

OTOLITHS, SQUID BEAKS AND BIOMETRIC MEASUREMENTS FROM DAVIS STRAIT

OTOLIETEN, INKVISSNAVELS EN BIOMETRISCHE GEGEVENS UIT DE DAVIS STRAAT

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Measurements of otoliths of fish and beaks of squid caught at Store Hellefiskebanke in Davis Strait were used to work out otolith-size / fish size (beak-size / squid size) relationships. These relationships may be used in diet studies of seabirds and marine mammals. The sample, taken from species which had not been studied before in sufficient detail and/or taken at a location from which no similar data were collected, is thought to contribute to the 'virtual database' on this sort of measurements which is exploited during diet studies of top-predators.

In diet studies of seabirds and marine mammals, stomach contents, pellets or regurgitated material may be checked for slowly digestable remains such as bones, scales, feathers and hairs. Studies of piscivorous species usually concentrate on otoliths or very distinctive bones, whereas studies of squid consumers usually focus on squid beaks. Established relationships between the size of the otolith, bone or beak and the overall size of the animal from which these bones originated (e.g. length, height, mass) are used to estimate the size of prey items (e.g. Härkönen 1986). To prevent every student to have to set up and maintain his or her own reference collection and database of these bone size/fish size relationships, it is helpful to have such data published and therefore available for use in future studies. Particularly so when samples can be taken in remote areas or from little known prey species.

*Table 1. Species, length and sample size of fish and squid collected in Davis Strait.
Tabel 1. Soorten, lengte en steekproefgrootte van vis en inktvis in Davis Straat.*

Species	length (mm)	n
Arctic cod <i>Boreogadus saida</i>	48 - 220	112
Rockfish <i>Sebastes mentella</i>	65 - 285	114
Greenland halibut <i>Reinhardtius hippoglossoides</i>	99 - 442	72
Gelatinous seasnail <i>Liparis fabricii</i> (<i>koefoedi</i>)	75 - 140	19
Snake blenny (<i>Stichaidae</i>) not ident.	90 - 129	18
Squid <i>Gonatus fabricii</i>	53 - 447	40

During pelagic fishing onboard RV *Shinkai Maru* just north of 'Store Hellefiskebanke' (68°00'N, 56°00'W) in Davis Strait off West Greenland, the opportunity was taken to sample some potential seabird prey items. This paper presents measurements of Arctic cod *Boreogadus saida*, Deepwater rockfish *Sebastes mentella*, Greenland halibut *Reinhardtius hippoglossoides*, Gelatinous seasnail *Liparis fabricii (koefoedii)*, snake blenny *Stichidae* spp. and squid *Gonatus fabricii* (Table 1).

Measurements were obtained from late August to early September 1992. The animals were caught in 30 mm mesh size trawl over depths of 150-400 meter. The trawl was hauled during all times of day. Considering the rough mesh, the animals caught cannot be thought to be representative of potential prey in the area. All animals were measured within two hours of capture and

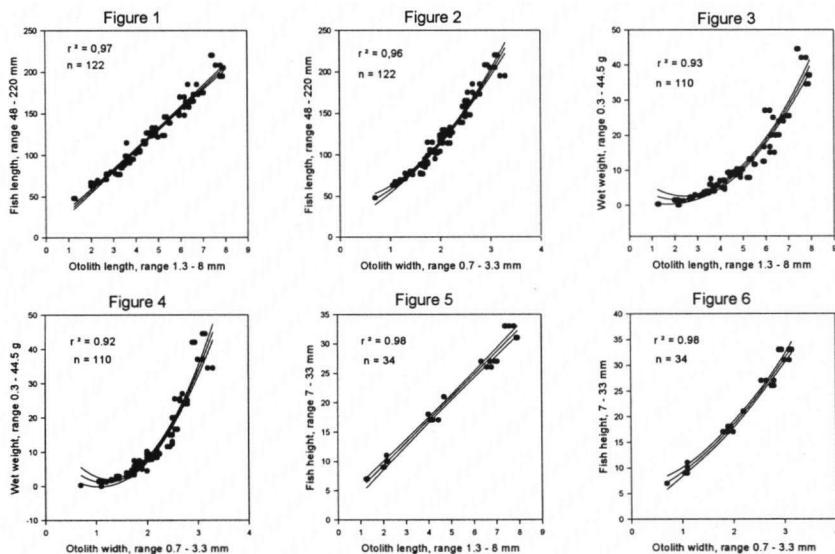
Table 2. Relationships between otolith dimensions and fish size (length, height or weight and squid beaks and squid size, from specimens collected in Davis Strait (Table 1). OL = Otolith length, OW = Otolith Width, UB = Upper Bill, LB = Lower Bill.

