

ICTALURUS CHIHUAHUA, A NEW CATFISH FROM NEW MEXICO,
TEXAS AND NORTHEASTERN MEXICO, WITH REMARKS ON
THE STATUS OF *ICTALURUS LUPUS*

Julian Humphries* and Robert Rush Miller**

ABSTRACT._____ A new species of catfish in the genus *Ictalurus* is described from the Chihuahuan desert region of the American Southwest. *Ictalurus chihuahua* has previously been confused with *I. lupus*, with which it overlaps considerably in geographic range. It is distinguished from that species by a reduced number of anal rays (22-2) and vertebrae (38-42), a weakly forked caudal fin, short and weak pectoral and dorsal spines, broad mouth, deep caudal peduncle, expanded vomer, and unique shape of the mandible, pectoral girdle and pectoral spine. Archeological material dating from 1100 AD has been recovered from a site in the Pecos River basin in New Mexico. Because of confusion between the names *Ictalurus lupus* and *I. vulpes* for the species now known as the former, we discuss the taxonomic history of that species and, as first revisors, designate *I. lupus* as the valid name for the headwater catfish.

*Department of Biological Sciences, University of New Orleans, New Orleans, LA
70148.

**Museum of Zoology, University of Michigan, Ann Arbor, MI 48109-1079.

INTRODUCTION

The genus *Ictalurus* (Rafinesque, 1820), a member of the North American catfish family Ictaluridae, comprises eight described living species (plus several undescribed Mexican forms) and four extinct species (Lundberg, 1992; Smith, 1987). It has recently been recognized as a clade distinct within the ictalurids (Lundberg 1982:Fig. 3). All living and one of the fossil species of *Ictalurus* are part of the Mexican ichthyofauna. This surprising diversity of large-river catfishes stems largely from allopatric drainage level speciation.

In this paper we describe a new species that has been confounded with *Ictalurus lupus* (Girard) and *I. punctatus* (Rafinesque) and discuss its taxonomic status and distribution. *I. chihuahua* occurs in the Rio Conchos of Mexico and the Rio Grande and Pecos River of New Mexico, Texas and Mexico, southward into the Rio San Fernando, an independent tributary to the Gulf of Mexico in Tamaulipas, Mexico (Fig. 1). We have no records for the species in the Rio Grande above El Paso or below Laredo, although it probably once occurred throughout the Rio Grande.

MATERIALS

Specimens of the new species and comparative material of *Ictalurus lupus*, *I. punctatus*, and other Mexican species used are from a number of different institutions. Abbreviations for these are as listed in Leviton et al. (1985). Material essential to the completion of our research was generously loaned by E.O. Wiley and J. T. Collins (KU), R.B. Suttkus (TU), L.P. Woods, D. Stewart, B. Chernoff and M. A. Rogers (FMNH), M. C. Molles and S. Platania (MSB), Salvador Contreras-Balderas (UANL), S-K Wu (UCM), W.L. Minckley and D. Hendrickson (ASU), R.F. Martin and K. Winemiller (TNHC) and F.

Hendricks (TCWC).

METHODS

Anal-ray counts were made from radiographs, skeletons, cleared and stained specimens, and young and juveniles up to about 70 mm SL, and include all rudimentary rays. This presents a minor problem when comparing our counts to those in the literature as most specimens have at least one and occasionally two ^{or three} rays that are not visible by dissection although they can be seen on young specimens and are readily seen on radiographs. On average our counts are one ^w ray higher than published accounts. Gill rakers were counted on the right side and include all rudiments. Vertebral counts, made from radiographs, cleared and stained material, and skeletons, are post-Weberian vertebrae only (add five to include the Weberian apparatus).

All measurements are straight-line distances and were made with needle-point calipers (for specimens smaller than 180 mm SL), and recorded to the nearest 0.1 mm. Measurements were transformed to logarithms for all subsequent analyses except for ratios. The measurement scheme approximates the truss system of Strauss and Bookstein (1982). The following measurements were recorded, with elaboration for non-standard measurements: standard length, dorsal origin to base of last anal-fin ray, dorsal origin to posterior connection of adipose fin, dorsal origin to anal origin, predorsal length, anal-base length, pelvic origin to posterior connection of adipose, body depth (at origin of anal fin), head length, head width (at opercle), pectoral origin to pelvic origin, pectoral origin to dorsal origin, pectoral origin to orbit, caudal peduncle length (anal base to hypural plate), caudal peduncle depth (least), base of last ray of anal fin to posterior connection of adipose, pectoral and dorsal spine lengths, length of the

cleithral process (from base of pectoral spine), mouth width, length of middle caudal rays (from hypural plate), orbit length, premaxilla tooth-plate width, fleshy interorbital width, and snout length.

Shape variation was initially assessed using the multivariate methods outlined in Bookstein, et al. (1985). However, because of large amounts of within-species variability in those "shape" characters most diagnostic (especially, spine lengths), the multivariate approach was not useful in separating taxa. Simple univariate and bivariate descriptors for body shape characteristics are presented as ratios and as regressions of pairs of measurements useful in identifying species of *Ictalurus*. From such regressions, one can calculate predicted values of a particular measurement for specimens of any given size. The regression formulas are generally more accurate than simple ratios because as ratios are typically correlated with size and the range of values for a specific measurement largely reflects such allometric variation. In addition we present growth allometries based on within-species principal component analysis (Humphries, 1984) with resulting first component coefficients scaled such that variables less than 1 represent negative allometry, those greater than 1, positive allometry and near 1, isometry.

