Examples of use of Local Ecological Knowledge in Greenland



Is climate change causing the increasing narwhal (*Monodon monoceros*) catches in Smith Sound, Greenland?

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Keywords
Climate change; Greenland; *Monodon monoceros*; Narwhal; whale management; whaling.

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Abstract

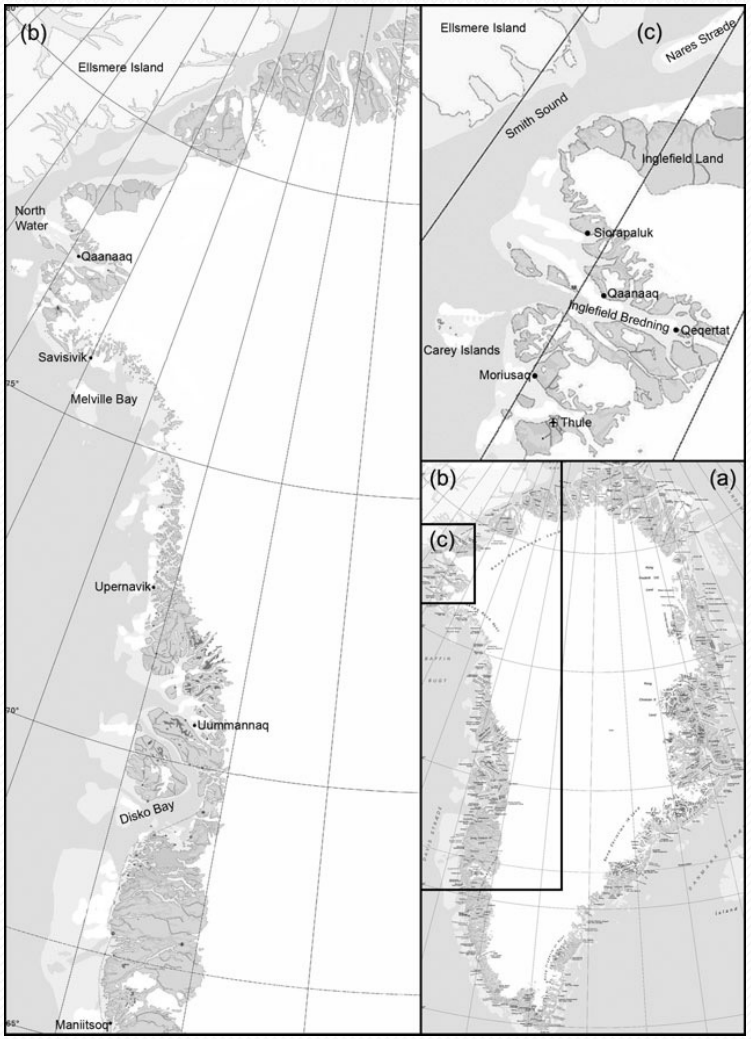
This paper evaluates recent changes in narwhal (*Monodon monoceros*) catches in Siorapaluk, the northernmost community in Greenland, in consideration of the effects of changing climate and uncertainty of stock delineation. The catch statistics show a significant increase in narwhal catches by hunters in Siorapaluk after 2002, which does not appear to be a result of increased effort. Hunters attribute the increase to changed sea-ice conditions providing access by boat to Smith Sound as early as June and July. This indicates that climate change is likely to have a considerable impact on narwhal hunting in northern Greenland. Traditional ecological knowledge and scientific surveys suggest that narwhal in Smith Sound constitute an independent stock. The absence of scientific recommendations for this stock has been seen as an opportunity to increase quotas in West Greenland. Scientific management recommendations are urgently needed to allow the authorities to assign sustainable quotas for this stock. The development of collaborative management agreements and locally based monitoring are recommended to ensure local acceptance of regulations, and to allow rapid responses to climate change.

Three independent stocks of narwhal (*Monodon monoceros*) are currently recognized in Greenland waters (Heide-Jørgensen & Laidre 2006). The summer stock at Inglefield Bredning, in Qaanaaq municipality, is considered to be the same stock that is caught in autumn and winter in Uummannaq municipality and the Disko Bay area (Heide-Jørgensen et al. 2005), with individuals straying only rarely as far south as Maniitsoq. This stock is referred to as the West Greenland stock. The summer stock in Melville Bay is caught by hunters from Upernavik municipality and from Savisivik in Qaanaaq municipality. This stock spends the winter in the central part of Baffin Bay (Dietz & Heide-Jørgensen 1995). Narwhal in East Greenland are genetically distinct from stocks in West Greenland (Palsbøll et al. 1997), and are considered to comprise one stock, largely because of a lack of information (Nielsen, unpubl. ms.). Surveys reveal that the narwhal summer stock in Inglefield Bredning halved over the course of 20 years (Heide-Jørgensen et al. 2002). The West Greenland winter population has also been reduced, and the latest population assessment predicts local extinction of this stock in less than 30 years if current harvest levels continue (JCNB/NAMMCO 2004). No reliable population estimates are available for the Melville Bay stock.

