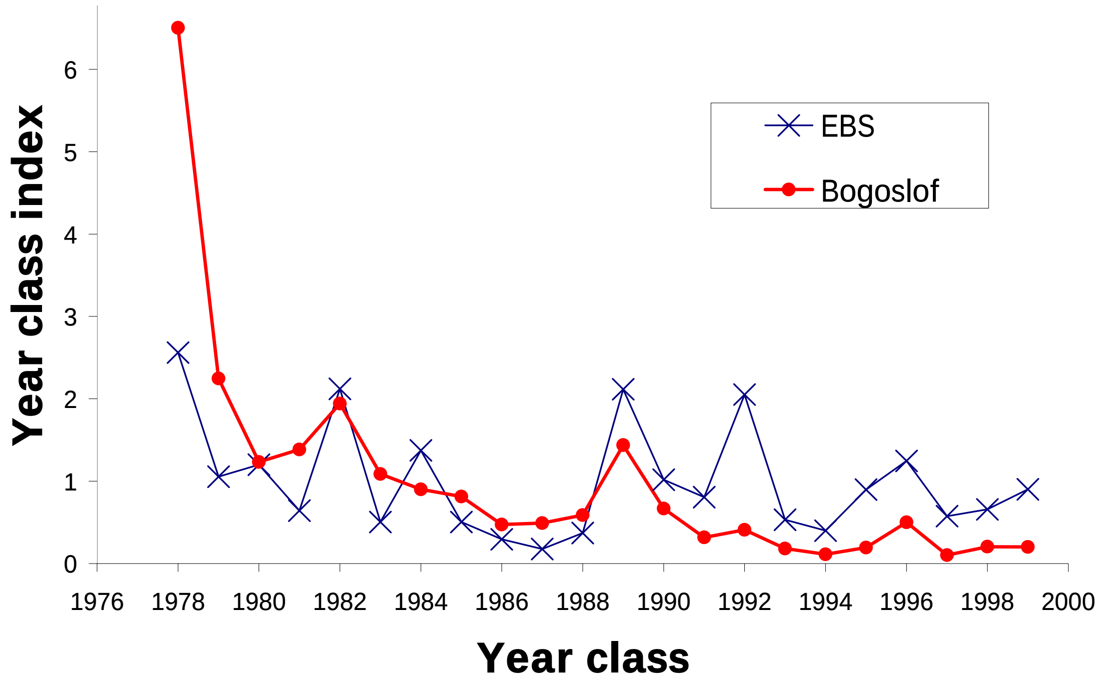

Figure 3. Relative year-class strengths (normalized to have a mean value of 1) for pollock as observed (averaged) from the Bogoslof EIT surveys and from a simple age-structured model for the Bogoslof Island stock compared with those observed from the main EBS pollock stock assessment model (Ianelli et al. 2004).

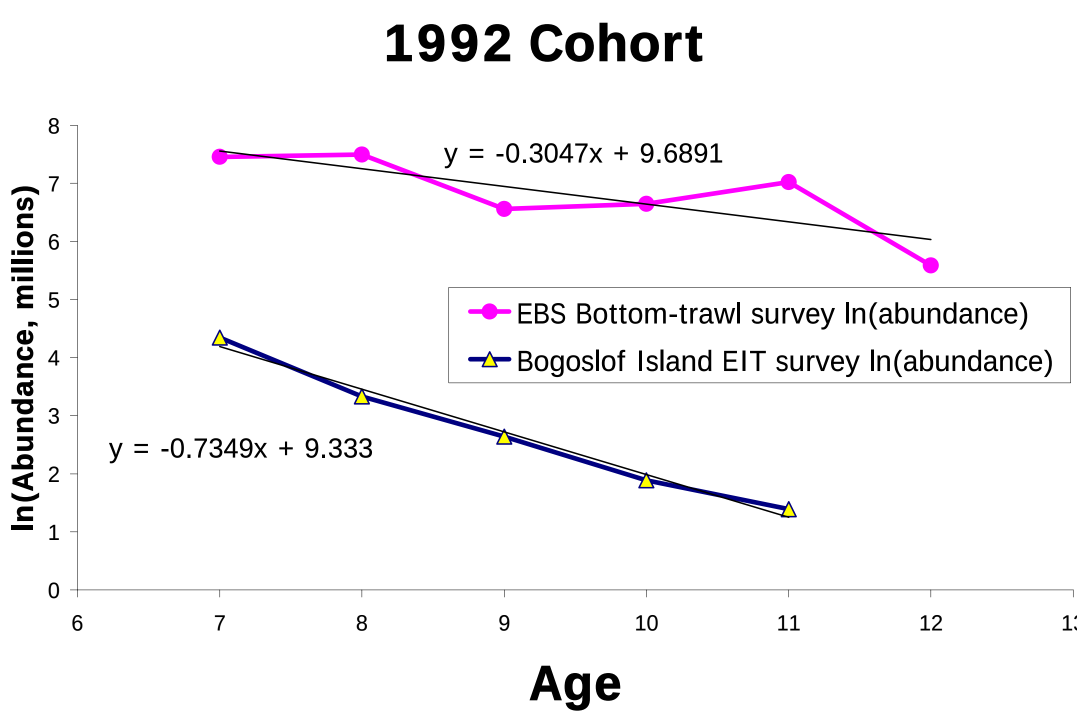

Figure 4. The 1992 pollock cohort abundances-at-age as observed from the EBS summer bottom trawl survey (top lines) and from the EIT survey in the Bogoslof region (lower lines).

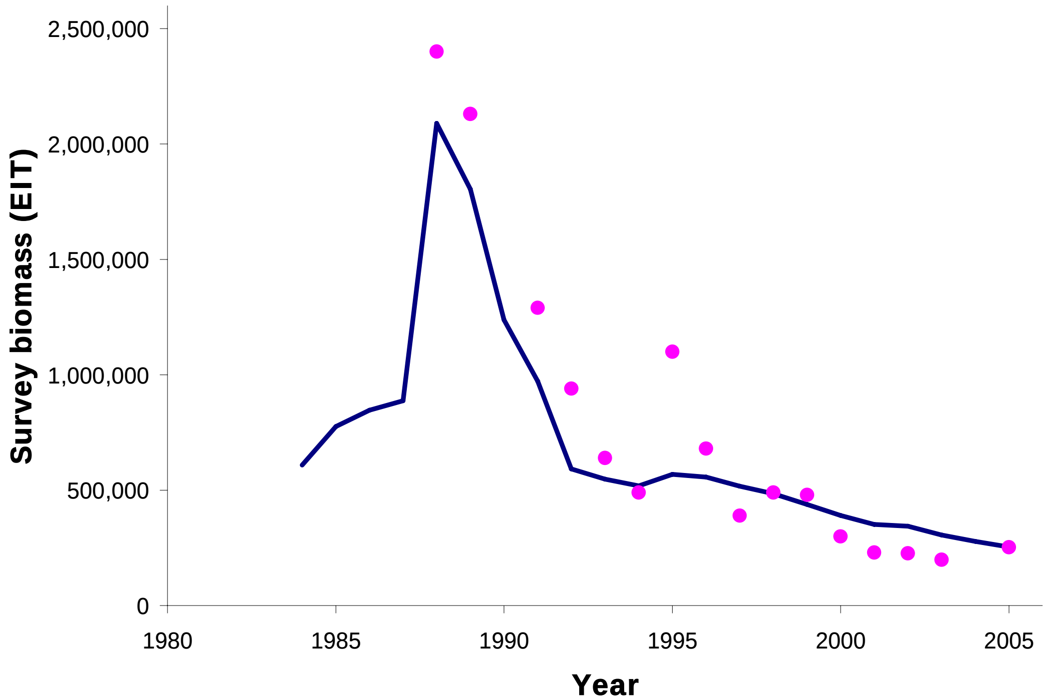

Figure 5. Simple age-structured model (line) tuned to the winter EIT Bogoslof pollock survey biomass estimates (points) 1984-2005.

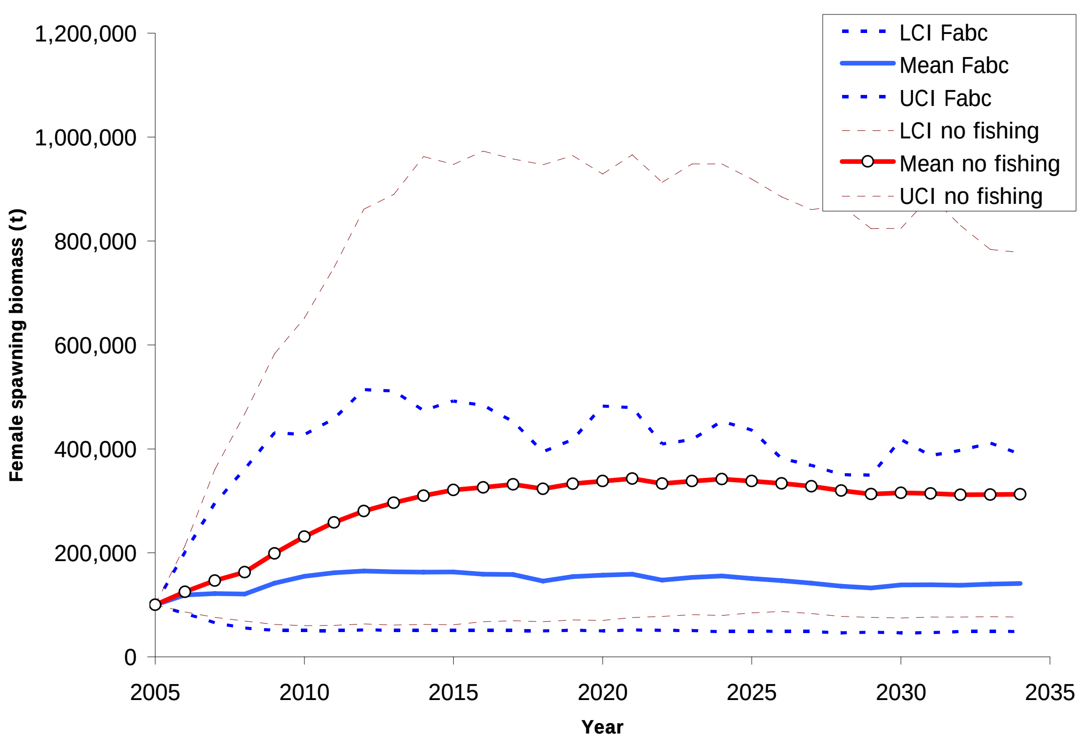

Figure 6. Projection simulations for Bogoslof region pollock based on the simple age structured model under no fishing and under fishing at the maximum permissible rate (as defined for the NPFMC for Tier 3 stocks).

Recent research activities and stock assessment approaches for the Aleutian Islands region

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The following is largely extracted from Barbeaux et al. (2004). See http://www.afsc.noaa.gov/refm/docs/2004/AIpollock.pdf for further details.

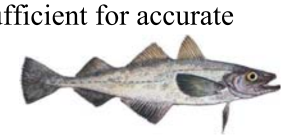
Walleye pollock are distributed throughout the Aleutian Islands with concentrations in areas and depths dependent on season. Generally, larger pollock occur in spawning aggregations during February – April. Three stocks of pollock are identified in the U.S. portion of the Bering Sea for management purposes. These are: eastern Bering Sea which consists of pollock occurring on the eastern Bering Sea shelf from Unimak Pass to the U.S.-Russia Convention line; the Aleutian Islands Region encompassing the Aleutian Islands shelf region from 170°W to the U.S.-Russia Convention line; and the Central Bering Sea—Bogoslof Island pollock. These three management stocks probably have some degree of exchange. The Bogoslof stock is a group that forms a distinct spawning aggregation that has some connection with the deep water region of the Aleutian Basin. Bailey et al. (1999) present a thorough review of population structure of pollock throughout the north Pacific region. Recent genetic studies using mitochondrial DNA methods have found the largest differences to be between pollock from the eastern and western sides of the north Pacific.

Previously, Ianelli et al. (1997) developed a model for Aleutian Islands pollock and concluded that the spatial overlap and the nature of the fisheries precluded a clearly defined “stock” since much of the catch was removed very close to the eastern edge of the region and appeared continuous with catch further to the east. In some years a large portion of the pollock removed in the Aleutian Islands Region was from deep-water regions and appear to be most aptly assigned as “Basin” pollock. This problem was confirmed and can be seen in the spatial distribution of historical catch patterns (Fig. 1). Hence, the data used here are organized to cover a region that is more consistent with survey observations and historical fishing patterns (Fig. 2).

The nature of the pollock fishery in the Aleutian Islands Region has varied considerably since 1977 due to changes in the fleet makeup and in regulations. During the late 1970s through the 1980s the fishing fleet was primarily foreign. In 1989, the domestic fleet began operating in earnest and has continued in the Aleutian Islands Region until 1999 when the North Pacific Fishery Management Council (NPFMC) recommended closing this region for directed pollock fishing due to concerns for Steller sea lion recovery. Length frequency data shows rather distinct characteristics when broken out by regions over this period (Fig. 3). There are notable similarities to the patterns over time for data from the eastern portion of the Aleutian Islands. This can also be seen from the mean-length of fish observed in the catch by these regions (Fig. 4). Another characteristic of the Aleutian Islands pollock is that mean length at age has changed substantially over time (Fig. 5). This pattern reflects the areas that are fished during these periods rather that actual changes in growth. I.e., during the early period, most of the pollock were caught towards the eastern edge of the Aleutian Islands region whereas the more recent period the pollock were from catch broadly distributed throughout the region.

The summer bottom trawl survey showed highly variable success in finding pollock in recent years, often with considerable concentrations toward the eastern edge (Fig. 6).

The R/V Kaiyo Maru conducted a survey between 170°W and 178°W longitude in the winter of 2002 after completing a survey of the Bogoslof region (Nishimura et al 2002; Fig. 7). Due to difficulties in operating their large mid-water trawl on the steep slope area they felt their catches in this area were insufficient for accurate



species identification and biomass estimation. They did however come up with some preliminary biomass estimations. For the entire area from 170°W and 178°W longitudes they estimated a biomass of 93,000 mt of spawning pollock biomass with between 61,000 mt estimated in the NRA east of 173°W and 32,000 mt in the remainder of the survey area to 178°W longitude. The largest aggregations in the NRA area were observed at 174°W longitude north of Atka Island. Most of the pollock echo sign was observed along the slope of the Aleutian Islands relatively near shore.

Process for setting ABC in Aleutian Islands

For many years, the Aleutian Islands pollock stock has lacked an age-structured model and the SSC has determined that the stock qualified for management under Tier 5 (see section below). In last year's assessment, preliminary explorations of several age-structured models were provided, all of which focused on the portion of the stock to the west of 174°W. For the 2004 management cycle, five alternative age-structured models were developed and evaluated. The 2004 assessment focused on two of those models, one of which (Model 1) uses data only from the portion of the stock to the west of 174°W, and the other of which (Model 1B) includes survey data from the entire Aleutian Islands management area. The Plan Team recommended the use of Model 1B, but due to the uncertainty in the survey catchability coefficient recommended setting the ABC below the maximum permissible level. The Plan Team, in their review of the assessment recommended setting the 2005 ABC at the equilibrium level associated with an $F_{40\%}$ harvest rate, which was 43,200 t.

The SSC determined that the Aleutian pollock stock did not qualify for management under Tier 3 and the stock remained at Tier 5. This was largely for concerns about conservation and acknowledged uncertainty that interacts with stock structure uncertainties and a reliable survey (summer bottom-trawl surveys done every other year are currently undertaken). The SSC therefore recommended a maximum permissible ABC for 2005 was computed as the product of the most recent survey biomass estimate (130,451 t) and 75% of the natural mortality rate (0.30), resulting in an ABC of 29,400 t, and an OFL of 39,100 t . The actual TAC was specified this year by congressional mandate at no more than 19,000 t. Under Tier 5, the stock is technically not evaluated for overfished determinations nor whether it is approaching an overfished condition. Nonetheless, based on the best available information the stock is not considered overfished nor is it approaching an overfished condition.

The 2005 Fishery

The directed Aleutian pollock fishery started in March, but little pollock was harvested. From 20 January – 15 April a total of 2,661 t of pollock were harvested in the Aleutian area out of the total 9,250 t first-season TAC. Preliminary reports from fishermen indicate that there was not adequate pollock sign outside of designated Steller sea lion critical habitat closure areas to justify continuation of the fishery in the first season. Also reported was large quantities of Pacific ocean perch in both the echosign and bycatch in the areas that vessels were allowed to fish. Since this was intended as primarily a roe-fishery, it is expected that much of the 2005 second-season TAC of 9,250 t will not be caught.

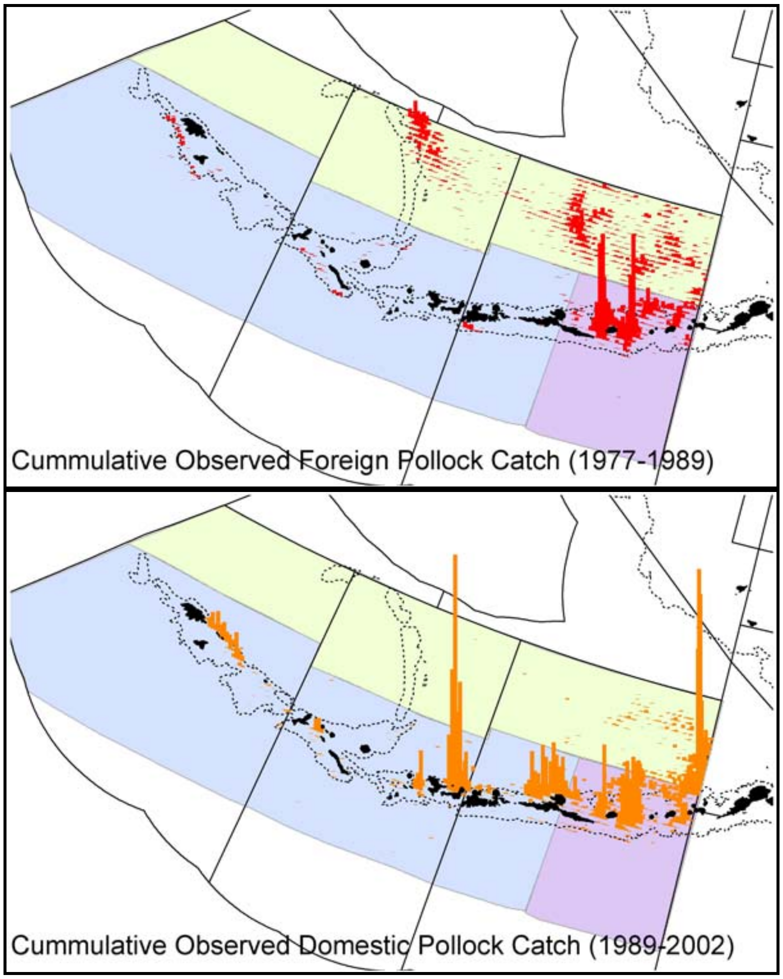


Figure 1. Observed foreign and J.V. (1978-1989), and domestic (1989-2002) pollock catch in the Aleutian Islands Area summed over all years and 10 minute latitude and longitude blocks. Both maps use the same scale (maximum observed catch per 10 minute block: foreign and J.V. 8,000 t and Domestic 19,000 t). Catches of less than 1 t were excluded from cumulative totals.

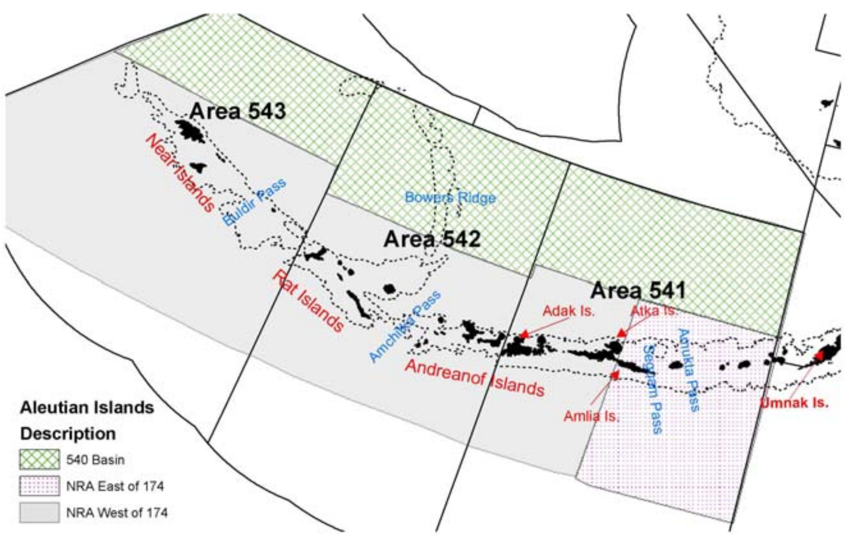


Figure 2. Regions defined for consideration of alternative data partitions for Aleutian Islands Region pollock. The abbreviation “NRA” represents the Near, Rat, and Andreanof Island groups.

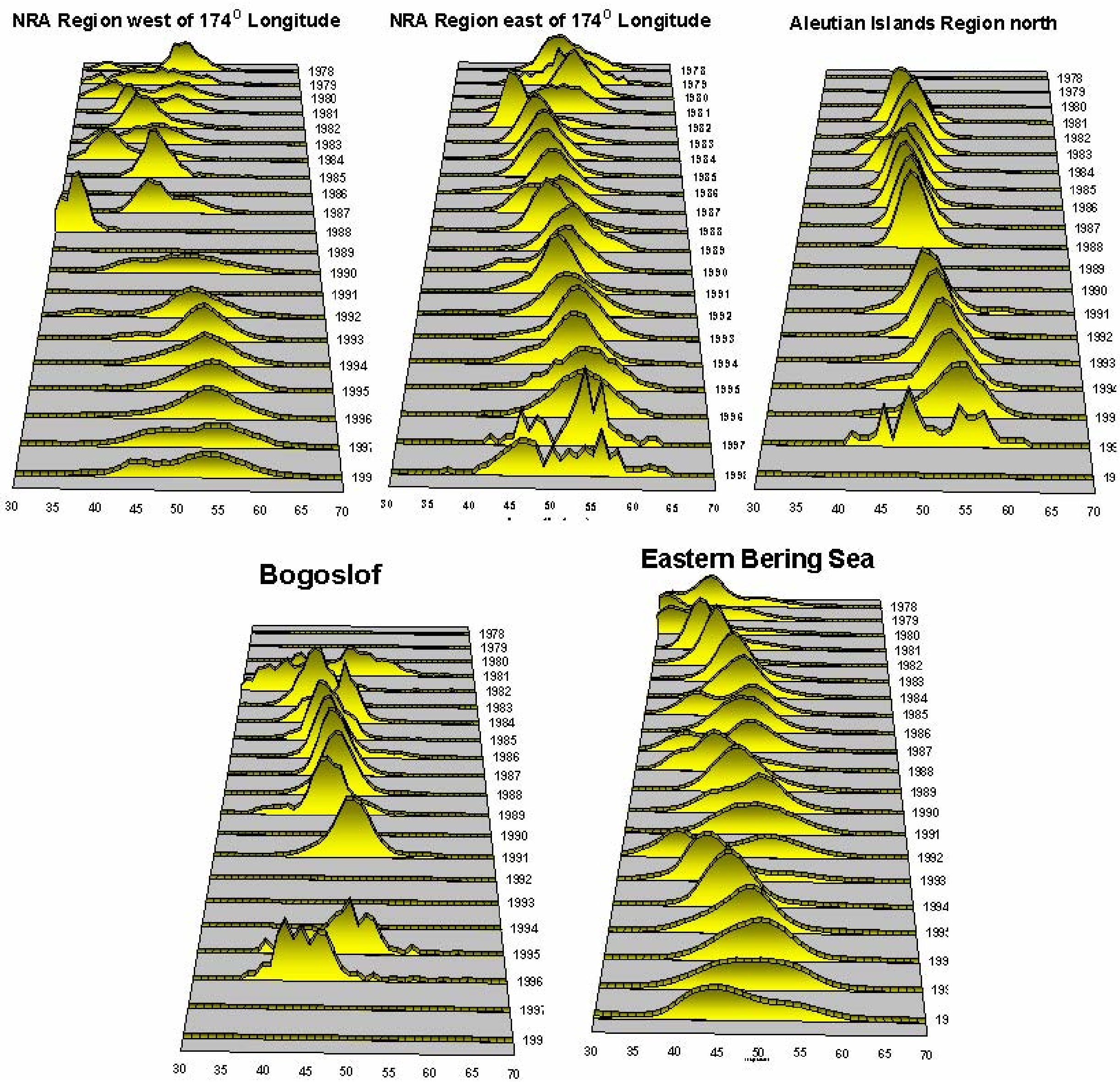


Figure 3. Pollock length frequency distributions by region.

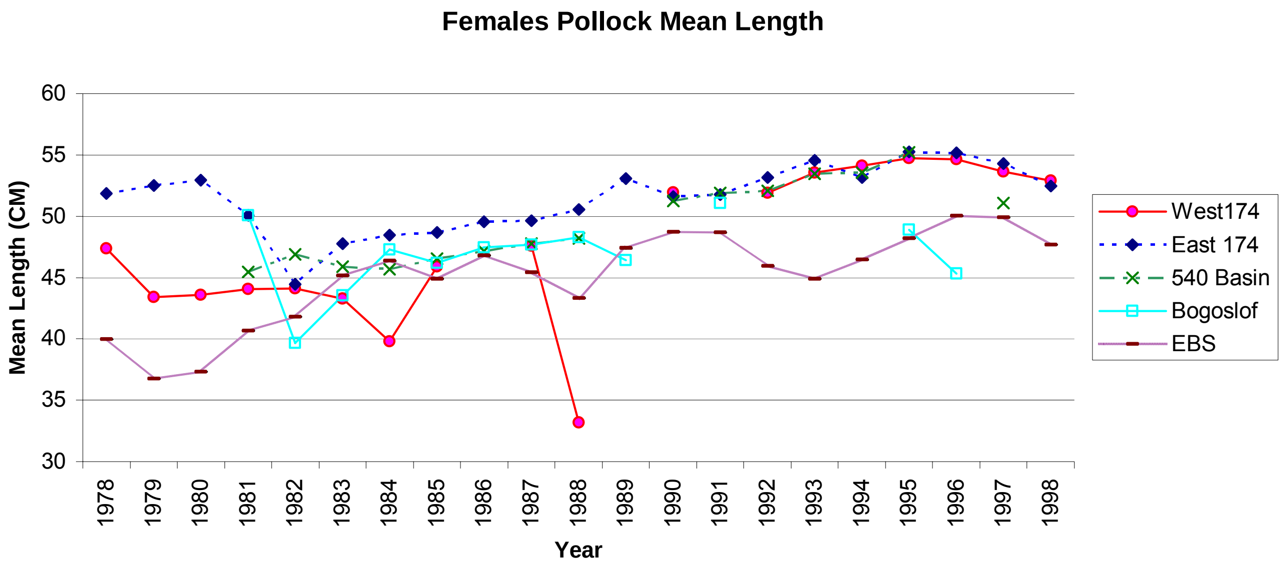


Figure 4. Mean length of female pollock in the catch from various areas based on observer data.

