Estimating Age and Growth of the Mekong Tiger Perch, *Datnioides undecimradiatus* (Roberts and Kottelat, 1994) by Using Hard Structures[1]

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DISCUSSION

The results of this study provide the option of using spines instead of otoliths of *D. undecimradiatus* in determining fish age and estimating growth. The otoliths are generally considered more suitable than the other hard structures to determine fish age, because it is not subject to resorption and reworking which always occur in skeletons or bones (Campana, 1999). Moreover, the otoliths are metabolically inert and do not reflect physiological changes, which may occur throughout the fish lifespan (Phelps *et al*., 2007). However, a great disadvantage of using the otolith is that the samples must be killed, which is not appropriate for fish species listed as endangered or having vulnerable status such as *D. undecimradiatus*. The ctenoid scale of *D. undecimradiatus* was also unsuitable due to the difficulty of locating the core according to our preliminary work. In contrast, the cycloid scale is considered as the best structure for age determination for cyprinid and channid fishes (Kamilov, 1984; Khan and Khan 2009; Jutagate *et al*., 2013). The advantages of using the scale include its easy collection, preparation and being non-destructive to the samples (Khan and Khan 2009). However Beamish and McFarlane (1987) reported that the disadvantages of using scales included cessation in scale growth in older fish and false annuli on the scale due to stress from food limitation or breeding.

The spines from dorsal-, ventral and anal-fins were used for aging *D. undecimradiatus* as alternatives to otoliths in this study. The fin spines are commonly used for estimating age in both freshwater fishes, e.g. sturgeon (Acipenseridae) and catfish (Ictaluridae) and marine fishes, e.g. dogfish (Squalidae), tuna (Scombridae), and billfishes (Istiophoridae and Xiphiidae) (Kopf *et al*., 2010; Paiboonleeskul *et al*., 2013). The relative precisions in these 4 spine types and otoliths were quite close, i.e. about 25%. In fish ageing, the term “precision” is used to explain the “agreement” on age reading among the readers, which reflect the relative difficulty of ageing each individual species (Kimura and Lyons, 1991). This implied that in every four samples, there was one which

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showed a disagreement in age determination among the readers. This is a bit higher when compared to the common range of 10 – 15% in age reading from the hard structures (DeMartini *et al*., 2007).

The results of the modified VBGF indicated that *D. undecimradiatus* from both stocks, i.e. the Mekong and Mun Rivers, took about 3 years to reach the size of about 20 cm TL and their life span was around 4 to 5 years old. Although the annuli-count may vary from each hard part, a non-significant difference from the maximum likelihood test was obtained in this study, indicating that each spine can be used in age and growth studies instead of otoliths, for *D. undecimradiatus*. However, researchers need to be aware of two things when using fin spines for fish ageing. Firstly, the presence of non-age related bands, i.e. false annuli, which always occur in the thinner transverse spine cutting-section (Hoolihan, 2006; Kopf *et al.*, 2010). Secondly, the vascularization of the fin spine core, i.e. bone remodeling, which could lead to significant age underestimation and overestimation of growth (Panfili *et al*., 2001; Kopf *et al*., 2010).

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