Supplements for: Modelling growth of northern krill (*Meganyctiphanes norvegica*) using an energy-budget approach

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Contents

1 Additional reconstructions

Additional reconstruction for the growth data provided by [2] for the Ligurian Sea in Figure 1. Alternative reconstruction assuming no shrinkage due to the buffering of lipid storage shown in Figure 2.

Additional reconstruction for the growth data provided by [1] for the Clyde Sea in Figure 3. Alternative reconstruction assuming no shrinkage due to the buffering of lipid storage shown in Figure 4.

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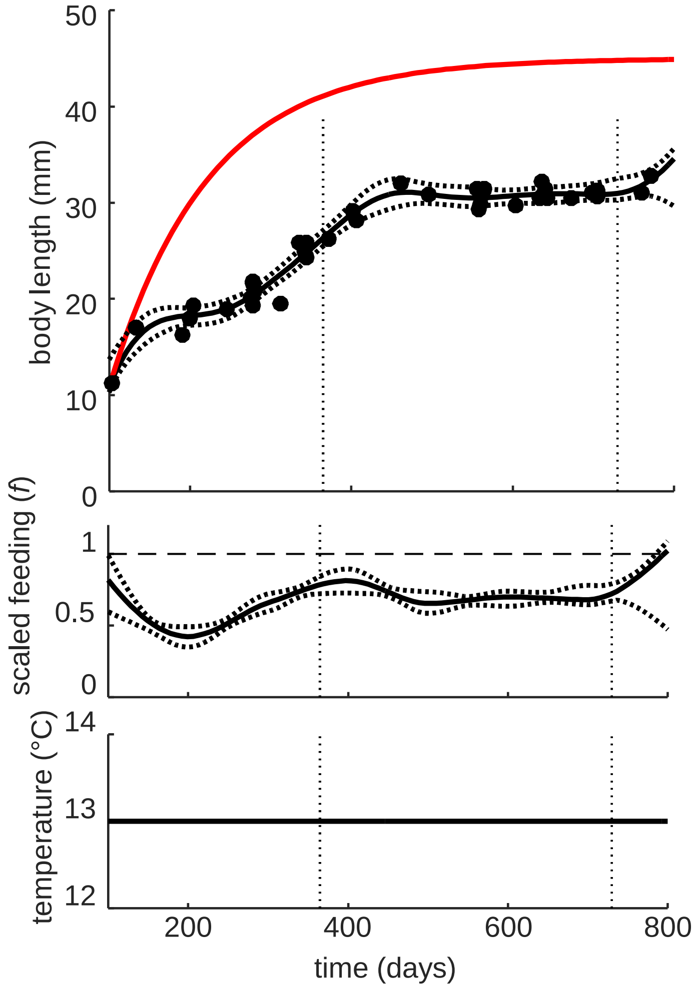

Figure 1: Reconstruction of the feeding history (scaled functional response f, middle plot) in the Ligurian Sea, based on observed size at age (top plot). Red line shows the predicted growth curve for constant *ad libitum* food availability. Bottom plot shows the assumed temperature profile. Apart from f, the only parameter estimated is the initial length ($L_{w0} = 10.9$ mm).

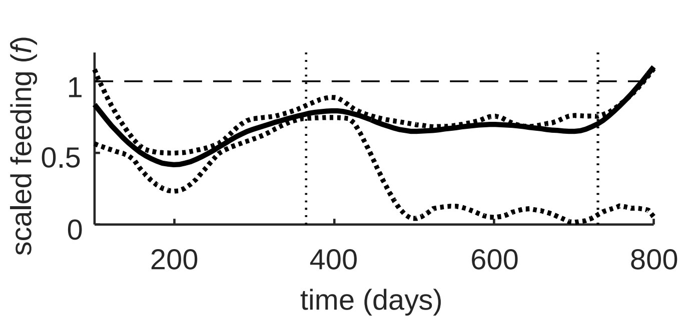

Figure 2: Alternative reconstruction of the feeding history in the Ligurian Sea, based on the assumption that krill do not shrink in winter due to their lipid storage.

