

Commercial aspects of the exploitation of narwhals (*Monodon monoceros*) in Greenland, with emphasis on tusk exports

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This study presents and evaluates data on recent commercial exchanges in narwhal (*Monodon monoceros*) products, particularly tusks, from Greenland. No evidence was found of an export trade in narwhal blubber or skin (mattak), but since the mid-1960s mattak has been sold to the Royal Greenland Trade Department (or more recently Royal Greenland Production) for re-sale within Greenland. Since 1977 the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) has required documentation for the international trade in narwhal tusks. The Greenland Home Rule Government assumed responsibility for this documentation beginning in 1985. More than 90% of the tusks exported with CITES permits issued by the Home Rule Government have given Denmark as the declared destination. Of the total tusks re-exported from Denmark with CITES documentation between 1985 and 1992, approximately two-thirds had the United Kingdom as the declared destination. The monetary value of an "average" tusk-bearing narwhal to a Greenlandic hunter in 1990 was estimated as 7632 Dkr (1272 US dollars). This estimate includes the tusk (6 kg), mattak (80 kg) and meat (46 kg) that were sold but makes no allowance for the products consumed by the hunter and his family. The cash value of narwhal products has not diminished in spite of high inflation in Greenland since the late 1960s.

Key words:

Narwhal, *Monodon monoceros*, tusks, exports, commercial trade.

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Introduction

The narwhal (*Monodon monoceros*) has long been an important game animal in Greenland. It provided several essential items for the Inuit who, since more than a thousand years ago, subsisted along the narrow strips of habitable land between the ice cap and the sea. In this ancient economy the most important products from narwhals were probably blubber for lamp fuel, red meat for human and dog food, skin (mattak), liver and heart for human food and sinew for thread.

In this paper we focus on the commercial distribution of narwhal tusks that originate in Greenland and are exported. The domestic selling of narwhal mattak (skin with adhering blubber) and red meat is also considered, but in less detail. Our main objectives are to: (1) provide a brief historical context for the current trade in narwhal

products, (2) specifically examine the nature and extent of the Greenlandic narwhal tusk trade since 1985 when permits became a requirement for exports, (3) evaluate the present economic significance of narwhal products in Greenland, (4) review legal aspects of the commerce in narwhal products and (5) consider the potential conservation significance of such trade.

Materials and methods

For historical information we relied on published sources and a few unpublished reports with limited distribution. For recent information (since 1985) we also depended on our own observations in Greenland and on data obtained from the files of the Greenland Home Rule Secretariat (Grønlands Hjemmestyre Sekretariatet, Nuuk) and the

Danish National Forest and Nature Agency (Skov- og Naturstyrelsen, Ministry of the Environment, Copenhagen).

We examined the export permits issued under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) by the Home Rule Government in the years 1985, 1986 (part only), 1988 and 1989. Data were extracted from the 1986 (missing part), 1987, 1990, 1991 and 1992 permits on our behalf by H. Thing, H. Lykke, K. Mortensen and P. Nielsen of the Home Rule Government's Environment and Nature Section (Miljø- og Naturafdelingen), Department of Health and Environment (Direktoratet for Sundhed og Miljø). For each permit examined we recorded the permit number, date issued, kind and number of items (e.g. tusks, carvings) and declared export destination. For some of the permits we also obtained information on the weight, length and condition (broken or not) of tusks, or on the more exact character of carvings (e.g. necklaces, crochet needles, letter knives, tupilaks).

Re-export data from Denmark for the period 1 January 1985 to 31 December 1992 were supplied to us by the National Forest and Nature Agency as lists, usually including destination, date, number of items, purpose (e.g. trade, exhibition, scientific, personal) and origin (mostly Greenland but occasionally Canada). For some of the entries, information was also given on total weight of the shipment, the original export permit number from the country of origin and the Danish re-export permit number. The Agency also provided lists of the numbers of narwhal tusks and carvings imported by Denmark in the years 1985–1990 and a more detailed list of imports recorded in 1992. The latter includes, for each transaction, the type of item, quantity, purpose, country of origin, declared destination and permit number (if available).

As part of this study we also searched the annual reports on wildlife trade published by the European Community (Commission of the European Communities 1987–92), and we received from TRAFFIC International, Cambridge, UK, a list, compiled from the annual reports of the CITES Parties (K. Lochen, TRAFFIC International, pers. comm. July 1993), showing all CITES transactions involving narwhal products, 1979–1991 (current to 6 July 1993). The data from these sources were used to supplement and evaluate the data obtained directly from the national CITES authorities in Greenland and Denmark.

For tabulating export, import and re-export data, we treated the source closest to the initial documentation as the most authoritative. In other words, we preferred to use information obtained by examining the CITES permits ourselves. As a second choice we relied on extracts provided directly to us by the national CITES authorities. Only when the information could not be obtained from one of these procedures did we depend on tertiary sources such as the TRAFFIC International compilation. Slight differences are unavoidable between lists made by differ-

ent persons examining the same permits. For example, it is sometimes unclear whether an item described on a permit as a "little tooth" is in fact a small erupted tusk, a tusk tip or even an embedded (unerupted) tooth. It is not possible to judge whether a tusk tip came from a particular broken tusk, in which case two separate transactions could refer to the tusk products of a single whale. It is also unclear how such items as "scraps" of ivory, parts of "teeth" and tusk pieces should be listed. They are not carvings or craft items but neither are they whole tusks. As far as we know, bidental skulls ("double-tuskers") are generally listed as two tusks even though each set represents only one killed whale.

We made enquiries to all local stores of the Greenland Trade Department (Kalaallit Niuerfiat, or KNI) concerning purchases and sales of narwhal tusks and to all Royal Greenland Production facilities concerning purchases and sales of mattak and meat (cf. Heide-Jørgensen 1994). We attempted to obtain more information on purchases of narwhal tusks by the Royal Greenland Trade Department between 1957 and 1985 but were advised that such statistics were not available in the Department's archives (N.-C. Urne Fischer, KNI, Nuuk, and U. Scheppelern, KNI, Copenhagen, pers. comm.).

Results

Historical development of trade in narwhal products

Barter in Greenland and the early overseas trade

Greenlanders probably bartered narwhal tusks among themselves long before the first contact with Europeans. As Crantz (1820: 160) explained:

... since the Southlanders have no whales, while the inhabitants of the north coast are in want of wood, numerous companies of Greenlanders make every summer, a voyage of from five hundred to one thousand miles out of the south, or even from the east coast, to Disko, in new kajaks and large boats. They barter their lading of wood for the horns of the narwhal, teeth, bones, and the sinews of the whale, which they in part sell again during their return homewards.

