

# Preface

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One purpose dominated the writing of the previous editions of *Fishes of the World* (Nelson, 1976, 1984, 1994): to present a modern introductory systematic treatment of all major fish groups, both fossil and living. The same objective prevailed in writing this revision. The acceptance of the previous three editions as a guide and reference to the classification of fishes by teachers of courses in ichthyology or fish biology, collection managers, aquarists, and by ichthyologists and other zoologists in general has been increasingly gratifying. Many important works have been published since the last edition (Nelson, 1994), and we think we have a better understanding of relationships than we had a decade ago; however, as in the past, only further work will enable us to judge whether all of our new ideas are advances. Many questions remain. In this edition I have revised the classification in light of recent research, given references to recent systematic works, listed more genera under the families, and given recent systematic information. Some new fish drawings have been added.

The introduction deals in an elementary way with various aspects of fish diversity. In the main text, the lower chordates and fishes appear in linear order in a manner that seems best to reflect their postulated evolutionary relationships. I often present alternative schemes of classification from recent literature. I have given categories down to at least family level and frequently lower. Subfamilies are recognized in many families, but the stability or degree to which we think they are monophyletic varies widely between and within families. In some families the subfamilies appear to be well founded (e.g., Salmoninae). In others, some or all in a family may be weakly founded and the composition of the nominal subfamily is likely to change (e.g., Characinae and Gobiinae).

I recognize a relatively large number of categories in order to provide a better presentation of postulated relationships. The categories used, and their endings in parentheses when consistent, are as follows: phylum, subphylum, superclass, grade, class, subclass, infraclass, division, subdivision, superorder, series (these 11 categories are centered in the text), order (iformes), suborder (oidei), infraorder, superfamily (oidea), family (idae), subfamily (inae), tribe (ini), genus, and subgenus. Not all categories are employed within a particular taxon. A dagger (†) denotes those taxa containing only fossil species; it is usually given only for the highest appropriate taxon and not for the lower extinct members of the group. Users who find the number of categories given to be a cumbersome proliferation may wish to use only class, subclass, order, suborder, and family (as given in the Appendix). Not all recognized (named) taxa are assigned rank (e.g., placed in a named category) (the recognition by named category of all branches in a cladistic classification would result in a great proliferation of categories). The following are examples of some major taxa that are part of the classification but for which no formal rank is assigned: Vertebrates (formally the Vertebrata), Neoteleostei, and Acanthomorpha. New in this edition is that a unique number is given for each order and family of living fishes (also given in the Appendix as in past editions) and a common name is given for each order.

For each family with living fishes, I give the most appropriate common name that I know (only a few have been coined and, for some, only a vernacular version of the scientific name is given) and its general range. For many families there is an outline drawing of a member, and sometimes more than one; remember, however, there is much variation in body shape within many of the illustrated groups. Although the outline drawings are based on actual species, details of such variable features as scales are not shown in order to keep the drawings generalized for the family. There is a short description for each family and for many taxa in higher categories; some are inconsistently brief, usually as a consequence of the lack of diagnostic features, especially those features that are external or otherwise easily seen. I have often omitted characters that are difficult to describe briefly, even if diagnostic for the group. For some groups I explore differing areas of interest, rather than trying to produce a uniform but limited text. When given, the numbers of abdominal and caudal vertebrae are placed in parentheses after the total vertebral number—for example, 25 (10 + 15). I often include interesting life-history or biological notes and the maximum length of the largest species. When possible, the length is qualified by giving standard length (SL), fork length (FL), or total length (TL). Also included are estimated numbers of recognized (valid) genera and species (in some cases the number of species in each genus is also given). These figures are always for living forms—never for fossils unless so stated. The degree of agreement with these figures by others will vary from group to group (in part due to the subjective matter of lumping and splitting). For example, everyone would agree that there are but two valid species of described percopsids, but one can find disagreement on the number of valid described species of cichlids and gobiids that should be recognized. I have tried to represent current but conservative thinking in

arriving at these numbers. In many groups, undescribed species are known to exist; these may be mentioned, but their number is not included in the species total. Priority is given to literature published after 1994 in giving references in the family sections. Nelson (1994) should be referred to for much of the literature forming the basis of earlier editions. I give examples of recognized generic names for each family; if the number is relatively small, I usually list them all. In choosing examples of generic names for large families, I have tried to choose those that represent the following: (1) genera with many species, (2) the type of a subfamilial category or that of a nominal family no longer recognized, (3) genera whose species exhibit some extreme biological diversity, and (4) genera whose species are commonly found or are important in commercial fishery, sports fishery, or aquarium use. Generic synonyms are *usually* given only for genera recognized as valid in Nelson (1994) but now considered junior synonyms. No attempt is made to recognize all commonly used junior synonyms, as these may easily be found in the very valuable Eschmeyer (1998). I have used Eschmeyer (1998) to verify the spelling of most of the names of extant genera, but time did not permit checking all.

I am assuming that a knowledge of fish anatomy, if not already acquired, will be obtained elsewhere. In the osteological descriptions, I use the terms circumorbital, infraorbital, and suborbital synonymously, and the lachrymal (= lacrymal, lacrimal) is the first bone in the series—i.e., it is synonymous with the first suborbital bone. However, proposals to change the name of some bones from that used in previous editions as a result of our better understanding of homologies have not been adopted unless otherwise indicated. For example, as noted in Janvier (1996), what are commonly termed the frontals and parietals in actinopterygians, originally taken from human anatomy, are homologous with the parietals and postparietals, respectively, of early tetrapods.

