

SYSTEMATICS OF THE AFRICAN CATFISH FAMILY AMPHILIIDAE (TELEOSTEI:
SILURIFORMES)

By

ALFRED WILLIAM THOMSON

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To my parents, Alfred S. and Gery L. Thomson, who have always been there for me
and have always supported me

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SYSTEMATICS OF THE AFRICAN CATFISH FAMILY AMPHILIIDAE (TELEOSTEI:
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By

Alfred William Thomson

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The phylogenetic relationships of the Amphiliidae are studied using Bayesian and Maximum Likelihood methods based on data from one mitochondrial locus and two nuclear loci from 12 of the 13 recognized amphiliid genera and more than half of the known species diversity of the family. The loci are analyzed separately and as a concatenated dataset. All analyses find strong support for two of the three currently recognized subfamilies, but the subfamily Amphiliinae is consistently recovered as polyphyletic. The three loci are then employed in Bayesian and Maximum Likelihood analyses of the largest genus in the family, *Amphilius*. No analyses support the monophyly of *Amphilius*, but the previously recognized High African and Low African morphological groups are consistently recovered as well supported clades. The name *Anoplopterus* Pfeffer, 1889 is resurrected for the species of the High African group, and all species of the Low African group are retained in *Amphilius*.

The *Amphilius jacksonii* complex is revised, and five new species are described: *A. n. sp.* Ruzizi from the Ruzizi drainage and northeastern tributaries of Lake Tanganyika; *A. n. sp.* Malagarasi from the Malagarasi drainage, Lake Rukwa basin, and

upper Great Ruaha River system, Rufiji basin; *A. n. sp.* Congo from the upper Congo basin; *A. n. sp.* Rufiji from the Rufiji and Wami basins; and *A. n. sp.* Lake Kyogo from the Lake Kyogo drainage, northeastern tributaries of Lake Victoria, and the Lake Manyara basin. Taxonomic work is also conducted on the High African *Amphilius*. The status of four nominal species, *Chimarrhoglanis leroyi* Vaillant 1897, *A. hargerii* Boulenger 1907, *A. brevidorsalis* Pellegrin 1919, and *A. platychir* var. *cubangoensis* Pellegrin 1936, that have long been placed in the synonymy of *A. uranoscopus* is addressed, and two new species are described: *A. n. sp.* Ruvu from the Ruvu basin, and *A. n. sp.* Mangula from the Rufiji basin.

CHAPTER 1 INTRODUCTION

Catfishes of the family Amphiliidae (Teleostei: Siluriformes) are small to moderate-sized fishes native to small streams throughout sub-Saharan Africa. The phylogenetic relationships, monophyly and limits of Amphiliidae have been the subject of considerable debate. Thirteen genera are currently recognized in three subfamilies. Eighty-five species are currently recognized, but a taxonomic revision of this family is badly needed. Most of the species have very restricted distributions and show a high level of endemism to river drainages and possibly to single river systems and rivers. The several recognized species with large distributions are thought to be species complexes with many populations worthy of taxonomic recognition. Additionally, recent collection efforts have yielded additional undescribed taxa that are awaiting formal taxonomic description.

He et al. (1999) and Diogo (2003) conducted phylogenetic analyses of the family using morphological data and reached different conclusions on the monophyly of the family. He et al. (1999) found that the genera of the subfamily Doumeinae and the genus *Zaireichthys* were more closely related to the Asian catfish family Sisoridae than to the genera of the subfamily Amphiliinae but Diogo (2003) found strong support for the monophyly of the family. In addition to Diogo's study, support for the monophyly of Amphiliidae was found in several broader studies on the phylogenetic relationships of the Siluriformes. Mo (1991) and Diogo (2005) both included representatives of all three recognized amphiliid subfamilies in their morphological phylogenetic studies of the Siluriformes and found strong support for the monophyly of Amphiliidae. The molecular phylogenetic analysis of the Siluriformes by Sullivan et al. (2006), which included four

amphiliid genera including representatives of each of the three subfamilies, also found strong support for the monophyly of Amphiliidae.

All phylogenetic studies on amphiliids have been limited in taxon sampling so the monophyly of each of the 13 recognized genera are untested and species relationships within genera are unknown. The most speciose and most widely distributed genus in the family is *Amphilius*. As currently recognized it includes 29 species and is distributed throughout Low Africa (northern and western Africa in which most of the land is at elevations between 500 and 1000 meters) and High Africa (southern and eastern Africa in which most of the land is at elevations well above 1000 meters (much above 4000 meters). Skelton (1984) identified two characters that distinguished most of the species from Low Africa from most of the species from High Africa. The Low African species have an epidermal fold at the base of the caudal fin and 6 + 7 or 7 + 8 principal caudal-fin rays while the High African species lack the epidermal fold and have 8 + 9 principal caudal-fin rays. The Low and High African *Amphilius* were later recognized as two different morphological groups by Thomson & Page (2010).

Within both the Low and High African morphological groups a considerable amount of undescribed diversity exists. In the Low African group, one of the most widely distributed species is *Amphilius jacksonii*. *Amphilius jacksonii* was described from Uganda but has since been recorded from throughout much of eastern Africa. There is a substantial amount morphological difference between populations from different drainages indicating the material identified as *Amphilius jacksonii* represents more than one species.

Amphilius uranoscopus is the most widely distributed species in the High African group. Thomson & Page (2010) removed two nominal species from the synonymy of *Amphilius uranoscopus* and described a population from the Athi River Kenya as a new species. Four other nominal species that have long been placed in the synonymy of *A. uranoscopus* were not addressed by Thomson & Page (2010) and their status needs to be addressed before additional species of High African *Amphilius* can be described.

In this dissertation, the phylogenetic relationships of Amphiliidae are analyzed based on data from one mitochondrial locus and two nuclear loci. Sequence data from 12 of the 13 currently recognized genera and more than half of the known species diversity of the family are included in the study allowing not only the monophyly of the subfamilies but also the monophyly of many of the genera to be tested. A phylogenetic analyses of *Amphilius* is also conducted employing the same loci but with more extensive taxon sampling. The analysis provides strong support for the monophyly of both the High and Low African morphological groups and also indicates a substantial amount of undescribed diversity. The *Amphilius jacksonii* complex is revised and five new species in the complex are described. Taxonomic work is also conducted on the High African *Amphilius*. The status of four nominal species that have long been placed in the synonymy of *A. uranoscopus* is addressed and two new species are described.

CHAPTER 2
MOLECULAR PHYLOGENY OF THE AFRICAN CATFISH FAMILY AMPHILIIDAE
(TELEOSTEI: SILURIFORMES).

Background

The family Amphiliidae was erected by Regan (1911), who divided it into two subfamilies. The genera *Amphilius* and *Paramphilius* were placed in the subfamily Amphiliinae, and the genera *Andersonia*, *Belonoglanis*, *Doumea*, *Paraphractura*, *Phractura* and *Trachyglanis* were placed in the subfamily Doumeinae. David and Poll (1937) proposed that the genus *Leptoglanis*, which was previously placed in the family Bagridae, was closely related to species of Amphiliidae and included it in the family. Harry (1953) rejected the inclusion of *Leptoglanis* in the family and placed *Paraphractura* in the synonymy of *Phractura*. Bailey and Stewart (1984) transferred *Leptoglanis* back to Amphiliidae and included *Zaireichthys*, a genus described by Roberts (1967) and thought to be closely related to *Leptoglanis*.

The inclusion of *Leptoglanis* and *Zaireichthys* in Amphiliidae was strongly supported in the phylogenetic analysis of Siluriformes by Mo (1991) who listed 14 derived features shared by these two genera and all or some amphiliids. Additionally, Mo (1991) identified two synapomorphies for the family Amphiliidae: two prominent spine-like processes on the posterior palatine, and presence of a hook-like dorsal laminar process on the pelvic girdle. He et al. (1999) conducted a phylogenetic analysis that included *Zaireichthys* (*Leptoglanis camerunensis* = *Zaireichthys camerunensis*) but not *Leptoglanis*, and concluded that Amphiliidae was not monophyletic. Their results indicated that the genera of the subfamily Doumeinae and *Zaireichthys* were more closely related to the sisorid genera *Euchiloglanis* and *Glyptothorax* and should be

recognized in their own family, Doumeidae, with Amphiliidae being restricted to *Amphilius* and *Paramphilius*.

Diogo (2003, 2005) proposed relationships among the genera of Amphiliidae that strongly supported the inclusion of *Leptoglanis* and *Zaireichthys* in Amphiliidae, and the subfamily Leptoglanidinae was erected independently by Diogo (2003) and Roberts (2003) for the inclusion of these genera in Amphiliidae. Roberts (2003) also described three new genera in Leptoglanidinae: *Dolichamphilius*, *Psammphiletria* and *Tetracamphilius*.

Diogo (2005) diagnosed Amphiliidae by 12 characters, three of which are autapomorphies. The three autapomorphies included one character inspired by Mo (1991) (autopalatine markedly bifurcate posteriorly), and two newly discovered synapomorphies: arrector ventralis markedly bifurcate mesially, and posterior portion of autopalatine significantly expanded dorsoventrally due to the presence of ventral and dorsal laminar expansions. The phylogenetic analysis of Siluriformes by Sullivan et al. (2006) based on Rag 1 and Rag 2 nuclear gene sequence data included four amphiliid genera including representatives of each of the three subfamilies. Their results strongly supported the monophyly of Amphiliidae in the parsimony and likelihood analyses with 100% bootstrap support and in the Bayesian analysis with a 100% posterior probability.

To date, all analyses have agreed on the monophyly of the three subfamilies of the family, but the available morphological and molecular data give conflicting hypotheses of the relationships among subfamilies. The morphological hypotheses proposed by He et al. (1999) and Diogo (2005) have the subfamily Leptoglanidinae as sister to the subfamily Doumeinae, while the molecular results of Sullivan et al. (2006)

have the genus *Amphilius* of the subfamily Amphiliinae as sister to the two doumeine genera included in the analysis. Taxon sampling was too limited in all analyses to test the monophyly of the genera of Amphiliidae. Presented here are the results of a phylogenetic analysis of the family based on data from one mitochondrial (cytochrome b, cyt b) locus and two nuclear (recombination activating gene subunit 2, Rag 2 and the first intron of the nuclear ribosomal S7 gene, S7) loci from 12 of the 13 recognized amphiliid genera and more than half of the known species diversity of the family.

While the analyses find support for two of the three currently recognized subfamilies, the subfamily Amphiliinae is consistently recovered as polyphyletic. Additionally, several currently recognized genera are not recovered as monophyletic.

Material and Methods

Acquisition of Specimens

Tissues for DNA analysis were obtained from the Genetics Research Repository at the Florida Museum of Natural History or borrowed from other institutions (Table 2-1). Materials examined in this study are deposited in the following institutions: the American Museum of Natural History, New York, New York (AMNH), the Natural History Museum, London (BMNH), the Cornell University, Vertebrate Collections, Ithaca, New York (CU), the University of Kansas Natural History Museum, Lawrence, Kansas (KU), the National Museums of Kenya, Nairobi, Kenya (NMK), the South African Institute for Aquatic Biodiversity, Grahamstown, South Africa (SAIAB), and the Florida Museum of Natural History, Gainesville, Florida (UF, FLMNH for tissue samples), Zoologische Staatssammlung München, Munich, Germany (ZSM). Sequences for outgroup taxa (species of Mochokidae and Malapteruridae) and some ingroup taxa were obtained from GenBank (GenBank numbers provided in Table 2-1).

DNA Extraction, PCR amplification, and Sequencing

Genomic DNA was extracted from fin or muscle tissue using a 5.0% Chelex solution with 3 μ L of Proteinase K and digestion at 55°C overnight or by using a Qiagen DNeasy Blood and Tissue Kit (Qiagen, Inc.) and following the manufacturer's instructions. The extracted DNA was used as template for amplification of three markers by polymerase chain reaction (PCR).

The complete cytochrome b gene (cyt b) was PCR amplified from the mitochondrial genome using previously published primers (GLU-2 and Pro-R1; Hardman and Page, 2003). The complete recombination activating gene subunit 2 (Rag 2) was PCR amplified using previously published primers (MHFA and MHR1) from Hardman (2004). The first intron of the nuclear ribosomal S7 gene was amplified for a subset of the same individuals and species, using previously published primers (S7RPEX1F and S7RPEX2R) of Chow and Hazama (1998). The cycling protocol for the cyt b locus was as follows: initial denaturation at 94°C for 30 s followed by 35 cycles of 94°C for 30 s, 56°C for 30 s, and 72°C for 45 s, and a final extension of 72°C for 10 min. The cycling protocol for the Rag 2 gene was: initial denaturation at 94°C for 3 min followed by 35 cycles of 94°C for 30 s, 56°C for 30 s, and 72°C for 1 min 30 s, and a final extension of 72°C for 5 min. The cycling protocol for the S7 intron was: initial denaturation at 98°C for 2 min followed by 33 cycles of 94°C for 1 min, 53°C for 45 s, and 72°C for 1 min, and a final extension of 72°C for 8 min.

Primers used in PCR amplification of the three markers were also used in sequencing reactions performed by the Interdisciplinary Center for Biotechnology Research at the University of Florida. Sequences were edited in CodonCode Aligner version 3.7.1 (CodonCode Corporation, Dedham, MA, USA), and initially aligned using

SEAVIEW v.4.1 (Galtier et al., 1996) using the MUSCLE algorithm (Edgar, 2004). Final alignments were inspected by eye for any obvious misreading. Pairwise sequence divergences for all taxa were generated for each molecular marker using PAUP* 4.0b10 (Swofford, 2003) using the appropriate evolutionary models. Appropriate evolutionary models for each marker were estimated by Modeltest 3.7 (Posada and Crandall, 1998). The best-fit model and its parameters selected under the Akaike Information Criterion (AIC) were implemented in the respective Bayesian and Likelihood analyses.

Gene Tree Reconstruction

Each marker and a concatenated dataset that included all three markers were analyzed with Bayesian methods implemented in Mr. Bayes version 3.1.2. In the concatenated analysis, partitions were set for each marker and model parameter values were estimated for each partition independently. Ten million generations of Markov chain Monte Carlo (MCMC) were performed using a random starting topology with trees sampled every 1000 generations. Four Markov chains with default priors were used in all analyses, and two replicate runs were conducted to ensure the MCMC went through a sufficient number of iterations to allow convergence in the estimations of tree topology with the best posterior probability. Tracer 1.4 (Rambaut and Drummond, 2004) was used to examine the distribution of log likelihood scores in order to determine stationarity and to determine the burn-in of the MCMC analysis. In each of the analyses, the first 1 million generation (10%) were discarded as burn-in. The remaining trees were used to calculate a 50% majority-rule consensus topology.

Each marker and the concatenated dataset were also analyzed under a maximum likelihood optimality criterion as implemented in the software GARLI 2.0 (Zwickl, 2006), using the Garli web service:

http://www.molrev.org/software/phylogenetics/garli/garli_create_job. In the concatenated analysis, the partitions were the same as in the Bayesian analysis and model parameter values were again estimated for each partition independently. Topological robustness was investigated using 1000 non-parametric bootstrap replicates.

Results

Characteristics of the Sequence Data and Models of Sequence Evolution

The length of the nucleotide sequences generated for the *cyt b* locus ranged from 1050 to 1158 bp. Of the 1158 nucleotide sites, 578 were variable and 530 were parsimony-informative. Sequence divergence (Tamura-Nei-corrected distances) between species of Amphiliidae ranged from 0.2% to 22.4%. Within the subfamily Doumeinae, sequence divergence between species ranged from 0.4% to 20.1%, and in the subfamily Leptoglanidinae, sequence divergence between species ranged from 7.6% to 18.5%. Sequence divergence ranged from 0.2% to 20.7% between species of *Amphilius*, 3.3% to 11.0% between species of *Doumea*, 0.4% to 11.6% between species of *Phractura*, and 0.8% to 17.8% between species of *Zaireichthys*. Sequence divergence between *Amphilius* and species of Doumeinae ranged from 12.4% to 20.4%, between *Amphilius* and species of Leptoglanidinae, 16.0% to 20.4%; between *Amphilius* and *Paramphilius*, 16.4% to 20.6%; between species of Doumeinae and Leptoglanidinae, 15.8% to 20.1%; between Doumeinae and *Paramphilius*, 16.4% to 18.4%; and between Leptoglanidinae and *Paramphilius*, 18.1% to 20.9%. The best-fit model of sequence evolution selected for *cyt b* was GTR+I+G.

The length of the nucleotide sequences generated for the *Rag2* gene ranged from 917 to 945 bp. Of the 945 nucleotide sites, 378 were variable and 242 were

parsimony-informative. Sequence divergence (Tamura-Nei-corrected distances) between species of Amphiliidae ranged from 0.1% to 11.0%. Within the subfamily Doumeinae, sequence divergence between species ranged from 0.2% to 9.3% and in the subfamily Leptoglanidinae, sequence divergence between species ranged from 1.1% to 9.1%. Sequence divergence ranged from 0.1% to 5.2% between species of *Amphilius*, 0.8% to 1.5% between species of *Doumea*, 0.5% to 2.5% between species of *Phractura*, and 1.1% to 5.7% between species of *Zaireichthys*. Sequence divergence between *Amphilius* and species of Doumeinae ranged from 1.9% to 6.0%; between *Amphilius* and species of Leptoglanidinae, 6.1% to 14.1%; between *Amphilius* and *Paramphilius*, 3.9% to 6.3%; between species of Doumeinae and Leptoglanidinae, 6.0% to 9.7%; between Doumeinae and *Paramphilius*, 3.4% to 5.0%; and between Leptoglanidinae and *Paramphilius*, 7.3% to 10.1%. The best-fit model of sequence evolution selected for the cyt b gene was HKY+I+G.

The length of the nucleotide sequences generated for the S7 gene ranged from 455 to 591 bp and of the 680 nucleotides sites; 480 were variable and 366 were parsimony-informative. Sequence divergence (Tamura-Nei-corrected distances) between species of Amphiliidae ranged from 0.2% to 35.4%. Within the subfamily Doumeinae, sequence divergence between species ranged from 0.4% to 11.1% and in the subfamily Leptoglanidinae, sequence divergence between species ranged from 3.5% to 20.8%. Sequence divergence ranged from 0.2% to 19.2% between species of *Amphilius*, 2.6% to 7.5% between species of *Doumea*, 0.4% to 11.2% between species of *Phractura*, and 3.6% to 14.3% between species of *Zaireichthys*. Sequence divergence between *Amphilius* and species of Doumeinae ranged from 7.4% to 21.6%;

between *Amphilius* and species of Leptoglanidinae, 23.2% to 35.4%; between *Amphilius* and *Paramphilius*, 15.2% to 21.9%; between species of Doumeinae and Leptoglanidinae, 23.6% to 32.1%; between Doumeinae and *Paramphilius*, 14.8% to 18.6%; and between Leptoglanidinae and *Paramphilius*, 28.5% to 33.3%. The best-fit model of sequence evolution selected for cyt b was GTR+I+G.

Phylogenetic Relationships: cyt b

The results of the Bayesian and likelihood analyses are shown in Figures 2-1 and 2-2. Both the Bayesian and likelihood the analyses recovered Amphiliidae as a well supported clade (1.0/86). In both analyses, the subfamilies Doumeinae and Leptoglanidinae were also recovered as clades with high support (Doumeinae: 1.0/89; Leptoglanidinae: 1.0/100). Amphiliinae was not recovered as a monophyletic group in either analysis with *Paramphilius baudoni* recovered as sister to all remaining amphiliids (Doumeinae + Leptoglanidinae + *Amphilius*) in both analyses. The likelihood analysis did not provide support for the monophyly of *Amphilius* but the genus was recovered as a monophyletic group in the Bayesian analysis with a posterior probability of 0.62. The High African morphological group of *Amphilius* (as recognized by Thomson & Page, 2010) was recovered in as a well supported clade in both analyses (1.0/96), but the Low African group was not recovered as a monophyletic group in either analysis. In both analyses, the genus *Congoglanis* was recovered as a well supported clade (1.0/100), and was recovered as the sister group to a clade that included all the other species of the subfamily Doumeinae. *Doumea* was recovered as a monophyletic group in the Bayesian analysis with a posterior probability of 0.82, but the likelihood analysis did not provide support for its monophyly. The genera *Phractura* and

Trachyglanis were found to be polyphyletic in both analyses. In the subfamily Leptoglanidinae, *Zaireichthys* was not recovered as a monophyletic group in either analysis. The High African species of *Zaireichthys* were recovered as a well supported clade (1.0/100) that was sister to a clade (0.92/64) that included *Dolocamphilius*, *Tetracamphilius*, *Leptoglanis*, and two species of *Zaireichthys* from the Congo River basin.

Phylogenetic Relationships: Rag 2

The results of the Bayesian and likelihood analyses for Rag 2 are shown in Figures 2-3 and 2-4. Both the Bayesian and likelihood analyses recovered Amphiliidae as a well supported clade (1.0/100). In both analyses, the subfamilies Doumeinae and Leptoglanidinae were also recovered as clades with high support (Doumeinae: 1.0/85; Leptoglanidinae: 1.0/100). As in the cyt b analyses, Amphiliinae was not recovered as a monophyletic group in either of the Rag 2 analyses. *Paramphilius baudoni* was again recovered as sister to all remaining amphiliids (Doumeinae + Leptoglanidinae + *Amphilius*) in both of the Rag 2 analyses. The likelihood analysis did not provide support for the monophyly of *Amphilius*, but the genus was recovered as a clade with weak support in the Bayesian analysis. The High African and Low African morphological groups of *Amphilius* were recovered in well supported clades in both analyses (High African group: 1.0/99; Low African group: 0.99/83). In both analyses, the genus *Congoglanis* was recovered as a well supported clade (1.0/99), and was recovered as the sister group to a clade that included all the others species of the subfamily Doumeinae. The genera *Doumea*, *Phractura* and *Trachyglanis* were found to be polyphyletic in both analyses. In the subfamily Leptoglanidinae, *Zaireichthys* was not recovered as a monophyletic group in either analysis. As in the cyt b analysis, the High

African species of *Zaireichthys* were recovered as a well supported clade (1.0/100) that was sister to a clade (1.0/99) that included *Dolocamphilius*, *Tetracamphilius*, *Leptoglanis*, and two species of *Zaireichthys* from the Congo River basin.

Phylogenetic Relationships: S7 Intron 1

The results of the Bayesian and likelihood analyses are shown in 2-5 and 2-6. As in the cyt b and Rag 2 analyses, the Bayesian and likelihood analyses of the first intron of the S7 gene recovered Amphiliidae as a well supported clade (1.0/100), and both Doumeinae (1.0/89) and Leptoglanidinae (1.0/100) as well supported clades. Again, Amphiliinae was not recovered as a monophyletic group in either analysis with *Paramphilius baudoni* recovered as sister to all remaining amphiliids (Doumeinae + Leptoglanidinae + *Amphilius*). Neither the Bayesian nor the likelihood analysis provided support for the monophyly of *Amphilius*, but the High African and Low African morphological groups of *Amphilius* were recovered in well supported clades in both analyses (High African group: 1.0/100; Low African group: 1.0/89). In both analyses, *Congoglanis* was again recovered as the sister group to a clade that included all other species of the subfamily Doumeinae, and the genera *Doumea*, *Phractura* and *Trachyglanis* were found to be polyphyletic. In the subfamily Leptoglanidinae, *Zaireichthys* was not recovered as a monophyletic group in either analysis. As in the cyt b and Rag 2 analyses, the High African species of *Zaireichthys* were recovered as a well supported clade (1.0/100) that was sister to a clade (0.97/99) that included *Dolocamphilius* and *Tetracamphilius*, and the one species of *Zaireichthys* from the Congo River basin that was included in the analysis.

Phylogenetic relationships: cyt b + Rag 2 + S7 Intron 1

The results of the concatenated Bayesian and likelihood analyses of the cyt b, Rag 2, and the S7 intron are shown in Figures 2-7 and 2-8. In the analyses, Amphiliidae, Doumeinae, Leptoglanidinae, *Amphilius*, Low African *Amphilius*, *Congoglanis*, and High African *Zaireichthys* are all recovered as well supported. The phylogenetic position of *Paramphilius baudoni* is the same as in the analyses of the individual genes, sister to all remaining amphiliids (Doumeinae + Leptoglanidinae + *Amphilius*). *Congoglanis* was again recovered as the sister group to a clade that included all other species of the subfamily Doumeinae, and the genera *Doumea*, *Phractura* and *Trachyglanis* were found to be polyphyletic. The High African species of *Zaireichthys* were again sister to a clade that included *Dolocamphilius*, *Tetracamphilius*, *Leptoglanis*, and the two species of *Zaireichthys* from the Congo River basin.

Discussion

Amphiliidae was recovered as a well supported clade in all analyses, consistent with the results of Mo (1991), Diogo (2003, 2005), and Sullivan et al. (2006). The subfamilies Doumeinae and Leptoglanidinae were also recovered as well supported clades in all analyses. A sister group relationship between Doumeinae and a monophyletic *Amphilius* was recovered with strong support in the concatenated analyses but was not well supported in any of the single genes analyses.

The support for the monophyly of Doumeinae is consistent with the results of He et al. (1999) and Diogo (2003, 2005) which found strong support for the monophyly of the subfamily. The genus *Congoglanis* was recovered as sister to a clade formed by the remaining doumeine genera as hypothesized by Ferraris et al. (2011) who described

the genus for species that lack many of the derived characters that had been traditionally used to define Doumeinae. The relationships recovered for the other doumeine taxa in this study indicates that the remaining genera, as currently defined, do not accurately reflect phylogenetic relationships. The genus *Phractura* is not recovered as a monophyletic group, and *Doumea* was recovered as monophyletic only in the Bayesian analysis of the cyt b gene. Taxon sampling was limited for both of these genera, and notably missing were *Phractura bovei*, the type species of *Phractura*, and species of the *Doumea chappuisi* complex, recognized by Ferraris et al. (2010) for three derived species of *Doumea*.

The current study included species from four of the five genera of Leptoglanidinae recognized by Roberts (2003), and the subfamily was recovered as a strongly supported clade in all analyses. Leptoglanidinae is primarily distributed in the Congo basin with four of the five genera in the subfamily endemic to the basin. All analyses recovered two well supported clades. One clade corresponded to species endemic to the lower or middle Congo basin, and the other clade to the *Zaireichthys rotundiceps* complex, which is found in the upper Congo basin and other eastern and southern African basins.

All analyses also recovered *Paramphilius baudoni* as sister to all remaining amphiliids (Doumeinae + Leptoglanidinae + *Amphilius*), and consequently rendered the subfamily Amphiliinae as currently recognized polyphyletic. *Paramphilius* was erected by Pellegrin (1907) for *Paramphilius trichomycteroides*, and the genus was subsequently placed in the subfamily Amphiliinae with the genus *Amphilius* by Regan

(1911). *Paramphilius baudoni* was described as *Amphilius baudoni* by Pellegrin (1928) and transferred to *Paramphilius* by Skelton (2007a).

The first phylogenetic study to include *Paramphilius* and *Amphilius* was that of He et al. (1999). Amphiliinae appeared as a monophyletic group in this work, but the authors were not able to find any synapomorphies to define the subfamily and stated that the reason for placing *Amphilius* and *Paramphilius* together is the lack of synapomorphies shared by other genera. In contrast, the results of Diogo (2005) concluded that Amphiliinae was clearly a monophyletic taxon diagnosed with 10 synapomorphic characters, four of which he considered derived, homoplasy-free autapomorphies. The results of the current study are not directly comparable to the studies of He et al. (1999) or Diogo (2005) because the species of *Paramphilius* used in the current study is different from the species used by He et al. (1999) and Diogo (2003, 2005), and *Paramphilius* has never been demonstrated to be a monophyletic group. He et al. (1999) and Diogo (2005) used *Paramphilius trichomycteroides* in their studies, the type species of *Paramphilius* which Skelton (1989) considered to be, along with *P. firestonei*, the most derived species of the genus. In the current study, *Paramphilius* was represented by *P. baudoni*, which was considered by Skelton (1989) to be the primitive, sister species of all upper Guinean *Paramphilius*. Because *P. baudoni* is not the type species of *Paramphilius* and its relationships to the upper Guinean *Paramphilius* is not confirmed, revising the classification of the genus based on the results of the current study would be premature.

The extensive taxonomic sampling in the genus *Amphilius* makes it possible to test the monophyly of the genus and the monophyly of the High African and Low African

morphological groups. *Amphilius* was recovered as a well supported clade in the cytochrome b Bayesian analysis and the concatenated analysis, and recovered as a clade with weak support in the Rag 2 Bayesian analysis. The genus was not recovered as a monophyletic group in any of the likelihood analyses or the S7 Bayesian analysis.

Amphilius can be divided into two morphological groups, a Low African group of species that have an epidermal fold at the base of the caudal fin and 6 + 7 or 7 + 8 principal caudal-fin rays, and a High African group of species that lack the epidermal fold and have 8 + 9 principal caudal-fin rays (Skelton, 1984; Thomson & Page, 2010). High Africa refers to parts of southern and eastern Africa where most of the land is at elevations well above 1000 ft. and much of it is at elevations above 4000 ft. Low Africa is northern and western Africa where most of the land is at elevations well between 1000 ft. (Roberts, 1975). The species of the High African morphological group were recovered as a well supported clade in all analyses. The species of the Low African morphological group were recovered as a well supported clade in the all of the nuclear gene analyses and the concatenated analyses, but not in either of the cytochrome b analyses. The taxonomic implications of this will be addressed following more extensive analyses of the phylogenetic relationships of the genus (Chapter 2).

Table 2-1 Locality, museum catalogue numbers, tissue numbers, and GenBank accession numbers for specimens used in the molecular analyses. **Bold:** Sequences from Genbank. CAR = Central African Republic; DRC = Democratic Republic of the Congo.

Taxon	Collection location	Voucher catalog #	Tissue #	GenBank nos.		
				cyt b	Rag 2	S7
<i>Amphilius atesuensis</i>	Loh River, Guinea	AMNH 248702	T5658	KC331868	JX573425	JX944623
<i>Amphilius brevis</i>	Amba River, DRC	ZSM 39281	DRC-2009/0885	KC331844	-	-
<i>Amphilius</i> cf. <i>jacksonii</i>	Ivi River, Uganda	UF 169238	FLMNH 2008-0370	KC331864	JX573390	-
<i>Amphilius</i> cf. <i>lentiginosus</i>	Lucala River, Angola	SAIAB 85100	SA85100-2	KC331867	JX573416	JX944607
<i>Amphilius</i> cf. <i>zairensis</i>	Wagenia Falls, DRC	CU 95906	CU-1852	KC331846	JX573417	JX944608
<i>Amphilius chalei</i>	Little Ruaha River, Tanzania	UF 170728	FLMNH 2007-0903	KC331847	JX573430	JX944609
<i>Amphilius cryptobullatus</i>	Lwela River, Zambia	CU 91059		KC331848	JX573424	-
<i>Amphilius cubangoensis</i>	Okavango River, Namibia	SAIAB 96484		KC331849	JX573374	JX944610
<i>Amphilius jacksonii</i>	Ishasha River, Uganda	UF 169242	FLMNH 2008-0355	KC331866	JX573380	JX944622
<i>Amphilius jacksonii</i>	Idete River, Tanzania	UF 170729	FLMNH 2007-0961	KC331865	JX573389	JX944621
<i>Amphilius kivuensis</i>	Ihizozo River, Uganda	Voucher lost	FLMNH 2008-0341	KC331852	JX573391	JX944613
<i>Amphilius krefftii</i>	Una River, Tanzania	UF 170724	FLMNH 2007-0780	KC331853	JX573426	JX944614
<i>Amphilius lampei</i>	Ukuma River, Ethiopia	KU 29940	KU T1389	KC331854	JX573392	-
<i>Amphilius laticaudatus</i>	Rotanda Stream, Mozambique	SAIAB 67569		KC331855	JX573393	-

Table 2-1 Continued

Taxon	Collection location	Voucher catalog #	Tissue #	GenBank nos.		
				cyt b	Rag 2	S7
<i>Amphilius longirostris</i>	Cameroon	AMNH 249566		KC331870	JX573364	JX944625
<i>Amphilius maesii</i>	Mbali River, DRC	AMNH 251819		KC331871	JX573363	JX944626
<i>Amphilius natalensis</i>	Mahlabane River, Swaziland	SAIAB 67360	SAIAB 67360a	KC331857	JX573395	-
<i>Amphilius nigricaudatus</i>	Cameroon	AMNH 249567		KC331858	-	-
<i>Amphilius nigricaudatus</i>	Dzousnou River, Rep. Congo	AMNH 253311		-	JX573397	JX944627
<i>Amphilius platychir</i>	Koumbouya River, Guinea	AMNH 250575	RS4	KC331873	JX573400	JX944628
<i>Amphilius rheophilus</i>	Finton River, Guinea	AMNH 250584	RS11	KC331872	JX573401	JX944629
<i>Amphilius uranoscopus</i>	Mbulumi River, Tanzania	CU 93741	FLMNH 2007-0872	KC331862	JX573402	JX944619
<i>Andersonia leptura</i>	Gribingui River, CAR	CU 91439		KC331874	JX573361	-
<i>Andersonia leptura</i>	Ethiopia	CU 94684		KC331875	JX573396	-
<i>Belonoglanis tenuis</i>	Gumi River, DRC	AMNH 241576		KC331877	JX573366	-
<i>Belonoglanis tenuis</i>	Mambili River, Rep. Congo	CU 88147		KC331878	DQ492376	JX944630
<i>Belonoglanis tenuis</i>	Lekeni River, Rep. Congo	CU 92915		-	JX573375	-
<i>Congoglanis alula</i>	Lower Congo River, Rep. Congo	AMNH 240438		KC331879	JX573404	JX944631
<i>Congoglanis alula</i>	Mbourou River, CAR	CU 91611		KC331880	JX573358	-
<i>Congoglanis alula</i>	Wagenia Falls, DRC	CU 95908		KC331881	JX573405	JX944632
<i>Congoglanis sagitta</i>	Mulembo River, Zambia	CU 91042		KC331882	JX573406	-

Table 2-1 Continued

Taxon	Collection location	Voucher catalog #	Tissue #	GenBank nos.		
				cyt b	Rag 2	S7
<i>Dolocamphilius</i> sp.	Lulua River, DRC	AMNH 252785	AMNH t-080-7918	KC331900	JX573407	JX944642
<i>Doumea gracila</i>	Lobé River, Cameroon	CU 90224		KC331883	JX573419	JX944633
<i>Doumea sanaga</i>	Djerem River, Cameroon	CU 93195		KC331884	JX573408	JX944634
<i>Doumea typica</i>	Gabon	UF 182240	FLMNH 2011-0484	KC331885	JX573427	JX944635
<i>Doumea typica</i>	Gabon	UF 182240	FLMNH 2011-0485	KC331886	JX573409	-
<i>Leptoglanis xenognathus</i>	N'Sele River, DRC	AMNH 249925	AMNH t-068-6731	KC331901	JX573423	-
<i>Malapterurus beninensis</i>	Ogooué River, Gabon	CU 80367		-	DQ492384	-
<i>Malapterurus beninensis</i>	Kribi, Cameroon	CU 93177		KC331841	JX573371	JX944603
<i>Malapterurus tanganyikaensis</i>	Lake Tanganyika, Tanzania	CU 88625		KC331842	JX573367	-
<i>Paramphilius baudoni</i>	Ngampoku River, DRC	AMNH 251816		KC331843	JX573410	JX944605
<i>Phractura intermedia</i>	N'Sele River, DRC	AMNH 250958	AMNH t-069-6855	KC331894	JX573372	JX944636
<i>Phractura lindica</i>	Mambili River, Rep. Congo	CU 88146		KC331891	JX573411	-
<i>Phractura lindica</i>	Biaro Creek, DRC	CU 96007		-	JX573412	JX944638
<i>Phractura longicauda</i>	Balé Creek, Gabon	CU 81153		-	DQ492377	-
<i>Phractura longicauda</i>	Ndingui Creek, Cameroon	CU 90221		KC331893	JX573420	-

Table 2-1 Continued

Taxon	Collection location	Voucher catalog #	Tissue #	GenBank nos.		
				cyt b	Rag 2	S7
<i>Phractura longicauda</i>	Balé Creek, Gabon	CU 92300		KC331892	JX573381	-
<i>Phractura scaphyrhynchura</i>	N'Sele River, DRC	AMNH 250919		KC331897	JX573368	JX944639
<i>Phractura sp.</i>	Lower Congo River, DRC	AMNH 241577		KC331887	JX573413	-
<i>Phractura sp.</i>	Lekenie River, Rep. Congo	CU 89214		KC331888	JX573377	-
<i>Phractura sp.</i>	Mbudei stream, DRC	ZSM 39413	DRC-2009/0857	KC331890	JX573369	-
<i>Phractura sp.</i>	Amba River, DRC	ZSM 39497	DRC-2009/0907	KC331889	JX573362	-
<i>Phractura tenuicauda</i>	Mbourou River, CAR	CU 91601		KC331896	JX573421	-
<i>Phractura tenuicauda</i>	Kotto River, CAR	CU 91606		KC331895	JX573376	JX944637
<i>Synodontis afrofisheri</i>	Lake Albert, Uganda	BMNH 2007.8.29.31	JJD 5547	-	-	FM878917
<i>Synodontis batesii</i>	Balé Creek, Gabon	CU 81129		-	DQ492382	-
<i>Synodontis polli</i>	Lake Tanganyika	BMNH 2006.3.6.21	JJD 5100	DQ886645	-	-
<i>Tetracamphilius notatus</i>	Liwa River, CAR	CU 91423		KC331902	JX573365	JX944643
<i>Tetracamphilius pectinatus</i>	Oubangui River, CAR	CU 93012		KC331903	JX573378	JX944644
<i>Trachyglanis cf. ineac</i>	Bakere River, DRC	ZSM 39343	DRC-2009/0794	KC331898	JX573373	JX944640
<i>Trachyglanis cf. sanghensis</i>	Luilaka River, DRC	AMNH 239576		KC331876	JX573385	-

Table 2-1 Continued

Taxon	Collection location	Voucher catalog #	Tissue #	GenBank nos.		
				cyt b	Rag 2	S7
<i>Trachyglanis</i> cf. <i>sanghensis</i>	Lower Congo River, DRC	ZSM 37683	DRC-2008/406	KC331899	JX573382	JX944641
<i>Zaireichthys</i> cf. <i>flavomaculatus</i>	Tshina River, DRC	AMNH 247475	AMNH t-055-5436	KC331904	JX573357	-
<i>Zaireichthys</i> cf. <i>rotundiceps</i>	Moyowosi River, Tanzania	CU 90424		KC331907	DQ492379	JX944645
<i>Zaireichthys</i> cf. <i>rotundiceps</i>	Malaba River, Uganda	UF 169234	FLMNH 2008-0298	KC331906	JX573379	-
<i>Zaireichthys mandevillei</i>	Tomi River, CAR	CU 91421		KC331905	JX573415	JX944648
<i>Zaireichthys</i> sp.	Lufubu River, Zambia	CU 91033	CU-0162	-	JX573428	JX944646
<i>Zaireichthys</i> sp.	Lubulafita Stream, Zambia	CU 91037	CU-0241	-	JX573360	-
<i>Zaireichthys</i> sp.	Ng'ona River, Zambia	CU 91038	CU-0245	KC331908	JX573383	JX944647
<i>Zaireichthys</i> sp.	Mutoloshi River, Zambia	CU 91039	CU-0329	-	JX573384	-
<i>Zaireichthys</i> sp.	Kanchibiya Stream, Zambia	CU 91040	CU-0378	-	JX573422	-
<i>Zaireichthys</i> sp.	Mumbuluma Falls, Zambia	CU 91091	CU-0101	-	JX573414	-
<i>Zaireichthys wamiensis</i>	Wami River, Tanzania	UF 170710	FLMNH 2007-0828	KC331909	JX573429	-

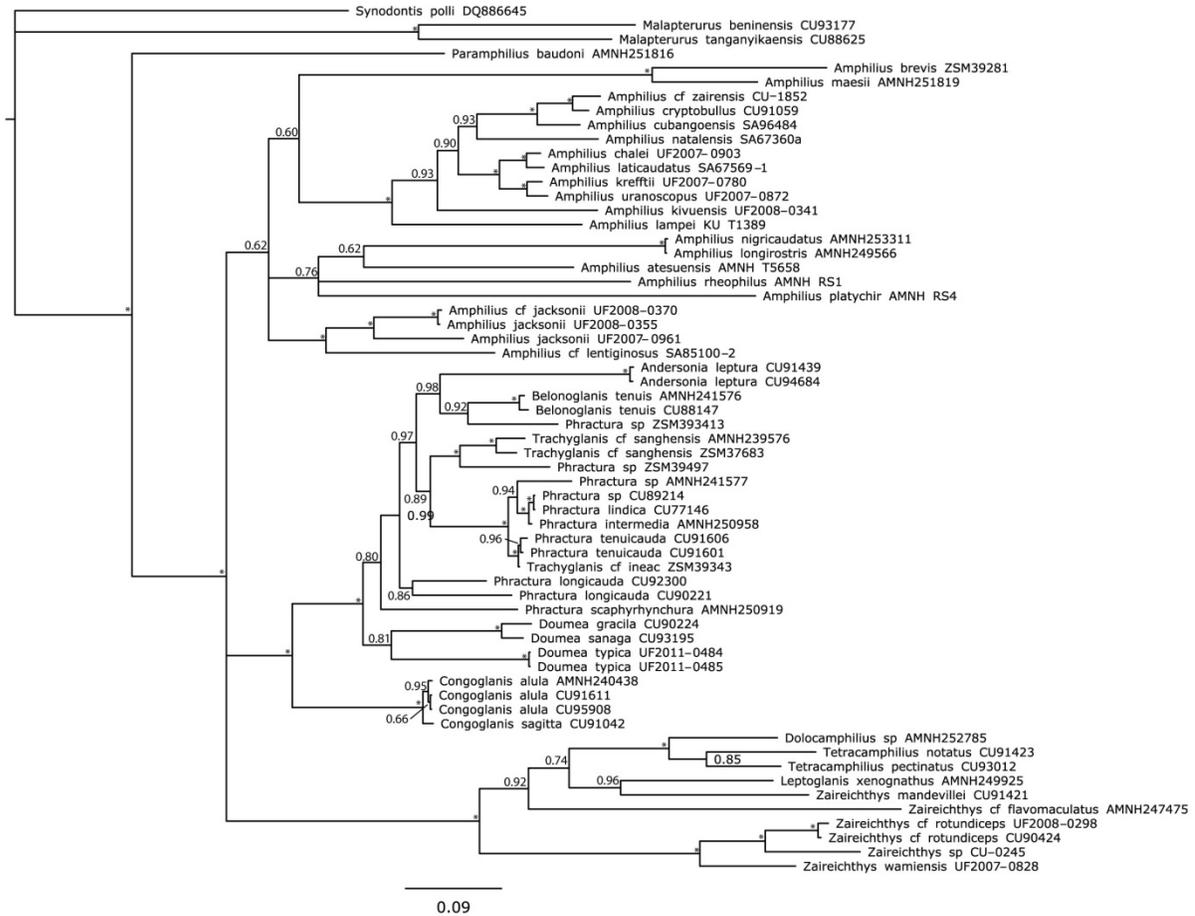


Figure 2-1 Majority rule consensus tree from the Bayesian analysis of the mitochondrial cyt b locus. Numbers on nodes are posterior probabilities. Asterisks indicate posterior probability values of 1.0. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 2-1.

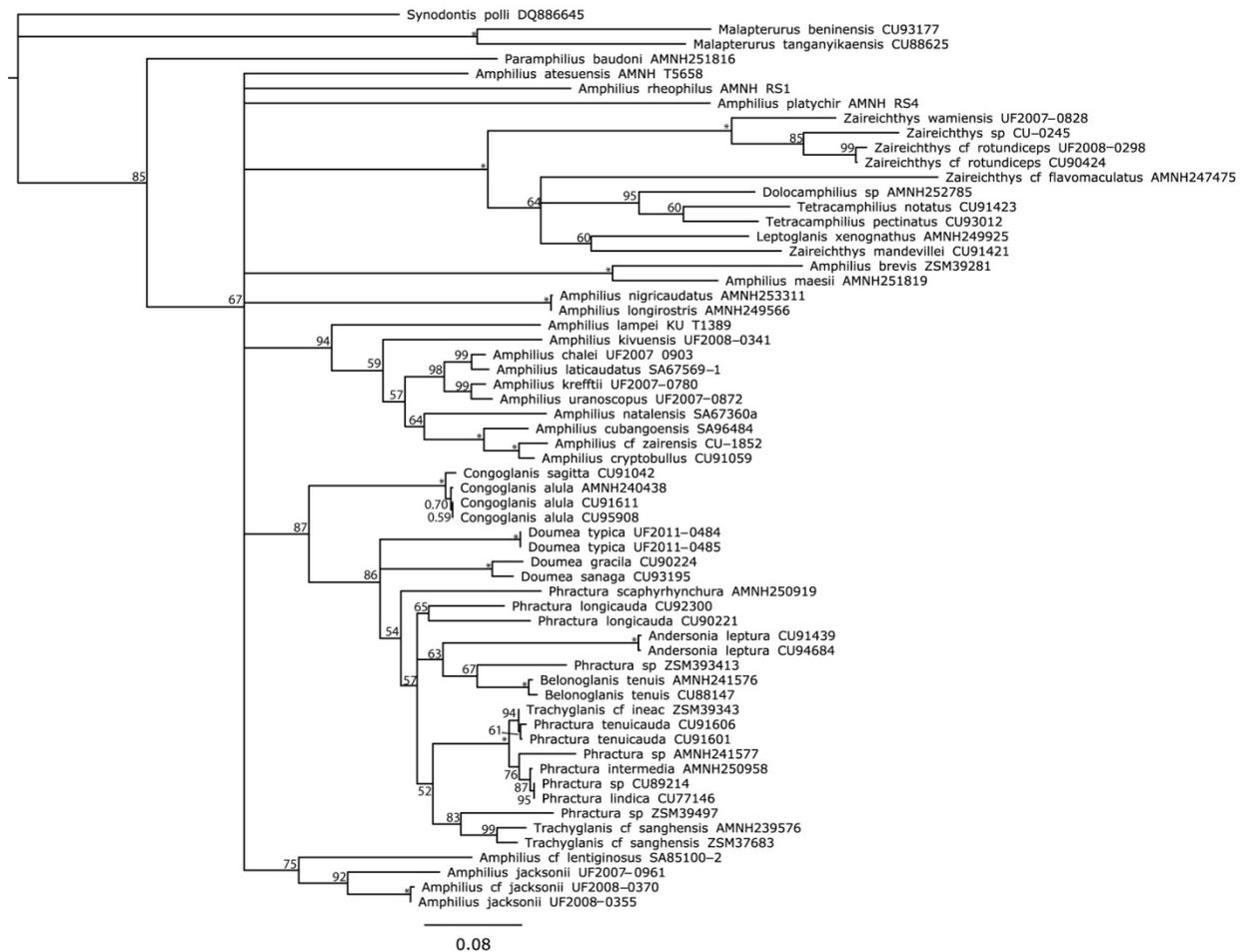


Figure 2-2 Majority rule consensus tree from the likelihood analysis of the mitochondrial cyt b locus. Numbers on nodes are bootstrap support values. Asterisks indicate bootstrap support values of 100. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 2-1.

