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Lethrinid fishes (Lethrinidae) of Wallacea region

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Abstract. The emperor fishes (Lethrinidae) are a family of tropical reef fishes that comprise an important component of commercial in water of Wallacea. This study was conducted to provide an update on the species of *Lethrinus* fish in Wallacea waters and describe the emperor fishes of the lethrinid subfamily Lethrininae from the Wallacea and the result will be used as basis for further study especially on biodiversity monitoring for the area. Specimens were collected in South Sulawesi, North Sulawesi, Southeast Sulawesi, Indonesia at August 2018 to July 2019. Results showed that there were sixteen species representing 29 species which are widely distributed in Indo-Pacific areas all over the world inhabiting the area were examined and identified: *L. amboinensis*, *L. atkinsoni*, *L. conchylatus*, *L. erythracanthus*, *L. erythropterus*, *L. genivittatus*, *L. harak*, *L. lentjan*, *L. microdon*, *L. nebulosus*, *L. obsoletus*, *L. olivaceus*, *L. ornatus*, *L. rubrioperculatus*, *L. semicintus*, and *L. xanthocyllus*.

1. Introduction

Carpenter & Allen [1] have published the family Lethrinidae currently comprising 39 species in five genera into two subfamilies: Lethrininae (a single genus, *Lethrinus*) and Monotaxinae (*Gnathodentex* genera, *Gymnocranius*, *Monotaxis* and *Wattsia*). The emperor fishes consist of 29 species and about 86% of all species found in Wallacea waters [2–4].

Lo Galbo et al. [5] have published the research on studies on the lethrinid fish evolution using Cytochrome b gene sequence variations for 20 species of *Lethrinus*. They indicated the existence of three trophic categories in the genus *Lethrinus* in relation to body form and dentition type. These categories are low-bodied, high speed, stalking predators with conical teeth, the second category is high-bodied, slow speed carnivores with molariform teeth capable of crushing hard-shelled benthic prey, and high-bodied but with conical teeth feeding mostly on small or soft-shelled benthic prey [6].

Systematic research on *Lethrinus* fish has provided information on the latest reports on *Lethrinus* fish species. Carpenter & Randall [2] discovered *L. ravus* as a new type of the genus *Lethrinus*. In addition, Burhanuddin & Iwatsuki [3] published a book about Snapper and Emperor of Spermonde Archipelago, Indonesia and they found 10 species of the genus *Lethrinus*. Kimura & Matsuura [4] about fishes of Bitung in the Northern Tip of Sulawesi, Indonesia and they found 5 species of the genus *Lethrinus*. However, this information presents different species found.

Lack of taxonomic understanding sometimes leads to ambiguity in species identification [7]. Most researchers still find it difficult to distinguish the species of *Lethrinus* family lethrinid and regard the genus *Lethrinus* as one species. They only focus on identifying body shapes and color pattern. However, according to Galbo et al. [5] if the method is used as a basis for classifying *Lethrinus* fish, it will be a problem in the future because the character is related to eating habits and homoplasy (it may disappear or appear depending on the environment at any time).

The information is necessary to allow an evaluation of the consequences of multi-species regulations for each of the species affected and, perhaps, consideration given to precautionary management strategies appropriate to the most vulnerable of the under common regulation [8]. This research aims to provide an update on the species of *Lethrinus* fish in Wallacea waters.

2. Materials and methods

Specimens of Lethrinid fishes were purchased in South Sulawesi, North Sulawesi, and Southeast Sulawesi from August 2018 to July 2019. The specimens purchased had been collected mostly by hand-line. The specimens examined at the Laboratory of Marine Biology, Faculty of Marine Science and Fisheries, Hasanuddin University, Makassar. Species identification based on morphological characters follows [3,6,9].

3. Results and discussions

The species of emperor fishes that have been identified were around 70% of the 23 species scattered in the Wallacea waters, especially in the waters of South Sulawesi, North Sulawesi and South-East Sulawesi, Indonesia. Based on the identification results that a common species and easily found its availability; *L. erythropterus*, *L. harak*, *L. lentjan*, *obsoletus*, *L. ornatus*, *L. rubrioperculatus*, and *L. micintus*. While species that are found rarely and few in number such as *L. amboinensis*, *L. atkinsoni*, *L. conchyliatus*, *L. erythracanthus*, *L. genivittatus*, *L. microdon*, *L. olivaceus*, and *L. xanthochilus*. The species name: longspine emperor, *L. genivittatus* is only found in the North Sulawesi waters.

