

Relationship of the Indian and African Freshwater Fish-Faunas. By FRANCIS DAY, F.L.S.

[Read 4th December, 1884.]

AMONG the many interesting problems in Zoology, few exceed that of the Geographical Distribution of Animals, in which the freshwater fish-fauna holds no inconspicuous place. It is therefore highly advisable that when discussing such a question, facts should be first ascertained, and theories be founded on them, for if the former are not quite accurate, the latter may be untenable.

During the years 1877, 1878, and 1879, I had the honour of reading three papers before this Society on "The Geographical Distribution of the Freshwater Fishes of India," deduced from personal researches into the fish-fauna of that empire. I compared that fauna with the African and that of the Malay Archipelago, and these papers were published in the Journal of this Society*. All the species alluded to with their local distribution will also be found in my 'Fishes of India,' which was published in four parts at the following dates:—Part I. August 1875, Part II. August 1876, Part III. August 1877, and Part IV. August 1878.

In 1880, about October, Dr. Günther brought out his 'Introduction to the Study of Fishes,' wherein he adduces a different statement of facts, to a great extent due to his examining groups instead of genera and species, and consequently arrives at widely different conclusions from mine; but it would seem to me possible that, owing to some oversight, he has omitted whole genera from his list of Indian freshwater forms, and likewise misplaced marine ones to among such as belong to the freshwater. That he had not even referred to my 'Fishes of India' is evident, for he remarks (*l. c.* 1880, p. 30) that it "contains an account of the freshwater and marine species, and is not yet complete," whereas the entire work had been published by August 1878†.

I think, from a close examination of his figures, that I am correct in asserting that his tables are compiled from the species enumerated in the 'Catalogue of Fishes in the British Museum,' to which are added those subsequently admitted into the 'Zoo-

* Part I. *Acanthopterygii*, vol. xiii. p. 138, Feb. 28th, 1877; Part II. *Siluridæ*, *l. c.* p. 338, Aug. 20th, 1877; and Conclusion, vol. xiv. p. 543, April 23rd, 1879.

† See also 'Encyclop. Brit.,' art. Fish, xii. p. 635, wherein Dr. Günther has reiterated his statement, but in a different way.

logical Record,' unless in some instances of a few species, which, having obtained access into the latter publication, have not been counted in the enumeration in the 'Introduction to the Study of Fishes,' or else it may be that some of the species in the 'Catalogue' have been suppressed owing to further research*.

Up to the present my time has been so occupied that I have been unable to analyze the two statements, a very necessary work if it is desired to know whether any, and if so where, the difference lies. To the remarks I made in the Society's Journal I have nothing to add, so in this paper shall simply refer to them. "*India*" in my paper only including "India, Burma, and Ceylon," whereas the "*Indian region*" of Dr. Günther includes "Asia south of the Himalayas and the Yang-tse-kiang, and the islands to the west of Wallace's Line." As I found in India proper 19 genera of Acanthopterygian fishes, whereas Dr. Günther only admits 16 genera in his larger "Indian region," of which mine forms merely a little more than half, there must exist some great error on one side or the other.

I will first consider *what is a freshwater fish?* A reply to such a question would appear to be easy. If a fish lives entirely in fresh water, rears its young there, and never descends to the sea, such surely would constitute a strictly freshwater form, as several species of *Ambassis*, Gobies as *Gobius giuris*, Mulletts as *Mugil cascasia*—forms entirely omitted from Dr. Günther's list, although, if his Catalogue is referred to, it will be found that he defines the genus *Ambassis* as "small fishes living in the fresh and brackish waters, and in the seas of the Indian region" (i. p. 222), and he restricts some entirely to fresh waters. As regards the genus *Gobius*, their habitat in the Catalogue (vol. iii. p. 5) is given as "found on all the coasts of the temperate and tropical regions, many species entering fresh waters, and some entirely confined to them;" and although *Gobius giuris* (l. c. p. 22) is