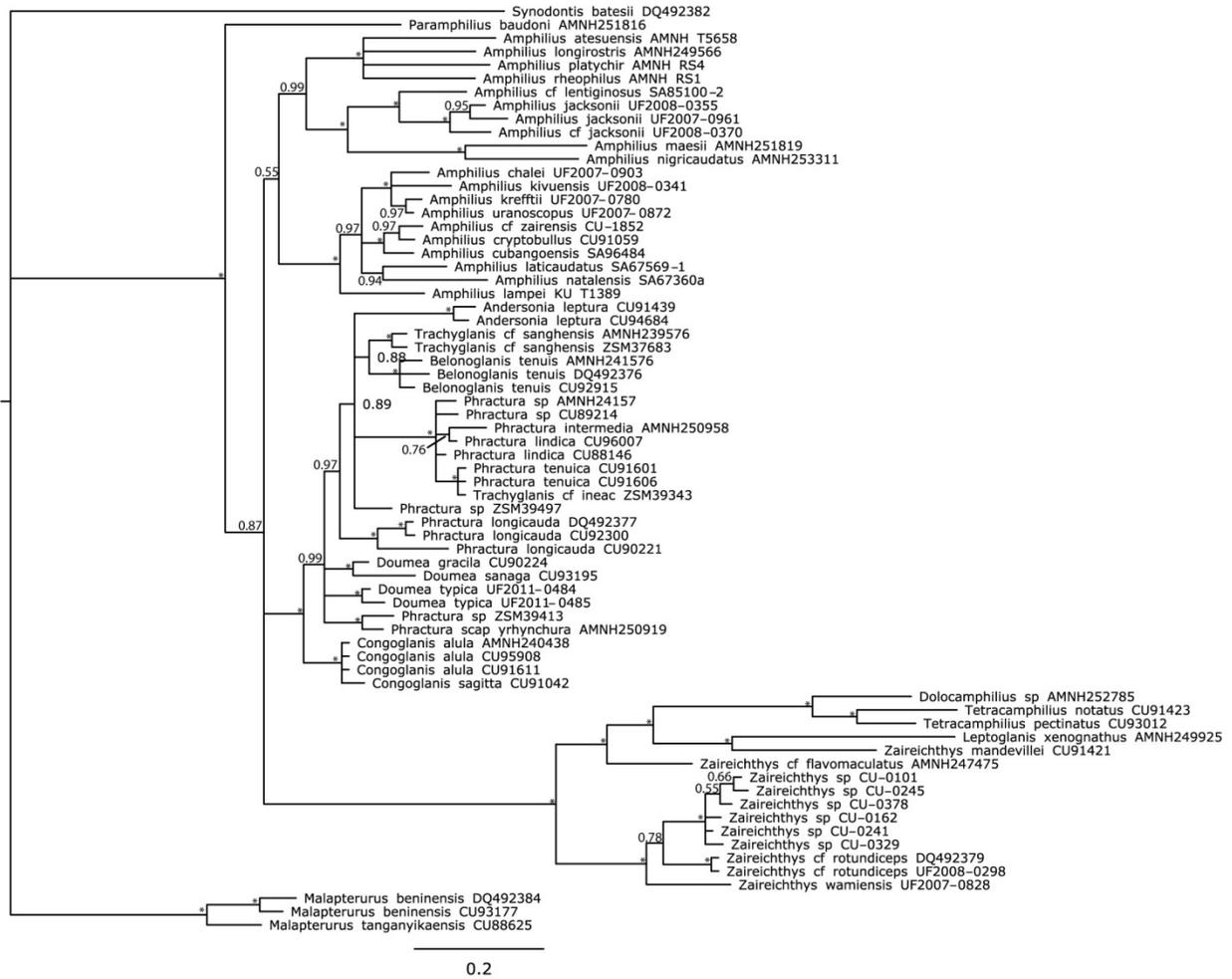


Figure 2-3 Majority rule consensus tree from the Bayesian analysis of the nuclear Rag 2 gene. Numbers on nodes are posterior probability values. Asterisks indicate posterior probability values of 1.0. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 2-1.



Figure 2-4 Majority rule consensus tree from the likelihood analyses of the nuclear Rag 2 gene. Numbers on nodes are bootstrap support values. Asterisks indicate bootstrap support values of 100. Catalog number of voucher specimen or tissue number of tissue samples follows species name and correspond to data in Table 2-1.

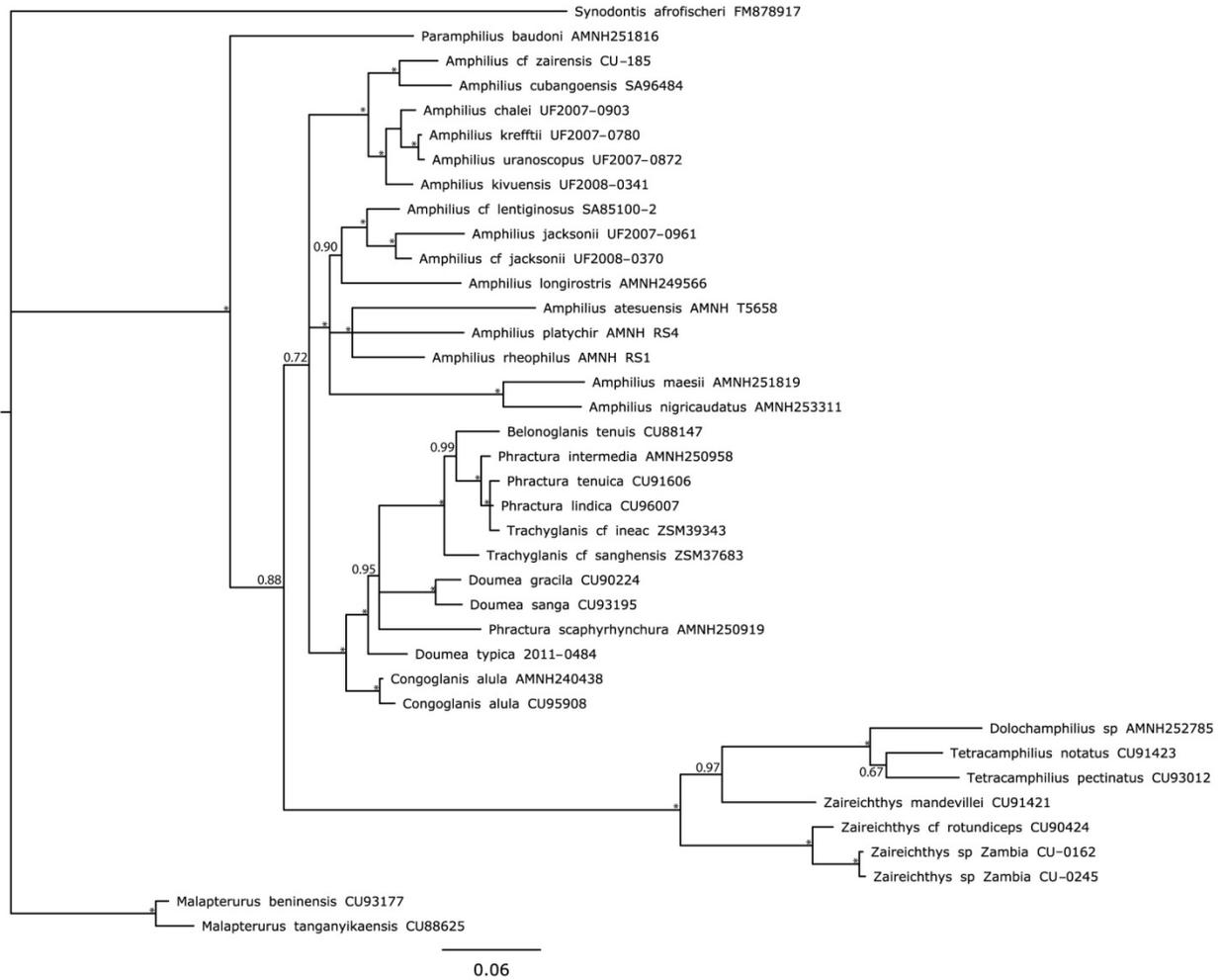


Figure 2-5 Majority rule consensus tree from the Bayesian analysis of the nuclear S7 intron. Numbers on nodes are posterior probability values. Asterisks indicate posterior probability values of 1.0. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 2-1.

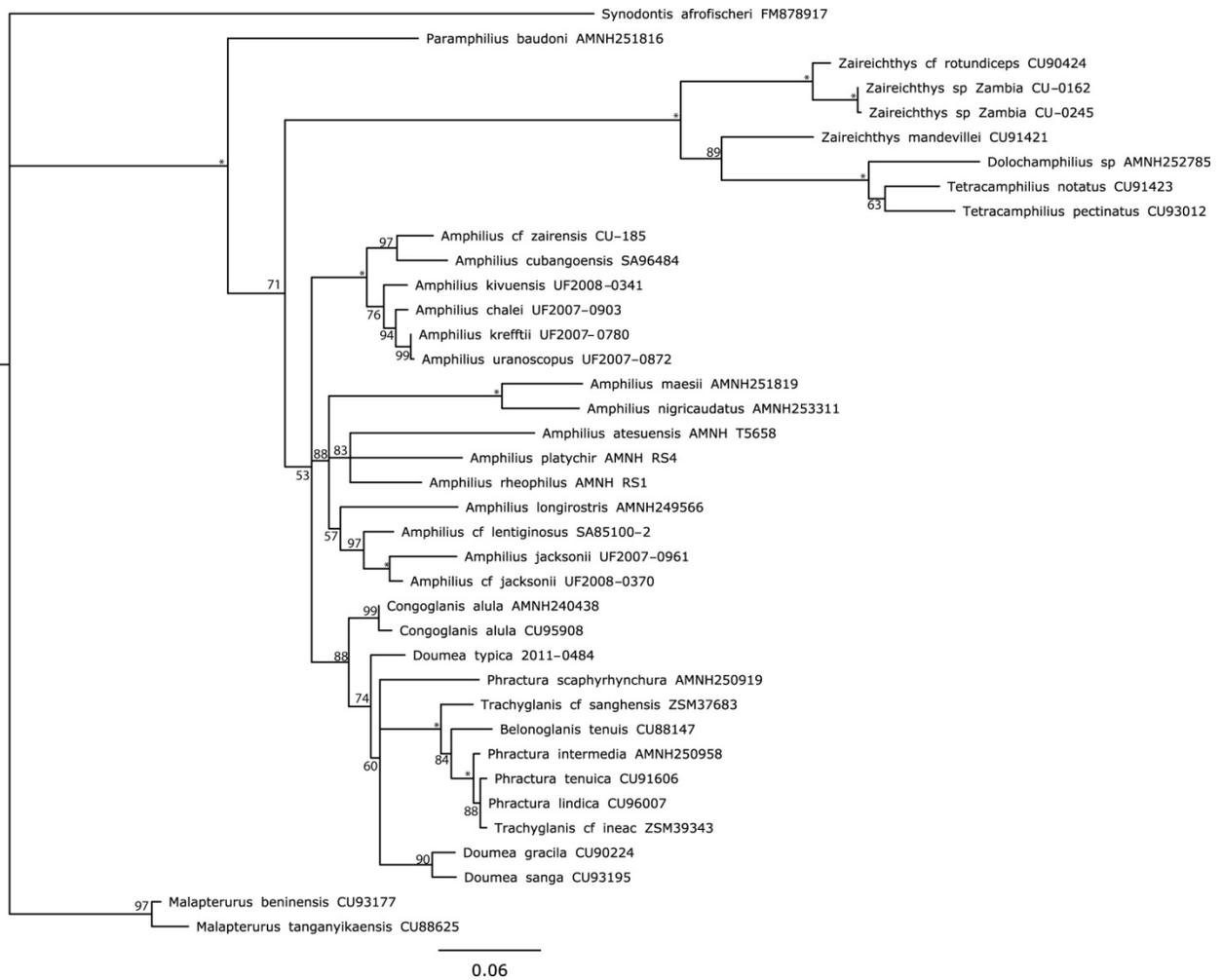


Figure 2-6 Majority rule consensus tree from the likelihood analysis of the nuclear S7 intron. Numbers on nodes are bootstrap support values. Asterisks indicate bootstrap support values of 100. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 2-1.

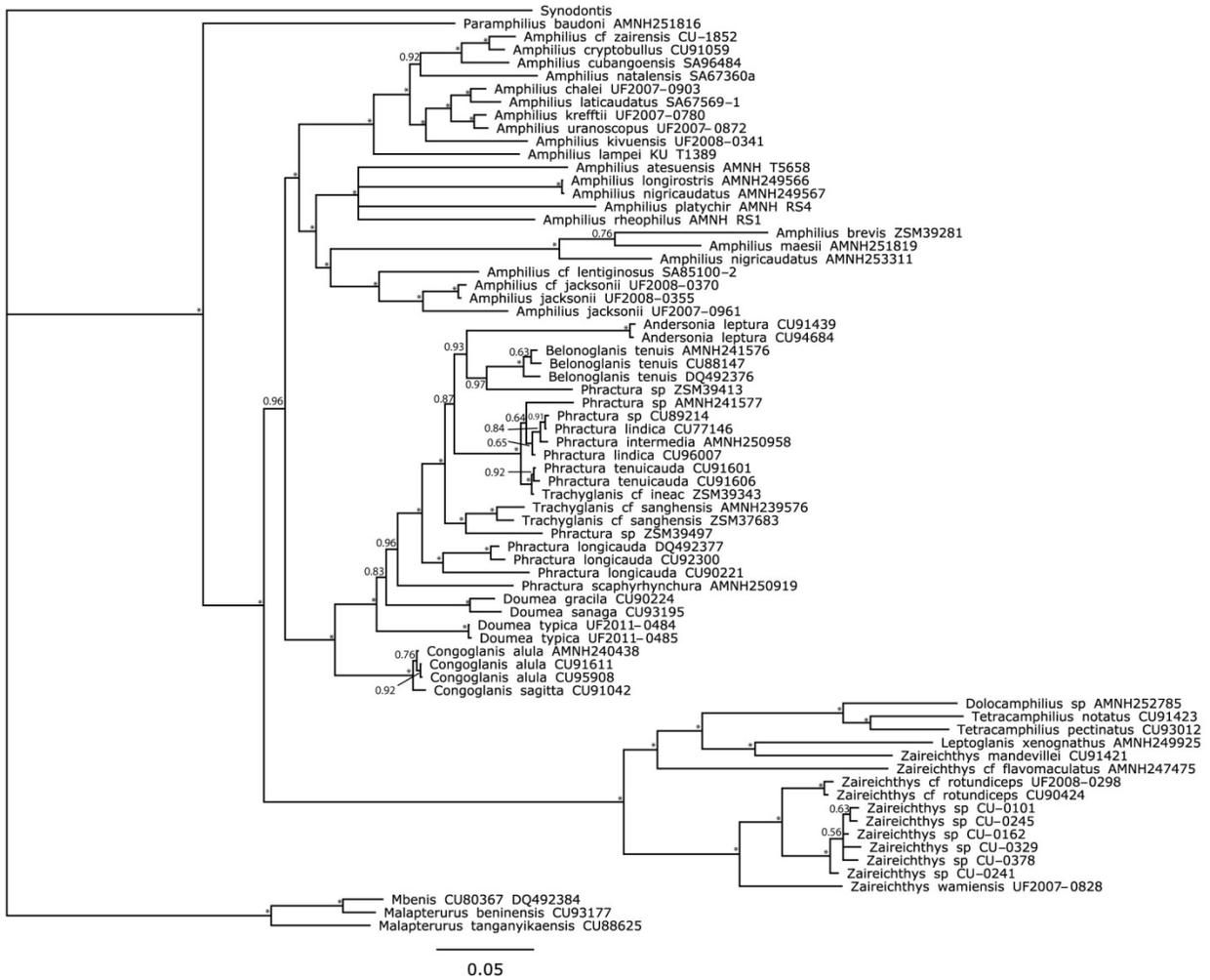


Figure 2-7 Majority rule consensus tree from the Bayesian analysis of the concatenated cyt b, Rag 2, and S7 data. Numbers on nodes are posterior probability values. Asterisks indicate posterior probability values of 1.0. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 2-1.

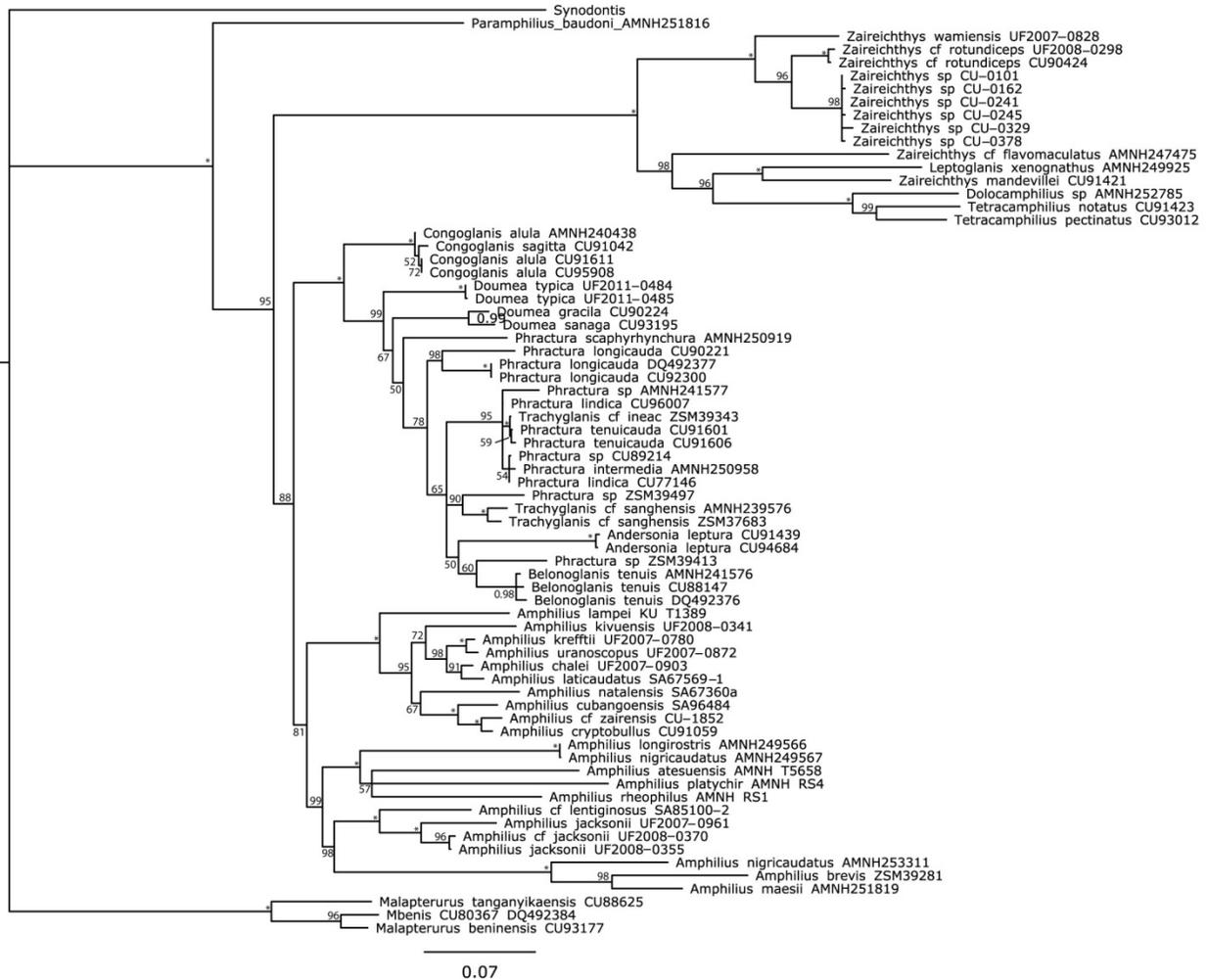


Figure 2-8 Majority rule consensus tree from the likelihood analysis of the concatenated cyt b, Rag 2, and S7 data. Numbers on nodes are bootstrap support values. Asterisks indicate bootstrap support values of 100. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 2-1.

CHAPTER 3
MOLECULAR PHYLOGENY OF THE AFRICAN CATFISH GENUS *AMPHILIUS*
(SILURIFORMES: AMPHILIIDAE).

Background

The African catfish genus *Amphilius* includes soft-bodied species of Amphiliidae that lack spines in the dorsal and pectoral fins and are adapted for fast flow and rocky habitats (Skelton 1986). The genus is widely distributed throughout sub-Saharan Africa and can be divided into two morphological groups, a Low African group of primarily western species that have an epidermal fold at the base of the caudal fin and 6 + 7 or 7 + 8 principal caudal-fin rays, and a High African group of primarily eastern and southern species that lack the epidermal fold and have 8 + 9 principal caudal-fin rays (Skelton, 1984; Thomson & Page, 2010). High Africa is southern and eastern Africa in which most of the land is at elevations well above 1000 ft. and much of it is at elevations above 4000 ft. Low Africa is northern and western Africa in which most of the land is at elevations between 500 and 1000 ft. (Roberts, 1975).

In a study of the phylogenetic relationships of the family Amphiliidae (Chapter 2), *Amphilius* was not recovered as a monophyletic group in individual likelihood analyses of the mitochondrial (cytochrome b, cyt b) locus and two nuclear (recombination activating gene subunit 2, Rag 2 and the first intron of the nuclear ribosomal S7 gene, S7) loci. The genus was recovered as a well supported clade in a concatenated Bayesian analysis of all three genes and in a Bayesian analysis of the cyt b locus, and was also recovered as a clade, but only with weak support, in a Bayesian analysis of the Rag 2 locus and was not recovered as a monophyletic group in the Bayesian analysis of the S7 locus. In contrast to the genus as a whole, species of the High African morphological group were recovered in a well supported clade in all analyses,

and the species of the Low African morphological group were recovered as a well supported clade in all of the nuclear gene analyses and the concatenated analyses, but not in either of the cytochrome b analyses.

Results of an expanded phylogenetic analysis of the genus, including sequences from 10 of the 18 currently recognized species of the Low African group and 10 of the 11 currently recognized species of the High African group, provide additional support for the recognition of each morphological group as a separate genus. The name *Anoplopterus* Pfeffer, 1889 is resurrected for the species of the High African group and all of the species of the Low African group are retained in *Amphilius*. The analyses also include extensive sampling of the *Amphilius jacksonii* complex and of species in the High African group. The analyses indicate that there is a great amount of undescribed diversity in both groups.

Material and Methods

Tissues for DNA analysis were obtained from the Genetics Research Repository at the Florida Museum of Natural History or borrowed from other institutions (Table 3-1). Materials examined in this study are deposited in the following institutions: the American Museum of Natural History, New York, New York (AMNH), the Cornell University, Vertebrate Collections, Ithaca, New York (CU), the University of Kansas Natural History Museum, Lawrence, Kansas (KU), the National Museums of Kenya, Nairobi, Kenya (NMK), the South African Institute for Aquatic Biodiversity, Grahamstown, South Africa (SAIAB), and the Florida Museum of Natural History, Gainesville, Florida (UF, FLMNH for tissue samples), Zoologische Staatssammlung München, Munich, Germany (ZSM). Additional sequences for outgroup taxa and some ingroup taxa used in this study are listed in Chapter 2.

Methods of DNA extraction, PCR amplification, sequencing, and gene tree reconstruction are described in Chapter 2.

Results

Characteristics of the Sequence Data and Models of Sequence Evolution

The length of the nucleotide sequences generated for the *cyt b* locus ranged from 906 to 1158 bp. Of the 1158 nucleotides sites, 548 were variable and 489 were parsimony-informative. Sequence divergence (Tamura-Nei-corrected distances) ranged from 0.0% to 20.8% within *Amphilius*, 0.0% to 13.1% within the High African group, 0.0% to 20.8% within the Low African group, and 0.0% to 9.9% within the *Amphilius jacksonii* complex. The best-fit model of sequence evolution selected for *cyt b* was GTR+I+G.

The length of the nucleotide sequences generated for the *Rag 2* locus ranged from 849 to 945 bp. Of the 945 nucleotides sites, 264 were variable and 142 were parsimony-informative. Sequence divergence (Tamura-Nei-corrected distances) ranged from 0.0% to 5.7% within *Amphilius*, 0.0% to 2.9% within the High African group, 0.0% to 5.6% within the High African group, and 0.0% to 1.4% within the *Amphilius jacksonii* complex. The best-fit model of sequence evolution selected for *Rag 2* was GTR+I+G.

The length of the nucleotide sequences generated for the *S7* locus ranged from 522 to 591 bp. Of the 649 nucleotides sites, 388 were variable and 199 were parsimony-informative. Sequence divergence (Tamura-Nei-corrected distances) ranged from 0.0% to 20.9% within *Amphilius*, 0.0% to 7.9% within the High African group, 0.3% to 20.9% within the High African group, and 0.3% to 6.7% within the *Amphilius jacksonii* complex. The best-fit model of sequence evolution selected for *Rag 2* was GTR+G.

Phylogenetic Relationships: cyt b

The results of the Bayesian and likelihood analyses are shown in Figures 3-1 and 3-2. The likelihood analysis did not provide support for the monophyly of *Amphilius*, but the genus was recovered as a monophyletic group in the Bayesian analysis with a posterior probability of 1.0. The High African morphological group of *Amphilius* was recovered as a well supported clade in both analyses (1.0/94), and a clade of all the High African species except *Amphilius lampei* and *A. kivuensis* was recovered in both analyses. The clade was composed of two clades that were well supported in both analyses. One clade included mostly species found in the Congo and Zambezi River basins and basins south the Zambezi River. The other clade included mostly species found in Tanzania.

The Low African group was not recovered as a monophyletic group in either analysis. In both analyses, the *Amphilius jacksonii* complex was recovered as a well supported clade (1.0/80), and was recovered as the sister group of *A. cf. lentiginosus*. In the Bayesian analysis, the Low African species were recovered in three strongly supported clades: a clade that included the *A. jacksonii* complex + *A. cf. lentiginosus*, a clade that included the upper and lower Guinea species, and a clade that included two species from the Congo River basin. In the likelihood analysis, the *A. jacksonii* complex + *A. cf. lentiginosus* clade and the Congo River basin species clade were recovered with strong support but the upper and lower Guinea species were not recovered as a clade.

Phylogenetic Relationships: Rag 2

The results of the Bayesian and likelihood analyses for Rag 2 are shown in Figures 3-3 to 3-8. Both the Bayesian and likelihood analyses recovered *Amphilius* as a

clade with weak support (0.77/59). The High African morphological group of *Amphilius* was recovered in a well supported clade in both analyses (1.0/98), and a well supported clade of all the High African species except *A. lampei* was recovered in both analyses. In both analyses three well supported clades within this clade were recovered. One clade included *A. natalensis* and *A. laticaudatus*, and the other two clades were similar in composition to the clades recovered in the cyt b analyses.

In both the Bayesian and likelihood analyses, the Low African species were recovered as a well supported clade (1.0/91) and the *A. jacksonii* complex was recovered as a well supported clade (1.0/98) sister to *A. cf. lentiginosus*. The remaining species were recovered in two well supported clades in both analyses: a clade that included the upper Guinea species + *A. longirostris*, and a clade that included two species from lower Guinea + *A. maesii*.

Phylogenetic Relationships: S7 Intron 1

The results of the Bayesian and likelihood analyses are shown in Figures 3-9 and 3-10. *Amphilius* was not recovered as a clade in either analysis. The High African morphological group of *Amphilius* was recovered in a well supported clade in both analyses (1.0/97) and was recovered as sister to *Dolichamphilius*. In the High African group, two well supported clades we recovered that were similar in composition to the clades recovered in the cyt b and Rag 2 analyses.

The Low African species were recovered as a clade in both analyses (1.0/59) and the *A. jacksonii* complex was recovered as a well supported clade (1.0/99) sister to *A. cf. lentiginosus*. The upper Guinea species were recovered in a well supported clade (1.0/80) and *A. maesii* and *A. nigrocaudatus* were recovered as sister species in both analyses.

Phylogenetic Relationships: cyt b + Rag 2 + S7 Intron 1

The results of the concatenated Bayesian and likelihood analysis of the cyt b, Rag 2, and the S7 intron are shown in Figure 3-11 and 3-12. *Amphilius* was recovered as a well supported clade (1.0/93). The High and Low African groups were also recovered as well supported clades (High African group: 1.0/100; Low African group: 1.0/98). In the High African clade, a well supported clade (1.0/95) was recovered that included all species except *A. lampei*. Within this clade, a well supported clade (1.0/100) was recovered that included all species from the Congo, Zambezi, and Rovuma River basins and basins south of the Zambezi River except *A. natalensis* and *A. laticaudatus*. A weakly supported clade (0.53/50) that included most of the species from Tanzania was also recovered.

In the Low African clade, two well supported clades were recovered. A clade including the upper Guinea species + *A. longirostis* and one specimen of *A. nigricaudatus* (1.0/95), and a clade including the *A. jacksonii* complex, *A. cf. lentiginosus*, and all other lower Guinea species including a second specimen of *A. nigricaudatus* (0.99/97). The lower Guinea species were recovered as a well supported clade (1.0/100) and the *A. jacksonii* complex was recovered as a well supported clade (1.0/100) sister to *A. cf. lentiginosus*.

Discussion

Many of the specimens used in this analysis could not be placed in any known species of *Amphilius* and likely represent undescribed species. It was therefore necessary to list these specimens with various terms indicating their apparent taxonomic position. What follows is an explanation of all the specimens that could not be assigned to species. *Amphilius cf. lentiginosus* is a species very similar to *A. cf.*

lentiginosus that is found in the Cuanza River basin and the Kwango River system, Congo River basin in Angola. *Amphilius* cf. *jacksonii* is a species of the *A. jacksonii* complex from the Ive River in Uganda that is being described by another researcher. The sequences identified as *A. cf. rheophilus* are from a specimen that was identified as such by Schmidt and Pezold (2011). *Amphilius* n. sp. Congo is an undescribed species known from three specimens from the Republic of the Congo.

Amphilius n. sp. A is an undescribed species from the lower Congo River. *Amphilius* sp. B and C are also specimens from the lower Congo River, both of which are very similar to *A. zairensis*. The specimens identified as *A. cf. zairensis* are also very similar to *A. zairensis* but are from Wagenia Falls, middle Congo River. *Amphilius zairensis* was described from the lower Congo River so *Amphilius* sp. B or C may actually be *A. zairensis* but direct comparison of the specimens to the types is needed to determine which one is *A. zairensis*. Initially, the specimen of *Amphilius* sp. C and the specimens of *Amphilius* cf. *zairensis* were identified as the same species, but the molecular data gave conflicting results as to whether *A. cf. zairensis* is the same species as either *Amphilius* sp. B or C.

The sequences identified as *Amphilius* n. sp. Rovuma are from a small specimen from a tributary of the lower Rovuma River. The specimen and other specimens collected with it are very similar to several small specimens collected from a southeastern tributary of Lake Malawi in Mozambique. Sequences from one of these specimens are identified as *Amphilius* n. sp. Malawi trib. The sequences identified as *Amphilius* n. sp. Malawi are from a specimen from the North Rukuru River, a northwestern tributary of Lake Malawi. Sequences identified as *Amphilius* n. sp. S.

Africa are from specimens from the Limpopo, Incomatti, and Pongola River basins in South Africa and Swaziland. Sequences identified as *Amphilius* n. sp. mottled and *Amphilius* n. sp. Rufiji are from three specimens collected from three sites in the Rufiji River basin. All three specimens are heavily mottled unlike all other specimens collected in the basin except one other specimen collected with one of the specimens above. This other mottled specimen is morphologically distinct from the above specimens but could not be included in the analyses because a tissue sample was not taken from it.

Amphilius cf. *natalensis* are from the Buzi River basin. They are similar to *A. natalensis* but differ from *A. natalensis* from South Africa in that they have an adipose fin confluent with the caudal fin. *Amphilius* n. sp. Ruvu and *Amphilius* n. sp. *Mangula* are species being described in a taxonomic revision of *Amphilius uranoscopus* (Chapter 3). *Amphilius* n. sp. Ruvu is known from one location in the Ruvu River basin and *Amphilius* n. sp. *Mangula* is known from several localities in the Rufiji River basin. All specimens of *Amphilius* n. sp. *Malagarasi* are from the Lower Malagarasi River in Tanzania that were formerly identified as *A. uranoscopus*. The sequences identified as *Amphilius* sp. Great Ruaha are from a specimen collected from the Great Ruaha River at a bridge in Kidatu with one of the mottled specimens mentioned above. The cyt b analysis indicates it should be identified as *A. chalei* while the Rag 2 analysis indicates it should be identified as *Amphilius* n. sp. Ruvu; however it is morphologically distinct from both of these species.

The *Amphilius jacksonii* complex was recovered as a well supported clade and sister to *A. cf. lentiginosus* in all analyses. In addition to being the only species of the Low African morphological group distributed in High Africa, they differ from all other

species of the genus by having a variably mottled body pattern that includes dark saddles (vs. body coloration not mottled and without dark saddles). The relationships recovered within the *A. jacksonii* complex are consistent with a taxonomic revision of the complex that will describe several new species (Chapter 4). The concatenated analysis recovered a clade of *A. cf. jacksonii* and the following geographic groupings: Lake Edwards drainage, Uganda; Lake Kyogo and Lake Victoria drainages, Kenya and Uganda; Rufiji and Wami basins, Tanzania; Upper Congo River; and Malagarasi River drainage, Tanzania. Most of the resolution of these clades is due to variation in the *cyt b* locus. The *Rag 2* locus was not variable enough to resolve relationships within the complex and too few sequences were available for the *S7* locus to show relationships. Although *Rag 2* was not able to resolve most relationships within the complex, it did recover *A. cf. jacksonii* as sister to all the remaining species in the complex in contrast to the *cyt b* analyses which recovered it as sister to specimens of *A. jacksonii* from the Lake Edwards drainage, Uganda.

The remaining species of the Low African *Amphilius* were generally recovered in two clades: a clade of mostly upper Guinea species and a clade of mostly lower Guinea species plus Congo River basin species. The two specimens of *A. nigricaudatus* were recovered in different clades. One of the specimens only had nuclear genes amplified and was recovered in the Guinea species and Congo River basin clade. The other specimen had only the mitochondrial gene amplified and was recovered in the upper Guinea clade sister to an *A. longirostris* specimen with which it was collected. The *cyt b* sequence from the *A. nigricaudatus* specimen was nearly identical to the *cyt b*

sequence from the *A. longirostris* specimen indicating introgression between these species.

Amphilius lampei was recovered as sister to all other species of High African *Amphilius* in all analyses except the cyt b likelihood analysis. The distribution of *A. lampei* is disjunct from all other species in the genus. It is found only in the Shebeli River basin in Ethiopia. It is also one of only three species of African *Amphilius* with a very posteriorly placed dorsal fin (first dorsal pterygiophore intercept count usually four, five or six vs. usually two or less). The phylogenetic placement of the two other species with a very posteriorly placed dorsal fin, *A. kivulensis* and *A. natalensis*, varied considerably between analyses. *Amphilius kivulensis* was recovered as sister to all other species of High African *Amphilius* in the cyt b likelihood analysis, sister to all other species of High African *Amphilius* except *A. lampei* in the cyt b Bayesian analysis, and nested within a clade of mostly Tanzanian species in both Rag 2 analyses and the concatenated Bayesian analysis. It was not included in the S7 analyses and was recovered in a polytomy with several other clades in the concatenated likelihood analysis.

Amphilius natalensis was recovered as sister to *A. cf. natalensis* in the cyt b analyses and the concatenated likelihood analysis, but as sister to a clade that included *A. laticaudatus* and *A. cf. natalensis* in the Rag 2 analyses and the concatenated Bayesian analysis. *Amphilius natalensis* was not included in the S7 analyses.

The *Amphilius uranoscopus* species group recognized by Thomson and Page (2010) for High African *Amphilius* species with a relatively elongate body (usually 36–42 vs. 32–35 total vertebrae) and an anteriorly placed dorsal fin, was not recovered as a

monophyletic group in any of the analyses. In addition to the various phylogenetic placements of *A. kivulensis* and *A. natalensis* rendering the group paraphyletic, relatively short-bodied species were consistently found to be closely related to relatively elongate species. There did not appear to be any correlation between body length and phylogenetic position.

Within the High African *Amphilius*, two clades (identified as clades A & B in Figures 3-3 and 3-4) were consistently recovered. No morphological characters could be found to distinguish these two clades but clade A mostly contains species that are mottled or have darkly blotched bodies while species in clade B are never mottled and generally don't have dark blotches on their bodies. There is also a strong correlation with geography. Most of the species in clade A are from the Congo basin and river basins on the east coast of Africa from the Rovuma River and south. Most of the species in clade B are river basins on the east coast of Africa north of the Rovuma River.

The High African *Amphilius* species were recovered as a well supported clade in all analyses. The Low African *Amphilius* species were recovered as a clade in all the analyses that included nuclear genes and was well supported in all except for the S7 likelihood analyses which had 59% bootstrap support. Neither of the two analyses that included only the cyt b locus recovered the Low African *Amphilius* species as a monophyletic group.

Only the cyt b Bayesian analysis and the concatenated likelihood analyses recovered *Amphilius* as a well supported clade. These results are congruent with the results of Chapter 2, which also found strong support for the monophyly of the High

African species and more support for the monophyly of the Low African species than for the entire genus. Given the stronger support for the individual High and Low African clades, the weak support for a clade including all the High and Low African species, and the morphological differences between the High and Low African clades, the High and Low African species are placed in separate genera. The name *Anoplopterus* Pfeffer, 1889 is available for the High African species and the Low African species are retained in *Amphilius*.

Taxonomic Descriptions

***Amphilius* Günther, 1864**

Amphilius Günther. 1864: 115, 134. (Type species: *Pimelodus platychir* Günther, 1864. Type by monotypy.

Diagnosis (based, in part, on Roberts, 2003 and Skelton, 2007b)

Distinguished from all genera of Amphiliidae except *Anoplopterus* by the following combination of characters: soft bodied, outermost pectoral and pelvic fin rays with elaborate lepidotrichia and unculiferous pads. Caudal peduncle short and deep, length more than five times in SL and depth less than three times in caudal peduncle length. Barbels slender and filamentous. Branchiostegal membrane divided mid-ventrally, mouth terminal with broad gape. *Amphilius* is distinguished from *Anoplopterus* by the presence (vs. absence) of an epidermal fold at the base of the caudal fin and 6 + 7 or 7 + 8 principal caudal-fin rays (vs. 8+9).

Species included

Amphilius atesuensis, *A. brevis*, *A. caudosignatus*, *A. dimonikensis*, *A. grammatophorus*, *A. jacksonii*, *A. kakrimensis*, *A. korupi*, *A. lamani*, *A. lentiginosus*, *A.*

longirostris, *A. maesii*, *A. mamonekenensis*, *A. nigricaudatus*, *A. opisthophthalmus*, *A. platychir*, *A. pulcher*, and *A. rheophilus*.

Distribution

Species of *Amphilius* are distributed in Sub-Saharan Africa from the Senegal basin in West Africa west and south to the Cuvo River basin in Angola. One species, *A. jacksonii*, is found in the upper Nile River basin in Uganda, Burundi, Rwanda, and Kenya, in the Wami and Rufiji basins in eastern Tanzania, the Lake Rukwa basin of southwestern Tanzania and northeastern Zambia, and the Lake Manyara basin in northeast Tanzania. Several species of the genus are found in the lower and middle Congo River basin, but only *A. jacksonii* is found in the upper Congo River (including tributaries of Lake Tanganyika).

Notes

Recent authors have considered *A. grammatophorus* a synonym of *A. platychir* but Schmidt and Pezold (2011) presented data that indicates that it is a valid species. The sequences used in this study are from a specimen that they identified as *A. grammatophorus*.

***Anoplopterus* Pfeffer, 1889**

Anoplopterus Pfeffer, 1889: 15. (Type species: *Anoplopterus uranoscopus* Pfeffer, 1889. Type by monotypy.

Chimarrhoglanis Vaillant, 1897: 81. (Type species: *Chimarrhoglanis leroyi* Vaillant 1897. Type by monotypy.

Diagnosis (based, in part, on Roberts, 2003 and Skelton, 2007b)

Distinguished from all genera of Amphiliidae except *Amphilius* by the following combination of characters: Soft bodied, outermost pectoral and pelvic fin rays with elaborate lepidotrichia and unculiferous pads. Caudal peduncle short and deep, length

more than five times in SL and depth less than three times in caudal peduncle length. Barbels slender and filamentous. Branchiostegal membrane divided mid-ventrally, mouth terminal with broad gape. *Anoplopterus* is distinguished from *Amphilius* by the absence (vs. presence) of an epidermal fold at the base of the caudal fin and 8+9 principal caudal-fin rays (vs. 6 + 7 or 7 + 8).

Species included

Anoplopterus athiensis, *A. brevidorsalis*, *A. chalei*, *A. cryptobullatus*, *A. cubangoensis*, *A. grandis*, *A. hageri*, *A. kivuensis*, *A. krefftii*, *A. lampei*, *A. laticaudatus*, *A. leroyi*, *A. natalensis*, *A. uranoscopus*, and *A. zairensis*.

Distribution

Species of *Anoplopterus* are distributed in Sub-Saharan Africa from the Ewaso Ngiro River basin in Kenya south to the Umzimkulu (Mzimkulu) River basin in South Africa. One species, *A. cubangoensis*, is found in the upper Zambezi River basin and the Okavango basin. Several species are found in the Congo River including the lower, middle, and upper parts of the basin. One species, *A. kivuensis*, is found in the upper Nile River basin in Uganda, Burundi, Rwanda, and Kenya and *A. lampei* is found in the Shebele River basin in Ethiopia.

Notes

Anoplopterus brevidorsalis, *A. cubangoensis*, *A. hageri*, and *A. leroyi* have been considered synonyms of *A. uranoscopus* by recent authors but are being redescribed and recognized as valid species in a taxonomic revision of *A. uranoscopus* (Chapter 3).

Table 3-1 Locality, museum catalogue numbers, tissue numbers, and GenBank accession numbers for specimens used in the molecular analyses. DRC = Democratic Republic of the Congo.