We have had difficulty in our analyses with specimens that are possible hybrids between *I. chihuahua* and *I. lupus* and between both these species and *I. punctatus*. Based on conventional morphological or meristic evidence alone it is not always possible to be confident whether outlying counts or measurements are due to hybridization or simple variation. We have been cautious in including outliers in our description of *I. chihuahua*, and in comparisons with other species.

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Ictalurus chihuahua new species

Chihuahua Catfish

Figs. 1-x

Ictalurus punctatus (in part).—Treviño-Robinson, 1959; Hubbs, et al., 1977 (Table 1);
Hubbs, 1982

Ictalurus "pricer.—Miller, 1978:372, in part (Table 1)

Ictalurus lupus.—Hubbs and Miller 1978:587 (listed); Smith et al., 1984:399 (Conchos basin); Yates et al. 1984:98 (DeBaca Co., N.M., MSB 7778=NK 4891); Smith and Miller 1986:462 (Table 13.1, misentry for *I. cf. lupus*); Williams et al. 1989:6 (populations from Chihuahua); Hubbs and Garrett 1990:446 (reference to occurrence in Rio Conchos)

Ictalurus cf. lupus.—Miller 1986:135 (Table 1)

Ictalurus n. sp.—Sublette et al 1990:241 (advance notice, brief notes on distribution, characters)

Amiurus lupus (in part).—Meek, 1904:xxix, xxxiv, 14 (record, FMNH 100478; 1 spec. from Rio Camacho at Linares, Tamaulipas.

Holotype.—Adult male, 177 mm in standard length (SL), UMMZ 214590, Rio San Pedro, trib. to Rio Conchos, at road crossing 7 km S of Satevó, Chihuahua, 27°53'N, 106°07'W, elev. 1350 m., 23 May, 1978, R. R. Miller, E. Marsh and M. L. Smith

Paratopotypes.—UMMZ 203009 (28), collected with holotype.

Other Paratypes.—NEW MEXICO: MSB 3180 (1), Pecos R. below Eddy, Loving Co; UMMZ 66188 (1), Middle Berendo Cr. N. of Roswell, Chavez Co. TEXAS: TNHC 4240 (2), Rio Grande, El Paso; TNHC 2037 (1), San Felipe Cr., Del Rio, Val Verde Co;

Ictalurus sp.
→

000 (1), Rocky rry, trib. Pecos River NW Concho Eddy

UMMZ 201537 (1), Rio Grande, mouth Indian Creek, Terrell Co MEXICO: UANL 1892

(6), Rio Florido, Jiménez, Chihuahua; UANL 7121 (10), Rio Florido, Saucillo,

Chihuahua; UMMZ 203240 (3) and UANL 2153 (7), Rio de Allende, Allende,

v 7 ec 4E14-E17, Rio San Pedro near Juze on left Rio Concho, Chihuahua
Chihuahua; UMMZ 161739 (1), Rio Florido between El Cristo and Villa Ocampo,

A Durango; ASU 64-0859 (1) and UMMZ 196733 (1), Rio San Pedro, Meoqui, Chihuahua;

UANL 5661 (2) Julimes, Chihuahua; FMNH 100478 (1) Linares, Nuevo Leon

/ BOB, I know you have designated some additional types. I don't have counts or measurements on some of those and have not seen others. I think I probably want to examine any specimens we designate as paratypes.

Nontype Material.—NEW MEXICO (Gila drainage): MSB. Although we do not formally list these specimens as types (because their origin is uncertain) there is no question that most of those from the Gila River are *I. chihuahua*. How they got into that drainage is a puzzle discussed below. Pecos drainage: MSB 7778 (1), Pecos. R. below Summer Reservoir, DeBaca Co. 1981.

Diagnosis.—A member of the *I. punctatus* species group as defined by Lundberg (1992), including that species plus *australis* (equals ~~*punctatus*~~), *dugesi*, *lupus*, *mexicanus*, *pricei*, *punctatus*, and several other undescribed catfishes from central Mexico. It is separable from those species by the following combination of characters: 22 to 26 (usually 23 or 24) anal rays, 38 to 42 (usually 39-41) vertebrae, a shallowly forked caudal fin, short pectoral and dorsal spines (Table 1), a robust, heavy-set body,

more cylindrical in cross section (Fig. 1), with a deep caudal peduncle and broad head.

Distinctive osteological traits include: a distinctive coronoid process of the dentary, further back along the mandible and with a steeper posterior slope, humeral process of the cleithrum shorter, approximately equal in length to dorsal processes, and with less pronounced striations, vomer broadly expanded anterior-ventrally, mesethmoid

don't have skeleton of the head I, 2,

relatively broad , pectoral spine with smooth anterior surface and weak posterior serration (Fig. 2). Shares with all members of the *punctatus* group except *I. punctatus* a distinct gap between the supraoccipital process and the dorsal fin supraneural.

Description.—Morphometric and diagnostic meristic values are listed in Tables 1 and 2, general body features and pigmentation are illustrated in Figure 1. Additional morphometric details appear in the comparison section below. *I. chihuahua* reaches a SL of at least 280 mm (female skeleton, UMMZ 203009). Other meristic values include: Gill rakers, 13-17; pectoral rays 1,9 (occasionally 8) , dorsal rays 1,6, pelvic rays i,7.

Coloration.— We have no observations of life colors. In alcohol, juvenile to adults have lateral surfaces brownish with small to moderate spots (1.5-40 mm in diameter) between the base of the caudal fin and the snout, but sparse on the top of the head. Spots are concentrated above the midline. Considerable variation in the number and distribution of spots occurs among specimens, even within a single population. The venter is paler and without spots. The dorsal surface is slightly darker than the sides. All fins are pale and without spotting, with a noticeable translucent character in the distal portion. The dorsal spine has a dark epidermal covering which extends past the

tip of the spine itself. The caudal fin has a thin, dark edge. The most dorsal caudal ray is dark, the ventral ray is pale. Barbels are dark on the dorsal surface, pale on the ventral.