Although Crantz's experience was as a visitor to Greenland in the early 1760s (well after Danish colonization had begun), the bartering described in this passage would not have required any external impetus and was probably indigenous to Greenlandic society.

Narwhal tusks from Greenland have been in international trade for hundreds of years. Although walrus tusks and polar bear hides were their export staples, the Norse colonists in southern Greenland almost certainly provided some, or most, of the narwhal tusks that reached

Fig. 1. Map of Greenland showing places mentioned in the text.



Europe in the Middle Ages to become coveted as “unicorn horns” (Shepard 1930). The nature and scale of these early shipments are poorly documented. Shepard (1930: 254) estimated that only about 20 whole narwhal tusks were well known in Europe by the late 1500s. Referring to the wreck of a ship with narwhal tusks on board near Iceland in 1126 he remarked:

How many cargoes such as this were brought safely to port in later years no one can say, for they belonged to a business in which it did not pay to advertise. There were not enough of them, at any rate, to glut the market, nor did they come in frequently enough to attract the slightest attention in Europe.

Narwhal skulls found buried together in the chancel of a

Norse cathedral in southern Greenland suggest that they, like walrus skulls, could have been kept occasionally as hunting trophies by the Norsemen (McGovern 1985). Alternatively, these skulls may simply have been in storage for trade.

The demise of the Norse colonies by about 1500 was followed by a century or so of virtual isolation of Greenland from Europe. Not until the 1600s did Danish-Norwegian and Dutch ships begin making regular visits to southern and western Greenland for whaling and trading. When the *St. Peter* entered Itilleq Fjord (Fig. 1) in 1652 the Inuit came out from shore to barter fish, sealskin clothing and narwhal tusks in exchange for nails, knives and needles. Gad (1971: 238) inferred from this incident that such exchanges were typical. He quoted from the vessel’s logbook entry of 7 July:



Fig. 2. Hunters at Uumannaq posing for a photograph early this century with the head of a large tusked narwhal. Photo: A. Bertelsen. Copyright Arktisk Institut, Denmark.

... otherwise when coming on board, the Greenlanders will point to the sun and beat their chests shouting 'Ele-vout', and when our sailors did the like, then they immediately came quite close and shouted 'tuacha', which is unicorn

At least two Danish trading ships returned to Copenhagen in 1652 with cargoes that prominently included narwhal tusks (Dalgård 1962: 409). A voyage of 1653 returned with 343 Danish pounds (172 kg) of narwhal tusks; nine complete tusks in this shipment weighed, in total, 88.5 Danish pounds (44 kg; Bencard 1989). Some of these tusks may have been intended for use in the construction of the famous throne at Rosenborg Palace (cf. Rosing 1986, Bruemmer 1993).

There is no way to guess how many narwhal tusks were taken out of Greenland during the seventeenth and eighteenth centuries. They were obtained at least occasionally by European whalers involved in the Davis Strait fishery for bowhead whales (*Balaena mysticetus*) that began in the early eighteenth century (Gad 1973). Particularly after 1814 when the British began whaling for bowheads on the west (Canadian) side of Davis Strait and

Baffin Bay, narwhal tusks in the whaling returns could indicate catches and trade off either Greenland or Baffin Island (Reeves & Mitchell 1987a). Few commercial whalers hunted narwhals themselves, but many of them obtained tusks and skins through barter with the Inuit. Not all of the narwhal tusks leaving the arctic regions were destined for Europe. For example Dutch commerce with Greenland had an Oriental connection: many narwhal tusks secured by Dutch whaling and trading vessels apparently ended up in Japanese collections and medicine shops (Shepard 1930).

Official exports after 1774

Establishment of the Royal Greenland Trade Department (Kongelige Grønlandske Handel, KGH) in 1774 was the culmination of Danish efforts to create a trade monopoly in Greenland (Tejsen 1977). Most of the produce shipped to Denmark by KGH, on an exclusive basis, initially consisted of train oil (oil from marine mammals), baleen (whalebone), polar bear and fox hides, sealskins, narwhal and walrus ivory and eider down (see Fig. 2). The KGH monopoly continued until 1953 when Greenland became

Table 1. Amount of narwhal ivory (kg) purchased by KGH, by year and district or municipality (after 1952). Sources: Anon. (1909–58) and KNI (1991–1992, see text).

Year	1908/	1909/	1910/	1911/	1912/	1913/	1914/	1915/	1916/	1917/	1918/	1919/	1920/	1921/	1922/	1923/	1924/	1925/	1926/	1927/	1928/	1929/	1930/	1931/	1933	1934	1935	
District	09	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32				
Sisimiut																												
Aasiaat	6,5	21	4,5	7	8,5	119	45,5	85,5	4,5				1	1	2	9	5		5				4					
Qasigiannuguit	16	5,5			11,5	6	72	241			3												2					
Ilulissat	8,5	15					45,5	116																				
Ritenbenk		5		13	4		29	13			131							5										
Qullissat																											2	
Qeqertarsuaq					3	14	5,5	850	29	3		14																
Uummannaq	78	95,5	92	48	96,5	47	84	124	271	317	65	64	29	36	17	33	8	20	2	4								
Upernavik	139	72	78	57,5	91,5	66	114,5	196	148		71	193	82	46	117	132	136	99	76	138	136	82	99	207	3–17,7		33	
Avanersuaq																												
Tasiilaq																												
Ittoqqortoormiit																					15	29	14	3	5			
East Greenland																					15	29	14	3	5			
West Greenland	248	214	174,5	128,5	226	243,5	1240,5	804,5	426,5	317	270	272	112	84	143	170	144	124	83	142	136	86	99	209	3–17,7	1	36	
Total	248	214	174,5	128,5	226	243,5	1240,5	804,5	426,5	317	271	272	112	84	143	170	144	124	83	157	165	100	102	214	3–17,7	1	36	

Table 1. Continued.

