MYOMERE AND VERTEBRA COUNTS OF THE NORTH AMERICAN CYPRINIDS AND CATOSTOMIDS

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ABSTRACT

Myomere counts, which are valuable in larval fish identification, have been reported for only about 20% of the North American cyprinids and catostomids. Since there is a nearly direct correlation between total myomeres and total vertebrae, the latter, which are known for many more species, can be used to approximate the former. The range of total vertebra and/or myomere counts for 70 cyprinid species, 28 to 51, is larger and essentially includes that for 27 catostomids, 32 to 52. Preanal and postanal myomere counts ranged from 19 to 31 and 10 (9?) to 18, respectively, for cyprinids and 25 to 42 and 5 (3?) to 12 (14?) for catostomids. The two families can be readily distinguished by the proportion of postanal to preanal myomeres, about ½ or greater for cyprinids and 1/3 or less for catostomids, or preanal to total myomeres, about 2/3 or less for cyprinids and 3/4 or more for catostomids. The genera of each family are characterized by distinctive ranges of total myomeres or vertebrae which can be used to help determine the identity of unknown cypriniform larvae.

INTRODUCTION

Myomere counts are important in larval fish taxonomy, but they have been reported for only about 20% of North America's approximately 260 species of minnows (Cyprinidae) and suckers (Catostomidae). However, myomeres are directly associated with vertebrae and vertebra counts have been reported for most species. The purpose of this paper is to summarize myomere and/or vertebra counts for many cyprinids and catostomids and to compare and characterize these counts for the two families.

METHODS

Literature was surveyed extensively, but by no means completely, for records of total vertebrae and total, preanal, and postanal myomere counts. These counts were supplemented with unpublished data from several researchers. Vertebra counts were either assumed or adjusted to include the Weberian ossicles. Preanal and postanal myomere counts were either assumed or adjusted to conform with Seifert's (1969) method, *i.e.* all entire myomeres posterior to the posterior margin of the vent were considered postanal and the remainder preanal. Adjustment depended on the availability of reasonably accurate drawings from which revised counts were made. Some myomere counts were verified with personal reference specimens. A few highly unlikely counts or extremes were disregarded. Percentages or proportions of preanal to total and postanal to preanal myomeres were calculated using the median values of the typical ranges for each species. Total vertebrae (or myomeres when vertebra counts were not found) for all genera considered were summarized in range intervals of uniform size (*e.g.* 35-40 and 40-45).

RESULTS AND DISCUSSION

Extreme ranges for total myomeres were entirely included in the extreme ranges for vertebrae or vice versa in about 70% of the cases and at least partially overlapped in 90% of the cases for which both ranges were available (Table 1). Considering the paucity of data for some species and the probability of inaccurate data, there appears to be sufficient evidence to support the generalization that there is a nearly direct, one to one, correlation between total myomeres and total vertebrae, Weberian ossicles included. Accordingly, total vertebrae can be used with reasonable

Table 1. Typical myomere and vertebra counts for selected cyprinid and catostomid fishes. Reported or observed ranges, excluding unlikely extremes, are given in parentheses. Sources, coded by letters, are keyed below with the year of publication or, if the data used is unpublished, with an asterisk. Preanal and postanal myomere counts were either assumed or adjusted to conform with Seifert's (1969) method. Some counts were determined from drawings. Vertebra counts were either assumed or adjusted to include the Weberian ossicles.

Species	Preanal Myomeres	Postanal Myomeres	Total Myomeres	Total Vertebrae
Cyprinidae:				
Acrocheilus alutaceus				44-45 z
Campostoma anomalum	26-28 ekC	11-15 ekC	38-41 eC	
Carassius auratus	21-23 (20-24) qC	9-12 qC	30-34 (29-36) qC	28-32 qz
Clinostomus elongatus	20 e	15 e	35 e	40-41 (38-41) z
Clinostomus funduloides	22-25 k	11-14 k		
Couesius plumbeus				40-41 (39-43) z
Cyprinus carpio	24-26 (20-27)ekqsCGH	11-13 (10-15)ekqsCGH	35-38 (32-40)eqCGH	35-36 (32-39)qzH
Ericymba buccata	25-26 t	13 t	38-39 t	
Exoglossum maxillingua	24-27 hC	12-15 hC	38-39 hC	38 z
Gila cypha				46-47 (45-49) mz
Gila elegans				49 (47-51) m
Gila robusta	29-31 (26-31) C	16-17 (16-18) C	45-48) C	46 (45-48) m

continued

Table 1. continued.