Comparisons.____On the basis of meristic, morphometric, or qualitative characters *I. chihuahua* is easily separable from all members of the *I. punctatus* species group except *lupus* and *mexicanus*. Although we performed a shape analysis (Bookstein, et al, 1985) to investigate body shape differences among these species, we quickly discovered that except for caudal peduncle depth and mouth width (plus spine lengths, which seem to show different patterns of variation than "typical" body shape characters), there is little shape difference recognizable in these multivariate analysis. The distinctive "rounder" or torpedo shaped body that is visible to the eye in *I. chihuahua* does not manifest itself in any of the multivariate shape analysis methods.

For those most diagnostic distance characters we are presenting simple regressions, either against standard length (demonstrating differences in allometry) or against each other (for identification purposes). Figure 3 illustrates between species differences in the diagnostic shape measurements between *I. chihuahua* and *lupus*. In all plots, dorsal and pectoral spine lengths for chihuahua are shorter and grow at a slower pace than for lupus. The wider mouth and deeper caudal peduncle improve the scatter and allow positive identification when compared (via regression or ratios, Table 2) against the spine lengths (Figure 3x).

Distribution.--*Ictalurus chihuahua* occurs in the upper and middle parts of the Rio Conchos basin in Chihuahua, and Durango, Mexico, in the Rio Grande, from El Paso to just above Laredo, Texas, formerly, in the Pecos River to at least 7.2 km north of

Roswell, N.M. (UMMZ 66188) and possibly as far upstream as Summer Reservoir, DeBaca Co., with one record (FMNH 100478) from the Rio San Fernando basin, Tamaulipas, Mexico (see synonymy) (Figure 4). At one time it probably inhabited the Rio Grande in N.M. Based on two ten-day trips in March and April, 1977 (Hubbs et al., 1977), it was found to have a limited distribution in the Texas-Chihuahua portion of the Rio Grande. A recent resurvey of the same part of this river by Bestgen and Platania (1988, unpubl.) captured no specimens of *I. chihuahua*.

In addition we have identified specimens of *Ictalurus chihuahua* from nine collections in the Gila River of western New Mexico, taken from 1949 to 1989. As stated by Miller (1959:107) living species of catfish are not native to the Pacific Slope of North America north of the Rios Yaqui and Sonora, Mexico. Stocking records (N.M. Dept. Game and Fish, Ann. Repts. 1935-1955) indicate that "catfish" have been planted in the Gila River since the early part of the 20th century. The sources of these fish are uncertain, but they came from federal warm-water hatcheries at either Uvalde or Dexter, New Mexico, after 1934, ^{possibly} and from other U.S. hatcheries before that time. Discussions with hatchery personnel (Brooks, pers. comm., 1989) have failed to reveal the precise original sources for these catfish. However, the 1935-36 annual report of the New Mexico Department of Fish and Game lists (p. 11) 700 catfish sent by the Dexter Hatchery. *Ictalurus punctatus*, *I. lupus*, and *I. chihuahua* were available in the adjacent Pecos River.

We know that within historic times *I. chihuahua* inhabited the Rio Grande at least as far upstream as El Paso, Texas, and up the Pecos River to north of Roswell, N.M. Either the Rio Grande or Pecos populations would have been a logical source for stock.

Ictalurus lupus was also transplanted into the Gila River basin. Finally, it is certain that *I. punctatus* was also an early introduction into that basin.

Our own research on *I. lupus* indicates that where reservoir populations of *punctatus* come into contact with *lupus*, we tend to find specimens with hybrid characteristics. With three species in the Gila, absolute identification of some individuals is impossible without using genetic (allozymic) markers. On the other hand, some pure *I. chihuahua* may be surviving in upper tributaries to the Gila River.

Archeology.—An archeological site dated about 1100 AD, rich in fish remains, is located at Rocky Arroyo, which lies about 11 km SW of Roswell, New Mexico, just W of the Rio Hondo in the Upper Pecos River valley (Wiseman, 1985). Included in the fish fauna are five species of catfish, four *Ictalurus* plus *Pylodictys*. Included are a series of loose bones, including a lower jaw, pectoral spine and cleithrum all identifiable as *I. chihuahua*. (Fif)

Etymology.—The specific name refers to the Chihuahuan Desert region to which this species is endemic.

Habitat. The habitat of the Chihuahua catfish is like that of its close relative, the headwater catfish, with which it is commonly sympatric except in the Rio Conchos basin. It inhabits the middle to upper parts of moderate to large rivers and occurs also in small, headwater creeks and springs. The water, often clear may be muddy (as in the Rio Grande), and substrates comprise gravel, rubble, rocks, boulders and mud.

Currents vary from strong to none; aquatic vegetation consists of algae and *Po. amogeton*, depths commonly vary to 2 meters or more.

Conservation.—*I. chihuahua* is certainly an endangered species in the Rio Grande basin in Texas and New Mexico, ^(where it was formerly) and is treated as being of special concern in the Conchos basin (Williams et al., 1989—see synonymy). The most imminent danger is from hybridization with exotic *I. punctatus* or even *I. lupus*. Channel catfish are the most widely stocked catfish in North America (Moyle, 1976). Recent collections, particularly in sections of river upstream from reservoirs, frequently contain specimens suspected of having hybrid phenotypes. This situation has made difficult the task of describing *I. chihuahua*. Specimens occasionally show single counts or measurements outside the normal range for the species, in the direction of *I. punctatus* or *I. lupus*. Such specimens have been listed but are not designated as types.

