International Commission on Whaling

(Constituted under the International Whaling Convention signed at Washington on 2nd December, 1946)

TWENTY-SECOND REPORT OF THE COMMISSION

(covering the twenty-second fiscal year 1970-1971)

(As approved by the Commission at its Twenty-third Meeting in Washington, June, 1971, and authorized to be printed)

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LIST OF MEMBERS OF THE COMMISSION

ARGENTINA	MR. S. N. MARTINEZ
AUSTRALIA	MR. C. G. SEITER
CANADA	DR. W. M. SPRULES
DENMARK	MR. J. NØRGAARD
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MEXICO	MR. R. MILLAN MORALES
NORWAY	MR. I. RINDAL (VICE-CHAIRMAN)
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U.S.A.	DR. J. L. McHUGH (CHAIRMAN)

R. STACEY
Secretary

Office of the Commission,
Great Westminster House,
Horseferry Road,
London, S.W.1.

June 1971

INTERNATIONAL WHALING COMMISSION

REPORT 1970-71

1. This report relates to the Twenty-second Meeting of the Commission held in London from 22nd June to 26th June 1970 under the Chairmanship of Mr I. Fujita (Japan), to subsequent developments during the year, and to the meeting of the Scientific Committee held in Washington from 14th to 18th June 1971 under the Chairmanship of Dr D. G. Chapman (USA). Reports of these meetings are contained in Appendices III and IV respectively. The details of the catches of whales contained in the report relate to the 1970/71 season in the Antarctic and, on grounds outside the Antarctic, to the calendar year 1970.

2. Antarctic Catch Limitation At its Twenty-second Meeting, the Commission agreed to a catch limit for baleen whales in the Antarctic for the 1970/71 season of 2,700 blue whale units; the same number as the limit for the 1969/70 season. The Schedule was amended accordingly at that Meeting.

3. The 1970/71 Antarctic Catch The season opened on 12th December 1970 and closed on 7th April 1971. Six expeditions were operated in the Antarctic. This compared with seven expeditions in 1969/70:-

	1969/70	1970/71
Japan	3	3
Norway	1 (factory/catcher)	-
USSR	3	3
	7	6

The number of catcher boats operating in the 1970/71 season was 86 compared with 85 in 1969/70. These were distributed as follows:-

	1969/70	1970/71
Japan	38	40
Norway	1	-
USSR	46	46
	85	86

The following table shows the baleen whale catch in 1970/71, the comparative catch in the 1969/70 season being shown in brackets.

	Fin	Sei	Total Blue Whale Units
Japan	1,607 (1,821)	4,137 (3,495)	1,493 (1,493)
Norway	- (4)	- (22)	- (6)
USSR	1,283 (1,176)	2,016 (2,339)	977 (978)

It will be seen that the total Antarctic pelagic baleen catch was 2,470 units, 7 less than in 1969/70.

The distribution by geographical area (See Appendix VIII) of the catch in blue whale units, with comparative figures for 1969/70 was as follows:-

	Area I (120°-60°W)	Area II (60°W-0°)	Area III (0°-70°E)	Area IV (70°-130°E)	Area V (130°E-170°W)	Area VI (170°-120°W)
1970/71	-	260	1032	990	105	83
1969/70	-	232	1108	853	242	42
Increase	-	28	-	137	-	41
Decrease	-	-	76	-	137	-

The number of sperm whales caught by the Antarctic pelagic expeditions south of 40° south latitude totalled 2,745 compared with 3,090 in 1969/70. The total is made up as follows:-

Japan	179 (18)
Norway	- (6)
USSR	2,566 (3066)

The total oil output for the 1970/71 Antarctic pelagic season, including sperm oil, was 470,287 barrels. Total oil production in the previous season amounted to 461,285 barrels. The average catch per catcher's day's work by pelagic expeditions was 0.31 blue whale units, the same as in the previous season.

The average fin whale size was 65.7 feet compared with 66.4 feet in 1969/70 and the average size of sei whales 47.4 feet compared with 47.9 feet. The average sperm whale size was 43.4 feet compared with 44.98 feet in the preceding season.

No whaling operations were carried out by member governments from land stations in the Antarctic during the 1970/71 season.

4. Outside the Antarctic A total of 30,317 whales was caught outside the Antarctic. Of these 27,818 whales were caught by the 5 factory ships and 14 land stations which operated in 1970; and 2,499 sperm whales were caught by the Antarctic pelagic expeditions north of 40° south latitude. Total oil production amounted to 834,225 barrels. The comparable figures for 1969 were 29,942 whales, of which 1,862 were sperm whales caught by Antarctic pelagic expeditions north of 40° south latitude, and 817,732 barrels of oil.

5. North Pacific Catch Of the total catch outside the Antarctic 20,489 whales were taken in the North Pacific Ocean. The whaling countries in that area continued their restriction of the catch of whales in the North Pacific and set the 1970 pelagic catch limit at 1,332 for fin whales (excluding the catch for the East China Sea), and for sei whales 4,924. This represented, in each case, a 10% reduction on the 1969 limit. For sperm whales, the limit was fixed at 11,273 whales, a reduction of 10% on

the 1968 catch. The catches of the land stations were set at levels not exceeding those established for 1969. The catches were as follows:-

North Pacific

1970 catch

	Fin	Sei/Bryde's	Sperm	Others	Total
Factory Ships					
Japan	518	3,235	2,700	-	6,453
USSR	412	782	8,585	66	9,845
Total	930	4,017	11,285	66	16,298
Land Stations					
Japan	77	484	3,484	73	4,118
USA	5	4	64	-	73
Total	82	488	3,548	73	4,191
Grand Total	1,012	4,505	14,833	139	20,489

At its Twenty-second Meeting the Commission agreed to catch limits in the North Pacific Ocean for 1971 of 1,308 fin whales and 4,710 sei and Bryde's whales. Appropriate amendments were made to the Schedule which also enabled the limits of the catch of either species to be exceeded by not more than 10% provided there was a comparable reduction in the catch of the other species. Because of a procedural difficulty it was not possible to include in the Schedule a catch limit for sperm whales in the North Pacific Ocean but the whaling countries in the area agreed that the total catch of that species by pelagic fleets and land stations should not exceed 13,551 whales. The question of amending the Schedule to include a catch limit for sperm whales in the North Pacific Ocean will be considered by the Commission at its Twenty-third Meeting in June 1971.

6. Catchers Functioning as Factory Ships Reports had been received of a combined catcher/factory ship operating in the Atlantic and as such a vessel was not in all cases subject to the Commission's requirements and prohibitions, recommendations were agreed at the Commission's Twenty-second Meeting bringing this class of vessel within the provisions of the Schedule.

7. Scientific Investigation of the Whale Stocks For a number of years the Food and Agriculture Organization has provided a report on the effect of pelagic operations on the Antarctic whale stocks and the status of the stocks. At the Twenty-first Meeting it was announced that the FAO did not consider it any longer necessary to report regularly on the stocks and proposed to withdraw from these special investigations; a report was not therefore submitted in 1970. The Commission decided that this subject should be withdrawn as a continuing item on the agenda.

8. Collection of Catch, Effort and Length Distribution Data The Commission received a report on the progress made in the collection and processing of catch, effort and length distribution data for whale stock assessment which the Bureau of International Whaling Statistics had under-

taken on behalf of the Commission and approved the payment of a further sum of £500 to the Bureau in respect of this work.

9. Amendments to the Schedule to the Convention At the Twenty-second Meeting of the Commission it was agreed (i) to amend paragraph 4(1)(b) to provide for the extension of the ban on the killing of blue whales in the North Pacific Ocean, and (ii) to extend the provisions of paragraph 6(4) forbidding the killing or attempting to kill humpback whales in the North Pacific Ocean, in each case for a further period of three years. Paragraph 8(a) was amended to limit the total Antarctic pelagic catch for the 1970/71 season to 2,700 blue whale units. Three new sub-paragraphs (f), (g) and (h) were added to paragraph 8 introducing catch limits for fin, sei and Bryde's whales in the North Pacific Ocean. Paragraphs 9(a) and (b) were amended to continue the exclusion of the North-East Pacific area from the requirement that the meat of whales of the smaller dimensions prescribed in paragraphs 9(a) and (b) of the Schedule must be used for local consumption as human or animal food. Paragraph 11 was amended to remove the exclusion of the North Pacific Ocean from the ban on using in other areas in the same season factory ships which had operated in the Antarctic. Amendments were made to the following paragraphs to bring combined catcher/factory ships within the provisions of the Schedule: paragraphs 4(2), 5, 6(5), 7(a), (b), 8(a), (c), (d), 9(b), 13(a) and (d). Paragraphs 8(b)(3), 9(a) and 18(1) were amended to differentiate between sei and Bryde's whales.

10. Finance The Commission reviewed its financial position at the Twenty-second Meeting and approved, subject to audit, the statement of income and expenditure for the financial year ended 31st May 1970.

The Commission considered the estimate of income and expenditure for 1970/71. Expenditure was estimated to total £7,075. This represented an increase of £445 on the previous year due to increased costs generally. An income of £5,300 was expected from 14 Contracting Governments contributing £350 each and interest on investments, this amount comparing with an income of £5,701 in 1969/70, the reduction arising mainly from the withdrawal of a member country. The Commission approved the estimate and in doing so decided not to propose any change in the amount of contribution paid by member countries for 1970/71, the deficit on the year's working to be met from the accummulated balance. It accepted the recommendation of the Finance and Administration Committee that subject to the usual review at the next meeting the rate of contribution should be increased by 10% for 1971/72.

A copy of the audited accounts for 1970/71 is shown at Appendix V. Expenditure was £6,519 compared with £6,630 in the previous year. Income amounted to £5,198 which included the flat rate contributions from the Contracting Governments and £298 from interest on capital invested during the year. There was a balance in hand at the end of the year of £3,071.

11. National Quotas The Commission was advised that representatives of Japan, Norway and the Union of Soviet Socialist Republics met in London under the Chairmanship of Mr R. G. R. Wall and agreed on a quota distribution of the pelagic catch limit for the 1970/71 Antarctic season fixed by the Commission at 2,700 blue whale units (see para 2). The following allocations were agreed:-

Japan	...	...	...	1,493 blue whale units
Norway	...	...	...	231 " " "
USSR	...	...	...	976 " " "

The Agreement operated until the end of the 1970/71 season.

The Commission was also informed that an agreement on North Pacific whaling for 1971 was signed in Tokyo in December 1970 which provided the following divisions of the global quotas for the North Pacific which had been approved by the Commission (see para 5):-

	Fin whales	Sei and Bryde's whales
Japan	568	3,132
USSR	700	1,527
USA	40	51

It was also agreed that the catch of sperm whales in the North Pacific should be allocated in the following manner and that each Commissioner of the North Pacific whaling countries should recommend to his Government the voluntary implementation of this allocation.

Japan	5,760
USSR	7,716
USA	75

12. Infractions Appendix VI of this Report gives a summary of infractions of the Convention reported by Contracting Governments in respect of the 1970/71 Antarctic season and the 1970 season in waters outside the Antarctic.

13. Permits to take Whales for Scientific Purposes The Commission was notified during the year of the following permits issued under Article VIII of the Convention:

Canada: a permit for the taking of not more than 40 fin whales and 30 humpback whales for scientific purposes.

Japan: * a permit for the taking of not more than 5 lactating sei whales and their calves for scientific purposes.

Norway: a permit for the taking of not more than 20 fin whales in East Greenland waters for scientific purposes.

South Africa: (i) a permit for the taking of not more than 15 sperm whale calves for scientific purposes;

(ii) a permit for the taking of not more than 12 lactating minke whales and their calves for scientific purposes.

USA: (i) a permit for the taking of not more than 4 sperm and 2 humpback whales for maintaining alive in captivity for scientific purposes;

(ii) a permit for the taking of not more than 3 sperm whales for maintaining alive in captivity for scientific purposes;

(iii) a permit for the taking of not more than 2 gray whales for maintaining alive in captivity for scientific purposes.

USSR: a permit for the taking of not more than 3 pygmy right, 10 Bryde's, 5 pygmy blue and 2 humpback whales for scientific purposes.

* This permit was issued as it had not been possible to obtain the requisite number of lactating sei whales and their calves under the permit issued by the Government of Japan on 28th April 1970.

14. The constitution of the Commission at the Twenty-second Meeting is shown in Appendix I and that of the Technical, Scientific and Finance and Administration Committees in the Chairman's Report of the meeting in Appendix III.

R. Stacey
Secretary to the Commission

APPENDIX I

LIST OF COMMISSIONERS AND ADVISERS ATTENDING THE TWENTY-SECOND MEETING OF THE COMMISSION, JUNE 1970

Chairman: Mr. I. Fujita

	Commissioners or Delegates	Advisers
Argentina	Mr. S. N. Martinez	
Australia	Mr. W. C. Duggan	Mr. B. K. Bowen Mr. R. M. A. Jackson Mr. J. D. Murray Mr. J. L. Bannister
Canada	Dr. W. M. Sprules	Mr. K. R. Allen Dr. E. D. Mitchell
France	Mr. R. A. Lagarde	Mr. C. Roux
Iceland	Mr. E. Benedikz	
Japan	Mr. I. Fujita	Mr. H. Maki Mr. K. Fujimura Mr. T. Wada Mr. M. Takahashi Mr. K. Hoketsu Mr. T. Abo Mr. T. Endo Mr. K. Iino Dr. H. Omura Dr. S. Ohsumi Dr. Y. Fukuda Mr. K. Kakudoh Mr. Y. Takato
Norway	Mr. I. Rindal	Mr. E. Moe Dr. A. Jonsgard
Panama	Mr. A. T. Boyd	
South Africa	Dr. B. van Dyk de Jager	Mr. F. J. Cronje Mr. L. C. Surman
United Kingdom	Mr. J. Graham	Mr. A. J. Aglen Mr. G. N. Dixon Dr. N. A. Mackintosh Mr. R. Gambell Mr. S. G. Brown Mrs. C. Lockyer Dr. R. Clarke

	Commissioners or Delegates	Advisers
USA	Dr. J. L. McHugh	Mr. S. Blow Dr. D. G. Chapman Mr. D. W. Rice Mr. D. D. Smith
USSR	Mr. M. N. Sukhoruchenko	Mr. G. V. Zhigalov Dr. V. G. Lafitsky Dr. M. V. Ivashin Mr. V. M. Nikolaev

	Observers
Chile	Comdr. H. Julio Mr. V. Berguno
Italy	Dr. U. Vattani
Peru	Mr. G. Balbwena
F.A.O.	Mr. L. K. Boerema
I.C.E.S.	Mr. A. J. Aglen
Fauna Preservation Society	Mr. R. S. R. Fitter
International Society for the Protection of Animals	Mr. C. Platt
International Union for Conservation of Nature and Natural Resources	Dr. C. W. Holloway
International Association of Game, Fish and Conservation Commissioners	Mr. S. McVay
World Wildlife Fund	Dr. R. S. Payne

APPENDIX II

Ref: AP XXII 21 April 1970

Dear Commissioner,

CIRCULAR LETTER TO ALL COMMISSIONERS

AGENDA: TWENTY-SECOND MEETING 1970

I enclose two copies of the agenda for the Twenty-second Meeting of the Commission to be held at Riverwalk House, Millbank, London, S.W.1 from 22 June to 26 June 1970. The opening session will begin on Monday, 22 June at 10.30 a.m.

The agenda has been amended in the light of comments received on the draft provisional agenda circulated with my letter of 18 March 1970.

The proposal included in Items 12 and 18(b) to amend the Schedule to bring catcher-cum-factory ships within the Commission's regulations has been made by the United Kingdom Government and its inclusion is supported by the Canadian Government. The United Kingdom Government considers the amendment necessary since the present wording of the Schedule provides a loop-hole for vessels capable of catching and processing whales on board. The Japanese Government has requested that provision be made for an amendment to Paragraph 11 of the Schedule. The Japanese Government explains that its reasons for the proposed amendment are:-

(i) Since restrictive measures have been already taken in the Pacific Ocean in terms of the number of factory ships and whale catchers, and the catch of whales and the period of whaling by factory ship type whaling, there will be no possibility of increased intensity of whaling activities in the North Pacific, even if a factory ship which has been used during a season in the Antarctic for the purpose of treating baleen whales is used again in the North Pacific for the same purpose within a period of one year from the termination of that season in the Antarctic.

(ii) With the strengthening of the catch restrictions of whales, both in the Antarctic and in the North Pacific, it has been an increasingly heavy economic burden for the Japanese whaling industry to maintain two kinds of factory ships, one for the Antarctic and the other for the North Pacific, to observe the provisions of Paragraph 11.

PROPOSED DRAFT AMENDMENT

Insert the following after the phrase "in any other area". "except the North Pacific Ocean and its dependent waters north of the Equator".

The Government of the U S S R requested the addition of the words "including catch limit" to Item 18(m). The Government of the U S A suggested a similar amendment.

Copies of the financial statements referred to under Item 4 will be circulated as soon as possible after the end of the current financial year on 31 May 1970.

A meeting of the Scientific Committee is being convened to commence on Monday, 15 June, 1970. It is expected that the report to be discussed under Item 6 will not be available until the beginning of the Commission's meeting.

A copy of the Agenda and this covering letter are being sent to each Contracting Government. Further copies may be obtained from the Commission's office.

I should be glad to be informed by 8 June, or earlier if possible, of the names of all those who will be present at the Twenty-second Meeting on behalf of your Government.

Yours faithfully,

R. STACEY

Secretary to the Commission

Agenda for the Twenty-second Meeting to begin at 10.30 a.m. on Monday 22nd June, 1970 at Riverwalk House, London, S.W.1.

1. Address of Welcome.
2. Arrangements for meeting and adoption of Agenda.
3. Appointment of Committees.
4. Finance and Administration:
   (a) Review of the Commission's financial position (accounts for 1969/70 and estimate for 1970/71 to be circulated with Paper IWC/22/3).
   (b) Review of the level of contribution from Contracting Governments.
5. Review of previous season's catches.
6. Report of the Scientific Committee. (report to be circulated as Paper IWC/22/4).
7. Special scientific investigation of the whale stocks:
   (a) Reports and action arising therefrom.
   (b) Arrangements for continuation of stock assessment work.
8. Sperm whale stocks (paragraph 14 of Chairman's Report of 21st Meeting):
   (a) Report of Scientific Committee.
   (b) Action arising.
9. North Pacific whale stocks (paragraph 13 of Chairman's Report of 21st Meeting):
   (a) Report of Scientific Committee.
   (b) Report of Commissioners of North Pacific Whaling Countries.
   (c) Action arising.
10. Separation in Schedule of Bryde's whale from Sei whale (paragraph 20 of Chairman's Report of 21st Meeting.
11. International Observer Scheme.
12. Amendment of Schedule to cover catchers functioning as factory ships.
13. Exclusion of the North Pacific Ocean and its dependent waters north of the Equator from the application of paragraph 11 of the Schedule.

14. Infractions (report to be circulated as Paper IWC/22/5).

15. Technical Committee Report (to be circulated during meeting).

16. Finance and Administration Committee Report (to be circulated during meeting).

17. Twenty-first Annual Report (a draft will be circulated as Paper IWC/22/6).

18. Amendments to the Schedule:

(a) Paragraph 4(1)(b) - extension or modification of prohibition on the killing of blue whales in the North Pacific Ocean and its dependent waters north of the Equator starting with the 1971 season.

(b) Paragraphs 4(2), 5, 6(5), 7(a) and (b), 8(a) (c) and (d), 9(b), 12(b), 13(a) (b) and (c) - to apply the provisions of these paragraphs to catchers which also function as factory ships (arising out of Item 12).

(c) Paragraph 5 - position of the Sanctuary.

(d) Paragraph 6(4) - extension or modification of prohibition on the killing of humpback whales in the North Pacific Ocean and its dependent waters north of the Equator starting with the 1971 season.

(e) Paragraph 7(a) and 8(d) - determination of opening and closing dates of Antarctic pelagic baleen season.

(f) Paragraph 8(a) - pelagic catch limit in the Antarctic for 1970/71.

(g) Paragraph 8(b) (3) - to insert "or Bryde's" after "sei".

(h) Paragraph 9(a) - to insert "Bryde's" after "sei" in the first line and "and Bryde's" after "sei" in the fourth and sixth lines.

(i) Paragraph 9(a) and 9(b) - extension or modification of the exception of the North-east Pacific area as prescribed in these paragraphs after 1 April 1971.

(j) Paragraph 11 - exemption of the North Pacific Ocean and its dependent waters north of the Equator from the prohibition on the use of the factory ships as prescribed in this paragraph (arising out of Item 13).

18. (k) (contd) Paragraph 18 (1) - to insert between the definition of "blue whale" and "dauhval" the following: "Bryde's whale" (Balaenoptera edeni or brydei) means any whale known by the name of "Bryde's whale";"and to delete from the definition of "sei whale" the following words "and shall be taken to include Bryde's whale (B.brydei)".

(l) Provision for restriction of the catch of sperm whales (arising out of Item 8).

(m) Provision for restriction of the catch of whales including catch limit in the North Pacific (arising out of Item 9).

19. Date and place of next meeting.

20. Arrangements for Press Release.

21. Any other business.

APPENDIX III

INTERNATIONAL WHALING COMMISSION

CHAIRMAN'S REPORT OF THE TWENTY-SECOND MEETING

1. Date and Place. The Twenty-second Meeting of the Commission was held at Riverwalk House, Millbank, London, S.W.1 from 22 to 26 June 1970. The proceedings were conducted by the Chairman, Mr I Fujita (Japan).

2. Representation. Commissioners and Delegates of Contracting Governments represented Argentina, Australia, Canada, France, Iceland, Japan, Norway, Panama, South Africa, the Union of Soviet Socialist Republics, the United Kingdom and the United States of America. Observers attended from Chile, Italy, Peru, the Food and Agriculture Organisation of the United Nations, the International Council for the Exploration of the Sea, the International Union for the Conservation of Nature and Natural Resources, the Fauna Preservation Society, the International Society for the Protection of Animals, the International Association of Game, Fish and Conservation Commissioners and the World Wildlife Fund.

3. Address of Welcome. The opening session was addressed by Mr R G R Wall, CB, Deputy Secretary of the Ministry of Agriculture, Fisheries and Food. In welcoming Commissioners, Delegates and Observers to London Mr Wall referred to the fact that eighteen or twenty years ago the Antarctic catch limit was standing at a figure of 15,000 or 16,000 blue whale units whereas the figure for last season was 2,700 units. He said that this would not perhaps itself indicate a record of successful achievement. But this was not the whole story. Throughout the years the Commission had been tenaciously fighting the battles for the conservation of the whale stocks. It had increased scientific knowledge of the stocks, the essential base of successful conservation, and by intensifying its regulations had established the principle of the maximum sustainable yield on which depended the maintenance of stocks at their reduced level and still more their recovery towards higher levels. He wished the Commission well in its continuing endeavours for the conservation of the whale stocks.

4. Mr H Th Knudtzon. The death was reported of Mr Knudtzon, the Commissioner for Norway for the last three years and a member of the Norwegian Delegations to the Commission's meetings for many years. The Chairman paid tribute to the contribution made by Mr Knudtzon to the work of the Commission and the meeting stood in silent tribute to his memory.

5. Adoption of Agenda. The agenda was adopted on the proposal of the Commissioner for Canada seconded by the Commissioner for Norway.

6. Review of Previous Season's Catches. Statistics relating to the catch outside the Antarctic in 1969 and the catch in the Antarctic in 1969/70 prepared by the Bureau of International Whaling Statistics were distributed. The new Commissioner for Norway, Mr I Rindal presented a report on behalf of Mr Vangstein, the Director of the Bureau, who was unable to be present. He said that in 1969 three Soviet Union and three Japanese expeditions operated in the North Pacific. The catch was reduced compared with 1968. It comprised about 1,170 fin whales and about 4,700 sei whales corresponding to about 1,360 blue whale units. In addition, about 11,200 sperm whales were caught and the production amounted to about 495,000 barrels of oil, about 100,000 barrels more than the production in the Antarctic during the last two seasons. Operations in the Antarctic in 1969/70 were carried out by three Soviet Union and three Japanese expeditions and one Norwegian catcher/factory ship. The total catch was 3,002 fin whales and 5,857 sei whales, corresponding to 2,477 blue whale units, 223 units less than the limit set by the Commission. For the period 1962-70 the total catch has been about 8,000

blue whale units below the combined quota for three years. The number of sperm whales caught in the Antarctic was 3,090 and the number caught on the voyages to and from the Antarctic was 2,300.

7. Scientific Committee. The Scientific Committee met under the Chairmanship of Dr D G Chapman (USA) from 15 to 22 June 1970 and its report was issued as meeting document IWC/22/4.

8. Scientific Investigation of the Whale Stocks. This had been a continuing item on the agenda for the Commission's meetings and related to the investigations of the FAO Stock Assessment Group. FAO announced its withdrawal from the special investigations into the whale stocks at the last meeting and no report was now before the Commission. It was decided that this subject should be withdrawn as a continuing item on the Commission's agenda.

9. Pelagic Catch Limit in the Antarctic. The Scientific Committee reported that it had considered three papers estimating the size of the fin whale stock in the Antarctic but despite the progress made at a special meeting on fin whale assessment held during the year in Honolulu, the Committee was unable to reach agreement on an estimate of the sustainable yield of fin whales in 1970/71. All members except Japan agreed that the recent level of fin whale catch (2,700 average over the last five seasons) appeared fairly close to the present sustainable yields. Japanese scientists believed the best estimate was 3,520 to 4,350. Two estimates of the present sustainable yield of sei whales studied by the Committee indicated it to be about 5,000 whales. The Commission accepted the Technical Committee's recommendation that the catch limit in the Antarctic should be 2,700 blue whale units on the understanding that the actual catches would not be substantially increased above recent levels. It decided to amend the Schedule to the Convention by deleting "1969/70" from paragraph 8(a) and substituting "1970/71". Three delegations while agreeing with the decision expressed misgivings whether the limit would hold the present stock level.

10. Length of Antarctic Season. The Commission accepted the Technical Committee's recommendation that there should be no change in the opening and closing dates of the Antarctic season.

11. The Sanctuary. The Commission accepted the Technical Committee's recommendation that the Sanctuary should remain open in 1970/71.

12. Baleen Catch Limits in the North Pacific. The Scientific Committee's review of the new assessments of fin and sei whales in the North Pacific Ocean had been considered by the North Pacific Group of Commissioners who had agreed that for 1971 catches of fin whales would be reduced by 10% and sei and Bryde's whales combined by 15%, giving limits of 1,308 and 4,710 respectively. Because of the practical difficulties in implementing these limits it was agreed that either of them might be exceeded by 10% provided an appropriate reduction was made in the other catch. The Technical Committee accepted the Group's proposal that the agreement should be implemented by amendment of the Schedule and the Commission approved the addition of the following sub-paragraphs to paragraph 8 as recommended by the Committee:

"(f) Subject to sub-paragraph (h), the number of fin whales taken in the North Pacific Ocean and dependent waters excluding the catch in the East China Sea shall not exceed 1,308 whales in 1971.

(g) Subject to sub-paragraph (h), the number of sei and Bryde's whales combined taken in the North Pacific Ocean and dependent waters shall not exceed 4,710 whales, in 1971. The numbers taken in the succeeding few years shall be further adjusted on the basis of the latest scientific assessment so that within a few years the catch shall be less than the estimate of the sustainable yield.

(h) The catch specified in either sub-paragraph (f) or (g) may be exceeded by not more than 10% provided that an appropriate reduction is made in the catch specified in the other sub-paragraph".

13. Sperm Whale Stocks. The Scientific Committee reported that it had agreed that further analyses of sperm whale stocks in the southern hemisphere were needed and had made no assessment of the sustainable yield in that area. In regard to the North Pacific, the Technical Committee reported that the North Pacific Commissioners had considered the limitation of the catch in that area in the light of the report of the Scientific Committee and had agreed that the 1970 catch should be reduced by 10% for 1971 giving a limit of 13,551 sperm whales for pelagic fleets and land stations. For procedural reasons it was not possible to implement this agreement in the Schedule this year but the Technical Committee expect to be in a position to propose an appropriate amendment to the Schedule to limit the sperm whale catch in the North Pacific at the next meeting.

14. Ban on Killing Blue and Humpback Whales in North Pacific Ocean. The Technical Committee accepted the Scientific Committee's recommendation that the ban on the killing of blue and humpback whales in the North Pacific Ocean should be continued and the Commission approved the following amendments to the Schedule proposed by the Technical Committee:

Paragraph 4(1)(b) delete "1966" and substitute "1971"
Paragraph 6(4) delete "1968" and substitute "1971"

15. Exception of North-East Pacific Area in Paragraph 9 of the Schedule. The Technical Committee recommended the continuation of the exclusion of the North-east Pacific area from the requirement that the meat of whales of the smaller dimensions prescribed in Paragraphs 9(a) and (b) of the Schedule must be used for local consumption as human or animal food and the Commission approved the following amendments to the Schedule:

Paragraph 9(a) Ninth line, delete "1968" and substitute "1971"
Paragraph 9(b) Eighth line, delete "1968" and substitute "1971"

16. Catchers Functioning as Factory Ships. Reports had been received of a combined catcher/factory ship operating off the coast of Africa and as such a vessel was not in all cases subject to the Commission's requirements and prohibitions. The following amendments to bring this class of vessel within the provisions of the Schedule were proposed by the Technical Committee and approved by the Commission:

Paragraph 4(2) Delete the first two lines and substitute "It is forbidden to use a factory ship or whale catcher attached thereto for the purpose of taking or treating baleen whales except minke whales in any of the following areas:"

Paragraph 5 Delete the first two lines and substitute "It is forbidden to use a factory ship or whale catcher attached thereto for the purpose of taking or treating baleen whales in the waters south of 40° South Latitude".

Paragraph 6(5) Delete the sub-paragraph and substitute the following: "It is forbidden to use a factory ship or whale catcher attached thereto for the purpose of taking or treating sperm whales in the waters between 40° South Latitude and 40° North Latitude".

Paragraph 7(a) Delete first two lines and substitute "It is forbidden to use a factory ship or whale catcher attached thereto for the purpose of taking or treating baleen whales (excluding minke whales) in"

Paragraph 7(b) Delete all words in second line before "sperm" and substitute "It is forbidden to use a factory ship or whale catcher attached thereto for the purpose of taking or treating"

Paragraph 8(a) Delete "whale catchers attached to factory ships" in second line and substitute "factory ships or whale catchers attached thereto"

Paragraph 8(c) Delete fourth line and substitute "all factory ships or whale catchers attached thereto under the jurisdiction of each Contracting"

Paragraph 8(d) Delete last sentence and substitute "The taking or attempting to take baleen whales by factory ships or whale catchers attached thereto shall be illegal in any waters south of 40° South Latitude after midnight of the date so determined"

Paragraph 9(b) Second, Third and Fourth lines, delete "for delivery to factory ships or land stations"

Paragraph 13(a) First line, delete "delivery to" and substitute "treatment by"

Paragraph 13(d) Delete up to and including "immediately" in the second line and substitute "The information specified in sub-paragraph (c) of this paragraph shall be entered immediately by a factory ship"

17. Exclusion of the North Pacific Ocean and its Dependent Waters North of the Equator from the Restrictions on the use of the Antarctic Factory Ships. The Technical Committee considered a proposal by the Japanese delegation to amend paragraph 11 of the Schedule to remove the exclusion of the North Pacific Ocean from the ban on using in other areas in the same season factory ships which had operated in the Antarctic. The purpose was to rationalise the whaling industry which at present had to maintain two kinds of factory ships, one for the Antarctic and the other for the North Pacific. The Japanese proposal was agreed to subject to the addition of a proviso that catch limits for the area were established. It was also agreed on the proposition of the Commissioner for Norway, that minke whales should be excluded from the terms of the paragraphs. The following amendments to paragraph 11 of the Schedule recommended by the Technical Committee were approved by the Commission:

Second line, after "baleen whales" add "apart from minke whales"
Third line, after "area" add "except the North Pacific Ocean and its dependent waters north of the Equator"
Fourth line, after "season" add "provided that catch limits in the North Pacific Ocean and dependent waters are established as provided in paragraph 8(f), (g) and (h)"

18. Bryde's Whale. At its 21st meeting the Commission agreed on the proposal of the Scientific Committee that sei and Bryde's whales should be recognised as distinct species and that appropriate amendments to the Schedule should be placed on the agenda for the 22nd meeting. The Technical Committee considered the proposed amendments and on the Committee's recommendation the Commission approved them as follows:

Paragraph 8(b)(3) After "sei" add "or Bryde's"
Paragraph 9(a) First line, add "Bryde's" after "sei",
Fourth and sixth lines, add "and Bryde's" after "sei"
Paragraph 18(1)(i) Between sixth and seventh lines add'"Bryde's whale" (Balaenoptera edeni or brydei) means any whale known by the name of "Bryde's whale"'.
(ii) Delete "and shall be taken to include Bryde's whale (B. brydei)" from last two lines at foot of page 7.

19. Infractions. The Technical Committee appointed a sub-committee to consider the details of the infractions of the Convention as reported by the whaling countries. The Sub-Committee reported a slight increase in the number of infractions expressed as a percentage of the total catch and that the percentage for sperm whales continued to be higher than that for baleen whales. The Sub-Committee did not consider a specific recommendation was warranted but pointed to the continuing need for each whaling nation to enforce measures designed to keep infractions to a minimum.

20. International Observer Scheme. The Technical Committee again proposed that the International Observer Scheme should be implemented and a number of Commissioners urged strongly that steps should be taken to bring into operation the Scheme already approved by the Commission. The view was expressed that the Scheme should cover all whaling areas and land stations as well as pelagic expeditions. The Chairman pointed out that there was no disagreement as to the necessity of implementing the Scheme and the countries concerned were urged to implement it as soon as possible by themselves putting forward concrete proposals.

21. The Commission's 21st Report. The draft report which had been circulated was approved subject to minor drafting amendments to which the Secretary drew attention and the addition of some of the statistical details that were awaited from the Bureau of International Whaling Statistics.

22. Collection of Catch, Effort and Length Distribution Data. The Director of the Bureau of the International Whaling Statistics included in his report (para 5) a note on the progress that had been made in the collection of this data on behalf of the Commission. The Scientific Committee reviewed the progress that had been made and recommended the payment of a further sum of £500 towards the Bureau's costs in this connection.

