Annex H

Report of the Sub-Committee on the Comprehensive Assessment of Humpback Whales

Members: Hammond (Chair), Baker, Baldwin, Bando, Bannister, Berggren, Best, Brandão, Brownell, Butterworth, Carlson, Childerhouse, Clapham, Clark, C., Clark, E., Collins, Dalebout, Diake, Donahue, Donovan, Ensor, Friday, Fujise, Fulford-Gardiner, Gales, Garrigue, George, Goodman, Goto, Grønvik, Gunnlaugsson, Hakamada, Hatanaka, Haug, Hedley, Hester, Iniguez, Ishikawa, Johnston, Kasuya, Kell, Kim, Kingsley, Kock, Larsen, Matsuoka, Mattila, Melnikov, Mikhalev, Minton, Miyashita, Morishita, Murase, Nagahata, Nagatomo, Nishiwaki, Northridge, Ohsumi, Øien, Okamura, Oosthuizen, Palsbøll, Pastene, Peddemors, Perrin, Pike, Punt, Rademeyer, Rambally, Reeves, Ridoux, Robbins, Rogan, Rosenbaum, Rowles, Sadler, Sakamoto, Schweder, Shimada, Simmonds, Smith, Swartz, Tamura, Taylor, Thiele, Urban-Ramirez, Van Waerebeek, Víkingsson, Wade, Wakako, Walløe, Weinrich, Williams, Witting, Yamamura, Yasunaga, Yoshida, Zeh, Zenitani, Zerbini.

1. CONVENOR'S OPENING REMARKS

Hammond welcomed the participants. He noted that the sub-committee would continue work on the Comprehensive Assessment of North Atlantic humpback whales, begun last year. The sub-committee would also be responsible for reviewing continuing work on the Comprehensive Assessment of Southern Hemisphere humpback whales.

2. ELECTION OF CHAIR AND APPOINTMENT OF RAPPORTEURS

Hammond was elected Chair. Clapham undertook the duties of rapporteur, with assistance from Robbins.

3. ADOPTION OF AGENDA

The adopted agenda is given as Appendix 1. The Chair appointed Childerhouse to convene a Working Group to deal with Item 6.

4. REVIEW OF DOCUMENTS

Documents identified as containing information relevant to the sub-committee included: SC/54/H1-23; SC/54/IA16; SC/54/O10, 12, 14.

5. NORTH ATLANTIC HUMPBACK WHALES

5.1 New information

5.1.1 Population structure and stock identity

Incidental observations of humpback whales given in the logbooks of 19th century American whalers (those primarily targeting other species, particularly sperm whales) were summarised in SC/54/H22. Although these data are difficult to interpret without knowledge of effort, they are of interest in that they show humpback whales in locations where little or no survey effort has occurred in recent times. In particular, a surprising number of whales were reported on, or to the west of, the Mid-Atlantic Ridge. Although some of these undoubtedly represent whales migrating north to feeding grounds, sightings in summer (June and July) are difficult to explain in this way, and may represent animals in previously unknown mid-ocean feeding habitats. Clark noted that singing is common on the Mid-Atlantic Ridge from November through March; no acoustic sampling had occurred there during June, July and August. Acoustic sampling in this region in summer would be useful in the future.

A query was raised regarding the distribution of the sperm whaling effort on which these incidental observations were based. Examination of Townsend's (1935) charts of sperm whale catches suggested that the logbooks examined in SC/54/H22 were reasonably representative of sperm whaling activity. The relatively larger number of sightings on the Western Ground suggested that humpbacks were more abundant in the central North Atlantic than on the sperm whaling grounds to the west (notably in May and June). The lack of sightings between the Western Ground and the Cape Verde Islands could be due to a lack of whales or an absence of effort.

Palsbøll noted that he had recently analysed three biopsy samples taken on a US research cruise in the eastern Caribbean; one of these matched (by microsatellite genotyping) an individual sampled in the Barents Sea. This represents the first match (either photographic or genetic) between the eastern Caribbean and the northeastern North Atlantic.

The sub-committee repeated its request from previous years that samples and photographs from the St Vincent hunt be submitted to the appropriate central archives for comparison to existing material (specifically the North Atlantic Humpback Whale Catalogue at the College of the Atlantic in Maine, and the YoNAH genetic database at the University of California at Berkeley). Lawrence informed the sub-committee that photographs had been taken and that

tissue samples would be analysed in collaboration with Japanese colleagues. Hester reported that a collaborative project among eastern Caribbean countries had been initiated to collect photo-identification data. The sub-committee encouraged further collaboration and looked forward to results next year. This is discussed further under Item 5.4.

5.1.2 Catches and incidental takes

Intersessional work attempting to improve estimates of historical removals of humpback whales was presented. Searches of historical archives in Maine and in Provincetown, Massachusetts yielded a modest amount of new information (SC/54/H16). To refine estimates of catches from the West Indies and the Cape Verde Islands, whaling logbooks from an additional stratified sample were read. From this, the proportions of voyages attempting to take humpback whales, and the average number of whales landed per voyage were estimated. These figures were then multiplied by the total number of voyages that were known or thought to have gone to the West Indies or Cape Verdes to provide an overall estimate of humpback whales landed in these areas. The resulting figures generally corroborate previous work, but improve the accuracy of removal estimates and provide measures of precision that were lacking in these earlier studies.

A struck and lost rate of 1.85 was applied to West Indies and Cape Verde non-mechanised shore fisheries up to 1957; this was derived from information given in Mitchell and Reeves (1983). A rate of 1.23 was used for catches after 1957; this was derived from data given in Price (1985), and reflects the fact that use of power boats to tow dead whales resulted in a decrease in the struck and lost rate.

Vikingsson reported the bycatch of a single humpback in Icelandic waters in 1998.

The new data were added to existing records of removals; these are listed by year in Appendix 2. It was stressed that these figures were provided for use in the assessment model and while they represent plausible estimates they should not be taken as absolute values. However, they are best rather than minimum estimates, with the possible exception of a shore-based fishery in the Cape Verde Islands (searches for information on which have not been conducted). Current knowledge suggests that there are no substantial gaps in the catch history as presented. Rambally pointed out that some historical data on shore whaling at St Lucia were available but have yet to be incorporated into the catch history. Reeves responded that if any of the oil initially landed at St Lucia had been exported via St Vincent, it probably would have been taken into account, but that direct examination of the St Lucia Blue Books was nevertheless desirable.

Hester reported the catch of a 55ft non-lactating female and a 28ft male (no milk present in stomach) at Bequia on 27 March 2002. He stated that photos and skin samples had been taken. However, he noted that the animal's ventral side may not have been not have been photographed due to problems turning it over. More specific information on these catches is given in SC/54/ProgRep St Vincent and the Grenadines. Hester confirmed that a straight line measurement was used to determine length. However, the whale was measured in water, which would have been logistically more difficult and may have introduced a measurement error. Brownell and Clapham noted that a length of 55ft for a North Atlantic humpback whale was highly improbable (Clapham and Mead, 1999) and suggested that this reflected a measurement error.

5.1.3 Abundance and trends

Information on humpback whales was presented for the Icelandic component of the NASS-95 survey, with an estimate of abundance that was revised from that presented to the sub-committee last year (SC/54/H10). The revised estimate was 13,900, with a wide confidence interval (95% CI = 3,900-29,000). SC/54/H10 also presented estimates for each of the two vessels separately. One of these, 7,900 (CV = 0.22) for the vessel AFR was considered by the sub-committee to be the most appropriate estimate for inclusion as input into the assessment model (see Item 5.2). An estimate of abundance for Icelandic nearshore waters from the NASS-2001 aerial survey (SC/54/H2) was given as 3,057 (95% CI = 1,727-5,410). However, this survey did not sample the entire area and the analysis did not account for availability bias; these are both sources of negative bias.

A trend of 11.4% (SE = 2.1%) annual increase was estimated from an analysis of sighting rates of humpback whales in four aerial surveys conducted in Icelandic coastal waters in the period 1986-2001 (SC/54/H6). The reported rate was similar to one of 11.6% reported from sightings of humpback whales recorded by whalers for the period 1970-1988. In discussion, it was noted that these figures should not necessarily be taken as population growth rates; they are close to the maximum plausible rates for humpback whales calculated from demographic parameters (Clapham *et al*., 2001). Some members believed that this may reflect a combination of population growth and immigration into the survey area from other regions.

5.1.4 Biological parameters

An update on previously published data on reproductive parameters of Gulf of Maine humpback whales was presented in SC/54/H23. Apparent birth rates were calculated for the period 1979-2001; the average for all years ranged from 0.27-0.47 calves per mature female per year, depending on assumptions about the maturational state of the sample of females. The wide range in those values was due, in part, to heterogeneity in the data from geographic shifts in animal distribution over time. Mature females observed in five consecutive years produced an average of 0.43 calves during that time period. Older females produced more calves than younger animals, and all mature females observed for at least five consecutive years ultimately reproduced. There was no evidence for reproductive senescence among individually identified whales tracked for more than 20 years. There is evidence that mothers and calves are much more likely to occur in the south-western Gulf of Maine (rather than the northern area) and recent data weighted towards that region continues to support findings that the average age at first parturition in this population is six years. The single female observed to first parturition in the northern Gulf of Maine produced her first calf at age 13. This suggests that studies of humpback whale reproductive rates in other populations may be subject to bias (notably negative bias) if sampling is not undertaken in all parts of the feeding range; this may have important implications for assessments of humpback whales in other feeding populations.

5.1.5 Environmental concerns

There was no new information on environmental concerns in relation to North Atlantic humpback whales.

5.2 Assessment

5.2.1 Framework for assessment

Last year, the sub-committee had recommended further development of the assessment model (IWC, 2002a, p.239). The Commission had supported this work and an improved framework for the assessment of North Atlantic humpback whales was outlined in SC/54/H1. The population dynamics model underlying the assessment is density-dependent, age- and sex-structured, and allows for multiple feeding and breeding grounds, 'stock'- or feeding ground-specific values for the resilience parameter and survival rates, as well as depensation. The model is fitted to data on absolute abundance, trends in relative abundance, estimated rates of increase, and information about the proportion of animals from each breeding ground on the feeding grounds. In runs of the model on a preliminary dataset, the model formulations that can adequately mimic the bulk of the data all involve invoking depensatory dynamics at low stock size.

5.2.2 Results

A Working Group consisting of Friday, Hammond, Kingsley, Mattila, Punt and Reeves met to discuss which were the appropriate options for running the assessment model described in SC/54/H1, and how the new information provided at this meeting should be incorporated. A series of model runs were agreed upon. After it became clear that none of the cases considered resulted in a good fit of the assessment model to the data, an additional case was specified that allowed the resilience parameter to vary among feeding areas, rather than being a single value for all feeding areas. However, this run also provided a poor fit to the data.

Results from the model runs are given in Appendix 3. The main general features of all the results are: (1) a poor fit; (2) populations in all areas have recovered to carrying capacity. This is not consistent with observed continuing increases in a number of areas. In addition, the observed fecundity rate (0.43 in SC/54/H23) is not consistent with the model's prediction of a lower rate.

Punt commented that the data for North Atlantic humpback whales were very similar in their pattern to those observed for eastern North Pacific gray whales. To explore the problems with the data, Punt employed a simple exponential model, which assumed that catches and abundance data for each feeding ground were independent, and approximated the trend in each feeding ground. The simple model requires only two parameters (initial abundance and rate of increase). For areas (such as Eastern Canada) for which there was inadequate or no information, data were approximated using information on trends from the West Indies. The results of this simple model suggested that population sizes for the Gulf of Maine and Iceland were still very low during the period 1940 to the 1960s. This is not consistent with known catch data in at least Iceland, which were believed to be fairly accurate and therefore any additional (unrecorded) catches would have to have occurred elsewhere. Gunnlaugsson noted that sightings by whalers of humpback whales off the western coast of Iceland were very rare in the 1950s. In response to a query, Punt responded that it might be possible to calculate the number of catches that would be required to provide a better fit to the data, but the increase in current known catches would likely be substantial.

It was agreed that possible explanations for the failure of the assessment model to fit the data included:

(1) The model structure is wrong. It is possible that other structures, such as an inertia model (Witting, 2001), might provide a better approach to the assessment.
(2) The catch data contain major gaps. This is unlikely to be the case for the 20th century, for which the catch record is reasonably well documented, but it is possible that removals from earlier periods have been significantly underestimated. Best wondered whether 20th century humpback catches off equatorial West Africa (not included in the assessment) might include some Northern Hemisphere animals. Reeves believed that this was implausible.
(3) The recent estimates of abundance are wrong. These would have to be overestimates to explain the problems with model fitting; this was not considered likely.
(4) Carrying capacity may have fluctuated and increased in recent years, thus affecting the abundance of whales. It was acknowledged that the marine ecosystem has changed in many respects over the last century as a result of human exploitation and climatic variations.
(5) The existence of a largely unexploited population of humpback whales in some unknown area of the North Atlantic, which has expanded and is now recolonising other habitats.

With regard to the last possibility, the sub-committee noted the incidental historical sightings around the Mid-Atlantic Ridge (SC/54/H22) as well as recent acoustic observations of humpback whales in the Norwegian Sea in winter (reported by Clark last year). It was also noted that satellite tagging (in the North Pacific) has shown that humpback whales sometimes feed in remote offshore areas. Overall, the impression of the humpback whale as largely a coastal and shelf animal may well be erroneous.

5.3 Management advice

As discussed in Item 5.2.2, the assessment model developed over the last two years did not provide good fits to the available data, nor were the results consistent with the observed data. In particular, all the best fits of the model under the range of options discussed above (Item 5.2.1) predicted that the populations in all areas have recovered to carrying capacity. As a result of this inconsistency, the sub-committee is unable to provide advice on the population level of North Atlantic humpback whales in relation to carrying capacity. This statement applies to past carrying capacity and to present carrying capacity.

In conclusion, the sub-committee agreed that it had greatly increased its knowledge of North Atlantic humpbacks as a result of its Comprehensive Assessment. In particular, populations are increasing in a number of areas in the North Atlantic (Gulf of Maine, Iceland, West Indies) and the rate of increase of the West Indies breeding population is estimated at 3% per annum between 1979 and 1992 (IWC, 2002a, p.236). This breeding population had an estimated population size of 10,752 in 1992 (IWC, 2002b, p.258).

The sub-committee reiterated its view of last year that the population identity of humpback whales in the eastern Caribbean remains unresolved.

In response to a specific request to the Chair of the Scientific Committee from the Commissioner for St Vincent and the Grenadines, the sub-committee considered the likely impact on the stock of an annual take of four whales. Assuming that the humpback whales found in the eastern Caribbean are part of the West Indies breeding population, the sub-committee **agreed** that a catch of up to four whales taken annually would be unlikely to harm this stock.

5.4 Future work

At last year's meeting, the sub-committee had an extensive discussion of future work that would lead to a better understanding of North Atlantic humpback whales (IWC, 2002a, pp.239-41). This year, catch data had been updated (Item 5.1.2), new information on abundance around Iceland had been received (Item 5.1.1), analysis of data on calves per mature female in the Gulf of Maine had been completed (Item 5.1.4) and work recommended on development of the assessment model had been completed (Item 5.2.1).

However, most of the identified areas of future work had not yet been progressed. In addition, the sub-committee identified a number of additional areas of future work arising from discussions this year. The following areas of future work were identified by the sub-committee.

Catches

(1) Review of historical data sources for land station catches in the Cape Verde Islands.
(2) Examination of eastern North Atlantic catch data by season.
(3) Review of additional historical data to allocate unidentified catches to species in the Faroe Islands and Iceland for the period approximately 1880-1930.
(4) Further examination of Bermuda Blue Books and other colonial records on the Bermuda shore fishery.
(5) Review of the Blue Books for Grenada, St Lucia and other West Indies Islands not previously covered.
(6) Examination of whaling station diaries from West Greenland.

Analysis and data collection

(1) Obtaining photographic and genetic samples from the Cape Verde Islands. The Commission has provided partial support for sample collection being undertaken in the Cape Verde Islands this year by Jann and colleagues. The sub-committee looked forward to the results of this work being presented at a future meeting and noted that further recommendations for additional work may be warranted in light of those results.
(2) Estimation of survival rates in areas other than the Gulf of Maine.
(3) Examination of the effect of heterogeneity of capture probabilities on abundance estimates.
(4) Further examination of patterns of migration and distribution using photo-identification data and historical records.
(5) Matching the YoNAH dataset to the North Atlantic Humpback Whale Catalogue. This work would greatly facilitate recommendations 3 and 4, above.
(6) Further elucidation of the relationship between animals in the Lesser Antilles (eastern Caribbean) and the rest of the West Indies; additional photographic and genetic samples are required (see Item 5.1.1).
(7) Calculation of abundance estimates from NASS and NILS data that have not yet been analysed.
(8) Investigation of oceanic distribution through satellite tagging, offshore surveys or other means. In particular, the collection of acoustic data at the mid-Atlantic ridge during the summer months would be valuable.
(9) Additional photo-identification and biopsy-based surveys off the eastern coast of Iceland.
(10) Genetic approaches to determine the number and identity of animals using a 'missing' breeding and/or feeding ground, based on an analysis of microsatellites and/or haplotype frequencies.
(11) Continuation of assessment model development, including incorporation of the ability for carrying capacity to change, and exploring other types of models.

The sub-committee agreed that all of these areas of future work were valuable and **recommended** that they should be pursued as possible.