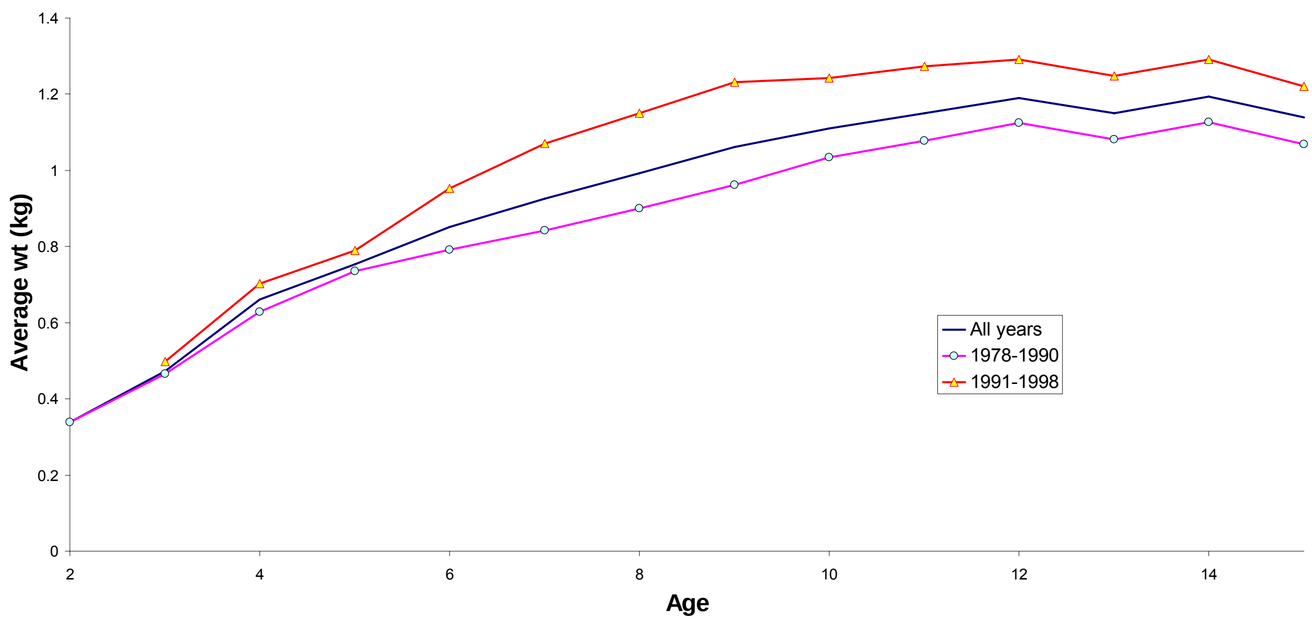


Figure 5. Average weight-at-age for Aleutian Islands pollock for all years combined, 1978-1990, and 1991-1998.

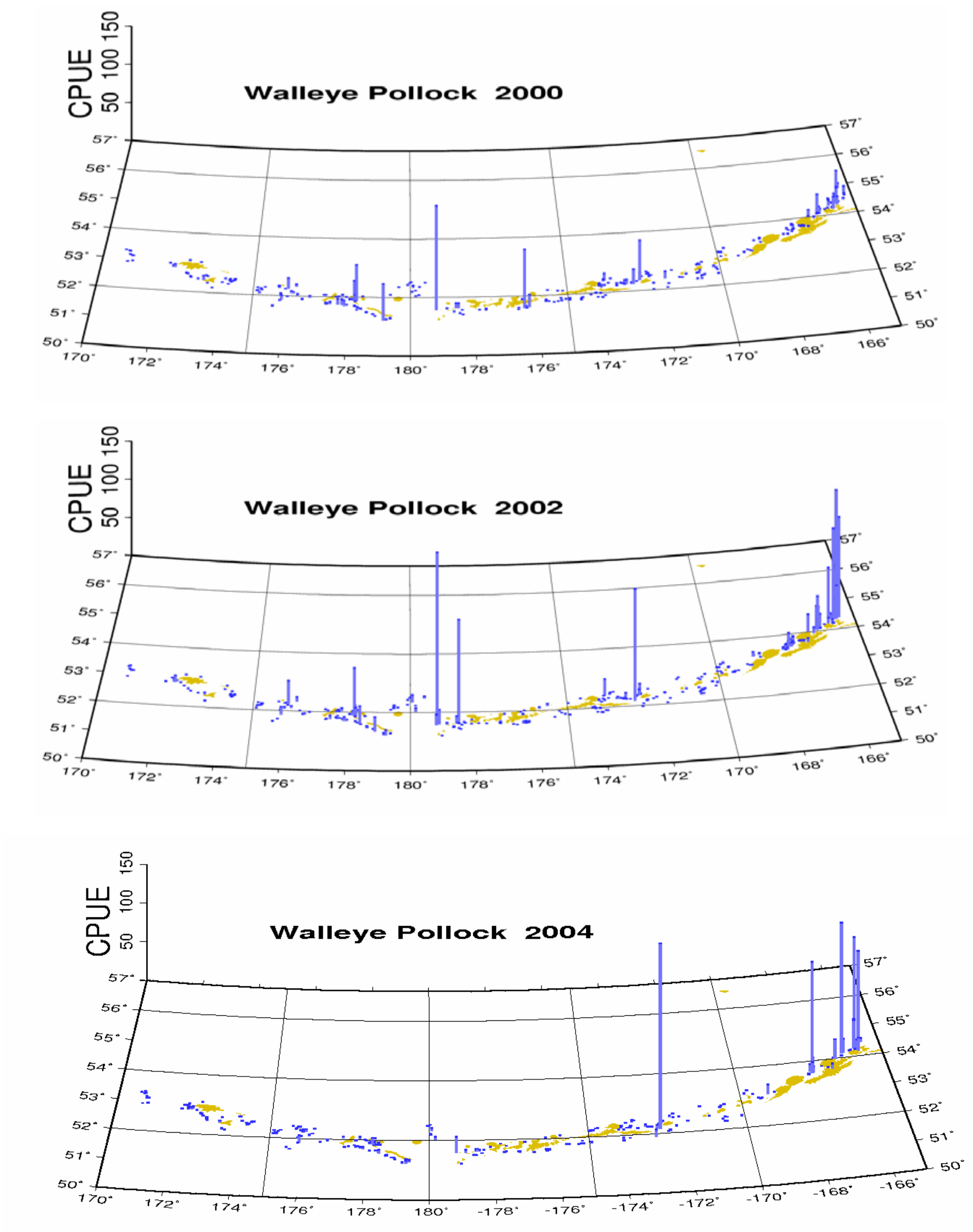


Figure 6. Catch per tow of pollock in the Aleutian Islands Region and east of 170°W during summer months from bottom-trawl surveys, 2000-2004.

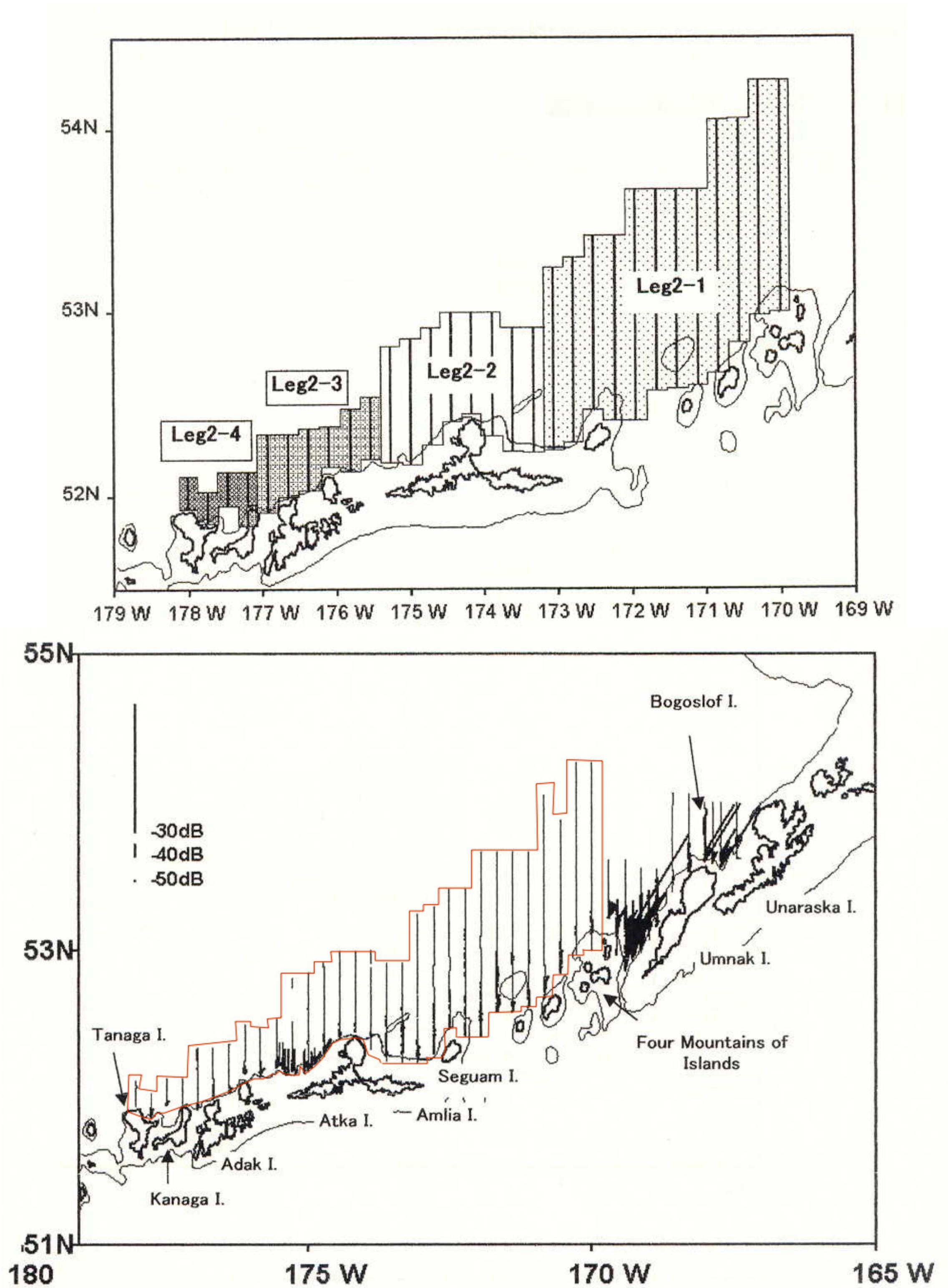


Figure 7. R/V Kaiyo Maru 2002 echo integration-trawl survey (above) strata for leg2 and below observed S_A in both legs. Please note that in the bottom picture the encircled area is leg 2.

Update on the status of Eastern Bering Sea pollock

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The following is largely extracted from Ianelli et al. (2004). See http://www.afsc.noaa.gov/refm/docs/2004/EBSpollock.pdf for further details.

The pollock fishery in the EBS is the largest single-species fishery in the US and catches in the past few years have been at the highest levels in recent history, approaching 1.5 million t.

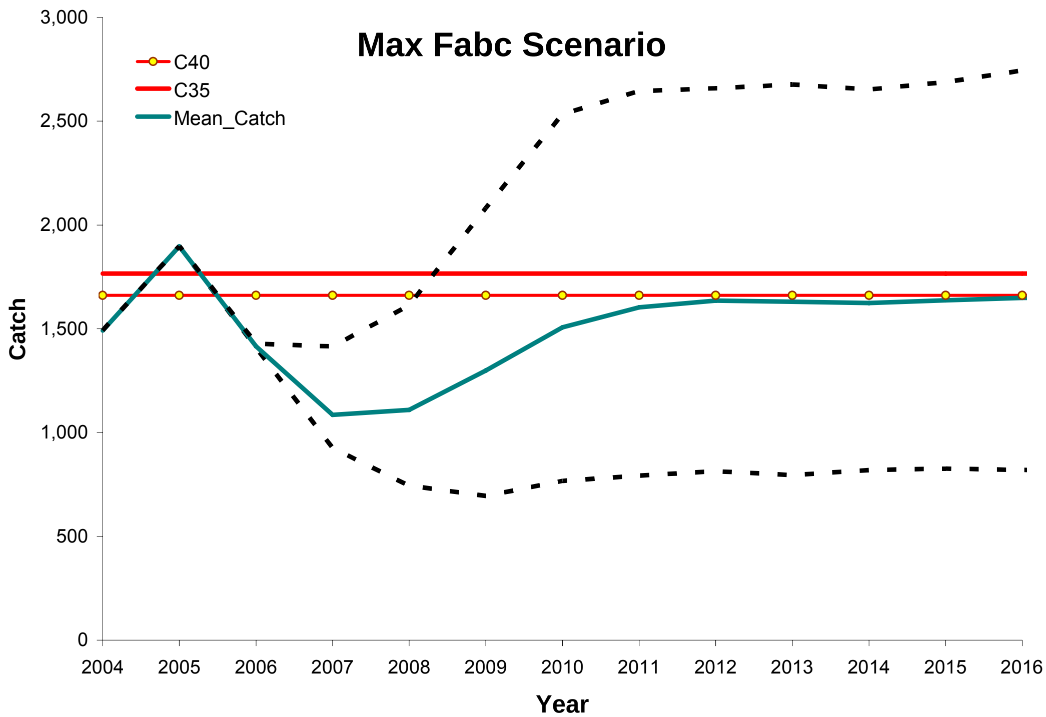
Bottom trawl and echo-integration trawl surveys where conducted in summer 2004 in the eastern Bering Sea. The biomass estimate from the 2004 NMFS summer bottom-trawl survey was 3.75 million tons, a substantial drop from the value of 8.14 million tons estimated in 2003. The biomass estimate from echo-integration trawl survey was 3.31 million tons, down from 3.6 million tons estimated in 2002 but close to the average estimated by this survey since 1982 (3.36 million tons). Stock levels for EBS pollock appear to be lower overall than estimated in 2003 and the projected 2005 biomass is the lowest estimated since 1992. The 2000 year class appears to be above average and the main age group available to the fishery. Subsequent year classes are currently estimated to be below average and will result in further short-term declines in abundance. Projections (based on Tier 3 harvest levels) indicate the ABC could be below 1.1 million t by 2007 (Fig. 1). However, since in the BSAI region there is a cap on the total groundfish TAC of 2 million tons, the catch of pollock is unlikely to exceed 1.5 million t. Hence, projections using alternative constant catch scenarios may be more realistic for projection purposes (e.g., Fig. 2). While current stock levels are quite high, given the expected recruitment and array of year-classes available to this fishery, the stock is expected to decline in the next few years to near or below target levels.

ABC setting process for EBS pollock

The stock assessment for EBS pollock is considered by the NPFMC SSC to have reliable estimates of uncertainty in F_{msy} and SSB and therefore maximum permissible ABC and OFL are derived from Tier 1 of the amended FMP (see WP-7 of this meeting). As with all NPFMC groundfish species, the recommended ABC can be set below the maximum permissible ABC level. In practice, this is done for various conservation reasons including ecosystem concerns, stock status uncertainty, and analyses on risk aversion. The Tier 1 calculations are derived from a risk averse analysis and have the basic property that the greater the uncertainty (in F_{msy} and current stock size), the lower the maximum permissible ABC. For 2005, the maximum permissible ABC was 1.962 million tons, based on the harmonic mean value of F_{msy}. The OFL level was specified at 2.104 million tons corresponding to the arithmetic mean of F_{msy}. The TAC was set to 1.478 million t due to constraints imposed by having the sum of all groundfish TACs be no greater than 2.0 million t.

The 2005 Fishery

Preliminary results for the first half of the 2005 fishery indicate that production rates were similar to recent years (Fig. 3). The distribution of the catch has varied in this period but generally progresses from heavy concentrations of removals north of Unimak Island and extending north and west of this area along the 200 m isobath as the season develops (Fig. 4). A clearer picture emerges on catch-location variability if the spatial aspect of the fishery is plotted each year against some average catch level. This was done for the period 2000-2005 for the first months of the winter fishery (Fig. 5).



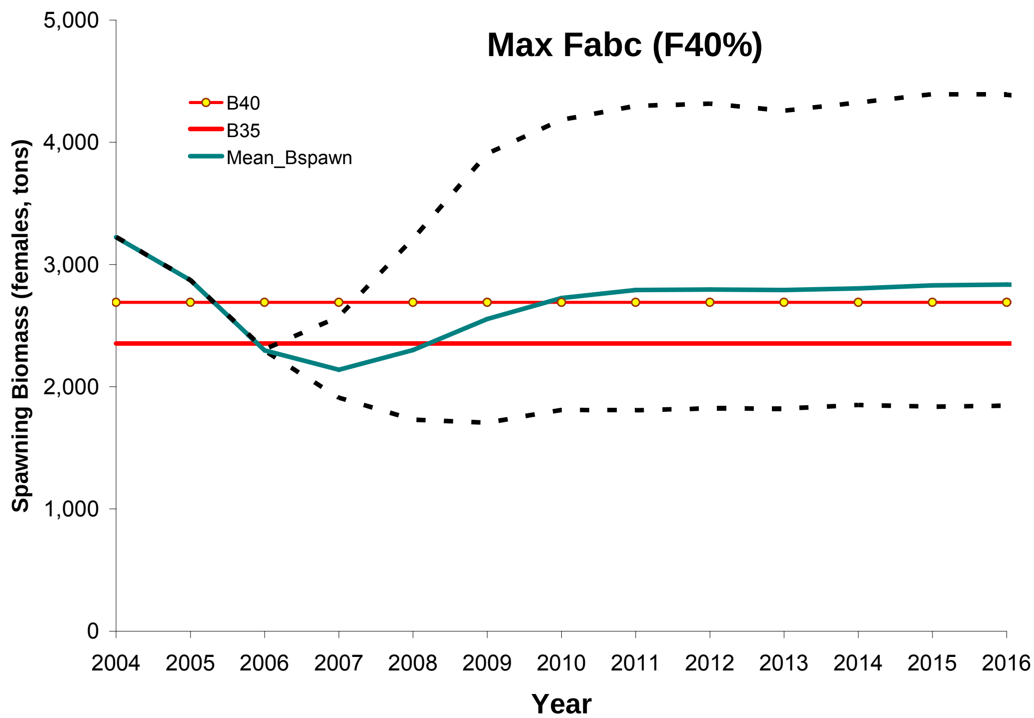


Figure 1. Projected EBS walleye pollock **yield** (top) and **Female spawning biomass** (bottom) relative to the long-term expected values under $F_{35\%}$ and $F_{40\%}$ (horizontal lines) for Model 1. $B_{40\%}$ is computed from average recruitment from 1978-2004. Future harvest rates follow the guidelines specified under Scenario 1, max F_{ABC} assuming $F_{ABC} = F_{40\%}$.

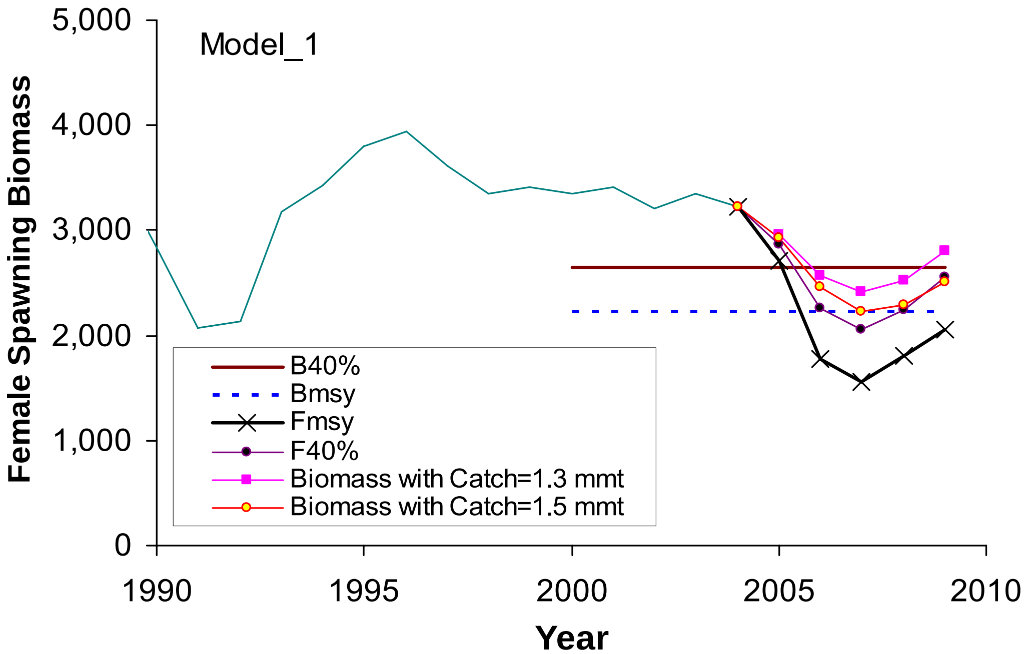


Figure 2. EBS walleye pollock female spawning biomass abundance trends, 1990-2009 as estimated by Ianelli et al., 2004 under different 2005-2009 harvest levels. Note that the F_{msy} and $F_{40\%}$ catch levels are unadjusted arithmetic mean fishing mortality rates. Horizontal solid and dashed lines represent the B_{msy}, and $B_{40\%}$ levels, respectively.

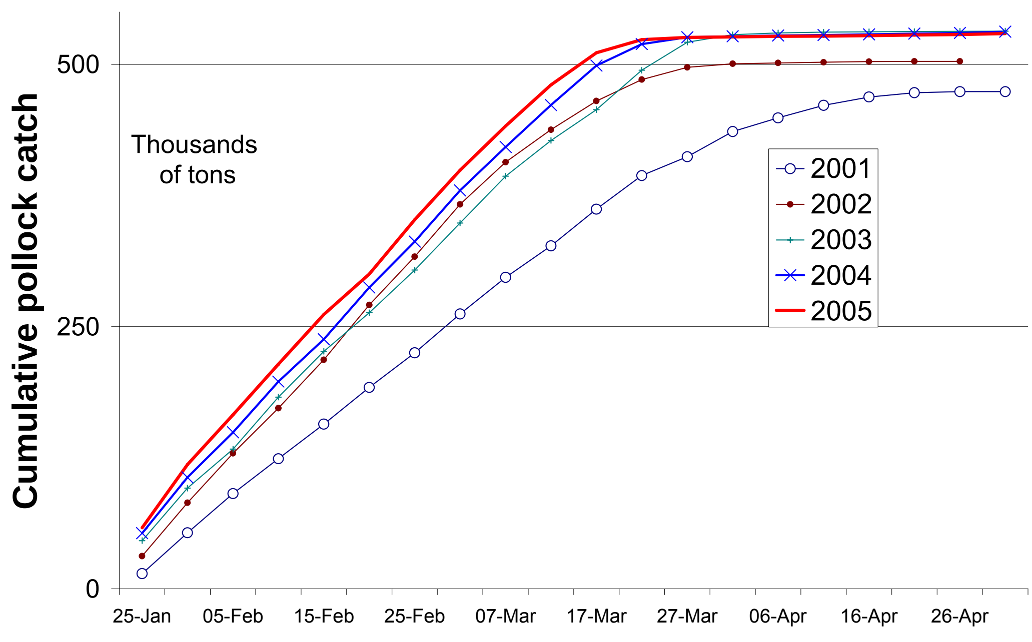


Figure 3. Cumulative catch levels for 2005 compared to recent years for the first season (winter) based on observer data.

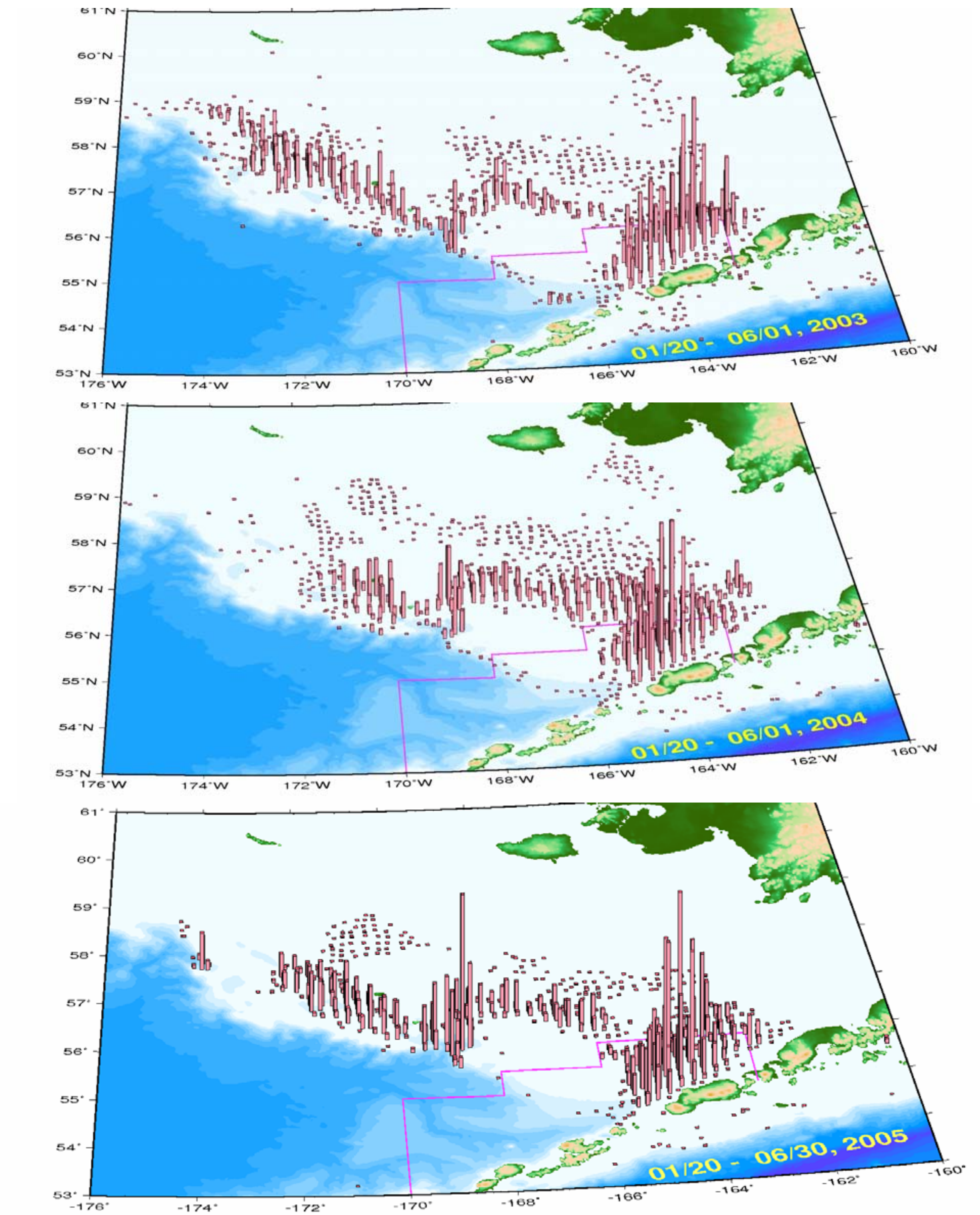


Figure 4. Concentrations of the pollock fishery 2003-2005, January - June on the EBS shelf. Line delineates SCA (sea lion conservation area). The column height represents relative removal on the same scale in all years.

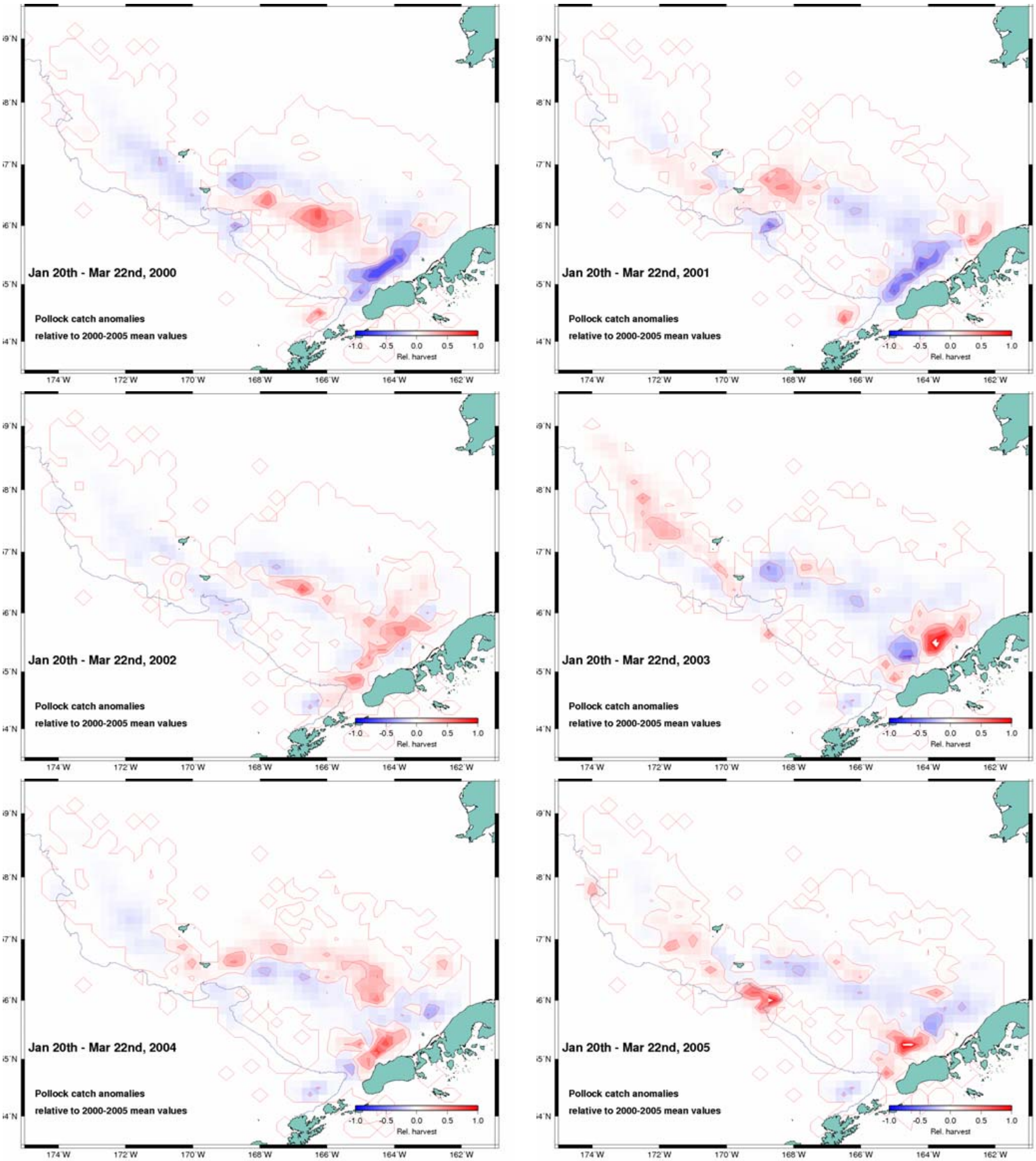


Figure 5. Geographic anomalies of catch for the period Jan 20th – March 22nd by year relative to the average catch over 2000-2005.

