

# AN ANNOTATED BIBLIOGRAPHY OF SLIPMOUTHS (PISCES : LEIOGNATHIDAE)

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and  
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**INTERNATIONAL CENTER FOR LIVING AQUATIC RESOURCES MANAGEMENT  
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(Pisces: Leiognathidae)**

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## Abstract

Pauly, D. and S. Wade-Pauly. 1981. An Annotated Bibliography of Slipmouths (Pisces: Leiognathidae). ICLARM Bibliographies 2, 62 p. International Center for Living Aquatic Resources Management, Manila, Philippines.

A bibliography of the fishes of the *Leiognathidae* family (slipmouth, pony-fishes, silver-bellies, etc.) is presented. A total of 941 references, most of which are annotated, are listed, covering all aspects of their biology, including fishery related aspects, physiology and anatomy (e.g., their bioluminescence) as well as their use as human food. Comprehensive subject and geographic indices are provided.

## Introduction

Among the many taxa of demersal fishes caught by artisanal and commercial fishermen along the shores of the tropical Indo-Pacific, one family, the Leiognathidae, is particularly prominent. This is so especially in Southeast Asia, off the Indian subcontinent and off East Africa, where leiognathids generally account for one third or more of the catches made by trawlers.

The Leiognathidae, also known as slipmouths, silver bellies or pony fishes, are generally small and rather bony, the result being that they are considered as "trash-fish" throughout most of their range. They are, for this reason most often thrown overboard when caught by shrimping boats, and often remain unsorted and unreported even when caught by fishery research vessels.

There are, therefore, relatively few papers dealing specifically with the fishery biology of leiognathid fishes; most of the information available on this group is indirect, i.e., Leiognathidae are mentioned *en passant* in reports dealing with the biology of other fishes.

Yet leiognathids are important. Being extremely abundant, especially over the muddy grounds of estuaries, they provide the bulk of the food available to larger, more valuable fishes. They are also an important source of protein for domestic animals especially in Southeast Asia. Finally, in several countries, leiognathids, especially

the larger species (*Leiognathus equulus*, *L. splendens*), are consumed directly by people, and often represent one of the few sources of high quality protein available for mass consumption.

In addition to representing a considerable, if often neglected resource, the fishes of the family Leiognathidae share a feature which has attracted the attention of numerous scientists: they are bioluminescent, and emit downward-directed light which reduces their visibility from below. The adaptations involved here, and the symbiotic bacteria which actually produce the light have generated a considerable number of interesting papers.

However, much of the physiological work on leiognathid bioluminescence has been done by researchers who were most often unaware of the ecological information gathered on this group by fishery biologists. Similarly, much of the fishery-oriented work on these fishes was done by researchers who were often unaware of each other's work, mainly because much of the material available on Leiognathidae has not been formally published. This bibliography, we hope, will help alleviate this situation.

The collection of annotated references presented here began in early 1975, at the Ichthyological Department of the Senckenberg Museum and Forschungsinstitut,

Frankfurt am Main and continued at Kiel University (FRG), where most of the standard references were consulted (Zoologischer Anzeiger, Dean's Bibliography of Fishes, Zoological Records, Biological Abstracts, Aquatic Sciences and Fisheries Abstracts, etc.). In 1975 and 1976, libraries and colleagues' personal reprint collections in Indonesia, Thailand and Mauritius were consulted. A preliminary version of this bibliography was prepared in 1977 and expanded until December 1980 with additional references obtained from libraries in France, the U.S.A., the Philippines, Kenya, Great Britain, Australia and Italy.

Despite all efforts, we know that the bibliography is still incomplete, because we aimed at including everything even remotely related to the Leiognathidae, whether formally published or not.

The annotations to the references are very variable in length and information content. As a general rule, anno-

tations are longer for papers that are not published formally, and/or difficult to access, and shorter for papers published in books and journals available in major libraries. We have not seen approximately one third of the papers whose references are included here. Having little prospects of ever seeing these papers and checking their contents, and not knowing what would have been gained by omitting such unchecked references, we have included here all we had on the Leiognathidae, seen or unseen, and annotated as much as we could without fantasizing. While being the most risky option (for us), this might turn out to be the most helpful one (for the reader).

