Marine and freshwater fishes of Alabama: a revised checklist and discussion of taxonomic issues

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Abstract

Checklists are fundamental and important tools for organizing information about biodiversity that provide a basis for conservation and additional scientific research. While Alabama is recognized as an aquatic biodiversity 'hotspot' with the highest native freshwater fish diversity in the contiguous United States, we currently lack an up-to-date list of the state's fishes. In particular, much has changed over the past ~20 years regarding our knowledge of fishes from Alabama and the Mobile River Basin, rendering past comprehensive treatments by Mettee *et al.* (1996) and Boschung and Mayden (2004) out of date. Here, we provide a revised checklist of marine and freshwater fishes known from the coastal and inland waters of Alabama that includes 463 species (335 primarily freshwater fishes, and 128 marine or diadromous fishes) in 35 orders, 78 families, and 176 genera. Extant, extirpated, and extinct species are included, as are putative candidate species. The checklist is based on prior work, searches of the literature and online sources, as well as parsing a large compilation of >140,000 fish records for Alabama and the Mobile River Basin from 37 data providers in the global Fishnet2 database (www.fishnet2.net) and >4000 marine survey records from the SEAMAP database (https://www.gsmfc.org/seamap.php). After editing and quality control checks, the final combined database contained 144,215 collection records, ~95% of which were georeferenced. We discuss the species descriptions, nomenclatural changes, and updates to marine species that account for changes to the state list, and we close with a discussion of ~13 candidate species forms that remain undescribed, which represent outstanding taxonomic issues in need of further research attention.

Key words: ichthyofauna; marine environments; Mobile River Basin; rivers and streams; systematics; taxonomy

Introduction

Checklists of the species recorded from a region are fundamentally important tools for organizing information about biodiversity and provide a basis for communication by diverse users (e.g., taxonomists, other scientists and managers, policy makers), as well as a basis for conservation and scientific research (e.g., Hamer *et al.* 2012; Hobern *et al.* 2021). While Alabama is widely recognized as an aquatic biodiversity 'hotspot' with an exceptionally diverse fish fauna encompassing ~38% of North American freshwater fishes (Lydeard & Mayden 1995; Warren *et al.* 2000; Boschung & Mayden 2004; Jelks *et al.* 2008) and the highest native freshwater and coastal/inshore marine fish diversity of any state in the contiguous U.S. (>400 species; Mettee 2008), we currently lack an up-to-date and comprehensive list of the state's fishes. The first of Alabama's authoritative 'fish books' was published by Smith-Vaniz (1968) and contained taxonomic keys and descriptions of 282 freshwater and marine fish species known from Alabama, crystalized in 209 pages. Subsequently, this work was updated in Boschung (1992) and in comprehensive books by Mettee *et al.* (1996), who reported 327 freshwater and marine species in 42 families from Alabama and the Mobile River Basin, and Boschung and Mayden (2004), who treated 340 fish species in 41 families from the state's fresh and marine waters. These latter two more recent syntheses were published 19–27 years ago. Since that time, much has changed regarding our knowledge of coastal and inland fishes from Alabama and the Mobile River Basin that drains most of its area, including new phylogenetic inferences and related supraspecific taxonomic changes, new species discoveries and collection records, and new species descriptions (e.g., Bailey *et al.* 2004; Neely *et al.* 2007; Williams *et al.* 2007; Baker *et al.* 2008, 2013; Bagley *et al.* 2011, 2018; Mayden & Allen 2015; Gilbert *et al.* 2017; Kozal *et al.* 2017; Tan & Armbruster 2018; Kim *et al.* 2022; Stout *et al.* 2022). Accordingly, scientific progress, as well as the passage of time, has rendered the fish lists in previous comprehensive treatments by Mettee *et al.* (1996) and Boschung and Mayden (2004) out of date, and a new checklist is needed to address and summarize new taxonomic knowledge of the fauna gleaned during the past ~20 years.

Here, we meet this need by providing a revised checklist of marine and freshwater fishes known from the coastal and inland waters of Alabama. The present checklist is based on searches of the literature and online sources, our own collection records, and parsing a large compilation of >140,000 fish collection records for Alabama and the Mobile River Basin from the global