Year	1936	1936/	1937	1937/	1938	1938/	1939	1939/	1940/	1941/	1942/	1943/	1944/	1945/	1946/	1947	1947/	1948/	1949/	1950/	1951/	1953	1954	1955	1956	1957	Sum	Mean	1991	1992	
District/ Municipality		37		38		39		40	41	42	43	44	45	46	47		48	49	50	51	52										
Maniitsoq																														6,7	6,7
Sisimiut																												0		0	0
Aasiaat																												331	18	55	6,6
Qasigiannuguit																												357	45	0	0
Ilulissat											9			5							5	8						212	27	0	0
Ritenbenk	2	3																									205	23			
Qullissat							13	65				74,5		13														173	29		
Qeqertarsuaq								5						7														931	103	12	0
Uummannaq	1	16			1	13	1	8	8	8	13		2		8				3								197	9	1819	54	404
Upernavik	7	123	8	23	17	114	61	53	50	34	196,9	97		49		69	41	11	14							3582	85		20		
Avanersuaq					39	242	75	244	288	138	240	82,2	100	122	173	141	285	227	344	131		87	87	142	75	180	3367	168		143	
Tasiilaq																															
Ittoqqortoormiit	3		10																		4	7						90	10	0	0
East Greenland			48		45																4	7						170	19	0	0
West Greenland	10	142	8	23	57	369	89	383	349	196	287	362,6	199	147	230	141	354	271	355	150	139	87	87	142	284	189	11181	211			
Total	13	190	18	68	57	369	89	383	349	196	287	362,6	199	147	230	141	354	271	355	154	146	87	87	142	284	189	11251	212	73,4	580,3	

Table 2. Declared export destinations of raw narwhal tusks from Greenland, 1985–1992. Source: Greenland Home Rule. Note that there are some discrepancies between the data shown here and those in Reeves (1993a: table 3), particularly for 1991. The 1991 figures in Reeves (1993a) are from country totals provided by A. Andersen (*in litt.*, 9 April 1992) whereas those given here for 1991 and 1992 are from data provided by P. Nielsen (*in litt.*, 9 August 1993).

Year	DK	JP	CA	NO	FO	DE	SE	CH	FR	GB	BE	IT
1985	42	0	3	0	1	0	2	0	1	0	0	0
1986	93	11	1	1	2	0	0	2	1	0	0	0
1987	90	1	0	1	1	2	0	0	0	4	0	0
1988	158	2	3	4	0	0	1	0	2	0	0	0
1989	153	3	0	1	2	4	2	3	0	0	1	0
1990	325	3	0	0	0	1	3	0	0	0	0	2
1991	271	1	0	1	0	3	1	0	9	0	0	2
1992	180	2	1	0	0	0	0	0	0	0	0	0
TOT.	1312	23	8	8	6	10	9	5	13	4	1	4

Abbreviations used in Tables 2 and 4: AT, Austria; AU, Australia; BE, Belgium; CA, Canada; CH, Switzerland; CS, Czechoslovakia; DE, (West) Germany; DK, Denmark; ES, Spain; FI, Finland; FO, Faroe Islands; FR, France; GB, United Kingdom; IS, Iceland; IT, Italy; JP, Japan; MA, Morocco; MC, Monaco; NO, Norway; NZ, New Zealand; PH, Philippines; PL, Poland; SE, Sweden; GL, Greenland; US, United States; XX, Unknown.

a Danish county and was granted equal status with the rest of the kingdom. Although the monopoly has been legally abolished, KGH (renamed KNI after 1986) continues to dominate international trade and much of the internal trade in Greenland, particularly north of Disko Bugt (Fig. 1). Its stores remain the chief financial and exchange centers in most villages.

Rink (1877: 313) stated that the average quantity of narwhal tusks exported annually from Greenland (south of 73°N) in the period 1853–1872 was 550 Danish pounds (275 kg). Vibe's (1967: fig. 44) summary of KGH purchases from 1800 to the 1950s does not include data from the Disko Bugt region where, judging by Rink's statement and the data in Table 1, considerable numbers of narwhal tusks were often traded. Published tables of trade statistics have many inconsistencies. For example the yearly amounts of narwhal tusks listed, by district, for the years 1908/09 to 1957 in Anonymous (1909–58; see Table 1) differ from the yearly country-wide compilations listed for 1915/16 to 1938/39 in Anonymous (1946: table 302, p. 806).

Amounts of narwhal tusks sold (in kg, by year) are published for the Avanersuaq (Thule) area only for the years 1938–1957, and amounts reported for the district during this time far exceed the combined totals for other districts in most years (Table 1). The lack of data from Avanersuaq for years before 1938 and after 1957 certainly does not mean that there was no catch. Rather, an annual catch of 125–250 narwhals has been assumed for this district on the basis of reported catches in 1961–1964 (Kapel 1977, Heide-Jørgensen 1994). Born & Olesen (1986) assumed an annual catch of 150 whales (range: 110–274) based on estimated landings given in the Hunters' Lists of Game. The published lists only occasionally give figures for amounts of narwhal tusks traded on the east coast of Greenland (Table 1), where the annual catch in recent years has been estimated at at least about 80 narwhals (Dietz *et al.* 1994).

There was a substantial market for narwhal (and white whale, *Delphinapterus leucas*) skins in British and European tanneries during the nineteenth and early twentieth centuries (Mitchell & Reeves 1981, Reeves & Mitchell 1987b). Although white whale skins obtained in the net fisheries at Maniitsoq (Sukkertoppen) and Kangersuatsiaq (Prøven) were purchased and exported through KGH (Oldendow 1935, Anonymous 1909–58, 1944), we are not aware that KGH bought narwhal skins for export.

White whale blubber was often purchased and exported (Anonymous 1963). For some years pinniped blubber is not distinguished from cetacean blubber in the statistics, but for most years separate amounts are listed for blubber from white whales. Some narwhal blubber could have been lumped with that from white whales for statistical purposes, but we have found no documentation confirming that it was. Nor have we attempted here to evaluate the influence that blubber sales might have had on narwhal hunting effort. In any event blubber could only have been landed when the whales or seals were near a storage facility, and this would rarely have been the case for narwhals taken and flensed in the ice of Disko Bugt or in more northern areas that had no blubber-storage facilities.

Internal markets

Kapel & Petersen (1982: 71) described the present internal trade in hunting products as "a development of the traditional distribution system in an adaptation to modern conditions". Although the traditional distribution system, based on sharing and gifting, and interpreted to include the sending of food to relatives living in towns, continues to some extent in Greenland (Hertz & Kapel 1986, Dahl 1989, Caulfield 1993), traditional foods, including narwhal mattak and meat, are also distributed widely within Greenland on a cash basis.

Table 3. Comparison of number of whole tusks exported from Greenland to Denmark vs. the number imported by Denmark, 1985–1992.

	Greenland Exports ¹	Danish Imports ²
1985	42	47
1986	93	100
1987	90	80
1988	158	157
1989	153	148
1990	325	389
1991	271	243
1992	180	182
Totals	1312	1346

¹Data from Greenland Home Rule (Greenland).

²Data from National Forest and Nature Agency (Denmark).

