

ABSTRACT

The Asian arowana (*Scleropages formosus*) is an extremely popular and expensive aquarium fish. This species is endangered in the wild and was listed in CITES Appendix I. Genetic variation within and between various two wild and five hatchery strains of arowana were assessed by means of microsatellite analysis. MtDNA sequences were used to infer the phylogenetic relationships of arowana. The twenty one microsatellite loci screened showed different degrees of polymorphisms. Null alleles were detected frequently in the Malaysian red-tail gold arowana. A reduction of microsatellite heterozygosity was observed. Every strain screened in this study faced loss of microsatellite alleles and a different degree of inbreeding. A recent bottleneck was detected in the wild and hatchery strains of green arowana. The microsatellite data yielded high value of F_{ST} between strains except for between the wild and hatchery strains of the Malaysian yellow-tail gold arowana. There were weak correlations between microsatellite markers with morphological traits and with geographical regions. The green arowana is seen as the outgroup while the Malaysian red-tail gold has a closer relationship with the farmed green arowana than with the farmed Malaysian yellow-tail gold and the Indonesian gold arowana. Sequences of *ATPase* subunit 6 and 8 were obtained for ten specimens from five colour strains and all the haplotypes had unique sequences. The sequences of of the *ATPase* gene of the arowana were not as variable when compared with microsatellites. The mtDNA data yielded a gene tree with a topology different from that based on microsatellites. The arowana is made up of a monophyletic group of mtDNA with three different lineages which represent the three different colours red, green and gold. The red arowana is the outgroup but the phylogeny is not fully resolved for the gold strains. The phylogenetic structure derived from mtDNA was correlated with colour trait but was not associated with geographical regions. Using the molecular clock for fish *ATPase* genes, the divergence time of the different colour strains of arowana was dated back to from the late Pliocene to the late Pleistocene eras. Based on the molecular and paleogeographical evidences, it is believed that the arowana dispersed in South East Asia when Sundaland was formed even though their migrational pathway is still yet to be elucidated.

ABSTRAK

Arowana Asia (*Scleropages formosus*) merupakan ikan akuarium yang sangat mahal. Spesies ini terancam di persekitaran semula jadi dan disenaraikan dalam Apendiks I CITES. Analisis mikrosatelit digunakan untuk menilaikan variasi genetic daalm dan antara dua strain liar dan lima strain ternakan arowana. Urutan nukleotid mtDNA digunakan untuk menentukan hubungan filogenetik arowana. Alel null kerap dikesan dalam arowana emas Malaysia yang berekor merah. Pengurangan keheterozigotan dikesan. Semua strain arowana menghadapi pengurangan alel mikrosatelit dan tahap pembiakbakaan dalam yang berbeza. "Bottleneck" yang terjadi baru-baru ini dikesan dalam strain arowana hijau dari kawasan semula jadi dan lading. Data mikrosatelit menghasilkan nilai F_{ST} yang tinggi di antara setiap strain kecuali antara strain emas Malaysia yang berekor kuning. Korelasi antara penanda mikrosatelit dengan ciri-ciri morfologi dan kawasan geografi adalah lemah. Arowana hijau merupakan kumpulan terasing. Araoana emas Malaysia yang berekor merah pula berhubung rapat dengan arowana emas Malaysia yang berekor kuning dan arowana emas Indonesia. Sepuluh spesimen yang terdiri daripada lima strain dipilih untuk memperolehi urutan nukleotid subunit 6 dan 8 *ATPase*. Semua haplotip mempunyai urutan yang unik. Variasi gen *ATPase* adalah lebih rendah berbanding dengan mikrosatelit. Data mtDNA menghasilkan dendrogram yang berbeza dengan mikrosatelit. Spesies ini merupakan kumpulan monofiletik dengan tiga asal usul yang mewakili tiga warna, iaitu merah, hijau dan emas. Arowana merah merupakan kumpulan terasing tetapi hubungan antara strain emas tidak dapat ditentukan. Struktur filogenetik yang diperolehi daripada mtDNA berkorelasi dengan ciri-ciri warna tetapi tidak berkaitan dengan kawasan geograafi. Pencapahan antara strain arowan yang berlainan dijangka berlaku dari lewat Pliocene hingga lewat Pleistocene. Berdasarkan bukti molekul dan palcogeografi, arowana dipercayai tersebar di Asia Tenggara apabila Sudaland terbentuk.