

**Phylogeny and Systematics of Indo-Pacific mullets  
(Teleostei: Mugilidae) with special reference to the  
mulletts of Australia**

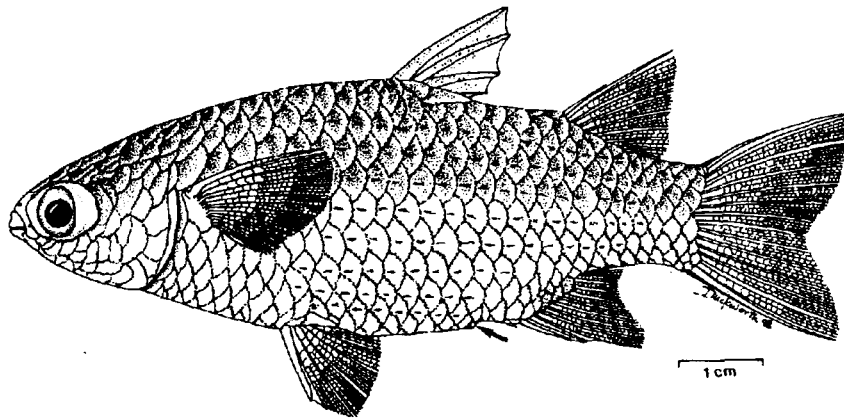
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## DECLARATION

This work is in accordance with the regulations of Macquarie University for the Degree of Doctor of Philosophy. All work is that of the author unless otherwise indicated. The material presented has not been submitted, either in whole or in part, for a degree at this or any other University.

Javad Ghasemzadeh

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## SUMMARY

Systematic, phylogeny and geographical distribution of Mugilidae in Indo-Pacific and Australian waters was reviewed, using morphological and osteological data. The original description, and synonymies, of all genera and species were compiled, and the extant type specimens in the Australian Museum, Queensland Museum, Western Australian Museum, British Museum of Natural History, Paris Museum of Natural History, Amsterdam, and Leiden Museums of Natural History were examined. Specimens of 11 species were collected from 50 coastal sites of Australia between Cairns (Queensland), to Port Elliston (South Australia), and Tasmania. Species that could not be collected were borrowed from the above mentioned museums. Thirty nine genera of mullets have been described worldwide of which 18 genera were recognised as valid in this study and a new genus '*Paramugil*' is described. Mulletts are most speciose in Indo-Pacific and this research suggests that 27 species (excluding *Mugil broussonetii* Valenciennes, 1836), belonging to 14 genera are found in this region.

The osteology and musculature of *Mugil cephalus*, as representative of Mugilidae is described. Distinguishing osteological characters within the group are defined. Osteology is a useful discriminant between genera and, in combination with morphometrics and meristics, establishes useful criteria for the identification of these fishes.

Phylogenetic analysis of data was performed using PAUP (Phylogenetic Analysis Using Parsimony) computer software. Keys for identification of genera and species of Indo-Pacific mullets are developed and description of different genera and species are given following the hierarchy of relationships among them on the cladogram. The genera of *Cestraeus* and *Aldrichetta* represent the plesiomorphic (primitive) subfamily of Agonostominae in Indo-Pacific. Mugilinae containing the other Indo-Pacific mullets is apomorphic (advanced). The cladogram of phylogenetic analysis suggests that *Myxus elongatus* and *Trachystoma petardi* are the most plesiomorphic members of the subfamily

Mugilinae and sister group to other Indo-Pacific species. Osteology and morphology of alimentary canal of *Gracilimugil argenteus* also supports the superficial differences of this genus from *Liza*, and the cladogram separates it as a distinct lineage following *Trachystoma*, and more primitive compared to the rest of Indo-Pacific mullets. Osteology also strongly suggests that *Gracilimugil ramsayii* is a junior synonym of *Gracilimugil argenteus*. The cladogram also separates *Ellochelon vaigiensis* as a distinct lineage which is plesiomorphic to *Liza* and the rest of derived Indo-Pacific mullets. *Valamugil georgii* and *Liza parmata* display some morphological features different from diagnostic characters for *Mugil*, *Valamugil* and *Liza*. The autapomorphic character states of distinct morphology of maxilla, articular, palatine and lachrymal plus ctenoid scales without membranous hind margin, and lack of pectoral axillary scale grouped them as a distinct lineage in the cladogram and sister-group to *Liza*. 'Paramugil' a new genus is erected for '*Mugil*' *parmatus* and '*Mugil*' *georgii*. The genera *Crenimugil* and *Valamugil* are sister-groups, and except morphology of mouth do not reveal any significant differences.

Twenty species of mullets belonging to twelve genera are found in Australian waters. Species *Trachystoma petardi*, *Myxus elongatus*, *Gracilimugil argenteus*, and *Paramugil georgii*, are restricted only to Australian waters. *Trachystoma petardi* is confined to freshwater rivers of north New South Wales to south Queensland. *Myxus elongatus* inhabits in temperate waters of Australia, Lord Howe Island and Norfolk Island. *Gracilimugil argenteus* is limited to southern coasts of Australia from Cardwell in Queensland to Geraldton in Western Australia and *Paramugil georgii* is confined to temperate and tropical coastal waters of Australia. *Aldrichetta forsteri* is restricted to temperate waters of Australia and New Zealand. The most diversity in Australian mullets is observed in tropical waters of north Queensland, Northern Territory and north Western Australia. *Liza macrolepis* occurs in the waters of north and north-east Australia. There is no record of *Neomyxus leuciscus*, *Cestraeus* spp., *Liza affinis*, *Valamugil speigleri* and *Valamugil perusii* in Australian Waters.

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