6. SOUTHERN HEMISPHERE HUMPBACK WHALES

6.1 New information on distribution, stock structure, abundance and trends

Information on surveys for humpback whales off the coast of Oman during the period 2000-2002 was presented (SC/54/H3). This population appears to be resident in the Arabian Sea year-round, and was subject to illegal catches by the Soviet Union in the 1960s (Mikhalev, 1997). There were relatively low encounter rates (range 0.0 to 0.545 whales per hour), with more whales seen inshore than in offshore areas. A total of 36 individuals was photo-identified; two of these were resighted in different years. Skin biopsies were taken for genetic analysis; these revealed sex ratios at parity in October, but strongly biased towards males in February. Feeding was observed in both spring and autumn, but observations of song and of mother/calf pairs in February supported the suggestion by Mikhalev (1997) that this population is on a Northern Hemisphere breeding cycle. There is evidence that many whales in the region are involved in fisheries entanglements.

Genetic analysis was conducted on samples from 27 humpback whales from Oman (SC/54/H4). Six mtDNA haplotypes were found, and haplotype diversity was somewhat lower than that reported from the southern Indian Ocean. Two of the six haplotypes had not been reported in other studied populations. Analysis of molecular variance showed statistically significant variance between the Omani samples and those collected from sites in the southwestern Indian Ocean. The two lineages shared between Oman and the southwestern Indian Ocean does not necessarily imply a recent migratory connection between the two areas. However, given the observations of year-round feeding off Oman in SC/54/H3, it is possible that animals that breed in the southwestern Indian Ocean cross the equator to feed in the Arabian Sea in the austral summer (boreal winter).

Humpback whale occurrence and distribution around Mayotte in the Mozambique Channel was investigated from boat-based surveys on 136 survey days during the austral winters of 1995-2001 (SC/54/H18). There were sightings of 152 groups of humpback whales involving 197 animals. Eighty-eight individuals were identified by fluke pattern. Of the 152 humpback groups, 64% were mother/calf pairs; this is a much higher percentage than has been reported for other studied breeding areas such as Hawaii and Samana Bay (Dominican Republic), and suggests that Mayotte may represent an important nursing/calving area or resting point along the migration route. Singletons were also observed frequently, but there were very few sightings of competitive groups. Photographic comparisons revealed two matches between Mayotte and Antongil Bay, Madagacar.

SC/54/H20 summarised research on humpback whales in the coastal waters of eastern Madagascar and off Gabon. To date, 1,875 hours of boat-based surveys have been completed in Antongil Bay (Madagascar) where 951 groups of whales were encountered, 809 skin samples collected for genetic analysis, 4,388 photographs catalogued for

identification of individual whales and 3,715 records of positional data recorded for spatial analysis. In Gabon, 300 hours of boat-based surveys have been conducted during the initial two years, where 242 groups of whales were encountered, 261 skin samples collected, 1,167 identification photographs catalogued and 735 positions recorded. Based on historical catch data and the assumption that Antongil Bay and Gabon represent wintering grounds that are at the northernmost extent of the migration, it would be expected that relative seasonal abundance would be characterised by a unimodal peak in distribution. Data from Antongil Bay indicate a relatively stable rate in the number of identified individuals per hour throughout the season, with a gradual decline following a peak in late July and early August. Because only one full season of prolonged systematic surveys has been completed in Gabon, it is not possible at this time to make any conclusive statement regarding the seasonal abundance. Abundance of humpback whales in Antongil Bay between the years 1996 and 1999 was estimated using the Chapman-modified Petersen estimator, resulting in an estimated population size between 1,128 (for 1996 and 1999) and 2,004 (for 1997 and 1998) individuals in Antongil Bay, with CVs ranging from 0.30-0.43. The weighted mean of six pair-wise estimates was 1,746 (CV = 0.19). This estimate is conservative, since 47.0% of the identified individuals exist from dorsal fin photographs and were excluded from the analysis. Occurrence data from Antongil Bay and Gabon do not contradict the previous assumption that most individuals are relatively transient throughout their breeding range. Revised population size estimates and analyses of population structure are anticipated at the next meeting.

Rosenbaum described the formation and activities of the Indo-South Atlantic Humpback Whale Network. The Network exists to promote collaboration and to coordinate research among scientists working in the Indian and South Atlantic Oceans (primarily around Africa). A regionally distributed database consisting of data from systematic surveys from each group in the network will be implemented. This is a critical first step for large-scale data comparisons to investigate migration links, population structure, trends in abundance, and identification of critical habitats for humpback whales over a large proportion of their range around Africa and in the northern Indian Ocean. The Government of South Africa has contributed ship time for a whale research and training cruise, which will be conducted in collaboration with dedicated shore-based surveys off Cape Vidal. The sub-committee expressed its appreciation to the Network and to the Government of South Africa for this important collaborative effort, and looked forward to seeing the results next year.

A shore-based survey for humpback whales on the west coast of South Africa was conducted from July to December 2001, using a lookout position on North Head, Saldanha Bay (SC/54/H21). This is only a few kilometres from two land stations that operated in Saldanha Bay from 1909 until the last one (Donkergat) closed in 1967. Because of the scarcity of previous surveys in this area, the commercial catch and effort data from these two stations (and one at Hangklip, 180km to the southeast) between 1920 and 1930 were first examined for clues to the migratory pattern. These years were chosen because they were as close to the start of exploitation as possible, and because there were no legal restrictions on size or the taking of lactating females in operation at the time, so the catches may have been more representative of the population. Data sources were principally the Harmer records from the Natural History Museum, London, and the Cape Provincial archives, Cape Town. Catch per unit effort data from the Donkergat and Salamander whaling stations showed two peaks in humpback whale availability, one in July and the other in November/December (when the whaling season closed for presumed logistical reasons). The size composition of the catch (after adjusting for the fact that the whales were not measured in the standard way) indicated that these peaks coincided with an influx of mature animals, suggesting that they represented peaks of migration. Females with near-term foetuses occurred prior to 25 August (mean date 25 July), i.e. in the first peak of migration, whereas females in early pregnancy occurred after 10 October (mean date 1 November), or in the second migration peak. The incidence of females in late pregnancy between April and August (when they should all have been discovered) was 38.6%, which, although imprecise, is similar to other estimates of pregnancy rate from whaling data, and calves-per-mature-female estimated from photo-identification data. There was no sign of a male-biased sex ratio in the catch of either immature or mature whales. Incidental records indicated that some females on the autumn and subsequent spring migrations were still accompanied by the previous winter's calf. Shore-based observations at North Head in 2001 were carried out on 102 days for 681 hours between 24 July and 20 December, and 95 sightings of 233 humpback whales, and 217 sightings of 354 right whales were made. Observations probably started too late to include much of the first expected migration peak, but clearly detected a rise in humpback availability from late October, presumably representing the onset of the southern migration. The results of theodolite tracking of 71 groups, however, showed that whereas most groups were moving southwards from July to September, from October onwards there were as many groups moving northwards or in an indeterminate direction. Adopting a linearity index of > 0.9 as indicative of active migration, the proportion of actively migrating animals declined from 100% in July and August to less than 50% in December. These results seem to confirm the presence of a suspended migration in spring, as proposed in earlier work on the West Coast of South Africa (Best *et al*., 1995). This suspension may be associated with bouts of feeding. When weather permitted, groups were approached from the shore in a 6m inflatable, and 41 biopsies and 23 fluke photographs were obtained from 40 groups of 101 humpback whales. Shore-based observations will resume on 5 May 2002, and are planned to run through to April 2003. Apart from describing the characteristics of the migration as closely as possible, the project aims to investigate the possible correlation between local environmental conditions (upwelling) and the patterns of migratory behaviour shown by both humpback and right whales in the area.

In discussion, it was noted that the Saldanha Bay data and the recent observations from Gabon suggest the occurrence of a somewhat unusual and interesting situation off this coast, with what may be a suspended migration.

Carlson noted that surveys for humpback whales and other marine mammals off Kenya were being conducted (Weru, 2001), and would be coordinated with other members of the Indo-South Atlantic Humpback Whale Network. The sub-committee welcomed this work, and strongly supported research in this important and previously unstudied area.

Data from field notebooks kept by the late Dr William Dawbin include information on land-based sighting surveys for humpback whales in Fiji during the austral winters of 1956, 1957 and 1958. A preliminary analysis of these data

(SC/54/H7) indicated that humpbacks were quite abundant in the area during this period. Surveys ran from May to October. Sightings peaked during August, with as many as 43 whales per day recorded. Anecdotal reports indicate that humpbacks are much rarer in Fijian waters today than they were in the late 1950s, suggesting that this population has yet to recover from intensive commercial whaling. Clapham noted that, if details of Dawbin's field effort could be obtained from his notebooks, there would be an attempt to conduct replicate surveys in the area to better assess the present status of this population, which is presumably part of the depleted Area VI stock.

Activities of another regional collaborative organisation, the South Pacific Whale Research Consortium (SPWRC) were summarised in SC/54/O14. This group includes researchers from areas of Oceania and the South Pacific (including French Polynesia, the Cook Islands, Tonga, Samoa, New Caledonia, New Zealand and Eastern Australia) as well as from adjacent regions of South America and the Antarctic. Matching within the regional catalogue of fluke photographs (representing 949 individuals from Oceania alone) has revealed some degree of migratory interchange between adjacent areas of Oceania, South Pacific, but there was no interchange with South America or the Antarctic Peninsula. Non-systematic surveys and published capture-recapture estimates based on photo-identification indicate that the density of whales remains low throughout the wintering grounds of Oceania and the New Zealand migratory corridor. Genetic analyses of skin samples collected throughout the Oceania region are underway.

Ishikawa commented that the South Pacific Whale Research Consortium (SPWRC) stated in SC/54/O14 that they would not use data from JARPA for ethical reasons. JARPA has collected sighting data, photographs and biopsy samples of humpback whales using non-lethal methods and therefore Ishikawa believed that the position of the SPWRC was based on political rather than ethical reasons. He noted that from a scientific perspective, this lack of collaboration is unfortunate. Baker replied that members of the SPWRC were not convinced that the JARPA programme meets the requirements of animal experiment guidelines or regulations in effect in most countries, including Japan, or those of many international scientific journals. For this reason, the Consortium has chosen not to approach JARPA for collaboration on comparison of individual identification photographs from the Antarctic. In response, Ishikawa pointed out that Baker was incorrect and that there had been many scientific papers from JARPA data published in international journals including those with experimental guidelines (e.g. Journal of Veterinary Medical Sciences, Theriogenology).

The abundance of humpback whales in New Caledonia was estimated from a catalogue of 214 individuals identified by microsatellite genotyping, 217 individuals identified by fluke photographs and combined records of both, collected from 1995-2001. Estimates from the weighted mean of Petersen capture-recapture estimates ranged from 319-520 individuals. Two estimates from the combined genotypes and photo-identification records provided the greatest precision but were likely to be biased downwards as only resightings were included in dataset extensions. The estimate obtained from the genotype data (n = 520, 95% CI = 366-674) was larger and less precise that the photo-identification estimate (n = 355, 95% CI = 279-432). The genotype estimates of males and females (278 and 248, respectively) were similar although the female estimate was less precise. The genotyping was used to detect a small number of errors in the photo-identification records; this work does not support the suggestion that the predominance of white flukes is an obstacle to photo-identification. Overall, it is apparent that the population of humpback whales in New Caledonia is small.

The relatively equal sex-specific estimates from New Caledonia differ from those of the West Indies, which showed a larger proportion of males. This could be explained by the longer sampling period (both in terms of years and within seasons), and lower density in New Caledonia, resulting in a more complete or more representative sampling. Although there were unresolved methodological issues with combined photo-identification and genotyping estimates of abundance, the sub-committee noted that this was a promising approach and encouraged further investigation into this issue. In this context, a collaborative discussion between the Indo-South Atlantic Humpback Whale Network, the South Pacific Whale Research Consortium, and researchers in the North Atlantic was **recommended**.

SC/54/H14 summarised the occurrence of humpback whales in French Polynesia over the period 1988-2001. From 1988-2001, more than a thousand observations of humpback whales were made near 25 islands in four of French Polynesia's five archipelagos; no humpbacks have been confirmed in the Marqueses. In the Society Islands, whales have been observed from mid-June to early December. The area is used as both a calving and mating ground. Dedicated surveys for photo-identification and genetic sampling have been conducted at Mo'orea, with lower effort in the Austral Islands at Rurutu and Tubuai. A total of 185 individual humpbacks was photographically identified between 1991 and 2001; there was a relatively low resighting rate, although some whales were present for more than six weeks at Rurutu. Analysis of 15 sloughed skin samples showed a male-biased sex ratio, as well as few mtDNA haplotypes shared with other areas of the South Pacific. Given the high haplotype diversity within this region, this latter finding is not surprising. A local hunt, introduced by westerners to the Rurutu islanders in the early 1900s, took small numbers of humpbacks (nine from 1930 to 1959, including two mother/calf pairs). The hunt ceased in 1959.

SC/54/H5 reported on aerial surveys carried out off the coast of Brazil, between 12 and 20°S. This area corresponds to a portion of the distribution area of the breeding stock 'A'. Surveys were carried out as far offshore as the 500m isobath with the objective of investigating distribution and abundance of humpback whales. Standard line transect sampling was conducted from a high-wing two-engine aircraft. Estimates were corrected for availability bias by calculating the time whales spend at the surface and the time window during which whales are within the visual range of the observers. Whales were observed along the whole latitudinal range of the area sampled, but a substantially higher density was recorded in the southern portion. Higher densities were found on Abrolhos Bank, a large coral reef area off the eastern coast of South America. Corrected abundance was estimated as 2,291 individuals (CV = 0.45). The authors noted that this was the first of a series of three surveys to be carried out in the coming years.

Population estimates for humpback whales from Abrolhos Bank, Brazil over the period 1996 and 2000 ranged from 1,389 to 3,977 with an average CV of 0.27 (SC/54/H11). A maximum-likelihood estimate for the year 2000 was 3,871 (95% CI = 2,795-5,542), and this analysis estimated growth

rate at 31%. In discussion, it was noted that this growth rate was clearly unreasonable (see Clapham *et al*., 2001), and suggested the existence of some unknown methodological problems in sampling or in the estimation process. As a result, the estimate of abundance should be treated with considerable caution.

SC/54/H12 described research conducted off the western side of the Antarctic Peninsula, in particular the Gerlache Strait. This study was part of the cetacean component of the Brazilian Antarctic Survey (PROANTAR) and had the objectives of conducting photo-identification and biopsy sampling of humpback whales as well as investigating distribution and density of cetaceans in the Antarctic Peninsula area. SC/54/H12 provided encounter rates of humpback whales in the Gerlache Strait from summer, 1997/98 to 2001/02. Encounter rates were not statistically different among years and therefore the authors pooled data across years to investigate monthly variation in encounter rates in the area. Results showed that whales were more abundant in the Gerlache Strait from January to early March. The authors concluded that the area is appropriate for ecological cetacean studies as well as to conduct photo-identification and biopsy sampling of humpback whales. They encouraged the development of multidisciplinary habitat studies in the region to improve the understanding of humpback whale ecology in the Antarctic.

The sub-committee regretted that a lack of funding had prevented the authors of the papers SC/54/H5, H11 and H12 from attending the meeting, and highlighted the need for the IWC to support the attendance of researchers from developing countries.

It was noted that there were plans to continue work in the Gerlache Strait within the next year. In addition, Bannister noted an observation of humpback whales in the Strait of Magellan in mid-February 2002, and that Chilean scientists were conducting research in this area.

A comparison of duplicate sighting rate for Southern Hemisphere humpback whales between the second and third circumpolar surveys of IWC/IDCR-SOWER was presented in SC/54/IA16. A factor that strongly affects duplicate sightings is school size. The duplicate sighting probability for school sizes greater than 2 was 1.6 times larger than for a single school. This confirms that duplicate sighting probability (and hence $g(0)$) is dependent on school size. The probability of duplicate sighting did not differ significantly between the second and third set of circumpolar surveys. However, the mean duplicate sighting probability is low for the northern area of the third circumpolar compared to the southern area of the second circumpolar, and this may be because of the bad weather conditions in the former region.

Sightings of humpback whales from the 2001/2002 JARPA survey were summarised in SC/54/O18. More humpback whales were observed during this survey than in previous JARPA surveys in 1999 and 2000. Total primary sightings of humpback whales were 1,219 schools/2,387 animals, and this was the highest record for any JARPA survey; this was particularly true in the north and west-south strata of Area IV. Biopsy samples were obtained. Humpback whales and minke whales showed clear separation in most areas, except for some areas near the ice edge where both species were concentrated. The authors suggested that the increase in abundance of humpback whales may have resulted in interspecific competition with minke whales.

In response, Clapham noted that simple overlaps in distribution were not sufficient to support claims of interspecific competition, which was a complex issue (Clapham and Brownell, 1996). Weinrich also noted that experience in the Gulf of Maine over 25 years has shown that patterns of prey abundance and distribution can cause medium-scale annual shifts in humpback distribution. Hence, dramatic local increases cannot be interpreted without similar effort throughout the stock's feeding range. In response, Ishikawa noted that JARPA surveys covered a large part of the Antarctic and had been conducted repeatedly over the last 15 years, and that therefore the results were reliable and showed that there had been an increase in humpback whales.