Fishnet2 database (www.fishnet2.net) as well as a compilation of >4000 marine species records from fisheries-independent bottom longline surveys of Alabama's coastal waters from the Southeast Area Monitoring and Assessment Program's (SEAMAP) database (Eldridge 1988; https://www.gsmfc.org/seamap.php). The FishNet2 records are entirely composed of vouchered museum lots, rendering an overwhelming majority of our final combined database supported by voucher specimens. Thus, unlike traditional taxonomic studies of fishes whose source material sometimes remains unverifiable (e.g., 18th and 19th Century morphological species descriptions with no known types), nearly all fish species/lineages in the present checklist are verifiable and supported by museum voucher specimens, including several recently described species (e.g., Neely *et al.* 2007; Williams *et al.* 2007; Gilbert *et al.* 2017). The only exceptions to this were a few large-bodied marine species (e.g., Tiger Shark, *Galeocerdo cuvier*) and newly identified but undescribed candidate species (e.g., '*Micropterus* sp. cf. *punctulatus*'; Bagley *et al.* 2011; Tringali *et al.* 2015; where, if present, vouchers may be limited or listed under the priority name). After presenting the updated checklist, we round out our paper with a discussion of (i) taxonomic and phylogenetic updates contributing to changes in the checklist (e.g., new species); (ii) sampling effort overall and by habitat; and (iii) future challenges for understanding Alabama's fishes, particularly the ~13 candidate species that presently remain undescribed from the fauna, which represent a set of outstanding taxonomic issues whose resolution will require additional research attention. This paper provides a baseline of information for developing fully annotated checklists (e.g., core synonymized checklists including details of species distributions and taxonomic remarks) of fishes of Alabama and the Mobile River Basin, which is an area of ongoing collaboration by the authors.

Methods

Our study area was the state of Alabama (30°11' N–35° N, 84°53' W–88°28' W), which is bordered inland by four other U.S. states (Mississippi, Tennessee, Georgia, and Florida) and by the Gulf of Mexico at Mobile Bay, as well as areas of the Mobile River Basin extending into nearby regions of northeastern Mississippi, northwestern Georgia, and southeastern Tennessee (Fig. 1). Historically, since 1953, state submerged lands of the U.S. have extended three nautical miles offshore; hence, we used a distance of three nautical miles from Alabama lands to define the limits of 'coastal' or 'inshore' marine waters of Alabama. As a result, our study area included

marine environments of the Mississippi Sound, Mobile Bay, Dauphin Island, and nearby coastal areas of the northern Gulf of Mexico within three nautical miles of the Alabama mainland or Dauphin Island. However, several species meeting this criterion for inclusion in our study based on some records had other records from much farther offshore (see below).

We have attempted to present all coastal and inland marine and freshwater fish species known from Alabama and the Mobile River Basin and supported by collections data meeting our criteria in this paper. Extant, extirpated, and extinct species are included, as are putatively distinct forms that are known but remain undescribed (hereafter, 'candidate species'), to ensure that our list reflects the full spectrum of biodiversity of Alabama's fishes. While this checklist emphasizes freshwater fishes, marine and euryhaline taxa were included if they occur along Alabama's coastal or inshore waters as defined above or if they are known to invade Mobile Bay (e.g., near Weeks Bay, a large area of tidal and forested wetlands in Baldwin Co., Alabama) or further inland (e.g., reaching the Mobile–Tensaw Delta) based on vouchered or georeferenced collection records.

To construct our checklist, an initial list of species was obtained from Mettee *et al.* (1996) and updated to currently valid names and authorities (Fricke *et al.* 2022). The list was updated by researching undescribed species listed in Mettee *et al.* (1996) and Boschung and Mayden (2004); compiling data on evolutionarily significant units (ESUs), interpreted as candidate species, from the Southeastern Fishes Council (SFC 2022); searching the literature for new species descriptions including material from Alabama (e.g., Google Scholar searches using terms "new species," "fish," and "Alabama"); and following up on, and assessing, name-change references from Fricke (2022) given in Eschmeyer's Catalog of Fishes (Fricke *et al.* 2022). Several freshwater species were added by taking descriptions and redescriptions into account, including taxonomic works elevating subspecies to species status (e.g., Bailey *et al.* 2004; Wernecke & Armbruster 2015).

When these resources were exhausted, we compiled a comprehensive database of public fish collections data for the state of Alabama from online sources (*cf.* Doosey *et al.* 2021) and used this database to improve and corroborate the checklist. Our collections database came from two sources. First, we downloaded fish collections for Alabama and the Mobile River Basin as made available from 37 data providers in the FishNet2 (www.fishnet2.net) database (Table 1). The data citation required by FishNet2 for data usage is as follows: "Data were obtained from the

