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Greenland shark in Greenland waters in NAFO Subarea 1 and ICES XIV.

By

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Abstract

The Greenland shark fishery has been of great importance in Greenland until 1966, mainly for liver and skin production. Since then, it has been an unwanted by-catch species. Even if catches are rarely reported on logbooks, 64 t were reported in 2017 in NAFO SA1. Data from the surveys carried out by the Greenland Institute of Natural Resources for the period 1988 to 2017 are provided. Highest impact is with gillnets in NAFO div. 1A.

Introduction

The Greenland shark (*Somniosus microcephalus*) longevity, in Greenland waters, has been studied during a Ph.D. in the recent five years (Nielsen, 2017).

The aim of these work is to provide all the available knowledge from surveys and in the literature as well as provide new insights. This document summarizes these findings as they relate to NAFO and furthermore summarizes historic catch and known present catch.

Data

Two sources of information are used in this document.

Greenland Institute of Natural Resources annual surveys (1988-2017):

All Greenland sharks that are caught in annual surveys offshore (bottom trawl) and inshore (gill net and long line) are measured and associated with position, depth, date, and so on. Offshore, this has been done since 1988, and inshore since 2005. Due to handling issues, the specimens are rarely weighted. The length distribution for the period 1988-2012 of all sampled sharks in shown in Fig. 1. Number of individuals caught during the surveys for the period 1988-2017, is shown in table 1 (by division and by gear). Starting in 2012 a subset of this by-catch was used for scientific studies of feeding, age, maturity and genetics. Because the catch of a Greenland shark could be the reason to consider a station as rejected, all stations (valids and rejected) are considered in the data provided in that document.

Logbook data

Although all vessels larger than 30 ft are obligated to fill out logbooks and registering all species, there is surely under-reporting off Greenland shark catches (an unwanted discarded or released bycatch). Sorting grids are mandatory in the shrimp fishery and most Greenland sharks should escape thorough the escape window. In the inshore fishery, only vessels larger than 30ft are required to provide logbooks but since 2017, it has been mandatory to report bycatch. However, there is little data available from this segment, but anecdotal information suggests that Greenland sharks is a problematic by-catch in the fishery for Greenland halibut inshore. Some areas are avoided for fishing due to Greenland sharks.

Results

Survey data

From 1988 to 2017, 239 Greenland sharks were caught in 16 148 hauls, in West and East Greenland surveys (Table 1). Highest catches were in division 1A with gillnet during years 2014-2017 (62 specimens). The catch locations are shown in Fig. 2, where the sharks collected for scientific studies in 2012 are also indicated. The capture depth in the offshore trawl survey varies. Sharks are typically caught between 250 m and 500 m (Fig. 3). Generally, large sharks (>300 cm) are caught at depths shallower than 1,000 m, whereas smaller (<200 cm) are caught deeper than 1000m and all on the West coast of Greenland. The sexually mature females (>450 cm) are rarely seen, and are only caught in southwestern Greenland (south of 63˚N) (Nielsen et al. 2013).

A large increase compared to the pre-2012 period is a result of a change in survey design. Gill nets are now used inshore in northern fjords, targeting Greenland halibut. Some of these stations have resulted in very high catches of sharks, indicating that certain areas are shark hot spots.

The catch rates (5-6 sharks*yr^{-1}) in the offshore bottom trawl survey has not changed during this period. Although highly uncertain total abundance estimate for the offshore trawl survey mean yearly biomass and abundance estimate since 2012 is still around 70.000 tonnes (100.000 sharks), in the West Greenland shelf area, from south Greenland to Upernavik alone.