Tabel 2. Relaties tussen otolietdimensies en visgrootte (lengte, hoogte of gewicht), of snavelafmetingen en inktvisgrootte op grond van exemplaren verzameld in Davis Straat (Tabel 1). OL= otoliet lengte, OW= otoliet breedte, UB= bovensnavel, LB= ondersnavel.

Species	Equation	Ref.
Arctic cod	Length = 6.85 + (OL*24.88)	fig 1
	Length = 29.5 + (OW*14.8) + (OW ² * 13.8)	fig 2
	Weight = 6.80 - (OL*4.90) + (OL ² * 1.13)	fig 3
	Weight = 14.4 - (OW*22.0) + (OW ² * 9.7)	fig 4
	Height = 1.54 + (OL*3.85)	fig 5
	Height = 3.70 + (OW*3.67) + (OW ² * 1.84)	fig 6
Rockfish	Length = (OL*25.11) - 10.06	fig 7
	Height = (OL*7.08) - 6.75	fig 8
	Weight = 116 - (OL*51.27) + (OL ² * 5.83)	fig 9
Greenland halibut	Length = (OW*53.04) - 27.34	fig 10
	Width = (12.08*OW) - 1.13	fig 11
	Weight = 201 - (OW*128.5) + (OW ² * 20.9)	fig 12
Gelatinous seasnail	Length = (OL*298.8) - 210 - (OL ² * 63.5)	fig 13
	Weight = (OL*18.04) - 20.87	fig 14
	Height = (OL*165) - 139.8 - (OL ² * 40.1)	fig 15
Snake blenny	Length = 41.4 + (OL*59.2)	fig 16
	Length = 38.94 + (UB*10.91) + (UB ² * 14.5)	fig 17
Squid	Length = (LB * 22.14) - 10.33	fig 18
	Weight = 4.86 - (UB*7.97) + (UB ² * 4.88)	fig 19
	Weight = 3.91 - (LB*2.06) + (LB ² * 0.46)	fig 20
	Mantle length = 16.7 + (UB*11.5) + (UB ² *5.6)	fig 21
	Mantle length = 15.9 + (LB*4.5) + (LB ² *0.52)	fig 22

Figure 1-6. Otolith length and -width versus fish length (1-2), wet weight (3-4) and fish height (5-6) in Arctic cod *Boreogadus saida*

Figuur 1-6. Otoliet lengte en -breedte in relatie tot vislengte (1-2), vers gewicht (3-4) en vishoogte (5-6) bij Poolkabeljauw *Boreogadus saida*.



excess water was removed with tissue paper prior to weighing. All length, width and height measurements represent the maximum measurements possible. Relations between otolith size and fish measurements were assessed by means of least square estimation, using Sigma Plot software: non-linear relations were expressed as second order polynomials. Relations are pictured (figures 1-22) fitted with 95% confidence limits.

Arctic cod inhabits surface waters and is a very important prey item of many arctic piscivorous seabirds and marine mammals. Deepwater rockfish is a pelagic species which mainly occurs at depths of 300-900 m in the northern North Atlantic (Klekowsky & Weslawski 1990). Greenland halibut occurs most abundantly at depths between 200-600 m, but exceptionally at 2000 m. Sea snails occur at variable depths (0-1000 m, *fabricii* usually at 40-600 m). Snake blennies are bottom living fish which are most common between 40-100 m depth (Wheeler 1978).