The identification results of the Lethrinid fish species based on trophic categories in the genus *Lethrinus* in relation to body form and dentition type. Species classified as low-bodied, high speed, stalking predators with conical teeth (8 species), high-bodied, slow speed carnivores with molariform teeth capable of crushing hard-shelled benthic prey (7 species), and one species of high-bodied but with conical teeth feeding mostly on small or soft-shelled benthic prey (table 1).

Most species found in Wallacea waters include trophic categories: low-bodied, high speed, stalking predators with conical teeth, namely *L. amboinensis*, *L. conchyliatus*, *L. genivittatus*, *L. microdon*, *L. olivaceus*, *L. rubrioperculatus*, *L. semicintus*, and *L. xanthochillus*. Species that are classified as high-bodied, slow speed carnivores with molariform teeth capable of crushing hard-shelled benthic prey, namely *L. atkinsoni*, *L. erythropterus*, *L. harak*, *L. lentjan*, *L. nebulosus*, *L. obsoletus*, and *L. ornatus*. Meanwhile, the third category: high-bodied but with conical teeth feeding mostly on small or soft-shelled benthic prey, found only orange-spotted emperor type, *L. erythracanthus*.

Table 1. Fishes Lethrinid in Wallacea region

No	Scientific name	English name	Local name
Trophic category: Low bodied-conical teeth			
1	<i>Lethrinus amboinensis</i> (Bleeker, 1854)	Ambon emperor	Ketambak, Lencam
2	<i>Lethrinus conchyliaius</i> (Smith, 1959)	Redaxil emperor	Ketambak, Lencam
3	<i>Lethrinus genivittatus</i> (Valenciennes, 1830)	Longspine emperor	Ketambak, Lencam
4	<i>Lethrinus microdon</i> (Valenciennes, 1830)	Smalltooth emperor	Tambak Moncong, Lencam
5	²⁵ <i>Lethrinus olivaceus Valenciennes, 1830</i>	Longface emperor	Tambak Mongcong, Lencam
6	<i>Lethrinus rubrioperculatus Sato, 1978</i>	Spotcheek emperor	Ketambak, Lencam
7	<i>Lethrinus semicinctus Valenciennes, 1830</i>	Black blotch emperor	Ketambak, Lencam
8	<i>Lethrinus xanthochilus Klunzinger, 1870</i>	Yellowlip emperor	Ketambak, Lencam
Trophic category: high bodied-molariform teeth			
1	¹⁹ <i>Lethrinus atkinsoni</i> (Seale, 1910)	Pacific yellowtail emperor	Ketambak, Lencam
2	<i>Lethrinus erythropterus</i> (Valenciennes, 1830)	Longfin emperor	Ketambak, Lencam
3	<i>Lethrinus harak</i> (Forsskål, 1775)	Thumbprint emperor	Tambak Belah, Tompel
4	<i>Lethrinus lentjan</i> (Lacepède, 1802)	Pink ear emperor	Tambak Pasir, Lencam
5	<i>Lethrinus nebulosus</i> (Forsskål, 1775)	Spangled emperor	Ketambak, Lencam
6	<i>Lethrinus obsoletus</i> (Forsskål, 1775)	Orange-striped emperor	Ketambak, Lencam
7	<i>Lethrinus ornatus</i> (Valenciennes, 1830)	Ornate emperor	Jangki, Sikuda, Lencam
Trophic category: high bodied-conical teeth			
1	<i>Lethrinus erythracanthus</i> (Valenciennes, 1830)	Orange-spotted emperor	Ketambak, Jangki, Lencam

The existence of this small-sea fish is very much determined by the habitat condition and the availability of food in its environment. In addition, another problem that threatens the Existence of this