23. Finance. The report of the Finance and Administration Committee was considered by the Commission.

(a) The Statement of Income and Expenditure for 1969/70
The statement showed that expenditure amounted to £6,630 compared with £5,813 in 1968/69. The increase arose mainly from pay awards during the year to the staff of the Ministry of Agriculture, Fisheries and Food, higher cost of printing etc. (notably the printing of the Annual Report), the increased cost of the Annual Meeting (the previous one was held in Tokyo) and the payment made in respect of the collection of the catch, effort and length distribution data. Income of £5,701 was lower by £146 on the previous year. It comprised £5,250 representing the contribution of £350 from each of the 15 Contracting Governments and £451 interest on the funds invested. Expenditure thus exceeded income over the year by £929. The Commission approved the statement on the recommendation of the Finance and Administration Committee.

(b) The Estimate for 1970/71
The estimate showed an increase on most items of expenditure due to higher costs and staff pay awards. It included £500 contribution to the National

Institute of Oceanography towards the costs of its whale marking operations and a further contribution of £500 to the Bureau of International Whaling Statistics for the work on collecting and processing catch, effort and length distribution data as recommended by the Scientific Committee. The Commission approved the estimate as recommended by the Finance and Administration Committee.

(c) Amount of Contribution
The Finance and Administration Committee recommended no change in the amount of contribution from Contracting Governments. It took note, however, of the expected increase in expenditure and reduced income in 1970/71 which would have the effect of reducing the accumulated balance to £2,617, and recommended that, subject to the usual review at the next meeting, the rate of contribution should be increased by 10% for 1971/72. The Commission accepted the recommendations of the Committee.

24. Date and Place of Next Meeting. The United States Commissioner stated that he was authorised to invite the Commission to hold its meeting in 1971 in Washington DC. This had been considered by the Finance and Administration Committee. It felt that in view of the advantages to the Commission the invitation should be accepted although it had not been sent formally to the Commission before the meeting. The Committee accordingly recommended that the meeting should be held in Washington during the week commencing June 21, 1971. The Commission unanimously accepted the Committee's recommendation and expressed sincere thanks to the United States Government.

25. Statements by Observers from other Organisations. Statements were made by Mr L K Boerema of the Food and Agriculture Organisation, Mr R S Fitter of the Fauna Preservation Society, Mr C Platt of the International Society for the Protection of Animals, Dr C W Holloway of the International Union for Conservation of Nature and Natural Resources, Mr S McVay of the International Association of Game, Fish and Conservation Commissioners and Dr R S Payne of the World Wildlife Fund.

26. Constitution of Committees. The membership of the Commission's Committees for the year was as follows:

Technical Committee: Australia, Canada, France, Japan, Norway, South Africa, Union of Soviet Socialist Republics, United Kingdom and United States of America. Dr J L McHugh (United States of America) was elected Chairman.

Scientific Committee: Australia, Canada, France, Japan, Norway, Union of Soviet Socialist Republics, United Kingdom and United States of America. Dr D G Chapman (United States of America) was elected Chairman.

Finance and Administration Committee: The Chairman of the Commission nominated representatives from Canada, France, Japan, Norway and the Union of Soviet Socialist Republics. Dr W M Sprules (Canada) was elected Chairman.

I Fujita
Chairman

APPENDIX IV

REPORT OF THE SCIENTIFIC COMMITTEE

1. The Committee met at 9:30 a.m. on 14 June 1971 and following days in the International Conference Suite, Department of State Building, Washington, D.C. under the chairmanship of Dr D.G. Chapman.

2. There were present:

Australia	J.L. Bannister
Canada	K.R. Allen E.D. Mitchell
Japan	Y. Fukuda S. Ohsumi H. Omura K. Yonezawa
Norway	A. Jonsgaard
South Africa	P.B. Best
U.K.	S.G. Brown R. Gambell
U.S.A.	D.G. Chapman D.W. Rice
U.S.S.R.	M.V. Ivashin Y.B. Ryazantsev
Observers	L.K. Boerema (FAO) C. Holloway (IUCN)

RESEARCH AND INFORMATION

3. Progress reports and numerous other papers were available to the Committee. These are listed in Annex B with the numbers that were used to identify them.

4. The Committee received information from several members on the status of special permits issued during the past year and on the status of the reports on the results of research derived from the collection of such whales. The special permits generally relate to research items that are useful and important and reports on such research have been forthcoming with satisfactory promptness.

5. Mr Brown provided a summary table (Annex C) showing the number of whales marked by area and species in the past year.

6. The sighting programme for prohibited species was considered; each member indicated the way in which the reports from the programme are handled in his country. A new sighting form (Annex D) was developed and is recommended for future use. It was agreed that members of the Committee should take responsibility for the sighting data for their own country and could use the form developed by the Committee. They could, however, use

forms requiring additional detail if so desired. It was also agreed that members would take the responsibility for reporting the data (or appropriate summaries thereof) to the Committee as part of their annual Progress Report, together with whatever additional analysis they deemed appropriate. It was also agreed that the Secretary of the Commission should continue to transmit to and collect from whaling countries not represented on the Scientific Committee the standard form.

7. The Committee expressed its appreciation of the co-operation of whaling operators who have reported sightings of prohibited species and asks that the Secretary write asking for co-operation of other operators in this matter.

8. The Committee requests the Secretary of the Commission to send a letter of thanks to the participants of the sighting programme by S.C.A.R. and suggests that the programme now be terminated. It also expresses thanks to Mr. Brown for his careful analysis of the last three seasons' observations (SC/12).

STATUS OF STOCKS

SOUTHERN HEMISPHERE BALEEN WHALES

Fin Whales

9. The Committee discussed at length the papers (SC/1, SC/2, SC/8, SC/9) bearing on status and yields of the Antarctic fin whale stock, particularly those aspects having to do with the rate of recruitment and those that have raised doubts concerning the analysis of this stock. One of these has to do with the age at sexual maturity (cf. Table 1, p.6 of SC/2). The differences of the estimated age of sexual maturity could be real Area differences or could be due to differences of interpretation. It is therefore desirable to have an exchange of material for comparative purposes to ensure that standardization of readings is achieved.

10. Papers referred to in paragraph 9 and additional studies by the Committee provide estimates of recruitment by the method of Allen using actual data and by the models of Ohsumi using estimates of changes in the basic parameters. The changes of the stock under the various models and as estimated directly were also considered. Present stock size estimates fall between 70 and 82 thousand. However the Committee was unsuccessful in reaching a single estimate for the sustainable yield in 1971/72.

The different positions are summarized in the following two paragraphs.

11. Allen's estimates of sustainable yield using the actual estimated recruitments of recent years calculated in two ways are 1.2 thousand, and 2.2 thousand (average 1.7 thousand). Estimates of the recruitment vary both between methods and between years. In addition it must be recognized that recent recruitments have come from the larger parent stocks of the early 1960's. These considerations have been taken into account in the estimates of sustainable yield in this paragraph. Dr. Chapman calculated the sustainable yield using Japanese population estimates and Japanese recruitment rate estimates, with natural mortality rate held constant, and obtained an estimate of 2.7 thousand for the sustainable yield. The average of Allen's and Chapman's estimates is 2.2 thousand, which all members of the Committee, except Japan and USSR, believe is the best estimate of the 1971/72 sustainable yield. All members of the Committee, except Japan and USSR, also believe that there is no direct evidence that the Antarctic fin whale population has

increased in the past five years.

12. Japanese scientists are convinced that the estimates as calculated above are too low to be realistic. Their best estimate of sustainable yield is 3.9 to 4.6 thousand. They also calculated the annual values of available yield in recent years from Allen's population estimates and obtained 3.8 and 5.4 thousand (average 4.6 thousand) for 1970/71.

13. Japanese scientists consider that the population of Antarctic fin whales has been increasing since 1964/65 and hence recruitment has been increasing since 1969/70, and that it is certain that catches since 1964/65 have been below the available yield. Recruitment in the coming season, the bulk of which is to come from the parent stock of 1966/67, is expected to be no smaller than that of last year, confirming that the available yield in the coming season is well above 3,000.

14. The Soviet delegate believes that the method used by Allen provides too low estimates of the available yield to seem realistic for the Antarctic stock of fin whales of 70 - 82 thousand. He notes that the Japanese estimate is even somewhat smaller than their recalculation of the 1970/71 available yield from Allen's population estimates. A combined value between the two estimates appears to be more realistic and would reflect the potential of the present stock of the Antarctic fin whales.

Sei Whales

15. The Committee had before it some analyses of South African data and of sightings by Japanese expeditions (SC/23, SC/1) but few new analyses for other Areas. Concern was expressed because of the sharp decline in CPUE and sightings both off the east coast of South Africa and in Area III. It was agreed that more analyses of all sei whale stocks are needed, particularly using biological data. This is made more feasible by the new method of treating sei whale earplugs for age determination developed by Mrs. Lockyer (SC/11). It was agreed that it would be useful to exchange sei whale material to standardize age determination. Mr. Gambell will co-ordinate this study and that for fin whales referred to above.

16. Despite the declines in CPUE and in sightings in Area III, there is insufficient basis for a change in the estimate of sustainable yield. We therefore retain the estimate of 5000. The present total population level may be above the level which gives maximum sustainable yield, though the population also could be below this level in some Areas.

Blue, Humpback and Right Whales

17. Data on sightings of these species by Japanese expeditions were analysed by their scientists and reported in SC/1. The blue whale sighting index which includes pigmy blue whales shows a slight tendency to increase but the other two species show no such tendency.

Sperm Whales

18. The Committee had received during the year data summaries on sperm whales from the Bureau of International Whaling Statistics. During the past year FAO has received no new age length keys; members are urged to supply FAO with new age length keys as they are developed.

Southern Hemisphere

19. The Committee reports that catches in the Southern Hemisphere in the past season have been

Pelagic		N of 40 S	S of 40 S	Total
	1970/71	3146	2745	5891

Coastal		Australia			South Africa			South America			Combined
		♂	♀	Total	♂	♀	Total	♂	♀	Total	Total
	1970	776	23	799	983	841	1824			1512	4135

This represents a slight increase over 1969 in both operations.

20. The Committee reviewed analyses by Ohsumi (SC/3), by Gambell (SC/10) and a general paper on sperm whale biology by Best (SC/13). In general the CPUE data (available for pelagic operations outside the Antarctic baleen season and for coastal operations) show no clear trends. For the stock off Durban, which is assumed to include those sperm whales in pelagic areas in the southern hemisphere from 20°E to 70°E, a model developed by Gambell plus an estimate derived from Japanese sightings were considered. The mean of the estimates of the size of this exploited stock is about 30,000 with a sustainable yield of 1200 from each sex. This compares with a recent level of annual catches of about 2,000 males and 900 females. Although there has been no decrease in CPUE and in sightings and also it is unclear whether there is a surplus of males, it seems wise to prevent any increase in the male catch.

North Pacific

21. In the North Pacific sperm whale catches have been

	♂	♀	Total
1969	11329	3605	14934
1970	11236	3579	14815

The Committee reviewed a population model by Ohsumi and Fukuda (SC/6) amplifying their results of last year. This confirms the conclusion reached last year that the accumulated surplus of males has now probably been removed and the male population stands at about the level giving the maximum sustainable yield of males. The female population level is still above the level giving the combined maximum sustainable yield. The maximum sustainable yields are estimated to be 4800-6700 (males) and 4900-5100 (females).

22. The Committee recommends that catches of males be kept within the sustainable yield noted above; it recognizes the difficulty of establishing appropriate regulations to do this and urges that steps be taken as rapidly as possible to review the possibilities of achieving the objectives by such means as size limits, regional restrictions, quotas or combinations thereof.

North Pacific Baleen Whales

Fin, Sei and Bryde's Whales

23. Catches of fin, sei and Bryde's whales in the North Pacific have been

	Fin whales	Sei whales	Bryde's whales
1969	1276	5158	89
1970	1012	4504	139

24. The Committee reviewed the updated analysis included in SC/5. This indicates that the present available yield of fin whales is about 1100 (range 1020-1150) and is expected to decrease over the next one or two years, since parent stocks have been declining. The present stock level is about 12-13 thousand below the level giving maximum sustainable yield. If catches are reduced below the present available yield, the surplus would help rebuild the stock towards the level of maximum sustainable yield.

25. In regard to sei whales this analysis indicates the present available yield to be 3130-3340. The present population levels are very close to the level giving maximum sustainable yield west of 180°, but probably above this level east of 180°. The Committee wishes to remind the Commission of its statement of last year that "Since the size of the surplus is uncertain and higher levels of catch reduce the surplus more rapidly, the Commission is urged to take steps to ensure that the sei whale stocks are not reduced to the level below that giving maximum sustainable yield. The danger of this can be reduced if the level of catch is reduced from the present level". The Committee believes that this makes necessary a further considerable decrease in the level of sei whale catch in 1972.

26. In regard to Bryde's whales in the western North Pacific, the recent average annual catch of 200 to 300 appears to have been taken from a population of about 5,000 to 18,000, probably above the level giving the maximum sustainable yield, which is now roughly estimated as 300 to 600 (21st Report, Annex J.).

Other Species

27. Japanese sighting data (SC/5) show that blue and humpback whale populations remain at low levels with perhaps a slight tendency for the blue whale stocks to increase. Right whale sightings remain extremely low. This year's estimate of the California gray whale stock (SC/21) is still at about 11,000 as it has been for the past three seasons.

North Atlantic Baleen Whales

28. The Committee reviewed the analyses of northwest Atlantic stocks (SC/14, SC/24) and received an oral report from Dr. Jonsgaard on stocks off Norway. A preliminary review of the northwest Atlantic fin whale stocks suggests that the present Nova Scotian stock is about half the unexploited stock level and the quota for this stock may need to be reduced. The stock fished by the Newfoundland stations may still be above the level giving maximum sustainable yield. There is need for further study of stock and recruitment levels in the northwest Atlantic. Dr. Jonsgaard stated that fin whale stocks off the southwest coast of Norway and off the Faroe Islands are considerably depleted and need further protection.

Minke and Other Small Whales

29. The Committee reviewed data on recent catches of minke whales in the Antarctic, off South Africa and in the North Atlantic and noted the recent expansion of Norwegian whaling in the latter area. The Committee urges members to obtain additional data on their countries' minke whale operations and provide further analysis to the Committee.

30. For the Antarctic minke whales the Committee had an analysis by Ohsumi (SC/4). The present population is estimated to be about 150-200,000. A preliminary estimate of the maximum sustainable yield of this stock is 5000. This figure is subject to revision as data become available if this

stock is exploited and of course it is understood that at this time the stock has a surplus available for catching.

Data Collection and Other Matters

31. The Committee expressed its thanks to the National Institute of Oceanography of the United Kingdom and to Mr. Brown for efforts in distributing marking data. The Committee received information on the increased cost of whale marks and it also expressed a very urgent need for increased marking of sperm whales in the southern hemisphere. It recommends continuation of the coordination of the whale marking programme by N.I.O. and urges the Commission to consider the possibility of an increase in its support of the international marking scheme. If this is not possible, support at the previous level should continue.

32. The Committee notes that FAO is willing to continue to provide age data as age length keys are supplied by members. Appreciation is expressed to Mr. Boerema for this and members are urged to supply him with the necessary keys or data.

33. The Committee accepted a report from the subcommittee on central storage and processing of catch, effort and length statistics on the provision of data summaries by the Bureau of International Whaling Statistics. This report is included as Annex E.

34. The Committee recommends that a special sperm whale stock assessment meeting be held well in advance of the next Commission meeting. If this recommendation is accepted it is suggested that Mr. Gambell be asked to convene the meeting.

SUMMARY AND RECOMMENDATIONS TO THE COMMISSION

A. Antarctic Baleen Whales

1. The Committee was again unsuccessful in reaching a single estimate for the sustainable yield of fin whales in the Antarctic in 1971/72. All Committee members except Japan and USSR believe that the best estimate for 1971/72 is 2200. Japanese scientists believe the best estimate for 1971/72 is 4250.

2. The estimated sustainable yield of sei whales in the Antarctic in 1971/72 is about 5,000. The present total population level may be above the level which gives maximum sustainable yield, though the population could be below this level in some Areas. Particular concern was expressed about Area III stocks.

3. The Committee noted with pleasure that baleen whale catches in the North Pacific have now for two seasons been regulated by means of separate quotas for individual species, and that it has evidently been practicable for the industry to operate under such an arrangement. It, therefore, strongly urges the Commission to replace the Blue Whale Unit by separate species quotas in the Antarctic. It emphasizes that this is the most effective way of holding the catch of each species at levels which will ensure that no further decline in the stocks occurs and that the fin whale stock can be built up to a more productive level.

4. The Committee sees no reason for closing the Sanctuary.

5. In regard to the opening date, the Committee wishes to reiterate its recommendation of the last six years that it would prefer to see no earlier

opening date than the one now in force and sees no reason for recommending any change in the closing date.

6. The Committee recommends no change in the ban on killing blue and humpback whales in the waters south of the Equator.

B. Sperm Whales

7. Further analysis and new population models are needed for sperm whale stocks and it is recommended that a special stock assessment meeting be held early in 1972.

8. An assessment is now available for the area between 20°E and 70°E in the southern hemisphere and the Committee considers it wise to prevent any increase in the male catch in this area.

9. The Committee notes that the estimated maximum sustainable yield of males in the North Pacific Ocean is 4800-6700 and that the male sperm whale stock has now reached a level at which there is little or no furtner surplus. The Committee recommends that catches of males be kept within this sustainable yield; it recognizes the difficulty of establishing appropriate regulations to do this and urges that steps be taken as rapidly as possible to review the possibilities of achieving the objectives by such means as size limits, regional restrictions, quotas or combinations thereof. The female population level is still estimated to be above the level of maximum sustainable yield; the maximum sustainable yield of females is estimated to be 4900-5100.

C. North Pacific Baleen Whales

10. The best estimate of the present sustainable yield of fin whales in the North Pacific (excluding the East China Sea) is about 1100. The present stock level is about 12-13 thousand below the level giving maximum sustainable yield. It is recommended that total catches of fin whales at land stations and in pelagic operations should be held below 1100.

11. The present sustainable yield of sei whales is about 3200. While the present population level may be above that which will give maximum sustainable yield, the Committee suggests that at the present level of catches any such surplus will soon be depleted. The Committee believes that this makes necessary a further considerable decrease in the level of sei whale catch in 1972.

12. The Committee recommends no change in the present ban on killing blue and humpback whales in the North Pacific.

D. North Atlantic Baleen Whales

13. The Committee recommends further study of these stocks so that appropriate regulations may be established.

14. The Committee recommends no change in the ban on killing blue and humpback whales in the North Atlantic.

E. Minke and Other Small Whales

15. Preliminary estimates of the population size and maximum sustainable yield of minke whales in the Antarctic are 150-200,000 and 5,000 respectively and the stock is essentially unexploited.

F. General

16. The Committee recommends continuation of the arrangements with the National Institute of Oceanography whereby it acts as a central agency for whale marking data and recommends that the Commission continues to give financial support to the international marking scheme at least at the previous level.

17. The Committee recommends continuation of the arrangements with the Bureau of International Whaling Statistics to act as a central agency for the catch, effort and length distribution data and recommends that the Commission budget £500 for this work.

18. The Committee requests that the Secretary send a letter of thanks to the participants of the sighting programme by S.C.A.R. and inform them that the programme should now be terminated.

19. The Committee recommends that the Commission request continued cooperation of the whaling companies in reporting sightings of prohibited species in all areas.

ANNEX A

SCIENTIFIC COMMITTEE

Agenda for Meeting beginning 9.30 a.m. Monday 14th June, 1971 at the Department of State, International Conference Suite, Washington, D.C.

1. Research and Information

1.1 Progress reports, including reports relative to special permits.

1.2 Progress of whale marking and whale mark recoveries. Commission's contribution to whale marking.

1.3 Reports of previous season's catches.

1.4 Data analyses and reports of national groups.

1.5 Sighting programme; consideration of forms for sighting data and of the data reports from 1969/70 season. Analysis of sighting data.

2. Status of Stocks and Recommendations to Commission

2.1 Southern Baleen whales. Commission Agenda Item 17 (c), (d), (e).

2.11 Fin whales.

2.12 Sei whales.

2.13 Other species including Blue and Humpback whales.

2.14 Consideration of Blue whale unit.

2.2 Sperm whales. Commission Agenda Items 7, 17 (j).

2.3 North Pacific Baleen whales. Commission Agenda Items 8, 17 (g), (h), (i).

2.31 Fin whales.

2.32 Sei and Bryde's whales.

2.33 Other species including Blue, Humpback and Gray whales.

2.4 North Atlantic stocks.

2.5 Minke whales. Commission Agenda Item 9, 17 (f).

3. Data Collection and Other Matters

3.1 Review of the arrangements for exchange of data and for collection by a central agency; continuation of stock assessment work.

3.2 Data arrangements for Antarctic stocks.

3.3 Data arrangements for North Pacific stocks.

3.4 Data arrangements for sperm whales stock.

3.5 Need for special studies and/or meetings.

4.0 Other Business.

ANNEX B

SCIENTIFIC COMMITTEE DOCUMENTS

SC/1 (ANNEX H)	OHSUMI & MASAKI:	Status of Stocks of Baleen Whales in the Antarctic 1971/72.
SC/2 (ANNEX I)	OHSUMI:	Examination of the Recruitment Rate of the Antarctic Fin Whale Stocks by Use of Mathematical Models.
SC/3	OHSUMI:	Preliminary Estimate of Population Size of the Sperm Whale in the Southern Hemisphere.
SC/4	OHSUMI & MASAKI:	Revised Estimates of Population Size and MSY of the Antarctic Minke Whale.
SC/5 (ANNEX J)	OHSUMI & MASAKI:	Eighth Memorandum on the Results of Japanese Stock Assessment of Whales in the North Pacific.
SC/6 (ANNEX K)	OHSUMI & FUKUDA:	A Population Model and its Application to the Sperm Whale in the North Pacific.
SC/7	DOI:	Further Development of Sighting Theory on Whales.
SC/8 (ANNEX F)	ALLEN:	Further Notes on the Assessment of Antarctic Fin Whale Stocks.
SC/9 (ANNEX G)	CHAPMAN:	Review of 1970/71 Catch and Effort Data together with Further Analysis of Marking Data for Antarctic Baleen Whale Stocks.
SC/10	GAMBELL:	Sperm Whales off Durban.
SC/11	LOCKYER:	A Method of Bleaching Earplugs of the Sei Whale (Balanoptera borealis) in Preparation for the Counting of Growth Layers.
SC/12 (ANNEX N)	BROWN:	Report on SCAR Whale Observations 1967/68 to 1969/70.
SC/13	BEST:	Biology of the Sperm Whale as it Relates to Stock Management.
SC/14 (ANNEX L)	MITCHELL:	Assessments of Northwest Atlantic Fin Whale Stocks.
SC/15	Progress Report -	Australia
SC/16	" "	Canada
SC/17	" "	Japan
SC/18	" "	Norway
SC/19	" "	South Africa
SC/20	" "	United Kingdom

SC/21	Progress Report - U.S.A.	
SC/22	"	" U.S.S.R.
SC/23	GAMBELL:	The Fin and Sei Whale Stocks off Durban.
SC/24 (ANNEX M)	MITCHELL:	Memorandum on Northwest Atlantic Sei Whales.

ANNEX C

WHALE MARKING - PROGRESS REPORT, 1971

S.G. Brown

Whale Research Unit, National Institute of Oceanography

(Revised)

The following information is available on whale marking during 1970 and in the Antarctic season 1970/71 (see Table 1).

A total of 267 whales was marked in the southern hemisphere, including 4 blue, 16 fin, 24 sei, 2 humpback, 5 minke, 7 right and 197 sperm whales. 136 whales were marked in the northern hemisphere, including 1 blue, 25 fin, 27 sei, 8 humpback and 75 sperm whales. Information on the distribution of marking in the different regions is given in the Progress Reports on Whale Research presented to the Scientific Committee.

Information is available on marks recovered from 6 fin, 3 sei and 6 sperm whales in the North Pacific in 1970. Four marks were recovered from fin whales in the North Atlantic in 1970.

Whale marks recovered in the Antarctic whaling season 1970/71

Eleven whale marks found during the Antarctic whaling season 1970/71 have been reported to the N.I.O. (see Table 2). No pre-war marks were recovered and no marks from sei whales in the international scheme series. There are three marks from one fin and two sei whales in the U.S.S.R. series.

Of the seven marks from fin whales, the oldest is in the 14 year-group. Two in the 0-group were recovered only five days after being fired. The most interesting recovery is of Nos. 16335 and 18288, both fired into the same fin whale off Durban in August 1969 and recovered eighteen months later when the whale was killed on 25th February 1971 in position 43°32'S, 53°16'E. These marks are the first to demonstrate the migration of fin whales southwards from South African waters, though there are several returns showing the reverse migration northward from the Antarctic into these warmer waters. This whale was one of only five fin whales marked in South African waters in post-war

years and the recovery confirms the view that the marking of even very small numbers of fin whales in these waters may yield important returns.

Mark No. 16327, recovered seven years after firing, is the first return from a sperm whale in the international scheme series to show movement from one Antarctic whaling Area (IV) into another (III).

TABLE 1

WHALES MARKED DURING 1970 AND IN ANTARCTIC SEASON 1970/71

	Blue	Fin	Sei	Humpback	Minke	Right	Sperm	Bottle-Nosed	Killer	Pilot	Total
SOUTHERN HEMISPHERE											
Antarctic 1970/71 (International scheme - Japan)	4	12	19	2	-	3	65	-	-	-	105
Antarctic 1970/71 (U.S.S.R.)	-	4	1	-	-	4	8	1	1	10	29
North of 40°S (U.S.S.R.)	-	-	4	-	4	-	35	-	-	-	43
Australia 1970	-	-	-	-	-	-	12	-	-	-	12
South Africa 1971	-	-	-	-	1	-	77	-	-	-	78
TOTAL	4	16	24	2	5	7	197	1	1	10	267
NORTHERN HEMISPHERE											
North Atlantic											
Canada 1971 (March)	-	7	2	-	-	-	10	-	-	-	19
Norway 1971 (May)	-	2	-	-	-	-	1	-	-	-	3
North Pacific											
Japan 1970	1	16	21	8	-	-	57	-	-	-	103
U.S.S.R.	-	-	4	-	-	-	7	-	-	-	11
TOTAL	1	25	27	8	-	-	75	-	-	-	136

TABLE 2

MARKS RECOVERED IN THE ANTARCTIC SEASON 1970/71

Mark no.	Date marked	Date recovered	Years	Position marked	Position recovered	Sex	Length in feet
			Fin whales				
17570	22.xii.56	12.ii.71	14	64°19'S,176°23'E	67°55'S,160°34'E	Female	72
24450	25.ii.61	15.ii/8.iii.71 (from boiler)	10	46°50'S, 35°50'E	45°25'S, 45°38'E (approx.)	-	-
25697	26.xi.62	30.i.71	8	57°37'S, 54°09'E	54°02'S, 82°52'E	Female	69
16335 }	29.viii.69	25.ii.71	1½	30°39'S, 33°06'E	43°32'S, 53°16'E	Male	57
18288 }		25.ii.71 (from refrigerator vessel)			44°01'S, 55°17'E (approx.)		
28481	9.ii.71	13.ii.71	0	46°30'S, 40°27'E	46°37'S, 40°25'E	Female	66
28483	9.ii.71	13.ii.71	0	46°46'S, 40°03'E	47°00'S, 41°40'E	Male	64
			Sperm Whales				
16327	18.xi.63	9.i.71	7	40°53'S, 87°40'E	44°50'S, 58°52'E	Male	35
			U.S.S.R. Series				
611092 (Fin)		14.i.71 (from refrigerator vessel)			41°30'S, 77°13'E (approx.)	-	-
610499 (Sei)		26.xii.70			41°37'S, 95°55'E	Male	50
650362 (Sei)		10.i.71			42°37'S,100°37'E	Male	49

ANNEX D

INTERNATIONAL WHALING COMMISSION

FORM TO REPORT SIGHTINGS OF PROHIBITED SPECIES

Fleet/Land Station- Year-

MONTH	AREA[1]	NUMBER SEEN				EFFORT[3]
		Blue	Hump-back	Right	Other[2]	

1/ To be filled in for each area monthly for as many months as operations were carried out.

2/ Gray, bowhead (or Greenland Right), Pigmy Right

3/ For example, number of catches X number of days worked.

ANNEX E

REPORT OF THE SUBCOMMITTEE ON CENTRAL STORAGE AND PROCESSING OF CATCH/EFFORT AND LENGTH STATISTICS

The Scientific Committee reviewed the information made available to the scientists by the Bureau of International Whaling Statistics, and wishes to express its appreciation for the excellent way in which the data have been provided.

It noted that the data summaries of effort for sperm whales in the Antarctic outside the baleen whale season, and the summaries for sperm whales outside the Antarctic, have been prepared manually and that the basic data are not available on cards. The available summaries are sufficiently detailed for most purposes, and computer processing is, therefore, not considered to be necessary at this stage.

The Committee requests annual updating of the data presently provided. (Antarctic baleen whale data and world-wide sperm whale data). In addition, the Committee requests the detailed tables of the Antarctic catch and effort species, sex, month, 10° square and country which are available for the year 1964/65 till the present for baleen whales be extended backwards as far as possible. Further it requests tables of the Antarctic catch during the baleen whale season of sperm whales by sex, month, 10° square and country for the present season and as far back as possible.

The Committee also requests the BIWS to prepare tables showing time series of the catches of fin, sei and sperm whales by sex and statistical Area in the Antarctic and distribute those to the members receiving special material.

For these purposes, it recommends that the Commission continue to provide the BIWS with the necessary funds to carry out this work. For this work, it suggests a sum of £500 in 1971/72 and similar sums in future years until the work is completed.

The Committee noted that Table r in the odd numbered volumes of the International Whaling Statistics, referring to the USSR catches in the North Pacific, bears the heading Kamtchatka. The catches are made by pelagic operations in the North Pacific, and it is, therefore, recommended that the heading is changed to North Pacific and Bering Sea (USSR). The word (Japan) should be added to the heading of Table q. Similar changes should be made in Tables g and h.

ANNEX F

FURTHER NOTES ON THE ASSESSMENT OF ANTARCTIC FIN WHALE STOCKS

by

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1. CHANGES IN SEX RATIO AND DIFFERENCES IN MORTALITY RATE BETWEEN SEXES

During the history of Antarctic whaling there has been a fairly steady reduction in the proportion of males in the catches from about 55% to about 45%. In a paper presented to the 1970 Annual Meeting of the Scientific Committee the author examined the possibility that this change could be accounted for by a difference in the natural mortality rates of the two sexes. He showed that this would require a combination of a value of M for males of 0.035 with a value for females of 0.02. The Special Meeting on the Assessment of Antarctic Fin Whale Stocks in Honolulu in 1970 had noted that 0.035 was the most likely value for M for males but it found evidence that the value for females was higher than this. There was thus a discrepancy between these results. This analysis, however, made no allowance for the fact that the fishing mortality rate for females is reduced by the protection of females accompanied by calves. Shimadzu had estimated the proportion of females protected in this way as 0.2.

The model has now been revised to include this effect and it has been found that a combination of values of M of 0.035 for males and 0.045 for females with a protection factor for females of 0.2 will account very largely for the observed changes in the sex ratio of the catches. This is shown in Figure 1 for each of Areas II-VI and for the Antarctic as a whole for the period up to 1963. In the Figure the dots represent the observed sex ratios and the continuous lines the expected values. It will be seen that a very satisfactory fit is obtained for almost all Areas.

It appears that a differential natural mortality rate between sexes which is based on independent evidence, together with the observed rate of protection of females with calves, will account effectively for a very large degree of the actual changes which have occurred in the sex ratio in the catches.

2. ESTIMATED POPULATIONS BY AREAS

The least squares method has also been applied to estimate the populations independently for each of the Areas II-VI and for the Antarctic as a whole. The estimates have been based on catch and effort data for the period 1954 to 1963 when results were least affected by the taking of other species, and the natural mortality rates, and female protection rate referred to above, have been used. The recruitment rates have been calculated from the age distributions for each area separately using data up to 1966 supplied by Dr Ohsumi, and using the length distribution of the catches and the area age-length keys supplied by Dr Ohsumi for more recent years. The results are summarized in Table 1. Estimates were not made for Area I due to the limited amount of catching done in this area. The agreement between the total for the individual areas and the combined total is generally quite good. It appears from these results that approximately half of the entire population is in Area III at the present time.

3. FACTORS AFFECTING THE CATCHABILITY COEFFICIENT (q)

The analysis also provides estimates for each Area of the value of q, and these are shown in Table 2. It will be seen that although the estimate for the Antarctic as a whole is, as would be expected, much lower than that for any of the individual statistical area there are also quite large differences between the Areas themselves. Since q is the instantaneous rate of catching by a unit of effort, it may be standardized to permit comparison between different statistical area by multiplying it by the size of the surface area in each case. This has been done in Table 2. The surface areas of the statistical areas have been calculated approximately, making allowance for any land masses or permanent ice in them. The Table shows that even when this has been done, substantial differences in the value of qA remain. The standardized values may now be compared with measures of the size or density of the whale populations in the statistical areas. Table 2 therefore shows the estimated populations for 1959 (the mid-point of the period of estimation) reduced to a standard area. To avoid any circular effects since the population estimates have been obtained by the same analysis as that obtaining the values of q, the Table also shows the total catches from each statistical area from 1932 onwards, both in total and standardized to whales per 107 square miles. It is apparent that there is a strong negative relationship between the population density, whichever measure is used, and the value of qA. The reciprocal of qA has therefore been plotted in Figure 2 against both the 1959 population densities and the total catch densities. In each case a strong negative linear correlation is apparent.

It is unlikely that a relationship of this kind has applied within each statistical area during the time it has been exploited, because it would imply that the catch per unit effort remained constant as the population declined and this has manifestly not taken place. It seems more likely that this effect is caused by the whale populations being about the same density originally in the occupied parts of each of the statistical areas, but only occupying parts of the areas. The relatively constant catches per unit effort in all Areas in 1959, as shown in the Table, support this hypothesis.

4. RECRUITMENT RATE

Introduction of the female protection rate of 0.2 and the values of M referred to above, has made minor changes in the estimated recruitment rates when calculated with reference to the size of the parent populations. Also, recruitment rates have now been estimated for Areas II-VI individually. Some of the results are summarized in Figure 3. This shows the recruitment rate expressed as the number of recruits per 100 females 7 years and older in the parent population. The points represent this rate for each of the post-war years for which recruitment is complete, plotted against the size of the parent exploited population. It will be seen that, as in previous analyses of this kind which were limited to the Antarctic as a whole, the results in some cases show a declining tendency in the recruitment rate as the stock has diminished. Thus, although there appears to be evidence, both of an increase in the pregnancy rate and of an advance in the age of maturity, direct measurement of the recruitment rate so far presents no evidence of any compensatory rise accompanying the decline in the population.

