Odor discrimination in Cape fur seals, *Arctocephalus pusillus*

Aquatic mammals are traditionally believed to have a poorly developed sense of smell. Here I show that Cape fur seals can discriminate between odors and the results suggests that seals may be able to use their sense of smell to detect fish rich in oil.

There have been few studies performed on the sense of smell in seals and the few studies that have been performed have yielded contradictory results of the significance of the sense of smell in this group of animals[1].
The areas responsible for the sense of smell in the brain of seals are somewhat reduced[2] and partly because of this some authors have stated that seals have a poor sense of smell[3].
Grey seals *Halichoerus grypus* have often been observed to appear downwind the oil slick resulting from another seal surfacing and consuming a captured salmon (Arne Fjälling, pers.comm.). Are they using their sense of smell to detect these oil slicks?
The aim of this study was to develop a method to test the capabilities of the sense of smell in Cape fur seals and then to test the seals ability to discriminate between odors and in particular between the odors of fish that differ in their content of oil. I also measured the seals long-term memory for odors.
The animals tested performed a rewarded operant conditioning paradigm. They had to choose between two odors (tab.1) that were simultaniously presented to them. One odor was the correct and the other odor was incorrect. Correct choice was rewarded and the nose by one of the odors was the operant.

Rewarded stimuli (S+)		Unrewarded stimuli (S-)
1: Fish + salmon oil	vs.	Empty container
2: Fish + salmon oil	vs.	Clove (essential oil)
3: Fish + salmon oil	vs.	Black pepper (essential oil)
4: Fish + salmon oil	vs.	Myrtle (essential oil)
5: Fish + salmon oil	vs.	Fish without salmon oil
6: Squid	vs.	Fish without salmon oil
7: Empty container	vs.	Empty container

Table 1 These odor-combinations the Cape fur seals had to discriminate between in the study.

All animals were successful in discriminating between odors. They also succeeded in discriminating between fish with salmon oil and fish without salmon oil. The seals also showed a long-term (at least 14 days) memory for the reward-value of odors.
These results show that Cape fur seals are capable of acquiring a food-rewarded sense of smell discrimination method. This kind of method has not been used in a study about the sense of smell in seals before this study but a similar two-choice discrimination method has been used successfully in a study of the visual capability in Cape fur seals *Arctocephalus pusillus* and South American fur seals *Arctocephalus australis* by Busch and Dücker[4].
The method used had many advantages like a simple design and that the animals were tested in their homecages when they were tested eliminating the problems of testing the animals in a new environment[5]. The method gave successful results.
The results show that seals are able to learn the reward value of a new non-rewarded odor that is presented to them while the rewarded odor stays the same.
That the seals are able to detect and discriminate fish rich in oil is of behavioral relevance for them. That they were able to detect the fish with oil open for the possibility that their olfactory capabilities are not reduced even though their olfactory areas are reduced. In pigtail

macaques *Macaca nemestrina* the sense of smell is believed to have only little, if any, behavioral relevance. Pigtail macaques have somewhat reduced areas responsible for smell in the brain but they have been shown to have a well-developed sensitivity for the smell of monomolecular odorants of aliphatic aldehydes, that are present in a large variety of fruits that are included in their diet[6].
In a field study with baited buoys performed by Beszczýnska[7] on Baltic grey seals *Halichoerus grypus* the results indicated that the seals´ sense of smell is of minor importance in their foraging behavior. Nevertheless grey seals *Halichoerus grypus* have often been observed to appear downwind the oil slick resulting from another seal surfacing and consuming a captured salmon (Arne Fjälling, pers.comm.) and now the results from this project opens for the possibility that seals can use their sense of smell in their foraging behavior. For example to locate fishing nets and/or discriminate between different species of fish.

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