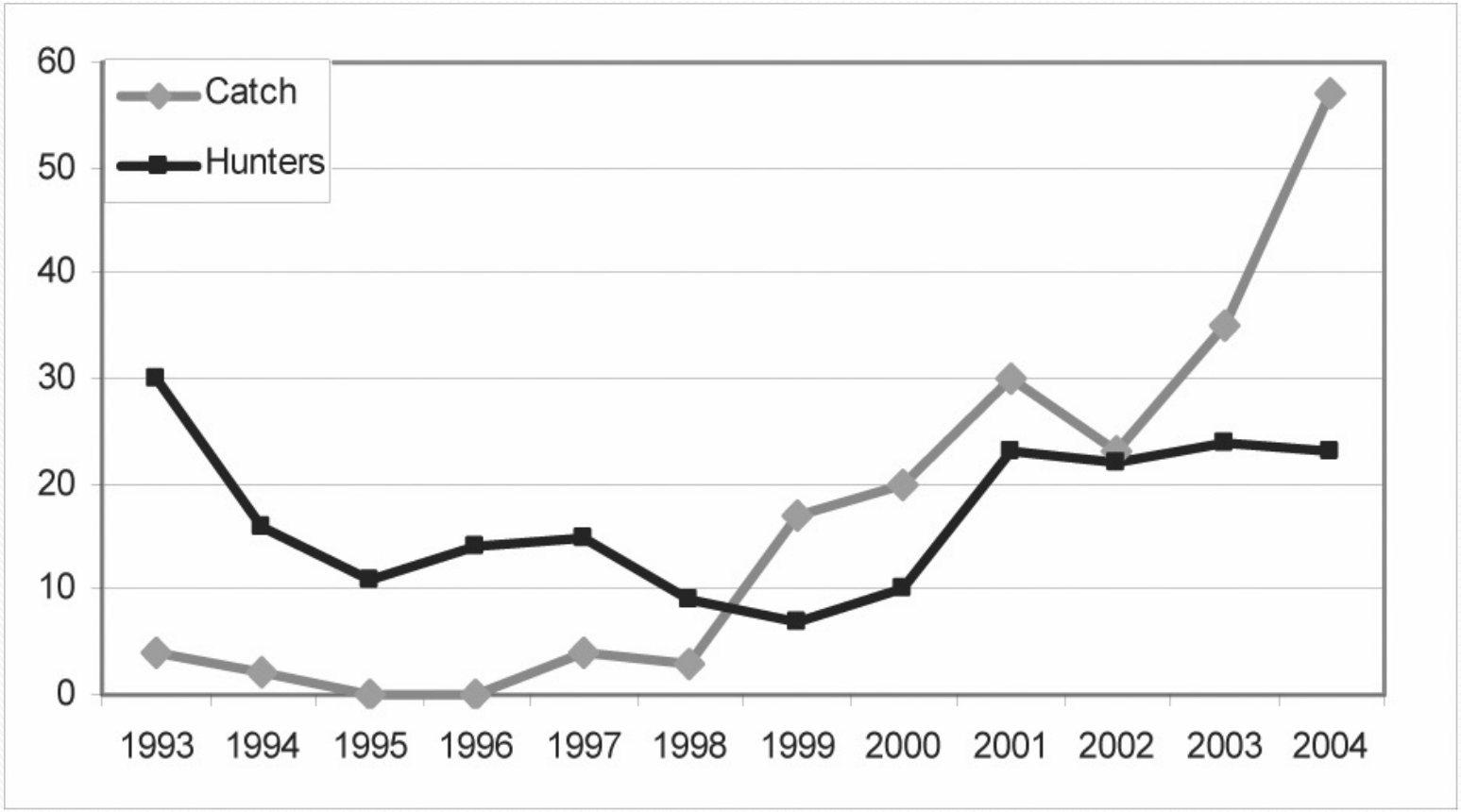
Quotas were introduced by the Greenland Home Rule Government through an executive order on protection and hunting of beluga and narwhal in 2004. Management advice is provided by the Canada–Greenland Joint Commission on Conservation and Management of Narwhal and Beluga (JCNB). The JCNB receives scientific recommendations on harvest sustainability by a Joint Working Group (JWG) comprising the JCNB Scientific Working Group and a working group from the Scientific Committee of the North Atlantic Marine Mammal Commission (NAMMCO). The JWG recommends a maximum catch of 135 narwhal from the West Greenland stock (Witting 2005). However, uncertainty surrounds the stock delineation of narwhal populations in Baffin Bay and the northern strait between Greenland and Canada, the so-called Smith Sound, which in the winter constitutes part of the North Water Polynya (Heide-Jørgensen et al. 2005). Unclear stock delineation and the lack of reliable population estimates prevent the assignment of population-specific quotas to the relevant Greenlandic municipalities, where isolated communities depend on narwhals as a source of nourishment and income (Stevenson et al. 1997; Freeman et al. 1998). The urgency to solve this problem increases as the Greenland

