Taxonomic studies on the puffers (*Tetraodontidae, Teleostei*) from Japan and adjacent regions — VI. Variation of pectoral fin.

(With some additions to the previous reports of the present series)

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NOMENCLATURAL NOTES

After the fifth report of the present series was published in 1949, the following papers pertaining to the classification of puffers were received from the authors:

BREDER, C. M., JR. and CLARK, E. 1947. A contribution to the visceral anatomy, development, and relationships of the Plectognathi. Bulletin of the American Museum of Natural History, lxxxviii, article 5, pp. 282-320, pls. 11-14.

CLARK, E. 1949. Notes on some Hawaiian Plectognath fishes, including a key to the species. American Museum Novitates, no. 1397, pp. 1-22.

FRASER-BRUNNER, A. 1943. Notes on the Plectognath fishes.-VIII. The classification of the suborder *Tetraodontoidea*, with a synopsis of the genera. Ann. Mag. Nat Hist., ser. 11, vol. x, pp. 1-18.

SMITH, J. L. B. 1949. The sea fishes of southern Africa. xvi+550 pp., 102 pls.

Moreover, the present writer has received from the Australian Museum (Sydney) a specimen of *Sphoeroides tuberculiferus* Ogilby, type of the genus *Torquigener* Whitley (1930), through the kindness of Dr. A. B. Walkom (Director of the Australian Museum) and Dr. G. P. Whitley (of the same Museum). He wishes to express here his sincere thanks to the donors of the gift publications and gift specimen for their generosity and effective cooperation with him.

In his elaborate work of 1943, Dr. Fraser-Brunner introduced many generic names of puffers previously not commonly used by previous writers. The present writer owes him much for his valuable suggestions. It is regretted, however, that the present writer will not be able in the near future to consult old papers and examine specimens of foreign countries freely following his suggestions because of the present situation. He wishes to give here only some notes on the generic and subgeneric names of the common Sino-Japanese puffers which Dr. Fraser-Brunner referred to the genus *Torquigener* based on the descriptions by Ogilby and by Dr. Whitley. Upon careful examination of the specimen of *Sphoeroides tuberculiferus*

Ogilby mentioned above*, it has been found that this species is closely related to *Sphoeroides hypselogeneion* (Bleeker)**. For the reception of the latter the present writer proposed the subgenus *Shippofugu* in 1949 (Abe, 1949b), because it is well separated from the other subgenera of the large genus *Sphoeroides* adopted by him in the same paper. In this connection he designates below the types of the subgenera proposed by him in the paper just mentioned and in another of 1938:

Subgenus *Shippofugu* Abe, 1949, p. 90. Type: *Tetraodon hypselogeneion* Bleeker, 1852.
Subgenus *Takifugu* Abe, 1949, p. 90. Type: *Tetrodon oblongus* Bloch, 1786.
Subgenus *Torafugu* Abe, 1938, p. 336. Type: *Tetraodon rubripes* Temmink et Schlegel, 1850.
Subgenus *Shosaifugu* Abe, 1949, p. 92. Type: *Tetraodon vermicularis* Temminck et Schlegel, 1850.
Subgenus *Higanfugu* Abe, 1949, p. 93. Type: *Tetraodon pardalis* Temminck et Schlegel, 1850.

The writer is now somewhat doubtful as to the validity of the subgeneric name *Shippofugu*, because Dr. Fraser-Brunner referred its type, *hypselogeneion*††, to the genus *Amblyrhynchotes* Troschel, the type of which (*Tetrodon honckenii* Bloch) has not been examined by the present writer. If *hypselogeneion* and *honckenii* belong to the same genus, *tuberculiferus* also should be referred to the same genus, and, at all events, as to the generic name of the Sino-Japanese puffers of the subgenera *Torafugu, Shosaifugu, Higanfugu* and *Liosarcus*, the adoption of *Torquigener* for them is believed inadmissible, and the name *Sphoeroides* will be adopted for them provisionally in the following pages as was done in the previous reports of the present series.