5. SUSTAINABLE YIELD

As has been reported earlier, the annual gross recruitment rate, calculated from the age compositions, appears to be about 0.05 or 0.06 of the exploited parent stock. If the natural mortality rate is 0.04 this leads to a net recruitment rate of 0.01 or 0.02. Determination by difference in this way

leads to the proportionally much larger possible errors in the net rate than in the gross rate. It is therefore worthwhile to examine the problem further particularly as it affects the present sustainable yield.

Table 3 shows the estimated potential increase (equal to the sustainable yield) for each of the last five years calculated by calculating the number of recruits from the estimated proportion in the population and subtracting the natural mortality at 4% of the population. This is then compared with the parent population assuming mean recruitment at either 4 or 5 years. The mean sustainable yield over these 5 years is thus estimated at 2700. This, however, is derived from a parent population of either 100,000 or 86,000 whales compared with the 1966-70 level which was fairly stable for the 5 year period at about 64,000, or with the current level of about 67,000. If, over this relatively short range, from 23-26% down to 18% of the original population, the number of recruits varies linearly with size of the parent stock, then the continuing sustainable yield at the present stock size is given, for 5 year recruitment by $\frac{5,285 \times 67,000}{100,000} - 2,680 = 861$. The corresponding figure for 4 year recruitment is 1,437. The mean of these values probably provides the best estimate of present sustainable yield by this method, and gives a value of 1,150.

An alternative approach is to apply the method of Schaefer and estimate potential increases as the sum of catch and population change, using the estimated population to provide the latter parameter. The results are shown in Table 4 and Figure 4. To avoid minor fluctuations caused by changes in intensity of whaling the data have been averaged over 5 year periods. The figure shows that the net recruitment rate remains very constant over a large part of the population range and declines rapidly for populations about 300,000-350,000. This is therefore the MSY stock level, and corresponds to an MSY of about 10,000-12,000. Below this level the net recruitment rate, averaged over the estimates based on 4 year and 5 year recruitment, is about .033.

The continuing sustainable yield at present stock level is therefore about .033 x 66,000 = 2,000, with a small additional quantity still entering from the larger stocks of 5-10 years ago. Combining these two approaches the continuing sustainable yield is estimated to be in the range 1,150-2,000, with a median value of about 1,600.

Table 1. Estimated exploited populations of fin whales in Areas II to VI and in the Antarctic as a whole during the post-war period (in thousands).

	II	III	IV	V	VI	Total II-VI	Combined
1947	98.9	106.6	35.3	23.0	-	263.8 +	351.9
1950	85.7	102.6	29.0	18.7	28.4	264.4	313.7
1955	62.0	93.4	22.4	14.2	20.6	212.6	253.7
1960	38.5	66.6	16.7	12.1	9.6	143.5	159.4
1965	14.4	33.2	8.2	3.7	4.9	69.4	72.8
1970	16.4	34.5	7.7	2.9	9.6	71.1	66.4
1971	18.6	34.9	7.2	2.8	10.0	73.5	67.8

Table 2. Comparison of the estimated values of q with whale stock density and with the size of the surface area for Areas II to VI and for the Antarctic as a whole.

	Area						
	I	II	III	VI	V	VI	Total
Area ($x10^7$ sq m) (A)	1.47	1.69	1.77	1.40	1.50	1.41	9.25
$q(x10^{-4})$	-	.596	.415	1.70	2.35	2.00	.158
$qA(x10^4)$	-	.101	.073	.238	.352	.282	.146
$1/qA(x10^{-4})$	-	9.93	13.60	4.20	2.84	3.55	6.85
Total pelagic catch 1932-71 (x1000)	17.1	150.6	195.6	80.4	37.2	30.5	511.4
Total catch per 10^7 sq m	11.6	89.1	110.5	57.4	24.8	21.6	55.3
1959 pop per 10^7 sq m	-	23.5	41.1	16.0	9.4	8.2	19.4
1959 catch/CDW	-	2.57	2.87	2.63	2.30	2.33	2.63

Table 3. Estimation of annual potential increase over the period 1966 to 1970.

	No of Recruits	Population	Natural Mortality (4%)	Potential Increase	Population 5 years Earlier	Population 4 years Earlier
1966	5120	66840	2674	2446	135827	115859
1967	3200	64510	2580	620	115859	94811
1968	3417	63047	2522	895	94811	79440
1969	3119	60684	2427	692	79440	72782
1970	11569	66949	2678	8891	72782	66840
Mean	5285	64046	2576	2709	99744	85946

Table 4. Calculation of Mean Net Recruitment Rate by the Schaefer Method for 5 year periods.

5 years Ending	Total Catch	Population Change	Total Net Recruitment	Annual Mean Net Recruitment	Stock 5 years Earlier	Net Recruitment Rate	Stock 4 years Earlier	Net Recruitment Rate
1935	30015	+5911	35926(4 yrs)	8981	c.380000	.0236	c.380000	.0236
1940	95767	-53168	42599	8520	375857	.0227	377766	.0226
1945	13847	+24750	38597	7719	365149	.0211	354785	.0218
1950	87105	-25228	61877	12375	341711	.0362	346661	.0357
1955	124916	-74315	50601	10120	336494	.0301	326498	.0310
1960	141804	-96863	44941	8958	276518	.0325	261655	.0344
1965	100029	-68987	31042	6208	194223	.0320	174850	.0355
1970	13096	+957	14053	2811	99743	.0282	85946	.0327

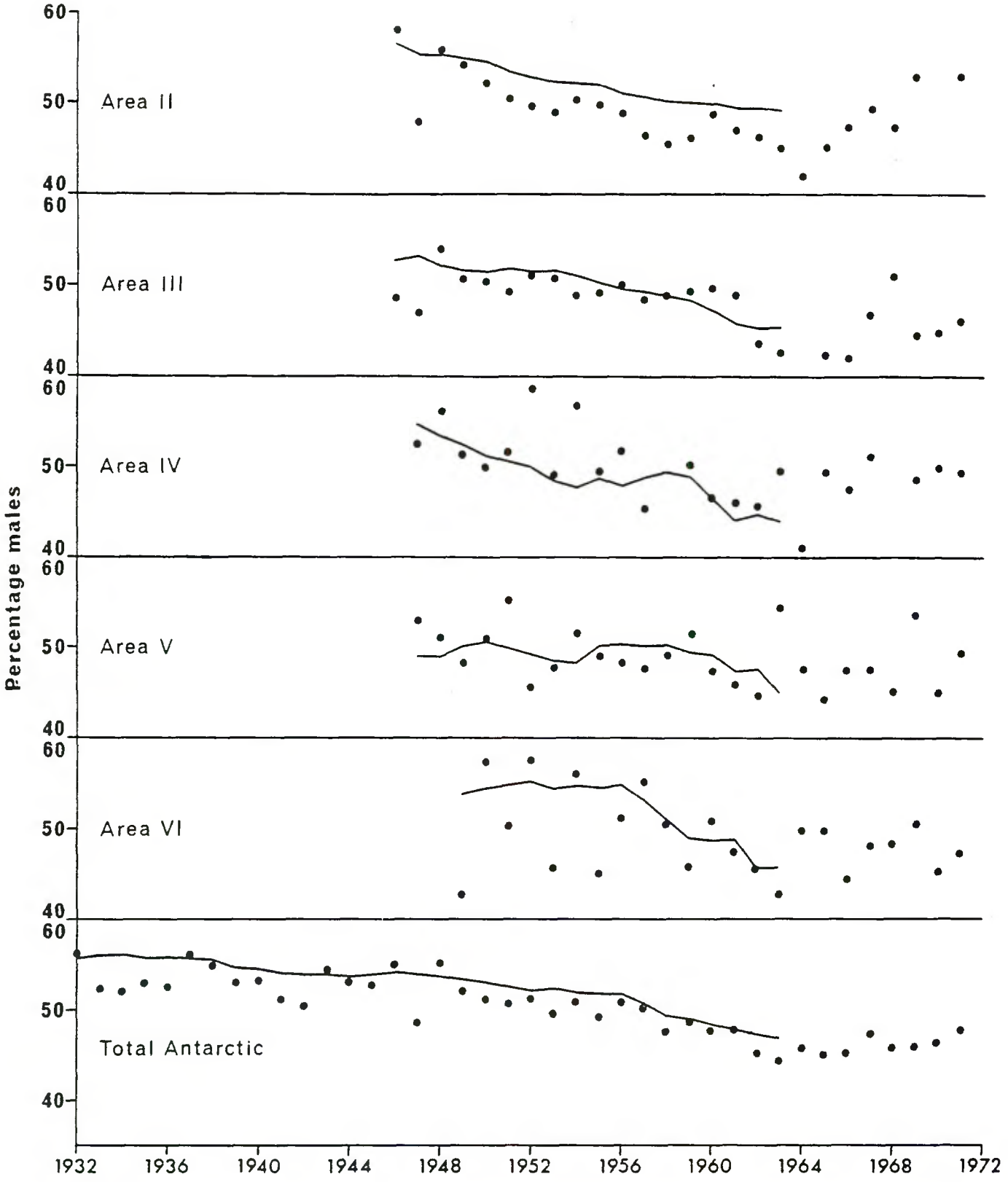
Percentage males
60
50
40
Area II
Area III
Area IV
Area V
Area VI
Total Antarctic
1932
1936
1940
1944
1948
1952
1956
1960
1964
1968
1972

Figure 1

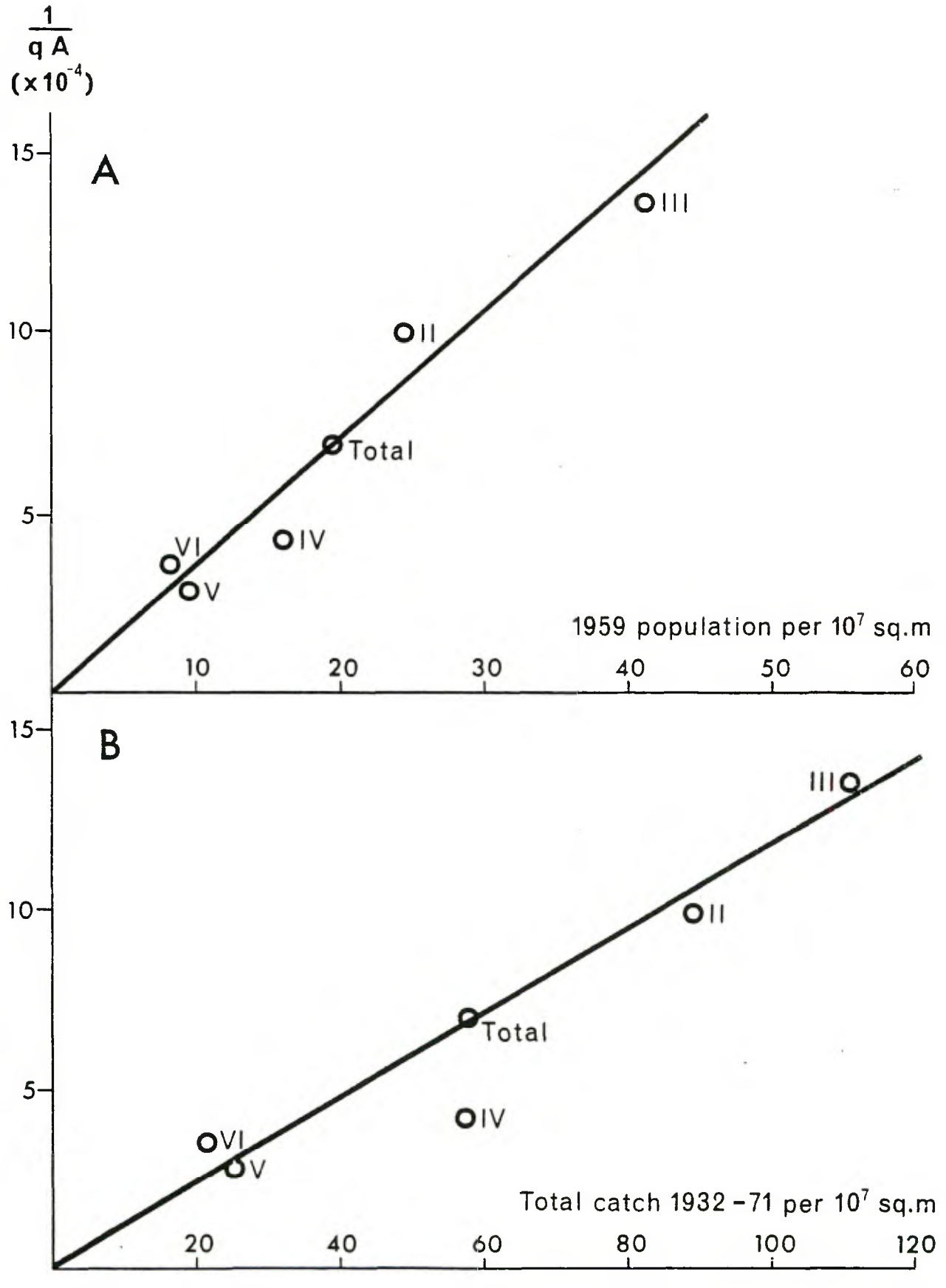
1/qA (x10⁻⁴)
A
15
10
5
III
II
Total
IV
VI
V
1959 population per 10⁷ sq.m
10
20
30
40
50
60
B
15
10
5
III
II
Total
IV
VI
V
Total catch 1932-71 per 10⁷ sq.m
20
40
60
80
100
120

Figure 2

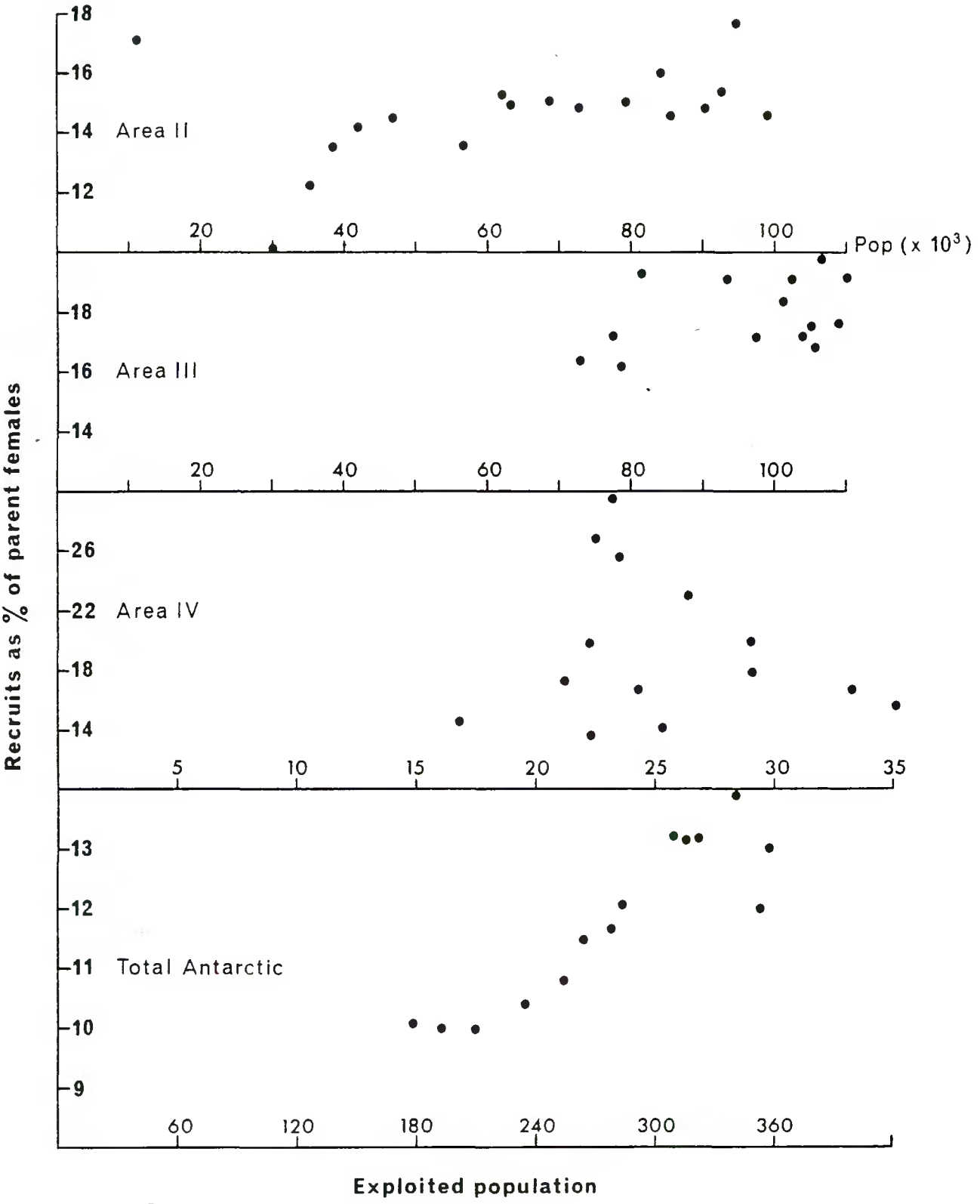
Area II
Area III
Area IV
Total Antarctic
Pop (x 10³)
Recruits as % of parent females
Exploited population

Figure 3

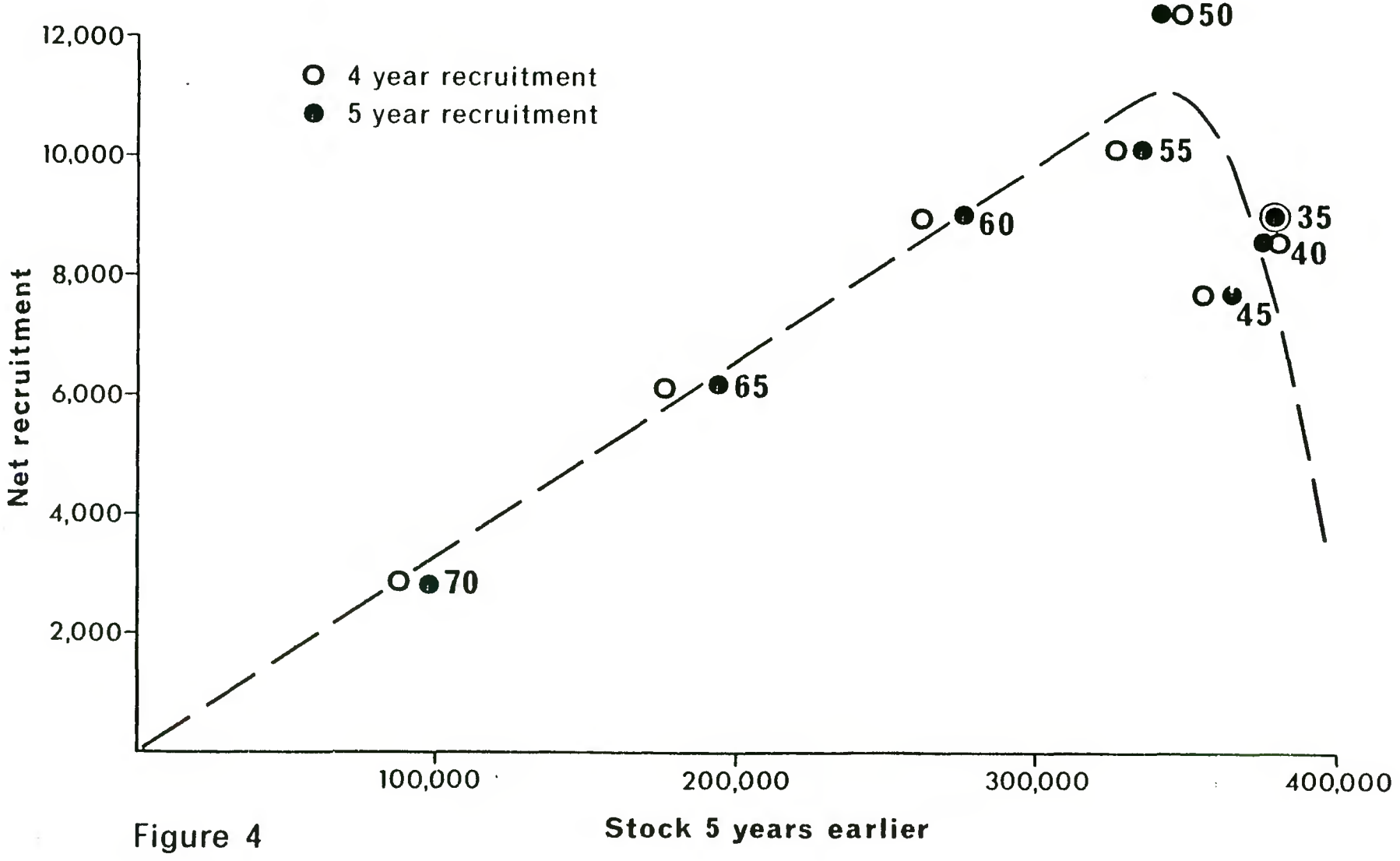
12,000
10,000
8,000
6,000
4,000
2,000
Net recruitment
4 year recruitment
5 year recruitment
50
55
60
35
40
45
65
70
100,000
200,000
300,000
400,000
Stock 5 years earlier

Figure 4

ANNEX G

Review of 1970/71 Catch and Effort Data Together with Further Analysis of Marking Data for Antarctic Baleen Whale Stocks

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The following review consists of two parts. The first part consists of a series of tables (1 to 5) updating those made last year and shown in IWC, 21, Annex I and essentially continuing the FAO tables. The second part is an analysis of recent mark-recovery data. No attempt is made to analyze catch and effort data to determine the effects of exploitation upon the stocks. Catches of both fin and sei whale stocks have been close to the estimated sustainable level. Hence little change in CPUE is expected unless previous estimates have been grossly in error. No such changes are observed so that CPUE analysis gives some confirmation to previous sustainable yield estimates. Marking analysis suggests that if estimates are in error, they are too high rather than too low. This suggests that care should be taken in setting quotas.

Table 1 - Catches and effort by the Antarctic pelagic expeditions

Season	Catcher Days	Average Catcher Tonnage	Catches			Catch/Uncorrected Catcher Day		
			Fin	Sei	BWU	Fin	Sei	BWU
1959/60	21,269	633	26,415	3,234	13,746	1.24	0.15	0.64
1960/61	23,998	642	27,374	4,310	14,405	1.14	0.18	0.60
1961/62	29,952	657	26,338	4,749	13,968	0.88	0.16	0.47
1962/63	22,504	703	18,668	5,503	10,232	0.83	0.24	0.45
1963/64	20,407	709	13,870	8,286	8,448	0.68	0.40	0.41
1964/65	17,475	715	7,308	19,874	6,980	0.42	1.13	0.40
1965/66	13,122	743	2,318	17,583	4,083	0.18	1.34	0.31
1966/67	11,760	754	2,873	12,368	3,500	0.24	1.05	0.30
1967/68	9,785	769	2,155	10,357	2,801	0.22	1.06	0.29
1968/69	8,327	787	3,020	5,776	2,469	0.36	0.69	0.30
1969/70	7,920	805	3,002	5,857	2,469	0.38	0.74	0.31
1970/71	8,003	-	2,888	6,151	2,469	0.36	0.77	0.31

Table 2 - Percentage distribution of catcher days in each season by area

Season	Sub-Area IIW	Sub-Area IIE	Area III 0-70°E	Area IV 70-130°E	Area V 130°E-170°W	Area VI 170-120°W	Area I 120-60°W	All Areas
1962/63	13.1	14.0	41.7	12.4	5.6	2.7	10.5	100
1963/64	12.4	28.8	32.5	9.6	16.2	-	0.5	100
1964/65	41.7	18.0	9.8	13.0	17.0	-	0.5	100
1965/66	28.2	21.2	19.0	4.7	19.2	7.4	0.2	100
1966/67	4.1	5.7	43.8	19.4	15.6	11.6	-	100
1967/68	-	5.8	28.1	23.1	27.0	16.0	-	100
1968/69	0.4	3.1	30.6	27.6	23.5	14.8	-	100
1969/70	6.7	3.4	43.0	28.4	15.1	3.4	-	100
1970/71	14.7	2.0	36.4	34.6	8.7	3.6	-	100

Table 3 - Percentage distribution of catcher days by series

Series / Season	D 40-50°S	A 50-60°S	B 60-70°S	C 70-80°S	All Series
1962/63	22.3	45.3	32.3	0.1	100
1963/64	22.7	62.4	14.9	-	100
1964/65	38.3	52.2	9.5	-	100
1965/66	54.7	19.9	25.4	-	100
1966/67	44.4	15.0	39.1	1.5	100
1967/68	36.7	31.6	31.7	-	100
1968/69	47.4	28.1	24.5	-	100
1969/70	66.4	13.6	20.0	-	100
1970/71	73.2	18.5	8.3	-	100

Table 4 - Effort, Catch by Species and CPUE by Area, Zone and Month 1970/71

Area I None

Area II	Dec.	Jan.	Feb.	Mar.	April	Total
D	36-1-0 0.03;0.00	372-1-491 0.00;1.32	48-0-61 0.00;1.27	48-3-16 0.06;0.33	36-2-13 0.06;0.36	540-7-581 0.01;1.08
A	180-64-2 0.35;0.01	- -	252-103-24 0.41;0.10	324-133-33 0.41;0.10	- -	756-300-59 0.40;0.08
B	- -	- -	36-0-0 0.00;0.00	- -	- -	36-0-0 0.00;0.00

Area III	Dec.	Jan.	Feb.	Mar.	April	Total
D	340-63-277 0.19;0.81	592-274-101 0.46;0.17	1380-1106-485 0.80;0.35	579-241-201 0.42;0.35	- -	2891-1684-106 0.58;0.37
A	- -	- -	- -	24-26-1 1.08;0.04	- -	24-26-1 1.08;0.04
B	None					

Area IV	Dec.	Jan.	Feb.	Mar.	April	Total
D	859-13-2481 0.02;2.89	1001-233-1330 0.23;1.33	36-28-14 0.78;0.39	51-2-16 0.04;0.31	- -	1947-276-3841 0.14;1.98
A	- -	455-314-21 0.69;0.05	215-46-88 0.21;0.41	- -	- -	670-360-109 0.54;0.16
B	- -	136-18-15 0.13;0.11	17-3-2 0.18;0.12	- -	- -	153-21-17 0.14;0.11

Area V	Dec.	Jan.	Feb.	Mar.	April	Total
D	- -	- -	- -	357-37-133 0.10;0.37	119-4-25 0.03;0.21	476-41-158 0.09;0.33
A	- -	- -	- -	17-0-0 0.00;0.00	- -	17-0-0 0.00;0.00
B	- -	- -	204-74-127 0.36;0.62	- -	- -	204-74-127 0.36;0.62

Area VI	Dec.	Jan.	Feb.	Mar.	April	Total
D	None					
A	- -	- -	- -	17-0-17 0.00;1.00	- -	17-0-17 0.00;1.00
B	- -	- -	136-52-74 0.38;0.54	136-47-103 0.35;0.76	- -	272-99-177 0.36;0.65

The five figures for each month, zone, Area are
CDW (Uncorrected) - Catch of fin whales - Catch of sei whales
CPUE (fin); CPUE (sei)

Table 5 - Catches of Sei whales by Area 1959/60-1970/71

Season	I	II	III	IV	V	VI	Total
1959/60	159	1,498	230	526	1,649	232	4,294
1960/61	102	1,938	336	103	563	2,030	5,072
1961/62	1,629	1,696	427	633	409	369	5,163
1962/63	807	1,812	1,457	631	430	345	5,482
1963/64	28	4,459	1,984	274	1,820	-	8,565
1964/65	40	16,076	443	1,564	2,207	-	20,330
1965/66	32	12,722	2,724	436	1,014	599	17,527
1966/67	-	1,540	6,865	2,826	717	402	12,350
1967/68	-	195	2,352	2,271	3,327	2,207	10,352
1968/69	73	188	1,771	1,030	2,156	552	5,770
1969/70	-	1,278	1,997	1,925	474	156	5,830
1970/71	-	640	1,065	3,967	285	194	6,151
Total	2,870	44,042	21,651	15,186	15,051	7,086	106,886

Analysis Based Upon Mark-Recaptures for Fin Whales

Tables 6A and 6B below show the number of whales marked and recaptures from these marks by season of recapture for Areas III and IV since 1954/55. This information is taken from the I.W.C., Form G, compiled by the N.I.O.

Table 6A. Area III fin whale marks and recaptures by season.

Season	No. Marked	0	1	2	3	4	5	6	7	8	9	10	11	12
1954/55	197	5	1	5	4	1	4	7	7	7	0	3		
1955/56	105	3	1	3	1	6	5	1	2	3	0	1		
1956/57	2													
1957/58	51	2	5	1	1	1	0	1						1
1958/59	35	5	3	2	1									
1959/60	3													
1960/61	88	10	11	2										
1961/62	117	15	6	0	0	0	2	2						
1962/63	90	9	1	4	1	0	2	3	1					
1963/64	39	2	2	1										
1966/67	6													
1967/68	1													
1968/69	21	2	1											
1969/70	27													

Table 6B. Area IV fin whale marks and recaptures by season

Season	No. Marked	0	1	2	3	4	5	6	7	8	9	10	11
1955/56	14		1	1									
1956/57	2				1								
1957/58	8	1											
1958/59	15		1										1
1959/60	62	12	1	2	1						1		
1960/61	46	3	1										
1961/62	5												
1966/67	17		1	1									
1967/68	14												
1968/69	16	3	2										
1969/70	7	1											

Only these two Areas are shown since essentially no marking was carried out in recent years in other Areas. Before analyzing this rather scant data, it is necessary to make some adjustment for unreported tags. Three possible assumptions are considered. These are:

(a) no unreported tags.

(b) the estimate of efficiency of recovery used in SM 70/F/4, comparison of prewar and postwar mark recoveries (data originally given in I.W.C. 17, pp. 34-39), may be used. This estimate for the efficiency of recovery is 59.2 per cent.

(c) an estimate of efficiency of recovery may be made from the 1959/60 - 1963/64 series since for these years we have good estimates of the population sizes and a reasonable number of marks were placed. The basic data are shown in Table 7.

Table 7. Estimation of efficiency of mark-recovery.

Season	Area	Estimated Population Size[1]	Expected Mark Recoveries (zero year)	Actual Mark Recoveries (zero year)
1960/61	III	46.4	25.3	10
1961/62	III	37.4	36.9	15
1962/63	III	30.0	27.0	9
1963/64	III	25.4	7.3	2
1959/60	IV	18.0	22.4	12
1960/61	IV	18.0	5.4	3
TOTAL			124.3	51

[1]From I.W.C. 21, Annex I, Tables 6 and 7, pp. 70-71.

Estimated efficiency of recovery of zero year marks = 51/124.3 = 0.41.

To obtain an estimate of population size in 1966/67 to 1969/70, we combine the four seasons as follows:

Let C_i = catch in season i, M_i = number marked in season i, R_i = recaptures adjusted.

Then estimated population size = $\frac{\sum C_i M_i}{\sum R_i}$

For season zero recaptures $\sum C_i M_i$ = 63,546 for Area III.

The adjusted recaptures are (a) 2

(b) 3.4

(c) 4.9

The corresponding estimates of the population for this period are 31,773, 18,690 and 12,969. Note that the most reasonable estimate, the median estimate is below the extrapolated estimate from 1961/62, assuming a median level of recruitment (about 29,000 - cf. I.W.C. 21, p. 71). While the sampling error with such few recoveries is extremely large, there is no evidence to support the hypothesis that recruitment is increasing and that populations and sustainable yields are going up. For Area IV the same analysis yields estimated populations for the 1966/67 - 1969/70 period as 12,572 (no adjustment), 7,439 (median adjustment as in (b) above) and 5,153 (adjustment of mark-recaptures as developed in (c)). All of these estimates are below the median extrapolated estimate which is approximately 14,000 for Area IV.

ANNEX H

STATUS OF STOCKS OF BALEEN WHALES IN THE ANTARCTIC, 1971/72

Seiji Ohsumi and Yasuaki Masaki
(Far Seas Fisheries Research Laboratory)

Following a similar method to that shown in Document No. IWC/SC/22/24 the states of stocks of fin and sei whales in 1971/72 are evaluated.

Doi (1971) has developed a refined theory on whale sighting and the new procedures have now been applied to estimate the abundances by use of sighting data.

1. Fin Whale

1-1. Change in CPUE

Yearly changes in catch and CPUE of fin whales caught in the Antarctic from 1961/62 to 1970/71 seasons are shown in Table 1.

Apparent CPUE of fin whales in 1970/71 season decreased by about 5% compared to the previous season, although the abundance has been gradually increasing since 1965/66. Apparent CPUE of sei whales in 1970/71 season, on the other hand, increased by about 5.5% compared to the 1969/70 season, as shown in Table 4, against our inference that the abundance of Antarctic sei whales has been decreasing. Such apparent discrepancies are due to unavoidable but expedient use of the overall effort instead of the possibly real effort for fin, sei and sperm whales respectively.

1-2. Change in abundance by means of whale sighting

Whale sighting data on board scouting boats, accompanied by Japanese expeditions, have been collected since the 1965/66 Antarctic season. (Table 2)

Following the procedures developed by Doi (1971), abundance of fin whales in waters south of 40°S in the summer was estimated by sectors. Table 2 shows yearly change in the abundance. Sighting did not cover the entire Antarctic, and there are many fluctuations observed within and among areas. As a whole, no tendency to decrease has been observed in these years, and it is estimated to be 60-100 thousand even in the covered areas alone. This figure is close to the present population size of the Antarctic fin whale as estimated below.

1-3. Calculation of population size and ASY

Population size and ASY in 1971/72 season are calculated in the same manner as in the previous report. (Table 3)

Population is steadily recovering, but it is still below the level giving MSY. Actual sustainable yield (ASY) in the 1971/72 season is estimated as 3,960 - 4,650.

In the light of recent findings on the population parameters, the recruitment rate of the Antarctic fin whale has been examined by one of the authors, and it is found that K-value of Doi *et al* (1969) needs some modification. Revised estimates (probably slightly different from the above) will be available in the near future.

2. Sei Whale

2-1. Change in CPUE

Table 4 shows yearly change of catch and CPUE of the sei whale in the Antarctic since the 1961/62 season.

CPUE in the 1970/71 season increased by about 5.5% compared to the previous season, in conformity with increase of catch.

2-2. Estimation of abundance by means of whale sighting

Whale sighting data since 1965/66 and Doi's new procedures (1971) were used to calculate the abundance of sei whales in waters south of 30°S . The average abundance by sectors during the 1965/66 - 1970/71 seasons are shown in Table 5.

At first glance, the abundance of sei whales may appear to be too large. But Doi and Ohsumi (1970) have already estimated that there should be a large adult population (S) which supports the exploitable population (N) of the Antarctic sei whale. If the initial level of the exploited population was 150 thousand the adult population that supported it could have been 240 thousand, plus the immature animals.

