Towards predictive models of feed intake and growth in Atlantic salmon

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Feed is a major cost in aquaculture, and matching feed supply to actual intake while minimizing waste remains a key challenge. Feeding decisions still rely largely on operator judgement and feeding tables prescribing daily rations. In Atlantic salmon, feed intake and growth are strongly influenced by temperature, dissolved oxygen, and stress, but the mechanisms linking these factors to metabolism and appetite (Fig. 1) remain poorly understood.

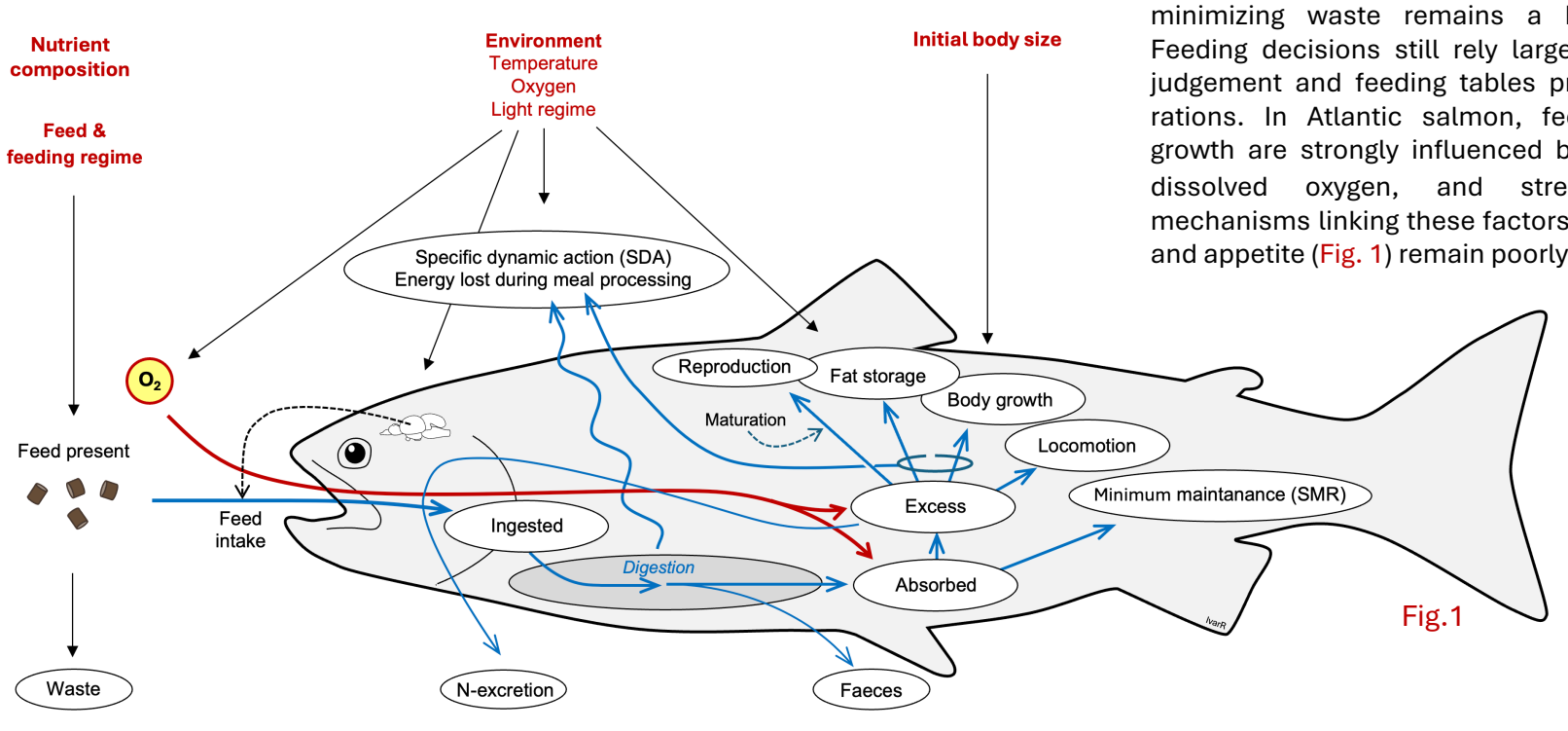


Fig.1

Here, **we propose a conceptual framework for predictive feed-intake modelling** that integrates genetic growth potential with simplified neural, endocrine, and metabolic regulators of body size, nutrient status, energetic demand, and environmental conditions (Fig. 1). Feeding is treated as goal-directed behaviour emerging *from feedback between the environment, physiological state, and motivational pathways*, with parameters reflecting the growth potential.