Review of the NPFMC approach for setting ABC and OFL levels

Amendment 56 to the GOA Groundfish FMP, approved by the Council in June 1998, defines ABC and OFL for the GOA groundfish fisheries. The definitions are shown below, where the fishing mortality rate is denoted F, stock biomass (or spawning stock biomass, as appropriate) is denoted B, and the F and B levels corresponding to MSY are denoted F_{MSY} and B_{MSY} respectively. The conditions for determining the fishing mortality rate under the amended FMP is shown in Box 1 below.

Acceptable Biological Catch is a preliminary description of the acceptable harvest (or range of harvests) for a given stock or stock complex. Its derivation focuses on the status and dynamics of the stock, environmental conditions, other ecological factors, and prevailing technological characteristics of the fishery. The fishing mortality rate used to calculate ABC is capped as described under "overfishing" below.

Overfishing is defined as any amount of fishing in excess of a prescribed maximum allowable rate. This maximum allowable rate is prescribed through a set of six tiers which are listed below in descending order of preference, corresponding to descending order of information availability. The SSC will have final authority for determining whether a given item of information is reliable for the purpose of this definition, and may use either objective or subjective criteria in making such determinations. For tier (1), a pdf refers to a probability density function. For tiers (1-2), if a reliable pdf of B_{MSY} is available, the preferred point estimate of B_{MSY} is the geometric mean of its pdf. For tiers (1-5), if a reliable pdf of B is available, the preferred point estimate is the geometric mean of its pdf. For tiers (1-3), the coefficient α is set at a default value of 0.05, with the understanding that the SSC may establish a different value for a specific stock or stock complex as merited by the best available scientific information. For tiers (2-4), a designation of the form "$F_{X\%}$" refers to the F associated with an equilibrium level of spawning per recruit (SPR) equal to X% of the equilibrium level of spawning per recruit in the absence of any fishing. If reliable information sufficient to characterize the entire maturity schedule of a species is not available, the SSC may choose to view SPR calculations based on a knife-edge maturity assumption as reliable. For tier (3), the term $B_{40\%}$ refers to the long-term average biomass that would be expected under average recruitment and $F=F_{40\%}$.

In summary, Figure 1 shows a schematic of how harvest rates are adjusted depending on the current stock size. In this illustration, the MSST represents the minimum stock-size threshold, which for pollock occurs at 50% of the "target" biomass of $B_{40\%}$. Note that due to ecosystem concerns and Steller sea lion prey, the fishing mortalities will be specified to be zero should the stock drop below the MSST. This is further illustrated in a simulation showing catch and fishing mortality for a simple age-structured model result for Bogoslof pollock (Fig. 2). In practice, these harvest control rules have properties that enhance the likelihood that the stock will increase to above the target SSB when it drops below. At the other extremes (when stocks are at high levels), over-arching OY principles (e.g., bycatch constraints, 2 million t cap on all groundfish quotas) play a large role in preventing over-capitalization and thereby relieves some economic pressures when quotas are required to be reduced.

Box 1. Conditions for fishing mortality rates under the current (2004) Tier system used under amendment 56 to the FMP for North Pacific groundfish fisheries.

Tier

1) Information available: *Reliable point estimates of B and* B_{MSY} *and reliable pdf of* F_{MSY}.

- 1a) Stock status: $B/B_{MSY} > 1$
  - $F_{OFL} = \mu_A$, *the arithmetic mean of the pdf*
  - $F_{ABC} \leq \mu_H$, *the harmonic mean of the pdf*
- 1b) Stock status: $\alpha < B/B_{MSY} \leq 1$
  - $F_{OFL} = \mu_A \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
  - $F_{ABC} \leq \mu_H \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
- 1c) Stock status: $B/B_{MSY} \leq \alpha$
  - $F_{OFL} = 0$
  - $F_{ABC} = 0$

2) Information available: *Reliable point estimates of B,* B_{MSY}, F_{MSY}, $F_{35\%}$, *and* $F_{40\%}$.

- 2a) Stock status: $B/B_{MSY} > 1$
  - $F_{OFL} = F_{MSY}$
  - $F_{ABC} \leq F_{MSY} \times (F_{40\%} / F_{35\%})$
- 2b) Stock status: $\alpha < B/B_{MSY} \leq 1$
  - $F_{OFL} = F_{MSY} \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
  - $F_{ABC} \leq F_{MSY} \times (F_{40\%} / F_{35\%}) \times (B/B_{MSY} - \alpha)/(1 - \alpha)$
- 2c) Stock status: $B/B_{MSY} \leq \alpha$
  - $F_{OFL} = 0$
  - $F_{ABC} = 0$

3) Information available: *Reliable point estimates of B,* $B_{40\%}$, $F_{35\%}$, *and* $F_{40\%}$.

- *3a) Stock status:* $B/B_{40\%} > 1$
  - $F_{OFL} = F_{35\%}$
  - $F_{ABC} \leq F_{40\%}$
- *3b) Stock status:* $\alpha < B/B_{40\%} \leq 1$
  - $F_{OFL} = F_{35\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$
  - $F_{ABC} \leq F_{40\%} \times (B/B_{40\%} - \alpha)/(1 - \alpha)$
- *3c) Stock status:* $B/B_{40\%} \leq \alpha$
  - $F_{OFL} = 0$
  - $F_{ABC} = 0$

4) Information available: *Reliable point estimates of B,* $F_{35\%}$, *and* $F_{40\%}$.

  - $F_{OFL} = F_{35\%}$
  - $F_{ABC} \leq F_{40\%}$

5) Information available: *Reliable point estimates of B and natural mortality rate M.*

  - $F_{OFL} = M$
  - $F_{ABC} \leq 0.75 \times M$

6) Information available: *Reliable catch history from 1978 through 1995.*

  - *OFL = the average catch from 1978 through 1995, unless an alternative value is established by the SSC on the basis of the best available scientific information*
  - $ABC \leq 0.75 \times OFL$

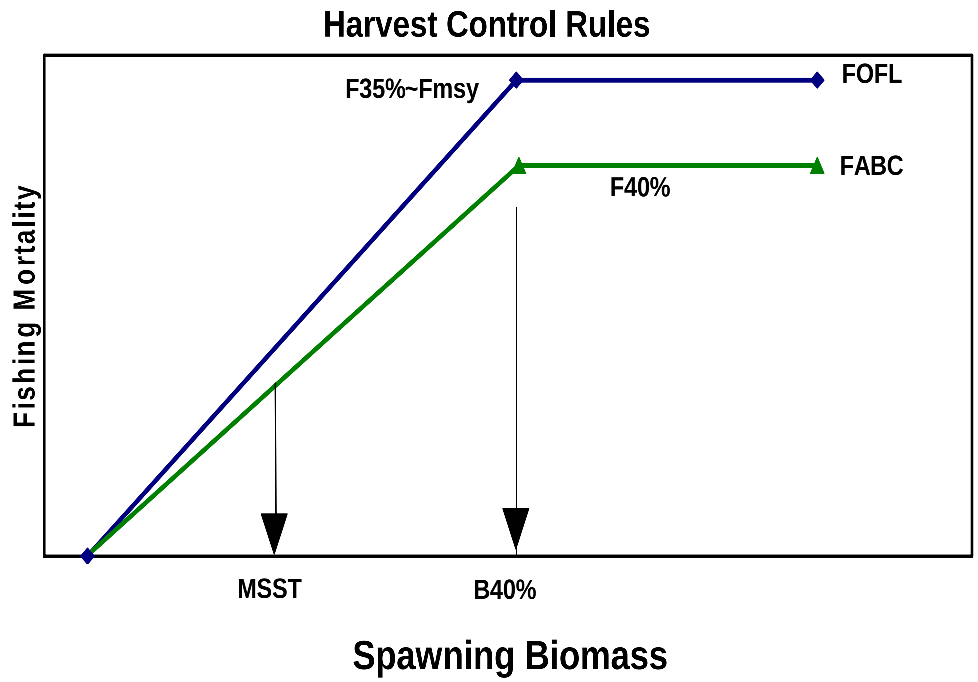


Figure 1. General schematic of harvest control rule used for N. Pacific groundfish stocks.

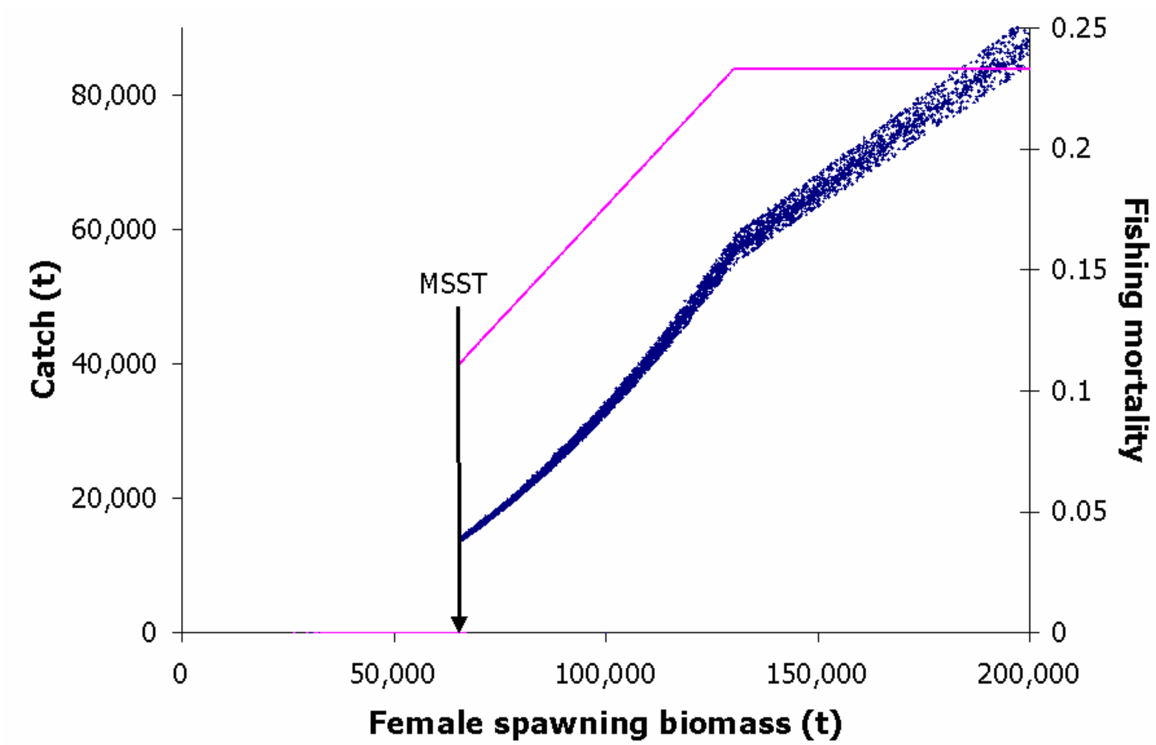


Figure 2. Simulation results showing harvest control rule in effect for Bogoslof pollock where the $B_{40\%}$ level is about 130,000 t of female spawning biomass and the MSST is about 65,000 t. The catch is shown by the band of points and the fishing mortalities by the straight line segments.

ABC, OFL, and TAC levels set for 2005 and 2006

In order to follow the administrative procedures act and follow the guidelines for environmental assessments of actions (including fishing), the NPFMC and NMFS now require estimates of ABC and OFLs (and preliminary TACs) projected for two years. The result of these projections are shown in the table below as published in the Federal Register.

TABLE 1.—2005 AND 2006 OVERFISHING LEVEL (OFL), ACCEPTABLE BIOLOGICAL CATCH (ABC), TOTAL ALLOWABLE CATCH (TAC), INITIAL TAC (ITAC), AND CDQ RESERVE ALLOCATION OF GROUNDFISH IN THE BSAI.[1]

[Amounts are in metric tons]

Species	Area	2005					2006				
		OFL	ABC	TAC	ITAC[2]	CDQ[3]	OFL	ABC	TAC	ITAC[2]	CDQ[3]
Pollock[4]	BS[2]	2,100,000	1,960,000	1,478,500	1,330,650	147,850	1,944,000	1,617,000	1,487,756	1,338,980	148,776
	AI[2]	39,100	29,400	19,000	17,100	1,900	39,100	29,400	19,000	17,100	1,900
	Bogoslof	39,600	2,570	10	10		39,600	2,570	10	10	
Pacific cod	BSAI	265,000	206,000	206,000	175,100	15,450	226,000	195,000	195,000	165,750	14,625
Sablefish[5]	BS	2,950	2,440	2,440	2,013	336	2,690	2,310	2,310	982	87
	AI	3,170	2,620	2,620	2,129	442	2,880	2,480	2,480	527	47
Atka mackerel	BSAI	147,000	124,000	63,000	53,550	4,725	127,000	107,000	63,000	53,550	4,725
	EAI/BS		24,550	7,500	6,375	563		21,190	7,500	6,375	563
	CAI		52,830	35,500	30,175	2,663		45,580	35,500	30,175	2,663
	WAI		46,620	20,000	17,000	1,500		40,230	20,000	17,000	1,500
Yellowfin sole	BSAI	148,000	124,000	90,686	77,083	6,801	133,000	114,000	90,000	76,500	6,750
Rock sole	BSAI	157,000	132,000	41,500	35,275	3,113	145,000	122,000	42,000	35,700	3,150
Greenland turbot	BSAI	19,200	3,930	3,500	2,975	263	11,100	3,600	3,500	2,975	263
	BS		2,720	2,700	2,295	203		2,500	2,500	2,125	188
	AI		1,210	800	680	60		1,100	1,000	850	75
Arrowtooth flounder	BSAI	132,000	108,000	12,000	10,200	900	103,000	88,400	12,000	10,200	900
Flathead sole	BSAI	70,200	58,500	19,500	16,575	1,463	56,100	48,400	20,000	17,000	1,500
Other flatfish[6]	BSAI	28,500	21,400	3,500	2,975	263	28,500	21,400	3,000	2,550	225
Alaska plaice	BSAI	237,000	189,000	8,000	6,800	600	115,000	109,000	10,000	8,500	750
Pacific ocean perch	BSAI	17,300	14,600	12,600	10,710	945	17,408	14,600	12,600	10,710	945
	BS		2,920	1,400	1,190	105		2,920	1,400	1,190	105
	EAI		3,210	3,080	2,618	231		3,210	3,080	2,618	231
	CAI		3,165	3,035	2,580	228		3,165	3,035	2,580	228
	WAI		5,305	5,085	4,322	381		5,305	5,085	4,322	381
Northern rockfish	BSAI	9,810	8,260	5,000	4,250	375	9,480	8,040	5,000	4,250	375
Shortraker rockfish	BSAI	794	596	596	507	45	794	596	596	507	45
Rougheye rockfish	BSAI	298	223	223	190	17	298	223	223	190	17
Other rockfish[7]	BSAI	1,870	1,400	1,050	893	79	1,870	1,400	1,050	893	79
	BS		810	460	391	35		810	460	391	35
	AI		590	590	502	44		590	590	502	44
Squid	BSAI	2,620	1,970	1,275	1,084		2,620	1,970	1,275	1,084	
Other species[8]	BSAI	87,920	53,860	29,000	24,650	2,175	87,920	57,870	29,200	24,820	2,190
Total		3,509,332	3,044,769	2,000,000	1,774,719	186,608	3,093,360	2,547,259	2,000,000	1,772,778	187,350

[1] These amounts apply to the entire BSAI management area unless otherwise specified. With the exception of pollock, and for the purpose of these harvest specifications, the Bering Sea (BS) subarea includes the Bogoslof District.

[2] Except for pollock and the portion of the sablefish TAC allocated to hook-and-line and pot gear, 15 percent of each TAC is put into a reserve. The ITAC for each species is the remainder of the TAC after the subtraction of these reserves.

[3] Except for pollock, squid and the hook-and-line or pot gear allocation of sablefish, one half of the amount of the TACs placed in reserve, or 7.5 percent of the TACs, is designated as a CDQ reserve for use by CDQ participants (see §§ 679.20(b)(1)(iii) and 679.31).

[4] Under § 679.20(a)(5)(i)(A)(*1*), the annual Bering Sea pollock TAC after subtraction for the CDQ directed fishing allowance—10 percent and the ICA—3.35 percent, is further allocated by sector for a directed pollock fishery as follows: inshore—50 percent; catcher/processor—40 percent; and motherships—10 percent. Under regulations that would be effective with the final rule implementing Amendment 82, the annual AI pollock TAC, after first subtracting for the CDQ directed fishing allowance—10 percent and second the ICA—2,000 mt, would be allocated to the Aleut Corporation for a directed pollock fishery.

[5] Twenty percent of the sablefish TAC allocated to hook-and-line gear or pot gear and 7.5 percent of the sablefish TAC allocated to trawl gear is reserved for use by CDQ participants (see § 679.20(b)(1)(iii)).

[6] "Other flatfish" includes all flatfish species, except for halibut (a prohibited species), flathead sole, Greenland turbot, rock sole, yellowfin sole, arrowtooth flounder and Alaska plaice.

[7] "Other rockfish" includes all *Sebastes* and *Sebastolobus* species except for Pacific ocean perch, northern, shortraker, and rougheye rockfish.

[8] "Other species" includes sculpins, sharks, skates and octopus. Forage fish, as defined at § 679.2, are not included in the "other species" category.

Summary of genetic stock identification studies in the Bering Sea

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Early studies of allozyme variation in walleye pollock (Iwata 1975; Grant and Utter 1980) reported differentiation across broad spatial scales in the Bering Sea. A more recent study using mitochondrial DNA restriction fragment length polymorphism (RFLP) provided some evidence for population substructure at smaller spatial scales in the eastern Bering Sea (Mulligan et al. 1992). However, other studies examining mtDNA (Shields and Gust 1995; Kim et al. 2000), nuclear microsatellite DNA (O'Reilly et al. 2004), or a combination of allozyme and mtDNA variation (Olsen et al. 2002) have failed to resolve stock discretion in the eastern Bering Sea. A study of variation at the pantophysin (Pan I) locus (Canino et al. in press), a gene that appears to be influenced by natural selection (Canino and Bentzen 2004), showed a clear distinction between a sample from the central Bering Sea and the Unimak Pass area (Fig. 1). However, the central Bering Sea sample was taken in September, thus the potential for stock admixture can not be ruled out. Gene frequency distributions at the Pan I locus were correlated with water temperatures (Fig.2) suggesting the effects of temperature-mediated selection over moderate geographic scales. Table 1 summarizes various genetic studies on pollock, the areas covered, methods used, and key results.

Currently, there is no conclusive evidence for genetic discretion of the Donut Hole stock component in the Bering Sea. Results from Mulligan et al. (1992) showed a sample from Adak Island to be distinct from samples in the Donut Hole or from Bogoslof Island but the Donut Hole sample did not show significant differentiation from Bogoslof Island in the eastern Bering Sea. Sample sizes from the two studies that included the Donut hole area (Mulligan et al. 1992, n = 50; Shields and Gust 1995, n = 8) are too small, and mtDNA variation may not be sufficiently polymorphic to resolve expected weak levels of population structuring in walleye pollock. Future efforts should be directed towards collecting larger samples (e.g. 100 - 200 individuals) from spawning aggregates and the use of highly polymorphic markers (e.g. microsatellites).

General conclusions from recent genetic studies

- Evidence for subpopulation structuring within the Bering Sea (Olsen et al. 2002; Canino et al. in press) and between the Bering Sea and the Gulf of Alaska (Olsen et al. 2002; O'Reilly et al 2004;
- No evidence for genetic discretion of the Donut hole stock component

  Possible reasons:
  - small sample sizes (Mulligan et al. 1992, n = 50; Shields & Gust 1995, n = 8)
  - samples taken from non-spawning individuals

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Table 1. Studies of genetic population structure in walleye pollock since 1998

Study	Area	Marker	Results
Kim et al. 2000	Korea -Bogoslov	mtDNA RFLP	• no significant genetic heterogeneity
Olsen et al. 2002	Western north Pacific, Eastern BS, GOA, PWS	mtDNA RFLP allozyme microsatellites	• east -west heterogeneity between Asian and N American populations • regional heterogeneity among GOA samples (PWS vs SHEL) • Discordant results between BS and GOA - significant differentiation observed with allozymes and mtDNA but in different years
O'Reilly et al. 2004	Western north Pacific, North Central BS, Eastern BS, GOA, Puget Sound	microsatellites	• weak structuring (global FST = 0.004) • genetic isolation by distance over moderate scales (~1500 km) • sign. genetic differentiation between NCBS and GOA
Canino et al. In press	Western north Pacific, North Central BS, Eastern BS, GOA, Puget Sound	pantophysin (Pan I) locus	• stronger differentiation than observed with microsatellites (global FST = 0.038) • north-south cline in Pan I allele frequencies correlated with water temperature • North Central BS sample differentiated from Eastern BS and PWS sample
Grant In review	reanalysis of data from Mulligan et al. 1992 Kim et al. 2000 Olsen et al. 2002	mtDNA	• nested clade analysis indicated 3 phylogroups within data in Mulligan et al. 1992 and Olsen et al. 2002 studies • mosaic patterns in subpopulation diversity over moderate geographic scales but no clear pattern in range-wide diversity • patterns best explained by metapopulation dynamics

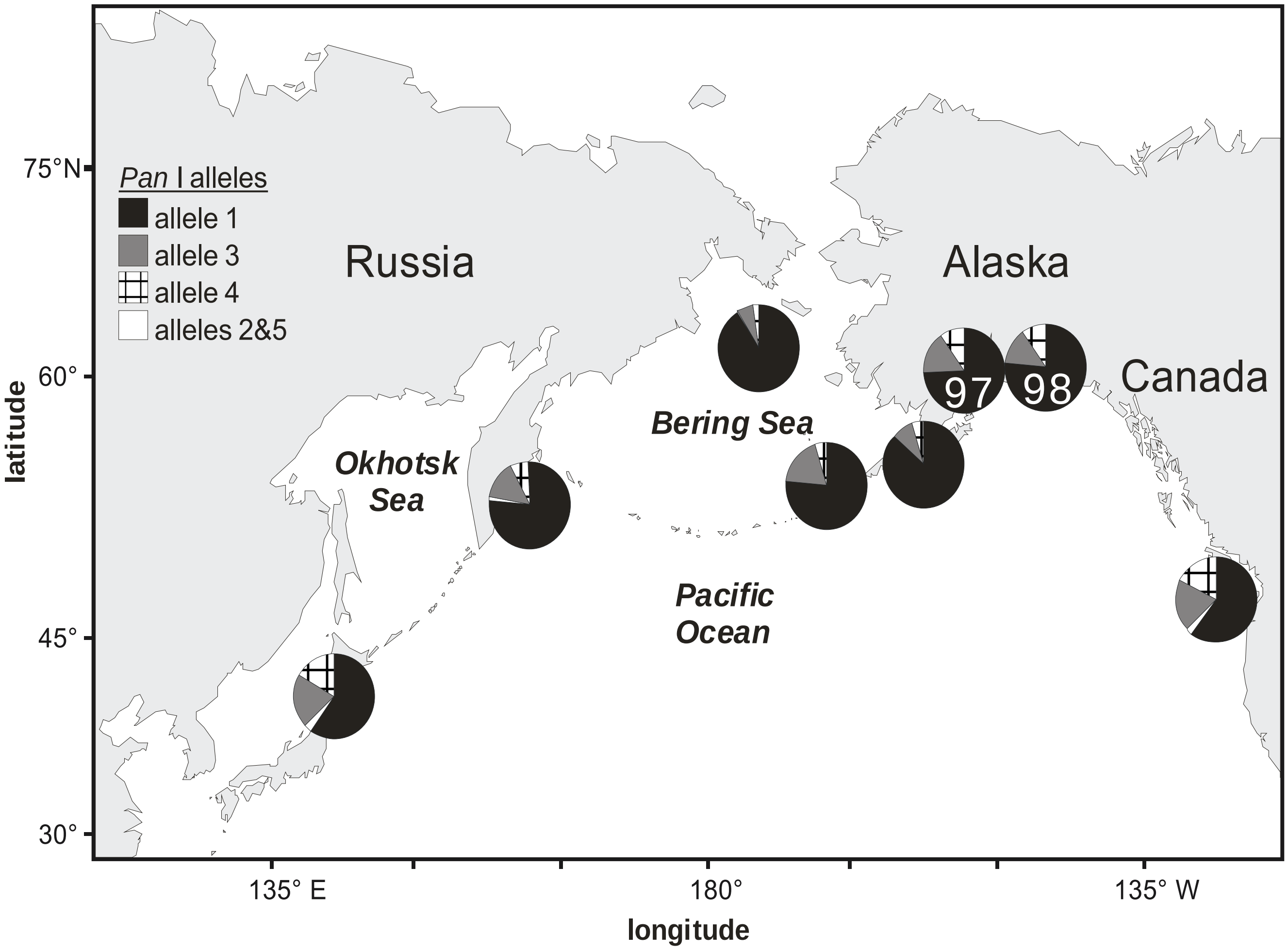

Figure 1. Frequencies of *Pan* I alleles in walleye pollock (*Theragra chalcogramma*). Samples taken in Prince William Sound in 1997 and 1998 are indicated by year. (Canino et al. in press).

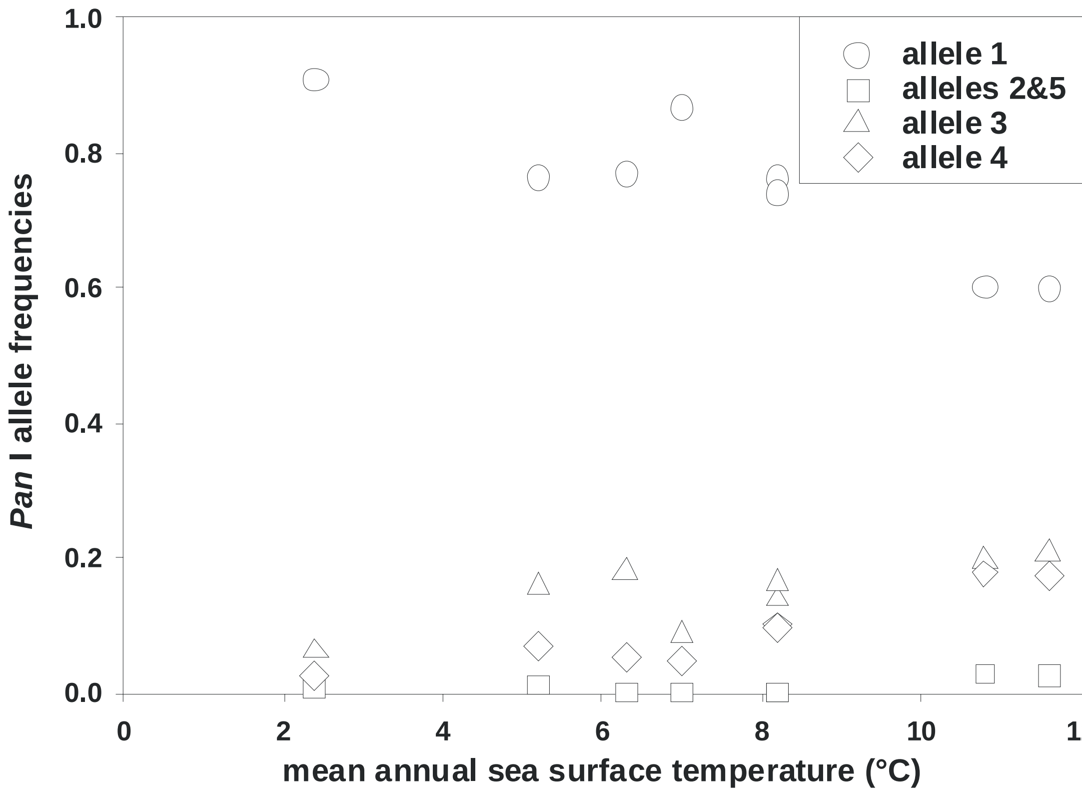

Figure 2. Frequency occurrence of Pan I alleles in walleye pollock (*Theragra chalcogramma*) versus estimated annual mean surface temperature. (Canino et al. in press).