There is segregation by age in the distribution of the sei whale and young whales are often distributed in waters of lower latitudes. Table 5 indicates that there are many sei whales distributed in waters north of 40°S even in summer.

Table 6 shows the yearly change in abundance in waters south of 40°S. Large fluctuations are observed among sectors. But, as a whole, it is clearly recognized, that the sei whale has been decreasing in abundance.

2-3. Calculation of population size and ASY

Table 7 shows an estimated exploitable population size and ASY, calculated in the same manner as in the previous report for the 1971/72 season.

Population decrease was only about 900, and the present population level is still above the level giving MSY.

3. Prohibited Whales

Present information on the status of stocks of prohibited whales are given only by means of whale sightings. The following results were obtained in the same way as above.

3-1. Blue Whale

About 15,000 blue whales, including pigmy blue whales, are estimated to be distributed in waters south of 30°S in summer. They are most abundant in sector IIID, most of which are assumed to be pigmy blue whales. (Tables 8 and 9).

3-2. Humpback Whale

The abundance of the humpback whale is the lowest of all the large sized whale species. About 3,300 humpbacks are distributed in waters south of 30°S in summer. No sign of increase has yet been recognized for this species. (Tables 10 and 11)

3-3. Right Whale

About 4,100 right whales are considered to be distributed in waters south of 30°S in summer. The abundance in the lower latitudes is more than that in higher latitudes. (Tables 12 and 13)

Table 1. Catch and CPUE of fin whales

		Catch							CPUE						
Season	CDW	II	III	IV	V	VI	I	Total	II	III	IV	V	VI	I	Total
1961/62	29952	6650	11847	3129	1098	1120	2520	26364	0.80	1.04	0.99	0.62	0.59	0.74	0.88
1962/63	22504	5570	8977	1725	645	346	1373	18636	0.91	0.96	0.62	0.51	0.56	0.58	0.83
1963/64	20407	7319	4753	603	1144	-	34	13853	0.87	0.72	0.31	0.35	-	0.36	0.68
1964/65	17475	4528	1199	766	747	-	66	7306	0.44	0.67	0.34	0.25	-	0.89	0.42
1965/66	13122	636	1008	64	385	204	17	2314	0.10	0.41	0.10	0.15	0.22	0.38	0.18
1966/67	11760	81	1554	372	304	530	44	2885	0.07	0.29	0.16	0.16	0.39	1.10	0.24
1967/68	9785	173	780	749	223	227	-	2152	0.30	0.29	0.33	0.10	0.12	-	0.22
1968/69	8327	32	552	1627	413	260	130	3014	0.11	0.22	0.71	0.21	0.27	0.45	0.36
1969/70	7948	32	1546	1064	321	33	-	2996	0.04	0.45	0.47	0.27	0.12	-	0.38
1970/71	8003	307	1710	657	115	99	-	2888	0.23	0.59	0.24	0.16	0.34	-	0.36

Table 2. Abundance of fin whales by means of whale sighting (south of 40°S)

	II	III	IV	V	VI	Total
1965/66	2,150	27,370	30,770	13,640	5,290	79,220
1966/67	3,540	20,040	56,760	14,320	5,290	99,950
1967/68	3,540	9,560	39,110	25,600	5,960	83,770
1968/69	3,540	26,680	23,070	2,010	4,570	59,870
1969/70	4,920	18,230	25,880	13,640	5,290	67,960
1970/71	3,540	53,610	8,780	12,240	5,350	83,520

Excluding Sectors IIB, IIIB and VB.

Table 3. Estimated population size and ASY of the fin whale

	Population size	ASY
Initial level	378,500	0
MSY level	227,000 - 236,000	9,500 - 10,600
1971/72 level	73,900 - 82,400	3,960 - 4,650

Table 4. Catch and CPUE of sei whales

		Catch							CPUE						
Season	CDW	II	III	IV	V	VI	I	Total	II	III	IV	V	VI	I	Total
1961/62	29952	1249	427	633	409	369	1629	4716	0.15	0.04	0.20	0.23	0.19	0.48	0.16
1962/63	22504	1812	1457	631	430	345	807	5482	0.30	0.16	0.23	0.34	0.56	0.34	0.24
1963/64	20407	4150	1984	274	1820	-	28	8256	0.49	0.30	0.14	0.55	-	0.30	0.40
1964/65	17495	15584	443	1564	2207	-	40	19838	1.50	0.26	0.69	0.74	-	0.54	1.13
1965/66	13122	12718	2756	442	1008	599	35	17558	1.96	1.12	0.69	0.40	0.63	0.78	1.34
1966/67	11760	1553	6860	2825	717	402	3	12360	1.43	1.33	1.24	0.39	0.30	0.08	1.05
1967/68	9785	194	2352	2271	2653	2880	-	10350	0.33	0.86	1.00	1.14	1.54	-	1.06
1968/69	8327	188	1771	1030	2156	552	73	5770	0.64	0.69	0.45	1.10	0.58	0.25	0.69
1969/70	7948	1298	1997	1925	474	33	-	5852	1.62	0.58	0.85	0.39	0.57	-	0.73
1970/71	8003	640	1065	3967	285	194	-	6151	0.48	0.37	1.43	0.41	0.67	-	0.77

Table 5. **Average abundance of sei whales by means of whale sighting during 1965/66 - 1970/71**

	II	III	IV	V	VI	Total
E	26,700	40,000	28,900	27,700	+	123,300+
D	18,200	28,000	31,600	45,200	14,000	137,000
A	4,300	3,800	14,000	10,700	20,300	53,100
B	+	+	400	1,500	5,400	7,300+
Total	49,200+	71,800+	74,900	85,100	39,700+	320,700+

Table 6. Yearly change in abundance of sei whales by means of whale sighting (south of 40°S)

	II	III	IV	V	VI	Total
1965/66	48,700	29,400	45,900	57,400	39,700	221,100
1966/67	6,700	53,000	74,400	115,300	43,100	292,500
1967/68	22,500	57,500	44,100	39,200	76,500	239,800
1968/69	22,500	22,900	19,600	41,200	30,200	136,400
1969/70	12,000	9,900	54,900	57,400	39,700	173,900
1970/71	22,500	17,800	36,300	33,600	8,900	119,100

Table 7. Estimated population size and ASY of the sei whale

	POPULATION SIZE	ASY
Initial	150,000	0
MSY	52,700 - 51,400	4,180 - 6,450
1971/72	81,650	5,080

Table 8. Average abundance of blue whales during seasons 1965/66 - 1970/71

	II	III	IV	V	VI	Total
E	0	1,440	420	2,490	+	4,350+
D	40	5,210	1,100	980	0	7,330
A	0	990	350	260	290	1,890
B	+	+	170	670	580	1,420
Total	40+	7,640+	2,040	4,400	870 +	14,990+

Table 9. Yearly change in abundance of blue whales since 1965/66 (south of 30°S)

	II	III	IV	V	VI	Total
1965/66	40	4,260	2,040	4,400	870	11,610
1966/67	40	4,330	2,120	4,160	870	11,520
1967/68	40	8,080	2,110	3,510	870	14,610
1968/69	40	10,970	1,990	4,400	640	18,040
1969/70	40	10,110	1,920	4,400	870	17,340
1970/71	40	8,120	2,040	5,520	1,100	16,820

Table 10. Average abundance of humpback whales during seasons 1965/66 - 1970/71

	II	III	IV	V	VI	Total
E	0	240	240	0	+	480+
D	300	70	510	210	80	1,170
A	460	260	120	80	370	1,290
B	+	+	100	70	210	380+
Total	760+	570+	970	360	660+	3,320+

Table 11. Yearly change in abundance of humpback whales since the 1965/66 season (south of 30°S)

	II	III	IV	V	VI	Total
1965/66	580	480	970	360	660	3,070
1966/67	1,180	330	2,670	530	660	5,580
1967/68	760	630	480	400	380	2,440
1968/69	760	570	400	360	660	2,760
1969/70	510	710	930	360	660	3,170
1970/71	760	530	410	350	1,020	3,010

Table 12. Average abundance of right whales during seasons 1965/66 - 1970/71

	II	III	IV	V	VI	Total
E	1,070	280	780	0	+	2,130+
D	550	70	610	120	70	1,420
A	70	0	80	300	140	590
B	+	+	0	0	0	+
Total	1,690+	350+	1,470	420	210	4,140+

Table 13. Yearly change in abundance of right whales since the 1965/66 season

	II	III	IV	V	VI	Total
1965/66	1,200	380	1,470	420	210	3,680
1966/67	2,790	380	1,550	420	210	5,350
1967/68	1,690	400	1,200	560	150	4,000
1968/69	1,690	320	890	310	260	3,470
1969/70	1,060	200	2,670	420	210	4,560
1970/71	1,690	440	1,080	400	210	3,820

ANNEX I

EXAMINATION OF THE RECRUITMENT RATE OF THE ANTARCTIC FIN WHALE STOCK BY USE OF MATHEMATICAL MODELS

Seiji Ohsumi
(Far Seas Fisheries Research Laboratory)

Introduction

As a result of extensive discussion at the Scientific Committee of the IWC, gaps between the estimates of the stock size of the Antarctic fin whale by Commission scientists have been considerably narrowed.

However, their views are still divided on the estimation of recruitment rates and hence of the sustainable yields. Japanese scientists (Doi et al., IWC/SC/21/18) considered that the rate of recruitment increases with stock size declining. They estimated the net recruitment rate, r-M, for late 1960's to be in the range from 0.057 to 0.064. Chapman (SM/F/4) thought that the net recruitment rate in recent years would be regarded as constant at 0.04. Allen (IWC/SC/22/14) maintained that the recruitment rate might be decreasing in recent years, averaging at 0.05. His estimate of the average net recruitment rate in recent years is 0.01.

Which of the foregoing three views is closer to the truth will eventually come to surface as time progresses. However, in light of the urgent need for the Commission scientists to agree on the estimation of the sustainable yields, the present paper will attempt to shed further light on the question of recruitment, making best use of the available knowledge on the parameters affecting the size of this whale stock.

Parameters affecting population size

Using mathematical models, Japanese scientists have brought to light that out of various parameters affecting the size of whale stock, the most important are the following:

Pregnancy rate (p)

Age at sexual maturity of females (t_m)

Age at recruitment (t_c)

Natural mortality coefficient after and before recruitment (M and M' respectively)

(see IWC/SC/21/19, IWC/SC/22/22, IWC/SC/22/23)

The present paper will first consider the changes in the above parameters with stock size in the following sections.

In the absence of the agreement of the Commission scientists on the stock size from the initial level, the estimates as given in IWC/SC/21/18 were used to calculate the relative stock size of different years as compared with the initial size. The changes in the above-listed parameters were then examined in the context of the calculated relative stock size.

1) Pregnancy rates (p)

Laws (1962), Shimadzu (1970) and others reported of an increase in the pregnancy rate with the decline in stock size.

The International Whaling Statistics also publishes pregnancy rates annually. Those quoted in Laws and the IWS are the proportions of pregnant whales in mature females found in the catches. Shimadzu (1970), however, pointed out that these rates did not necessarily represent true ones, since females accompanied by calves and suckling whales are not represented. Shimadzu's estimates as given in Table 1 are amended to eliminate this bias.

In Fig. 1 p, three smoothed curves are fitted to Shimadzu's and IWS data for the recruitment rate. Curve C was drawn against the IWS data in such a way as to eliminate the bias between the true and apparent rates. The apex of this curve was determined so as to be in accordance with the consensus at the Honolulu meeting that the pregnancy rate would not exceed 0.50. Another consensus of the meeting that the rate in pre-war years was around 0.33 was also taken into consideration in determining the shape of Curve C.

2) Age at sexual maturity of females (t_m)

Ohsumi (1970) and Lockyer (1970 a and b) reported a decline in the age at sexual maturity of the Antarctic fin whale with stock size. Ohsumi (1970) estimated the age at which the sexual maturity rate became 50% on the basis of lamination counts of earplugs. Lockyer (1970a) reported the transition stage in the formation of laminae, which she found was closely related to sexual maturity. Based on this finding, she (1970b) further examined annual variations in the ages at sexual maturity. Ohsumi and Miyao (unpublished) confirmed this to arrive at their estimation of this age.

The estimated ages at sexual maturity by the three authors are given in Table 1. They are also plotted in Fig. 1 t_m against stock size, and two smoothed curves were fitted to represent the relationship between the age at sexual maturity and stock size. Tm in Curve A is made to decrease from 11 to 6 years, whilst that in Curve B from 9.2 to 5.

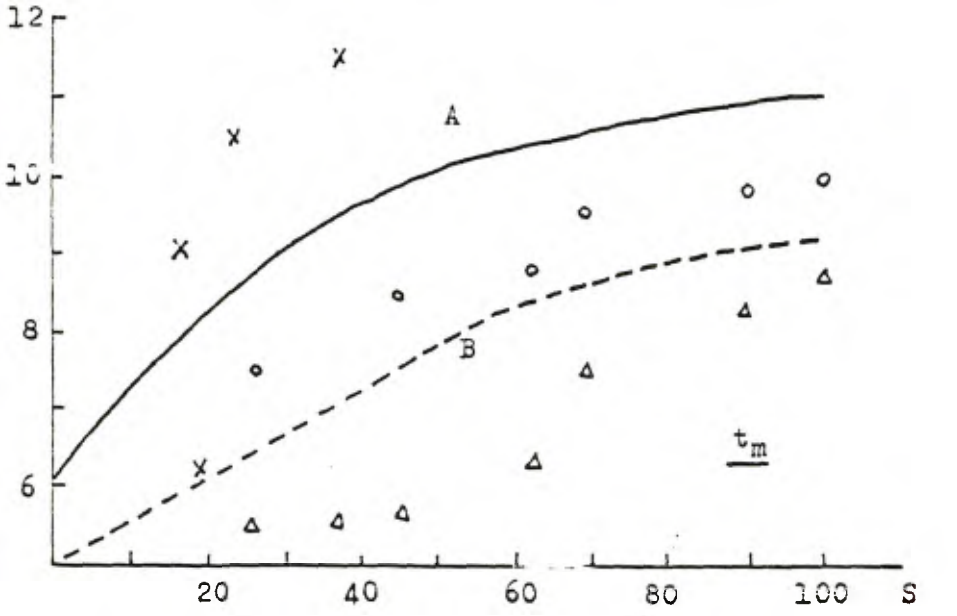
3) Age at recruitment (t_c)

Usually the best way to estimate the age at recruitment should be to examine age-composition data. However, this is not the case with the Antarctic fin whale due to the following reasons:

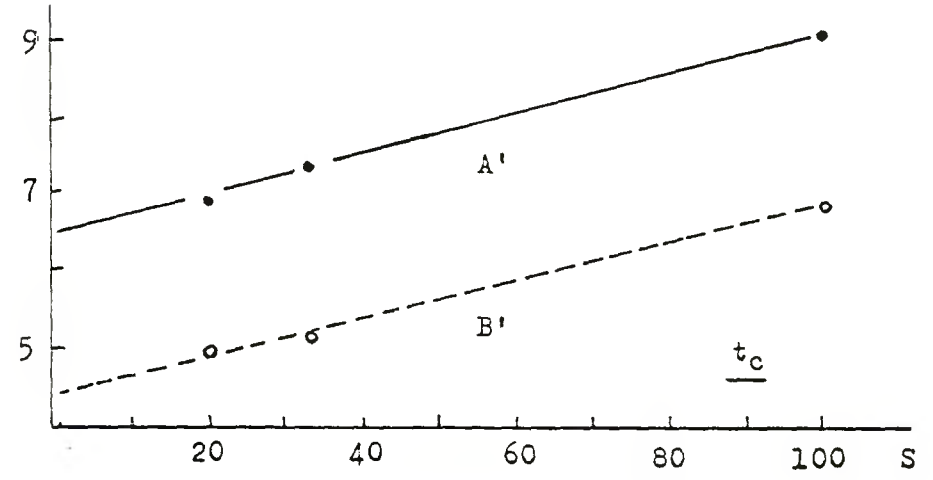
a) Age composition data prior to 1957 are not based on earplugs and hence not reliable.

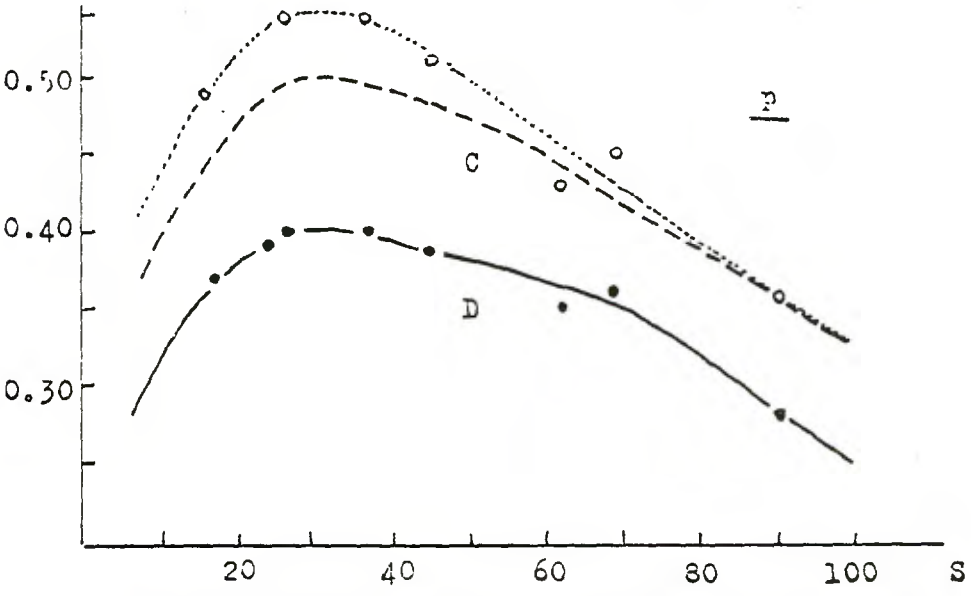
b) The present age-length keys are not adequate enough to use for length data of earlier years.

Sexual maturity rates of the Antarctic fin whale are available in the International Whaling Statistics, which indicate a decrease from 80-90% in the 1930's to about 70% in the mid 1960's.



× : Ohsumi (1970). o: Ohsumi & Miyao (Unpublished)
△ : Lockyer (1970b)





o : Apparent (IWC) ● : True (Shimadzu,1970)

Fig. 1. Change in population parameters (p, t_m,t_c,M and M') with change in population level (S) for the Antarctic fin whale.

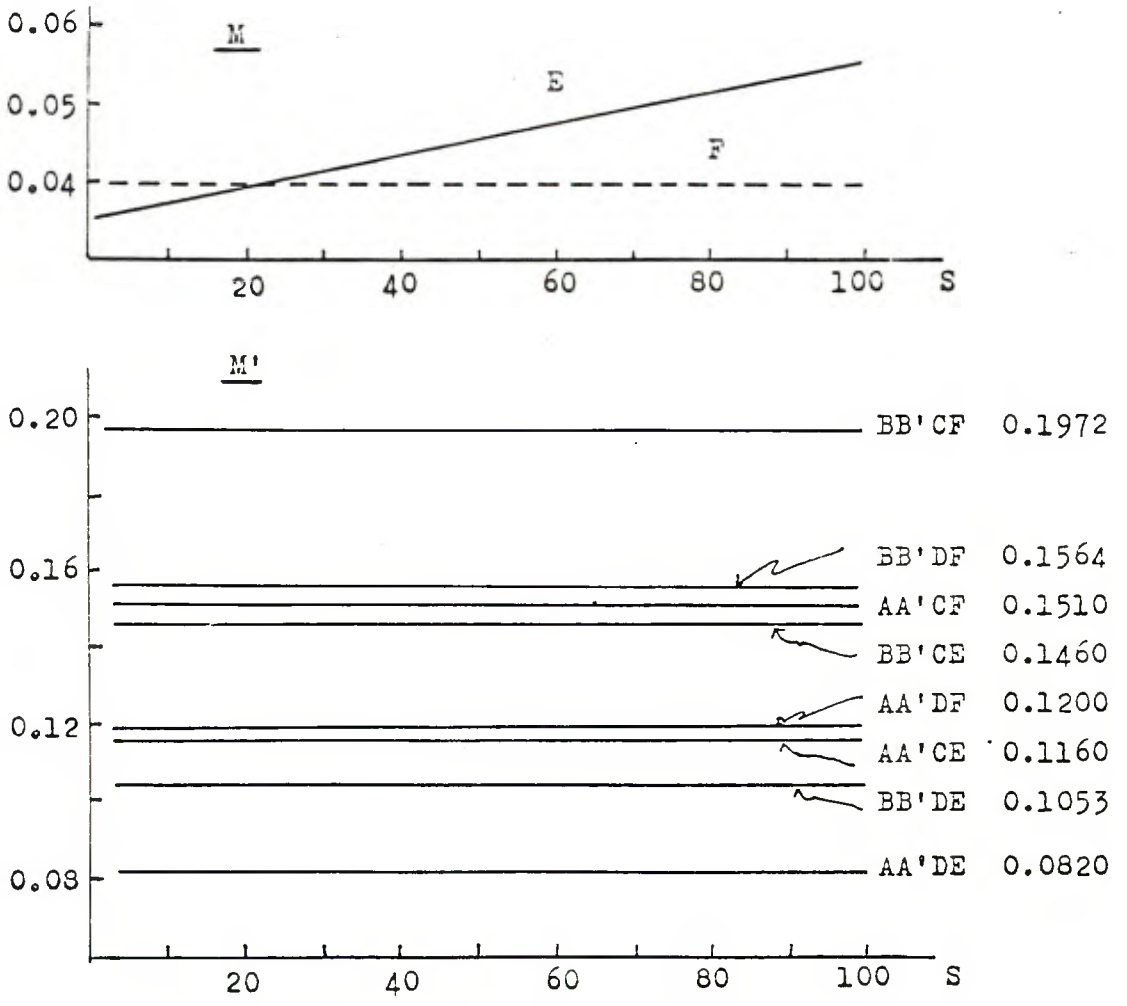


Fig. 1. (continued)

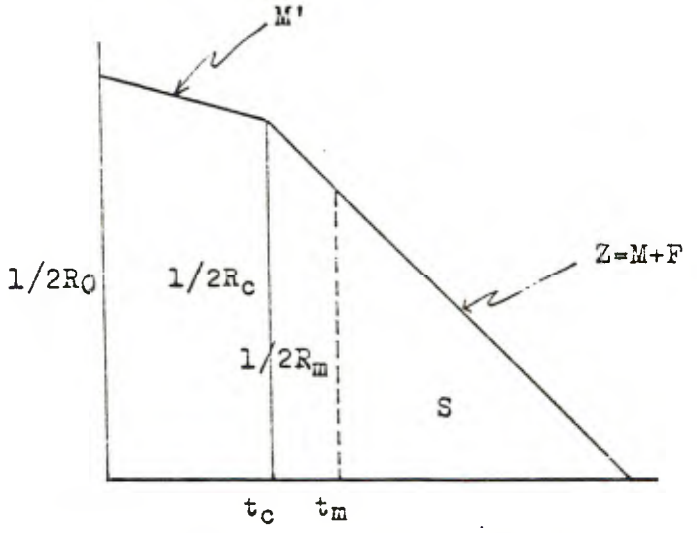


Fig. 2. Population model for the fin whale.

Table 1. Size of mature female stock and the values of relevant parameters.

Year	S	S'	p_1	p_2	t_{m1}	t_{m2}	t_{m3}	H(%)	E_1(%)	E_2(%)
1930	160,000	100	-	-	8.7	9.9	-	-	-	-
1935	144,000	90	0.36	0.28	8.3	9.8	-	85	4	-
1940	110,000	69	0.45	0.36	7.5	9.5	-	78	8	-
1945	111,000	69	0.29	0.25	7.0	9.0	-	-	-	-
1950	89,000	62	0.43	0.35	6.3	8.8	-	80	10	-
1955	72,000	45	0.51	0.39	5.7	8.5	-	75	13	-
1957	59,000	37	0.54	0.40	5.6	-	11.5	74	13	-
1958	53,000	33	-	-	-	-	-	72	-	26
1960	42,000	26	0.54	0.40	5.5	7.5	-	70	21	-
1961	37,000	23	0.54	0.39	-	-	10.6	69	22	-
1962	32,000	20	-	-	-	-	-	68	-	15
1964	25,000	16	0.49	0.37	-	-	9.2	68	20	-
1968	30,000	19	0.45	-	-	-	6.0	77	3	-

S: Population of mature females (Doi et al., 1969 IWC/SC/21/18)

S': Relative stock size of mature females, putting the population in 1930 as 100

p_1: Pregnancy rate by the International Whaling Statistics

p_2: Pregnancy rate by Shimadzu (1970)

t_{m1}: Age at sexual maturity of females by Lockyer (1970b)

t_{m2}: Age at sexual maturity of females by Ohsumi and Miyao (unpublished)

t_{m3}: Age at sexual maturity of females by Ohsumi (1970)

H: Sexual maturity rate by the International Whaling Statistics

E_1: Fishing rate by Doi et al. (1969, IWC/SC/21/18)

E_2: Fishing rate as computed on the basis of the stock size as agreed at the Honolulu meeting

Assuming recruitment completed before sexual maturity is attained, the average age at recruitment (knife-edge) is obtainable by solving the following equations:

$$S = \frac{R_m}{2(1-s)} \quad \ldots\ldots\ldots (1)$$

$$R_o = \frac{R_m}{2(1-s)} P \quad \ldots\ldots\ldots (2)$$

$$P_c = R_o e^{-t_c M'} \quad \ldots\ldots (3)$$

$$R_c = \frac{R_m}{e^{-(t_m - t_c)Z}} \quad \ldots\ldots (4)$$

$$R_m = R_c e^{-(t_m - t_c)Z} \quad \ldots (5)$$

$$N = \frac{R_c}{1 - s} \quad \ldots\ldots\ldots (6)$$

$$\frac{2S}{N} = e^{-(t_m - t_c)Z} \quad \ldots\ldots (7)$$

Substituting $\frac{2S}{N}$ in equation (7) by sexual maturity rates and t_m being known, equation (7) can be solved for t_c, if total mortality coefficient, Z, is estimated.

Although there are no data available for direct assessment, Z can be measured if fishing and natural mortality rates are estimated for particular years. For this purpose, fishing rates (E_2) were calculated for 1958 and 1962, since there was good agreement on the part of Commission scientists in respect of the estimation of stock size in these two years. The calculated E_2 are given in Table 1. For an estimate for the natural mortality coefficient, 0.04 was used on these calculations. It is also possible to calculate t_c at the initial stock level by equation (7), since Z = M, M = 0.055-0.04, and the sexual maturity rate at this level is estirated to be 90%

With t_m determined by Curves A and B in Fig. 1 t_m, we obtained two sets of t_c each for 1958, 1962 and the initial stock level, to which two straight lines were fitted as shown in Fig. 1 t_c. Line A' in Fig. 1 t_c corresponds to Curve A in Fig. 1 t_m.

4) Natural mortality coefficient after recruitment (M)

In view of the lack of more precise information on this coefficient, two sets of estimates were used for the purpose of this paper (Lines E and F in Fig. 1 M).

In Line E, M is made to decrease from 0.055 at the initial stock level to 0.035 at 0 level, whilst in Line F, M is kept constant at 0.04. Both sets assume that M in recent years averages at 0.04.

5) Natural mortality coefficient before recruitment (M')

There are no data available for direct estimation of this parameter. However, from equations (1) to (5) we obtain

$$1 - e^{-M} = \frac{1}{2} e^{-t_c M'} e^{-(t_m - t_c)} \quad \ldots\ldots (8)$$

With M, p, t_c and t_m given, equation (8) can be solved for M', which is the average natural mortality coefficient for the entire pre-recruitment period.

Using 8 sets of combination of t_m, t_c, p and M, the following 8 estimates of M' were obtained as follows:-

t_m, t_c, p and M	Calculated values of M'
A A' D E	0.0820
B B' D E	0.1053
A A' C E	0.1160
A A' D F	0.1200
B B' C E	0.1460
A A' C F	0.1510
B B' D F	0.1564
B B' C F	0.1972

It is very likely that the value of this coefficient changes with stock size. However, in view of the reduction in age at recruitment in recent years, M' was regarded in this paper as constant for all stock sizes.

Estimation of the rate of recruitment

Between the following parameters, we have:

$$R = p S e^{-t_c M'} \quad \ldots\ldots\ldots\ldots (9)$$

$$s = e^{-(M + F)} \quad \ldots\ldots\ldots\ldots (10)$$

$$K = \frac{1}{2\bar{F}} = \frac{1 - s}{e(t_m - t_c)} \quad \ldots\ldots\ldots (11)$$

$$L = \frac{F}{F+M} \left\{ 1 - e^{-(F+M)} \right\} \quad \ldots\ldots (12)$$

$$N = \frac{R}{1-s} \quad \ldots\ldots\ldots\ldots (13)$$

$$C = LN \quad \ldots\ldots\ldots\ldots (14)$$

With p, t_c, t_m, M and M' at each stock level known, the above equations can be solved for corresponding F, K, s, F, L, N and C.

Then the rate of rate of recruitment (r) is calculated as;

$$r = \frac{R}{N} \quad \ldots\ldots\ldots\ldots (15)$$

By definition, the net recruitment rate is given as r - M.

Results of calculations, by use of the above-mentioned 5 sets of combination of relevant parameters, are as shown in Tables 3A-B (see also Fig. 3).

Discussion and conclusions

1) K-Values

Doi et al. (1969, IWC/SC/21/18) examined changes in K-values using a variety of theoretical models and suggested that K would increase as stock size declines.

In my calculation, however, K-values were shown to reach a maximum when the stock size of S is 25-32% of the initial size as shown in Fig. 3. The computation in this paper also indicated that Doi et al. (1969)'s values tended to be too high when the stock declines to less than 35% of the original size.

2) r-Values

The recruitment rate increases to 0.075-0.102 as the stock, N, decreases to 20-25% of the initial size. Below this point, r decreases as the stock is reduced. Table 3B and Fig. 4 indicate that Allen (1970)'s estimate of 0.05 would be too low to be applied to the present stock level.

3) r - M -Values

The net recruitment rate was also shown to change with stock size, reaching maximum of 0.04 - 0.06 when the stock is at 20-30% of the original stock.

Taking as generally accepted that the present stock size is 20-30% of the initial size, Allen's estimate of 0.01 is obviously too low.

The present r-M would be in the range from 0.04 to 0.06, probably closer to the upper figure, as indicated by the present knowledge on the fin whale stock in the Antarctic.

4) Further examination of the inter-dependence of relevant population parameters

Values of K, r, and r-M depend much on the natural mortality coefficient. For example, the differences between Computation No. 1 and No. 5 are mostly explained by differences in M and M' as shown in Table 3.

It is still an open question if M at present is 0.04. If it is close enough, it is hardly likely that M at the initial stock level was of this magnitude. E in Fig. 1 is, therefore, considered to be more realistic than F. For the same reason, the true r-M would be closer to 0.06 than to 0.04.

The effects of the ages at sexual maturity or at recruitment become most pronounced when Computation Nos. 1 and 2 or Nos. 3 and 4 are compared. When stock is not far from the unexploited condition, the difference in age at recruitment or at maturity exerts little impact on the size of r-M. Their effects are maximized when values of K, r, and r-M attain maxima as shown in Fig. 3.

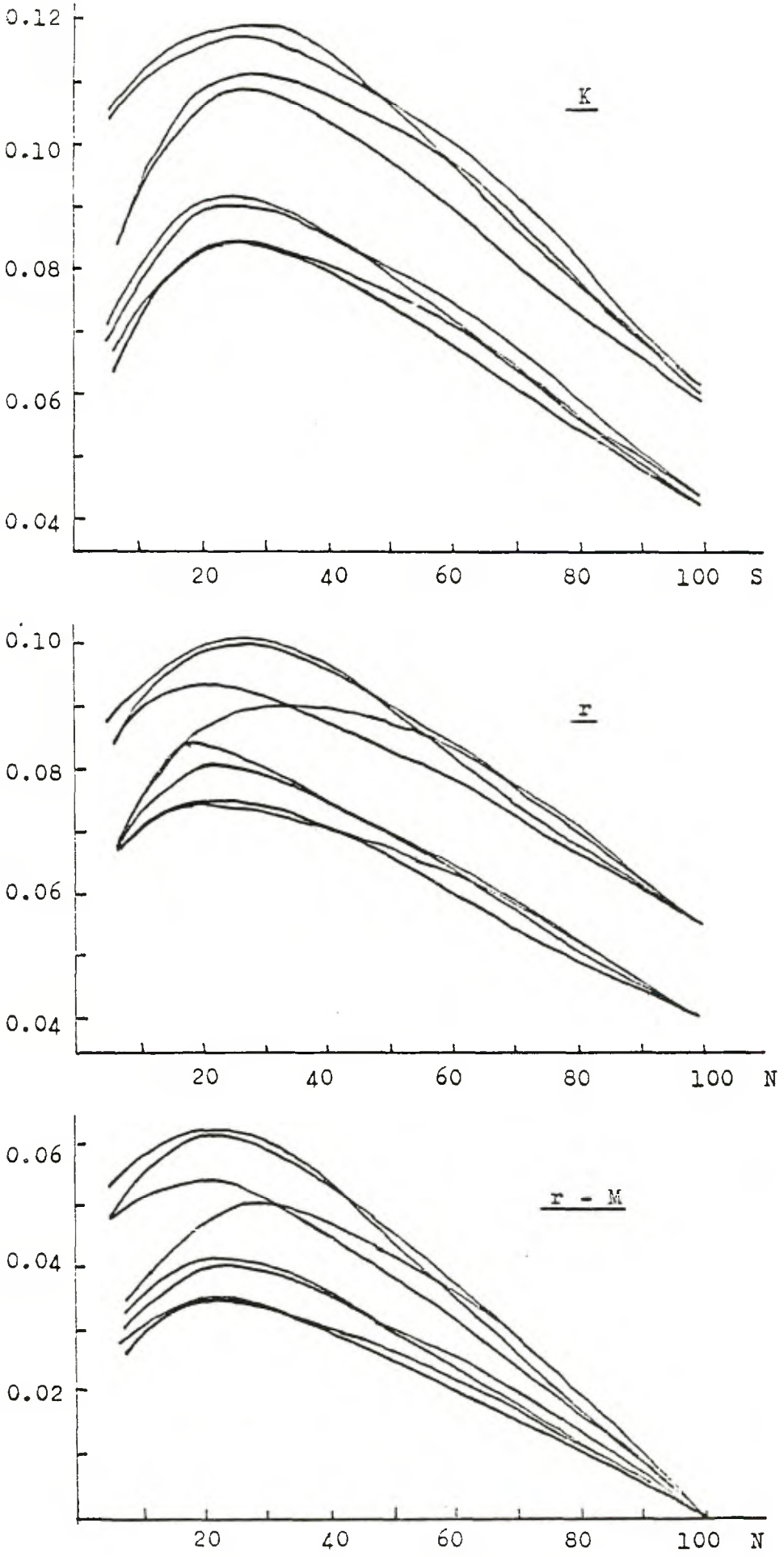


Fig. 3. Eight examples of calculation of values-K, r, and r-M under the various combination of input parameters for population model of the Antarctic fin whale.