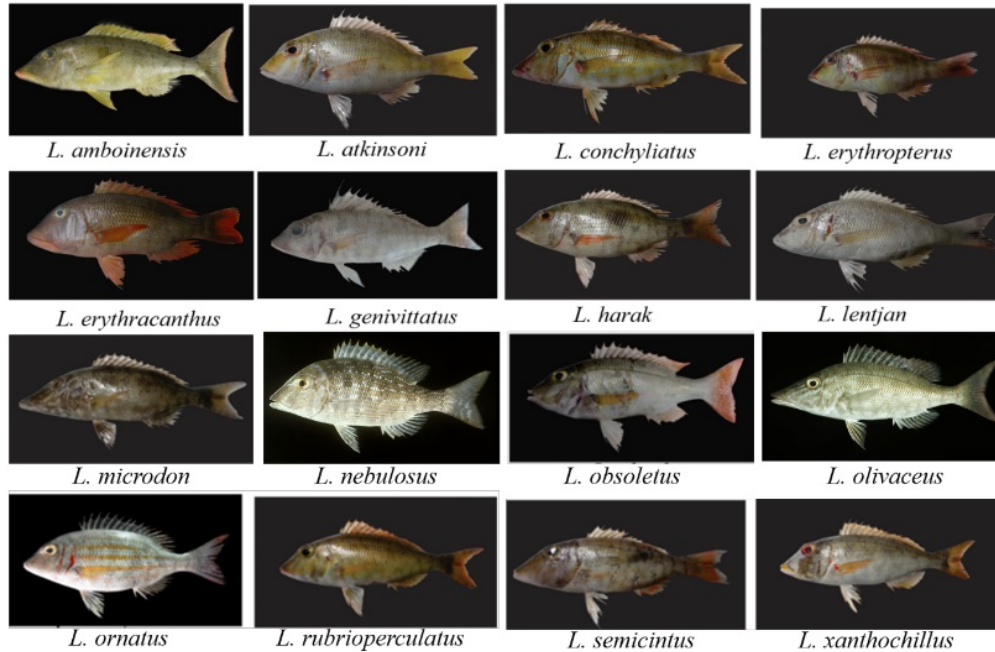


Figure 1. Lethrinus species based on morphological characters in Wallacea waters

Fish resources is the *destructive fishing* practice as one of its fishing methods [9]. Catching small-sea fish by *destructive fishing* involves the use of explosives, cyanide poisoning and anesthesia, where this practice causes damage to coral reefs and seagrass beds as nurseries and feeding ground of Lethrinid fish [10]. This certainly forces the fish to adapt to the environment and tend to move to look for food in deeper waters.

Identification of *Lethrinus* fish species in Wallacea waters used the morphological characters as a characteristic of each species (Fig. 1). The character is then described as follows:

3.1. *L. amboinensis* Bleeker, 1854

Ambon emperor (*Ketambak, Lencam*)

Body yellowish with scattered indistinct dark blotches, head brown with light streaks, lips reddish, axil of pectoral fins orangish, basal portion of center ray pectoral fin white, the outer edges yellow, pelvic and anal fins white or yellowish; dorsal and caudal fins mottled brown or yellow with and orange or reddish edge. Body moderately elongate, dorsal profile in front of eye nearly straight, snout moderately long, interorbital space convex, inner surface of pectoral-fin base without scales. Posterior angle of operculum fully scaly [3].

3.2. *L. atkinsoni* Bleeker, 1910

Pacific yellowtail emperor (*Ketambak, Lencam*)

Generally blue grey to yellowish tan with narrow dark scale margins, shading to white ventrally, frequently with yellowish head and broad, yellow midlateral stripe on side of body. Body moderately deep body, lateral jaw teeth rounded or molar-like. Lateral line scales 47 to 48, inner surface of pectoral fin axil densely scaled [11].

3.3. *L. conchyliatus* (Smith, 1959)

Redaxil emperor (*Ketambak, Lencam*)

Generally brown to grayish with lips, pectoral fin-base, and edge of operculum red. Body relatively elongate, greatest body depth, inner surface of pectoral-fin axil scales, lateral jaw teeth conical, snout moderately short. Generally brown to grayish with lips, pectoral fin-base, and edge of operculum red [11,12].

3.4. *L. erythracanthus* (Valenciennes, 1830)

Orange-spotted emperor (*Ketambak, Jangki, Lencam*)

Body brownish, head darker brown with faint orange spots, fins orange to reddish. Body moderately deep, snout moderately short, small scales usually present in axil of pectoral fin, teeth on side of jaws nodular, molariform (sometimes with small tubercle on top) [5,6,11,13–15].

3.5. *L. erythropterus* (Valenciennes, 1830)

Longfin emperor (*Ketambak, Lencam*)

Head and body brown or rust red, lighter ventrally, sometimes 2 light bars on caudal peduncle, area around eye, a broad streak from eye to tip of snout, lips, and base of pectoral fins red, all fin reddish, often a bright red or orange. Body moderately deep, dorsal profile near eye nearly straight or slight convex, snout moderately short. Interorbital space convex or almost flat, posterior nostril an oblong longitudinal opening closer to orbit than anterior nostril, eye situated close to or slightly removed from dorsal profile, the third, fourth, of fifth soft ray usually the longest, its length much longer than length of base of soft-rayed portion of anal fin. [11,16,17].