ADDITIONAL NOTES ON THE VERTEBRAL VARIATION

i) In April, 1950, a paper on the life history of *Sphoeroides ocellatus obscurus* Abe was read by Prof. K. Uchida before the Annual Meeting of the Japanese Society of Scientific Fisheries. According to him, this puffer ascends the rivers of western Korea to spawn, and near Pyongyang it spawns in April-May in shallow water of the river. In this connection the writer wishes to lay stress on the fact that the present form (like *S.*

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* Total length 121 mm. Trawled by the "Endeavour", 20 miles N. E. of Bustard Head Light, Queensland, in 20 fathoms, July 8, 1910. ♀, ovaries comapratively large. The common Sino-Japanese puffers (with the exception of *S. niphobles*) have not such large overies at the size like that of this specimen.

** Except for the coloration, *Sphoeroides tubercuriferus* resembles *Sphoeroides hypselogeneion* and differs from the common Sino-Japanese puffers of the subgenera *Torafugu, Shosaifugu, Higanfugu, etc.* in the following characters:
D. 10 (ii+7+i); A. 7 (ii+4+i). Dorsal and anal fins without membrane connecting the posterior margin of the fin with the skin of caudal peduncle. Spines much larger and two-rooted. Two lateral spinulose areas, one in front of the gill-opening and the other behind the base of pectoral fin. Tubercles, or papillae, at the anterior rim of the lower part of gill-opening conspicuous, each containing a distinct spine (in *hypselogeneion* they are less conspicuous). Bony interorbital space much narrower (0.036 of standard length) (in one specimen of *hypselogeneion* 0.043; in one specimen of *Sphoeroides rubripes rubripes* 0.107; in one specimen of *S. vermiculalis vermicularis* 0.116; in one specimen of *S. pardalis* 0.121; in one specimen of *S. chrysops* 0.141).
† *vide* "Key" on page 90 of the same paper.

†† Lower lateral fold (or ridge) is distinct in *hypselogeneion* and *tuberculiferus*, although he stated (p. 9, p. 10, fig. 3) that it is absent in the former species.

pardalis which spawns in spring) has exceptionally numerous vertebrae as was stated in a previous paper (Abe 1949b, p. 98, foot-note).

ii) Through the kindness of Dr. H. Nakamura and Mr. T. Kamimura, numerous specimens of *Lagocephalus lagocephalus oceanicus* Jordan et Evermann obtained from the alimentary canal of *Makaira mazara* (Jordan et Snyder) and *M. mitsukurii* (Jordan et Snyder) have been examined by the present writer. In one of them the total number of vertebrae was 18 (=8+10).

iii) In the two specimens of *Lagocephalus laevigatus inermis* (Temminck et Schlegel) taken from East China Sea or its adjoining waters (obtained at the Central Wholesale Market of Tokyo, one specimen of 282 mm. total length on June 28, 1947, and the other of 365 mm. total length on December 25, 1947) the total number of vertebrae was 18(=8+10).

iv) In addition to the publications referred to in the previous works (Abe, 1942, 1944, 1949, 1949a), the following papers pertaining to the vertebral variation in fishes have been seen by the present writer.

BREDER, C. M., JR. and NICHOLS, J. T. 1934. On the significance of vertebral counts in exocoetid taxonomy. Proc. Biol. Soc. Wash., xlvii, pp.37-44.

BRUUN, A. F. 1933. On the value of the number of vertebrae in the classification of the *Exocoetidae*. Vidensk. Medd. Naturh. Foren., xciv, pp. 375-384. Not seen in the original.

GABRIEL, M. L. 1944. Factors affecting the number and form of vertebrae in *Fundulus heteroclitus*. J. Exp. Zool., xcv, pp. 105-147. Not seen in the original.

GOSLINE, W. A. 1947. Some meristic characters in a population of the fish *Poecilichthys exilis*: their variation and correlation. Occasional Papers of the Mus. Zool., Univ. Michigan, no. 500, July 22, 1947, pp. 1-24, pls. 1, 2.