With the continual introduction of channel catfish, the likelihood of pure stocks of *I. chihuahua* remaining within its natural range in the U.S. are slim. Since at least 1975 *I. punctatus* has been stocked in Central Mexico (Contreras-B., and Escalante-C., 1984) and hybridization with and replacement of native species is occurring. Similar replacement of *I. pricei* though hybridization and competition with *I. punctatus* in the Rio Yaqui is also occurring (RRM, pers. observ., 1988).

If further surveys within the Rio Grande show *I. chihuahua* to have become extinct in that river (as apparently has taken place in the Pecos River), the only location within its original range where specimens may still be collected is in the Rio Conchos. However, another possible source for reintroducing *I. chihuahua* are the surviving populations in the upper Gila River of New Mexico in the East Fork and its tributary, Beaver Creek (MSB 6395 and 6392). Putative pure stock persists in the East Fork and is being monitored (David Propst, pers. comm. 1991). Under any circumstances, an

electrophoretic survey of isozymes should be carried out on Gila River populations (compared to Conchos specimens as well as *I. punctatus* and *lupus*) to ascertain whether these are unquestionably pure *I. chihuahua*.

Status of *Ictalurus lupus* and *I. vulpes*

The validity and nomenclatural status of *Ictalurus lupus* have a confusing history. The most vexing problem concerns the simultaneous description of an ictalurid catfish, *Ictalurus vulpes* (Girard), also from Texas.

Ictalurus lupus was described as *Pimelodus lupus* by Girard (1858:211) in a report on the fishes collected during a railroad survey of a route to the Pacific Ocean. Unfortunately, this report appeared in several forms, with several titles (1856, 1857, 1858), over a period of at least three years. Despite the various dates, these reports were apparently published only as early as 1858, but the month is undetermined and thus is considered to be the last day of that year (ICZN, 1985). The text of the species description is identical in each volume. One important fact concerning the sequence of publication of *lupus* and *vulpes* is that the description of *lupus* explicitly refers to *vulpes*, implying that it was an already published name. There are two lots of syntypes, USNM 915 a single young specimen collected from "Indianola to Nueces" in 1854. Indianola is the earlier name for Port Lavaca, near Matagorda Bay, and Nueces may refer to the Nueces River, but could refer to a since vanished town. USNM 916 is a lot of three adults collected from the "Head waters of the Rio Pecos", also in 1854. All specimens match our concept of *I. lupus*. The Indianola specimens are a problem. Despite published statements to the contrary (Connor and Suttkus, 1986; Kelsch and Hendricks, 1986, 1990) we have been unable to identify any specimens of *lupus* from

the Gulf-slope of Texas (north and east of the Rio Grande) collected since 1894.

Pimelodus vulpes was described by Girard (1859a, 1859b) in two different publications. One was the Proceedings of the Academy of Natural Sciences of Philadelphia, Volume X (Sig. 12), pages 167-171. This is dated both 1858 and 1859 on the title page, referring to the range of dates of individual signatures published separately. No specimens or types are referred to; however, the locality and collectors of specimens listed are given in the publication discussed below. According to Recommendation 72B of the Article 72 (ICZN, 1985:72) on admission of external evidence those specimens are to be considered syntypes of *vulpes*.

Girard (1859b) also described *vulpes* in Volume 2 of the U. S. And Mexican Boundary Survey. This appeared twice (F. Gehlbach, personal communication), the first time in 1858. No month of publication is established. Seven series of specimens are listed as USNM 843-849. Various localities in the lower Rio Grande and Gulf-slope drainages are included. We have located numbers 843, 845, and 846 and all are referable to *lupus*.

From the above, it is unclear which name, *lupus* or *vulpes*, has precedence for the form we know as *Ictalurus lupus*. There is evidence that the ANSP publication was actually printed in July, 1858, as that date appears on the bottom of each page of the signature containing the *vulpes* description. Actual distribution of each signature occurred subsequent to printing and we have no evidence on what date that transpired.

Dates of ANSP publications (Nolan, 1913) shows that various signatures were acknowledged by institutions receiving each ANSP publication. Unfortunately, no date is given for signature 12 containing the pages on which *vulpes* was described. Given

CATOSTOMIDAE

pharyngeal teeth in 1 row and numerous, no teeth on jaws, no adipose fin. Highly diversified in body shape, but tending to be dorso-ventrally compressed or at least flat on the belly Distributed in North American and Eurasia, north of the tropics (details here). Paleocene occurrence of Catostomus-like fish, Eocene Ictiobus-like genus Amyzon, etc. Tetraploids

Ictiobine

Ictiobus, Carpiodes (ecology, systematics, distributions for each following)

Cycleptine

Cycleptus, Myxocyprinnus

Catostomine

Catostomus/Pantosteus/Deltistes/Xyrauchen

Moxostomini (Scartomyzon, Erimyzon, Hypentelium, Thoburnia, and others)

the uncertainty in the actual date of publication of this volume as well as the dates for the Mexican Boundary Survey and Pacific Railroad Surveys we consider all to have been published on the last day of 1858. Following Article 24 of the Rules (ICZN 1985:24), as first revisers we elect to use the name *lupus*, in current use, rather than *vulpes*, which has long rested in the synonymy of *I. punctatus*.

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hatch, nm fish and game, cashner (collecting) mhg, brooks, bd, FHM, Platania, Propst.