Bannister and Hedley (2001) outlined results of aerial surveys to provide relative abundance estimates of humpback whales migrating northward along the coast of Western Australia between 1976 and 1994. These demonstrated a high rate of increase, at least between 1982 and 1991, of approximately 10% per year. The 1994 survey confirmed the rate of increase and provided an abundance estimate of 4-5,000. The most recent survey in 1999, planned to provide an estimate of absolute abundance, was considerably affected by poor weather. Nevertheless, applying a correction factor for animals missed while submerged to the estimated number sighted gives a 1999 population estimate of 8,207-13,640. This result is dependent on 'deep diving' time and would be proportionally lower should this dive time be less than the range used (10-15 minutes). Reported rates of increase and population estimates for this stock in the Antarctic (Area IV) were reviewed, as well as preliminary Southern Hemisphere population estimates that take account of much larger than officially reported catches in the 1950s-60s. Plans for future surveys were discussed.

Carlson reported on the status of IWC Research Contract 16, the Antarctic Humpback Whale Catalogue (SC/54/H13). The catalogue has received 448 images from 17 contributors during the contract period, bringing the total number of catalogued individuals to 1,405. Of particular note were thirteen matches, including between Southern Ocean Area V and Eastern Australia (one match) and between the Antarctic Peninsula and Costa Rica (three matches). There was considerable discussion about the protocols for accessing these data. A Working Group was set up to discuss this issue; its report is given as Appendix 4. The sub-committee was pleased to receive this information and **recommended** that this work continues to be supported with the new conditions laid out in Appendix 4.

Overall, in reviewing current studies in the Southern Hemisphere, the sub-committee commended all of the researchers working on humpback whales in Oman, Kenya, Madagascar, the Comoros, Mayotte, Brazil, South Africa, Australia, Oceania and the Antarctic. The sub-committee was particularly pleased to see multi-area collaborations such as the Indo-South Atlantic Humpback Whale Network and the South Pacific Whale Research Consortium, and strongly encouraged the development of additional collaborative work of this nature.

6.2 Population dynamics modelling

An assessment of the West and East Australian stocks of humpback whales was conducted using an age-aggregated production model that allows for mixing in the feeding grounds of Areas IV and V (SC/54/H17). The approach is similar to that presented for the North Atlantic (SC/54/H1). Analysis of the available data provided a self-consistent picture of populations recovering well from their minima of the 1960s; the models were fitted to CPUE and relative abundance data from the breeding grounds, as well as to

JARPA abundance estimates from feeding grounds in Areas IV and V. These populations were projected to reach pristine levels (assuming zero catches) in 10-15 years for the western stock and 15-20 years for the more depleted eastern breeding stock. It was suggested that further modelling of males and females separately would be useful. The authors noted that their results were dependent upon absolute abundance estimates available for the two breeding stocks; the current estimate for the western stock is the less firmly founded of the two and would merit further study. A subsequent reanalysis of the data was conducted using new estimates of abundance provided by Bannister and Hedley (2001); use of the upper limit of that estimate (13,640 in 1999) suggested that current abundance was about 65% of the pristine level.

Baker commented that the total known catch was greater than the number of animals assumed by the model over certain periods. Butterworth responded that the numbers reflected a combination of mixing and reproduction. It was suggested that this merited further examination. Baker commented that genetic analysis in progress may allow the assignment of animals from the feeding grounds to the breeding grounds, and that this would assist future modelling efforts.

In response to a question, the authors responded that the growth rate in the model began with an initially high rate of approximately 12.6% when abundance was at its lowest, and that this rate declined as the population grew in size. Clapham noted that 12.6% was the maximum plausible rate of increase derived from knowledge of humpback whale biological parameters.

6.3 Work required to complete assessment

It was noted that substantial progress had been made in recent years in improving the understanding of humpback whales in certain areas of the Southern Hemisphere. However, many major gaps in data remain. Because of the time constraints facing the sub-committee, a comprehensive review of the current state of knowledge about Southern Hemisphere humpbacks was impossible to achieve during the meeting. To address this, an intersessional group under Bannister was established (see Annex S). The terms of reference of this group were: (1) to summarise current knowledge regarding Southern Hemisphere humpback whales, by population or management area; (2) to identify major gaps in knowledge; and (3) to establish priorities for research to fill these gaps. Current information under (1) would include abundance and trends, catches and incidental takes, population structure and stock identity, biological parameters, environmental concerns, and assessment models. The intersessional group would use the North Atlantic humpback whale Comprehensive Assessment as a model in summarising information. After reviewing the group's report at next year's meeting, further consideration will be given to whether it is feasible to set a deadline for the completion of the Comprehensive Assessment.

The sub-committee **agreed** that the results of the most recent East Australia humpback whale survey (in 2000) were important to the assessment, and **strongly recommended** that they be made available soon.

6.3.1 Work plan

The sub-committee **agreed** that considerable progress had been made in some areas of the work plan from last year; however many items still required further work. The sub-committee proposed the following work plan for the coming year.

(1) An intersessional working group (see above) will summarise current knowledge regarding Southern Hemisphere humpback whales, by population or management area; identify major gaps in knowledge; and establish priorities for research to fill these gaps.
(2) To the extent possible, run the humpback population dynamics model for breeding stock E with three sub-populations, for which individual population estimates are available.
(3) Conduct a sensitivity analysis for breeding ground C using the combined Mozambique and low-latitude Madagascar abundance estimates, as reported in Rosenbaum *et al*. (2000).
(4) Investigate use of a population dynamics model disaggregated by sex for stocks D and E.
(5) Investigate use of a model with depensation.
(6) Investigate the data from whaling operations from a time shortly after blue/humpback whales were protected that are held by the IWC Secretariat (see IWC, 2001, p.185), with a view to using them to provide relative abundance estimates.
(7) Investigate the feasibility of using a model that incorporates information on biological parameters, similar to that being developed for the North Atlantic.
(8) Further investigate the use of the abundance estimates from IDCR/SOWER and JARPA survey data in the population dynamics model.
(9) Update the Antarctic humpback whale photo-identification catalogue.
(10) Investigate the issue of correlation between minke and humpback whale distribution on IDCR/SOWER and JARPA surveys.

The only item that has funding implications is the Antarctic humpback whale catalogue with a budget of £5,100 (as laid out in SC/54/H13).

7. ADOPTION OF REPORT

The report was adopted at 18:37 on 5 May 2002. On behalf of the sub-committee the Chair expressed thanks to Childerhouse for his chairing of the Working Group dealing with Item 6, and to the rapporteurs. The sub-committee reiterated its appreciation of the efforts of Friday and Punt for their work during the year and at the meeting. The sub-committee expressed its appreciation to Hammond for chairing the meeting.

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Appendix 1

AGENDA

1. Convenor's opening remarks
2. Election of Chair and appointment of rapporteurs
3. Adoption of agenda
4. Review of documents
5. North Atlantic humpback whales
   - 5.1 New information
     - 5.1.1 Population structure and stock identity
     - 5.1.2 Catches and incidental takes
     - 5.1.3 Abundance and trends
     - 5.1.4 Biological parameters
     - 5.1.5 Environmental concerns
   - 5.2 Assessment
     - 5.2.1 Framework for assessment
     - 5.2.2 Results
   - 5.3 Management advice
   - 5.4 Future work
6. Southern Hemisphere humpback whales
   - 6.1 New information on distribution, stock structure, abundance and trends
   - 6.2 Population dynamics modelling
   - 6.3 Work required to complete assessment
     - 6.3.1 Work plan
7. Adoption of report

Appendix 2

ESTIMATING HISTORIC HUMPBACK WHALE REMOVALS FROM THE NORTH ATLANTIC: AN UPDATE

Tim D. Smith and Randall R. Reeves

Abstract
Updated estimates of historical landings and total removals of humpback whales in the North Atlantic are presented for three fisheries, along with a table of estimates of removals for all breeding and feeding grounds.

Introduction
Last year removals of humpback whales were estimated for some 30 fisheries in the North Atlantic (Smith and Reeves, 2002). No estimates were provided for the American non-mechanised coastal fishery and only minimal estimates were provided for the American mechanised coastal fishery, both of which fisheries were assumed to target the Gulf of Maine feeding stock. Estimates for the American non-mechanised pelagic fishery in the two breeding grounds (West Indies and Cape Verdes) were based on numbers of voyages with certain characteristics (Starbuck, 1878; Hegarty, 1959), using landings per voyage estimated from a sample of logbooks that was not randomly selected (IWC, 2002, p.239). Results of additional investigations into historical data sources for these three fisheries have been reported to this meeting (SC/54/H16, SC/54/H15). Also, in addition to contemporary bycatches of humpbacks in Canadian waters previously included, there was a report from Iceland (Vikingsson, pers. comm.) of one humpback taken in 1998. Here, these new results are used to generate revised time series of total removals that update the estimates given in Smith and Reeves (2002).

Methods
Landings were estimated for the three fisheries (as defined by Reeves and Smith, 2002) using essentially the same assumptions and procedures as in Smith and Reeves (2002). Corresponding total removals were estimated by adjusting

Table 1

The struck-and-lost factors (S&L Factors) used to convert estimated landings of humpback whales into total removals, and the catch composition in terms of percent calves and percent non-calves that were female, for each of the North Atlantic fisheries for which catches were estimated.

Fisheries	Sub-Fisheries	S&L Factor	% Calves	Non-calf % Female
Norwegian	N. Norway	1.02	0.047	0.38
	W. Norway	1.02	0.047	0.38
	Svalbard	1.02	0.047	0.38
	Iceland	1.02	0.047	0.38
	Faroes	1.02	0.047	0.38
	British Isles	1.02	0.047	0.38
Mechanised	Newfoundland	1.02	0.047	0.38
	Gulf of St Lawrence	1.02	0.047	0.38
	Nova Scotia	1.02	0.047	0.38
Shore	Grenada	1.02	0.020	0.19
	Spain	1.02	0	0.50
Norwegian Mechanised Pelagic		1.02	0.047	0.38
Greenland Non-mechanised Shore		1.5	0.04	0.52
Greenland Mechanised Shore		1.02	0	0.5
Canada Non-mechanised Shore		1.5	0	0.5
Canada Non-mechanised Pelagic (Gaspé)		1.5	0	0.5
American Non-mechanised coastal		1.5	0	0.5
American Mechanised Coastal		1.5	0	0.5
Bermuda Non-mechanised Shore		1.85	0.41	0.78
West Indies	Barbados	1.85	0.41	0.78
	St. Vincent & the Grenadines:			
	Before 1958	1.85	0.41	0.78
	1958-present	1.23	0.41	0.78
Non-mechanised	Grenada	1.85	0.41	0.78
	Trinidad			
Shore		1.85	0.41	0.78
American Non-mechanised Pelagic	West Indies	1.85	0.10	0.43
	Cape Verde Islands	1.85	0.10	0.43
Cape Verde Islands Non-mechanised Shore		1.85	0.41	0.78

Table 2

Nominal annual landings of humpback whales by the American non-mechanised and mechanised coastal fisheries in the Gulf of Maine, derived for input to the model described in SC/54/H1 and based on data in Reeves and Smith (2002) and SC/54/H16. Constant landings were assumed from the beginning to ending year of each period, inclusive, for whaling operations in the states of Massachusetts and Maine. Notes indicate the rationale used in formulating the entries.

State	Period (Years)		Number landed/year	Notes
	Beginning	Ending		
Massachusetts	1730	1776	5	Decline of right whales resulted in some redirection of effort towards humpbacks.
Massachusetts	1777	1812	10	Between wars with Britain, some effort of Nantucket distant-water whalers was redirected to local waters; 4 Wellfleet vessels humpbacking in Gulf of Maine during early 1800s.
Maine	1810	1834	4	1 shore station.
Massachusetts	1813	1849	5	After War of 1812, Massachusetts effort shifted towards distant-water voyages.
Maine	1835	1840	5	Peak of activity for the 1 shore station; reported average catch 6-7, maximum 10, probably not all humpbacks.
Maine	1841	1860	7	Second shore station opened taking at least 3/yr; earlier station continued at nominal 4/yr.
Massachusetts	1850	1878	10	Several Provincetown schooners operating; up to 6 whales taken by 1 vessel in a year; 349bbls humpback oil taken in one year.
Maine	1861	1879	1	Minimal activity reported.
Massachusetts	1879	1883	20	Schooner activity increased, along with expanded use of bomb-lances; 20 reported in 1 year at Provincetown.
Maine	1880	1880	10	Menhaden fishery collapsed; 1 steamer converted to whaling, with bomb-lances.
Maine	1881	1882	10	1 steamer
Maine	1883	1883	20	2 steamers
Maine/Mass	1884	1884	40	4 steamers
Maine/Mass	1885	1885	50	5 steamers
Maine/Mass	1886	1886	30	3 steamers
Maine/Mass	1887	1887	25	At least 2-3 steamers
Massachusetts	1888	1896	10	1 steamer
Maine	1914	1914	5	1 shore station

the landings estimates to account for struck and lost animals, using loss rates appropriate to each fishery. Total removals were allocated to males, females and calves as appropriate to each fishery.

For the American non-mechanised and mechanised coastal fisheries in the Gulf of Maine, the limited data in Reeves and Smith (2002) and SC/54/H16 were used to interpolate and extrapolate to total landings. Best judgment was applied in deriving estimates from fragmentary data on, e.g. the number of vessels and shore stations or oil factories operating, published descriptions of the fisheries, and anecdotal observations in newspapers and other sources. It was necessary to make educated guesses not only on the scale of whaling effort and levels of catch, but also on the species composition of catches. This applied particularly to the mechanised fishery from 1880-96 that involved a high proportion of fin whales. For the American non-mechanised pelagic fishery, annual landings of humpbacks for two breeding grounds were estimated from the total landings for 1865-86 given in SC/54/H15, by assuming that each year's catch was proportional to the number of voyages sailing that year.

The struck-and-lost factors ('correction factors') used by Smith and Reeves (2002) to estimate total removals from estimated landings for the various fisheries are shown in Table 1. Where necessary, the correction factors for fisheries with sufficient struck/lost data were applied to similar fisheries with insufficient data.

The proportion of calves and sex ratio of non-calves for the Norwegian mechanised fisheries were estimated from individual-animal catch data. For sub-fisheries on feeding grounds, the data were pooled to produce a single set of rates. The proportion of calves and sex ratio for non-calves for the American non-mechanised pelagic fishery were estimated from data from a sample of logbooks and data from the YoNAH project, in which West Indies animals were sexed by molecular genetic techniques (Robbins *et al*., 2001). Although the rationale was summarised in last year's sub-committee report (IWC, 2002, p.234), the calculations were not completely reported by Smith and Reeves (2002). These are described here. The sample of logbooks described in IWC (2002, p.234) included 142 whales reported landed. Fourteen of those were calves, so the calf proportion was estimated as $14/142 = 0.10$. Of the remaining whales, 26 were female and 102 were not specified. The female proportion of the 102 whales was estimated using the observed proportion females in the YoNAH sample after excluding mothers and calves, 0.285 ($n = 284$). Thus, the proportion of females in the fishery landings was estimated to be $(26+0.285*102)/(26+102) = 0.43$.

Results

American non-mechanised and mechanised coastal fisheries

Estimated annual landings by the American non-mechanised and subsequent mechanised coastal fisheries in the Gulf of Maine from 1730-1914 are given in Table 2. The total of landings for the non-mechanised fishery from 1730-1850 was 990. The total of landings for the mechanised fishery from 1851-1914 was 759, with a slow increase from 1851-1879 followed by a pronounced increase after the switch from menhaden fishing to whaling in 1880 (Fig. 1)[1].

[1]Preliminary estimates of landings used in SC/54/H1 totalled 1,227 for American non-mechanised coastal whaling and 1,697 for American mechanised coastal whaling.

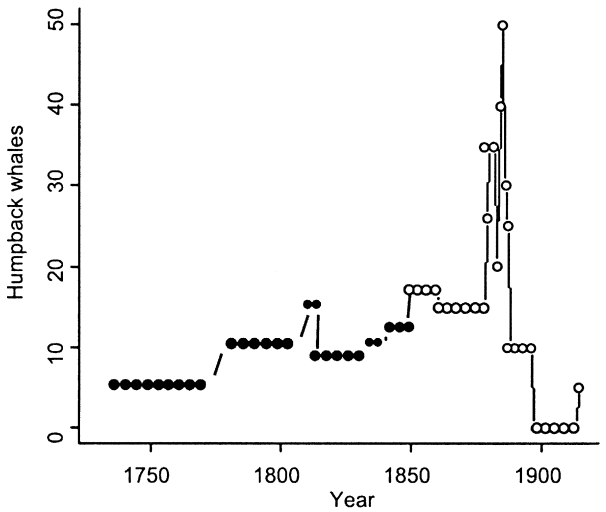

Fig. 1. Nominal landings of humpback whales in the Gulf of Maine from 1730 to 1914 by the American non-mechanised (1730-1850, solid circles) and mechanised (1851-1914, open circles) coastal fisheries (Table 2).

These were the only two fisheries known to have operated in the Gulf of Maine, and the estimated total removals are shown in Table 3.

American non-mechanised pelagic fishery (West Indies and Cape Verde Islands sub-fisheries)

The estimated total landings for the American non-mechanised pelagic fishery from 1865-86 were 1,617 and 441 for the West Indies and Cape Verde Islands, respectively (SC/54/H15). Estimated landings for other periods are unchanged from those in Smith and Reeves (2002). The estimated landings were allocated to year by multiplying the total landings for the period 1865-86 by the proportion of voyages for that period that sailed in each year. The new estimated landings for 1865-86 and for the earlier period of this fishery are shown in Fig. 2. The estimated total removals are shown in Table 3.