We would be very thankful to be informed of errors or glaring omissions, and will consider such comments in the synopsis of data on the fishes of the family Leiognathidae, which one of us (D.P.) has begun preparing.

### Acknowledgments

Many people helped, in one form or the other, with the preparation of this bibliography, and we are thankful to all of them. We are particularly indebted to the following persons and institutions:

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- Mrs. Leticia Dizon (ICLARM) for her typing of the final draft.
- and especially Mrs. Helen Randall (B.P. Bishop Museum, Hawaii) for checking and annotating the references to taxonomic works included here. (However, remaining errors are ours, not hers!)

- 001 Abe, T. 1939. A list of the fishes of the Palao Islands. *Palao Trop. Biol. Stn. Stud.* 4: 523-584. p. 557 lists *G. minuta*.
- 002 Abe, T. 1963. *Encyclopedia ichthyologica illustrated in colors with keys to the Japanese species.* Hokuryukan Co., Tokyo. 358 p. (In Japanese)
- 003 Abe, T. and Y. Haneda. 1972. Description of two new species of the ponyfish genus *Leiognathus* from Indonesia. *Sci. Rep. Yokosuka City Mus.* 19: 1-7.  
*L. hataii* and *L. aureus*, nov. spp., from Ambon. These two new species should be attributed to the genus *Secutor* Gistel.
- 004 Agassiz, L. 1837. *Recherches sur les poissons fossiles.* Vol. 5. Neuchâtel.  
p. 24 Skeleton of *Leiognathus fasciatus* (Plate B) under *E. setigera*.
- 005 Agassiz, L. 1846. *Nomenclator Zoologicus. Pisces.* Soloduri.  
Emendation of *Leiognathus* to *Liognathus*.
- 006 Ahrens, G. 1965. Untersuchungen am Leuchtorgan von *Leiognathus klunzingeri* (Steindachner). *Z. Wiss. Zool.* 173 (1/2): 90-113.  
Basic work on light organ of *L. klunzingeri*.
- 007 Akyüz, E. 1957. Observation on the Iskenderun red mullet (*Mullus barbatus*) and its environment. *Proc. Gen. Fish. Council. Mediterr.* 4, Tech. Pap. 38: 305-326.  
*L. klunzingeri* reported from Iskenderun Gulf, Turkey.
- 008 Al-Nasiri, S.K. and S.M. Shamsul Hoda. 1975. Survey of fish fauna of Shatt-al-arab from Abu-al-Khasib to Karmat Ali. *Bull. Basrah Nat. Hist. Mus.* 2: 36-46.
- 009 Angot, M. 1950. Poissons littoraux de Soalara. *Mém. Inst. Sci. Madagascar, Sér. A*, 4 (1): 175-196.  
Lists among the Carangidae, *G. minuta*, *G. equulaeformis* and *E. edentula* from a poikilohaline biotope, with muddy waters.
