

Genetic Divergence and Phylogeographic Structuring in *Lethrinus* (Osteichthyes: Lethrinidae): Evidence of Species Complexes and Regional Lineages

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INTRODUCTION

The emperors (*Lethrinus*, Lethrinidae) are ecologically and commercially important reef fishes distributed across the Indo-Pacific. Morphological similarity and synonymy have led to taxonomic confusion. DNA barcoding using COI enables assessment of genetic divergence and cryptic structuring across oceanic basins.

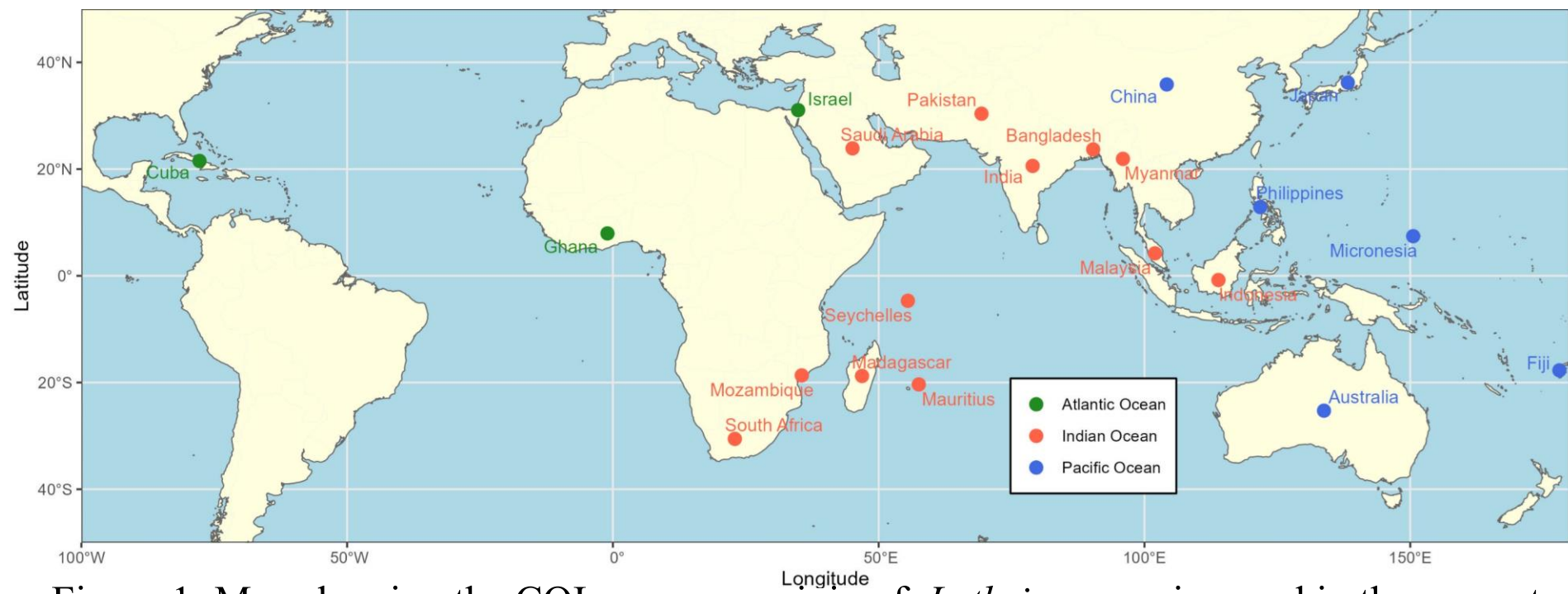
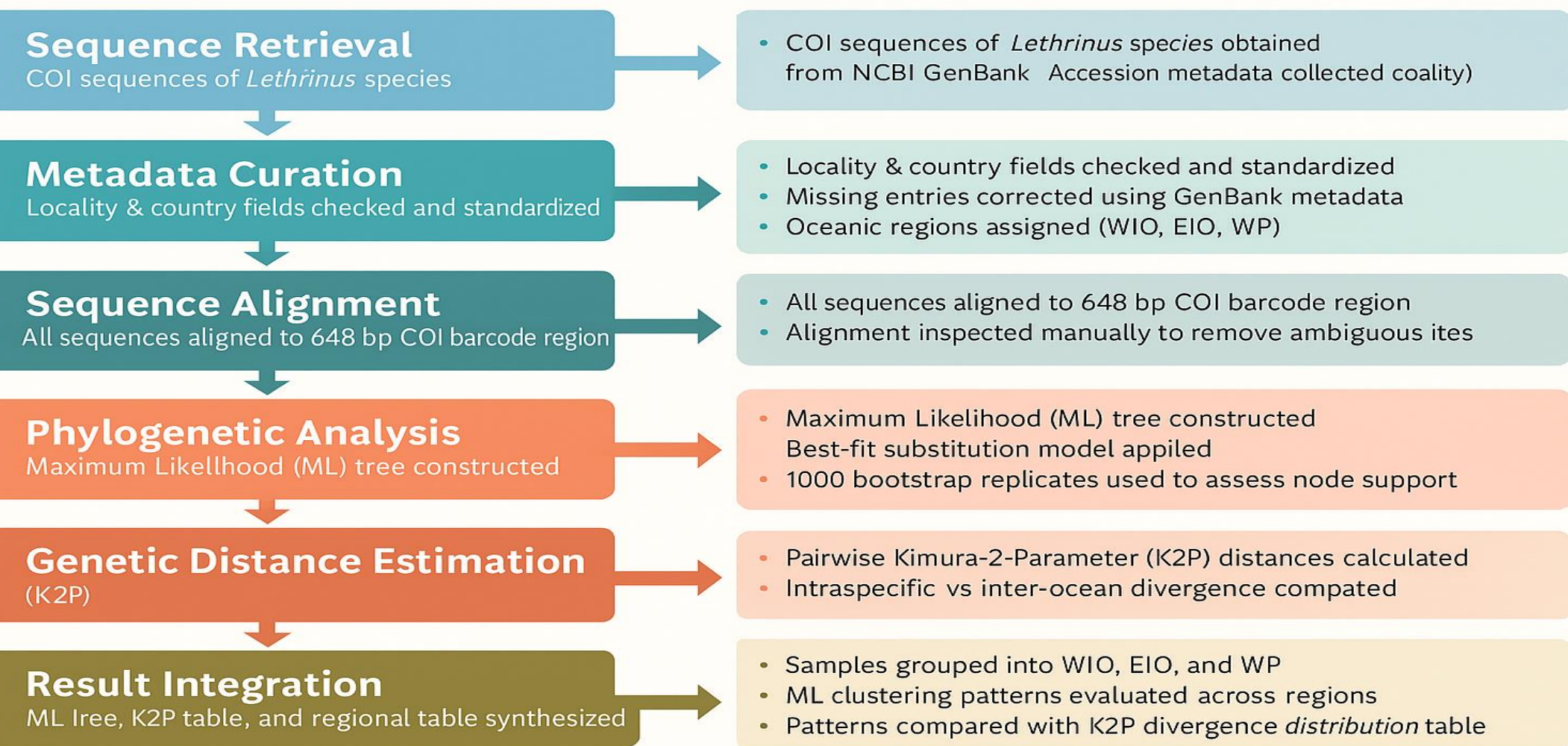