Mattak began to be purchased as early as 1965 (Heide-Jørgensen 1994). Based on his observations during a brief visit to the Avanersuaq area Bruemmer (1971) guessed that about 80% of the mattak obtained from narwhals and white whales was sold to KGH. Some of the frozen mattak was later bought back by local Inuit at twice the price that the hunters had received for it. He also stated that an unspecified portion of the sinew and frozen mattak was exported to southern Greenland. Although sinew is no longer purchased, mattak and meat continue to be purchased from hunters; they are frozen and shipped south for sale in the fishing and herding districts (Born 1987, Heide-Jørgensen 1994). Consumer prices for frozen narwhal and white whale meat are moderate, while those for frozen mattak are fairly high relative to the prices for imported and other locally-produced foods available in the shops (Reeves 1993a, personal observations).

Recent exports of narwhal tusks

Detailed information on tusk exports from Greenland is available only beginning in 1985 when Greenland withdrew from the European Community (EC). Such withdrawal placed Greenland outside Denmark's customs area and therefore made it necessary for CITES export permits to be issued by Greenland Home Rule.

The vast majority (more than 90%) of the raw (unworked) tusks from Greenland entering international trade (with CITES documentation) have been exported initially to Denmark (Table 2). For the period 1 January 1985 to 31 December 1992 a total of approximately 1312 narwhal tusks covered by Greenland CITES export permits had Denmark as the declared destination. Declared exports from Greenland and declared imports by Denmark do not match exactly but are in rough agreement most years (Table 3).

Some tusks, especially those with Denmark as the

declared destination, are shipped in bulk for re-selling. For example Home Rule data for 1990 show that 215 of the 335 exported tusks (64%) were covered by permits issued to KNI for consignments ranging in size from 4 to 60 tusks. The estimated rates of export for re-sale in other years are lower. If one assumes that lots of three or more tusks represent shipments for re-sale (ruling out those for which we could identify the exporter as a private individual), the percentages of tusks exported for re-sale are 40% in 1985, 19% in 1986, 11% in 1987, 42% in 1988 and 31% in 1989. The 1991 and 1992 data suggest that no more than 30–45% of the tusks exported in these years were for re-sale. Some retail shops (e.g. the post office in Ilulissat – Jakobshavn) ship tusks to Denmark on the customer's behalf, then arrange for them to be forwarded to their final destination (P. Nielsen pers. comm., August 1993). Thus some of the shipments that we have assumed to be for re-sale may actually consist of tusks that have already been purchased by individuals and are simply being handled, in bulk, by intermediaries to spare customers the trouble of carrying them home.

Re-exportation of narwhal tusks

At least 742 tusks were re-exported from Denmark with CITES documentation between 1980 and 1992 (Table 4). Of 451 re-exported tusks for which we have detailed information 430 were re-exported for "trade", 14 for "personal" and 7 for "exhibition" or "zoo" purposes. We have the Greenland export-permit numbers (indicating the year of issue) for 331 of the 742 re-exported tusks. For this sample 186 tusks (56%) were re-exported in the same calendar year as the export permit, and 140 (42%) were re-exported in the calendar year following that of the export permit. Re-exported tusks were shipped in lots of one to 20. If it is assumed that shipments of three or more tusks represent transactions with the intention to re-sell (the "3-tusk criterion"), then 404, or nearly 90%, of the 451 tusks were shipped for resale. Of the 164 re-export shipments documented 55 (34%) were for resale according to our 3-tusk criterion. A particularly high proportion of these shipments (73%) went to the UK. Of the 539 tusks re-exported between 1985 and 1992, 356 (66%) had the UK as their declared destination.

We did not make an extensive search for information on re-exportation by countries other than Denmark. Some of the Greenlandic tusks imported by Switzerland have been re-exported to Japan (Reeves 1993a). Of 91 tusks (of any origin) re-exported from the UK under CITES between 1979 and 1984, Italy was the declared destination for 46 and Switzerland for 14 (Reeves 1993a). Since the UK reported importing 388 tusks from Canada and only two from Denmark during 1979–1984 (Reeves 1993a) most of the tusks re-exported by the UK in these years presumably originated in Canada rather than Greenland. The published lists of exports and re-exports by EC

Table 4. Declared re-export destinations of raw narwhal tusks from Denmark, 1980–1992. Sources: 1980–1984, TRAFFIC International; 1985–1992, National Forest and Nature Agency. Data for 1980–1984 are probably incomplete, as indicated by “-” in cells for which no information is available in CITES records.

Year	GB	JP	CH	FR	BE	DE	ES	IT	AT	AU	MA	NO	PL	SE	US	CA	GL	IS	MC	PH	XX	CS	Tot
1980	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-	-	-	-	2
1981	-	-	4	-	-	-	-	-	-	-	-	-	-	-	1	126	-	-	-	-	-	-	131
1982	1	-	10	-	-	25	-	5	2	-	-	-	-	-	-	2	-	-	-	-	-	-	45
1983	-	-	2	-	-	-	-	5	2	-	-	-	-	-	1	3	-	-	-	-	-	-	13
1984	3	-	3	-	-	2	-	-	2	-	-	-	-	-	1	1	-	-	-	-	-	-	12
1985	6	4	1	1	0	1	0	0	3	0	0	0	0	0	1	0	0	0	0	0	0	0	17
1986	15	2	1	3	0	1	0	0	2	0	0	1	0	1	0	0	0	0	0	0	0	0	26
1987	12	1	2	0	0	0	0	2	0	2	0	0	0	0	1	0	2	0	0	0	0	0	22
1988	30	0	0	0	0	1	0	0	0	1	2	1	0	1	0	1	0	1	0	0	0	0	38
1989	63	11	1	1	1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	0	79
1990	109	0	15	3	15	0	1	1	0	0	0	0	1	0	0	0	0	0	0	0	0	2	147
1991	55	1	7	0	10	3	0	19	0	0	0	3	0	0	0	0	0	0	12	1	1	0	112
1992	66	1	11	4	2	5	0	0	1	0	0	1	0	1	0	0	3	0	0	0	0	3	98
Tot	360	20	57	12	28	38	1	32	12	3	2	6	1	4	5	135	6	1	12	1	3	3	742

countries for the years 1985–1989 (Commission of the European Communities 1987–92) only cover shipments to non-EC countries. Judging by these lists and the TRAFFIC International data for 1990 and 1991 Denmark has been the only EC country regularly re-exporting tusks outside the Community.

Recent exports of carvings and other craft items

A large variety of items are carved or crafted in Greenland using narwhal tusks. CITES export permits are required for these items as they are for whole tusks. The data in Table 5 provide an idea of the nature and scale of craft exports. As with raw tusks, Denmark was the principal declared export destination for worked narwhal ivory. Occasionally items made from Greenlandic narwhal tusks have been exported from Denmark back to Greenland. For example 266 carvings in 1987 and one in 1990 were shipped from Denmark to Greenland for “trade” purposes, and two items in 1989 were sent as personal effects.