- 010 Anon. 1915. List of Tamil names of fishes of the Madras Presidency. *In Papers from 1899*, relating chiefly to the development of the Madras Fisheries Bureau. *Bull. Madras Fish. Bur.* 1(1): 1-237.  
Tamil names for 10 leiognathid species.
- 011 Anon. 1929, Liste des poissons de l'Indochine envoyés, par le Docteur Gilbert Tirant, au Muséum des Sciences Naturelles de Lyon, p. 167-175. *In Réimpression, Oeuvre ichthyologique de G. Tirant.* Serv. Océanogr. de l'Indochine 6<sup>ième</sup> Note.  
Lists under Carangidae: *E. brevirostris* C & V and *E. edentula* Bl., collected in Hué, 1882.
- 012 Anon. 1951. Annotated list of animals and plants of Mie Prefecture, Japan. The Committee of the Biological Survey of Mie Prefecture.  
Lists *L. nuchalis* (T & S) and *L. rivulatus* (T & S).
- 013 Anon. 1958. A guide to the fisheries of Ceylon. *Fish. Res. Stn., Dep. Fish. Ceylon Bull.* No. 8. 72 p.  
*Leiognathidae* (Sinhalese: Karalla, Tamil: Karal) listed among the abundant resources in lagoons and inshore waters and contributing greatly to the sustenance fisheries.
- 014 Anon. 1962. *Kerala Fisheries.* Government Press, Trivandrum.
- 015 Anon. 1967. Results of the joint Thai-Malaysian-German trawling survey off the East Coast of the Malay Peninsula. *Mar. Fish. Lab., Bangkok/Fish. Res. Inst., Malaysia.* 64 p.  
Catch data for leiognathids, per area and depth ranges. Species list.
- 016 Anon. 1968. Results of the exploratory trawling survey in the outer part of the Gulf of Thailand and in the South China Sea by R.V. *Fisheries Research 2*, Cruise No. 1/2511. *Spec. Publ. SR 001.* 79 p. Exploratory Fishing Unit, Department of Fisheries, Bangkok.
- 017 Anon. 1969a. [Annual Report of Phuket Marine Fisheries Station] 210 p. (In Thai)  
Description and figures for *L. bindus*, *L. brevirostris*, *L. elongatus*, *L. equulus*, *L. leuciscus*, *L. smithursti*, *L. splendens* and *S. ruconius*.
- 018 Anon. 1969b. [Marine animals used as food by Thai people] Exploratory Fishing Division, Department of Fisheries, Bangkok. (In Thai)  
Contains photos, descriptions and miscellaneous data reportedly of *Leiognathus daura*, *L. splendens*, *L. equulus*, *L. smithursti*, *L. sp.*, *Secutor insidiator* and *Gazza minuta*. Identifications seem questionable in a few cases.