—— 1948. Some possible use of X-rays in ichthyology and fishery research. Copeia, 1948, no. 1, pp. 58-61.

HATANAKA, M. and OKAMOTO, R. 1950. Studies on populations of the Japanese sand lance (*Ammodytes personatus* Girard). The Tohoku Journal of Agricultural Research, i, no. 1, pp. 57-67.

HUBBS, C. L. 1924. Seasonal variation in the number of vertebrae of fishes. Papers Mich. Acad. Sci., Arts and Letters, ii, pp. 207-214. Not seen in the original.

ROMER, A. S. 1949. The vertebrate body. viii+643 pp.

SNYDER, R. C. 1949, Vertebral counts in four species of suckers (*Catostomidae*). Copeia, 1949, no. 1, pp. 62-65.

SUND, O. 1943. Variation of the number of vetebrae in the Norwegian winter herring. Ann. Biol. (Copenhagen), i, pp. 56-57. Not seen in the original.

TÅNING, Å. V. 1944. Experiments on meristic and other characters in fishes. Medd. Komm. Danmarks Fisk. of Havunders., ser. Fiskeri., xi, pp. 1-127. Not seen in the original.

—— 1946. Stage of determination of vertebrae in teleostean fishes. Nature, clvii (May 4, 1946), p. 594.

—— 1950. Influence of the environment on number of vertebrae in teleostean fishes. Nature, clxv (Jan. 7, 1950), p. 28.

ADDITIONAL PAPERS PERTAINING TO THE VARIATION OF CAUDAL FIN WHICH HAVE BEEN REFERRED TO IN THE STUDY OF THE PRESENT SERIES

In additon to the papers referred to in a previous paper (Abe, 1949a) the following papers pertaining to the variation of caudal fin of fishes have been seen recently.

OKADA, Y. K. 1943. Regeneration of the tail in fish. Annot. Zool. Japon., xxii, no. 2, pp. 59-68, pl. 3.

—— 1950. A coffer-fish with double caudal fins. Zool. Mag. (Tokyo), lix, no. 1, p. 8.

TOTTON, A. K. 1914. The structure and development of the caudal fin of the teleostean fish, *Pleurogramma antarcticum*. P. Z. S. London, 1914, pp. 251-262, 2 pls.

VARIATION OF PECTORAL FIN

Reserving the study of the variation of the shoulder girdle and the coloration of the pectoral fin for future work, some of the variations of the visible portion of the pectoral fin in the puffers will be dealt with below.

a. Sum (Pl+r) of the number of the fin-rays of the left pectoral and that of the right pectoral

There are some difficulties in studying the variation of the total number of pectoral fin-rays. First, the uppermost ray is rudimentary and hidden beneath the skin in the examined members of *Liosaccus*, *Sphoeroides* and *Lagocephalus* (exceptng for *L. sceleratus*), and was not counted by most of predecessors. The second ray from above, though unbranched and divided as in the uppermost one, is nearly as long as the longest ray of the fin, and was regarded by them as the uppermost one in the three genra mentioned just adove. Thus, the number of the pectoral fin-rays of puffers given in the papers by previous writers should be examined with discretion*. Secondly, the pectoral fin of the puffers is subject to considerable bilateral variation, the number of the fin-rays also being different not infrequently from one side to the other. This latter variation, along with the other bilateral variation of the pectoral, will be treated of later than the examination of the sum of the number of the fin-rays of the pectoral of the both sides in order to facilitate the evaluation of the taxonomic

* In Bleeker's Atl. Ichth., v, are given the numbers of the pectoral fin-rays in many species of puffers. He distinguished the upper unbranched rays from the rest, of which the majority are usually branched. But he did not count the rudimentary uppermost ray, and stated nothing about the lowermost unbranched rays. He also made no distinction between the fins of the both sides.

significance of the number of the pectoral fin-rays which are usually treated of without the distinction between the fins of the both sides.

In Table 1 the total number of the pectoral fin-rays (P_{l+r}) is the sum of the number of the left pectoral rays and that of the right ones. P_{l+r} is followed by the number of the left pectoral fin-rays (P_l) and then by that of the right pectoral fin-rays (P_r).

