

Estimating field metabolic rates using 3D stereo-video reveals the pace of life of coral reef fishes in the wild

First author: Francesca Conte*, Nina M. D. Schiettekatte* Contributing authors (alphabetic order): Simon J. Brandl, Beverly French, Chris Fulton, Alexandre Merciere, Tommy Norin, Valeriano Parravicini, Sébastien Villéger

Introduction

Anthropogenic stressors such as overfishing and climate change are affecting fish communities at an unprecedented scale. In recent times, the concern is growing that impoverished fish communities may not be able to sustain ecosystem functioning and provide the ecosystem services that are indispensable for human well-being. In order to take the pulse of the functioning of a community, it is essential to quantify key ecosystem processes such as nutrient cycling, herbivory, predation, growth, etc (Brandl et al. 2019). The metabolic rate is an essential component to estimate all of these processes. Therefore, our ability to understand the role of fishes in a changing world hinges on our capacity to quantify the metabolic rate of fishes in their natural environment.

Metabolic rates are generally evaluated through two metrics: i) standard metabolic rate (SMR; Fry, 1957; Winberg, 1956), which corresponds to the metabolic rate of an inactive and fasting individual (Clark et al., 2013), and ii) maximum metabolic rate (MMR), which corresponds to the aerobic metabolic rate of an animal that is exercising maximally (Norin and Clark, 2016). Knowing these two metrics allows for calculations of an animal's aerobic scope, which is the difference between MMR and SMR and represents the capacity to elevate metabolic rate above maintenance to support energetically demanding tasks such as physical activity (Clark et al., 2013). SMR and MMR can be estimated quite accurately in the laboratory through measurements of oxygen uptake rates (Clark et al., 2013), however, animals in the wild rarely reside at SMR or exercise maximally, so without information on the activity rate of individuals, we cannot estimate the metabolic rate of wild animals going about their daily activities.

The field metabolic rate (FMR) represents the average metabolic rate of an individual in the wild (Chung et al., 2019, Nagy et al., 2011) and lies somewhere between SMR and MMR. As