- 019 Anon. 1969c. Marine fish production in India 1950-1968. Bull. Cent. Mar. Fish. Res. Inst., Mandapan Camp, India. 13. 144 p.  
Catch and landings data including *Leiognathus* spp. and *Gazza*.
- 020 Anon. 1971. Offshore fishery development of the Republic of Viet-Nam, trawling survey in the South China Sea and the Gulf of Thailand. Annual Report prepared for the Food and Agricultural Organization of the United Nations (acting as executing agency for the United Nations Development Programme). FAO/FI:SF/VIE 3 Tech. 3. Kyokuyo Co., Ltd., Tokyo. 271 p.  
Leiognathids mentioned.
- 021 Anon. 1972a. A review of the trawling industry in West-Malaysia. Proc. Indo-Pacific Fish. Council. 13(3): 541-545.  
Leiognathidae comprise 2% of estimated fish landings in 1967 (= 1,057.79 tons).
- 022 Anon. 1972b. [Survey by the R.V. *Tabularasa* in the years 1971-72] Lembaga Penelitian Perikanan Laut. (In Indonesian)  
Contains catch data for Leiognathidae.
- 023 Anon. 1973a. [Report of the North Sumatra Provincial Marine Fisheries Service] Annual Report. 50 p. (In Indonesian)  
Contains catch and landing data for Leiognathidae.
- 024 Anon. 1973b. Report of exploratory operation of trawl in the Gulf of Siam and the Java Sea. Fish Res. Dev. Agency, Office of Fisheries, Busan, Korea. 131 p.  
*Leiognathus rivulatus* reported in catch is a probable misidentification.
- 025 Anon. 1974a. [Annual Report 1973, East Java Provincial Fisheries Office] Jawa Timur. 119 p. (In Indonesian) (mimeo)  
Contains landing data, by month, for Leiognathidae in East Java Province.
- 026 Anon. 1974b. Progress report No. 6. UNDP/FAO Pelagic Fishery project, India. 141 p.
- 027 Anon. 1975a. [A guide to the collection, interpretation and presentation of fisheries statistics. Book 1. Standard fisheries statistics] Directorate General of Fisheries. 207 p. (In Indonesian)  
General description of Leiognathidae with a figure of *L. bindus* and sketches of the protrusile mouth.
- 028 Anon. 1975b. Report on cruise Nos. 1 and 2 of R/V *Dr. Fridtjof Nansen*. Indian Ocean Fish. Dev. Progr. Pelagic Fish Assessment, North Arabian Sea (subcontractor: Inst. of Mar. Res., Bergen, Norway). 89 p. (mimeo)  
Catch data, by station and species (mainly *L. bindus*).
- 029 Anon. 1975c. The three bays multidisciplinary environmental project. Cleveland Bay, Halifax Bay, Bowling Green Bay. 1st Report. James Cook University of North Queensland (Australia). 102 p. (mimeo)  
*Leiognathus splendens* and *L. bindus* reported (p. 80) dominant in numbers in trawl catches. Also reports (p. 82) of abundance of *E. novae-hollandiae* and *G. minuta*.
- 030 Anon. 1976a. R/V *Lemuru* Cruise 7501 (Jakarta-Belawan, 8-27 January 1975). Data and observations. Paper presented at the workshop on the fishery resources of the Malacca Strait, 29 March-2 April 1976, Jakarta, Indonesia. Working Paper no. 6. 14 p. South China Sea Fish. Dev. Coord. Progr., Manila.
- 031 Anon. 1976b. Report on cruise No. 3 of the R/V *Dr. Fridtjof Nansen*. Indian Ocean Fish. Dev. Progr. Pelagic Fish Assessment Survey, North Arabian Sea (subcontractor: Inst. of Mar. Res., Bergen, Norway) 49 p. (mimeo)  
Gives catch data for leiognathids, *L. bindus* dominant.
- 032 Anon. 1976c. Status Report No. 1. Survey Results of *Dr. Fridtjof Nansen* 1975. Indian Ocean Fish. Dev. Progr. Pelagic Fish Assessment Survey, North Arabian Sea (subcontractor: Inst. of Mar. Res., Bergen, Norway) 30 p. (mimeo)  
Catch data, by station and species (*L. bindus* mainly).
- 033 Anon. 1976d. Progress report No. 12. UNDP/FAO Pelagic Fishery project, India. 116 p.
- 034 Anon. 1976e. Progress report No. 13. UNDP/FAO Pelagic Fishery project, India. 107 p.
- 035 Anon. 1979. Demersal resources of the Gulf and Gulf of Oman. FAO/RAB/71/278/6. 44 p. FAO, Rome.

