

V. Visconti¹, L. S. Chen², E. D. L. Trip¹, M. Jones¹, A. Sabetian^{1*}

¹ Institute for Applied Ecology, Auckland University of Technology, New Zealand

² National Museum of Marine Science & Technology Keelung, Taiwan

Abstract

Age, size, growth and sex ratio of the Blue-barred parrotfish *Scarus ghobban* were investigated from Taiwan and Solomon Islands. While both populations exhibited similar rapid early growth, the longevity, maximum size and asymptotic length of *S. ghobban* in Taiwan were significantly higher than in the Solomon Islands. Gender analysis showed the oldest and largest size classes from the Solomon Islands to be males, while *S. ghobban* from Taiwan exhibited persistence of females in the oldest age classes, indicating that not all females in this protogynous hermaphrodite changed sex to males. The drivers for sex change in this protogynous hermaphrodite may be more a function of genetics and longevity, and less so due to fishing pressure.

Introduction

Parrotfish are classified as a clade (*Scarinae*) within the *Labridae* family (Westneat & Alfaro, 2005) and known for their functional role as bio-eroders on the coral reef matrix. The importance of parrotfish to commercial and artisanal fisheries has been highlighted (Liao *et al.*, 2004; Aswani & Sabetian, 2010; Thyresson *et al.*, 2011; Ebisawa *et al.*, 2016) and their functional role in coral reef health first recognized at the 11th International Coral Reef Symposium (2008), which advocated for concerted conservation measures.

Here, we extract aged-based demographic and gender information from the Bluebarred parrotfish *Scarus ghobban* (Fig. 1) from two locations, Solomon Islands and Taiwan, in order to apply some comparative demographic perspectives on a species that is commercially important in both countries (Liao *et al.*, 2004; Aswani & Sabetian, 2010). Specifically, our objectives were to compare age and sex structure, and, overall and sex-specific differences in size and growth rates and longevity.

Methods and Materials

Specimens were collected from Solomon Islands and Taiwan. For all specimens, information such as size (standard length [SL] and fork length [FL] in mm), total weight (gm), and colouration phase (initial phase [IP] and terminal phase [TP]) were also recorded. Sagittal otoliths (Fig. 2) were removed and sectioned for age analysis, while population parameters were partitioned by colouration phase, as a proxy for gender. The relationship between age and size was modelled using both the von Bertalanffy growth function (VBGF) and Francis' re-parameterised VBGF (rVBGF) (Francis, 1988).