Figure 1: Map showing the COI sequence origin of *Lethrinus* species used in the present study

Key Objective: Assess COI-based genetic divergence, phylogenetic structure, and evidence of species complexes and regional lineages in *Lethrinus*.

METHODS



PHYLOGENETIC RESULTS

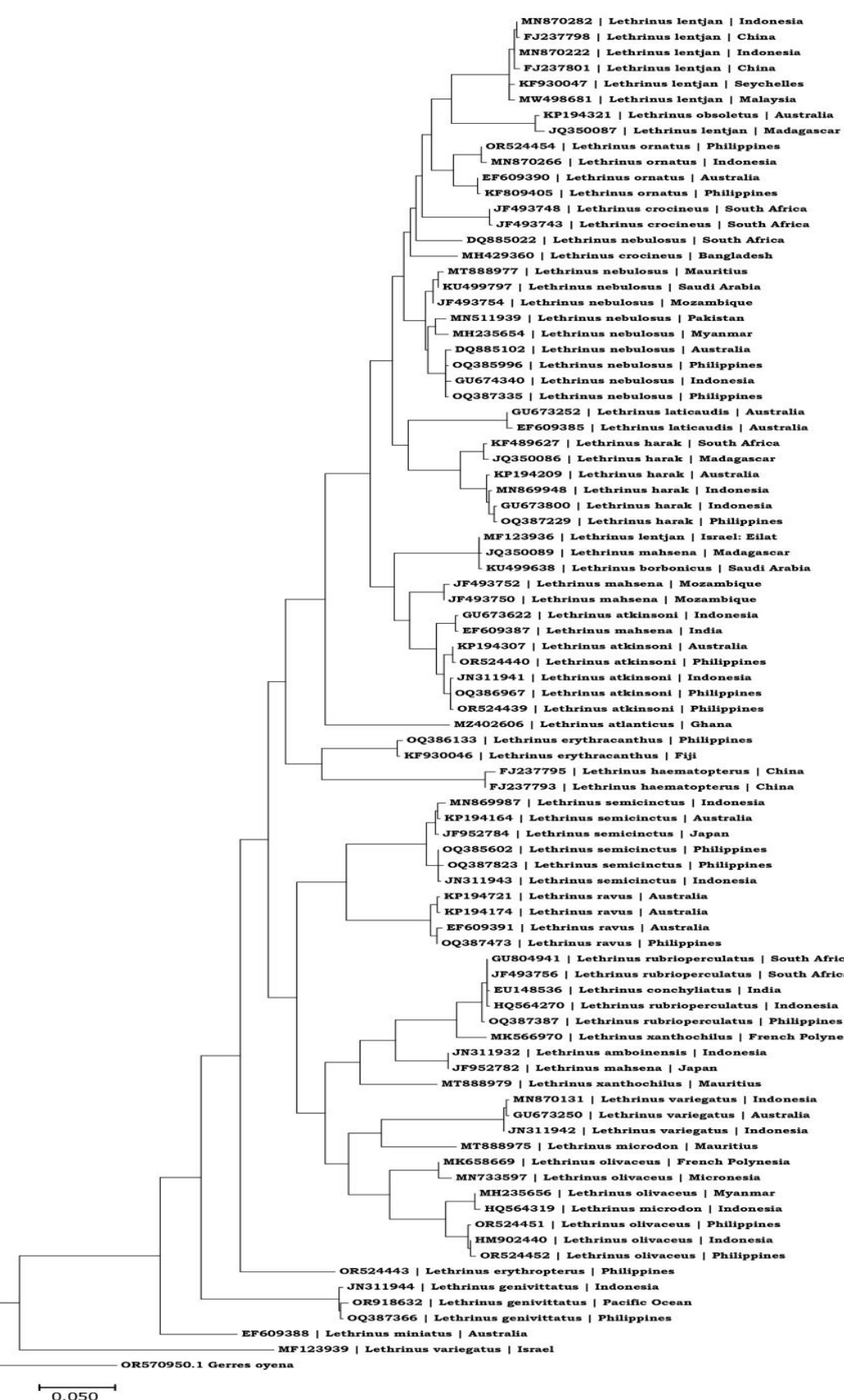


Figure 2: Maximum Likelihood Tree of *Lethrinus* COI sequences used in this present study

- Strong Indian–Pacific divergence** in *L. harak*, *L. nebulosus*, and *L. rubrioperculatus*, with WIO and WP samples forming distinct, well-supported lineages.
- Widespread species** (*L. lentjan*, *L. ornatus*, *L. obsoletus*) show **intermixed Indo-Pacific clustering** with shallow COI divergence.
- Pacific-centered structuring** is present in the *microdon*–*variegatus* group, though separation remains shallow.
- Shallow WIO-restricted lineages** (*L. mahsena*, *L. crocineus*) cluster exclusively within Indian Ocean branches.
- Overall tree pattern reflects both **regional isolation** and **broad Indo-Pacific connectivity** among different *Lethrinus* species.