Historic and present catch:

Historically, the Greenland shark fishery has been of great importance in Greenland (Oldendow, 1942; Mattox 1973). Shark livers and skins were exported for the production of oils for lamps, engine oil and vitamin A rich oil, and the skin for leather production. Greenland sharks have nationally been used mainly for lamp oil and dried for dogfood, and are even today still today directly targeted although no statistics are available from this (most likely limited) direct subsistence fishery. Records of trade with shark livers in Greenland during 1850–1938 estimate annual shark landings of up to 44000 individuals and up to 800 tonnes of shark liver (Oldenow, 1942). Oldenow reports a mean liverweight of just 19 kg in south Greenland and 13 kg in North Greenland with a maximum record of 300 kg in one individual. After World War 2, the export gradually decreased with failing demand the production of liver stopped in 1963 and skins in 1966 (Fig. 4) (Mattox, 1973). Since 1966, Greenland sharks have mainly been limited to an unwanted bycatch in all fisheries and a likely small directed private natural economy fishery for dogfood, in North-west Greenland and probably East Greenland. Most recent reported catches are from bycatch in the offshore fishery targeting Greenland halibut whereas the shrimp fishery has not noted any bycatch in recent years, likely due to the implementation of sorting grids in shrimp trawls.

In the inshore areas, Greenland sharks are still a problem for the commercial longline and gillnet fishery and fishermen still avoid certain areas at certain times a year, due to problems with Greenland sharks (author personal experience and communication with fishermen). Greenland sharks are reported in logbooks as either FAO: SHX (large sharks)/GSK (Greenland sharks) and both are mostly Greenland sharks. In 2017, 64 tonnes of Greenland sharks were reported (>101 individuals) from NAFO SA1 and 39 tonnes (>122 individuals) from ICES XIV and V.

Specific studies

Based on collections over the past 5 years, several studies have been conducted. Nielsen et al. 2017 provide the first age estimates of Greenland sharks. As expected, the longevity is extreme (~400 years) and the onset of maturity in females is estimated to be at least 156 years.

The adult, mature females in the North Atlantic are rarely seen, and Nielsen 2017 illustrates their preference for being in southwest Greenland. The juveniles are an even rarer occurrence, and no nursing ground have been identified.

The feeding of Greenland shark in Greenland waters is described in Nielsen et al. 2013. Generally, there is a shift from a squid in the smallest individuals, to a fish based diet in medium sized sharks, and a gradual shift towards a more mammalian based diet in the largest sharks. This is consistent with similar studies in other regions.

Discussion

Greenland sharks are found throughout Greenland waters. There are, however, patterns, with large females being in southwest Greenland and with particular hot spots although the extent of these is unknown both spatially and temporally. Survey data indicate that the deeper northern fjords have large aggregations of sharks (juveniles) and that the offshore area around 62°N in West Greenland is a key habitat for large females and sharks in general. Highest impact is with gillnets.

Records of trade with shark livers in Greenland during 1890–1938 estimate mean annual shark landings around 15000 individuals from 1862 to1872, and annual landings of 44000 livers from 1903-1910 (Oldenow, 1942). Although there must be some uncertainty about these numbers since they were based on conversion factors from landings of shark livers there is little doubt that the fishery was huge. Whereas the conversion from liver to individual is somewhat uncertain the numbers of shark skins produced, seems more reliable where 1 skin likely = 1 shark. The production of skins reached 8447 skins in 1961. Such large landings could suggest that if the longevity estimates in Nielsen et al. 2017 are correct, the Greenland shark stock should have collapsed. Clearly, this is not the case, but both the Nielsen et al. 2017 and other circumstantial evidence (e.g. Hansen 1963; Fisk et al. 2002) clearly indicate that the longevity should be measured in centuries. Hence, the population size must have been extremely large during the 20th century, and remains so today, especially with the very limited fishery since. The fact that Oldenow, 1942 reports fairly small sharks being landed and that these are rarely seen today might further support the longevity of the Greenland shark. Accordingly, although it is difficult to quantify due to the reporting system, the current catch and by-catch of a few hundred Greenland sharks per year, seems insignificant compared to the historic fishery and the trawl survey abundance and biomass estimates.

References

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Nielsen J., Hedeholm R.B., Simon M., Steffensen J.F. 2014. Distribution and feeding ecology of the Greenland shark (*Somniosus microcephalus*) in Greenland waters Polar Biology 37, 37–46.

Nielsen J. 2017. The Greenland shark (*Somniosus microcephalus*). Diet, tracking and radiocarbon age estimates reveal the world's oldest vertebrate. Ph. D. thesis, University of Copenhagen. 141 pp.