- Discusses the distribution of Leiognathidae in the Gulfs, in which they are the most abundant demersal fishes. Leiognathidae listed among the "unmarketable" or "non-commercial groups." Also presents data on seasonal and day/night differences in Leiognathidae catch rates. Standing stock of Leiognathidae estimated.
- 036 Anon. 1980. Marine Fisheries Research Department. Annual Report, 1979. Southeast Asian Fisheries Development Center, Singapore. 31 p.  
List pony fish (*Leiognathus elongata*) among trash fish used for the production of fish-jelly.
- 037 Anon. 1980. The present state of mangrove ecosystems in Southeast Asia and the impact of pollution—Singapore. SCS/80/WP/94d. 76 p. South China Sea Fish. Dev. Coord. Progr., Manila.  
p. 69 lists, among the fish species recorded from Singapore mangrove swamps: *G. minuta*, *L. brevisrostris*, *L. dussumieri*, *L. equulus* (which is also listed among the spp. important to sustenance fishermen) *L. fasciatus*, *L. ruconius*.
- 038 Anon. Undated. Common species of fish found in Tonga. (mimeo)  
Lists *L. equulus*, gives body length (14 cm) and spawning period ("lay eggs in June").
- 039 Apparao, T. 1966. On some aspects of the biology of *Lactarius lactarius* (Schneider). Indian J. Fish. 13(2): 334-349.  
*Leiognathus* spp. recorded in stomach contents.
- 040 Aprieto, V. and E. Viloso. 1977. Fishes caught by otter trawl in the Visayan Sea. Fish. Res. J. Philipp. 2(2): 40-49.  
Lists leiognathid species caught.
- 041 Arifien, S. 1972. [Composition of the fish catch of lift nets from Tanjungpasir, Naga Bay, Tangesang] Bogor Agric. Inst., Indones. 66 p. Thesis. (In Indonesian)  
Catch data and length frequencies for leiognathids caught by lift nets.
- 042 Arora, H.L. 1952. A contribution to the biology of the silver-belly, *Leiognathus splendens* (Cuvier). Proc. Indo-Pacific Fish. Counc. 3, Tech. Pap. 4: 75-80.  
First paper on the biology of *L. splendens*. Contains estimates of growth rate and size at first maturity, both of which may be underestimated (see Beck & Sudradjat, 1978).
- 043 Avery, A. 1950. Fish processing handbook for the Philippines. Res. Rep. U.S. Fish. Wildl. Serv. 26. 149 p.  
Presents figures for *L. equulus*, *L. fasciatus*, *L. daura*, *S. ruconius* and *S. insidiator*. Discusses processing of leiognathids.
- 044 Baasch, H., P. Jarchau, H.V. Westernhagen and M. Zureck. 1976. Fischerei auf den Philippinen und Möglichkeiten ihrer Förderung. Projekt Nr. 7425127-000603, Fed. Min. Econ. Coop (BMZ) Bonn.  
Mentions leiognathids among the important fish groups.
- 045 Badrudin. 1977. Catch rate distribution of pony-fishes—Leiognathidae, p. 22-23. In A. Dwiponggo (ed.) Peta Beberapa Sumber Perikanan Demersal (Dasar) Di Laut Jawa Dan Laut Cina Selatan. Marine Fisheries Research Institute. Jakarta.  
Maps showing catch rates of Leiognathidae in the Java and South China Seas, 1975-76.
- 046 Baissac, J. de. 1952. Contribution à l'étude des poissons de l'île Maurice. V. Proc. R. Soc. Arts Sci. Mauritius 1: 185-240.  
Descriptions of *Leiognathus equulus*, *L. fasciatus*, *G. minuta* and another undetermined species.
- 047 Baissac, J. de. 1976. Poissons de Mer des Eaux de l'île Maurice. Proc. R. Soc. Arts Sci. Mauritius 3: 191-226.  
Lists from Mauritius: *S. insidiator* (Petite mangouste) *L. equulus* (sap-sap); *L. fasciatus* (sap-sap) *L. elongatus* (sap-sap long) and *G. minuta* (sap-sap les dents).
- 048 Bal, D.V. and L.B. Pradhan. 1945. Investigation of fish eggs and fish larvae from Bombay waters. First Progress Report, 1944-45. Govt. Central Press, Bombay.  
Occurrence of eggs and larvae attributed to *L. fasciatus*.
- 049 Bal, D.V. and L.B. Pradhan. 1946. Investigation of fish eggs and fish larvae from Bombay waters. Second Progress Report, 1945-46. Govt. Central Press, Bombay.  
Occurrence of eggs and larvae attributed to *L. fasciatus*.