3.6. *L. genivittatus* (Valenciennes, 1830)

Longspine emperor (*Ketambak, Lencam*)

Body moderately elongate, moderately slender, the second dorsal-fin spine the longest, sometimes much longer than other dorsal-fin spines. A pair of teeth in lower jaw strongly curved; outer surface maxilla with a distinct knob. Lateral-line scales 44 to 47; check without scales; $4^{1/2}$ scale rows between lateral line and base of middle dorsal-fin spines. Body tan or brown on upper sides, lower sides white with 3 brown or tan stripes, sides often with scattered irregular black oblique bars and square black blotch above pectoral fins and bordering below lateral line; head brown, somewhat indistinct vertical and oblique bands; fin pale, speckled with small white blotches [4].

3.7. *L. harak* (Forsskål, 1775)

Thumbprint emperor (*Ketambak Belah, Tompel*)

Body moderately deep elongate, dorsal profile near eye distinctly or slightly convex; snout short and blunt. Interorbital space convex or almost flat; posterior nostril a narrow longitudinal slit, closer to orbit than anterior nostril; eye situated close to dorsal profile. Lateral-line scales usually 45 to 46; cheek without scales; usually $5^{1/2}$ scale rows between lateral-line and base of middle dorsal-fin spines. Inner surface of pectoral-fin densely covered with scales; posterior angle of operculum fully scaly. A large elliptical black spot, often broadly edged in yellow, on side directly below lateral line and centered at a vertical near the posterior tip of pectoral fins; caudal fin orange; vertical fins sometimes striped [18–20].

3.8. *L. lentjan* (Lacepède, 1802)

Pink ear emperor (*Ketambak Pasir, Lencam*)

Body greenish or grey, shading to white below, center of scales on upper sides often white; pectoral fin white; yellow, or pinkish; pelvic and anal fins white to orange; dorsal fin white and orange mottled with a reddish margin. Body moderately deep elongate, dorsal profile near eye distinctly or slightly convex; snout short and blunt. Interorbital space convex or almost flat; posterior nostril a narrow longitudinal slit, closer to orbit than anterior nostril; eye situated close to dorsal profile. Lateral-line scales usually 45 to 46; check without scales; usually $5^{1/2}$ but sometimes $4^{1/2}$ scales rows between

lateral line and base of middle dorsal-fin spines. Inner surface of pectoral-fin base densely covered with scales, or naked; posterior angle of operculum fully scaly. [8,18,21–23].

3.9. *L. microdon* (Valenciennes, 1830)

Smalltooth emperor (*Ketambak Moncong, Lencam*)

Silvery to bluish grey, greyish green with large dark blotch below lateral line, frequently with three dark streaks radiating from lower eye. Body relatively elongate, snout moderately long, posterior nostril a longitudinal opening, closer to orbit than anterior nostril. Lateral teeth in jaws conical. Lateral line scales 47-48; cheek without scales, pectoral-fin axil scaled, usually scale rows between lateral line and base of middle dorsal spines $4^{1/2}$, 9 to 11 scales in supratemporal patch. [5,6,11,12,22,24,25].

3.10. *L. nebulosus* (Forsskål, 1775)

Orange-striped emperor (*Ketambak, Lencam*)

Body yellowish or bronze, lighter below, centers of many scales with a white or light blue spot, sometimes irregular dark indistinct bars on sides and a square black blotch above pectoral fins bordering below lateral line; 3 blue lines between eye and mouth; fins whitish or yellowish, pelvic fins dusky, edge of dorsal fin reddish. Body moderately deep, dorsal profile near eye nearly straight, or in large individuals, distinctly concave; snout moderately long. Interorbital space usually convex. Lateral line scales 46 to 48, cheek without scales, $5\frac{1}{2}$ scale rows between lateral line and base of middle dorsal-fin spines. inner surface of pectoral-fin base densely covered with scales; posterior angle of operculum fully scaly. [8,12,26–30].