Taxon	Collection location	Voucher catalog #	Tissue #	GenBank nos.		
				cyt b	Rag 2	S7
<i>Amphilius brevidorsalis</i>	Muohwa River, Mozambique	SAIAB 67582		KC331845	JX573386	JX944606
<i>Amphilius brevidorsalis</i>	Muzuma River, Mozambique	SAIAB 67618		-	-	KC620191
<i>Amphilius brevidorsalis</i>	Muchanga Stream, Mozambique	SAIAB 67621	SAIAB 67621-1	-	-	KC620192
<i>Amphilius cf. jacksonii</i>	Ivi River trib., Uganda	UF 169237	FLMNH 2008-0376	KC620284	KC667103	-
<i>Amphilius cf. jacksonii</i>	Ivi River trib., Uganda	UF 169237	FLMNH 2008-0377	KC620285	KC667104	-
<i>Amphilius cf. jacksonii</i>	Ivi River trib., Uganda	UF 169237	FLMNH 2008-0378	KC620286	-	-
<i>Amphilius cf. jacksonii</i>	Ivi River trib., Uganda	UF 169237	FLMNH 2008-0379	KC620287	-	-
<i>Amphilius cf. lentiginosus</i>	Kuquema River, Angola	SAIAB 85058	SAIAB 85058-1s	KC620288	KC667076	-
<i>Amphilius cf. natalensis</i>	Muchinene Stream, Mozambique	SAIAB 67413	SAIAB 67413a	KC620226	KC667077	-
<i>Amphilius cf. natalensis</i>	Muchinene Stream, Mozambique	SAIAB 67413	SAIAB 67413b	KC620227	KC667078	-
<i>Amphilius cf. rheophilus</i>	Bafing River, Guinea	AMNH 248685	11803F	KC620291	KC667121	-
<i>Amphilius cf. zairensis</i>	Wagenia Falls, DRC	CU 95907	CU-1862	KC620205	KC667080	-
<i>Amphilius cf. zairensis</i>	Wagenia Falls, DRC	CU 95907	CU-1863	KC620206	JX573387	-
<i>Amphilius chalei</i>	Little Ruaha River, Tanzania	UF 170728	FLMNH 2007-0900	KC620207	KC667075	-
<i>Amphilius cryptobullatus</i>	Mulembo River, Zambia	CU 91058		KC620208	KC667081	-

Table 3-1 Continued

Taxon	Collection location	Voucher catalog #	Tissue #	GenBank nos.		
				cyt b	Rag 2	S7
<i>Amphilius cubangoensis</i>	Kaluebo, DRC	AMNH 252831	AMNH t-081-8077	KC331863	JX573403	JX944620
<i>Amphilius cubangoensis</i>		SAIAB 95820	SAIAB 95820-1	KC620209	KC667082	KC620193
<i>Amphilius grammatophorus</i>	Fétoré River, Guinea	AMNH 250593	11303F	KC331869	JX573418	JX944624
<i>Amphilius grandis</i>	Sagana River, Kenya	NMK Uncat.	Tissue # 32	KC331850	JX573388	JX944611
<i>Amphilius grandis</i>	Ewaso Nyiro River, Kenya	NMK uncat.	Tissue # 98	KC620210	-	-
<i>Amphilius hargerii</i>	Ruo River, Malawi	SAIAB 87161 (tissue only)	SAIAB QQ0619	KC331851	JX573359	JX944612
<i>Amphilius jacksonii</i>	Malagarasi River, Tanzania	CU 90414		KC620257	-	-
<i>Amphilius jacksonii</i>	Malagarasi River, Tanzania	CU 95207	CU-1235	KC620258	KC667089	KC620200
<i>Amphilius jacksonii</i>	Malagarasi River, Tanzania	CU 95207	CU-1236	KC620259	KC667090	-
<i>Amphilius jacksonii</i>	Malagarasi River, Tanzania	CU 95207	CU-1237	KC620260	KC667091	-
<i>Amphilius jacksonii</i>	Malagarasi River, Tanzania	CU 95211	CU-1562	KC620261	KC667092	KC620201
<i>Amphilius jacksonii</i>	Malagarasi River, Tanzania	CU 95211	CU-1563	KC620262	KC667093	-
<i>Amphilius jacksonii</i>	Malagarasi River, Tanzania	CU 95211	CU-1564	KC620263	KC667094	-
<i>Amphilius jacksonii</i>	Malagarasi River, Tanzania	CU 90426	FLMNH 2008-0167	KC620264	-	-
<i>Amphilius jacksonii</i>	Malagarasi River, Tanzania	CU 90426	FLMNH 2008-0168	KC620265	-	-

Table 3-1 Continued

Taxon	Collection location	Voucher catalog #	Tissue #	GenBank nos.		
				cyt b	Rag 2	S7
<i>Amphilius jacksonii</i>	Malagarasi River, Tanzania	CU 90426	FLMNH 2008-0169	KC620266	KC667088	-
<i>Amphilius jacksonii</i>	Wami River, Tanzania	UF 170707	FLMNH 2007-0835	KC620268	KC667101	-
<i>Amphilius jacksonii</i>	Divue River, Tanzania	UF 170708	FLMNH 2007-0886	KC620267	KC667102	-
<i>Amphilius jacksonii</i>	Sonjo River, Tanzania	UF 170702	FLMNH 2007-0928	KC620269	KC667099	-
<i>Amphilius jacksonii</i>	12 Bridges River, Tanzania	UF 170706	FLMNH 2007-0994	KC620270	KC667100	-
<i>Amphilius jacksonii</i>	Manafwa River, Uganda	UF 169233	FLMNH 2008-0286	KC620271	KC667098	-
<i>Amphilius jacksonii</i>	Manafwa River, Uganda	UF 169233	FLMNH 2008-0287	KC620272	KC667097	-
<i>Amphilius jacksonii</i>	Manafwa River, Uganda	Voucher lost	FLMNH 2008-0288	KC620273	-	-
<i>Amphilius jacksonii</i>	Musanyi River, Kenya	NMK uncat.	Tissue # 1596	KC620274	-	-
<i>Amphilius jacksonii</i>	Ishasha River, Uganda	UF 169242	FLMNH 2008-0353	KC620275	-	-
<i>Amphilius jacksonii</i>	Ishasha River, Uganda	UF 169242	FLMNH 2008-0354	KC620276	KC667095	-
<i>Amphilius jacksonii</i>	Munyage River, Uganda	UF 169243	FLMNH 2008-0389	KC620277	KC667096	-
<i>Amphilius jacksonii</i>	Munyage River, Uganda	UF 169243	FLMNH 2008-0390	KC620278	-	-
<i>Amphilius jacksonii</i>	Luongo River, Zambia	CU 91053		KC620279	-	-
<i>Amphilius jacksonii</i>	Luongo River, Zambia	CU 91055		KC620280	KC667084	-

Table 3-1 Continued

Taxon	Collection location	Voucher catalog #	Tissue #	GenBank nos.		
				cyt b	Rag 2	S7
<i>Amphilius jacksonii</i>	Kanchibiya Stream, Zambia	CU 91056		KC620281	KC667086	-
<i>Amphilius jacksonii</i>	Diptera River, DRC	SAIAB 77478	SAIAB 77478a	KC620282	KC667085	-
<i>Amphilius jacksonii</i>	Diptera River, DRC	SAIAB 77478	SAIAB 77478b	KC620283	KC667087	-
<i>Amphilius kivuensis</i>	Ihizozo River, Uganda	Voucher lost	FLMNH 2008-0339	KC620211	-	-
<i>Amphilius krefftii</i>	Kihuhwi River, Tanzania	UF 170713	FLMNH 2007-0748	KC620212	KC667105	-
<i>Amphilius krefftii</i>	Pangani River, Tanzania	UF 170712	FLMNH 2007-0765	KC620213	KC667106	-
<i>Amphilius krefftii</i>	Soni Falls, Tanzania	UF 170744	FLMNH 2007-0773	KC620214	KC667107	-
<i>Amphilius krefftii</i>	Soni Falls, Tanzania	UF 170744	FLMNH 2007-0774	KC620215	-	-
<i>Amphilius krefftii</i>	Kikuletwa River, Tanzania	UF 170721	FLMNH 2007-0784	KC620216	-	-
<i>Amphilius krefftii</i>	Mokoyetti River, Kenya	NMK uncat.	Tissue # 1758	KC620217	-	-
<i>Amphilius lampei</i>	Ukuma River, Ethiopia	KU 29940	KU T1387	KC620218	-	-
<i>Amphilius lampei</i>	Ukuma River, Ethiopia	KU 29940	KU T1388	KC620219	-	-
<i>Amphilius laticaudatus</i>	Muchinene Stream, Mozambique	SAIAB 67411	SAIAB 67411-1	KC620220	-	-
<i>Amphilius laticaudatus</i>	Mussapa Grande R., Mozambique	SAIAB 67584		-	KC667108	-
<i>Amphilius leroyi</i>	Ruvu River, Tanzania	UF 170711	FLMNH 2007-0801	KC620221	KC667109	-
<i>Amphilius leroyi</i>	Ruvu River, Tanzania	UF 170711	FLMNH 2007-0802	KC331856	JX573394	JX944615

Table 3-1 Continued

Taxon	Collection location	Voucher catalog #	Tissue #	GenBank nos.		
				cyt b	Rag 2	S7
<i>Amphilius leroyi</i>	Ruvu River, Tanzania	CU 93725	FLMNH 2007-0812	KC620222	KC667110	-
<i>Amphilius leroyi</i>	Ruvu River, Tanzania	UF 170717	FLMNH 2007-0813	KC620223	KC667111	-
<i>Amphilius leroyi</i>	Ruvu River, Tanzania	UF 170726	FLMNH 2007-0817	KC620224	KC667112	-
<i>Amphilius leroyi</i>	Ruvu River, Tanzania	UF 170726	FLMNH 2007-0818	KC620225	KC667113	-
<i>Amphilius longirostris</i>	Ngonebok Creek, Cameroon	CU 89988		KC620289	KC667114	KC620202
<i>Amphilius maesii</i>	Kwango River, DRC	ZSM 38161	DRC- 2008/633	KC620290	KC667115	-
<i>Amphilius</i> n. sp. A	River Louvoubi, Rep. Congo	AMNH 240436	AMNH t-022- 2158	KC620228	KC667117	-
<i>Amphilius</i> n. sp. A	River Louvoubi, Rep. Congo	AMNH 240240		KC620203	KC667118	KC620194
<i>Amphilius</i> n. sp. Buzi	Muchanga Stream, Mozambique	SAIAB 67621	SAIAB 67621-1	KC620230	KC667120	-
<i>Amphilius</i> n. sp. Congo	Lekenie River, Rep. Congo	CU 92435		-	KC667122	-
<i>Amphilius</i> n. sp. Rufiji	Sonjo River, Tanzania	UF 184935	FLMNH 2007-0926	KC620243	KC667123	KC620195
<i>Amphilius</i> n. sp. Rufiji	Great Ruaha River, Tanzania	UF 170715	FLMNH 2007-0977	KC620231	KC667124	-
<i>Amphilius</i> n. sp. Malawi trib	Lake Malawi trib., Mozambique	SAIAB 87161	SAIAB 87161	KC620232	KC667125	-
<i>Amphilius</i> n. sp. Lake Rukwa	Saisi River, Zambia		MMo7-G	KC620233	-	-

Table 3-1 Continued

Taxon	Collection location	Voucher catalog #	Tissue #	GenBank nos.		
				cyt b	Rag 2	S7
<i>Amphilius</i> n. sp. Lake Rukwa	Saisi River, Zambia		MMo7-H	KC620234	KC667126	-
<i>Amphilius</i> n. sp. <i>Malagarasi</i>	Malagarasi River, Tanzania	CU 90401		KC331859	JX573398	JX944616
<i>Amphilius</i> n. sp. <i>Malagarasi</i>	Malagarasi River, Tanzania	CU 90423		KC620236	KC667131	KC620199
<i>Amphilius</i> n. sp. <i>Malagarasi</i>	Malagarasi River, Tanzania	CU 95213	CU-1242	KC620237	KC667127	-
<i>Amphilius</i> n. sp. <i>Malagarasi</i>	Malagarasi River, Tanzania	CU 95216	CU-1558	KC620240	KC667128	KC620196
<i>Amphilius</i> n. sp. <i>Malagarasi</i>	Malagarasi River, Tanzania	CU 95216	CU-1559	KC620238	KC667129	KC620197
<i>Amphilius</i> n. sp. <i>Malagarasi</i>	Malagarasi River, Tanzania	CU 95218	CU-1582	KC620239	KC667130	KC620198
<i>Amphilius</i> n. sp. Malawi	North Rukuru R., Malawi	SAIAB 78387		KC620241	KC667132	-
<i>Amphilius</i> n. sp. Mangula	Lukosi River, Tanzania	CU 93743	FLMNH 2007-0910	KC620235	KC667133	-
<i>Amphilius</i> n. sp. Mangula	Sonjo River, Tanzania	UF 184935	FLMNH 2007-0925	KC620242	KC667134	-
<i>Amphilius</i> n. sp. Mottled	Lukosi River, Tanzania	UF 184937	FLMNH 2007-0911	KC620244	KC667135	-
<i>Amphilius</i> n. sp. Rovuma	Chimbonila River, Mozambique	SAIAB 87188		KC620245	KC667083	-
<i>Amphilius</i> n. sp. Ruvu	Ruvu River, Tanzania	CU 97551	FLMNH 2007-0824	KC331860	JX573370	JX944617
<i>Amphilius</i> n. sp. Ruvu	Ruvu River, Tanzania	UF 184938	FLMNH 2007-0825	KC620247	KC667136	-

Table 3-1 Continued

Taxon	Collection location	Voucher catalog #	Tissue #	GenBank nos.		
				cyt b	Rag 2	S7
<i>Amphilius</i> n. sp. S. Africa	Komati River, Swaziland	SAIAB 66126		KC620248	KC667137	-
<i>Amphilius</i> n. sp. S. Africa	Sakane River, Swaziland	SAIAB 66166	SAIAB 66166-1	KC331861	JX573399	JX944618
<i>Amphilius</i> n. sp. S. Africa	Ngwengwana River, Swaziland	SAIAB 70713	SAIAB 70713-1	KC620251	KC667139	-
<i>Amphilius</i> n. sp. S. Africa	Groot Marico R., South Africa	SAIAB 78430		KC620250	-	-
<i>Amphilius</i> n. sp. S. Africa	Magalies River, South Africa	SAIAB 78453		KC620249	KC667138	-
<i>Amphilius</i> sp. B	Lower Congo River, DRC	AMNH 246501		KC620229	KC667119	-
<i>Amphilius</i> sp. C	Lower Congo River, DRC	AMNH 242332		KC620204	-	-
<i>Amphilius</i> sp. Rufiji	Great Ruaha River, Tanzania	UF 170714	FLMNH 2007-0978	KC620246	KC667140	-
<i>Amphilius uranoscopus</i>	Mbulumi River, Tanzania	UF 170716	FLMNH 2007-0873	KC620252	-	-
<i>Amphilius uranoscopus</i>	Divue River, Tanzania	UF 170723	FLMNH 2007-0881	KC620253	KC667141	-
<i>Amphilius uranoscopus</i>	Divue River, Tanzania	UF 170723	FLMNH 2007-0882	KC620254	KC667142	-
<i>Amphilius uranoscopus</i>	12 Bridges River, Tanzania	UF 170720	FLMNH 2007-0993	KC620255	KC667116	-
<i>Amphilius uranoscopus</i>	Wami River, Tanzania	UF 170718	FLMNH 2007-1004	KC620256	KC667143	-

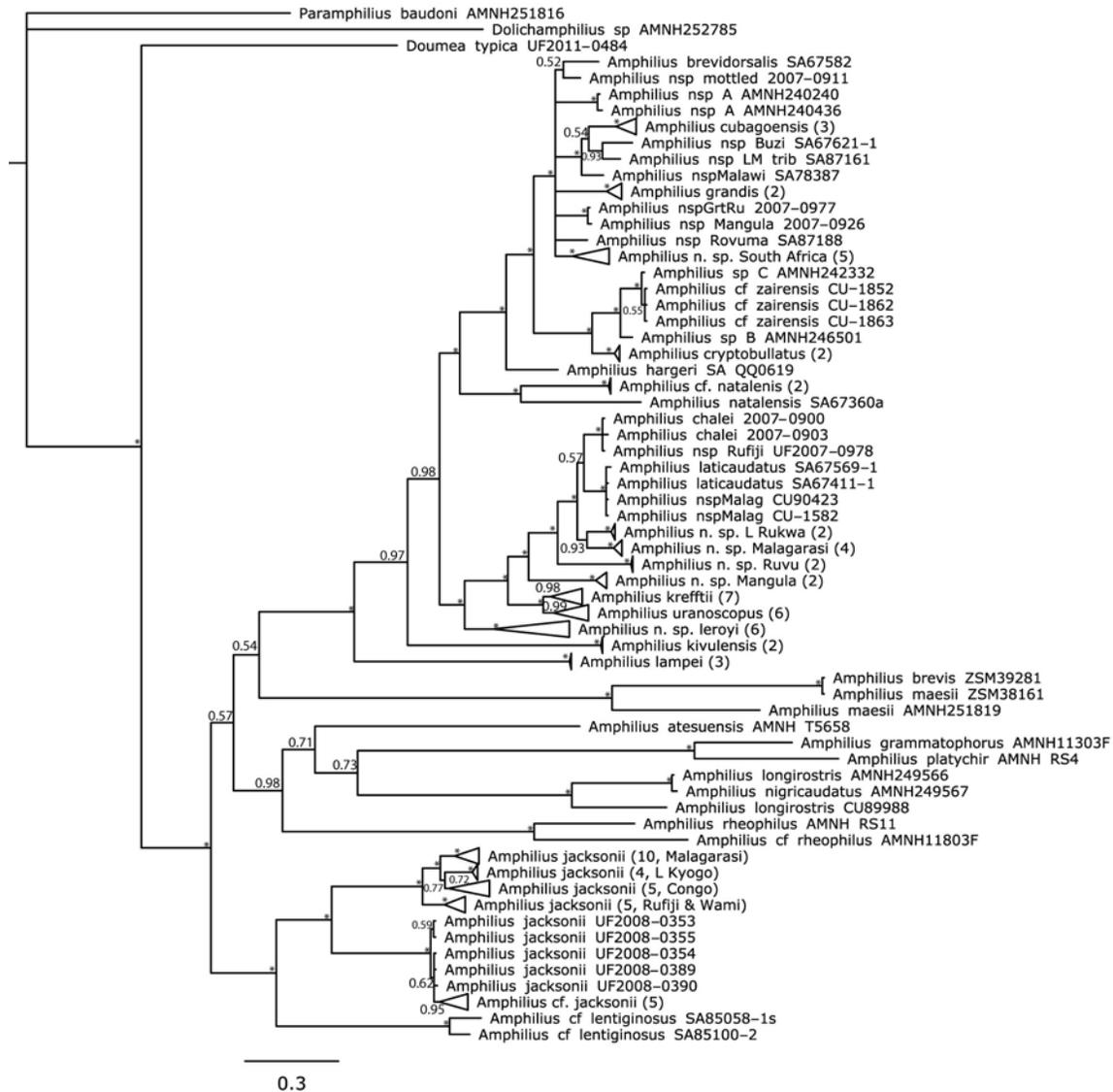


Figure 3-1 Majority rule consensus tree from the Bayesian analysis of the mitochondrial cyt b locus. Numbers on nodes are posterior probabilities. Asterisks indicate posterior probability values of 1.0. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 3-1.



Figure 3-2 Majority rule consensus tree from the likelihood analysis of the mitochondrial cyt b locus. Numbers on nodes are bootstrap support values. Asterisks indicate bootstrap support values of 100. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 3-1.

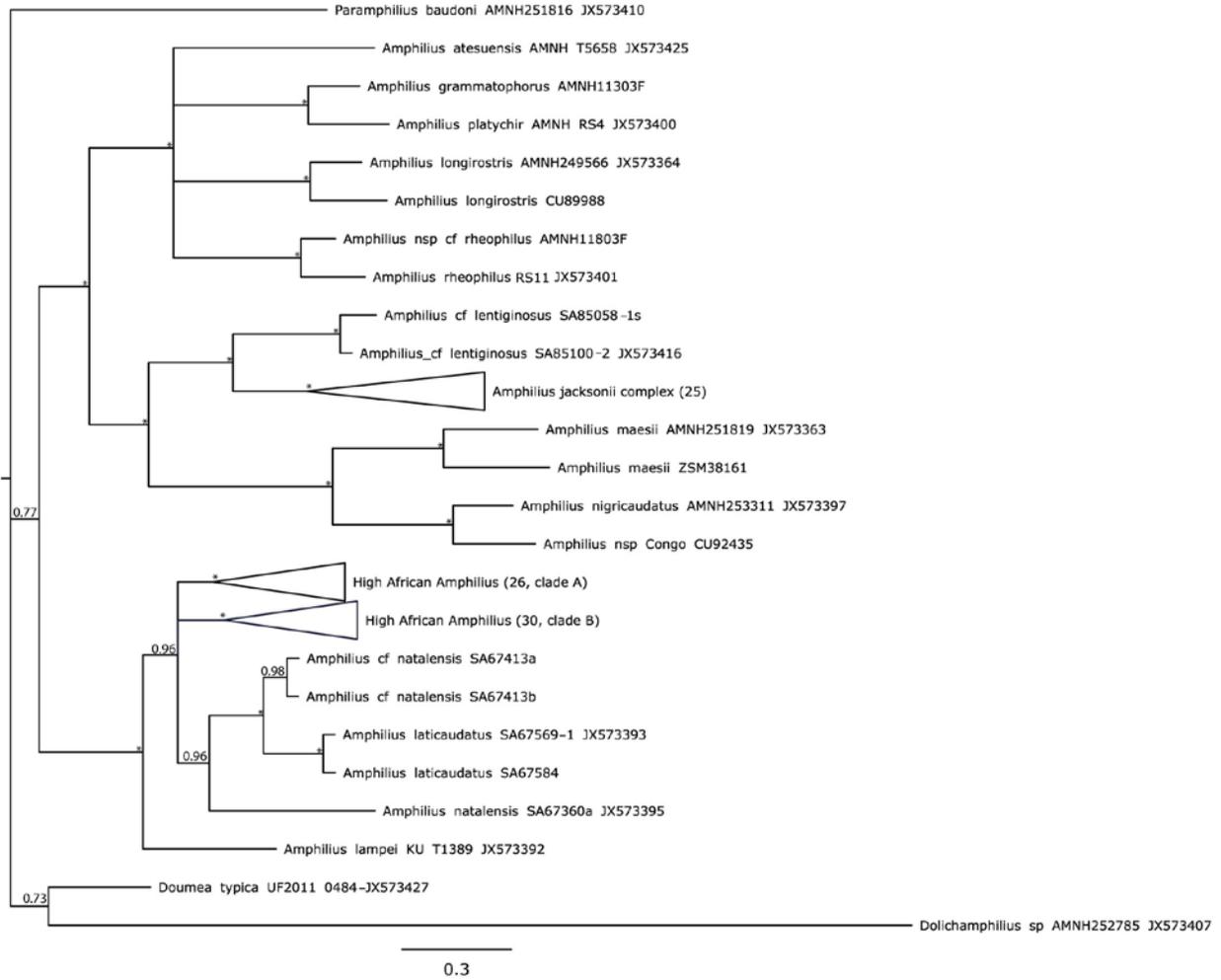


Figure 3-3 Majority rule consensus tree from the Bayesian analysis of the nuclear Rag 2 gene. Numbers on nodes are posterior probability values. Asterisks indicate posterior probability values of 1.0. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 3-1.

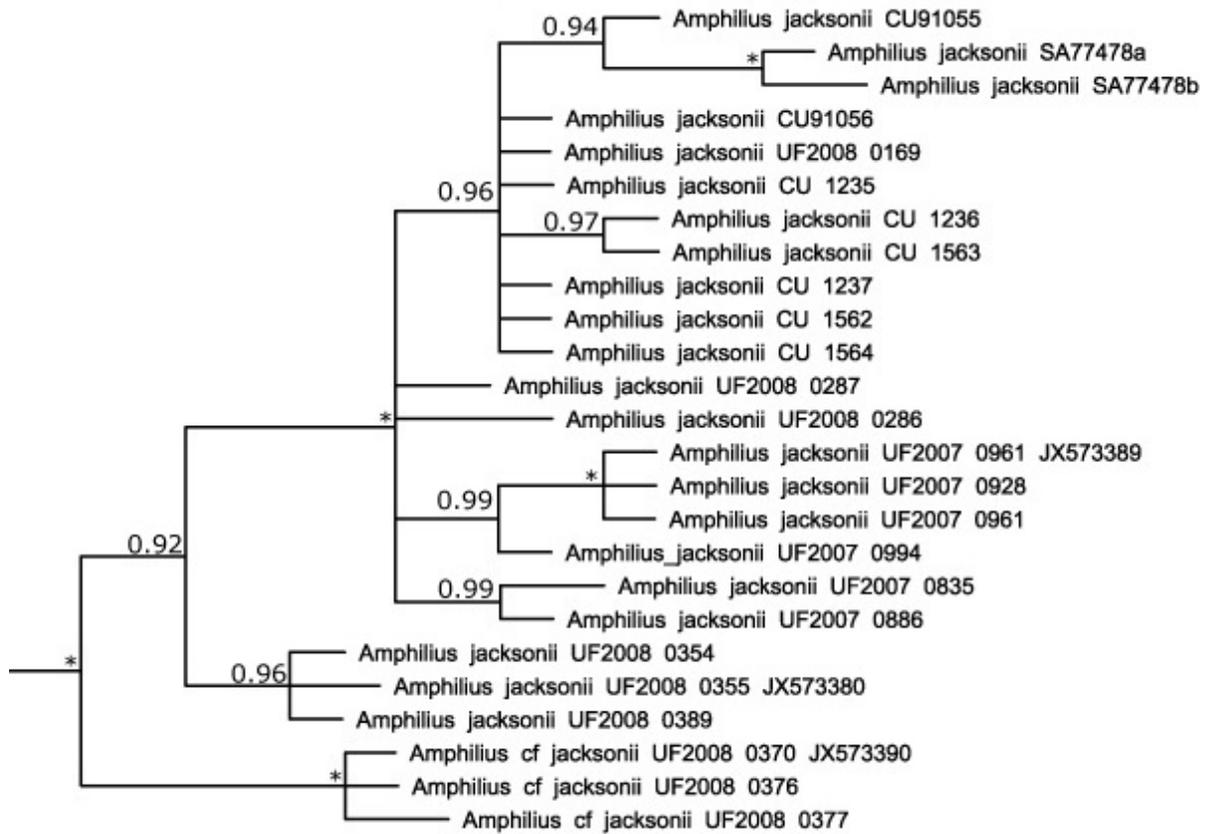


Figure 3-4 Majority rule consensus tree of the from the Bayesian analysis of the nuclear Rag 2 gene showing only the *Amphiliius jacksonii* complex. Numbers on nodes are posterior probability values. Asterisks indicate posterior probability values of 1.0. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 3-1.

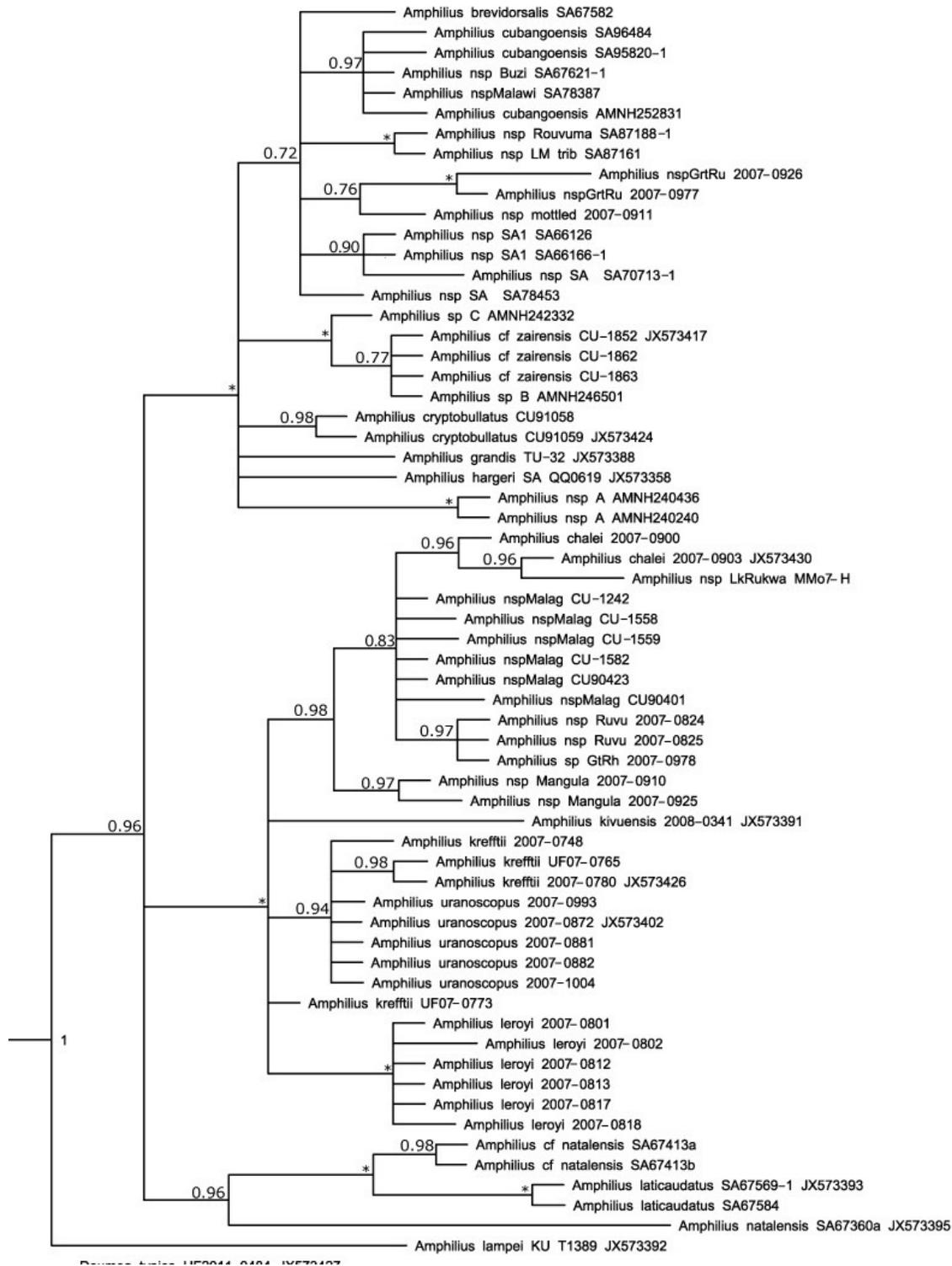


Figure 3-5 Majority rule consensus tree of the from the Bayesian analysis of the nuclear Rag 2 gene showing only the High African *Amphilius*. Numbers on nodes are posterior probability values. Asterisks indicate posterior probability values of 1.0. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 3-1.

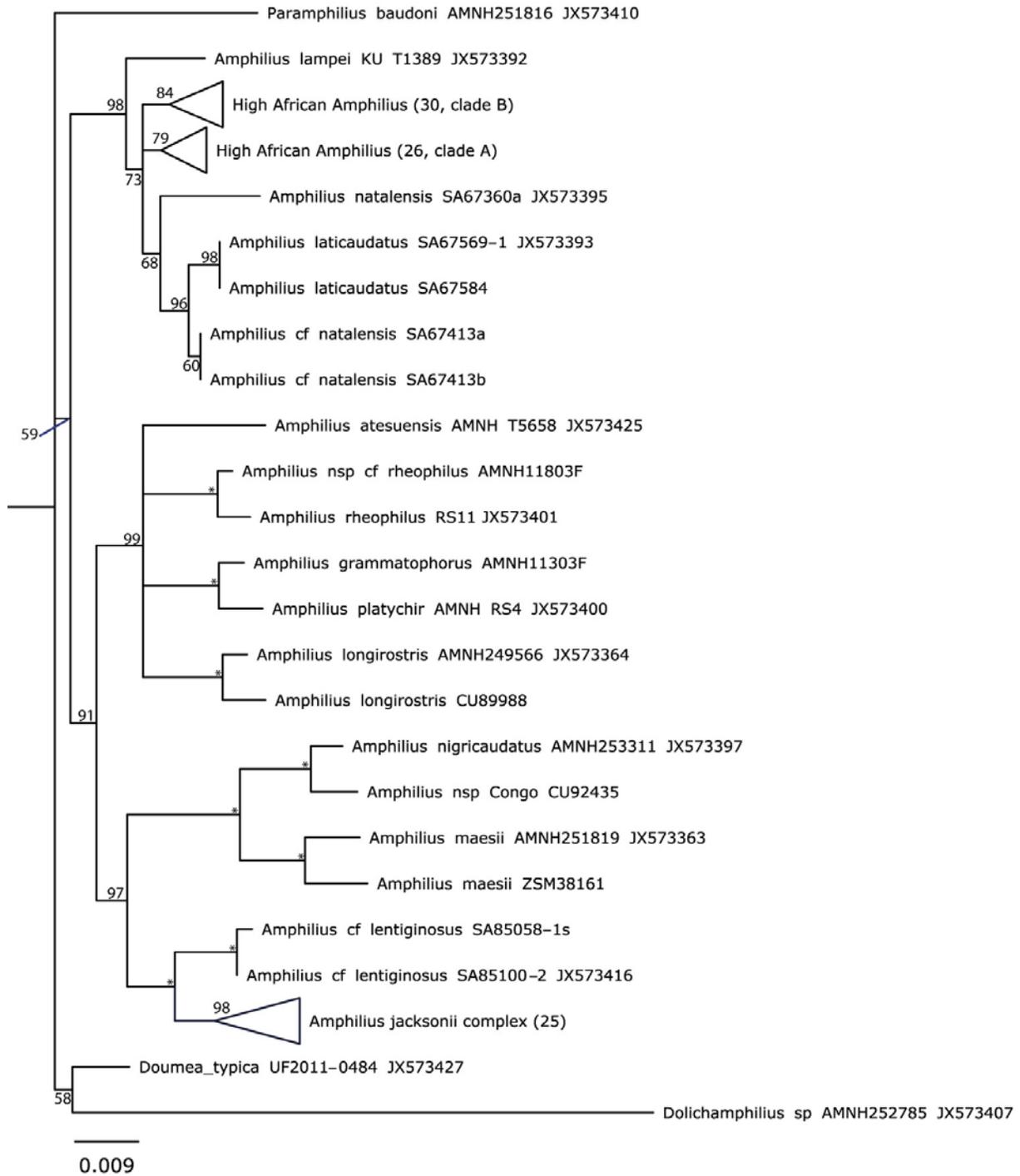


Figure 3-6 Majority rule consensus tree from the likelihood analyses of the nuclear Rag 2 gene. Numbers on nodes are bootstrap support values. Asterisks indicate bootstrap support values of 100. Catalog number of voucher specimen or tissue number of tissue samples follows species name and correspond to data in Table 3-1.

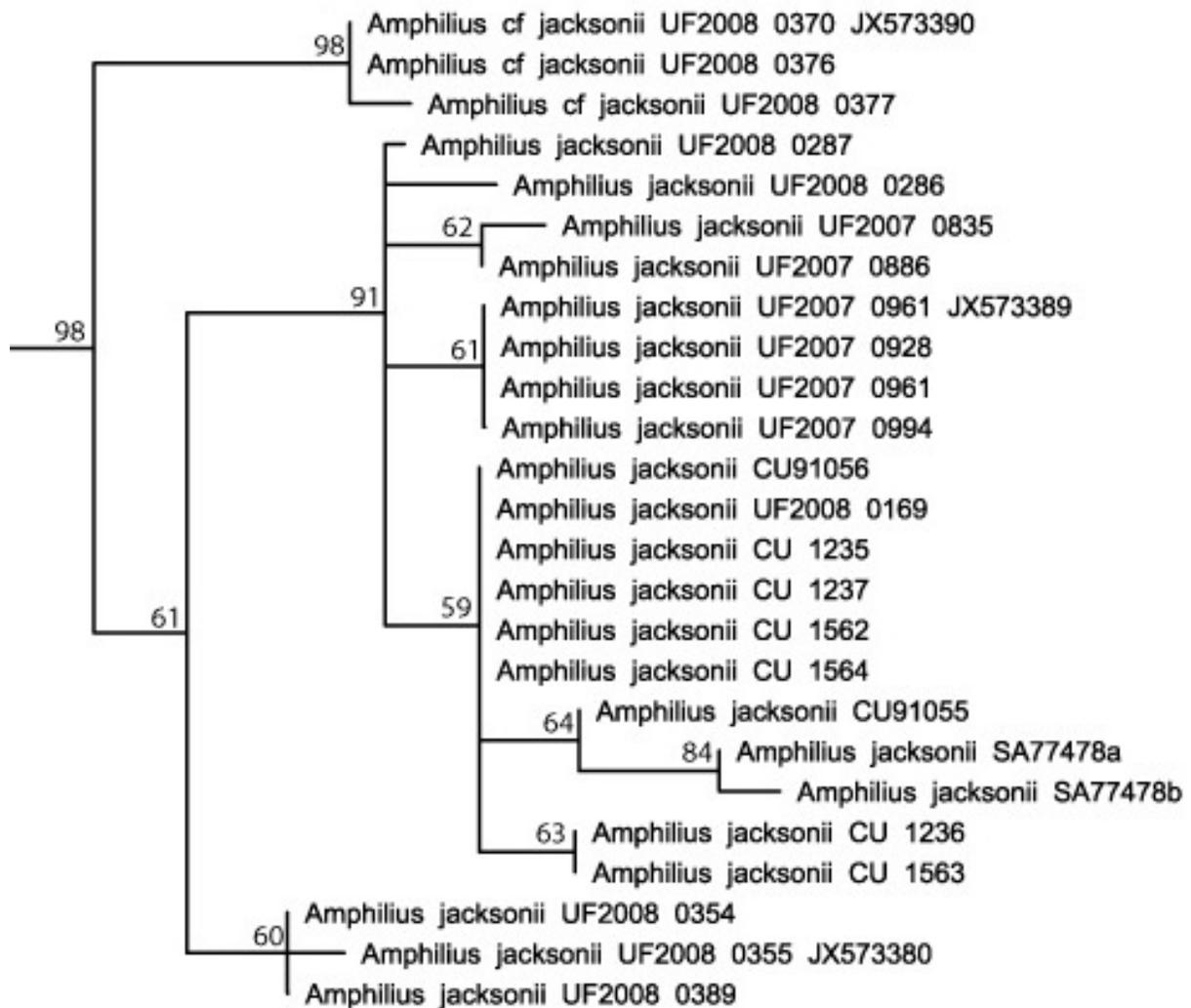


Figure 3-7 Majority rule consensus tree from the likelihood analyses of the nuclear Rag 2 gene showing only the *Amphilius jacksonii* complex. Numbers on nodes are bootstrap support values. Asterisks indicate bootstrap support values of 100. Catalog number of voucher specimen or tissue number of tissue samples follows species name and correspond to data in Table 3-1.

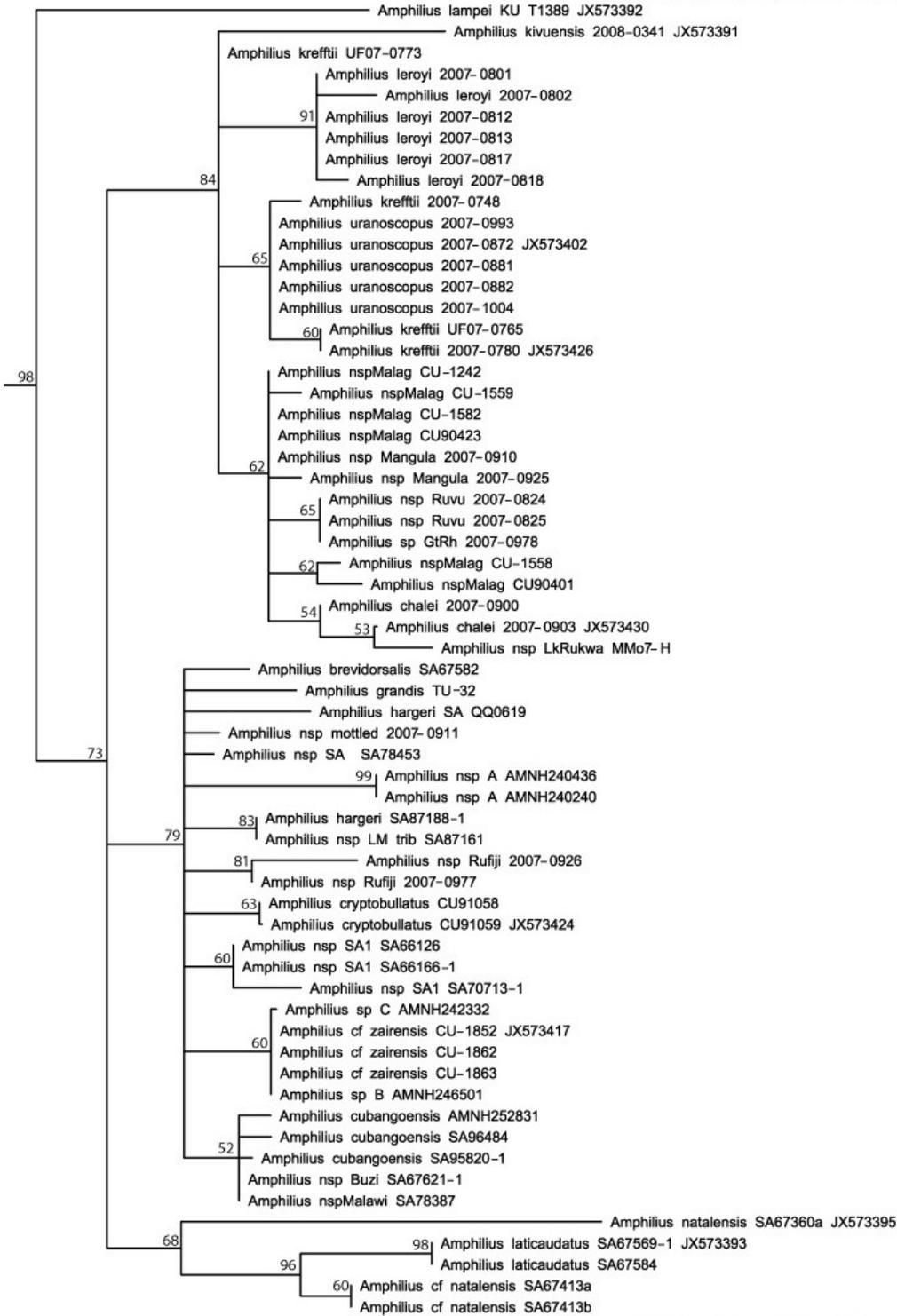


Figure 3-8 Majority rule consensus tree from the likelihood analyses of the nuclear Rag 2 gene showing only the High African *Amphilius*. Numbers on nodes are bootstrap support values. Asterisks indicate bootstrap support values of 100. Catalog number of voucher specimen or tissue number of tissue samples follows species name and correspond to data in Table 3-1.

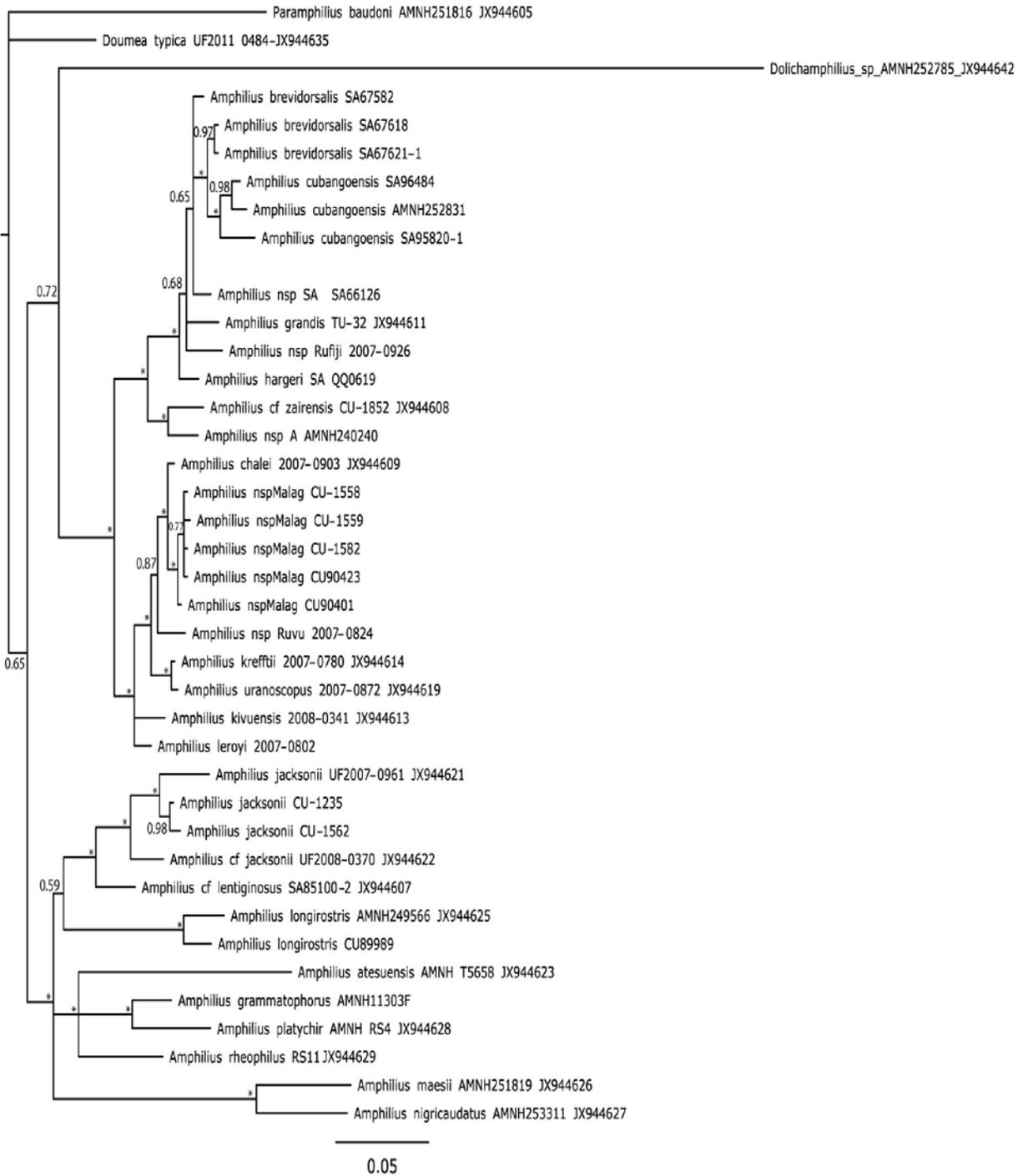


Figure 3-9 Majority rule consensus tree from the Bayesian analysis of the nuclear S7 intron. Numbers on nodes are posterior probability values. Asterisks indicate posterior probability values of 1.0. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 3-1.

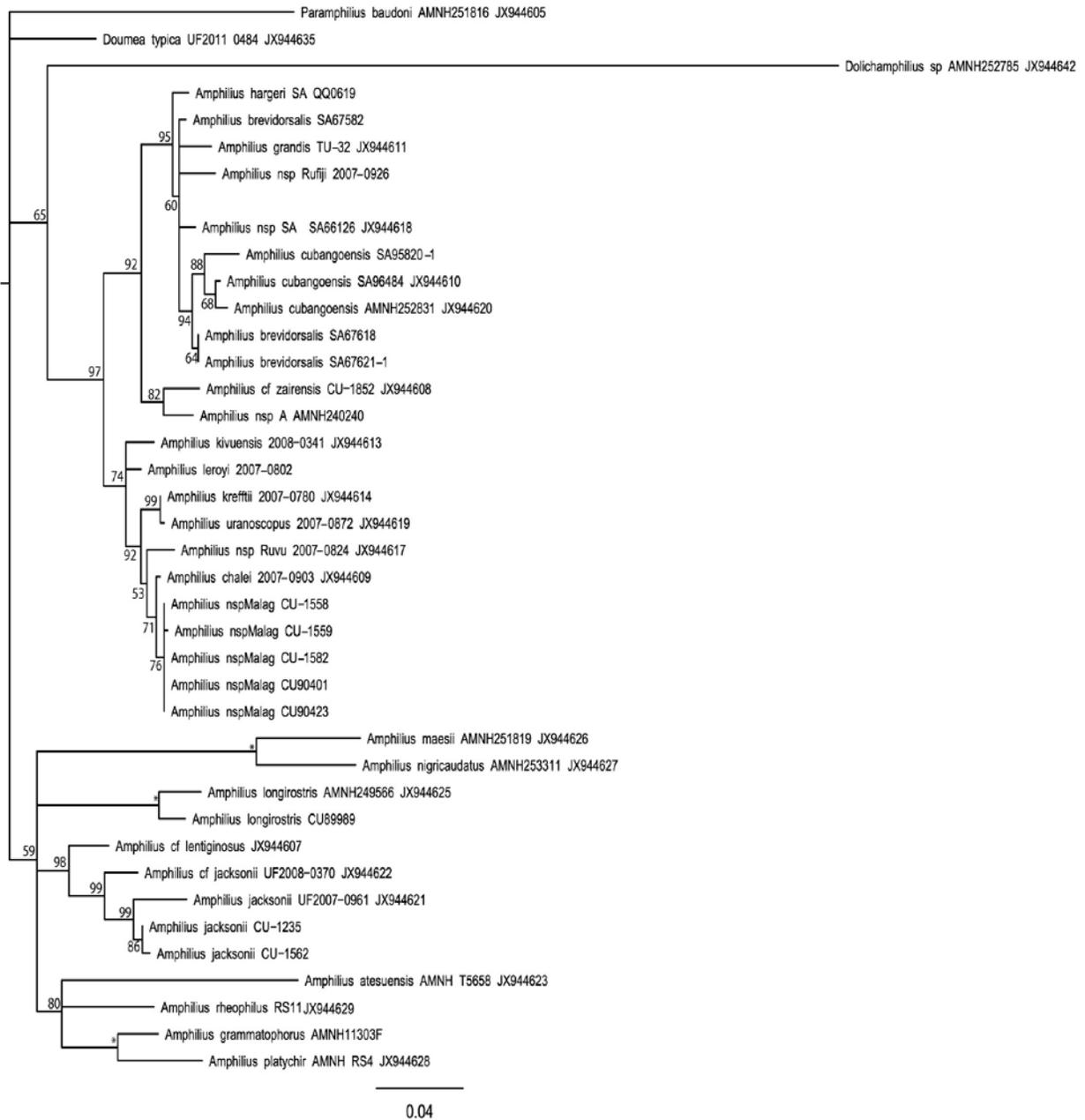


Figure 3-10 Majority rule consensus tree from the likelihood analysis of the nuclear S7 intron. Numbers on nodes are bootstrap support values. Asterisks indicate bootstrap support values of 100. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 3-1.

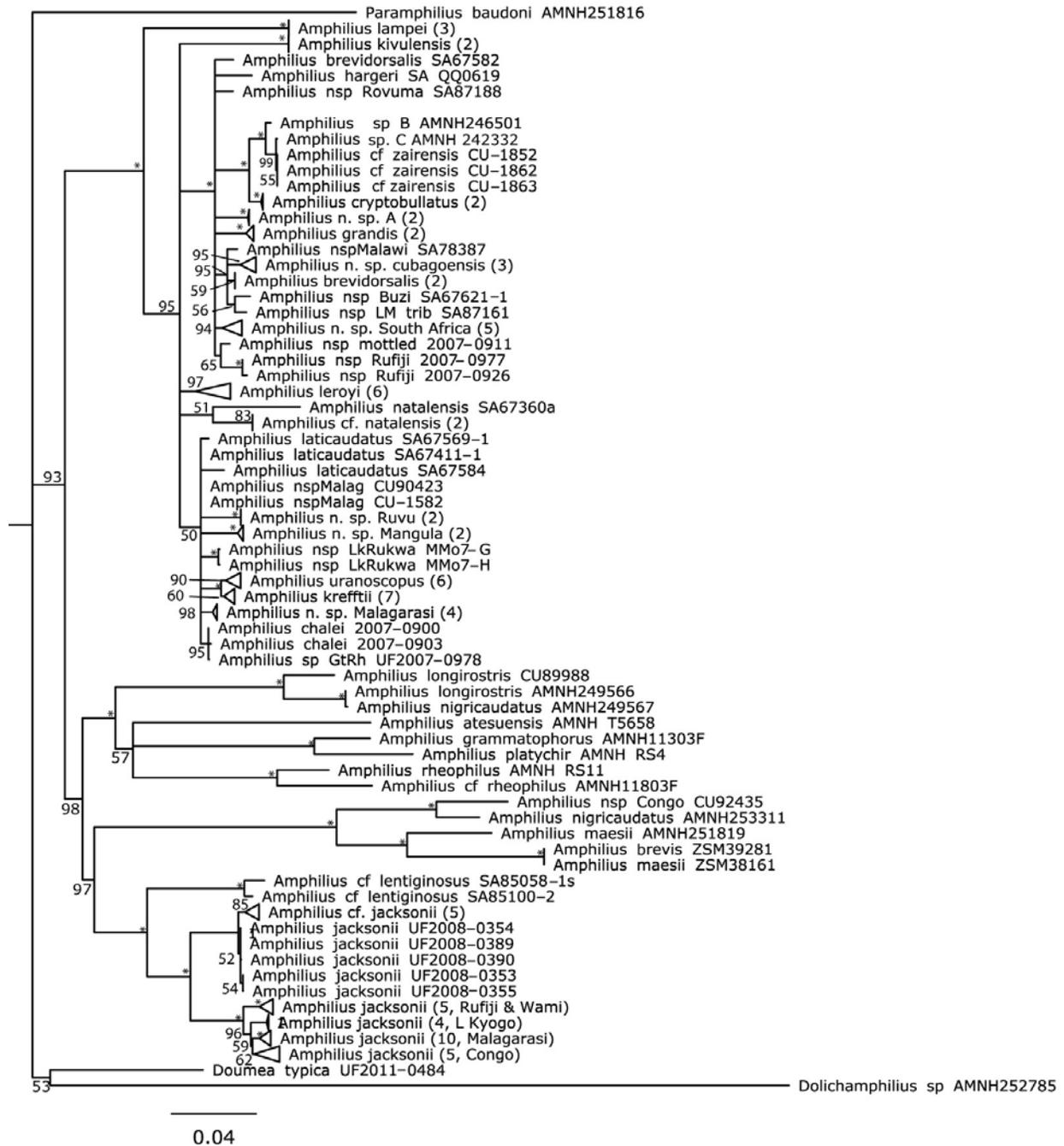


Figure 3-12 Majority rule consensus tree from the likelihood analysis of the concatenated cyt b, Rag 2, and S7 data. Numbers on nodes are posterior probability values. Asterisks indicate posterior bootstrap support values of 100. Catalog numbers of voucher specimens or tissue numbers follow the species name and correspond to data in Table 3-1.

