IVANOV, V. N. 1969. The chromosomes of the Black Sea flatfish *Rhombus maeoticus* Pallas. Dokl. Biol. Sci. USSR 187(1–6):507–509.
MOORHEAD, P. S., P. C. NOWELL, W. J. MELLMAN, D. M. BATIPPS AND D. A. HUNGERFORD. 1960. Chromosome preparations of leukocytes cultured from human peripheral blood. Expl. Cell Res. 20:613–616.
NAYYER, R. P. 1966. Karyotype studies in thirteen species of fishes. Genetica 37:78–92.
NEWCOMER, E. H., AND G. M. DONNELLY. 1963. Leukocyte culture for chromosome studies in the domestic fowl. Stain Technol. 38:54–56.
NOGUSA, S. 1960. A comparative study of the chromosomes in fishes with particular considerations on taxonomy and evolution. Mem. Hyogo Univ. Agriculture 3(1). Biol. Ser. 3.
NOWELL, P. C. 1960. Phytochemagglutinin: an initiator of mitosis in cultures of normal human leukocytes. Cancer Res. 20:462–466.
PAPE, A. 1935. Contribution to the natural history of *Pleuronectes pseudoflesus*, a hybrid between plaice and flounder. Wiss. Meeresunters. Kiel N. F. 22:53–88. (Original in German.)
RILEY, J. D., AND G. T. THACKER. 1969. New intergeneric cross within the Pleuronectidae, dab × flounder. Nature, Lond. 221:484–486.
ROTHFELS, K. H., AND L. SIMONOVITCH. 1958. The chromosome complement of the rhesus monkey (*Macaca mulatta*) determined in kidney cells cultivated *in vitro*. Chromosoma 9: 163–175.
SETO, T., C. M. POMERAT AND J. KEZER. 1964. The chromosomes of *Necturus maculosus* as revealed in cultures of leukocytes. Amer. Nat. 98:71–78.
VOLPE, E. P., AND B. M. GEBHARDT. 1968. Somatic chromosomes of the marine toad, *Bufo marinus* (Linné). Copeia 1968:570–576.

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KARYOLOGY OF THREE GALAXIID FISHES *GALAXIAS MACULATUS*, *G. PLATEI*, AND *BRACHYGALAXIAS BULLOCKI*.—The classification of animals should be based on the sum of the similarities and differences obtained by diverse studies (Mayr, 1965; Rohlf and Sokal, 1967). Although discrepancies in the results from experimental and morphological studies are usually emphasized, most comparisons show considerable concordance (Hubbs, 1971). Because most morphologic features of fishes have been shown to have the potential of being modified by environmental conditions (Svärdson, 1965; Fowler, 1970) a morphologically based classification should be tested by features not likely to be environmentally plastic. Chromosome structure is likely to reflect genetic divergence and have a minimum of environmental distortion.

Karyological studies on fishes were long plagued by technique problems so that pre-1945 studies are often suspect (Booke, 1968), but use of newer techniques, especially chromosome squashes, permits repeatable results with a variety of tissues. Much of the post-1945 teleost karyology work has been on salmoniform fishes. For example, Booke (1968) listed counts for 30 salmonids; but Lieppman and Hubbs (1969) only listed 21 counts in the much more speciose Cyprinidae. Although the cytology of many salmoniforms are well known, no previous studies have been done on galaxiids, a family of fishes inhabiting coastal and fresh waters in the southern hemisphere.

Chromosomes have been obtained for *Galaxias maculatus* from Australia and Chile, *G. platei* from Chile, and *Brachygalaxias bullocki* from Chile.

Material and Methods.—The slides were prepared from gill epithelium following techniques developed by McPhail and Jones (1966) and modified by Setzer (1970). The specimens (numbers of slides in parentheses) were obtained from the following localities: *Galaxias maculatus* from the Bunyip River north of Koo-weep-rup, Victoria, Australia (20♂ and 20♀) and Rio Calle-Calle and Lago Pangupulli, Chile (54♂ and 30♀); *G. platei* from 100 to 300 meters depth in Lago Riñihne, Chile (75♂ and 45♀); *B. bullocki* from a small lake at Saval, Valdivia, Chile (54♂ and 14♀).

The classification of chromosomes follows criteria set up by Levan et al. (1964).

Karyology.—Karyotypes of specimens of *G. maculatus* from Australia are very similar to those from Chile (Fig. 1); all having $2n = 22$. Both types have 8 metacentric, 12 submetacentric, and 2 telocentric chromosomes. Similarly, the land locked populations in Lago Pangupulli and catadromous populations in the Rio Calle-Calle, Chile had the same karyotypes. Finally, males and females could not be distinguished on the basis of chromosome structure. Although up to 10% of the karyotypes did deviate from the standard type, no pattern was noted and the unusual numbers were attributed to occasional imperfections in preparation.

