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Short Note
The Antarctic toothfish: how common a prey for Weddell seals?

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The Antarctic toothfish (*Dissostichus mawsoni* Norman) has been considered an occasional large prey item of the Weddell seal (*Leptonychotes weddellii* Lesson) (Kooyman 1967, Calhaem & Christoffel 1969, Testa *et al*. 1985, Castellini *et al*. 1992, Davis *et al*. 1999, Fuiman *et al*. 2002). The seal's most common prey is the Antarctic silverfish (*Pleuragramma antarcticum* Boulenger) as well as benthic and sub-ice fish, cephalopods, and crustaceans (Dearborn 1965, Green & Burton 1987, Plotz 1987, Plotz *et al*. 1991, Castellini *et al*. 1992, Burns *et al*. 1998).

Here we report observations of Weddell seals frequently feeding on Antarctic toothfish in McMurdo Sound, Antarctica. During the springs and summers of 2001, 2003, and 2004, sea ice camps with experimental dive holes were located on the sea ice of McMurdo Sound, at 77°52.680'S, 166°51.480'E (January 2001), and 77°42.858'S, 166°06.483'E (November 2003, 2004). Depths at these sites were > 300 m. The 2001 camp was located *c*. 15–20 km from the ice edge. In 2003, the Ross Sea ice edge was less than 10 km from the camp. In 2004, the ice edge, near Beaufort Island, was > 50 km from the camp. Sea ice thickness at each camp was *c*. 2 m.

In January, 2001, at least ten toothfish were brought to the surface by Weddell seals over an 11-day period. Nine seals utilized this breathing hole, but we do not know if captures were limited to specific seals. In November 2003, one Weddell seal was observed to consume at least four toothfish over a three day period. These observations were aided by the sub-ice observation chamber as the fish were eaten underwater, and were not always brought up to the surface of the dive hole (Fig. 1). More extensive observations at the surface and from the sub-ice chamber in October–November 2004 confirmed that at least 28 fish were captured over a 37-day period by three Weddell seals visiting the dive hole. On one occasion, a seal was observed to begin eating a second toothfish within an hour after consuming another. During one evening, a seal cached up to three toothfish in the dive hole (Fig. 2).

These observations extend prior reports of Weddell seals feeding upon the Antarctic toothfish at experimental dive holes in McMurdo Sound (Kooyman 1967, Calhaem & Christoffel 1969, Castellini *et al*. 1992, Davis *et al*. 1999), and confirm a report of Weddell seals possibly caching prey beneath the ice (Kim *et al*. 2005). The incidence of capture may be underestimated by the nature of our opportunistic observations, and by the fact that such activity often occurs below the ice with the fish not being brought to the surface. Indeed, the use of the sub-ice observation chamber in 2003 and 2004 was essential to many of our observations. In addition, time of year and the location and water depth of experimental dive holes may also contribute to differences in the feeding behaviours of seals at different sites (Testa *et al*. 1985). The toothfish is generally associated with depths > 300 m (Eastman 1993). However, encounters with toothfish on 14 dives of instrumented Weddell seals occurred at a mean depth of 132 ± 87 m (Fuiman *et al*. 2002). In 2003–04, toothfish distribution may also have been affected by exceptionally thick (> 3 m), multiyear ice in most of McMurdo Sound.

The frequency of toothfish capture is potentially difficult to determine from scat and even stomach samples because Weddell seals are reported to rarely eat the bony parts of the toothfish, (Ainley 2004). Frequent captures of toothfish by Weddell seals are demonstrated by our observation of a second toothfish capture within an hour after the seal consumed the first fish, and the capture of four toothfish in five hours reported by Calhaem & Christoffel (1969) who estimated that one Weddell seal repeatedly captured 150–200 lb of toothfish



Fig. 1. Weddell seal feeding upon Antarctic toothfish underwater (2004).

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Fig. 2. Weddell seal and two cached Antarctic toothfish in dive hole (2004).

per night over a two week period. However, the vast majority of prey items of Weddell seals instrumented with video cameras were the Antarctic silverfish (Davis *et al*. 1999, Fuiman *et al*. 2002). It may be that toothfish are captured by specialists, namely, older, larger and more experienced seals. Possible differences in foraging ecology between female and male adult Weddell seals, and among different age groups have been suggested by differences in stable isotope signatures (Burns *et al*. 1998, Zhao *et al*. 2004).

We conclude that Antarctic toothfish may be an important component of the Weddell seal diet. Further examination of this hypothesis is warranted given the introduction and expansion of a Ross Sea fishery (CCAMLR 2005) for the slow growing Antarctic toothfish (Eastman 1993, Horn 2002). In CCAMLR Subarea 88.1, which includes the Victoria Land coastal waters of the Ross Sea, more than 99% of the 2004–05 reported catch of *Dissostichus* spp. was the Antarctic toothfish, *D. mawsoni* (CCAMLR 2005). With an annual legal limit of 3250 metric tons in Sub-area 88.1 in 2005 (CCAMLR 2005) and unknown illegal takes, the impact of such fishing extends beyond that of fish stocks alone. In order to determine the effects of the toothfish fishery on the entire Ross Sea ecosystem, trophic models (Ainley 2004, Pinkerton *et al*. 2005) should include toothfish-apex predator interactions. Two top predators that may be affected include the type C killer whale (*Orcinus orca* L.) (Pittman & Ensor 2003), and the Weddell seal. Further investigations of these predators' diets are warranted (i.e. fatty acid signature analyses (Budge *et al*. 2006), and in Weddell seals, remote video monitoring of feeding behaviour).

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