Mississippi Museum of Natural Science, Oregon State University, Texas Natural History Science Center – Texas Natural History Collections, North Carolina State Museum of Natural Sciences, University of Alberta Museums, Auburn University Museum of Natural History, Canadian Museum of Nature, University of Kansas Biodiversity Institute – Specimens collection, Sam Noble Oklahoma Museum of Natural History, Cornell University Museum of Vertebrates (CUMV), Los Angeles County Museum of Natural History (LACM), Tulane University Museum of Natural History – Royal D. Suttkus Fish Collection, Swedish Museum of Natural History, Scripps Institute of Oceanography, Field Museum, Florida Museum of Natural History, Ohio State University – Fish Division, University of Michigan Museum of Zoology, Louisiana State University Museum of Zoology, Michigan State University Museum (MSUM), National Museum of Natural History, Smithsonian Institution, California Academy of Sciences, Texas A&M University Biodiversity Research and Teaching Collection, University of Washington Fish Collection, University of Alabama Ichthyological Collection, Royal Ontario Museum, University of Tennessee – Etnier Ichthyological Research Collection, Florida Fish and Wildlife Conservation Commission, Illinois Natural History Survey, University of Kansas Biodiversity Institute – Tissues collection, University of Colorado Museum of Natural History, Yale University Peabody Museum, GBIF-MNHN (Paris), Museum of Southwestern Biology, Academy of Natural Sciences at Philadelphia, Fort Hays Sternberg Museum of Natural History, MCZ-Harvard University (Accessed through the Fishnet2 Portal, www.fishnet2.net, 4/18/2022)."

Second, to complement our FishNet2 records and ensure that the representation of marine species in our list was as comprehensive and accurate as possible, we also compiled a database of fisheries-independent observations of marine fish species from the SEAMAP database (Eldridge 1988; https://www.gsmfc.org/seamap.php). Our raw SEAMAP fish dataset included observations from bottom longline surveys conducted by SEAMAP in marine waters from March to October. Bottom longlines used for the surveys had 1-nautical mile mainlines (900–1000 lb. test monofilament) rigged with 100 evenly spaced gangions, each of which consisted of a #15/0 (~235 mm) hook attached to a 3.7 m monofilament leader (730 lb. test strength). The longlines were baited consistently with the same bait across all hooks (e.g., Atlantic Mackerel, *Scomber scombrus*), deployed and set over variable bottom substrate (while monitoring bottom topography with an echosounder), allowed to soak for 1 h, and then retrieved with a large spool or hydraulic reel system. The gear did not target particular species, but instead was designed to

be effective for groundfish, including sharks, rays, flounders, and other marine teleosts. We subsetted these data to observations from marine waters of the state of Alabama spanning the years 2010–2022. Using the geographical coordinates for catch data, we reduced this dataset further to observations within approximately three nautical miles of Alabama coastlines and Dauphin Island. We then cleaned the reduced SEAMAP dataset by updating species names in Microsoft Excel to produce a final, cleaned SEAMAP dataset.

We parsed and edited our raw FishNet2 dataset using regular expressions, as well as quality-control checks performed 'by-eye' in Microsoft Excel (e.g., removing records based solely on otoliths or specimens from local pet shops) while cross-referencing species names against the species list and Eschmeyer's Catalog of Fishes (Fricke 2022; Fricke *et al.* 2022). North American minnow (Leuciscidae) names were also checked against recent changes proposed by Stout *et al.* (2022), which were given precedence over corresponding names in Fricke *et al.* (2022). During data cleaning, we removed 502 hybrid specimen lots, and we also removed >2000 lots flagged for being geographically out-of-scope, containing nonsense or invalid names, lacking the specific epithet, or for containing likely misidentifications. Over 23,000 species name entries and 56,416 family name entries were corrected by hand.

We classified species in both datasets as freshwater ('F'), freshwater and marine ('F, M'), or primarily marine ('M') in habitat based on the literature (e.g., Mettee *et al.* 1996), our prior knowledge of the species, and habitat classifications listed in Fricke *et al.* (2022). The 'F, M' designations included species known to enter freshwater and marine environments (freshwater and brackish water, or fresh, brackish, and marine waters), as well as diadromous species that migrate between these two habitats (e.g., American Eel, *Anguilla rostrata*). The habitat classifications were added to each collections dataset in a separate habitat column.

We collated the fish collections and observations data from our final, cleaned FishNet2 and SEAMAP datasets into a combined database of all remaining observations. This 'final combined database' was ideal for our study as it represented comprehensive spatial, temporal, and taxonomic coverage for the state's fish fauna. We interrogated the final combined database (i) to ensure that described species in our checklist were supported by voucher specimens wherever possible and (ii) to search for additional species with good weight of evidence to add to the checklist, indicated by verifiable collections meeting the following criteria. First, given freshwater fishes are generally confined to freshwater rivers and streams, we assumed that

records for these species indicated residency of the species in Alabama. Thus, some rare species, introduced species, and undescribed forms were added to our checklist even if they were only supported by a single collection. Second, in trying to add new marine taxa, we ignored described species whose presence in Alabama was supported by only one or two lots or specimens, and we emphasized the addition of lesser-known species supported by at least three lots. This decision was based on the fact that marine species can often move over large areas in the Gulf of Mexico due to a lack of dispersal barriers; hence, singletons or doubletons might represent waif dispersalists that only occasionally visit our state's marine waters and are not residents. We arbitrarily defined the encounter rate for occasional species as one fish per decade, or 0.1 record/year, and we expected the encounter rate for native or resident marine species to be higher (generally much higher) than this value.

