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# WHY THE WHELK (*BUCCINUM UNDATUM*) HAS BECOME EXTINCT IN THE DUTCH WADDEN SEA*

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## ABSTRACT

**The disappearance of the whelk from the western Dutch Wadden Sea started in the mid 1920s with a gradual decline due to overfishing and lethal shell damage by fishing gear. When fishery stopped in the early 1970s, tributyltin-based (TBT) antifouling paints had become into use. Such paints caused imposex and possibly reproduction failure in the whelk leading to its local extinction. The whelk will disappear from larger parts of its present distribution area if fishery-free areas do not become effective, and if the use of TBT-based paints continues.**

Key words: whelk, Wadden Sea, population ecology, TBT, fishery

## 1. INTRODUCTION

The whelk, *Buccinum undatum* L., has now disappeared from the Dutch Wadden Sea where it was once abundant. The last living specimen probably was collected in 1991 (Ten Hallers-Tjabbes *et al.*, 1993).

Whelks are relatively large gastropods with a maximum recorded length of 15 cm (Hancock, 1967), but specimens in the Wadden Sea seldom exceed 8 cm, in accordance with the size given by Jeffreys (1867). They reach sexual maturity at about 5 cm length when they are 2 or 3 years old. The females attach clumps of egg capsules to hard substrates in winter. Some of these egg masses become detached, accumulate along shores and perish. Egg capsules may contain up to 3000 eggs, most of which are nurture eggs. This late maturation and low production of eggs make them particularly vulnerable to (over)fishing. Moreover, modern beam-trawl fishery has proved to damage large numbers of benthic organisms including whelks (Bergman & Hup, 1992). Trawling may also cause detachment of egg masses (Cadée, 1995b).

In this note we will discuss possible causes of the recent extinction of the whelk in the Dutch Wadden Sea. Several causes can have contributed: overfishing; shell damage due to fishery as observed for instance in the North Sea in the bivalve *Arctica islandica* (Witbaard & Klein, 1994); or pollution in particularly by tributyltin (TBT) antifouling paints causing imposex and reproduction failure as observed in dog whelks *Nucella lapillus* (Blaber, 1970; Bryan *et al.*, 1986; Gibbs & Bryan, 1986).

## 2. RESULTS

A substantial whelk fishery, mainly for export, once existed, and landings have been recorded since 1912. Fig. 1 is based on these published data for the western Dutch Wadden Sea (Anonymous, 1912-1970). Peak landings of whelks of 500000 $kg \cdot a^{-1}$ occurred around 1925/26, after which landings gradually decreased to practically zero in 1970, putting an end to fishery. During the two worldwars, 1914/18 and 1940/45, fishery was temporarily discontinued because no export was possible. The increase in landings since 1920 was mainly due to increased efforts by oyster fishers switching to whelks after a mass mortality in oysters in 1921. Formerly whelks were a bycatch for oyster fishers; now oysters became a bycatch for whelk fishers. The use of more ships in the 1930s (40 in 1934, 67 in 1936/37, 61 in 1938, Anonymous, *l.c.*) did not result in higher catches, but rather in a decline. This decline continued after the 1940-45 war. After 1970, whelk fishery in the western Dutch Wadden Sea stopped altogether.

To investigate whether whelk fishery caused shell damage, a sample of 80 whelks present in the collection of the National Natural History Museum (NNM), Leiden, was studied (Cadée, 1995b). The sample

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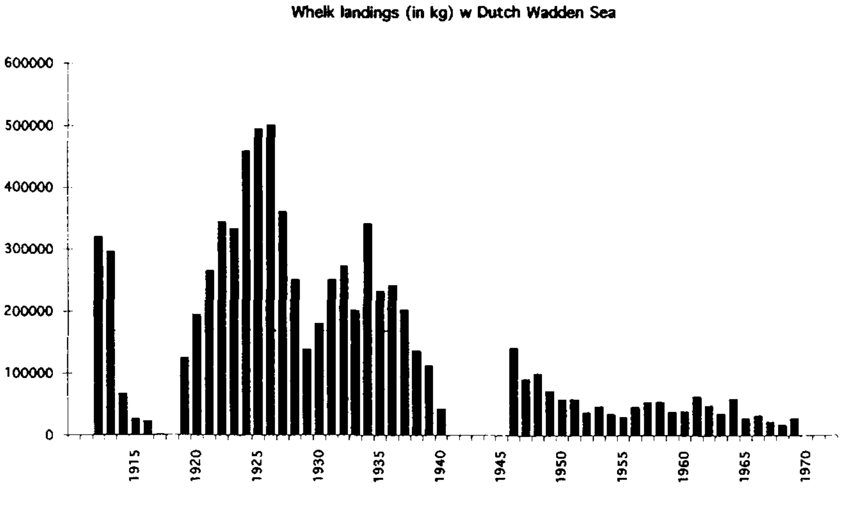