Version 1

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Central Bering Sea Pollock Workshop

June 6-9, 2005
Jimmie Traynor Room, Building 4
NOAA Regional Center

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Microsatellite analysis of the population structure of the Bering Sea pollock

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The study continues a series of effort aimed at genetic certification of the spawning concentrations of the Bering Sea pollock using microsatellite markers. The numerous microsatellite loci are relatively evenly distributed throughout the genomes and, as a rule, are marked by a high allele polymorphism. Such polymorphism emerges thanks to the DNA-polymerase sliding through along one of the chains in the process of replication. The allele variants are inherited according to Mendel laws, and are customarily considered to be selectively neutral. Despite the very low values of differentiation indices caused by the large effective population size and a high level of gene flow, the sea fishes, including pollock, are weakly but significantly genetically structured by neutral loci within a vast spatial scale (Bailey et al., 1999, DeWoody&Avise, 2000, Bentzen et al., 1996). The Bering Sea pollock was analyzed previously using Karagin, Olutor, Koryak, Navarin and North Kuril concentration samples. It was shown, however, that the genetic distances between the territorially separated spawning concentrations are short, and the dendrograms founded on those distances are not stable. The microsatellite DNA molecular features marked by homoplastics (i.e. differences in the ways of evolution of the same allele variants), and the high probability of reverse mutations slow down the allele frequencies becoming divergent among various spawning concentrations, and entail discrepancies between the results obtained from the samples separated by considerable time intervals (Olsen et al., 2002). The minimum size of sample for the sea fish species of little variance is 70-150 fish depending on the number of allele variants. The number of preparations examined from each sample must not be less than 50. The specimens from territorially distant spawning stocks of an established population status should be introduced into the analysis.

Our study involved the analysis of 306 specimens from six regions of the Bering Sea (Fig. 1): Karagin, Olutor, Shirshov Ridge, Navarin, North Kuril and East Bering Sea. The pollock samples from the East Bering Sea were provided by the courtesy of N. Williamson (Alaska Fisheries Research Center).

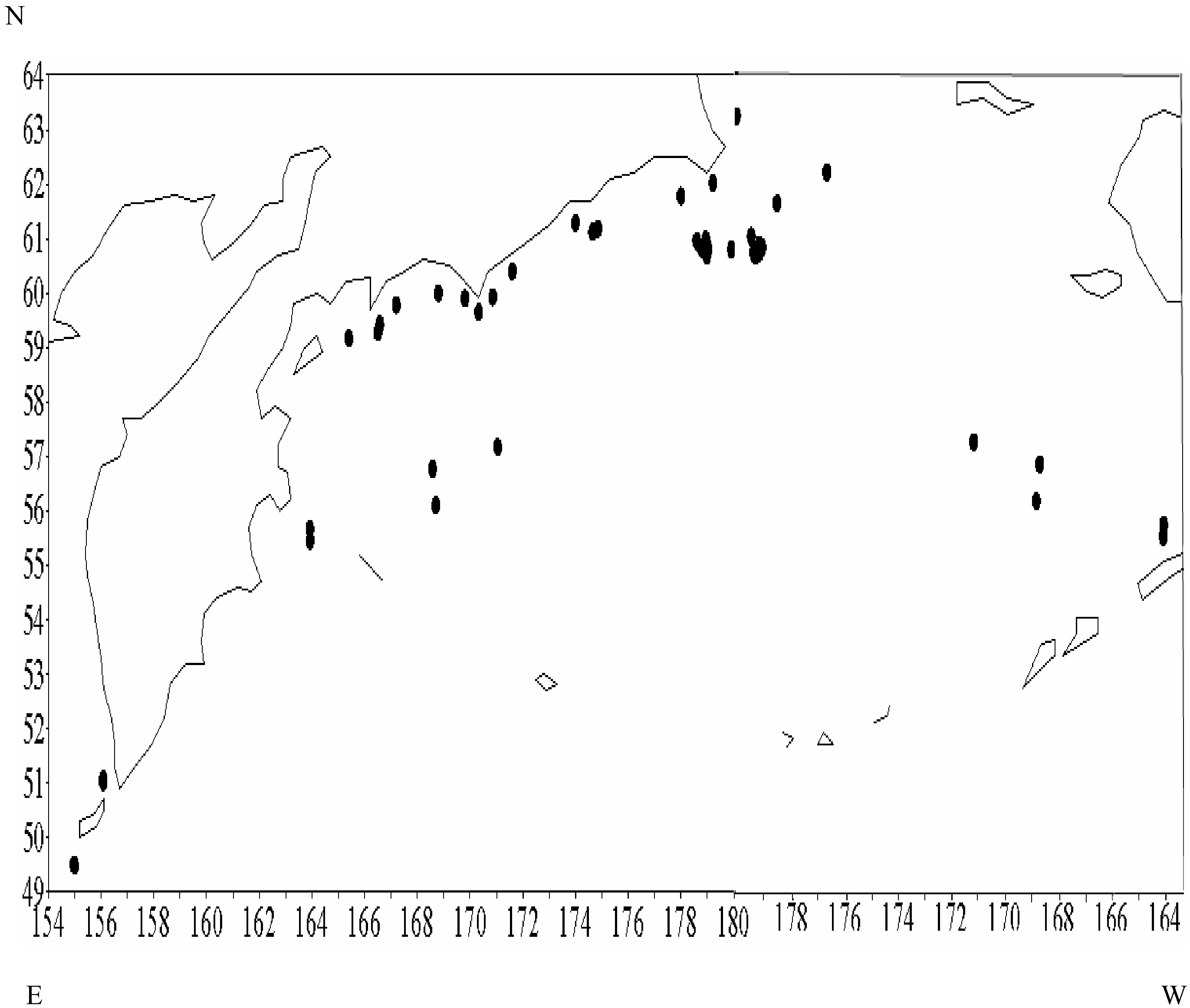


Fig. 1. Sites of genetic sampling.

<u>Materials and methods</u>

Nine microsatellite loci identified by O'Reilly (O'Reilly et al.., 2000) were selected for analysis: Tch5, Tch10, Tch12, Tch13, Tch14, Tch15, Tch18, Tch19 and Tch22. The sequences of nine microsatellite sites and their primers are given in Figure 2.

Tch5 $(GATA)_{14}$
F: gcc tta ata tca cgc aca
R: tcg cat tga gcc tag ttt

Tch10 $(GGCT)_6$CTCT $(GTCT)_2$
F: gtc tct atg tct gtc ttt cta ttt g
R: acg aaa ccc aac cct gat t

Tch12 $(GGTT)_{22}$
F: caa ttt gtc agc ctc tgt tac c
R: agt aca gct tga ttg ttt ctg gg

Tch13 $(GT)_9$
F: ttt ccg atg agg tca tgg
R: agt aca gct tga ttg ttt ctg gg

Tch14 $(GAAA)_{31}$
F: cat aca ttg gtc act ctt tct tac
R: aaa ctg ata tac gcc caa ct

Tch15 $(GA)_3(CA)_2$GACA $(GA)_5$CAGATA$(GA)_8$
F: aaa ctt cac ctg acc aac
R: gca aca caa ctt aat cat ct

Tch18 $(GT)_{15}$
F: gga gat ggt gct aac tgg
R: aac gca cat gca cat acg.

Tch19 $(GTCT)_{15}$
F: tat gct gat tgg tta ggc
R: gat cat ttg ttt cag aga gc

Tch22 $(GACA)_6$
F: atc ata tct ggc caa gtt c
R: ctc tct ctg aat ccc tct g

Fig. 2. The sequences of nine microsatellite sites and their primers (F-forward; R-reverse).

Electrophoretic subdivision of allele variants and genotyping

The PCR products containing microsatellite fragments were divided in a 6% or 8% polyacrylamid gel in TB acetate. Upon the completion of electrophoresis the gels were colored with ethidium bromide and photographed in UV light. Allele variants were typed with KODAK 1D Image analysis software. When data on marker fragment size is introduced this program allowed us to determine the absolute size of microsatellite alleles. An example of stage of typing process is given in the Figure 3.

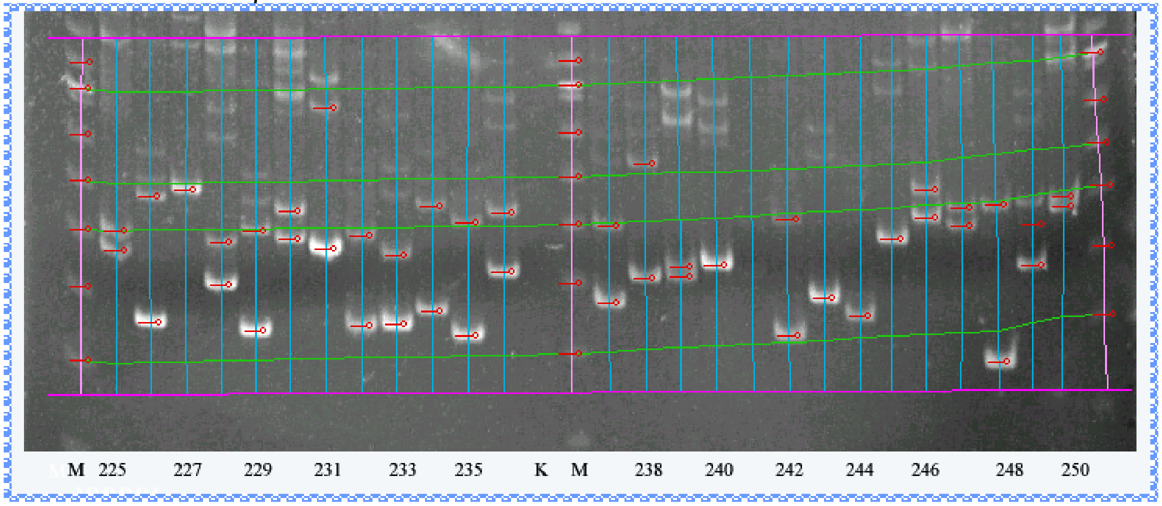


Fig. 3. Locus Tch19 type setting stage.

The products of typing of Tch13, Tch15, Tch18 and Tch22 loci were chemically not stable; that is why those loci were excluded from the analysis.

Tables of allele variants were compiled on the basis of typing.

The genetic parameters of the expected populations examined were determined using TFPGA (Miller, 1997) and GENEPOP 3.1. (Raimond and Rousset, 1995) programs. Hardy-Weinberg equilibrium performance was verified by individual loci of specific populations using criterion X^2 and Haldane (1954) test, with a 99% significance limit (TFPGA), and Guo-Thompson method for polymial distribution (GENEPOP). The equilibrium of populations in Markov chain algorithms was verified by Haldane (1954), Weir (1990) and Robertson-Hill (1984) summary test and Fisher probability test based on tables of conjugated characteristics for each locus, for the given population, and for all loci and populations in general. The genotype imbalance by conjugation was found by pairs between loci within each population, and for all populations simultaneously. The values of F_{is}, F_{it} and F_{st}. (f, F and Θ in Weir-Cockerham algorithms) was determined for all populations by individual loci and alleles, and for all population pairs. The jacknife procedure applied by the loci totally made it possible to estimate F-statistic variance, while the bootstrap procedure set up confidence limits. In the given case one thousand bootstrap steps were made for the 95% level. The interpopulation genetic distances (Nei, 1972, 1978) were calculated as based on the value of F_{st} ($F_{st} = 2D^2$) and are expressed both as a diagonal matrix, and graphically as an unrooted UPGMA dendrogram (TFPGA, PHYLIP).

The genotype imbalance by linkage was determined by pairs between loci within each population, and by all populations together.

Results and discussion

The results of genotyping of DNA preparations by loci are represented in histograms. The height of tiers corresponds to the absolute values of allele frequencies in the given sample; X-axis shows the allele variants of loci while the Y-axis shows the frequency of their occurrence.

Small differences in histograms from various samples were recorded in locus Tch5 (Fig. 4).

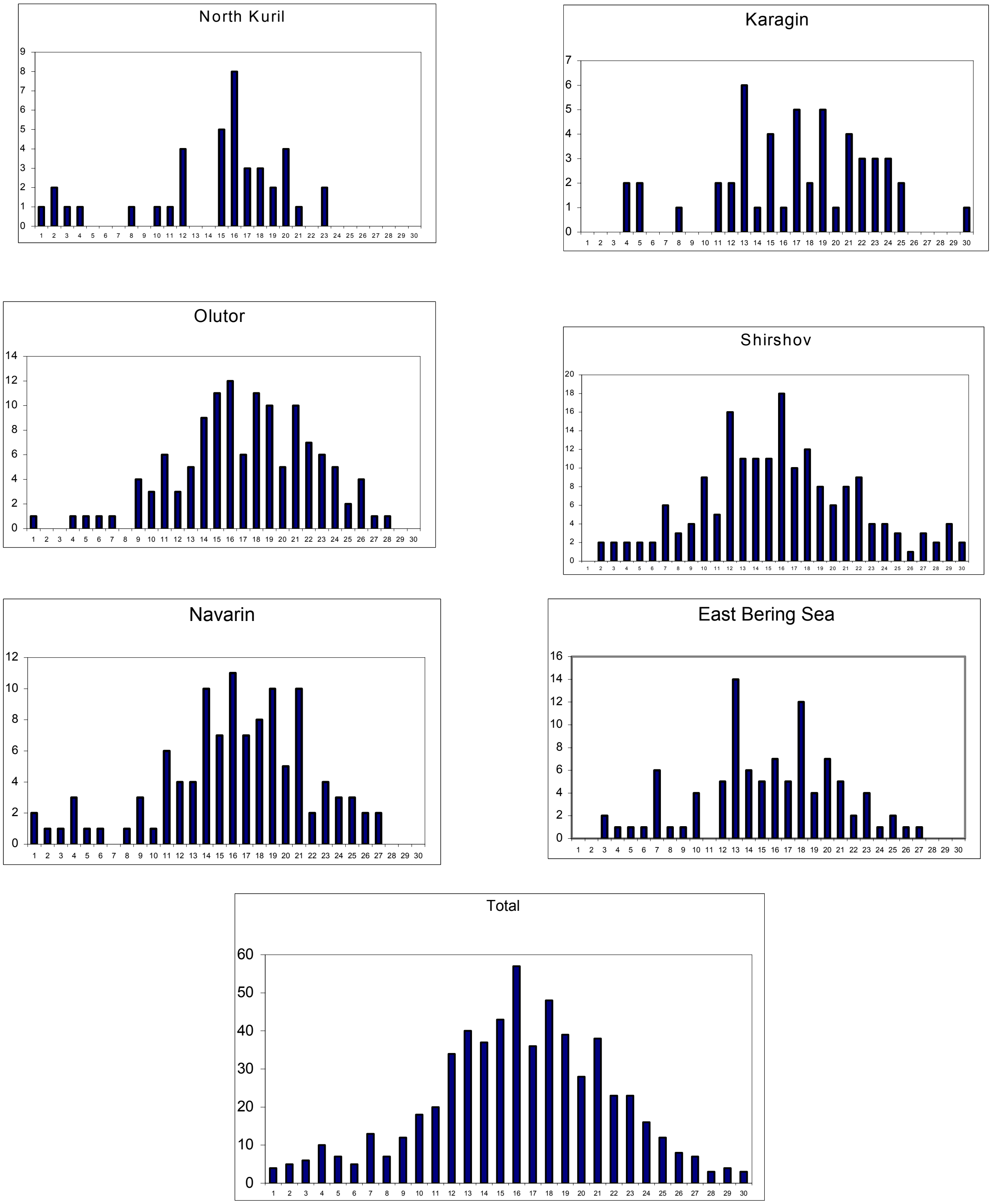


Fig. 4. Distribution of allele frequencies in locus Tch5.

The distribution of allele frequencies in Tch10 varies slightly between the Olutor – Shirshov and East Bering Sea samples. Differences from the small North Kuril sample were observed too. On the whole, however, the profiles were similar (Fig. 5).

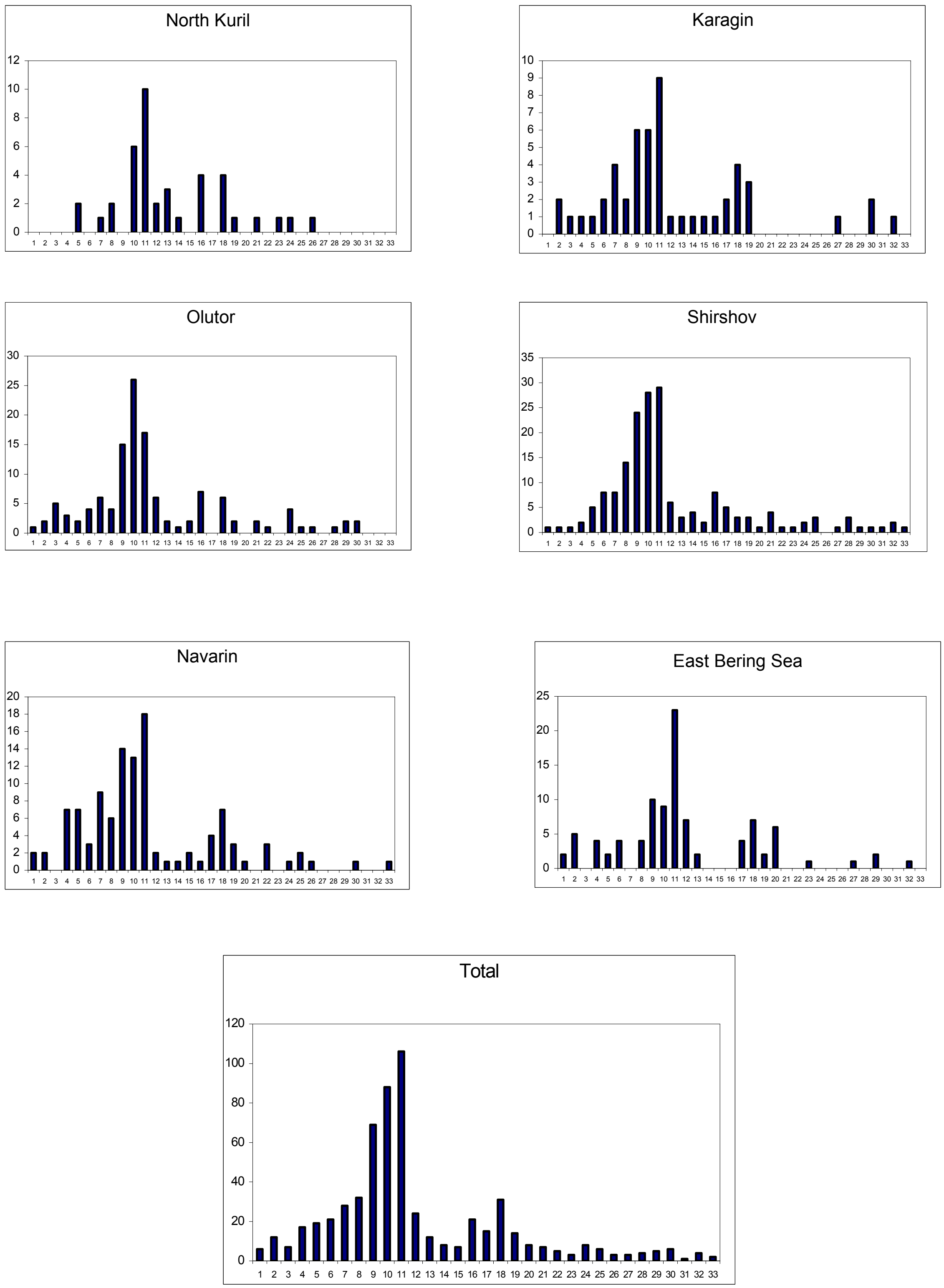


Fig. 5 Distribution of allele frequencies in locus Tch10.

For locus 12 differences were obtained between the North Kuril and Karagin samples only which may result from the insufficient volume of these samples (Fig. 6).

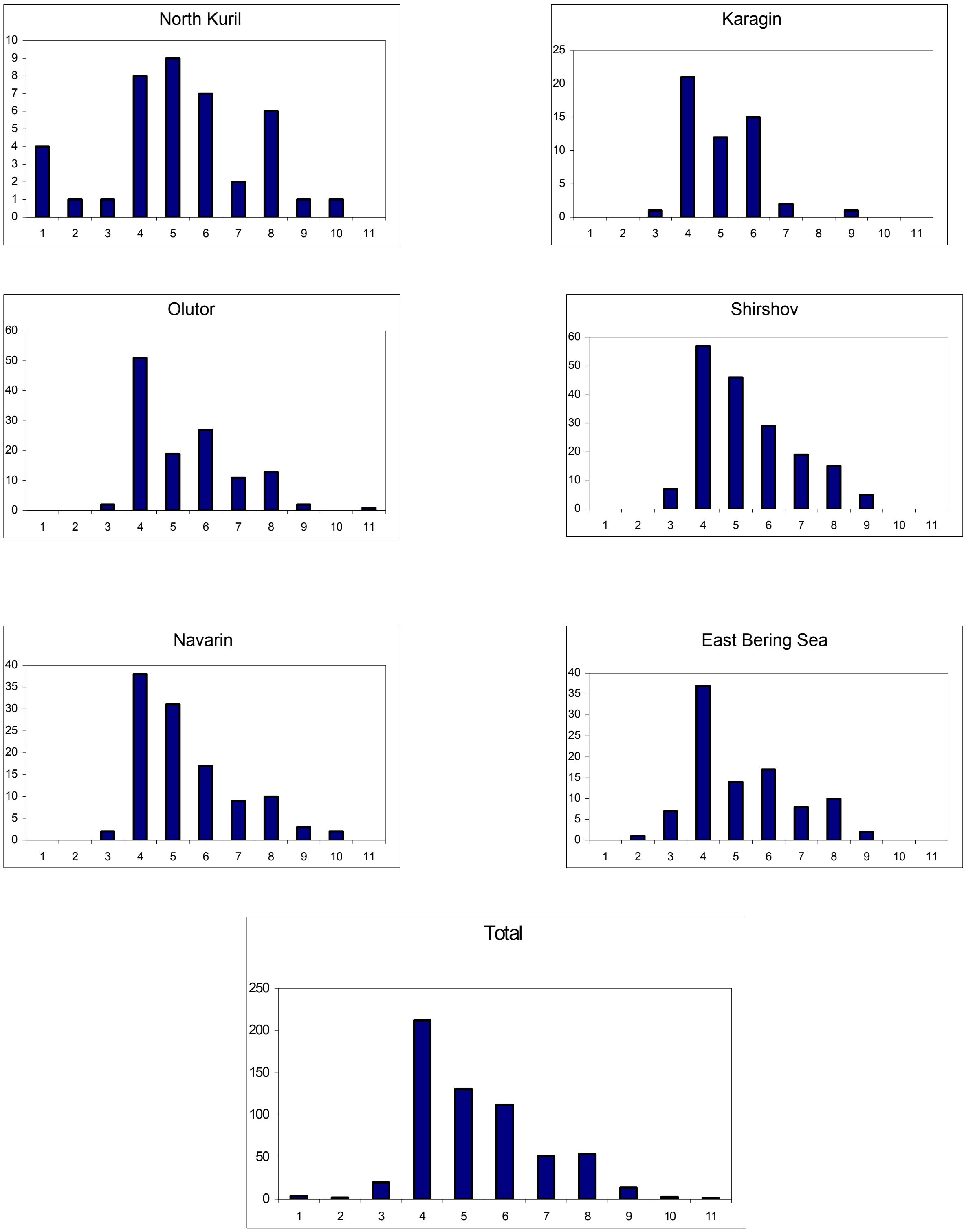


Fig. 6. Distribution of allele frequencies in locus Tch12.

There is some bias in distribution of allele frequencies in the East Bering Sea sample but it occurs smoothly in the series of the Karagin – Olutor – Shirshov– Navarin – East Bering Sea samples (Fig. 7). Totally, the sample's distribution is close to normal.

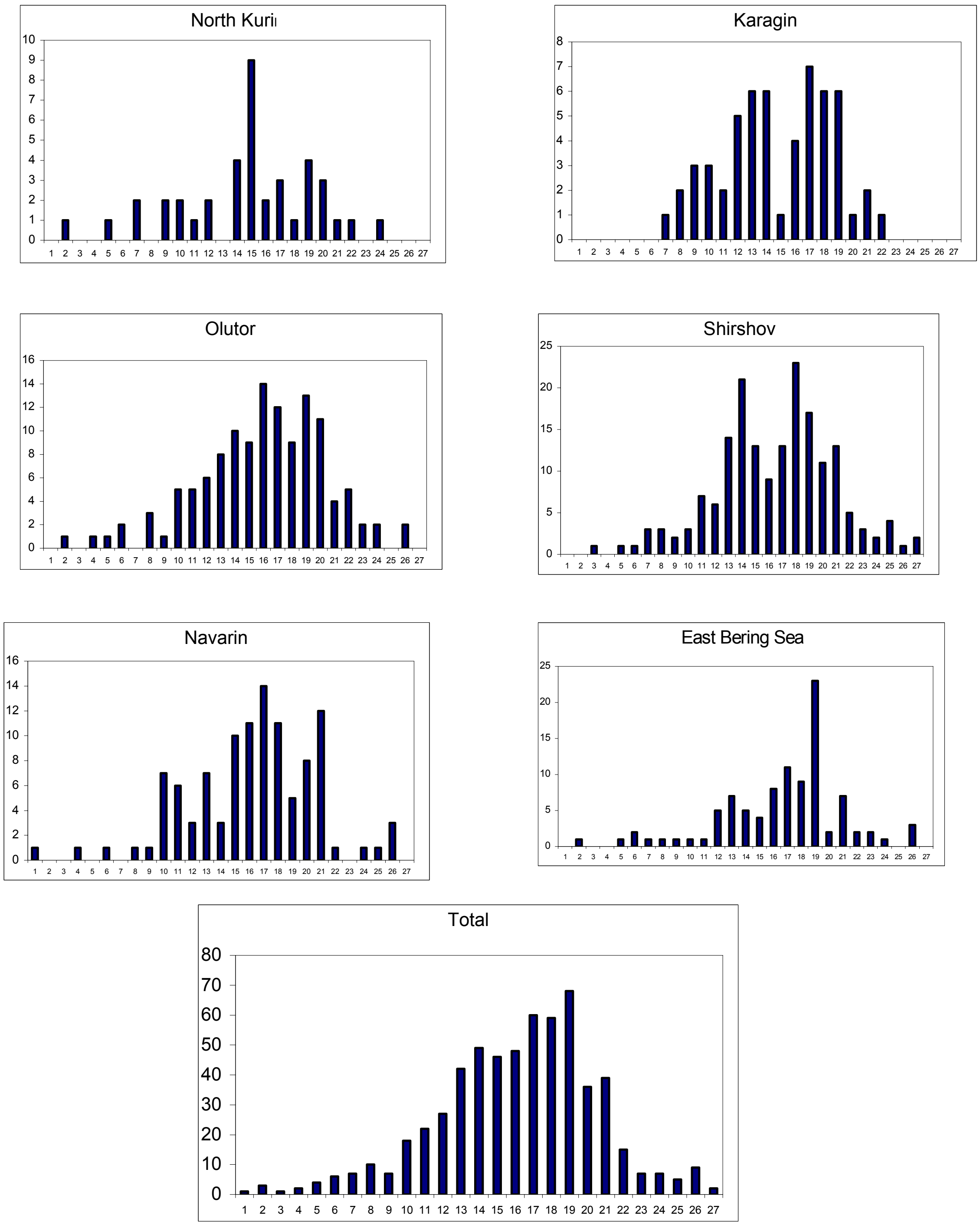


Fig. 7. Distribution of allele frequencies in locus Tch14.