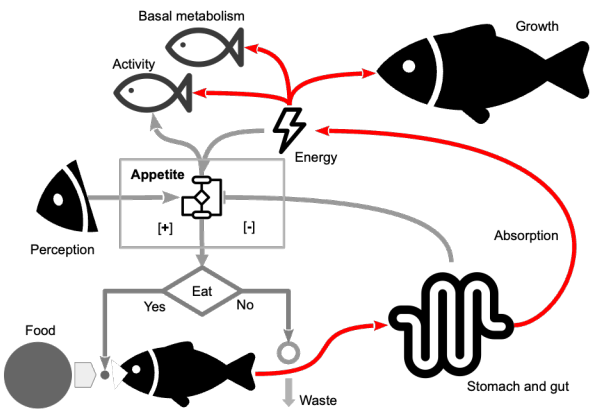


Fig.2

Gray arrows: information/control feedbacks
Red arrows: energy flows

The framework builds on the existing **FishMet digital twin** (Fig. 2), which simulates feed intake through stomach filling, gastric evacuation, gut transit, and dynamic energy budgeting, and has previously been validated at pilot scale (Budaev et al., 2025).

The revised model (Fig. 3) incorporates temperature, oxygen availability, and body weight as key modulators of feed intake and growth. Temperature regulates metabolic rates, whereas hypoxia suppresses feed intake, growth, and lipid retention, while partly preserving protein accretion through selective mobilization of energy reserves.

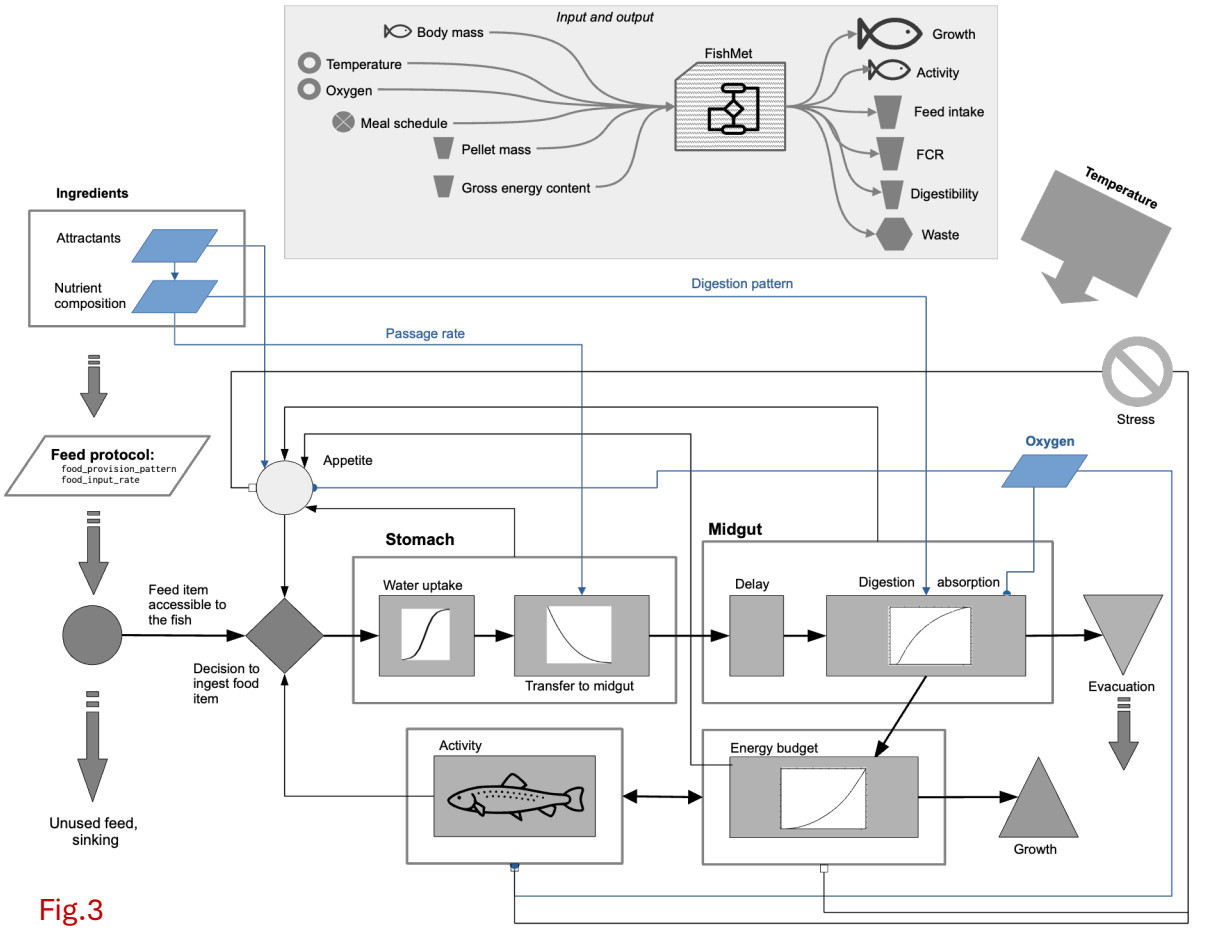


Fig.3

The revised model provides a platform for improving nutrient and energy demand estimates from growth trajectories. Future developments will integrate diet composition, digestibility, and post-absorptive metabolism to support precision feeding and improved resource efficiency in salmon aquaculture.

References: Budaev, S., Cusimano, G.M., Rønnestad, I., 2025. FishMet: A Digital Twin Framework for Appetite, Feeding Decisions and Growth in Salmonid Fish. Aquaculture, Fish and Fisheries 5(2), e70064.