Table 1. Number of Greenland shark, by division and by gear, caught in the surveys carried out by the Greenland Institute of Natural Resources in West and East Greenland, and number of total hauls for the period 1988-2017.

Count specimens by division and gear										
				NAFO				ICES		Total
	1A	1A	1A	1B	1C	1D	1E	XIV	TOTAL	number of
Year	Gillnet	Longline	Trawl	Trawl	Trawl	Trawl	Trawl	Trawl		hauls
1988	-	-	0	1	0	0	-	-	1	191
1989	-	-	0	0	0	0	-	1	1	231
1990	-	-	0	0	0	3	-	1	4	391
1991	-	-	0	0	0	0	0	-	0	341
1992	-	-	0	0	0	1	6	0	7	318
1993	-	-	0	0	0	0	0	1	1	292
1994	-	-	0	0	0	6	0	0	6	293
1995	-	-	1	0	0	0	9	0	10	326
1996	-	-	0	1	0	0	0	1	2	277
1997	-	-	0	0	0	4	0	-	4	359
1998	-	-	0	0	0	0	0	2	2	359
1999	-	-	2	1	0	1	0	2	6	377
2000	-	-	0	0	0	0	0	5	5	396
2001	-	-	0	1	0	0	0	0	1	405
2002	-	-	1	0	0	0	1	2	4	327
2003	-	-	1	0	1	1	1	2	6	293
2004	-	-	1	0	0	0	0	0	1	443
2005	-	0	3	0	0	1	4	1	9	575
2006	0	0	3	1	0	1	4	1	10	569
2007	-	-	0	0	0	1	9	3	13	528
2008	0	-	1	1	0	1	1	2	6	670
2009	-	-	3	0	0	1	2	0	6	568
2010	0	5	2	0	0	1	7	1	16	863
2011	4	0	2	0	0	0	3	1	10	804
2012	0	1	1	0	0	1	2	1	6	822
2013	2	2	1	0	0	0	0	2	7	743
2014	13	3	1	2	0	0	3	1	23	764
2015	18	0	5	0	0	0	4	0	27	1025
2016	15	-	0	0	0	0	2	2	19	1535
2017	16	-	2	0	0	0	7	1	26	1063
	68	11	30	8	1	23	65	33	**239**	**16148**