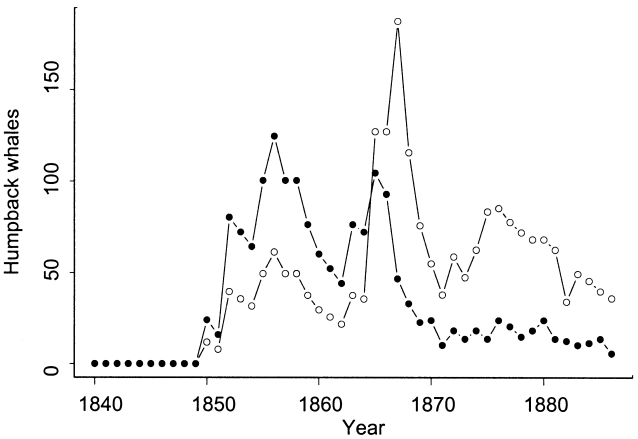

Fig. 2. Estimated landings of humpback whales by American pelagic whalers in the West Indies (open circles) and Cape Verde Islands (solid circles) breeding areas from 1840 to 1886. The values for 1840-64 are identical to those in Smith and Reeves (2002), while those for 1865-86 are derived from SC/54/H15 (see text).

Table 3

Estimated numbers of North Atlantic humpback whales removed from 1664 to 1999 from two breeding grounds (West Indies and Cape Verde Islands) and five feeding grounds (Gulf of Maine, Canada, Greenland, Iceland, Norway), for males (M), females (F), and calves (C). Includes incidental catches in Canada from 1869 to 1992.

	West Indies			Cape Verde			Gulf of Maine			Canada			Greenland			Iceland			Norway		
Year	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C
1664	1	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1665	4	14	12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1666	2	8	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1667	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1668	1	3	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1669	2	8	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1670	2	8	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1671	2	8	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1672	2	8	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1673	2	8	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1674	2	8	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1675	2	8	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1676	2	8	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1677	2	8	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1678	2	8	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1679	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1680	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1681	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1682	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1683	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1684	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1685	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1686	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1687	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1688	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1689	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1690	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1691	2	7	6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1692	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1693	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1694	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1695	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1696	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1697	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1698	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1699	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1700	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1701	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1702	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1703	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1704	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1705	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 3 (continued)

	West Indies			Cape Verde			Gulf of Maine			Canada			Greenland			Iceland			Norway		
Year	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C
1706	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1707	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1708	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1709	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1710	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1711	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1712	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1713	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1714	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1715	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1716	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1717	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1718	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1719	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1720	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1721	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1722	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1723	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1724	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1725	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1726	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1727	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1728	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1729	3	12	11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1730	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1731	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1732	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1733	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1734	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1735	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1736	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1737	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1738	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1739	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1740	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1741	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1742	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1743	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1744	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1745	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1746	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1747	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1748	5	17	15	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1749	3	12	11	0	0	0	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0
1750	3	12	11	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1751	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1752	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0

Table 3 (continued)

	West Indies			Cape Verde			Gulf of Maine			Canada			Greenland			Iceland			Norway		
Year	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C
1753	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1754	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1755	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1756	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1757	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1758	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1759	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1760	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1761	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1762	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1763	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1764	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1765	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1766	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1767	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1768	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1769	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1770	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1771	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1772	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1773	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1774	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1775	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1776	1	2	2	0	0	0	4	4	0	0	0	0	4	4	0	0	0	0	0	0	0
1777	1	2	2	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1778	1	2	2	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1779	1	2	2	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1780	0	1	1	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1781	0	1	1	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1782	0	1	1	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1783	0	1	1	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1784	0	1	1	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1785	0	1	1	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1786	1	2	2	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1787	1	2	2	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1788	1	2	2	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1789	1	2	2	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1790	1	2	2	1	4	4	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1791	1	2	2	1	4	4	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1792	1	2	2	1	4	4	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1793	1	2	2	1	4	4	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1794	1	2	2	1	4	4	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1795	1	2	2	1	4	4	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1796	1	2	2	1	4	4	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1797	0	0	0	1	4	4	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1798	1	2	2	1	4	4	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1799	1	2	2	1	4	4	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0

Table 3 (continued)

	West Indies			Cape Verde			Gulf of Maine			Canada			Greenland			Iceland			Norway		
Year	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C
1800	1	2	2	1	4	4	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1801	1	2	2	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1802	1	2	2	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1803	1	2	2	0	0	0	8	8	0	0	0	0	4	4	0	0	0	0	0	0	0
1804	1	2	2	0	0	0	8	8	0	14	14	0	4	4	0	0	0	0	0	0	0
1805	1	2	2	0	0	0	8	8	0	14	14	0	4	4	0	0	0	0	0	0	0
1806	1	2	2	0	0	0	8	8	0	14	14	0	4	4	0	0	0	0	0	0	0
1807	1	2	2	0	0	0	8	8	0	14	14	0	4	4	0	0	0	0	0	0	0
1808	1	2	2	0	0	0	8	8	0	14	14	0	4	4	0	0	0	0	0	0	0
1809	1	2	2	0	0	0	8	8	0	14	14	0	4	4	0	0	0	0	0	0	0
1810	1	2	2	0	0	0	10	10	0	14	14	0	4	4	0	0	0	0	0	0	0
1811	1	2	2	0	0	0	10	10	0	14	14	0	4	4	0	0	0	0	0	0	0
1812	1	2	2	0	0	0	10	10	0	14	14	0	4	4	0	0	0	0	0	0	0
1813	1	2	2	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1814	1	2	2	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1815	1	2	2	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1816	1	2	2	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1817	1	2	2	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1818	1	2	2	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1819	1	2	2	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1820	1	2	2	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1821	1	2	2	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1822	1	2	2	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1823	1	2	2	0	0	0	7	7	0	0	0	0	4	4	0	0	0	0	0	0	0
1824	1	2	2	0	0	0	7	7	0	0	0	0	4	4	0	0	0	0	0	0	0
1825	1	2	2	0	0	0	7	7	0	0	0	0	4	4	0	0	0	0	0	0	0
1826	3	12	10	0	0	0	7	7	0	0	0	0	4	4	0	0	0	0	0	0	0
1827	3	9	8	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1828	1	3	3	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1829	1	4	4	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1830	4	14	13	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1831	4	13	12	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1832	7	24	21	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1833	5	17	15	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1834	9	32	29	0	0	0	7	7	0	14	14	0	4	4	0	0	0	0	0	0	0
1835	8	28	25	0	0	0	8	8	0	14	14	0	4	4	0	0	0	0	0	0	0
1836	7	25	22	0	0	0	8	8	0	14	14	0	4	4	0	0	0	0	0	0	0
1837	7	25	22	0	0	0	8	8	0	14	14	0	4	4	0	0	0	0	0	0	0
1838	9	31	28	0	0	0	8	8	0	14	14	0	4	4	0	0	0	0	0	0	0
1839	6	21	19	0	0	0	8	8	0	14	14	0	4	4	0	0	0	0	0	0	0
1840	8	27	24	0	0	0	8	8	0	14	14	0	4	4	0	0	0	0	0	0	0
1841	7	26	23	0	0	0	9	9	0	14	14	0	16	16	0	0	0	0	0	0	0
1842	7	25	22	0	0	0	9	9	0	14	14	0	13	13	0	0	0	0	0	0	0
1843	7	25	22	0	0	0	9	9	0	14	14	0	13	13	0	0	0	0	0	0	0
1844	5	19	17	0	0	0	9	9	0	14	14	0	10	10	0	0	0	0	0	0	0
1845	6	23	20	0	0	0	9	9	0	14	14	0	13	13	0	0	0	0	0	0	0
1846	6	21	19	0	0	0	9	9	0	14	14	0	13	13	0	0	0	0	0	0	0
1847	2	7	6	0	0	0	9	9	0	14	14	0	13	13	0	0	0	0	0	0	0

Table 3 (continued)

	West Indies			Cape Verde			Gulf of Maine			Canada			Greenland			Iceland			Norway		
Year	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C
1848	9	32	29	0	0	0	9	9	0	14	14	0	13	13	0	0	0	0	0	0	0
1849	7	24	21	0	0	0	9	9	0	14	14	0	13	13	0	0	0	0	0	0	0
1850	16	26	18	23	17	4	13	13	0	14	14	0	11	11	0	0	0	0	0	0	0
1851	12	23	17	15	12	3	13	13	0	14	14	0	13	13	0	0	0	0	0	0	0
1852	41	42	19	76	58	15	13	13	0	14	14	0	13	13	0	0	0	0	0	0	0
1853	40	46	25	69	52	13	13	13	0	14	14	0	13	13	0	0	0	0	0	0	0
1854	34	38	20	61	46	12	13	13	0	14	14	0	13	13	0	0	0	0	0	0	0
1855	51	51	23	95	72	19	13	13	0	14	14	0	13	13	0	0	0	0	0	0	0
1856	63	61	27	118	89	23	13	13	0	28	28	0	13	13	0	0	0	0	0	0	0
1857	51	51	23	95	72	19	13	13	0	28	28	0	13	13	0	0	0	0	0	0	0
1858	51	50	22	95	72	19	13	13	0	40	40	0	13	13	0	0	0	0	0	0	0
1859	39	38	17	72	55	14	13	13	0	34	34	0	13	13	0	0	0	0	0	0	0
1860	32	36	18	57	43	11	13	13	0	34	34	0	13	13	0	0	0	0	0	0	0
1861	28	32	17	50	37	10	8	8	0	27	27	0	13	13	0	0	0	0	0	0	0
1862	23	23	11	42	32	8	8	8	0	21	21	0	13	13	0	0	0	0	0	0	0
1863	37	33	12	72	55	14	8	8	0	12	12	0	13	13	0	0	0	0	0	0	0
1864	35	31	11	69	52	13	8	8	0	20	20	0	13	13	0	0	0	0	0	0	0
1865	122	95	27	33	25	6	8	8	0	12	12	0	13	13	0	0	0	0	0	0	0
1866	122	98	30	33	25	6	8	8	0	10	10	0	2	2	0	0	0	0	0	0	0
1867	180	143	42	49	37	9	8	8	0	21	21	0	2	2	0	0	0	0	0	0	0
1868	112	89	27	30	23	6	8	8	0	14	14	0	2	2	0	0	0	0	0	0	0
1869	74	60	19	20	15	4	8	8	0	14	14	0	2	2	0	0	0	0	0	0	0
1870	53	43	14	14	11	3	8	8	0	17	17	0	2	2	0	0	0	0	0	0	0
1871	42	50	27	10	7	2	8	8	0	14	14	0	2	2	0	0	0	0	0	0	0
1872	61	60	27	15	11	3	8	8	0	7	7	0	2	2	0	0	0	0	0	0	0
1873	50	52	25	12	9	2	8	8	0	9	9	0	2	2	0	0	0	0	0	0	0
1874	66	67	31	17	16	7	8	8	0	10	10	0	2	2	0	0	0	0	0	0	0
1875	85	81	34	23	21	8	8	8	0	14	14	0	2	2	0	0	0	0	0	0	0
1876	86	81	33	23	21	8	8	8	0	8	8	0	2	2	0	0	0	0	0	0	0
1877	80	77	33	21	19	8	8	8	0	8	8	0	2	2	0	0	0	0	0	0	0
1878	78	87	45	20	18	7	8	8	0	4	4	0	2	2	0	0	0	0	0	0	0
1879	70	67	29	19	18	7	16	16	0	7	7	0	2	2	0	0	0	0	0	0	0
1880	72	74	35	19	18	7	22	22	0	7	7	0	2	2	0	0	0	0	0	0	0
1881	66	68	32	17	16	7	22	22	0	8	8	0	2	2	0	0	0	0	5	3	0
1882	41	54	33	10	11	6	22	22	0	4	4	0	2	2	0	0	0	0	0	0	0
1883	53	58	30	15	18	10	30	30	0	4	4	0	2	2	0	0	0	0	19	12	2
1884	60	91	61	14	17	10	30	30	0	2	2	0	2	2	0	0	0	0	16	10	1
1885	49	70	44	13	16	10	38	38	0	4	4	0	2	2	0	0	0	0	58	35	5
1886	60	118	88	12	16	9	22	22	0	4	4	0	4	4	0	0	0	0	61	37	5
1887	13	48	42	2	9	8	19	19	0	4	4	0	4	4	0	0	0	0	18	11	1
1888	5	18	16	2	9	8	8	8	0	2	2	0	4	4	0	0	0	0	42	25	3
1889	7	25	23	2	9	8	8	8	0	0	0	0	2	2	0	8	5	1	13	8	1
1890	9	31	28	2	9	8	8	8	0	0	0	0	4	4	0	7	4	1	14	9	1
1891	7	25	22	2	9	8	8	8	0	0	0	0	4	4	0	11	7	1	34	21	3
1892	6	21	19	2	9	8	8	8	0	0	0	0	2	2	0	17	11	1	49	30	4
1893	11	39	35	2	9	8	8	8	0	0	0	0	6	6	0	33	20	3	53	33	4
1894	7	25	22	1	4	4	8	8	0	0	0	0	7	7	0	38	23	3	52	32	4
1895	8	29	26	1	4	4	8	8	0	0	0	0	6	6	0	47	29	4	39	24	3

Table 3 (continued)

	West Indies			Cape Verde			Gulf of Maine			Canada			Greenland			Iceland			Norway		
Year	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C
1896	8	29	26	1	4	4	8	8	0	0	0	0	2	2	0	59	36	5	112	69	9
1897	21	74	66	1	4	4	0	0	0	0	0	0	5	5	0	61	37	5	43	26	3
1898	4	13	11	1	4	4	0	0	0	19	11	1	2	2	0	106	65	8	46	28	4
1899	9	33	29	1	4	4	0	0	0	22	13	2	5	5	0	99	61	8	50	31	4
1900	12	44	39	1	4	4	0	0	0	22	14	2	8	8	0	94	57	7	65	40	5
1901	17	61	54	1	4	4	0	0	0	52	32	4	8	8	0	166	102	13	103	63	8
1902	14	49	43	2	9	8	0	0	0	95	58	8	8	8	0	191	117	15	134	82	11
1903	13	47	42	2	9	8	0	0	0	173	106	14	8	8	0	149	91	12	41	25	3
1904	4	15	13	2	9	8	0	0	0	169	104	13	8	8	0	117	71	9	33	20	3
1905	3	10	9	2	9	8	0	0	0	97	59	8	4	4	0	127	78	10	6	4	0
1906	5	17	15	2	9	8	0	0	0	49	30	4	4	4	0	80	49	6	5	3	0
1907	4	16	14	2	9	8	0	0	0	48	29	4	4	4	0	105	64	8	7	4	1
1908	6	20	18	2	9	8	0	0	0	14	9	1	4	4	0	94	58	8	6	4	0
1909	3	10	8	2	9	8	0	0	0	20	12	2	4	4	0	120	74	10	10	6	1
1910	2	7	6	2	9	8	0	0	0	14	9	1	2	2	0	83	51	7	8	5	1
1911	2	7	6	2	9	8	0	0	0	14	9	1	6	5	0	29	18	2	4	2	0
1912	2	8	8	2	9	8	0	0	0	13	8	1	6	5	0	22	13	2	2	1	0
1913	1	5	5	0	0	0	0	0	0	5	3	0	2	2	0	6	4	0	2	1	0
1914	1	4	3	0	0	0	4	4	0	8	5	1	2	2	0	2	1	0	2	1	0
1915	2	7	6	0	0	0	0	0	0	3	2	0	2	2	0	2	1	0	2	1	0
1916	3	10	8	0	0	0	0	0	0	0	0	0	2	2	0	2	1	0	2	1	0
1917	1	5	5	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0
1918	1	5	5	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	1	0	0
1919	4	13	12	0	0	0	0	0	0	0	0	0	8	5	1	0	0	0	2	1	0
1920	4	13	12	0	0	0	0	0	0	0	0	0	1	1	0	10	6	1	10	6	1
1921	1	2	2	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
1922	3	12	11	0	0	0	0	0	0	0	0	0	85	53	7	0	0	0	0	0	0
1923	2	8	7	0	0	0	0	0	0	2	1	0	91	56	7	1	0	0	1	0	0
1924	3	11	10	0	0	0	0	0	0	10	6	1	27	19	2	1	0	0	1	0	0
1925	84	21	4	0	0	0	0	0	0	21	13	2	4	4	0	1	1	0	1	1	0
1926	58	17	5	0	0	0	0	0	0	11	7	1	6	6	0	1	1	0	2	1	0
1927	1	2	2	0	0	0	0	0	0	48	29	4	5	6	0	0	0	0	0	0	0
1928	1	5	5	0	0	0	0	0	0	13	8	1	4	5	0	1	1	0	2	1	0
1929	1	4	3	1	1	0	0	0	0	7	4	1	5	5	0	0	0	0	1	1	0
1930	1	2	2	0	0	0	0	0	0	4	3	0	18	12	1	5	3	0	17	11	1
1931	1	4	3	0	0	0	0	0	0	0	0	0	13	9	1	3	2	0	11	7	1
1932	1	3	2	0	0	0	0	0	0	0	0	0	5	4	0	1	1	0	4	3	0
1933	1	2	2	0	0	0	0	0	0	0	0	0	3	2	0	1	1	0	3	2	0
1934	1	2	2	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	1	1	0
1935	1	4	3	0	0	0	0	0	0	6	4	0	3	3	0	1	0	0	1	0	0
1936	1	2	2	0	0	0	0	0	0	6	4	0	2	3	0	0	0	0	0	0	0
1937	1	2	2	0	0	0	0	0	0	5	3	0	7	5	1	2	1	0	1	1	0
1938	1	2	2	0	0	0	0	0	0	0	0	0	0	1	0	1	0	0	1	0	0
1939	1	4	3	0	0	0	0	0	0	2	1	0	1	1	0	1	1	0	1	1	0
1940	0	1	1	0	0	0	0	0	0	4	3	0	0	0	0	0	0	0	0	0	0
1941	1	2	2	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0
1942	0	1	1	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
1943	0	0	0	0	0	0	0	0	0	4	2	0	0	0	0	0	0	0	1	1	0

