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***Gill morphology, movements, and in vivo temperature measurements of an endothermic fish, the opah, *Lampris guttatus*.***

The opah, *Lampris guttatus*, is the only fish known to exhibit a whole-body form of endothermy and must therefore meet increased metabolic demands to maintain an elevated internal temperature relative to the environment. Accordingly, opah gill structure is specialized to uptake sufficient oxygen to drive the metabolic reactions within its tissues and to optimize heat retention. In this study, gill surface area of the opah was determined across a range of body sizes for comparison with other fishes and to determine the relationship of gill surface area to body mass. It was found that the opah has much larger gills than those of most other fishes and a high gill surface area to body mass scaling exponent (1.16, with most teleosts being between 0.8-0.9). This high scaling exponent suggests a disproportionate increase in oxygen demand as the fish grows, which may consequently allow for an increased capacity for endothermy with size. In addition to gill measurements, a number of opah were outfitted with customized PSATs (pop-up archival satellite tags) with an intermuscular thermocouple to better understand their daily movements and habitat preference in relation to internal body temperature. Fish were observed to frequently make deep dives into cold, nutrient-rich waters, however, the internal temperature of the fish remained significantly elevated above the decreasing ambient temperature. Together, gill and tagging data provide needed insight into the correlation of gill morphology, metabolism, life-history and habitat preference, yielding a better understanding of opah specialization for endothermy in the mesopelagic zone.