NSF GB-3594 (to RRM) supported field work in Mexico. (Jmh will fix these), Fran

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Teresa Peterson

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Table 1. Morphometrics of *Ictalurus chihuahua*. Data are mean percent of standard length, standard deviation of the mean, minimum and maximum of the same ratio, actual mm lengths of the holotype and multivariate allometric coefficient.

Character	Mean	Std. Dev.	Minimum	Maximum	Holotype (mm)	Allometric Coefficient
Standard Length (mm)	103.25	41.27	59.4	256.0	177.3	0.97
Dorsal fin o.-anal fin b.	54.95	1.19	52.78	57.73	95.8	1.02
Dorsal fin o.-adipose	50.20	1.56	47.57	53.34	89.6	1.03
Dorsal fin o.-anal fin o.	33.77	1.17	31.93	36.95	59.5	1.04
Pelvic fin o.-adipose	39.48	1.29	36.95	41.79	69.6	1.07
Predorsal length	37.16	1.05	35.02	39.10	68.3	0.96
Anal base length	26.22	1.09	24.26	28.70	43.6	1.01
Body Depth	19.46	1.44	16.84	24.06	35.7	1.29
Head Length	26.24	0.93	24.50	27.91	47.3	0.97
Head Width	20.27	0.95	18.11	22.94	37.2	1.04
Pectoral fin o.-pelvic fin o.	25.54	1.14	23.32	28.52	43.0	1.02
Pectoral fin o.-dorsal fin o.	21.50	0.95	19.70	23.64	38.6	1.03
Pectoral fin o.-orbit	11.06	0.57	9.85	12.30	20.8	1.03
Pectoral spine Length	11.44	0.99	8.52	13.59	18.0	0.68
Dorsal spine length	11.32	1.38	7.62	14.18	15.0	0.66
Cleithral process length	9.76	0.82	7.55	11.67	15.2	0.78
Snout length	11.42	0.63	10.38	13.06	20.1	1.05
Fleshly interorbital width	11.52	1.11	9.93	14.39	24.2	1.50
Mouth width	10.87	0.93	9.07	13.80	21.9	1.26
Anal fin b.-adipose	11.69	0.72	10.25	13.18	21.9	1.20
Caudal peduncle depth	10.89	0.68	8.95	12.42	18.8	1.03
Caudal peduncle length	14.15	0.95	11.65	16.22	25.5	1.00
Caudal fin length	14.24	1.22	10.51	17.85	23.5	0.68
Orbit diameter	5.66	0.82	3.40	6.87	8.2	0.34

Premaxilla tooth-plate	6.87	0.76	5.72	8.88	14.6	1.35
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TABLE 2

Comparison of four species of *Ictalurus* from Gulf Slope Drainages. Proportions are mean \pm S.D.

Character	<i>I. chihuahua</i>	<i>I. lupus</i>	<i>I. mexicanus</i>	<i>I. punctatus</i>
Anal rays, range (mean)	22-26 (23.6)	23-27 (24.9)	20-24 (21.7)	26-32 (29.7)
Typical values	23-24	24-26	21-22	28-30
Vertebrae range (mean)	38-43 (40.0)	39-46 (40.8)	38-40(39.1)	42-46 (43.9)
Typical vertebral values	39-41	40-42	39	43-45
Pectoral spine post. serration	few, non-recurved, short, blunt	many fine, recurved, sharp	very few, blunt or tiny points	many large, recurved
Caudal forking	shallow	moderate	very shallow	deep
Extent of posterior cleithral process	even with ascending process	slightly past ascending process	even with ascending process	posterior to ascending process
P. Spine/mouth width	1.06 \pm .14	1.33 \pm .20	1.04 \pm .11	1.71 \pm .24
P. Spine/Caud. Ped. Dep.	1.05 \pm .11	1.30 \pm .11	1.10 \pm .06	1.76 \pm .20
D. Spine/Mouth width	1.05 \pm .18	1.32 \pm .25	1.18 \pm .29	1.77 \pm .19
D. Spine/Caud. Ped. Dep.	1.04 \pm .13	1.29 \pm .16	1.23 \pm .21	1.82 \pm .18

¹ Very large specimens have reduced or worn teeth.

