Reliability of non-lethal assessment methods of body composition and energetic status exemplified by applications to eel (Anguilla anguilla) and carp (Cyprinus carpio)

Non-lethal assessments of proximate body composition of fish can help unravelling the physiological and condition-dependent mechanisms of individual responses to ecological challenges. Common non-lethal methods designed to index nutrient composition in fish include the relative condition factor (Kn), bioelectric impedance-based assessments of body composition (BIA), and microwave-based “fat” meters (FM). Previous studies have revealed mixed findings as to the reliability of each of these. We compared the performance of Kn, BIA and FM at different temperatures to predict energetic status of the whole bodies of live eel (Anguilla anguilla) and carp (Cyprinus carpio) and the dorsal white muscle of carp. Homogenized fish flesh was used for calibration. Relative dry mass was strongly correlated with relative fat content (R² up to 96.7%) and energy density (R² up to 99.1%). Thus, calibrations were only conducted for relative dry mass as an index of energetic status of a fish. FM readings were found to predict relative dry mass of whole body in eel (R² = 0.707) and carp (R² = 0.676), and dorsal white muscle of carp (R² = 0.814) well. By contrast, BIA measurements and Kn were much less suited to identify variation in relative dry mass. BIA-based models were also temperature-dependent. As a result, a regression model calibrated at 10 • C and applied to BIA measurements at 20 • C was found to underestimate energetic status of a fish. By contrast, no effects of temperature on FM calibration results were found. Based on our study, the FM approach is the most suitable method to non-lethally estimate energetic status in both, carp and eel, whereas BIA is of limited use for energetic measurements in the same species, in contrast to other reports in the literature.