Table 3 (continued)

	West Indies			Cape Verde			Gulf of Maine			Canada			Greenland			Iceland			Norway		
Year	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C
1944	0	0	0	0	0	0	0	0	0	6	4	0	0	0	0	0	0	0	0	0	0
1945	0	0	0	0	0	0	0	0	0	5	3	0	0	0	0	0	0	0	0	0	0
1946	0	0	0	0	0	0	0	0	0	3	2	0	2	2	0	0	0	0	1	1	0
1947	0	1	1	0	0	0	0	0	0	4	2	0	2	3	0	0	0	0	0	0	0
1948	1	3	2	0	0	0	0	0	0	9	6	1	0	1	0	0	0	0	0	0	0
1949	0	0	0	0	0	0	0	0	0	7	4	1	1	1	0	2	1	0	1	1	0
1950	0	0	0	0	0	0	0	0	0	10	6	1	1	2	0	0	0	0	5	3	0
1951	0	0	0	0	0	0	0	0	0	17	11	1	2	3	0	1	0	0	3	2	0
1952	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	1	0
1953	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	2	1	0	3	2	0
1954	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	4	2	0
1955	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
1956	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	1	0
1957	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1958	1	4	4	0	0	0	0	0	0	2	1	0	0	0	0	0	0	0	0	0	0
1959	1	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1960	0	1	1	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1961	0	0	0	2	2	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1962	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0	0	0	0
1963	1	3	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1964	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1965	0	1	1	0	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0
1966	0	0	0	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0
1967	1	3	2	0	0	0	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0
1968	1	3	2	0	0	0	0	0	0	0	0	0	2	3	0	0	0	0	0	0	0
1969	1	3	2	0	0	0	1	1	0	4	3	0	1	2	0	0	0	0	0	0	0
1970	2	7	6	0	0	0	1	0	0	9	6	1	0	0	0	0	0	0	0	0	0
1971	1	3	2	0	0	0	2	1	0	11	7	1	2	2	0	0	0	0	0	0	0
1972	1	5	5	0	0	0	0	0	0	1	1	0	1	2	0	0	0	0	0	0	0
1973	0	1	1	0	0	0	0	0	0	1	1	0	5	6	0	0	0	0	0	0	0
1974	0	1	1	1	1	0	0	0	0	1	1	0	4	5	0	0	0	0	0	0	0
1975	0	0	0	0	0	0	0	0	0	1	1	0	4	5	0	0	0	0	0	0	0
1976	0	1	1	1	1	0	0	0	0	1	1	0	4	5	0	0	0	0	0	0	0
1977	0	0	0	0	0	0	0	0	0	1	1	0	8	8	1	0	0	0	0	0	0
1978	0	1	1	1	1	0	0	0	0	4	4	0	11	12	1	0	0	0	0	0	0
1979	1	3	3	0	0	0	0	0	0	6	6	0	7	7	1	0	0	0	0	0	0
1980	0	2	2	0	0	0	0	0	0	8	8	0	7	8	1	0	0	0	0	0	0
1981	0	0	0	0	0	0	0	0	0	4	4	0	6	6	0	0	0	0	0	0	0
1982	1	2	2	0	0	0	0	0	0	2	2	0	6	6	0	0	0	0	0	0	0
1983	0	1	1	0	0	0	0	0	0	2	2	0	7	8	1	0	0	0	0	0	0
1984	0	0	0	0	0	0	0	0	0	3	3	0	7	8	1	0	0	0	0	0	0
1985	0	0	0	0	0	0	0	0	0	4	4	0	4	4	0	0	0	0	0	0	0
1986	0	1	1	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0
1987	0	1	1	0	0	0	0	0	0	2	2	0	0	0	0	0	0	0	0	0	0
1988	0	1	1	0	0	0	0	0	0	6	6	0	0	1	0	0	0	0	0	0	0
1989	0	0	0	0	0	0	0	0	0	2	2	0	1	1	0	0	0	0	0	0	0
1990	0	0	0	0	0	0	0	0	0	5	5	0	0	1	0	0	0	0	0	0	0
1991	0	0	0	0	0	0	0	0	0	4	4	0	0	1	0	0	0	0	0	0	0

Table 3 (continued)

Year	West Indies			Cape Verde			Gulf of Maine			Canada			Greenland			Iceland			Norway		
	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C	M	F	C
1992	0	1	1	0	0	0	0		0	4	4	0	0	1	0	0	0	0	0	0	0
1993	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
1995	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1996	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0
1999	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Discussion

The present estimates are substantial improvements over those of Smith and Reeves (2002) for these three fisheries. The lack of removal estimates for the American non-mechanised coastal fishery in the previous time series (Smith and Reeves, 2002) reflected the fact that little information was available at last year's meeting. Following a directed search for additional data (SC/54/H16), the fragmentary information that exists for this fishery has been examined and considered more closely and plausible, albeit extremely crude, estimates have been generated (Table 1). These estimates represent the time periods of operation and catch patterns of the fishery. It is emphasised, however, that the absolute values of the landings given in Table 2 are only educated guesses produced for modelling purposes. The total of removals for this fishery is now estimated at 1,556 humpbacks (Table 3).

The previous estimates of total removals for the American mechanised coastal fishery totalled 183 (Smith and Reeves, 2002, pp.253-4), which is substantially less than the new total of 1,142 (Table 3). This increase is largely the result of new data from Webb (2001) and an intensive, focused search of various materials not previously examined in detail (SC/54/H16).

The present estimates of total removals for the American non-mechanised pelagic fishery between 1865-86 are somewhat lower than those in Smith and Reeves (2002): 2,990 vs 3,180 for the West Indies and 816 vs 1,084 for the Cape Verdes. Estimates by Smith and Reeves (2002) were based on simple extrapolations of voyage catch rates to relatively coarsely selected voyages made by the American whaling fleet. The new estimates in SC/54/H15 were based on the reading of a stratified random sample of logbooks for the period 1865-1886. It is encouraging that the new estimates, while lower, are similar to those obtained by Smith and Reeves (2002). This suggests that estimates of removals before 1865, while probably biased upwards, may in fact not be greatly biased.

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Appendix 3

RESULTS OF NORTH ATLANTIC HUMPBACK WHALE ASSESSMENT RUNS

Case A
Catch data: New data series as agreed under Item 5.2.2
MSY level: 60% of *K* (IWC convention)
Depensation: No
Resilience: Single parameter

Case B
Catch data: New data series as agreed under Item 5.2.2
MSY level: 60% of *K*
Depensation: Yes
Resilience: Single parameter

Case C
Catch data: New catch series as agreed under Item 5.2.2 but with Gulf of Maine catches multiplied by 2
MSY level: 60% of *K*
Depensation: No
Resilience: Single parameter

Case D
Catch data: New data series as agreed under Item 5.2.2
MSY level: 75% of *K*
Depensation: No
Resilience: Single parameter

Case E
Catch data: New data series as agreed under Item 5.2.2
MSY level: 60% of *K*
Depensation: No
Resilience: Variable among feeding areas

Abundance estimates were the same for all Cases. These were the same as used last year (IWC, 2002), but the estimate for the Iceland feeding area was replaced with the shipboard estimate for 1995 from the single vessel AFR from SC/54/H10 (see Item 5.1.3). All other data and options were as described in IWC (2002).

REFERENCE

International Whaling Commission. 2002. Report of the Scientific Committee. Annex H. Report of the Sub-Committee on the Comprehensive Assessment of North Atlantic Humpback Whales. Appendix 5. Specification of stock structure hypotheses and input data for the assessment model. *J. Cetacean Res. Manage. (Suppl.)* 4:258-9.

Cases A–E on following pages

Case A
Number of parameters = 8. Objective function value = 18.1704.
Single value for resilience parameter, *A*, estimated as 4.32709.
Depensation not allowed.

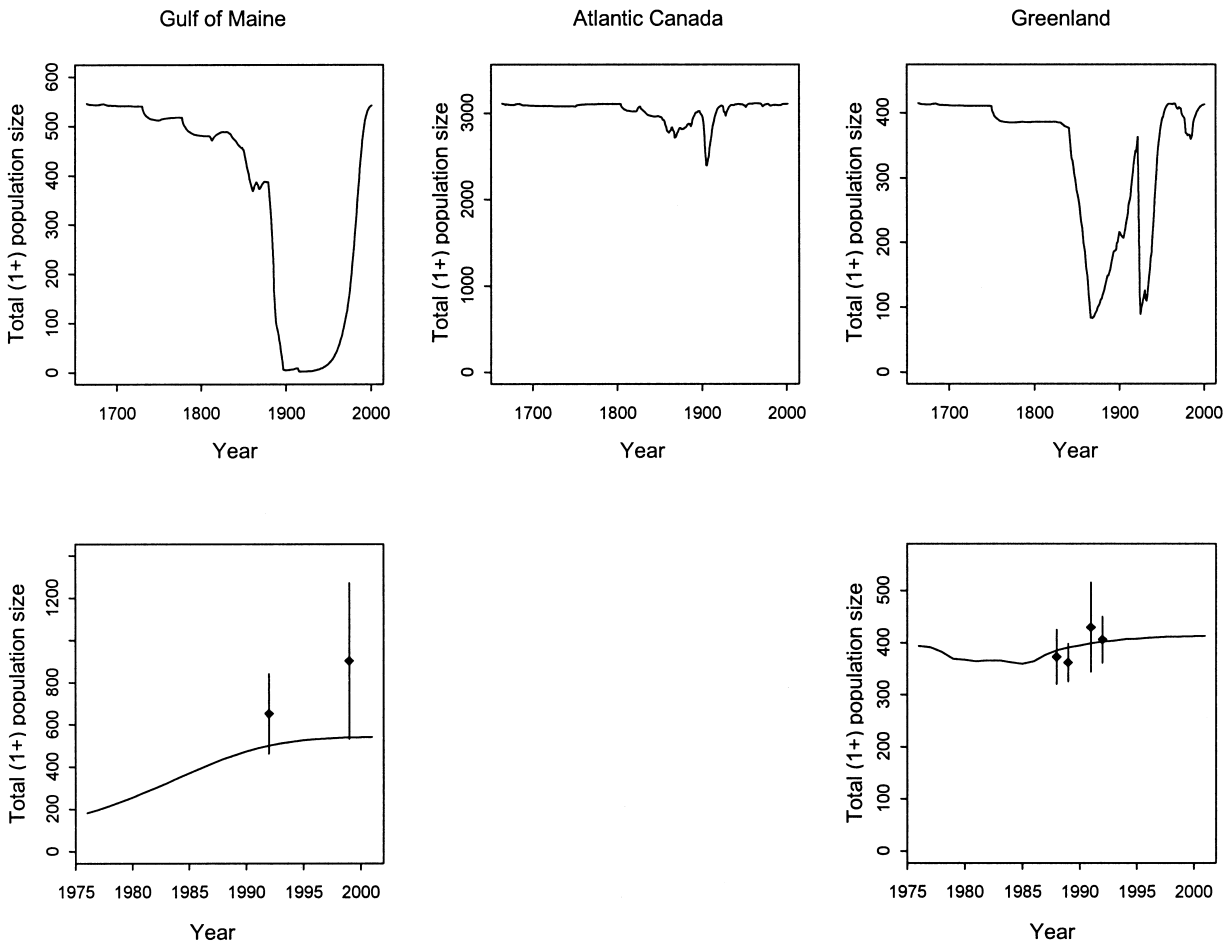
Gulf of Maine	Years	Predicted	Observed	SD
Rate of Increase	1979-1991	0.0614808	0.063	0.011
Average Fecundity	1995-2001	0.13171429	0.43	0.141

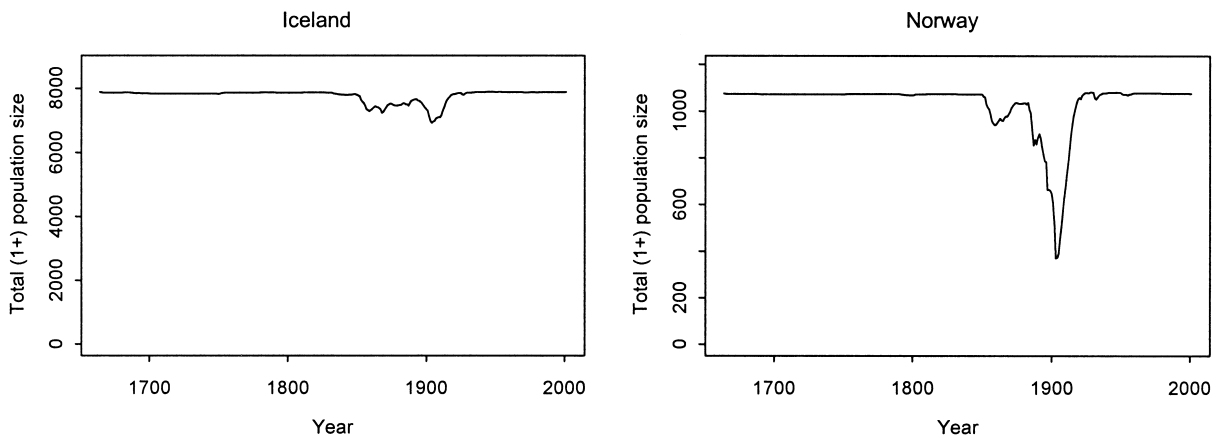
Ratios of feeding area from the West Indies.

	Year	Predicted	Observed	SD
Iceland	1992	0.599950	0.60	0.050
Norway	1992	0.129233	0.13	0.057

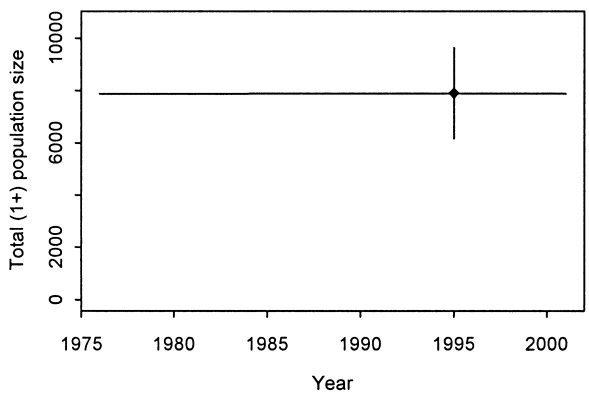
Carrying capacity (K) and population size (N) estimates

	K	N_{2001}	(N_{2001}/K)%	min(N)	max(N)
Gulf of Maine	546	542	99	2	546
Canada	3111	3109	100	2394	3114
Greenland	415	413	100	83	415
Iceland Total	7889	7887	100	6926	7896
Norway Total	1075	1076	100	369	1082
Iceland-West Indies	5536	4728	85	4286	5536
Iceland-Cape Verde	2353	3159	134	2244	3159
Norway-West Indies	205	139	68	50	205
Norway-Cape Verde	870	937	108	320	940
West Indies	9813	8931	91	6974	9813
Cape Verde	3222	4096	127	2963	4096
Total NA	13036	13027	100	9970	13036




Iceland
Total (1+) population size
0
2000
4000
6000
8000
1700
1800
1900
2000
Year

Norway
Total (1+) population size
0
200
600
1000
1700
1800
1900
2000
Year


Total (1+) population size
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1975
1980
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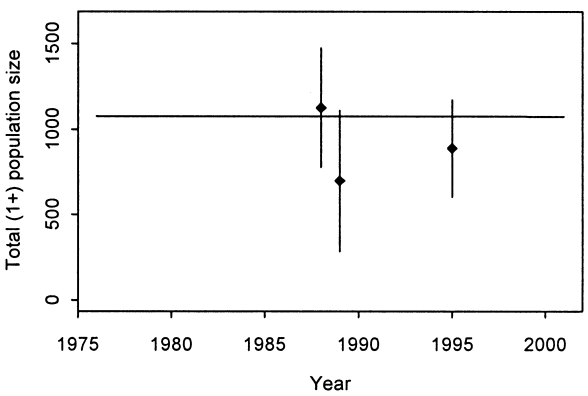
1990
1995
2000
Year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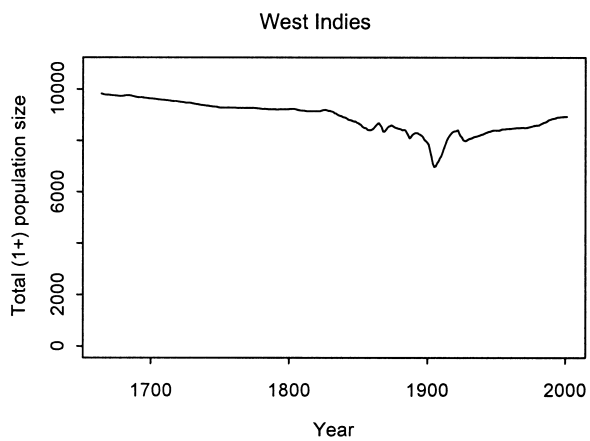
1000
1500
1975
1980
1985
1990
1995
2000
Year