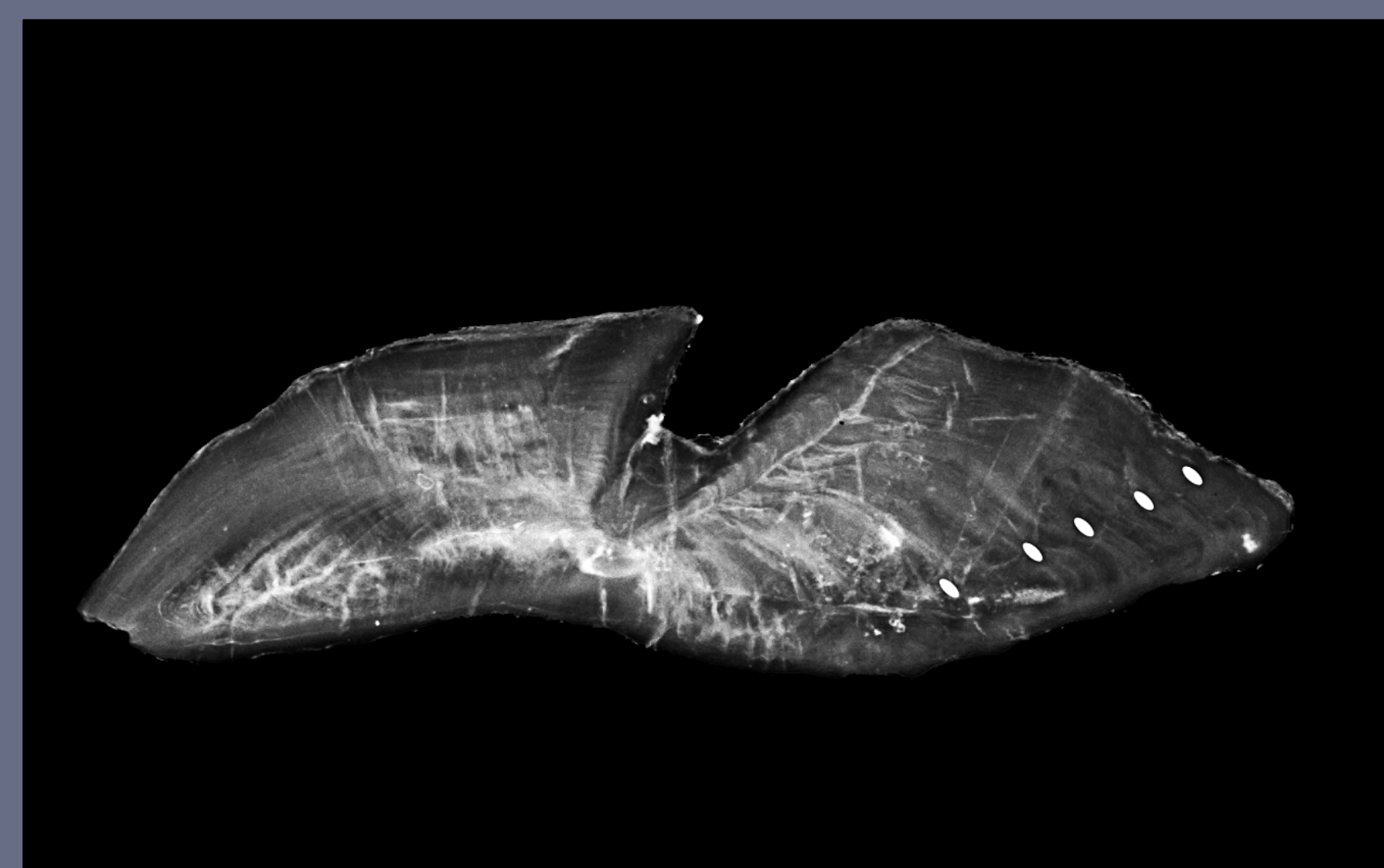


Figure 2. Sectioned otolith of a 5 years old *S. ghobban*.

Results

The modal size-class of *S. ghobban* for Solomon Islands was between 220-239 mm and 340-359 mm for Taiwan, while the modal age of *S. ghobban* was 1 & 3 years for Solomon Islands and Taiwan, respectively. Comparisons of VBGF growth trajectories between Solomon Islands and Taiwan confirm substantial differences in length-at-age of *S. ghobban* (Fig. 3). Although both populations appear to enjoy relatively similar size at equivalent age in the earliest life stages (see Table 1), clearly the difference is more pronounced in the older age classes (Fig. 4). The length and rate at which each population reached asymptote was markedly different, with Taiwan displaying a much larger maximum size (L_{∞} 422 mm) and lower growth coefficient (K 0.68) compared to Solomon Islands (L_{∞} 288 mm; K 1.51).