The karyotype of *G. platei* is distinct from that of *G. maculatus* and has $2n = 30$ (Fig.

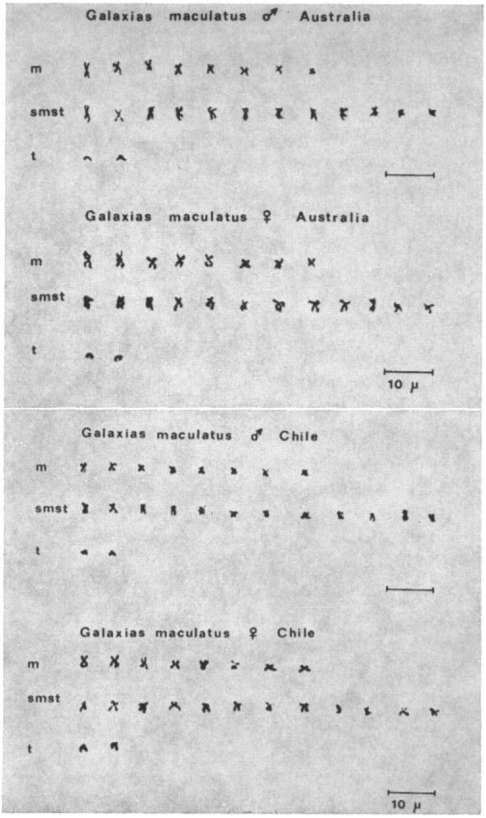

Fig. 1. Karyotypes of *Galaxias maculatus*.

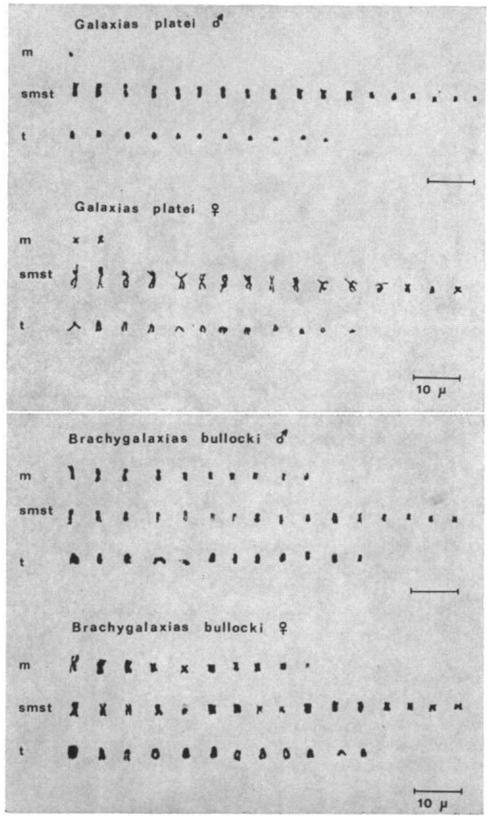

Fig. 2. Karyotypes of *Galaxias platei* and *Brachygalaxias bullocki*.

2). Again some nuclei deviated from the standard by up to 2 chromosomes but 85% had 30 chromosomes. Apparently *G. platei* has dimorphic sex chromosomes in the male. Only one chromosome is clearly metacentric, 18 are submetacentric, and 11 telocentric. If the classification above is correct the homologue (Y chromosome) is telocentric. The female in contrast has two distinct metacentrics, 16–18 submetacentrics, and 10–12 telocentrics. The classification of the smallest telocentrics is somewhat arbitrary.

The species *Brachygalaxias bullocki* (Fig. 2) has 2n = 38 chromosomes; many more than either species of *Galaxias* studied. About 30% of the nuclei had different numbers of chromosomes but 70% had 10 metacentrics, 16 submetacentrics, and 12 telocentrics. No sex chromosomes were noted.

Cytotaxonomy.—The galaxiids have many fewer chromosomes (2n = 22–38 and 42–64 arms) than previously listed for salmoniform fishes. Booke (1968) reported a minimum of 52 metacentrics in *Oncorhynchus gorbuscha* (= 104 arms) and a minimum of 72 arms in *Salmo salar* for salmonids (he rightly questioned Kupka's (1948) count of 2n = 36 for *Coregonus asperi*—most *Coregonus* have 2n = 80). Ohno (1970) reported that two osmerids have 2n = about 50 (= about 60 arms) and that salmonids (sensu lato) usually have over 100 arms. Deep-sea bathylagids have 2n = 36 to 64 (Chen, 1969), numbers reasonably close to those obtained here for galaxiids. They also seem to have sex chromosomes and it is the male that is heterogametic as is the male of *G. platei*. In contrast, the X chromosome is by far the largest in bathylagids and in the galaxiid the putative sex chromosomes are small. Therefore, the chromosomes of galaxiids are distinct from those of other salmoniformes. The only similarity seems to be in arm number in which osmerids and galaxiids (especially *Brachygalaxias bullocki*) may have about 60 arms, a circumstance that recalls Gosline's (1960) grouping of galaxioids with the osmeroids.