JMH to write figure legends

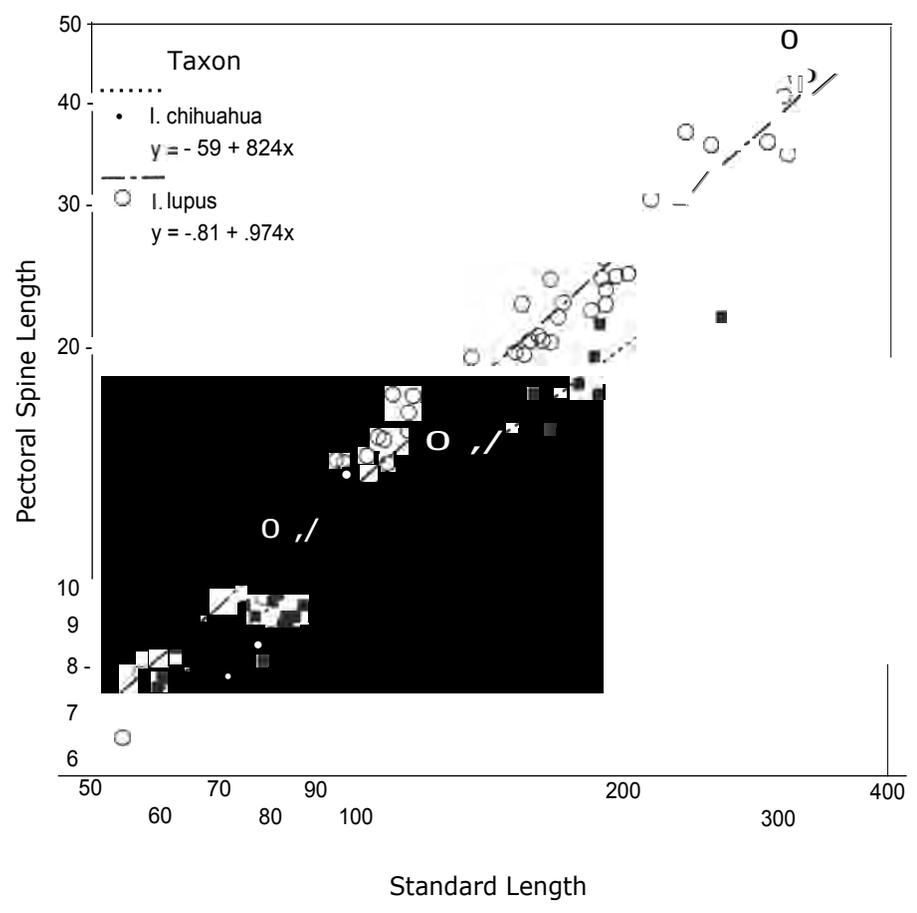
Figure 1. Drawings of holotype

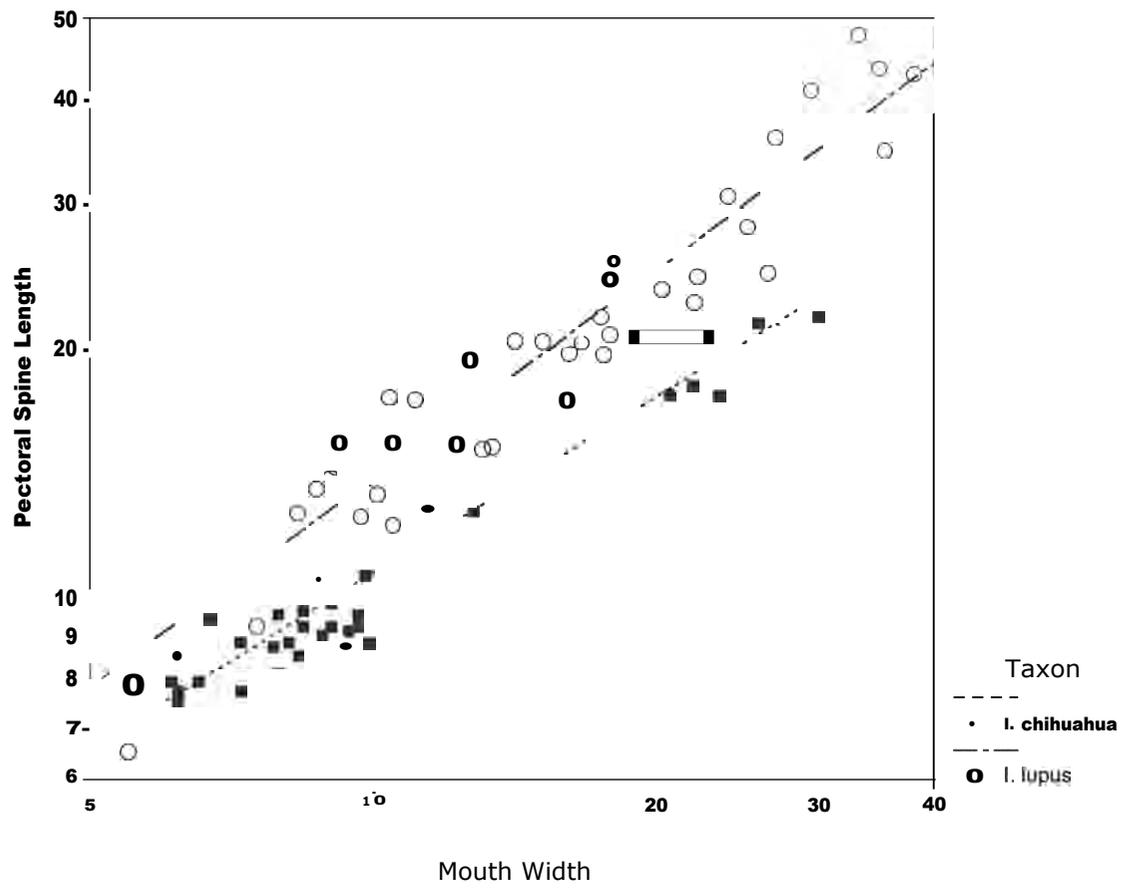
Figure 2. Bone illustrations

Figure 3. Scatter Plots