- 050 Bal, D.V. and L.B. Pradhan. 1947. Investigation of fish eggs and fish larvae from Bombay waters. Third Progress Report, 1946-47. Govt. Central Press, Bombay.  
Occurrence of eggs and larvae attributed to *L. fasciatus*.
- 051 Bal, D.V. and L.B. Pradhan. 1951. Occurrence of fish larvae and postlarvae in Bombay waters during 1944-47. J. Univ. Bombay New Ser. 20B. 15 p.  
Occurrence of larvae and postlarvae attributed to *Leiognathus* and *Gazza* spp.
- 052 Balakrishnan, K.P. 1959. Marine zoology and fisheries in the Indian Ocean. I. Fish eggs and larvae of the Kerala Coast. Proc. 1st All Indian Congr. Zoology (Jabalpur).  
Eggs and larvae attributed to *L. brevirostris*.
- 053 Balan, V. 1967. Biology of the silver-belly, *Leiognathus bindus* (Val.). Indian J. Fish. 1963 10A(1): 118-134. Also: Adv. Abstr. Contr. Fish. Aquat. Sci. India 1(1): 14-15.  
Basic work on the biology of *L. bindus*. See Pauly and David (1980a & b) for interpretation of the length frequency data.
- 054 Baldwin, W.J. 1977. A review of the use of live baitfishes to capture skipjack tuna, *Katsuwonus pelamis*, in the Tropical Pacific Ocean, with emphasis on their behavior, survival and availability, p. 8-35. In R.S. Shomura (ed.) Collection of Tuna Baitfish Papers. NOAA Tech. Rep. NMFS Circ. 408. 167 p.  
p. 11 and 25 discuss suitability of leiognathids, especially *G. minuta*, as live bait resource. Suggests low attraction rate, and reports of schooling behavior at or near surface.
- 055 Banasopit, T. and T. Wongratana. 1967. A check list of fishes in the reference collection maintained at the Marine Fisheries Laboratory. Contrib. Mar. Fish. Lab., Bangkok 7. 73 p.  
p. 20 lists 13 species of Leiognathidae, with Thai, English and scientific names.
- 056 Banerji, S.K. and A.V.V. Satyarayana. 1958. A note on the general trend of marine fish catch in India. Indian J. Fish. 5: 195-200.  
Gives 11,838 tons of Leiognathidae or 2.04% of the all-Indian catch for the period 1950-56.
- 057 Bapat, S.V. and D.V. Bal. 1952. The food of some young fishes from Bombay. Proc. Indian Acad. Sci. 35B(2): 78-92.
- 058 Bapat, S.V., N. Radhakrishnan and K.N. Rasachandra Kartha. 1972. A survey of the trawl fish resources of Karwar, India. Proc. Indo-Pacific Fish. Council. 13(3): 354-383.  
*Leiognathus*, comprising 30.12% of the catch in the area, belongs to the principal trawl fish off Karwar.
- 059 Barnard, K.H. 1925. A monograph of the marine fishes of South Africa. Ann. S. Afr. Mus. 21: 1-1065.  
Describes *L. equula*, *L. insidiator*, *G. minuta*. Mentions that members of the family ascend rivers, are consumed by people, but are of no commercial value.
- 060 Barnard, K.H. 1949. A pictorial guide to South African fishes. Maskew Miller Ltd., Capetown.  
Describes "slimy" *Leiognathus equula* and "spotted slimy" *S. insidiator*.
- 061 Barus, H.R. 1968. [*Leiognathus* spp. caught by trawl off Batang, Central Java]. Bogor Agric. Inst., Indones. 20 p. Thesis. (In Indonesian)  
About 60% of the catch consisted of *L. equulus*, *L. splendens*, *L. dussumieri*, *L. daura*, *S. insidiator* and *S. ruconius*.
- 062 Basheeruddin, S. and K.N. Nayar. 1962. A preliminary study of the juvenile fishes of the coastal waters off Madras City. Indian J. Fish. 8(1): 169-188.  
Occurrence, size-range, major size group and food of young *L. insidiator*, *L. ruconius*, *L. splendens*, *L. fasciatus*, *L. equulus* and *G. minuta*.
- 063 Bassot, J.-M. 1966. On the comparative morphology of some luminous organs, p. 557-610. In F.H. Johnson and Y. Haneda (eds.) Bioluminescence in progress. Princeton Univ. Press, Princeton.  
As per title, including observations on Leiognathidae.
- 064 Bassot, J.-M. 1975. Les organes lumineux a bactéries symbiotiques de quelques téléostéens léiognathides. Arch. Zool. Exp. Gen. 116(3): 359-373.  
Describes light organ and bacterial symbionts in *L. equula*, *E. novae-hollandiae* and *S. ruconius*.