Third, when assessing the final database for additional marine and diadromous species to add to our checklist, we emphasized (i) taxa with 'recent' records supported by collections from the past ~20 years (since ~2000–2003) and (ii) taxa with geographical distributions along coastlines or extending substantially north into Mobile Bay (e.g., north of Weeks Bay; preferably but not always with onshore collections in Mobile and Baldwin counties). Based on historical definitions of state submerged lands (see above), marine species known in our database from over three nautical miles offshore were excluded from our final list, while species with nearshore records and inshore records zero to three nautical miles from shore were retained. Some marine species retained in the final database on the basis of one or more inshore records had additional records from over three nautical miles from shore (sometimes over ~100 miles [~140 km] offshore).

All SEAMAP observations were georeferenced in decimal degrees; however, georeferencing coverage was partial for FishNet2 records. Thus, FishNet2 lots with georeferenced locality data were set apart and a subset of 419 latitude/longitude coordinate pairs were manually georeferenced or corrected by hand, e.g., converting degrees-minutes-seconds format to decimal degrees. Subsequently, latitude/longitude coordinate data from the two datasets were combined and cleaned to remove duplicates, filtered to decimal degrees format, and used to determine a final set of unique collection localities represented by the data. To evaluate the spatial extent and density of sampling in our final combined dataset, all unique coordinate pairs were mapped over a digital elevation model layer with 30 arc-second resolution

from WorldClim v2.1 (Fick & Hijmans 2017) and gray hill shade data in QGIS v2.14 Essen (https://qgis.org/en/site). We also subsetted the unique coordinates to collections corresponding to primarily freshwater taxa ('F' designations) vs. primarily marine taxa ('M' designations) and generated maps in QGIS that contrasted collections by these habitat types.

To more precisely summarize the collection localities by habitat category ('F', 'M', and 'F, M' designations), we generated a Venn diagram, and we labeled the three main groups with the total number of unique localities for each group. While maps of collection localities mentioned above relied on unique coordinates determined from the full dataset (allowing no duplicates between habitat categories), this would violate the assumptions of set theory for triple Venn diagrams. Thus, we constructed the Venn diagram on a dataset of collections allowing no duplicates within habitat categories (i.e., sets) but allowing duplicates between them.

In our final checklist, orders and families are arranged from the earliest branching (roughly older) lineages to more-recently branching (younger) lineages following recent phylogenetic results (Betancur-R. *et al.* 2013; Mirande 2017; Hughes *et al.* 2018). However, within families, genera and their species names are presented in alphabetical order (*cf.* Artüz & Fricke 2019). With limited exceptions, genus and species names and the corresponding taxonomic references follow the latest version of Eschmeyer's Catalog of Fishes (Fricke *et al.* 2022), while family names and their allocation to orders follow the corresponding classification (van der Laan *et al.* 2023). Where institutional abbreviations are mentioned, we follow the updated lists of Sabaj (2020, 2022).

Results

Our raw FishNet2 dataset contained n = 146,604 collection lots representing more than ~1.09 million individual specimens of freshwater and marine fishes of Alabama and the Mobile River Basin, based on records from >53,000 lots with readily discernable counts (although this number is an underestimate). An estimated ~64% of scientific collections of Alabama's fishes for which data were available in FishNet2 (considering records of primarily in-state collections, excluding Tombigbee River sites in Mississippi) are housed in natural history museums located in the state, with ~40% of all Alabama fish collections stored in the University of Alabama Ichthyological Collection (UA) and an additional ~24% of state collections stored at the Auburn University Museum of Natural History collection (AUM) (Table 1). The institution with the next largest

holding of Alabama's preserved fish materials is Tulane University (TU), with ~18% of all Alabama fish collections. Beyond these three collections, only five other provider institutions harbor more than 2000 lots of Alabama's fishes, including (in order of decreasing number of lots) the University of Michigan Museum of Zoology (UMMZ); Florida Museum of Natural History (UF); National Museum of Natural History, Smithsonian Institution (USNM); Mississippi Museum of Natural Science (MMNS); and the Cornell University Museum of Vertebrates (CUMV). Only 287 lots of Alabama's fishes are housed internationally in Canada, Sweden, and France (Table 1).

Our raw SEAMAP dataset contained n = 36,611 catch or observation data records, including a total of n = 4,448 records from n = 233 bottom longline sampling stations in Alabama waters. We parsed and subsetted these data to a total of n = 3,060 records from within roughly three nautical miles of the Alabama coast or Dauphin Island. The final SEAMAP dataset for this study contained catches or observations from n = 158 SEAMAP sampling events from n = 152 unique SEAMAP stations meeting our inclusion criteria, all of which were georeferenced.