* Dr. Günther (Introd. Study of Fishes, p. 226) observes, with reference to relations of the Indian region in freshwater fishes to that of the Tropical Pacific, that the following must have immigrated from the former into the latter—" *Lates calcarifer*, species of *Dules*, *Plotosus anguillaris*," and "species of *Arius*." He continues, "All these fishes must have migrated by the sea; a supposition which is supported by what we know of their habits." If he had continued that all these forms are marine and not belonging to a freshwater fauna, he would have been correct in the observation, and made the reader, who has not been in the east, more readily understand why it was they should have come by the sea.

stated to be "found on all the Indian coasts, entering fresh waters," it is very doubtful whether more than one species are not included under this head. I found this fish throughout the freshwater regions I examined, from the Punjab to Cape Comorin, from Sind to the eastern extremity of Burma, and even some way up the Himalayas, living and breeding in fresh water, where their young were being reared.

Then we have catadromous forms which I should locate among those of the freshwater, but of these there are, so far as I am aware, only the Eel. There are a considerable number of anadromous forms, and these are not so easy to arrange as to whether they are or are not to be considered freshwater or marine fishes. Among anadromous forms we find some, as in the Salmon of our rivers, which ascend to breed, and wherein the young continue until they may be in a condition to propagate their kind : these would rank among freshwater forms. Then we have the Shad, which likewise ascends rivers to breed, but the young do not appear to be raised in the rivers, unless in the lower reaches, and these could hardly be termed freshwater fishes. Similarly among the species in India, it may be questionable whether the *Sciæna coitor* may not be a simple anadromous form wherein the young drops down to the sea ; but this I do not think to be the case, as I have found the young in rivers far above impassable weirs. In the following paper I have thought it advisable to omit, as far as possible, my own observations made among the fishes in India, as such have already been published, and to give the opinions of others who have worked in the same localities as field-naturalists, and whose records are the results of what they have personally found. Following this course, I think it possible to show that I was and am entirely justified in placing the fishes I did among the Indian freshwater fish-fauna, although they have, subsequent to the publication of my papers, been rejected as such by Dr. Günther, and that without any comment or explanation being given for the course which he has adopted.

Dr. Günther furnishes an elaborate list of the forms of freshwater fish inhabiting the Indian region (Introduction to the Study of Fishes, p. 220), and of the Acanthopterygians as follows :—

"PERCINA, *Lates* (also Africa)."—This first genus in India is not a freshwater form, but found in the mouths of rivers, up which it

occasionally ascends in pursuit of prey*. In the 'Catalogue of Fishes of the British Museum,' it is observed that it is found at the "mouths of large Indian rivers" (vol. i. p. 67), and even in the 'Introduction' (p. 377), that it is the "Perch of the Ganges and other East-Indian rivers, which enters freely brackish waters." Hamilton Buchanan (Fishes of the Ganges, p. 87) remarks that "the *Vacti* abounds in all the mouths of the Ganges, which it ascends as far as the tides, and follows this into marshes, ditches, and ponds; but those found in salt water are of by far the best quality." Bleeker, in his 'Fishes of Bengal,' gives as its habitat "Ostia Gangetica, Coromandelia." Cantor, in his 'Malayan Fishes' (p. 2), observes that it is found in the "Bay of Bengal, estuaries of the Ganges, Indian Ocean," &c. This genus must be erased from among those composing a portion of the freshwater fish-fauna of India.

