



The effect of prey quality and ice conditions on the nutritional status of Baltic gray seals of different age groups

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Abstract We analyzed a long-term data set of the body condition of Baltic gray seals (*Halichoerus grypus*) over time and investigated how average subcutaneous blubber thickness of different age groups of seals corresponds to environmental factors. Blubber thickness of pups declined until 2010. The decreasing weight of 5–6-year-old herring (*Clupea harengus*), the main prey fish for Baltic gray seals, explained well the decline. In the Gulf of Finland, the blubber thickness of pups declined also in recent years (2011–2015) with declining number of days with permanent ice cover. In other regions, the blubber thickness of pups increased during recent years with increasing weight of herring. The blubber thickness of subadults in Baltic Proper and that of hunted adult females in the Bothnian Bay also increased during recent years, and the weight of age 6+ or 7-year-old herring best explained the increase. The blubber thickness of all age groups of seals was thinnest in the Bothnian Bay where also herring weight was lowest. There was a negative correlation between blubber thickness of seals and herring catch size (an index of herring abundance) suggesting that herring quality, not the quantity, is important for the nutritional status of Baltic gray seals. Nutritional status of gray seals may thus reveal changes in

the marine food web which affect herring quality. Marine food web, in turn, may be affected, e.g., by climate change. The warming climate also has an impact on ice cover and thus body condition of seal pups.

Keywords Baltic food web · Blubber thickness · Climate change · *Halichoerus grypus* · Herring

Introduction

Marine mammals in strongly seasonal environments rely on their subcutaneous blubber layer for thermal insulation during the cold season, but also for energy storage during periods with little and inactive prey. Average thickness of the blubber layer in a population varies between years with environmental conditions and can be used as an index of nutritional status of seals. Blubber layer and weight of pups of the year are closely correlated to their subsequent first year survival (Hall et al. 2001; Harding et al. 2005) but also have delayed effects influencing age at sexual maturity and size at first parturition of female seals (Boyd et al. 1999; Bowen et al. 2015). Blubber thickness may also affect reproductive rate of mature females through implantation of embryos and fetal mortality (e.g., Boyd 1984). Variation of blubber thickness of seals is thus important for the growth rate of seal populations because it affects both mortality and reproductive rates.

Blubber thickness of seals is also adopted as an indicator of the environmental status of the Baltic Sea by international environmental protection authorities such as HELCOM (Harding et al. 2015). Primary environmental factors, which might affect blubber thickness, are the quantity and quality of food resources, e.g., a decline in the nutritional status of seals may indicate a change in the marine food web through the abundance or quality of prey species (Kjellqvist et al. 1995).

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