Damaged tusks and tusk pieces are often sold for use in carving, and this ivory is sometimes exported. For example a consignment of four broken tusks exported to Denmark in 1990 (Export Permit 26.4/100) was declared as being for use in domestic crafts by a certified Greenlandic artist. In 1992 three consignments of “scrap” were imported to Denmark, and one of these consisted of 45 pieces of tusk (Export Permit GL 71/92, Import Permit F 267 P, DK9124532). Some of the carvings made from narwhal ivory are actually made from embedded teeth rather than from tusks. This applies particularly to crochet needles but may also apply to many of the other small items.

Prices of narwhal products

The prices of narwhal products in Greenland have generally increased through time (Table 6). However, much of the increase can be attributed to inflation, which has been high in Greenland for the past 25 years (Hertz & Kapel 1986, Born 1987). The prices paid to hunters by KNI for tusks were stable at 725 Dkr (ca 121 US dollars) per kg for A-quality and 200 Dkr (ca 33 US dollars) per kg for B-quality (broken) tusks from 1990 to August 1993.

In practice, local KNI stores in the smaller towns often pay hunters A-quality prices for B-quality tusks. Also, purchasers sometimes recognize quality classifications between A and B (Henning Thing *in litt.*, 24 September 1990). KNI’s mark-up for retail sales of narwhal tusks in Greenland was 65% in 1990 (H. Thing *in litt.*, 24 September 1990). The retail price of undamaged whole tusks at the post office in Ilulissat in August 1993 was 1300 Dkr (ca 186 US dollars) per kg, indicating a net mark-up of nearly 80% over the price paid to hunters.

The combined value of mattak, meat and tusks makes the narwhal one of the more important cash-generating game animals in Greenland (Bruemmer 1971, Born 1987, Heide-Jørgensen 1990, 1994). Born & Olesen (1986) estimated that during the mid 1980s a hunter could receive 5000 to 15 000 Dkr by selling the products of a single narwhal. We made a similar estimate based on data from a large purchase of narwhal products by KNI at Uummannaq in 1990, when the reported narwhal catch for this municipality was 1019 animals (Greenland Statistical Office data). The 306 tusks purchased by KNI weighed a total of 1848 kg (R. Fleischer *in litt.*) for an average of about 6 kg per tusk. The average price paid was 538 Dkr (90 US dollars) per kg (R. Fleischer *in litt.*) so an average tusk would have been purchased for about 3228 Dkr (538 US dollars). Royal Greenland Production purchased 81 500 kg of narwhal mattak at Uummannaq

Table 5. Carvings and other craft items made from narwhal ivory that were declared on CITES export permits from Greenland, 1984–1992 (all data from Greenland Home Rule). Note that raw tusks are sometimes declared on the same permits as are one or more craft items. Jewelry pieces can include necklaces, bracelets, ear or finger rings, brooches and pendants. Carved figures can be of bears, sleds, kayaks or hunting implements. A tupilak is a small figurine.

Year	No. Permits	No. Items	Declared Destination
1984	1	3 tupilaks	Canada
1985	3	4 tupilaks	Canada
	6	9 tupilaks 2 necklaces 2 lampstands	Denmark
1986	17	35 tupilaks 2 crochet needles 5 necklaces 1 kayak paddle	Denmark
	1	5 tupilaks	Canada
1987	2	7 tupilaks, knives, buttons (for exhibit)	Japan
	40	1 carving 1 tupilak 15 carved figures 123 tupilaks 5 pieces of jewelry 2 utensil handles	W. Germany Denmark
1988	1	1 tupilak	Venezuela
	51	6 tupilaks 86 tupilaks 13 pieces of jewelry 1 lampstand 57 carved figures 1 "souvenir" 1 crochet needle 2 flagstands	Canada Denmark
1989	1	1 tupilak	Hungary
	38	6 tupilaks 1 carving 90 tupilaks 32 carved figures 3 "souvenirs" 21 pieces of jewelry 5 tupilaks 5 carvings	France Sweden Denmark
1990	1	4 letter knives 46 tupilaks 14 carved figures 11 pieces of jewelry 2 "games"	Sweden Norway Denmark
	25	87 tupilaks 45 carved figures 48 pieces of jewelry 4 napkin rings 4 crochet needles 1 lampstand 1 knife handle 1 tusk tip 3 tusk pieces 1 "little tusk"	Denmark
1991	50	57 tupilaks 1 rib 1 bone 4 lampstands 57 carved figures 56 pieces of jewelry 5 crochet or other needles 3 letter knives 2 toys 61 "diverse" items ("scrap"?) 2 pieces of tusk	Denmark
	1	1 tupilak	Canada

(K. L. Rasmussen *in litt.*) for an average of about 80 kg per whale. At the official price of 47.52 Dkr (8 US dollars) per kg this would mean that an average narwhal provided about 3800 Dkr (634 US dollars) worth of mattak. Royal Greenland Production bought 46 555 kg of narwhal meat at Ummannaq for 13 Dkr (2.17 US dollars) per kg. The average amount of meat sold per whale was about 46 kg so hunters received about 598 Dkr (100 US dollars) for the meat of each narwhal caught. These data suggest that an average tusked narwhal provided approximately 7632 Dkr (1272 US dollars) to the hunter.

An adult male narwhal can be considerably larger and thus more valuable than our "average" specimen. Hay & Mansfield (1989) gave the following maximal values from their Canadian sample of narwhals: 8 kg of ivory, 140 kg of mattak and 450 kg of meat. At the unit prices quoted above, an animal of these maximal dimensions would have been worth more than 16 800 Dkr (2800 US dollars) in 1990.

Discussion

Historical development of trade in narwhal products

Vibe (1967: 73) expressed the opinion that KGH data provided a fairly complete record of ivory production through 1950: "... it is safe to assume that the greater part of the Narwhal tusks acquired have landed in the stores". Although he provided no information on exchange values or prices, Vibe (1967) claimed that narwhal tusks (Fig. 3) had always been good trading commodities. By the late 1960s and early 1970s large, unbroken tusks were sometimes sold privately, *i.e.* without KGH involvement (Hansen 1970, Bruemmer 1971). The steadily expanding presence of non-Greenlanders, *e.g.* scientists, engineers, aviators, tourists, military personnel and school teachers, since the 1950s (see Lyck & Taagholt 1987) has created more opportunities for direct sales of tusks. Thus KNI data are much less complete as a record of the actual numbers of tusks sold nowadays than they were 25 and more years ago. Although we have not attempted a comprehensive review of the scattered and sometimes contradictory historical information on the trade in narwhal products, we believe that such a study would be an interesting and useful contribution.