In this fin-formula of the left or right pectoral, the small Roman numeral on the left represents the number of the uppermost unbranched ray which, as stated above, is often rudimentary and hidden beneath the skin. The Arabic numerals in the middle of the formula represent the number of the other fin-rays, namely, the second (from the top) to the lowermost ones. The Roman numeral on the right signifies that the second ray (from the top) is unbranched as the uppermost ray. The second ray is always long, and seems to have been reckoned by many of predecessors as equivalent to the third and the subsequent rays which are mostly branched. In a few cases the third ray from above is also unbranched, or, the second ray is branched. These are pointed out by asterisks or daggers. The lowermost ray (or very rarely rays) is (or are) unbranched in some individuals, probably irrespective of species or irrespective of the size of the fish*. Whether the lowermost ray is branched or not is neglected in Table 1, but mention will be made of it later under the heading of "Bilateral variation".

Speaking generally, the number of the fin-rays in each of the pectoral fins in the puffers is less variable, varying between 12 and 20 (23 in *Tetraodon palembangensis*, according to Bleeker's Atl. Ichth., v), than the total number of the dorsal (D) or anal fin-rays (A_n), D varying between 7 and 19 (38 in *Xenopterus naritus*, according to the Bleeker's book just mentioned) and A_n varying between 7 and 16 (32 in *Xenopterus naritus*, according to the Bleeker's book just mentioned). This is probably correlated with the available space for the bases of the fins.

Comparison between genera or widely-separated species. With respect to the genera or widely-separated species, the number of the pectoral fin-rays is quite different from that of the dorsal (D) or anal fin-rays (A_n) on the one hand and from that of the caudal fin-rays on the other in the nature of its variation (*cf.* Abe, 1944, 1949, 1949a). Whereas D and A_n [like the total number of vertebrae (N)] are distinctly smaller in

* The changes of the pectoral fin-rays with advancing age have not been studied by the present writer. But it seems certain that some individuals of larger size have the lowermost ray unbranched while some others of smaller size of the same species have it branched, and *vice versa*.

Table 1

The frequency distributions of the sum (P_{l+r}) of the number of the left pectoral fin-rays (P_l) and the number of the right pectoralfin-rays (P_r) for all samples and species or forms of *Tetraodontidae* examined. The frequency distributions of Pl and P_r are also given. ⟦⟧: The presence of the uppermost rudimentary ray (usually hidden benea th the skin) is not certain, but counted as one. In spring, 1934, the present writer began the taxonomic studies on the puffers, and during the subsequent several years he paid little attention to the uppermost rudimentary ray of the pectoral fin. It was only recently that he noticed its taxonomic importance and commenced to count it. In many specimens, more particularly in skeletons, the counting of the pectoral fin-rays have not been repeated, because they have been mostly lost, whereas the shoulder girdles along with skulls and vertebral columns are well preserved. So far as the writer reexamined the pectoral fins, the uppermost rudimentary ray of the pectoral fin in *Liosaccus*, *Sphoeroides* and *Lagocephalus* (excepting *L. sceleratus*) is invariably present, and it is assumed that the uppermost rudimentary ray existed in those specimens of which the writer did not examined it carefully. (): Whether the second ray from above is unbranched or abnormally branched is not certain. *: The 2nd ray from above (namely, the next one to the uppermost rudimentary ray in the three genera mentioned just above) is abnormally branched. The asterisk, on the left side of a figure shows that the left pectoral fin has only one unbranched ray above, the 2nd ray being abnormally branched, and the asterisk on the right side of a figure shows that the right pectoral fin has only one unbranched ray on top of the fin. Two asterisks, one on the left side and the other on the right side of a figure show that the left and right pectoral fins have only one unbranched ray above.
†: The 3rd ray from above is unbranched (like the lst and 2nd rays of the normal fin). The dagger on the left side of a figure shows that the left pectoral fin has three uppermost unbranched rays, and the dagger on the right side of a figure shows that the right pectoral fin has three uppermost unbranched rays. Two daggers, one on the left side and the other on the right side of a figure, show that the left and right pectoral fins have three uppermost unbranched rays. ††: The 4th (like the 1st–3rd) ray from above is abnormally unbranched. The daggers are placed on either side of a figure showing that the left or right fin is subject to this abnormality. †††: The 5th (like the 1st–4th) ray from above is abnormally unbranched. Italicized figures in the right columns show that the number of the left or right pectoral fin-rays exceeds that of the fin-rays of the other side by 2, *e. g.*, P = i + 17 and P_r = i + 15.