No notable differences were observed in allele frequency distribution in locus Tch19 (Fig. 8).

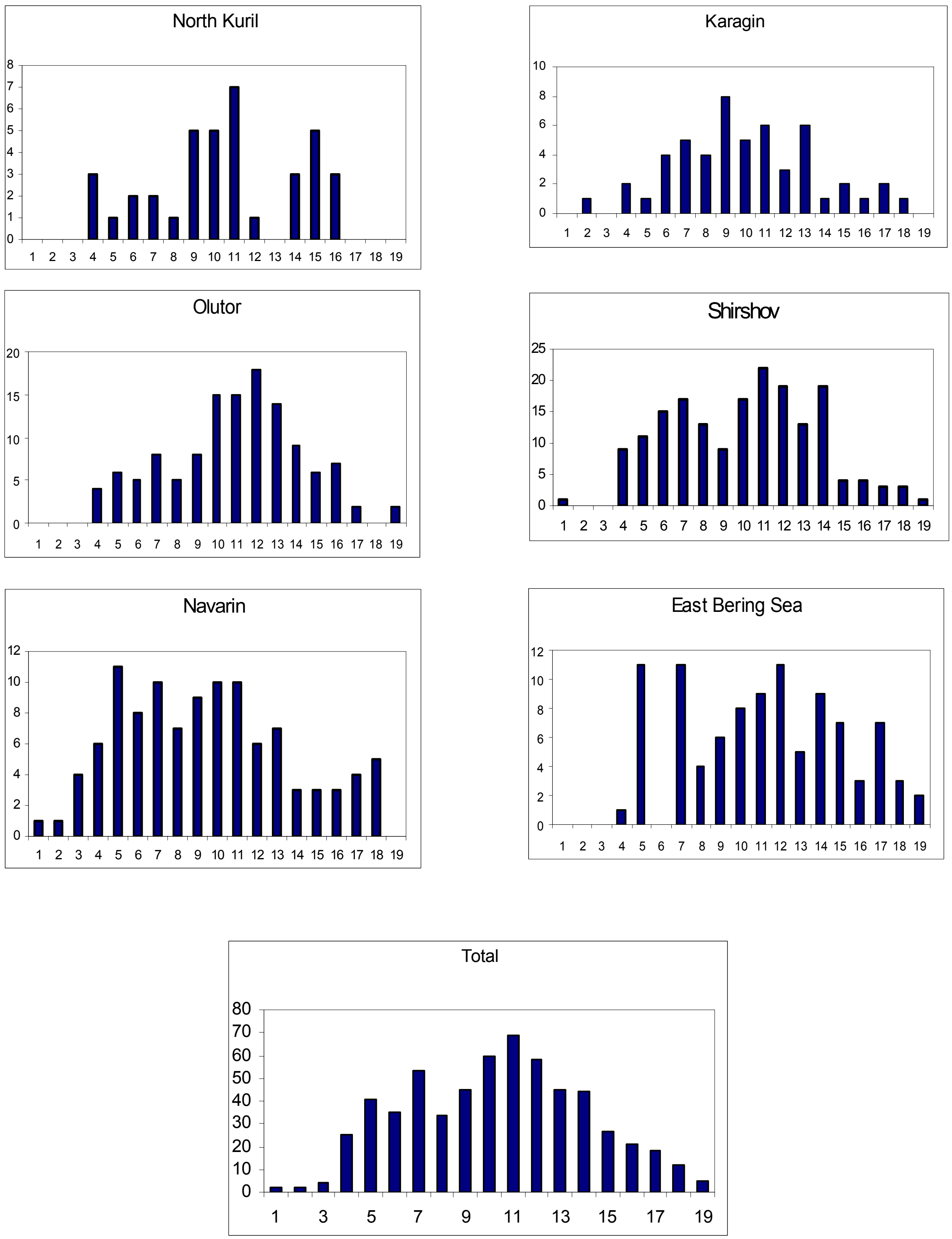


Fig. 8. Distribution of allele frequencies in locus Tch19.

The main genetic indicators of the pollock samples examined and the characteristics of the microsatellite markers used for that are given in Table 1. It includes the volume of the summary samples examined, for each locus, the number of alleles in locus, the allele size pitch in nucleotide pairs, the expected and observed heterozygosity. The most deviant loci are marked with asterisks. The Hardy-Weinberg equilibrium is followed in loci Tch5 and Tch10 only.

Table 1. Characteristics of the main genetic indicators of samples and microsatellite loci. Notation: N – number of specimens examined; Na – number of alleles in locus; R – allele size pitch in nucleotide pairs; He – expected heterozygosity; Ho – heterozygosity observed.

Sample	Loci					
		Tch 5	Tch 10	Tch 12	Tch 14	Tch 19
North Kuril	N	20	20	20	20	19
	N_a	16	15	10	13	12
	R	186-274	145-187	118-154	116-212	106-162
	H_e	0,90	0,88	0,84	0,90	0,88
	H_o	0,90	0,85	0,60*	0,60***	0,74
Karagin	N	25	26	26	25	26
	N_a	19	21	7	16	16
	R	198-302	139-209	126-150	144-204	94-162
	H_e	0,93	0,92	0,70	0,90	0,91
	H_o	0,96	1,00	0,65	0,56***	0,81
Olutor	N	63	63	63	63	62
	N_a	25	26	8	22	15
	R	186-294	137-199	126-158	116-220	106-166
	H_e	0,94	0,91	0,75	0,93	0,91
	H_o	0,83	0,87	0,48***	0,75***	0,66***
Shirshov	N	90	90	89	89	90
	N_a	29	33	7	24	17
	R	190-302	137-213	126-150	124-224	90-166
	H_e	0,95	0,91	0,79	0,93	0,92
	H_o	0,89	0,81	0,61*	0,65***	0,63***
Navarin	N	56	56	56	54	54
	N_a	26	25	8	21	18
	R	186-290	139-209	126-154	112-220	90-162
	H_e	0,94	0,92	0,77	0,92	0,93
	H_o	0,85	0,84*	0,57**	0,70***	0,57***
East Bering Sea	N	49	49	48	49	49
	N_a	25	19	8	22	15
	R	194-290	137-209	122-150	119-224	106-166
	H_e	0,93	0,90	0,78	0,90	0,92
	H_o	0,80**	0,76	0,69	0,71*	0,45***

The analysis of this table shows that heterozygote deficiency of some degree is a feature of all the samples examined. There is no correlation with the size of samples or the number of alleles in polymorphous loci. O'Reilly and others who have developed the set of microsatellite markers used in this paper recognize that in a number of loci (including Tch14 and Tch19) the level of heterozygosity is low (O'Reilly et al., 2004). However, they ascribe that to technical causes, namely to masking in electrophoresis of long alleles by the short ones, and to a greater number of O-alleles (mutations in flanking sequences – Blankenship et al., 2002), and they believe that the "other methods of electrophoresis" and involvement of programs accounting for the probability of deviation from equilibrium make it possible to track down additional alleles which raises the heterozygosity.

The population differences were analyzed by the genotype variants, allele diversity, and gene frequency variance. The North Kuril sample is a significantly differentiated one both in terms of genotypic and allele variants. The second ranking sample showing loci differentiation comes from the East Bering Sea. The concentrations from the Northwest Bering Sea do not show any significant differentiation. The error in summary testing of loci for genotype and allele differentiation is 0.0226 and 0.000 respectively. It is noteworthy that genotype differentiation was found only in loci 5, 10 and 12, for which Hardy-Weinberg law correspondence was shown (Tch12 has a marginal deviation value).

The quantitative measure of the degree of differentiation in a population is a standardized variance of gene frequencies. It is calculated as difference between the variance in an undivided total population and the intrapopulation variance. Table 2 represents the values of variances calculated using two software which apply different algorithms. F_{it} is variance of allele frequencies in the total undivided sample; F_{is} is the intrapopulation variance; F_{st} is the standardized interpopulation variance. The degree of differentiation which we revealed was very low, though the two estimates of this value obtained by using two software agreed almost fully. Locus Tch14 is the only exception where small differences were recorded.

Table 2. F – statistics estimates obtained with GENEPOP and TFPGA software reflecting allele frequency distribution in five microsatellite loci of pollock. * - Locus where differences in variance estimates were recorded.

Software	**GENEPOP**			**TFPGA**		
Estimates / Loci	F_{IT}	F_{ST}	F_{IS}	F_{IT}	F_{ST}	F_{IS}
Tch5	0,092193	0,001542	0,090791	0,0922	0,0015	0,00908
Tch10*	0,064332	0,002922	0,061589	0,0858	0,0026	0,0834
Tch12	0,244932	0,002893	0,242741	0,2460	0,0031	0,2436
Tch14	0,270590	0,003663	0,267908	0,2706	0,0037	0,2679
Tch19	0,316928	-0,000785	0,317464	0,3313	-0,007	0,3318
average	0,1961	0,0020	0,1945	0,2036	0,0020	0,2020

A precise test for subdivision of samples in general by applying TFPGA program using Markov chains concurrently for each of the five loci showed lack of difference for Tch5 locus only (Raimond and Rousset, 1995).

The multilocus test produced the value of X^2 as 60.5213, the number of degrees of freedom being equal to the 10% and 100% probability of differentiation.

Table 3. Pairs of genetic Nei distances (original ones above the diagonal; unbias ones below the diagonal) between various groups of pollock by five microsatellite loci

Concantration	Shirshov	Olutor	North Kuril	Karagin	Navarin	East Bering Sea
Shirshov	***	0,0701	0,2206	0,1128	0,0708	0,1137
Olutor	**0,0121**	***	0,2375	0,1061	0,0906	0,1148
North Kuril	**0,0890**	**0,0987**	***	0,3331	0,2492	0,3042
Karagin	**0,0150**	**0,0011**	**0,1545**	***	0,11185	0,1441
Navarin	**0,0045**	**0,0172**	**0,1022**	**0,0053**	***	0,1445
East Bering Sea	**0,0473**	**0,0412**	**0,1570**	**0,0307**	**0,0627**	***

As is known, Nei distances are functions of the distances expressed in F_{st} units. That is why it is only the unbias values adjusted by the size of sample that are of interest in Table 3.

The major source of being subdivided in the samples analyzed by genetic distances is the set of the North Kuril samples. The difference between the size of Nei distances for the Bering Sea samples is very small; still, there is some correlation with the sites of samples. At any rate, the East Bering Sea and Navarin samples are genetically somewhat more distant than the Navarin and West Bering Sea ones. The UPGMA cluster based on Nei genetic distances is shown in Figure 9. The bootstrap analysis of the cluster showed that the linkpoint uniting the Shirshov and Olutor samples has a 51% bootstrap coefficient, and is supported by 3 loci; linkpoints 2 and 3 (Navarin and Karagin samples respectively) have bootstrap coefficient of 78% and 66%. Finally, the East Bering Sea and North Kuril samples were 100% supported by all the markers used.

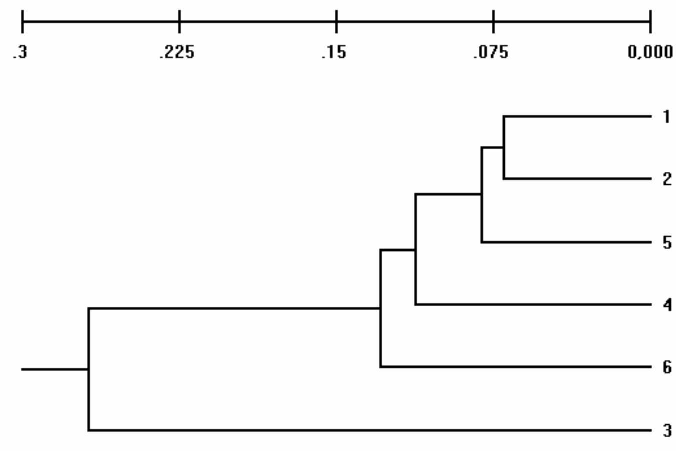
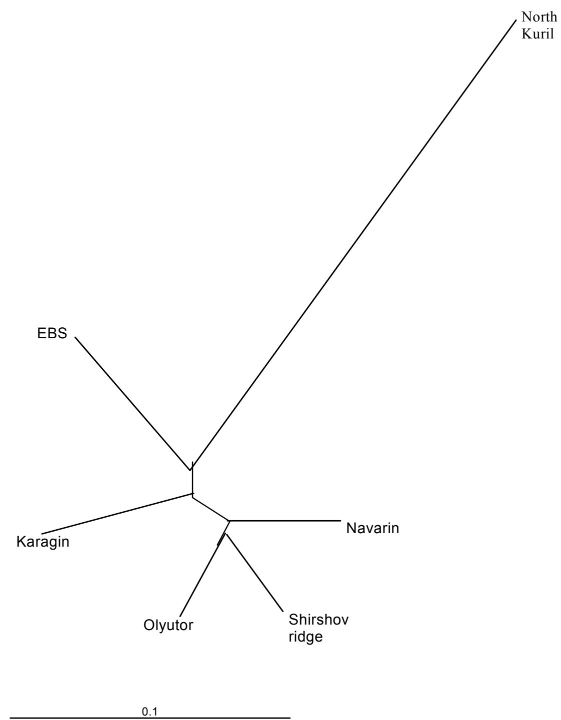


Fig 9. UPGMA dendrogram of pollock concentrations based on Nei genetic distances. Samples; 1. Shirshov; 2. Olutor, 3. North Kuril; 4. Karagin; 5. Navarin; 6 East Bering Sea.

The unrooted dendrogram constructed on the basis of Nei distances shows the degree of genetic distance of pollock groupings from one another which agrees well with the geographic distances between them (Fig. 10).

Fig 10. UPGMA dendrogram of pollock concentrations based on Nei genetic distances (unrooted)



Conclusions

1. Hardy-Weinberg law test confirmed the genetic equilibrium of all the groupings examined.
2. The allele frequency analysis was used as basis for the conclusion regarding the existence of a genetic structure in the sample considered.
3. A quantitative evaluation of the difference showed similarity among the West Bering Sea concentrations, Navarin inclusive. The East Bering Sea samples are very disparate in terms of genetic distances. The North Kuril Grouping stands expressly aside.
4. The genetic distances between the samples on the whole reflect the geographic remoteness of concentrations. The Karagin grouping is an exception. This might result from the insufficiency of the sample.

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Federal Agency of Fisheries Russian Federation

Pacific Research Fisheries Centre (TINRO-centre)

STATUS OF STOCKS AND REPRODUCTION OF THE EASTERN BERING SEA POLLOCK (*Theragra chalcogramma*) IN 2003-2005

(document submitted for Workshop on the Determination of allowable Harvest Levels and Genetics Research on Pollock Resources in the Central Bering Sea, Seattle)

By

Stepanenko M.A. and A.V. Nikolaev

2005

The trend of Eastern Bering Sea pollock biomass increasing were stable by the end of 1990-s and early 2000-s as result of annual recruitment by average 1995, 1997-1999 and numerous 1996, 2000 year classes. Pollock biomass had increased for 61% in period 1996-2002.

The oceanology condition and pollock spatial distribution were close to average at first part of 1990-s. Some signs of cooling had appears in the Bering Sea by the end of 1997 and it have maximum in 1999. At the same time, cold period in the Bering Sea was short and new warming process began in 2001-2002. The high positive water temperature anomaly observed in the Bering Sea in 2003-2004.

There is direct interrelationship between distribution of pollock and variability of oceanology condition, basically of water temperature, in summer-autumn time. Distribution of pollock in the northwestern Bering Sea have big scale interannual variability depends of changing water temperature. Scale of pollock distribution into northwestern Bering Sea much higher in period warm oceanology condition.

Indicated interrelationships between interannual variability of the Eastern Bering Sea pollock spatial distribution, biomass (5.0 - 9.0 mln.t) and changing oceanology condition were observed in period between middle 1990-s and early 2000-s.

Spatial distribution of the Bering Sea pollock in feeding period depends on it abundance and biomass, age composition and environmental condition. The eastern Bering Sea pollock usually distributed very widely at shelf and deep water Aleutian and Commandor basin in periods of it high abundance (12.0-15.0 mln.t).

The eastern Bering Sea pollock biomass decreased to about 5.5-6.0 mln.t in middle 1990-s but by the end of 1990-s it increased again on behalf of new relatively abundant year classes.

Interannual variation of pollock abundance and biomass in the Navarin area also very significant as indicated by bottom trawl and echointegration survey data (Table 1).

Table 1

Estimated of walleye pollock abundance and biomass in the Navarin area in 1996-2002 (by EI MWT and BT surveys data)

Year	Bottom **			Midwater			Total	
	S (mile^2)	N (mln.fish)	B (ths.t)	S (miles^2)	N (mln. fish)	B (ths.t)	N (mln.fish.)	B (ths.t)
1996	18500	1158	390	17520	769	259	1927	649
1997	24050	1004	333	27036	1323	250	2327	583
1998	15820	962	390	13640	234	71	1196	461
1999	32663	532	250	12688	291	70	823	320
2000	22400	203	64	15420	365	54	568	118
2001	38027	1642	384	22380	218	32	1860	416
2002	42146	938	215	14040	672	58	1610	273

** Estimates of biomass off bottom in 1997-1999, 2001- 2002 by BT surveys (K=1.0), in 2000 by EI MWT survey

As a rule, pollock abundance and biomass have high long term and short term interannual variability everywhere in the North Pacific. By the end of 1980-s and early 1990-s had appeared stable trend decreasing of most pollock populations abundance . Biomass of the eastern Bering Sea pollock decreased to 5.5-6.0 mln.t in middle 1990-s. The Eastern Bering Sea pollock stock is neither overfished and it biomass increased (8.0-9.0 mln. t) by the end of 1990-s and early 2000-s (Table 2).

The AFSC pollock biomass estimate by bottom-trawl (BT) survey for 2003 is very high – 8.51 mln. tons, an increase of 77 % from the 2002 estimate of 4.82 mln. tons. The echo-integration trawl (EIT MWT) survey biomass for 2002 is 3.6 mln. tons.

The time series of survey estimates suggest an increasing trend of pollock biomass in the southeastern Bering Sea by the end of 1990-s and early 2000-s.. Interannual variability of biomass estimates is due to the effect of year class variability. (NPFMC Bering Sea/ Aleutian Islands SAFE document, 2003).

The annual catch of pollock in the Bering Sea have varies depends of pollock abundance and biomass and recently have stable trend for increasing (Table 3).

The annual eastern Bering Sea pollock recruitment and spatial distribution of mature and immature fish also variates significantly

Table 2

Biomass of the eastern Bering Sea pollock in 1979-2004, mln.t (according to AFSC data)

Year	***Survey data***			
	BT,shelf	***EI, shelf***	***EI, Bogoslof***	***Total***
1979	2.00	1.550	-	3.55
1980	0.99	-	-	-
1981	2.27	-	-	-
1982	3.54	4.640	-	8.18
1983	4.81	-	-	-
1984	3.96	-	-	-
1985	4.36	5.450	-	9.82
1986	4.31	-	-	-
1987	5.03	-	-	-
1988	5.94	4.160	2.400	12.50
1989	4.78	-	2.100	-
1990	7.70	-	-	-
1991	5.10	1.400	1.300	7.80
1992	4.30	-	0.980	-
1993	5.50	-	0.680	-
1994	4.98	2.760	0.540	8.28
1995	5.41	-	1.020	-
1996	3.20	2.239	0.682	6.12
1997	3.03	2.590	0.390	6.01
1998	2.21	-	0.490	-
1999	3.57	3.290	0.480	7.34
2000	5.13	3.05	0.301	8.48
2001	4.1	-	0.232	-
2002	4.81	3.60	0.227	8.63
2003	8.5	-	0.198	-
2004	3.75	3.31	-	7.06

Table 3

Catch of the Bering Sea pollock in 1984-2004, ths. m.t. (according to AFSC and TINRO data)

Year	***EBS shelf***	***Bogoslof I.***	***WBS shelf***	***Aleutian Basin***	***Aleutian Islands***	***Total***
1984	1092.05	-	503.0	181.20	81.80	1858.0
1985	1139.67	-	488.0	363.40	58.70	2049.8
1986	1141.99	-	570.0	1039.00	46.60	2797.6
1987	859.41	377.40	463.0	1326.30	28.70	3054.8
1988	1228.72	87.80	852.0	1395.90	30.00	3594.4
1989	1229.60	36.00	684.0	1447.60	15.50	3412.7
1990	1455.19	151.60	232.0	917.40	79.00	2835.2
1991	1217.30	264.70	178.0	293.40	78.60	2037.3
1992	1164.44	0.160	315.0	10.00	48.70	1538.3
1993	1326.60	0.886	389.0	1.95	57.10	1775.4
1994	1363.45	0.566	178.0	-	58.60	1600.6
1995	1262.76	0.264	320.0	-	64.40	1647.4
1996	1192.77	0.387	700.8	-	29.06	1922.2
1997	1124.59	0.168	680.0	-	25.94	1830.6
1998	1101.16	0.080	643.6	-	23.82	1768.7
1999	992.00	0.029	632.7	-	1.00	1625.8
2000	1112.5	0.028	378.0	-	1.24	1490.5
2001	1381.6	0.029	526.1	-	0.80	1908.5
2002	1485.0	0.001	383.4	-	1.04	1869.4
2003	1489.4	0.002	415.6	-	1.64	1906.6
2004	1492.0	-	455.1	-	1.14	1948.2

The annual eastern Bering Sea pollock spatial distribution varies especially significantly in periods of anomalous environmental condition.

In summer, 1999 most of pollock were distributed at shelf placed between Pribilof Isles and $177^0$00 W. Relatively intensive northwestern migrations indicated just by the end of August. Distribution pollock in the Bering Sea in 1999 quite different compare the 1994-1997 pattern.

Scale of pollock distribution in the northwestern Bering Sea was less as average also in 2000, especially in first part of summer, because that area was occupied by extremely cold water.

In 2003-2004 water temperature was much higher entire Bering Sea and pollock distribution in the northwestern area had increased.

The some trend of increasing of pollock recruitment in the Bering Sea, including southeastern shelf indicated in 1998 - 2000.

The immature pollock of 2000 year class were really abundant in 2002 both in the northwestern and southeastern Bering Sea.

At the same time, summer 2004 survey data indicated that spatial distribution pollock significantly differs from 2000-2003 data and abundance of 2001-2003 year classes much less as 2000 year class.

In summer 2004 most of immature pollock and fish of numerous 2000 year class were distributed in the northwestern shelf. Older pollock of 1998-1999 year classes predominated in the southeastern Bering Sea (23.8% and 36.6%) and fish of 2000 year class consisted just 16.2% of abundance (Fig. 1). Biomass of pollock in the southeastern Bering Sea estimated in 2.05 mln.t by EI MWT survey data.

The pollock of 2000, 1999 and 2001 year classes predominated in the northwestern Bering Sea in the U.S. EEZ – 31.4%, 21.6% and 19.6% consequently and abundance of 2003 year class pollock very low (Fig. 2). Biomass pollock in the northwestern shelf estimated in 2.93 mln.t.

The pollock biomass in the Bering Sea (0.5 m off bottom-surface, AFSC EI MWT survey data) estimated in 4.98 mln.t in 2004 (in 2002 – 4.63 mln.t, in 2000 - 3.74 mln.t, in 1999 – 4.04 mln.t.) (Table 4). The pollock of 2000 and 1999 year classes predominated in the eastern Bering Sea by numbers – 31.4% and 21.6% consequently (Fig. 3).

Table 4

Biomass and abundance pollock in the Bering Sea in 1996-2004 (by EI MWT survey data).

	Biomass, mln.t			Abundance, mln.specimen.		
Год	Surface-3м off bottom	3-0.5м off bottom	Surface-0.5м off bottom	Surface-3м off bottom	3-0.5м off bottom	Surface-0.5м off bottom
1996	2370.7	681.0	**2991.7**	6525.3	1311.5	**7836.7**
1997	2631.7	961.9	**3593.6**	18554.9	2016.4	**20571.3**
1999	3202.2	842.3	**4044.4**	8833.7	2046.9	**10880.5**
2000	3050.3	690.0	**3740.3**	7629.1	1311.4	**8940.6**
2002	3707.2	930.4	**4637.6**	11877.8	1673.7	**13551.5**
2004*	4115.2	871.6	**4986.8**	8595.8	1313.7	**9909.5**
2004	3846.0	814.6	**4660.6**	7521.7	1149.6	**8671.3**

* - including biomass estimated in the Navarin area

The 2001 and 2002 year classes abundance much less compare abundance of 2000 year class. Abundance of 1-year old pollock of 2003 year class very low by 2004 EI MWT survey data, in spite of extremely high abundance of pollock juveniles registered both in the northwestern and southeastern Bering Sea shelf in 2003. It's demonstrates that natural mortality of 0+ year old pollock were very high in winter 2003-2004 but reason of it unknown.

Relative abundance of immature 1-3 years old pollock in the Bering Sea in 2004 much less compare 1999, 2000 and 2002 by EI MWT survey data (Fig. 4).

Aleutian Basin pollock spawning stock in the Bogoslof Island area have been surveyed regular since 1988. The last years surveys data demonstrates low pollock spawning biomass in the area (NPFMC Bering Sea/ Aleutian Islands SAFE document, 2003).

The originally shelf and deep water pollock habits in the eastern Bering Sea shelf before first maturing. Identification of origin immature pollock at shelf unpossibly by present methods. At the same time, there are a lot of observations of distinct differentiation of immature pollock at the Bering Sea shelf by growth rate, length, body morphology as well as it behaviour and distribution.

The survey data of 2000 indicated possibility high abundance Bogoslof I origin of 2000 year class pollock on base of distribution pollock juveniles. A lot number of pollock juveniles were distributed close to shelf edge in area placed from Unimak Pass to eastern side of Pribilof canyon in 2000 and were speculated that the juveniles originally from Bogoslof reproduction area. Another big concentration of pollock juveniles in summer 2000 was found at shelf off eastern side of Pribilof Islands.

The age of first maturing Bogoslof I spawning stock pollock is 4+-5+.Quite possibly that by the end winter and early March some prespawning 4+ - 5+ pollock migrates from outer shelf into adjacent continental slope basically inside the canyons. Most solid concentrations of prespawning fish observed in the Pribylof and Zhemchug canyons in first part of February each year in 1990-2000-s. The recruits of 2005 represent basically pollock of abundant 2000 year class.

Prespawning pollock begin migrate from big canyons area to southeast along direction continental slope, into Bogoslof I spawning ground by the end of February and early March. Big concentrations of prespawning pollock observed in deep water (about 400-500 m) of the Bering canyon, in area placed to north from Akutan I during second part February or early March almost annually.

Interannual data of prespawning pollock maturity dynamics in the Bogoslof I reproduction area (Yanagimoto et al., 2002) indicated that active spawning, especially younger fish, start basically in second part of March (1992-1993, 1995-1996, 1998-1999).

Quite possibly that spawning of abundant 2000 year class recruits in 2005 taken place basically later the regular EI survey time (March 4-11), - in second part of March.

The high density concentrations of mature pollock were observed at shelf and adjacent continental slope off eastern Aleutian Islands (Akun I.– Akutan I. – northern Unalaska I) in summer 2002 and 2004. This pollock differs sharply from fish distributed at shelf by length-age composition and gonads maturity. In 2002 the pollock of 1995-1996 year classes (42-50 cm) and in 2004 of 1998-1999 year classes (42-48 cm) predominated off eastern Aleutian Islands. Apart from, in 2004 pollock of 1995-1997 year classes also was relatively abundant in that area. The gonads of pollock males have not any remains of sperm and females resorbing eggs of previous generation. It shows that active spawning period of this fish was long time ago and much earler as spawning of pollock at shelf.

Quite possibly that feeding pollock distributed off eastern Aleutian Islands is a part Bogoslof Island spawning stock and mature fish of 1998-1999 year classes represent a recruits of it spawning stock in 2004.

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Update of Navarin walleye pollock stock assessment

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Navarin pollock stock status was re-estimated using the following data:

- catch-at-age, weight-at-age, maturity-at-age (1984-2004);
- CPUE for 2 fleets (medium and large vessels) – as FSB relative indices;
- age-structured young fish surveys ((1) in summer and (2) in autumn) – as abundance-at-age indices;
- 0-group abundance estimates (from young fish surveys) - as SSB relative index.

