

## The excavation technique for molluscs of Pacific Walruses (*Odobenus rosmarus divergens*) under controlled conditions

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### Summary

The main prey of walruses are molluscs. Tracks in the sea bed in walrus feeding areas have raised the question of how walruses excavate these bivalves. This study, using an artificial sand bottom in a pool, shows that walruses first root into the substrate using the upper edge of their snout, and then stir up the sand by water jetting with their mouths, in order to reach the molluscs.

### Introduction

Walruses eat benthic invertebrates. The main prey items are bivalves (Fay, 1982). Furrows with an average length of 47 m and a width of 40 cm made by walruses in search of food are found in the ocean floor (Nelson & Johnson, 1987). Fay (1982) postulated the snout as a digging or 'rooting' organ, because of the abrasion on the vibrissae and tusks, the protective cornification of the skin at the upper edge of the snout, and the powerful levitating musculature of the head and neck. Oliver *et al.* (1983) described walrus foraging tracks in more detail. Next to the furrows and excavation pits they found discarded bivalve shells. They suggested that in addition to 'rooting' with the snout and vibrissae, walruses excavate bivalve prey by hydraulic jetting, using their mouth.

Because it is considered dangerous to be in the water with wild walruses, the suggested excavation technique of this species has not been investigated further. Since the Harderwijk Marine Mammal Park houses walruses, that are accustomed to eat molluscs (Kastelein *et al.*, 1989), it was practical and safe to study their excavation technique under controlled conditions.

### Materials and Methods

#### Study animals

The Harderwijk Marine Mammal Park houses a pair of Pacific walruses, *Odobenus rosmarus divergens* (codes: OrZH003 and OrZH004). Both were born in Alaska in 1982 and were found beached that same

year. They were rehabilitated by Sea World, USA, and arrived at the Harderwijk Park in 1985 where they have since been kept together.

#### Study area

The study area consists of an outdoor pool with an adjacent land area. The pool is 4 m deep and has reinforced concrete walls and floor. In this pool a stainless steel container was placed which was also used as an underwater digging trough in a previous study (Kastelein & Wiepkema, 1989). For one day (in February 1988) this trough was filled with sand as a digging substrate (surface area: 5.2 m<sup>2</sup>, sand layer: 50 cm deep).

Twice that day 20 live gapers (*Mya arenaria*) were put 10 cm deep into the sand substrate. Half an hour after the gapers were placed in the sand, the 2 walruses were allowed to go into the water. The underwater behaviour of the walruses was filmed with a video camera (Philips VKR 6800) which was placed in a waterproof housing.

### Results

The animals showed the following behaviour. The positioned themselves on their front flippers on the sand, with their body at an angle of 30-90 degrees with the bottom surface (Fig. 1). They slowly moved