Species	Preanal Myomeres	Postanal Myomeres	Total Myomeres	Total Vertebrae
Gila seminuda				45 (44-47) m
Hybognathus hankinsoni				35-37 z
Hybognathus nuchalis	21-23 (21-26) qsH	13-15 (12-15) qH	35-37 (34-41) qH	37-38 (36-38)qzH
Hybopsis aestivalis	22-23 C	15 C	37-38 C	
Hybopsis gracilis				43-47 (40-47) z
Hybopsis storeriana	22-24 G	14-15 G	36-39 G	39 (38-41) z
Hybopsis x-punctata				37-39 z
Lavinia exilicauda		13? M		
Lepidomeda albivallis				43 (42-44) w
Lepidomeda altivelis				43 (42-44) w
Lepidomeda mollispinis				42-43 (42-44) w
Lepidomeda vittata				41-42 (41-43)uw
Leuciscus idus	27-29 d	16 d	43-45 d	46-47 d
Meda fulgida				40 (39-42) w
Mylocheilus caurinus				45 (44-46) z
Nocomis biguttatus				38 (37-39) z

continued

Table 1. continued.

Species	Preanal Myomeres	Postanal Myomeres	Total Myomeres	Total Vertebrae
Nocomis micropogon	25-27 et	12-15 et	37-40 (-41?) et	38-39 z
Notemigonus crysoleucas	23-25 (22-26) ekqtCD	13-14 (12-15) ekqtCD	36-38 (35-40) eqtCDH	36-38 (35-40) qszH
Notropis anogenus				32-36 z
Notropis amoenus	23-27 qC	13-15 qC	37-41 qtC	38-40 (37-42) q
Notropis analostanus	22-24 (20-24) qE	13-14 (12-14) qE	35-37 (32?-37) qE	35-36 (35-38) E
Notropis atherinoides	25-26 (23-26) ekC	12-15 (10-15) ekC	38-41 (35-41) eC	39-42 (38-44) zHn
Notropis bifrenatus	19-20 (17-20) q	14-15 q	34 (32-34) q	34-36 q
Notropis blennius				36-37 z
Notropis buchanani	19-21 C	15-16 C	34-36 C	
Notropis chalybaeus	19-20 q	14-15 q	33-35 q	35 (33-37) q
Notropis cornutus	24-26 eCL	11-14 (11-16) eCL	36-39 (35-40) eCL	39-40 (38-43) z
Notropis dorsalis				34-36 (34-37) zH
Notropis emilae				37-38 z
Notropis girardi	24 x	13 x	37 x	
Notropis heterodon				35-36 z
Notropis heterolepis	21 e	14 e	34-35 e	34-36 z

continued

Table 1. continued.

Species	Preanal Myomeres	Postanal Myomeres	Total Myomeres	Total Vertebrae
Notropis hudsonius	23-25 (22-25) eqstC	13-16 (12-18?) eqC	37-38 (36-40) eqC	37-38 (35-40) qszH
Notropis lutrensis	20-23 (19-23) yCG	12-14 (11-15) yCG	33-36 (32-37) yCG	
Notropis panarcys				35 (34-36) o
Notropis proserpinus				35-37 o
Notropis rubellus	26-27 et	13-14 et	39 et	39 (37-41) zH
Notropis spilopterus	22-24 (22-25) ktCDE	13-15 (11-15) ktCDE	36-38 (35-40) CDE	37-39 zE
Notropis stramineus	20-23 C	12-13 C	33-35 C	35 (33-36) z
Notropis umbratilis				35-36 z
Notropis venustus	23 (20-24) G	12-15 G	35 (33-38) G	
Notropis volucellus	20 C	14 C	34 C	36 (34-37) z
Phoxinus eos				37 (35-38) z
Phoxinus neogaeus				37-39 z
Pimephales notatus	22-24 etC	12-14 etC	34-37 etC	37-39 zH
Pimephales promelas	22-24 (20-25) ekCD	12-14 (11-15) ekCD	35-37 (34-38) eCD	36-37 (35-38) z
Pimephales vigilax	21-23 G	12-14 G	34-37 G	
Plagopterus argentissimus				40 (39-41) w
Ptychocheilus lucius	31-35 C	15-17 (14-17) C	48-50 (47-51) C	48 (47-48) A

continued

Table 1. continued.