After parsing, cleaning, and collating our FishNet2 and SEAMAP datasets, the final combined database for this study contained n = 144,215 records, including n = 141,155 vouchered collection lots from FishNet2 and n = 3,060 marine fish observations from SEAMAP bottom longline surveys. The final combined database is made available through a Mendeley Data accession available online (Bagley 2023).

Several freshwater taxa were included in the list despite being rarely encountered. Specifically, three freshwater taxa in the FishNet2 data were included in our checklist even though they were only represented by a single specimen lot, including Mountain Madtom, *Noturus eleutherus*, Brown Madtom, *Noturus phaeus*, and Slough Darter, *Etheostoma gracile*. The resurrected species *Amia ocellicauda* was included in our list based on two collections in the FishNet2 dataset and at least seven collections in Brownstein *et al.* (2022).

Several marine taxa in the final combined database were excluded from our checklist because their presence in Alabama waters was only confirmed by one or two specimen lots. These taxa included primarily pelagic, offshore marine fishes from the Gulf of Mexico such as Little Thunny, *Euthynnus alletteratus*, Skipjack Tuna, *Katsuwonus pelamis*, and other scombrids. Other marine fishes were excluded despite having sufficient collections because they are offshore-pelagic or offshore-demersal species, including tunas (e.g., *Thunnus atlanticus*),

Common Dolphinfish (*Coryphaena hippurus*), and various serranid and scorpaeniform taxa (e.g., *Centropristis ocyurus*, *Pontius longispinis*).

A total of *n* = 136,432 lots (~95%) in our final combined dataset were georeferenced in decimal degrees, and many of these had duplicate localities. After cleaning and removing duplicates, we determined that these data represented *n* = 10,325 unique collection localities, which are mapped in Fig. 2. The vast majority of these (~98%) were specimen-backed fish collections records from FishNet2. Considering only localities within the state of Alabama, the greatest densities of fish records were registered in and near the main stems of major rivers of the Mobile River Basin and the Tennessee River system, Mobile Bay, and lower–middle reaches of coastal rivers located east of the Mobile River Basin (Fig. 2). Areas with relatively lower sampling densities, indicated qualitatively by less overlap of transparent collection points in Fig. 2, included tributaries of the Tombigbee River in West Alabama, parts of the upper Black Warrior River system, southern tributaries to the Tennessee River system in northeastern Alabama, and the upper reaches of the coastal river systems between Mobile Bay and the Chattahoochee drainage. However, viewing our sampling as a whole, we can see that our FishNet2 data includes much less dense sampling of Mobile River Basin areas outside of Alabama. Portions of the Tombigbee River drainage in Mississippi were mainly sampled in these data along the main river channel. Also, relatively fewer records were available from the upper Coosa River drainage in northwestern Georgia as compared to areas of this drainage within Alabama (Fig. 2). Apparently, recent data from the Noxubee River (e.g., Calloway *et al.* 2017) and other Tombigbee River tributaries have not yet been incorporated into FishNet2.

Our final combined database highlighted large discrepancies in sampling effort for fishes classified as primarily freshwater vs. marine in habitat, with *n* = 8,320 unique collection localities for freshwater fishes (out of *n* = 9,335 ‘F’ collection localities) but only *n* = 665 unique localities for marine fishes (out of *n* = 1,258 ‘M’ collection localities) (Figs. 3 and 4). Fish species considered to enter both freshwater and marine environments (*n* = 1,247 ‘F, M’ collection localities) were largely split between these other two categories, with few (*n* = 88) unique collections, as shown in the Venn diagram (Fig. 4C). Additionally, the Fig. 3 map of marine versus freshwater collection localities revealed the geographical extent of upstream invasions of marine fishes into fresh waters of the Mobile River Basin and Alabama’s other major river systems, which was extensive in some cases but was always limited to areas below

333 the Fall Line.

