

I. INTRODUCTION

1.1 Background

Freshwater eels (*Anguilla spp.*) of the Anguillidae family are catadromous fishes that migrate between freshwater and marine environments (Tesch, 2003). Freshwater eels are generally found in temperate, tropical, and sub-tropical areas (Arai, 2016). It has been known that the Indo-Pacific region was the origin of the speciation of the freshwater eels of the genus *Anguilla* (Aoyama and Tsukamoto, 1997; Lin *et al.*, 2001). The ancestors of both temperate and tropical eels originated from the Indo-Pacific region, particularly in the archipelagic area of Indonesia, Malaysia, and the Philippines (Jamandre *et al.*, 2007).

There were about 19 species of *Anguilla* have been identified in the world (Sugeha *et al.*, 2008; Sugeha and Suharti, 2008), while in Indonesian waters, approximately five to seven species of *Anguilla* were found (Wouthuyzen *et al.*, 2009). However, several studies stated that there were nine species/sub-species of *Anguilla* found in Indonesian waters including *Anguilla celebensis*, *Anguilla marmorata*, *Anguilla borneensis*, *Anguilla interioris*, *Anguilla obscura*, *Anguilla bicolor bicolor*, *Anguilla bicolor pacifica*, *Anguilla nebulosa*, and *Anguilla megastoma* (Sugeha and Arai, 2010). There were two species of *Anguilla* found in West Sumatera, specifically in Mentawai waters including *A. marmorata*, *A. bicolor* both *A. bicolor bicolor*, and *A. bicolor pasifica* (Syarifullah *et al.*, 2019).

A. bicolor and *A. marmorata* are of interest for research and development because they have the largest distribution and highest abundance (Fahmi, 2013). However, freshwater eels have shown drastic decreases worldwide for the last three decades. This happened because of the aquaculture of freshwater eels is still dependent on the availability of freshwater eels

in nature (Widyasari, 2013). Nonetheless, future strategies for the production of eel require data on the haplotype diversity for successful broodstock and genetic resources management. In the future, efforts to sustainably use and improve eel stocks may rely on managing fisheries at various life history stages, particularly restocking (Cucherousset *et al.*, 2007). One of future strategies for sustainability of freshwater eels is provide the genetic data particularly the haplotype data of freshwater eels.

Haplotype (*Haploid Genotype*) is the combination of marker alleles on a single chromosome (Zhao *et al.*, 2003). An important aspect of DNA sequences analysis from individual in one or several populations is the inference of ancestry-descendance relationship among haplotypes. Haplotype networks are powerful tools to explore the relationship among individuals characterised with genotypic or sequence data. Haplotypes can be generated from physical maps or re-sequenced loci (sequence haplotypes) or from genetic maps (marker haplotypes) (Nielsen *et al.*, 2004).

Haplotype tree is used to define a series hierarchically nested clades (branches within branches). A haplotype tree is the evolutionary sequence of mutations that defines the current haplotypes through DNA lineages that interconnect the current DNA molecules to the common ancestral DNA molecule (Templeton, 2004) Haplotype networks are used in the analysis of population genetic data to visualise genealogical relationships at the intra-specific level, as well as to make inference about biogeography and history of population (Leigh and Bryant, 2015).

There were 129 different haplotypes of *Anguilla* species that identified from Indonesian waters, while most of them for the first time, showing haplotype and nucleotide diversities of 0.98 and 4.57%, respectively. *A. bicolor* was clearly found to be composed of

two subspecies, *A. b. bicolor* and *A. b. pacifica*. The first subspecies was split into two major clades supported by a high bootstrap value, with each clade characterized by two diagnostic nucleotides (Fahmi *et al.*, 2015). But, the haplotype diversity of freshwater eels especially from West Sumatra is still limited.

Mitochondrial DNA is widely used as molecular markers because it's inherited maternally and can produce data quickly and consistently (Arab *et al.*, 2017). One of mitochondria genes that encoded protein is *cytochrome b*. *Cytochrome b* gene is also known as genes that have high variation among the 13 genes coding for the mitochondrial gene (Sato *et al.*, 2016). Analysis of mitochondrial *cytochrome b* sequences successfully confirm the differentiation between *Anguilla* species (Fahmi *et al.*, 2015).

Previous research about freshwater eels (*Anguilla spp.*) that has been conducted includes the species composition of eels larvae (Anguillidae) in Mentawai Islands by Syaifullah *et al.* (2019), but research of freshwater eels on adult stages not widely explore especially in West Sumatra. This research is conduct in Sungai Bangek (Padang), Sungai Batang Antokan (Lubuk Basung), Sungai Batang Maligi (Pasaman Barat), and Sungai Batang Tarusan (Pesisir Selatan) because these four DAS are potential for freshwater eels to inhabit. This research needs to be conducted to obtain information about the haplotype diversity of freshwater eels (*Anguilla spp.*) in West Sumatra. The information obtained later can be used as a basis information in the study of freshwater eels (*Anguilla spp.*) conservation and aquaculture.

1.2 Problem Formulation

The problem formulation of this research are:

1. How many haplotype of freshwater eels (*Anguilla spp.*) in West Sumatra based on *cytochrome b* gene?
2. How haplotype diversity of freshwater eels (*Anguilla spp.*) in West Sumatra based on *cytochrome b* gene?

1.3 Research Objectives

The purpose of this study are:

1. To determine haplotype of freshwater eels (*Anguilla spp.*) in West Sumatra based on *cytochrome b* gene.
2. To determine haplotype diversity of freshwater eels (*Anguilla spp.*) in West Sumatra based on *cytochrome b* gene.

1.4 Significance of The Research

The significance of this research is to provide basic data for the management of eels (*Anguilla spp.*) especially in the conservation and aquaculture of freshwater eels (*Anguilla spp.*).