I have made numerous minor and major changes to the classification presented in the previous edition. As in the last edition, I adopt a cladistic classification. This will provide users with some idea of the hypothesized sister-group relationships and monophyletic groups, and it will help workers in all disciplines of comparative fish biology interpret their work in an evolutionary or historical context. However, I have also tried to make only those changes that seemed well founded. In order to keep the book within reasonable length, I have not always given reasons for the decisions in making changes. However, in preparing this edition I have again attempted to be relatively conservative in making changes while, at the same time, accepting new and often radically different schemes, or parts thereof, within a cladistic framework when they seem to be well founded. It is very naive to accept the latest proposals as always being the best in postulating systematic relationships, regardless of the method used and even if the study gives sound comparative information. All new proposals should be critically evaluated. It is good to be innovative in systematic research, but I feel that changes in a classification such as this should be made only when evidence is relatively strong. Of course, researchers in presenting new information will normally be advised to give the implications of their work to classification.

The 515 families with living species recognized in this edition represents an increase from that in the previous three editions. This has resulted, in part, from an increased practice to reject families that are clearly not monophyletic by placing taxa of uncertain familial affinity into separate families. However, it continues to be my belief that in ichthyology we recognize more families than is desirable for the benefit of the nonsystematist, although I do not believe we should necessarily avoid recognizing monotypic families even if their sister group is known. When cladistic relationships are better understood, we may be able to reduce the number of families to a more manageable number while expressing lower relationships with the increased use of subfamily and tribe categories. I have attempted, within the above framework, to keep the number of families from increasing even further and hope to keep instability at the family level to a minimum.

As long as there are active, creative ichthyologists, there will be major disagreements in our classification in the foreseeable future (there is similar disagreement in almost all important fields of biology). Fish classification is in a dynamic state, and the student pursuing ichthyology will find that all groups can be reworked. There are many challenges, both in developing the theory of classification and in its actual practice. Because particular classifications eventually become obsolete (as will most biological information), they should be regarded as frameworks that will provide a basis for building as advances are made. If, however, anyone questions the value of learning a classification, it should be remembered that classifications are useful vehicles on which to base an understanding of biology. We do not stop using objects or acquiring the present state of knowledge merely because our technical information is going to improve.

The primary task of the systematist is to seek an understanding of the evolutionary history of life. The systematist must also deal with such matters as how to spell the names of taxa that have variant names in the literature—a matter that sometimes tries one's patience. It is surely frustrating and confusing, especially for the nonsystematist, to find differences in the spelling of taxonomic names. There are still some problems in agreeing on how certain family names should be spelled (e.g., in family names ending in -ididae vs. -idae; see also discussion under family Lampridae-202). With regard to the latter problem, there is some feeling that it may be more important to have names pronounceable than to be grammatically correct. In this regard, a few of us such as W. N. Eschmeyer and J. R. Paxton, while following provisions of the "International Code of Zoological Nomenclature," hope to arrive at some agreement, eventually!

Although in this edition I have given a common name in English for every family, I cannot state that we have agreement in family common names. Eventually, with the help of such people as K. E. Carpenter and R. Froese, we hope to produce a standardized common name for each family, mainly for the sake of the nonsystematist. In this regard, such publications as *Common and Scientific Names of Fishes from the United States, Canada, and Mexico* (Nelson et al., 2004), FAO species identification guides (edited primarily by K. Carpenter), other FAO publications, and *FishBase* (Froese and Pauly, 2003) are especially useful.

The ichthyologist is a student of fish systematics. A good grounding in many of the sciences is necessary for the future ichthyologists to test the hypotheses we have today. Ichthyology courses may be designed for students interested in ichthyology or fisheries biology as a career and for the general biology student wishing to learn something of those animals that comprise over one-half of the vertebrate species. The laboratory section of courses usually demonstrates the diversity of fishes and the probable course of evolution, shows systematically important characters, provides insight into how ichthyologists determine which characters to use, and provides training in identification. Emphasis may be given to the local fish fauna, and for this purpose there are many fine regional books. However, it is desirable to have a broad look at fish classification and to place one's local fauna in perspective to all fishes. Depending on the time available, students may, for example, learn how to hypothesize homologies, attempt to explain the biological significance of differences we consider to be systematically important, and learn how morphology determines function and how ways of life can determine morphology. Fishes provide good examples in showing how natural selection results in diverse adaptations to common functions. Collecting trips, curatorial functions, and special projects (e.g., skeletal preparation and clearing and staining specimens) may also be involved. The laboratory can be a good place to discuss taxonomic problems as well. The student of ichthyology must be well versed in the methods and theories of systematic biology. An understanding of how systematic relationships are postulated (hypothesized) and knowing the strengths and weaknesses of various approaches so that classifications can be critically evaluated are far better than just learning the end results (which are likely to be short-lived). Meetings such as those of the American Society of Ichthyologists and Herpetologists, American Elasmobranch Society, American Fisheries Society, Desert Fishes Council (dedicated to the preservation of America's desert fishes), European Congress of Ichthyology, Indo-Pacific Fish Conference, International Meeting on Mesozoic Fishes, and the Society of Vertebrate Paleontology provide excellent forums for learning and exchanging ideas. It behooves students of ichthyology, both apprentice and professional, to become actively involved in such groups.