Genus *Ambassis*.—Dr. Günther does not include this genus (which is absent from Africa) as among the Indian freshwater forms. In his 'Catalogue' (p. 222), he gives as its geographical distribution, "small fishes living in the fresh and brackish waters and in the seas of the Indian region," &c.; and in his 'Introduction' (p. 394) that "they are most abundant on the coasts of the Tropical Indo-Pacific and in the freshwaters belonging to that area." Hamilton Buchanan observes of *Chanda*† *nalua* (p. 108), that it is "found in the freshwater rivers of Lower Bengal;" of *C. nama*, that it "is common in ponds throughout Bengal" (p. 109); of *C. phula*, that it "is found in the ponds and rivers of the north-eastern parts of Bengal" (p. 111); of *C. bagoda*, that it "is also found in the north-eastern parts of Bengal" (p. 111); *C. baculis* in the same locality (p. 112); *C. ranga* "is found in the fresh waters of all the Gangetic provinces" (p. 113); and *C. lata* "is found along with the last described" (p. 114). Bleeker, for different Indian species, gives Dekkan Bengal, Loodinah, and Jihlum Glum. Sykes, in his "Fishes of the Dukhun" (Trans. Zool. Soc. ii. 1841), gives *Ambassis Barlovi* as a species "found in the Beema river at Pairgaon" (p. 350). From the foregoing one would imagine that (leaving my observations out of the question) the evidence of every author who

* It is unnecessary to observe upon how many sea-fishes, as the European Bass &c., may be acclimatized to freshwater when they are unable to obtain access to the ocean

† This genus is identical with *Ambassis*, C. & V.

has made the study of Indian fishes his occupation might be entitled to some credence, and that many of these forms are distinctly freshwater species.

Consequently, among the PERCINA, instead of the *Lates*, common to India and Africa, being the only genus in the fresh waters of the Indian region, it must be erased from such a list, and restricted to a marine fauna; while *Ambassis* has to be introduced among the freshwater fauna, a genus which is absent from Africa.

Next in succession Dr. Günther gives the following:—NANDINA, 7 species, consisting of *Badis* 2 species, *Nandus* 2 species, *Pristolepis* (he elects to term it *Catopra*) 3 species, as recorded in the British-Museum Catalogue. These numbers would seem to omit the *Pristolepis marginatus*, Jerdon, and *P. malabaricus*, Günther, both restricted to the Indian region.

“LABYRINTHICI (Africa), 25 species.”—If we add the species admitted into the ‘Zoological Record’ to those in the British-Museum Catalogue, we obtain as follows:—*Anabas* 4, *Hplostoma* 1, *Polyacanthus* 7, *Macropus* 1, *Osphromenus* 6, *Trichogaster* 4, *Betta* 2, or 25 species. Now, although the genera *Spirobranchus* and *Ctenopoma*, both belonging to the Labyrinthici, are found in Africa, they do not extend to the Indian region. The genera of this family present in Africa are distinct from the genera which exist in Asia; or Labyrinthici includes 7 Indian and 2 African genera, none of which are common to both regions.

LUCIOCEPHALIDÆ.—Represented by a small species of *Luciocephalus* found in the East-Indian archipelago.

SCIÆNIDÆ.—Members of this family, in the ‘Introduction,’ find no place among the freshwater fish-fauna of India. Genus *Sciæna* affords one species, *S. coitor*, that lives and breeds in many of the Indian rivers. Hamilton Buchanan observes:—“This fish is found in the Ganges, from the sea up as far at least as Kanpur (Cawnpore), and in the Jumna as far as Agra. It is, however, much more common where the tide reaches, although its quality improves in the upper parts of the river, especially where the shores are rocky” (Gangetic Fishes, p. 75). In the ‘Introduction to the Study of Fishes,’ Dr. Günther observes of *Sciæna** *coitor* on its being one of the most common fishes on

* He makes the same remark of *S. diacanthus*, a species which only ascends as far as the tidal influence reaches, or perhaps a little above; while *S. coitor* breeds in rivers above large weirs destitute of any fish-passes.

the coast of the East Indies, ascending the great rivers for a long distance from the sea (p. 430).