Trends in narwhal tusk exports

We believe that the low number of tusk exports attributed to Greenland before 1985 (*cf.* Payne 1988, Klinowska 1991) is largely a reporting artifact rather than an accurate indication of little trading activity. Some, possibly



Fig. 3. Inughuit in the Avanersuaq (Thule) area with narwhals taken during the mid 1920s. Photos: P. Freuchen: Arktisk Institut, Denmark.

Table 6. Official prices paid to hunters for narwhal products in Greenland (Dkr/kg). Inflation-adjusted prices in parentheses are expressed in 1971 Dkr. Note that "unpublished data" are from KNI (tusk prices) or Royal Greenland Production (mattak and meat prices).

Year	A-tusks ²	B-tusks ²	Mattak	Meat	Source
Mid 1960s ¹			1.00 (1.45)		Bruemmer (1971)
1968	45.00 (52.65)		7.50 (8.78)	2.00 (2.34)	Hansen (1970)
1971		45.00 ³ (45.00)	7.50 (7.50)		Bruemmer (1971)
1984	715.00 (185.23)		35.00 (9.06)	25.00 (6.48)	Born (1987)
1985	500.00 (118.76)				Born (1987)
1990	725.00 (133.32)	200.00 (36.77)	47.52 (8.74)	13.00 (2.39)	H. Thing <i>in litt.</i> ; unpublished data
1991	725.00 (127.54)	200.00 (35.18)	50.00 (8.80)	13.00 (2.29)	Unpublished data
1992	725.00 (125.50)	200.00 (34.62)	50.00 (8.66)	13.00 (2.24)	Unpublished data
1993	725.00	200.00	51.10	11.00	Unpublished data

¹ "Just a few years ago" (Bruemmer 1971).

² A-tusks have unbroken tips; B-tusks have broken tips.

³ Bruemmer (1971) referred to a single price paid for tusks by KGH but noted that "they get only the broken tusks". "Good" tusks were sold for 50–100 dollars (Canadian?) "to local Danes (legally) or at the Air Base (illegally)".

much, of the increase in reported exports from Greenland in the years after 1985 is due to changes in the reporting system. According to Home Rule authorities, by 1987 the export of narwhal tusks and ivory carvings from Greenland to Denmark was being "strictly monitored according to CITES rules: export permits from Greenlandic authorities, import permits from Danish authorities" (Trolle 1987). If this assessment is correct, then trends in the number of tusks covered by CITES export permits since 1986 should reflect actual trends in the rate of export.

The data shown in Table 2 indicate an increase in tusk exports in 1988/1989, a peak in 1990, a slight decline in 1991 and a further decline in 1992. We are unable to fully explain these developments. Such a short time series should, in any event, not be interpreted to represent long-term trends. Improved reporting procedures (notwithstanding the statement by Trolle, quoted above) could be a partial explanation of the apparent increase in the late 1980s. Also, as has been noted by others (Kapel 1977, Born & Olesen 1986, Heide-Jørgensen 1994, Siegstad & Heide-Jørgensen 1994), there can be strong fluctuations in the catch of narwhals in West Greenland due, at least in part, to the exceptional hunting opportunities provided periodically by ice entrapment (sassat) and oceanographic factors. The spike in tusk exports in 1990 may be related to the exceptional catch of 1019 narwhals in the Uummahnaq area that year (see above). This catch was made possible by an unusual occurrence of narwhals in November just before freeze-up in Uummannaq.

Lyck (1990) called for a more integrated and "dynamic" economy in Greenland, suggesting, for example, that markets for seal products be expanded within Greenland and that further dependence on external markets be avoided. However there appears to be little potential for internalizing the market for narwhal tusks. Danish expatriates working temporarily in Greenland often acquire tusks, which they eventually take back to Denmark as personal effects. Narwhal tusks are sometimes given as gifts to foreign dignitaries or business colleagues. Sales to tourists and other visitors, along with bulk or wholesale shipments mainly to Denmark, are the other primary means of disposing of whole narwhal tusks.

The carving industry provides a strong internal demand for ivory, and narwhal tusks and embedded teeth are used by some Greenlandic carvers. In 1993 at least two shops in Nuuk-Godthåb (Santa's Work Shop and KNI) and one in Ilulissat (post office) were selling raw narwhal ivory in 5–15 cm sawed chunks at 280 DKr (40 US dollars) per kg. Sperm whale (*Physeter catodon*) teeth imported from Japan were traditionally used to make tupilaks, but with the decline and closure of Japanese whaling for sperm whales this supply of ivory is no longer available. Caribou antler, walrus ivory and narwhal ivory have become the main ingredients for tupilaks as well as for jewelry and figurines. An illustrated flyer was produced by KGH to promote sales of tupilaks made from narwhal ivory (Rosing no date). Some of the market

for carvings may be internal, but we assume that many if not most of the carvings are eventually exported.

The claim was made recently that narwhals are "at risk" because of the international ban on trade in elephant ivory under CITES (Bradstock 1990). It seems unlikely that narwhal ivory would be a good substitute for elephant ivory in the Asian carving industry because of its relative hardness and brittleness (Jardine 1837, Degerbøl & Freuchen 1935). However two Early Netsuke carvings of narwhal ivory are in the British Museum (accession numbers HG 222 and 224, dated to the Qing Dynasty) so it has played at least a minor role in this Oriental craft. Also, the use of narwhal teeth as substitutes for sperm whale teeth in tupilak production in Greenland demonstrates some degree of interchangeability among ivories. The CITES data that we have examined do not suggest that inferior or broken narwhal tusks have been exported to Japan at a proportionally high rate. Rather, most of the tusks exported to Japan in recent years apparently have been large ones. Of 211 tusks exported to Japan from Canada between 1986 and 1990, 135 (64%) were at least 2 m and a further 40 (19%) at least 1.7 m long (unpubl. data from Canadian CITES permits, Hull, Québec – cf. Reeves 1992). All 39 of the tusks exported commercially from Canada to Japan in 1992 were 1.9–2.9 m long (R. R. Campbell *in litt.*, 14 July 1993). The only tusk exported to Japan from Greenland for which we know the length was 2.48 m long (Export Permit no. 057/89).

Trends in re-exportation of narwhal tusks

The most striking feature of the Danish re-export data (Table 4) is the large number of tusks shipped to the UK. Prior to the closing of the UK market for Canadian narwhal tusks under EC regulations in 1984 (see below) the UK was the major importer of tusks from Canada; few tusks have been exported from Canada to the UK since 1984 (Reeves 1992, 1993a). It would appear that after a period of adjustment (ca 1984–1987) importers based in the UK began importing more tusks from Greenland (via Denmark) as a replacement for imports from Canada. Of 73 re-export permits issued by Denmark for shipments to the UK between 1 January 1985 and 31 December 1992, 40 involved lots of three or more tusks (range: 3–20) (data from National Forest and Nature Agency). Although such "bulk" shipments (accounting for 85% of the total tusks re-exported to the UK) suggest that a high proportion of those imported to the UK is for re-sale, very little re-exportation by the UK has been documented under CITES since 1979 (Reeves 1993a).

