Growth and reproduction of the common whelk (*Buccinum undatum* L.) in Breiðafjörður

Hildur Magnúsdóttir[1,2], Erla Björk Örnólfsdóttir[1]

[1] Vör – Marine Research Center at Breiðafjörður, Norðurtanga, 355 Ólafsvík

[2] Department of Biology, University of Iceland, Askja, Sturlugata 7, 101 Reykjavík

Sjávarrannsóknarsetur við Breiðafjörð
Marine Research Center at Breiðafjörður

Introduction

The common whelk (*Buccinum undatum* L.) is one of the most abundant subtidal invertebrate predator in the North Atlantic ocean (Jalbert et al. 1989). *B. undatum* is most commonly found in the subtidal area down to 50 m depth but has been found down to 1200 m depth. *B. undatum* is gonochoric, has internal fertilization and the female whelk lays eggs on a hard substrate, from which fully developed juveniles emerge (Martel et al. 1986). Through the years the common whelk has been harvested in Europe and Canada for bait and human consumption (DFO 2006). In 1996 whelk fishery was initiated in Breiðafjörður, West Iceland. The goal of this study is to investigate the growth and reproductive cycle of the common whelk in order to facilitate a sustainable fishery of the whelk in the fjord. Life history traits to be determined are; size at sexual maturity, time of mating, time of egg laying, growth rate and population structure of the whelk in Breiðafjörður.

Methods

Whelks were collected in 5 areas in Breiðafjörður. Samples were collected monthly at two locations within each area, from June 2007 to January 2008 (Fig. 1). The snails were dissected after the whelks were weighed with and without the shell. The height and width of the shell of the whelk was measured with vernier calipers. Sex was determined after the animal had been removed from the shell. For male whelks (Fig. 2A) length of the penis was measured. Then testis, seminal vesicle and digestive gland were removed and the animal weighed after each organ had been removed. For female whelks (Fig. 2B) the pallial oviduct, ovary and digestive gland were removed in the same way. Size at sexual maturity was determined for male whelks. Size at sexual maturity is the size interval at which 50% of the males are mature. Age of whelks was determined by dyeing the operculum with methylene blue before the annual circles were counted.

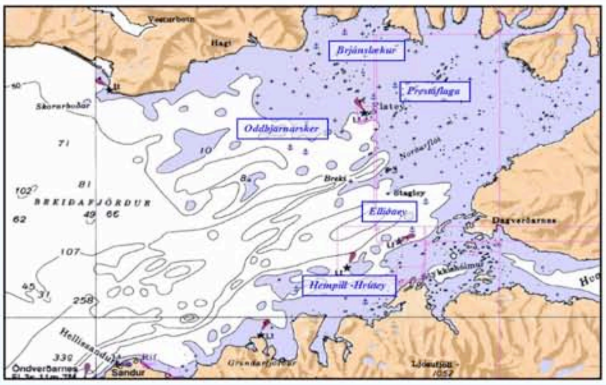

Figure 1. Samples were taken monthly at 10 stations in Breiðafjörður: Brjánslækur 1 and 2; Prestaflaga 1 and 2; Oddbjarnarsker 1 and 2; Elliðaey 1 and 2; Hempill and Hrútey. In all areas except Elliðaey, station nr. 1 is the northernmost station (stations are indicated with a blue anker).

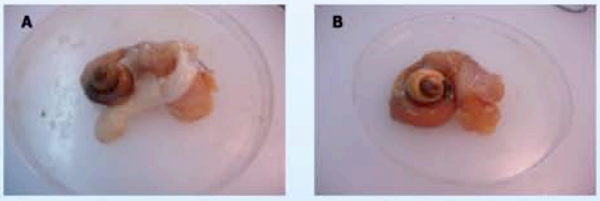

Figure 2. A) A male whelk has been taken out of the shell and is about to be dissected. **B)** A female whelk.

Results

- Average shell height of whelks ranged from 49,71 mm to 58,12 mm (Table 1)
- Average weight of whelks ranged from 13,64g to 22,47 g
- Sexual maturity was reached at size intervals from 45-50 mm to 70-75 mm
- The percentage of female animals ranged from 42%-56%.
- Shell height of whelks was normally distributed at most stations (Fig. 3)
- In general, young whelks grew faster than sexually mature whelks at the ten stations in Breiðafjörður (Fig. 4)
- The seasonal variation in the ratio between gonads and accessory sexual glands to eviscerated weight was not significantly different between months (Fig. 5)

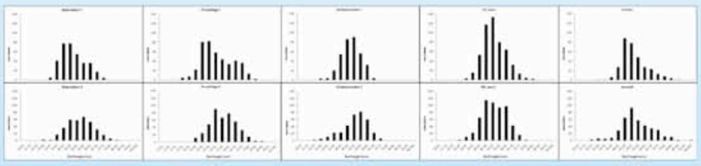

Figure 3. Size distribution of the common whelk at the ten sample sites in Breiðafjörður.