Siorapaluk

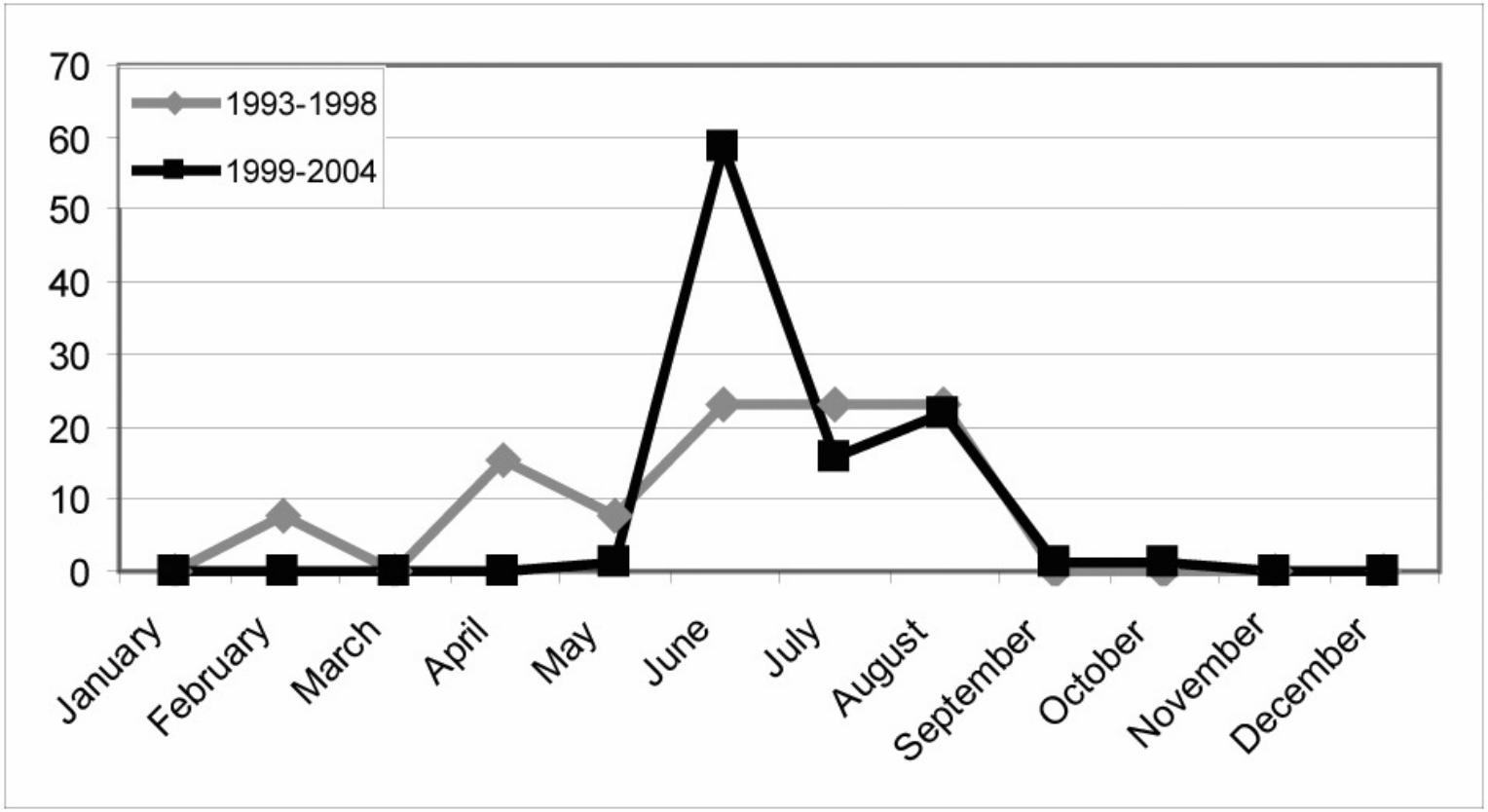
- 60 inhabitants
- 16 occupational hunters
- 7 part-time hunters
- High cultural value
- Subsistence and economic importance
- Hunting from kayak using harpoons