3.11. *L. obsoletus* (Forsskål, 1775)

Orange-striped emperor (*Ketambak, Lencam*)

Body pale brownish with faint dark bars, an orange-yellow stripe on lower side at the level of the pectoral fin base, with two additional more faint orange-yellow stripes above and one below this stripe. Body moderately deep, pectoral-fin axil scaled, scale rows between lateral line and base of middle dorsal spines $4^{1/2}$, lateral jaw teeth conical. Lateral line scales 45 to 48. scale rows between lateral line and base of middle dorsal spines $4^{1/2}$ [18].

3.12. *L. olivaceus* (Valenciennes, 1830)

Longface emperor (*Ketambak Mongcong, Lencam*)

Overall grey to olive with narrow dark scale margin, lighter ventrally, often with scattered irregular dark blotches; snout with wavy dark streaks, upper jaw, especially near corner of mouth sometimes edged behind with red. Body moderately slender, dorsal profile near eye nearly straight or with small bump. interorbital space convex to flat; posterior nostril a longitudinal oblong opening. Lateral line scales 46 to 48, cheek without scales, $5\frac{1}{2}$ scale rows between lateral line and base of middle dorsal-fin spines, inner surface of pectoral-fin base without scales; posterior angle of operculum fully scaly, usually 7 to 9 scales in supratemporal patch [7,8,13,31,32].

3.13. *L. ornatus* Valenciennes, 1830

Omate emperor (*Jangki, Sikuda, Lencam*)

Body dusky whitish. Lighter below, with 5 to 6 orange stripes; posterior edge of operculum and preoperculum bright red; head brown, sometimes a red spot on lower front edge of eye; pectoral fins orangish; pelvic and anal fins, and most of dorsal fin whitish; edge of dorsal and caudal fins reddish. Body moderately deep, dorsal profile near eye nearly straight. Interorbital space usually convex flat. Outer surface of maxilla usually smooth, sometimes with a longitudinal ridge. Lateral line scales usually 46 to 47; cheek without scales; $5^{1/2}$ scale rows between lateral line and base of middle dorsal-fin spines [3,8].

3.14. *L. rubrioperculatus* Sato, 1978

15) Cheek emperor (*Ketambak, Lencam*)

Body olive grey or brown, with scattered irregular small black blotches; lips and a spot on upper edge of operculum usually red; fins pale or pinkish. Body moderately elongate, interorbital space flat or slightly convex; posterior nostril a longitudinal oblong opening, closer to orbit than anterior nostril; eye situated close or slightly removed from dorsal profile. Lateral-line scales 47 to 49, check without scales, 4 ½ scale rows between lateral line and base of middle dorsal-fin spines; 15-16 scale rows in transverse series between origin of anal fin and lateral line [2,6,8,11,13,18,19,33,34].

3.15. *L. semicinctus* Valenciennes, 1830

Black blotch emperor (*Ketambak, Lencam*)

Body brown or tan, with scattered irregular small black blotches, a large oblong black blotch below soft-rayed portion of dorsal fin and bordering below lateral line; fins pale or pinkish. Body moderately elongate, dorsal profile near eye convex but without a distinct hump. Interorbital space usually flat or slightly convex to flat. Lateral-line scales 46 to 48; check without scales; 4^{1/2} scale rows between lateral line and base of middle dorsal-fin spines; usually 14 or 15 scale rows in transverse series between origin of anal and lateral line. Inner surface of pectoral-fin base without scales; posterior angle of operculum fully scaly [2-4,11].

3.16. *L. xanthochilus* Klunzinger, 1870

Yellowlip emperor (*Ketambak, Lencam*)

Body yellowish grey with scattered irregular dark spots; lips yellowish, upper lip more intense; a red spot at upper base of pectoral fins; fins bluish grey and mottled, bases of fins lighter and edges of dorsal and caudal fins reddish. Body moderately elongate, dorsal profile near eye convex. Interorbital space distinctly concave; posterior nostril a longitudinal or vertical oblong opening, closer to orbit than anterior nostril; eye situated close to dorsal profile. Lateral-line scales 47 to 48; 4 ½ scale rows between lateral line and base of middle dorsal-fin spines; 15-16 scale rows in transverse series between origin of anal fin and lateral line; inner surface of pectoral fins without scales; posterior angle of operculum fully scaly [8].

4. Conclusions

Sixteen species of genus *Lethrinus* of family Lethrinidae were described from the Wallacea waters: *L. amboinensis*, *L. atkinsoni*, *L. conchylatus*, *L. erythracanthus*, *L. erythropterus*, *L. genivittatus*, *L. harak*, *L. lentjan*, *L. microdon*, *L. nebulosus*, *L. obsoletus*, *L. olivaceus*, *L. ornatus*, *L. rubrioperculatus*, *L. semicinctus*, and *L. xanthocyllus*.