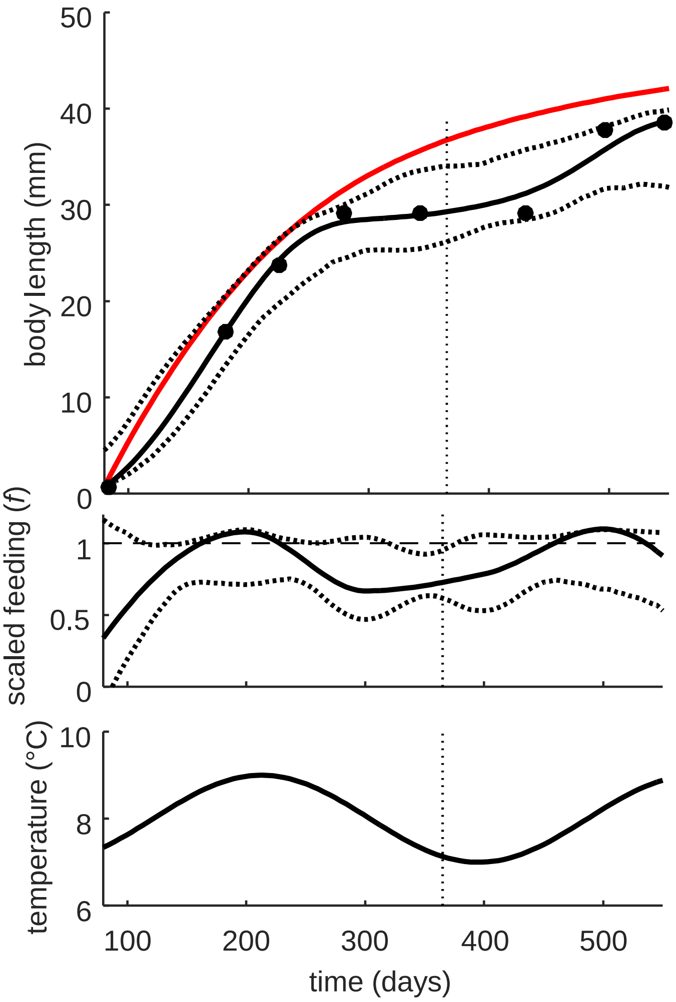

Figure 3: Reconstruction of the feeding history (scaled functional response f, middle plot) in the Clyde Sea, based on observed size at age (top plot). Red line shows the predicted growth curve for constant *ad libitum* food availability. Bottom plot shows the assumed temperature profile. Apart from f, the only parameter estimated is the initial length ($L_{w0} = 0.729$ mm).

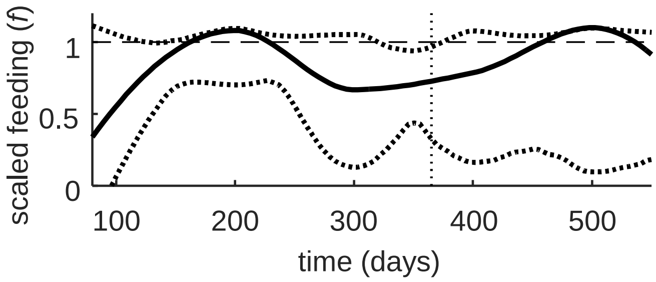

Figure 4: Alternative reconstruction of the feeding history in the Clyde Sea, based on the assumption that krill do not shrink in winter due to their lipid storage.