Catch and Effort



Distribution of the catch

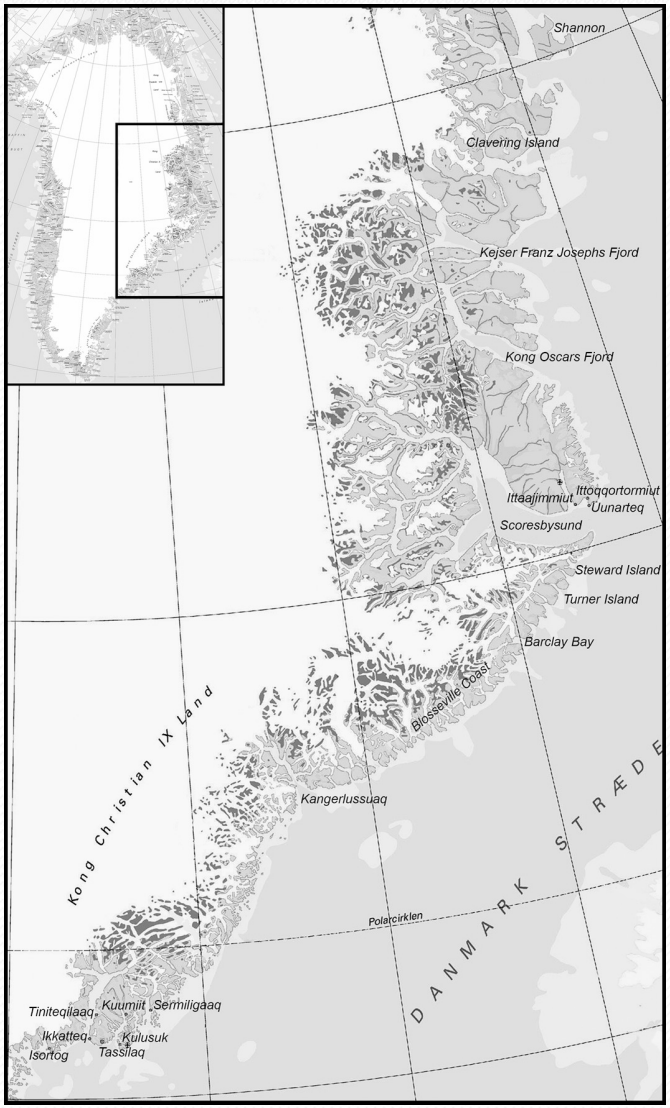


Trends in narwhal (*Monodon monoceros*) stocks and options for co-management in East Greenland: An investigation of CPUE and potential impacts of quotas on Inuit communities

Martin R. Nielsen & Henrik Meilby

East Greenland

- Little knowledge on abundance and stock deliniation
- Cultural implications of quotas and regulation meassures



Climate variations

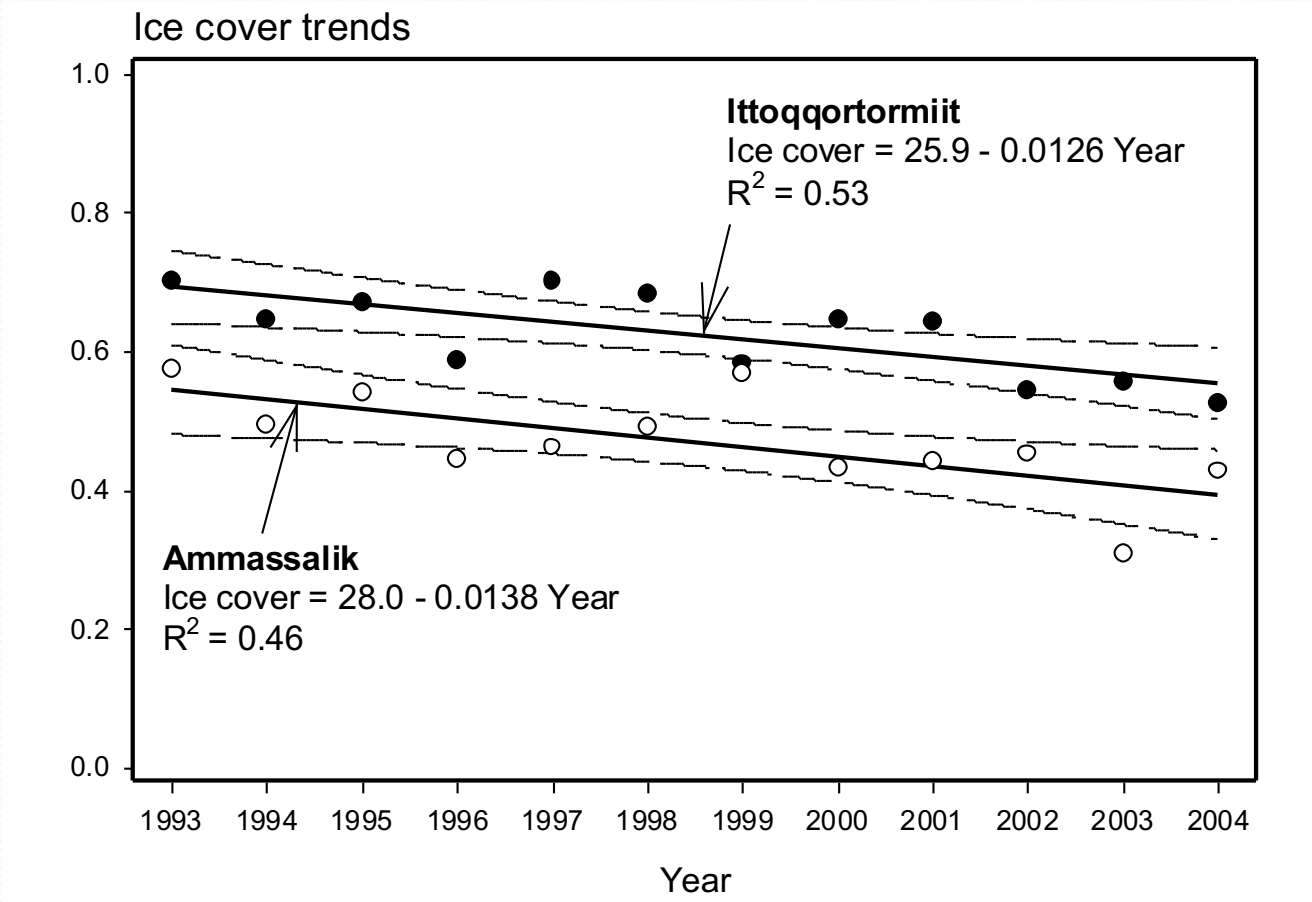


Fig. 2. Data and variation of mean annual ice cover in Ittoqqortormiit (filled circles) and Ammassalik (open circles) and linear regressions with 95% confidence intervals (dashed) of the expected value.