Fig. 1. Landings of whelks (*Buccinum undatum*) from the western Dutch Wadden Sea based on the annual fishery reports (Anonymous, 1912-1970).

was donated by the fishery inspection and collected alive in 1926 in one of the whelk fishery areas south of Wieringen, the Wieringermeer, part of the former Zuiderzee. This area was directly connected with the Wadden Sea and reclaimed in 1929. All of these shells showed more or less damaged outer lips and the specimens larger than 3 cm also frequently showed one or more repairs of former outer-lip damages; seven specimens also had a hole in the last whorl of the shell. The 15 specimens smaller than 3 cm all showed substantial damage of the outer lip: up to a quarter of the body whorl had broken off. This proves that whelk fishery caused substantial shell damage, also in whelks that had escaped the nets as indicated by the frequent shell repairs. Part of the damage was apparently non-lethal, but large holes in the body-whorl were apparently lethal as no hole-repairs were observed in whelks from this site nor from other parts of the Wadden Sea.

In the laboratory we studied (always in duplicate) shell damage, survival and repair over a six-week period in whelks collected in the North Sea with a 12-m commercial beam trawl. Only 0 and 8% of the control whelks collected by bait-pots died. Of trawled, mainly adult whelks, with no or light outer-lip damage (animal still able to withdraw soft parts completely into the damaged shell), 70 and 90% died within two weeks. Of more heavily damaged, mainly juvenile, animals 50 and 65% died in the same period. In these juvenile shells (< 40 mm) the siphonal canal was often broken as well. Survivors had completely repaired their outer lip and siphonal canal after the six weeks. This indicates a heavy toll of commercial trawling, but part of the damaged animals may recover. However, even in those cases where shell damage by fishery is non-lethal, shell repair is energy consuming (Vermeij, 1993).

## 3. CONCLUSIONS

The results indicate that whelk fishery together with shell damage due to (whelk)fishery may have caused the gradual decline of the whelk population in the Wadden Sea, indicated by the decrease in whelk landings between the mid 1920s and 1970 (Fig. 1). However, whelk fishery stopped, of course, before whelks had completely disappeared from the Wadden Sea. The later complete extinction of the whelk, instead of its recovery after fishery had stopped, was most probably caused by TBT antifouling paints in use since the 1970s. Such paints cause imposex (production of penis homologues and vas deferens in females) observed now in *Nucella lapillus* (Blaber, 1970; Bryan *et al.*, 1986; Gibbs & Bryan, 1986), *Nassarius obsoletus* (Smith, 1981), *Hexaplex trunculus* (Axiak *et al.*, 1995), *Buccinum undatum* (Ten Hallers-Tjabbes *et al.*, 1994) and many other neogastropods (Stewart *et al.*, 1992). In *Buccinum undatum*, imposex has been observed in the Southern Bight of the North Sea (Ten Hallers-Tjabbes *et al.*, 1994, 1996), and the Eastern Scheldt (Mensink *et al.*, 1996b). Exposure to TBT just after hatching seems to cause the most dramatic effects (Mensink *et al.*, 1996a). In *Nucella lapillus* also decline of reproductive potential was observed (Bryan *et al.*, 1986; Gibbs & Bryan, 1986); this was suggested for *Hexaplex trunculus* (Axiak *et al.*, 1995), and might be the case also in *Buccinum undatum*.

Disappearance of whelks from the Wadden Sea will in the long run also influence hermit crabs negatively because they will be unable to find gastropod shells of a suitable size when they become too large for the small *Littorina littorea* shells (Cadée, 1995a).

Failure to make large fishery-free areas in the North Sea effective as proposed *e.g.* by Lindeboom (1995), and failure to ban TBT antifouling paints, will ultimately cause extinction of whelks in the North Sea as well.

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