West Indies
Total (1+) population size
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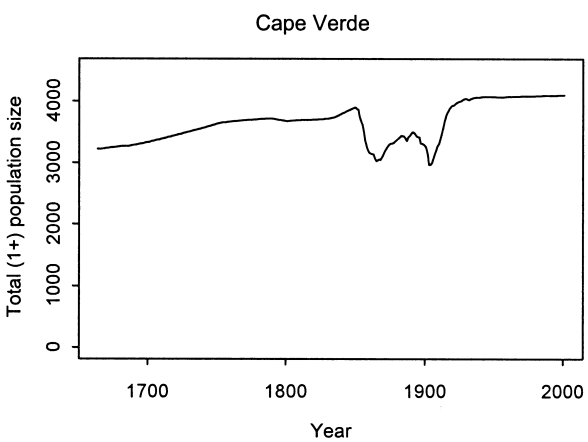
2000
6000
10000
1700
1800
1900
2000
Year


Cape Verde
Total (1+) population size
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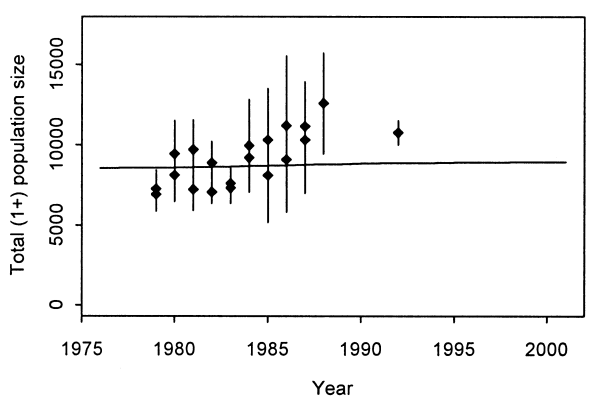
3000
4000
1700
1800
1900
2000
Year


Total (1+) population size
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1985
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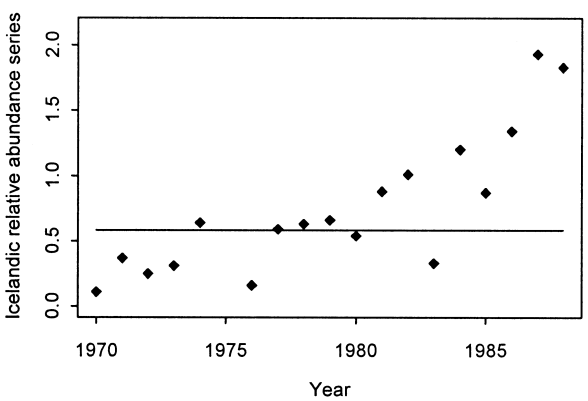
1995
2000
Year


Icelandic relative abundance series
0.0
0.5
1.0
1.5
2.0
1970
1975
1980
1985
Year

Case B
Number of parameters = 9. Objective function value = 16.087421.
Single value for resilience parameter, *A*, estimated as 0.055502253.
Depensation allowed, β estimated as 3.597113.

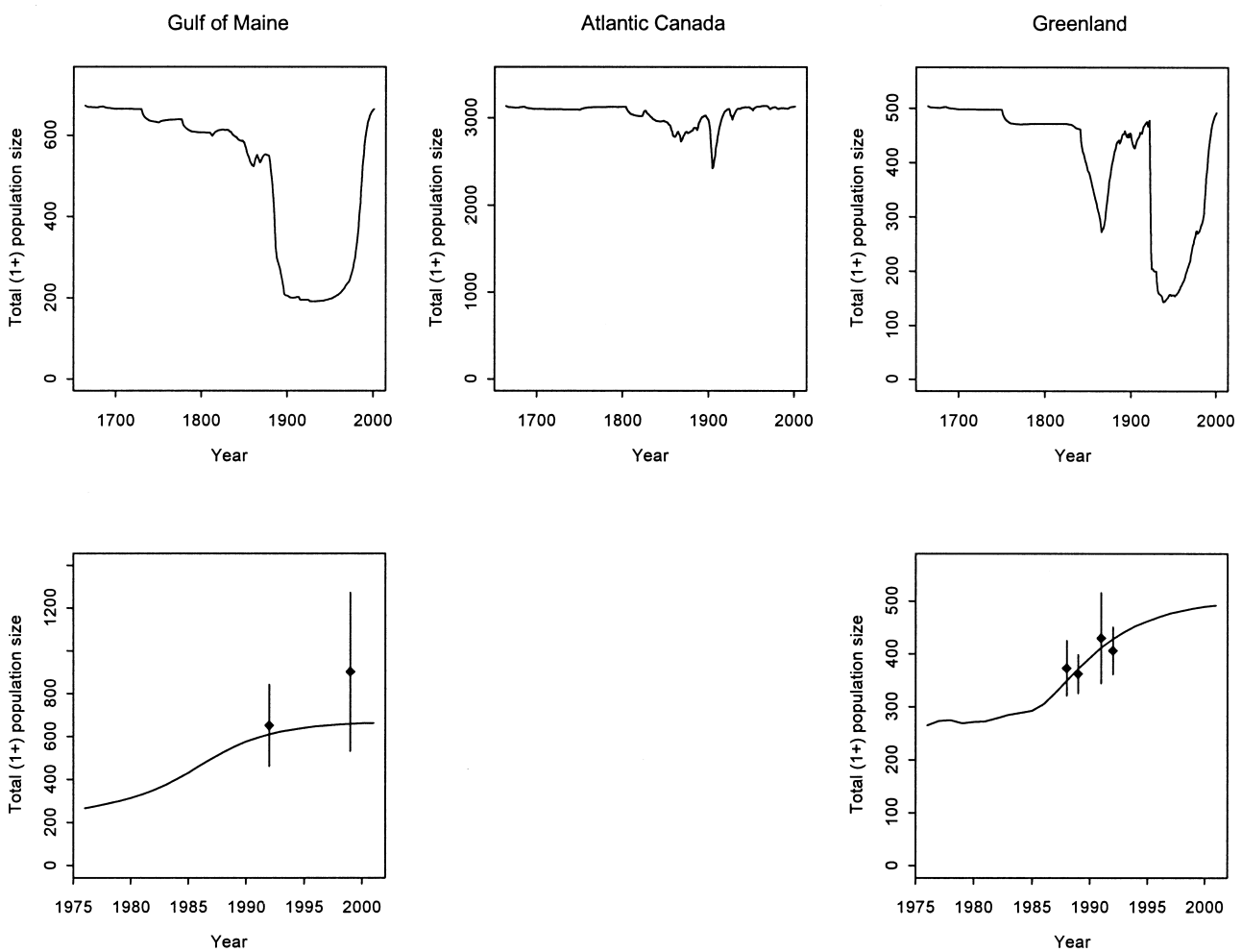
Gulf of Maine	Years	Predicted	Observed	SD
Rate of Increase	1979-1991	0.0612433	0.063	0.011
Average Fecundity	1995-2001	0.13457143	0.43	0.141

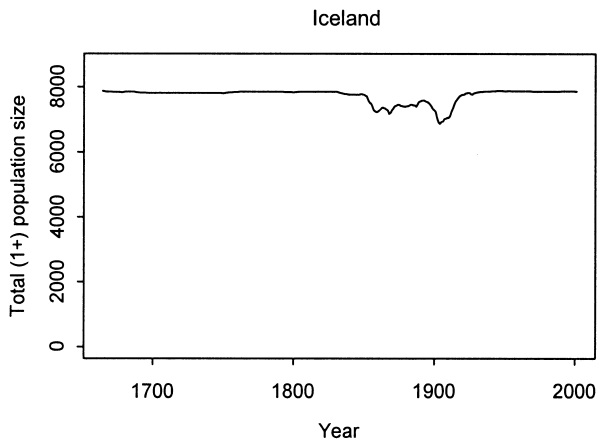
Ratios of feeding area from the West Indies.

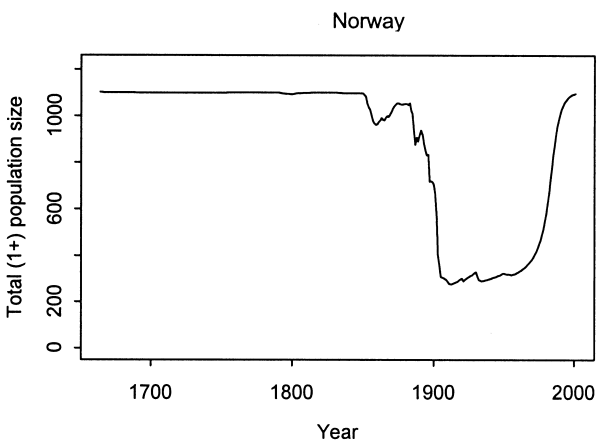
	Year	Predicted	Observed	SD
Iceland	1992	0.600351	0.60	0.050
Norway	1992	0.136343	0.13	0.057

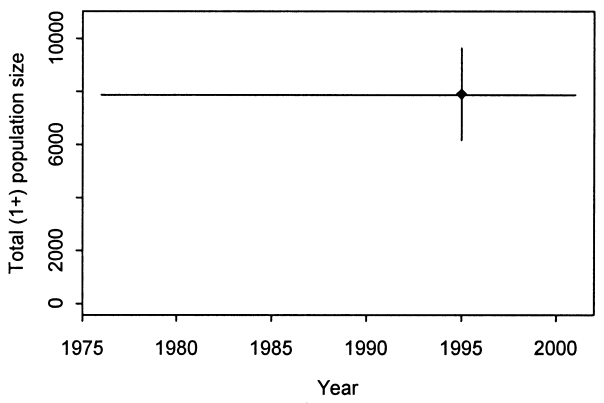
Carrying capacity (*K*) and population size (*N*) estimates

	K	N_{2001}	(N_{2001}/K)%	min(*N*)	max(*N*)
Gulf of Maine	672	664	99	191	672
Canada	3135	3130	100	2424	3137
Greenland	504	492	98	143	504
Iceland Total	7866	7863	100	6864	7875
Norway Total	1101	1096	99	276	1101
Iceland-West Indies	5459	4717	86	4232	5459
Iceland-Cape Verde	2407	3146	131	2271	3146
Norway-West Indies	215	149	69	40	215
Norway-Cape Verde	886	946	107	237	946
West Indies	9984	9153	92	7359	9984
Cape Verde	3294	4093	124	2918	4093
Total NA	13278	13245	100	10277	13278




Iceland
Total (1+) population size
0
2000
4000
6000
8000
1700
1800
1900
2000
Year


Norway
Total (1+) population size
0
200
600
1000
1700
1800
1900
2000
Year


Total (1+) population size
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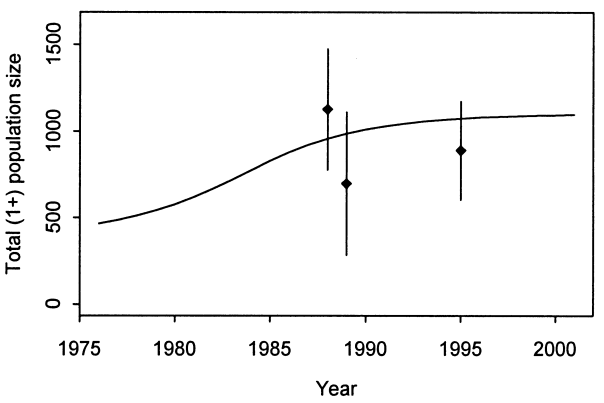
Year


Total (1+) population size
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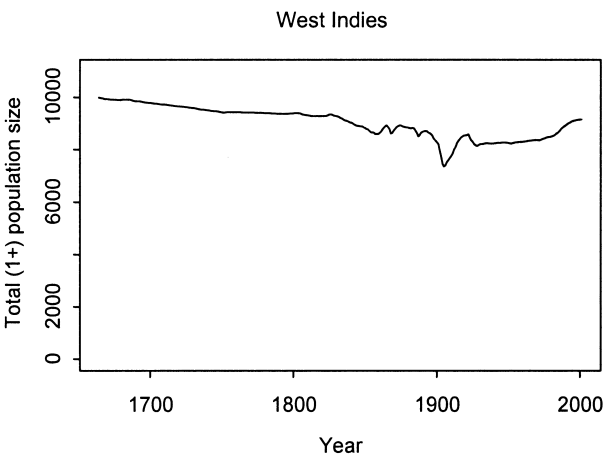
1000
1500
1975
1980
1985
1990
1995
2000
Year


West Indies
Total (1+) population size
0
2000
6000
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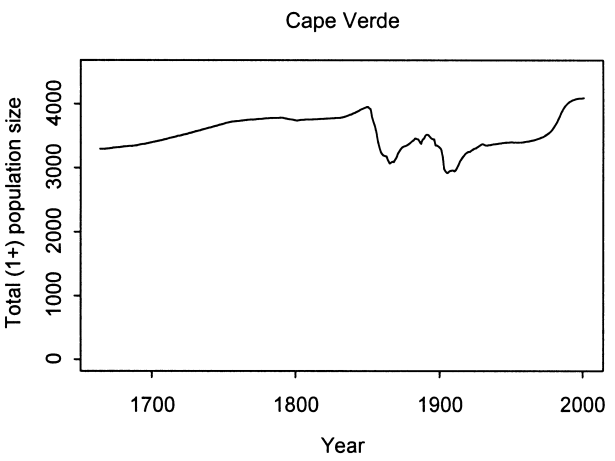
1800
1900
2000
Year


Cape Verde
Total (1+) population size
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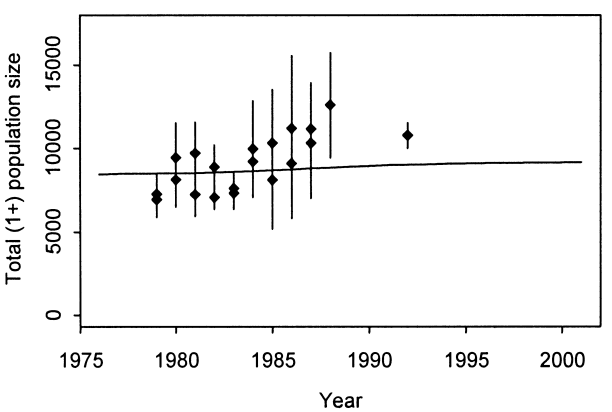
1800
1900
2000
Year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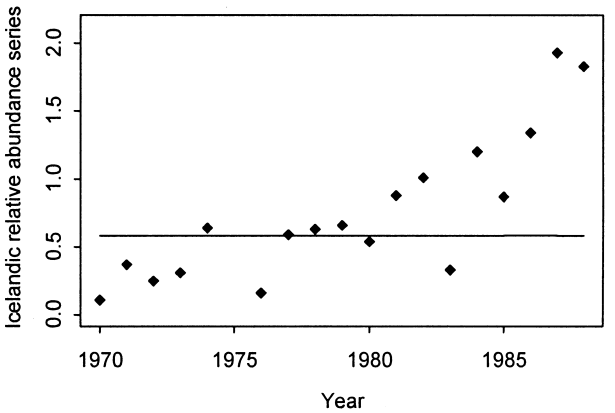
Year


Icelandic relative abundance series
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1.0
1.5
2.0
1970
1975
1980
1985
Year

Case C
Number of parameters = 8. Objective function value = 16.9639.
Single value for resilience parameter, A, estimated as 4.24898.
Depensation not allowed.

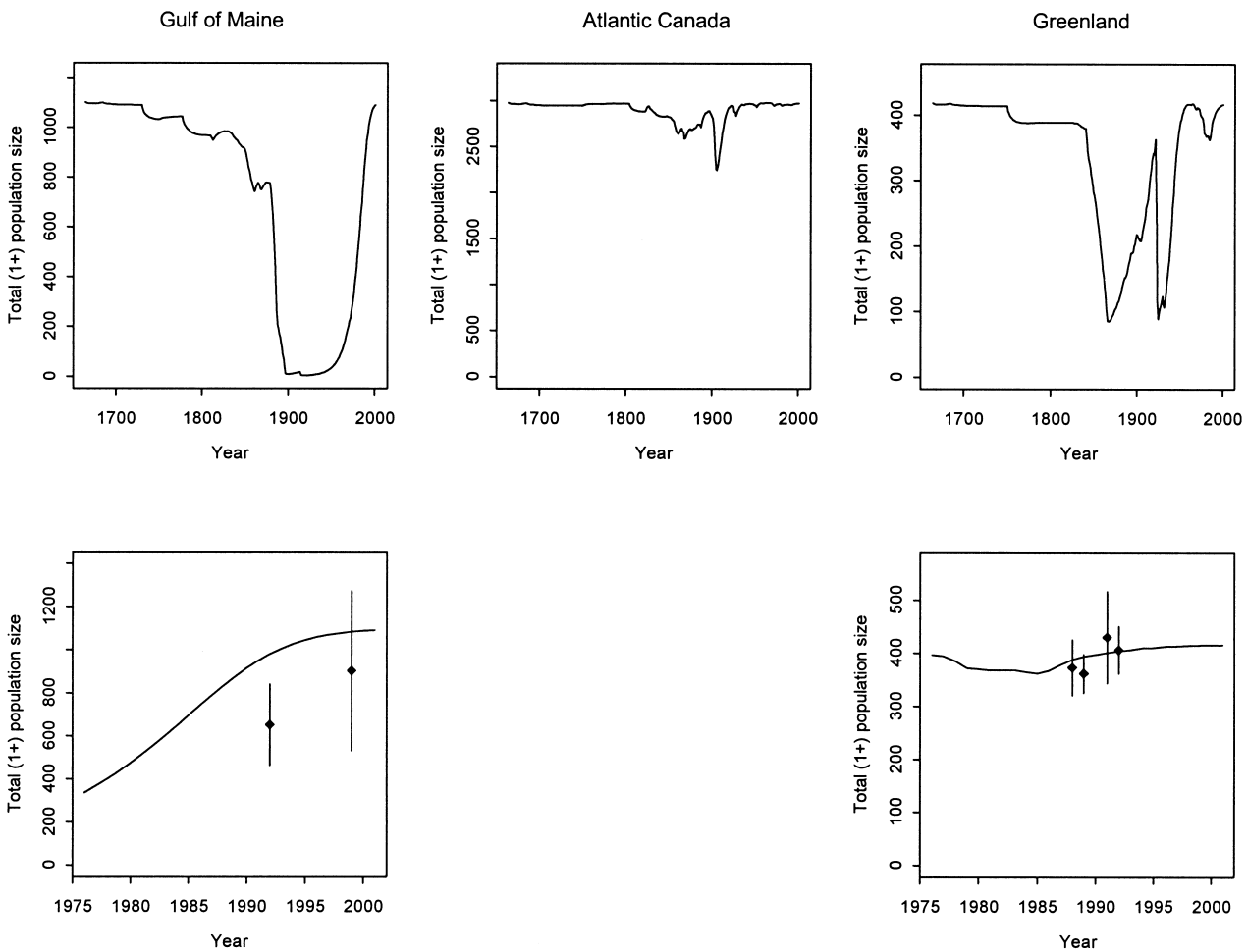
Gulf of Maine	Years	Predicted	Observed	SD
Rate of Increase:	1979-1991	0.0656379	0.063	0.011
Average Fecundity:	1995-2001	0.14	0.43	0.141

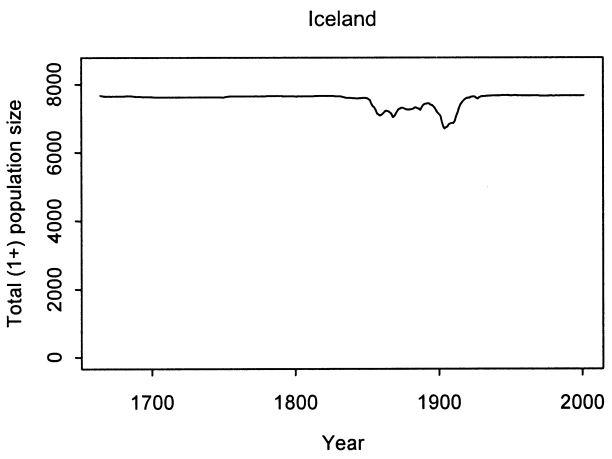
Ratios of feeding area from the West Indies.