Tab. 2. Regression coefficients with standard errors in brackets of the model (see text) describing the variation in ice cover including trend and lag effect. *, ** and *** signify statistical significance at 0.1, 0.05 and 0.01 levels, respectively.

Variable	Statistics
Ittoqqortormiit*January	60.69 (20.36)***
Ittoqqortormiit*February	60.82 (20.36) ***
Ittoqqortormiit*March	60.59 (20.36) ***
Ittoqqortormiit*April	60.77 (20.32) ***
Ittoqqortormiit*May	60.28 (20.29) ***
Ittoqqortormiit*June	59.77 (20.25) ***
Ittoqqortormiit*July	59.32 (20.22) ***
Ittoqqortormiit*August	59.04 (20.20) ***
Ittoqqortormiit*September	59.04 (20.21) ***
Ittoqqortormiit*October	59.98 (20.24) ***
Ittoqqortormiit*November	61.34 (20.28) ***
Ittoqqortormiit*December	60.65 (20.33) ***
Ammassalik*January	60.06 (20.28)***
Ammassalik*February	60.32 (20.28)***
Ammassalik*March	60.42 (20.29)***
Ammassalik*April	60.89 (20.27)***
Ammassalik*May	61.05 (20.26)***
Ammassalik*June	59.61 (20.25)***
Ammassalik*July	59.30 (20.21)***
Ammassalik*August	59.29 (20.19)***
Ammassalik*September	59.21 (20.20)***
Ammassalik*October	58.71 (20.21)***
Ammassalik*November	59.58 (20.22)***
Ammassalik*December	60.15 (20.24)***
Year	-0.03 (0,01)***
Average temperature	-0.05 (0.02)**
Average wind speed	-0.11 (0.04)***
Ice cover (month-1)	0.52 (0.05)****
N	278
R-square	0.89
Root MSE	0.526

Slight but significant negative trend in ice cover

Climate variations

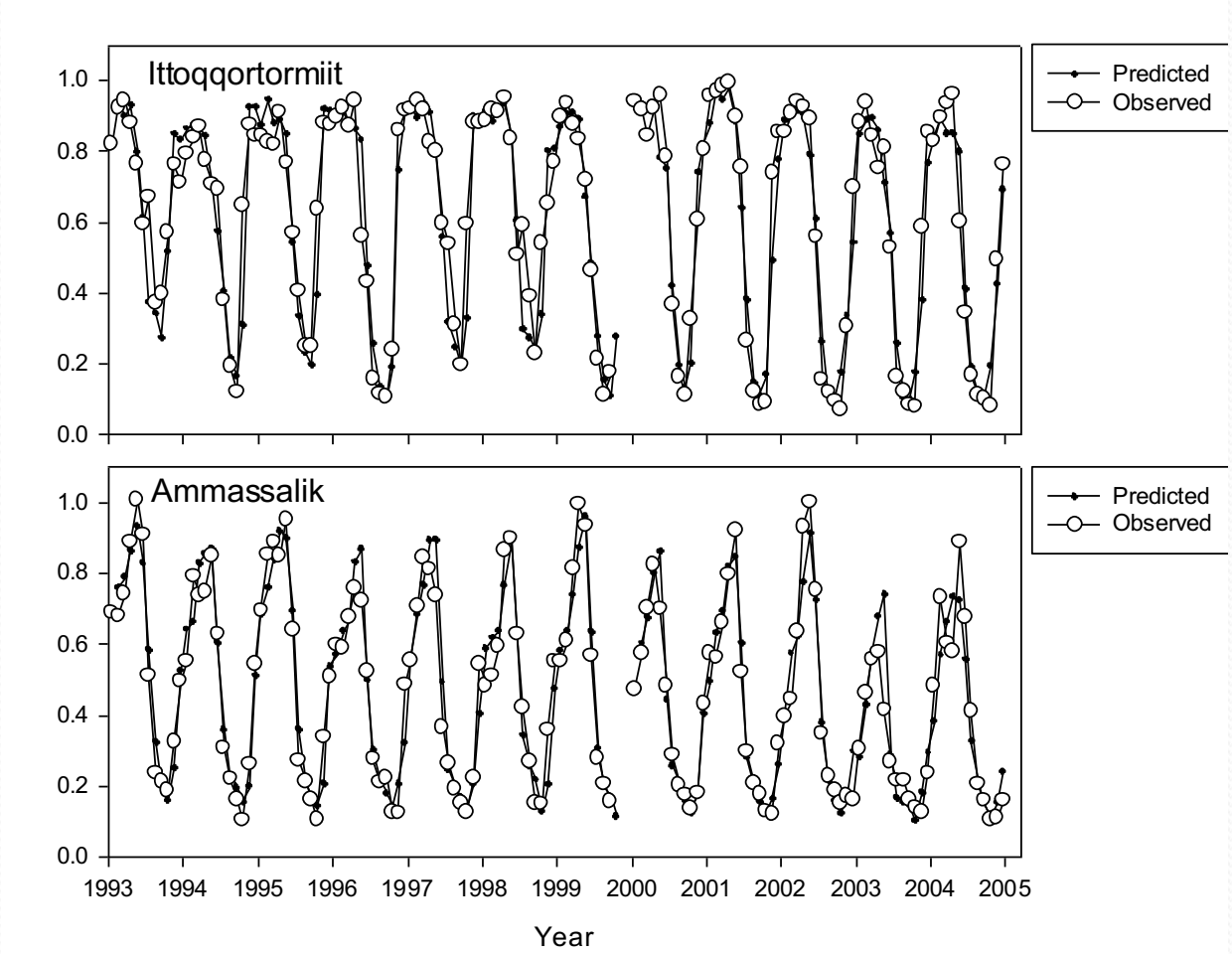


Fig. 3. Observed versus predicted ice cover (model in Tab. 2) in Ittoqqortormiit and Ammassalik municipalities in the period 1993- 2004.