CHAPTER 4
TAXONOMY OF THE AFRICAN CATFISH GENUS *ANOPLOPTERUS*
(SILURIFORMES: AMPHILIIDAE) WITH DESCRIPTIONS OF TWO NEW SPECIES
AND REDESCRIPTIONS OF *ANOPLOPTERUS URANOSCOPIUS*,
CHIMARRHOGLANIS LEROYI, *AMPHILIUS BREVIDORSALIS*, *AMPHILIUS HARGERI*
AND *AMPHILIUS CUBANGOENSIS*.

Background

Thomson and Page (2010) recognized the *Amphilius uranoscopus* species group for species of *Amphilius* that lack an epidermal fold at the base of the caudal fin, have 8 + 9 principal caudal-fin rays, a relatively elongate body (usually 36–42 vs. 32–35 total vertebrae), and an anteriorly placed dorsal fin (leading pterygiophore of the dorsal fin intercepts the vertebral column at the first, second or third post-Weberian vertebra vs. at the fourth, fifth or sixth post-Weberian vertebra). They recognized six species in the group: *Amphilius uranoscopus* (Pfeffer 1889), *A. grandis* Boulenger 1905, *A. krefftii* Boulenger 1911, *A. cryptobullatus* Skelton 1986, *A. chalei* Seegers 2008, and *A. athiensis* Thomson & Page 2010 from Kenya, Tanzania, and the upper Congo River basin (Figure 4-1). Two of the species, *A. grandis* and *A. krefftii*, had previously been placed in the synonymy of *A. uranoscopus*, but the study did not address the status of four other nominal species (*Chimarrhoglanis leroyi* Vaillant 1897, *A. hargerii* Boulenger 1907, *A. brevidorsalis* Pellegrin 1919, and *A. platychir* var. *cubangoensis* Pellegrin 1936) that have long been placed in the synonymy of *A. uranoscopus*.

Following a phylogenetic analysis of *Amphilius* (Chapter 3), *Amphilius* was restricted to species that have an epidermal fold at the base of the caudal fin and 6+7 or 7+8 principal caudal-fin rays. The name *Anoplopterus* Pfeffer, 1889 was resurrected for species that lack an epidermal fold at the base of the caudal fin, have 8 + 9 principal caudal-fin rays. Additionally, the *A. uranoscopus* species group was not recovered as a

monophyletic group. The two short bodied species of *Anoplopterus* (*A. laticaudatus* and *A. zairensis*) and one of the species with a posteriorly placed dorsal fin (*A. natalensis*) were consistently recovered as part of a clade that included all of the elongate bodied species.

In this study, the status of the nominal species not dealt with by Thomson & Page (2010) are addressed by examining type specimens and more recently collected material from the river drainages from which they were described. All four species are valid, and they are redescribed along with *A. uranoscopus*. Additionally, two new species from Tanzania, *Anoplopterus* n. sp. Ruvu from the Ruvu basin, and *A. n. sp.* Mangula from the Rufiji basin, are described.

Material and Methods

Measurements were made point-to-point with digital calipers, and data were recorded to tenths of a millimeter. Subunits of the head are presented as proportions of head length (HL). Head length and measurements of other body parts are given as proportions of standard length (SL). Use of the terms origin and insertion to designate, respectively, the most anterior and posterior points on the bases of all fins follows Cailliet et al. (1986). Counts and measurements were made on the left side of a specimen when possible and follow Thomson & Page (2010). Only specimens 40.0 mm SL or larger were measured, but counts were made on all specimens.

For fin-ray counts, numbers of unbranched soft rays are indicated by lower case Roman numerals, and branched soft rays by Arabic numerals. The number of anterior unbranched rays in the anal fin is difficult to determine, and the counts were checked with radiographs whenever possible. Amphiliids typically have a small spinelet in front of the first unbranched dorsal-fin ray. The spinelet is not included in the counts.

Branchiostegal ray counts only include rays that articulate with the ceratohyal (anterohyal). Vertebrae were counted by means of radiographs; counts exclude the five Weberian vertebrae. The last abdominal vertebra is the last vertebra in which the distal end of the hemal spine lies anteriorly to the first anal-fin pterygiophore. Postabdominal counts include all vertebrae posterior to the abdominal vertebrae, with the ural centrum counted as one vertebra. The first dorsal pterygiophore intercept count is the number of vertebrae up to and including the vertebra opposite, or anterior to, the spine of the leading dorsal pterygiophore.

Material examined is given under each species account and is listed by drainage followed by catalog number, country, locality, geographic coordinates and, in parentheses, the number of specimens and the size range in mm SL. Materials examined in this study are deposited in the following institutions: the American Museum of Natural History, New York, New York (AMNH), the Natural History Museum, London (BMNH), the California Academy of Sciences, San Francisco, California (CAS), the Cornell University Vertebrate Collections, Ithaca, New York (CU), the Field Museum of Natural History, Chicago, Illinois (FMNH), the Harvard Museum of Comparative Zoology, Cambridge, Massachusetts (MCZ), the Muséum National d'Histoire naturelle, Paris, France (MNHN); the Royal Museum of Central Africa, Tervuren, Belgium (MRAC), the South African Institute for Aquatic Biodiversity, Grahamstown, South Africa (SAIAB), the Florida Museum of Natural History, Gainesville, Florida (UF), the Smithsonian Institution National Museum of Natural History, Washington, DC (USNM), and the Universität Hamburg, Biozentrum Grindel und Zoologisches Museum, Ichthyology, Hamburg, Germany (ZMH).

Synonymies include all references to the species from eastern Africa.

References of species outside eastern Africa that give only a general distribution in eastern Africa are excluded. The first page of the reference to the species and all figures are listed. If the species is also listed in a key on a separate page from the account, that page is also listed. The type of information in the reference is given followed by the locality for the species as given in the account. Additionally, any specimens on which that account is known to be based are listed. If the account is only based in part on the species, only the information that is applicable to that species is listed.

Taxonomic Descriptions

***Anoplopterus uranoscopus* Pfeffer, 1889 (Figure 4-2; Table 4-1)**

Anoplopterus uranoscopus Pfeffer 1889: 16, Original description, Type locality: Ushonda and Monda, upper ranges of Wami River, Tanzania [ZMH 11944 and ZMH 8401]; Pfeffer, 1893: 161. Pl. 2, (figs. 1-2), description, Bach bei Ushonda (Ungúu) and Bäder bei Mhonda; Pfeffer, 1896: 33, (fig. 14), Bach bei Ushonda (Ungúu) and Bäder bei Mhonda; Boulenger, 1898a: 255, reference to original description; Boulenger, 1901: 447, distinctive characters; no distribution information; Poche, 1902a: 121; Boulenger, 1902: 41, in key;

Amphilius uranoscopus Boulenger, 1905a: 64, in key; Boulenger, 1905b: 48, Upper ranges of the Wami River; Boulenger 1911: 357, (fig. 277), Ushonda and Mhonda, Upper ranges of Wami River; Harry, 1953: 187, Synonymy; Copley, 1958: 99 (in part), upper ranges of the Wami River; Bailey, 1969: 192, Wami River; Bernacek, 1980: 36 (in part), listed as present in the Wami drainage; Skelton, 1984: 41 (in part), Wami River; Skelton, 1986: 263 (in part), comparisons based on type specimens; Skelton, 1994: 113 (in part), Wami River; Seegers, 1996: 192 (in part), (figs. 136-137), type specimens, Lectotype designated.

Material Examined

Wami River basin: BMNH 2010.2.16.1–2, ex. UF 170723, (2: 53.5–70.7); CU 93740, Tanzania, Divue River above and below falls along road from Dumila to Turiani, altitude 374 m, 6°10'27"S, 37°35' 00"E (21: 31.7–97.8); CU 93741, Tanzania, Mbulumi

River at bridge in Turiani on road from Dumila to Turiani, altitude 377 m, 6°08'38"S, 37°35' 47"E (5: 61.0–109.4); CU 93742, Tanzania, Wami River at rapids above bridge on road from Chalinze to Segera, altitude 60 m, 6°14'42"S, 38°23' 00"E (1: 81.4); MRAC 2010-08-P-1-2, ex. UF 170723, (2: 58.6–68.3); SAIAB 87472, ex. UF 170723, (2: 49.0–62.7); UF 170716, same data as CU 93741, (7: 26.3–108.5); UF 170718, same data as CU 93742, (2: 43.3–46.8); UF 170723, same data as CU 93740, (19: 31.1–96.2); ZMH 8401, Tanzania, Bad bei Ushonda (Ungúu), ca. 6°20'S, 37°10'E (paralectotype, photographs and x-rays examined); ZMH 11944, same data as ZMH 8401, (lectotype, photographs and x-rays examined). **Rufiji River basin:** CU 93748, Tanzania, 12 Bridges River at overhead bridge for train on road from Mikumi to Ifakara, altitude 419 m, 7°27'53"S, 37°00' 52"E (7: 51.8-82.0), UF 170720, same data as CU 93748, (7: 56.7-91.0).

Diagnosis

Diagnostic characters are summarized in Tables 4-2 and 4-3. *Anoplopterus uranoscopus* is diagnosed from *A. n. sp. Ruvu*, *A. n. sp. Mangula*, *A. krefftii*, and *A. cryptobullatus* by having a forked caudal fin (vs. emarginated caudal fin) and from *A. n. sp. Ruvu*, *A. athiensis*, and *A. cubangoensis* by having a body color that is not finely spotted or mottled (vs. body finely spotted in *A. n. sp. Ruvu* and *A. athiensis*, and mottled in *A. cubangoensis*). It is diagnosed from *A. brevidorsalis*, *A. cubangoensis*, *A. n. sp. Ruvu*, and *A. chalei* by having a wider interorbital width (25.2-28.1% HL vs. 17.9-25.3% HL) and from *A. leroyi* by having a smaller head height (10.0-11.9% SL vs. 11.7-13.8% SL). *Anoplopterus uranoscopus* is diagnosed from *A. leroyi*, *A. hargerii*, *A. n. sp. Ruvu*, *A. n. sp. Mangula*, and *A. krefftii* by having a longer body with 38 to 40 vertebrae (vs. usually 37 or fewer vertebrae). It is diagnosed from *A. hargerii* and *A. n. sp. Ruvu* by

its first dorsal pterygiophore intercept count (1 vs. usually 2) and from *A. athiensis* and *A. grandis* by having distinct pale patches at origin and insertion of dorsal fin (vs. pale patches absent). *Anoplopterus uranoscopus* is further diagnosed from *A. n. sp. Mangula* by having a longer predorsal length (35.0-38.6% SL vs. 31.6-34.9% SL) and from *A. cubangoensis* and *A. chalei* by having a deeper body (body depth at anus 12.7-16.3% SL vs. 8.9-12.2% SL). It is further diagnosed from *A. cubangoensis*, *A. n. sp. Mangula*, and *A. chalei* by having a shorter caudal-peduncle length (15.1-17.9% SL vs. 17.7-21.9% SL) and from *A. cubangoensis* and *A. chalei* by having a deeper caudal peduncle (10.9-14.3 SL vs. 7.1-10.9% SL). *Anoplopterus uranoscopus* is further diagnosed from *A. brevidorsalis* and *A. n. sp. Ruvu* by usually having 9 to 11 gill rakers on the first arch (vs. usually having 6 to 8, rarely 9) and from *A. n. sp. Ruvu* by having 6 or 7 branched anal-fin rays (vs. usually 5, rarely 6). It is further diagnosed from *A. n. sp. Ruvu* by having longer maxillary barbels (69.5-99.1% HL vs. 37.3-49.6% HL).

Description

Morphometric data in Table 4-1. Body elongate, ventral profile flattened ventrally to anal-fin base, then tapered dorsally to end of caudal peduncle. Dorsal profile rising gently from tip of snout to origin of dorsal fin, then nearly horizontal to end of caudal peduncle. Greatest body depth at dorsal-fin origin. Caudal peduncle laterally compressed. Anus and urogenital openings located just posterior to base of pelvic fin, closer to insertion of pelvic fin than to origin of anal fin. Skin smooth. Lateral line complete, extending from dorsal edge of opercular cavity to base of caudal fin. Total vertebrae 38 (9) or 39 (5). Abdominal vertebrae 21 (1), 22 (8), or 23 (5). Caudal vertebrae 15 (1), 16 (11), or 17 (2). First dorsal pterygiophore intercept count 1 (14).

Head and anterior part of body depressed and broad. Head wedge-shaped in lateral view. Snout broad, moderately pointed when viewed from above. Head becoming wider from tip of snout to pectoral-fin base. Branchiostegal membranes moderately joined at isthmus forming a V-shaped or deeply concave connection.

Mouth broad, gently curved, subterminal. Lips moderately fleshy, papillate. Rictal lobe large and papillate. Anterior portion of premaxillary tooth band exposed with mouth closed. Premaxillary tooth patches joined, forming U-shaped band, with short conical teeth. Dentary teeth short and conical, tooth patches forming U-shaped band, separated medially.

Three pairs of simple, tapered circumoral barbels. Maxillary barbel large, fleshy and flattened with pointed tip; barbel extending posterolaterally from corner of mouth to just short of pectoral-fin base. Outer mandibular barbel thin with pointed tip, origin at posterior corner of lower jaw, extending to edge of branchiostegal membrane. Inner mandibular barbel originates anterolaterally of inner mandibular barbel, extending to edge of branchiostegal membrane. Branchiostegal membrane with 8 (43), or 9 (10) rays. Gill rakers on first epibranchial 2 (6), 3 (48) or 4 (1); rakers on first ceratobranchial 5 (3), 6 (21), 7 (25) or 8 (6); total gill rakers on first arch 8 (5), 9 (23), 10 (20), or 11 (7).

Eyes small, positioned dorsolaterally approximately midway between tip of snout and posterior margin of operculum. Horizontal diameter of eye slightly wider than vertical diameter. Eye without free orbit; covered with skin confluent with dorsal surface of head. Anterior and posterior nares with prominent tubular rims; nares separate but relatively close to each other. Posterior nare located about midway between eye and tip of snout.

Dorsal-fin origin at point over tip of pectoral fin. Dorsal fin with i,6 (57) rays, and fin margin straight. Pectoral fin with i,8 (1), i,9 (5) or i,10 (51) rays; unbranched ray greatly thickened. Pectoral fin with four or five innermost rays progressively shorter making posterior fin margin rounded. Pelvic fin inserted posteriorly to dorsal-fin base. Pelvic fin with i,5 (57) rays with first ray unbranched and greatly thickened. Pelvic fin with straight posterior margin.

Adipose-fin base longer than anal-fin base; origin anterior to origin of anal-fin base; fin extending past anal-fin insertion. Margin strongly convex with sharply rounded edge, not deeply incised posteriorly. Caudal fin emarginate, with i,7,7,i (1), or i,7,8,i (55) principal rays. Anal fin with short base; origin posterior to origin of adipose-fin base; fin with ii,6 (27), ii,7 (4), iii,5 (4), iii,6 (20), or iii,7 (2) rays. Anal-fin margin almost straight.

Coloration

Dorsal and lateral surfaces of head and body dark grey with diffuse black stripe along side. Ventral region light brown. Light dorsal saddles at origin and insertion of dorsal fin and adipose fin. Dorsal, adipose, caudal, and anal fins dark grey. Pectoral and pelvic fins positioned horizontally with upper surfaces dark grey and lower surfaces light yellow. Maxillary and mandibular barbels grey. Caudal fin with dark crescent-shaped band at base and broad diffuse band on rays. Juvenile coloration similar to that of adult.

Distribution

Known only from the Wami River and Rufiji River basins, Tanzania (Figure 4-3).

***Anoplopterus leroyi* (Vaillant, 1897) (Figure 4-4; Table 4-4)**

Chimarrhoglanis leroyi Vaillant 1897: 82, Original description, Type locality: Torrent of Mrogoro at Zanguebar, Oukami, East Africa [MNHN 1897-0003]; Boulenger, 1898a: 254, as synonym of *Amphilius platyichir*, type locality information; Boulenger, 1898b: 4, as synonym of *Amphilius platyichir*; Poche, 1902a: 121, as synonym of *Anoplopterus platyichir*; Poche, 1902b: 211, as synonym of

Anoplopterus platyichir, Pellegrin, 1905: 177, type information; Bertin & Estève, 1950: 35, type information; Harry, 1953: 186, as synonym of *Amphilius platyichir*.

Amphilius grandis (non Boulenger): Bailey, 1969: 192, Ruvu River

Amphilius platyichir (non Günther): Boulenger, 1905d: 48 (in part), Head-waters of the Ruvu River.

Amphilius uranoscopus (non Pfeffer): Bernacek, 1980: 36 (in part), listed as present in the Ruvu drainage; Skelton, 1984: 45 (in part), in synonymy, type information, Ruvu River; Skelton, 1986: 263 (in part), comparisons based on type specimens; Skelton, 1994: 113 (in part), listed as present in Ruvu drainage.

Material Examined

Ruvu River basin: CU 93725, Tanzania, Kibundi River along road from Kipera to Mgeta, altitude 633m, 6°59'08"S, 37°33'31"E (11: 27.7-52.0); CU 93727, Tanzania, Ruvu River at bridge on road from Mikese to Mtambo, altitude 96 m, 7°01'24"S, 37°48'36"E (5: 36.2-71.6); FMNH 111682, Tanzania, Uluguru Mts., Uluguru North Forest Reserve, 3 km W, 1.3 km N Tegetero, 1345 m, 6°55'45"S, 37°42'20"E (1: 55.7); FMNH 111683, Tanzania, Uluguru Mts., Uluguru North Forest Reserve, 5.1 km W, 2.3 km N Tegetero, 1535 m, 6°55'12"S, 37°41'00"E (3: 26.4-52.4); MNHN 1897-0003, Torrent of Mrogoro at Zanguebar, Oukami, East Africa, ca. 6°46'S, 37°44'E (1: 117.3, holotype); UF 84882, Tanzania, Southern side of Uluguro Mountains, about 1 km N of Ruvu River, S of Kibungo Village [on Rd from Mikese to Matambo], Kimboza Forest, ca. 7°02'S, 37°48'E (7: 21.9-40.4); UF 84885, same locality as UF 84882, (1: 9.2); UF 170711, same data as CU 93727, (5: 39.9-76.5); UF 170717, same data as CU 93725, (12: 31.2-116.1).

Diagnosis

Diagnostic characters are summarized in Tables 4-2 and 4-3. *Anoplopterus leroyi* is diagnosed from *A. n. sp. Ruvu*, *A. n. sp. Mangula*, and *A. krefftii* by having a forked

caudal fin (vs. emarginated caudal fin) and from *A. n. sp. Ruvu*, *A. athiensis*, and *A. cubangoensis* by having a body color that is not finely spotted or mottled (vs. body finely spotted in *A. n. sp. Ruvu* and *A. athiensis*, and mottled in *A. cubangoensis*). It is diagnosed from *A. brevidorsalis*, *A. cubangoensis*, *A. n. sp. Ruvu*, and *A. chalei* by having a wider interorbital width (25.8-30.2% HL vs. 17.9-25.3% HL) and from *A. uranoscopus* by having a larger head height (11.7-13.8% SL vs. 10.0-11.9% SL). *Anoplopterus leroyi* is diagnosed from *A. uranoscopus*, *A. n. sp. Ruvu*, *A. krefftii*, *A. chalei*, and *A. athiensis* by its total vertebrae count (usually 37 vs. usually 38 or more in *A. uranoscopus* and *A. athiensis*, and usually 36 or fewer in *A. n. sp. Ruvu* and *A. krefftii*). It is diagnosed from *A. hargerii* and *A. n. sp. Ruvu*, by its first dorsal pterygiophore intercept count (1 vs. usually 2) and from *A. athiensis* and *A. grandis* by having distinct pale patches at origin and insertion of dorsal fin (vs. pale patches absent). *Anoplopterus leroyi* is further diagnosed from *A. hargerii* and *A. cryptobullatus* by having a shorter predorsal length (34.7-36.8% SL vs. 37.3-38.4% SL) and from *A. cubangoensis*, *A. n. sp. Mangula*, and *A. chalei* by having a deeper body (body depth at anus 13.0-16.0% SL vs. 8.9-13.1% SL). It is further diagnosed from *A. cubangoensis*, *A. n. sp. Mangula*, and *A. chalei* by having a shorter caudal-peduncle length (14.9-17.8% SL vs. 17.7-21.9% SL) and from *A. chalei* by having a deeper caudal peduncle (10.0-13.4 SL vs. 7.1-9.7% SL). *Anoplopterus leroyi* is further diagnosed from *A. n. sp. Ruvu* by usually having 8 to 10 gill rakers on the first arch (vs. usually having 6 or 7, rarely 8) and by having 6 or 7 branched anal-fin rays (vs. usually 5, rarely 6). It is further diagnosed from *A. n. sp. Ruvu* by having longer maxillary barbels (69.0-94.8% HL vs. 37.3-49.6% HL).

Description

Morphometric data in Table 4-4. Body elongate, ventral profile flattened ventrally to anal-fin base, then tapered dorsally to end of caudal peduncle. Dorsal profile rising gently from tip of snout to origin of dorsal fin, then nearly horizontal to end of caudal peduncle. Greatest body depth at dorsal-fin origin. Caudal peduncle laterally compressed. Anus and urogenital openings located just posterior to base of pelvic fin, closer to insertion of pelvic fin than to origin of anal fin. Skin smooth. Lateral line complete, extending from dorsal edge of opercular cavity to base of caudal fin. Total vertebrae 36* (3) or 37* (13). Abdominal vertebrae 19 (1), 20* (4), 21 (10) or 22 (1). Caudal vertebrae 15 (1), 16* (13), or 17 (1). First dorsal pterygiophore intercept count 1 (15) or 2* (1).

Head and anterior part of body depressed and broad. Head wedge-shaped in lateral view. Snout broad, moderately pointed when viewed from above. Head becoming wider from tip of snout to pectoral-fin base. Branchiostegal membranes moderately joined at isthmus forming a V-shaped or deeply concave connection.

Mouth broad, gently curved, subterminal. Lips moderately fleshy, papillate. Rictal lobe large and papillate. Anterior portion of premaxillary tooth band exposed with mouth closed. Premaxillary tooth patches joined, forming U-shaped band, with short conical teeth. Dentary teeth short and conical, tooth patches forming U-shaped band, separated medially.

Three pairs of simple, tapered circumoral barbels. Maxillary barbel large, fleshy and flattened with pointed tip; barbel extending posterolaterally from corner of mouth to just short of pectoral-fin base. Outer mandibular barbel thin with pointed tip, origin at posterior corner of lower jaw, extending to edge of branchiostegal membrane. Inner

mandibular barbel originates anterolaterally of inner mandibular barbel, extending to edge of branchiostegal membrane. Branchiostegal membrane with 8* (23), 9 (20), or 10 (2) rays. Gill rakers on first epibranchial 2 (16), 3 (23) or 4* (5); rakers on first ceratobranchial 4 (1), 5* (8), 6 (24), or 7 (11); total gill rakers on first arch 7 (1), 8 (17), 9* (17), or 10 (9).

Eyes small, positioned dorsolaterally approximately midway between tip of snout and posterior margin of operculum. Horizontal diameter of eye slightly wider than vertical diameter. Eye without free orbit; covered with skin confluent with dorsal surface of head. Anterior and posterior nares with prominent tubular rims; nares separate but relatively close to each other. Posterior nare located about midway between eye and tip of snout.

Dorsal-fin origin at point over tip of pectoral fin. Dorsal fin with i,6 (46) rays, and fin margin straight. Pectoral fin with i,9* (19) or i,10 (27) rays; unbranched ray greatly thickened. Pectoral fin with four or five innermost rays progressively shorter making posterior fin margin rounded. Pelvic fin inserted posteriorly to dorsal-fin base. Pelvic fin with i,5 (46) rays with first ray unbranched and greatly thickened. Pelvic fin with straight posterior margin.

Adipose-fin base longer than anal-fin base; origin anterior to origin of anal-fin base; fin extending past anal-fin insertion. Margin strongly convex with sharply rounded edge, not deeply incised posteriorly. Caudal fin emarginate, with i,6,7,i (2), i,7,7,i (5), or i,7,8,i* (39) principal rays. Anal fin with short base; origin posterior to origin of adipose-fin base; fin with ii,6 (1), ii,7 (1), iii,6* (34), or iii,7 (10) rays. Anal-fin margin almost straight.

Coloration

Dorsal and lateral surfaces of head and body brown with diffuse dark brown stripe along side. Ventral region light brown. Light dorsal saddles at origin and insertion of dorsal fin and adipose fin. Dorsal, adipose, caudal, and anal fins brown. Pectoral and pelvic fins positioned horizontally with upper surfaces brown and lower surfaces light yellow. Maxillary and mandibular barbels brown. Caudal fin with dark crescent-shaped band at base and broad diffuse band on rays. Juvenile coloration similar to that of adult.

Distribution

Known only from the Ruvu River basin, Tanzania (Figure 4-3).

***Anoplopterus harger* (Boulenger, 1907) (Figure 4-5; Table 4-5)**

Amphilius harger Boulenger 1907: 488, Original description, Type locality: Ruo River, Mlanji, British Central Africa [Malawi] [BMNH 1907.10.14.8]; Boulenger 1911: 358, (fig. 278), description; in key, sources of Ruo River, Mlanji; Boulenger, 1917: 432, diagnosis from *A. natalensis*; Pellegrin, 1919: 401, diagnosis from *A. brevidorsalis*; Pellegrin 1933: 172, *A. kivuensis*; Harry, 1953: 189, synonymy.

Amphilius platyichir (non Günther): Boulenger 1911: 357, (fig. 277), Ruo River; Tweddle & Willoughby, 1976: 12, Listed from Shire Valley Game Reserves; Tweddle & Willoughby, 1979: 18, Shire River system;

Amphilius uranoscopus (non Pfeffer): Skelton, 1984: 67 (in part), type specimens, Ruo River; Skelton, 1994: 129 (in part), Lower Zambezi drainage.

Holotype.— BMNH 1907.10.14.8, Ruo River, Mlanji, British Central Africa [Malawi], ca. 16°02'S, 35°30'E (1: 48.8).

Material examined

Lower Zambezi River basin: BMNH 1893.11.15.88-90, Malawi, Mlanji, River Ruo, ca. 16°02'S, 35°30'E (3: 22.4-32.1); BMNH 1907.10.14.8, British Central Africa [Malawi], Mlanji, Ruo River, ca. 16°02'S, 35°30'E (1: 48.8, holotype); BMNH 1921.9.6.54-63, Malawi, Mlanji, Nswadzi River, Cholo, ca. 16°04'S, 35°08'E (9: 56.7-106.1); BMNH 1960.12.30.12, Malawi, Mlanji, ca. 16°02'S, 35°30'E (1: 49.8); BMNH

1978.8.3.2041, Malawi, ca. 15°59'N, 35°27'E (1: 72.8); SAIAB 34319, Malawi, Maperera River, Near Chikwawa, ca. 16°05'40"S, 34°54'30"E (1: 61.5); SAIAB 34327, Malawi, Ntwadzi River, Thyolo road, Satemba Estate, ca. 16°04'10"S, 35°05'30"E (13: 38.1-78.1); SAIAB 34332, Malawi, Nachidwa River, Mujiwa, ca. 16°03'S, 35°47'E (22: 43.0-128.9); SAIAB 34344, Malawi, Lichenya River, Mini Mini Estate, ca. 16°03'30"S, 35°35'00"E (19: 26.6-74.8); SAIAB 34349, Malawi, Lichenya River, 5km above confluence Ruo River, ca. 16°05'40"S, 35°29'43"E (11: 26.71-77.28); SAIAB 34354, Malawi, Mlanji, Ruo River at bridge, ca. 16°04'36"S, 35°40'17"E (1: 59.4); SAIAB 34356, Malawi, Likabula River, tributary of Ruo River, at bridge on Mulange-Phalumbe road, ca. 15°55'S, 35°30'E (4: 40.3-62.8); SAIAB 51955, Malawi, Ruo River at Sankhulani, ca. 16°27'S, 35°16'E (1: 76.9); USNM 86637, Malawi, Nswadgi River, Cholo, ca. 16°04'S, 35°08'E (1: 66.3). **Rovuma Basin:** SAIAB 35795, Malawi, Mulanje, Mandimba River at Rte 131 crossing, ca. 14°24'S, 35°36'E (5: 57-126).

Diagnosis

Diagnostic characters are summarized in Tables 4-2 and 4-3. *Anoplopterus hargeri* is diagnosed from *A. uranoscopus*, *A. leroyi*, *A. brevidorsalis*, *A. cubangoensis*, *A. n. sp. Mangula*, *A. krefftii*, *A. chalei*, and *A. athiensis* by its first dorsal pterygiophore intercept count of usually 2 (vs. usually 1). It is diagnosed from *A. n. sp. Ruvu*, *A. n. sp. Mangula*, and *A. krefftii* by having a forked caudal fin (vs. emarginated caudal fin) and from *A. n. sp. Ruvu* by having a body coloration that is not heavily spotted (vs. body heavily spotted, with spots usually coalesced to form vermiculations). *Anoplopterus hargeri* is diagnosed from *A. brevidorsalis*, *A. cubangoensis*, *A. n. sp. Ruvu*, and *A. chalei* by having a wider interorbital width (25.7-21.7% HL vs. 17.9-25.3% HL) and from *A. uranoscopus* and *A. chalei* by having a greater head height (12.3-13.2% SL vs. 9.7-

12.4% SL). *Anoplopterus harger* is diagnosed from *A. uranoscopus*, *A. chalei*, and *A. athiensis* by having a shorter body with 36 to 37 vertebrae (vs. usually 38 or more vertebrae) and from *A. athiensis* and *A. grandis* by having distinct pale patches at origin and insertion of dorsal fin (vs. pale patches absent). *Anoplopterus harger* is further diagnosed from *A. leroyi*, *A. n. sp. Mangula*, and *A. chalei* by having a longer predorsal length (37.3-38.4% SL vs. 31.6-36.8% SL) and from *A. cubangoensis* and *A. chalei* by having a deeper body (body depth at anus 13.0-14.4% SL vs. 8.9-12.2% SL). It is further diagnosed from *A. cubangoensis*, *A. n. sp. Mangula*, and *A. chalei* by having a shorter caudal-peduncle length (14.4-16.8% SL vs. 17.7-21.9% SL) and from *A. cubangoensis* and *A. chalei* by having a deeper caudal peduncle (11.8-13.5 vs. 7.1-10.9% SL). *Amphilius harger* is further diagnosed from *A. n. sp. Ruvu* by usually having 8 to 10 gill rakers on the first arch (vs. usually having 6 or 7, rarely 8) and by usually having 6 branched anal-fin rays (vs. usually 5, rarely 6). It is further diagnosed from *A. n. sp. Ruvu* by having longer maxillary barbels (62.2-95.9% HL vs. 37.3-49.6% HL).

Description

Morphometric data in Table 4-5. Body elongate, ventral profile flattened ventrally to anal-fin base, then tapered dorsally to end of caudal peduncle. Dorsal profile rising gently from tip of snout to origin of dorsal fin, then nearly horizontal to end of caudal peduncle. Greatest body depth at dorsal-fin origin. Caudal peduncle laterally compressed. Anus and urogenital openings located just posterior to base of pelvic fin, closer to insertion of pelvic fin than to origin of anal fin. Skin smooth. Lateral line complete, extending from dorsal edge of opercular cavity to base of caudal fin. Total vertebrae 36 (2) or 37* (5). Abdominal vertebrae 20 (3) or 21* (4). Caudal vertebrae 15 (1), 16* (4), or 17 (2). First dorsal pterygiophore intercept count 2 (6) or 3* (1).

Head and anterior part of body depressed and broad. Head wedge-shaped in lateral view. Snout broad, moderately pointed when viewed from above. Head becoming wider from tip of snout to pectoral-fin base. Branchiostegal membranes moderately joined at isthmus forming a V-shaped or deeply concave connection.

Mouth broad, gently curved, subterminal. Lips moderately fleshy, papillate. Rictal lobe large and papillate. Anterior portion of premaxillary tooth band exposed with mouth closed. Premaxillary tooth patches joined, forming U-shaped band, with short conical teeth. Dentary teeth short and conical, tooth patches forming U-shaped band, separated medially.

Three pairs of simple, tapered circumoral barbels. Maxillary barbel large, fleshy and flattened with pointed tip; barbel extending posterolaterally from corner of mouth to just beyond pectoral-fin base. Outer mandibular barbel thin with pointed tip, origin at posterior corner of lower jaw, extending to pectoral-fin base. Inner mandibular barbel originates anterolaterally of inner mandibular barbel, extending to edge of branchiostegal membrane. Branchiostegal membrane with 7 (16), 8* (25), or 9 (1) rays. Gill rakers on first epibranchial 2 (5) or 3* (36); rakers on first ceratobranchial 5 (1), 6* (19), 7 (10) or 8 (1); total gill rakers on first arch 7 (1), 8* (2), 9 (29), 10 (8), or 11 (1).

Eyes small, positioned dorsolaterally approximately midway between tip of snout and posterior margin of operculum. Horizontal diameter of eye slightly wider than vertical diameter. Eye without free orbit; covered with skin confluent with dorsal surface of head. Anterior and posterior nares with prominent tubular rims; nares separate but relatively close to each other. Posterior nare located closer to tip of snout than eye.

Dorsal-fin origin at point over tip of pectoral fin. Dorsal fin with i,5 (1) or i,6 (41) rays, and fin margin straight. Pectoral fin with i,8 (1), i,9* (20), i,10* (19) or i,11 (1) rays; unbranched ray greatly thickened. Pectoral fin with four or five innermost rays progressively shorter making posterior fin margin rounded. Pelvic fin inserted posteriorly to dorsal-fin base. Pelvic fin with i,5 (42) rays with first ray unbranched and greatly thickened. Pelvic fin with straight posterior margin.

Adipose-fin base longer than anal-fin base; origin anterior to origin of anal-fin base; fin extending past anal-fin insertion. Margin strongly convex with sharply rounded edge, deeply incised posteriorly. Caudal fin forked, with i,7,7,i (2), or i,7,8,i* (40) principal rays. Anal fin with short base; origin posterior to origin of adipose-fin base; fin with ii,5 (2), ii,6 (31), ii,7 (2), iii,5 (1)*, iii,6 (2), or iv,6 (1) rays. Anal-fin margin almost rounded.

Coloration

Dorsal and lateral surfaces of head and body dark brown, usually with black blotches or spots. Ventral region light brown. Light dorsal saddles at origin and insertion of dorsal fin and adipose fin. Dorsal, adipose, caudal, and anal fins brown. Pectoral and pelvic fins positioned horizontally with upper surfaces dark brown and may have black spots. Lower surfaces light yellow. Maxillary and mandibular barbels dark brown. Caudal fin with dark crescent-shaped band at base and broad diffuse band on rays. Juvenile coloration similar to that of adult but usually with larger black blotches on body and may appear mottled.

Distribution

Known from the Shire River system of the Lower Zambezi River basin and Ruvuma River basin in Malawi and Mozambique (Figure 4-6).

***Anoplopterus brevidorsalis* (Pellegrin, 1919) (Figure 4-7; Table 4-6)**

Amphilius brevidorsalis, Pellegrin 1919: 399, Original description, Type locality: Revue River at Manica, Mozambique [MNHN 1919-0488]; Bertin & Estève, 1950: 36, type information.

Amphilius grandis (non Boulenger): Crass, 1960: 443 (in part), Mozambique; Jubb, 1961: 120 (in part), Buzi River basin;

Amphilius natalensis (non Boulenger); Barnard, 1942: 257.

Amphilius platychnis (non Günther): ?Bell-Cross, 1973: 9, 14, Buzi/Revue system (could be *A. brevidorsalis* or *A. natalensis*); Bell-Cross & Jubb, 1973: 2.

Amphilius uranoscopus (non Pfeffer): Skelton, 1984: 67, type specimen, Revue River.

Material examined

Buzi River basin: MNHN 1919-0488, Mozambique, Revue River at Manica, ca. 18°58'S, 33°03'E (1: 42.8, holotype); SAIAB 53691, Mozambique, Bonde River at causeway, ca. 19°10'S, 33°05'E (13: 26.8-88.2); SAIAB 53695, same locality as SAIAB 53691, (3: 37.4-80.3); SAIAB 53698, Mozambique, Bonde River, Inflow to Lake Chicamba, ca. 19°10'S, 33°03'E (9: 36.0-48.4); SAIAB 53712, Mozambique, Mupandeia River at bridge, ca. 19°10'S, 32°58'E (58: 27.4-92.7); SAIAB 60023, Mozambique, Small River Below Lake Chicamba Wall, ca. 19°20'S, 32°56'E (36: 23.4-67.5); SAIAB 60024, Mozambique, Pool Below Chicamba Wall, near Chaine, ca. 19°11'S, 32°54'E (1: 37.5); SAIAB 60025, Mozambique, Nyamanguena River at bridge, ca. 19°17'S, 33°02'E (10: 29.5-45.4); SAIAB 67527, Mozambique, very small tributary of Mussapa Grande, ca. 19°39'S, 33°09'E (4: 80.2-111.3); SAIAB 67550, Mozambique, Mussapa Pequena, near park 'gate', ca. 19°35'S, 33°05'E (1: 42.0); SAIAB 67576, Mozambique, Mukuru Stream on Chikukwe Road, 19°03'06"S, 33°04'09"E (3: 40.5-69.2); SAIAB 67582, Mozambique, 19°42'18"S, 32°58'35"E (3: 71.3-89.5); SAIAB 67586, Mozambique, Nyabawa Stream,

19°42'19"S, 33°01'29"E (2: 64.2-66.0); SAIAB 67618, Mozambique, Muzuma River, 19°47'19"S, 33°20'55"E (1: 54.5); SAIAB 85585, Mozambique, Bonde River causeway above Lake Chicamba, 19°19'23"S, 32°54'15"E (15: 24.1-74.4); SAIAB 85593, Mozambique, 19°10'12"S, 32°53'06"E (2: 53.7-68.5); SAIAB 85659, Mozambique, Msika River at Bridge, about 10 km WSW of Manica, 18°59'14"S, 33°02'57"E (4: 45.6-62.5); SAIAB 85740, same locality as SAIAB 85585, (8: 29.8-58.1); SAIAB 85828, Mozambique, Zonue River Inflow, ca. 19°09'S, 32°54'E (1: 55.2); SAIAB 85862, same locality as SAIAB 85585, (20: 28.6-67.0). **Pungue River basin:** BMNH 1973.9.27.2-3, Zimbabwe, Nyazengu stream, above Pungwe River, ca. 18°20'S, 32°50'E (2: 77.8-89.8); USNM 296983, Mozambique, Beina District, ca. 19°42'S, 34°54'E (1).

Diagnosis

Diagnostic characters are summarized in Tables 4-2 and 4-3. *Anoplopterus brevidorsalis* is diagnosed from *A. n. sp. Ruvu*, *A. n. sp. Mangula*, and *A. krefftii* by having a forked caudal fin (vs. emarginated caudal fin) and from *A. n. sp. Ruvu* by having a body coloration that is not heavily spotted (vs. body heavily spotted, with spots usually coalesced to form vermiculations). It is diagnosed from *A. uranoscopus*, *A. leroyi*, and *A. hargeri* by having a narrower interorbital width (22.2-25.3% HL vs. 25.2-31.7% HL). *Anoplopterus brevidorsalis* is diagnosed from *A. n. sp. Ruvu* and *A. krefftii* by having a longer body with 37 to 38 total vertebrae (vs. usually 36 or less). It is diagnosed from *A. hargeri* and *A. n. sp. Ruvu* by its first dorsal pterygiophore intercept count (1 vs. usually 2) and from *A. athiensis* and *A. grandis* by having distinct pale patches at origin and insertion of dorsal fin (vs. pale patches absent). *Anoplopterus brevidorsalis* is further diagnosed from *A. n. sp. Mangula* by having a longer predorsal length (35.9-38.9% SL vs. 31.6-34.9% SL) and from *A. chalei* by having a deeper body

(body depth at anus 12.5-14.0% SL vs. 8.9-10.8% SL). It is further diagnosed from *A. n. sp. Mangula* and *A. chalei* by having a shorter caudal-peduncle length (16.4-17.3% SL vs. 18.2-21.9% SL) and from *A. chalei* and *A. cubangoensis* by having a deeper caudal peduncle (10.7-13.7 vs. 7.1-10.9% SL). *Anoplopterus brevidorsalis* is further diagnosed from *A. uranoscopus*, *A. hargeri*, *A. cubangoensis*, and *A. athiensis* by usually having 7 or 8 gill rakers on the first arch (vs. usually 9 to 10, rarely 7 or 8) and from *A. n. sp. Ruvu* by usually having 6 or 7 branched anal-fin rays (vs. usually 5, rarely 6). It is further diagnosed from *A. n. sp. Ruvu* by having longer maxillary barbels (64.9-86.0% HL vs. 37.3-49.6% HL).

Description

Morphometric data in Table 4-6. Body elongate, ventral profile flattened ventrally to anal-fin base, then tapered dorsally to end of caudal peduncle. Dorsal profile rising gently from tip of snout to origin of dorsal fin, then nearly horizontal to end of caudal peduncle. Greatest body depth at dorsal-fin origin. Caudal peduncle laterally compressed. Anus and urogenital openings located just posterior to base of pelvic fin, closer to insertion of pelvic fin than to origin of anal fin. Skin smooth. Lateral line complete, extending from dorsal edge of opercular cavity to base of caudal fin. Total vertebrae 37* (1) or 38 (6). Abdominal vertebrae 21* (1) or 22 (6). Caudal vertebrae 16 (7). First dorsal pterygiophore intercept count 0* (1) or 1 (6).

Head and anterior part of body depressed and broad. Head wedge-shaped in lateral view. Snout broad, moderately pointed when viewed from above. Head becoming wider from tip of snout to pectoral-fin base. Branchiostegal membranes moderately joined at isthmus forming a V-shaped or deeply concave connection.

Mouth broad, gently curved, subterminal. Lips moderately fleshy, papillate. Rictal lobe large and papillate. Anterior portion of premaxillary tooth band exposed with mouth closed. Premaxillary tooth patches joined, forming *U*-shaped band, with short conical teeth. Dentary teeth short and conical, tooth patches forming *U*-shaped band, separated medially.

Three pairs of simple, tapered circumoral barbels. Maxillary barbel large, fleshy and flattened with pointed tip; barbel extending posterolaterally from corner of mouth to just short of pectoral-fin base. Outer mandibular barbel thin with pointed tip, origin at posterior corner of lower jaw, extending to edge of branchiostegal membrane. Inner mandibular barbel originates anterolaterally of inner mandibular barbel, extending to edge of branchiostegal membrane. Branchiostegal membrane with 7 (2), 8 (28), or 9 (1) rays. Gill rakers on first epibranchial 2 (14) or 3* (18); rakers on first ceratobranchial 3 (1), 4 (1), 5* (20), or 6 (10); total gill rakers on first arch 6 (1), 7 (8), 8* (20), or 9 (3).

Eyes small, positioned dorsolaterally approximately midway between tip of snout and posterior margin of operculum. Horizontal diameter of eye slightly wider than vertical diameter. Eye without free orbit; covered with skin confluent with dorsal surface of head. Anterior and posterior nares with prominent tubular rims; nares separate but relatively close to each other. Posterior nare located about midway between eye and tip of snout.

Dorsal-fin origin at point over tip of pectoral fin. Dorsal fin with *i*,6 (32) rays, and fin margin straight. Pectoral fin with *i*,8 (1), *i*,9 (7), or *i*,10* (18) rays; unbranched ray greatly thickened. Pectoral fin with four or five innermost rays progressively shorter making posterior fin margin rounded. Pelvic fin inserted posteriorly to dorsal-fin base.

Pelvic fin with i,5 (32) rays with first ray unbranched and greatly thickened. Pelvic fin with straight posterior margin.

Adipose-fin base longer than anal-fin base; origin anterior to origin of anal-fin base; fin extending past anal-fin insertion. Margin strongly convex with sharply rounded edge, not deeply incised posteriorly. Caudal fin emarginate, with i,6,7,i (1) or i,7,8,i* (31) principal rays. Anal fin with short base; origin posterior to origin of adipose-fin base; fin with ii,6 (15), ii,7 (7), iii,5* (3), or iii,6 (7) rays. Anal-fin margin almost straight.

Coloration

Dorsal and lateral surfaces of head and body light brown/yellow, usually with black blotches or spots. Ventral region light brown. Light dorsal saddles at origin and insertion of dorsal fin and adipose fin. Dorsal, adipose, caudal, and anal fins light brown/yellow. Pectoral and pelvic fins positioned horizontally with upper surfaces light brown/yellow and lower surfaces light yellow. Maxillary and mandibular barbels brown. Caudal fin with dark crescent-shaped band at base and broad diffuse band on rays. Juvenile coloration similar to that of adult but usually with larger black blotches on body and may appear mottled.

Distribution

Known only from the Buzi River and Pungue River basins, Mozambique (Figure 4-6).

***Anoplopterus cubangoensis* (Pellegrin, 1936) (Figure 4-8; Table 4-7)**

Amphilius platyichir var. *cubangoensis*, Pellegrin 1936: 56, Original description, Type locality: Cubango [Okavango] River, near Vila da Ponte, Angola [MHNG 856.86, MNHN 1936-0101 to 0103, MRAC 138769, NMBA 5213]; Harry, 1953 (in part): 186, in synonymy of *A. platyichir*; Weber, 1998: 9, type information.

Amphilius platyichir (non Günther): Jubb & Gaigher, 1973: 10, 18, 20, listed as occurring in the Okavango drainage complex, Botswana; Balon, 1974: 653, listed from edge of Victoria Falls [ROM 31814, ROM 31873].

Amphilius platyichir cubangoensis Bell-Cross & Jubb, 1973: 1, in synonymy of *A. platyichir*; Mahnert, 1976: 472, type information.

Amphilius uranoscopus (non Pfeffer): Skelton, 1984: 67 (in part), type information, Okavango basin and upper Zambezi River basin; Van der Waal & Skelton, 1984: 316, Listed as present in Zambezi River at Caprivi, Namibia; Skelton, 1985: 9 (in part), Okavango basin; Skelton, 1994: 129 (in part); Okavango, upper Zambezi, and middle basins.