334 The final, updated checklist of marine and freshwater fishes from coastal and inland
335 waters of Alabama and the Mobile River Basin includes 463 species, including 335 primarily
336 freshwater fishes and 128 marine or diadromous fishes, in 35 orders and 78 families (Table 2).
337 Additionally, the present understanding of taxonomic diversity in the Alabama fish assemblage
338 is expanded in our list to include 176 genera (Table 2). A version of the final combined database
339 subsetted only to species in the final checklist (n > 137,000 lots) is provided in our data
340 accession (Bagley 2023). Data on species status are summarized in Fig. 4A, which demonstrates
341 that the overwhelming majority (~93%) of fish species in Alabama's waters are native, while
342 only a combined ~3.5% of species are introduced species. Five species are considered extirpated
343 from Alabama ("Exstate"; ~1%), and two of these, Lake Sturgeon, *Acipenser fulvescens*, and
344 Spotfin Chub, *Erimonax monachus*, have been reintroduced in the state (Table 2; Fig. 4A). Seven
345 species, including Yellowfin Shiner, *Hydrophlox lutipinnis*, Brook Trout, *Salvelinus fontinalis*,
346 Etowah Darter, *Etheostoma etowahae*, Cherokee Darter, *Etheostoma scotti*, Amber Darter,
347 *Percina antesella*, Conasauga Logperch, *Percina jenkinsi*, and Bridled Darter, *Percina kusha*,
348 have status in Alabama of "N/A" in the checklist because they occur in the upper Mobile River
349 Basin regions of northwestern Georgia (e.g., Etowah River in the Coosa River system; Fig. 1)
350 and do not technically occur in Alabama. Of the 128 species reported herein that inhabit or enter
351 marine environments, 53 commonly or occasionally inhabit fresh waters ('F, M') while 75 are
352 considered fully marine ('M'; Fig. 4B). Of the 'F, M' species, six are well known as diadromous,
353 migrating between freshwater and saltwater environments to feed or spawn during their
354 lifetimes: Gulf Sturgeon, *Acipenser desotoi*, American Eel, *Anguilla rostrata*, Blueback Herring,
355 *Alosa aestivalis*, Alabama Shad, *Alosa alabamae*, Atlantic Needlefish, *Strongylura marina*, and
356 Striped Bass, *Morone saxatilis*.

357 **Discussion**

358 Previous books on the freshwater fishes of Alabama containing checklists of the fauna (Smith-
359 Vaniz 1968; Mettee *et al.* 1996; Boschung & Mayden 2004) provided an excellent starting point
360 for conducting the present study. Although increasingly outdated, these two prior syntheses are
361 highly cited and remain in wide use by wildlife biologists, environmental scientists, and
362 academics. Readers are referred to these texts for reviews of the history of ichthyology in

Alabama, as well as additional details on the geological and ecological setting in which the state's ichthyofauna is emplaced (also see Lacefield 2013, refs. therein). A brief review of taxonomic and systematic differences between these two sources, upon which the present study is built, is provided in the Appendix S1 file of our data accession (Bagley 2023). By building on these works with a literature search and a large, curated database of >140,000 specimen collections and observations for the fish fauna of the state and its main river basins gleaned from FishNet2 and SEAMAP, we have produced an updated and much improved checklist of marine and freshwater fishes known from the coastal and inland waters of Alabama (Table 2). Below, we describe in detail the new species additions, nomenclatural changes to existing species and supraspecific taxa, and marine species additions and marine invaders registered in the present checklist. We conclude our discussion by summarizing one of the foremost challenges for understanding and conserving the Alabama fauna moving forward: the presence of taxonomic uncertainty as represented by ~13 undescribed, candidate species included in the present checklist.

New Species

This section discusses the names, distributions, and conservation status of 13 fish species that were discovered/delimited and described as new to science since the publication of the last update on fishes of Alabama (Boschung & Mayden 2004) and are included in our list. The Longjaw Minnow, *Ericymba amplamala*, was described by Pera and Armbruster (2006) as a new species for the southern populations of the Silverjaw Minnow, *Ericymba buccata*, and ranges from eastern Louisiana across the Gulf Coast to southwestern Georgia, including all populations formerly considered *E. buccata* in the state of Alabama, as well as a set of disjunct northern Georgia populations. In Alabama, *E. amplamala* is widely distributed below the Fall Line in larger, flowing, sand- and gravel-bottomed streams. The conservation status of *E. amplamala* is generally considered secure, but the species may be vulnerable to extirpation in some parts of its range, e.g., Louisiana.

Macrhybopsis boschungi, *M. etnieri*, and *M. pallida* were recently described by Gilbert *et al.* (2017) from the *Macrhybopsis aestivalis* species complex. Mobile Chub, *Macrhybopsis boschungi*, occurs in all large rivers of the Mobile River Basin in Mississippi and Alabama, including the Tombigbee, Alabama, Cahaba, Coosa, and Tallapoosa rivers, and is confined below the Fall Line (Gilbert *et al.* 2017). By contrast, Coosa Chub, *M. etnieri*, is restricted to

areas above the Fall Line in the Cahaba, Coosa, and Tallapoosa rivers, and overlaps with *M. boschungi* (with no evidence of hybridization at allozyme loci) in a 40-km-long section of the Cahaba River (Gilbert *et al.* 2017). *Macrhybopsis boschungi* and *M. etnieri* are both Mobile River Basin endemics. Pallid Chub, *Macrhybopsis pallida*, is confined to the Conecuh, Yellow, and Choctawhatchee rivers along the Coastal Plain. Dr. Carter Gilbert's work on the *M. aestivalis* complex has been known for some time and was reported as forthcoming by Mettee *et al.* (1996, p. 30 and p. 219), who referred to them as "*M.* sp. cf. *aestivalis* (MBE)" and "*M.* sp. cf. *aestivalis*." Now, with the formal publication of Gilbert *et al.* (2017), no populations of *Macrhybopsis* in Alabama are recognized as *M. aestivalis*; hence, *M. aestivalis* is excluded from our list. The conservation status of the above new species of *Macrhybopsis* remains unclear and is an area in need of research attention, although it seems that their populations are likely to be secure in Alabama.