Catch per unit effort

Tab. 3. Poisson regression model (see text) describing the variation of quarterly catch per unit effort as a function of municipality, quarter of the year, hunter status (part time, full time or inactive), year, ice cover and number of active hunters (part- and full-time altogether). Regression coefficients with standard errors in brackets. *, ** and *** signify statistical significance at 0.1, 0.05 and 0.01 levels, respectively; NS = not significant.

Variable	Statistics
Ittoqqortormiit*1st.quarter	-9.05 (1.17)***
Ittoqqortormiit*2nd.quarter	-8.74 (1.06) ***
Ittoqqortormiit*3rd.quarter	-9.47 (1.02) ***
Ittoqqortormiit*4th.quarter	-10.07 (1.05) ***
Ammassalik*1st.quarter	-13.61 (1.16)***
Ammassalik*2nd.quarter	-12.33 (1.15)***
Ammassalik*3rd.quarter	-10.84 (1.12)***
Ammassalik*4th.quarter	-13.67 (1.14)***
Part time hunters	6.23 (1.00)***
Full time hunters	7.74 (1.00)***
Inactive hunters	0.00 (0.00)
(Year-1990)* Ittoqqortormiit	0.041 (0.02)**
(Year-1990)*Ammassalik	0.165 (0.02)***
$(\text{Ice cover})^3$	-4.09 (0.67)***
Number of active hunters	$-0.0008\ (0.0008)^{NS}$
N	69184
Deviance	5627.75
Scaled deviance	5627.75
Pearson Chi-squared	86305.81
Scaled Pearson X^2	86305.81
Log likelihood	-2645.87