Figure 7-9. Otolith length versus fish length (7), fish height (8) and wet weight (9) in Deepwater rockfish *Sebastes mentella*.

Figuur 7-9. Otoliet lengte in relatie tot vislengte (7), vishoogte (8) en visgewicht (9) bij roodbaars *Sebastes mentella*.

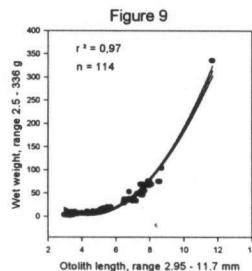
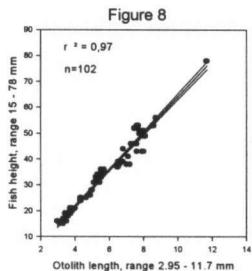
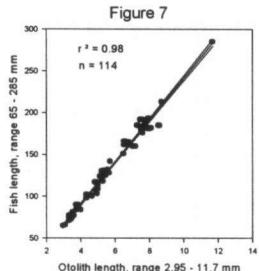


Figure 10-12. Otolith width versus fish length (10), fish height (11) and wet weight (12) in Greenland halibut *Reinhardtius hippoglossoides*.

Figuur 10-12. Otoliet breedte in relatie tot vislengte (10), vishoogte (11) en vis gewicht (12) bij de kleine heilbot *Reinhardtius hippoglossoides*.

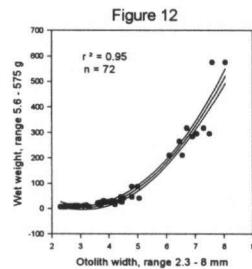
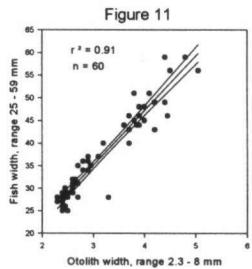
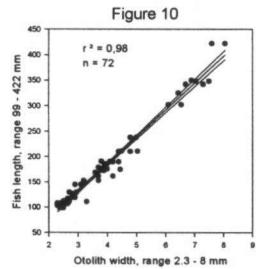


Figure 13-15. Otolith length versus fish length (13), wet weight (14) and fish height (15) in Gelatinous seasnail *Liparis fabricii* (koefodii).

Figuur 13-15. Otoliet lengte in relatie tot vislengte (13), vers gewicht (14) en vishoogte (15) bij slakdolf *Liparis fabricii* (koefodii).

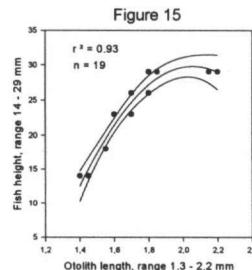
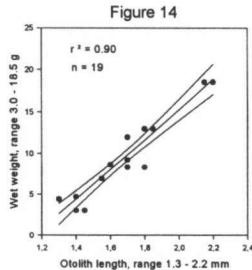
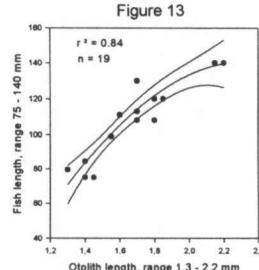


Figure 16

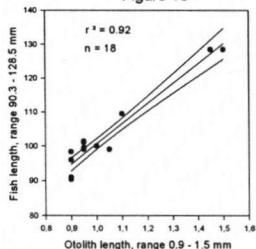


Figure 16. Otolith length versus fish length in snake blennies Stichidae (not identified to species).

Figuur 16. Ototiet lengte in relatie tot vislengte bij ongedetermineerde bandvis Stichidae.

Figure 17-22. Upper- and lower beak versus total squid length (17-18), wet weight (19-20) and mantle length (21-22) in arctic squid *Gonatus fabricii*.

Figuur 17-22. Boven- en ondersnavellengte in relatie tot inktvislengte (17-18), gewicht (19-20) en mantellengte (21-22) bij arctische pijlinktvissen *Gonatus fabricii*.