GENETIC DIVERGENCE

Species	Intra-K2P	Between-Ocean	Notes
<i>L. lentjan</i>	0.003	0.004	Cohesive Indo-Pacific lineage
<i>L. ornatus</i>	0.004	0.005	Genetically stable
<i>L. obsoletus</i>	0.006	0.008	Closely allied to ornatus
<i>L. harak</i>	0.009	0.02	WIO vs. Pacific divergence
<i>L. nebulosus</i>	0.011	0.024	Strong regional split
<i>L. rubrioperculatus</i>	0.01	0.022	Bi-oceanic divergence
<i>L. olivaceus</i>	0.007	0.008	Monophyletic lineage
<i>L. genivittatus</i>	0.004	—	Distinct taxon

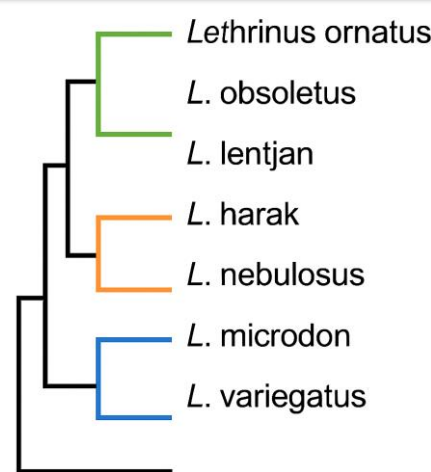
Table 1: Pairwise K2P distances reveal cohesive Indo-Pacific lineages in *L. lentjan*, *L. ornatus*, and *L. obsoletus* (intra-K2P <0.006), strong WIO–Pacific divergence in *L. harak* and *L. nebulosus* (0.020–0.024), deep bi-oceanic separation in *L. rubrioperculatus* (0.022), and clear genetic distinctness in *L. genivittatus* and *L. olivaceus*.

PHYLOGEOGRAPHIC STRUCTURING

Species	Western Indian Ocean (WIO)	Eastern Indian Ocean (EIO)	Western Pacific (WP)	Structuring Pattern
<i>L. harak</i>	Present	—	Present	Strong WIO–WP split
<i>L. nebulosus</i>	Present	—	Present	Strong WIO–WP split
<i>L. rubrioperculatus</i>	Present	—	Present	Reciprocal monophyly (WIO vs WP)
<i>L. lentjan</i>	Present	Present	Present	Pan–Indo-Pacific continuity
<i>L. ornatus</i>	Present	Present	Present	Pan–Indo-Pacific continuity
<i>L. obsoletus</i>	Present	Present	Present	Pan–Indo-Pacific continuity
<i>L. semicinctus</i>	—	Present	Present	Indo-Pacific continuum
<i>L. crocineus</i>	Present	—	—	WIO-restricted lineage
<i>L. mahsena</i>	Present	—	—	WIO-restricted lineage
<i>L. microdon</i>	—	Present	Present	Pacific-centered divergence
<i>L. variegatus</i>	—	Present	Present	Pacific-centered divergence

Table 2: Summary of basin-level phylogeographic structuring in *Lethrinus* species across the Indo-Pacific, showing which taxa maintain Indo-Pacific connectivity versus those forming distinct Indian or Pacific lineages.

SPECIES COMPLEXES



- L. ornatus*–*L. obsoletus*–*L. lentjan*–*L. harak*** → low divergence (<1%)
- L. harak*–*L. nebulosus*** → biogeographic split (0.02–0.024)
- L. microdon*–*L. variegatus*** → shallow separation (0.012–0.018)

CONCLUSIONS

- COI barcoding reveals both deep species separations and regionally restricted lineages in *Lethrinus*.
- Inclusion of *L. obsoletus* validates the *ornatus*–*obsoletus*–*lentjan*–*harak* complex proposed previously.
- Refined datasets corrected earlier polyphyly in *L. olivaceus* and confirmed WIO–Pacific divergence in *L. harak*, *L. nebulosus*, and *L. rubrioperculatus*.
- Findings support historical biogeographic partitioning and potential cryptic diversity within Indo-Pacific emperors.

REFERENCES

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- Ward, R.D., Zemlak, T.S., Innes, B.H., Last, P.R. & Hebert, P.D.N., 2005. DNA barcoding Australia's fish species. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 360(1462), pp.1847–1857. <https://doi.org/10.1098/rstb.2005.1716> [PMC](https://pubmed.ncbi.nlm.nih.gov/161716/)