LABORATORY DERIVED NITROGEN AND ENERGY BUDGETS FOR A JUVENILE GOATFISH, *PARUPENEUS PORPHYREUS*, FED BRINE SHRIMP, *ARTEMIA SALINA*, WITH A DESCRIPTION OF THE PATTERN OF GROWTH IN WILD FISH

A THESIS SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT
OF THE REQUIREMENTS FOR THE DEGREE OF
MASTER OF SCIENCE
IN OCEANOGRAPHY

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ABSTRACT

The nitrogen and energy budget equations for juvenile kumu, Parupeneus porphyreus (Mullidae), were evaluated using brine shrimp, Artemia salina as food. Laboratory growth experiments measured consumption, assimilation and growth at different levels of ration. Starvation metabolism, routine postabsorptive metabolism and the metabolic costs of food processing (specific dynamic action, SDA, of the food) were measured in separate laboratory experiments. Other measurements estimated food consumption, growth, size-related biochemical composition and caloric density and total metabolism for wild and pond-held populations of kumu consuming a more natural diet. The proximate biochemical composition of fish, food and feces was monitored during most of the experiments.

Log-transformed values for total food consumption and weight-specific food consumption in the laboratory were related to wet fish weight. Assimilation efficiencies were between 86 and 98% for all levels of ration. Specific growth rates depended on feeding level. Consumed food nitrogen and energy were linearly related to growth in terms of body nitrogen and energy. Laboratory derived gross conversion efficiencies for nitrogen and energy were 20% or less. Extrapolated results indicated values may increase to between 20 and 40%, if consumption increases. Kumu, a tropical species, appeared to have a higher maintenance nitrogen requirement than temperate species which have been studied. During starvation, kumu derived approximately two-thirds of their maintenance energy requirements by catabolism of protein and one-third by lipid catabolism.

Nonprotein nitrogen (NPN) content of the fish in the laboratory and pond growth experiments varied between 25 and 40% of total fish nitrogen (TN). Conversion of TN to total protein by a standard conversion factor may overestimate the protein value.

Specific growth rates for pond reared fish were two to three times those of similar sized fish reared in the laboratory and fed to satiation twice a day. Estimated daily rates of consumption of nitrogen and energy in the pond were higher than observed consumption rates at maximum ration in the laboratory. Estimated gross conversion efficiencies in terms of nitrogen and energy for pond reared fish were between 30 and 39%.

In the laboratory, routine postabsorptive oxygen consumption and ammonia excretion increased with wet fish weight. The slopes of these equations indicated that metabolism is more nearly proportional to surface area than weight in juvenile kumu. Approximately 20% of ingested calories and 48% of ingested nitrogen at all ration levels were partitioned into the metabolism of food processing (SDA). It was indirectly determined that 80% of excreted nitrogen was in the form of ammonia. Oxygen to nitrogen ratios (O/N) were approximately 8, suggesting that protein was used extensively as a substrate for metabolism by juvenile kumu independent of feeding level or size.

Partitioned nitrogen and energy budgets for laboratory and pond reared juvenile kumu using independent estimates of each term are presented. Comparison of partitioned budgets for laboratory and pond reared fish indicated that, in the laboratory, the principal metabolic

loss of nitrogen was due to SDA, while in terms of energy the principal metabolic loss was due to routine activity. These metabolic sinks assumed proportionally less importance to juvenile fish in the pond environment. Results of all laboratory experiments emphasized the general importance of protein nitrogen to both the anabolic and catabolic processes of juvenile kumu. Results further indicated that both food and body protein may be of greater importance than food or body lipid as a source of energy during normal periods of food availability as well as during periods of food deprivation.

Field samples showed that during the transformation from pelagic pre-juvenile to benthic juvenile, lipid was utilized as the major metabolic substrate. The changes in transforming fish are described as the termination of one growth stanza and the beginning of another. These changes may constitute a critical period in the early life history of the fish, particularly from the point of view of aquaculture.