Figure 17

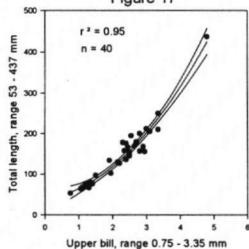


Figure 18

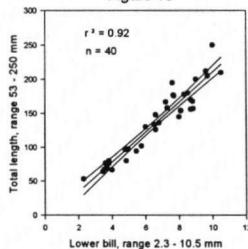


Figure 19

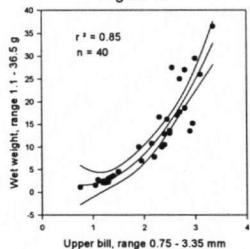


Figure 20

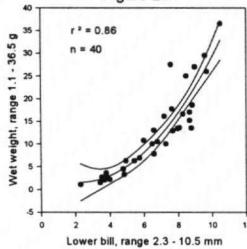


Figure 21

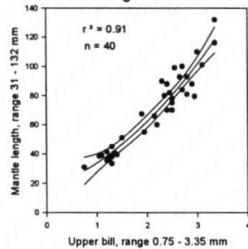
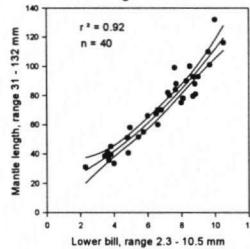


Figure 22



At the Store Hellefiskebanke, large quantities of zooplankton were also caught, notably *Parathemisto libellula*, *Thyssanoessa raschii*, *Thyssanoessa inermis*, *Meganyctiphanes norvegica*, *Clione* spp. and small *Pandalus borealis*. This study is a by-product of observations of seabirds and cetaceans for the Danish National Environmental Research Institutes Department of Arctic Environment.

SAMENVATTING

Bij dieetstudies van visetende zeevogels en zeezoogdieren wordt in het algemeen de voedselkeuze geanalyseerd aan de hand van langzaam verterende, soortspecifieke onderdelen van prooidieren zoals de gehoorsteentjes bij vissen (otolieten), opmerkelijk gevormde botjes en graatjes en de snauwels van inktvissen. De relatie tussen de dimensies van deze onderdelen en de grootte (lengte, hoogte, gewicht) van het gehele prooidier wordt gebruikt om de grootte van de geconsumeerde prooien uit te rekenen. Voor dergelijke studies is een uitgebreide kennis van de karakteristieke onderdelen van de (mogelijke) prooidieren noodzakelijk en veel onderzoekers leggen daarom een referentiecollectie aan. Dergelijke collecties worden doorgaans aangelegd aan de hand van vers materiaal. Omdat sommige soorten moeilijk te krijgen zijn en omdat de relaties tussen visgrootte en visgrootte een flinke steekproef vereisen, is het nuttig dergelijke gegevens voor derden beschikbaar te maken door publicatie van de relevante gegevens. In dit artikel worden de biometrische gegevens van poolkabeljauw, een roodbaars, een slakdolf, de kleine heilbot, een bandvis en een pijlinktvissen gepresenteerd zoals die werden verzameld tijdens een trip in Davis Straat. De dieren werden gevangen met een sleepnet op 150-400m diepte in augustus-september 1992 op Store Hellefiskebanke ($68^{\circ}00'N$, $56^{\circ}00'W$). De relaties tussen otolietlengte of -breedte en de vislengte, -hoogte en het (verse) visgewicht zijn uitgezet met daarbij het 95% betrouwbaarheidsinterval (figuren 1-22). De regressies zijn voor verder gebruik samengevat in tabel 2.

Härkönen T. 1986 . Guide to the Otoliths of the bony fishes of the Northeast Atlantic. Danbiu, Copenhagen.

Klekowski R.Z. & Weslawski J.M. 1990. Atlas of the marine fauna of southern Spitsbergen. Polish Academy of Sciences, Inst. of Ecology and Inst. of Oceanology, Wroclaw.

Wheeler A. 1978. Key to the fishes of Northern Europe. Frederick Warne, London.