A new catfish species, the Chucky Madtom, *Noturus crypticus*, was described from the Tennessee River basin by Burr *et al.* (2005) based on a very small amount of material, including only eight specimens from populations in Little Chucky Creek in Greene Co., Tennessee. The species is now thought to occur in the Tennessee River drainage in Alabama as well. However, the geographic range of *N. crypticus* is extremely limited, and thus the species has been listed as critically endangered by the IUCN (NatureServe 2013b) and has been federally listed as endangered under the Endangered Species Act of 1973 since 2011 (USFWS 2011). The recovery plan for *N. crypticus* is described in Kuhajda *et al.* (2016).

A new sculpin species, the Tallapoosa Sculpin, *Cottus tallapoosae*, was described from the Tallapoosa River in the Mobile River Basin by Neely *et al.* (2007). In the same work, Chattahoochee Sculpin, *C. chattahoochee*, was also described from the Chattahoochee River system, but the analyses were based solely on material from the state of Georgia and it remains unclear whether populations of *C. chattahoochee* exist in Alabama; hence, *C. chattahoochee* was excluded from our checklist. We expect that *C. chattahoochee* might be found at new sites in Alabama after additional field sampling is conducted in the Chattahoochee River system. Both of these new *Cottus* species are considered species of Least Concern under IUCN 3.1 (e.g., NatureServe 2013a).

Since 2004, four new species of black basses from the genus *Micropterus* have been formally described. Specifically, Baker *et al.* (2013) tested the hypothesis of Hubbs and Bailey

(1940) that Redeye Bass, *Micropterus coosae*, from the Black Warrior River exhibited morphological variation potentially consistent with a new species. Based on evidence from morphology and mitochondrial DNA genetic relationships, Baker *et al.* (2013) found support for this hypothesis and described four new species of black basses from within the range of Redeye Bass. These included the Warrior Bass, *M. warriorensis*, endemic to the Black Warrior River drainage, Cahaba Bass, *M. cahabae*, endemic to the Cahaba River drainage, Tallapoosa Bass, *M. tallapoosae*, endemic to the Tallapoosa River, and Chattahoochee Bass, *M. chattahoochae*, endemic to the Chattahoochee River system (Baker *et al.* 2013). Redeye bass were redescribed as occurring in the Coosa River drainage in Alabama, and Baker *et al.* (2013) considered *M. coosae* from the Altamaha and Savannah river drainages in Georgia and South Carolina as representing a morphologically and genetically distinct lineage ("Bartram's Bass"; see below). Recent phylogenomic and species delimitation analyses by Kim *et al.* (2022b) based on phylogenomic analyses of double-digest restriction site-associated DNA sequencing (ddRAD-seq) data upheld the validity of the taxonomy proposed by Baker *et al.* (2013), supporting the existence of the five currently recognized species in the *M. coosae* group, as well as undescribed forms (see below). At present, the conservation status of the new *Micropterus* species above has not been finalized and needs more research attention.

Among darters and perches in the family Percidae, four new species have been described since 2004 that represent updates in our list. These include the Bankhead Darter, *Percina sipsi*, which was described by Williams *et al.* (2007) from Sipsey Fork of the Black Warrior River in the greater Tombigbee River drainage of the Mobile River Basin. *Percina sipsi* is listed with Vulnerable status by the IUCN 3.1 assessment (NatureServe 2013d). Williams *et al.* (2007) also described the Muscadine Darter, *Percina smithvanizi*, from above the Fall Line in the Tallapoosa River drainage of eastern Alabama and northwest Georgia, as well as Bridled Darter, *Percina kusha*, which is restricted to tributaries of the upper Coosa River in Tennessee and northwest Georgia. *Percina smithvanizi* is considered Near Threatened in status under IUCN 3.1 (NatureServe 2013e), while *P. kusha* is considered Endangered under IUCN 3.1 (NatureServe 2013c) but is not federally listed as threatened or endangered in the United States. Near and Kozal described the Blueface Darter, *Etheostoma cyanoprosopum* from an extremely small zone (<20 km) of Tennessee River drainage tributaries in northwestern Alabama, including the Bear Creek system (Kozal *et al.* 2017). *Etheostoma cyanoprosopum* is part of the snubnose darter

group (subgenus *Ulocentra*) and was initially discovered and informally recognized as a distinct form within the range of *E. zonistium* (*E.* sp. cf. *zonistium*) 22 years before its description, by Kuhajda and Mayden (1995). The conservation status of *E. cyanoprosopum* remains uncertain and is a topic in need of additional research; however, the species restricted distribution suggests it is a candidate for being listed as threatened or endangered. Indeed, a recent population genetics study by Fluker *et al.* (2019) found a lack of historical genetic structuring in *E. cyanoprosopum*, as well as reduced levels of genetic diversity, suggesting that existing populations are susceptible to inbreeding and local extirpation.