2 Detailed respiration plots

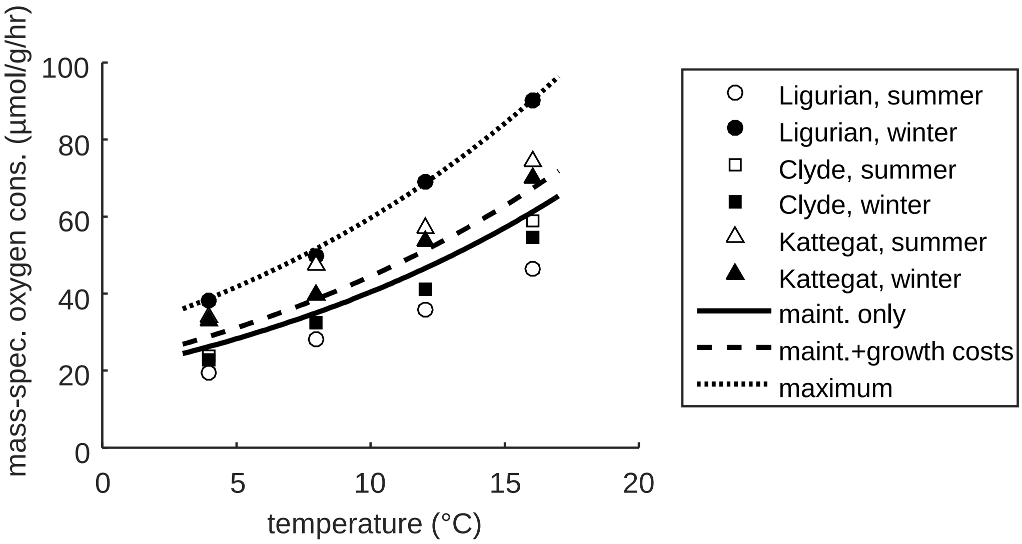

Figure 5: Predicted and measured respiration rates versus temperature. Data from [4], which were corrected by the original authors to a body size of 30 mm.