Material examined

Okavango River basin: MNHN 1936-0101, Angola, Cubango [Okavango] River, near Vila da Ponte [Vila arthur de Pavia], Angola, ca. 14°27'S, 16°18'E (1: 74.1, syntype); MNHN 1936-0103, same data as MNHN 1936-0101, (3: 60.6-90.9, syntypes); MRAC 138769, same data as MNHN 1936-0101, (1: 75.5, syntype); SAIAB 22055, Namibia, Okavango River at Popa Rapids (or Falls), near Bagani, ca. 18°06'S, 21°36'E (8: 38.7-82.7); SAIAB 22090, same locality as SAIAB 22055, (3: 39.0-76.5); SAIAB 27387, Namibia, Okavango River at Kahenge, ca. 17°40'S, 18°40'E (3: 31.-63.3); SAIAB 36842, same locality as SAIAB 22055, (1: 35.0); SAIAB 39055, same locality as SAIAB 22055, (1: 68.5); SAIAB 40755, Namibia, Okavango River at Mabushe, ca. 17°55'S, 20°25'E (1: 15.7); SAIAB 42970, Namibia, Okavango River at Popa, ca. 18°07'S, 21°36'E (2: 19.8-22.9); SAIAB 43421, same locality as SAIAB 22055, (6: 38.9-82.5mm SL); SAIAB 55056, same locality as SAIAB 22055, (7: 43.4-107.3); SAIAB 56944, Namibia, Okavango River at Mashare, ca. 17°53'S, 20°13'E (2: 63.5-67.0); SAIAB 70395, same locality as SAIAB 22055, (1: 73.5); SAIAB 96484, Namibia, Okavango River at Popa Rapids (or Falls), west side near camp site, 18°07'03"S, 21°34'57"E (9: 45.9-102.1); SAIAB 96500, Namibia, Okavango River at Popa Rapids (or

Falls), side channel in campsite, 18°07'19"S, 21°34'59"E (8: 42.9-71.1). **Lower Zambezi River basin:** SAIAB 40163, Zimbabwe, Sohwe Falls, near Muzarabani, ca. 16°29'S, 31°01'E (4: 38.1-88.4); SAIAB 83586, Zambia, Kundalila River, above falls, ca. 13°09'12"S, 30°42'36"E (19: 26.2-84.7). **Middle Zambezi River basin:** ROM 31617, Zambia, Sichikwenkwe Stream at Kalomo, ca. 17°03'S, 26°30'E (2: 32.5-92.2); ROM 31651, Zambia, Kalomo River, (1: 86.6). **Upper Zambezi River basin:** ROM 31814, Zambia, Victoria Falls Edge, ca. 17°55'25"S, 25°55'21"E (22: 52.3-104.8); ROM 31873, same locality as ROM 31814, (19: 30.34-138.7); SAIAB 24214, Namibia, Kwando (Cuando) River at Safari Camp, ca. 18°12'S, 23°23'E (1: 64.4); SAIAB 27723, Zambia, Near Kalengwa, Zambia, Musondweji River system, ca. 13°28'S, 25°00'E (1: 67.5); SAIAB 27725, same locality as SAIAB 27723, (3: 49.4-54.6); SAIAB 27729, Zambia, Musondweji River, ca. 13°30'S, 25°10'E (2: 41.9-65.0); SAIAB 40099, same locality as SAIAB 27729, (6: 69.4.7); SAIAB 41046, Zambia, Lumwana River, off Solwezi-Mwinilunga Road, ca. 12°16'S, 25°40'E (1: 66.0); SAIAB 41207, Zambia, Lumwana River at East Lumwana confluence between Mwinilunga-Solwezi, ca. 12°15'S, 25°40'E (1: 70.2); SAIAB 42892, Zambia, Sakeji River at Sakeji School, Ikelengi, ca. 11°14'S, 24°16'E (9: 29.8-57.7); SAIAB 42900, Zambia, 10kms from Zambezi River source, ca. 11°14'S, 24°21'E (2: 37.1-49.0); SAIAB 42901, same locality as SAIAB 42892, (11: 35.9-71.6); SAIAB 42907, Zambia, Kabompo River, Solwezi-Mwinilinge road bridge, 11°53'17"S, 25°15'02"E (6: 33.8-69.0); SAIAB 71035, Zambia, Kabompo River near Kabompo, 13°36'49"S, 24°12'20"E (6: 31.8-120.2); SAIAB 71080, Zambia, Upper Zambezi River near town of Sioma, near junction of Route M10 and Route RD323, 16°39'29"S, 23°34'19"E (22: 23.2-136.0); SAIAB 71116, Zimbabwe, Upper Zambezi

River near Sankaia, just west of Livingstone, about 15 km upstream of Victoria Falls, 17°15'21"S, 25°46'20"E (19: 29.6-89.8); SAIAB 71131, Zimbabwe, Upper Zambezi River near Sankaia, just west of Livingstone, about 14 km upstream of Victoria Falls, 17°51'51"S, 25°46'50"E (3: 40.2-54.6); SAIAB 72566, Zambia, Upper Zambezi River just north of junction of route RD324 with route M10, near town of Ilwendo [=Iluando], 17°12'00"S, 24°04'00"E (3: 42.2-76.8); SAIAB 72661, Zambia, Sioma Falls on the Upper Zambezi River, near town of Sioma, near junction of Route M10 and Route RD323, 16°39'27"S, 23°34'20"E (32: 39.0-100.0); SAIAB 73317, Zambia, Maheba River on Solwezi-Mwinilinge road bridge (route T5), 12°20'36"S, 25°44'28"E (4: 44.3-103.2); SAIAB 73342, Zambia, East Lumwana River, 12°16'37"S, 25°39'57"E (2: 59.3); SAIAB 73365, Zambia, Upper Zambezi River, north of Kalene Hill, 11°07'32"S, 24°11'29"E (18: 44.8-107.8); SAIAB 73374, Zambia, Upper Zambezi River, below Upper Zambezi bridge, 11°08'09"S, 24°07'45"E (13: 43.0-87.4); SAIAB 73386, Zambia, Luakela River at Rte T5 crossing near Ikatu north of Mwinilunga, 11°31'37"S, 24°24'33"E (45: 38.2-93.0); SAIAB 73402, Zambia, East Lumwana near at Rte T5 crossing, 12°16'39"S, 25°39'59"E (21: 37.7-95.0); SAIAB 73424, Zambia, Mwombezhi River, 12°14'35"S, 25°34'26"E (37: 39.7-114.3); SAIAB 73476, same locality as SAIAB 42907, (71: 26.4-88.3); SAIAB 73501, Zambia, Kaseka River at Mwinilunga-Ikelenge road (route T5) crossing about 40 km north of Mwinilunga, 11°25'48"S, 24°20'09"E (2: 71.6-71.8); SAIAB 73511, Zambia, Lwina River, near Ikelenge, 11°14'01"S, 24°15'00"E (66: 37.2-96.2); SAIAB 73521, Zambia, Upper Zambezi River, above upper Zambezi bridge, 11°08'09"S, 24°07'45"E (19: 39.0-105.0); SAIAB 73554, Zambia, Madamyana River near junction with West Lunga River, just south of Mwinilunga, 11°45'17"S, 24°26'13"E (16: 42.9-117.8); SAIAB

73574, Zambia, Kanyanda River, on road from Mwinilunga to Kabompo (route D286), about 33 km south of Mwinilunga, 11°59'43"S, 24°21'04"E (10: 27.9-120.1); SAIAB 73585, Zambia, Ramukonye River, on road from Mwinilunga to Kabompo (route D286), about 35 km south of Mwinilunga, 12°00'26"S, 24°20'33"E (6: 67.5-96.8); SAIAB 73645, Zambia, Makondu River on road from Zambezi to Chavuma (route D293), about 21 km north of Zambezi, 13°22'22"S, 23°04'32"E (3: 54.1-83.1); SAIAB 73674, Zambia, Zambezi River near Katombora, at Zambezi-Zimbabwe border, 17°50'59"S, 25°22'24"E (24: 36.0-107.0); SAIAB 80446, Zambia, East Lumwana River downstream of Malundwe, 12°14'19"S, 25°47'41"E (10: 40.7-68.0); SAIAB 80468, Zambia, Malundwe tributary, causeway across river, East Lumwana River tributary, 12°11'17"S, 25°48'35"E (12: 37.2-78.8); SAIAB 80487, Zambia, Malundwe tributary, Causeway across Malundwe, East Lumwana River tributary, 12°10'39"S, 25°49'37"E (8: 41.8-72.0); SAIAB 80511, Zambia, Kabompo River, Solwezi-Mwinilinge road bridge, 11°53'17"S, 25°15'02"E (6: 35.2-68.3); SAIAB 80539, Zambia, East Lumwana River at Rte T5 crossing between Chisasa and Chibombe, 12°16'25"S, 25°39'59"E (11: 31.0-92.0); SAIAB 80555, Zambia, Malundwe tributary, above East Lumwana confluence, 12°13'59"S, 25°48'02"E (9: 44.1-96.2); SAIAB 80564, Zambia, Chimiwungo tributary, bridge on mine site, East Lumwana River system, 12°15'06"S, 25°39'59"E (6: 68.5-105.5); SAIAB 80577, Zambia, Maheba River on Solwezi-Mwinilinge road bridge (route T5), 12°20'36"S, 25°54'28"E (3: 43.0-80.3); SAIAB 95870, Zambia, 12°15'40"S, 25°17'35"E (3: 42.9-136.4).

Diagnosis

Diagnostic characters are summarized in Tables 4-2 and 4-3. *Anoplopterus cubangoensis* is diagnosed from *A. n. sp. Ruvu*, *A. n. sp. Mangula*, and *A. krefftii* by

having a forked caudal fin (vs. emarginated caudal fin) and from *A. uranoscopus*, *A. leroyi*, *A. hargerii*, *A. brevidorsalis*, *A. n. sp. Mangula*, *A. n. sp. Ruvu*, *A. grandis*, *A. krefftii*, *A. chalei* and *A. athiensis* by having a mottled coloration in adults (vs. body not mottled in adults). It is diagnosed from *A. uranoscopus*, *A. leroyi*, *A. hargerii*, *A. n. sp. Mangula*, and *A. athiensis* by having a narrower interorbital width (19.8-23.9% HL vs. 23.5-31.7% HL). *Anoplopterus cubangoensis* is diagnosed from *A. n. sp. Ruvu* and *A. krefftii* by having a longer body with 37 to 38 total vertebrae (vs. usually 36 or less). It is diagnosed from *A. hargerii* and *A. n. sp. Ruvu* by its first dorsal pterygiophore intercept count (1 vs. usually 2) and from *A. athiensis* and *A. grandis* by having distinct pale patches at origin and insertion of dorsal fin (vs. pale patches absent). *Anoplopterus cubangoensis* is further diagnosed from *A. n. sp. Mangula* and *A. chalei* by having a longer predorsal length (36.0-38.5% SL vs. 31.6-34.9% SL) and from *A. uranoscopus*, *A. leroyi*, *A. hargerii*, and *A. n. sp. Ruvu* by having a shallower body (body depth at anus 10.2-12.2% SL vs. 12.5-16.3% SL). It is further diagnosed from *A. uranoscopus*, *A. leroyi*, *A. brevidorsalis* and *A. hargerii* by having a longer caudal-peduncle length (17.7-21.7% SL vs. 14.4-17.9% SL) and from *A. uranoscopus*, *A. brevidorsalis* and *A. hargerii* by having a shallower caudal peduncle (8.1-10.9 vs. 10.7-14.3% SL). *Anoplopterus cubangoensis* is further diagnosed from *A. brevidorsalis* and *A. n. sp. Ruvu* by usually having 9 or 10 gill rakers on the first arch (vs. usually 6 to 8, rarely 9). It is further diagnosed from *A. n. sp. Ruvu* by having longer maxillary barbels (51.4-78.4% HL vs. 37.3-49.6% HL).

Description

Morphometric data in Table 4-7. Body elongate, ventral profile flattened ventrally to anal-fin base, then tapered dorsally to end of caudal peduncle. Dorsal profile rising

gently from tip of snout to origin of dorsal fin, then nearly horizontal to end of caudal peduncle. Greatest body depth at dorsal-fin origin. Caudal peduncle laterally compressed. Anus and urogenital openings located just posterior to base of pelvic fin, closer to insertion of pelvic fin than to origin of anal fin. Skin smooth. Lateral line complete, extending from dorsal edge of opercular cavity to base of caudal fin. Total vertebrae 37 (4) or 38 (5). Abdominal vertebrae 20 (2), 21 (3), or 22 (3). Caudal vertebrae 16 (2), 17 (4), or 18 (2). First dorsal pterygiophore intercept count 1 (9).

Head and anterior part of body depressed and broad. Head wedge-shaped in lateral view. Snout broad, moderately pointed when viewed from above. Head becoming wider from tip of snout to pectoral-fin base. Branchiostegal membranes moderately joined at isthmus forming a V-shaped or deeply concave connection.

Mouth broad, gently curved, subterminal. Lips moderately fleshy, papillate. Rictal lobe large and papillate. Anterior portion of premaxillary tooth band exposed with mouth closed. Premaxillary tooth patches joined, forming U-shaped band, with short conical teeth. Dentary teeth short and conical, tooth patches forming U-shaped band, separated medially.

Three pairs of simple, tapered circumoral barbels. Maxillary barbel large, fleshy and flattened with pointed tip; barbel extending posterolaterally from corner of mouth to just short of pectoral-fin base. Outer mandibular barbel thin with pointed tip, origin at posterior corner of lower jaw, extending to edge of branchiostegal membrane. Inner mandibular barbel originates anterolaterally of inner mandibular barbel, extending to edge of branchiostegal membrane. Branchiostegal membrane with 6 (2), 7 (37), 8 (28), or 9 (1) rays. Gill rakers on first epibranchial 2 (14), 3 (83) or 4 (2); rakers on first

ceratobranchial 5 (7), 6 (49), 7 (37) or 8 (6); total gill rakers on first arch 7 (1), 8 (8), 9 (57), 10 (26), or 11 (7).

Eyes small, positioned dorsolaterally approximately midway between tip of snout and posterior margin of operculum. Horizontal diameter of eye slightly wider than vertical diameter. Eye without free orbit; covered with skin confluent with dorsal surface of head. Anterior and posterior nares with prominent tubular rims; nares separate but relatively close to each other. Posterior nare located about midway between eye and tip of snout.

Dorsal-fin origin at point over tip of pectoral fin. Dorsal fin with i,6 (108) rays, and fin margin straight. Pectoral fin with i,8 (1), i,9 (52), or i,10 (51) rays; unbranched ray greatly thickened. Pectoral fin with four or five innermost rays progressively shorter making posterior fin margin rounded. Pelvic fin inserted posteriorly to dorsal-fin base. Pelvic fin with i,5 (108) rays with first ray unbranched and greatly thickened. Pelvic fin with straight posterior margin.

Adipose-fin base longer than anal-fin base; origin anterior to origin of anal-fin base; fin extending past anal-fin insertion. Margin strongly convex with sharply rounded edge, not deeply incised posteriorly. Caudal fin emarginate, with i,7,8,i (99) principal rays. Anal fin with short base; origin posterior to origin of adipose-fin base; fin with ii,5 (32), ii,6 (61), iii,5 (11), or iii,6 (1) rays. Anal-fin margin almost straight.

Coloration

Dorsal and lateral surfaces of head and body mottled black with light brown/cream patches. Body head, and fins sometimes heavily spotted. Ventral region light brown. Light dorsal saddles at origin and insertion of dorsal fin and adipose fin. Dorsal, adipose, caudal, and anal fins brown. Pectoral and pelvic fins positioned

horizontally with upper surfaces brown and lower surfaces light yellow. Maxillary and mandibular barbels brown. Caudal fin with dark crescent-shaped band at base and broad diffuse band on rays. Juvenile coloration similar to that of adult.

Distribution

Known from the Okavango River and Zambezi River basins in Zambia, Zimbabwe, Namibia, and Angola (Figure 4-6).

***Anoplopterus* n. sp. *Mangula* new species (Figure 4-9; Table 4-8)**

Holotype.—UF 170702, Tanzania, Sonjo River at bridge in Man'gula on road from Mikumi to Ifakara, altitude 302 m, Kilombero River drainage, Rufiji River basin, 7°48'29.6"S, 36°53'47.6"E (1: 95.6).

Paratypes.—CU 93746, same data as holotype (9: 32.5-97.2); UF 18943, same data as holotype, (8: 32.5-124.2).

Non-types

Rufiji River basin, Kilombero River drainage: AMNH 215941, Tanzania, Udzungwa mountains national park, Njokamoni River system, ca. 7°51'S, 36°53'E (3: 15.1-41.7); same locality as AMNH 215941, (11: 40.0-64.6); **Rufiji River basin, Great Ruaha River drainage:** CU 93743, Tanzania, Lukosi River along road from Iringa to Morogoro (Rte A7), altitude 721 m, 7°40'08.5"S, 36°13'50.3"E (3: 46.4-54.5); SAIAB 59413, Tanzania, Iyovi River on road from Mikumi to Mbuyuni (Rte A7 crossing) above Kidatu Dam, ca. 7°34'S, 36°47'E (2: 25.5-62.8); SAIAB 59431, Tanzania, Lukosi River along road from Iringa to Morogoro (Rte A7) just ENE of Matassi, ca. 7°34'S, 36°47'E (2: 69.9-70.4); UF 184936, same data as CU 93743, (2: 47.6-59.1).

Diagnosis

Diagnostic characters are summarized in Tables 4-2 and 4-3. *Anoplopterus* n. sp. *Mangula* is diagnosed from *A. uranoscopus*, *A. leroyi*, *A. brevidorsalis*, *A. hargerii*, *A.*

cubangoensis, *A. grandis*, *A. chalei*, and *A. athiensis* by having a emarginate caudal fin (vs. forked caudal fin) and from *A. n. sp. Ruvu*, *A. athiensis*, and *A. cubangoensis* by having a body color that is not finely spotted or mottled (vs. body finely spotted in *A. n. sp. Ruvu* and *A. athiensis*, and mottled in *A. cubangoensis*). It is diagnosed from *A. cubangoensis* and *A. chalei* by having a wider interorbital width (24.3-27.2% HL vs. 17.9-24.2% HL). *Anoplopterus n. sp. Mangula* is diagnosed from *Amphilius uranoscopus*, *A. chalei*, and *A. athiensis* by having a shorter body with 36 to 37 vertebrae (vs. usually 38 or more vertebrae). It is diagnosed from *A. hageri* and *A. n. sp. Ruvu* by its first dorsal pterygiophore intercept count (1 vs. usually 2) and from *A. athiensis* and *A. grandis* by having distinct pale patches at origin and insertion of dorsal fin (vs. pale patches absent). *Anoplopterus n. sp. Mangula* is diagnosed from *A. uranoscopus*, *A. leroyi*, *A. brevidorsalis*, *A. hageri*, *A. cubangoensis*, *A. n. sp. Ruvu* and *A. athiensis* by having a shorter predorsal length (31.6-34.9% SL vs. 35.0-39.9% SL), from *A. chalei* by having a deeper body (body depth at anus 11.6-13.1% SL vs. 8.9-10.8% SL), and *A. leroyi* and *A. hageri* by having a shallower body (body depth at anus 11.6-13.1% SL vs. 13.0-16.0% SL). It is further diagnosed from *A. uranoscopus*, *A. leroyi*, *A. brevidorsalis*, *A. hageri*, *A. n. sp. Ruvu* and *A. athiensis* by having a longer caudal-peduncle length (18.2-20.3% SL vs. 14.4-18.3% SL) and from and *A. chalei* by having a deeper caudal peduncle (9.9-12.4 vs. 7.1-9.7% SL). *Anoplopterus n. sp. Ruvu* is further diagnosed from *A. n. sp. Ruvu* by usually having 8 or 9 gill rakers on the first arch (vs. usually 6 to 7, rarely 8) and by usually having 6 branched anal-fin rays (vs. usually 5, rarely 6). It is further diagnosed from *A. n. sp. Ruvu* by having longer maxillary barbels (71.4-92.6% HL vs. 37.3-49.6% HL).

Description

Morphometric data in Table 4-8. Body elongate, ventral profile flattened ventrally to anal-fin base, then tapered dorsally to end of caudal peduncle. Dorsal profile rising gently from tip of snout to origin of dorsal fin, then nearly horizontal to end of caudal peduncle. Greatest body depth at dorsal-fin origin. Caudal peduncle laterally compressed. Anus and urogenital openings located just posterior to base of pelvic fin, closer to insertion of pelvic fin than to origin of anal fin. Skin smooth. Lateral line complete, extending from dorsal edge of opercular cavity to base of caudal fin. Total vertebrae 36 (4) or 37* (7). Abdominal vertebrae 19* (2), 20 (7), or 21 (1). Caudal vertebrae 16 (4), 17 (5), or 18* (1). First dorsal pterygiophore intercept count 1* (11).

Head and anterior part of body depressed and broad. Head wedge-shaped in lateral view. Snout broad, moderately pointed when viewed from above. Head becoming wider from tip of snout to pectoral-fin base. Branchiostegal membranes moderately joined at isthmus forming a V-shaped or deeply concave connection.

Mouth broad, gently curved, subterminal. Lips moderately fleshy, papillate. Rictal lobe large and papillate. Anterior portion of premaxillary tooth band exposed with mouth closed. Premaxillary tooth patches joined, forming U-shaped band, with short conical teeth. Dentary teeth short and conical, tooth patches forming U-shaped band, separated medially.

Three pairs of simple, tapered circumoral barbels. Maxillary barbel large, fleshy and flattened with pointed tip; barbel extending posterolaterally from corner of mouth to just short of pectoral-fin base. Outer mandibular barbel thin with pointed tip, origin at posterior corner of lower jaw, extending to edge of branchiostegal membrane. Inner mandibular barbel originates anterolaterally of inner mandibular barbel, extending to

edge of branchiostegal membrane. Branchiostegal membrane with 8* (17) or 9 (6) rays. Gill rakers on first epibranchial 2 (1) or 3 (22); rakers on first ceratobranchial 4 (3), 5 (12), or 6* (8); total gill rakers on first arch 7 (4), 8 (11), or 9* (8).

Eyes small, positioned dorsolaterally approximately midway between tip of snout and posterior margin of operculum. Horizontal diameter of eye slightly wider than vertical diameter. Eye without free orbit; covered with skin confluent with dorsal surface of head. Anterior and posterior nares with prominent tubular rims; nares separate but relatively close to each other. Posterior nare located about midway between eye and tip of snout.

Dorsal-fin origin at point over tip of pectoral fin. Dorsal fin with i,6* (22) or i,7 (1) rays, and fin margin straight. Pectoral fin with i,9 (6) or i,10* (17) rays; unbranched ray greatly thickened. Pectoral fin with four or five innermost rays progressively shorter making posterior fin margin rounded. Pelvic fin inserted posteriorly to dorsal-fin base. Pelvic fin with i,5 (23) rays with first ray unbranched and greatly thickened. Pelvic fin with straight posterior margin.

Adipose-fin base longer than anal-fin base; origin anterior to origin of anal-fin base; fin extending past anal-fin insertion. Margin strongly convex with sharply rounded edge, not deeply incised posteriorly. Caudal fin emarginate, with i,7,8,i (22) principal rays. Anal fin with short base; origin posterior to origin of adipose-fin base; fin with ii,5 (2), ii,6* (20), or iii,6 (1) rays. Anal-fin margin almost straight.

Coloration

Dorsal and lateral surfaces of head and body brown. Ventral region light brown. Light dorsal saddles at origin and insertion of dorsal fin and adipose fin. Dorsal, adipose, caudal, and anal fins brown. Pectoral and pelvic fins positioned horizontally

with upper surfaces brown and lower surfaces light yellow. Maxillary and mandibular barbels brown. Caudal fin with dark crescent-shaped band at base and broad diffuse band on rays. Juvenile coloration similar to that of adult.

Distribution

Known only from the Rufiji River basin, Tanzania (Figure 4-3).

***Anoplopterus* n. sp. Ruvu new species (Figure 4-10; Table 4-9)**

Holotype.—UF 170727, Tanzania, Mgeta River at Mgeta Secondary School, altitude 1001 m, 7°02'16.5"S, 37°34'09.8"E (1: 75.6).

Paratypes.—CU 97551, same data as holotype (15: 47.0-80.5); UF 184938, same data as holotype (13: 44.1-80.6).

Diagnosis

Diagnostic characters are summarized in Tables 4-2 and 4-3. *Anoplopterus* n. sp. Ruvu is diagnosed from *A. uranoscopus*, *A. leroyi*, *A. brevidorsalis*, *A. cubangoensis*, *A. n. sp. Mangula*, *A. krefftii*, *A. chalei*, and *A. athiensis* by its first dorsal pterygiophore intercept count (usually 2 vs. usually 1) and from *A. uranoscopus*, *A. leroyi*, *A. brevidorsalis*, *A. cubangoensis*, *A. grandis*, *A. chalei* and *A. athiensis* by having a shorter body with usually 35 to 36 total vertebrae (vs. usually 37 or more). *Anoplopterus* n. sp. Ruvu is diagnosed from *A. uranoscopus*, *A. leroyi*, *A. brevidorsalis*, *A. hageri*, *A. cubangoensis*, *A. grandis*, *A. chalei*, and *A. athiensis* by having a emarginate caudal fin (vs. forked caudal fin) and from all other species of the *Anoplopterus* by having a heavily spotted coloration with spots usually coalesced to form vermiculations (vs. body not finely spotted or if spotted, spots never coalesced to form vermiculations). It is diagnosed from *A. uranoscopus*, *A. leroyi*, and *A. hageri* by having a narrower interorbital width (20.7-24.9% HL vs. 25.2-31.7% HL) and *A. grandis* by having distinct pale patches at origin and insertion of dorsal fin (vs. pale patches absent). *Anoplopterus*

n. sp. Ruvu is further diagnosed from *A. n. sp. Mangula* and *A. chalei* by having a longer predorsal length (36.1-39.9% SL vs. 31.6-34.9% SL) and from *A. cubangoensis* and *A. chalei* by having a deeper body (body depth at anus 12.8-15.7% SL vs. 8.9-12.2% SL). It is further diagnosed from *A. n. sp. Mangula* and *A. chalei* by having a shorter caudal-peduncle length (16.0-18.2% SL vs. 18.2-21.9% SL) and from *A. chalei* by having a deeper caudal peduncle (10.3-12.3 vs. 7.9-9.7% SL). *Anoplopterus* n. sp. Ruvu is further diagnosed from *A. uranoscopus*, *A. leroyi*, *A. hargerii*, *A. cubangoensis*, *A. n. sp. Mangula*, *A. krefftii*, *A. grandis*, and *A. athiensis* by usually having 6 or 7 gill rakers on the first arch (vs. usually 8 or more) and from *A. uranoscopus*, *A. leroyi*, *A. brevidorsallis*, *A. hargerii*, *A. n. sp. Mangula*, and *A. grandis* by usually having 5 branched anal-fin rays (vs. usually 6 or 7). It is further diagnosed from all other species of the *A. uranoscopus*, *A. leroyi*, *A. hargerii*, *A. brevidorsallis*, *A. cubangoensis*, *A. n. sp. Mangula*, *A. grandis*, *A. chalei*, and *A. athiensis* by having shorter maxillary barbels (37.3-49.6% HL vs. 49.7-99.1% HL).

Description

Morphometric data in Table 4-9. Body elongate, ventral profile flattened ventrally to anal-fin base, then tapered dorsally to end of caudal peduncle. Dorsal profile rising gently from tip of snout to origin of dorsal fin, then nearly horizontal to end of caudal peduncle. Greatest body depth at dorsal-fin origin. Caudal peduncle laterally compressed. Anus and urogenital openings located just posterior to base of pelvic fin, closer to insertion of pelvic fin than to origin of anal fin. Skin smooth. Lateral line complete, extending from dorsal edge of opercular cavity to base of caudal fin. Total vertebrae 35* (9), 36 (4), or 37 (1). Abdominal vertebrae 20* (9), or 21 (5). Caudal

vertebrae 14 (1), 15* (11), or 16 (2). First dorsal pterygiophore intercept count 1* (2) or 2 (11).

Head and anterior part of body depressed and broad. Head wedge-shaped in lateral view. Snout broad, moderately pointed when viewed from above. Head becoming wider from tip of snout to pectoral-fin base. Branchiostegal membranes moderately joined at isthmus forming a V-shaped or deeply concave connection.

Mouth broad, gently curved, subterminal. Lips moderately fleshy, papillate. Rictal lobe large and papillate. Anterior portion of premaxillary tooth band exposed with mouth closed. Premaxillary tooth patches joined, forming U-shaped band, with short conical teeth. Dentary teeth short and conical, tooth patches forming U-shaped band, separated medially.

Three pairs of simple, tapered circumoral barbels. Maxillary barbel large, fleshy and flattened with pointed tip; barbel extending posterolaterally from corner of mouth to just short of pectoral-fin base. Outer mandibular barbel thin with pointed tip, origin at posterior corner of lower jaw, extending to edge of branchiostegal membrane. Inner mandibular barbel originates anterolaterally of inner mandibular barbel, extending to edge of branchiostegal membrane. Branchiostegal membrane with 8 (28) rays. Gill rakers on first epibranchial 2* (24) or 3 (5); rakers on first ceratobranchial 4* (14) or 5 (15); total gill rakers on first arch 6* (11), 7 (16), or 8 (2).

Eyes small, positioned dorsolaterally approximately midway between tip of snout and posterior margin of operculum. Horizontal diameter of eye slightly wider than vertical diameter. Eye without free orbit; covered with skin confluent with dorsal surface of head. Anterior and posterior nares with prominent tubular rims; nares separate but

relatively close to each other. Posterior nare located about midway between eye and tip of snout.

Dorsal-fin origin at point over tip of pectoral fin. Dorsal fin with i,6 (29) rays, and fin margin straight. Pectoral fin with i,9* (28) or i,10 (1) rays; unbranched ray greatly thickened. Pectoral fin with four or five innermost rays progressively shorter making posterior fin margin rounded. Pelvic fin inserted posteriorly to dorsal-fin base. Pelvic fin with i,5 (29) rays with first ray unbranched and greatly thickened. Pelvic fin with straight posterior margin.

Adipose-fin base longer than anal-fin base; origin anterior to origin of anal-fin base; fin extending past anal-fin insertion. Margin strongly convex with sharply rounded edge, not deeply incised posteriorly. Caudal fin emarginate, with i,7,8,i* (29) principal rays. Anal fin with short base; origin posterior to origin of adipose-fin base; fin with ii,5* (27) or ii,6 (2) rays. Anal-fin margin almost straight.

Coloration

Dorsal and lateral surfaces of head and body heavily spotted, spots usually coalesced to form vermiculations. Ventral region light brown. Light dorsal saddles at origin and insertion of dorsal fin and adipose fin. Dorsal, adipose, caudal, and anal fins brown. Pectoral and pelvic fins positioned horizontally with upper surfaces brown and lower surfaces light yellow and with spots. Maxillary and mandibular barbels brown. Caudal fin with dark crescent-shaped band at base and broad diffuse band on rays. Juvenile coloration similar to that of adult but spots usually larger.

Distribution

Known from the Ruvu River basin, Tanzania (Figure 4-3).

Discussion

The present study examined over 1000 museum specimens of *Anoplopterus* from the Wami River basin south to the Buzi River basin and west to the upper Zambezi River and Okavango River basins in eastern and southern Africa. This study area included the type localities of *A. uranoscopus* (Wami basin), *A. leroyi* (Ruvu basin), *A. hargeri* (Zambezi basin), *A. brevidorsalis* (Buzi basin), and *A. cubangoensis* (Okavango basin) all of which were determined to be valid species based on differences in coloration, body shape, and meristic counts. Additionally, two new species, *A. n. sp.* Ruvu from the Ruvu River basin and *A. n. sp.* Mangula from the Rufiji basin, were described. This brings the total number of species of *Anoplopterus* to 17, eight of which occur in eastern Tanzania and southern Kenya.

Of the 17 species, four species (*A. cryptobullatus*, *A. lampei*, *A. kivuensis*, and *A. zairensis*) do not occur in southeastern Africa. *Anoplopterus cryptobullatus*, which is found in the upper Congo basin, is diagnosed from all other species of *Anoplopterus* by having extremely large bilateral bony swimbladder capsules (see Skelton, 1986 figure 16a) (vs. bilateral bony swimbladder capsules normally developed) and from all species recognized in this study by the combination of an emarginated caudal fin and mottled body coloration. *Anoplopterus lampei*, from Ethiopia, is diagnosed from all species described in this study by having an adipose fin confluent with the caudal fin. *Anoplopterus kivuensis*, known from the Nile and Congo basins is diagnosed by its posteriorly placed dorsal fin, and first dorsal pterygiophore intercept count usually 4 or more vs. usually 2 or less). *Anoplopterus zairensis*, found in the lower Congo basin, is diagnosed by its shorter body and 32–35 vs. 36–42 total vertebrae in all species except *A. n. sp.* Ruvu which has 35-37 total vertebrae. *Anoplopterus zairensis* is diagnosed

from *A. n. sp. Ruvu* by having no dark spots on the body (vs. heavily spotted with spots usually coalesced to form vermiculations).

Two species found in southeastern Africa were not compared in the diagnoses because they are morphologically distinct and easily distinguished from other species recognized in this study. *Anoplopterus laticaudatus* is found in the Buzi basin and is diagnosed from all other species by having an adipose fin confluent with the caudal fin. *Anoplopterus natalensis* occurs in the Buzi and lower Zambezi basins and is diagnosed by its posteriorly placed dorsal fin, first dorsal pterygiophore intercept count usually 4 or more vs. usually 2 or less.

This increase in the number of species of *Anoplopterus* from five recognized by Skelton (1984) to the current number is due almost entirely to the increased availability of specimens from eastern and southern Africa due to recent collecting. Of the seven new species described since Skelton's revision, six were described entirely from specimens collected after his study. Additionally, at the time of Skelton's study, the only specimens of *A. uranoscopus* available were the two type specimens and the only specimen of *A. leroyi* available was the holotype. *Anoplopterus uranoscopus* and *A. leroyi* are the two oldest names available for eastern African *Amphilius* and, until the identities of these two species could be determined, it was not possible to determine the validity of the other nominal species described from eastern Africa.

In the fall of 2007, 57 specimens of *A. uranoscopus* were collected from three localities in the Wami River basin including two localities very close the type locality. Additionally, 33 specimens of *A. leroyi* were collected from the Ruvu basin. These collections allowed for the first time the identities of *A. uranoscopus* and *A. leroyi* to be

determined and for the status of the other nominal species placed in the synonymy of *A. uranoscopus* to be revisited. The status of three of these nominal species, *A. grandis*, *A. oxyrhinus*, and *A. krefftii*, were addressed by Thomson & Page (2010), but they did not address the status of *A. leroyi*, *A. hargerii*, *A. brevidorsalis*, and *A. cubangoensis* which have been determined to be valid species in this study.

Anoplopterus uranoscopus occurs in the Wami River basin in eastern Tanzania where it is probably the only species of the *A. uranoscopus* group in the basin. It is also found to be present in the Rufiji River basin based on a single collection from 12 Bridges River. These specimens have subtle differences in coloration from specimens from the Wami River basin but don't differ in any meristic counts and are supported with molecular data to be most closely related to specimens from the Wami basin.

Anoplopterus leroyi occurs only in the Ruvu basin where *A. n. sp. Ruvu* also occurs. *Anoplopterus leroyi* was found at multiple sites in the Ruvu basin, but *A. n. sp. Ruvu* was found only at the highest elevation site collected in the basin. At the collection site of *A. n. sp. Ruvu*, a large series of specimens that were initially identified as *A. leroyi* were also collected. When examined more closely, these specimens were found to differ from *A. leroyi* and require further study. *Anoplopterus hargerii* occurs in the Shire River system of the Lower Zambezi River basin and the Rovuma River basin. It is the only species of *Anoplopterus* known from the Rovuma River basin, but is found with *A. natalensis* in the Shire River system. *Amphilius natalensis* is similar to *A. hargerii* externally but can be separated from this species by its more posteriorly placed dorsal fin (first dorsal pterygiophore intercept count usually 4 or more vs. usually 2 or less in *A. hargerii*).

Anoplopterus brevidorsalis occurs in the Buzi basin in Mozambique where *A. natalenis* and *A. laticaudatus* also occur, but can be separated from these species by having an adipose fin that is not confluent with the caudal fin (vs. adipose fin confluent with the caudal fin in *A. laticaudatus* and Buzi River populations of *A. natalenis*).

Anoplopterus cubangoensis is found throughout the upper Zambezi River basin and the Okavango River basin. It is also the species of *Anoplopterus* that occurs at the edge of Victoria Falls identified as *A. platyichir* by Balon (1974). *Anoplopterus cubangoensis* has also been collected from the middle Zambezi River basin in tributaries just below Victoria Falls. It is the only species of *Anoplopterus* that occurs in the middle and upper Zambezi River basins and the Okavango River basin.

Frequency tables were constructed for counts of four meristic characters (Tables 4-10 to 4-13). Total vertebrae count, first dorsal pterygiophore intercept count, total gill raker count, and branched anal-fin ray count were found to be useful for distinguishing species. Total vertebrae count varied from 35 to 40 in the specimens examined (Table 4-10). Five species are characterized by a low vertebral count, usually having fewer than 38 total vertebrae: *A. leroyi*, *A. hargerii*, *A. n. sp. Mangula*, *A. n. sp. Ruvu*, and *A. krefftii*. Three other species, *A. uranoscopus*, *A. chalei*, and *A. athiensis*, have high vertebral counts, usually having 38 or more total vertebrae. First dorsal pterygiophore intercept count varied from zero to three among species, but the count is very stable within species (Table 4-11). *Anoplopterus hargerii* and *A. n. sp. Ruvu* have a first dorsal pterygiophore intercept count that is almost always two. All other species except *A. grandis* have a dorsal pterygiophore intercept count that is almost always one. In *A. grandis*, the count is one or two.

Total gill raker count varied from six to 11 (Table 4-12). Counts were quite variable within species, but *A. brevidorsalis* and *A. n. sp.* Ruvu mostly had counts of eight or less while *A. uranoscopus*, *A. cubangoensis*, *A. chalei*, and *A. athiensis* mostly had counts of nine or more. Branched anal-fin ray count varied from five to seven, with most species having a mode of six (Table 4-13). *Anoplopterus n. sp.* Ruvu is the only species with a mode of five branched anal-fin rays.

Although this study greatly increases the number of species recognized in *Anoplopterus*, taxonomic work on the genus is far from complete. Within the study area, additional undescribed diversity likely exists in the tributaries of Lake Malawi. I was able to examine a few specimens from northern Malawi tributaries that appeared to be an undescribed species based on color pattern; however, additional material needs to be examined to confirm the number of species in the tributaries.

In the Rufiji River basin, *Anoplopterus n. sp.* Mangula was collected at three sites with a total of four heavily mottled specimens. The two mottled specimens that were collected together appear to be different species based on caudal fin shape. One of the specimens has a deeply forked caudal fin, while the other has an emarginated caudal fin. The other two mottled specimens have forked caudal fins, but the color patterns in all four specimens look very different from one another.

Outside the study area, study is needed of material from the Incomati, Maputo, Umbuluzi (Mbuluzi), and Limpopo River basins in South Africa and Swaziland. This material has been recognized as *A. uranoscopus* (Skelton, 2001), but is actually more similar to *A. brevidorsalis* and probably represents one or more undescribed species. Specimens from the Malagarasi River drainage, the Lake Rukwa basin, and southern

tributaries of Lake Tanganyika that have been identified as *A. uranoscopus* may also represent undescribed species. Several different species similar to *A. uranoscopus* appear to be present in the Malagarasi River drainage and multiple species also appear to be present in the southern tributaries of Lake Tanganyika.

Comparative Material Examined

Anoplopterus athiensis: **Galana River basin**: BMNH 1905.12.11.2, Kenya, Nairobi River, Kikaya, ca. 1°10'33"S, 36°56'24"E (1: 160.3, paratype); BMNH 1909.11.15.21-23, Nairobi River, elev. 2500 ft., ca. 1°10'33"S, 36°56'24"E (2: 89.1-119.5, paratypes); BMNH 1910.10.31.31, Nairobi, Kenya, ca. 1°16'28"S, 36°48'47"E (1: 150.0, holotype); BMNH 1928.11.10.11-12, Nairobi River, elev. 6500 ft., ca. 1°10'33"S, 36°56'24"E (3: 59.6-140.5, paratypes); BMNH 1928.11.10.13-18, Kenya, Riara River, elev. 5700 ft., ca. 1°8'49"S, 36°57'47"E (2: 37.6-87.2, paratypes); BMNH 1937.12.11.16-18, Kenya, Mbakasi River, ca. 1°18'10"S, 36°55'10"E (3: 58.1-110.3, paratypes); BMNH 1937.6.4.43, Kenya, Athi River, Fourteen Falls, ca. 1°7'40"S, 37°21'25"E (1: 44.0, paratype); BMNH 1969.3.24.61-62, Kenya, Ngong River, tributary of Nairobi River, ca. 1°18'25"S, 36°53'23"E (2: 123.6-146.9, paratypes); BMNH 1987.3.23.4, Kenya, Athi River, S. E. of Nairobi, ca. 1°26'32"S, 36°59'25"E (1: 36.0, paratype); CAS SU 24169, ex. BMNH 1928.11.10.13-18, (1: 87.1, paratype); MCZ 32518, ex. BMNH 1928.11.10.13-18, (1: 96.5, paratype); MRAC A7-25-P-1-2, ex. BMNH 1928.11.10.13-18, (2: 78.0-82.0, paratypes); SAIAB 87475, ex. BMNH 1909.11.15.21-23, (1: 106.0, paratype); UF 167873, ex. BMNH 1928.11.10.13-18, (2: 79.4-92.6, paratypes); USNM 72922, Kenya, Nairobi R., near Nairobi, ca. 1°10'33"S, 36°56'24"E (2: 113.4-159.4, paratypes).

Anoplopterus chalei: **Rufiji River basin**: CU 93744, Tanzania, Little Ruaha River at bridge in Ihembe on road from Iringa to Dabaga, altitude 1680 m, 7°54'41"S, 35°47'44"E (63: 32.2–108.5); UF 170728, same data as CU 93744, (63: 26.6–123.9).

Anoplopterus grandis: **Ewaso Ngiro River basin**: BMNH 1912.22.120, Kenya, Eusso Mara, a swift mountain stream, tributary of Eusso Nyiro [= Ewaso Ngiro], ca. 0°46'13"N, 37° 33'27"E (1: 166.0, holotype of *A. oxyrhinus*); BMNH 1908.9.17.13–18, Kenya, Nyiro-Narok; Niro-Narok system, elev. 4000-5000 ft., ca. 0°15'18"N, 36° 32'21"E (5: 93.4-181.4); BMNH 1912.3.22.119, Kenya, Eusso Nyiro [= Ewaso Ngiro], below falls, ca. 0°47'02"N, 38° 05'04"E (1: 113.6), SAIAB 87474, ex. BMNH 1908.9.17.13-18, (1: 135.3); UF 177478, ex. BMNH 1908.9.17.13-18, (1: 120.2). **Tana River basin**: BMNH 1904.12.23.50-52, Kenya, Chania River of Tetse, Kenya, elev. 7000 ft., ca. 1°01'26"N, 37° 04'07"E (2: 136.1–160.0, Syntypes); BMNH 1937.6.4.36–42, Kenya, Thika River, Ndula Falls, ca. 1°02'58"N, 37° 05'34"E (12: 32.1–65.9); BMNH 1965.12.7.125, Kenya, Rogati River, Sagana, ca. 0°39'53"N, 37° 12'07"E (1: 42.9); BMNH 1965.12.7.126-128, same locality (3: 60.9–89.7); BMNH 1965.12.7.129, same locality (1: 156.8); BMNH 1965.12.7.130–131, same locality (2: 74.9–98.7); BMNH 1965.12.7.132, same locality (1: 51.8); BMNH 1966.6.28.2-3, same locality (2: 65.9-102.6); BMNH 1966.8.25.18, same locality (1: 34.8); MRAC 74-48-P-12-13, Kenya, upper Tana, side creek, ca. 00°50'S, 37°15'E (2: 52.6-60.3). **Unknown river basin**: CAS SU 66020, Kenya, East Macania [Makania] River (1: 43.5).

Anoplopterus krefftii: **Galana River basin**: BMNH 1969.3.24.63-69, Kenya, Tsabo [Tasvo] River tributary of Athi [Galana] River, mountain Mbololo, ca. 3°14'50"S, 38° 27'45"E, (7: 43.6–99.5); BMNH 1969.3.24.70, Kenya, Voi River, Teita hills, Voi

District, 3°26'51"S, 38° 29'16"E (1: 106.6). **Lake Jipe basin:** BMNH 1966.6.28.1, Tanzania, Jipe River, ca. 3°43'45"S, 37° 45'06"E (1: 69.7). **Pangani River basin:** BMNH 1905.7.25.41-42, Kenya, Kibosho, Kilimandjaro, ca. 3° 15'S, 37° 19'E (2: 77.9–94.9); BMNH 1968.10.25.3, Tanzania, River Lume (upper reaches of Pangani River) at source, 5 miles east of Lake Chala, ca. 3°23'22"S, 37° 43'45"E (1: 106.6); BMNH 1968.10.25.8, Tanzania, River Lume (upper reaches of Pangani River) east of Taveta, ca. 3°23'22"S, 37° 43'45"E (1: 67.2); BMNH 1969.1.15.1, Tanzania, From a stream at Arusha in the foothills of Mount Meru, ca. 3°17'23"S, 36° 45'37"E (1: 84.7); CU 93726, Tanzania, Una River directly below Kinukamori Falls near Marangu, altitude 1343 m, 3°16'39"S, 37° 31'10"E (5: 37.1–208.0); CU 93728, Tanzania, Kikuletwa River at below dam along road from Moshi to Samanga, altitude 757 m, 3°26'30"S, 37° 18'11"E (13: 30.1–80.3); CU 93729, Tanzania, Kikavu River at bridge on road from Moshi to Arusha, altitude 413 m, 3°19'08"S, 37° 13'05"E (5: 36.8–85.1); CU 93736, Tanzania, Mkuzi River directly below Soni Falls on road from Mombo to Loshoto, altitude 1428 m, 4°50'51"S, 38° 21'58"E (17: 37.3–118.3); CU 93737, Tanzania, Mkuzi River along road from Mombo to Loshoto, altitude 384 m, 4°52'04"S, 38° 20'52"E (34: 34.7–109.4); CU 93738, Tanzania, Pangani River at bridge in Hale on road from Muheza to Segera, altitude 226 m, 5°17'50"S, 38° 36'13"E (6: 34.9–60.7); FMNH 111684, Tanzania, West Usambara Mts., in river (stream) near Ambangulu Tea Estate factory, ca. 5°04'54"S, 38° 25'55"E (1: 29.0); MRAC 2010-08-P-3-5, ex. UF 170744, (3: 46.6-51.5); SAIAB 87473, ex. UF 170744, (3: 43.0-53.2); UF 170704, Tanzania, Pangani River along road from Same to Korogwe, altitude 350 m, 5°08'06"S, 38° 23'41"E (1:65.3); UF 170712, same data as CU 93738, (6: 32.4–72.2); UF 170719, same data as CU 93729, (5: 42.9–89.7); UF 170721,

same data as CU 93728, (12: 30.0–115.9); UF 170722, same data as CU 93736, (18: 40.5–139.3); UF 170724, same data as CU 93726, (7: 39.9–201.5); UF 170744, same data as CU 93737, (28: 33.4–123.9). **Sigi River basin:** BMNH 1909.10.19.26-27, Tanzania, Usambara, in rivulet running from Anani Hills to Sigi R., ca. 5° 0'S, 38° 48'E (2: 47.5–86.0, Syntypes); BMNH 1968.10.25.5-6, Tanzania, Kisiwani, near Amani, East Usambura mountains, elev. 1,475 ft., ca. 5°11'34"S, 38° 37'39"E (2: 36.2–43.1); BMNH 1968.10.25.7, Tanzania, River Sigi, east Usumbura Mountains, ca. 5° 0'S, 38° 48'E (1: 72.7); CAS 63737, Tanzania, Zigi [Sigi] R., Corn mill, in the Usambara Mountains, 10 km southeast (via the Amani-Muheza Road) of Amani, ca. 5°07'44"S, 38° 42'57"E (1: 47.8); CU 93735, Tanzania, Kihuhwi River at bridge on road from Muheza to Amani, altitude 225 m, 5°07'39"S, 38° 41'23"E (1: 63.0); FMNH 111678, Tanzania, East Usambara Mountains, 4.5 km ESE Amani, Monga Tea Estate, ca. 5° 05'S, 38° 36'E (1: 112.0); MCZ 51041, Tanzania, Amani, Usambara Mts., ca. 5° 05'S, 38° 36'E (1: 90.0); UF 170713, same data as CU 93735, (2: 70.3–73.0).

