Do Fishpot Catches and Underwater Visual Fish Surveys Tell the Same Story along a Gradient of Fishing Pressure in a Small Caribbean Island?

Cuentan las Capturas de Peces en Nasas y los Censos Visuales Submarinos de Peces la misma Historia a lo Largo de un Gradiente de Presión Pesquera en una Pequeña Isla del Caribe?

Est-ce que les Captures de Poissons dans les Nasses et les Recensements Visuels Sous-marins de Poissons Racontent la Même Histoire le Long d'un Gradient de Pression de Pêche dans une Petite Île des Caraïbes?

HENRI VALLÈS[1] and HAZEL A. OXENFORD[2]

[1]*Department of Biological and Chemical Sciences, The University of the West Indies, Cave Hill Campus, Barbados.* hevals@gmail.com.

[2]*Centre for Resource Management and Environmental Studies, The University of the West Indies, Cave Hill Campus, Barbados.* hazel.oxenford@cavehill.uwi.edu.

EXTENDED ABSTRACT

Management of Caribbean coral reef fisheries would benefit from the use of simple indicators of the state of exploited reef fish communities, as this would facilitate monitoring and improve communication across different stakeholder groups (Ye et al. 2011). Monitoring fishpot catches and conducting underwater visual fish censuses (UVC) are two widely-used methods of obtaining simple fish metrics (Munro 1983, English et al. 1997). However, the data provided by each method will be subject to fundamentally different sampling biases (Acosta et al. 1991, Bozec et al. 2011), raising concerns about the comparability of both methods to inform about the state of fish communities. In this study, we compare spatial trends in three simple fish metrics, i.e. fish biomass, fish density, and average fish body length, obtained using both methods concurrently. We also examine the effect that aggregating data at different levels of organization, i.e. species (for the dominant species), family (for the dominant families), trophic category (herbivores versus carnivores), and community (all species combined), has on the consistency of spatial trends between the two methods.

Between June and August 2011, we surveyed six shallow (5-7 m deep) fringing reef sites along a gradient of fishing pressure on the west coast of Barbados using fishpots and UVC concurrently. Each UVC involved deploying ten (2 x 30 m) belt transects and recording fish species and fish size (fork length (FL) to the nearest 1 cm) for all fish >5 cm FL encountered along each transect. Each fishpot survey involved deploying six standard Antillean fishpots (mesh size: 3.2 cm) for a 3-d soak period and identifying, measuring (FL to the nearest 0.1 cm), and subsequently releasing all fishes caught. At each site, we conducted five consecutive surveys at 3-d intervals using both methods, for a total of 30 surveys (6 sites x 5 surveys). Variability in fishing pressure across the six sites was quantified through detailed one-on-one interviews with the majority of reef fishers (Gill 2014). UVC fish data were first averaged across transects for each survey, and then averaged across the five surveys at each site so as to yield a single mean value for each fish metric at each site. Only fishes of trappable size were included in these data. Similarly, fishpot fish metric data were first averaged across fishpots for each survey, and then averaged across the five surveys at each site. Spearman rank correlations were then used to assess the degree of consistency in fish metric variability along the fishing gradient (i.e. across sites) between methods.

Overall, we found high consistency in species composition between methods with 34 species (15 families) jointly recorded by both methods, representing 96% and 94% of all fish counts by UVCs and fishpots, respectively. The three dominant families, as recorded by both methods, were Scaridae, Acanthuridae and Haemulidae. The seven dominant species, as recorded by both methods, were *Acanthurus coerulus*, *A. bahianus*, *A. chirurgus*, *Haemulon flavolineatum*, *Scarus taeniopterus*, *S. iseri*, and *Sparisoma aurofrenatum.* However, Spearman rank correlation tests generally revealed low consistency across sites between methods, irrespective of whether fish biomass, fish density, or average fish body length were examined at the species level or aggregated at the family, trophic or community levels (for most (80%) correlations: $r_s < 0.80$, $p > 0.050$, n = 6). The only notable exception involved the three parrotfish metrics (fish biomass, fish density, and average fish body length) when data were aggregated at the family level, all of which exhibited very high consistency across sites between methods (all three correlations: $r_s > 0.94$, $p < 0.008$, n = 6). Furthermore, (family-level) average parrotfish body length in particular exhibited a very strong correlation with the fishing pressure gradient, irrespective of method (for both methods: $r_s = -1.00$, $p = 0.001$, n = 6).

On the one hand, and given the very tight spatio-temporal coupling in the implementation of both methods in our study, these findings raise concerns about the validity of comparing trends in simple fish metrics between both methods to assess the effects of fishing (Karnauskas and Babcock 2012), particularly when comparisons involve small changes in fishing pressure. On the other hand, this study further highlights the value of simple size-based family-level parrotfish metrics as an indicators of fishing effects in the Caribbean (Vallès and Oxenford 2014, Vallès et al., in review), by underscoring that the sensitivity of these fish metrics to fishing pressure appears robust to the choice of sampling method.

LITERATURE CITED

Acosta, A.R., R.G. Turingan, R.S. Appeldoorn, and C.W. Recksiek. 1991. Reproducibility of estimates of effective area fished by Antillean fish traps in coral reef environments. *Proceedings of the Gulf and Caribbean Fisheries Institute* **43**:346-354.

Bozec, Y.-M., M. Kulbicki, F. Laloë, G. Mou-Tham, and D. Gascuel. 2011. Factors affecting the detection distances of reef fish: implications for visual counts. *Marine Biology* **158**:969-981.

English, S., C. Wilkinson, and V. Baker. 1997. *Survey Manual for Tropical Marine Resources*. 2nd edition. Australian Institute of Marine Science.

Gill, D. 2014. T*he Economic Value of Reef Fishes to the Fishing and Dive Tourism Industries in the Caribbean*. PhD. The University of the West Indies, Cave Hill.

Karnauskas, M., and E. A. Babcock. 2012. Comparisons between abundance estimates from underwater visual census and catch-per-unit-effort in a patch reef system. *Marine Ecology Progress Series* **468**:217-230.

Munro, J. L. 1983. *Caribbean Coral Reef Fishery Resources*. ICLARM Studies and Reviews 7. International Center for Living Aquatic Resources Management, Manila, Philippines.

Vallès, H., D. Gill, and H. A. Oxenford. In review. Parrotfish size as an indicator of fishing effects in a small Caribbean island. *Coral Reefs* (Submitted on March 10th 2014).

Vallès, H., and H. A. Oxenford. 2014. Parrotfish size: a simple yet useful alternative indicator of fishing effects on Caribbean reefs? P*LoS One* **9**(1): e86291.

Ye, Y. M., K. Cochrane, and Y. S. Qiu. 2011. Using ecological indicators in the context of an ecosystem approach to fisheries for data-limited fisheries. *Fisheries Research* **112**:108-116.