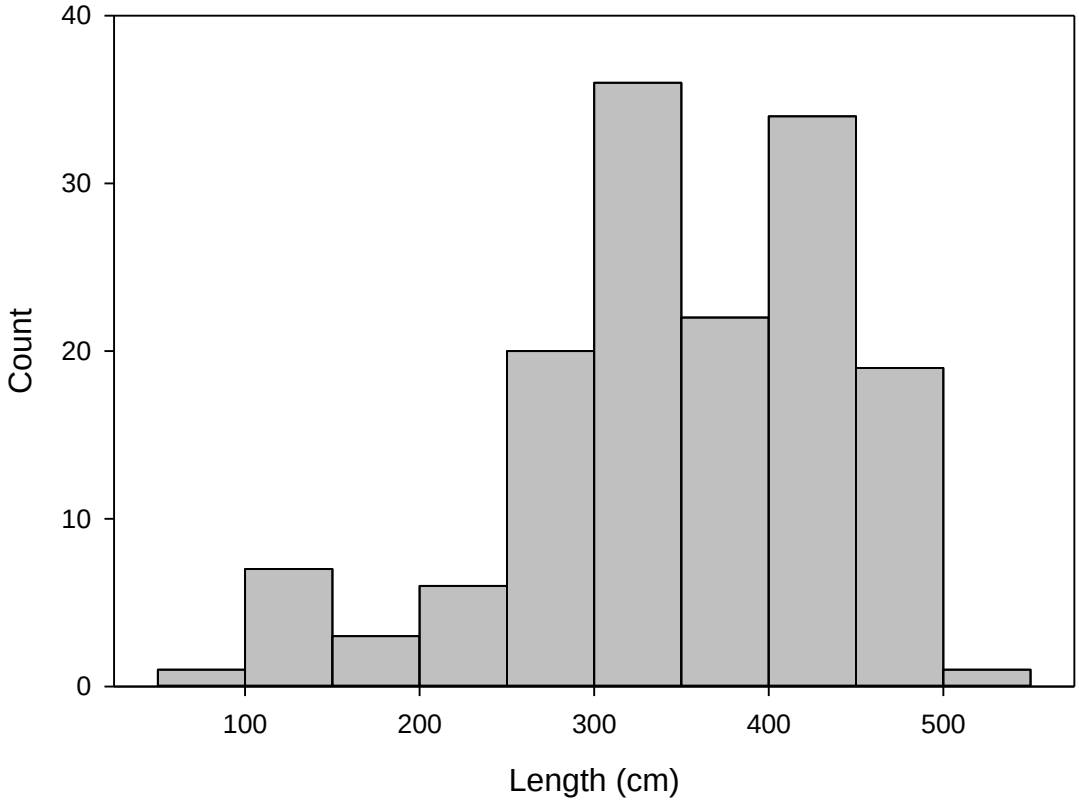

Fig. 1. Overall length distribution for all measured Greenland sharks caught in surveys for the period 1988-2012.