GOBIIDÆ.—Members of this family are omitted by Dr. Günther from among the freshwater fish-fauna of India. In the district or division to which I restricted my designation of "India," several genera are found having representatives in the fresh waters, and which I will enumerate.—*Gobius*: Dr. Günther says, "Not a few have become entirely acclimatized in fresh waters, especially lakes" (p. 486).—*Gobius giuris*, H. B. Hamilton Buchanan observes that it is found "in all the ponds and freshwater rivers in the Gangetic provinces, where it is a very common fish" (Gangetic Fishes, p. 51); Bleeker, that it is found in "Bombay, Bengalia, Jihlum, Dukhun" (p. 51); Sykes gives it as in the Deccan under the designation of *Gobius kurpah* (l. c. p. 352); Jerdon says *G. kokius* is "very common in tanks, rivers, and ditches throughout the south of India" (Madras Journ. Lit. & Science, 1849, vol. xv. p. 148).

Genus *Sicydium*, of which I have obtained two species, one from fresh waters in Burma, the other from fresh waters in Canara. In Dr. Günther's 'Introduction' he says of these fish, "Small freshwater fishes inhabiting the rivers and rivulets of the islands of the Tropical Indo-Pacific" (p. 487). Possibly my species, which are figured in the 'Fishes of India,' have been overlooked; also Bleeker's, referred to in the 'Catalogue of the Fishes of the British Museum' (vol. iii. p. 93), as *S. xanthurum* from "rivers of West Sumatra and Bali," *S. micrurum* from "rivers of Amboyna and Bali" (p. 94), &c. &c.

Genus *Periophthalmus*, of which I obtained *P. Schlosseri* in fresh waters, especially in the Irrawaddi and its branches, as well as in estuaries.

Genus *Eleotris*.—I have found the *E. fusca* in fresh waters; while of this genus Dr. Günther (Introduction, p. 488) observes on "some of them being abundant in the rivulets of the islands of the Indo-Pacific." Hamilton Buchanan, alluding to this species under the designation of *Cheilodipterus culius*, says it "is pretty common in the ponds and ditches of Bengal" (l. c. p. 55); Jerdon, that "it is very common in Malabar in ditches and tanks" (l. c. p. 149).

Thus it appears that in the list of the Indian freshwater fish-fauna the family of GOBIIDÆ has been omitted by Dr. Günther

although it has representatives residing inland of species of the genera *Gobius*, *Sicydium*, *Periophthalmus*, and *Eleotris*.

"MASTACEMBELIDÆ (or RHYNCHOBDELLIDÆ), 3 species in Africa; 10 species" in the Indian region.—In the 'Catalogue' vol. iii., *Rhynchobdella* 1 species, and *Mastacembelus* 8 species, are given. In the 'Zoological Record' are added in this region *Rhynchobdella sinensis*, Bleeker, *Mastacembelus fasciatus*, Bleeker, and *M. Guentheri*, Day.

CHROMIDES.—Two species of *Etroplus* are admitted from India, *E. canarensis*, Day, being probably rejected: a figure of this form from the life along with *E. maculatus* are therefore exhibited, all three forms being fully described and figured in the 'Fishes of India' and alluded to in the 'Zoological Record.'

MUGILIDÆ, omitted from the list of freshwater fishes in the Indian region. One of the three forms, *M. Hamiltonii*, I discovered in the fresh waters of Burma. Of *M. corsula*, Hamilton Buchanan observes that it "is found in most rivers of the Gangetic provinces, and in the southern parts of Bengal has been introduced into some ponds" (Gangetic Fishes, p. 221); of *M. cascasi* he remarks, "This fish I found in the northern rivers of Bengal" (*l. c.* p. 217). According to my views these Mulletts, which live and breed in fresh waters, belong to the freshwater fauna.

"OPHIOCEPHALIDÆ 30 species (1 from Africa)."—In the Catalogue, 25 species of *Ophiocephalus* and 1 of *Chauna* are stated to exist in the Indian region as defined in the 'Introduction.' In the 'Zoological Record' are 4 more species of *Ophiocephalus*, with localities given, which would complete the list. Although only one species, (I suppose) *O. obscurus*, Günther, is given from Africa, possibly *O. africanus*, Steind., from West Africa, was unintentionally omitted.