Species	Preanal Myomeres	Postanal Myomeres	Total Myomeres	Total Vertebrae
Ptychocheilus oregonensis				45-46 (44-46) F
Rhinichthys atratulus	24-25 (22-26) ght	15-16 t	38-39 t	38-39 (37-40) z
Rhinichthys cataractae	25-27 (24-27) eght	14-15 et	40-41 (37-41) et	38-40 (37-42) z
Rhinichthys falcatus				38-40 z
Rhinichthys osculus	24-25 C	13-15 C	37-39 (34-39) pC	37-38 z
Richardsonius balteatus	23-25 (23-26) rC	14-16 (13-17) rC	38-41) rC	38-43 z
Semotilus atromaculatus	25-26 eC	14-15 eC	39-42 eC	41-43 (39-44) z
Semotilus corporalis	29 t	17 t	46 t	42-43 (41-44) qzH
Semotilus margarita				39-40 (38-40) z
Tinca tinca				38-39
Catostomidae:				
Carpiodes carpio	30 C	8 C	38 C	
Carpiodes cyprinus	27-31 (26-32) fjqsC	8-9 (5-10) fjqsC	37-40 (32?-41) efjqC	38 (37-40) fjsz
Carpiodes velifer	26-27 (25-29) J	7-9 (6-11) J	33-37 (33-38) J	
Catostomus catostomus	37-38 (36-40) i	8-9 (5-12) i	46-48 (44-50) i	45-47 z
Catostomus clarki				46-49 (45-51) B

continued

Table 1. continued.

Species	Preanal Myomeres	Postanal Myomeres	Total Myomeres	Total Vertebrae
Catostomus columbianus				46-49 (43-51) zB
Catostomus commersoni	36-39 (33?-42) efqC	8-9 (5-11) efqC	44-47 (41-52) efqC	44-48 qzH
Catostomus discobolus	37-38 C	9-11 C	47-48 C	45-49 (43-50) B
Catostomus fumeiventus	32?-34? v	9-10? v	41?-44? v	45-46 (44-48) v
Catostomus latipinnis	38-39 C	10-11 C	48-49 (48-50) C	
Catostomus macrocheilus				47-49 Z
Catostomus platyrhynchus				44-47 (42-48) zB
Catostomus plebius				43-44 (42-46) B
Catostomus santaanae	33? N	9? N	42+? N	43-44 (42-46) N
Erimyzon oblongus	30-31 (30-33) ft	8-10 (7-10) ft	39-41 (38-42) ft	
Erimyzon sucetta				35-36 z
Hypentelium nigricans	34-38 (33-40) aef	7-9 (3-11) aef	41-47 (39-49) aef	42-45 z
Ictiobus bubalus	25 K	8 K	33 K	
Ictiobus cyprinellus	30 C	7 C	37 C	36-37 z
Minytrema melanops	33-35 (30-35) klIJ	6-8 (3-9) (-14?) klIJ		43-44 z
Moxostoma anisurum	31 e	11 e	42-43 e	40 z

continued

Table 1. continued.

Species	Preanal Myomeres	Postanal Myomeres	Total Myomeres	Total Vertebrae
Moxostoma carinatum				42 z
Moxostoma duquesnei				43 z
Moxostoma erythrurum	33-35 (31-37) i	7-8 (6-9) i	41-42 (39-45) i	40 z
Moxostoma hubbi				43 z
Moxostoma macrolepidotum	32-37 (30-39) bftC	6-8 (5-9) bftC	41-45 (38-45) bftC	42 (41-44) qzH
Moxostoma valenciennesi				42-44 z