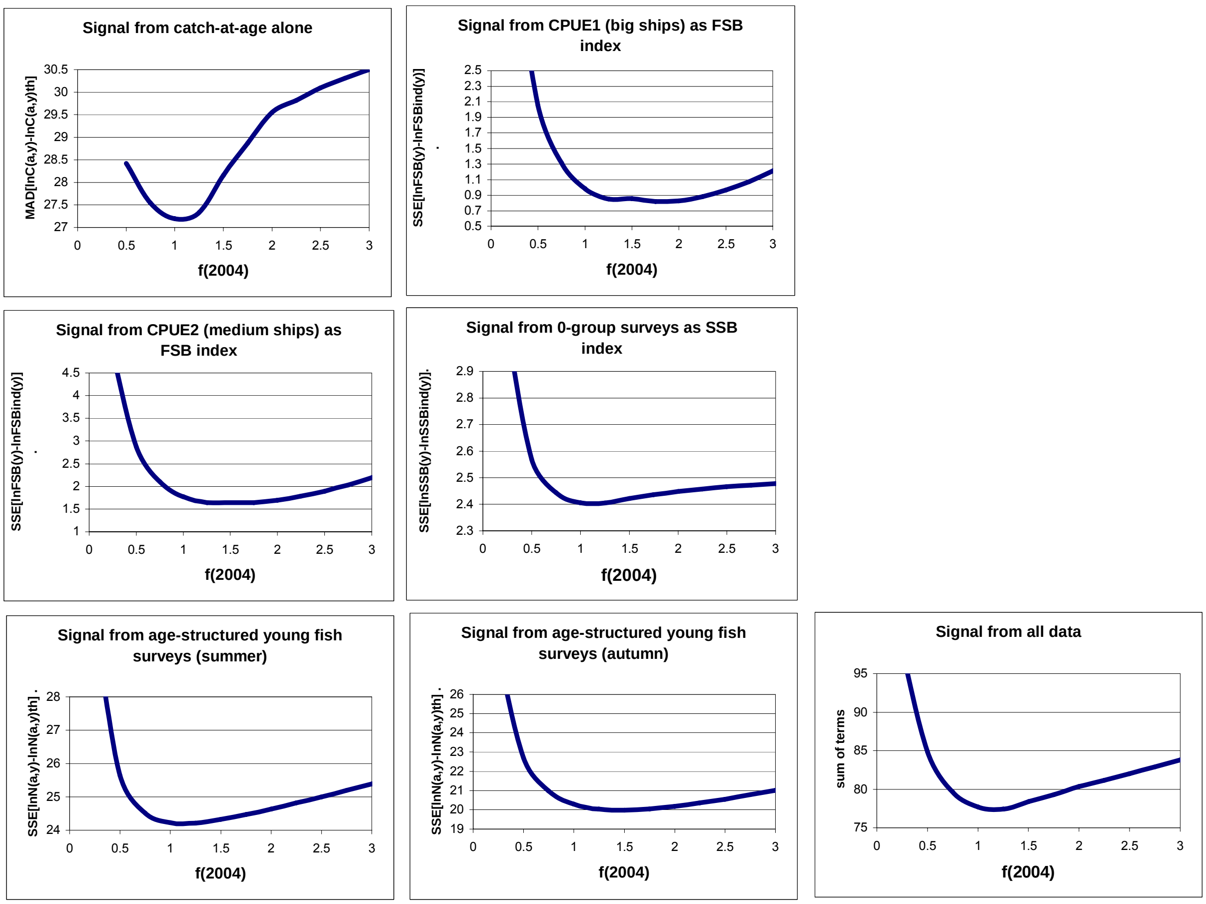
Stock assessment model was so called effort-controlled version of the ISVPA-group of separable cohort models (for details of the model see appendix and references to it). This version of the model attributes residuals in cohort part of the model to errors in catch-at-age data, assuming that selection pattern (patterns) is stable. This version is often more robust for noisy catch-at-age data. Additional robustness of cohort part of the model with respect to outliers in catch-at-age was attained 1) by minimization of median absolute deviation (MAD) of residuals in logarithmic catch-at-age as a measure of closeness of the model fit to catch-at-age data, and 2) condition of unbiased separable representation of fishing mortality coefficients. Change in selection pattern in 2001 was taken into consideration by estimation of two respective selection patterns.

In this assessment for the first time the estimates of abundance from young fish surveys were included. These data were incorporated into the model in two ways: (1) as age-structured abundance index and (2) 0-group abundance was used as relative index of SSB. Other sources of information were catch-at-age of commercial catches and CPUE time series of two fleets (medium and large vessels).

Profiles of components of the model loss function, as well as profile of the total loss function, are presented on figure 1 as a function of the effort factor value in the terminal year. Although level of noise in the survey data was found to be rather high, the results of application of the model revealed rather coherent signals about the stock size from all sources of information, including young fish surveys. It could be concluded that young fish surveys provide reasonable estimates of trends in abundance of young age groups, while survey-derived abundance estimates of age group 0+ may serve as a reasonable index of SSB in frames of age-structured stock assessment models.

Bootstrap-estimated uncertainty levels for model-derived estimates of fishing stock biomass (FSB) and total stock biomass (TSB) for age groups 2 and older (conditional parametric with respect to catch-at-age, non-conditional parametric with respect to auxiliary data; lognormal error distribution in catch-at-age, in FSB and SSB indices, and in age-structured abundance indices was assumed) are presented on figure 2.

Since it was hardly possible to assume any reliable stock-recruitment relationship having existing observations (see figure 3), yield-per-recruit analysis (figure 4) seems to be more reasonable source for biological reference points estimation in current informational situation.



Profiles of components of the ISVPA loss function with respect to effort factor in 2004

Figure.1

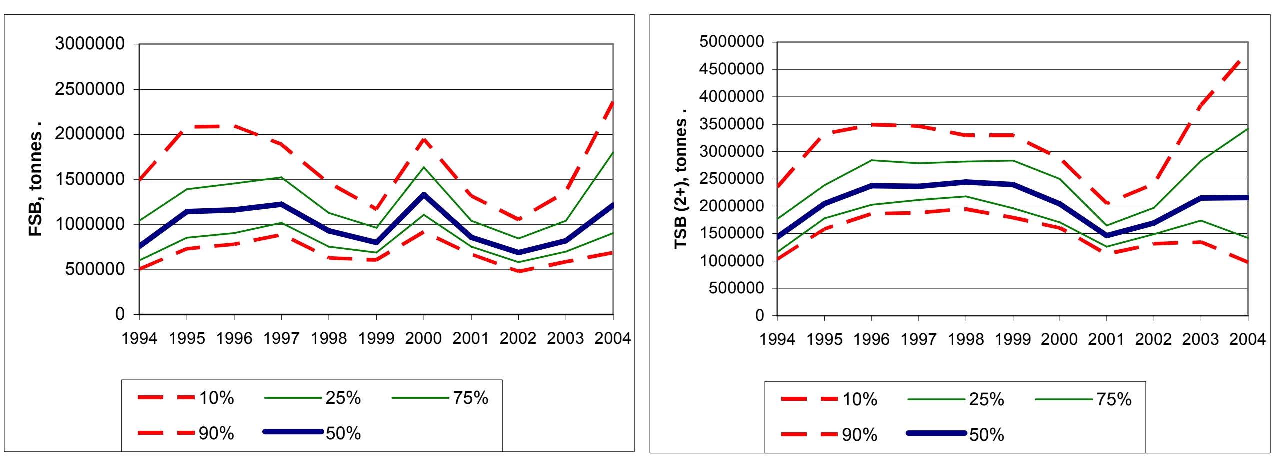


Figure.2. Percentiles of bootstrap distribution for FSB and TSB estimates.

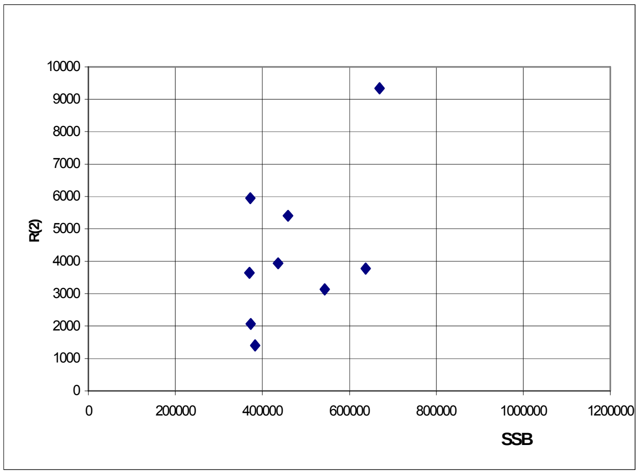
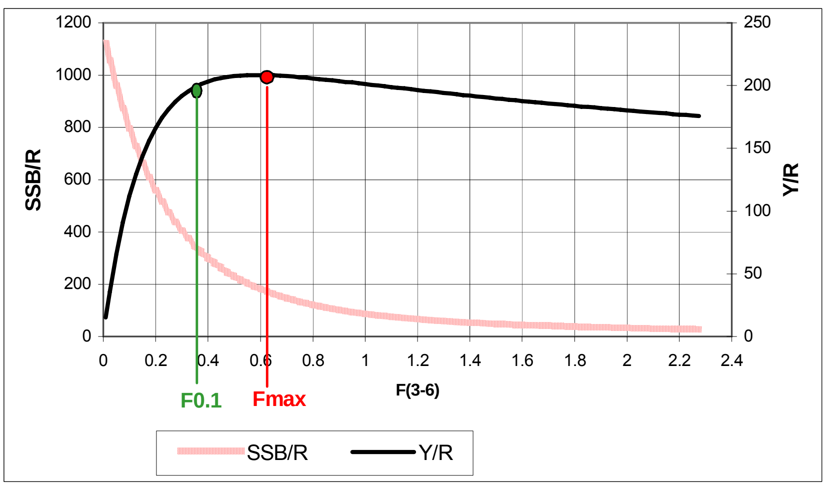


Figure 3. Estimates of recruitment vs. SSB.



YPR analysis

Figure 4.

Appendix

W.D. to ICES WGMHSA, 2004.

DESCRIPTION OF THE ISVPA (version 2004.3)

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Brief description of the model is summarized in the table below:

Model	**ISVPA**
Version	**2004.3**
Model type	A separable model is applied to one or two periods, determined by the user. The separable model covers the whole assessment period
Selection	The selection at oldest age is equal to that of previous age; selections are normalized by their sum to 1. For the plus group the same mortality as for the oldest true age.
Estimated parameters	
Catchabilities	The catchabilities by ages and fleets can be estimated or assumed equal to 1. Catchabilities are derived analytically as exponents of the average logarithmic residuals between the catch-derived and the survey-derived estimates of abundance.
Plus group	The plus group is not modelled, but the abundance is derived from the catch assuming the same mortality as for the oldest true age.
SSB surveys	Considered as absolute or relative. If considered as relative, coefficient of proportionality is derived analytically as exponent of the average logarithmic residuals between the catch-derived and the survey estimates of SSB.
Surveys in year (terminal + 1)	Can be taken into account (in assumption that fishing pattern in the year (terminal+1) is equal to that of terminal year)
Objective function	The objective function is a weighted sum of terms (weights may be given by user). For the catch-at-age part of the model, the respective term is: • sum of squared residuals in logarithmic catches, or • median of distribution of squared residuals in logarithmic catches MDN(M, fn), or • absolute median deviation AMD(M, fn). For SSB surveys it is sum of squared residuals between logarithms of SSB from cohort part and from surveys. For age- structured surveys it is SS, or MDN, or AMD for logarithms of N(a,y) or for logarithms of proportions-at-age, or for logarithms of weighted (by abundance) proportions-at-age.
Variance estimates/ uncertainty	For estimation of uncertainty parametric conditional bootstrap with respect to catch-at-age, (assuming that errors in catch-at-age data are log-normally distributed, standard deviation is estimated in basic run), combined with adding noising to indexes (assuming that errors in indexes are log-normally distributed with specified values of standard deviation) is used.
Other issues	Three error models are available for the catch-at-age part of the model: • errors attributed to the catch-at-age data. This is a strictly separable model ("effort-controlled version") • errors attributed to the separable model of fishing mortality. This is effectively a VPA but uses the separable model to arrive at terminal fishing mortalities ("catch-controlled version") • errors attributed to both ("mixed version"). For each age and year, F is calculated from the separable model and from the VPA type approach (using Pope's approximation). The final estimate is an average between the two where the weighting is decided by the user or by the squared residual in that point. Four options are available for constraining the residuals on the catches: 1. Each row-sum and column-sum of the deviations between fishing mortalities derived from the separable model and derived from the VPA-type (effort controlled) model are forced to be zero. This is called "unbiased separabilization" 2. As option 1, but applied to logarithmic catch residuals. 3. As option 1, but the deviations are weighted by the selection-at-age. 4. No constraints on column-sums or row-sums of residuals.
Program language	Visual Basic

1. Introduction

Separability assumption is widely used in various cohort models (Pope, 1974; Doubleday,1976, Pope and Shepherd,1982; Fournier and Archibald, 1982; Deriso et al. (1985), Kimura (1986), Gudmundsson (1986), Patterson (1995), etc.). A group of separable cohort model, named ISVPA, may serve as an example of comparatively simple stochastic separable cohort models (Kizner and Vasilyev,1997; Vasilyev 1998, 1998a, 2001). Models of the ISVPA group are similar in many aspects to other separable cohort models and imply the existence of errors in catch-at-age data and in separable representation of fishing mortality coefficients. But their parameter estimation procedures is based on some principles of robust statistics what helps to diminish the influence of error (noise) in catch-at-age data on the results if the assessment. Besides the solution is guaranteed to be unbiased in chosen statistical sense. Special parameterization of the model makes it unnecessary to use any preliminary assumptions about the age of unit selectivity and about the shape of selectivity pattern. This helps to get unique solution in cases when catch-at-age data are noisy and auxiliary information is too controversial or is not available. Otherwise ISVPA may be used in order to outline stock tendencies from catch-at-age data taken alone.

For simplicity any model from the group we will further refer to as ISVPA model, if necessary giving concretization of the version used.

2. Basic relationships

The Instantaneous Separable VPA (or ISVPA) group of models is designed for stock assessment when catch-at-age data are noisy; auxiliary information may be incorporated, or not used at all (if it is not available or considered as unreliable). The word “Instantaneous” means that similarly to Cohort Analysis by Pope (1972) the catch is assumed to be taken “instantaneously”, that is within comparatively short period within a year. The approximation of “instantaneous” catch is absolutely correct for short fishing seasons, but it also can be regarded as being an approximate method for assessment of continuously exploited age-structured populations. In should be noted that the assumption of a constant fishing mortality coefficient during a year, that underlines conventional VPA, is also only a approximation. These two hypotheses are in fact two opposite marginal simplifications in the frames of cohort models. The acronym ISVPA should not be confused with that of Integrated Stochastic VPA by Lewy (1988).

Let us remind that Pope's Cohort Analysis is based on the observation equation (Baranov's catch equation):

$$C_{a,y} = F_{a,y}/(F_{a,y} + M)*N_{a,y}\,[1 - e^{-(F_{a,y} + M)}] \qquad (1)$$

(a=1,..., m; y=1,...,n),

and the dynamic state equation:

$$N_{a,y} = (N_{a+1,y+1}e^{M/2} + C_{a,y})e^{M/2} \qquad (2)$$

(a=1,..., m-1; y=1,...n-1), where a - age index, m - total number of age groups, y - year index, n - total number of years, $N_{a,y}$ - abundance of age group a in year y,$C_{a,y}$ - catch from age group a in year y, M - instantaneous natural mortality coefficient (may be constant or a function of age). For simplicity a=1 and y=1 correspond to the first age group and first year in the available data respectively.

Equation (1) express the total catch from age group a, accumulated in the y-th year if the dynamics of the group abundance N and the accumulated catch C (at time t) during the year are governed by the well known equations: $dN/dt=-(F+M)N$ and $dC/dt=FN$, where F and M do not depend on t (indices are omitted). Equation (2) is traditionally regarded as a discrete approximation of a continuous process; it becomes an exact one if the catch $C_{a,y}$ is taken instantaneously in the middle of the year y.

However, there are many exploited stocks with such short periods of fishing that the latter may be regarded as momentary. In such a case if the period of fishing falls in the middle of a year, equation (1) may be replaced by

$$C_{a,y} = \varphi_{a,y}\, N_{a,y}e^{-M/2}, \qquad (3)$$

where $\varphi_{a,y}$ plays the role similar to that of $F_{a,y}$ in equation (1) but cannot be called a fishing mortality coefficient. Strictly speaking, it is the fraction of the abundance of the a-th age group, taken as catch in the middle of the year y. The model (2)-(3) may be regarded as "instantaneous" analogue of VPA. The word "separable" shows that the hypothesis of separability (i.e. of age selectivity of the fishery) is accepted.

In terms of ISVPA it means that

$$\varphi_{a,y} = s_a \cdot f_y \qquad (4)$$

where f_y is proportional to the fishing effort (a year effect), while s_a is the selectivity of the fishery (an age effect). Further we will call them as effort factor and selectivity factor.

Selectivity factors in the model are normalized:

$$\sum_{a=1}^{m} s_a = 1 \tag{5}$$

It is clear that in reality the fishing season does not necessarily fall within the middle of the calendar year. For the model it means that instead of factors $e^{M/2}$ и $e^{-M/2}$ the Equations (2) and (3) must contain factors $e^{\beta M}$, $e^{(1-\beta)M}$ and $e^{-\beta M}$, where β is a given constant (0 < β < 1). For simplicity in further explanations we will use β=1/2.

As can be seen, calculation of abundances in Equation (2) is undertaken directly through catch values. Catch values in this case are treated as true, the same way as in deterministic cohort models. But separabilization of the model makes it possible to look for unique values of $N_{a,y}$. . By this reason the version of the model determined by Equations (2)-(5) may be called ***catch controlled***. In this version of the model the role of separabilization consists only in estimation of terminal populations and this version may be regarded simply as a method of tuning of ordinary cohort analysis, while the loss function of the model (for example - sum of squared residuals between logarithms of real and theoretical catches) may be regarded as a measure of inseparability of the catch-at-age data (in logarithmic form) .

The effort-controlled version of the ISVPA, which do not treat catch-at-age data as true, is based on another dynamic state equation, resulting from substitution of the expression for theoretical catch $\hat{C}_{a,y} = s_a f_y N_{a,y} e^{-M/2}$ instead of real catch $C_{a,y}$ into Equation (2):

$$N_{a,y} = \frac{N_{a+1,y+1} e^{M}}{1 - s_a f_y} . \tag{2'}$$

Thus, in estimation of abundance by this version of the model it is implied that separable representation of fishing mortality is true and residuals are attributed to errors in catch-at-age data. Here the value of loss function may be regarded as a measure of "precision" of catch-at-age data (if to assume that the fishery is fairly separable).

In practice in most cases both assumptions (that catch-at-age data are precise or fishery is well separable) are rather far from reality. If there are some ideas about their relative validity it is possible to use ***mixed*** version of ISVPA in which the equation of stock dynamics is a mixture (with the coefficient given by user) of equations (2) and (2'). In this version of the ISVPA the same weight (or "level of relative confidence") of the two assumptions is used for all points.

Since often the user has no preliminary ideas about relative validity of the above mentioned assumptions and since the relative weight of these assumptions may be strongly different for different points (*a,y*), the 4-th version of ISVPA named ***mixed with weighting by points*** is also available. In this version for *every point (a,y)* equations (2) and (2') are weighted by reciprocal squared residuals between the given catch*(a,y)* value and its respective "theoretical" value $\hat{C}_{a,y} = s_a f_y N_{a,y} e^{-M/2}$ where $N_{a,y}$ is calculated by equation (2) or (2'). These weights are recalculated on every iteration within the iterative procedure of the model parameters estimation (see below).

Equation (2) or (2') is treated as an exact one and serves for calculation of the matrix $||N_{y,a}||$ through M and $||C_{y,a}||$ (in the catch controlled version) or M and the vectors s_a and f_y (in the effort controlled version). Equations (3)-(4), postulating the separability, or age selectivity of fishing, is regarded as approximate ones, and the unknowns M, s_a and f_y are estimated so that to reduce the residual in (3) as much as possible (as a rule, the squared logarithmic error is meant). Equation (5) is a normalizing condition and is treated as an exact one.

Estimated values of $\varphi_{a,y}$ may be recalculated into traditional instantaneous coefficients of fishing mortality $F_{a,y}$ by the formula: $F_{a,y} = -ln(1-\varphi_{a,y})$, which becomes obvious if to rewrite the equation (2') as

$$Ln\ (N_{a,y} / N_{a+1,y+1}) = M - \ln(1-\varphi_{a,y})$$

and to compare it with traditional VPA equation:

$$Ln\ (N_{a,y} / N_{a+1,y+1}) = F_{a,y} + M.$$

3. Algorithm of the model

In general outline, for each version of the ISVPA the algorithm consists of a '*core*', in which all the model parameters are evaluated from the iterative procedure at given natural mortality coefficient, M, and terminal fishing effort, f_n, and an outward '*shell*', a loop in which the best M and f_n are fitted.

The 'core' is represented in the program ***by 4 iterative procedures***. The three procedures described in details below are designed to ensure "unbiasness" of the solution, each - in its own sense.

The 4-th procedure is intended to produce the best fit to catch-at-age data, but the solution will be free from any restriction on bias. The 4-th procedure is rather time consuming derivative-free procedure, but experiments with very noisy data showed that if parameters are strongly interdependent and minimum is flat it works better (gives better fit) with respect to some of tested algorithms, including Marquardt-Levenberg and Simplex.

Basic iterative procedure (procedure A).

Within any ISVPA iterative procedure the given M and f_n are not changed. The calculations start with setting the initial values of the fishing effort, f_y at y=1,..., n-1 and selectivity, s_a; at a=1,..., m (the normalizing condition (5) must be kept). Each iteration consists of the following steps.

First, the terminal vectors $\{N_{a,n}\}$ and $\{N_{m,y}\}$ are evaluated from (3), then all other $N_{a,y}$ are determined from (2) or (2'). After that the matrix of fractions $\|\varphi_{a,y}\|$ is evaluated from the Equation

$$\varphi_{a,y} = \frac{C_{a,y}}{N_{a,y}} e^{M/2}, \qquad (6)$$

and $\{f_y\}$ and $\{s_a\}$ are determined as

$$f_y = \sum_{a=1}^{m} \varphi_{a,y} \qquad (7)$$

and
$$s_a = \frac{\sum_{y=1}^{n} \varphi_{a,y}}{\sum_{a=1}^{m} \sum_{y=1}^{n} \varphi_{a,y}} \tag{8}$$

To make the convergence better, s_m and s_{m-1} are replaced with their arithmetic mean:

$$s_m = s_{m-1} = \frac{\sum_{y=1}^{n} (\varphi_{m,y} + \varphi_{m-1,y})}{2\sum_{a=1}^{m} \sum_{y=1}^{n} \varphi_{a,y}}. \tag{9}$$

Note that the selectivity values remain normalized since the initial normalization.

Equations (7) and (8) are algebraic consequences of the relationship (4) which represents the hypothesis of separability of the fraction of the *a*-th age group abundance in the middle of the *y*-th year taken as catch. Strictly speaking, the symbol $\varphi_{a,y}$ is allotted to the estimate of the fraction given by formula (6) at every iteration *IT*. To avoid confusion, its separable analog, which also can be evaluated at every iteration, will be designated as $\varphi^{sp}_{a,y} = s_a f_y$.

Assume that the convergence is already achieved, and $\varphi_{a,y}$ and $\varphi^{sp}_{a,y}$ are limits of the corresponding fractions at $IT \to \infty$. When we deal with the 'pure', completely separable data, convergence means that $\varphi_{y,a} = \varphi^{sp}_{y,a}$. However, in the general case, when the catch-at-age data do not correspond to completely separable fishing (and contain errors), the two fraction estimates, $\varphi_{a,y}$ and $\varphi^{sp}_{a,y}$ must differ. This difference may serve as a measure of non-separability in the data, thus appearing in the role of a random error, $\varepsilon_{a,y}$, in the fraction $\varphi_{a,y}$ with respect to the separable fraction $\varphi^{sp}_{a,y}$:

$$\varphi_{a,y} = s_a f_y + \varepsilon_{a,y}. \tag{10}$$

Now let us clear up the question of whether our separable estimates of φ are unbiased or not. Such an analysis requires calculation of the mathematical expectation of the random values ε. It is reasonable to regard such errors within each age group at y=1,...,n-1 as being independent and equally distributed. When this is the case, the averaging of ε within the same age group furnishes the required estimation of the bias. At $IT \to \infty$ relationships (5), (7) and (10) yield:

$$f_y = \sum_{a=1}^{m} (s_a f_y + \varepsilon_{a,y}) = f_y + \sum_{a=1}^{m} \varepsilon_{a,y}$$

or

$$\sum_{a=1}^{m} \varepsilon_{a,y} = 0, \tag{11}$$

for every year *y*. Similarly, at $IT \to \infty$, relationships (5), (8), (10) and (11) involve:

$$s_a = \frac{\sum_{y=1}^{n} (s_a f_y + \varepsilon_{a,y})}{\sum_{a=1}^{m} \sum_{y=1}^{n} (s_a f_y + \varepsilon_{a,y})} = s_a + \frac{\sum_{y=1}^{n} \varepsilon_{a,y}}{\sum_{y=1}^{n} f_y},$$

or

$$\sum_{y=1}^{n} \varepsilon_{a,y} = 0 \tag{12}$$

for every age group *a* (certainly, transformation (9) does not break this result). Relationships (11) and (12) prove that the separable estimates of φ supplied by this iterative procedure are unbiased.

Weighted arithmetical mean procedure (procedure B)

When the selectivity is strongly dependent on age, the errors corresponding to different age groups hardly can be regarded as equally distributed (although, relationship (10) shows that their mean over age also equals zero). In this case, a modified iterative procedure might be appropriate, in which inverse selectivity values serve as weights at the stage of calculating the efforts.

Within this, 'weighted' iterative procedure, relationship (7) is replaced with the following equation for calculating the efforts:

$$f_y = \frac{1}{m}\sum_{a=1}^{m}\frac{\varphi_{a,y}}{s_a}, \tag{13}$$

(which is also an algebraic consequence of the separability hypothesis), and the efforts are calculated from (13) taking the selectivity values from the previous iteration. Thereupon the current selectivity values are computed from (8).

Analysis of statistical sense of the solution for this procedure is similar to the previous one. At $IT \rightarrow \infty$ relationships (5), (13) and (10) result in:

$$f_y = \sum_{a=1}^{m}(s_a f_y / s_a + \varepsilon_{a,y} / s_a) = f_y + \sum_{a=1}^{m}(\varepsilon_{a,y} / s_a)$$

or

$$\sum_{a=1}^{m}(\varepsilon_{a,y} / s_a) = 0, \tag{11'}$$

for every year *y*. Similarly, at $IT \rightarrow \infty$, relationships (5), (8), (10) and (11') will give:

$$s_a = \frac{\sum_{y=1}^{n}(s_a f_y / s_a + \varepsilon_{a,y} / s_a)}{\sum_{a=1}^{m}\sum_{y=1}^{n}(s_a f_y / s_a + \varepsilon_{a,y} / s_a)} = s_a + \frac{\sum_{y=1}^{n}(\varepsilon_{a,y} / s_a)}{\sum_{y=1}^{n} f_y},$$

or

$$\sum_{y=1}^{n}(\varepsilon_{a,y} / s_a) = 0 \tag{12'}$$

for every age group *a*. Relationships (11') and (12') prove that the separable estimates of φ weighted by selectivity factor, supplied by this iterative procedure are unbiased.

"Logarithmic" (geometrical mean) procedure (procedure C)

Logarithmic transformation of the relationships (3) and (4) leads to the third iterative algorithm, similar to the basic and the weighed arithmetic mean ones but dealing with logarithms of C, φ, s, f, etc. Within this, logarithmic iterative procedure relationships (6) - (8), that are used at IT-s iteration, must be replaced with:

$$\ln \varphi_{a,y} = \frac{M}{2} \ln \frac{C_{a,y}}{N_{a,y}}, \tag{14}$$

$$\ln f_y = \frac{1}{m} \sum_{a=1}^{m} \ln(\frac{\varphi_{a,y}}{s_a}), \tag{15}$$

$$\ln s_a = \frac{1}{n} \sum_{y=1}^{n} \ln \frac{\varphi_{a,y}}{f_y}, \tag{16}$$

and

$$\ln s_m = \ln s_{m-1} = \frac{1}{2n} \sum_{y=1}^{n} (\ln \frac{\varphi_{m,y}}{f_y} + \ln \frac{\varphi_{m-1,y}}{f_y}) \tag{16a}$$

When evaluating f_y from (15), selectivities are taken from the previous iteration. At the end of each iteration, selectivities must be re-normalized so that to satisfy condition (5). This procedure can also be called "weighed geometrical mean procedure", as from (15) and (16) it immediately follows that f_y and s_a equal to the geometrical means of $\varphi_{a,y}$ weighed by s_a and f_y respectively.