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References

- [1] Carpenter K E and Allen G R 1989 FAO Species Catalogue Vol.9 Emperor Fishes And Large-4) e Brems Of The World (Family Lethrinidae) *FAO Fish. Synopsis* **9**
- [2] Carpenter K E and Randall J E 2003 ZOOTAXA *Lethrinus ravus*, a new species of emperor fish (Perciformes: Lethrinidae) from the western Pacific and eastern Indian oceans *Zootaxa* **240** 1-8
- [3] Burhanuddin A I and 17) tsuki Y Burhanuddin
- [4] Kimura S and Keiichi Matsuura 2003 *Fishes of Bitung Northern Tip of Sulawesi, Indonesia*
- [5] Lo Galbo A M, Carpenter K E and Reed D L 2002 Evolution of trophic types in emperor

- fishes (Lethrinus, Lethrinidae, Percoidae) based on cytochrome B gene sequence variation *J. Mol. Evol.* **54** 754–62
- [6] Annotated A N, Catalogue I, Sea O F, Species T and To K 1990 Fao Species Catalogue *Fao Fish. Synopsis* **11** 125–125
- [7] Borsa P, Hsiao D R, Carpenter K E and Chen W J 2013 Cranial morphometrics and mitochondrial DNA sequences distinguish cryptic species of the longface emperor (Lethrinus olivaceus), an emblematic fish of Indo-West Pacific coral reefs *Comptes Rendus - Biol.* **336** 505–14 **3**
- [8] Currey L M, Williams A J, Mapstone B D, Davies C R, Carlos G, Welch D J, Simpfendorfer C A, Ballagh A C, Penny A L, Grandcourt E M, Mapleston A, Wiebkin A S and Bean K 2013 Comparative biology of tropical Lethrinus species (Lethrinidae): Challenges for multi-species management *J. Fish Biol.* **82** 764–88 **126**
- [9] Kimura S and Matsuura K 2003 *Fishes of Bitung Northern Tip of Sulawesi, Indonesia* (Tokai University Press) **11**
- [10] Edinger, Jompa J, Limmon G, Widjatmoko W and Risk M 1998 Reef degradation and coral biodiversity in indonesia: Effects of land-based pollution, destructive ... *Mar. Pollut. Bull.* **36** 617–30
- [11] Hite W T, Last P R, Dharmadi, Faizah R, Chodrijah U, Prisantoso B I, Poginoski J J, Puckridge M and Blaber S J M 2013 *Market Fishes of Indonesia*
- [12] Santharajan M, Jawahar P, Francis T and Shanmugam S 2012 Age , Growth and Mortality Characteristics of Lethrinus nebulosus (Forsskal , 1775) in Thoothukudi Coast of Tamilnadu , India **6**
- [13] Borsa P, Collet A, Carassou L, Ponton D and Chen W J 2010 Multiple nuclear and mitochondrial genotyping identifies emperors and large-eye breams (Teleostei: Lethrinidae) from New Caledonia and reveals new large-eye bream species *Biochem. Syst. Ecol.* **38** 370–89
- [14] Nair R J 2007 Note The orange spotted emperor Lethrinus erythracanthus Valenciennes , 1830 (Perciformes : Lethrinidae) - a new record from Indian waters **49** 234–6
- [15] Anon 2015 Orange spotted emperor Lethrinus erythracanthus Valenciennes , 1830 (Perciformes : Lethrinidae) - a new record from ... **1830**
- [16] Moore B, Capelle J, Kabua E, Kiareti A, Lemari L, Liu R and White M 2013 Monitoring the Vulnerability and Adaptation of Coastal Fisheries to Climate Change Majuro Atoll Republic of the Marshall Islands
- [17] Afrisal M, Isyriani R and Burhanuddin A I 2018 Morphologic and radiographic analyses of Lethrinus erythropterus (Lethrinidae) from the Spermonde Archipelago , Indonesia **11** 1696–56 **56**
- [18] Rascalou G and Justine J 2007 Three species of Calydiscooides (Monogenea : Diplectanidae) from five Lethrinus spp . (Lethrinidae : Perciformes) off New Caledonia , with a description of Calydiscooides terpsichore sp . n . 191–202 **10**
- [19] Healey A J E, McKeown N J, Taylor A L, Provan J, Sauer W, Gouws G and Shaw P W 2018 Cryptic species and parallel genetic structuring in Lethrinid fish: Implications for conservation and management in the southwest Indian Ocean *Ecol. Evol.* **8** 2182–95 **9**
- [20] Mziray P and Kimirei I A 2016 Bioaccumulation of heavy metals in marine fishes (Siganus sutor, Lethrinus harak, and Rastrelliger kanagurta) from Dar es Salaam Tanzania *Reg. Stud. Mar. Sci.* **7** 72–80
- [21] Anil M K, Gomati **29**, Sugi V V, Raheem P K, Raju B, Gop A P, Santhosh B, Philipose K K, Gopakumar G and Gopalakrishnan A 2018 Captive maturation, breeding and seed production of Pink ear emperor, Lethrinus lentjan (Lacepede, 1802) (Family: Lethrinidae) in recirculating aquaculture system (RAS) M.K. *aquaculture*
- [22] Alah H M M K, Mehanna S and Makkey A F 2017 Studies on age , growth , and mortality rates for management of the redspot emperor , Lethrinus lentjan (Lacepede , 1802) in the Egyptian sector of Red Sea *Egyptian Journal of Aquatic Biology & Fisheries Studies on age ,*