Sources: a=Buynak and Mohr 1978, b=Buynak and Mohr*, d=Ehrenbaum 1909, e=Fish 1932, f=Fuiman 1978, g=Fuiman and Loos 1977, h=Fuiman and Loos 1978, i=Fuiman and Witman*, j=Gerlach 1973, k=Hogue *et al.* 1976, l=Hogue and Buchanan 1977, m=Holden and Stalnaker 1970, n=Hubbs 1922, o=Hubbs and Miller 1978, p=Hufzinger*, q=Jones *et al.* 1978, r=Lentsch*, s=Lippson and Moran 1974, t=Loos *et al.**, u=Miller 1963, v=Miller 1973, w=Miller and Hubbs 1960, x=Moore 1944, y=Saksena 1962, z=Scott and Crossman 1973, A=Seethaler 1978, B=Smith 1966, C=Snyder*, D=Snyder *et al.* 1977, E=Stone 1940, F=Suttkas and Clemmer 1977, G=Taber 1969, H=Werner and Young*, I=White 1977, J=Wiltz*, K=Wrenn and Grinstead 1969, L=Zicari*, M=Swift 1965, N=Greenfield *et al.* 1970.

confidence to approximate total myomeres.

Some variation in myomere counts is attributable to differences in techniques, difficulty in discerning the most anterior and posterior myomeres, and the specific stages from which the counts were determined. With respect to the latter, relative vent position may change somewhat during larval and early juvenile development, and the most posterior myomeres in protolarvae and early mesolarvae may be associated with the future or forming hypural complex and may cease to exist or be evident in later stages. In addition, some counts referenced herein may be based on erroneously identified specimens. Due caution is therefore advised in the use of the data presented, especially when total myomeres are notably different from total vertebrae (*e.g. Clinostomus elongatus*, Table 1).

The range of total myomeres or vertebrae for 70 cyprinid species, 28 to 51, is greater and in fact practically includes that for 27 catostomids, 32 to 52 (Figure 1). However, over 75% of the cyprinids have counts within the more restricted range of 34 to 43 and the catostomids within the more restricted range of 39 to 49, 33 to 38 for the ictiobinae and 41 to 49 for the catostominae. *Carassius* is responsible for the low end of the cyprinid range and *Gila*, *Mylocheilus*, *Leuciscus*, *Ptychocheilus*, and *Hybopsis gracilis* (*Platygobio gracilis* according to Scott and Crossman, 1973) for the upper end (Figure 2 and Table 1). The genera *Ictiobus* and *Catostomus* are respectively responsible for the lower and upper extremes of the catostomid range.

Ranges of preanal and postanal myomere counts are 19 to 31 and 10 (9?) to 18, respectively, for the cyprinids, and 25 to 42 (30 to 42 excluding Ictiobinae) and 5 (3?) to 12 (14?), respectively, for the catostomids (Figure 3). However, over three quarters of the cyprinids have preanal

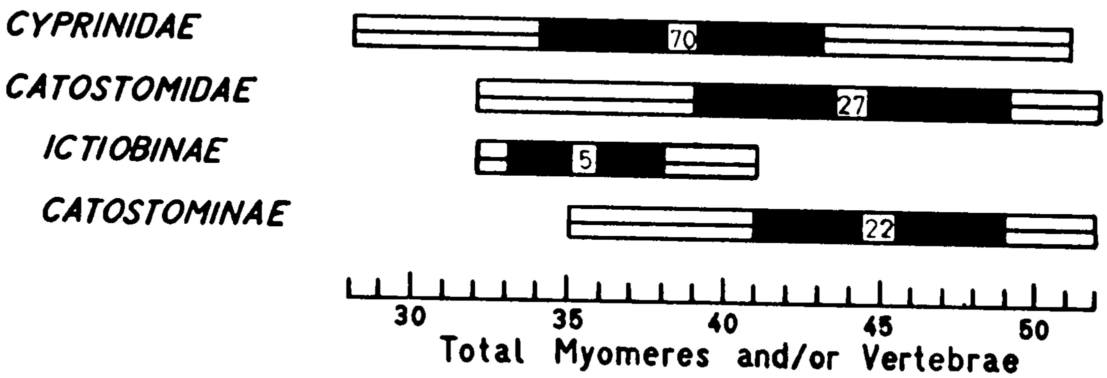

Figure 1. Cumulative ranges of total vertebrae and/or myomeres for the families Cyprinidae and Catostomidae, and the subfamilies Ictiobinae and Catostominae. Solid bars represent the modal ranges which include over 75% of the species. Numbers indicate the number of species on which the data are based. Based on data in Table 1.