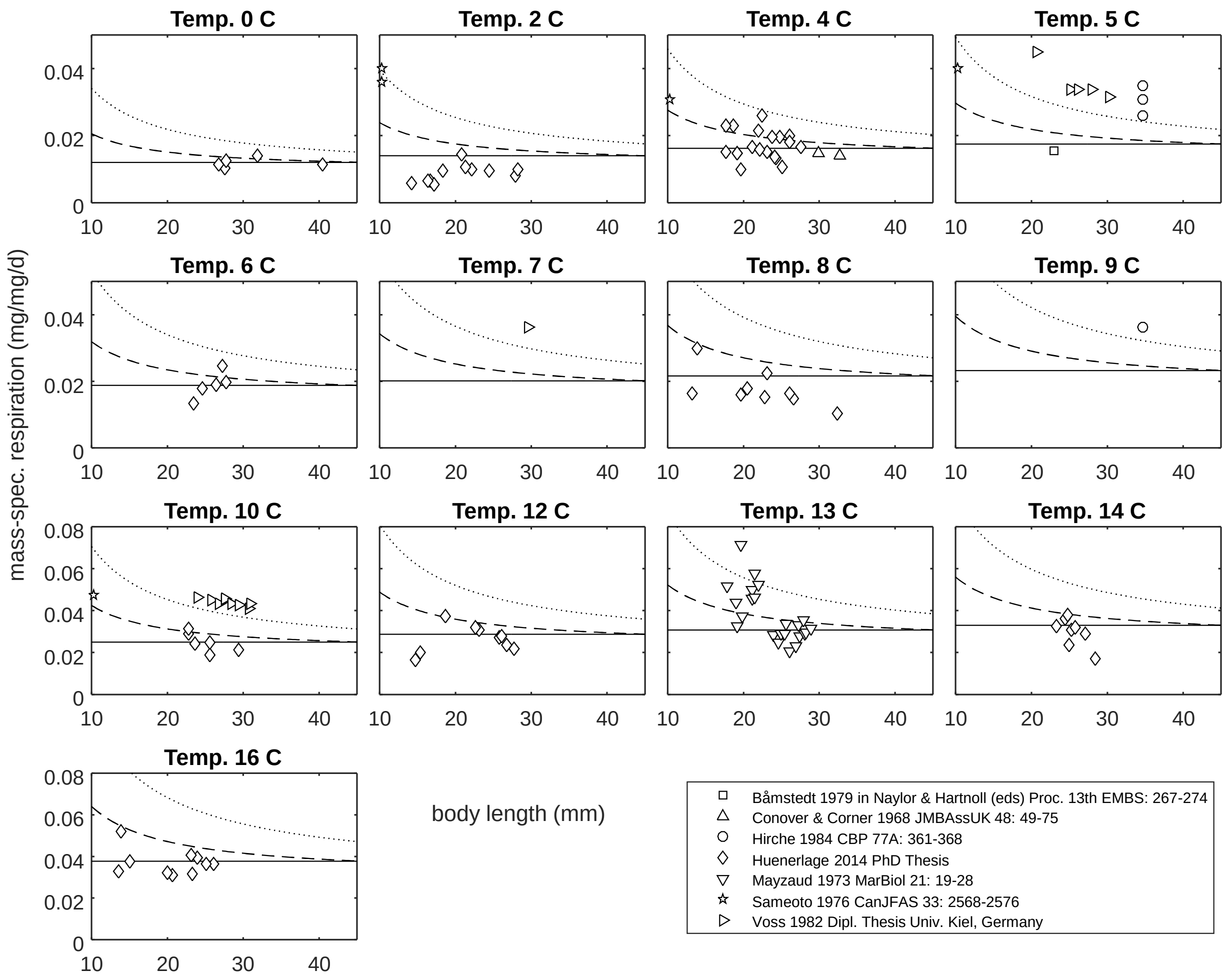

Figure 6: Predicted and measured respiration rates versus body length. Data from [6] shown for different temperatures. Predictions (same line styles as in previous graph) corrected for temperature using the Arrhenius temperature as mentioned in the main text.

3 Storage build-up and use

The parameterised DEBkiss model also makes predictions for the build up of the lipid storage and for its use during seasonal food shortage. However, using this information in conjunction with the reconstructed growth curves, or simulating realistic scenarios, is not so simple. We do not know to what extent krill feed in the poor season (the reconstructed feeding levels show a wide confidence interval, when considering that a storage is present), we do not know how long they take to build up the buffer (i.e., when in the season do they switch from spawning to storing?), and it is likely that krill are able to decrease their maintenance needs during the poor season (as was shown for Antarctic krill, e.g., [3, 5]).

We can, however, reveal some of the energetic constraints on the build-up and use of the storage. Here, we make a quick calculation for how many days an individual of a certain size would need to feed *ad libitum* to be able to pay its maintenance costs for one day under complete starvation. The result is shown in Fig. 7. This result is independent of temperature, as both the storage rate (J_R) and the maintenance rate (J_M) depend on temperature in the same manner. We here assume that the build-up and use of the storage occurs at the same temperature; if the starvation occurs at a lower temperature (in winter), the resulting lines in Fig. 7 would be somwehat lower.

Clearly, maintenance needs are a serious part of the total energy budget. An individual needs to feed 2-3.5 days *ad libitum* to build up sufficient storage to pay maintenance needs for one day. Assuming a reduction in maintenance needs in the poor season (based on [3]) leads to 0.5-1 day build up.

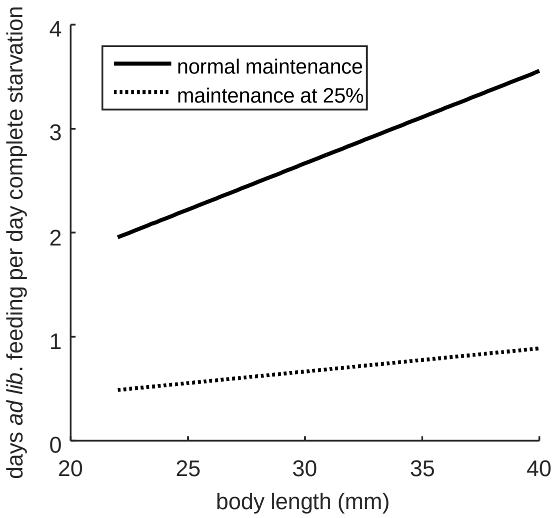

Figure 7: Number of days that an individual krill needs to feed *ad libitum* to be able to pay its maintenance needs for a single day, under the same temperature conditions. Broken line represents a scenario where maintenance costs are reduced to 25% under starvation.

References

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