C O L O R A D O P A R K S & W I L D L I F E

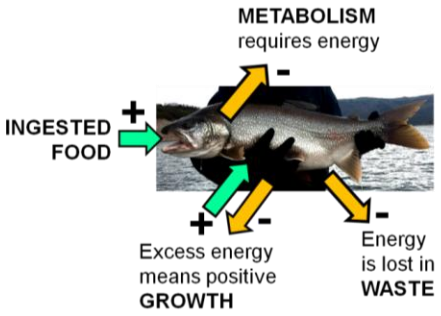
Fish Bioenergetics Research

COUNTING CALORIES FOR SPORT FISH IN COLORADO'S COLDWATER RESERVOIRS

What is fish bioenergetics and why is it useful?

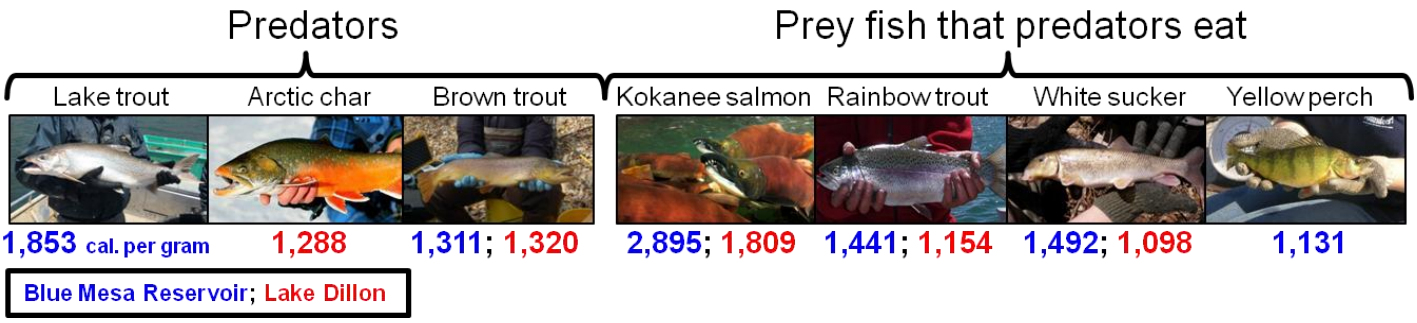
Fish bioenergetics is the study of how factors such as metabolism, water temperature, and quality of prey regulate the ability of fish to convert energy from food into body mass or growth in weight. Much effort has been devoted to developing models that describe the bioenergetic characteristics of different species of sport fish found in Colorado's lakes and reservoirs and elsewhere. These models help biologists address a number of critical fisheries management questions and guide efforts to improve growth within fish populations and ultimately fishery quality. For example, fish bioenergetics is useful for answering:

- *What limits fish growth the most: temperature, prey availability, or the quality of prey?*
- *How much prey do predators eat? Is it too much, or can prey populations handle higher levels of predation?*
- *What is the optimal number of fish to stock based on the available food supply in a lake or reservoir?*



Caloric content of fish: the currency of bioenergetics

Knowing the "energy richness" of fish is important because it is an indicator of fish health, prey quality, and because energy is the common currency used to convert the amount of food eaten by a fish into weight gain or loss in bioenergetics models; this approach is similar to counting calories in the foods we eat and tracking the fate of those calories once ingested. Many factors influence the caloric content of fish, and it is possible for the same species to differ among lakes. In this study, we estimated the caloric content (number of calories in one gram of fish tissue) of key predator and prey fish found in Colorado's coldwater reservoirs to improve the applicability of bioenergetics models to CPW's management of these species. The average caloric content of different species examined is shown in the figure below:



The most striking observation was the high caloric content of kokanee salmon, which was 2-fold or more greater on average than the other species of prey fish available to predators. For example, a lake trout in Blue Mesa Reservoir would need to eat two or three rainbow trout, white suckers, or yellow perch to obtain the same amount of energy gained from eating a single kokanee of equal size. This observation also indicates that kokanee are more efficient consumers of zooplankton, a primary food source for prey fish in our fluctuating coldwater reservoirs. Thus, kokanee help maximize fishery productivity. Overall, this research highlights the irreplaceable role kokanee play as a sport fish for anglers and as energy rich prey fish for predators in Colorado's reservoir food webs. Managing for populations of healthy, abundant kokanee ensures the long-term maintenance of CPW's kokanee stocking program and benefits therein to anglers seeking to catch and eat kokanee or seeking to catch predatory sport fish like lake trout that rely on plentiful kokanee for supporting high feeding and growth.

Associated peer-reviewed publication: Johnson, B.M., W.M. Pate, and A.G. Hansen. *In press*. Energy density and dry matter content in fish: new observations and an evaluation of some empirical models. *Transactions of the American Fisheries Society*.