Reply to Horizons Article 'Some ideas about the role of lipids in the life cycle of *Calanus finmarchicus*' Irigoien (2004): II

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Recently, Irigoien (Irigoien, 2004) suggested a conceptual model of the role of lipids in the life cycle of the marine copepod *Calanus finmarchicus*. As he pointed out, lipids accumulated before overwintering have traditionally been regarded as an energy reserve to supply metabolic needs during diapause. However, *C. finmarchicus* may have practically no metabolic costs during diapause (Jonasdottir, 1999), with large lipid stores remaining at arousal. If this is correct, then models addressing the optimality of the energy allocation in *C. finmarchicus* assumed a specific resting metabolic rate that was too high, in the range of 0.001 (Fiksen, 2000) to 0.008 (Fiksen and Carlotti, 1998) g g^{-1} day^{-1}. Consequently, basic metabolic requirements was the primary reason for 'energy storage' (lipid accumulation) in these models, although predicted fat allocation increased when excess fat could be used for egg production or moulting, gonad formation and related processes. With low metabolic costs, these models predict an extra generation or longer diapause instead of fat storage as optimal life history strategy.

Irigoien did not mention that predation may also explain the early descent to overwintering habitats. In the Norwegian Sea, *C. finmarchicus* are favoured prey of many fishes, and due to longer days and the arrival of planktivorous fish (Norwegian spring spawning herring, blue whiting and mackerel) predation risk increases with time (Kaartvedt, 2000). In addition, storage of fat and proteins is less time consuming than the more complex processes of building somatic tissues, which may be done more safely at depths before next season. By providing eggs with more resources, offspring are also able to develop in advance of the bloom, and further reduce lifetime exposure to fish predators. However, the explicit fitness advantages of early reproduction remain to be quantified, and if there are negligible metabolic costs during overwintering, we do not have a consistent theory for why *C. finmarchicus* act as a 'capital breeder' instead of as an 'income breeder' (Jönsson, 1997).

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