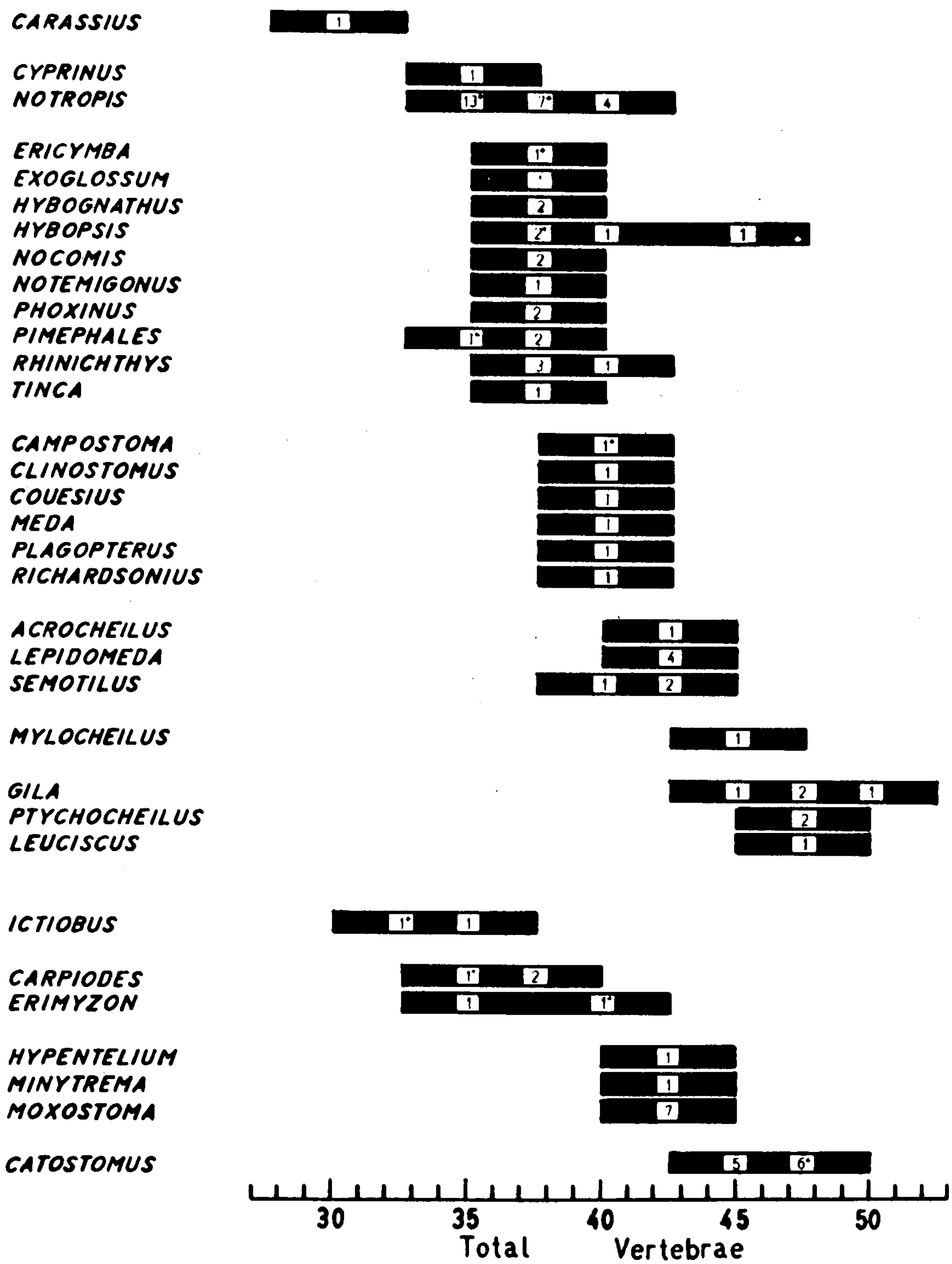

Figure 2. Total vertebrae summarized by genera in uniformly sized range intervals. Numbers indicate the number of species on which the data ~~for~~ is base, an asterist indicates that one or more species ~~is~~ are based on total myomeres rather than vertebrae. Based on data in Table 1.