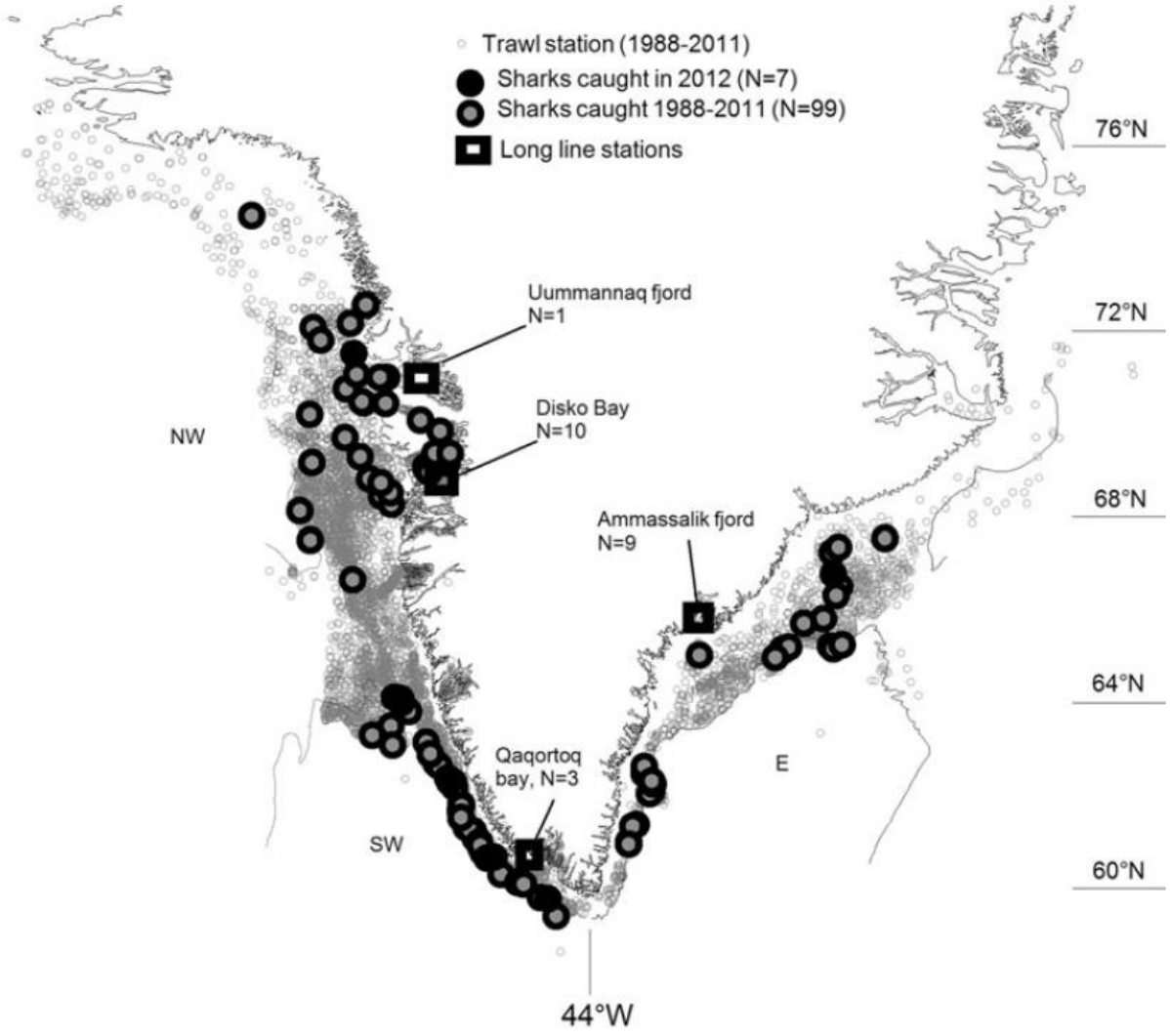

Fig. 2. Each circle represents a trawling haul from 1988 to 2011 (N = 9 744). Gray-filled circles represent locations where Greenland sharks have been caught in bottom trawl prior to 2012 (N = 99), and black-filled circles represent sharks caught in bottom trawl in 2012 (N = 7). Squares represent inshore regions where the number of sharks caught in 2012 is specific for each region. Sharks from these areas were caught on longline (N = 23).

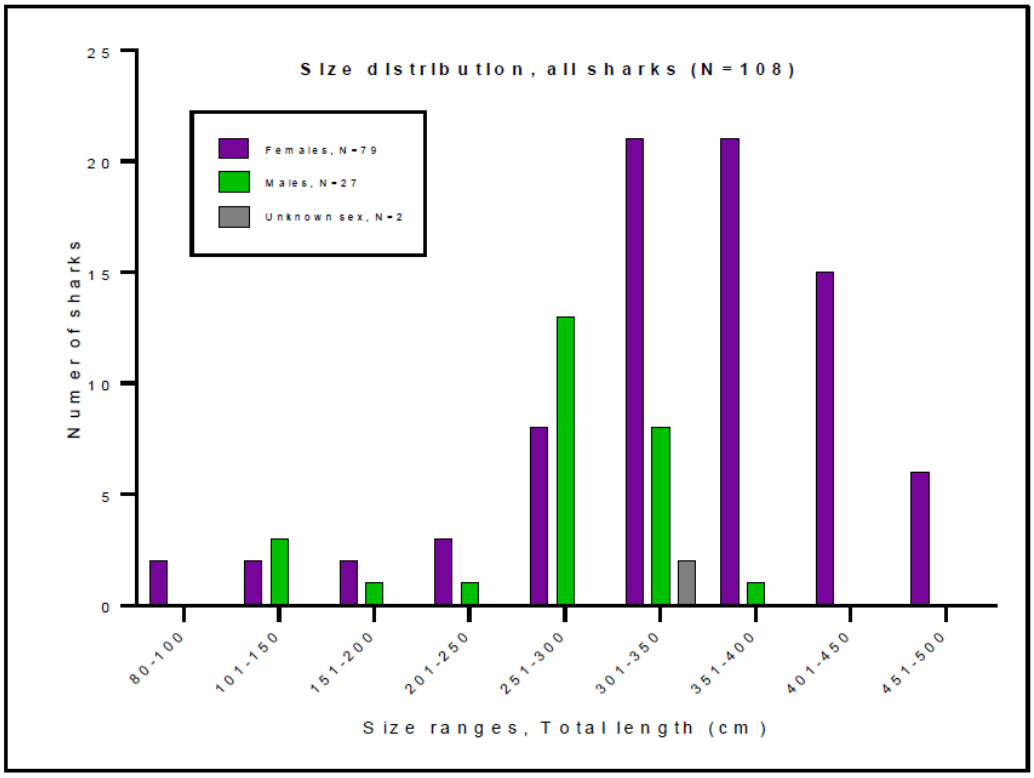

Fig. 3. Size distribution of Greenland sharks for the period 1988-2012 (Source: Nielsen, 2017).