Table 4-1 Morphometric data for *Anoplopterus uranoscopus*.

	Range (n=51)	Mean±SD
%SL		
Head length	24.1-26.7	25.3±0.7
Head width	19.6-22.4	20.9±0.7
Head height	10.0-11.9	11.4±0.4
Body depth	11.7-16.4	13.5±1.1
Body depth at anus	12.7-16.3	14.2±0.6
Predorsal length	35.0-38.6	36.4±0.9
Prepectoral length	17.6-20.5	19.5±0.7
Preanal length	72.0-77.1	74.7±1.1
Dorsal-fin base length	8.3-13.6	10.7±1.1
Adipose-fin base length	23.4-28.9	25.9±1.4
Anal-fin base length	7.0-12.1	10.1±0.9
Pelvic-fin length	17.3-22.5	20.0±1.2
Pectoral-fin length	20.2-24.6	22.2±1.0
Anal-fin length	14.9-19.8	17.6±0.9
Caudal-peduncle length	15.1-17.9	16.6±0.8
Caudal-peduncle depth	10.9-14.3	11.9±0.8
Anus to anal fin length	9.2-13.8	11.7±1.2
Prepelvic length	48.2-54.1	51.6±1.3
Postpelvic length	47.2-52.8	49.2±1.3
Dorsal-fin insertion to adipose	42.3-49.5	46.3±1.9
Dorsal-fin origin to caudal	64.1-69.8	67.1±1.3
Preanus length	59.4-64.9	62.4±1.1
%HL		
Snout length	43.7-52.7	48.1±2.2
Interorbital distance	25.2-28.0	26.5±0.8
Maxillary barbel length	69.5-99.1	83.6±8.0
Inner mandibular barbel length	24.4-44.0	32.9±5.3
Outer mandibular barbel length	42.8-69.8	55.6±6.5
Eye diameter	10.2-17.5	13.8±1.6

Table 4-2 Meristic traits, caudal-fin shape, and coloration diagnostic for species of *Anoplopterus*.

Species	Gill rakers on first arch	Branched anal-fin rays	Total vertebrae	1st dorsal pterygiophore intercept count	Caudal-fin shape	Coloration
<i>Anoplopterus uranoscopus</i>	9-11, rarely 8	6 or 7, rarely 5	usually 38-39, rarely 40	1	Forked	Grey with diffuse stripe along side; distinct pale patches at origin and insertion of dorsal fin
<i>Anoplopterus leroyi</i>	8-10, rarely 7	6 or 7	usually 37, rarely 36	1, rarely 2	Forked	Brown/yellow with diffuse stripe along side; distinct pale patches at origin and insertion of dorsal fin
<i>Anoplopterus hargerii</i>	8 or 10, rarely 7 or 11	6, rarely 5 or 7	36-37	2, rarely 3	Forked	Brown; black spots/blotches usually present; distinct pale patches at origin and insertion of dorsal fin; juveniles with large black blotches and may appear mottled
<i>Anoplopterus brevidorsalis</i>	7 or 8, rarely 6 or 9	6 or 7, rarely 5	37-38	1	Forked	Brown/yellow; black spots/blotches usually present; distinct pale patches at origin and insertion of dorsal fin; juveniles with large black blotches and may appear mottled
<i>Anoplopterus n. sp. Mangula</i>	8 or 9, rarely 7	6, rarely 5	36-37	1	Emarginate	Grey/yellow; no dark marking on body; distinct pale patches at origin and insertion of dorsal fin

Table 4-2 Continued

Species	Gill rakers on first arch	Branched anal-fin rays	Total vertebrae	1st dorsal pterygiophore intercept count	Caudal-fin shape	Coloration
<i>Anoplopterus n. sp. Ruvu</i>	6 or 7, rarely 8	5, rarely 6	35-36, rarely 37	2, rarely 1	Emarginate	Heavily spotted, spots usually coalesced to form vermiculations; distinct pale patches at origin and insertion of dorsal fin
<i>Anoplopterus grandis</i>	8-10, rarely 6, 7 or 11	6	usually 37-39, rarely 40	1 or 2	Forked	Uniformly light brown or brown with large dark spots or blotches; no distinct pale patches at origin and insertion of dorsal fin
<i>Anoplopterus krefftii</i>	8-10, rarely 7 or 11	5 or 6, rarely 7	usually 36, rarely 37 or 38	1, rarely 2	Emarginate	Brown/yellow; black spots/blotches rarely present; distinct pale patches at origin and insertion of dorsal fin
<i>Anoplopterus chalei</i>	9-10, rarely 11	5 or 6	usually 38, rarely 39	1	Forked	Usually dark blotches alongside but may be uniformly brown; usually distinct pale patches at origin and insertion of dorsal fin
<i>Anoplopterus athiensis</i>	9 or 10, rarely 11	5 or 6, rarely 7	usually 38, rarely 39 or 40	1, rarely 2	Forked	Brown and finely spotted; no distinct pale patches at origin and insertion of dorsal fin

Table 4-3 Morphometric traits diagnostic for species of the *Anoplopterus*.

Species	Caudal-peduncle depth (% SL)	Caudal-peduncle length (% SL)	Interorbital width (% HL)	Head depth (% SL)	Predorsal length (% SL)	Body depth at anus (% SL)	Maxillary barbel length (% HL)
<i>Anoplopterus uranoscopus</i>	10.9-14.3	15.1-17.9	25.2-28.1	10.0-11.9	35.0-38.6	12.7-16.3	69.5-99.1
<i>Anoplopterus leroyi</i>	10.0-13.4	14.9-17.8	25.8-30.2	11.7-13.8	34.7-36.8	13.0-16.0	69.0-94.8
<i>Anoplopterus hargeri</i>	11.8-13.5	14.4-16.8	25.7-31.7	12.3-13.2	37.3-38.4	13.0-14.4	62.2-95.9
<i>Anoplopterus brevidorsalis</i>	10.7-13.7	16.4-17.3	22.2-25.3	11.3-13.9	35.9-38.9	12.5-14.0	64.9-86.0
<i>Anoplopterus cubangoensis</i>	8.1-10.9	17.7-21.7	19.8-23.9	10.0-13.3	36.0-38.5	10.2-12.2	51.4-78.4
<i>Anoplopterus</i> n. sp. Mangula	9.9-12.4	18.2-20.3	24.3-27.2	10.8-13.1	31.6-34.9	11.6-13.1	71.4-92.6
<i>Anoplopterus</i> n. sp. Ruvu	10.3-12.3	16.0-18.2	20.7-24.9	11.2-13.6	36.1-39.9	12.8-15.7	37.3-49.6
<i>Anoplopterus grandis</i>	9.0-12.6	14.6-19.0	22.1-32.6	11.3-14.8	33.7-40.4	11.0-14.4	49.7-83.8
<i>Anoplopterus krefftii</i>	10.2-13.5	14.5-22.7	22.5-29.6	9.1-14.1	31.8-38.3	11.1-16.5	41.3-93.6
<i>Anoplopterus chalei</i>	7.1-9.7	19.0-21.9	17.9-24.2	9.7-12.4	31.5-36.4	8.9-10.8	50.6-90.7
<i>Anoplopterus athiensis</i>	10.1-12.6	14.6-18.3	23.5-32.5	11.3-14.9	35.2-39.6	11.1-15.3	69.2-88.0

Table 4-4 Morphometric data for *Anoplopterus leroyi*. Range and mean include the holotype.

	Holotype	Range (n=31)	Mean±SD
%SL			
Head length	25.2	24.1-26.5	25.4±0.8
Head width	22.0	20.3-23.6	21.4±0.7
Head height	11.7	11.7-13.8	12.7±0.5
Body depth	14.8	12.6-15.9	14.2±0.9
Body depth at anus	13.5	13.0-16.0	14.4±0.7
Predorsal length	34.9	34.7-36.8	35.9±0.6
Prepectoral length	19.4	18.0-22.4	19.8±1.2
Preanal length	75.6	71.2-77.7	73.8±1.6
Dorsal-fin base length	9.9	9.9-13.0	11.3±0.8
Adipose-fin base length	25.3	21.9-25.7	24.0±1.1
Anal-fin base length	8.8	8.8-13.4	11.2±1.1
Pelvic-fin length	18.9	18.1-21.5	19.8±1.0
Pectoral-fin length	19.7	19.7-23.7	22.3±1.0
Anal-fin length	16.1	16.1-19.1	17.8±0.9
Caudal-peduncle length	16.6	14.9-17.8	16.5±0.6
Caudal-peduncle depth	11.7	10.0-13.4	12.2±0.8
Prepelvic length	52.0	47.1-54.9	50.2±2.1
Postpelvic length	47.9	47.3-53.2	50.3±1.8
Dorsal-fin insertion to adipose	50.9	44.5-50.4	46.4±1.4
Dorsal-fin origin to caudal	67.3	67.1-70.9	68.8±1.1
Preanus length	61.0	59.2-63.9	61.5±1.3
%HL			
Snout length	49.6	43.1-51.6	47.4±2.1
Interorbital distance	26.8	24.6-30.2	27.0±1.3
Maxillary barbel length	78.5	69.0-94.8	78.8±8.1
Inner mandibular barbel length	46.3	27.8-46.3	34.4±4.9
Outer mandibular barbel length	58.3	50.6-69.9	57.9±4.8
Eye diameter	9.5	9.5-19.8	13.8±2.2

Table 4-5 Morphometric data for *Anoplopterus harger*. Range and mean include the holotype.

	Holotype	Range (n=20)	Mean±SD
%SL			
Head length	25.2	24.6-26.7	25.7±0.7
Head width	23.0	20.6-23.9	21.9±1.0
Head height	13.1	12.3-13.2	12.7±0.3
Body depth	13.1	12.3-15.9	14.4±1.1
Body depth at anus	13.1	13.0-14.4	13.6±0.4
Predorsal length	38.3	36.2-39.2	37.8±0.8
Prepectoral length	18.4	18.4-21.5	20.0±0.9
Preanal length	75.6	72.7-77.7	74.9±1.4
Dorsal-fin base length	8.8	8.7-12.1	10.3±1.1
Adipose-fin base length	20.3	18.0-22.9	20.3±1.7
Anal-fin base length	10.9	8.1-10.9	9.8±1.1
Pelvic-fin length	18.2	18.5-20.9	19.7±0.8
Pectoral-fin length	20.3	20.2-25.4	22.5±1.4
Anal-fin length	18.9	16.4-19.9	17.6±1.0
Caudal-peduncle length	16.4	14.4-16.8	16.1±0.8
Caudal-peduncle depth	11.9	11.8-13.5	12.5±0.5
Prepelvic length	52.3	50.2-53.2	51.6±0.9
Postpelvic length	50.1	46.8-50.8	49.1±1.2
Dorsal-fin insertion to adipose	44.3	41.6-48.1	44.1±2.1
Dorsal-fin origin to caudal	66.2	64.5-69.0	66.1±1.3
Preanus length	61.5	59.9-63.8	62.0±1.2
%HL			
Snout length	52.5	45.9-53.9	50.4±2.5
Interorbital distance	31.7	25.7-31.7	28.6±2.0
Maxillary barbel length	95.9	62.2-95.9	74.1±11.0
Inner mandibular barbel length	46.3	26.6-51.6	34.1±6.3
Outer mandibular barbel length	69.1	41.7-70.0	54.4±8.1
Eye diameter	13.8	11.0-15.9	13.2±1.5

Table 4-6 Morphometric data for *Anoplopterus brevadorsalis*. Range and mean include the holotype.

	Holotype	Range (n=13)	Mean±SD
%SL			
Head length	26.4	23.9-27.0	25.9±0.8
Head width	22.2	20.0-22.8	21.3±0.9
Head height	13.8	11.3-13.9	12.9±0.8
Body depth	16.4	12.8-16.4	14.2±1.1
Body depth at anus	13.3	12.5-14.0	13.3±0.5
Predorsal length	38.6	35.9-38.9	37.4±1.1
Prepectoral length	20.8	18.7-22.9	20.8±1.1
Preanal length	75.7	70.6-75.7	73.1±1.4
Dorsal-fin base length	-	9.6-12.0	11.0±0.8
Adipose-fin base length	-	19.8-24.2	22.6±1.4
Anal-fin base length	-	9.8-12.2	11.2±0.7
Pelvic-fin length	18.2	17.0-21.7	19.5±1.3
Pectoral-fin length	20.3	20.3-23.9	22.4±1.1
Anal-fin length	17.3	17.3-19.9	18.8±0.9
Caudal-peduncle length	17.3	16.4-17.3	16.8±0.3
Caudal-peduncle depth	10.7	10.7-13.7	12.1±0.9
Prepelvic length	54.7	50.1-54.7	52.4±1.2
Postpelvic length	48.8	47.2-50.7	48.7±1.2
Dorsal-fin insertion to adipose	-	40.6-45.5	43.1±1.7
Dorsal-fin origin to caudal	-	61.6-66.5	65.2±1.4
Preanus length	-	59.7-64.0	61.7±1.5
%HL			
Snout length	43.4	43.1-50.6	47.1±2.7
Interorbital distance	24.8	22.2-25.3	23.8±0.9
Maxillary barbel length	69.0	64.9-86.0	74.8±5.8
Inner mandibular barbel length	-	26.7-59.8	36.5±8.1
Outer mandibular barbel length	-	37.8-67.1	53.0±8.3
Eye diameter	10.6	10.6-16.0	13.2±1.6

Table 4-7 Morphometric data for *Anoplopterus cubangoensis*. Range and mean include the holotype.

	Syntypes (n=5)	Range (n=59)	Mean±SD
%SL			
Head length	25.3 -26.7	24.6-28.2	26.6±0.8
Head width	19.7-23.6	19.0-23.6	21.0±0.9
Head height	10.2-12.2	10.0-13.3	12.1±0.8
Body depth	9.6-12.4	9.3-15.5	12.9±1.4
Body depth at anus	10.2-11.9	10.2-12.2	11.5±0.6
Predorsal length	36.9-38.5	36.0-38.5	37.2±0.8
Prepectoral length	19.3-22.6	18.9-24.6	20.8±1.3
Preanal length	73.5-77.6	69.7-77.6	72.8±1.7
Dorsal-fin base length	9.4-10.2	9.9-13.0	11.3±0.8
Adipose-fin base length	17.4-20.0	17.4-24.3	20.3±1.5
Anal-fin base length	5.6-8.7	5.6-12.1	9.9±1.2
Pelvic-fin length	16.7-18.9	15.3-20.9	18.1±1.2
Pectoral-fin length	19.1-21.8	18.2-23.8	20.9±1.3
Anal-fin length	15.8-18.2	14.8-20.0	17.5±1.2
Caudal-peduncle length	17.8-19.4	17.7-21.7	19.1±1.0
Caudal-peduncle depth	8.1-9.6	8.1-10.9	9.7±0.6
Prepelvic length	50.0-55.1	50.0-5.7	51.9±1.2
Postpelvic length	46.8-50.7	45.2-51.9	49.4±1.4
Dorsal-fin insertion to adipose	40.7	40.3-45.8	42.7±1.4
Dorsal-fin origin to caudal	63.5	62.3-70.3	66.5±1.8
Preanus length	59.2	58.4-63.7	60.9±1.3
%HL			
Snout length	43.9-49.2	43.4-51.1	47.4±1.9
Interorbital distance	19.2-23.6	17.5-23.9	22.1±1.3
Maxillary barbel length	58.7-70.7	51.4-78.4	63.5±6.3
Inner mandibular barbel length	24.4	22.4-40.9	30.4±4.2
Outer mandibular barbel length	34.8	33.5-66.2	47.1±7.4
Eye diameter	10.6-12.7	9.5-19.1	13.5±2.0

Table 4-8 Morphometric data for *Anoplopterus* n. sp. Mangula. Range and mean include the holotype.

	Holotype	Range (n=16)	Mean±SD
%SL			
Head length	23.1	22.3-26.3	24.4±1.2
Head width	19.3	19.2-21.4	20.2±0.6
Head height	10.8	10.8-13.1	12.0±0.8
Body depth	13.1	12.1-15.2	13.1±0.9
Body depth at anus	12.6	11.6-13.1	12.7±0.5
Predorsal length	32.1	31.6-34.9	33.4±1.2
Prepectoral length	17.3	17.3-20.3	19.2±0.9
Preanal length	69.5	69.5-73.5	71.7±1.2
Dorsal-fin base length	11.1	10.0-12.2	11.0±0.7
Adipose-fin base length	26.5	25.3-27.2	26.4±0.6
Anal-fin base length	10.6	9.1-11.1	10.1±0.7
Pelvic-fin length	19.9	18.6-21.6	20.1±0.9
Pectoral-fin length	24.0	22.4-25.4	23.7±0.8
Anal-fin length	17.0	16.0-18.9	17.3±0.7
Caudal-peduncle length	20.0	18.2-20.3	19.0±0.6
Caudal-peduncle depth	10.0	9.9-12.4	11.1±0.7
Prepelvic length	48.3	48.2-51.0	49.5±0.8
Postpelvic length	53.3	49.3-53.3	50.9±1.2
Dorsal-fin insertion to adipose	48.5	44.5-49.7	47.2±1.7
Dorsal-fin origin to caudal	70.2	67.0-71.1	69.0±1.5
Preanus length	59.9	58.6-61.9	60.5±1.0
%HL			
Snout length	49.6	44.7-51.3	48.1±2.0
Interorbital distance	26.8	24.3-27.2	25.8±1.1
Maxillary barbel length	78.5	71.4-92.6	79.8±7.0
Inner mandibular barbel length	46.3	24.6-31.6	27.5±2.4
Outer mandibular barbel length	58.3	39.6-57.3	47.8±5.9
Eye diameter	9.5	8.2-12.5	10.0±1.1

Table 4-9 Morphometric data for *Anoplopterus* n. sp. Ruvu. Range and mean include the holotype.

	Holotype	Range (n=16)	Mean±SD
%SL			
Head length	23.8	23.5-25.8	24.7±0.7
Head width	20.7	19.9-22.4	21.1±0.6
Head height	12.2	11.2-13.6	12.3±0.6
Body depth	13.0	12.8-15.8	13.8±0.8
Body depth at anus	14.6	12.8-15.7	14.2±0.8
Predorsal length	37.1	36.1-39.9	37.5±1.0
Prepectoral length	17.0	17.0-20.8	18.6±0.9
Preanal length	72.7	72.2-77.3	74.4±1.4
Dorsal-fin base length	10.5	9.6-12.5	10.8±0.8
Adipose-fin base length	23.6	21.4-26.1	23.9±1.2
Anal-fin base length	9.4	8.2-10.0	9.1±0.6
Pelvic-fin length	19.5	18.1-21.5	19.7±0.9
Pectoral-fin length	22.6	21.0-24.9	22.6±1.0
Anal-fin length	17.2	14.6-18.8	16.7±0.9
Caudal-peduncle length	17.2	18.2-20.3	19.0±0.6
Caudal-peduncle depth	11.7	16.0-18.2	17.3±0.5
Prepelvic length	50.4	48.1-52.3	50.4±1.2
Postpelvic length	51.2	48.8-52.7	50.6±1.0
Dorsal-fin insertion to adipose	46.8	41.8-48.4	45.7±1.7
Dorsal-fin origin to caudal	65.4	62.4-66.9	65.1±1.2
Preanus length	59.8	58.0-63.2	61.1±1.3
%HL			
Snout length	48.1	45.7-50.4	48.4±1.2
Interorbital distance	23.7	20.7-24.9	23.5±1.2
Maxillary barbel length	46.6	37.3-49.6	44.2±3.3
Inner mandibular barbel length	21.1	16.3-22.3	20.3±1.5
Outer mandibular barbel length	30.8	28.8-40.4	33.8±3.0
Eye diameter	16.5	14.2-19.1	15.7±1.4

Table 4-10 Distribution of total vertebrae counts in species of *Anoplopterus*.

Total Vertebrae	35	36	37	38	39	40
<i>Anoplopterus uranoscopus</i>					9	5
<i>Anoplopterus leroyi</i>		3	13			
<i>Anoplopterus harger</i>		2	5			
<i>Anoplopterus brevidorsalis</i>			1	6		
<i>Anoplopterus cubangoensis</i>			4	5		
<i>Anoplopterus</i> n. sp. Mangula		4	7			
<i>Anoplopterus</i> n. sp. Ruvu	9	4	1			
<i>Anoplopterus grandis</i>			8	15	11	1
<i>Anoplopterus krefftii</i>		9	1	1		
<i>Anoplopterus chalei</i>				9	1	
<i>Anoplopterus athiensis</i>				8	3	2

Table 4-11 Distribution of 1st dorsal pterygiophore intercept counts in species of *Anoplopterus*.

1st dorsal pterygiophore intercept count	0	1	2	3
<i>Anoplopterus uranoscopus</i>		14		
<i>Anoplopterus leroyi</i>		15	1	
<i>Anoplopterus harger</i>			6	1
<i>Anoplopterus brevidorsalis</i>	1	6		
<i>Anoplopterus cubangoensis</i>		9		
<i>Anoplopterus</i> n. sp. Mangula		11		
<i>Anoplopterus</i> n. sp. Ruvu		2	11	
<i>Anoplopterus grandis</i>		22	13	
<i>Anoplopterus krefftii</i>		11	1	
<i>Anoplopterus chalei</i>		10		
<i>Anoplopterus athiensis</i>		12	1	

Table 4-12 Distribution of total gill-raker counts in species of *Anoplopterus*.

Total Gill Rakers	5	6	7	8	9	10	11
<i>Anoplopterus uranoscopus</i>				5	23	20	7
<i>Anoplopterus leroyi</i>			1	17	17	9	
<i>Anoplopterus harger</i>			1	2	29	8	1
<i>Anoplopterus brevidorsalis</i>		1	8	20	3		
<i>Anoplopterus cubangoensis</i>			1	8	57	26	7
<i>Anoplopterus</i> n. sp. Mangula			4	11	8		
<i>Anoplopterus</i> n. sp. Ruvu	11	16	2				
<i>Anoplopterus grandis</i>	6	3	5	18	7	1	
<i>Anoplopterus krefftii</i>			11	37	89	39	3
<i>Anoplopterus chalei</i>				2	13	6	
<i>Anoplopterus athiensis</i>					7	12	2

Table 4-13 Distribution of branched anal-fin ray counts in species of *Anoplopterus*.

Branched anal-fin rays	4	5	6	7	8
<i>Anoplopterus uranoscopus</i>		4	47	6	
<i>Anoplopterus leroyi</i>			35	12	
<i>Anoplopterus harger</i>		3	34	2	
<i>Anoplopterus brevidorsalis</i>		3	22	7	
<i>Anoplopterus cubangoensis</i>		33	62		
<i>Anoplopterus</i> n. sp. Mangula		2	21		
<i>Anoplopterus</i> n. sp. Ruvu		27	2		
<i>Anoplopterus grandis</i>			36		
<i>Anoplopterus krefftii</i>		32	133	21	
<i>Anoplopterus chalei</i>		11	11		
<i>Anoplopterus athiensis</i>		7	13	2	

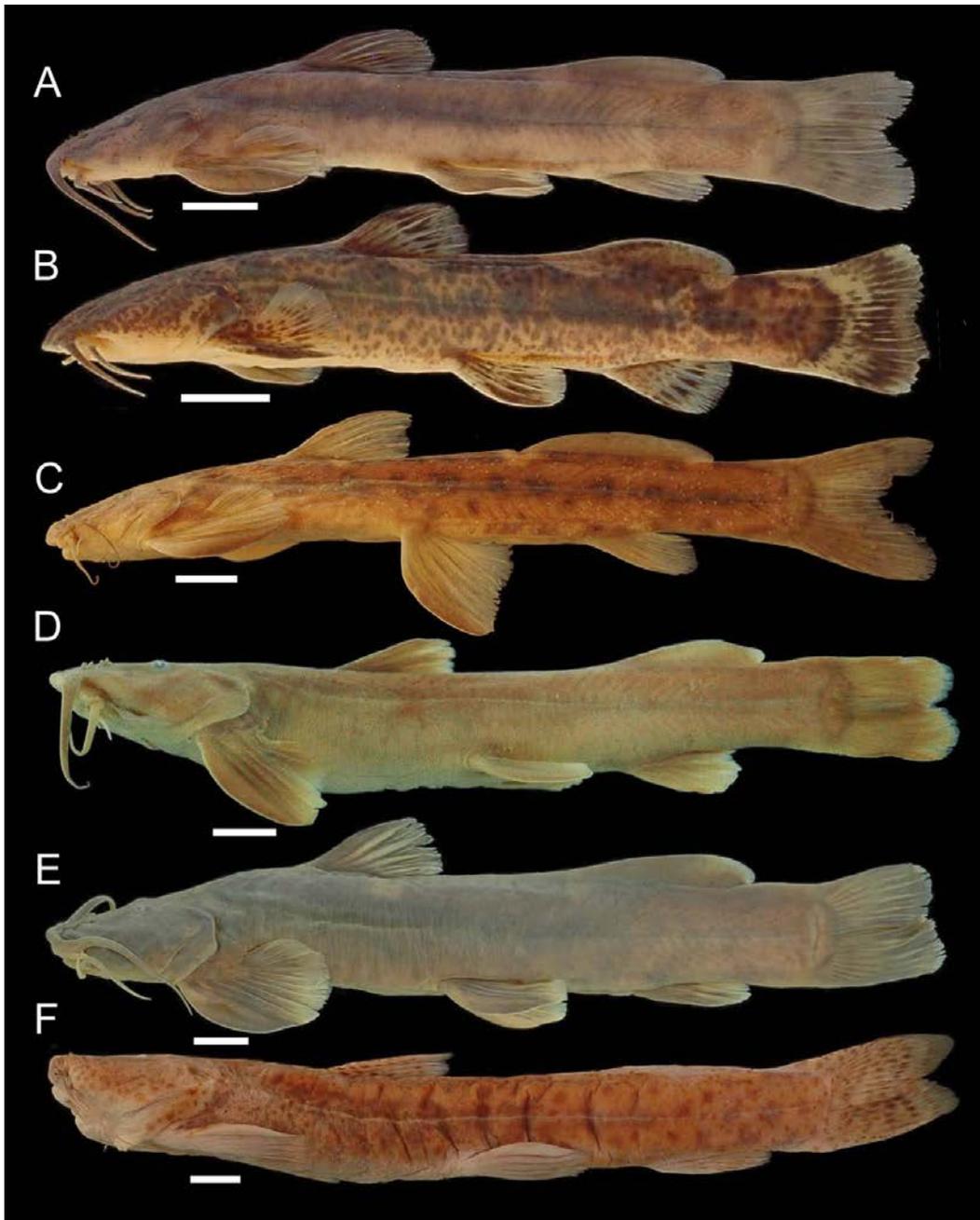


Figure 4-1 Species of the *Anoplopterus uranoscopus* group recognized by Thomson & Page (2010). Lateral views of A: *Anoplopterus uranoscopus*, UF 170723, 96.2 mm SL, Wami River basin, Tanzania; B: *Anoplopterus cryptobullatus*, CU 91072, 88.5 mm SL, Congo River basin, Zambia; C: *Anoplopterus chalei*, UF 170728, 123.9 mm SL, Rufiji River basin, Tanzania; D: *Anoplopterus grandis*, UF 177478, 120.2 mm SL, Ewaso Nigiro River basin, Kenya; E: *Anoplopterus krefftii*, UF 170722, 139.3 mm SL, Pangani River basin, Tanzania; F: *Anoplopterus athiensis*, BMNH 1910.10.31.31, 150.0 mm SL, Galina River basin, Kenya. Scale bars equal 1 cm.



Figure 4-2 *Anoplopterus uranoscopus*, UF 170723 96.2 mm SL; lateral, dorsal and ventral views.

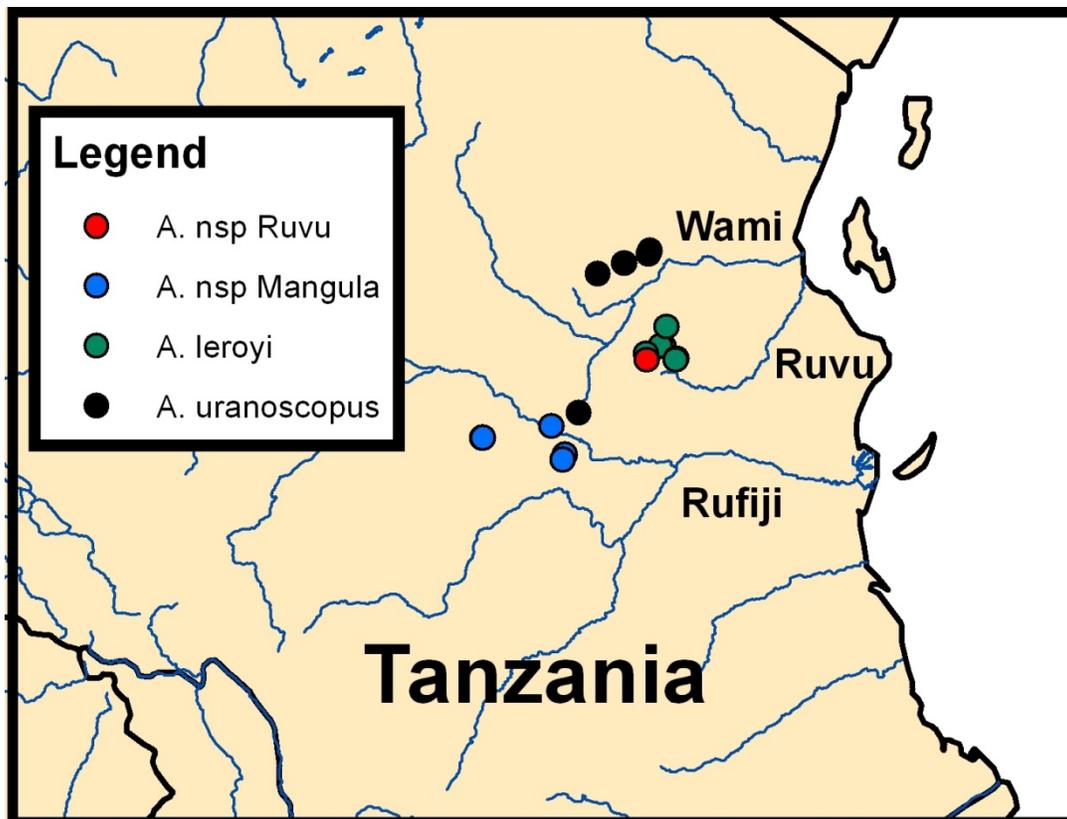


Figure 4-3 Distribution of *Anoplopterus* n. sp. Ruvu, *A. n. sp. Mangula*, *A. leroyi*, and *A. uranoscopus*.



Figure 4-4 *Anoplopterus leroyi*, CU 93725 83.9 mm SL; lateral, dorsal and ventral views.



Figure 4-5 *Anoplopterus hageri*, SAIAB 34332 80.3 mm SL; lateral, dorsal and ventral views.

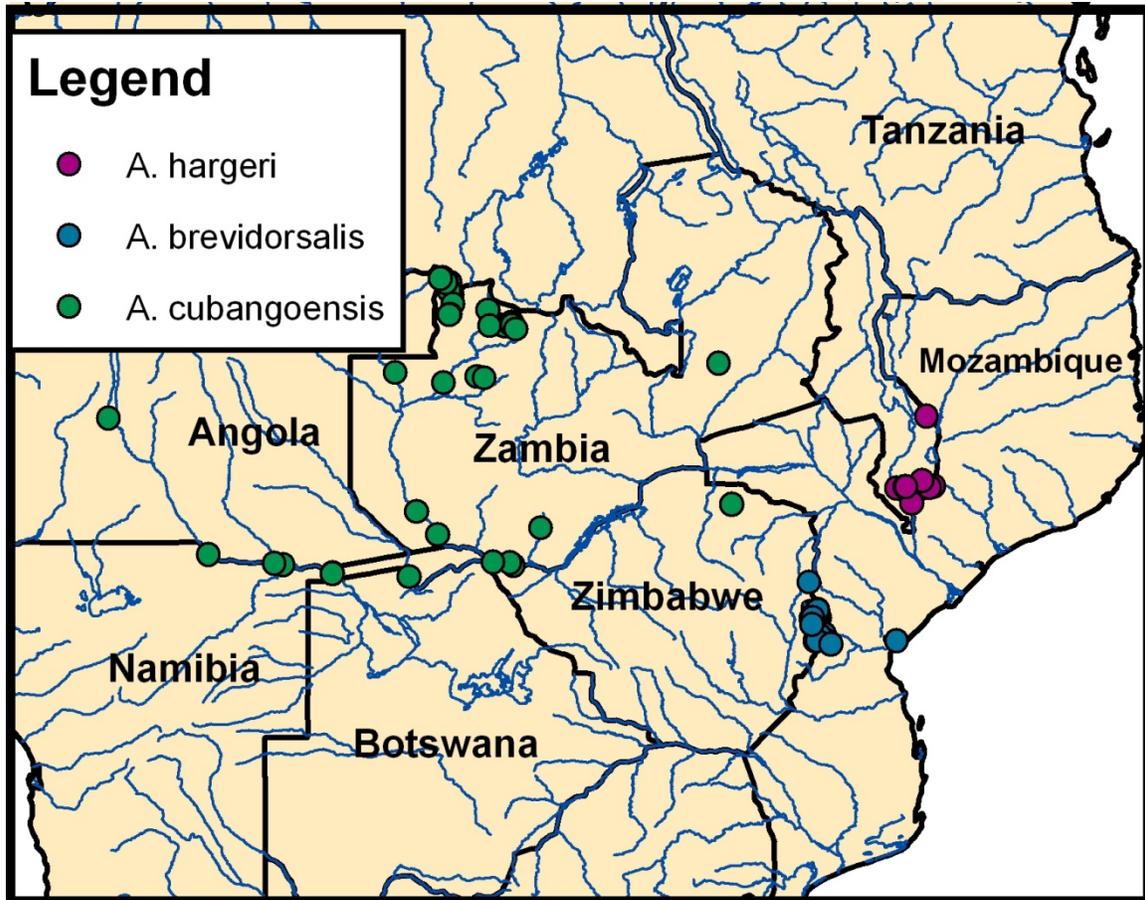


Figure 4-6 Distributions of *Anoplopterus brevidorsalis*, *A. hargeri*, and *A. cubangoensis*.



Figure 4-7 *Anoplopterus brevidorsailis*, SAIAB 53691 85.8 mm SL; lateral, dorsal and ventral views.



Figure 4-8 *Anoplopterus cubangoensis*, SAIAB 80539 69.7 mm SL; lateral, dorsal and ventral views.



Figure 4-9 *Anoplopterus* n. sp. Mangula, UF 170702 95.6 mm SL, holotype; lateral, dorsal and ventral views.



Figure 4-10 *Anoplopterus* n. sp. Ruvu, UF 170727 75.4 mm SL, holotype; lateral, dorsal and ventral views.

CHAPTER 5
REVISION OF THE AMPHILIUS JACKSONII COMPLEX (SILURIFORMES:
AMPHILIIDAE), WITH THE DESCRIPTION OF FIVE NEW SPECIES.

Background

The African catfish genus *Amphilius* includes 18 species of the subfamily Amphiliinae that are primarily distributed in western Africa. It is distinguished from the closely related genus *Anoplopterus* by having an epidermal fold at the base of the caudal fin and 6 + 7 or 7 + 8 principal caudal-fin rays (vs. 8+9) (Chapter 3). The distribution of *Amphilius* is primarily Low African while the distribution of *Anoplopterus* is primarily High African. Low Africa is northern and western Africa in which most of the land is at elevations well between 500 and 1000 ft. and High Africa is southern and eastern Africa in which most of the land is at elevations well above 1000 ft. and much of it is at elevations above 4000 ft. (Roberts, 1975). Only two species of *Amphilius* occur in High Africa, *Amphilius lentiginosus* from Angola and *Amphilius jacksonii* which is widely distributed in eastern Africa.

Amphilius jacksonii was described from a single specimen collected from the Hima River, a tributary of Lake George in western Uganda (Boulenger, 1912). Subsequent authors have recorded this species throughout much of eastern Africa including the Lake Edwards drainage in western Uganda (Walsh et al., 2000), the Malagarasi drainage in Burundi & western Tanzania (David, 1937; De vos et al., 2001), the Rizizi drainage as *Amphilius platyichir* (Marlier, 1953), the Rufiji basin in eastern Tanzania as *Amphilius platyichir* (Matthes, 1967; Bailey, 1969), the Lake Rukwa basin in Tanzania (Seegers, 1996), and the Upper Congo drainage in Zambia (Seegers, 1996).

Beyond distributional data, very little published information is available on *Amphilius jacksonii*. The species was described and figured in both editions of "Fishes

of Uganda” (Greenwood, 1958, 1966), Seegers (1996) figured the type specimen and described specimens from the Lake Rukwa basin, and Walsh et al. (2000) redescribed the species and provided habitat and life-history notes from the Lake George drainage, Uganda. The Weberian complex of this species was described and figured by Chardon (1968), and Diogo & Chardon (2000) described the mandibular barbel structure. There have been no studies that have examined geographic variation in *A. jacksonii*.

A study of geographic variation in specimens identified as *Amphilus jacksonii* revealed substantial morphological differences among populations from different drainages. The aim of this study is to determine the number of species that material identified as *A. jacksonii* represents, determine the distribution of each of the species, and formally describe each species.

Materials and Methods

Measurements were made point-to-point with digital calipers, and data were recorded to hundredths of a millimeter. Subunits of the head are presented as proportions of head length (HL). Head length and measurements of other body parts are given as proportions of standard length (SL). Use of the terms origin and insertion to designate, respectively, the most anterior and posterior points on the bases of all fins follows Cailliet et al. (1986). Counts and measurements were made on the left side of a specimen when possible and follow Skelton (1981, 1984, 1986) with the additional measurements of body depth at anus, prepectoral-fin length, preanal-fin length, dorsal-fin base length, adipose-fin base length, pelvic- and pectoral-fin lengths, prepelvic-fin length, postpelvic-fin length, and preanus length. Only specimens 40.0 mm SL or larger were measured, but counts were made on all type specimens. Descriptions of new species are based on the holotype and the paratypes. Specimens from drainages that

do not include the type locality and specimens that were examined but from which no morphometric or meristic data was taken are listed as non-types.

For fin-ray counts, numbers of unbranched soft rays are indicated by lower case Roman numerals, and branched soft rays by Arabic numerals. The number of anterior unbranched rays in the anal fin is difficult to determine, and the counts were checked with radiographs whenever possible. Amphiliids typically have a small spinelet in front of the first unbranched dorsal-fin ray. The spinelet is not included in the counts.

Branchiostegal ray counts include all branchiostegal rays. Material examined is given under each species account and is listed by drainage followed by catalog number, country, locality, geographic coordinates and, in parentheses, the number of specimens and the size range in mm SL. Geographic coordinates preceded by ca. are estimated from other original locality data. Materials examined in this study are deposited in the following institutions: the American Museum of Natural History, New York, New York (**AMNH**), the Auburn University Museum Fish Collection, Auburn, Alabama (**AUM**), the Natural History Museum, London (**BMNH**), the Cornell University, Vertebrate Collections, Ithaca, New York (**CU**), the Harvard Museum of Comparative Zoology, Cambridge, Massachusetts (**MCZ**), the Royal Museum of Central Africa, Tervuren, Belgium (**MRAC**), the South African Institute for Aquatic Biodiversity, Grahamstown, South Africa (**SAIAB**), and the Florida Museum of Natural History, Gainesville, Florida (**UF**).

Synonymies include all references to the species in east-central Africa. The first page of the reference to the species and all figures are listed. If the species is also listed in a key on a separate page from the account, that page is also listed. The type of

information in the reference is given followed by the locality for the species as given in the account. Additionally, any specimens on which the account is known to be based are listed. If the account is only based in part on the species, only the information that is applicable to that species is listed. Accounts of species outside east-central Africa that give only a general distribution in east-central Africa are excluded.

Taxonomic Descriptions

***Amphilius jacksonii* complex**

The *Amphilius jacksonii* complex is distinguished from all other species of *Amphilius* by the following combination of characters: a variably mottled body coloration that includes dark saddles (vs. body coloration not mottled with dark saddles), head and body not heavily spotted (vs. head and body heavily spotted), crenulations present on epidermal fold (vs. epidermal fold smooth), lobes formed by epidermal fold crenulations rounded (vs. lobes formed by epidermal fold crenulations elongated and pointed), branchiostegal rays usually 6 to 8 (vs. greater than 8), and total gill rakers usually 6 to 11 (vs. greater than 11).

The *Amphilius jacksonii* complex differs from all other species of the genus (*A. atesuensis*, *A. brevis*, *A. caudosignatus*, *A. dimonikensis*, *A. grammatophorus*, *A. kakrimensis*, *A. korupi*, *A. lamani*, *A. longirostris*, *A. maesii*, *A. mamonekenensis*, *A. nigricaudatus*, *A. opisthophthalmus*, *A. platychir*, *A. pulcher*, *A. rheophilus*) except *A. lentiginosus* by its variably mottled body coloration that includes dark saddles that are joined laterally (vs. body coloration not mottled, without dark saddles that are joined laterally). It differs from *A. lentiginosus* by having its head and body not spotted (vs. head and body heavily spotted) and by having fewer total gill rakers on the first gill arch (6-11, rarely 5 or 12 vs. 14-16). The *Amphilius jacksonii* complex differs from *A.*

longirostris and *A. opisthophthalmus* by having 6+7 principal caudal-fin rays (vs. 7+8) and a well developed crenelated epidermal fold (vs. fold rudimentary) and differs from *A. brevis*, *A. dimonikensis*, *A. korupi*, and *A. maesii* by having distinct crenelations on the epidermal fold (vs. crenelations absent or very weak). It differs from *A. kakrimensis*, *A. platyichir*, and *A. rheophilus* by the shape of the lobes formed by the crenelations on the epidermal fold (lobes rounded vs. elongate and pointed) and from *A. brevis*, *A. caudosignatus*, *A. dimonikensis*, *A. korupi*, *A. lamani*, *A. maesii*, *A. mamonekenensis*, *A. nigricaudatus*, and *A. pulcher* by having fewer branchiostegal rays (usually 6-8, rarely 5 or 9 vs. 9-10 in *A. pulcher*, more than 9 in the other species).

***Amphilius jacksonii* Boulenger 1912 (Figure 5-1; Table 5-1)**

Amphilius jacksonii Boulenger 1912: 602, Original description, Type locality: Hima R. flowing into Lake George (Ruisamba), eastern Uganda, elev. 3500 ft. [Lake George drainage, Nile basin], holotype: BMNH 1912.10.15.47; Boulenger, 1916b: 307, fig. 182, description based on type; David & Poll, 1937: 255, description, Rutshuru River [Lake Edward drainage, Nile basin]; Poll, 1939: 17, 62, records from Albert National Park [Lake George and Lake Edwards drainages]; Harry, 1953: 190, synonymy; Greenwood, 1957: 77, figs. 49, 80, description, size, habitat, distribution [Lake George and Lake Edwards drainages]; Copely, 1958: 154, Hima R.; Greenwood, 1958: 89, fig. 49, description, size, habitat, distribution [Lake George and Lake Edwards drainages]; Whitehead, 1958: 198, western Uganda rivers; Corbet, 1961: 81 [not examined]; Greenwood, 1966: 93, fig. 49, description, size, habitat, distribution [Lake George and Lake Edwards drainages]; Seegers, 1996: 188, figs. 133-134 (in part), type information, holotype figured, Seegers, 1996b: 251 (in part), type information, distribution; Walsh et al., 2000: 166, redescription, diagnosis, description, life-history aspects, habitat, distribution [Lake George drainage].

Material examined

Lake George drainage: AMNH 97419, Uganda, Dura River, Dura station, south end of Kibale Forest Reserve near Queen Elizabeth National Park, ca. 0° 12' 00"N, 30° 22' 00"E (6: 41.9-79.5); BMNH 1912.10.15.47, Uganda, Hima River, ca. 0° 17' 19"N, 30° 10' 23"E (1: 86.7, holotype); BMNH 1971.1.5.37-38, Uganda, Mapanga River, about 8

km upstream just below rapids, ca. 0° 05' 10.6"N, 30° 23' 03.8"E (2: 58.7-60.1); BMNH 1971.1.5.39, Uganda, Sibwe River, ca. 0° 10' 01.4"N, 30° 12' 36.8"E (1: 87.0); BMNH 1971.2.19.14-15, Uganda, Sibwe River, ca. 0° 10' 01.4"N, 30° 12' 36.8"E (1: 87.0); CU 97331, ex. UF 110746 (4: 37.6-92.7); MCZ 100587, Uganda, Middle Dura River, Kanyanchu, Kibale Forest Reserve, ca. 0° 27' 00"N, 30° 22' 00"E (1: 76.7); MRAC 90-046-P-68-78, Uganda, Ruimi (Rwimi) River, road between Fort Portal-Kasese [route A 109], ca. 0° 22' 23.5"N, 30° 12' 40.8"E (11: 44.0-84.2); MRAC 90-046-P-79-87, Uganda, Ruimi (Rwimi) River, road between Fort Portal-Kasese [route A 109], ca. 0° 22' 23.5"N, 30° 12' 40.8"E (11: 47.2-83.0); SAIAB 187245, ex. UF 110746 (42.3-97.0); UF 110743, Uganda, Middle Dura River, Kanyanchu, Kibale Forest Reserve, ca. 0° 27' 00"N, 30° 22' 00"E (12: 48.6-104.3); UF 110744, Uganda, Middle Dura River, Kanyanchu, Kibale Forest Reserve, ca. 0° 27' 00"N, 30° 22' 00"E (19: 23.6-115.9); UF 110745, Uganda, Middle Dura River, Kanyanchu, Kibale Forest Reserve, ca. 0° 27' 00"N, 30° 22' 00"E (5: 54.6-88.6); UF 110746, Uganda, Middle Dura River, Kanyanchu, Kibale Forest Reserve, ca. 0° 27' 00"N, 30° 22' 00"E (36: 34.1-102.0); UF 110747, Uganda, Dura River-Mainaro, ca. 0° 37' 00"N, 30° 16' 00"E (34: 54.4-111.1); UF 110748, Uganda, Ruimi River at bridge on road between Fort Portal and Hima, ca. 0° 22' 22.2"N, 30° 12' 41"E (41: 42.7-92.8); UF 110749, Uganda, Ruimi River at bridge on road between Fort Portal and Hima, ca. 0° 22' 22.2"N, 30° 12' 41"E (1: 47.6); UF 110750, Uganda, Mubuku River at bridge on road between Fort Portal and Kasese, ca. 0° 15' 30.8"N, 30° 07' 9.7"E (7: 52.8-85.1). **Lake Edward drainage:** AUM 47138, Uganda, Munyage River, below Butogota town, DRC-Uganda border foot path, elev. 1190m, 0° 53' 00"S, 29° 37' 50"E (3: 60.1-69.9); AUM 47139, Uganda, Tributary of Ishasha at bridge between Karangara

and Butogota. Outside BINP, sources in park, elev. 1180m, 0° 52' 18"S, 29° 39' 59"E (2: 73.41-80.8); AUM 47143, Uganda, River Ishash, below bridge in cattle farm on Butogota-Kanungu road. elev. 1300m, 0° 49' 50"S, 29° 38' 21"E (2: 65.7-73.4); AUM 47146, Uganda, Bwindi Impenetrable Forest National Park, ca. 0° 1' 26"S, 29° 41' 23"E (4: 58.8-86.6); MRAC 22551, Uganda, Rutshuru, Buseregenyi, ca. 1° 04' 00"S, 29° 26' 00"E (1: 80.0); MRAC 23233, Uganda, Rutshuru, Buseregenyi, ca. 1° 04' 00"S, 29° 26' 00"E (1: 82.2); MRAC A5-019-P-0048-0056, Uganda, Munyage River, below Butogota town, DRC-Uganda border foot path, elev. 1190m, ca. 1° 04' 00"S, 29° 26' 00"E (9: 39.4-97.3); UF 169241, ex. AUM 47143 (3: 65.9-70.7); UF 169242, ex. AUM 47139 (3: 80.7-87.3); UF 169243, ex. AUM 47138 (2: 67.1-86.3); UF 169257, ex. AUM 47146 (3: 60.7-75.1). **Kagera River drainage:** MRAC 164876, Rwanda, Mwogo River, 18 km NE of Butare, ca. 2° 29' 00"S, 29° 38' 00"E (1: 77.2); MRAC 71783-850, Rwanda, Mwogo River, the source of the Nile, ss-tributary of Kagera River, ca. 2° 22' 52"S, 29° 41' 48"E (61: 38.5-107.0); MRAC 71851-925, Rwanda, Mwogo River, the source of the Nile, ss-tributary of Kagera River, ca. 2° 22' 52"S, 29° 41' 48"E (74: 38.5-106.4); MRAC 83417, Burundi, Urigoli, Nyalugogo [Nyabugogo?] River, Urigoli territory, ca. 3° 25' 26"S, 29° 53' 30"E (1: 34.7); MRAC 86-27-P-0088-0095, Rwanda, Rubondo River, tributary of Kiryango River, near town of Mukugi, ca. 2° 12' 00"S, 29° 41' 00"E (8: 51.8-86.1); MRAC 91-30-P-0296-0299, Burundi, Nyakijanda River, tributary of Ruvubu River, the bridge on Road of General interest 4, 38 km from Kinyinya, ca. 3° 36' 00"S, 30° 07' 00"E (4: 49.5-65.0); MRAC 91-34-P-0147-0150, Burundi, Kavuruga River, tributary of Ruvubu River, near town of Buhinyuza, ca. 3° 02' 00"S, 30° 21' 00"E (4: 49.4-74.9); MRAC 91-34-P-0151-0152, Burundi, Kinyanderama River, tributary of Ruvubu River, near town

Buhinyuza, ca. 3° 02' 00"S, 30° 21' 00"E (2: 66.6-71.1); MRAC 91-34-P-0160-0164, Burundi, Nyabiko River, on Musinga-Gitega Road, small tributary, rocky and sandy bottom, ca. 5° 29' 00"S, 30° 14' 00"E (5: 35.1-92.3); MRAC 91757-763, Rwanda, Nyabugogo River at confluence of Lusine River, ca. 1° 47' 41"S, 30° 07' 23"E (7: 58.9-96.8); MRAC 91764-836, Rwanda, Nyabugogo River at confluence of Lusine River, ca. 1° 47' 41"S, 30° 07' 23"E (72: 34.9-79.8); MRAC 93097-120, Rwanda, Nyabugogo River, at outlet of Lake Mohasi, ca. 1° 46' 45"S, 30° 07' 58"E (23: 28.2-77.0); MRAC 94272-276, Rwanda, ca. 2° 32' 15"S, 29° 40' 16"E (5: 40.1-82.9); MRAC 96031.1611-1614, Burundi, Karuzi, small tributary stream of the fish-farming ponds, Ndurumu system, ca. 3° 06' 05"S, 30° 09' 53"E (4: 29.3-78.4).

