MF Leopold (2015) Eat and be eaten - Porpoise diet studies

Abstract. The principal goal of the research presented in this thesis was to gain a better understanding of the feeding ecology of harbour porpoises *Phocoena phocoena* in Dutch waters. As no two porpoises are likely to be equal, important questions were: which factors are at play in pushing diets of individual porpoises away from the population average? How much is diet governed by the prey on offer (which is largely unknown in sufficient detail) or are for instance ontogenetic developments important in the prey choice of porpoises? What is the seasonal variation in prey taken? Are there differences between individual porpoises, in requirements for specific foods or in their skills to obtain these prey? Are there, in other words, more or less fixed patterns, or "rules" governing the prey choice of individuals, given the prey on offer? The main findings were: first, that gobies (in fact, mostly sand gobies *Pomatoschistus minutus*), gadoids (mostly whiting *Merlangius merlangus*), clupeids (herring *Clupea harengus* and sprat *Sprattus sprattus*) and sandeels (*Ammodytes marinus* and *A. tobianus*, as well as *Hyperoplus lanceolatus*) were the "big four" of porpoise diet. Second, there is a clear ontogenetic development in prey choice. Porpoises start taking solid foods while still accompanied by their mother, and probably while still nursing. The first prey are small: mostly gobies. These bottom-dwelling fishes of only a few cm long were found to be on average one gram in body mass. A young porpoise of 1 meter long would require 2000 gobies daily. This must be a feasible number, given the numbers of otoliths found in some of the examined stomachs. However, a porpoise of 150 cm would require 5000 gobies per day, or 3.5 per minute at continuous feeding, which seems an impossibly high rate. Therefore, larger porpoises must switch to larger, and/or energy-richer prey, to keep the daily intake at the required level. Porpoises thus must learn to catch larger, faster prey and need to master the necessary foraging skills in time to counter their own increase in energy demands. The proportion of gobies in the diet gradually decreases with porpoise size, while the proportion of gadoids increases. The third major finding is that of seasonal variation. In summer, reconstructed prey masses are significantly lower than at other times of year. Also in summer, porpoise blubber thickness is at its lowest, across all length classes, but particularly in younger individuals. Mortality rates are highest in summer, also particularly among young porpoises (as seen in stranding records). Young harbour porpoises may thus have trouble feeding efficiently in summer. The fourth major result is the finding that, once a porpoise loses body mass, it may get into a downward spiral of reduced insulation, higher costs for thermoregulation and possibly poorer diving performance due to a less positive buoyancy. Should this lead to a very poor nutritional condition, the animal may lose the capacity to catch the most profitable, high-energy prey, that it would seem to need to recover from such a condition, and the process may become irreversible, leading to its death. Body condition was found to be related to diet, and so is the location, within the water column, of feeding. The fifth result of the study was that bottom-feeding porpoises have a different diet as compared to mid-water feeding individuals. Animals that probably died by drowning in bottom-set gillnets mostly had been feeding near the sea floor, on demersal

fish species. This finding may help to identify victims of such bycatch on the necropsy table. Along similar lines, stomach contents of porpoises which had died from grey seal attacks, showed that the porpoises had been attacked either at the sea floor, or higher in the water column. The stomach contents matched with the nature of the attack wounds. Grey seal attacks on harbour porpoises were a new phenomenon, discovered in the course of this study. This became evident after we realised that some 200 mutilated carcasses, that had initially been labelled as highly probable cases of fisheries bycatch, were in fact victims of grey seal predation. Definite proof that grey seals were the aggressors behind these mutilations (the sixth main finding of this study) was found in a co-operation between biologists, molecular geneticists and veterinary pathologists. DNA-evidence, pathological evidence and stomach contents proved these seals to be attackers of porpoises, which helped convincing the many sceptics of the hypothesis that grey seals are not just cuddly animals, but fierce predators.