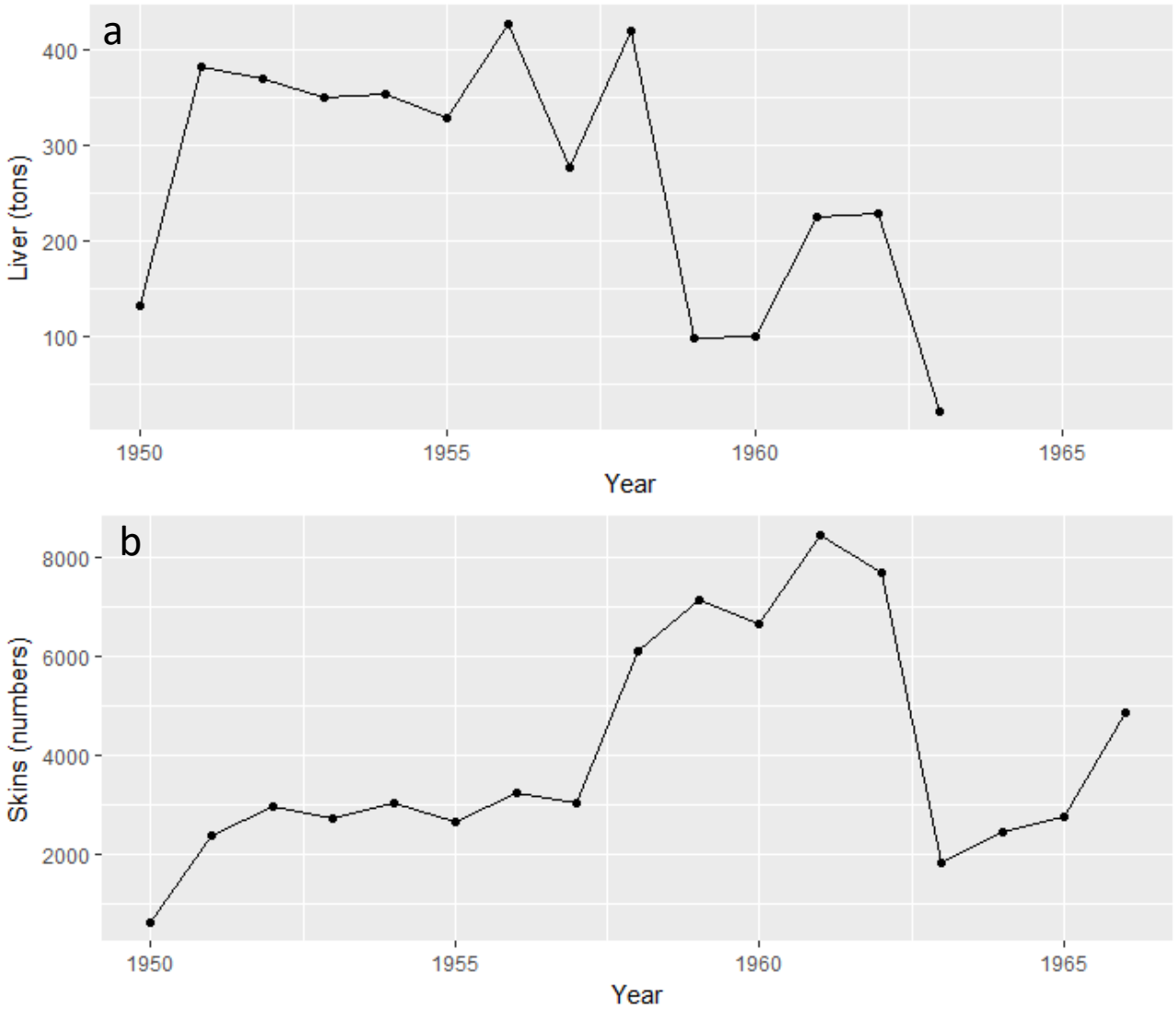

Fig. 4. Production of Greenland shark liver (a) and skins (b) from West Greenland for the period 1950-1966 (Data source: Mattox, 1973)