Discrepancies and inconsistencies in reporting

As anyone who has worked on trade-documentation problems knows, it is easy to detect discrepancies and inconsistencies. While there are some obvious differences in the reports of Greenlandic tusk exports to Denmark vs. the reports of Danish imports (Table 3), we do not consider them major. Among the possible explanations, apart from simple coding errors, are the following: (1) Permits sometimes expire, get withdrawn or are otherwise not used. (2) Permits issued in one reporting year can be used in another, so exportation and importation of the same consignment can be recorded in different reporting years. (3) Some imports destined for re-exportation might be kept in bonded warehouses and thus would never officially "enter" the country at all. A few minor inconsistencies are also revealed by comparing the import and re-export data obtained directly from the National Forest and Nature Agency with those published by Commission of the European Communities (1987–92) and with those appearing in the TRAFFIC International list.

Although we are not aware that any illegal exports have been documented, it would be naive to assume that all whole tusks and craft items leaving Greenland are covered by CITES permits. Thus the export data shown in our tables probably under-represent the actual volume of international trade in narwhal products, especially the trade in jewelry and other small craft items.

Controls on narwhal hunting and trade

KGH's trade monopoly, which lasted until 1953, provided virtual regulation of the export trade in hunting products. It prevented competitive stimulation of narwhal exploitation such as occurred in northern Baffin Island in the 1910s and 1920s (Mitchell & Reeves 1981). Moreover KGH deliberately refrained from developing commercial markets for certain hunting products. For example the shop in the Avanersuaq area refused to purchase narwhal blubber because of concern that doing so would lead to critical winter shortages of fuel, food and dog food among the Inughuit (Vibe 1950: 83).

Customary hunting regulations emanating from local communities in Greenland were codified beginning in the early twentieth century (Qujaakitsoq 1990). These are recorded in "Nalunaerutit-Grønlandsk Lovsamling" and "Grønlandsk Lovregister". Such regulations relate mainly to hunting technology and practices; they have rarely involved explicit limitations on catches or hunting effort (Kapel & Petersen 1982). Regarding narwhals specifically, Greenlandic laws neither limit harvests nor restrict the

uses of hunting products within Greenland. The regulations governing narwhal and white whale hunting were consolidated in Home Rule Law (Hjemmestyrets bekendtgørelse) No. 10 issued in July 1992 (Anonymous 1992), and revised in No. 21 issued in July 1993 (Anonymous 1993). These regulations define hunter eligibility, designate closed areas, specify approved hunting, processing and transporting methods and establish procedures for the reporting of catches and the collecting of lower jaws from caught whales. Any export of narwhal or white whale products requires approval from the Home Rule Government. Commercial exportation of meat from all cetaceans is prohibited under Greenland Home Rule Law (para. 6(3) in Bekendtgørelse 33, Nal. D, 1985, p. 263–266).

Greenland's special relationship with Denmark has meant that its interests have been represented in most international agreements by the Danish government. Because of Denmark's membership in the International Whaling Commission (IWC) the exploitation of "large" whales, including the minke whale (*Balaenoptera acutorostrata*), in Greenlandic waters has been subject to IWC regulation. Narwhals, however, are not included in the Commission's schedule of whaling regulations, and the responsibility to manage the hunt for this species rests with national, regional and local authorities.

Denmark joined CITES in 1977. The narwhal's listing in Appendix II of this convention has meant that although international trade is allowed, it must be documented with permits issued by the exporting country (Wijnstekers 1990). Greenland was granted home rule in 1979 but remained within the Danish customs area until 1985, so the exportation of narwhal tusks to Denmark was technically not international trade before 1985. Narwhal tusks leaving Greenland required CITES permits only if they were being exported directly from Greenland to a country other than Denmark. We have not seen any CITES documentation of Greenlandic exports prior to 1985.

EC Regulations 3626/82 and 3418/83 effectively prohibit commercial trade by treating all species of Cetacea as if they were in Appendix I of CITES. Since 1984 these EC regulations have had a dramatic effect on Canada's export trade in narwhal tusks (Reeves 1992). An explicit exemption, however, was given in Regulation 3626/82 to the parts and derivatives of Appendix II species "taken by the people of Greenland under licence granted by the competent authorities of Greenland or Denmark" (Anonymous 1982). Thus the importation of Greenlandic narwhal tusks by EC countries has been allowed to continue under the normal Appendix II provisions. A proposal sponsored by the Federal Republic of Germany to move the narwhal into CITES Appendix I was defeated at the biennial meeting of parties in April-May 1985, and no further proposal has been made to change the narwhal's status under CITES.

In addition to the CITES permit requirements and the EC regulations, imports to the United States were prohibited under the Marine Mammal Protection Act of 1972. In

spite of this prohibition narwhal tusks destined for the United States have appeared occasionally in published CITES export, import and re-export records (Tables 2 and 4, Commission of the European Communities 1987–92, Canadian Wildlife Service 1978–93, Reeves 1993a).

Recent and current monetary value of narwhals

The increasingly open and monetized character of the Greenlandic economy has made it vulnerable to fluctuations in external demand for hunting products. An important development of the past decade has been the sharp decline in hunter prices for sealskins – an indirect result of actions taken by animal protectionists to halt the commercial hunt for harp seals (*Phoca groenlandica*) and hooded seals (*Cystophora cristata*) (Hertz & Kapel 1986, Wenzel 1991). By early 1984 the narwhal hunt had “come to play a critical role in the ability [of hunters in the Avanersuaq area] to pay the installments on village houses and boats, to pay for heating oil, gasoline, ammunition, radios, cloth for anoraks, and other items ...” (Sillis 1984: 527). Born (1987) interpreted the increase in mattak purchases by KGH in the Avanersuaq area during the mid 1980s as compensatory for the declining value of sealskins.

The decline in 1985 in the price offered by KGH for narwhal tusks, from 715 to 500 Dkr per kg, is said to have been caused by “a reduced market outside Greenland probably related to import restrictions enforced in 1984 by the EEC” (Born 1987: 122), even though, as noted above, Greenlandic products were exempt from the EC regulations. A steeper decline in hunter prices for narwhal tusks occurred in Canada during 1984–1985, but this was reversed as the decline in exports to EC countries (especially the UK) was offset in the late 1980s and early 1990s by increases in exports to Japan and Switzerland (Reeves 1992, Canadian Wildlife Service 1978–93).

