INTEGRATING MULTIPLE SOURCES OF DATA TO CONSTRUCT A TIME SERIES OF RECREATIONAL CATCH AND EFFORT FOR THE WEST COAST BIOREGION OF WESTERN AUSTRALIA

EVA KWOK MAN LAI[ID]

There is growing attention on reconstructing recreational catch to quantify the impacts of recreational fishing [1, 6]. In the absence of quantitative catch and effort data, a time series of reconstructed catch and effort is determined from sporadic data sources [2, 5]. The aim of this study was to reconstruct a time series of recreational catches for key species from a boat-based recreational fishery in the West Coast Bioregion of Western Australia from 1993/94 to 2017/18, based on data collected by various survey approaches [3, 7]. Prior to the reconstruction, there was a need to develop a thorough understanding of the survey methods and the data collected to ensure scientific credibility and stakeholder acceptance of reconstruction results. Thus, preparatory aspects of the reconstruction included a statistical comparison of catch and effort estimates from four Access Point surveys between 1996/97 and 2009/10, which highlighted the need to monitor recreational fisheries at appropriate intervals, particularly when the impacts of management changes on fish populations need to be considered [3]. A further aspect was an assessment of biases in survey design and estimation methods by corroborating independent survey methods involving an off-site Phone-Diary and on-site Bus-route Access Point and Remote Camera surveys conducted concurrently over a 12-month period in 2011/12 [4]. It was found that the relatively low cost and availability of a licensing database as a sampling frame favoured the Phone-Diary survey as a long-term monitoring tool for this boat-based recreational fishery. These two studies provided necessary information for developing the reconstruction method and understanding the limitation of the data and difficulties

of the reconstruction. To reconstruct a time series of recreational catches, a method was developed to integrate data gathered from aperiodic Access Point surveys between 1996/97 and 2009/10, and biennial Phone-Diary surveys from 2011/12 to 2017/18. The catch reconstruction models included parameters for participation (number of fishers) based on the Estimated Residential Population and number of Recreational Boat Fishing Licences, effort (number of days fished per fisher per year) and catch (number of fish per fisher per day) based on the probability of a catch and nonzero catch rate. For many of the species considered, reconstructed annual catch was variable and aligned with estimates from the Access Point and Phone-Diary surveys. Catch information from periodic Phone-Diary surveys provided the necessary information for catch reconstructions, which in turn provided an approach to fill in the gaps between surveys. The reconstruction of catch from recreational fishing provided a time series that can be compared against the commercial sector and used in stock assessment modelling.

References

[1] S. J. Cooke, P. Venturelli, W. M. Twardek, R. J. Lennox, J. W. Brownscombe, C. Skov, K. Hyder, C. D. Suski, B. K. Diggles, R. Arlinghaus and A. J. Danylchuk, 'Technological innovations in the recreational fishing sector: implications for fisheries management and policy', *Rev. Fish Biol. Fish.* **31**(2) (2021), 253–288.

[2] K. M. F. Freire, D. Belhabib, J. C. Espedido, L. Hood, K. M. Kleisner, V. W. L. Lam, M. L. Machado, J. T. Mendonça, J. J. Meeuwig, P. S. Moro, F. S. Motta, M.-L. D. Palomares, N. Smith, L. Teh, D. Zeller, K. Zylich and D. Pauly, 'Estimating global catches of marine recreational fisheries', *Front. Mar. Sci.* **7** (2020), 1–18.

[3] E. K. M. Lai, U. Mueller, G. A. Hyndes and K. L. Ryan, 'Comparing estimates of catch and effort for boat-based recreational fishing from aperiodic access-point surveys', *Fish. Res.* **219** (2019), Article no. 105305.

[4] E. K. M. Lai, K. L. Ryan, U. Mueller and G. A. Hyndes, 'Corroborating effort and catch from an integrated survey design for a boat-based recreational fishery in Western Australia', *Fish. Res.* **236** (2021), Article no. 105865.

[5] D. Pauly and D. Zeller, 'Catch reconstructions reveal that global marine fisheries catches are higher than reported and declining', *Nat. Commun.* **7** (2016), 1–9.

[6] Z. Radford, K. Hyder, L. Zarauz, E. Mugerza, K. Ferter, R. Prellezo, H. V. Strehlow, B. Townhill, W. C. Lewin and M. S. Weltersbach, 'The impact of marine recreational fishing on key fish stocks in European waters', *PLoS One* **13**(9) (2018), 1–16.

[7] K. L. Ryan, N. G. Hall, E. K. Lai, C. B. Smallwood, A. Tate, S. M. Taylor and B. S. Wise, 'Statewide survey of boat-based recreational fishing in Western Australia 2017/18', Fisheries Research Report, 297 (Department of Primary Industries and Regional Development, Western Australia, 2019).

EVA KWOK MAN LAI, School of Science,
Edith Cowan University, Joondalup, Western Australia 6027, Australia
e-mail: eva.lai@dpird.wa.gov.au