	Year	Predicted	Observed	SD
Iceland	1992	0.596012	0.60	0.050
Norway	1992	0.128421	0.13	0.057

Carrying capacity (K) and population size (N) estimates

	K	N_{2001}	(N_{2001}/K)%	min(N)	max(N)
Gulf of Maine	1101	1090	99	4	1101
Canada	2973	2971	100	2242	2976
Greenland	418	416	99	85	418
Iceland Total	7672	7670	100	6691	7679
Norway Total	1083	1084	100	368	1090
Iceland-West Indies	5331	4568	86	4121	5331
Iceland-Cape Verde	2341	3102	133	2201	3102
Norway-West Indies	203	139	69	49	203
Norway-Cape Verde	880	945	107	319	948
West Indies	10026	9184	92	6665	10026
Cape Verde	3221	4047	126	2892	4047
Total NA	13247	13231	100	9587	13247




Iceland
Total (1+) population size
0
2000
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8000
1700
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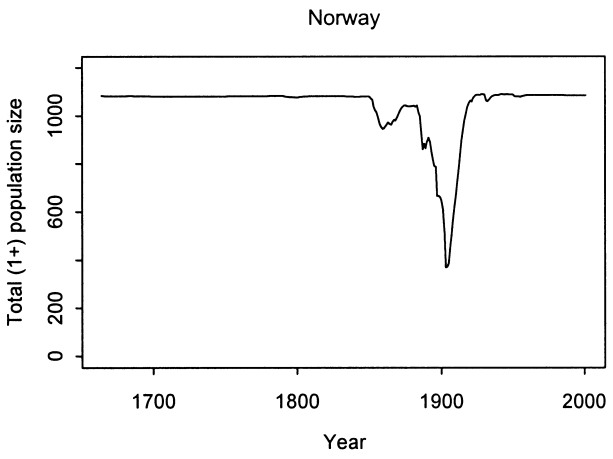
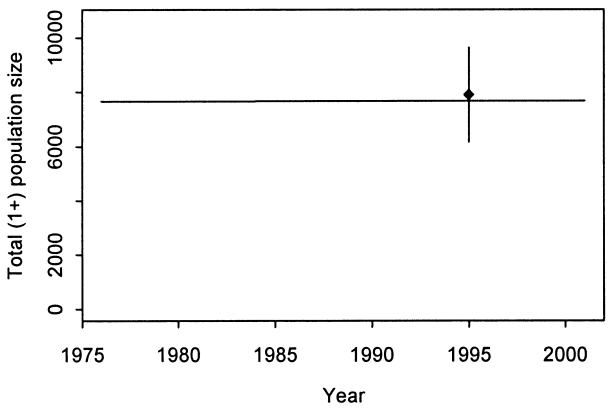
1900
2000
Year


Norway
Total (1+) population size
0
200
600
1000
1700
1800
1900
2000
Year


Total (1+) population size
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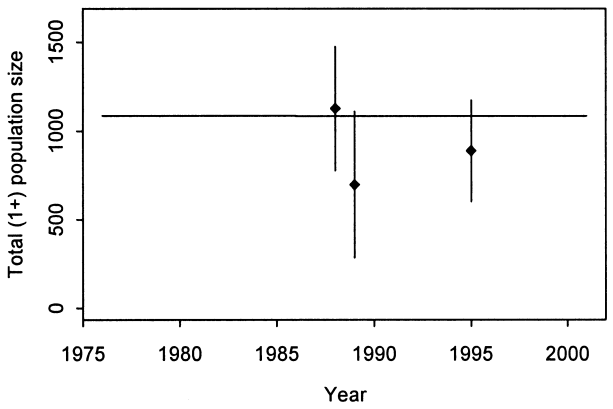
Year


Total (1+) population size
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1500
1975
1980
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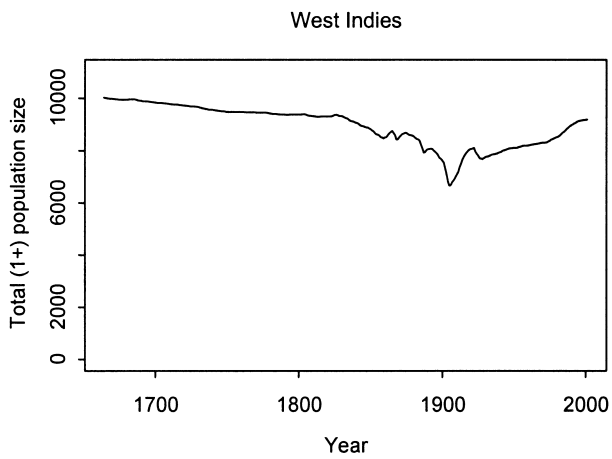
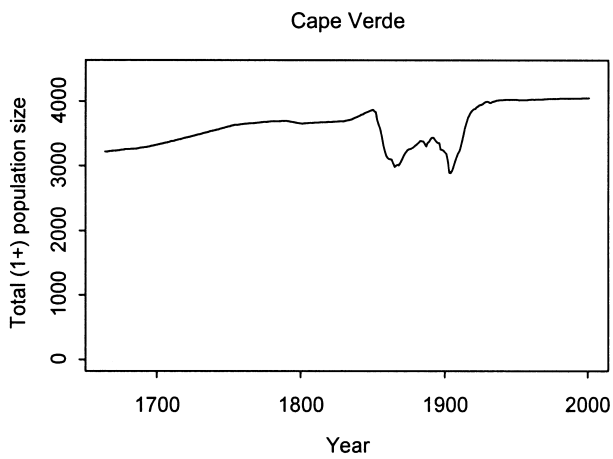
1990
1995
2000
Year


West Indies
Total (1+) population size
0
2000
6000
10000
1700
1800
1900
2000
Year


Cape Verde
Total (1+) population size
0
1000
2000
3000
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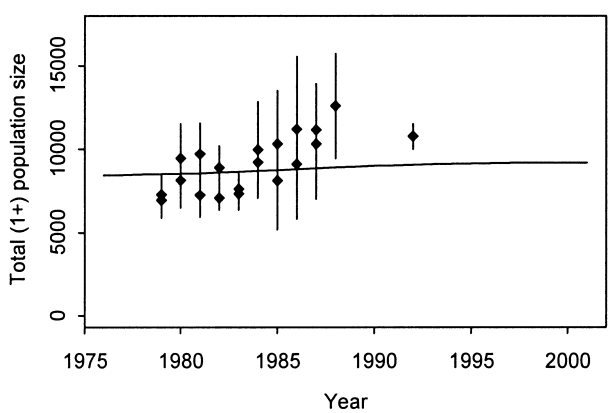
1700
1800
1900
2000
Year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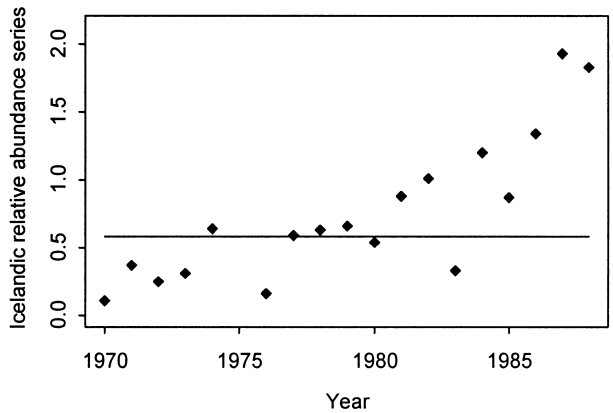
2000
Year


Icelandic relative abundance series
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0.5
1.0
1.5
2.0
1970
1975
1980
1985
Year

Case D
Number of parameters = 8. Objective function value = 20.021.
Single value for resilience parameter, A, estimated as 1.49462.
Depensation not allowed.

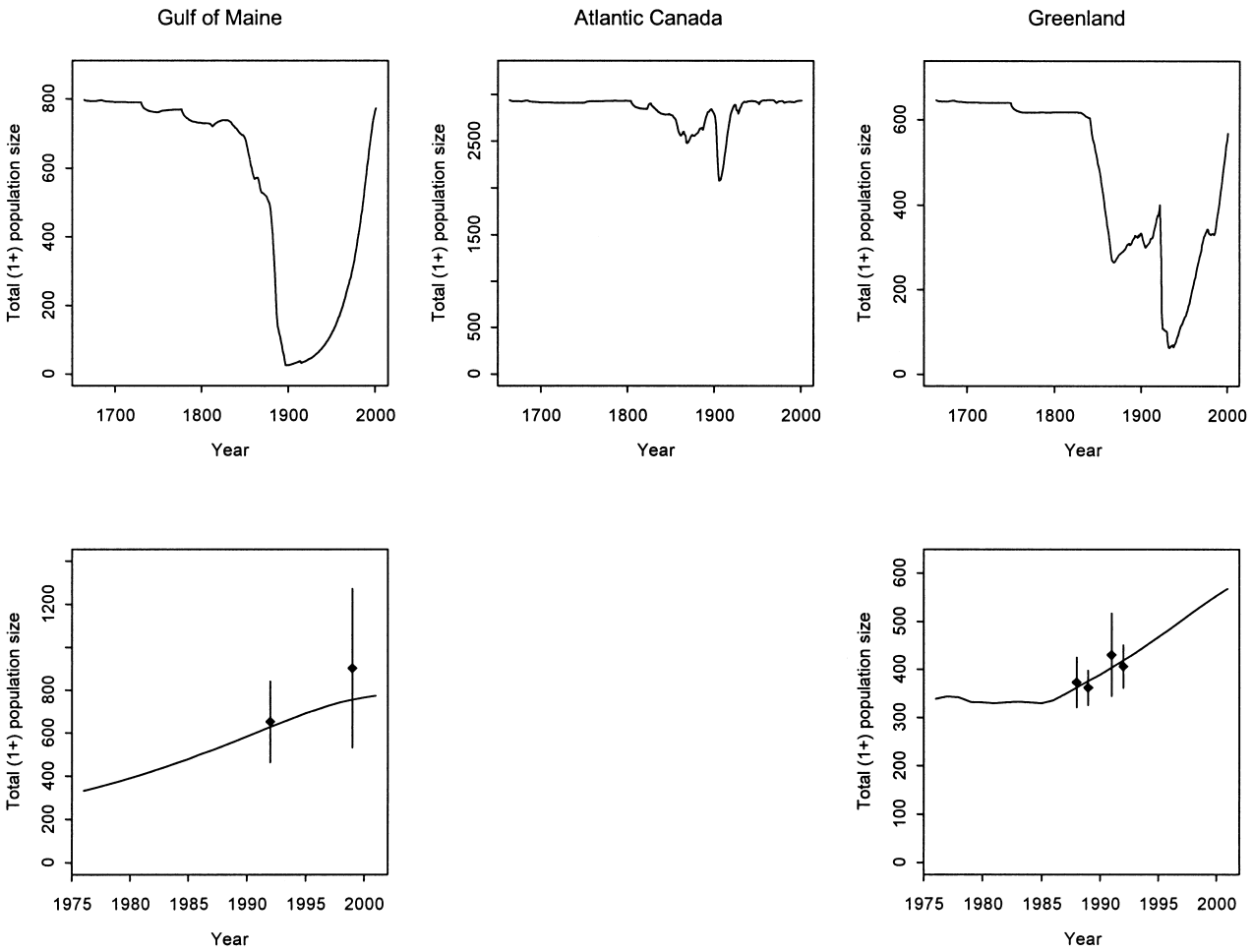
Gulf of Maine	Years	Predicted	Observed	SD
Rate of Increase	1979-1991	0.0400168	0.063	0.011
Average Fecundity	1995-2001	0.18085714	0.43	0.141

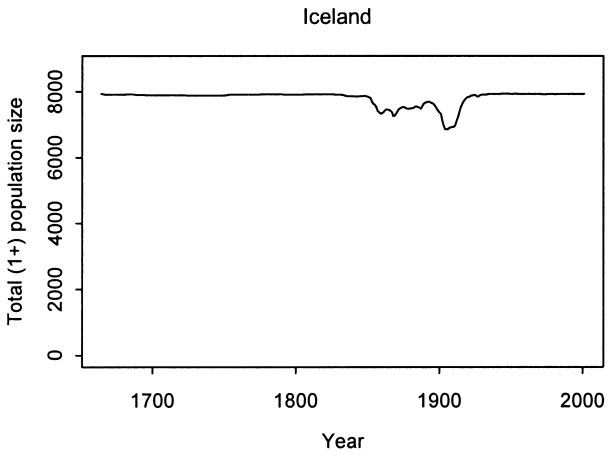
Ratios of feeding area from the West Indies.