Scientific name / P_{l+r}	27	28			29		30			31			32		33		34		35		36	37		38	40	Total	$P_l>P_r$	P_l+P_r	$P_l<P_r$
P_l	i+14(1·	i+14(1·	i+12(1·	i+13(1·	i+14(1·	i+13(1·	i+15(1·	i+13(1·	i+14(1·	i+11(1·	i+15(1·	i+14(1·	i+16(1·	i+15(1·	i+16(1·	i+15(1·	i+17(1	i+16(1·	i+17(1·	i+16(1·	i+17(1·	i+18(1·	i+17(1·	i+18(1·	i+19(1·				
P_r	i+11(1·	i+12(1·	i+14(1·	i+13(1·	i+13(1·	i+14(1·	i+13(1·	i+15(1·	i+14(1·	i+18(1·	i+14(1·	i+15(1·	i+14(1·	i+15(1·	i+15(1·	i+16(1·	i+15(1·	i+16(1·	i+15(1·	i+17(1·	i+17(1·	i+17(1·	i+18(1·	i+18(1·	i+19(1·				
Canthigaster valentini (Bleeker)														††1+1†		2										4		2	2
Canthigaster margaritatus (Rüppell)																(1)		1+(1)								3		2	1
Canthigaster amboinensis (Bleeker)																		1+1†								2		2	
Canthigaster jactator (Jenkins)																		(1)								1		1	
Canthigaster compressus (de Procé)														†1†+1		1										3		2	1
Canthigaster rivulatus (Temminck et Schlegel)														1	3			6		1						11	3	7	1
Liosaccus cutaneus (Günther)									†1†+ 1+((5))		(1)+(1) +((1))	((1))		†1+1+((5))		1										19	3	14	2
Lagocephalus lagocephalus oceanicus Jordan et Evermann					1	1			1†+2					1												6	1	4	1
Lagocephalus laevigatus inermis (Temminck et Schlegel)																	1	1			1+(1)					4	*1*	3	
Lagocephalus lunaris (Bloch et Schneider)									1+ ((5))		((4))	2+(1)		9+(4)+((22))	(1)	1	1	12+(1*)+(2) +(5)+((6))	((1))	1	1					80	*1*+6	68	5
Lagocephalus sceleratus (Gmelin)												1		5	1						3+(1)					11	1	9	1
Sphoeroides maculatus (Bloch et Schneider), from Woods Hole														(1)				1+(3)								5		5	
Sphoeroides tuberculiferus Ogilby, from Australia				1																						1		1	
Sphoeroides hypselogeneion (Bleeker)				1										1+((1))		1										4		3	1
Sphoeroides oblongus (Bloch)													1					1								2	*1*	1	
Sphoeroides ocellatus ocellatus (Linnaeus)																								1		1		1	
Sphoeroides ocellatus obscurus Abe															2			2			1			1		6	2	4	
Sphoeroides xanthopterus (Temminck et Schlegel)															1			6+(1) +((1))	1	3+((1))	1†+16+ +(1)+(2)			1		35	2	29	4
Sphoeroides basilevskianus (Basilewsky) Jordan et Metz																				((1))	1					2		1	1
Sphoeroides rubripes rubripes (TemmincK et Schleger)															2		1	9+((2))	3+((2))	2	1†+17+(1) +(2)+((1))		1	(1)		45	*1*+7	34	3
Sphoeroides rubripes chinensis Abe																1		1+ 1)	1		2					6	1	4	1