Our estimate of the value of an “average” narwhal in Greenland in 1990 – 7632 Dkr (1272 US dollars; see above) – is conservative for the following reasons: (a) Some of the mattak would have been sold informally at high prices without involvement of Royal Greenland Production. (b) Some, and perhaps the best, of the tusks would have been kept by the hunters to be sold directly to tourists and other visitors. Private sales are sometimes at unit prices much higher than those offered by KNI. (c) Some of the mattak and meat would have been consumed by the hunters and their families outside the cash-mediated marketing system. Thus the average yields of mattak and meat from the catch at Uummannaq are underestimated when based only on the amounts sold. An imputed value equivalent to the foregone earnings could be added to our estimate of the cash value.

At the prevailing prices of the late 1960s and early

1970s the “average” narwhal as defined above (80 kg of mattak at 7.50 Dkr, 6 kg of tusk at 45.00 Dkr, and 46 kg of meat at 2.00 Dkr – see Table 6) would have been worth 962 Dkr, which would have bought approximately 2400 litres of kerosene (see kerosene price curve in Hertz & Kapel 1986: fig. 3). At the prevailing rates in 1985 (35 Dkr per kg for mattak, 500 Dkr per kg for tusks and 25 Dkr per kg for meat – Born 1987) the “average” narwhal would have been worth 6950 Dkr, enough to buy about 2100 litres of kerosene. Using the 1984 price of 750 Dkr rather than the lowered 1985 price of 500 Dkr per kg for tusks (Born 1987) the money made from an “average” narwhal (8450 Dkr) would have bought about 2600 litres of kerosene. From this analysis it can be concluded that the actual “purchasing power” of narwhal products to a Greenlandic hunter was little different in the mid 1980s from what it had been in the late 1960s and early 1970s.

Using the official consumer price index for Greenland (Greenland Statistical Office, Nuuk) instead of the kerosene price as an index, the real value of narwhal products (including only mattak, tusk and meat that is sold) is seen to have increased by somewhat less than 1.5 times between the late 1960s/early 1970s and 1990 (*i.e.* from about 960 to about 1400 Dkr, expressed in 1971 Dkr, for an “average” narwhal; using 1990 unit prices paid to hunters of 538, 47.52 and 13 Dkr per kg for tusk, mattak and meat, respectively). It should be noted that in 1971 sinew was also sold to KGH (Bruemmer 1971), but it is no longer of any commercial value.

Conclusions

Persons concerned with wildlife conservation have used a dichotomy – commercial vs. subsistence – to define and characterize different hunting and fishing regimes (*cf.* Berkes 1988, Wenzel 1991). Some scientists have denied the appropriateness of this approach for analyzing Greenlandic (and certain other) hunting (Kapel & Petersen 1982, Hertz & Kapel 1986, Freeman 1993). They have argued that hunting in Greenland is not oriented towards profit maximization but rather that money has merely facilitated the continuation of a traditional country-wide distribution system and allowed modern hunters to outfit themselves efficiently. Dahl (1989) claimed that rising prices for hunting products do not necessarily lead to intensified hunting. Rather, the intensity of hunting is, according to Dahl, governed primarily by structural features of the hunting communities rather than by external demand factors. Similar arguments have been made concerning seal hunting in Canada (Wenzel 1989, 1991).

From a strictly biological point of view, with the health of the whale stock (*i.e.* its capacity for renewal, or its probability of persistence) as the paramount concern, questions as to how hunting products are consumed and distributed (whether it is “subsistence” or “commercial”) or as to how the animals are taken (whether by “tradi-

tional" or "modern" means) have no intrinsic relevance (although in the case of hunting methods, these can help determine the amount of hunting loss due to sinking and escapement). What is most important for conservation is to ensure that the rate of hunting removals is sustainable on a long-term basis. In the absence of reliable estimates of sustainable yield from the stock(s) of narwhals available to Greenlandic hunters, and given the lack of any formal system for limiting the size of harvests (such as a quota, for example), it is appropriate to be concerned about the sensitivity of hunting effort to demand factors such as the sales of mattak and tusks.

The human population of Greenland has more than doubled since the mid 1950s, and the trend of rapid increase has continued until recently (Lyck & Taagholt 1987). This inevitably has placed greater demands on the country's resources. Since narwhal mattak and meat are consumed both in the hunting communities and in the towns, and since mattak, in particular, is highly esteemed by most Greenlanders (and some non-Greenlanders), the aggregate demand for these products has remained strong and may have increased through the years (*cf.* Born 1987).

Little is known about the size and character of the worldwide demand for narwhal tusks. Much of it is clearly for large unbroken tusks to be kept as souvenirs or ornaments. There is also considerable demand for the carvings and other craft items made from small or broken tusks and tusk pieces (Table 5). Extreme price fluctuations for Canadian narwhal tusks have been interpreted as reflecting the vagaries of market developments, restrictive trade policies and macroeconomic trends (Mitchell & Reeves 1981, Reeves 1992). Prices and sales of Greenlandic tusks and ivory products are undoubtedly influenced by similar forces.

We recognize that the processes which determine hunting effort and success may be complex. Ice and weather can play an important role by influencing the movements of whales and thus their availability to the hunters (*e.g.* see Siegstad & Heide-Jørgensen 1994 for a discussion of ice entrapments). Born *et al.* (1994) suggested that annual differences in prey distribution could help explain year-to-year variability in the movements and abundance of narwhals in Inglefield Bredning. Some hunters are more skilled than others, and this can be an especially important factor in kayak hunting, which usually accounts for a large proportion of the Greenlandic narwhal catch. It is reasonable to assume that prices and opportunities for selling products affect the ways that hunters decide to allocate effort. Also, the cash value of different products (*e.g.* tusks and mattak) may affect the extent to which hunters hunt selectively for whales of a particular size, age or sex (*cf.* Reeves 1993b).

The Canada-Greenland Joint Commission on Conservation and Management of Narwhal and Beluga met for the first time in January 1991 and has met annually since then to discuss problems of mutual concern. As this commission seeks to develop a narwhal conservation

program it will need to take account of the mixed character of narwhal hunting (both subsistence and commercial; see Dahl 1989) and the openness of markets for narwhal products. At present we are unable to say to what degree hunting effort is sensitive to market factors, such as the domestic demand for mattak in both Canada and Greenland and the international demand for tusks and carvings. However market factors certainly could provide an incentive for intensified hunting. This paper should provide a benchmark for assessing future trends in the commerce in narwhal products originating in Greenland.

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