	Year	Predicted	Observed	SD
Iceland	1992	0.599206	0.60	0.050
Norway	1992	0.126807	0.13	0.057

Carrying capacity (K) and population size (N) estimates

	K	N_{2001}	(N_{2001}/K)%	min(N)	max(N)
Gulf of Maine	797	772	97	25	797
Canada	2937	2935	100	2080	2939
Greenland	646	567	88	62	646
Iceland Total	7939	7937	100	6854	7946
Norway Total	1347	1348	100	334	1353
Iceland-West Indies	5589	4752	85	4236	5589
Iceland-Cape Verde	2350	3185	136	2245	3185
Norway-West Indies	255	171	67	44	255
Norway-Cape Verde	1092	1177	108	290	1179
West Indies	10223	9198	90	6695	10223
Cape Verde	3442	4362	127	2913	4362
Total NA	13665	13560	99	9625	13665




Iceland
Total (1+) population size
0
2000
4000
6000
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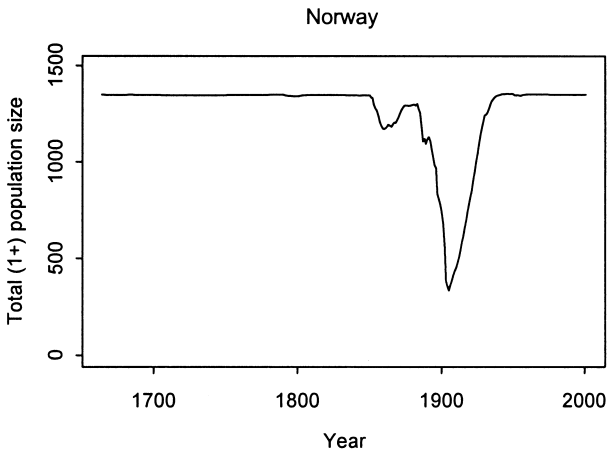
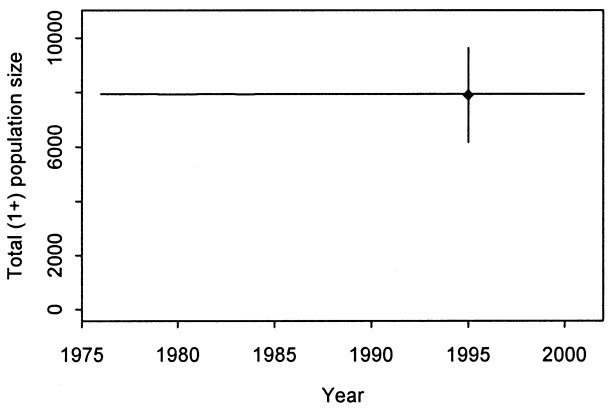
2000
Year


Norway
Total (1+) population size
0
500
1000
1500
1700
1800
1900
2000
Year


Total (1+) population size
0
2000
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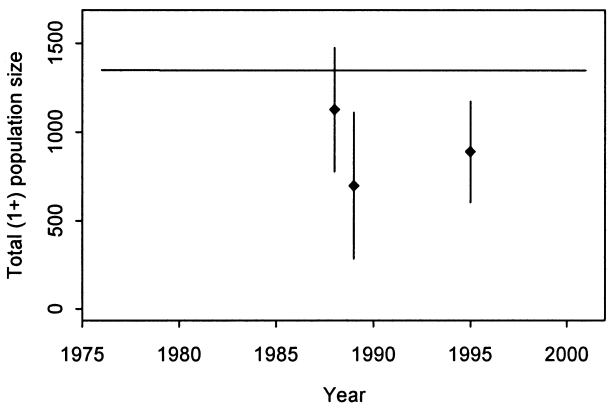
Year


Total (1+) population size
0
500
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1975
1980
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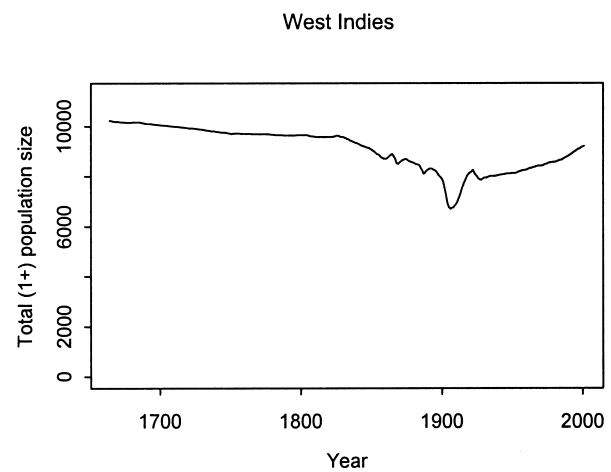
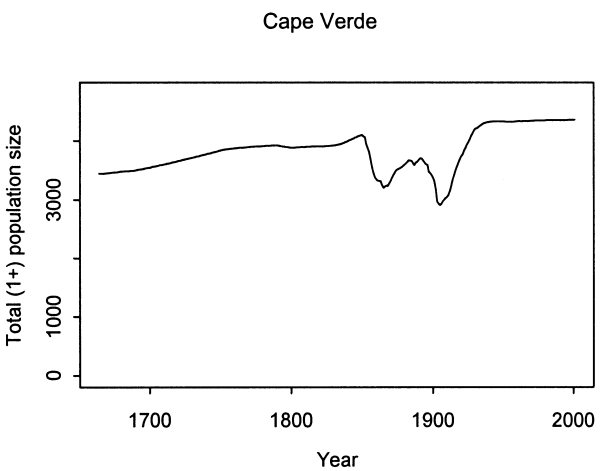
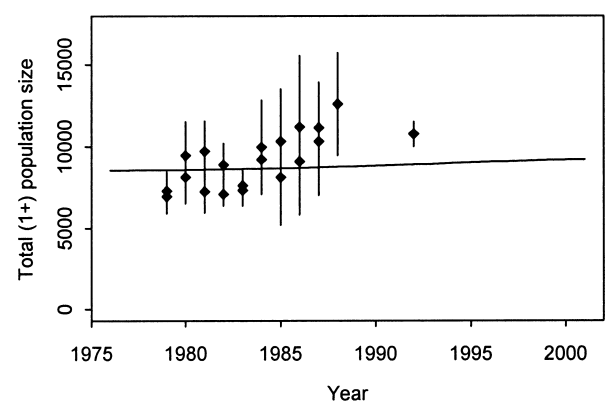
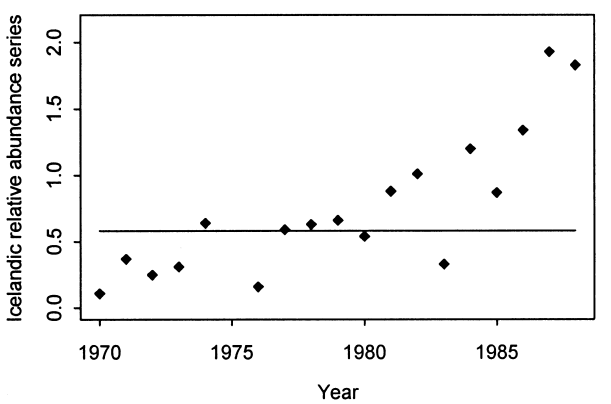
2000
Year


West Indies
Total (1+) population size
0
2000
6000
10000
1700
1800
1900
2000
Year


Cape Verde
Total (1+) population size
0
1000
3000
1700
1800
1900
2000
Year


Total (1+) population size
0
5000
10000
15000
1975
1980
1985
1990
1995
2000
Year


Icelandic relative abundance series
0.0
0.5
1.0
1.5
2.0
1970
1975
1980
1985
Year

Case E
Number of parameters = 12. Objective function value = 18.148139.
Depensation not allowed.

*A*par	Gulf of Maine	Canada	Greenland	Iceland	Norway	Mean(*A*rel) +*A*par
4.36156	-0.03877	-0.00929	0.01272	-0.00942	0	4.35261

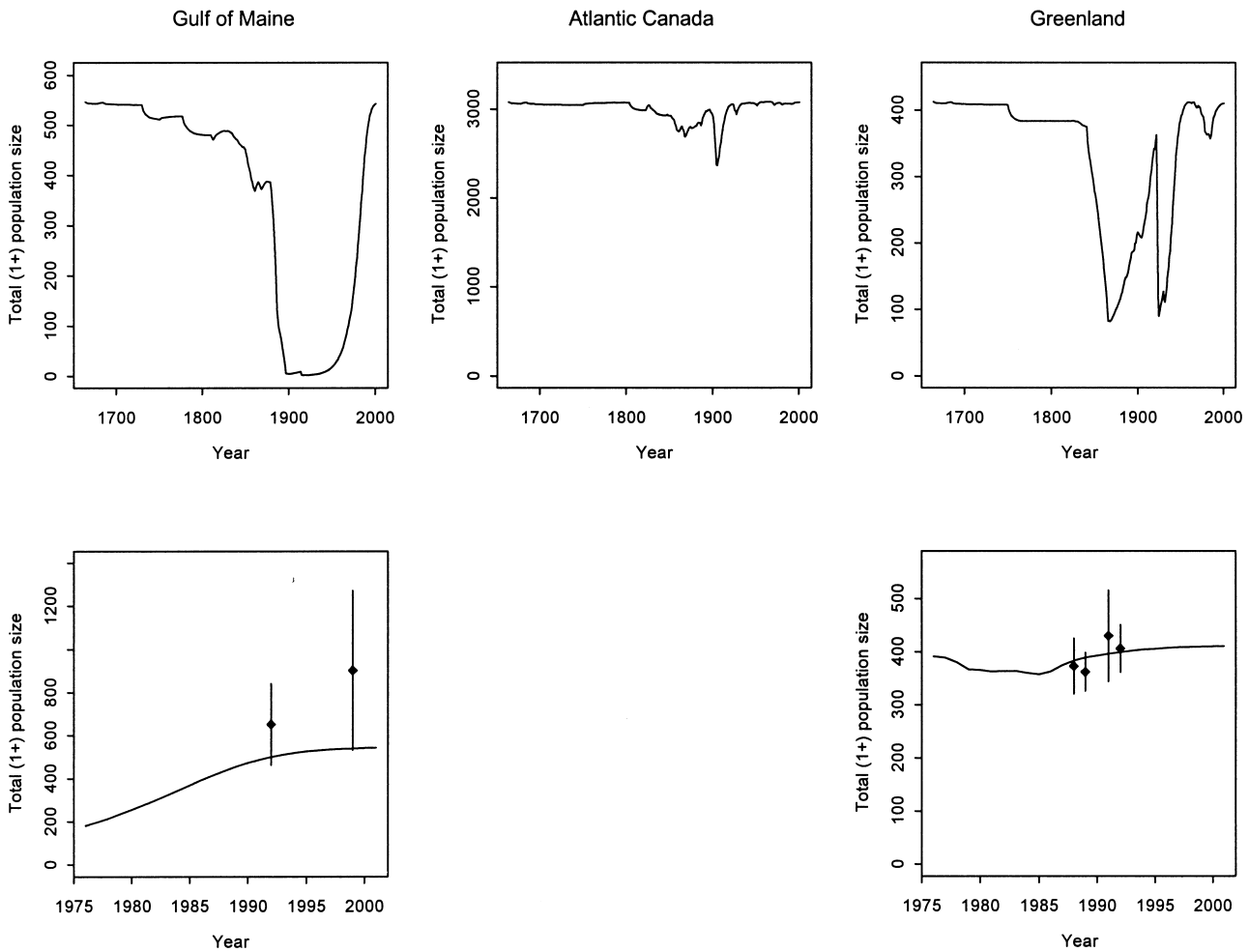
Gulf of Maine	Years	Predicted	Observed	SD
Rate of Increase	1979-1991	0.0617176	0.063	0.011
Average Fecundity	1995-2001	0.13214286	0.43	0.141

Carrying capacity (*K*) and population size (*N*) estimates

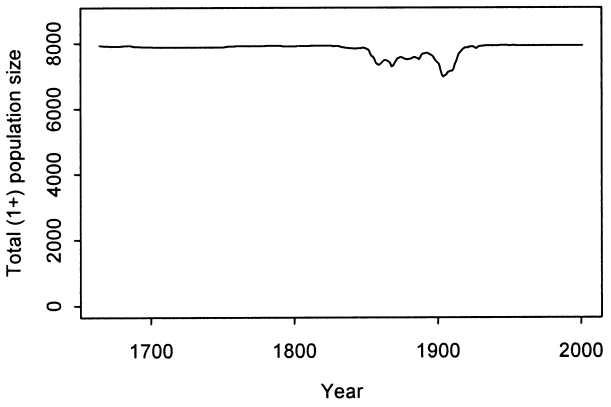
	K	N_{2001}	(N_{2001}/K)%	min(*N*)	max(*N*)
Gulf of Maine	546	543	99	2	546
Canada	3080	3078	100	2366	3083
Greenland	412	410	100	82	412
Iceland Total	7932	7930	100	6973	7939
Norway Total	1071	1072	100	370	1078
Iceland-West Indies	5573	4759	85	4320	5573
Iceland-Cape Verde	2359	3171	134	2253	3171
Norway-West Indies	205	139	68	50	205
Norway-Cape Verde	866	934	108	320	937
West Indies	9817	8928	91	6981	9817
Cape Verde	3226	4105	127	2976	4105
Total NA	13042	13033	100	9990	13042

Ratios of Feeding area from the West Indies.

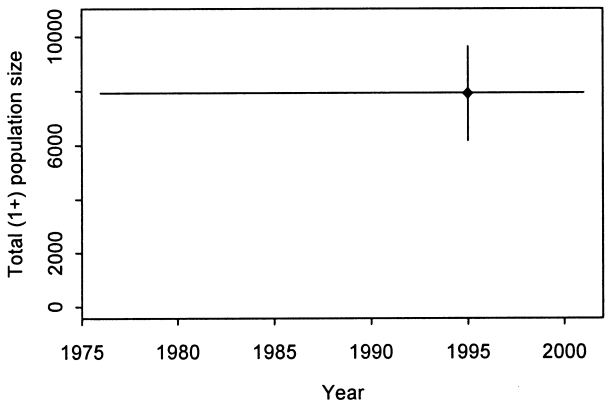
	Year	Predicted	Observed	SD
Iceland	1992	0.600580	0.60	0.050
Norway	1992	0.129376	0.13	0.057

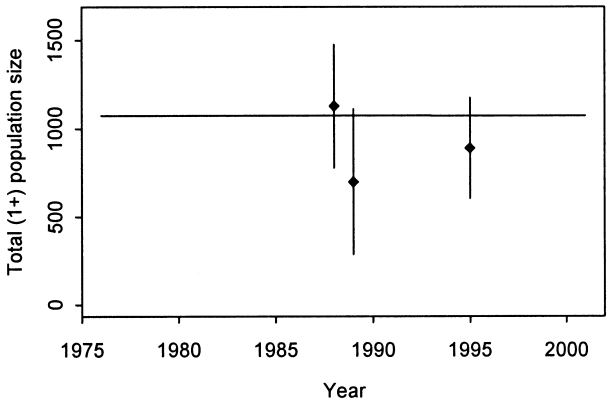


Iceland



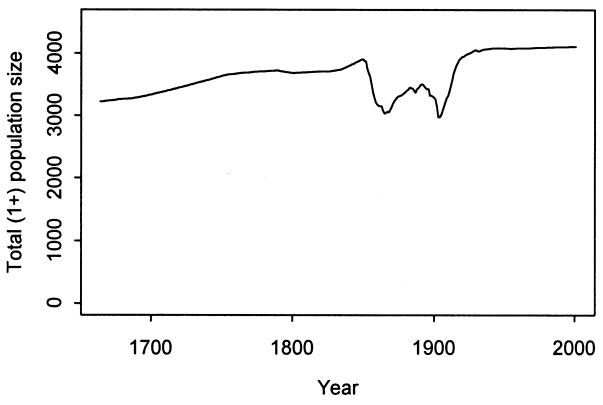
Norway

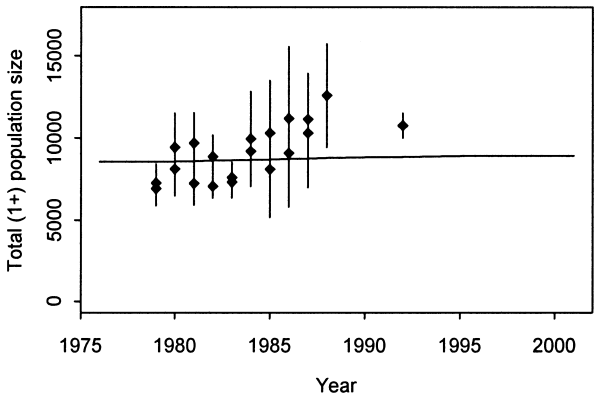


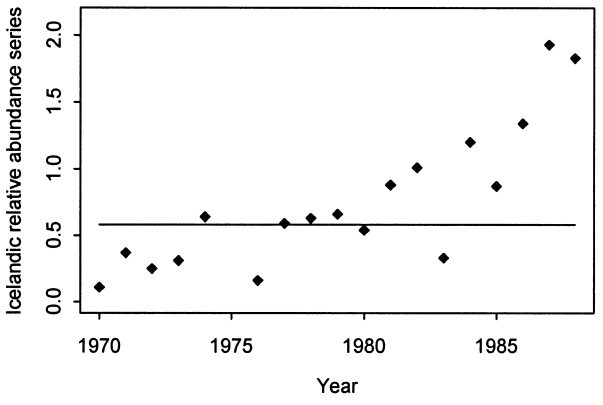


West Indies

Cape Verde







Appendix 4

REPORT OF THE WORKING GROUP ON THE ANTARCTIC HUMPBACK WHALE CATALOGUE

Members: Baker, Carlson, Childerhouse, Clapham, Donovan, Garrigue, Pastene and Rosenbaum.

The Working Group discussed and clarified the following issues:

(1) Access to IDCR/SOWER photos. Donovan clarified that members of the Scientific Committee should have full access to photographs collected on IDCR/SOWER cruises and that this is in line with standard IWC data policy. Members are able to approach the Secretariat and obtain access to these photographs (e.g. original negatives and proof sheets) but it is not clear (based on the contract with the College of the Atlantic (COA)) whether or not they can gain access to these same images which have been compiled in the COA Antarctic catalogue.
(2) At present, access to all photographs in the COA Antarctic catalogue is only available to the Secretariat, contributors, and others on a case-by-case basis as agreed by contributors.
(3) Presently, the only information associated with each photograph in the catalogue is catalogue number, the regional area where the photograph was taken, and the contact details of contributors.
(4) The purpose of the COA Antarctic humpback catalogue was to centralise the collection and make accessible photographs of humpback whales from the Antarctic. Since its creation, photographs have been provided from other Southern Hemisphere areas, including breeding areas, and these have been included in the catalogue.
(5) It was recognised that access to the catalogue was for contributors only but that a person or group desiring access to the catalogue only need submit a single photograph to be considered a contributor and thereby gain access.

The Working Group proposed the following:

(1) The Secretariat approach the COA and renegotiate access to images collected by IDCR/SOWER surveys stored in the COA Antarctic catalogue. This is with the aim of giving open access to these images to *everyone*, in accordance with IWC policy.
(2) The Secretariat approach the COA and ask them to provide a list of addresses of contributors, which will be made available to Scientific Committee members upon request.
(3) The Secretariat approaches the COA and discusses options for sorting all images by regional area.

After requests from the Secretariat for specific new contractual 'conditions', the following conditions were supplied, based on proposals 1 and 3 above:

(1) Access to humpback photographs collected on IWC-funded research in the Antarctic (e.g. IDCR, SOWER surveys) held in the COA Antarctic catalogue is available over the web to *everyone*.
(2) All humpback photographs collected on IWC-funded research in the Antarctic (e.g. IDCR, SOWER surveys) held in the COA Antarctic catalogue, are searchable by regional area where the photographs were taken.

The Working Group agreed that:

(1) Members of the Scientific Committee should have full access to images collected on IDCR/SOWER cruises.
(2) The new conditions listed above should be negotiated with COA as soon as possible.