Sphoeroides pseudommus (Chu)															1											1	1		
Sphoeroides niphobles Jordan et Snyder	((1))		1	1+((3))	((1))	6+(1) +((1))			41+*1 +(3)+ (5)+ ((38))		20+1*+ (1)+ ((15))	16+(2) +(1) +((7))		2†+105+*2+2* +*1*+(10)+(9) +((22))	10+1*+(2)	9+(1)	1	21+(3) +((1))								368	1 (abnormal) + *1*+51	270	*1*+44
Sphoeroides stictonotus (Temminck ct Schleegel)		1			1+(1)	†1+1			†1†+†2 9+(9)+ (1)		2	†1†+3+ (1)+(1)		†1†+1†+7+(1) +(2)+((4))				1								52	*1*+4	39	8
Sphoeroides vermicularis vermicularis (Temmninck et Schlegel)				((1))	1+(1)	(1)+ ((2))			6+(9) +((8))		2+(7) +((2))	2+(5) +((7))		†1†+1†+10 +(22)+((25))	1+((2))	((1))		(2)+(1) +((1))								121	16	87	18
Sphoeroides vermicularis radiatus Abe														2+(2)				6+(3)	1+(1)		*1+(1)					17	2	15	
Sphoeroides vermicularis porphyreus (Temminck et Schlegel)							1*		3+(2) +((1))		4+(1)	1+(1)+ (1)+ ((1))		50+(11)+((11))	7+(1) +((2))	9+(1) +((1))		1††+18+ (12)+((6))	(1)+(1)	2						150	*1*+17	115	17
Sphoeroides exascurus Jordan et Snyder				1		1			2+(2)		1															7	1	5	1
Sphoeroides peocilonotus (Temminck et Schlegel)					†1+1		1		3+(1)+ (2)+ ((3))		2+(2) +((1))	1+ ((3))		1†+16+(7) +(2)+((6))	((1))	1+(1†) +((1))		3+(3) +((1))								69	*1*+8	53	7
Sphoeroides pardalis (Temminck et Schlegel)			(1*)						2		3+(1) +((1))	2	((1))	(†1)+55+*1 +1*+*1*+ (24)+(8)+ ((10))	††1+1†+19 +5*+(1*)+ (5)+(8)+ ((1))	14+(3) +(1) +((2))	1	†1+69+*4+ 3*+*1*+ (1*)+(27)+ (8)+((7))	1+(2) +((1))	2+1* +((1))	1†+5 +(1) +(1)					306	*2*+45	232	*1*+26
Sphoeroides chrysops (Hilgendorf)					((1))	((1))			13+(1) +(2)		2	2		1												23	3	17	3
Chelonodon patoca (Hamilton-Buchanan)									1					2+*1												4		4	
Chelonodon firmamentum (Temminck et Schlegel)								†1†						†††1+(†1)+2												5		4	*1*
Tetraodon immaculatus manillensis de Procé																1		7+(2)		2						12		9	3
Tetraodon reticularis Bloch et Schneider																			1*		3+(1)		3	2		9	1	6	2
Tetraodon hispidus Linnaeus																		2	(1)		*1*+4+(7)	1		1*		17	2	15	
Tetraodon mappa Lesson																					2+*1*	(1)				4	1	3	
Tetraodon meleagris Lacépède										((1))																1			1 (abnormal)
Tetraodon nigropunctatus Bloch et Schneider																			1		2			2	1	6	1	5	
Tetraodon stellatus Bloch et Schneider																			1		1†+1	1+(1)	(1)	6		12	3	8	1
Dichotomycter fluviatilis (Hamilton-Bucahnan)																					1			2	1	4		4	