Diagnosis

Diagnostic characters are summarized in Table 5-2. *Amphilius jacksonii* is diagnosed from all other species of the *Amphilius jacksonii* complex by its more slender caudal peduncle (4.8-7.9% SL vs. 8.1-12.3% SL). It is further distinguished from *A. n. sp. Malagarasi*, *A. n. sp. Congo*, and *A. n. sp. Rufiji* by its longer caudal peduncle (caudal peduncle length 16.7-20.6% SL vs. 13.3-18.8% SL), and from *A. n. sp. Congo*, *A. n. sp. Rufiji*, and *A. n. sp. Lake Kyogo* by its more slender body (body depth at anus 9.6-13.2% SL vs. 13.5-17.4% SL). It is further distinguished from *A. n. sp. Congo* by having fewer total gill rakers on the first gill arch (6-9, rarely 10 vs. 10-11, rarely 9 or 12) and from *A. n. sp. Ruzizi* by having a wider interorbital width (26.7-32.0% HL vs. 23.4-25.1% HL).

Description

Morphometric data are in Table 2. Body elongate, ventral profile flattened ventrally to anal-fin base, then tapered dorsally to end of caudal peduncle. Dorsal profile

rising gently from tip of snout to origin of dorsal fin, then nearly horizontal to end of caudal peduncle. Greatest body depth at dorsal-fin origin. Caudal peduncle laterally compressed, with crenellated epidermal fold. Anus and urogenital opening located at midpoint of adpressed pelvic fin, closer to insertion of pelvic fin than to origin of anal fin. Skin smooth. Lateral line complete, extending from dorsal edge of opercular cavity to base of caudal fin.

Head and anterior part of body depressed and broad. Head wedge-shaped in lateral view. Snout broad, blunt when viewed from above. Head becoming wider from tip of snout to pectoral-fin base. Branchiostegal membranes moderately joined at isthmus forming a *U*-shaped connection.

Mouth broad, gently curved, subterminal. Lips moderately fleshy, slightly papillate. Rictal lobe large and papillate. Anterior portion of premaxillary tooth band exposed with mouth closed. Premaxillary tooth patches joined, forming *V*-shaped band with anterior broad protrusion. Premaxillary and dentary teeth short, conical. Dentary tooth patches forming *U*-shaped band, separated medially.

Three pairs of simple, tapered circumoral barbels. Maxillary barbel large, fleshy and flattened with pointed tip; barbel extending posterolaterally from corner of mouth to pectoral-fin base. Outer mandibular barbel thin with pointed tip, origin at posterior corner of lower jaw, extending to origin of pectoral,fin. Inner mandibular barbel originates anterolaterally of inner mandibular barbel, extending to edge of branchiostegal membrane. Branchiostegal membrane with 6 (5), 7 (85), 8 (147), or 9 (1) rays. Gill rakers on first epibranchial 1 (4), 2 (178) or 3 (47); rakers on first ceratobranchial 4 (22),

5(88), 6 (99), 7 (15), or 8 (1); total gill rakers on first arch 6 (25), 7 (74), 8 (83), 9 (38), or 10 (6).

Eye small, positioned dorsolaterally approximately midway between tip of snout and posterior margin of operculum. Horizontal diameter of eye slightly wider than vertical diameter. Eye without free orbit, covered with skin confluent with dorsal surface of head. Anterior and posterior nares with prominent tubular rims; nares separate but relatively close to each other. Posterior nare located about midway between eye and tip of snout.

Dorsal-fin origin at point over tip of adpressed pectoral fin. Dorsal fin with i,6 (243) rays, margin straight. Pectoral fin with i,7 (1), i,8 (104), or i,9 (137) rays; unbranched ray greatly thickened. Pectoral fin with four or five innermost rays progressively shorter making posterior fin margin rounded. Origin of pelvic fin posterior to dorsal-fin insertion. Pelvic fin with i,5 (243) rays with first ray unbranched and greatly thickened. Pelvic fin with straight posterior margin.

Adipose-fin base longer than anal-fin base, origin anterior to origin of anal-fin base; fin extending past anal-fin insertion. Margin strongly convex with sharply rounded edge, not deeply incised posteriorly. Caudal fin deeply forked with tips of lobes rounded; fin with i,5,5,i (8), i,5,6,i (230), or i,6,6,i (1) principal rays. Anal fin with short base, origin posterior to origin of adipose-fin base, with ii,6 (62), ii,7 (107), ii,8 (9), iii,6 (48), iii,7 (16), or iv,7 (1) rays. Anal-fin margin almost straight.

Coloration

Body variably mottled and with dark saddles. First saddle immediately posterior of head, second saddle under dorsal fin, third saddle between dorsal and adipose fins, fourth saddle under anterior of adipose fin, and fifth saddle on caudal peduncle. All

saddles connected laterally by broad stripe. Ventral region light brown with fourth and fifth saddles extending around ventral side. Dorsal and anal fins light brown with dark medial band. Adipose fin dark brown, cream colored distally. Pectoral and pelvic fins positioned horizontally with upper surfaces brown and lower surfaces light yellow; each with dark medial band. Caudal fin brown with medial cream patch and tips of upper and lower lobes cream. Caudal coloration asymmetrical, lower lobe with more pigment than upper lobe.

Distribution

Lake George, Lake Edwards, and Kagera River drainages, Nile basin, eastern Uganda, Rwanda, and Burundi (Figure 5-2).

***Amphilius* n. sp. Ruzizi (Figure 5-3; Table 5-3)**

Amphilius platyichir (non Günther) Marlier, 1953: 194, Distribution in Ruzizi drainage;

Distribution mapped.

Holotype: MRAC 93294, Rwanda, Lufiro River, upper reaches of Matchuza, Ruzizi River drainage, ca. 2° 44' 00"S, 29° 02' 99"E (1: 82.8)

Paratypes: CU 97332, same data as holotype (1: 47.7); MRAC 91529-531, Democratic Republic of the Congo, Kiliba River, ca. 3° 14' 30"S, 29° 09' 36"E (3: 31.2-64.9); MRAC 93295-297, same data as holotype, (3: 41.3-45.3); MRAC 93126-128, Burundi, Nyakagunda River, ca. 2° 47'S, 29° 04'E (3: 37.5-66.5); MRAC 93129-130, Burundi, Nyamagana River, ca. 2° 55'S, 29° 08'E (2: 116.1-120.6); MRAC 93131, Burundi, Lua River, ca. 2° 46'S, 29° 02'E (1: 79.5); SAIAB 187262, same data as holotype (1:64.2); UF 184236 (69.8).

Non-types

Mutimbuzi River drainage: MRAC 91330-389, Burundi, Murago River, ca. 3° 17'S, 29° 23'E (59: 29.2-71.4); MRAC 93076-096, Burundi, Musazi River [=Muzazi River], ca. 3° 17'S, 29° 25'E (20: 33.1-91.0); MRAC 126266-267, Burundi, Murago River, ca. 3° 17'S, 29° 23'E (7: 41.3-82.8). **Ruzizi River drainage:** MRAC 91034.0153-0159, Burundi, Nyamagana River near town of Mabayi, ca. 2° 42'S, 29° 15'E (7: 47.7-79.9); MRAC 91390, Burundi, Nyakagunda River, Bugarama, ca. 2° 47'S, 29° 04'E (1: 25.6); MRAC 93051-054, Democratic Republic of the Congo, Muniowe River, Luvungi, ca. 2° 56'S, 28° 57'E (4: 43.9-95.2); MRAC 93055-075, Democratic Republic of the Congo, Luvubu River, ca. 2° 52'S, 29° 02'E (20: 27.3-108.5); MRAC 93121-125, Burundi, Nyamagana River, ca. 2° 55'S, 29° 08'E (5: 44.1-97.6), MRAC 96031.1571-1576, Burundi, Nyamagana River, 3km after Mabayi, center Kivogero, ca. 2° 42' 56"S, 29° 14' 40"E (5: 46.2-88.0); MRAC 96031.1590-1595, Ikibenga River, 26 km on Cibitoke-Mabayi road, ca. 2° 43' 03"S, 29° 10' 05"E (6: 50.5-69.3). **Unknown drainage:** MRAC 91392-395, Burundi, Kikoma River, ca. 3° 20'S, 29° 18'E (4: 45.3-86.6).

Diagnosis

Diagnostic characters are summarized in Table 5-2. *A. n. sp. Ruzizi* is diagnosed from *A. n. sp. Malagarasi*, *A. n. sp. Congo*, and *A. n. sp. Rufiji* by its more slender caudal peduncle (caudal peduncle depth 8.6-9.5% SL vs. 9.7-12.3% SL) and from *A. jacksonii*, *A. n. sp. Malagarasi*, *A. n. sp. Rufiji*, and *A. n. sp. Lake Kyogo* by its narrower interorbital width (23.4-25.1% HL vs. 26.7-35.8% HL). It is further diagnosed from *A. n. sp. Congo*, *A. n. sp. Rufiji*, and *A. n. sp. Lake Kyogo* by its more slender body (body depth at anus 11.1-12.9% SL vs. 13.5-17.4% SL). *A. n. sp. Ruzizi* is further diagnosed from *A. n. sp. Congo* by having fewer branchiostegal rays (6-7 vs. 8-9), fewer total gill

rakers on the first gill arch (6-8, rarely 5 or 9 vs. 10-11, rarely 9 or 12), and a longer caudal peduncle (caudal peduncle length 18.7-20.3% SL vs. 14.4-16.4% SL). It is further diagnosed from *A. n. sp. Rufiji* by a longer caudal peduncle (caudal peduncle length 18.7-20.3% SL vs. 13.3-15.5% SL) and shorter dorsal-fin insertion to adipose-fin insertion length (38.2-41.5% SL vs. 42.2-44.6% SL). It is further diagnosed from *A. jacksonii* by its deeper caudal peduncle (caudal peduncle depth 8.6-9.5% SL vs. 4.8-7.9% SL).

Description

Morphometric data are in Table 5-3. Body elongate, ventral profile flattened ventrally to anal-fin base, then tapered dorsally to end of caudal peduncle. Dorsal profile rising gently from tip of snout to origin of dorsal fin, then nearly horizontal to end of caudal peduncle. Greatest body depth at dorsal-fin origin. Caudal peduncle laterally compressed, with crenellated epidermal fold. Anus and urogenital openings located at midpoint of adpressed pelvic fin, much closer to insertion of pelvic fin than to origin of anal fin. Skin smooth. Lateral line complete, extending from dorsal edge of opercular cavity to base of caudal fin.

Head and anterior part of body depressed and broad. Head wedge-shaped in lateral view. Snout broad, blunt to rounder when viewed from above. Head becoming wider from tip of snout to pectoral-fin base. Branchiostegal membranes moderately to broadly joined at isthmus forming a *U*-shaped connection.

Mouth broad, gently curved, subterminal. Lips moderately fleshy, slightly papillate. Rictal lobe large and slightly papillate. Anterior portion of premaxillary tooth band exposed with mouth closed. Premaxillary tooth patches joined, forming crescent

shaped band. Premaxillary and dentary teeth short, conical. Dentary tooth patches forming *U*-shaped band, separated medially.

Three pairs of simple, tapered circumoral barbels. Maxillary barbel large, fleshy and flattened with pointed tip; barbel extending posterolaterally from corner of mouth, not reaching pectoral-fin base. Outer mandibular barbel thin with pointed tip, origin at posterior corner of lower jaw, extending to just short of origin of pectoral-fin. Inner mandibular barbel originates anterolaterally of inner mandibular barbel, extending to about two-thirds of distance to edge of branchiostegal membrane. Branchiostegal membrane with 6 (7), or 7 (8) rays. Gill rakers on first epibranchial 2 (15) or 3 (1); rakers on first ceratobranchial 3 (1), 4 (8), 5(2), 6 (4), or 7 (1); total gill rakers on first arch 5 (1), 6 (8), 7 (1), 8 (5), or 9 (1).

Eye small, positioned dorsolaterally approximately midway between tip of snout and posterior margin of operculum. Horizontal diameter of eye slightly wider than vertical diameter. Eye without free orbit; covered with skin confluent with dorsal surface of head. Anterior and posterior nares with prominent tubular rims; nares separate but relatively close to each other. Posterior nare located about midway between eye and tip of snout.

Dorsal-fin origin at point over or just posterior to tip of pectoral fin. Dorsal fin with *i*,6 (16) rays, and fin margin straight. Pectoral fin with *i*,8 (2), or *i*,9 (14) rays; unbranched ray greatly thickened. Pectoral fin with four or five innermost rays progressively shorter making posterior fin margin rounded. Origin of pelvic fin posterior of dorsal-fin insertion. Pelvic fin with *i*,5 (16) rays with first ray unbranched and greatly thickened. Pelvic fin with straight posterior margin.

Adipose-fin base longer than anal-fin base, origin anterior to origin of anal-fin base, fin extending past anal-fin insertion. Margin strongly convex with sharply rounded edge, deeply incised posteriorly. Caudal fin moderately forked with tips of lobes rounded; fin with i,5,6,i (15) principal rays. Anal fin with short base, origin posterior to origin of adipose-fin base, with ii,5 (3), ii,6 (2), iii,5 (1), iii,6 (7), or iii,7 (3) rays. Anal-fin margin almost straight.

Coloration

Body variably mottled with dark saddles. First saddle posterior of head, second saddle at dorsal fin, third saddle between dorsal and adipose fins, fourth saddle under anterior of adipose fin, and fifth saddle on caudal peduncle. All saddle connected laterally by broad stripe. Ventral region light brown with fourth saddle extending around ventral side. Dorsal, and anal fins brown with dark medial band (band on anal fin often indistinct on small specimens). Adipose fin dark brown, cream colored anteriorly, posteriorly and on distal edge. Pectoral and pelvic fins positioned horizontally with upper surfaces brown with cream colored distal edge. Lower surfaces light yellow. Caudal fin cream colored with medial dark band.

Distribution

Ruzizi drainage, eastern Rwanda and Burundi, western Democratic Republic of the Congo. Also, northeastern tributaries of Lake Tanganyika in Burundi (Figure 5- 2).

***Amphilius* n. sp. Malagarasi (Figure 5-4; Table 5-4)**

Amphilius jacksonii David, 1937: 418, Malagarasi River; De vos et al., 2001: 131,
Malagarasi River.

Holotype: CU 97334, ex. CU 95207, Tanzania, Malagarasi River at Lower Igamba Falls (Kasagwe), Malagarasi River drainage, 5° 10' 48"S, 30° 03' 03"E (1: 52.3).

Paratypes: **Malagarasi River drainage:** CU 90414, Tanzania, Downstream of bridge across Malagarasi River at Uvinza, 5° 07' 03.7"S, 30° 22' 27.1"E (1: 50.8); CU 95207, same data as holotype, (6: 41.3-69.8); CU 95208, Tanzania, Malagarasi River up river 12 km E of Uvinza near Village of Kanzibwe, 5° 08' 23.5"S, 30° 29' 21.6"E (1: 55.3); CU 95209, Tanzania, Malagarasi River downriver 4 km W from Uvinza; village of Nkwasa, 5° 05' 52.6"S, 30° 21' 16.2"E (5: 38.1-74.7); CU 95210, Tanzania, Malagarasi River near fork in road to Ngutu, 5° 06' 56.3"S, 30° 17' 48.1"E (1: 67.6), CU 95211, Tanzania, Malagarasi River in first site in gorge, 5° 13' 44.2"S, 30° 13' 26.5"E (6: 41.2-52.9); CU 95212, Tanzania, Malagarasi River in gorge, 5° 12' 10.2"S, 30° 10' 11.1"E (1: 44.8); MRAC B3-06-P-1-3, ex CU 95209 (3: 46.3-54.6); SAIAB 187275, ex CU 95209 (3: 45.6-52.6); UF 184234, ex CU 95209 (3: 41.8-64.7).

Non-types

Malagarasi River drainage: CU 90426, Tanzania, Malagarasi River at bridge between Kafuru and Makere, 4° 01' 32.5"S, 30° 33' 06.5"E (3:24.6-29.3), CU 90469, Tanzania, Malagarasi River at bridge between Kafuru and Makere, 4° 01' 32.5"S, 30° 33' 06.5"E (26: 24.7-46.7); MRAC 47343-362, Burundi, Malagarazi River and its tributaries, (19: 38.7-96.2), MRAC 91030.0217, Burundi, Nyesasa River, Trib of Muyovozi River (which is a tributary of the Malagarazi), at bridge on RN8 [now RN11] just before Gihofi, ca. 3° 59'S, 30° 09'E (1: 51.4); MRAC 91030.0218-0225, Burundi, Kinywa River, Trib of Malagarazi, at the bridge on Route Pr85, near town of Buyaga, ca. 3° 55'S, 30° 10'E (7: 16.2-69.7); MRAC 91030.0226-0248, Burundi, Nyankanda River, Trib of Malagarazi, in the Fault of the Germans, on Route Pr 85, ca. 3° 54'S, 30° 13'E (23: 33.5-65.4); MRAC 91030.0249-0295, Burundi, Ntanga River, Trib of Malagarazi, at

the bridge on Road of General interest 4, 7 km from Kinyinya, ca. 3° 37' 39.3"S, 30° 17' 54.5"E (47: 26.4-76.6); MRAC 91030.0300-0309, Burundi, Musasa River, Trib of Muyovozi, at the bridge on RN8, ± 5 km Rutana, ca. 3° 58' 44.9"S, 30° 01' 56.0"E (10: 45.6-71.5); MRAC 91030.0310-0315, Burundi, Mutsindozi River, trib of Malagarazi at bridge on Route RN12, km 39 from Lake Nyanza, ca. 4° 05'S, 29° 57'E (6: 54.7-67.5); MRAC 91061.0106, Burundi, Musasa River, Trib of Muyovozi, at the bridge on RN8, ± 5 km Rutana, ca. 3° 58' 44.9"S, 30° 01' 56.0"E (1: 55.3); MRAC 91062.0896-0923, Burundi, Mutsindozi River, near the sugar refinery, Gihofi, ca. 4° 02'S, 30° 09'E (28: 29.6-73.1); MRAC 91062.0924-0929, Burundi, Musasa River, Trib of Muyovozi, at the bridge on RN8, ± 5 km Rutana, ca. 3° 58' 44.9"S, 30° 01' 56.0"E (6: 36.4-85.9); MRAC 91062.0930-0932, Burundi, Mashuro River, about 5 km from Gihofi towards Giharo, 3° 57' 37"S, 30° 09' 54.6"E (3: 28.9-48.7); MRAC 91062.0933, Burundi, Ruru River, trib of Rumpungwe River, on the road towards Cendajuru, ca. 3° 19'S, 30° 34'E (1: 79.2); MRAC 91062.0950-0957, Burundi, Kabingo, Mazimero River, on Rutana- Kinyinya Road, 3° 53' 01.5"S, 30° 11' 54.2"E (8: 37.1-63.1); MRAC 91062.0958-1056, Burundi, Rugoma River, trib of Rumpungwe River, 4 km from Kinyinya, ca. 3° 38'S, 30° 23'E (99: 24.6-100.9); MRAC 91062.1057-1081, Burundi, Rugaragara River, on Kinyinya-Gisuru Road, about ± 20 km from Gisuru, ca. 3° 27'S, 30° 24'E (25: 25.9-67.7); MRAC 91062.1082-1094, Burundi, Kiruhura River, trib of Mwambu River, zone Muyange, ENE of Cendajuru, ca. 3° 16'S, 30° 40'E (13: 32.6-71.8); MRAC 91062.1095-1107, Burundi, Nyabigosi River, trib of Rumpungwe River, near Gisuru, ca. 3° 29'S, 30° 30'E (13: 28.3-68.5); MRAC 91062.1139-1168, Burundi, Gitinwa River, trib of Ruru River, trib of Rumpungwe River, near Cendajuru, before village of Gusiana, ca. 3° 20'S, 30° 34'E (30:

24.6-83.9); MRAC 91062.1169-1245, Burundi, Mukitcha River, ± 8 km towards Cendajuru from Gasenyi, ca. 3° 17'S, 30° 36'E (77: 28.7-74.6); MRAC 91079.0055-0058, Burundi, Musasa river, (local name Uruhuzi) 78 km SSE of Gitega, ± 10 km SE of Rutana, 4° 00' 00"S, 30° 06' 47.3"E (5: 25.9-71.9); MRAC 93150.0184-0186, Burundi, Mazimero River, on road from Rutana-Kinyinya, ca. 3° 54'S, 30° 13'E (3: 63.5-75.9); MRAC 93150.0187-0238, Burundi, Ruru River, about 9 km from Muyaga towards Cendajuru, ca. 3° 18'S, 33° 13'E (52: 35.4-80.4); MRAC 93150.0239, Burundi, Ntanga River, Trib of Malagarazi, at the bridge on Road of General interest 4, 7 km from Kinyinya, ca. 3° 38'S, 30° 18'E (1: 52.7); MRAC 93150.0240-0260, Burundi, Mukazyee River (Nyamabuye), 10 km from Giharo towards Kinyinya, ca. 3° 47'S, 30° 18'E (21: 26.9-72.9); MRAC 93150.0261-0333, Burundi, Idumaniro River, on Cendajuru- Gitwenge road, ca. 3° 15'S, 30° 39'E (73: 25.8-81.1); MRAC 93150.0351-0359, Burundi, Rumpungwe River, near Gisuru, on road from Kinyinya-Gisuru, ca. 3° 27'S, 30° 29'E (9: 26.2-74.3); MRAC 93150.0360-0378, Burundi, Kiruhura River, on Cendajuru- Gitwenge road, ca. 3° 15'S, 30° 39'E (18: 35.8-65.8), MRAC 93150.0379-0382, Burundi, Nyanzari River, on Cankuzo-Mushiha road, near Gishungo, 3° 04' 25"S, 30° 39' 22"E (4: 48.3-68.6); MRAC 93150.0383-0392, Burundi, Mutsindozi River, near the sugar refinery, Gihofi, ca. 4° 00'S, 30° 40'E (12: 44.2-80.0); MRAC 93152.0613-0622, Tanzania, Malagarazi River, rapids at Uvinza, near salt mine, 5° 06' 07"S, 30° 21' 56"E (11: 37.1-59.9); MRAC 93152.0623-0643, Tanzania, Nyamgongo River, trib of Malagarazi River, km 46 from Uvinza to Kasulu, 4° 48' 34"S, 30° 12' 51"E (21: 28.3-69.0); MRAC 96031.1548-1549, Burundi, Nyarugunga River, km 30 after Kinyinya, on Kinyinya-Gisuru road, ca. 4° 52'S, 29° 50'E (2: 53.7-58.6); MRAC 96031.1550-1562, Burundi,

Nyarugunga River, km 30 after Kinyinya, on Kinyinya-Gisuru road, ca. 4° 52'S, 29° 50'E (13: 47.6-86.6); MRAC 96031.1563-1570, Burundi, Nyarubare River, km 15 on Kinyinya-Gisuru road, ca. 3° 34'S, 30° 26'E (8: 45.7-81.8); MRAC 96083.1141, Tanzania, Ruchigi River, 7km after Kasulu to Kibando, trib of Malagarasi, 4° 32' 01.4"S, 30° 08' 58.6"E (1: 71.5); MRAC 96083.1142-1145, Tanzania, Mgandazi River, near Kasulu, ca. 4° 37'S, 30° 06'E (4: 48.7-72.6). Luiche River drainage: MRAC 93152.0644-0649, Tanzania, Mukuti River, trib. of Luiche River, on road from Kigoma to Kasulu, 4° 53' 12.1"S, 29° 52' 12"E (6: 35.0-118.8); MRAC 93152.0650-0651, Tanzania, Mungonya River, trib of Luiche River, ± 10 km from Kigoma, route Kigoma-Kasulu, 4° 52' 28"S, 29° 49' 52"E (2: 65.2-90.9); MRAC 93152.0652-0661, Tanzania, Kidahwe River, km 34 on Kigoma-Uvinza road, trib of Luiche River, ca. 4° 53'S, 29° 48'E (12: 68.6-112.0). Lake Rukwa Basin: MRAC 191055-057, Zambia, Saisi and Kalambo river, Tunduma road, ca. 9° 06'S, 31° 29'E (3: 30.6-39.1); MRAC 191092-113, Zambia, Saisi River, at crossing of Abercorn-Tunduma road, 9° 05' 38.1"S, 31° 29' 20.5"E (22: 27.5-104.8); MRAC 191423-424, Zambia, Lumi river, Kawimbe road, ca. 8° 50'S, 31° 32'E (2: 31.6-35.4); MRAC 94034.0822-0831, Tanzania, Piti River, 63 km south of Rungwa River on road to Makongolosi, 7° 26' 48.5"S, 33° 25' 22.1"E (10: 32.9-66.6); SAIAB 37397, Zambia, Near Mbala, Saisi River at Tunduma Road near Neilsons Farm, ca. 9° 05'S, 31° 32'E (1: 55.4); SAIAB 38096, Zambia, Saisi River at Tunduma Road bridge, 9° 05' 39"S, 31° 29' 22"E (1: 35.8); SAIAB 39557, Zambia, Saisi River at Tunduma Road bridge, ca. 9° 05' 39"S, 31° 29' 22"E (1: 57.0); SAIAB 38108, Zambia, Chitungulu stream, Nsunzu Farm, trib of Saisi River, ca. 9° 05'S, 31° 32'E (2: 54.3-70.3); SAIAB 39543, Zambia, Chitungulu stream, Nsunzu Farm, trib of Saisi River, ca. 9° 05'S, 31° 32'E (1: 37.6);

SAIAB 50333, Tanzania, Lupa River at Lupatingatinga, on Makongolsi-Rungwa Road, 8° 01' 48.9"S, 33° 16' 18.9"E (1: 42.0). Rufiji basin, Upper Great Ruaha River system: SAIAB 59388, Tanzania, Bridge near Chinata on Mbeya-Iringa road, 8° 51' 35.7"S, 34° 01' 33"E (31: 49.2-111.7); SAIAB 59397, Tanzania, Great Ruaha River at Rte A104 crossing just east of Chimala, 8° 51' 16.4"S, 34° 05' 7.0"E (32: 30.3-72.6).

Diagnosis

Diagnostic characters are summarized in Table 5-2. *Amphilius* n. sp. Malagarasi is diagnosed from *A. jacksonii*, *A. n. sp. Ruzizi* and *A. n. sp. Lake Kyogo* by its deeper caudal peduncle (caudal peduncle depth 9.9-12.3% SL vs. 4.8-9.5% SL), and from *A. n. sp. Ruzizi* and *A. n. sp. Congo* by its wider interorbital width (28.1-35.8% HL vs. 23.4-27.7% HL). It is distinguished from *A. n. sp. Rufiji* by its longer caudal peduncle (caudal peduncle length 16.0-18.8% SL vs. 13.3-15.5% SL) and shorter dorsal-fin insertion to adipose-fin insertion length (37.5-41.7% SL vs. 42.2-44.6% SL). It is further diagnosed from *A. n. sp. Congo* by having fewer total gill rakers on the first gill arch (7-9, rarely 6 or 10 vs. 10-11, rarely 9 or 12).

Description

Morphometric data are in Table 4. Body elongate, ventral profile flattened ventrally to anal-fin base, then tapered dorsally to end of caudal peduncle. Dorsal profile rising gently from tip of snout to origin of dorsal fin, then nearly horizontal to end of caudal peduncle. Greatest body depth at dorsal-fin origin. Caudal peduncle laterally compressed, with crenellated epidermal fold. Anus and urogenital openings located at midpoint of adpressed pelvic fin, much closer to insertion of pelvic fin than to origin of anal fin. Skin smooth. Lateral line complete, extending from dorsal edge of opercular cavity to base of caudal fin.

Head and anterior part of body depressed and broad. Head wedge-shaped in lateral view. Snout broad, blunt when viewed from above. Head becoming wider from tip of snout to pectoral-fin base. Branchiostegal membranes moderately joined at isthmus forming a V-shaped connection.

Mouth broad, gently curved, subterminal. Lips moderately fleshy, slightly papillate. Rictal lobe large and slightly papillate. Anterior portion of premaxillary tooth band exposed with mouth closed. Premaxillary tooth patches joined, forming crescent shaped band. Premaxillary and dentary teeth short, conical. Dentary tooth patches forming U-shaped band, separated medially.

Three pairs of simple, tapered circumoral barbels. Maxillary barbel large, fleshy and flattened with pointed tip; barbel extending posterolaterally from corner of mouth, to pectoral-fin base. Outer mandibular barbel thin with pointed tip, origin at posterior corner of lower jaw, extending to origin of pectoral-fin. Inner mandibular barbel originates anterolaterally of inner mandibular barbel, extending to edge of branchiostegal membrane. Branchiostegal membrane with 7 (17), or 8 (24) rays. Gill rakers on first epibranchial 2 (20) or 3 (21); rakers on first ceratobranchial 4 (1), 5 (8), 6 (25), or 7 (7); total gill rakers on first arch 6 (1), 7 (4), 8 (16), 9 (16) or 10 (4).

Eye small, positioned dorsolaterally approximately midway between tip of snout and posterior margin of operculum. Horizontal diameter of eye slightly wider than vertical diameter. Eye without free orbit; covered with skin confluent with dorsal surface of head. Anterior and posterior nares with prominent tubular rims; nares separate but relatively close to each other. Posterior nare located about midway between eye and tip of snout.

Dorsal-fin origin at point over or just posterior to tip of pectoral fin. Dorsal fin with i,6 (41) rays, and fin margin straight. Pectoral fin with i,8 (35), or i,9 (6) rays; unbranched ray greatly thickened. Pectoral fin with four or five innermost rays progressively shorter making posterior fin margin rounded. Origin of pelvic fin posterior of dorsal-fin insertion. Pelvic fin with i,5 (41) rays with first ray unbranched and greatly thickened. Pelvic fin with straight posterior margin.

Adipose-fin base longer than anal-fin base, origin anterior to origin of anal-fin base, fin extending past anal-fin insertion. Margin strongly convex with sharply rounded edge, deeply incised posteriorly. Caudal fin deeply forked with tips of lobes rounded; fin with i,5,6,i (40) principal rays. Anal fin with short base, origin posterior to origin of adipose-fin base, with ii,6 (7), ii,7 (2), iii,5 (4), iii,6 (27), or iii,7 (1) rays. Anal-fin margin almost straight.

Coloration

Body variably mottled with dark saddles. First saddle posterior of head, second saddle at dorsal fin, third saddle between dorsal and adipose fins, fourth saddle under anterior of adipose fin, and fifth saddle on caudal peduncle. All saddle connected laterally by broad stripe. Ventral region light brown with fourth and fifth saddle extending around ventral side. Dorsal, and anal fins light brown with dark medial band. Adipose fin dark brown to black, with posterior distal edge cream colored. Pectoral and pelvic fins positioned horizontally with upper surfaces cream colored with dark fin base and dark medial band. Lower surfaces light yellow. Caudal fin cream colored with dark markings on upper and lower lobes. Caudal coloration asymmetrical, with lower lobe almost completely dark (except for small cream colored mark at base of caudal and cream

colored tip). Upper lobe with less dark pigment, with dark blotch covering dorsal edge, but caudal base, medial ventral edge, and tip cream colored.

Distribution

Malagarasi River drainage, western Tanzania and southern Burundi. Also, Luiche River drainage western Tanzania, Lake Rukwa basin, Tanzania and Zambia, and upper Great Ruaha River system, Rufiji basin, eastern Tanzania (Figure 5- 2).

Amphilius n. sp. Congo

(Fig. 5-5; Table 5-5)

Amphilius platyichir (non Günther) Boulenger, 1920: 26, Lubumbashi à Élisabethville

(MRAC P-6787) [Kafubu River system, Upper Congo basin]

Holotype: CU 97335, ex. CU 91052, Zambia, Tswishi Stream at bridge under construction, Lwela River system, 11° 33' 26"S, 29° 09' 59"E (1: 83.1).

Paratypes: **Lwela River system:** AUM 57570, ex. CU 91049 (3: 36.3-51.7); CU 91049, Zambia, Lwela River at bridge on Mansa-? Road, 11° 33' 25"S, 29° 10' 10"E (21: 32-104.5); CU 91050, Zambia, Ngo Stream, about 40 km SW of Mansa, 11° 31' 33"S, 29° 09' 03"E (4: 34.2-46.8); CU 91052, same data as holotype, (11: 31.7-44.9); SAIAB 76634, same data as CU 91049 (12: 32.7-86.7); SAIAB 76789, same data as CU 91050 (5: 36.0-47.5); MRAC B3-06-P-4-6, ex. CU 91049 (3: 41.9-47.4); SAIAB 76799, same data as holotype (13: 27.3-57.2); UF 184235 (3: 39.0-50.8).

Non-types

Chambeshi River system: CU 91056, Zambia, Kanchibiya Stream at bridge on Kasama-Mpika road, 11° 29' 44.2"S, 31° 16' 46.6"E (28: 32.5-57.0); MRAC 96031.1540-1547, Zambia, Musombizi River, trib of Chambeshi, ± 55km on the road Mbala-Kasama, ca. 09° 18'S, 31° 16.5'E (8: 25.8-57.8); MRAC 96031.1620-1625, Zambia, Chambeshi

River, at bridge km 40 on road Mbala-Kasama, 09° 12' 15.3"S, 31° 20' 49.8"E (6: 57.7-135.6); SAIAB 40125, Zambia, Chambeshi River, rapids near Kapoloso Stream, ca. 10° 43'S, 31° 15'E (1: 47.8); SAIAB 46788, Zambia, Mansha River, Shiwa Hot Springs & road bridge, ca. 11° 10'S, 31° 35'E (16: 32.0-64.8); SAIAB 77139, Zambia, Samfa Rapids at pontoon on Chambeshi River, 10° 51' 07.6"S, 31° 10' 02.3"E (1: 69.5); SAIAB 77142, same data as CU 91056 (28: 29.4-85.3). **Kafubu River system:** MRAC 6787, Democratic Republic of the Congo, Lubumbashi River, at Elisabethville [Lubumbashi], ca. 11° 39'S, 27° 28'E (1: 39.1); MRAC 183365-366, Democratic Republic of the Congo, at the bridge on Lubumbashi River, forested camp of the Kipopo, ca. 11° 33'S, 27° 22'E (2: 31.7-33.1); MRAC 183367-369, Democratic Republic of the Congo, Lubumbashi River, ± 25 km upstream of Elisabethville, ca. 11° 33'S, 27° 22'E (3: 33.9-39.2); MRAC 73025.0803, Democratic Republic of the Congo, Lubumbashi, in front of Lido, Lubumbashi River, ca. 11° 39'S, 27° 27'E (1: 118.8).

Luapula River system: SAIAB 76705, Zambia, Mambilima Falls on Luapula River, 10° 32' 22.2"S, 28° 39' 40.3"E (1: 57.0). **Lufira River system:** MRAC 165341, Democratic Republic of the Congo, Gombela, Kafila River, Katanga, 10° 46' 31"S, 27° 47' 38"E (1: 60.8); SAIAB 77478, Democratic Republic of Congo, Diptera River near Fungurume, 10° 36' 20.9"S, 26° 16' 40.1"E (4: 43.5-77.0). **Luongo River system:** CU 91051, Zambia, Luongo River, below Musonda Dam, on road from Mansa to Kashiba (route D79), 10° 42' 15.5"S, 28° 48' 03.6"E (2: 60.0-62.0); CU 91053, Zambia, Luongo River above pontoon south of Musonda Falls, Mansa-Serenje Road (route D235), 10° 40' 51.6"S, 28° 43' 09.1"E (2: 57.0-78.7); CU 91054, Zambia, Luongo River at bridge on Kashiba-Mwenda road (route M3), 10° 28' 12.7"S, 31° 01' 28.2"E (3: 44.0-105.1);

SAIAB 76663, same data as CU 91053 (3: 54.6-94.3); SAIAB 76670, same data as CU 91051 (1: 83.2); SAIAB 76729, same data as CU 91054 (5: 39.9-65.4); SAIAB 76925, Zambia, Luongo River at Mukonshi Bridge on Mwenda-Kawambwa road (route M13), 10° 08' 39"S, 29° 10' 01.2"E (41: 32.2-53.8). **Upper Congo (Lualaba) River system:** SAIAB 81501, Democratic Republic of the Congo, Bona River [Tributary of Lac Delcommune (= Lac Nzilo)], Near Lenge Village, 10° 36' 34"S, 25° 49' 15"E (1: 78.8); SAIAB 81566, Democratic Republic of the Congo, Large Stream 1, Bona River system, 10° 35' 49"S, 25° 53' 23"E (1: 43.0); SAIAB 82855, Democratic Republic of the Congo, Kisanfu River, Upstream of Nayebe crossing, 10° 48' 01.1"S, 25° 58' 52.6"E (2: 46.8-85.4); SAIAB 82877, Democratic Republic of the Congo, Kisanfu River, Just below bridge by hydroelectric station, 10° 45' 49.3"S, 25° 57' 49.3"E (6: 36.5-42.1); SAIAB 82898, Democratic Republic of the Congo, Kisanfu River, Channel downstream of hydro station, 10° 45' 49.3"S, 25° 57' 49.3"E (6: 37.5-74.3).

Diagnosis

Diagnostic characters are summarized in Table 5-2. *Amphilius* n. sp. Congo is diagnosed from all other species of the *Amphilius jacksonii* complex by having more gill rakers on the first gill arch (10-11, rarely 9 or 12 vs. 6-9, rarely 5 or 10). It is further diagnosed from *A. jacksonii* by its deeper caudal peduncle (caudal peduncle depth 9.7-11.4% SL vs. 4.8-7.9% SL), shorter caudal peduncle (caudal peduncle 14.4-16.4% SL vs. 16.7-20.6% SL), and less slender body (body depth at anus 13.9-14.9% SL vs. 9.6-13.2% SL). It is further diagnosed from *A. n. sp. Ruzizi* by having more branchiostegal rays (8-9 vs. 6-7), a deeper caudal peduncle (caudal peduncle depth 9.7-11.4% SL vs. 8.6-9.5% SL), shorter caudal peduncle (caudal peduncle 14.4-16.4% SL vs. 18.7-20.3% SL), and less slender body (body depth at anus 13.9-14.9% SL vs. 11.1-12.9% SL).

Amphilius n. sp. Congo is further diagnosed from *A. n. sp. Malagarasi*, *A. n. sp. Rufiji*, and *A. n. sp. Lake Kyogo* by its narrower interorbital width (25.1-27.7% HL vs. 28.1-35.8% HL), and from *A. n. sp. Rufiji* by having more branchiostegal rays (8-9 vs. 6-7, rarely 8), more branched pectoral-fin rays (9-10 vs. 7-8, rarely 9), and a shorter dorsal-fin insertion to adipose-fin insertion length (37.5-41.2% SL vs. 42.2-44.6% SL). It is further diagnosed from *A. n. sp. Lake Kyogo* by its deeper caudal peduncle (caudal peduncle depth 9.7-11.4% SL vs. 8.1-9.5% SL), shorter caudal peduncle (caudal peduncle 14.4-16.4% SL vs. 16.8-20.9% SL).

Description

Morphometric data are in Table 5-5. Body elongate, ventral profile flattened ventrally to anal-fin base, then tapered dorsally to end of caudal peduncle. Dorsal profile rising gently from tip of snout to origin of dorsal fin, then nearly horizontal to end of caudal peduncle. Greatest body depth at dorsal-fin origin. Caudal peduncle laterally compressed, with crenellated epidermal fold. Anus and urogenital openings located at midpoint of adpressed pelvic fin, closer to insertion of pelvic fin than to origin of anal fin. Skin smooth. Lateral line complete, extending from dorsal edge of opercular cavity to base of caudal fin.

Head and anterior part of body depressed and broad. Head wedge-shaped in lateral view. Snout broad, blunt when viewed from above. Head becoming wider from tip of snout to pectoral-fin base. Branchiostegal membranes moderately joined at isthmus forming a V-shaped connection.

Mouth broad, gently curved, subterminal. Lips moderately fleshy, slightly papillate. Rictal lobe large and slightly papillate. Anterior portion of premaxillary tooth band exposed with mouth closed. Premaxillary tooth patches joined, forming crescent

shaped band. Premaxillary and dentary teeth short, conical. Dentary tooth patches forming *U*-shaped band, separated medially.

Three pairs of simple, tapered circumoral barbels. Maxillary barbel large, fleshy and flattened with pointed tip; barbel extending posterolaterally from corner of mouth, to pectoral-fin base. Outer mandibular barbel thin with pointed tip, origin at posterior corner of lower jaw, extending to origin of pectoral-fin. Inner mandibular barbel originates anterolaterally of inner mandibular barbel, extending to edge of branchiostegal membrane. Branchiostegal membrane with 8 (25), or 9 (12) rays. Gill rakers on first epibranchial 2 (1) or 3 (37); rakers on first ceratobranchial 7 (22), or 8 (15); total gill rakers on first arch 10 (22) or 11 (15).

Eye small, positioned dorsolaterally approximately midway between tip of snout and posterior margin of operculum. Horizontal diameter of eye slightly wider than vertical diameter. Eye without free orbit; covered with skin confluent with dorsal surface of head. Anterior and posterior nares with prominent tubular rims; nares separate but relatively close to each other. Posterior nare located about midway between eye and tip of snout.

Dorsal-fin origin at point over tip of pectoral fin. Dorsal fin with i,6 (37) rays, and fin margin straight. Pectoral fin with i,9 (37) rays; unbranched ray greatly thickened. Pectoral fin with four or five innermost rays progressively shorter making posterior fin margin rounded. Origin of pelvic fin posterior of dorsal-fin insertion. Pelvic fin with i,5 (37) rays with first ray unbranched and greatly thickened. Pelvic fin with straight posterior margin.

Adipose-fin base longer than anal-fin base, origin anterior to origin of anal-fin base, fin extending past anal-fin insertion. Margin strongly convex with sharply rounded edge, deeply incised posteriorly. Caudal fin deeply forked with tips of lobes rounded; fin with i,5,6,i (36) principal rays. Anal fin with short base, origin posterior to origin of adipose-fin base, with ii,6 (2), ii,7 (2), iii,6 (24), or iii,7 (10) rays. Anal-fin margin almost straight.

Coloration

Body variably mottled with dark saddles. First saddle posterior of head, second saddle at dorsal fin, third saddle between dorsal and adipose fins, fourth saddle under anterior of adipose fin, and fifth saddle on caudal peduncle. All saddle connected laterally by broad stripe. Ventral region light brown with fourth and fifth saddle extending around ventral side. Dorsal, and anal fins light brown with dark medial band. Adipose fin dark brown to black, with anterior and posterior distal edges cream colored. Pectoral and pelvic fins positioned horizontally with upper surfaces cream colored with dark fin base and dark medial band. Lower surfaces light yellow. Caudal fin cream colored with dark markings on upper and lower lobes. Caudal coloration asymmetrical, with lower lobe almost completely dark (except for small cream colored mark at base of caudal and cream colored tip). Upper lobe with less dark pigment, with dark blotch covering dorsal edge, but caudal base with large cream colored patch and tip cream colored.

Distribution

Upper Congo basin upstream of Kabalp, Democratic Republic of the Congo including tributaries of the Upper Congo mainstem, the Lufira River drainage, and the Kafubu, Chambeshi, Lwela, and Luongo River systems of the Luapula River drainage (Figure 5-2).

***Amphilius n. sp. Rufiji* (Figure 5-6; Table 5-6)**

Amphilius platyichir (non Günther) Bailey, 1969: 192 (in part), Kilombero (BMNH 1969.2.11.192-194) [Rufiji basin].

Holotype: UF 184237, ex. UF 170743, Tanzania, Sonjo River at bridge in Man'gula on road from Mikumi to Ifakara, altitude 302 m, Rufiji River basin, 07° 48' 29.6"S, 36° 53' 47.6"E (1: 86.3).

Paratypes: **Rufiji River basin:** AMNH 258334, same data as holotype, ex. CU 93734 (10: 43.4-61.5); AUM 57571, same data as holotype, ex. CU 93734 (10: 40.7-66.8); BMNH 1969.2.11.192-194, Tanzania, Near Kiberege, trib of Kilombero River, ca. 07° 57'S, 36° 52'E (3: 30.8-31.7); CU 93731, Idete River at bridge in Idete on road from Ifakara to Taveta, altitude 310 m, 08° 06' 14"S, 36° 29' 17"E (7: 27.3-67.3); CU 93732, Tanzania, 12 Bridges River at overhead bridge for train on road from Mikumi to Ifakara, altitude 419 m, 07° 27' 53"S, 37° 00' 52"E (4: 49.7-72.4); CU 93734, same data as holotype, (40: 36.7-69.9); MRAC B3-06-P-7-16, same data as holotype, ex. UF 170743 (10: 43.3-60.5); SAIAB 187279, same data as holotype, ex. UF 170743 (10: 45.1-57.0); UF 170706, same data as CU 93732 (5: 47.6-80.3); UF 170729, same data as CU 93731 (8: 28.9-84.7); UF 170743, same data as holotype (40: 39.8-84.7).