Figure 4. Map

Figure 1





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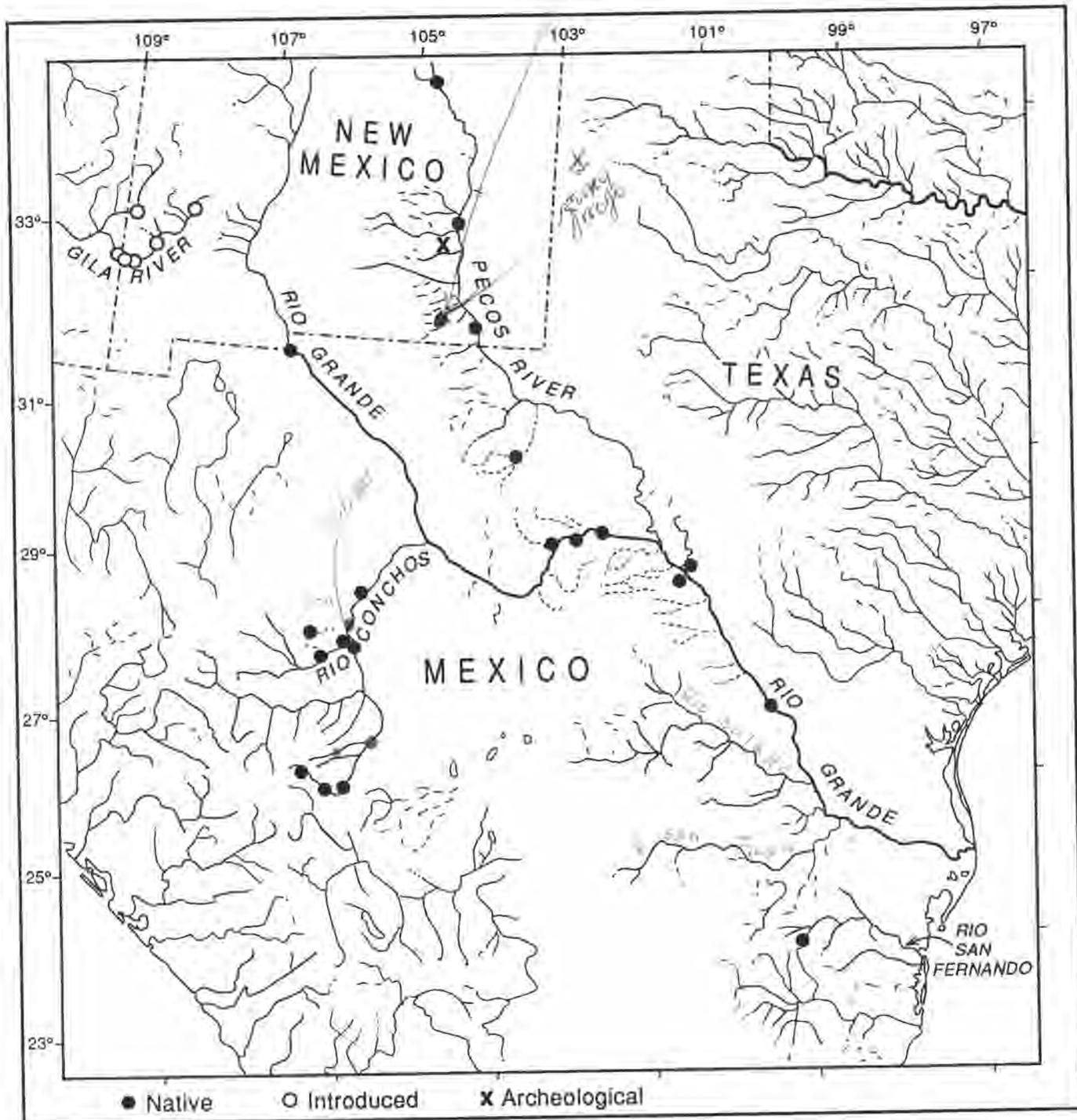
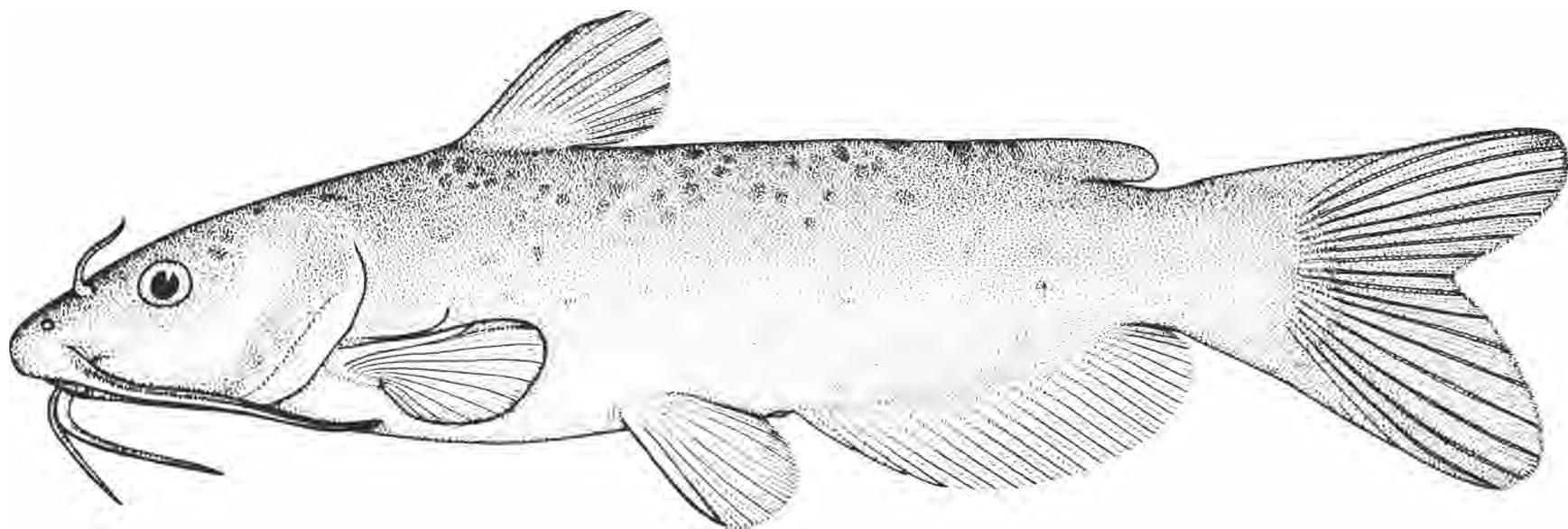
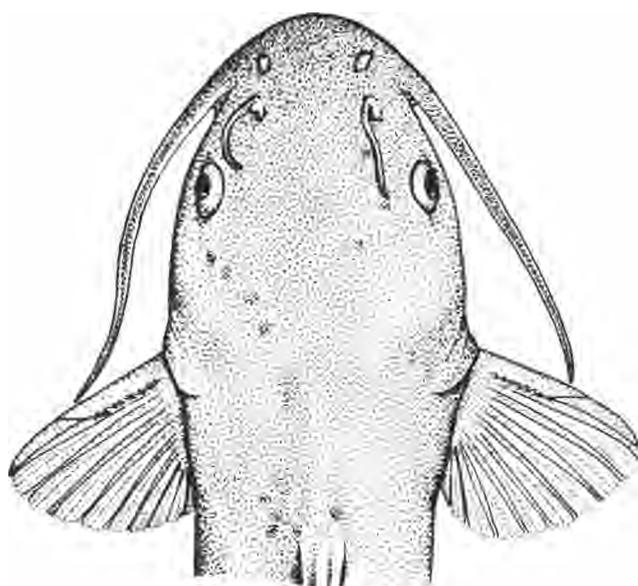


