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Expected selection responses in breeding plans aiming to limit environmental impacts of trout farming

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With the growing societal concerns about the sustainability of food production systems, there is increasing interest in considering not only economic gains but also environmental impacts in the selective breeding of farmed species. In this study, we compared expected selection responses for alternative breeding programs aiming to limit the environmental impacts of the production of rainbow trout, one of the most important farmed fish species in Europe. The consequences of genetic improvement based on optimal selection indexes derived to minimize various environmental impacts were investigated in a theoretical rainbow trout farm producing constant annual fry production volumes. A cradle-to-farm-gate life-cycle assessment was performed to evaluate the environmental value (ENV) of each trait that has been used in the breeding goals. The tested breeding goals included three different traits: the body weight (BW), the feed conversion ratio (FCR) measured through the feed conversion ratio and the fry survival rate (SR). Due to a lack of knowledge about the genetic links across these traits, we tested several correlation scenarios between the traits. We explored different impact categories as various environmental breeding goals, such as acidification, climate change, cumulative energy demand, eutrophication, land occupation and water dependence. Annual genetic gains ranged from 0.9 to 1.4% for the different impact categories, while the annual genetic gains ranged from 0.4 to 4.6 % for BW, 0.0 to 2.8 % for FCR and -11 to 0.9 % for SR. We demonstrated interest in using ENV in breeding goals to minimize environmental impacts at the farm level, while maintaining high genetic improvements in growth and feed efficiency-related traits. Nevertheless, another selection strategy should be considered to avoid negative consequences on SR when considering possible negative correlations between survival and production traits. Although our results are promising, their interpretations have to be qualified by the consideration of the economic repercussions of such a selection strategy.

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