The results indicate a positive trend considering effort and climate

Catch per unit effort

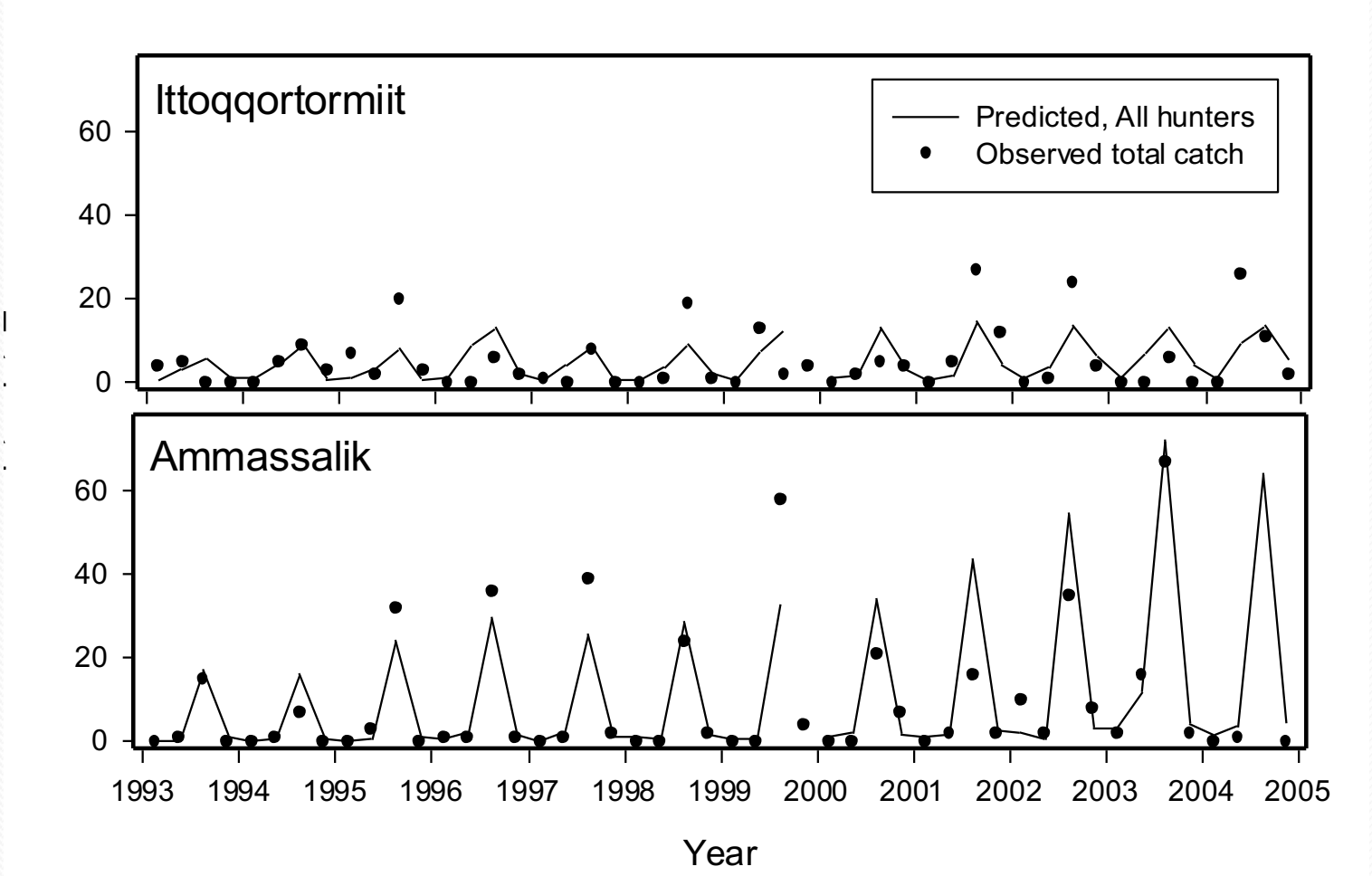


Fig. 4. Observed versus predicted catch (model in Tab. 3) in Ittoqqortormiit and Ammassalik municipalities in the period 1993- 2004.

Catch per unit effort

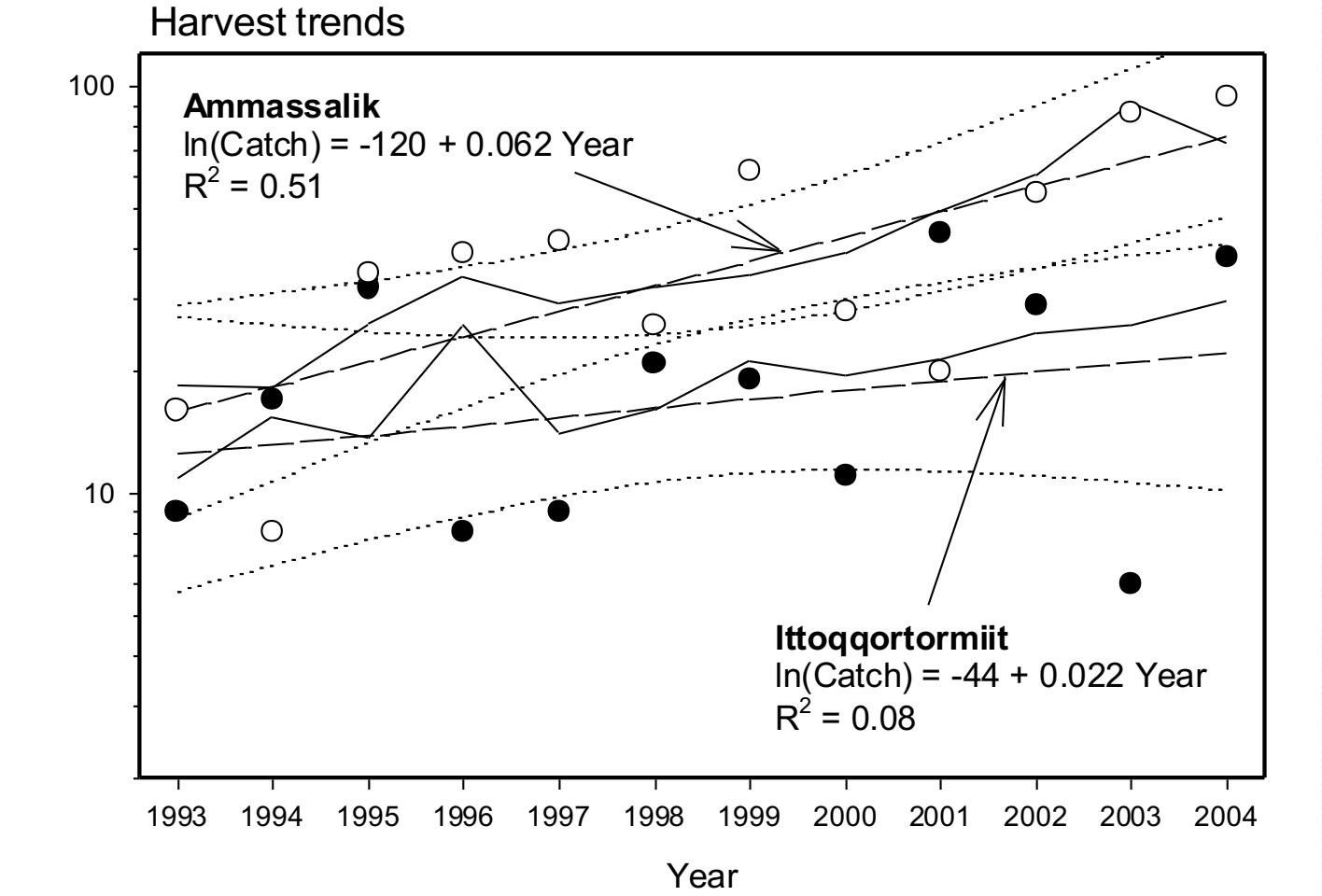


Fig 6. Development in total annual catch, 1993-2004. Solid lines are predictions based on the model in Tab. 3. Broken lines are trend curves and dotted lines 95% confidence intervals for the predicted trend curves. NB: logarithmic scale on ordinate axis. The slope parameter of regressions indicate annual growth rates.