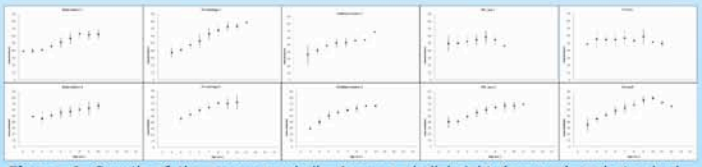

Figure 4. Growth of the common whelk. Average shell height (squares) and standard deviation (vertical bars) for the common whelk at the ten sample sites in Breiðafjörður.

Table 1: Average height, average weight, size at sexual maturity and percentage of females at each station.

	Brjáns lækur 1	Brjáns lækur 2	Presta flaga 1	Presta flaga 2	Odd bjarnar sker 1	Odd bjarnar sker 2	Elli_aey 1	Elli_aey 2	Hrútey	Hempill
Average height (mm) (stdev.)	49,71 (8,96)	54,71 (9,95)	53,58 (11,63)	58,12 (9,60)	50,24 (7,45)	53,32 (9,56)	53,41 (8,52)	53,56 (9,06)	54,39 (9,58)	56,26 (11,66)
Average weight (g) (stdev.)	13,64 (7,33)	18,12 (9,30)	17,51 (10,86)	20,98 (9,66)	14,17 (5,63)	16,23 (6,83)	15,77 (7,07)	17,57 (7,64)	19,81 (10,97)	22,47 (14,313)
Size at sexual maturity (mm)	60-65	65-70	60-65	70-75	50-55	50-55	45-50	60-65	65-70	55-60
Percentage of females (%)	52,86	56,57	55,76	49,88	45,71	42,00	56,31	55,92	51,08	50,88

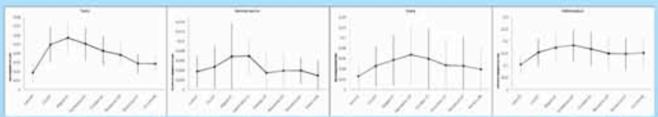

Figure 5. Seasonal variation in the ratio of gonads and accessory sexual glands to eviscerated weight, for males (testis and seminal vesicle) and females (ovary and pallial oviduct) from June 2007 to January 2008. The squares indicate the average and the vertical bars the standard deviation.

Discussion

The variation in shell length, weight and size at sexual maturity of the common whelk between areas in Breiðafjörður is consistent with previous observations of *B.undatum* in Breiðafjörður, Canada and Sweden (Gendron 1991, Gunnarsson and Einarsson 1995, Valentinsson 2002). Observed differences in the whelk's biology might suggest that there are local populations of whelk present on a relatively small geographical scale, as was suggested by Gunnarsson and Einarsson (1995) for Breiðafjörður. Present observation of morphological attributes of whelks in Breiðafjörður demonstrates that the snails show phenotypic plasticity (pers.obs.). To test whether this difference is also genotypical, whelks will be collected for genetic analysis.

First measurements of the reproductive cycle of the common whelk in Breiðafjörður suggest great variability in sexual status between individuals. In Europe mating of whelks takes place in autumn whereas in Canada it takes place in late spring (Martel et al. 1986, Valentinsson 2002). Whether the Icelandic whelks resemble the European or the American populations in their reproductive cycle or if they show a unique pattern remains to be resolved.

Acknowledgements

We are indebted to Poul Jepsen (Palli) and crew on Valdi SH–94 and Þorkell Marinó Magnússon and Jón Óli Sigurðsson on Garpur SH-95 for going out of their way helping us collect the samples. Financial support for this project was provided by NORA and AVS grants to Vör, and by financial support from The Ministry of Fisheries and Agriculture.

References

DFO, 2006. Assessment of Quebec coastal waters whelk stocks in 2005. DFO. Can. Sci. Advis. Sec. Sci. Advis. Rep. 2006/001; ***Gendron, L.***, 1992. Determination of the size at sexual maturity of the waved whelk *Buccinum undatum* Linnaeus, 1758, in the gulf of St. Lawrence, as a basis for the establishment of a minimum catchable size. Journal of Shellfish Research, **Vol. 11, No.1**: 1-7; ***Gunnarsson, K. and Einarsson, S.***, 1995. Observations on whelk populations (*Buccinum undatum* L., Mollusca; Gastropoda) in Breiðfjörður, Western Iceland. ICES C.M. 1995/K:20: 1-13; ***Jalbert, P., Himmelman, J.H., Béland, P., Thomas, B.***, 1988. Whelks (*Buccinum undatum*) and other subtidal invertebrate predators in the northern Gulf of St. Lawrence. Nat. Can. **116**: 1-15; ***Martel, A., L*** [illegible] 1986. Reproductive cycle and seasonal feeding activity of the neogastropod *Buccinum undatum*. Mar. Biol. **92**: 211-221; ***Valentinsson, D.***, 2002. Reproductive cycle and maternal effects on offspring size and number in the neogastropod *Buccinum undatum* (L.). Mar.Biol. **140**: 1139-1147