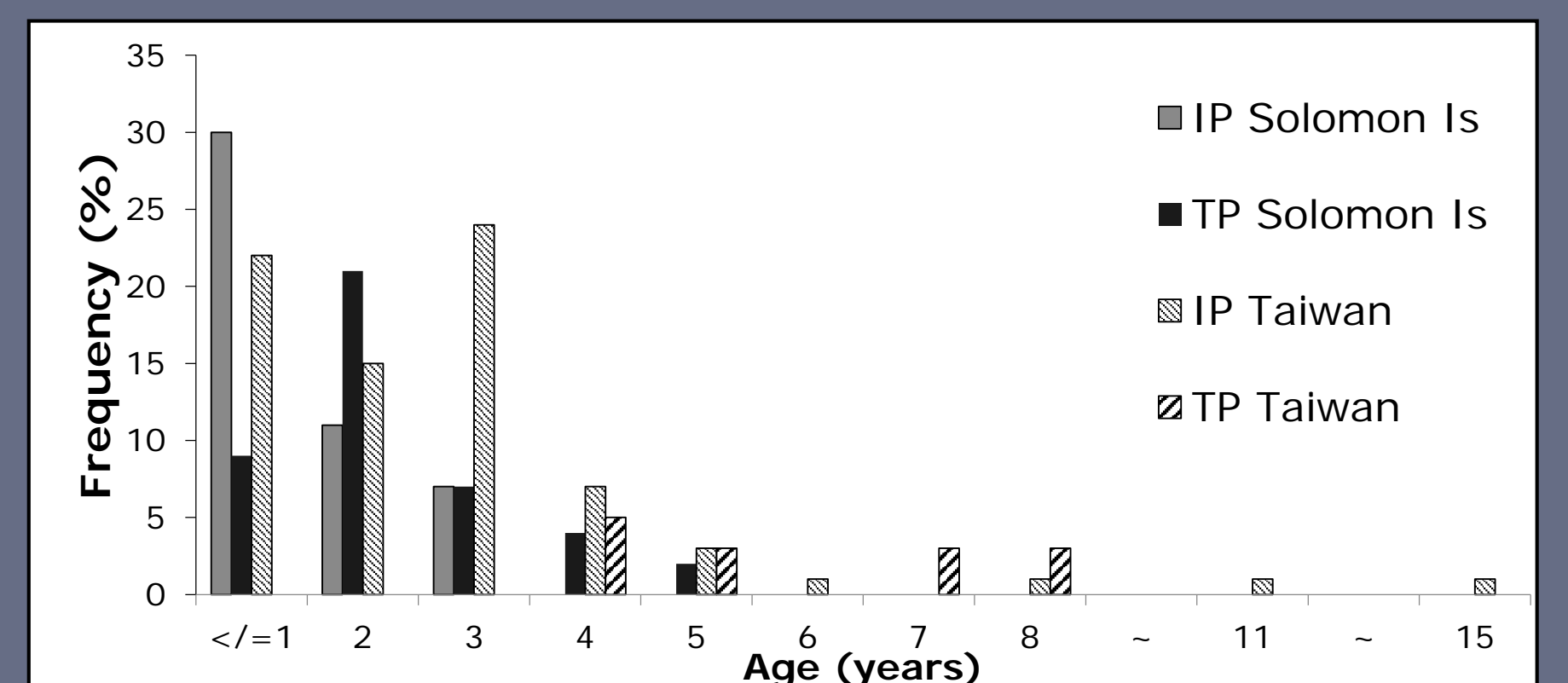


Figure 4. Age distribution of *S. ghobban* from Taiwan and Solomon Islands.



Figure 1. Blue-barred parrotfish *Scarus ghobban*.