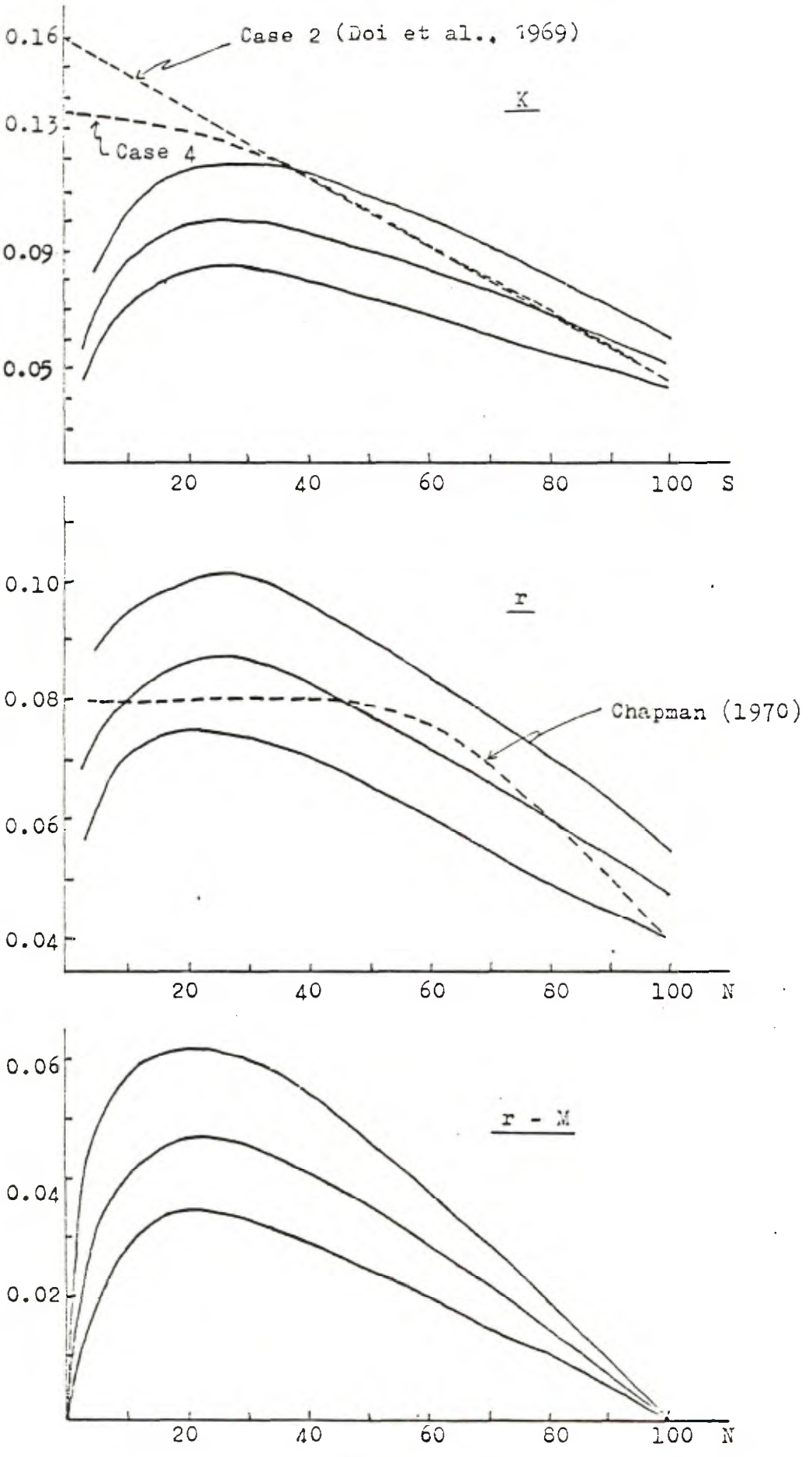


Fig. 4. Average and lower and upper limit of K, r and r-M (solid lines) of the eight examples in Fig.3, as compared with those of other authors (broken lines).

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Table 2-A Calculated values of populations parameters of Antarctic fin whales - Computation No. 1 (BB'CF)

S	p	t_c	t_m	M	M'	R	K	s	F	E	N	C	N'	C'	r	r-M
100	0.33	6.8	9.2	0.04	0.197	8.64	0.0432	0.961	0.0000	0.0000	221.54	0.00	100.00	0.00	0.040	0.000
90	0.36	6.6	9.1	0.04	0.197	8.83	0.0491	0.956	0.0050	0.0049	200.68	0.98	90.58	0.44	0.044	0.004
80	0.39	6.3	8.9	0.04	0.197	9.02	0.0564	0.951	0.0102	0.0100	184.08	1.85	83.09	0.84	0.049	0.009
70	0.42	6.1	8.6	0.04	0.197	9.02	0.0644	0.945	0.0166	0.0163	164.00	2.68	74.03	1.21	0.055	0.015
60	0.45	5.8	8.4	0.04	0.197	8.62	0.0718	0.939	0.0229	0.0224	141.31	3.17	63.78	1.43	0.061	0.021
50	0.47	5.5	7.8	0.04	0.197	7.95	0.0795	0.932	0.0304	0.0297	116.91	3.47	52.77	1.57	0.068	0.028
40	0.49	5.3	7.2	0.04	0.197	6.70	0.0838	0.927	0.0358	0.0349	91.78	3.20	41.43	1.44	0.073	0.033
30	0.50	5.1	6.7	0.04	0.197	5.49	0.0915	0.920	0.0433	0.0420	68.63	2.89	30.98	1.30	0.080	0.040
20	0.47	4.8	6.1	0.04	0.197	3.65	0.0913	0.918	0.0456	0.0442	44.51	1.97	20.09	0.89	0.082	0.042
10	0.40	4.6	5.5	0.04	0.197	1.62	0.0810	0.925	0.0379	0.0369	21.60	0.80	9.75	0.36	0.075	0.035
0	0.00	4.3	5.0	0.04	0.197	0.00	-	-	0.0000	0.0000	0.00	0.00	0.00	0.00	0.000	0.000

Table 2-B Calculated values of population parameters of Antarctic fin whales - Computation No. 2 (AA'CF)

S	r	t_c	t_m	M	M'	R	K	s	F	E	N	C	N'	C'	r	r-M
100	0.33	9.0	11.0	0.040	0.151	8.48	0.0424	0.961	0.0000	0.0000	217.44	0.00	100.00	0.00	0.040	0.000
90	0.36	8.7	10.9	0.040	0.151	8.71	0.0484	0.954	0.0070	0.0069	189.35	1.31	87.08	0.60	0.046	0.006
80	0.39	8.5	10.8	0.040	0.151	8.64	0.0540	0.952	0.0092	0.0090	180.00	1.62	82.78	0.75	0.048	0.008
70	0.42	8.2	10.6	0.040	0.151	8.52	0.0609	0.947	0.0144	0.0142	160.75	2.28	73.93	1.05	0.053	0.013
60	0.45	7.9	10.4	0.040	0.151	8.19	0.0682	0.941	0.0208	0.0204	138.81	2.83	63.84	1.30	0.059	0.019
50	0.47	7.7	10.0	0.040	0.151	7.35	0.0735	0.937	0.0251	0.0246	116.67	2.87	63.66	1.32	0.063	0.023
40	0.49	7.4	9.6	0.040	0.151	6.41	0.0801	0.931	0.0315	0.0307	93.00	2.85	42.72	1.31	0.069	0.029
30	0.50	7.2	9.0	0.040	0.151	5.06	0.0843	0.931	0.0315	0.0307	73.33	2.25	33.72	1.03	0.069	0.029
20	0.47	6.9	8.2	0.040	0.151	3.32	0.0829	0.925	0.0380	0.0370	44.27	1.64	20.36	0.75	0.075	0.035
10	0.40	6.7	7.2	0.040	0.151	1.45	0.0727	0.930	0.0325	0.0316	20.71	0.66	9.55	0.30	0.070	0.030
0	0.00	6.4	6.0	0.040	0.151	0.00	0.0000	-	-	0.0000	0.00	0.00	0.00	0.00	0.000	0.000

Table 2-C Calculated values of population parameters of Antarctic fin whales - Computation No. 3 (BB'DE)

S	p	t_c	t_m	M	M'	R	K	s	F	E	H	C	N'	C'	r	r-M
100	0.25	6.8	9.2	0.055	0.1053	12.22	0.0611	0.946	0.0000	0.0000	226.30	0.00	100.00	0.00	0.055	0.000
90	0.28	6.6	9.1	0.053	0.1053	12.58	0.0699	0.940	0.0088	0.0087	209.67	1.82	92.65	0.80	0.060	0.007
80	0.32	6.3	8.9	0.051	0.1053	13.19	0.0824	0.931	0.0204	0.0200	191.16	3.82	84.47	1.69	0.069	0.018
70	0.35	6.1	8.6	0.049	0.1053	12.89	0.0921	0.924	0.0300	0.0293	169.61	4.97	74.95	2.20	0.076	0.027
60	0.37	5.8	8.4	0.047	0.1053	12.05	0.1004	0.919	0.0374	0.0363	148.77	5.40	65.74	2.39	0.081	0.034
50	0.38	5.5	7.8	0.045	0.1053	10.65	0.1065	0.914	0.0449	0.0435	123.84	5.39	54.72	2.38	0.086	0.041
40	0.39	5.3	7.2	0.043	0.1053	8.93	0.1116	0.907	0.0546	0.0527	96.02	5.06	42.43	2.24	0.093	0.050
30	0.40	5.1	6.7	0.041	0.1053	7.01	0.1169	0.901	0.0633	0.0608	70.81	4.31	31.29	1.90	0.099	0.058
20	0.38	4.8	6.1	0.039	0.1053	4.58	0.1146	0.900	0.0663	0.0637	45.80	2.92	20.24	1.29	0.100	0.061
10	0.32	4.6	5.5	0.037	0.1053	1.97	0.0986	0.909	0.0584	0.0563	21.65	1.22	9.57	0.54	0.091	0.054
0	0.00	4.3	5.0	0.035	0.1053	0.00	0.0000	-	0.0000	0.0000	0.00	0.00	0.00	0.00	0.000	0.000

Table 2-D Calculated values of population parameters of Antarctic fin whales - Computation No. 4 (AA'DE)

S	p	t_c	t_m	M	M'	R	K	s	F	E	H	C	E'	C'	r	r-M
100	0.25	9.0	11.0	0.055	0.082	11.95	0.0598	0.946	0.0000	0.0000	221.30	0.00	100.00	0.00	0.055	0.000
90	0.28	8.7	10.9	0.053	0.082	12.35	0.0686	0.940	0.0088	0.0087	205.83	1.78	93.01	0.80	0.060	0.007
80	0.32	8.5	10.8	0.051	0.082	12.75	0.0797	0.932	0.0194	0.0190	187.50	3.56	84.73	1.61	0.068	0.017
70	0.35	8.2	10.6	0.049	0.082	12.51	0.0894	0.926	0.0279	0.0272	169.05	4.61	76.39	2.08	0.074	0.025
60	0.37	7.9	10.4	0.047	0.082	11.62	0.0968	0.921	0.0353	0.0343	147.09	5.05	66.47	2.28	0.079	0.032
50	0.38	7.7	10.0	0.045	0.082	10.11	0.1011	0.917	0.0416	0.0404	121.81	4.92	55.04	2.22	0.083	0.038
40	0.39	7.4	9.6	0.043	0.082	8.50	0.1063	0.913	0.0480	0.0465	97.70	4.54	44.15	2.05	0.087	0.044
30	0.40	7.2	9.0	0.041	0.082	6.65	0.1108	0.914	0.0489	0.0473	77.33	3.66	34.94	1.65	0.086	0.045
20	0.38	6.9	8.2	0.039	0.082	4.32	0.1080	0.912	0.0531	0.0405	49.10	1.99	22.19	0.90	0.088	0.049
10	0.32	6.7	7.2	0.037	0.082	1.85	0.0925	0.924	0.0420	0.0408	24.34	0.99	11.00	0.45	0.076	0.039
0	0.00	6.4	6.0	0.035	0.082	0.00	-	-	-	0.0000	0.00	0.00	0.00	0.00	0.000	0.000

Table 2-E Calculated values of population parameters of Antarctic fin whales - Computation No. 5 (BB'CE)

S	p	t_c	t_m	M	M'	R	K	s	F	E	N	C	N'	C'	r	r-M
100	0.33	6.8	9.2	0.055	0.1460	12.23	0.0612	0.947	0.0000	0.0000	228.60	0.00	100.00	0.00	0.055	0.000
90	0.36	6.6	9.1	0.053	0.1460	12.36	0.0687	0.941	0.0078	0.0077	209.49	1.61	91.64	0.70	0.059	0.006
80	0.39	6.3	8.9	0.051	0.1460	12.44	0.0778	0.935	0.0162	0.0159	191.38	3.04	83.72	1.33	0.065	0.014
70	0.42	6.1	8.6	0.049	0.1460	12.07	0.0862	0.928	0.0257	0.0251	167.64	4.21	73.33	1.84	0.072	0.023
60	0.45	5.8	8.4	0.047	0.1460	11.58	0.0965	0.922	0.0342	0.0333	148.46	4.94	64.94	2.16	0.078	0.031
50	0.47	5.5	7.8	0.045	0.1460	10.53	0.1053	0.914	0.0449	0.0435	122.44	5.33	53.56	2.33	0.086	0.041
40	0.49	5.3	7.2	0.043	0.1460	9.31	0.1164	0.904	0.0579	0.0558	96.98	5.41	42.42	2.37	0.096	0.053
30	0.50	5.1	6.7	0.041	0.1460	7.12	0.1187	0.900	0.0643	0.0618	71.20	4.40	31.15	1.92	1.100	0.059
20	0.47	4.8	6.1	0.039	0.1460	4.66	0.1165	0.899	0.0675	0.0648	46.14	2.99	20.18	1.31	0.101	0.062
10	0.40	4.6	5.5	0.037	0.1460	2.04	0.1022	0.906	0.0617	0.0594	21.70	1.29	9.49	0.56	0.094	0.057
0	0.00	4.3	5.0	0.035	0.1460	0.00	0.0000	0.000	0.0000	0.0000	0.00	0.00	0.00	0.00	0.000	0.000

Table 2-F Calculated values of population parameters of Antarctic fin whales - Computation No. 6 (B&'DF)

S	p	t_c	t_n	M	M'	R	K	s	F	E	N	C	N'	C'	r	r-M
100	0.25	6.8	9.2	0.04	0.1564	8.63	0.0432	0.961	0.0000	0.0000	220.15	0.00	100.00	0.00	0.040	0.000
90	0.28	6.6	9.1	0.04	0.1564	8.98	0.0499	0.955	0.0060	0.0059	199.56	1.18	90.65	0.54	0.045	0.005
80	0.32	6.3	8.9	0.04	0.1564	9.56	0.0597	0.948	0.0134	0.0132	183.85	2.43	83.51	1.10	0.052	0.012
70	0.35	6.1	8.6	0.04	0.1564	9.44	0.0674	0.942	0.0197	0.0194	162.76	3.16	73.93	1.43	0.058	0.018
60	0.37	5.8	8.4	0.04	0.1564	8.96	0.0747	0.937	0.0250	0.0245	142.22	3.48	64.60	1.58	0.063	0.023
50	0.38	5.5	7.8	0.04	0.1564	9.04	0.0804	0.932	0.0304	0.0297	118.24	3.51	53.71	1.60	0.068	0.028
40	0.39	5.3	7.2	0.04	0.1564	6.81	0.0851	0.926	0.0369	0.0359	92.03	3.31	41.80	1.50	0.074	0.034
30	0.40	5.1	6.7	0.04	0.1564	5.40	0.0901	0.921	0.0423	0.0411	68.35	2.81	31.05	1.28	0.079	0.039
20	0.38	4.8	6.1	0.04	0.1564	3.57	0.0893	0.920	0.0433	0.0420	44.63	1.88	20.27	0.85	0.080	0.040
10	0.32	4.6	5.5	0.04	0.1564	1.56	0.0779	0.927	0.0358	0.0349	21.37	0.75	9.71	0.34	0.073	0.033
0	0.00	4.3	5.0	0.04	0.1564	0.00	0.0000	-	0.0000	0.0000	0.00	0.00	0.00	0.00	0.000	0.000

Table 2-G Calculated values of population parameters of Antarctic fin whales - Computation No. 7 (AA'DF)

S	p	t_c	t_m	M	M'	R	K	s	F	E	N	C	N'	C'	r	r-M
100	0.25	9.0	11.0	0.040	0.120	8.49	0.0424	0.960	0.0000	0.0000	216.58	0.00	100.00	0.00	0.040	0.000
90	0.28	8.7	10.9	0.040	0.120	8.87	0.0493	0.955	0.0060	0.0032	197.11	0.63	91.01	0.29	0.045	0.005
80	0.32	8.5	10.8	0.040	0.120	9.23	0.0577	0.949	0.0229	0.0225	189.98	4.07	83.56	1.88	0.051	0.011
70	0.35	8.2	10.6	0.040	0.120	9.16	0.0654	0.943	0.0187	0.0130	160.70	2.09	74.20	0.97	0.057	0.017
60	0.37	7.9	10.4	0.040	0.120	8.60	0.0717	0.939	0.0336	0.0328	140.98	4.62	65.09	2.13	0.061	0.021
50	0.38	7.7	10.0	0.040	0.120	7.54	0.0754	0.935	0.0320	0.0313	116.00	3.63	53.55	1.68	0.065	0.025
40	0.39	7.4	9.6	0.040	0.120	6.42	0.0802	0.931	0.0315	0.0308	93.04	2.87	42.96	1.33	0.069	0.029
30	0.40	7.2	9.0	0.040	0.120	5.06	0.0843	0.927	0.0358	0.0280	69.32	1.94	32.01	0.90	0.073	0.033
20	0.38	6.9	8.2	0.040	0.120	3.32	0.0830	0.925	0.0380	0.0300	44.27	1.33	20.44	0.61	0.075	0.035
10	0.32	6.7	7.2	0.040	0.120	1.43	0.0176	0.931	0.0315	0.0308	20.72	0.64	9.57	0.30	0.069	0.029
0	0.00	6.4	6.0	0.040	0.120	0.00	0.0000	-	0.0000	0.0000	0.00	0.00	0.00	0.00	0.000	0.000

Table 2-H Calculated values of population parameters of Antarctic fin whales - Computation No. 8 (AA'CE)

S	p	t_c	t_m	M	M'	R	K	s	F	E	N	C	N'	C'	r	r-M
100	0.33	9.0	11.0	0.055	0.1160	11.62	0.0581	0.946	0.0000	0.0000	217.20	0.00	100.00	0.00	0.055	0.000
90	0.36	8.7	10.9	0.053	0.1160	11.81	0.0656	0.942	0.0068	0.0067	203.62	1.36	93.75	0.63	0.058	0.005
80	0.39	8.5	10.8	0.051	0.1160	11.64	0.0727	0.937	0.0141	0.0098	184.76	1.81	85.06	0.83	0.063	0.012
70	0.42	8.2	10.6	0.049	0.1160	11.36	0.0811	0.931	0.0220	0.0162	165.84	2.69	76.35	1.24	0.068	0.020
60	0.45	7.9	10.4	0.047	0.1160	10.80	0.0900	0.926	0.0299	0.0292	145.95	4.26	67.20	1.96	0.074	0.027
50	0.47	7.7	10.0	0.045	0.1160	9.62	0.0962	0.920	0.0378	0.0368	121.01	4.45	55.71	2.05	0.080	0.035
40	0.49	7.4	9.6	0.043	0.1160	8.31	0.1038	0.915	0.0458	0.0371	97.76	3.63	45.01	1.67	0.085	0.042
30	0.50	7.2	9.0	0.041	0.1160	6.51	0.1085	0.909	0.0544	0.0526	71.54	3.76	32.94	1.73	0.091	0.050
20	0.47	6.9	8.2	0.039	0.1160	4.22	0.1056	0.907	0.0586	0.0486	45.38	2.21	20.89	1.02	0.093	0.054
10	0.40	6.7	7.2	0.037	0.1160	1.84	0.0919	0.912	0.0550	0.0531	20.91	1.11	9.63	0.51	0.088	0.051
0	0.00	6.4	6.0	0.035	0.1160	0.00	0.0000	-	0.0000	0.0000	0.00	0.00	0.00	0.00	0.000	0.000

Table 3-A Calculated values of K at different mature female population levels

S	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	Total	Average
100	0.0432	0.0424	0.0611	0.0598	0.0612	0.0432	0.0424	0.0581	0.4114	0.05143
90	0.0491	0.0484	0.0699	0.0686	0.0687	0.0499	0.0493	0.0656	0.4695	0.05869
80	0.0564	0.0540	0.0824	0.0797	0.0778	0.0597	0.0577	0.0727	0.5404	0.06755
70	0.0644	0.0609	0.0921	0.0894	0.0862	0.0674	0.0654	0.0811	0.6069	0.07586
60	0.0718	0.0682	0.1004	0.0968	0.0965	0.0747	0.0717	0.0900	0.6701	0.08376
50	0.0795	0.0735	0.1065	0.1011	0.1053	0.0804	0.0754	0.0962	0.7079	0.08974
40	0.0838	0.0801	0.1116	0.1063	0.1164	0.0851	0.0802	0.1038	0.7673	0.09591
30	0.0915	0.0843	0.1169	0.1108	0.1187	0.0901	0.0843	0.1085	0.8051	0.10064
20	0.0913	0.0829	0.1146	0.1080	0.1165	0.0893	0.0830	0.1056	0.7912	0.09890
10	0.0810	0.0727	0.0986	0.0925	0.1022	0.0779	0.0716	0.0919	0.6884	0.08605
0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.00000

Table 3-B Calculated values of r at different population levels (N)

N	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	Total	Average
100	0.040	0.040	0.055	0.055	0.055	0.040	0.040	0.055	0.380	0.0475
90	0.045	0.044	0.062	0.063	0.060	0.046	0.046	0.060	0.426	0.0533
80	0.051	0.049	0.070	0.071	0.067	0.053	0.053	0.066	0.480	0.0600
70	0.058	0.055	0.077	0.077	0.074	0.060	0.059	0.073	0.533	0.0666
60	0.063	0.061	0.084	0.084	0.082	0.065	0.063	0.078	0.580	0.0725
50	0.069	0.066	0.090	0.087	0.089	0.070	0.067	0.082	0.620	0.0775
40	0.075	0.071	0.096	0.089	0.097	0.075	0.070	0.087	0.660	0.0825
30	0.080	0.074	0.100	0.090	0.101	0.079	0.073	0.092	0.689	0.0870
20	0.084	0.075	0.099	0.086	0.099	0.080	0.075	0.093	0.691	0.0864
10	0.075	0.070	0.091	0.074	0.094	0.073	0.070	0.089	0.636	0.0795
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.0000

Table 3-C Calculated (r-M) values at different population levels (N)

N	No. 1	No. 2	No. 3	No. 4	No. 5	No. 6	No. 7	No. 8	Total	Average
100	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
90	0.005	0.005	0.011	0.010	0.008	0.006	0.006	0.008	0.059	0.007
80	0.011	0.010	0.020	0.020	0.017	0.013	0.013	0.016	0.120	0.015
70	0.018	0.015	0.029	0.029	0.027	0.020	0.018	0.025	0.181	0.023
60	0.024	0.020	0.038	0.036	0.035	0.025	0.023	0.032	0.233	0.029
50	0.030	0.025	0.045	0.042	0.046	0.030	0.027	0.039	0.284	0.036
40	0.035	0.029	0.053	0.047	0.055	0.035	0.030	0.045	0.329	0.041
30	0.040	0.034	0.059	0.051	0.060	0.039	0.033	0.052	0.368	0.046
20	0.042	0.035	0.061	0.047	0.062	0.040	0.035	0.054	0.376	0.047
10	0.035	0.030	0.054	0.038	0.058	0.033	0.029	0.051	0.328	0.041
0	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000

ANNEX J

THE EIGHTH MEMORANDUM ON THE RESULTS OF JAPANESE STOCK ASSESSMENT OF WHALES IN THE NORTH PACIFIC

Seiji Ohsumi and Yasuaki Masaki

(Far Seas Fisheries Research Laboratory, Japan)

1. Introduction

During the 1970 season, 5 expeditions (3 Japanese and 2 USSR) and 7 land stations (1 USA and 6 Japanese) operated in the North Pacific. The catch, by species and by areas, is shown in Table 1.

Table 1. Catch of whales by Species and Areas in the North Pacific, 1970.

Area	CDW	Fin	Sei	Bryde's	Sperm
American coast	202	5	4	-	64
Area II	1,574	248	929	-	2,021
Area III	1,033	128	543*	-	1,374
Area IV	3,463	258	1,217	26	4,373
Area V	1,455	238	1,265	40	2,499
Area VI	786	58	71	-	1,000
Asian coast	2,137	77	484	73	3,484
Total	10,650	1,012	4,504	139	14,815

* Included one whale lost

The catch of fin, sei, and sperm whales was 79%, 87% and 99% respectively of the levels in 1969, but the catch of Bryde's whales increased by 56%. It is worthy of note that USSR expeditions caught Bryde's whales in the pelagic grounds for the first time in the North Pacific. Pelagic operation effort was concentrated in Area IV. The fin whale stock in the East China Sea is excluded here, because no whaling was carried out in the 1970 season as well as in 1969.

2. Fin whale

2-1. Index of abundance by means of catch statistics in the pelagic whaling ground

Index of abundance was calculated by means of Japanese whaling statistics under the following formula as shown in Table 2.

$$I_A = \sum \frac{Ci.Ai}{Wi}$$

Ci: Number of catch
Ai: Size of area
Wi: Effort, corrected by tonnage
i : 10 degree square

The observed average during the years 1965-1970 is used for the index of abundance in a square of no whaling.

Table 2. Index of abundance of fin whales in the North Pacific ground (north of 40° N)

	II	III	IV	V	VI	Total
1965	334	520	957	939	229	2,979
1966	308	422	798	1,087	360	2,974
1967	321	106	421	642	360	1,849
1968	321	252	825	1,019	490	2,906
1969	321	50	500	842	360	2,073
1970	321	288	411	933	360	2,313

It is to be noted here for Table 2 that the recent effort does not represent the true effort for the fin whale. Recently the greater part of the effort has been directed towards sei whales, that is, there has been a shift of operations into the sei whale grounds and intensified selection of sei whales which have caused the apparent abundance indices for the fin whale possibly to be biased downward.

2-2. Index of abundance by means of whale sighting in the pelagic ground

Index of abundance by means of whale sighting is calculated in the same manner as in the previous section (Table 3).

Table 3. Index of abundance of fin whales by means of whale sighting in the pelagic ground.

	II	III	IV	V	VI	Total
1965	8,340	4,540	17,620	3,060	2,960	36,520
1966	1,330	2,890	5,980	11,390	3,260	24,850
1967	3,130	2,530	5,990	3,900	2,120	17,670
1968	3,000	3,360	8,260	5,500	3,410	23,530
1969	2,200	1,890	7,960	3,460	2,510	18,010
1970	1,150	3,580	9,570	3,120	2,930	20,350

Here again it is to be noted that the estimates from the sighting data are not free from the biases, caused by shift of the main operations into the sei whale grounds. And there seems to have been no marked sign of decrease observed for the recent five years.

2-3. Estimation of population size based on population model

In the previous report, an evaluation by means of a population model and catch statistics was introduced to the fin whale stock in the North Pacific.

The present state of the fin whale population is re-evaluated as shown in Table 4.

The catch in 1970 was lower than ASY, so that the population size in 1971 has increased somewhat compared with that in 1970, and the ASY in 1971 is 1,020-1,150 in the total North Pacific. However, the present population level is much lower than the level which gives MSY.

Table 4. Population size and ASY 1971

	Asian side	American side	Total N. Pacific
Initial population size	17,000-18,000	25,000-27,000	42,000-45,000
MSY level population	10,600-11,300	15,600-16,900	26,300-28,100
MSY	480- 510	700- 760	1,180- 1,270
Population size in 1970	5,080- 7,540	7,890-10,130	12,970-17,670
Catch in 1970	373	639	1,012
Population size in 1971	5,150- 7,650	8,050-10,340	13,200-17,990
ASY in 1971	400- 460	620- 690	1,020- 1,150

3. Sei whale

3-1. Index of abundance by means of catch statistics in the pelagic whaling ground

The indices of abundance of sei whales in the pelagic whaling ground, derived in the same way as above, are shown in Table 5.

Generally speaking, there has recently been no sign of marked decrease observed.

Table 5. Index of abundance of sei whales by means of catch statistics

	II	III	IV	V	VI	Total
1965	1,014	1,464	1,340	698	71	4,588
1966	1,093	1,467	2,211	1,382	1,269	7,423
1967	1,029	1,133	1,836	2,215	1,270	7,482
1968	1,029	3,305	2,164	2,302	2,466	11,267
1969	1,029	606	469	1,024	1,269	4,398
1970	980	826	952	1,107	1,268	5,134

Since 1968, the total index appears to have decreased, although there are large fluctuations involved among areas and years.

Table 6 shows the indices of abundance by means of whale sighting.

Table 6. Index of abundance of sei whales by means of whale sighting

	II	III	IV	V	VI	Total
1965	6,910	11,920	11,490	8,360	550	39,230
1966	4,320	6,730	6,490	11,580	550	29,680
1967	4,900	6,120	9,860	12,080	610	33,570
1968	4,880	15,840	5,180	11,490	2,840	40,220
1969	2,540	13,800	11,600	5,090	60	33,100
1970	9,770	5,420	2,720	4,710	240	22,860

3-2. Estimated population size by means of population model and catch

A mathematical population model was introduced for the sei whale population as well and calculations of population size were shown at the previous meeting (SC/22/22 and SC/22/21).

The population size and ASY in 1971 are evaluated as shown in Table 7.

Population size is steadily decreasing, and while the stock on the Asian side is still above the level giving MSY, the one on the American side is very close to this level.

Table 7. Population assessment of sei whales in the North Pacific

	Asian side	American side	Total N. Pacific
Initial population size	28,000-32,000	30,000-50,000	58,000-82,000
MSY level population	15,680-18,560	17,400-29,000	33,080-47,560
MSY	1,190- 1,360	1,270- 2,120	2,460- 3,480
Population size in 1970	16,700-20,560	17,410-37,880	34,110-58,440
Catch in 1970	1,820	2,684	4,504
Population size in 1971	16,380-20,310	16,290-36,810	32,670-57,120
ASY in 1971	1,510- 1,580	1,620- 1,760	3,130- 3,340

As a whole in the North Pacific, the accumulated surplus is estimated on the average to be about 4,500. But it is to be noted that the present catch quota is higher than the ASY in 1971 of 3,130-3,340.

4. Prohibited whales

Indices of abundance in the waters north of 40°N were calculated with the same method as shown in Section 2-1 on blue, humpback and right whales. Gray whales were not sighted in 1970.

4-1. Blue whale

Table 8. Index of abundance of blue whales in the North Pacific pelagic ground (north of 40°N)

	II	III	IV	V	VI	Total
1965	210	570	1,180	660	70	2,690
1966	230	240	240	440	70	1,220
1967	190	240	610	270	30	1,340
1968	200	240	330	670	110	1,550
1969	200	240	190	260	70	960
1970	550	600	50	310	250	1,760

It seems that abundance has a tendency to increase since 1966.

4-2. Humpback whale

Table 9. Index of abundance of humpback whales in the North Pacific pelagic ground (north of 40°N)

	II	III	IV	V	VI	Total
1965	230	780	290	120	60	1,480
1966	0	990	1,380	0	60	2,530
1967	230	1,280	690	80	60	2,340
1968	280	1,050	110	140	160	1,740
1969	210	940	430	90	0	1,670
1970	730	1,670	510	100	0	3,010

The abundance of humpback whales seems the largest among three species of prohibited whales. But the tendency of increase has not yet been recognised clearly.

4-3. Right whale

Table 10. Index of abundance of right whales in the North Pacific pelagic ground (north of 40°N)

	II	III	IV	V	VI	Total
1965	40	10	140	20	0	210
1966	40	60	10	90	0	200
1967	40	110	350	20	0	520
1968	40	0	90	100	0	230
1969	0	10	130	80	0	220
1970	80	0	0	40	0	120

Abundance of this species is the lowest among the prohibited whales. It is estimated to be about one tenth of that of the humpback whale.

ANNEX K

A POPULATION MODEL AND ITS APPLICATION TO THE SPERM WHALE IN THE NORTH PACIFIC

Seiji Ohsumi and Yoshio Fukuda
(Far Seas Fisheries Research Laboratory)

At the Honolulu Meeting on Sperm Whale Biology in 1970, a variety of biological information from different sources was comprehensively discussed and then well summarized in the report (21st Report of IWC, Annex D, 1971; 40-50). Referring to the report, first of all it attempted to frame a population model of the sperm whale, to draw some aspects the model indicates for rational management, and then to evaluate the present state of the sperm whale stock in the North Pacific in the light of the theoretical findings and long records of exploitation available.

A simplified model was presented for preliminary analysis in 1968 (19th Report of IWC, Appendix VI, 1969; 39-83). Some advanced models were constructed by one of the authors at the last annual meeting, but they were still limited in scope since no consideration was given to the males except under the assumption that the female population was maintained at the unexploited level. As a matter of fact, the female sperm whales have already been under exploitation and in what follows consideration will be extended to cases where the female population is controlled at reduced levels by exploitation.

1. Formulation of model

The minimum size limits, long in practice, have primarily determined the age at recruitment to the catchable population, although they may not have worked much at the very early stage of exploitation when the accumulated larger sperm whales would have been available in abundance. The Honolulu report shows that the age at full recruitment in males, so far as available data are concerned, ranges from 18 to 28 years in pelagic grounds and 15 to 26 years in coastal grounds; in females the age at full recruitment is 18 to 22 years. The age at 50% recruitment has not yet been exactly estimated, but, at the relatively early stage of exploitation, it will be reasonably assumed to be about 15 years of age in males and 20 in females. Probably, as exploitation proceeds, it will decrease somewhat because of possible growth improvements.