growth , and mortality rates for

- [23] Le D Q, Tanaka K, Hii Y S, Sano Y, Nanjo K and Shirai K 2018 Importance of seagrass-mangrove continuum as feeding grounds for juvenile pink ear emperor *Lethrinus lentjan* in Setiu Lagoon, Malaysia: Stable isotope approach *J. Sea Res.* **135** 1–10
- [24] History A 2017 Article History: Received: Jan. 2017 Accepted: Feb 2017 **21** 63–72
- [25] Cosme N, Jones M C and Cheung W 2017 Supporting Information Spatial differentiation of marine eutrophication damage indicators based on species density
- [26] Al-Ansari E M A S, Abdel-Moati M A R, Yigiterhan O, Al-Maslamani I, Soliman Y, Rowe G T, Wade T L, Al-Shaikh I M, Helmi A, Kuklyte L, Chatting M and Al-Ansi Al-Yafei M A 2017 Mercury accumulation in *Lethrinus nebulosus* from the marine waters of the Qatar EEZ *Mar. Pollut. Bull.* **121** 143–53
- [27] Hiley A J E, Gouws G, Fennessy S T, Kuguru B, Sauer W H H, Shaw P W and McKeown N J 2018 Genetic analysis reveals harvested *Lethrinus nebulosus* in the Southwest Indian Ocean comprise two cryptic species *ICES J. Mar. Sci.* **75** 1465–72
- [28] Marriott R J, Jarvis N D C, Adams D J, Gallash A E, Norriss J and Newman S J 2010 Maturation and sexual ontogeny in the spangled emperor *Lethrinus nebulosus* 1396–414
- [29] Baghavi M, Vahabnezhad, Seyfabadi, Ghodrati S and Hakimelahi 2010 Growth , mortality and spawning season of the spangled emperor (*Lethrinus nebulosus* Forsskal , 1775) in coastal waters of Hormozgan province in the Persian Gulf and Oman Sea **9** 161–72
- [30] Mehanna S, Zaki S, Al-kiuymi F, Al-kharusi L and Al-bimani S 2014 Biology and fisheries management of spangled emperor *Lethrinus nebulosus* from the Arabian Sea Coast of Oman
- [31] Takeuchi T, Dedi J, Haga Y, Seikai T and Watanabe T 1998 Effect of vitamin A compounds on bone deformity in larval Japanese flounder (*Paralichthys olivaceus*) *Aquaculture* **169** 155–65
- [32] Haga Y, Suzuki T, Kagechika H and Takeuchi T 2003 A retinoic acid receptor-selective agonist causes jaw deformity in the Japanese flounder, *Paralichthys olivaceus* *Aquaculture* **221** 381–92
- [33] Thi O T, Vu Q, Ha D and Thuy B D 2015 Phylogenetic Relationships of Emperors (*Lethrinidae*) and Snappers (*Lutjanidae*) in Vietnam based on Mitochondrial DNA Sequences 16–9
- [34] Amin S, Motlagh T, Seyfabadi J, Vahabnezhad A and Shojaei M G 2010 Some Reproduction Characteristics and Weight-Length Relationships of the Spangled emperor , *Lethrinus nebulosus* (*Lethrinidae*) of the South Coastal of Iran (Persian Gulf and Oman Sea) **227** 221–7

