Morphological characteristics and migratory histories of silvering stage of Anguilla bicolor bicolor from Segara Anakan, Central Java, Indonesia

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Title： Morphological characteristics and migratory histories of silvering stage of *Anguilla bicolor bicolor* from Segara Anakan, Central Java, Indonesia

（インドネシア中部ジャワのセガラアナカンにおける *Anguilla bicolor bicolor* 銀化個体の形態的特徴と回遊履歴）

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Thesis Summary

To understand the morphological changes and life migratory histories during the silvering stages of *Anguilla bicolor bicolor*, 68 males and 39 females were collected from Segara Anakan in Cilacap, Central Java, Indonesia during December 2015 - September 2016, May 2017 and June 2018. Specimens were categorized into 5 stages based on body and pectoral fin coloration: Y1, Y2, S1, S2 and S3. Total length of silver males ranged from 342 mm to 501 mm, with mean ± SD 414.8 ± 40.38 mm and were notably smaller than silver females which ranged from 674 mm to 937 mm (786.1 ± 68.98 mm). Silver females were present in catches throughout the year, with peak collection during the dry months (May and June). This corresponded to the only period when silver males were caught. Locomotion indices such as, tail, dorsal fin, anal fin, pectoral fin and eye increased with progression in silvering stages, while feeding behaviour indices such as, both upper and lower lip depth, both upper and lower jaw, and snout remained constant. The increase in locomotion indices suggested that *A. bicolor bicolor* from Segara Anakan underwent morphological changes in preparation for spawning migration similar to those of temperate species, but unchanged feeding behavior indices together with all samples caught using baited traps, suggested that these tropical eels remained as feeding individuals even at late stage silver eels.

For life history studies otoliths of 11 males and 16 females were studied. Males displayed five types of migratory patterns. The first type was of freshwater residence throughout their lives (27.3%). The second type was predominantly brackish water residence with occasional intrusion into marine water (27.3%). The third was shifting residence from freshwater to brackish water (18.2%). The fourth was shifting residence from brackish water to freshwater (18.2%) and the fifth was shifting from freshwater to brackish water (short term) and back to freshwater (9.0%). Migratory pattern of females were divided into four types. The first type was predominantly brackish water residence with occasional marine water intrusion (62.5%). The second type was of shifting residence from freshwater to brackish water (12.5%). The third type was of an initial short term fresh water residence which then shifted to brackish water and finally to marine water (18.8%) and the fourth type was of initial brackish water residence which then shifted to a short period in fresh water and a return back to brackish water and finally to marine water (6.2%). Males had a more varied migratory pattern, while females preferred to live in brackish water throughout their growth stage until just before the spawning migration. The average Sr:Ca ratios in the present study indicated that males used both freshwater and brackish water environments, while females preferred brackish and marine

water areas with only a small proportion of the population which utilized freshwater environments (6.3%). Preference of females to reside in brackish and marine water environments maybe due to greater resource availability in these environments compared to freshwater and thus enabling females to maximize growth and minimize the time taken to reach sexual maturity. Thus findings of the present study will enable fisheries agencies to more easily conduct stock assessment, which in turn enable the promulgation of management programs in the South East Asian region.