The age at sexual maturity is estimated to be 19 years of age in males and 8 to 11 in females. Further, the age at social maturity in males is estimated to be 25 to 27. By definition any bull at sexual maturity can attain a harem-master status, but it is the bulls at social maturity that participate in breeding. Many ecological factors are probably concerned in determining the age at social maturity, but the ages at sexual maturity of both sexes can be reasonably assumed to decrease together with the decreasing year-class strength, and accordingly with the decreasing mature female population in a stable state.

As for pregnancy rate, the Honolulu report has noted that there exist some discrepancies in the estimates by grounds or units of population and in interpretation of them. Indeed it might depend on the stock conditions, but this terminology itself seems too vaguely defined in general to be incorporated in any population model and some additional biological evidences -- ovulation rate and so on -- appear to suggest something more than different stock conditions. In this respect, however, two observations are worthwhile to note here. The one is on the fin whales in the Antarctic, practically the only whale stock at present, for which any density dependency of the biological parameters can be confirmed by active observations. It is observed for this species that their age-specific pregnancy rates have increased more or less uniformly as stock level has been reduced (Ohsumi, unpublished). The other point is theoretical in character and was presented at the 22nd meeting. Provided that the female population be stabilized at the unexploited level, a numerical relation must hold among the following parameters; the age at sexual maturity in females, pregnancy rate, and natural mortalities for immatures and for matures.

The Honolulu meeting has arrived at a fairly good agreement that the best available estimate for natural mortality coefficient is 0.06 for adults of both sexes. Further, take into account the estimated median age at sexual maturity (9 years of age) and the widely accepted assumption that the natural mortality rate for immatures would not be smaller than that for matures, then if the pregnancy rate in the unexploited stock ranges from 0.20 to 0.25 the corresponding immature natural mortality coefficient is 0.060 to 0.085 (Ohsumi, 1970). On the basis of these two observations, and partly for convenience of calculation, it can be safely assumed here that the pregnancy rate varies from 0.25 to 0.33 as the female stock decreases that is, in terms of the average breeding cycle, it decreases from 4 to 3 years as population decreases.

Ecologically, the juvenile males leave their own nursery schools when they reach puberty. The age at puberty is estimated to be 9 to 11 years and, broadly speaking, almost the same as the age at sexual maturity in the female. Therefore, the same natural mortality rates will be assumed for these immatures of both sexes. Habitat segregation indicates possibly different natural mortalities for mature females and males, but here it is assumed that the same rate can be applied to both sexes.

It seems that there are some ambiguities involved in direct observations of the so-called harem size of the sperm whale. The Honolulu report indicates the best available average number of mature females per breeding male is 10 to 15 at the recent stage of exploitation. It is observed in the Southern Elephant Seals that this sex ratio in the breeding population might decrease as an effect of exploitation. But, here again, it is evidently premature at the present state of knowledge to assume any straightforward dependency on population level, even if it could be incorporated into the model. At the same time, it is now to be noted that the sex ratio observed in the breeding population does not imply any biologically allowable maximum for reproductive success. Indeed, this breeding sex ratio, and the age at social maturity as well, are not only biologically complicated, but also deeply involved in rational utilization of the resource. In principle, all surplus males over the minimum necessary for breeding can be removed. If this is true, it would be desirable to hold to this minimum, the number of sexually mature males of

19 years old and older. Under these circumstances, two moderately extreme values will be assumed here for these two parameters, fixed independently of population levels. It may look like unrealistic oversimplification, and practically it is partly for convenience of calculations, but by setting up some allowable ranges a wide variety of assumptions on these parameters can be taken into account, possibly sacrificing realistic conclusions.

To sum up the assumptions made in the calculations;

1) The pregnancy rate (p), 0.25 at the unexploited level, linearly increases up to 0.33 with the decreasing mature female population (S_F).

2) The immature natural mortality coefficient (M'), applied to both sexes up to the age at sexual maturity (t_m) in female, decreases linearly from 0.085 at the unexploited level to 0.050 in the same way as above.

3) The age at sexual maturity in females linearly decreases from 9.0 to 7.0 in the same manner as indicated in 1) and 2).

Given these three parameters, the annual recruitment to the mature female population (R_{mF}) can be determined in terms of the mature female population.

4) The mature natural mortality coefficient (M), applied to both sexes, 0.060 at the unexploited level, linearly decreases to 0.040 together with the reduction of the respective mature population size. Generally the male sperms are differently exploited from the female. Therefore, some additional iterations are required to meet this assumption in case of males.

5) The age at recruitment to the catchable female population (t_{cF}) linearly decreases from 20.0 to 15.0 in the same way as in 1).

Evidently, the annual recruitment must balance out the annual natural mortality to sustain the mature female population. The balance gives the sustainable yield for females at the given level of the mature female population. Given these parameters, not only the female sustainable yield (SY_F), but the annual recruitment to the catchable population (R_{cF}), and the size of the catchable female population (N_F) can be determined.

6) The age at recruitment to the catchable male population (t_{cM}) linearly decreases from 15.0 to 13.0 in the same way as above.

In addition to the male recruitment to the catchable population (R_{cM}), the possible size of the catchable male population at the unexploited level can be calculated, given t_{cM} and M.

7) As for the age at social maturity in males (t_s), two fixed values, 10 and 12, for ($t_s - t_{cM}$) are adopted for convenience in each series of calculations. It may sound somewhat unreasonable to assume that the age at social maturity linearly decreases from 25.0 to 23.0, or from 27.0 to 25.0, together with the decreasing mature female populations. Between them, however, such an assumption will include the possibility that the age at social maturity is fixed at 25.0 independently of the age of the female population.

8) For the number of mature females per breeding male (g), two moderately extreme values, 10 and 15, will be adopted.

Given these parameters, the size to be sustained (Q) of the breeding male population older than t_s can be determined corresponding to the mature female population. The annual surplus males to be removed, that is, sustainable yield from the catchable male population (SY_M), and the size of the catchable male population (N_M) can also be determined by use of the above parameters.

Some of the results are summarized in Table 1-1 (Female) and 1-2 (Male). For the males, the sustainable yield curves for the other two combinations of (g) and ($t_s - t_{cM}$) come between the cases in Table 1-2.

Table 1 - 1. Population levels and sustainable yields (Female)

S_F	R_{OF}	t_m	R_{mF}	M_F	t_{cF}	R_{cF}	N_F	SY_F
100	12.50	9.0	5.82	0.060	20.0	3.01	51.72	0.00
90	12.15	8.8	5.90	0.058	19.5	3.17	41.55	0.85
80	11.44	8.6	5.85	0.056	19.0	3.27	32.57	1.57
70	10.40	8.4	5.54	0.054	18.5	3.21	25.68	1.94
60	9.21	8.2	5.15	0.052	18.0	3.09	19.40	2.19
50	7.83	8.0	4.54	0.050	17.5	2.82	15.24	2.16
40	6.38	7.8	3.87	0.048	17.0	2.49	10.52	2.07
30	4.85	7.6	3.10	0.046	16.5	2.10	6.17	1.85
20	3.26	7.4	2.14	0.044	16.0	1.47	4.35	1.33
10	1.64	7.2	1.12	0.042	15.5	0.79	1.98	0.94
0	0.00	7.0	0.00	0.040	15.0	0.00	0.00	0.00

Table 1 - 2. Population levels and sustainable yields (Male)

				Case 1. g=15, t_s-t_c =10							Case 2. g=10, t_s-t_c =12						
S_F	R_{OM}	t_m	t_{cM}	M_M	R_{cM}	N_M (N'_M=69.8)	S_M	t_s	Q	SY_M	M_M	R_{cM}	N_M (N'_M=69.8)	S_M	t_s	Q	SY_M
100	12.50	9.0	15.0	0.052	4.26	30.8	16.9	25.0	6.67	2.79	0.054	4.21	39.1	25.2	27.0	10.0	2.21
90	12.15	8.8	14.8	0.052	4.32	29.4	15.0	24.8	6.00	2.91	0.054	4.27	39.7	22.9	26.8	9.0	2.34
80	11.44	8.6	14.6	0.052	4.28	27.8	13.5	24.6	5.33	2.94	0.053	4.26	36.1	20.7	26.6	8.0	2.46
70	10.40	8.4	14.4	0.051	4.08	25.9	11.7	24.4	4.67	2.87	0.052	4.05	33.3	18.3	26.4	7.0	2.43
60	9.21	8.2	14.2	0.050	3.82	23.5	10.0	24.2	4.00	2.74	0.051	3.79	30.1	15.7	26.2	6.0	2.34
50	7.83	8.0	14.0	0.049	3.38	20.4	8.3	24.0	3.33	2.46	0.050	3.38	26.1	13.1	26.0	5.0	2.15
40	6.38	7.8	13.8	0.048	2.90	17.1	6.5	23.8	2.67	2.15	0.048	2.90	21.9	10.5	25.8	4.0	1.92
30	4.85	7.6	13.6	0.046	2.35	13.5	4.8	23.6	2.00	1.78	0.046	2.35	17.3	7.9	25.6	3.0	1.61
20	3.26	7.4	13.4	0.044	1.64	9.3	3.1	23.4	1.33	1.27	0.044	1.64	11.9	5.1	25.4	2.0	1.15
10	1.64	7.2	13.2	0.042	0.87	4.8	1.6	23.2	0.67	0.69	0.042	0.87	6.2	2.6	25.2	1.0	0.63
0	0.00	7.0	13.0	0.040	0.00	0.0	0.0	23.0	0.00	0.00	0.040	0.00	0.0	0.0	25.0	0.0	0.00

2. Some aspects of population dynamics

Different aspects of the model will depend on whether it is the breeding or the catchable population under the minimum size limitation which is under consideration. It is worthwhile noting this because whaling is concerned with the annual sustainable yield and the catchable population size, while rational conservation is more concerned with, for instance, the breeding population, its state and structure. Thus the status of the stocks, under the present framework of exploitation, might be very much distorted from biological points of view.

Figure 1 shows the sustainable yields, against the different mature female population sizes. The upper curve for male, or combined sexes, represents a combination of the average harem size (g) = 15 and the waiting time for harem-master status, $t_s - t_{cM} = 10$, and the lower one a combination of $g = 10$ and $t_s - t_{cM} = 12$. As previously mentioned, these assumptions themselves may be biologically extreme but if any set of these parameters falls in the range assumed, irrespective of the mature female populations, then the sustainable yield from the set will come between these two curves. If, for instance, the age at social maturity is supposed fixed at 25 years of age, the sustainable yield curve will come close to the upper curve on the right hand side and between the two on the left hand side, although it shifts vertically depending on the harem size assumed.

The female sustainable yield, coming from the balance between recruitment and natural mortality, reaches its maximum at an intermediate level (around 55% of the mature female population at the unexploited level). The male sustainable yield, primarily determined by recruitment, reaches its maximum at a higher level than the female MSY level (about 75 to 78% of the mature female population at the unexploited level, depending on the assumptions). Of course, the combined MSY is attained between these two levels of the mature female population. The MSY in tonnage as well is obtained between them, but closer to the level giving the male MSY in number because of the size difference by sex.

Along the definition in the Honolulu report, the size of 19 year old and older males at each sustained level is shown as the mature male population (S_M) in Table 1-2. In contrast to the number of the breeding males assumed, it is considered a sufficiently large number of bulls is always reserved for harem-master status.

Now, consider what the model indicates in terms of the catchable population. Figure 2-1 and Figure 2-2 show the sustainable yield for female and for male separately against the respective catchable population levels. The catchable population levels there are indicated by the respective size of the unexploited stock, because the relative size of the catchable population is considered to be as observed through whaling statistics.

It is evident in Figure 2-1 that the overall picture is fairly distorted and the female sustainable yield reaches its maximum at a much lower level than that in terms of the mature female population. Of course it is due to the present framework of exploitation, under which the greater proportion of the mature females are conserved untouched, as the catchable female population decreases (Table 1-1). As for the males, it is noted, in addition to apparent distortion, that the level to be sustained when the females are unexploited is already very low in terms of the catchable population (Figure 2-2). In other words, the difference in level, amounting to about half of the possible catchable population at the unexploited level is

nothing but the accumulated surplus males to be removed. It is interesting to observe that the level of either sex giving the combined MSY is, broadly speaking, around 40% of the unexploited size. Apart from accuracy of the level itself, it is easily understood in the light of possible distortion by the present framework of exploitation that the levels giving the respective MSY come closer to each other and that the level giving the combined MSY falls in the narrower range between them.

The sustainable yields themselves primarily depend on relative magnitudes of pregnancy rate and natural mortality rate assumed. However, the changing pattern in sustainable yields against the decreasing mature female population does not seem to differ very much according to the relative magnitudes assumed, that is, the male sustainable yield generally decreases with the decreasing number of mature females, while the female sustainable yield increases up to a maximum at an intermediate level. Therefore, the sustainable yields of both sexes will come nearer each other in size, as exploitation proceeds. At the early stages of exploitation, it is true, the male yield — even any sustainability condition would not be required to be satisfied — can be much greater, but at the stages of full exploitation, especially under the minimum size limits, the sustainable yields would not be required to differ by sex so much as intuitively imagined from polygamous behaviour of the sperm whale.

These discussions do not intend to indicate that both sexes can and shall be equally exploited, but just to emphasize how and how much the pictures through whaling statistics can be distorted from a biological point of view.

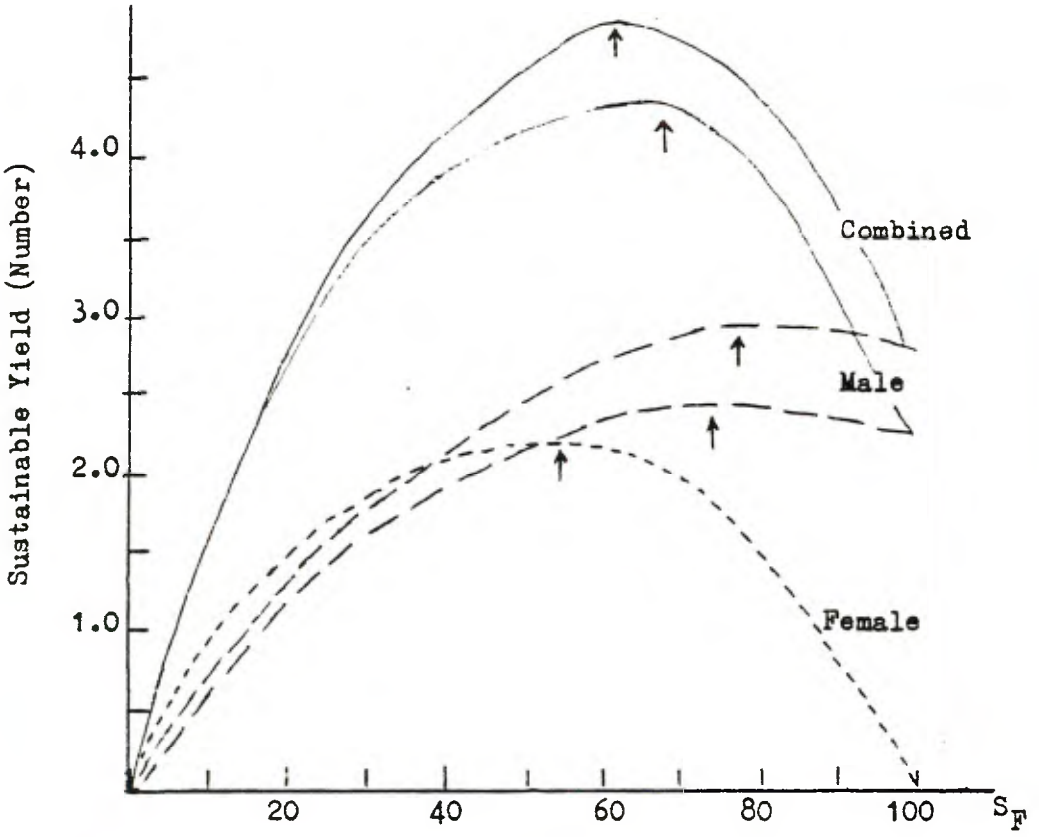
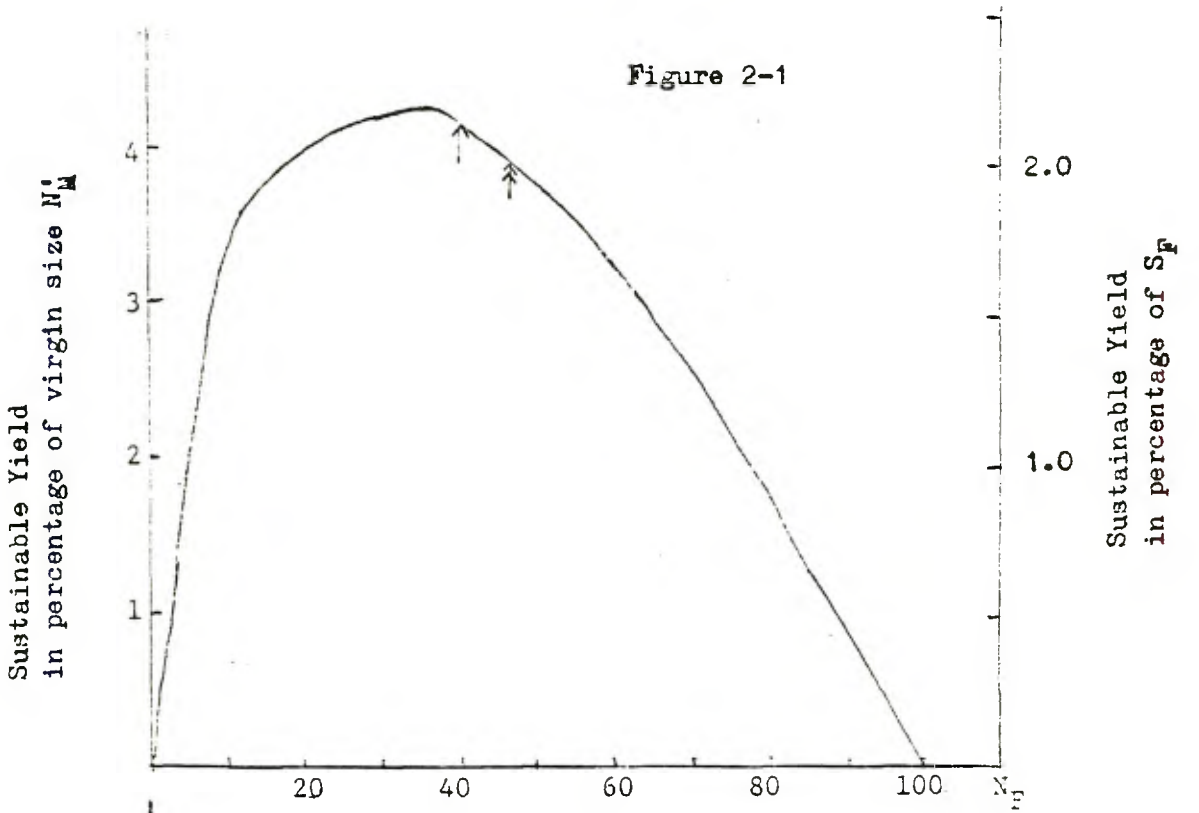


Figure 1. Sustainable Yields against Mature Female Population Levels

(Arrows indicate MSY.)



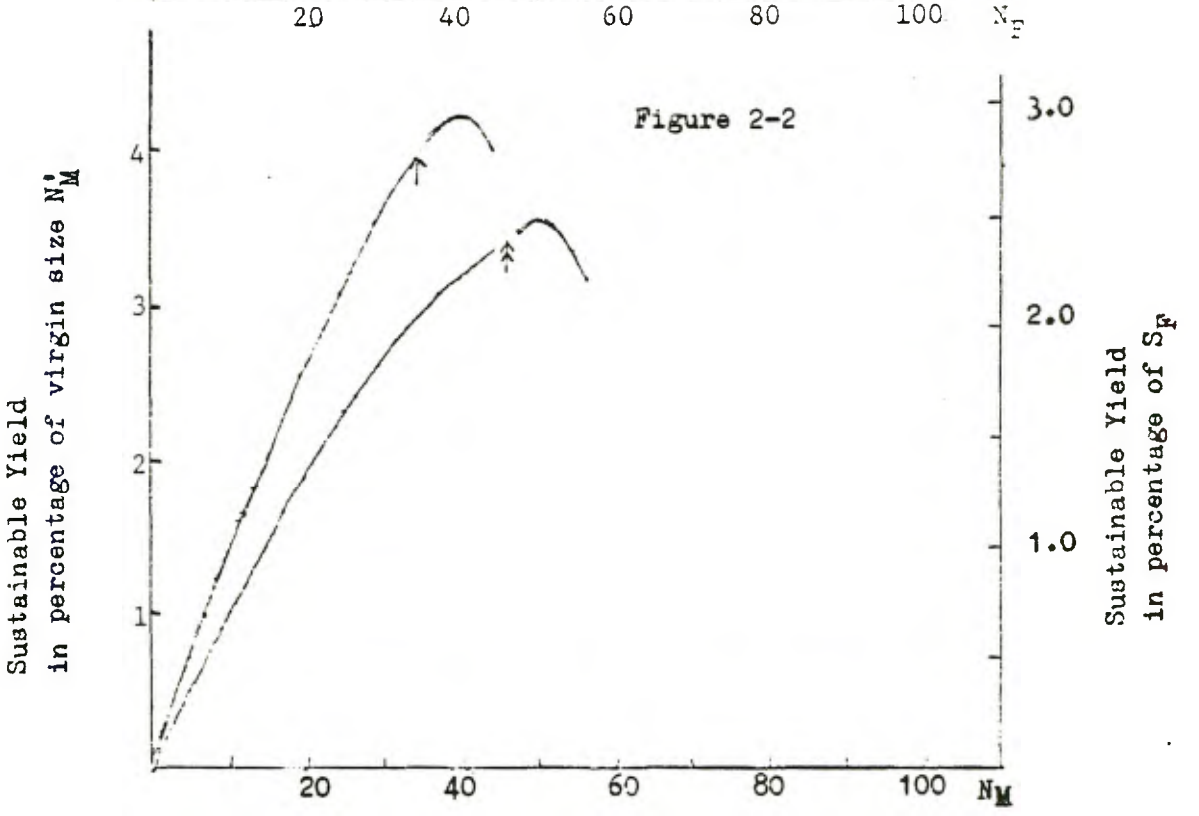


Figure 2. Sustainable Yields against the Catchable Population Levels

(Arrows indicate SY giving the combined MSY.)

3. State of the North Pacific sperm whale

It is reported (19th Report of IWC, 1969) that North Pacific whaling in the 19th century had rapidly declined since peak years in the 1830's. No detailed information is available, but catches thereafter went down to a very low level and it is assumed that the sperm whale stock, probably once very much reduced, would have recovered by the early 1900's, almost to the size of the unexploited stock. Catch statistics are now available through BIWS from 1910 onwards, but unfortunately no breakdowns by sex until 1946. These were estimated on the basis of information given by H Kasahara (1950). The results are shown in Tables 2-1 and 2-2, and in Figure 3.

Assuming that the North Pacific sperm whales were at unexploited stock levels in 1910, the size of the exploitable population at that time was estimated by one of the authors to be 167 thousand males and 124 thousand females (Doc. SC/22/21). The changes in the catchable population was then calculated successively year by year, making use of the model discussed above and catch records, as shown in Tables 2-1 and 2-2 and in Figure 4. The ASY in the tables and in Figure 3 is defined as yield by which the catchable population in the previous year will be sustained.

It is observed clearly in Figure 3 that recent development in the North Pacific sperm whaling began in 1949. Since then the catch of each sex has surpassed the respective ASY, though much greater in males (Figure 3), and the catchable population has begun to decrease appreciably (Figure 4). The female stock has now decreased to about 82% of the initial size and the male stock has decreased even more sharply to about 41% of the initial level.

The population model under consideration indicates that

1) the present female population is still at a level about 30% higher than that giving the male maximum sustainable yield. Further reduction to that level will result in an appreciable increase of the female sustainable yield, estimated to be about 3,700 at that level, comparable to the recent female catch. Possible reduction to the level giving the combined maximum sustainable yield in number would further increase the female sustainable yield up to 5,000 or so.

2) with the removal of the accumulated surplus males, the male population now stands close to the level giving the male maximum sustainable yield level or that of the combined MSY which is a little below the former level. Further reduction of males is, therefore, not desirable.

3) the catchable populations on initial stock and combined MSY levels and size of combined MSY as calculated are as follows;

	Male	Female	Combined
Initial Size	167,000	124,000	291,000
Combined MSY Levels	57,000-77,000	50,000-56,000	107,000-133,000
Combined MSY	4,800- 6,700	4,900- 5,100	9,700- 11,800

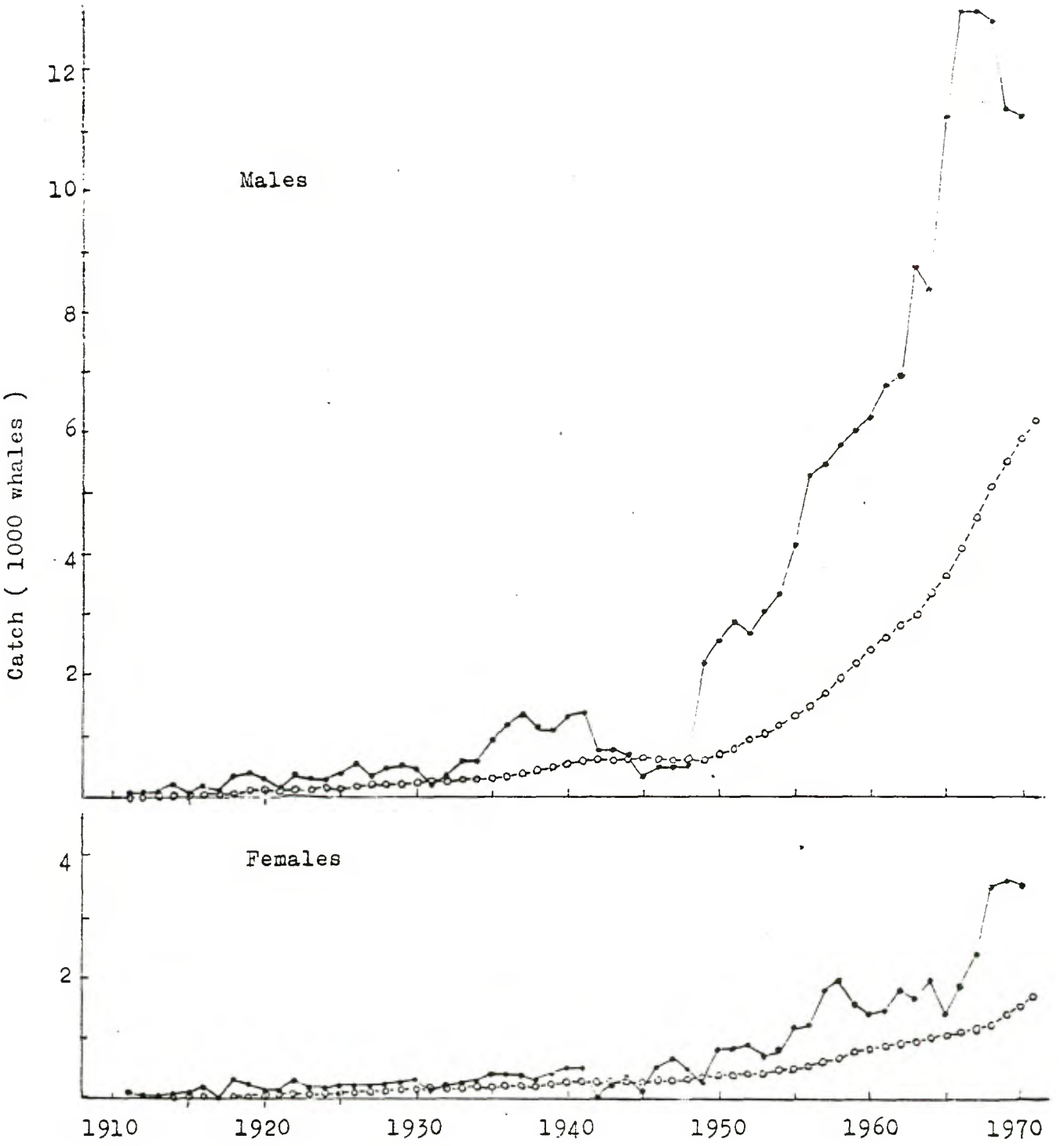


Fig.3 Progress of catch and ASY of the sperm whale in the North Pacific.

Closed circle and solid line: Catch. Open circle and broken line: ASY.

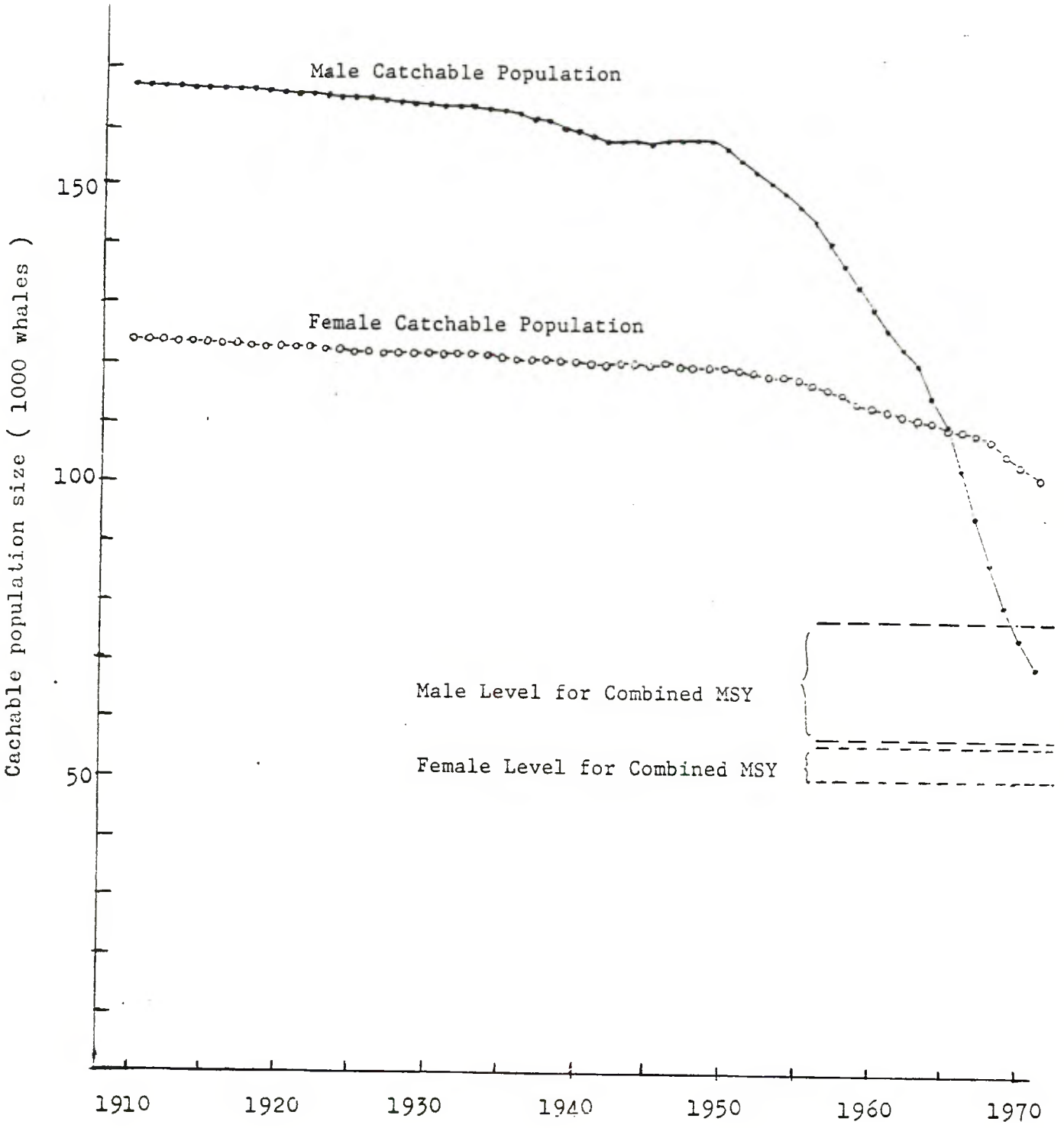


Fig. 4 Trend of size of exploitable population of male and female sperm whales in the North Pacific.

Closed circle and solid line: males. Open circle and broken line: females.

Table 2* Progress of Sperm Whaling in the North Pacific

	Female				Male			
Year	Population size	Catch	Recruit	ASY	Population size	Catch	Recruit	ASY
1911	124,000	100	7,220	0	167,000	62	9,730	0
1912	123,900	50	7,220	10	167,000	87	9,730	10
1913	123,800	40	7,220	10	166,900	89	9,730	20
1914	123,800	110	7,220	10	166,800	234	9,730	30
1915	123,700	125	7,220	20	166,600	62	9,730	40
1916	123,600	200	7,220	20	166,600	217	9,730	40
1917	123,500	10	7,220	30	166,400	117	9,730	50
1918	123,500	300	7,220	30	166,400	345	9,730	50
1919	123,200	200	7,220	50	166,100	413	9,730	70
1920	123,100	120	7,220	60	165,800	286	9,730	90
1921	123,000	160	7,220	60	165,600	143	9,730	100
1922	122,900	312	7,220	70	165,600	372	9,730	100
1923	122,700	175	7,220	80	165,300	314	9,730	120
1924	122,600	160	7,220	90	165,100	281	9,730	140
1925	122,600	220	7,220	100	165,000	391	9,740	160
1926	122,400	205	7,220	100	164,800	547	9,740	170
1927	122,300	235	7,220	120	164,400	303	9,740	200
1928	122,200	260	7,220	120	164,300	466	9,740	210
1929	122,100	265	7,220	130	164,100	499	9,740	220
1930	122,000	330	7,220	140	163,800	459	9,740	240
1931	121,800	155	7,220	150	163,600	204	9,740	250
1932	121,800	228	7,230	160	163,600	341	9,740	250
1933	121,700	255	7,230	170	163,600	613	9,750	260
1934	121,600	291	7,230	170	163,200	597	9,750	280
1935	121,500	410	7,230	190	162,900	942	9,750	300
1936	121,300	420	7,230	200	162,300	1,205	9,750	340
1937	121,100	390	7,230	220	161,500	1,342	9,750	410
1938	121,000	280	7,230	230	160,600	1,157	9,750	460
1939	120,900	400	7,230	230	160,000	1,088	9,750	500
1940	120,700	500	7,230	240	159,400	1,331	9,750	540
1941	120,500	509	7,230	260	158,700	1,381	9,750	580
1942	120,300	35	7,230	270	157,900	740	9,750	630
1943	120,500	240	7,230	260	157,800	775	9,750	630
1944	120,500	346	7,240	270	157,700	677	9,750	640
1945	120,400	109	7,240	270	157,600	363	9,750	640
1946	120,600	522	7,240	260	157,900	507	9,750	630
1947	120,300	651	7,240	280	158,000	513	9,750	620
1948	120,000	476	7,240	310	158,100	537	9,750	620
1949	119,800	238	7,240	320	158,200	2,203	9,750	620
1950	119,900	790	7,260	330	156,700	2,614	9,750	710
1951	119,400	837	7,260	370	154,900	2,899	9,750	830
1952	119,000	870	7,260	390	153,000	2,701	9,750	950
1953	118,600	730	7,260	420	151,300	3,077	9,750	1,050
1954	118,300	809	7,260	450	149,400	3,352	9,750	1,180
1955	117,900	1,171	7,260	470	147,400	4,172	9,750	1,310

* Tables 2-1 and 2-2 combined.