Canthigaster, Liosaccus cutaneus, Sphoeroides (*Sphoeroides*) *maculatus, Sphoeroides* (*Shippofugu*) *hypselogeneion, Chelonodon patoca, Tetraodon* and *Dichotomycter* than in the common Sino-Japanese puffers of the subgenera *Torafugu* and *Shosaifugu*, Pl+r is the largest in *Tetraodon* and *Dichotomycter**, and not smaller in *Canthigaster, L. cutaneus, S.* (*S.*) *maculatus, S.* (*Sh.*) *hypselogeneion* and *Ch. patoca* than in the subgenus *Shosaifugu*. Among the large genus *Sphoeroides* the majority of the members of the subgenus *Torafugu* have more Pl+r than the other puffers of the genus. *S.* (*T.* *niphobles* and a single specimen of *S.* (*T.*) *pseudommus* are remarkable in having (like *Shosaifugu*) fewer Pl+r than the other members of *Torafugu*, because as mentioned in a previous paper (Abe, 1949b), they closely resemble some of the members *Shosaifugu* in several other characters.

Comparison between closely-related forms. α) Among the genus *Lagocephalus*: *L. lagocephalus oceanicus* has smaller Pl+r (=29 to 32) than the other three members of the genus (Pl+r = 34 to 36 in *L. laevigatus inermis*; Pl+r = 30 to 36 in *L. lunaris*; Pl+r = 31 to 36 in *L. sceleratus*). β) Among the subgenus *Torafugu*: As stated just above, *niphobles* and probably *pseudommus* have fewer Pl+r than the other six members of the subgenus. The latter can not be distinguished from one another by Pl+r. γ) Among the subgenus *Shosaifugu*: Pl+r in *stictonotus* and *porphyreus* is not larger than that of the other members of the subgenus, while the size attained by the adult, D and An are distinctly larger in the former. The southern form, *radiatus*, seems to have more Pl+r than its very close allies, *vermicularis* and *porphyreus* (Table 1), although the first named is intermediate between the two latter in D, An and coloration. δ) Among the genus *Tetraodon*: As in several other characters, Pl+r is different between *manillensis* and the other members of the genus, namely, it is fewer (Pl+r = 33 to 35) in the former than in the latter (Pl+r = 34 to 40). Among the most compact group of *reticularis, hispidus* and *mappa*, Pl+r does not serve to distinguish them from one another.

Comparison between the samples of the same form. As in the total number of vertebrae (N), number of precaudal vertebrae (A), number of caudal vertebrae (B), number of the vertebrae of minor portions along vertebral column, total humber of dorsal fin-rays (D, number of anterior unbranched

* According to Bleeker (Atl. Ichth., v), Günther (Cat. Fish., viii) and Fraser-Brunner (1943), *Xenopterus naritus* (N=29; D=32 to 38; An=28 to 32) and *Chonerhinos modestus* (N=24; D=25 or 26; An=23 to 25), though exceptionally many-rayed in their dorsal and anal fins, have not more rays in their pectoral fin (the former having ii+15 or ii+16 rays in each of the fins and the latter having ii+12 to ii+14 rays in each of the fins) than do the other puffers which have much less dorsal or anal fin-rays.

dorsal fin-rays (d_1), number of the succeeding branched rays of the dorsal (d_2), number of interneurals (Δ), total number of anal fin-rays (An), number of anterior unbranched anal fin-ray ($a_{n,1}$), number of the succeeding branched rays of the anal ($a_{n,2}$) and number of interhaemals (A), the comparison of the total number of pectoral fin-rays have been made only for a few species. α) Among *Sphoeroides* (*Higanfugu*) *pardalis* (Table 2): Like N, A, B, D, b2, Δ, An, A, *etc.*, P_{l+r} in the samples form northern Japan, namely, from Onahama and northerly waters (P_{l+r} = 31 to 36; modal value 34; mean value 33.30 ± 0.056) is greater than in those from southern Japan, namely, from Misaki and southerly waters (P_{l+r} = 28 to 35; modal value 32; mean value 32.85 ± 0.068), the difference being 0.45 ± 0.088.

Table 2

Comparison of the sum (P_{l+r}) of the number of the left pectoral fin-rays (P_l) and the number of the right pectoral fin-rays (P_r) in *Sphoeroides pardalis* between the samples from norhtern Japan (mostly from Onahama) and those from southern Japan (mostly from Misaki). For 〔 〕, ( ), *, **, †, ††, *etc.* see Table 1.