In questions of geographical distribution more information is desirable than such as the following: "Ophiocephalidæ are found in India, China, and Africa;" for this might raise the supposition that they were equally common in all these localities: such, however, is by no means the case, they may abound in one or two of those districts, but be very sparsely distributed in a third. The abundance of forms ought to be considered along with their presence. Again, if one genus of a family has representatives in Africa, and 10 or 15 in Asia, it may be true that such a family is common to both continents, but such is the case to only a limited

extent. Consequently, one can scarcely argue that, because two genera of Labyrinthici are sparingly found in Africa and seven in Asia, some of these last being composed of many species or varieties extending in large numbers over wide distances, that the fishes of this family are common to the two continents, which, although true in fact, may be misleading without any explanation.

Respecting the SILURIDÆ, the marine and freshwater forms have been so mixed up in the 'Introduction to the Study of Fishes' (p. 222), that there will be a little difficulty in disentangling them; but to do this I must examine them in succession.

"CLARIINA (Africa), 12 species" (Introduction, p. 222).—11 forms pertaining to his Indian region are given in the Catalogue (vol. v.); also of CHACINA 3, as in 'Introduction'; of SILURINA 63 species (several nominal) are given in the Catalogue for this region, and more are in the 'Record.'

"BAGRINA (Africa), 50 species."—*Macrones*, 20 species; *Pseudobagrus*, 4 species; *Liocassis*, 4 species; *Bagroides*, 3 species; *Bagrichthys*, 1 species; *Rita*, 4 species; *Acrochordonichthys*, 6 species; *Akysis*, 3 species; *Olyra*, 1 species; *Branchiosteus*, 1 species; or 47 in the Catalogue. The omitted species it is unnecessary to follow out.

"ARIINA (Africa, Australia, and South America), 40 species."—Here again we have a large marine and estuary family placed among the freshwater fish-fauna! It is captured within the influence of the tides, or even occasionally ascending into and becoming imprisoned in brackish waters, and so may be left there until the next year's rains; but it is hardly correct to say "Some of the species prefer brackish to fresh water, and a few enter the sea but keep near to the coast" (p. 569). Hamilton Buchanan says of *Ageneiosus mino*, "This fish is found in the upper part of the estuaries, that is, where the water possesses little or no saltiness" (Gangetic Fishes, p. 159); *Pimelodus gagora*, "It is common in the estuaries of Bengal" (l. c. p. 167); *P. sagor* "is found along with *gagora*" (l. c. p. 169); of *P. arius*, "found in the same places as the *gangora*" (l. c. p. 170); *P. jatius* "is found in the same place, grows to the same size, and has similar colours to the *gagora*" (l. c. p. 171); *P. nenga*, "found in the same place" (l. c. p. 172); *P. soua*, "found in the same places" (l. c. p. 172). Cantor, in his 'Malayan Fishes,' only found

species of *Arius* in the seas and estuaries. Jerdon admitted none among his list of "the Freshwater Fishes of Southern India" (Madras Journ. Lit. & Sci. xv. 1849, pp. 139, 302). As far as my personal investigations in the East have gone, if the Ariinæ elsewhere have the same habit as along the coast of India, these 40 species should be erased from the freshwater fish-fauna.

"BAGARIINA, 20 species; " 16 are in the Catalogue.

"RHINOGLANINA (Africa), 1 species," as in Catalogue.

HYPOSTOMATINA (South America), 5 species."—Five in the Catalogue; but, as I long since pointed out, genus *Erethistes*, V., p. 263, is identical with *Hara*, p. 189; but this form possibly is not one of the five.

"CYPRINODONTIDÆ.—*Haplochilus*, 4 species."

SCOMBRESOCIDÆ.—Omitted from the Indian freshwater fish-fauna by Dr. Günther. *Belone cancila*: the habitat given in the 'Catalogue of the Fishes of the British Museum' (vi. p. 253) is "Indian Ocean;" I gave it as "fresh waters of Sind, India, and Ceylon, and throughout Burma." Hamilton Buchanan observes that it "is a very common fish in the ponds and smaller rivers of the Gangetic provinces" (Gangetic Fishes, p. 214). Sykes, 'Fishes of the Dukhun,' p. 367, terms it "a freshwater fish" found in the Mota Mola river at Poona. Jerdon, 'Freshwater Fishes of Southern India' (p. 345) states that "this fish is found in most of the rivers of the west coast up to the base of the mountains."