Table 2 (continued)

	Female				Male			
Year	Population size	Catch	Recruit	ASY	Population size	Catch	Recruit	ASY
1956	117,300	1,223	7,280	530	144,700	5,315	9,750	1,470
1957	116,600	1,794	7,280	590	140,900	5,489	9,750	1,720
1958	115,500	1,964	7,280	660	137,300	5,802	9,750	1,940
1959	114,200	1,558	7,280	760	133,700	6,056	9,750	2,190
1960	113,500	1,400	7,280	800	130,000	6,249	9,755	2,420
1961	112,900	1,451	7,290	850	126,400	5,815	9,755	2,640
1962	112,300	1,771	7,290	890	123,400	5,955	9,755	2,830
1963	111,500	1,650	7,290	960	120,500	8,760	9,755	3,020
1964	110,900	1,953	7,290	990	115,100	8,346	9,755	3,350
1965	110,000	1,442	7,290	1,050	110,400	11,236	9,755	3,640
1966	109,600	1,847	7,290	1,080	103,200	12,965	9,755	4,090
1967	108,900	2,411	7,300	1,150	94,800	12,960	9,755	4,600
1968	107,700	3,532	7,300	1,230	87,000	12,772	9,755	5,090
1969	105,500	3,605	7,300	1,370	79,700	11,329	9,755	5,530
1970	103,400	3,579	7,300	1,520	74,300	11,236	9,760	5,880
1971	101,500		7,300	1,660	69,200		9,760	6,200

ANNEX L

ASSESSMENTS OF NORTHWEST ATLANTIC FIN WHALE STOCKS

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1. Introduction

The entire Canadian effort for catching large whales is now centered in Nova Scotia and Newfoundland. Beginning in 1964 in Nova Scotia, whaling for fin whales in these waters represents a renewed effort that began in the 1890's and has been episodic from Newfoundland shores since then.

2. Tagging Evidence for Stock Identity

Six whale tagging and census cruises have been carried out in the summer months of 1966 and 1967, and the winter and spring months of 1968, 1969 and 1971. The coverage of these expeditions ranges throughout western and central North Atlantic and has resulted in extensive sighting of large and small cetaceans. One important conclusion resulting from these surveys is that fin whales are concentrated in the northwestern North Atlantic between the shore and the 1,000 fathom line, between latitudes 41°20' and 57°00' N. This area can be thought of as the summer feeding range of northwest Atlantic fin whales.

Numbers of fin whales observed per 1,000 square nautical miles have been calculated for regions of the North Atlantic ocean. Inspection of these figures indicates that the density of fin whales on the Canadian coast is approached only by the concentration of fin whales in Denmark Strait, which is representative of a stock fished by Iceland. Significant numbers of fin whales do not occur in the tropical waters of the North Atlantic during northern summer months. Thus there is strong evidence that fin whales of one or more populations concentrate on the Canadian Continental Shelf, and that this concentration is spatially separated from other concentrations in Denmark Strait in summer months.

A number of fin whales have been tagged in northwest North Atlantic waters (Mitchell, 1968, 1970). The positions of tags returned in Nova Scotian waters and Labrador - Newfoundland waters are consistent in demonstrating that a seasonal migration takes place on the continental shelf, from the region of Cape Cod in June and July up to and including waters on the central Labrador coast to 57° N latitude. Single whales probably do not make this entire trip during the period June - November, but instead the data corroborates Kellogg's (1929) suggestion that populations of fin whales on this coast are stratified and move latitudinally. Grounds occupied by a southern population in the summer are probably occupied by a northern population in the winter months.

Examining data from fin whales marked and tags returned by area in various parts of the northwest North Atlantic for years 1966 through 1970, the evidence clearly indicates that there is some interconnection, on the order of 10% or more, between the fin whale population in the Nova Scotian area and that in the Labrador area during summer months. No interchange has been demonstrated between the west Greenland area and the Labrador and Nova

Scotian areas, nor between the east Greenland - Iceland area and the Labrador - Nova Scotian area. A few fin whales have been tagged in the Gulf of St. Lawrence, and could be expected as returns in the Nova Scotian area early in the season, but to date none of these tags have been recovered. These data suggest that the fin whales in the Nova Scotian area and Labrador area, notwithstanding problems of interconnection between them, are clearly separable as a stock from the fin whale stock being fished in Denmark Strait by Iceland.

There is apparently some segregation during the migration schedule. Of approximately 22 tags returned from whales marked in the Nova Scotian area, 2 tags were from fin whales that migrated to waters off northeast Newfoundland. Both of these animals were males. On the other hand, the indicated rate of movement in nautical miles per day when compared to the age of a whale in ear plug laminations indicates that older whales have moved along the migration path more quickly than younger whales, regardless of sex, but the data is limited and this is not a conclusive finding. Partial segregation of some categories of fin whales in the migrating stream may be explained by varying times of departure from or arrival on the calving and breeding grounds.

3. History of Exploitation

In Newfoundland waters, between 1903 and 1905 many shore stations took 1,495 fin whales, an average of 498 per year. Using Lucas' (1908) estimates for 1906 and 1907, and taking 50% of the total catch as fin whales, 1,695 fins were taken between 1903 and 1907 for an average of 339 fins per year. (This adjustment makes more nearly equivalent the comparisons of catches during five years of the early period and seven years of the later period.) In the period 1945 - 1951, from stations on the northeast coast of Newfoundland only, approximately 3,250 fin whales were taken for an average of 464 per year. The early episode resulted in a fall of catches, and this along with high licensing fees, resulted in nine stations going out of business by 1907. Thus it is clear that the sustainable yield in these waters (all shores around Newfoundland) is on the order of 400 fin whales per year or less.

This finding places renewed emphasis on the catch between 1945 and 1951, in which an average of 464 fin whales per year were taken on the northeast coast, in the same waters presently being fished by the Williamsport and Dildo land stations. The termination of whaling operations in 1951 has been explained as an economic decision, the price of oil having dropped. Nevertheless, there were clear signs that effort was shifting from fin whales to blue whales, sei whales and humpback whales consistently from 1945 and 1951 inclusive, and there are other indications of overexploitation as well. Sergeant (Ms, 1966) concluded that decreasing length of the fin whale catch, the shift to sei and other species, and the increased number of undersized fin whales (which was not a matter of better inspection, inspection having remained at a consistent level throughout this fishery), all indicated overexploitation. Also confirmatory is the fact that sei whales were not a valuable whale in the late 1940's and early 1950's, thus the increasing sei whale catch represents a depletion of fin whales.

Thus it can be concluded that 464 fin whales per year is above the sustainable yield for this northeast region of the Newfoundland coast. It must be emphasized that a sizeable component (approximately 10%) of this catch, by Rose-au-Rue (to 1946), Hawkes Harbor and Williamsport whaling stations, may have been taken from the stock migrating northward from the Nova Scotian area. Thus the sustainable yield would be less than 464 whales minus 10% (464-46), or less than 418 fin whales.

Only three whaling stations have operated in the area of Nova Scotia and along the Nova Scotian and Quebec shores of the Gulf of St Lawrence. Catches in the Gulf of St Lawrence were small and consistent between 1911 and 1915.

The catch in Nova Scotian waters between 1964 and 1970, inclusive, comprises a total of 1,349 fin whales with an average of 193 per year. There is evidence that this catch is too high, thus the sustainable yield from this population is much less than 193.

4. Changes in Abundance

Sighting data from catcher vessels are available for waters off eastern Canada. Sightings of fin whales for the Chester for 1968 were 884, 714 for 1969 and 465 for 1970. The Thorarinn saw 1,746 fin whales in 1970. The West Whale 8 saw an increased absolute number of fin whales between 1969 and 1970. The Fumi saw 1,532 fin whales in 1969 and 1,477 fin whales in 1970. Thus there is a good data base. These sightings have been related to sighting effort in terms of hunting days or hours of hunting and chasing (Table 1).

Table 1. Some sightings of fin whales in the Northwest Atlantic.

STATION AND CATCHER	1966	1967	1968	1969	1970
BLANDFORD					
Chester (sightings/day)	7.8	6.3	7.3	6.2	6.8
Thorarinn (sightings/day)	-	-	-	-	13.6
DILDO					
Kyo Maru 17 (sightings/day)	4.5	-	-	-	-
R. D. Evans (sightings/day)	-	-	7.0	6.4	-
West Whale 8 (sightings/day)	-	-	7.9	6.3	6.1
WILLIAMSPORT					
Fumi (sighting/hour)	-	-	1.16	1.52	1.49
Fumi (sighting/day)	-	-	10.0	12.9	10.9

There is a trend in the data from the Chester of a drop in sightings between 1966 and 1969 with an increase 1969 to 1970, based on a steady drop in the absolute numbers of whales seen from a high of 884 to a low of 465. Availability of fin whales presumably increased to the Blandford fishery in 1970 on this evidence. There has been a steady decline in numbers of fin whales sighted by the West Whale 8. Sightings by the Fumi have remained steady. Data from analysis of catch per unit effort (Allen, 1971) are in accord with these trends.

5. Tag-recapture estimates of population size

The first tag return estimate was based upon the simple ratio: number of whales tagged/number of tags recovered = total number in population/number captured. Of 76 fin whales tagged on the 1966 cruise of the William S., three were undersized and not therefore in the population being hunted in year zero, so the number effectively marked (n_m) was 73. Up to November 10, 1966, four tags had been recovered by the Nova Scotian (Blandford) and Newfoundland (Dildo) whaling stations (n_r). To this same date, the two stations had taken a total of 372 fin whales (n_c). Then,

$$N = \frac{n_m \times n_c}{n_r} \quad , \quad N = \frac{73 \times 372}{4} \quad ,$$

N = 6,790 fin whales over 50 ft. in length.

Of the 61 fin whales tagged in western North Atlantic waters in 1967 (Mitchell, 1970), 55 were tagged west of Cape Farewell. Only 50 of these were of legal size (50 ft. long or longer).

Of the 76 fin whales tagged in 1966, 4 were recovered from a final catch of 427. The 1967 catch of 748 yielded only one tag (of year 0) placed in 1967 (year 0), but 6 tags (of year 1) placed in 1966. Utilizing data for both years:

$$N = \frac{(50 - 6 + 73 - 4)}{1 + 6} 748$$

N = 11,984 fin whales over 50 ft. in length.

This calculation is corrected for 6 fins tagged after 13 August 1967 that were moving south and not available to the fishery in the 1967 season, and for the 4 returns of 1966. It is the revised estimate of 10,566, cited by Allen (1970). For a number of reasons, the calculation is high and must be considered the maximum possible estimate of the total exploited fin whale population off eastern Canada.

Eleven tags were returned in the 1968 season. At this time, 22 tags (comprising 16%) had been returned from approximately 137 tagged fin whales. An estimate of population size based on all of these returns was 11,610 fin whales over 50 ft. in length (data mainly from returns in years 1 and 2).

These early, and all subsequent, tagging data have now been broken down by region, and detailed estimates will be reported upon in a future study. Treating whales off Nova Scotia and in the Gulf of St. Lawrence as a possibly separate stock from whales off northeast Newfoundland and east Labrador, tag returns for years 0, 1, 2, 3 and 4 can be calculated for the area (Table 2). These calculations omit entirely two tags from whales crossing between the two areas, hence are biased in this and other ways.

Table 2. Population estimates from tag - recapture experiments by year of return for fin whales tagged on Fisheries Research Board cruises, 1966 - 1970 in the Nova Scotian and Gulf of St. Lawrence region.

Year	No. Tagged	No. Caught	No. Returns	Estimate
0	111	1,164	3	43,000
1	107	903	3	32,200
2	88	585	10	5,200
3	78	323	6	4,200
4	49	169	2	4,100

The 1966 tagging effort in the Nova Scotian area was the most intensive of any in this region to date. Results (Table 3) show realistic estimates in years after year 0. The average of estimates from years 1 through 4 is approximately 3,600 fin whales.

Table 3. Population estimates from the 1966 tag - recapture experiment for fin whales tagged on Fisheries Research Board cruise of William S. in the Nova Scotian and Gulf of St. Lawrence region.

Year	No. Tagged	No. Caught	No. Returns	Estimate
1966-0	71	263	3	6,200
1967-1	67	318	3	7,100
1968-2	64	262	9	1,700
1969-3	55	154	6	1,400
1970-4	49	169	2	4,100

6. Strip Census Estimates of Population Size

The first strip census was based upon detailed logs of the 1966 tagging cruise of the William S. The track of the ship was plotted on appropriate charts, and the number of whales sighted on a given day was recorded. In order to calculate the area searched, the elapsed time run in daylight over a known course (T_e) was divided into the time on watch (T_o). The resulting percentage of time actually on watch ($T\%$), times the distance travelled (D_t), gives the distance in nautical miles over which a whale watch was kept (D_s). The average visibility, assuming that a whale could be sighted at a maximum of four miles away on the best of days, was doubled (V) and multiplied by the distance searched (D_s) giving the area searched (A_s). That is:

$$\frac{T_o}{T_e} = T\%$$

$$D_t \cdot T\% = D_s$$

$$D_s \cdot V = A_s$$

Since fin whales were not seen far off the continental shelf, south of Cape Cod or north of about 57° N on the Labrador coast, the calculations have been limited to the area of the continental shelf between 57° N and Cape Cod. Calculated from map USHO 0955, the area of the continental shelf in this region was determined to be 386,900 square miles. Addition of the daily totals of fin whales seen per unit areas searched reveals 238 fins (N_f) seen in 13,903 square miles (A_s). Then the simple ratio of areas searched divided by total area equals number of fins seen divided by the total number of fin whales:

$$\frac{A_s}{A_{total}} = \frac{N_f}{X}, \quad X = \text{total number of fin whales}$$

$$\frac{13,903}{386,900} = \frac{238}{X}, \quad X = 6,620 \text{ fin whales of all sizes}$$

Since then, the area of the continental shelf has been recalculated and is taken as 420,910 mi^2, resulting in a revised estimate of 7,205 fin whales. Fin whales comprised approximately 58% of all whales sighted.

The 1967 cruise of the Polarstar searched approximately 18,221 mi^2 on the continental shelf between 57° N and Cape Cod, sighting 137 fin whales. The resulting estimate was 3,162 fin whales. Fin whales comprised approximately 57% of all whales sighted.

These and subsequent data have been broken down by region, by direction of travel and by time. Details will be presented in a future report. Present maximum estimates, based on data from William S. (July - October, 1966) and Polarstar (July - October, 1967; May - June, 1969) cruises, are approximately 340 fin whales in the Gulf of St. Lawrence and approximately 2,800 in the remainder of the Nova Scotian area.

7. Catch per unit effort assessments

Allen (1971) used catch and effort data from the Blandford fishery for the period 1966-1969 to assess the available stock of fin whales. Taking M=0.04, and r=0.05 of the parent stock, Allen calculated the initial stock and concluded with an extrapolated estimate of the stock at the beginning of the 1970 season of 484 fin whales. Allen (1971) further concluded on the basis of changes in abundance that the effect of recent catching at the Blandford land station is quite different from that at the two northern Newfoundland stations, and that this is evidence for two distinct stocks of whales. Allen (1971) estimated the stock available off northern Newfoundland by assuming that the 8% reduction in catch per unit effort at Williamsport and Dildo was the direct result of catching. Then he calculated S_{68}, the mean stock in 1968, from

$$\frac{S_{68} - \frac{481 + 311}{2}}{S_{68}} = 0.92 ,$$

and concluded that S_{68} was approximately 5,000.

8. Conclusions

In 1966, two independent estimates of fin whale population size (one for legal-sized fins only, the other for all fins) were used along with figures on the then estimated sustained yield from Antarctic fin whales data:

$$(r-M) = .12$$
$$.12 \times 6{,}790 = 814 \text{ fins}$$
$$.12 \times 6{,}620 = 794 \text{ fins}$$

Both analyses indicated that about 800 fin whales might be killed per year off the entire Canadian east coast without seriously damaging the whale stock. This conclusion was also in accord with Sergeant's (1966 Ms) conclusion that sustained yield in the northern Newfoundland and Labrador area was approximately 400 fin whales per annum, but has not been supported by subsequent evidence.

In 1967 the estimate from tag - recapture experiments was 11,984, that from strip census data 3,162 fin whales.

The mean of the above estimates of the fin whale population in the continental shelf between Cape Cod and 57° N is approximately 7,200 whales. Taking a value of r-M as 0.08 (Allen, 1970), the sustainable yield would be about 560 fin whales for the entire northwest Atlantic population of fin whales.

There has been no significant fishery for fin whales in the Nova Scotian region in the past but the northern Newfoundland and Labrador area has been fished episodically since the 1890's. Catches averaging over 250 fin whales per year have been landed over long periods, with two periods averaging

nearly 500 per year. Picking two time series (1903-1907 and 1945-1951), it can be shown that the sustainable yield is of the order of 418 fin whales per annum or less for the stock being fished from the northeast coast of Newfoundland.

The population of fin whales in the Nova Scotian area may or may not be distinct from the population off northern Newfoundland and Labrador. Some evidence shows that the sustainable yield for the stock of fin whales being fished from Nova Scotia is less than 193 per year.

When the sustainable yield is considered from both of these populations, the total is close to that based upon census and tag - recapture data.

Sighting data show fluctuations in abundance of fin whales off Nova Scotia, a decline in abundance off the Dildo, Newfoundland station and relative stability off Williamsport, northern Newfoundland.

Canadian national quotas for fin whales have been steadily reduced in the light of additional data on the stock size of whales being fished (Table 4).

Table 4. Fin whale catch (C, mainly from IWS) and Canadian national quota (Q), 1964 - 1970.

Shore Station	1964 C/Q	1965 C/Q	1966 C/Q	1967 C/Q	1968 C/Q	1969 C/Q	1970 C/Q	1971 Q
Blandford	56/-	108/-	263/-	318/300	262/262	154/224	170/150	110
Lower Saulnierville	-/-	27/-	-/-	-/-	-/-	-/-	-/-	-
Dildo	-/-	6/-	164/-	168/250	219/219	168/188	181/225	160
Williamsport	-/-	-/-	-/-	262/250	219/219	188/188	225/225	200
Total	56/-	141/-	427/-	748/800	700/700	510/600	576/600	470

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ANNEX M

MEMORANDUM ON NORTHWEST ATLANTIC SEI WHALES

by Edward Mitchell
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Ste. Anne de Bellevue, Quebec)

Introduction

Beginning with a small catch of eight sei whales in 1966, the Blandford, Nova Scotia land station has consistently increased effort on sei whales. Catches have averaged 114 per year since 1968. Availability of sei whales to this fishery varies, and emphasis on selection for sei whales relative to fin whales has also varied.

Three hundred and ninety-six whales have been landed and examined at the Blandford, Nova Scotia land station in years 1967 through 1970. The mean length of the total catch has remained stable (44.7 ft., 43.9 ft., 44.5 ft., 44.5 ft., respectively), as did the mean length of the males and females, considered separately.

The percentage composition of the catch (in terms of female whales), has dropped between 1967 and 1970 (e.g. 41%, 41%, 39% and 37%, respectively). This trend may be due to normal fluctations in the availability of sei whales to the fishery, or changing emphasis in the fishing of sei whales at Blandford at different months within the season.

A comparison of the length of male sei whales with their occurrence through the season shows that for years 1967 through 1970 there has been a relatively consistent availability of sei whales in June and mid July and again in mid September and early to middle October.

The length of female sei whales plotted against time of occurrence throughout the season at Blandford reveals a generally similar pattern to that for males with some minor differences. The seasonal occurrence is approximately the same, June - July, and September - October. In both males and females this pattern in years 1968 - 1970 does not correspond exactly with 1967, a year in which some sei whales were taken in mid season.

Females were completely absent in the 1970 catch before the 25th of August. There was sei whale hunting effort in June and July of 1970, as demonstrated by the catch of a minimum of seven sei whales which were examined.

Although a sample of only nine fetuses is available from all sei whales examined at Blandford, the length of these fetuses plotted against time of occurrence throughout the season indicates a well defined breeding season for the population being fished.

Additional reproductive information is available for 52 females from the fishery between 1966 and 1969, which demonstrates that sei whales have been captured that do not show corpora lutea or corpora albicantia at lengths ranging from 35 ft. to 48 ft. Length at first ovulation is below 38 ft., since one animal was captured with 4 corpora at that length. Sei whales have been recorded with only one corpus at lengths between 42 and 48 feet in this fishery. The greatest number of whales with one or more corpora (14 whales or 27% of the sample) occurs at 47 ft. These whales have ovaries showing between 1 and 13 corpora. The greatest number of corpora observed in the ovaries of one whale is 17.

Geographic limits, migration and ranges are not certainly known for the population being fished. Numerous sei whales have been tagged in waters from the Labrador Sea to Northern Venezuela but to date no tags have been returned in over 396 whales examined. Sei whales have been fished off the Labrador coast in late season, August through November. Presumably sei whales migrate northward, in part through the Blandford catching field in June through mid July, and appear on the southern coast of Newfoundland in August and September on the way northward. Observations from the May - June 1969 research cruise of the Polarstar confirm numbers of sei whales in the Labrador Sea and Davis Strait. Availability of sei whales to Canadian shore stations may be episodic, and catch records reflect not only this but also the relative desirability of the species, when and if available. (Fin whales have always been favoured over sei on this coast). Since there is presently no evidence of depletion of the stock, and because effort on the sei whale is sporadic, no recommendation has yet been made for a Canadian national quota at present but the species is under study.

ANNEX N

REPORT ON SCAR WHALE OBSERVATIONS 1967/68 TO 1969/70

S G Brown (Whale Research Unit, National Institute of Oceanography)

Introduction

A programme for the collection of sightings of whales from ships of Antarctic expeditions, under the auspices of the Scientific Committee on Antarctic Research (SCAR) on behalf of the International Whaling Commission (IWC), has been in operation since the 1964/65 Antarctic summer season. An analysis of the records for the three seasons 1964/65 to 1966/67 inclusive, together with reports from the 1962/63 and 1963/64 seasons from British Antarctic Survey (BAS) vessels to the National Institute of Oceanography, was presented to the Scientific Committee of the IWC in June 1968 (Brown and Mackintosh 1969). A second analysis of the records for the three seasons 1967/68 to 1969/70 inclusive and a comparison with the earlier records, is presented here.

The main object of the programme is to find evidence of large changes in the population density of the commercially important species of whales in the Antarctic. It was originally hoped that evidence of the state of the stocks of those species (blue, humpback and southern right whales) which are at present protected might be available from the records. The tentative nature of the specific identifications made by the observers, however, precludes their use for this purpose, though the records provide a check on the state of the populations of baleen whales as a whole, in the region covered.

As in the previous report, a complete analysis of the whole of the available data has not been attempted but areas have been selected where the observations can be most easily compared with past and future records. For these selected areas, all the available sighting records have been tabulated but discussion is limited to records of large whales only.

Records available

Records of sightings are available for each of the three seasons 1967/68, 1968/69 and 1969/70 (Table 1). All the reports relate to voyages in the Falkland Islands sector of the Antarctic between about 10° and 70° West, that is in Area II and the eastern half of Area I. The vessels concerned were all operating for the BAS and the observations were made by the watch-keeping ship's officers and by BAS personnel on board the vessels. The records are in the same form as those received previously. The majority give the ship's noon position daily, with details of the hours of daylight, wind force and visibility for each day, whether or not any sightings were made. A few give this information only when a sighting was recorded.

Method of analysis

As in the previous analysis, the aim has been to calculate the number of whales sighted per unit distance steamed in conditions of good visibility on the various routes to provide a basis for comparisons with other observations made in the same areas.

The same methods were used as in the previous analysis; details are given in the previous report and need not be repeated here. The present series of observations cover many of the same passages between the different island groups and Antarctic bases as were covered by the previous series so that the numbering and classification of passages used in the first report can again be followed (Table 2).

Two passages have been added to the earlier list of classified passages; No 5a, Falkland Islands to the Argentine Islands is new, but No 15a, Halley Bay to the South Orkney Islands appeared in the unclassified passages (No 16) in the previous report. This voyage has now been repeated in the present series and the observations for both voyages (February 1967 and January 1968) appear in Table 15. The passages are shown in the key chart (Fig 1).

The passages covered by each vessel in each season are indicated in Table 3 and the coverage of passages (by half-monthly periods) for the three seasons combined, in Table 4.

Areas examined

The eighteen passages listed in Table 2 are divisible into two groups. In one the passages all involve open-sea crossings between the various island groups and the South American and Antarctic continents. The other smaller group includes passages in the inshore waters of Bransfield Strait and down the western side of the Antarctic Peninsula (Nos 11, 12, 13).

The present analysis, like the previous one, is confined to the first group of open-sea crossing indicated in the table and includes the passages examined in the previous report (Nos 1, 3-8, 14 and 15) together with Nos 5a and 15a. There are in the present series of records, no passages northward from South Georgia (No 2) and no direct voyages were made from South Georgia to the South Shetland Islands (No 9).

Results

The results of analysis of the data for the eleven passages are set out in Tables 5 to 15 inclusive. For each passage a separate table has been prepared. For passages Nos 1, 3-8 and 5a, the tables show for each half-month the number of voyages made in the period 1967/68 to 1969/70 inclusive and the total mileage steamed in good visibility. The number of whales sighted in each of the four groups, large, medium, small whales and "whales", is given and the calculated number per 1,000 miles steaming in good visibility. Details of any whales identified in each group by observers are also included.

For passages Nos 14, 15 and 15a, the tables list each voyage separately. This is done because the voyages here do not always follow the same route more or less closely as is the case with the other passages. This variation of route is a result of the variable pack-ice conditions in this region from year to year.

As in the previous analysis, the tables show that only small numbers of large whales were seen and that for some of the passages, the records are rather widely scattered.

A comparison between the records for the two periods 1962/63 to 1966/67, and 1967/68 to 1969/70, has been made for the three separate regions a Drake Strait - Scotia Sea (passages 7, 5, 4 and 8), b the northern waters (passages 1, 3 and 6), c passage 15 South Sandwich Islands to Halley Bay. In each case, in addition to sightings of large whales, the comparison includes sightings classified as unidentified "whales" since it is possible that some of these records include observations of large whales.

For the Drake Strait - Scotia Sea region (Table 16) the observations are scattered in both periods but comparisons are possible for some of the half-monthly records on each of the passages. Increased numbers of whales per 1,000 miles steaming were sighted in the 1967/70 period on passage 7 in December 1 and January 1; on passage 5 in March 2; on passage 4 in January 1 and April 1; on passage 8 in March 2. In contrast, smaller numbers were seen in this period than earlier on passage 4 in November 2, December 1 and December 2, and on passage 8 in January 1 and April 1.

For the northern waters (Table 17) comparisons between the two periods are restricted to passages 1 and 3. On passage 1 increased numbers of whales per 1,000 miles steaming were seen in the period 1967/70 in November 2, April 1 and April 2, with smaller numbers in this period than earlier in November 1 and January 1. On passage 3 larger numbers were seen in the most recent period in November 2, January 1 and April 1, and smaller numbers in February 1.

In both regions only small numbers of large whales or "whales" have been seen in either period and it is evident that what may be chance sightings of very small numbers of animals have a considerable effect on the available figures. In view of this, the comparisons which it has been possible to make provide no clear evidence of a general increase or decrease in the number of large whales present in these two regions in the more recent period compared with the earlier one.

For passage 15 (South Sandwich Islands to Halley Bay) a comparison is possible between the records for January 2 and February 1 over some or all of the years 1963, 1966 to 1970 inclusive. Only one vessel was concerned in each year and the sightings are divided into those made between 60° and 70° south latitude, and those made south of 70° south in the continental coastal waters. As in the previous analysis, there is a wide range in the numbers of animals seen in the three most recent years. There has been a big increase in the numbers of unidentified "whales" reported in January 2 in these years compared with the earlier period. There is some evidence that some at least of these unidentified "whales" in 1968 may have been minke whales but there is no information on the possible identities of this group in 1969 and 1970. For large whales there is no evidence of an increase in the numbers sighted in the most recent years in either month.

Conclusions

The results of the present analysis of the sightings records provided by the SCAR programme for the eleven passages involving crossings of the pelagic whaling grounds in Area II and part of the eastern half of Area I confirm the earlier findings that relatively few sightings are recorded in any one season and that because of the scattered nature of the records and the effects of chance sightings upon the data, comparisons must be made between series of seasons rather than between individual seasons.

A comparison of the records for eight of these passages in the two periods, 1962/63 to 1966/67, and 1967/68 and 1969/70, provides no clear evidence of any large change in the number of large whales (essentially baleen whales) present in the three main regions covered by the passages.

The tentative nature of the identifications by the observers does not permit the records to be used to provide estimates of the populations of the different baleen whale species separately. For this reason the records cannot be used to provide evidence of the state of the stocks of the protected blue, humpback and southern right whales.