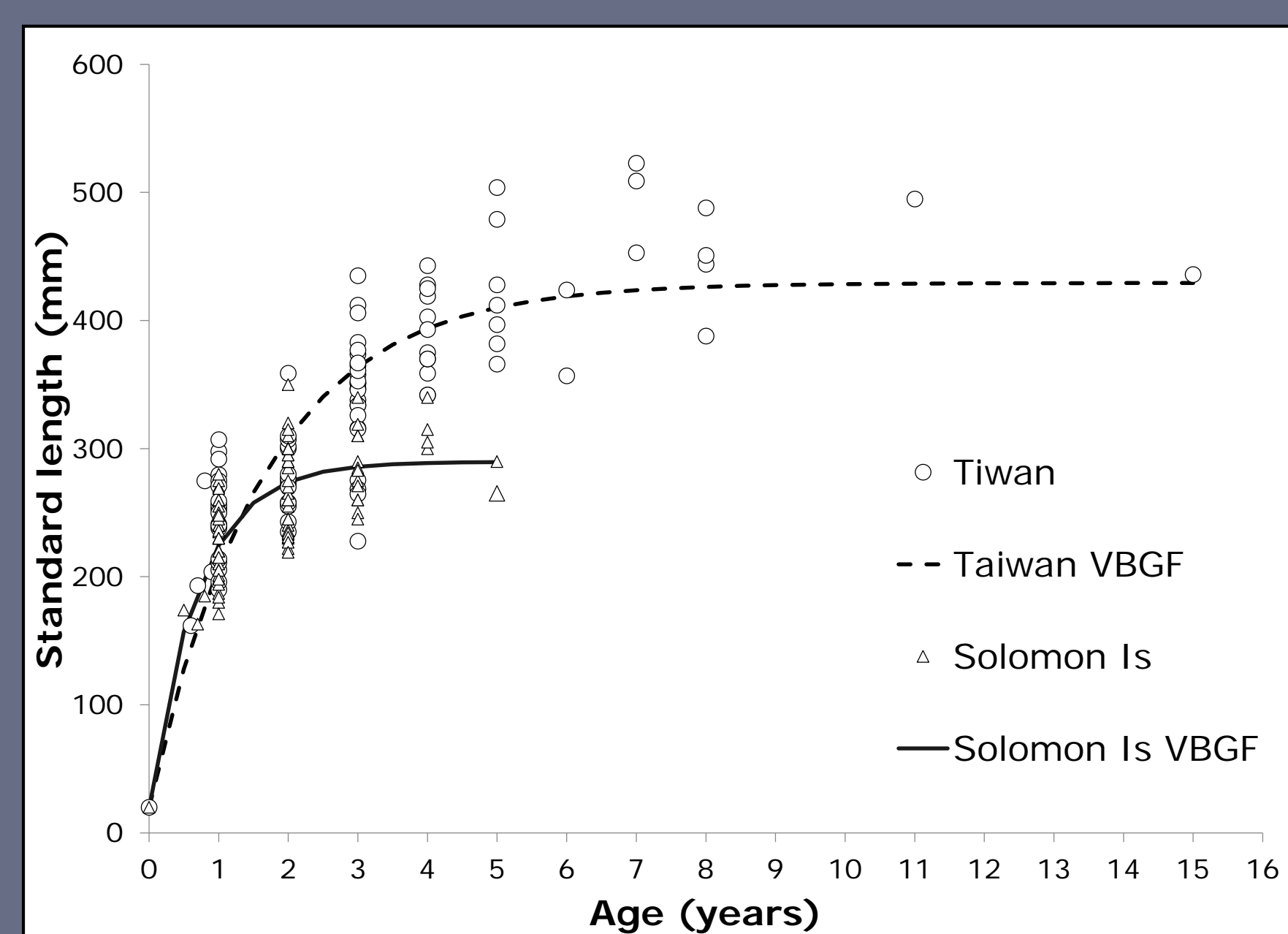


Figure 3. VBGF trajectories of *Scarus ghobban* from Taiwan and Solomon Islands.

Function	Parameters	Solomon Is	Taiwan
VBGF	L_{∞}	288.4 mm	422.04 mm
	K	1.51	0.68
	t_0	0	0
VBGF (TP male)	L_{∞}	278.7mm	397.3 mm
	K	1.94	0.67
	t_0	0	0
VBGF (IP female)	L_{∞}	297.5 mm	425.18mm
	K	1.26	0.69
	t_0	0	0
rVBGF	$L1$	224.48 mm	208.29 mm
	$L3$	285.84 mm	364.85 mm
	$L5$	289.43 mm	410.49 mm
Length-weight relationship	n	91	92
	b	3.15	2.89
	R^2	0.79	0.88
Otolith weight-age relationship	R^2	0.74	0.71
Sex ratio	(IP Female : TP Male)	1.14:1	5.4:1

Table 1. Model variables and parameters for *Scarus ghobban* from Solomon Islands and Taiwan.

Discussion

Scarus ghobban in Taiwan achieved significantly higher maximum age and asymptotic length (15 years, 422 mm) compared with Solomon Islands (5 years, 288mm), and bigger in $L3$ and $L5$ rVBGF parameters. This infers latitudinal difference in growth trajectories for *S. ghobban* between the two locations. Age distribution plotted against gender revealed that the oldest individuals were female in Taiwan and male in Solomon Islands. Given this finding we believe that sex change in *S. ghobban* may be a function of genetics and longevity in life span, rather than fishing pressure.

Conclusions

Although we have elucidated some basic population dynamics parameters for *S. ghobban* in this study, it is imperative that further spatially explicit and comparative investigations are carried out, not only to ascertain reproductive pathways in scarine labrids, but also to determine the magnitude of variation in life history parameters in relation to ocean systems and latitudinal gradient. This task may not be as laborious and time consuming given the fact that we established several major population demographic traits from relatively small sample sizes.

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*Contact

Armagan Sabetian
Auckland University of Technology
Email: armagan.sabetian@aut.ac.nz
http://www.aut.ac.nz/profiles/armagan-sabetian
Phone: +64 9 9219999 ext 8004