CYPRINIDÆ.—Of these as given in the list in the 'Introduction' (if we omit the majority of such as I have discovered in India) we have a fair compilation. OSTEOGLOSSIDÆ, NOTOPTERIDÆ, and SYMBRANCHIDÆ call for no observations.

If we analyze Dr. Günther's list with the foregoing remarks, we obtain the following results:—

Present in Indian and African regions:—1 Labyrinthici, 2 Ophiocephalidæ, 3 Mastacembelidæ, 4 Chromides, 5 Clariina, 6 Silurina, 7 Bagrina, 8 Rhinoglanina, 9 Cyprinodontidæ, 10 Cyprinina, 11 Rasborina, 12 Danionina, 13 Abramidina, 14 Osteoglossidæ, 15 Notopteridæ. The groups Percina, genus *Lates*, and Ariina must be erased, as not belonging to freshwater fauna.

Restricted to India:—1 Nandina, 2 Luciocephalidæ, 3 Chacina, 4 Bagariina, 5 Hypostomatina, 6 Semiplotina, 7 Homalopterina, 8 Cobitidina, and 9 Symbranchidæ.

But the following additions have to be made. Among the SCIÆNIDÆ, genus *Sciæna*, which has representatives among the freshwater fish-fauna of India, as have also the GOBIIDÆ, but whether any of the former are found in African fresh waters is hardly proved, but some of the latter have been.

Among the PERCINA, genus *Ambassis* is present in Indian fresh waters, but is not found in Africa.

Although Dr. Günther limits the investigations made into the fish-fauna of the Alpine tracts of the Himalayan region to what Griffith accomplished, the researches of Dr. Stoliczka showed that he obtained freshwater forms in Tibet at nearly 16,000 feet above the sea-level*.

But it may well be asked, Is it by examining large groups of fishes as a whole, or by investigating their distribution in genera or species, that we obtain the most accurate information as to the zoological affinities between different localities? I consider the latter plan is that which is best suited for this purpose, and in examining the analogy between the Indian and African freshwater fish-faunas, I find as follows:—

In India, as restricted, I found 87 genera of freshwater fishes, of which only 14 have representatives in Africa; while among the 369 species of which these genera are composed, only 4 extend to Africa. If we examine the relationship of the same fauna in this restricted Indian area we find, of the 87 genera, 44 extend to the Malay Archipelago, and of the 369 species, 29 are present in both localities; or, tabulated, it comes as follows:—

Indian Freshwater Fishes.

87 genera:—14 extend to Africa; 44 to the Malay Archipelago.
369 species:— 4 extend to Africa; 29 to the Malay Archipelago.

* Dr. Günther, 'Introduction to the Study of Fishes,' p. 227, observes:—"No observations have been made by which the altitudinal limits of fish-life in the Himalayas can be fixed; but it is probable that it reaches the line of perpetual snow, as in the European Alps, which are inhabited by Salmonoids, Griffith found an *Oreinus* and a Loach, the former in abundance in the Helmund at Gridun Dewar, altitude 10,500 feet, and another Loach at Kaloo at 11,000 feet." Even in the 'Catalogue of the Fishes of the British Museum,' vol. vii. p. 360, it is stated of Stoliczka's Loach, *Nemacheilus Stoliczkae*, "Province of Rupshu (Tibet), 15,500 feet above the level of the sea."



Day, Francis. 1885. "Relationship of the Indian and African Freshwater Fish-Faunas." *The Journal of the Linnean Society of London. Zoology* 18(107), 308–317. <https://doi.org/10.1111/j.1096-3642.1885.tb02049d.x>.

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