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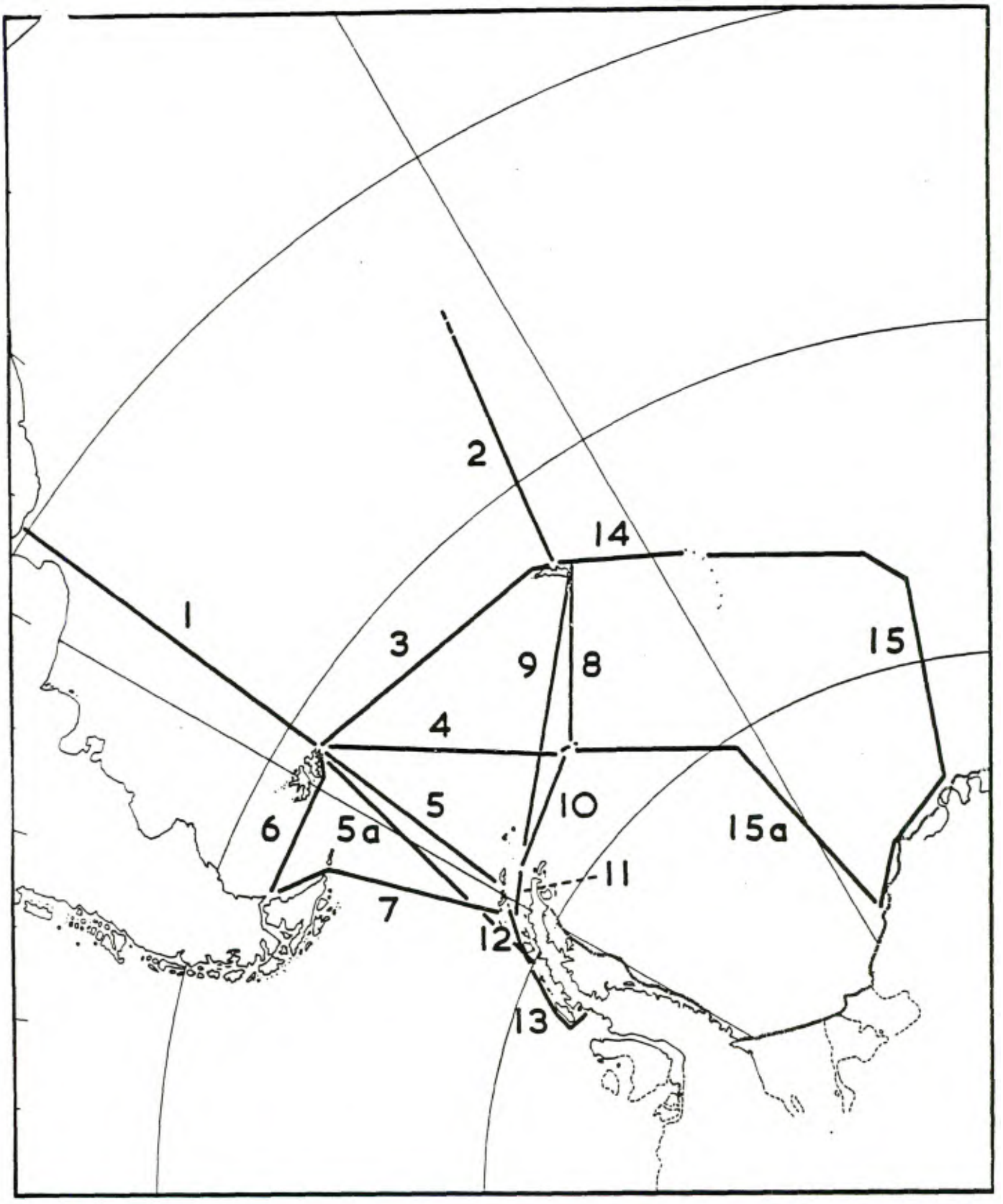


FIG.1 KEY CHART TO PASSAGES

Table 1 Whale sighting records available

Season	Vessel	Period Covered	Antarctic Area
1967/68	RRS John Biscoe	November/April	I, II
	RRS Shackleton	November/April	I, II
1968/69	RRS John Biscoe	November/April	I, II
	MS Perla Dan	December/February	II
	RRS Shackleton	November/April	I, II
1969/70	RRS John Biscoe	October/April	I, II
	MS Perla Dan	January/February	II

Table 2 SCAR Sightings Classification of Passages

A. Mainly sub-Antarctic

*1 Montevideo - Falkland Islands
2 Northward from South Georgia

B. Scotia Sea and Drake Strait (sub-Antarctic-Antarctic)

*3 Falkland Islands - South Georgia
*4 Falkland Islands - South Orkney Islands
*5 Falkland Islands - South Shetland Islands
*5a Falkland Islands - Argentine Islands
*6 Falkland Islands - Magellan Strait
*7 Magellan Strait - South Shetland Islands (Drake Strait)
*8 South Georgia - South Orkney Islands
9 South Georgia - South Shetland Islands (direct)

C. High latitudes west

10 South Orkney Islands - Bransfield Strait
11 In Bransfield Strait
12 South Shetland Islands - Anvers Island (65°S)
13 65° South - Marguerite Bay

D. High latitudes east

*14 South Georgia - South Sandwich Islands
*15 South Sandwich Islands - Halley Bay
*15a Halley Bay - South Orkney Islands

E. Other passages

16 Unclassified

*Passages analysed in the present report

Table 3. Passages covered by observing vessels in each season

	1. Montevideo to Falkland Islands	2. Northward from South Georgia	3. Falkland Islands to South Georgia	4. Falkland Islands to South Orkney Islands	5. Falkland Islands to South Shetland Islands	5a. Falkland Islands to Argentine Islands	6. Falkland Islands to Magellan Strait	7. Magellan Strait to South Shetland Islands
1967/68								
R.R.S. John Biscoe	Nov. 1 Nov. 2 Apr. 2		Nov. 2 Dec. 2 Jan. 1 Mar. 2	Dec. 1 Feb. 1 Apr. 1	Feb. 1 Mar. 2	Dec. 2		
R.R.S. Shackleton	Nov. 1 Apr. 1		Dec. 1 Dec. 2		Nov. 2 Dec. 1 Dec. 2	Mar. 1	Dec. 2 Jan. 1 Mar. 2	
1968/69								
R.R.S. John Biscoe	Nov. 2 Dec. 1 Apr. 2		Apr. 1	Jan. 2	Dec. 1		Jan. 1 Jan. 2	Jan. 1
M.S. Perla Dan	Dec. 2 Jan. 1		Feb. 1	Jan. 1				
R.R.S. Shackleton	Nov. 1 Apr. 2		Nov. 1 Nov. 2 Apr. 1	Nov. 2	Jan. 2 Feb. 1 Feb. 2 Mar. 1 Mar. 2		Mar. 2	Dec. 1 Dec. 2 Jan. 1 Mar. 1
1969/70								
R.R.S. John Biscoe	Oct. 2 Nov. 1 Apr. 2		Nov. 1 Nov. 2 Apr. 1	Nov. 2 Dec. 2 Jan. 1	Mar. 1		Mar. 2	Dec. 1 Dec. 2
M.S. Perla Dan	Jan. 1		Jan. 1 Jan. 2					

8. South Georgia to South Orkney Islands	9. South Georgia to South Shetland Islands	10. South Orkney Islands to Bransfield Strait	11. Bransfield Strait	12. South Shetland Islands to Anvers Island	13. 65°S to Marguerite Bay	14. South Georgia to South Sandwich Islands	15. South Sandwich Islands to Halley Bay	15a. Halley Bay to South Orkney Islands	16. Unclassified
Apr. 1		Dec. 1	Dec. 1		Dec. 2 Feb. 2 Mar. 1	Jan. 1	Jan. 1 Jan. 2	Jan. 2	
Dec. 2		Dec. 1 Dec. 2 Jan. 1 Jan. 2 Feb. 1 Feb. 2	Nov. 2 Dec. 1 Jan. 1 Jan. 2 Feb. 2	Jan. 1 Jan. 2 Feb. 2	Jan. 1 Jan. 2 Feb. 2				Jan. 1 Mar. 1 Mar. 2
Apr. 1		Jan. 2	Dec. 2 Jan. 1 Jan. 2	Dec. 1 Dec. 2 Jan. 2 Mar. 1	Dec. 1 Jan. 2 Feb. 1 Feb. 2 Mar. 1				
Jan. 1						Jan. 1 Jan. 2	Jan. 2 Feb. 1		
		Dec. 1 Dec. 2 Jan. 1	Dec. 1 Dec. 2 Jan. 1	Jan. 1 Feb. 2	Jan. 1 Feb. 2				Jan. 2 Feb. 1 Mar. 2 Apr. 1
Mar. 2 Apr. 1		Nov. 2 Dec. 2 Jan. 2	Nov. 2 Dec. 2 Jan. 2	Nov. 2 Dec. 1 Dec. 2 Jan. 2 Mar. 1	Dec. 1 Dec. 2 Jan. 2 Feb. 1 Feb. 2 Mar. 1				Mar. 2
						Jan. 2	Jan. 2 Feb. 1		

Table 4. Monthly coverage of passages

	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2
1. Montevideo to Falkland Islands	B.69	B.67 S.67 S.68 B.69	B.67 B.68	B.68	PD.68	PD.69 PD.70						S.68	B.68 B.69 S.69 B.70
2. Northward from South Georgia													
3. Falkland Islands to South Georgia		S.68 B.69	B.67 S.68 B.69	S.67	B.67 S.67	B.68 PD.70	PD.70	PD.69			B.68	B.69 S.69 B.70	
4. Falkland Islands to South Orkney Islands			S.68 B.69	B.67	B.69	PD.69 B.70	B.69	B.68				B.68	
5. Falkland Islands to South Shetland Islands			S.67	S.67 B.68	S.67		S.69	B.68 S.69	S.69	S.69 B.70	B.68 S.69		
5a. Falkland Islands to Argentine Islands					B.67					S.68			
6. Falkland Islands to Magellan Strait					S.67	S.68 B.69	B.69				S.68 S.69 B.70		
7. Magellan Strait to South Shetland Islands				S.68 B.69	S.68 B.69	B.69 S.69				S.69			
8. South Georgia to South Orkney Islands					S.67	PD.69					B.70	B.68 B.69 B.70	
9. South Georgia to South Shetland Islands													
10. South Orkney Islands to Bransfield Strait			B.69	B.67 S.67 S.68	S.67 S.68 B.69	S.68 S.69	S.68 B.69 B.70	S.68	S.68				
11. Bransfield Strait			S.67 B.69	B.67 S.67 S.68	B.68 S.68 B.69	S.68 B.69 S.69	S.68 B.69 B.70		S.68				
12. South Shetland Islands to Anvers Island			B.69	B.68 B.69	B.68 B.69	S.68 S.69	S.68 B.69 B.70		S.68 S.69	B.69 B.70			
13. 65°S to Marguerite Bay				B.68 B.69	B.67 B.69	S.68 S.69	S.68 B.69 B.70	B.69 B.70	B.68 S.68 B.69 S.69 B.70	B.68 B.69 B.70			

Table 4. Cont.

	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2
14. South Georgia to South Sandwich Islands						B.68 PD.69	PD.69 PD.70						
15. South Sandwich Islands to Halley Bay						B.68	B.68 PD.69 PD.70	PD.69 PD.70					
15a. Halley Bay to South Orkney Islands							B.68						
16. Falkland Islands to South Orkney Islands via Central Scotia Sea						S.68							
Scotia Sea										S.68	S.68		
Drake Strait - Scotia Sea											S.69 B.70	S.69	
Drake Strait Weddell Sea							S.69	S.69					

Key: B=R.R.S.John Biscoe; PD = M.S.Perla Dan; S = R.R.S.Shackleton

Table 5 Passage 1. Montevideo to Falkland Islands (Approximate distance 1020 miles)

	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2
No. of voyages	1/3	3 2/3	3/4	1/3	1/3	1 2/3	-	-	-	-	-	2	3
Mileage steamed in good visibility	200	2240	490	220	220	820	-	-	-	-	-	850	1020
Large whales no.	-	1	2	5	-	-						3	13/14
No./1000 miles	-	0.4	4.1	22.7	-	-						3.5	13.2
Medium whales no.	-	24	2	-	-	-						8	2
No./1000 miles	-	10.7	4.1	-	-	-						9.4	2.0
Small whales no.	-	74	20/21	14	-	35						158	12
No./1000 miles	-	33.0	41.8	63.6	-	42.7						185.9	11.8
"Whales" no.	-	1	5/6	2	-	4						1	1
No./1000 miles	-	0.4	11.2	9.1	-	4.9						1.2	1.0
Identifications:													
Large whales													
Medium whales		18 killer											
Small whales		26 Pilot whales				15 Dusky dolphins						10 Pilot whales	

Table 6 Passage 3. Falkland Islands to South Georgia (Approximate distance 760 miles)

	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2
No. of voyages	-	$2^{1}/6$	$3^{5}/6$	$^{2}/3$	$^{1}/3$	$1^{2}/3$	$^{1}/6$	1	-	-	1	3	-
Mileage steamed in good visibility	-	420	1610	410	180	810	100	480	-	-	360	340	-
Large whales no.		-	-	-	2	2	-	1			-	1	
No./1000 miles		-	-	-	11.1	2.5	-	2.1			-	2.9	
Medium whales no.		-	8	-	-	4	22	-			1	5	
No./1000 miles		-	5.0	-	-	4.9	220.0	-			2.8	14.7	
Small whales no.		-	19/20	-	-	-	-	-			12/13	18 *	
No./1000 miles		-	12.1	-	-	-	-	-			34.7	52.9*	
"Whales" no.		-	2	-	-	3	-	-			-	-	
No./1000 miles		-	1.2	-	-	3.7	-	-			-	-	
Identifications:													
Large whales								1 Finback				1 Fin	
Medium whales			1 Rorqual 4 Killer			1 Killer	22 Killer					2 Fin	
Small whales													

Table 7 Passage 4. Falkland Islands to South Orkney Islands (Approximate distance 680 miles)

	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2
No. of voyages	-	-	2	1	1	2	1	1	-	-	-	1	-
Mileage steamed in good visibility	-	-	740	390	330	620	220	490	-	-	-	130	-
Large whales no.			-	1	-	-	-	-				-	
No./1000 miles			-	2.6	-	-	-	-				-	
Medium whales no.			-	1	-	-	2	2				13	
No./1000 miles			-	2.6	-	-	9.1	4.1				100.0	
Small whales no.			10	-	-	13	31	12				2	
No./1000 miles			13.5	-	-	21.0	140.9	24.5				15.4	
"Whales" no.			-	-	-	4	-	-				4	
No./1000 miles			-	-	-	6.5	-	-				30.8	

Identifications:

Large whales

Medium whales

Small whales — 10 Peale's Porpoises; 8 Peale's Porpoises

Table 8 Passage 5. Falkland Islands to South Shetland Islands
(Approximate distance Eastern 620 miles, Western 690 miles)

	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2
No. of voyages	-	-	1 East	2 East	1+ East	-	2++ East	3 East	1 East	2 East 1 West 1	1½ East	-	-
Mileage steamed in good visibility	-	-	120	760	400	-	890	940	220	260	370	-	-
Large whales no.			-	-	-		1	1	-	-	1		
No./1000 miles			-	-	-		1.1	1.1	-	-	2.7		
Medium whales no.			-	-	-		7	28	-	-	-		
No./1000 miles			-	-	-		7.9	29.8	-	-	-		
Small whales no.			-	16	1 School		-	236+	-	2	5		
No./1000 miles			-	21.1	*		-	251.1*	-	7.7	13.5		
"Whales" no.			-	-	-		-	-	-	5	5		
No./1000 miles			-	-	-		-	-	-	19.2	13.5		

Identifications:

Large whales

Medium whales — 18 Killer

Small whales — 2 Commerson's dolphins; 74+ Pilot whales

+ Voyage in 55° W of. 57° W of regular Eastern passage.

++ 2 voyages to and from Clarence and Elephant Islands rather than King George Island.

Table 9 Passage 6. Falkland Islands to Magellan Strait
(Approximate distance 410 miles)

	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2
No. of voyages	-	-	-	-	1½	1 1/6	½	-	-	-	4	-	-
Mileage steamed in good visibility	-	-	-	-	400	130	Nil	-	-	-	770	-	-
Large whales no.					-	-	-				-		
No./1000 miles					-	-	-				-		
Medium whales no.					-	-	2				-		
No./1000 miles					-	-	(18.2)+				-		
Small whales no.					-	9	1				12		
No./1000 miles					-	69.2	(9.1)+				15.6		
"Whales" no.					-	-	-				-		
No./1000 miles					-	-	-				-		
Identifications:													
Large whales													
Medium whales							2 Killer						
Small whales					9 Commerson's dolphins								

+ Calculated on mileage steamed in daylight.

Table 10 Passage 7. Magellan Strait to South Shetland Islands
(Approximate distance Eastern 62°S 660 miles, Western 63°S 670 miles)

	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2
No. of voyages	-	-	-	2 1/3 East 1 West 1 1/3	1 2/3 West	1 3/4 West	-	-	-	2+ West	-	-	-
Mileage steamed in good visibility	-	-	-	1020	640	700	-	-	-	650	-	-	-
Large whales no.				6	1	15				-			
No./1000 miles				5.9	1.6	21.4				-			
Medium whales no.				2	-	6				-			
No./1000 miles				2.0	-	8.6				-			
Small whales no.				10	3	30				-			
No./1000 miles				9.8	Sightings *	42.9				-			
"Whales" no.				9	14	1				-			
No./1000 miles				8.8	21.9	1.4				-			
Identifications:													
Large whales				6 Fin	1 Rorqual	2 Rorquals							
Medium whales													
Small whales				10 Peale's porpoises		5 Pilot whales							

+ Includes part of a voyage west of the regular passage.

TABLE 11

Passage 8. South Georgia to South Orkney Islands
(Approximate distance 540 miles)

	Oct. 2	Nov. 1	Nov. 2	Dec. 1	Dec. 2	Jan. 1	Jan. 2	Feb. 1	Feb. 2	Mar. 1	Mar. 2	Apr. 1	Apr. 2
No. of voyages	-	-	-	-	1	1	-	-	-	-	1	2	-
Mileage steamed in good visibility	-	-	-	-	300	340	-	-	-	-	350	510	-
Large whales no.					-	-					-	-	
No./1000 miles					-	-					-	-	
Medium whales no.					3	15					-	2	
No./1000 miles					10.0	44.1					-	3.9	
Small whales no.					-	-					9	-	
No./1000 miles					-	-					25.7	-	
"Whales" no.					-	2					22	3	
No./1000 miles					-	5.9					62.9	5.9	
Identifications: Large whales													
Medium whales												2 Rorquals	
Small whales													

TABLE 12

Passage 14. South Georgia to South Sandwich Islands
(each voyage is listed separately)

		Jan. 1 Biscoe 68	Jan. 1 Perla Dan 69	Jan. 2 Perla Dan 69	Jan. 2 Perla Dan 70
Total distance steamed		410	100	310	410
Mileage steamed in good visibility		290	70	220	Nil
Large whales	no.	-	-	-	-
No./1000 miles		-	-	-	-
Medium whales	no.	1	2	-	-
No./1000 miles		3.4	28.6	-	-
Small whales	no.	-	-	-	-
No./1000 miles		-	-	-	-
"Whales"	no.	-	2	-	-
No./1000 miles		-	28.6	-	-
Identifications:					
Large whales					
Medium whales			2 Killer		
Small whales					

Table 13 Passage 15. South Sandwich Islands to Halley Bay
(Each voyage is listed separately)

		Jan 1 Biscoe 68	Jan 2 Biscoe 68	Jan 2 Perla Dan 69	Jan 2 Perla Dan 70	Feb 1 Perla Dan 69	Feb 1 Perla Dan 70
Total distance steamed		1200	160	1630	1730	120	130
Mileage steamed in good visibility		910	160	1320	1360	20	130
Large whales	no.	8	-	28	4	-	-
No./1000 miles		8.8	-	21.2	2.9	-	-
Medium whales	no.	9	-	35/36	-	-	-
No./1000 miles		9.9	-	26.9	-	-	-
Small whales	no.	2	-	-	-	-	-
No./1000 miles		2.2	-	-	-	-	-
"Whales"	no.	6	49+	31	310+	2	5
No./1000 miles		6.6	306.3*	23.5	227.9*	100.0	38.5
Identifications:							
Large whales		8 Fin		22 Sei	4 Rorquals		
Medium whales		4 Killer		15/16 Killer, 7 Minke			
Small whales							

Table 14. Passage 5a. Falkland Islands to Argentine Islands
(Approximate distance 860 miles)

	Dee 2	Mar 1
No. of voyages	1	1
Mileage steamed in good visibility	590	360
Large whales no.	3	3
No./1000 miles	5.1	8.3
Medium whales no.	8	2
No./1000 miles	13.6	5.6
Small whales no.	-	7/8
No./1000 miles	-	20.8
"Whales" no.	11	-
No./1000 miles	18.6	-
Identifications:		
Large whales	2 Sperm	
Medium whales		
Small whales		

Table 15. Passage 15a. Halley Bay to South Orkney Islands
(Each voyage is listed separately)

	Jan 2 Biscoe 68	Feb 1 Biscoe 67
Total distance steamed	1050	1120
Mileage steamed in good visibility	550	970
Large whales no.	2	-
No./1000 miles	3.6	-
Medium whales no.	4	11
No./1000 miles	7.3	11.3
Small whales no.	-	-
No./1000 miles	-	-
"Whales" no.	16	2
No./1000 miles	29.1	2.1
Identifications:		
Large whales		
Medium whales	3 Killer	8 Minke 2 Rorquals
Small whales		

Table 16. Comparison of sightings of large whales (L) and "whales" (W) on passages in the Drake Strait - Scotia Sea region in the two periods 1962/63 - 1966/67 and 1967/68 - 1969/70

		Passage 7				Passage 5				Passage 4				Passage 8			
		1962/67		1967/70		1962/67		1967/70		1962/67		1967/70		1962/67		1967/70	
		L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W
	Mileage	300		-		190		-		-		-		-		-	
Nov 1	Whales	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Whales/1,000 miles	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
	Mileage	-		-		360		120		1010		740		270		-	
Nov 2	Whales	-	-	-	-	1	-	-	-	1	9	-	-	-	-	-	-
	Whales/1,000 miles	-	-	-	-	2.8	-	-	-	1.0	8.9	-	-	-	-	-	-
	Mileage	1010		1020		770		760		1360		390		280		-	
Dec 1	Whales	-	4	6	9	-	-	-	-	8	-	1	-	-	-	-	-
	Whales/1,000 miles	-	4.0	5.9	8.8	-	-	-	-	5.9	-	2.6	-	-	-	-	-
	Mileage	-		640		-		400		670		330		-		300	
Dec 2	Whales	-	-	1	14	-	-	-	-	2	3	-	-	-	-	-	-
	Whales/1,000 miles	-	-	1.6	21.9	-	-	-	-	3.0	4.5	-	-	-	-	-	-
	Mileage	1630		700		1000		-		1410		620		140		340	
Jan 1	Whales	-	-	15	1	-	-	-	-	2	-	-	4	-	2	-	2
	Whales/1,000 miles	-	-	21.4	1.4	-	-	-	-	1.4	-	-	6.5	-	14.3	-	5.9
	Mileage	220		-		650		890		-		220		200		-	
Jan 2	Whales	-	-	-	-	1	-	1	-	-	-	-	-	3	-	-	-
	Whales/1,000 miles	-	-	-	-	1.5	-	1.1	-	-	-	-	-	15.0	-	-	-
	Mileage	-		-		350		940		100		490		-		-	
Feb 1	Whales	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-
	Whales/1,000 miles	-	-	-	-	-	-	1.1	-	-	-	-	-	-	-	-	-
	Mileage	310		-		390		220		-		-		110		-	
Feb 2	Whales	7	-	-	-	2	-	-	-	-	-	-	-	1	-	-	-
	Whales/1,000 miles	22.6	-	-	-	5.1	-	-	-	-	-	-	-	9.1	-	-	-

Table 16. Cont.

		Passage 7				Passage 5				Passage 4				Passage 8			
		1962-67		1967-70		1962-67		1967-70		1962-67		1967-70		1962-67		1967-70	
		L	W	L	W	L	W	L	W	L	W	L	W	L	W	L	W
	Mileage	250		650		-		260		110		-		170		-	
Mar 1	Whales	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-	-
	Whales/1,000 miles	-	-	-	-	-	-	-	19.2	-	-	-	-	-	-	-	-
	Mileage	-		-		1400		370		-		-		440		350	
Mar 2	Whales	-	-	-	-	2	-	1	5	-	-	-	-	-	-	-	22
	Whales/1,000 miles	-	-	-	-	1.4	-	2.7	13.5	-	-	-	-	-	-	-	62.9
	Mileage	210		-		100		-		200		130		240		510	
Apr 1	Whales	3	-	-	-	-	-	-	-	1	-	-	4	2/3	-	-	3
	Whales/1,000 miles	14.3	-	-	-	-	-	-	-	5.0	-	-	30.8	10.4	-	-	5.9

Table 17. Comparison of sightings of large whales (L) and "whales" (W) on passages in northern waters in the two periods 1962/63 - 1966/67 and 1967/68 - 1969/70

		Passage 1				Passage 3				Passage 6			
		1962-67		1967-70		1962-67		1967-70		1962-67		1967-70	
		L	W	L	W	L	W	L	W	L	W	L	W
Oct.2	Mileage	690		200		-		-		-		-	
	Whales	-	-	-	-	-	-	-	-	-	-	-	-
	Whales/1,000 miles	-	-	-	-	-	-	-	-	-	-	-	-
Nov.1	Mileage	1170		2240		190		420		260		-	
	Whales	2	-	1	1	-	-	-	-	-	3	-	-
	Whales/1,000 miles	1.7	-	0.4	0.4	-	-	-	-	-	11.5	-	-
Nov.2	Mileage	3070		490		1720		1610		140		-	
	Whales	10	2/3	2	5/6	-	-	-	2	-	-	-	-
	Whales/1,000 miles	3.3	0.9	4.1	11.2	-	-	-	1.2	-	-	-	-
Dec.1	Mileage	-		220		-		410		-		-	
	Whales	-	-	5	2	-	-	-	-	-	-	-	-
	Whales/1,000 miles	-	-	22.7	9.1	-	-	-	-	-	-	-	-
Dec.2	Mileage	-		220		-		180		-		400	
	Whales	-	-	-	-	-	-	2	-	-	-	-	-
	Whales/1,000 miles	-	-	-	-	-	-	11.1	-	-	-	-	-
Jan.1	Mileage	1020		820		310		810		-		130	
	Whales	7	-	-	4	-	-	2	3	-	-	-	-
	Whales/1,000 miles	6.9	-	-	4.9	-	-	2.5	3.7	-	-	-	-
Jan.2	Mileage	340		-		-		100		-		-	
	Whales	1	-	-	-	-	-	-	-	-	-	-	-
	Whales/1,000 miles	2.9	-	-	-	-	-	-	-	-	-	-	-
Feb.1	Mileage	210		-		540		480		-		-	
	Whales	-	-	-	-	-	8/9	1	-	-	-	-	-
	Whales/1,000 miles	-	-	-	-	-	15.8	2.1	-	-	-	-	-
Feb.2	Mileage	1280		-		550		-		-		-	
	Whales	1	-	-	-	5/6	-	-	-	-	-	-	-
	Whales/1,000 miles	0.8	-	-	-	10.0	-	-	-	-	-	-	-
Mar.1	Mileage	-		-		410		-		660		-	
	Whales	-	-	-	-	-	-	-	-	-	-	-	-
	Whales/1,000 miles	-	-	-	-	-	-	-	-	-	-	-	-
Mar.2	Mileage	-		-		-		360		290		770	
	Whales	-	-	-	-	-	-	-	-	-	-	-	-
	Whales/1,000 miles	-	-	-	-	-	-	-	-	-	-	-	-
Apr.1	Mileage	600		850		750		340		190		-	
	Whales	-	-	3	1	-	-	1	-	-	-	-	-
	Whales/1,000 miles	-	-	3.5	1.2	-	-	2.9	-	-	-	-	-
Apr.2	Mileage	1610		1020		320		-		-		-	
	Whales	-	-	13/14	1	-	-	-	-	-	-	-	-
	Whales/1,000 miles	-	-	13.2	1.0	-	-	-	-	-	-	-	-

Table 18. Comparison of sightings of large whales and "whales" in January 2 and February 1 in different years on passage 15 (South Sandwich Islands to Halley Bay)

		1963	1966	1967	1968	1969	1970
January 2	Miles Steamed	1120	980	1570	160	1320	1360
	Large Whales 60°/70°S	11	1	35/37	-	12	-
	" " S. of 70°S	101	16	23/24	-	16	4
	" " Total	112	17	58/61	-	28	4
	Large Whales/1000 miles	100.0	17.3	37.9	-	21.2	2.9
	"Whales" 60°/70°S	2	1	2	-	19	56+
	" S. of 70°S	1	2	1	49+	12	254+
	" Total	3	3	3	49+	31	310+
	"Whales"/1000 miles	2.7	3.1	1.9	306.3*	23.5	227.9*
February 1	Miles Steamed	1030	870	-	-	20	130
	Large Whales 60°/70°S	12	12			-	-
	" " S. of 70°S	15	6			-	-
	" " Total	27	18			-	-
	Large Whales/1000 miles	26.2	20.7	-	-	-	-
	"Whales" 60°/70°S	2	6			-	-
	" S. of 70°S	-	37/38			2	5
	" Total	2	43/44			2	5
	"Whales"/1000 miles	1.9	50.0	-	-	100.0	38.5

APPENDIX V

INTERNATIONAL WHALING COMMISSION

INCOME AND EXPENDITURE ACCOUNT FOR THE YEAR ENDED 31ST MAY 1971

EXPENDITURE				INCOME		
Previous Year				Previous Year		
£		£	£	£		£
	Secretary's Remuneration:-				Contributions for 1970/71	
750.00	Salary	750.00		5,250.00	14 Contracting Governments at £350 each	4,900.00
167.66	Social Security contributions including Selective Employment Tax	173.79	923.79		Other Income	
	Administrative, Clerical and Typing Staff provided by Ministry of Agriculture, Fisheries and Food: Rent for the Secretary's Office, and overhead expenses			450.89	Interest on Investments	298.48
1,810.65	of the Ministry		1,770.75			
1,021.43	Stationery, Printing and Postage		808.84			
	Cost of Meeting					
1,880.27	22nd Annual Meeting June 1970		2,033.86			
	Whale Marking					
500.00	Contribution to National Institute of Oceanography		500.00			
500.25	Contribution to Bureau of International Whaling Statistics, Norway		500.00	929.37	Balance: being excess of expenditure over income, transferred to Balance Sheet	1,338.76
£6,630.26			£6,537.24	£6,630.26		£6,537.24

INTERNATIONAL WHALING COMMISSION

BALANCE SHEET 31ST MAY 1971

LIABILITIES					ASSETS		
Previous Year				Previous Year			
£		£	£	£		£	£
	Creditors:						
23.55	Ministry of Agriculture, Fisheries and Food	26.08		441.34	Cash at Paymaster General		689.38
1,300.00	Others	576.29					
			602.37		Outstanding contributions:		
					∮ Argentina 1970/71	350.00	
					Mexico 1970/71	244.54	
					Panama 1970/71	349.02	
	Income and Expenditure Account:						
				692.75			943.56
	Balance at 31st May 1970	4,391.67					
					Investment in Local Authority		
	Less			4,500.00	Loans		2,000.00
	Balance transferred from 1970/71	1,338.76			Sundry debtors:		
					Accrued interest on Local		
4,391.67			3,052.91	81.13	Authority Loans		22.34
£5,715.22			£3,655.28	£5,715.22			£3,655.28

∮ Remittance in settlement of the outstanding contribution was received from the Government of the Republic of Argentina in September, 1971

(Signed.) R. Stacey
Secretary
International Whaling Commission
28th October, 1971

I have examined the above Account and Balance Sheet. I have obtained all the information and explanations that I have required, and I certify, as the result of my audit, that in my opinion the above Account and Balance Sheet are correct.

Exchequer and Audit Department
14th December, 1971

(Signed.) D. B. Pitblado
Comptroller and Auditor General

APPENDIX VI

SUMMARY OF INFRACTIONS

ANTARCTIC SEASON 1970/71						OUTSIDE ANTARCTIC 1970				
Whales taken	Undersized whales		Lactating whales	Whales lost	Whales remaining in sea over 33 hours	Whales taken (2')	Undersized whales		Lactating whales	Whales lost
	No.	%					No.	%		
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
				BLUE WHALES						
-	-	-	-	-	-	-	-	-	-	-
				FIN WHALES						
2,887	14	0.48	8	3	-	1,679	19	1.13	1	1
				OTHER BALEEN WHALES						
6,151	17	0.28	8	2	-	4,745	15	0.32	-	2
				SPERM WHALES						
(1') 6,055	352	5.81	14	5	-	17,460	392	2.24	17	25

Note: (1') The number of sperm whales taken in the Antarctic season includes the catch of the Antarctic pelagic expeditions north of 40° south latitude.

(2') The numbers shown of whales taken outside the Antarctic do not include the catch of the countries from whom no infractions reports were received.

APPENDIX VII

TABLE SHOWING OIL PRODUCTION ETC. 1960/61 TO 1970/71

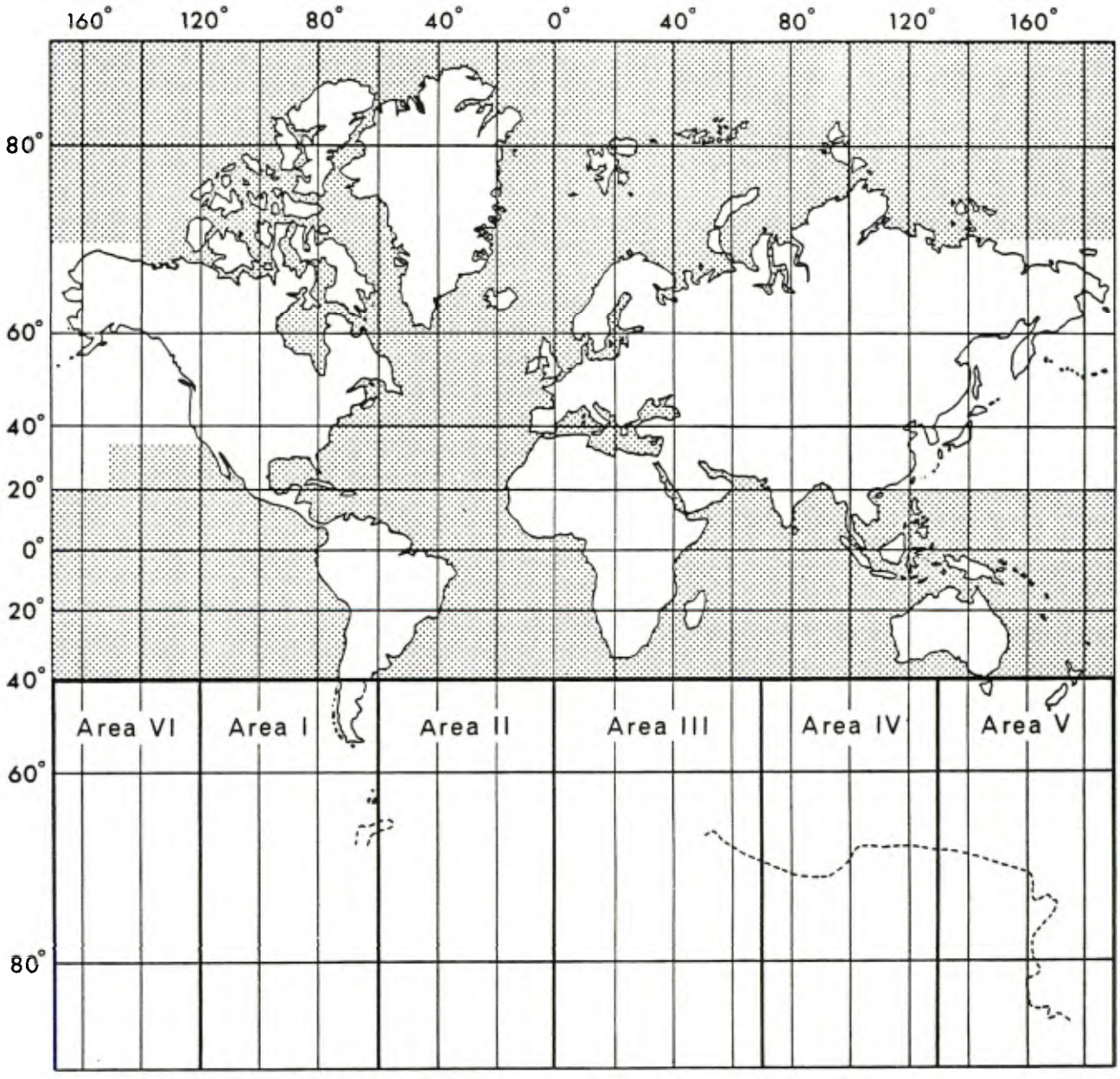
Year (1)	ANTARCTIC PELAGIC WHALING					LAND STATIONS SOUTH GEORGIA	OUTSIDE THE ANTARCTIC	TOTAL
	Baleen Season	No. of floating factories	No. of catchers	No. of blue whale units (3)	Oil production in barrels (2)	Oil production in barrels (2)	Oil production in barrels (2)	Oil production in barrels (2)
1960/61	28 Dec. 60-7 April 61	21	252	16,433	2,123,157	109,727	692,852	2,925,736
1961/62	12 Dec. 61-7 April 62	21	261	15,253	2,001,961	49,815	744,376	2,796,152
1962/63	12 Dec. 62-7 April 63	17	201	11,306	1,495,779	-	925,045	2,420,824
1963/64	12 Dec. 63-7 April 64	16	190	8,429	1,299,476	41,282	887,722	2,228,480
1964/65	12 Dec. 64-7 April 65	15	172	6,987	1,017,611	45,805	929,194	1,992,610
1965/66	12 Dec. 65-7 April 66	10	128	4,085	634,299	9,964	865,391	1,509,654
1966/67	12 Dec. 66-7 April 67	9	121	3,511	600,666	No whaling	874,983	1,475,649
1967/68	12 Dec. 67-7 April 68	8	97	2,804	419,046	No whaling	825,954	1,244,000
1968/69	12 Dec. 68-7 April 69	6	85	2,472	423,880	No whaling	817,732	1,241,612
1969/70	12 Dec. 69-7 April 70	7	85	2,477	461,285	No whaling	766,231	1,227,516
1970/71	12 Dec. 70-7 April 71	6	86	2,474	470,281	No whaling	Not yet available	Not yet available

(1) The years indicated in this column cover not only the Antarctic Season, but also the catches outside the Antarctic in the second of the two years. The 1970/71 figures are provisional.

(2) Barrel = 170 kg. or about 1/6th long ton (1long ton = 1,016 kg.).

(3) The limit governing the Antarctic pelagic whaling countries was suspended in 1960/61 and 1961/62, and set at 10,000 blue whale units in 1963/64. No catch limit was agreed upon for the 1964/65 season, but the limit was further reduced for the 1965/66 season to 4,500 units, for the 1966/67 season to 3,500 units and to 3,200 units for 1967/68 and 1968/69. For the 1969/70 and 1970/71 seasons the limit was set at 2,700 blue whale units.

Appendix VIII



Map of world showing Antarctic areas and (dotted) regions closed to factory ships for the purpose of taking and treating baleen whales

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