- 065 Bayoumi, A.R. 1972. Recent biological investigations in the Red Sea along the A.R.E. Coast. 1. On some demersal fishes of economic importance from the Red Sea with notes on migration of fish through the Suez Canal. Bull. Inst. Oceanogr. Fish., Cairo 2: 159-183.  
General account, with brief synonymy for *Leiognathus bindus*.
- 066 Bean, T.H. and A.C. Weed. 1912. Notes on a collection of fishes from Java made by Omer Bryant and William Palmer in 1909, with description of a new species. Proc. U.S. Nat. Mus. 42: 587-611.  
p. 120 *Gazza argentaria* (Majalibit Bay, Waigiu).
- 067 Beaufort, L.F. de. 1913. Fishes of the eastern part of the Indo-Australian Archipelago, with remarks on its zoogeography. Bijdr. Nederl. Dierk. 19: 95-163, 1 pl.  
p. 120 *Gazza argentaria* (Majalibit Bay, Waigin).
- 068 Beck, U. and A. Sudrajat. 1978. Variation in size and composition of demersal trawl catches from the north coast of Java with estimated growth parameters for three important food-fish species. Contrib. Demersal Fish. Proj. Mar. Fish. Res. Inst., Jakarta 4: 1-80.  
Discusses seasonal occurrence, depth distribution and growth of *Leiognathus splendens*, with  $L_{\infty}$  (cm) = 15.6 and K (yearly) = 1.745; correcting data in Pauly (1977a).
- 069 Ben-Tuvia, A. 1953a. Fishes caught off Caesarea, on the Mediterranean Coast of Israel. Bull. Res. Council, Israel 2(4): 439-440.  
Lists *L. klunzingeri*, states its Erythrean origin.
- 070 Ben-Tuvia, A. 1953b. Mediterranean fishes of Israel. Bull. Sea Fish. Res. Stn. Caesarea 8. 40 p.  
p. 2, 24 *Leiognathus klunzingeri*; p. 25 *L. mediterraneus*. *L. klunzingeri*, which came from the Red Sea through the Suez Canal, reported common in the eastern Mediterranean up to the Turkish coast.
- 071 Ben-Tuvia, A. 1953c. New Erythrean fishes from the Mediterranean Coast of Israel. Nature 172: 464.
- 072 Ben-Tuvia, A. 1963. Systematics and ecology of Indo-Pacific fishes recently established in the eastern Mediterranean. Proc. Int. Congr. Zool., Wash., D.C. 16(1): 115.  
Lists *L. klunzingeri*.
- 073 Ben-Tuvia, A. 1966. Red Sea fishes recently found in the Mediterranean. Copeia: 254-275.  
Lists *L. klunzingeri*, with complete synonymy for Mediterranean records.
- 074 Ben-Tuvia, A. 1973. Man-made changes in the eastern Mediterranean and their effect on the fishery resources. Mar. Biol. 19: 197-203 also in J. Ichthyol. 1970: 179-185.  
Lists *L. klunzingeri* among the Red Sea fishes having penetrated into the Mediterranean by means of a "Lessepsian" migration. *L. klunzingeri* now forms a main food item of *S. undosquamis*, also an immigrant.
- 075 Ben-Tuvia, A. 1978. Immigration of fishes through the Suez Canal. Fish. Bull. 76(1): 249-255.
- 076 Ben-Yami, M. and T. Glaser. 1974. The invasion of *Saurida undosquamis* (Richardson) into the Levant Basin—an example of biological effect of inter-oceanic canals. Fish. Bull. 72(2): 359-373.  
Reports that *L. klunzingeri* forms an important food source of *Saurida undosquamis*. Discussion of ecology and interactions.
- 077 Berg, L.S. 1940. Classification of fishes, both recent and fossil. Trav. Inst. Zool. Acad. Sci., USSR 5(2): 87-517. Available in reprint edition from J.W. Edwards, Ann Arbor, Michigan, 1947. (Russian and English text)
- 078 Berg, L.S. 1955. [Classification of fishes both recent and fossil. 2nd ed.] Tr. Zool. Inst. Akad. Nauk, USSR 20: 1-286. (In Russian)
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## Subject Index