Lethrinid fishes (Lethrinidae) of Wallacea region

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"Importance of seagrass-mangrove continuum as feeding grounds for juvenile pink ear emperor Lethrinus lentjan in Setiu Lagoon, Malaysia: Stable isotope approach", Journal of Sea Research, 2018
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4 fishbase.com % **1**
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5 hal-mnhn.archives-ouvertes.fr % **1**
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6 Philippe Borsa, Andrianus Sembiring, Cécile Fauvelot, Wei-Jen Chen. "Resurrection of Indian Ocean humbug damselfish, *Dascyllus abudafur*" % **1**

(Forsskål) from synonymy with its Pacific Ocean sibling, *Dascyllus aruanus* (L.)", *Comptes Rendus Biologies*, 2014

Publication

-
- | | | |
|---|---|-----|
| 7 | www.medjchem.com
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|---|---|-----|
-
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- | | | |
|---|--|-----|
| 9 | Razegheh Akhbarizadeh, Farid Moore, Behnam Keshavarzi. "Investigating a probable relationship between microplastics and potentially toxic elements in fish muscles from northeast of Persian Gulf", <i>Environmental Pollution</i> , 2018
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-
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| 12 | pasca.isi.ac.id
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- | | | |
|----|---|------|
| 13 | Sohana P. Singh, Johan C. Groeneveld, Sandi Willows-Munro. "Between the current and the coast: genetic connectivity in the spiny lobster <i>Panulirus homarus rubellus</i> , despite potential barriers to gene flow", <i>Marine Biology</i> , 2019 | <% 1 |
|----|---|------|

14 idosi.org Internet Source <% 1

15 fish.wa.gov.au Internet Source <% 1

16 docslide.us Internet Source <% 1

17 Anirban Chakraborty, Yukio Iwatsuki. "Genetic Variation at the Mitochondrial 16S rRNA Gene among *Trichiurus lepturus* (Teleostei:Trichiuridae) from Various Localities: Preliminary Evidence of a New Species from West Coast of Africa", *Hydrobiologia*, 2006
Publication

18 coastfish.spc.int Internet Source <% 1

19 Ditch Townsend. "First comprehensive list of the coral reef fishes of Tunku Abdul Rahman Park, Sabah, Malaysia (Borneo)", *Check List*, 2015
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20 biodiversity.edu.vn Internet Source <% 1

21 www.physiology.org Internet Source <% 1

22 www.derpharmachemica.com

Internet Source

<% 1

23

jfmt.indianjournals.com

Internet Source

<% 1

24

www.fishider.org

Internet Source

<% 1

25

S. Jennings. "Comparative size and composition of yield from six Fijian reef fisheries", *Journal of Fish Biology*, 1/1995

Publication

<% 1

26

Seishi Kimura, Takahiro Ito, Teguh Peristiwady, Yukio Iwatsuki, Tetsuo Yoshino, Paul V. Dunlap. "The *Leiognathus splendens* complex (Perciformes: Leiognathidae) with the description of a new species, *Leiognathus kupanensis* Kimura and Peristiwady", *Ichthyological Research*, 2005

Publication

<% 1

27

Newman, S.J.. "Mesh size selection and diel variability in catch of fish traps on the central Great Barrier Reef, Australia: a preliminary investigation", *Fisheries Research*, 199506

Publication

<% 1

28

tr.scribd.com

Internet Source

<% 1

Taylor N. Lipscomb, Quenton M. Tuckett, Amy

29 L. Wood, Joshua T. Patterson, Shane W. Ramee, Craig A. Watson, Matthew A. DiMaggio. " Culture protocols for the gulf coast pygmy sunfish, ", Journal of the World Aquaculture Society, 2019
Publication <% 1

30 archiv.ub.uni-heidelberg.de
Internet Source <% 1

31 Satoshi Morishita, Toshio Kawai, Hiroyuki Motomura. "Sebastiscus vibrantus, a new species of rockfish (Sebastidae) from Indonesia and Taiwan", Ichthyological Research, 2018
Publication <% 1

32 Yohei Nakamura. "The effects of distance from coral reefs on seagrass nursery use by 5 emperor fishes at the southern Ryukyu Islands, Japan", Fisheries Science, 09/29/2009
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