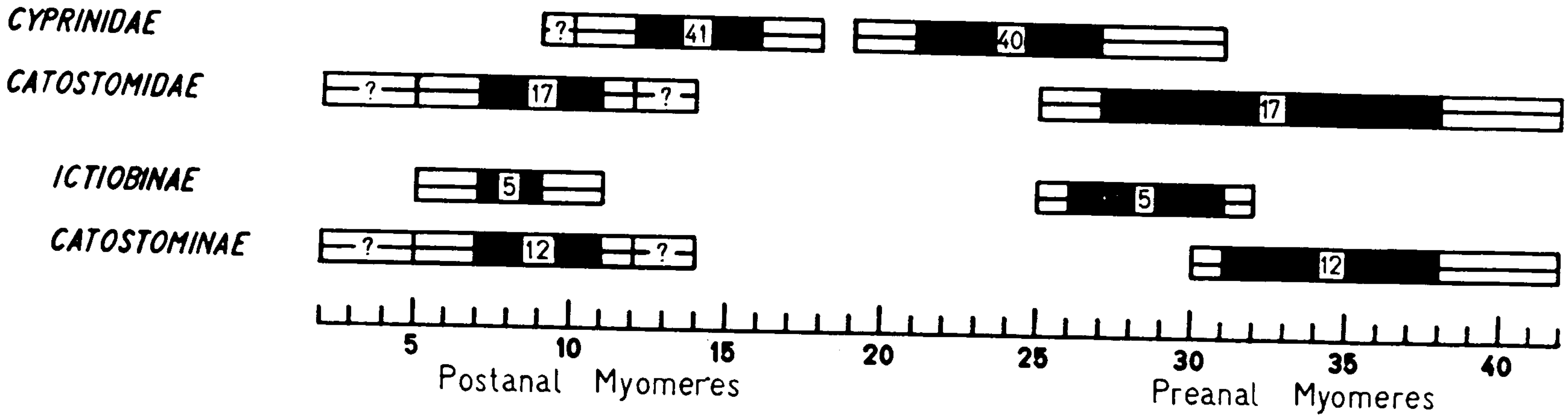

Figure 3. Cumulative ranges of preanal and postanal myomeres for the families Cyprinidae and Catostomidae and the subfamilies Ictiobinae and Catostominae. Solid bars represent the modal ranges which include over 75% of the species. Numbers indicate the number of species on which the data are based. Based on data in Table 1.

counts of 27 or fewer and postanal counts greater than 11, while over 75% of the catostomids have 27 or more preanal myomeres and 11 or fewer postanal myomeres.

Most larval fish biologists recognize vent position and the number of myomeres as key characters in distinguishing between cyprinid and catostomid larvae. Preanal lengths (snout-to-vent) relative to total length have often been reported as less than two-thirds for cyprinids and about two-thirds or more for suckers, but with some overlap. Likewise, as documented above, the ranges of total, preanal, and postanal myomeres for each family also overlap. The greatest degree of separation is found in the proportion of postanal to preanal myomeres which, based on the median values of the typical ranges (Table 1), is about ½ or greater for cyprinids (48 to 78%) and 1/3 or less for catostomids (20 to 35%). Good separation is also attained using the proportion of preanal to total myomeres, typically 2/3 or less for the minnows (57 to 69%) and 3/4 or more for the suckers (73 to 82%).

The genera within each family have more-or-less distinctive ranges of total myomeres or vertebrae (Figure 2). This information can be used, with care and an awareness of exceptions, to help determine the identity of some cypriniform larvae to at least a restricted group of genera and in a few instances to the specific level. As an example, consider an unidentified mesolarva with a myomere count of 29 preanal plus 16 postanal myomeres from the Upper Colorado River System. The high postanal count, and proportions of postanal to preanal (55%) and preanal to total myomeres (65%), place the specimen within the family Cyprinidae. Of the nine cyprinid genera known in the Upper Colorado River System, only *Semotilus*, *Gila*, and *Ptychocheilus* have ranges of total myomere counts that might include the count for this specimen 45; Figure 2). The total and preanal myomere ranges for the specific species encountered in this river system are a bit low in *Semotilus atromaculatus* and high in *Ptychocheilus lucius* and *Gila elegans* (Table 1). These tentative eliminations leave *Gila cypha*, a rare and endangered species, and *Gila robusta*, common in most of the system, as the most probably identities.

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