P_{l+r}	28	30	31		32	33		34		35		36	Total	Mean	$P_l>P_r$	$P_l=P_r$	$P_l<P_r$
P_l	i+12	i+14	i+15	i+14	i+15	i+16	i+15	i+17	i+16	i+17	i+16	i+17					
Locality / P_r	i+14	i+14	i+14	i+15	i+15	i+15	i+16	i+15	i+16	i+16	i+17	i+17					
Northern Japan			2+(1)	2	*1+1*+ *1*+29 +〔2〕+ (16)+ 〔(2)〕	††1+1† +2*+ 11+〔1*〕 +〔1〕+ +(1)	11+ (1)+ 〔(1)〕	(1)	*2+2*+ *1*+49 +〔1*〕+ 〔5〕+(17) +〔(2)〕	(2)	1*+2+ 〔(1)〕	1†+5 +〔1〕 +(1)	182	33.30	*1*+23	139	19
Southern Japan	〔1*〕	2	1+(1)		〔†1〕+ 20+ 〔6〕+ (8)+ 〔(7)〕	3*+ 8+ 〔2〕+ (4)	3+ 〔1〕+ (2)+ 〔(1)〕		†1+*2+ 1*+20+ 〔3〕+ (10)+ 〔(4)〕	1+〔(1)〕			120	32.85	21	91	*1*+7

Table 3

Comparison of the sum (P_{l+r}) of the number of the left pectoral fin-rays (P_l) and the number of the right pectoral fin-rays (P_r) in *Sphoeroides niphobles* between the samples from northern Japan, southern Japan and Okinawa Island. For [ ], ( ), *, †, *etc.* see Table 1.

P_{l+r}	27	28		29		30	31		32	33		34		Total	Mean	$P_l>P_r$	$P_l=P_r$	$P_l<P_r$
P_l	i+14	i+12	i+13	i+14	i+13	i+14	i+15	i+14	i+15	i+16	i+15	i+17	i+16					
P_r / Locality	i+11	i+14	i+13	i+13	i+14	i+14	i+14	i+15	i+15	i+15	i+16	i+15	i+16					
Northern Japan (mostly from Onahama)			1+[(1)]		4+(1)	*1+32+[(2)]	1*+9	10+[(1)]	*1+2*+*1*+35+(3)+[(1)]	1*+2	2			111	31.02	13	80	18
Southern Japan (from Kamakura to Kagoshima)	[(1)]	1	[(2)]	[(1)]	2+[(4)]	8+[5]+(3)+[(36)]	8+(1)+[(5)]	5+[1]+(2)+[(5)]	2†+*1+16+[5]+(3)+[(21)]	3	1		[(1)]	142 (*143*)	30.88 (*30.86*)	1(abnormal)+18	103	*1*+20
Okinawa I.						1	3	1	52+[3]+(5)+[(1)]	5+(2)	6+[1]	1	21+(3)	105	32.55	*1*+10	86	8

Table 4

Comparison of the sum (P_{l+r}) of the number of the left pectoral fin-rays (P_l) and the number of the right pectoral fin-rays (P_r) in *Lagocephalus lunaris* between the samples from Japan, Formosa, the Philippines and Tawau, Borneo. For [ ], ( ), *, *etc.* see Table 1.

P_{l+r}	30	31		32	33		34		35		36	Total	Mean
P_l	i+14	i+15	i+14	i+15	i+16	i+15	i+17	i+16	i+17	i+16	i+17		
P_r / Locality	i+14	i+14	i+15	i+15	i+15	i+16	i+15	i+16	i+16	i+17	i+17		
Japan	1+[(5)]	[(4)]	2+[1]	8+[4]+[(22)]	(1)	1		6+[1*]+[3]+(1)+[(6)]	[(1)]			67	32.30
Takao, Formosa								1				1	(34)
Philippines								[1]			1	2	(35)
Tawau, Borneo				1			1	5+[1]+(1)		1		10	33.90

(*To be concluded*)