Figure 1



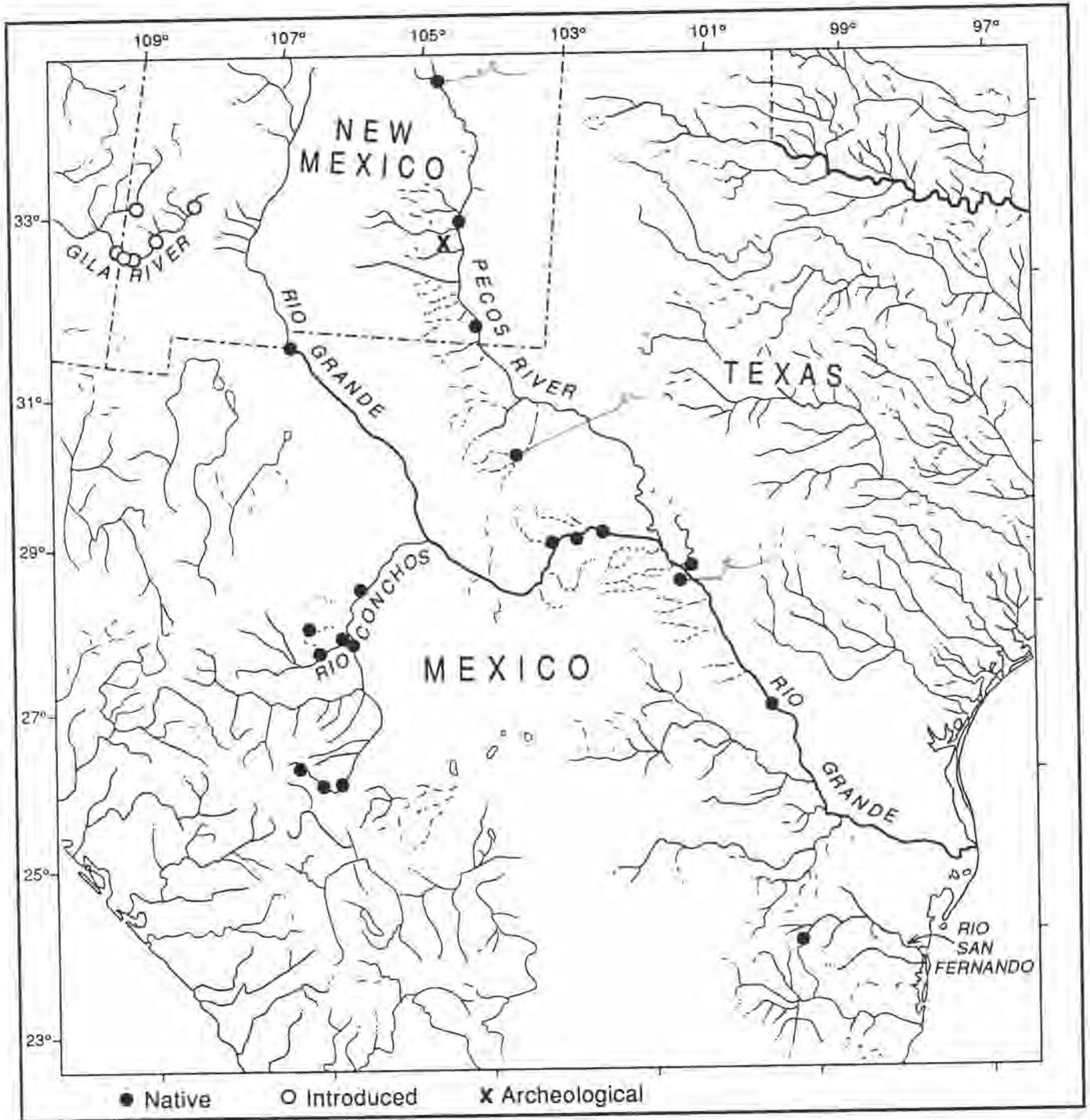
tal *chilobrama*
UMM 201 37 L. - Mexico, Rio Grande . Fink Apr 88



epinephelinae
epinephelus
182 mm SL
TOP ↓

- chihuahua. U. M. 153 ♂ 183 mm S.
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Figure 4



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ILLUSTRATIONS

Lateral view kha dorsal view ■■■ at io .sp
1537 paratype SL

(a) Left fin
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(b) 1/4
an array
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on
2x2
slides

Fig. 1. Fish showing 16 vertebrae
Fig. Spinal column 16 vert