Migration patterns

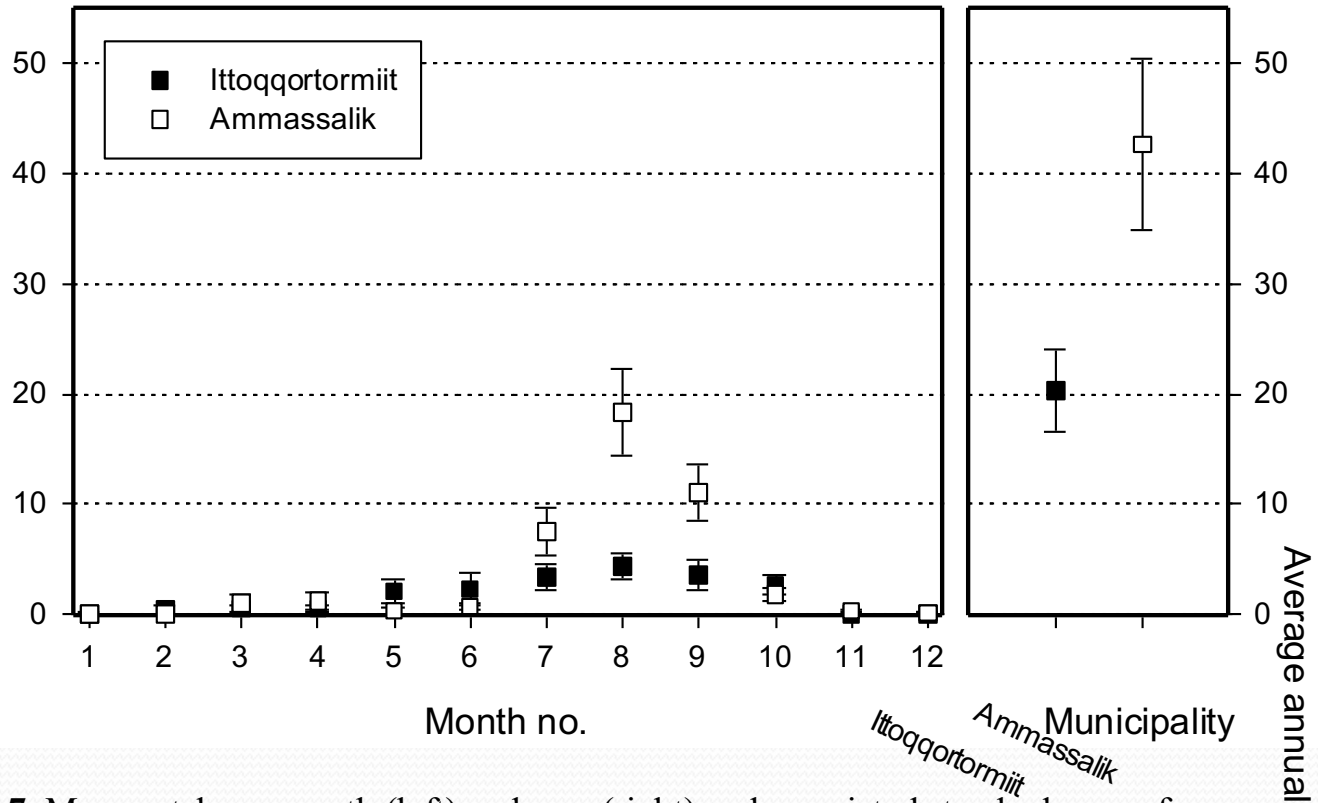


Fig. 7. Mean catch per month (left) and year (right) and associated standard errors for Ittoqqortormiit (filled symbols) and Ammassalik (open symbols) municipalities in the period 1993-2004.

Migration patterns

Tab. 4. Correlation between catch in one of the municipalities and catch in the other municipality until three months previously. *, ** and *** signify statistical significance at 0.1, 0.05 and 0.01 levels, respectively.

	Months previously in other municipality			
	0	**1**	**2**	**3**
Ammassalik	0.23*** (n=144)	0.22** (n=144)	0.22*** (n=143)	0.18** (n=141)
Ittoqqortormit	0.23*** (n=144)	0.14* (n=143)	0.04 (n=142)	-0.16* (n=141)

Attitudes towards regulations

West Greenland

- Applauded increased control with allocation of occupational hunter permits, exclusion of people without appropriate equipment and experience, and further restrictions on part-time hunters' access to quotas and proportion of the quota
- People above the official retirement age and people receiving disability retirement benefits should not be able to hold a occupational hunting license

East Greenland

- Opposed to any distinction between occupational and part time hunt
- Elder hunters have an important function in handing down experience and the suggestion was considered unacceptable.

Lessons

- LEK represents a largely untapped potential in Greenland
- LEK could inform national and local management decisions
- To fully integrate LEK in management decisions co-management agreements should be established
- Use the cost efficient data potential in systematically recorded observations by the hunters
- Pay close attention to stakeholder incentives in the use of LEK