The great similarity in the karyotype of *Galaxias maculatus* from Chile and Australia supports a genetic similarity of the populations from very distinct geographic regions. Although different species may have the same karyotype (Booke, 1968 and others), karyotype similarity found here tends to support conspecific relationship (McDowall 1967; Frankenberg, 1970) rather than Scott's (1968) interpretation that Australian populations are specifically distinct because *G. platei* has a species specific karyotype. The similarity recalls McDowall's (in press) meristic study in which catadromous stocks have similar meristics regardless of continent.

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Literature Cited

Booke, H. E. 1968. Cytotaxonomic studies of the coregonine fishes of the Great Lakes, USA: DNA and karyotype analysis. J. Fish. Res. Bd. Canada 25:1667–1687.

Chen, T. R. 1969. Karyological heterogamety of deep-sea fishes. Postilla 130:1–29.

Fowler, J. A. 1970. Control of vertebral number in teleosts—an embryological problem. Quart. Rev. Biol. 45:148–167.

Frankenberg, R. S. 1970. Studies on the evolution of galaxiid fishes with particular reference to the Australian fauna. Ph.D. Diss. Univ. Melbourne.

Gosline, W. A. 1960. Contributions toward a classification of modern isospondylous fishes. Bull. Brit. Mus. Zool. 6:325–365.

Hubbs, C. 1971. Teleost hybridization studies. Proc. Calif. Acad. Sci. 4th Ser., 38:289–298.

Levan, A., K. Fregda, and A. A. Sanberg. 1964. Nomenclature for centromeric positions on chromosomes. Hereditas 52:201–220.

Lieppman, M., and C. Hubbs. 1969. A karyological analysis of two cyprinid fishes, *Notemigonus crysoleucas* and *Notropis lutrensis*. Texas Rep. Biol. Medicine 27:427–435.

McDowall, R. M. 1967. Some points of confusion in galaxiid nomenclature. Copeia 1967: 841–843.

———. In press. Variation in diadromous and lacustrine populations of *Galaxias maculatus* (Jenyns) with a discussion of the "species problem" in freshwater fishes.

McPhail, J. D., and R. L. Jones. 1966. A simple technique for obtaining chromosomes from teleost fishes. J. Fish. Res. Bd. Canada 23: 767–767.

Mayr, Ernst. 1965. Classification and Phylogeny. Amer. Zool. 5:165–174.

Rohlf, F. J., and R. R. Sokal. 1967. Taxonomic structure from randomly and systematically scanned biological images. Syst. Zool. 16:246–260.

Scott, E. O. G. 1968. Certain nomenclatorial proposals in Galaxiidae: a rejoinder. Rec. Queen Victoria Mus. 29:1–10.

Setzer, Paulette Y. 1970. An analysis of a natural hybrid swarm by means of chromosome morphology. Trans. Amer. Fish. Soc. 99:139–146.

Svärdson, G. 1965. The coregonid problem. VII. The isolating mechanisms in sympatric species. Rep. Inst. Freshwater Res. Drottningholm 46:95–123.

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INCIDENCE OF THE PARASITIC ISOPOD, *OLENCIRA PRAEGUSTATOR*, IN JUVENILE ATLANTIC MENHADEN.—Infestation frequency of the parasitic isopod, *Olencira praegustator* (Latrobe), in juvenile Atlantic menhaden, *Brevoortia tyrannus* (Latrobe) was estimated in collections from 19 estuaries along the Atlantic Coast (Fig. 1) while conducting tagging studies in September 1970. Extensiveness of parasite damage, developmental stage of the parasites and number of parasites lost from the fish were also investigated. This is the first report on the infestation of juvenile menhaden by *O. praegustator* since reported by Smith (1892).

Infestation frequencies ranged from 0% to 46% in juveniles from the 19 estuaries (Table 1). Isopods were present in every sample of juvenile menhaden from the 14 estuaries south of Long Island, New York except for the collections from Chowan River, North Carolina. Five samples collected on or north of Long Island, however, did not contain any isopods. Westman and Nigrelli (1955) did not include *O. praegustator* in their list of parasites infesting menhaden in the New York region and Ellison (1951) suggested *O. praegustator* is only abundant in the menhaden's southern range. Our observations suggests that it may not occur in the menhaden's northerly range.

Two instances where schools of menhaden in the same estuaries had different infestation frequencies were observed. In Nansemond River, Virginia, samples of fish from two schools were both about 50% infested, whereas samples of fish from a third school