In order to understand the statistical meaning of the convergence point of this procedure, it is convenient to use the notion of estimated catch,

$\hat{C}_{a,y} = s_a f_y N_{a,y} e^{-M/2}$, and present $\varphi_{y,a}$ in the form:

$$\varphi_{a,y} = s_a f_y \frac{C_{a,y}}{\hat{C}_{a,y}} \tag{17}$$

As it was noted above, we are considering the convergence of the iterative procedure, i.e., the limits at $IT \to \infty$ of all the variables participating in the model. Therefore the fractions $\varphi_{a,y}$, which is determined by equation (14) and figures in (15) and (16), can be replaced with that given by relationship (17), where $\hat{C}_{a,y}$ is substituted by $\hat{C}^*_{a,y}$, the catch estimates supplied by the iterative procedure at $IT \to \infty$. This substitution implies:

$$\sum_{a=1}^{m}[\ln C_{a,y} - \ln \hat{C}^*_{a,y}] = 0 \qquad (18)$$

and

$$\sum_{y=1}^{n}[\ln C_{a,y} - \ln \hat{C}^*_{a,y}] = 0 . \qquad (19)$$

The meaning of (18) and (19) is that the log-transformed estimates of catches are unbiased. It can be simply shown that this procedure provides unbiased estimates of logarithms of $\varphi_{a,y}$, s_a and f_y.

4. Loss functions

In accordance with the assumptions about the error structure in the data the solution of the model may be based on standard minimization of sum of squared residuals or on minimization of more robust loss functions: median of distribution of squared residuals or absolute median deviation of residuals.

Minimization of the median, *MDN*, of squared residuals (that is, the use of the least median or LMSQ principle) instead of their sum (the classical LSQ-principle) sometimes is referred to be more resistant with respect to outliers, those elements of the data set which overstep considerably reasonable confidence limits and, hence, are suspicious of containing extremely high errors (O'Brien, 1997; Hampel et al., 1986).

According to this concept, an alternative ISVPA solution may be looked for as providing estimates of M and f_n, which secure minimum of the median of the distribution of the squared logarithmic residuals,

$$SE_{a,y} = (\ln C_{a,y} - \ln \hat{C}^*_{a,y})^2$$

(a = 1,...,m; y=1,...,n). The corresponding loss function will be denoted as $MDN(M, f_n)$.

In practice, the median of a random series is estimated by rearranging its elements in a descending or increasing order and taking the central element of the new series or the mean of two central elements (depending on whether the total number of the elements is odd or even). However, when used within the framework of ISVPA, this estimate sometimes may cause a certain roughness of the surface $MDN(M, f_n)$. In order to make the loss function smoother, the median is estimated here as the mean of a number (for example, 10) central elements of the ordered series of $SE_{a,y}$. So, in this version of ISVPA, the iterative procedures for estimating the vectors f and s remain the same as described above, the only difference being the use of the behavior of the median as an indicator of their convergence. Numerical experiments ascertain workability of the three versions of the ISVPA iterative procedures combined with the LMSQ principle.

As was noted above, in order to smooth the median estimates, averaging over a number of central elements of the ordered series of squared residuals is suggested. Certainly, the number of central elements can vary from one or two to $m \cdot n$, the total length of the series. However, in the latter case, the averaging results in estimation of the mathematical expectation and not the true median of the squared residuals. So, in fact, the suggested approach (when averaging over a number of central squared residuals is applied) can be regarded as a compromise between the true median minimization and the conventional least squares criterion. The advantage of this compromise is that, according to our experience, the use of the least squares approach leads to a sufficiently smooth loss function, while the minima of $MDN(M, f_n)$ are better pronounced.

One of the central issues in fitting a model to real data is the choice of the fitting criterion. Statistically, the use of the LSQ criterion is equivalent to accepting the hypothesis of normality of the distribution of the residuals (in the case when the sum of squared logarithmic residuals is minimized, the errors themselves are supposed to be logarithmically normal). What is the reason for using the median minimization approach? What kind of iterative procedure matches well the LMSQ criterion? To illuminate the nature of combining LMSQ criterion with ISVPA, let us consider the third, weighed logarithmic version of the iterative procedure.

It was shown above that the logarithmically transformed theoretical estimates of catches are unbiased. Strictly speaking, it means only that the mathematical expectation of the corresponding residuals is zero. We, however, believe that in practice, the distributions of the logarithmic residuals often are almost symmetric. This is confirmed by our numerous computer tests with both simulated and real data. Clearly, if a random value ε is distributed symmetrically the median of its squares, ε^2, indicates the compactness of the distribution of ε: the higher the median of ε^2, the greater the variance of ε. Conversely, the lower the median of the distribution of ε^2, the more compact is the distribution of ε. So, by minimizing the median of the squared logarithms of the catches residuals resulting from estimation of catches by means of the weighed logarithmic iterative procedure, the maximal allowable compactness of the distribution of the errors themselves is reached, thus providing a reasonable fit of the model to the catch-at-age data in the sense of the conventional maximum likelihood concept.

Such a statistical justification cannot be given to the median minimization approach when the first (**A**) or the second (**B**) version of the ISVPA iterative procedure is used, as neither of them impose any reasonable condition on the errors in logarithmically transformed catches. From this point of view for these versions the conventional least squares approach seems to be more appropriate.

From the other side, the approach when the quality of fitting is measured by some "window" in the distribution of residuals which does not include the tails of the distribution, may be considered as a mean to suppress the influence of outliers on the solution (because the residuals which corresponds to outliers, are located near the margin of distribution and will not influence the value of the median). From this point of view minimization of the median seems to be appropriate for procedures **A** and **B** also.

In addition to the two above mentioned ISVPA objective functions, the absolute median deviation $AMD(M, f_n)$ - the median of the absolute deviations of model residuals from their median value, known as one of the most robust measures of scale (Huber, 1981), also may be used. According to the author's experience in some cases (for example, when distribution of residuals, still having zero mean, has nonzero median) *AMD* gives more pronounced minimum with respect to *MDN(SE)* - minimization. But if the data are not informative (for example, if historical changes in catches and in stock are not pronounced) *AMD* may be not sufficiently sensitive and it may be better to use *MDN*.

Now let us say a few word about the procedure of estimation of the "best" (in the sense of the loss function chosen) values of (f_n, M). Its choice in the ISVPA was based on the following considerations:

- algorithmic simplicity, bearing in mind that in the *outer loop* only two (or even one, if M is considered as known) parameters are to be estimated;
- if the loss function surface has more than 1 minimum - possibility to start minimization in the vicinity of the required minimum and to arrive at it even if the surface is very flat (this implies that gradient methods may be ineffective).

As numerous simulation experiments have shown, the method, which was not fastest, but which allowed to precisely reach the minimum even if the error surface was very flat and the minimum was local, was the method of "lowering by coordinates" with successively diminishing steps. The step of the procedure (the increase in the tested parameter value) is fixed by the program and after the minimum is achieved with this step, the step is diminished by a factor of 10. After the minimum is achieved again, the step value is decreased again by the same factor, and so on, till the minimum is reached with the required precision by the tested parameter value.

It is necessary to mention that while minimization of sum of squared errors multiple minima are almost never encountered (here the problem is that for noisy data minimum of *SSE* is often reached at marginally high or low value of the tasted parameter), for median minimization the surface of the loss function (as a function of f_n and M) may have complex structure. That is why before the final run with precise estimation of the model parameters it is recommended to make preliminary point-by-point scanning of the (f_n ; M) area with sufficiently small step (for example, 0.1 for f_n and 0.01 for M). Program realization of ISVPA gives such a possibility.

5. Suppression of inter-iteration oscillations

When the level of noise in the initial data is high, the estimated effort and selectivity, as well as the sum of squared residuals, *SSE*, vs. the number of iteration, *IT*, contain a few visible slowly decaying modes of oscillations superimposed upon a certain rapidly stabilizing trends. These oscillations slow down the convergence of *SSE* to its limit, *SSE**, or of *MDN* to *MDN**, or *AMD* to *AMD** at $IT \rightarrow \infty$, thus becoming significant at the stage of searching for the minimum of $SSE^*(M, f_n)$ or $MDN^*(M, f_n)$, as in practice, at every M and f_n the iterative process is stopped at a finite *IT*. The most notable in this context are the saw-tooth type oscillations with a 2-year periodicity, i.e., those of the highest frequency. Conventional method for filtering oscillations and extraction of trends from numerical series is moving averaging. We, however, are dealing with an iterative process, where at any iteration *IT*, the current selectivity, $s_{IT}(a)$, or the effort,

f_{IT}, estimate is calculated after the previous value, $s_{IT}\text{-}1(a)$ or $f_{IT-1}(y)$, was found. That is why, by defining the corrected selectivity and effort estimates at *IT*-th iteration, $s'_{IT}(a)$ and $f'_{IT}(y)$, as

$$s'_{IT}(a) = \alpha s_{IT-1}(a) + (1-\alpha) s_{IT}(a) \quad (20)$$

$$f'_{IT}(y) = \alpha f_{IT-1}(y) + (1-\alpha) f_{IT}(y) \quad (21)$$

and by a proper choice of the coefficient 0<α<1, the desired filtration, similar to the moving averaging, can be achieved. According to (20), all the selectivity estimates, which were computed at the previous iterations, participate in the correction for the current, *IT*-th iteration. The same is valid for the effort (see (21)). So, the size of the averaging interval in this filtration procedure increases with the growth of *IT*. Nevertheless, as the weights of the last, *IT*-th, iterations remain constant, while the weights of the early iterations decay, the suggested filtering procedure can be regarded as an analog of a conventional moving averaging. The effective averaging interval is determined by the choice of α: the smaller α, the narrower the effective averaging interval. Experiments showed that the choice of α do not influence the result: there are almost identical for tested diapason of α from 0 to 0.95.

6. Treatment of zero catches.

Existence of zero values in catch-at-age matrix is known to be a rather complicated (and may be logically controversial when dealing with logarithmic residuals) problem and is solved differently in different methods. In ISVPA the following algorithm is applied:

1. If $C_{a,y}$=0, then the value of $\varphi_{a,y}$ is taken equal to its "theoretical" value, that is $\varphi_{a,y} = s_a f_y$.
2. Residuals for points of zero catches are taken equal zero.
3. Stock abundance is computed as follows:

3.1. If $N_{a+1,y+1}$ >0 and $C_{a,y}$=0, than $N_{a,y}$ is computed by (2.2).

3.2. If $N_{a+1,y+1}$ =0 and $C_{a,y}$=0, than $N_{a,y}$ = 0.

3.3. If $N_{a+1,y+1}$ =0 and $C_{a,y}$>0, than $N_{a,y}$ is computed by (2.3) -the same way, as for terminal points.

3.4. If $N_{a+1,y+1}$ >0 and $C_{a,y}$>0, than $N_{a,y}$ is computed by equation (2.2) or (2.2') or their mixture, according to the version chosen.

7. Some other variants of optimization algorithms

Some other variants of ISVPA parameter estimation procedures were also tested while working at the program. For example, to make faster the parameter estimation procedure an attempt was made to exclude the estimation of natural mortality coefficient from the "outer loop" and to estimate this parameter within the "inner" iterative procedure along with $\varphi_{a,y}$, s_a and f_y. For this purpose on every iteration, after the vectors s_a and f_y, are estimated, new matrix $\varphi_{a,y}=s_a f_y$ is building up and a new parameter X, being the average value of $e^{-M/2}$, is estimated: $X_{a,y} = C_{a,y}/(\varphi_{a,y} N_{a,y})$;

$$X = \frac{1}{nm}\sum_{y=1}^{n}\sum_{a=1}^{m} X_{a,y}$$

After that a new value of natural mortality coefficient is estimated as $M = -2LnX$. Naturally, an initial guess for M is to be input before the start of the procedure along with initial guess for s_a and f_y. For initial guess it is possible to use any positive values of s_a and f_y, such as $s_a f_y < 1$. For M the initial guess may be taken from the diapason $0 < M < 1$.

Unfortunately experiments showed that this variant of procedure is suitable only for very "clean" data (with very low noise) and for practical purposes this procedure is not effective.

Experiments also proved the importance of organization of ISVPA parameter estimation procedure in form of two concentric loops: attempts to estimate f_n (or both f_n and M) in frames of single loop along with other parameters was not successful: it was needed to use rather precise initial guess for all parameters, what is rarely possible in practice. This is explained by low curvature of loss function for real (that is noisy) data. Consequently, optimization by parameters f_n and M, which are most influenced by values of other parameters, does not work until the "best values" (for the tested values of f_n and M) of other parameters are not estimated (or "almost" not estimated).

8. Estimation of ISVPA parameters without limitation on bias

In order to test experimentally the role of limitation on bias, imposed by the above described ISVPA procedures, an additional, free of such limitations parameter estimation procedure was developed.

For “direct” fitting of multi-parameter models the Marquardt-Levenberg and Gauss-Newton method are traditionally used (Bard, 1974), as it was done, for example, in CAGEAN (Deriso et al., 1985) and ICA (Patterson, 1994). But in our case implementation of these methods is complicated by normalization equation (2.5): parameters are becoming inter-dependent. Attempt to use Simplex-method (Schnute, 1982) was also unsuccessful: for the case of many parameters the procedure is very time-consuming and also requires very qualified initial guess for parameters (the result is extremely sensitive to its choice).

Because of the above mentioned, the procedure of “direct” search for the ISVPA parameters, free of limitations on bias, was finally arranged as follows. The same was, as it was done with “iterative” inner ISVPA procedures, the procedure was designed as two concentric loops. In outer loop optimization by (f_n, M) is made, while the parameters $\{s_a\}$ and $\{f_y\}$ (except f_n) are estimated in the inner loop.

The inner loop is arranged as follows. Each parameter is optimized in succession, while the order of optimization appeared to be important. Starting from a set of initial guesses for all parameters $s_1,...,s_m$ и $f_1,...,f_{n-1}$, optimization begins from f_{n-1} ; after that the value of f_{n-2} is optimized, and so on till f_1 . After that, the best value (from point of view of the loss function) of s_1 is estimated, the other values of s_a being changed by means of normalization equation (5). The found value of s_1 is then “frozen up” and the ”best” value of s_2 is searched for (here the normalization equation (5) is applied to the rest of selectivity factors: $s_3,...,s_m$,). Then the next, s_3 , selectivity factor is estimated, and so on till s_{m-2}. . The rest of selectivities, $s_m=s_{m-1}$, appears to be already estimated by the normalization equation. After that the procedure again returns to estimation of f_1, and the sequence of calculations is repeated till convergence.

The above described procedure gives the solution free from restrictions on bias. For “clean” catch-at-age data (simulated data without noise) the procedure gives absolutely correct estimates of all parameters (as well as “iterative” procedures **A**, **B** and **C**). For noisy simulated data and for real data the solution based on this “unrestricted” fitting procedure as a rule is much worse, while the final value of loss function may be lower than for “unbiased” solutions.

It is necessary to mention that implementation of the above described procedure of “parameter-by-parameter” optimization for *median* minimization may be problematic if one (or a group) of parameters $s_1,...,s_m$ and $f_1,...,f_{n-1}$ occasionally influences only those values of residuals which are located on tails of distribution of residuals and, hence, do not influence the median value.

9. Dealing with auxiliary information

There is possibility to include up to 3 SSB indexes and up to 7 age structured stock abundance indexes into the model. In such a case ISVPA loss function will include additional components representing measures of discrepancy:

- for each SSB index : between logarithms of SSB from cohort part and from surveys;

-for each age-structured index: between logarithms of abundance (*a,y*) from cohort part of the model and from surveys (corrected to estimated age-dependent "fleet catchabilities" or not).

It is also possible to fit the model not only on survey abundance-at-age data, but on survey age proportions and “weighted” survey age proportions. In fact, age-structured abundance indexes, when being used for tuning of cohort models, sometimes give unclear or controversial signals about stock size, more precisely - about the value of terminal fishing mortality coefficient (F_{term}). In some cases the minimum of corresponding component of loss function of a model may be completely deteriorated, that is, the best fit is found for extremely low or high F_{term} . This indicates that abundance-at-age index data from surveys (or in cpue of a fishing fleet) are so far from the values calculated in cohort part of a model from catch-at-age data (theoretical values), that the best fit corresponds to almost zero (or extremely high) stock size in terminal year. It is not always clear why we have such a discrepancy. At least there could be two possible explanations: 1) age structure of abundance-at-age index from surveys (or for a fleet, used for tuning) is unrepresentative with respect to the whole stock (data are very noisy), and 2) there is a trend in catchability of surveys. Naturally, both the above mentioned factors may act simultaneously.

Considering the second reason (year-dependent factor in survey catchability), it is theoretically possible to make an attempt to estimate time trend in catchability, but this requires additional data and may make the model to be too flexible. That is why in some cases it is preferred to substitute fitting of the model to abundance-at-age index data by fitting on age composition (in proportion) of survey data (that is, by minimization of residuals between age composition of surveys and age composition of abundance derived from a model). Usually in such a case multinomial (Fournier et al., 1998) or, as it is done in COLERANE (Hilborn et al., 2000), robust-normal error model is used.

Influence of the first above mentioned reason (high level of noise in the survey data) may be diminished by robustization of the model, for example, by application of robust loss functions, such as the median of distribution of squared residuals instead of their sum.

In some cases survey data may have different quality in different years. For example, representativity of the data may correlate with stock abundance. In such a case a specific weights may be needed for specific years.

Let us assume lognormal error model. Then the residuals between "theoretical" (derived from a model) abundance-at-age $N_{a,y}^{(th)}$ and index abundance-at-age $N_{a,y}^{(Ind)}$ may be represented as:

$$res_{a,y} = Ln(\frac{N_{a,y}^{(th)}}{N_{a,y}^{(Ind)}}) = Ln(\frac{P_{a,y}^{(th)} \sum_{a=a\min}^{a\max} N_{a,y}^{(th)}}{P_{a,y}^{(Ind)} \sum_{a=a\min}^{a\max} N_{a,y}^{(Ind)}}) = Ln(\frac{P_{a,y}^{(th)}}{P_{a,y}^{(Ind)}}) + Ln(\frac{\sum_{a=a\min}^{a\max} N_{a,y}^{(th)}}{\sum_{a=a\min}^{a\max} N_{a,y}^{(Ind)}}) \qquad (22)$$

where $P_{a,y}^{(th)}$ and $P_{a,y}^{(Ind)}$ are proportions of age group a in the "theoretical" and "index" stock abundance in year y . From expression (22) it is clearly seen that, when dealing with minimization of residuals between abundances, in fact for each point (*a,y*) we are simultaneously minimizing residuals between age compositions and between total abundances. It is also seen that the ratio of total abundances may be considered as a "weighting factor" for ratio of proportions.

As it was mentioned above, for minimization of residuals in age compositions (proportions) it is more traditional to assume multinomial or robust-normal error model. Nevertheless in the ISVPA we use logarithmic residuals, because experiments shows that in some cases lognormal error model seems to be at least not less appropriate (e.g. see Vasilyev 2003). To be comparable, age proportions in each year are calculated only for those age groups, which are simultaneously present both in stock and in index data.

Another option, which was also added to the model, consisted in possibility of tuning by minimization of residuals between logarithms of models-derived abundance $LnN_{a,y}^{(th)}$ and index age structure $LnP_{a,y}^{(Ind)}$. In such a case model-derived estimates of total abundance serves as weighting factors for age proportion ratios (see expression (22)). This option could be helpful for stocks with strongly variable abundance, if representativity of survey data is strongly dependent on stock size. As well as for catch- at-age and for tuning on index abundance-at-age data, minimization for age structures (or for abundance and index age structures) can be undertaken in the model by minimization of the sum of squared logarithmic residuals (SSE), or by minimization of more robust statistics: the median of distribution of squared logarithmic residuals (MDN). Possibility for minimization of absolute median deviations (AMD) – the median of distribution of absolute deviations between logarithmic residuals and their median value is also reserved.

Thus, for each age-structured index the discrepancy may be measured as traditional sum of squared residuals, or by MDN, or AMD. The measure may be stated independently for each of "fleet".

For SSB indexes the only available measure in the model is the sum of squared residuals (because, as a rule, available number of years of SSB surveys is rather low).

10. The program

Current realization of ISVPA is made in Visual Basic and can be run from any Windows environment. If Visual Basic is installed on your computer it will be enough to copy only exe – file. If not – use ISVPA set up package.

Input files are blank-separated text files and include:

- "necessary" files: catch-at-age by years, weight-at-age by years in the stock and maturity-at-age by years;

-"optional" files (may be not given): natural mortality by ages, up to 3 files with SSB estimates by years and up to 7 files with age-structured abundance indexes by years.

All input files must be positioned into **C:\vbisvpa** directory or its subdirectories.

Output files include: the file with records of minimization (minim.out), the file of results (its name is given by user) of initial (“basic”) run, as well as bootstrap output files:

1) bootf.out - includes effort factor estimates by years and bootstrap runs;

2) bootm.out - includes natural mortality estimates by ages and bootstrap runs (if it was considered as unknown parameter);

3) boots1.out and boots2.out - include the estimates of selectivities (for first and second time intervals) by ages and bootstrap runs (the program gives possibility to fit 2 different selectivity patterns for 2 different successive time intervals);

4) bootssb.out - includes the SSB estimates by years and runs;

5) boottsb.out - includes the estimates of total stock biomass by years and runs;

6) bootntrm.out - includes terminal year abundance estimates by ages and runs.

The procedure of working with the program is the following.

1. First what is needed to be done while running the program is to enter the names of catch-at-age and weight-at-age files. If they are located directly in C:\vbisvpa directory - simply print their names (with extension). If they stand in some sub-directory of C:\vbisvpa - print the name of the file with the name of this subdirectory.
2. After that you will be asked about the **situation with natural mortality**: 1) to find *M* as age-independent value; 2) to find it as a simple quadratic function of age; 3) to use known values of *M(a)*. If option 2 is chosen, you will be asked to enter the age of minimum *M* (as a rule it may be taken equal to the age of 'mass' maturity). If option 3 is chosen, you will be asked to enter the name of file with known *M(a)* values.
3. Next you have to choose the method for parameter estimation. 4 options are available. Option 1 will produce solution with "unbiased separabilization"; option 3 - with "unbiased weighted separabilization"; option 2 will ensure "unbiased" estimates of logarithms of all parameters; option 4 will produce solution corresponding to best fit to logarithmic catches, not restricted by any condition on bias. While using option 4 be patient - it takes time. In most cases option 2 is recommended. It is strongly recommended **not to use option 4** when you minimize the median - error surface may be too "broken".
4. The next choice is what to minimize. It is possible to minimize sum of squared residuals in logarithmic catches, or median of distribution of squared residuals in logarithmic catches $MDN(M, f_n)$, or absolute median deviation $AMD(M, f_n)$. For noisy data minimization of *MDN* or *AMD* is recommended.
5. Selection of first and last year of analysis and the last year of first selectivity pattern (**the program gives possibility to fit 2 different selectivity patterns for 2 different successive time intervals**). After that it is needed to input the first and the last age groups. Naturally, they should be within the limits of the input data. After that you will be asked: is the oldest age in the data a "normal" age group, or it is +-group ?
6. Next question is about the "version" of the program (1. Catch-controlled, 2. Effort-controlled, 3. Mixed, 4. Mixed, weighted by points). Version 1 is preferable if fishery is known to be extremely non-separable. It also may be useful as a part of "mixed" versions 3 and 4. Version 2 is preferable if *M* is considered as unknown parameter and/or the data are very noisy.
7. If version 3 is chosen you will have to input relative weight of catch-controlled routine.
8. You may 1) scan the error surface or 2) look for precise solution. If scanning is chosen, you will be asked about minimum and maximum values of the parameter (f_{term} or (M and f_{term})) and of "step". It is recommended to make scanning first - there could be several local minima of the loss function. Option 2 allows to find precise solution. If several local minima

exist, you may look for the solution corresponding to the required minimum - by proper choice of initial guess for the parameter and sufficiently small initial step. Please note that if "scan" mode was chosen, the output file will contain the result at **rough** minimum of the loss function. To get the result at precise minimum you have to start the program again and to choose the option "precise solution". If "precise solution" is looked for - you have to input the value of initial guess for f_{term} or (M and f_{term}) and of initial step for searching procedure.

9. Next you will have to set the value of "inter-iteration smoother". In most cases any value within 0.5-0.9 will be OK. For very noisy data to suppress possible oscillations you may take the higher value - up to 0.9. Don't worry about "precise" value of this parameter: if procedure converges - it is OK. Experiments proved that final result will be the same even for 0.95.

10. If you have chosen the median minimization, you will have to input the number of central elements of the ordered series of squared residuals (or residuals) to use as its measure. In most cases 10 points is OK. If error surface contain too many local minima it may be useful to increase the number of central elements; if minimum is too flat - you may diminish the number of central elements. Please note that this setting will be used for MDN or AMD measures everywhere (for indexes also, if one of these measures will be used for some of them).

11. Enter the portion of the year for peak of catches (since the model is based on Pope's approximation of "instantaneous" catch). If fishing goes on uniformly all over the year - enter classic 0.5.

12. Enter the name of output file. It will be in C:\vbisvpa directory.

13. You have possibility to make output of currents results on screen. Output on screen makes the calculations slower, but it is comfortable to see what's happening.

14. Input maturity-at-age file name.

15. You will be asked to include SSB surveys or not. If "yes", you will have to input names of files with SSB surveys by years (up to 3).

16. If you have age-structured abundance indexes, you may use up to 7 different indexes. If "yes", input their names.

17. If any auxiliary information is used, you will be asked to input weight for catch-at-age-derived component in the overall loss function (any value is allowable, including 0).

18. If SSB surveys are included - for each of them input weights for components of the overall loss function, representing measures of their closeness to cohort part -derived estimates of SSB (for SSB indexes only one kind of measure is available - sum of squared residuals between their logarithmic values).

19. Input portion from start of the year before the moment when surveys are made (the same for all SSB indexes).

20. If SSB surveys are included – for each of them input the values of standard deviation of lognormal distribution, which will be used in stochastic runs.

21. If SSB surveys are included - state how to treat each of them: as absolute or relative index.
22. If age-structured indexes are included - input portion from start of the year before the moment when age-structured survey is made (for each kind of survey).
23. If age-structured indexes are included - state index of what they are (mature part, whole stock, or immature part).
24. If age-structured indexes are included - for each of them input weights for components of the overall loss function, representing measures of their closeness to cohort part- derived estimates of abundance.
25. If age-structured indexes are included - for each of them answer the question: to estimate age-dependent catchabilities or not (if "not" is chosen then it will be assumed that $q(a)$=1).
26. If age-structured indexes are included - choose for each of them what measure of closeness of fit will be used: MDN, SSE, or AMD.
27. If age-structured indexes are included – choose what you want to compare in tuning : 1) logarithmic abundances(a,y) from cohort part of the model and logarithmic abundances(a,y) in survey; 2) logarithmic abundance(a,y) (from cohort part of the model) and logarithmic age structure(a,y) of surveys; 3) logarithmic age structure of the stock(a,y) (from cohort part) and logarithmic age structure(a,y) of surveys.
28. If age-structured indexes are included –for each of them input the values of standard deviation of lognormal distribution, which will be used in stochastic runs.
29. When calculations are finished, you may make stochastic runs. Current version of the program gives possibility to run parametric conditional bootstrap with respect to catch-at-age, (assuming that errors in catch-at-age data are log-normally distributed, standard deviation is estimated in basic run), combined with adding noise to indexes (assuming that errors in indexes are log-normally distributed with specified values of standard deviation).

If something goes wrong or in unwanted direction, it is always possible to **stop the program** by clicking the button "stop". The program will return to initial (input) screen and you may run it again. The only what is necessary to remember when using stop by user is that if option of "direct search" of inner parameters is used, you have to let the program to finish at least one inner cycle (that is to finish calculation of inner parameters for at least one f_{term}) and to stop it after that (if not – interrupt will cause error and abortion of the program).

