16. Tricks of traits: which gives better prediction on fat percentage of gilthead seabream (Sparus aurata), increased model complexity or better morphological predictors?

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In recent years, the focus of aquaculture has gradually shifted from only productivity to sustainability and animal welfare. Breeding programs are expected to increase their diversity by including more traits. These traits should not only indicate production quality like body and fillet weight, but also reflect metabolism and health of the fish. Fat percentage is an important indicator that fulfil both purposes. However, direct measurement of fat percentage is usually post-slaughter, risking the loss of good selection candidates; Non-invasive measurement using sensor device can cause damage and stress on the objects, raising societal concerns. Previous research uses indirect measurements or predictions as a workaround to assess the fat percentage, like Fulton's condition factor which is a ratio factor like BMI in human; other methods approximate the fat percentage by measuring specific morphological traits like ventral scores, a qualitative scoring system to describe the roundness of the fish. However, more traits, factors and more complex models are still being discovered to improve the prediction on fat percentage. This study investigates what could be the most promising direction for improvement: finding a more complex model or a more specific trait? Three models were included to compare their prediction performance on fat percentage using body weight: linear regression, multilayer perceptron and multi-input neural network. Linear regression offers an interpretable and robust model using the correlation between body weight and fat percentage; Multilayer perceptron represents a simplified collection of all complex prediction models like polynomial or sinusoidal regression that possibly underlie between body weight and fat percentage; Multi-input neural network takes whole-fish image as extra input, including all morphological traits regardless of their biological interpretabilities. Results indicate no difference between simple and complex as linear regression yields similar accuracy as multi-layer perceptron. Increasing model complexity by adding more weight-related measurements or assuming non-linear relationship will not bring any improvement to the prediction. While the image-combined neural network has the highest prediction, accuracy compared to the other two. Follow-up study will investigate the imaginal features that contribute to fat percentage together with their biological significance.

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