Note: This index also contains selected references to three commercially important species, *Leiognathus bindus*, *L. equulus* and *L. splendens*; all references to "Mediterranean and Suez Canal" pertain to *L. klunzingeri*, and all references to "paleontology" refer to *L. † altipinnis*. A detailed taxonomic index was not feasible because of the presently confused state of leiognathid taxonomy.

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003, 022, 023, 024, 025, 027, 030, 041, 045, 061, 066, 067, 068, 098, 099, 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 114, 115, 116, 117, 118, 119, 122, 123, 124, 125, 127, 128, 129, 130, 131, 132, 133, 134, 135, 136, 137, 138, 139, 140, 141, 142, 143, 144, 145, 146, 148, 150, 151, 152, 153, 154, 155, 157, 158, 159, 160, 161, 162, 164, 166, 167, 168, 169, 170, 194, 246, 247, 277, 278, 302, 308, 315, 342, 359, 363, 364, 365, 366, 367, 421, 422, 424, 491, 513, 514, 554, 572, 576, 577, 626, 656, 659, 663, 664, 671, 674, 688, 743, 752, 770, 771, 801, 806, 812, 813, 814, 816, 874, 875, 878, 898, 899, 900, 901, 902, 918, 922
- Japan**  
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- Mauritius**  
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- Mediterranean and Suez Canal (= ref. to *L. klunzingeri*)**  
007, 069, 070, 071, 072, 073, 074, 075, 076, 180, 207, 208, 219, 260, 331, 332, 333, 334, 511, 545, 609, 637, 686, 687, 692, 811, 859, 861, 862, 863, 887, 925, 926
- Mossambique**  
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- Pacific Islands**  
001, 038, 054, 275, 276, 282, 284, 287, 289, 291, 298, 300, 303, 304, 305, 306, 341, 343, 345, 353, 354, 381, 388, 389, 390, 396, 397, 399, 463, 466, 473, 488, 495, 536, 544, 561, 578, 685, 754, 755, 756, 757, 758, 759, 761, 762, 765, 768, 769, 774, 810, 910, 911
- Pakistan**  
028, 031, 032, 205, 375, 596, 693, 694
- Papua New Guinea**  
173, 350, 483, 484, 485, 493, 543, 546, 563, 611, 613, 614, 615, 675, 699, 710, 786, 840



**Persian Gulf and Gulf of Oman**

008, 028, 031, 032, 035, 176, 371, 497, 523, 524,  
537, 618, 700, 907

**Philippines**

040, 043, 044, 163, 197, 198, 199, 200, 204, 229,  
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319, 320, 386, 387, 392, 395, 398, 405, 406, 407,  
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570, 571, 589, 602, 608, 649, 650, 670, 677, 703,  
711, 729, 731, 732, 733, 734, 735, 746, 760, 766,  
767, 777, 794, 795, 815, 844, 845, 854, 855, 856,  
857, 869, 870, 871, 872, 873, 876, 880, 881, 888,  
889, 897, 928, 937

**Red Sea**

065, 186, 191, 207, 268, 505, 506, 507, 509, 632,  
738, 739, 808

**Seychelles**

481, 798, 827, 892, 929

**Singapore**

036, 037, 113, 147, 149, 156, 303, 496, 541, 581,  
790, 832, 833, 834, 835, 864, 865

**Somalia**

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**South Africa**

059, 060, 095, 188, 244, 281, 290, 293, 314, 797,  
799, 877, 893, 894, 895

**Sri Lanka**

013, 080, 201, 241, 243, 264, 337, 477, 479, 504,  
569, 586, 610, 621, 667, 668, 681, 742, 791, 792,  
843

**Tanzania**

447, 552, 553, 684

**Thailand**

016, 017, 018, 020, 024, 055, 165, 250, 262, 263,  
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433, 519, 585, 598, 599, 600, 601, 661, 676, 713,  
724, 725, 726, 727, 736, 820, 821, 824, 831, 836,  
846, 847, 848, 850, 853, 858, 919, 920

**Vietnam**

011, 020, 206, 220, 221, 273, 522, 542, 940

**Yemen, South**

028, 031, 032, 255, 512, 638, 684, 809