Note: current version gives possibility to use surveys for terminal+1 year (that is for year without known catch-at-age) Fishing pattern in this year is assumed equal to that of "true" terminal year. In such a case all input files should be entailed to include data for this year (it is becoming terminal one); catch-at-age file should include zero values of catch-at-age for this year.

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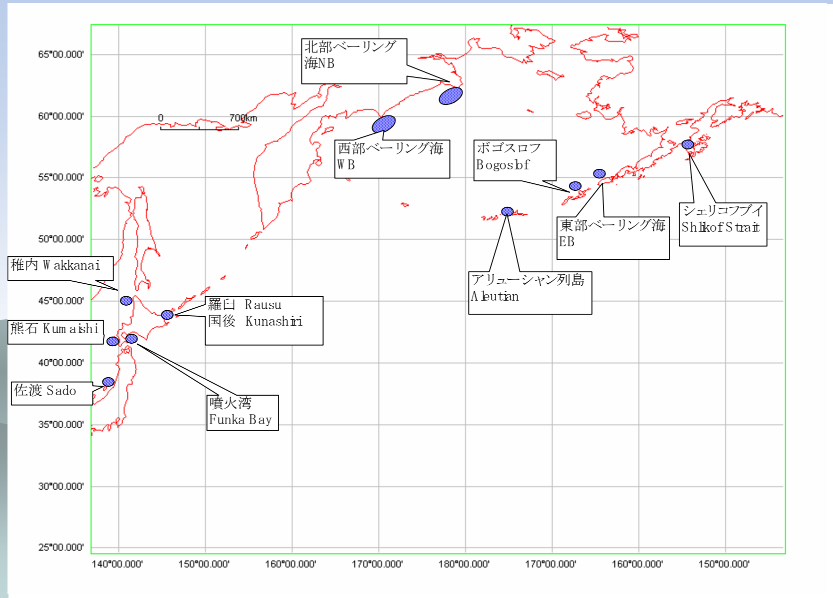
Summary of DNA analysis of walleye pollock by Japanese Scientists (2005)

- Takashi Yanagimoto (FRA, HNF)
- Toru Kitamura (Japan NUS co. jp)
- Takanori Kobayashi (FRA,NRIFS)
- Ichiro Nakayama (FRA,NRIFS)

DNA analysis

- Total mtDNA Sequenced
- mtDNA PCR-RFLP analysis
- mtDNA control region sequenced
- Nuclear DNA analysis (RAPD, TREP, SNP analysis of Calmodulin gene)

Sampling locations



Number of nucleotide substitutions and average nucleotide substitution rate of mtDNA from walleye pollock in the Japan Sea and the Bering Sea.

Table 5. Number of nucleotide substitutions and average nucleotide substitution rate of mtDNA from walleye pollock in the Japan Sea and the Bering Sea.

Region	Size (bp)	Number of nucleotide substitutions	Average nucleotide substitution rate (%)
12S rRNA	953	6	0.20
16S rRNA	1665	4	0.05
ND1	975	21	0.61 ⇦
ND2	1047	16	0.42
CO I	1551	13	0.23
CO II	699	2	0.10
ATPase8	168	2	0.45
ATPase6	684	11	0.45
CO3	786	10	0.29
ND3	351	6	0.55 ⇦
ND4L	297	1	0.07
ND4	1386	17	0.34
ND5	1839	35	0.54
ND6	522	6	0.26
Cyt*b*	1161	17	0.40
Control Region	873	12	0.50 ⇦

AB094061, AB182300-AB182308

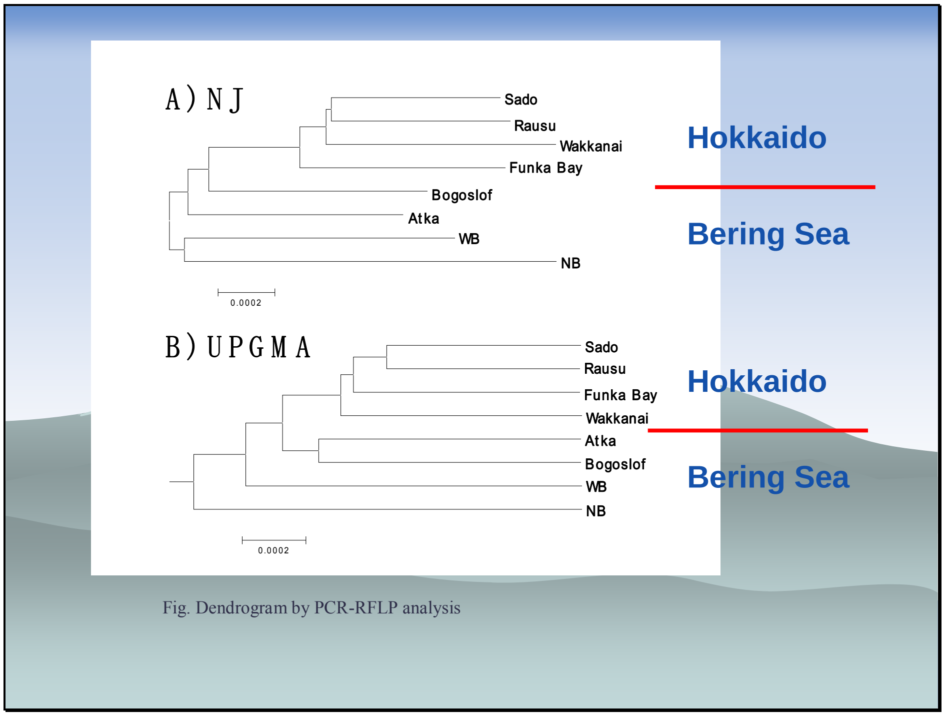
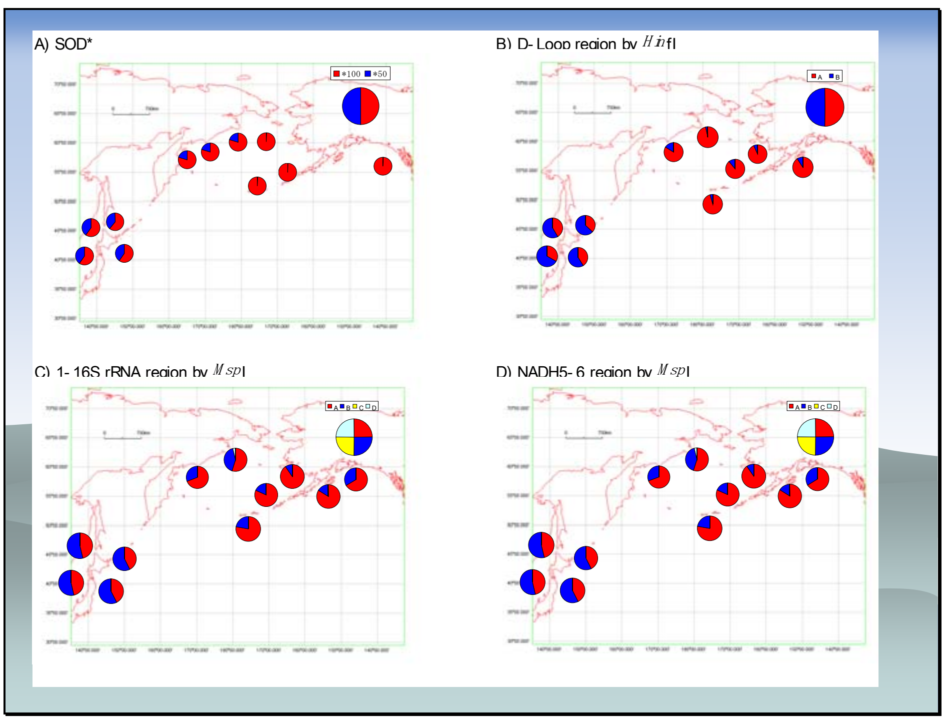
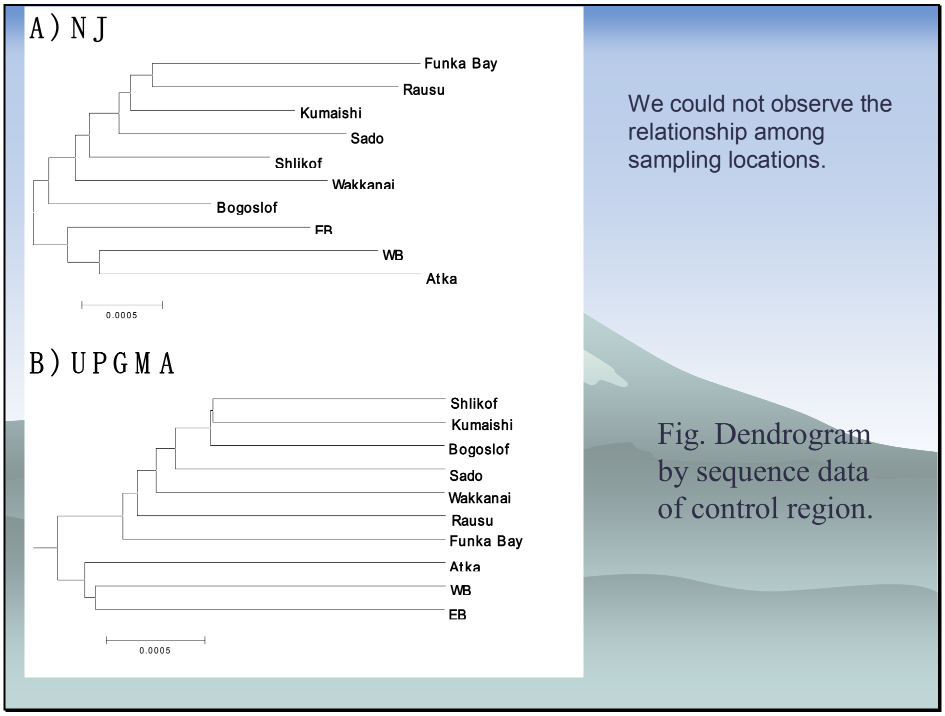


Fig. Dendrogram by PCR-RFLP analysis





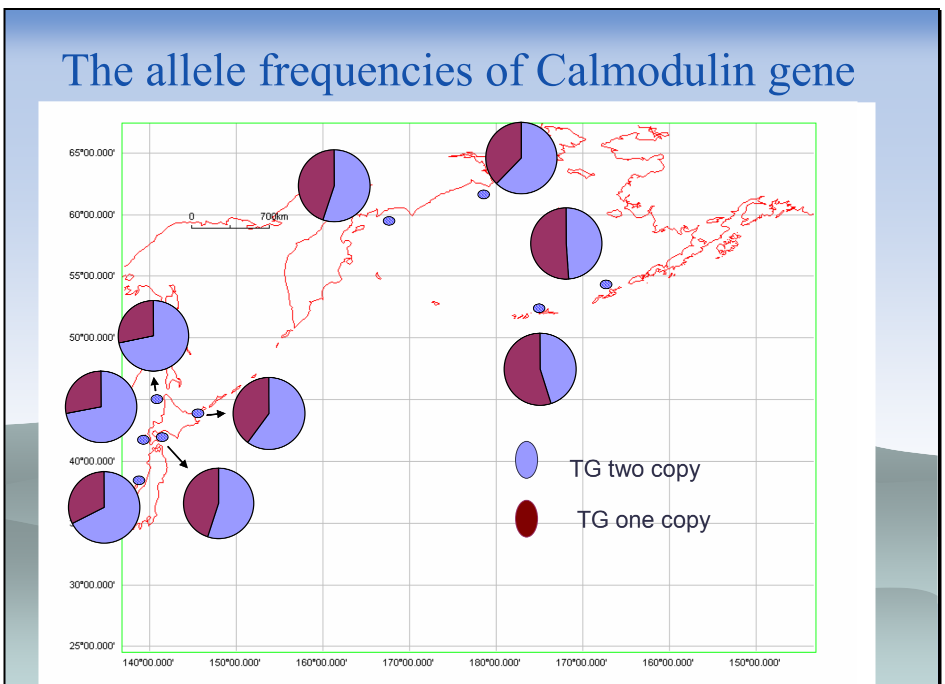


Fig. 3. The allele frequencies of L and S type obtained from SNAP analysis.

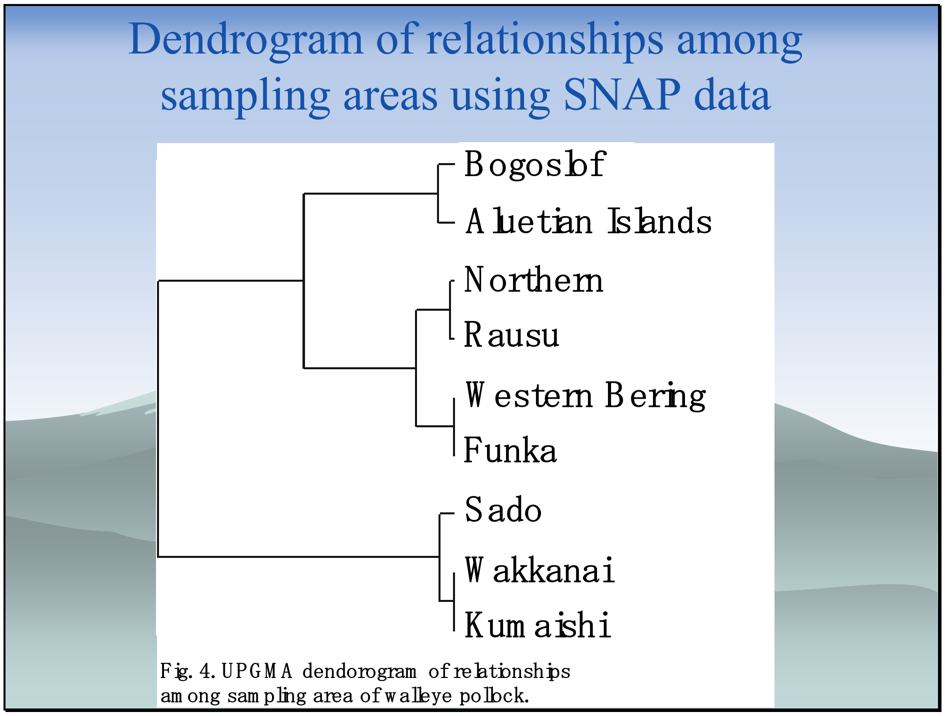


Fig. 4. UPGMA dendorogram of relationships among sampling area of walleye pollock.

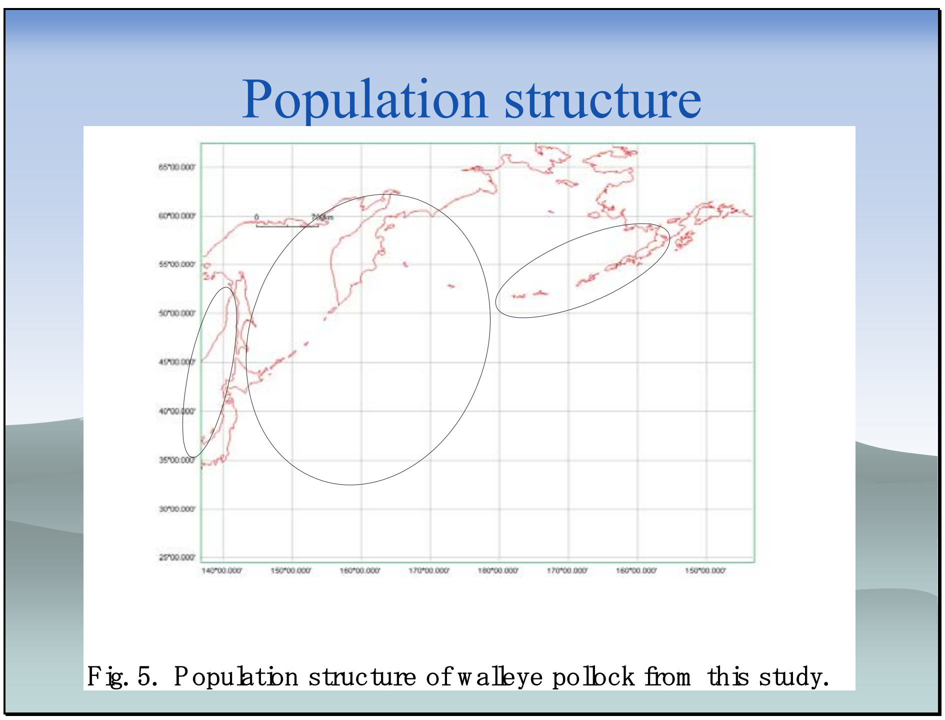


Fig. 5. Population structure of walleye pollock from this study.

Summary

- There were no area-specific nucleotide variations among sequences of mtDNA control region.
- In NJ tree, groups were formed without relations of the sampling locations by sequences data.
- In RFLP analyses, there were no area-specific fragment patterns. But the distribution of fragment patterns from three regions showed differences among sample sites.
- Composite mtDNA haploptype frequencies were different between Western Pacific and Bering Sea.
- Based upon SNAP analysis of Calmoduline region, these results are similar to past results (Allozyme).

Korean Proposal

Measures Adopted Pursuant to the Convention on the Conservation and Management of Pollock Resources in the Central Bering Sea

Trial Fishing for Pollock in 2006

September 8, 205

1. *Taking into account the report of the Scientific and Technical Committee on the status of Pollock resources in the Aleutian Basin, the 10th Annual Conference decided, as follows:*

   1.1 To establish the 2006 Allowable Harvest Level (AHL) at Zero; and

   1.2 To authorize trial fishing in the Convention Area.

2. *No more than 2 vessels from each Party to the Convention at any time may conduct trial fishing for pollock in the Convention Area.* ***However, the Republic of Korea is authorized to seek the trial fishing rights of two vessels from other Parties for two months for 2006.*** *Information on the vessels that will engage in the trial fishing will be provided to all parties at least two weeks prior to commencement of trial fishing. Such information will include vessel name, vessel type, vessels' international radio call sign (IRCS), vessel's satellite transmitter number, and the area and time of the trial fishing. Parties conducting trial fishing will notify the other Parties regarding the schedule of such trial fishing with sufficient notice to facilitate the embarkation and disembarkation of observers. Vessels engaged in trial fishing will have scientific observers of the flag-State on board and will accept at least one Scientific Observer of other Parties to the Convention, with the cost being paid by the requesting Party in accordance with arrangements to be made between the flag State of the vessel and the other Parties. All provisions of the Convention and all measures adopted by the annual conference regarding boarding and inspections, vessel monitoring systems, entry and transshipment notifications, safe boarding ladder standards, and shipboard logs and records will govern such trial fishing. Prior to the* ***11th*** *Annual Conference, Parties conducting trial fishing will submit to the other Parties a report of the trial fishing which provides the type of catch and distribution data as specified in the Central Bering Sea Observer Program Manual."*

Korea's Trial Fishing Plan for 2006

1. The Purposes of Trial Fishing

- To analyze the geographical distribution of Pollock in the Central Bering Sea.
- To estimate total weight and number of fish of Pollock and other species
- To collect biological data of Pollock and other species (length, sex, body weight, maturity)

2. Fishing Company

Name of Company	Address	Tel/Fax
Keukdong Fisheries Co.,Ltd	45, Okeum-Dong, SongPa-Ku, Seoul, Korea	82+2+3402+0919 / 82+2+3402+0966
Nambuk Fisheries Co.,Ltd	654, Nambumin-Dong, Seo-Ku, Busan, Korea	82+51+467+1551 / 82+51+243+4211
HanSung Enterprise Co.,Ltd	71, Daekyo-Dong 1Ga, YoungDo-Ku, Busan, Korea	82+51+410+7100 / 82+2+732+5300
Oyang Corporation	76-3, Taepyung-Ro 1Ga, Joong-Ku, Seoul, Korea	82+2+3277+1600 / 82+2+313+8079

3. Descriptions of Trial Fishing Vessel

3-1. Keukdong Fisheries Co.,Ltd

Name of Vessel	Type	G/T	Call Sign
CLOVER Ho	Stern Trawler	997.02	6.S.W.N
Main Dimension			**INMARSAT-C No.**
Length	**Breadth**	**Depth**	
63.18	11.40	5.10	444047812

3-2. Nambuk Fisheries Co.,Ltd

Name of Vessel	Type	G/T	Call Sign
Nambuk Ho	Stern Trawler	5,549.02	6.M.X.T
Main Dimension			**INMARSAT-C No.**
Length	**Breadth**	**Depth**	
104.30	17.80	11.00	444048214

3-3. Han Sung Enterprise Co.,Ltd

Name of Vessel	Type	G/T	Call Sign
Joon Sung Ho	Stern Trawler	2,866	6.L.S.U
Main Dimension			**INMARSAT-C No.**
Length	**Breadth**	**Depth**	
84.91	15.00	9.55	444095484

3-4. Oyang Corporation

Name of Vessel	Type	G/T	Call Sign
2 Oyang Ho	Stern Trawler	3,527.33	6.M.M.E
Main Dimension			**INMARSAT-C No.**
Length	**Breadth**	**Depth**	
88.94	15.00	9.80	444047612

4. Time of Trial Fishing Operation

Trial Fishing will occur from 1 July 2006 to 31 August 2006

The schedule of trial fishing in detail will be notified to the Parties two weeks prior to the beginning of trial fishing.

5. Cruise tracklines and survey method

Cruise tracklines will cover the Convention Area (Figure 1). Vessels engaged in trial fishing will observe conservation measures adopted by the Convention.
Vessels will be equipped with fish finders. The four vessels will detect fish schools in parallel, moving along the tracklines at the average speed of 7~8kt and about 5-mile in width. Fishing will be conducted with a large mid-water trawl net when fish schools are detected.

6. Observer

One observer from Korea will be on board each vessel. One observer from other parties will be welcome on board in accordance with the terms and conditions on trial fishing on Pollock in 2006. Cost for observer should be paid by the requesting party.

7. Report

The results of trial fishing will be submitted to the next Scientific and Technical Committee, and the Annual Conference, and to the other Parties. This will include the type of catch and distribution data as specified in the Central Bering Sea Observer Program Manual.

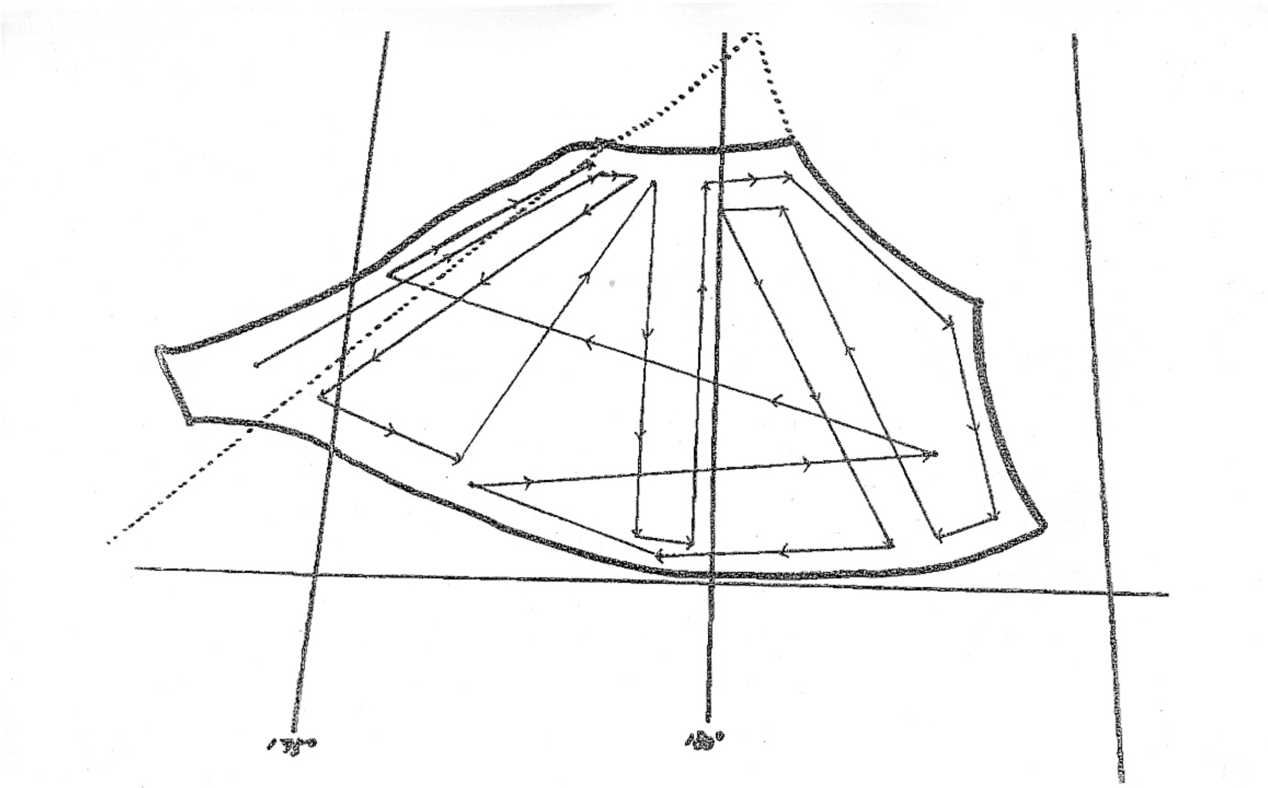


Figure 1. Trackline for Korean Trial Fishing in 2006.

Closing Remarks by Delegation of Japan

Mr. Chairman, I would like to present closing remarks to the 10th Annual Conference on behalf of Japanese delegation.

First and at the very beginning I want to express my cordial gratitude to the Korean Government and its associates for sparing no effort to conduct this year Annual Conference.

Let me also express my respect to our Chair, Mr. Barng, Mrs. Livingstone chairing, Chair of Scientific and Technical Committee meeting, and to our Rapporteur, Mr. Tinkham. You deserve our gratitude for smooth conducting of our proceedings.

Objectives of this Convention has been preservation, management and optimal use of Pollock stock at the Bearing Sea. Achieving these objectives demand cooperation by the Parties.

Unfortunately, at this meeting, in spite of expectations cherished by some Parties, including Japan, we were not able to reach consensus concerning the determination of AHL.

Still, when I was listening to straightforward statements at the meetings, I had the impression that we won here better mutual understanding inevitable to set up of AHL. I find it one of the promising results of our meeting.

Nevertheless, some Parties to the Convention continue with their rigid, traditional approach. We hope that by strengthening cooperation on the Pollock stock research, positions of costal states and fishing states, will be drawn closer.

The Moratorium has been in force for 12 years already. It has brought in its wake tremendous sacrifices on the side of all the fishermen, but produced no results. We need to cooperate in order to achieve as fast recovery of the stock, as it is only possible, but what I want to stress here, is that when we strive for stocks recovery, one would like to expect from the costal states to consider appropriate and suitable conservation and management measures and, providing it is necessary, thoroughly examine strengthening of their applied preservation and management measures.

Now, it is time to say that we wish the Chairman of the next convention meeting, to be held in Poland, a successful leadership.

We are eager to meet together again next year.

Thank you very much.

TENTH ANNUAL CONFERENCE
OF THE PARTIES TO THE CONVENTION
ON CONSERVATION AND MANAGEMENT OF POLLOCK
RESOURCES IN THE CENTRAL BERING SEA

SEPTEMBER 06-09, 2005, BUSAN, REPUBLIC OF KOREA

CLOSING STATEMENT
BY THE RUSSIAN FEDERATION

Mr. Chairman, Ladies and gentlemen,

On behalf of the Russian Federation Delegation I would like to express its sincere gratitude to the Government of Republic of Korea for arranging and hosting the Tenth Annual Conference. I also would like to extend special thanks to Mr. Barng for serving as chairperson of the annual Conference. Lastly thanks to all of you for fruitful cooperation and energetic participation in the work of the Conference.

The successful and intensive work of all participants of the Conference during the past four days helped us to add up new knowledge of the Central Bering Sea pollock. I would like to emphasize that the length of observation time series in fish stock dynamics studies becomes of special importance. We have entered the next decade of collection and accumulation of all the obtainable information on pollock in the Central Bering Sea following a uniform technique envisaged by the Convention. The database of over ten years helps us to raise significantly the accuracy of simulation, and allows us to select the models most adequate for the aggregations of pollock in the Bering Sea. My belief is that in the very near future we shall be able at last to obtain a clear idea of the prospects regarding pollock in the Donut Hole.

Finally, I would like to express my appreciation to the delegation of Korea for organizing this Conference, to you, Mr. Chairman, for you leadership, rapporteurs, interpreters, and thank you all once again for cooperation at this annual Conference.

Thank you.