Non-types

Wami basin: CU 93730, Tanzania, Divue River above & below falls along road from Dumila to Turiani, altitude 374 m, 06° 10' 26.8"S, 37° 34' 59.8"E (10: 27.1-57.5); CU 93733, Tanzania, Wami River at bridge in Rudewa on road from Dumila to Kilosa, altitude 433 m, 06° 40' 45.2"S, 37° 07' 27.0"E (8: 27.1-41.2); UF 170707, same data as CU 93733 (10: 25.9-77.0); UF 170708, same data as CU 93730 (10: 40.0-59.4).

Diagnosis

Diagnostic characters are summarized in Table 5-2. *Amphilius n. sp.* *Rufiji* is diagnosed from *A. jacksonii*, *A. n. sp.* Ruzizi, *A. n. sp.* Malagarasi, and *A. n. sp.* Lake Kyogo by its shorter caudal peduncle (caudal peduncle length 13.3-15.5% SL vs. 16.0-20.9% SL), and from *A. jacksonii*, *A. n. sp.* Ruzizi, and *A. n. sp.* Lake Kyogo by its deeper caudal peduncle (caudal peduncle depth 10.1-12.0% SL vs. 4.8-9.5% SL). It is diagnosed from *A. n. sp.* Ruzizi, *A. n. sp.* Malagarasi, and *A. n. sp.* Congo by its longer dorsal-fin insertion to adipose-fin insertion length (42.2-44.6% SL vs. 37.5-41.7% SL). *Amphilius n. sp.* *Rufiji* is further diagnosed from *A. jacksonii* by its deeper body (body depth at anus 14.5-17.4% SL vs. 9.6-13.2% SL), and from *A. n. sp.* Ruzizi by wider interorbital width (28.9-34.1% HL vs. 23.4-25.1% HL) and deeper body (body depth at anus 14.5-17.4% SL vs. 11.1-12.9% SL). It is further diagnosed from *A. n. sp.* Lake Kyogo by having fewer branched pectoral-fin rays (7-8, rarely 9 vs. 9), and from *A. n. sp.* Congo by its fewer branchiostegal rays (6-7, rarely 8 vs. 8-9), fewer branched pectoral-fin rays (7-8, rarely 9 vs. 9-10), fewer gill rakers on the first gill arch (6-8, rarely 9 vs. 10-11, rarely 9 or 12), and wider interorbital width (28.9-34.1% HL vs. 25.1-27.7% HL).

Description

Morphometric data are in Table 5-6. Body elongate, ventral profile flattened ventrally to anal-fin base, then tapered dorsally to end of caudal peduncle. Dorsal profile rising steeply from tip of snout to origin of dorsal fin, then nearly horizontal to end of caudal peduncle. Greatest body depth at dorsal-fin origin. Caudal peduncle laterally compressed, with crenellated epidermal fold. Anus and urogenital openings located at midpoint of adpressed pelvic fin, closer to insertion of pelvic fin than to origin of anal fin.

Skin smooth. Lateral line complete, extending from dorsal edge of opercular cavity to base of caudal fin.

Head and anterior part of body depressed and broad. Head wedge-shaped in lateral view. Snout broad, blunt when viewed from above. Head becoming wider from tip of snout to pectoral-fin base. Branchiostegal membranes moderately joined at isthmus forming a V-shaped connection.

Mouth broad, gently curved, subterminal. Lips moderately fleshy, slightly papillate. Rictal lobe large and slightly papillate. Anterior portion of premaxillary tooth band exposed with mouth closed. Premaxillary tooth patches joined, forming crescent shaped band. Premaxillary and dentary teeth short, conical. Dentary tooth patches forming U-shaped band, separated medially.

Three pairs of simple, tapered circumoral barbels. Maxillary barbel large, fleshy and flattened with pointed tip; barbel extending posterolaterally from corner of mouth, to pectoral-fin base. Outer mandibular barbel thin with pointed tip, origin at posterior corner of lower jaw, extending to origin of pectoral-fin. Inner mandibular barbel originates anterolaterally of inner mandibular barbel, extending to edge of branchiostegal membrane. Branchiostegal membrane with 6 (22), 7 (123), or 8 (2) rays. Gill rakers on first epibranchial 1 (1), 2 (122) or 3 (24); rakers on first ceratobranchial 4 (19), 5 (95), or 6 (33); total gill rakers on first arch 6 (19), 7 (79) 8 (42) or 9 (7).

Eye small, positioned dorsolaterally approximately midway between tip of snout and posterior margin of operculum. Horizontal diameter of eye slightly wider than vertical diameter. Eye without free orbit; covered with skin confluent with dorsal surface of head. Anterior and posterior nares with prominent tubular rims; nares separate but

relatively close to each other. Posterior nare located about midway between eye and tip of snout.

Dorsal-fin origin at point over tip of pectoral fin. Dorsal fin with i,6 (147) rays, and fin margin straight. Pectoral fin with i,7 (13), i,8 (130), or i,9 (4) rays; unbranched ray greatly thickened. Pectoral fin with four or five innermost rays progressively shorter making posterior fin margin rounded. Origin of pelvic fin posterior of dorsal-fin insertion. Pelvic fin with i,5 (147) rays with first ray unbranched and greatly thickened. Pelvic fin with straight posterior margin.

Adipose-fin base longer than anal-fin base, origin anterior to origin of anal-fin base, fin extending past anal-fin insertion. Margin strongly convex with sharply rounded edge, deeply incised posteriorly. Caudal fin deeply forked with tips of lobes rounded; fin with i,5,5,i (4), i,5,6,i (141) or i,6,6,i (2) principal rays. Anal fin with short base, origin posterior to origin of adipose-fin base, with ii,6 (56), ii,7 (34), iii,5 (3), iii,6 (50), or iii,7 (5) rays. Anal-fin margin almost straight.

Coloration

Body variably mottled with dark saddles. First saddle posterior of head, second saddle at dorsal fin, third saddle between dorsal and adipose fins, fourth saddle under anterior of adipose fin, and fifth saddle on caudal peduncle. All saddles connected laterally by broad stripe. Ventral region light brown with fourth and fifth saddle extending around ventral side. Dorsal, and anal fins light brown with dark medial band. Adipose fin dark brown to black, with anterior and posterior distal edges cream colored. Pectoral and pelvic fins positioned horizontally with upper surfaces cream colored with dark fin base and dark medial band. Lower surfaces light yellow. Caudal fin cream colored with

dark markings on upper and lower lobes. Caudal coloration variable but usually spotted and asymmetrical, with lower lobe more pigmented.

Distribution

Rufiji and Wami River basins, eastern Tanzania (Figure 5-2).

Amphilius n. sp. Lake Kyogo (Figure 5-7; Tables 5-7)

Amphilius jacksonii Seegers et al., 2003: 37, Lake Victoria drainage (affluent rivers)

[Nile basin]

Holotype: UF 184238, ex. UF 169233, Uganda, Manafwa River at Bumwangu, Lake

Kyogo drainage, Nile basin, 00° 56' 26.2"N, 34° 16' 49.2"E (1: 104.1).

Paratypes: **Lake Kyogo drainage:** AUM 47147, same data as holotype (16: 37.7-112.3); AUM 47149, Uganda, Malaba River at Lwakhakha, border between Uganda and Kenya, 00° 47' 04"N, 34° 22' 44"E (7: 46.3-98.1); BMNH 1961.6.13.19, Uganda, Malawa [=Malaba] River, ca. 00° 35'N, 34° 03'E (1: 99.4); BMNH 1962.2.6.62-63, Uganda, Malawa [=Malaba] River, ca. 00° 35'N, 34° 03'E (2: 80.0-107.9); BMNH 1965.10.15.18-21, Kenya, Malikisi River, ca. 01° 37'N, 34° 13'E (4: 35.7-48.0); CU 97333, same data as holotype, ex. AUM 47147 (3: 50.3-90.5); MRAC B3-06-P-17-19, same data as holotype, ex. UF 169233 (3: 56.0-88.1); SAIAB 187280, same data as holotype, ex. UF 169233 (3: 47.9-98.0); UF 169233, same data as holotype (15: 43.0-107.6); UF 169235, same data as AUM 47149 (7: 45.4-90.1).

Non-types

Lake Kyogo drainage: BMNH 1965.10.15.11-13, Uganda, Sironko River, ca. 01° 29'N, 34° 14'E (2: 103.7-119.5); BMNH 1965.10.15.14-15, Uganda, Sironko River, ca. 01° 29'N, 34° 14'E (1: 101.1); BMNH 1965.10.15.16-17, Uganda, Zuzu River, tributary of the Manafwa River, ca. 01° 13'N, 34° 21'E (2: 40.9-42.1). **Lake Manyara**

Basin: BMNH 1969.2.20.1, Tanzania, Stream entering Lake Manyara, ca. 03° 38'S, 35° 41'E (1: 45.0). **Nzoia River system (NE Lake Victoria tributary):** SAIAB 65048, Kenya, Moi Brgidge, Little Nzoia River, ca. 00° 55'N, 35° 07'E (1: 74.5).

Diagnosis

Diagnostic characters are summarized in Table 5-2. *Amphilius* n. sp. Lake Kyogo is diagnosed from *A. n. sp.* Malagarasi, *A. n. sp.* Congo, and *A. n. sp.* Rufiji by having a more slender caudal peduncle (depth 8.1-9.5% SL vs. 9.9-12.3% SL). It is diagnosed from *A. jacksonii* by having a deeper caudal peduncle (depth 8.1-9.5% SL vs. 4.8-7.9% SL) and a deeper body (body depth at anus 13.5-15.8% SL vs. 9.6-13.2% SL).

Amphilius n. sp. Lake Kyogo is diagnosed from *A. n. sp.* Ruzizi by having a wider interorbital width (28.3-31.7% HL vs. 23.4-25.1% HL) and a deeper body (body depth at anus 13.5-15.8% SL vs. 11.1-12.9% SL). It is further diagnosed from *A. n. sp.* Congo by having fewer gill rakers on the first gill arch (6-8, rarely 5 or 9 vs. 10-11, rarely 9 or 12) and a longer caudal peduncle (length 16.8-20.9% SL vs. 14.4-16.4% SL). *Amphilius* n. sp. Lake Kyogo is further diagnosed from *A. n. sp.* Rufiji by having more branched pectoral-fin rays (9 vs. 7-8, rarely 9) and a longer caudal peduncle (length 16.8-20.9% SL vs. 13.3-15.5% SL).

Description

Morphometric data are in Table 5-7. Body elongate, ventral profile flattened ventrally to anal-fin base, then tapered dorsally to end of caudal peduncle. Dorsal profile rising gently from tip of snout to origin of dorsal fin, then nearly horizontal to end of caudal peduncle. Greatest body depth at dorsal-fin origin. Caudal peduncle laterally compressed, with crenellated epidermal fold. Anus and urogenital openings located at

midpoint of adpressed pelvic fin, closer to insertion of pelvic fin than to origin of anal fin. Skin smooth. Lateral line complete, extending from dorsal edge of opercular cavity to base of caudal fin.

Head and anterior part of body depressed and broad. Head wedge-shaped in lateral view. Snout broad, blunt when viewed from above. Head becoming wider from tip of snout to pectoral-fin base. Branchiostegal membranes moderately joined at isthmus forming a V-shaped connection.

Mouth broad, gently curved, subterminal. Lips moderately fleshy, strongly papillate. Rictal lobe large and papillate. Anterior portion of premaxillary tooth band exposed with mouth closed. Premaxillary tooth patches joined, forming crescent shaped band. Premaxillary and dentary teeth short, conical. Dentary tooth patches forming U-shaped band, separated medially.

Three pairs of simple, tapered circumoral barbels. Maxillary barbel large, fleshy and flattened with pointed tip; barbel extending posterolaterally from corner of mouth, to pectoral-fin base. Outer mandibular barbel thin with pointed tip, origin at posterior corner of lower jaw, extending to origin of pectoral-fin. Inner mandibular barbel originates anterolaterally of inner mandibular barbel, extending to edge of branchiostegal membrane. Branchiostegal membrane with 7 (21), or 8 (25) rays. Gill rakers on first epibranchial 2 (36) or 3 (10); rakers on first ceratobranchial 4 (2), 5 (22), 6 (1), or 7 (1); total gill rakers on first arch 6 (2), 7 (16) 8 (23) or 9 (5).

Eye small, positioned dorsolaterally approximately midway between tip of snout and posterior margin of operculum. Horizontal diameter of eye slightly wider than vertical diameter. Eye without free orbit; covered with skin confluent with dorsal surface

of head. Anterior and posterior nares with prominent tubular rims; nares separate but relatively close to each other. Posterior nare located about midway between eye and tip of snout.

Dorsal-fin origin at point over tip of pectoral fin. Dorsal fin with i,6 (45) or i,7 (1) rays, and fin margin straight. Pectoral fin with i,9 (46) rays; unbranched ray greatly thickened. Pectoral fin with four or five innermost rays progressively shorter making posterior fin margin rounded. Origin of pelvic fin posterior of dorsal-fin insertion. Pelvic fin with i,5 (46) rays with first ray unbranched and greatly thickened. Pelvic fin with straight posterior margin.

Adipose-fin base longer than anal-fin base, origin anterior to origin of anal-fin base, fin extending past anal-fin insertion. Margin strongly convex with sharply rounded edge, deeply incised posteriorly. Caudal fin deeply forked with tips of lobes rounded; fin with i,5,6,i (46) principal rays. Anal fin with short base, origin posterior to origin of adipose-fin base, with ii,6 (10), ii,7 (12), iii,6 (19), or iii,7 (6) rays. Anal-fin margin almost straight.

Coloration

Body variably mottled with dark saddles. First saddle posterior of head, second saddle at dorsal fin, third saddle between dorsal and adipose fins, fourth saddle under anterior of adipose fin, and fifth saddle on caudal peduncle. All saddles connected laterally by broad stripe. Ventral region light brown with fourth and fifth saddle extending around ventral side. Dorsal, and anal fins light brown with faint medial bands. Adipose fin dark brown to black, with posterior distal edge cream colored. Pectoral and pelvic fins positioned horizontally with upper surfaces cream colored with darkened fin base and faint medial bands. Lower surfaces light yellow. Caudal fin cream colored with dark

markings on upper and lower lobes. Caudal coloration asymmetrical, with lower lobe almost completely dark (except for small cream colored mark at base of caudal and cream colored tip). Upper lobe with less dark pigment, with dark blotch covering dorsal edge, but caudal base with large cream colored patch and tip cream colored.

Distribution

Lake Kyogo drainage, western Uganda. Also known from the Nzoia River, a northeastern tributary of Lake Victoria and the Lake Manyara basin, Tanzania (Figure 5-2).

Discussion

The present study examined over 2000 museum specimens of the *Amphilius jacksonii* complex and has determined that it consists of six species, five of which were previously undescribed. Species of the complex are distinguished primarily by differences in body shapes, most notably by differences in body depth and caudal peduncle length and depth. *Amphilius jacksonii* is the species with the most slender body and the longest and most slender caudal peduncle. *Amphilius* n. sp. Rufiji has the deepest body and the shortest and deepest caudal peduncle and appears to have a much smaller maximum body size than the other species in the complex. The largest *Amphilius* n. sp. Rufiji specimen examined is only 86.3 mm SL while specimens greater than 115 mm SL were examined for all other species. Additionally only six of the 186 specimens examined for this species had a standard length greater than 70 mm while specimens greater than 80 mm SL were common in collections of all the other species with many specimens greater than 100 mm SL.

Frequency tables were constructed for counts of four different meristic characters (Tables 7 to 10). Branchiostegal ray counts, total gill raker counts, and branched

pectoral-fin ray counts were found to be useful for distinguishing species. The high number of branchiostegal rays (8 or 9) found in *A. n. sp. Congo* distinguishes it from both *A. n. sp. Rufiji* and *A. n. sp. Ruzizi* which typically have 6 or 7 branchiostegal rays (Table 5-8). *Amphilius n. sp. Congo* also had higher total gill raker counts than all the other species in the complex. Almost all specimens of *A. n. sp. Congo* examined had 10 or 11 gill rakers on the first ceratobranchial while almost all specimens examined of the other species had less than 10 (Table 5-9). The low number of branched pectoral-fin rays found in *A. n. sp. Rufiji* distinguishes it from *A. n. sp. Congo* and *A. n. sp. Lake Kyogo*. In *A. n. sp. Rufiji*, 180 of the 185 specimens examined had less than nine branched pectoral-fin rays while the 47 specimens of *A. n. sp. Lake Kyogo* and the 88 specimens of *A. n. sp. Congo* examined all had nine or more branched pectoral-fin rays (Table 5-10). No clear patterns were observed in the frequency-distribution table of branched anal-fin rays (Table 5-11).

In addition to the characters in the diagnoses, there are coloration differences between species. In *A. n. sp. Congo* and *A. n. sp. Lake Kyogo* the pigment on the caudal fins of juvenile and adult specimens are strongly asymmetrical, with the lower lobe almost completely pigmented (except for small cream colored mark at base of caudal and cream colored tip) and the upper lobe with less pigment, with dark blotch covering dorsal edge, but caudal base with large cream colored patch and tip cream colored. In *A. jacksonii*, *A. n. sp. Malagarasi*, and *A. n. sp. Rufiji*, juveniles have similar caudal-fin coloration, but adults have spotted caudal-fins that are less strongly asymmetrical. *Amphilius n. sp. Ruzizi* differs in caudal-fin coloration from all the other species in the complex. It does not have an asymmetrical caudal-fin pigmentation

pattern; instead it has dark a single dark band on the caudal fin with similar amounts of pigment on the upper and lower lobes.

Amphilius n. sp. Ruzizi also differs from other species in the complex in paired fin coloration and body coloration. The paired fins in *A. n. sp. Ruzizi* do not have dark medial bands as in the other species. Instead, the paired fins are almost entirely brown with only the distal edge cream colored. The body coloration in *A. n. sp. Ruzizi* is similar to other species in the complex in having the same variably mottled coloration with dark saddles, but the areas in between the saddles are uniformly cream colored (vs. these areas cream colored but also stippled with darker pigment in other species of the complex).

All specimens examined of *A. n. sp. Congo* have much bolder dark pigment than what was observed in specimens of all the other species of the complex. The dark pigment the fins and on the body of specimens is consistently much bolder in both juvenile and adult specimens of *A. n. sp. Congo* than juvenile and adult specimens of all other species in the complex.

There is at least one additional undescribed species of the *A. jacksonii* complex that is not described in this study. This species occurs only in the Ivi River system, Lake Edwards drainage, in southwestern Uganda and is being studied by another researcher. This undescribed species was included in a phylogenetic analysis of *Amphilius* that included five of the six species of the complex that are described in this study (Chapter 2). In the analyses that included MtDNA, this undescribed species could not be distinguished from *A. jacksonii*, but in the analyses that included only nuclear DNA, it was recovered as sister to all other members of the complex.

There may be addition undescribed species in the complex in the Rufiji basin. Four specimens examined from the Little Ruaha River system (SAIAB 59406) were very similar to *A. n. sp. Rufiji* but differ from it by having eight unbranched anal-fin rays, more than any of the 186 specimens examined of *A. n. sp. Rufiji* and more than the number in any other species in the complex with the exception of some specimens of *A. jacksonii* from the Kagera drainage, Nile basin (Table 10). These specimens are recognized here as *A. cf. n. sp. Rufiji* but are not formally described because of the small number of specimens examined and because they appear to differ from *A. n. sp. Rufiji* by just this single character. Several lots of specimens collected from the Rufiji and deposited at the American Museum of Natural History (AMNH 215916, 215922, 215930, and 215936) may also represent an undescribed species. These specimens were determined not to be *A. n. sp. Rufiji* but were not studied further because the locality data for them is vague and it is unclear what part of the river basin they were collected from.

Further study is needed of the material from the Upper Malagarasi deposited in MRAC and considered here to be conspecific with *A. n. sp. Malagarasi*. Although all these specimens were examined during a visit to MRAC, meristics were not taken on them and were identified as *A. n. sp. Malagarasi* without direct comparison to them.

Comparative Material Examined

Amphilius cf. n. sp. Rufiji: **Little Ruaha River system, Rufiji River basin**: SAIAB 59406, Tanzania, About 5 km on road Iringa to Ruaha, 7°46'58"S, 35°45'54"E (4: 54.7-65.2).

Amphilius sp.: **Kilombero River system, Rufiji River basin**: AMNH 215916, Tanzania, Udzungwa mountains national park, Man'gula camp site no. 3 on Mwaya

River, ca. 7°51'S, 36°53'E (5: 37-41); AMNH 215922, same data as AMNH 215916 (1: 58.9); AMNH 215930, same data as AMNH 215916 (2: 60.9-36.3); AMNH 215936, same data as AMNH 215916 (1: 38.6).

Table 5-1 Morphometric data for *Amphilius jacksonii*. Range and mean include the holotype.

	Holotype	Range (n=31)	Mean±SD
%SL			
Head length	22.2	21.2-26.6	24.0±1.3
Head width	18.2	18.1-21.7	19.4±1.0
Head height	11.8	11.5-14.0	12.5±0.8
Body depth	13.0	11.5-17.0	14.4±1.3
Body depth at anus	11.5	9.6-12.0	11.3±0.7
Predorsal length	37.7	31.7-39.8	36.2±1.5
Prepectoral length	18.5	17.4-22.7	19.5±1.4
Preanal length	73.1	67.8-77.4	71.2±2.0
Dorsal-fin base length	9.8	8.5-13.4	10.8±1.2
Adipose-fin base length	-	18.2-25.9	21.7±2.1
Anal-fin base length	10.6	10.2-18.0	12.0±1.5
Pelvic-fin length	19.3	17.9-23.6	20.5±1.3
Pectoral-fin length	22.8	19.7-27.7	23.6±1.8
Anal-fin length	15.6	13.7-22.5	19.3±1.9
Caudal-peduncle length	18.6	16.7-20.1	18.7±0.8
Caudal-peduncle depth	7.3	4.8-7.9	7.1±0.6
Anus to anal fin length	17.3	11.8-17.9	14.5±1.5
Prepelvic length	50.5	43.9-50.9	48.4±1.7
Postpelvic length	49.7	47.0-56.2	52.4±2.2
Dorsal-fin insertion to adipose	-	40.6-43.7	42.2±0.9
Dorsal-fin origin to caudal	-	59.7-71.7	66.2±2.1
Preanus length	-	51.7-60.0	56.6±2.0
%HL			
Snout length	44.8	44.8-55.1	48.3±2.2
Interorbital distance	29.2	26.7-32.2	28.3±1.2
Maxillary barbel length	65.1	64.8-90.2	75.5±6.5
Inner mandibular barbel length	-	34.1-47.2	40.8±3.1
Outer mandibular barbel length	-	49.8-73.1	62.2±6.1
Eye diameter	15.6	13.4-19.2	16.5±1.4

Table 5-2 External traits diagnostic for species of the *Amphilius jacksonii* complex.

Character	<i>Amphilius jacksonii</i>	A. n. sp. Ruzizi	A. n. sp. Malagarasi	A. n. sp. Congo	A. n. sp. Rufiji	A. n. sp. Lake Kyogo
Branchiostegal rays	7-8, rarely 6 or 9	6-7	7-8	8-9	6-7, rarely 8	7-8
Branched Pectoral Rays	8-9, rarely 7	8-9	8-10	9-10	7-8, rarely 9	9
Total Gill Rakers	6-9, rarely 10	6-8, rarely 5 or 9	7-9, rarely 6 or 10	10-11, rarely 9 or 12	6-8, rarely 9	6-8, rarely 5 or 9
Gill rakers on first ceratobranchial	4-7, rarely 8	4-6, rarely 3 or 7	5-6, rarely 4 or 7	7-8, rarely 6 or 9	4-6, rarely 3	5-6, rarely 4 or 7
Caudal-peduncle depth	4.8-7.9	8.6-9.5	9.9-12.3	9.7-11.4	10.1-12.0	8.1-9.5
Caudal-peduncle length	16.7-20.6	18.7-20.3	16.0-18.8	14.4-16.4	13.3-15.5	16.8-20.9
Interorbital width	26.7-32.0	23.4-25.1	28.1-35.8	25.1-27.7	28.9-34.1	28.3-31.7
Dorsal-fin insertion to adipose-fin insertion	40.6-43.7	38.2-41.5	37.5-41.7	37.5-41.2	42.2-44.6	38.2-42.0
Body depth at anus	9.6-13.2	11.1-12.9	11.4-17.7	13.9-14.9	14.5-17.4	13.5-15.8

Table 5-3 Morphometric data for *Amphilius* n. sp. Ruzizi. Range and mean include the holotype.

	Holotype	Range (n=7)	Mean±SD
%SL			
Head length	21.6	21.6-26.9	24.5±2.1
Head width	17.9	17.9-20.3	19.2±1.1
Head height	11.5	11.5-13.7	12.5±0.8
Body depth	14.0	12.9-14.2	13.6±0.5
Body depth at anus	11.1	11.1-12.9	12.1±0.8
Predorsal length	37.8	35.2-40.1	37.6±1.7
Prepectoral length	16.6	15.1-22.4	18.9±2.7
Preanal length	69.2	68.8-72.4	70.1±1.2
Dorsal-fin base length	8.6	8.6-10.7	9.7±0.7
Adipose-fin base length	15.0	15.0-18.9	16.4±1.3
Anal-fin base length	8.1	8.1-10.5	8.9±0.9
Pelvic-fin length	17.9	16.6-21.3	19.2±1.7
Pectoral-fin length	20.9	19.9-24.9	22.5±2.1
Anal-fin length	15.7	15.7-19.3	17.7±1.8
Caudal-peduncle length	20.3	18.7-20.3	19.4±0.6
Caudal-peduncle depth	8.6	8.6-9.5	9.1±0.3
Anus to anal fin length	17.9	13.8-17.9	15.0±1.5
Prepelvic length	47.4	46.5-50.3	48.2±1.3
Postpelvic length	51.4	51.4-53.6	52.5±0.9
Dorsal-fin insertion to adipose	40.6	38.2-41.5	39.9±1.3
Dorsal-fin origin to caudal	64.5	62.2-66.2	64.1±1.5
Preanus length	53.7	53.7-58.9	56.3±1.8
%HL			
Snout length	51.5	45.6-51.5	48.1±2.3
Interorbital distance	23.7	23.4-25.1	24.2±0.7
Maxillary barbel length	59.5	43.2-59.5	53.0±6.2
Inner mandibular barbel length	26.2	25.6-33.3	29.2±2.8
Outer mandibular barbel length	42.3	40.3-47.3	44.2±2.7
Eye diameter	12.7	11.6-14.3	12.8±0.8

Table 5-4 Morphometric data for *Amphilius* n. sp. Malagarasi. Range and mean include the holotype.

	Holotype	Range (n=32)	Mean±SD
%SL			
Head length	25.7	23.2-26.8	25.1±0.9
Head width	22.0	20.2-22.6	21.0±0.6
Head height	15.3	12.8-16.8	14.6±0.9
Body depth	20.0	14.1-20.2	17.9±1.5
Body depth at anus	16.9	13.7-17.7	15.7±0.9
Predorsal length	37.4	32.7-39.5	37.0±1.3
Prepectoral length	19.5	18.6-22.7	20.1±1.0
Preanal length	72.7	70.1-76.7	72.5±1.7
Dorsal-fin base length	10.9	9.1-13.3	11.4±1.0
Adipose-fin base length	16.8	16.7-23.5	20.2±1.7
Anal-fin base length	11.7	10.0-14.1	11.9±1.1
Pelvic-fin length	19.0	17.7-20.7	19.2±0.7
Pectoral-fin length	21.6	19.7-24.3	22.0±1.1
Anal-fin length	19.3	17.7-21.3	19.8±0.9
Caudal-peduncle length	17.9	16.0-18.8	16.8±0.8
Caudal-peduncle depth	11.4	10.1-12.3	11.3±0.5
Anus to anal fin length	15.5	12.4-16.9	14.9±1.1
Prepelvic length	50.7	47.3-52.1	49.6±1.2
Postpelvic length	50.6	49.2-55.1	51.6±1.3
Dorsal-fin insertion to adipose	40.5	37.5-41.7	40.3±1.0
Dorsal-fin origin to caudal	66.6	62.4-67.9	65.5±1.5
Preanus length	56.5	55.8-61.4	58.3±1.2
%HL			
Snout length	48.5	41.7-51.2	46.7±2.4
Interorbital distance	29.8	28.1-35.8	31.6±2.0
Maxillary barbel length	72.5	61.4-98.0	77.3±8.2
Inner mandibular barbel length	40.0	28.3-54.3	41.5±5.7
Outer mandibular barbel length	60.4	44.0-81.0	62.5±8.3
Eye diameter	15.1	14.0-19.3	16.1±1.3

Table 5-5 Morphometric data for *Amphilius* n. sp. Malagarasi. Range and mean include the holotype.

	Holotype	Range (n=20)	Mean±SD
%SL			
Head length	25.6	25.4-28.0	27.1±0.7
Head width	19.8	19.8-22.2	21.1±0.6
Head height	12.5	12.1-14.1	13.5±0.5
Body depth	15.3	15.0-17.3	16.0±0.7
Body depth at anus	14.1	13.9-14.9	14.3±0.3
Predorsal length	37.2	36.2-37.8	37.2±0.6
Prepectoral length	20.4	19.7-21.3	20.6±0.5
Preanal length	72.4	71.2-73.6	72.5±0.7
Dorsal-fin base length	11.8	9.6-12.7	11.0±1.0
Adipose-fin base length	20.0	18.6-22.9	20.5±1.1
Anal-fin base length	11.6	11.5-14.3	12.6±0.8
Pelvic-fin length	18.1	17.9-19.2	18.4±0.4
Pectoral-fin length	19.2	19.2-23.5	21.8±1.0
Anal-fin length	19.1	19.0-22.3	20.2±0.9
Caudal peduncle length	15.7	14.4-16.4	16.9±0.7
Caudal peduncle depth	10.2	9.9-12.3	15.4±0.5
Anus to anal fin length	14.5	11.7-15.7	13.8±0.9
Prepelvic length	49.6	48.6-50.9	50.0±0.7
Postpelvic length	50.8	50.3-53.1	51.1±0.7
Dorsal-fin insertion to adipose	40.7	37.5-41.2	39.5±1.1
Dorsal-fin origin to caudal	66.5	63.5-66.5	64.9±0.9
Preanus length	56.3	56.4-58.7	57.7±0.8
%HL			
Snout length	47.3	43.2-47.4	45.4±1.3
Interorbital distance	27.1	25.1-27.7	26.3±0.7
Maxillary barbel length	72.7	59.4-72.7	66.5±3.8
Inner mandibular barbel length	40.1	31.3-40.6	36.1±2.4
Outer mandibular barbel length	59.8	47.0-63.6	54.3±4.3
Eye diameter	13.3	12.1-16.2	14.3±1.1

Table 5-6 Morphometric data for *Amphilius* n. sp. Rufiji. Range and mean include the holotype.

	Holotype	Range (n=68)	Mean±SD
%SL			
Head length	25.9	24.0-26.7	25.4±0.7
Head width	21.1	19.6-22.1	20.6±0.5
Head height	13.5	12.9-15.2	13.8±0.5
Body depth	17.3	15.6-19.3	17.0±0.8
Body depth at anus	17.0	14.5-17.4	15.7±0.7
Predorsal length	37.7	35.6-39.7	37.4±1.1
Prepectoral length	19.2	18.4-21.1	19.8±0.6
Preanal length	74.1	70.7-75.0	72.9±1.1
Dorsal-fin base length	12.2	10.1-12.3	11.1±0.6
Adipose-fin base length	22.7	19.3-24.2	21.2±1.2
Anal-fin base length	10.9	10.5-13.8	11.9±0.7
Pelvic-fin length	20.6	18.2-20.9	19.8±0.7
Pectoral-fin length	21.7	20.5-24.1	22.2±0.7
Anal-fin length	19.2	18.1-21.4	19.7±0.8
Caudal peduncle length	15.3	13.3-15.5	14.8±0.6
Caudal peduncle depth	10.5	10.1-12.0	10.9±0.4
Anus to anal fin length	14.9	12.4-16.6	14.2±0.9
Prepelvic length	49.8	46.7-51.6	49.2±1.1
Postpelvic length	50.7	49.3-54.6	51.4±1.1
Dorsal-fin insertion to adipose	43.3	42.2-44.6	43.1±0.6
Dorsal-fin origin to caudal	67.8	63.2-68.3	66.2±1.2
Preanus length	58.5	56.8-60.9	58.8±1.1
%HL			
Snout length	50.5	45.3-50.7	48.2±1.2
Interorbital distance	28.9	28.9-34.1	31.0±1.3
Maxillary barbel length	76.1	65.5-91.4	75.0±5.6
Inner mandibular barbel length	34.3	33.7-50.7	39.8±3.7
Outer mandibular barbel length	60.4	51.1-82.2	64.1±6.0
Eye diameter	12.5	12.1-16.7	13.8±1.1

Table 5-7 Morphometric data for *Amphilius* n. sp. Lake Kyogo. Range and mean include the holotype.

	Holotype	Range (n=45)	Mean±SD
%SL			
Head length	24.2	22.4-25.0	24.1±1.3
Head width	19.5	19.1-20.7	19.5±0.9
Head height	13.3	11.7-14.3	13.2±1.3
Body depth	16.7	14.4-18.5	16.7±2.1
Body depth at anus	15.6	13.5-15.8	14.3±1.2
Predorsal length	36.0	34.4-38.3	36.5±2.0
Prepectoral length	18.9	17.6-20.5	19.2±1.5
Preanal length	72.9	69.0-74.4	71.5±2.7
Dorsal-fin base length	11.4	10.3-13.3	11.5±1.5
Adipose-fin base length	22.5	18.1-23.1	20.3±2.5
Anal-fin base length	12.2	10.3-14.0	11.8±1.8
Pelvic-fin length	17.8	17.5-21.5	19.2±2.0
Pectoral-fin length	21.8	20.0-23.6	22.3±1.8
Anal-fin length	16.8	16.8-20.9	18.8±2.1
Caudal-peduncle length	17.1	16.8-20.9	18.1±2.1
Caudal-peduncle depth	9.6	8.1-9.5	8.9±0.7
Anus to anal fin length	15.1	11.8-16.2	14.4±2.2
Prepelvic length	50.1	46.5-50.3	48.6±1.9
Postpelvic length	51.8	49.3-56.2	52.1±3.5
Dorsal-fin insertion to adipose	41.8	38.2-42.0	40.6±1.9
Dorsal-fin origin to caudal	66.2	65.3-69.0	66.8±1.9
Preanus length	58.7	54.8-60.6	57.2±2.9
%HL			
Snout length	50.5	42.9-52.9	49.5±5.1
Interorbital distance	28.7	28.3-31.7	29.2±1.8
Maxillary barbel length	83.3	61.6-85.0	73.2±11.7
Inner mandibular barbel length	38.7	35.1-44.6	40.6±4.8
Outer mandibular barbel length	61.9	48.2-72.4	61.9±12.2
Eye diameter	13.8	12.6-18.0	15.2±2.7

Table 5-8 Branchiostegal ray counts in *A. jacksonii*, *A. n. sp. Ruzizi*, *A. n. sp. Malagarasi*, *A. n. sp. Congo*, *A. n. sp. Rufiji*, and *A. n. sp. Lake Kyogo*

Branchiostegal Rays	5	6	7	8	9
<i>A. jacksonii</i>		5	85	147	1
<i>A. n. sp. Ruzizi</i>		7	10		
<i>A. n. sp. Malagarasi</i>			37	138	
<i>A. n. sp. Congo</i>				72	14
<i>A. n. sp. Rufiji</i>		25	158	2	
<i>A. n. sp. Lake Kyogo</i>			22	25	

Table 5-9 Total gill raker counts in *A. jacksonii*, *A. n. sp. Ruzizi*, *A. n. sp. Malagarasi*, *A. n. sp. Congo*, *A. n. sp. Ruzizi*, and *A. n. sp. Lake Kyogo*

Total Gill Rakers	5	6	7	8	9	10	11	12
<i>A. jacksonii</i>		25	74	83	38	6		
<i>A. n. sp. Ruzizi</i>	1	8	2	6	1			
<i>A. n. sp. Malagarasi</i>		5	27	72	59	10		
<i>A. n. sp. Congo</i>					2	50	31	3
<i>A. n. sp. Rufiji</i>	1	25	102	48	8			
<i>A. n. sp. Lake Kyogo</i>		2	16	24	5			

Table 5-10 Branched pectoral-fin ray counts in *A. jacksonii*, *A. n. sp. Ruzizi*, *A. n. sp. Malagarasi*, *A. n. sp. Congo*, *A. n. sp. Ruzizi*, and *A. n. sp. Lake Kyogo*

Branched Pectoral-Fin Rays	6	7	8	9	10
<i>A. jacksonii</i>		1	104	137	
<i>A. n. sp. Ruzizi</i>			4	14	
<i>A. n. sp. Malagarasi</i>			81	94	5
<i>A. n. sp. Congo</i>				84	4
<i>A. n. sp. Rufiji</i>		14	166	5	
<i>A. n. sp. Lake Kyogo</i>				47	

Table 5-11 Branched anal-fin ray *A. jacksonii*, *A. n. sp. Ruzizi*, *A. n. sp. Malagarasi*, *A. n. sp. Congo*, *A. n. sp. Ruzizi*, and *A. n. sp. Lake Kyogo*

Branched Anal-Fin Rays	5	6	7	8
<i>A. jacksonii</i>		110	124	9
<i>A. n. sp. Ruzizi</i>	4	9	5	
<i>A. n. sp. Malagarasi</i>	6	97	63	
<i>A. n. sp. Congo</i>	4	69	15	
<i>A. n. sp. Rufiji</i>	5	134	47	
<i>A. n. sp. Lake Kyogo</i>		29	18	



Figure 5-1 *Amphilius jacksoni*, UF 110743 XXmm SL; lateral, dorsal and ventral view.

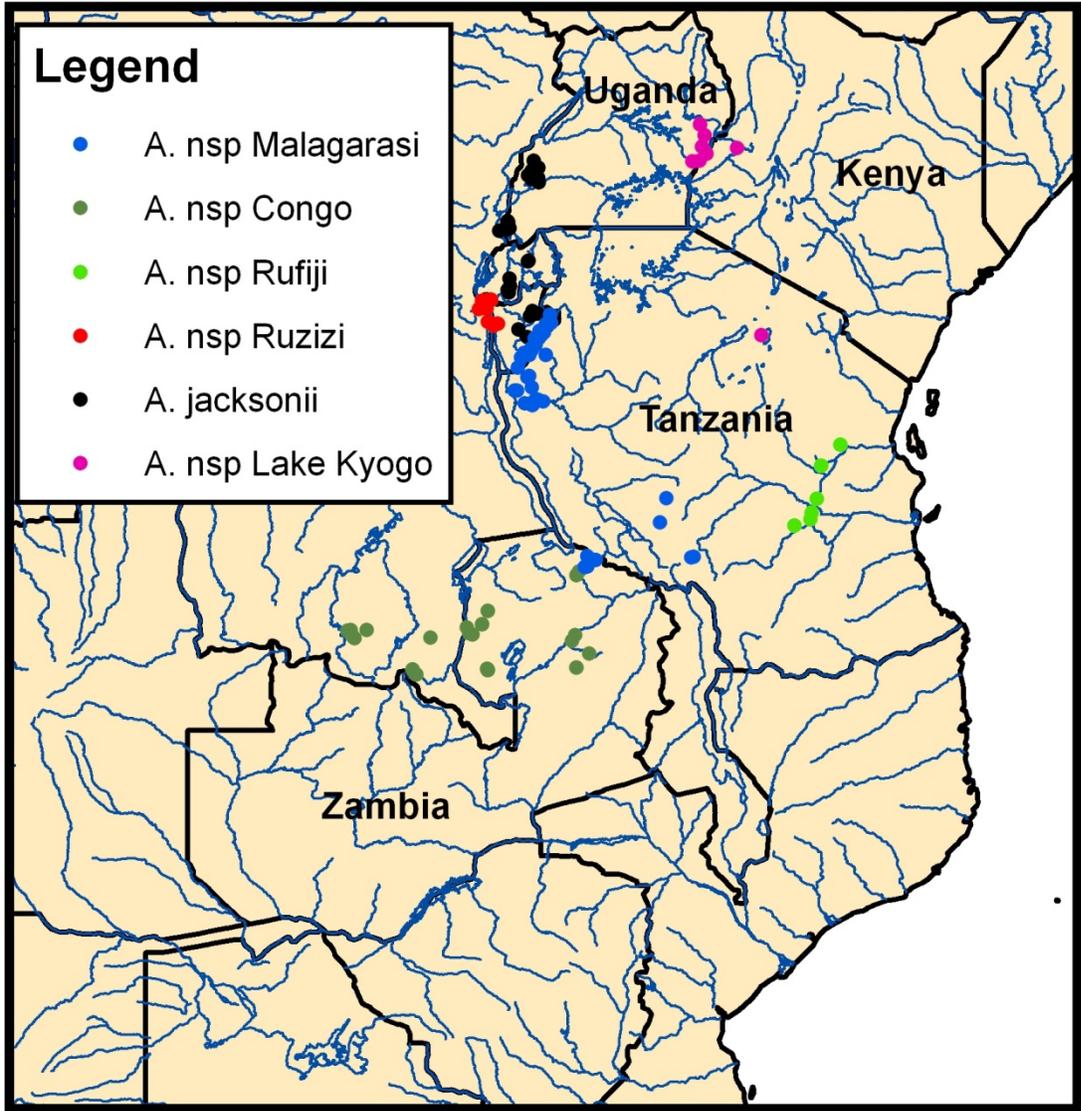


Figure 5-2 Distributions of species of the *Amphilius jacksonii* complex.



Figure 5-3 *Amphilius* n. sp. Ruzizi, MRAC 93294-93300 82.8 mm SL, Holotype; lateral, dorsal and ventral view.



Figure 5-4 *Amphilius* n. sp. Malagarisi, CU 97334, 52.3 mm SL, Holotype; lateral, dorsal and ventral view.



Figure 5-5 *Amphilius* n. sp. Congo, CU 97335, 83.1 mm SL, Holotype; lateral, dorsal and ventral view.



Figure 5-6 *Amphilius* n. sp. Rufiji, UF 184237, 86.3 mm SL, Holotype; lateral, dorsal and ventral view.



Figure 5-7 *Amphilius* n. sp. Lake Kyogo, UF 184238, 104.1 mm SL, Holotype; lateral, dorsal and ventral view.

CHAPTER 6 CONCLUSIONS

Although African fishes have been the subject of a great amount of research, the taxonomy and phylogenetic relationships of many African fish groups remain poorly known. One of the most widely distributed and diverse families of African fishes is the catfish family Amphiliidae. Chapter 2 is the first phylogenetic analysis of the family using molecular data, and the taxonomic sampling is much greater than in the previous morphological studies of the family. The molecular analyses provided strong support two of the three currently recognized subfamilies, but all analyses recovered *Paramphilius baudoni* as sister to all remaining amphiliids (Doumeinae + Leptoglanidinae + *Amphilius*), rendering the subfamily Amphiliinae polyphyletic. These results indicate that *Paramphilius* should be placed in its own subfamily. However, Diogo (2005) found strong support for a monophyletic Amphiliinae. The studies are not directly comparable because the species of *Paramphilius* used in each study differ, and because *P. baudoni* is not the type species of the genus. Placing *P. baudoni* in a new subfamily based on the results of the current study would be premature and create uncertainty about what to do with remaining species of *Paramphilius*.

The extensive taxonomic sampling in the study allowed for the monophyly of several genera to be tested for the first time. In the subfamily Leptoglanidinae, most species are placed in a single genus, *Zaireichthys*. Although only four of the 18 currently recognized species were included in the study, the genus was not recovered as monophyletic in any of the analyses. In the subfamily Doumeinae, all genera that had more than one species included in the study were not recovered as monophyletic in most analyses. Further research on the phylogenetic relationships of these two

subfamilies will benefit from increased taxon sampling as additional tissue samples are obtained. In the absence of sequences from additional taxa, research on the phylogenetic relationships of these subfamilies will continue to be primarily based on morphology. Although all the genera in these subfamilies have been delimited based on morphology, none of the characters used were identified using explicit phylogenetic methods. For example, the two largest doumein genera, *Doumea* and *Phractura*, are primarily defined by the absence of characters that are found in some of the other doumein genera. In his phylogenetic analysis of Amphiliidae, Diogo (2003) identified characters for all genera recognized at that time, but his taxon sampling was very limited (one of eight species of *Doumea*, two of 13 species of *Phractura*, and two of 18 species of *Zaireichthys*), and it is unknown how useful they may be in defining genera.

Chapter 3 is a phylogenetic analysis of *Amphilius*, the largest genus in the family. The genus was recovered as a well supported clade in the concatenated analyses but was not recovered as monophyletic in any of the nuclear gene analyses. Additionally, in the analyses of the S7 intron, the High African species were recovered as sister to the genus *Dolichamphilius*, a genus in the subfamily Leptoglanidinae. Two morphological groups have been recognized in *Amphilius*, a primarily Low African group of species that have an epidermal fold at the base of the caudal fin and 6 + 7 or 7 + 8 principal caudal-fin rays, and a primarily High African group of species that lack the epidermal fold and have 8 + 9 principal caudal-fin rays (Skelton, 1984; Thomson & Page, 2010). The High African *Amphilius* species were recovered as a well supported clade in all analyses. The Low African *Amphilius* species were recovered as a clade in all the analyses that included nuclear genes, but not in the two analyses that included only the

cyt b locus. Given the strong evidence that the High African *Amphilius* is monophyletic, the name *Anoplopterus* Pfeffer, 1889 was resurrected for the group. All the Low African species were retained in *Amphilius*.

Chapters 4 and 5 focus on the taxonomy of *Anoplopterus* and *Amphilius* respectively. The main goal of Chapter 4 was to determine the status of several nominal species that have been placed in the synonymy of *Anoplopterus uranoscopus*. The nominal species were all determined to be valid species and redescribed. Additionally, two new species were described from eastern Tanzania. The additional diversity described in this chapter substantially increased the recognized number of species in *Anoplopterus*, but there is still a large number of undescribed species awaiting descriptions. Chapter 5 focused on the taxonomy of the *Amphilius jacksonii* complex. Five new species of *Amphilius* are described, and *A. jacksonii* is redescribed. Additional diversity may be present in the complex, as discussed in the chapter. There is also a large amount of undescribed diversity in the genus outside the *A. jacksonii* complex that awaits description.

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BIOGRAPHICAL SKETCH

Alfred W. Thomson was born December 30, 1978, in Englewood, New Jersey. One of three children, he was interested in the natural world from an early age and has always been especially interested in fishes. He received his Bachelor of Science degree from Mansfield University in August 2001, and moved to Kenosha, Wisconsin to work as a research technician for the Illinois Natural History Survey at the Lake Michigan Biological Station in Zion, Illinois. In January 2004 he moved to Gainesville, Florida and worked as a research technician on the All Catfish Species Inventory Project at the Florida Museum of Natural History. In August 2005 he enrolled in UF's Department of Zoology as a full-time graduate student with a research assistantship from the All Catfish Species Inventory Project. He received his master's degree from the Zoology in August 2007 and was then admitted to the department as a Ph.D. student. He received his Ph.D. from the University of Florida in the spring of 2013. He is currently the collection manager for the ichthyology collection at the Florida Fish and Wildlife Research Institute in Saint Petersburg, FL.