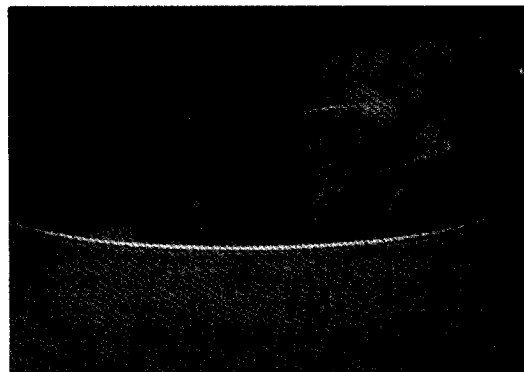
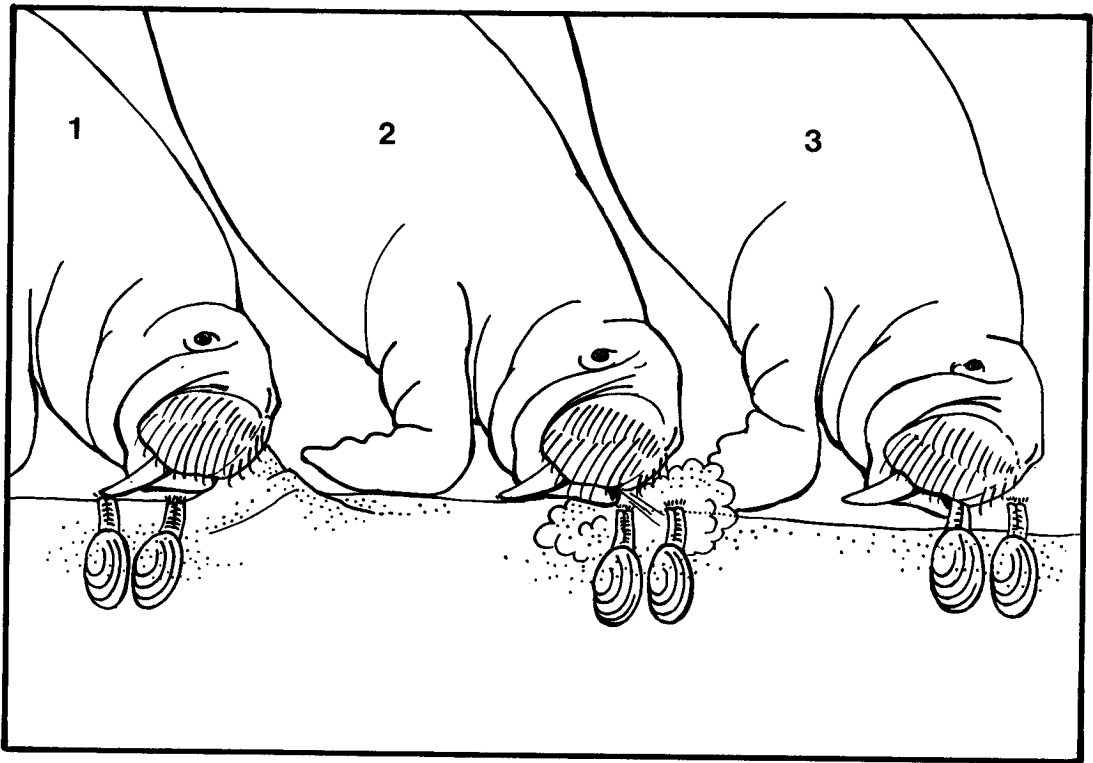


Figure 1. A walrus excavating gapers in the digging trough (picture taken from a video recording).



**Figure 2.** A schematic view of the excavation technique of molluscs by the walruses, showing the rooting (1), the water jetting (2) and the processing of a mollusc (3).

snout-first along the bottom, exploring it with their eyes open. The animals rooted in the sand with the upper edge of the snout and then made a pumping motion with the mouth cavity. This created a strong current in the water and stirred up the sand (Fig. 2). The gapers were found and excavated. After inspection with the vibrissae (which was difficult to see because it was done quickly between the snout and the substrate) the flesh was sucked from the shells. Afterwards the shells were dropped.

#### Discussion and conclusions

Although the behaviour of walruses reared in animal parks is not necessarily comparable to that of wild animals, the behaviour seen in this study is at least indicative of the extent of their capabilities.

This study only lasted for one day because the walruses ingested some sand, as anticipated from a previous study with pebbles (Kastelein & Wiepkema, 1989). Because of the large surface area, to which bacteria can adhere, the ingestion of large amounts of sand can be dangerous to animals (Neurohr, 1988). In the wild walruses also ingest indigestible material, but to what extent is not clear (Fay, 1982).

These observations of the 'rooting' motion corre-

spond with the fact that the vibrissae on the upper edge of the walrus's snout are worn down more than the lateral vibrissae (Fay, 1982; Kastelein & van Gaalen, 1988).

In this study the walruses severely disturbed the substrate with their excavation technique. In the wild, the disturbance to the substrate by foraging walruses can influence the structure of macrobenthic assemblages as studied by Oliver *et al.* (1985).

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