Nomenclatural Changes

This section considers changes to the names of existing species and supraspecific taxa that occur in the state of Alabama, and that have occurred since the publication of the last update on fishes of Alabama by Boschung and Mayden (2004). The single largest and most conspicuous nomenclatural change for the Alabama ichthyofauna over the past 19 years, which is registered in our checklist, is that all North American minnows formerly allocated to family Cyprinidae have been reallocated to Leuciscidae, which was previously considered a subfamily of the Cyprinidae (Tan & Armbruster 2018). Another supraspecific change that is reflected in the present list is that Chinese major carps that are introduced in Alabama and were formerly placed in Cyprinidae are now allocated to family Xenocyprididae (Tan & Armbruster 2018). The last of the family-level changes resulted from a new classification of herrings, anchovies, shads, and their allies in the order Clupeiformes. In a recent phylogenomics study of 1,165 filtered exon-capture loci, Wang *et al.* (2022) inferred a non-monophyletic Clupeidae, causing them to elevate three monophyletic clades they identified to family level, as Ehiravidae, Alosidae, and Dorosomatidae. Due to these changes, no clupeiform fish species in Alabama is currently allocated to Clupeidae; instead, representatives of *Alosa* and *Brevoortia* are allocated to Alosidae, while representatives of *Dorosoma* and *Harengula* are allocated to Dorosomatidae (Wang *et al.* 2022).

At the genus level, names of all three Atlantic stingrays that occur in Alabama waters have changed since the genus *Hypanus* was resurrected from the synonymy of *Dasyatis* by Last *et al.* (2016). Genus-only name changes in this group apply to Southern Stingray, *Hypanus americanus*, and Bluntnose Stingray, *Hypanus say* (Last *et al.* 2016). However, the binomial name of the Atlantic Stingray has also changed from *Dasyatis sabina* to *Hypanus sabinus* as a

result of the same study (Last *et al.* 2016).

Also at the genus level, the former subgenus name *Lethenteron* (Creaser & Hubbs 1922) is now applied as the genus name (rather than *Lampetra*) for American Brook Lamprey, *Lethenteron appendix*. *Lethenteron* has been recognized as a distinct genus for over 40 years since Vladykov and Kott (1979; see also Renaud 1997; Potter and Gill 2003). However, it was not until molecular phylogenetic results based on analyses of the mitochondrial cytochrome *b* gene by Lang *et al.* (2009) inferred a largely monophyletic *Lethenteron* that treatment of the genus as distinct, and applied to several species including *L. appendix*, entered into routine modern use (e.g., Page & Burr 2011; Page *et al.* 2013; Fricke *et al.* 2022). This is due, in part, to the fact that additional morphological and DNA evidence (e.g., Naseka & Renaud 2020; Pereira *et al.* 2021) supports the conclusions of Lang *et al.* (2009). In contrast to the above change for *L. appendix*, Least Brook Lamprey is maintained in the genus *Lampetra* in the present checklist, as *Lampetra aepyptera*, following other authors (*cf.* Potter & Gill 2003; Page & Burr 2011). Recent mitochondrial DNA results suggest that *L. aepyptera* is genetically distinct within a polyphyletic "*Lampetra*," and that it may be best to elevate subgenus *Okkelbergia* for this species (Lang *et al.* 2009; Pereira *et al.* 2021). Nevertheless, single-locus phylogenies do not provide a robust basis for erecting new genera for a single taxon, and the interpretation of *L. aepyptera* remains clouded by lack of a rigorous multilocus phylogeny of lampreys based on comprehensive taxon sampling. We recommend additional phylogenetic studies, and/or a taxonomic revision, of *L. aepyptera* and related taxa based on nuclear DNA and morphological evidence before any further taxonomic interpretations are made regarding this species.

Near and Keck (2005) recognized *Nothonotus* as a genus corresponding to darters in the *Etheostoma* subgenus *Nothonotus* (e.g., Page 1983). Given a lack of morphological apomorphies for *Etheostoma* (e.g., Bailey *et al.* 1954) and molecular evidence for *Etheostoma* polyphyly due to members of *Nothonotus* grouping with other darter genera (e.g., Song *et al.* 1998), they felt genus-level recognition of *Nothonotus* was justified (Near & Keck 2005). Such a treatment has been followed by others (e.g., Robison & Buchanan 2020), including various empirical studies generally supporting the distinctiveness of *Nothonotus* based on mitochondrial markers, nuclear markers, and morphology (e.g., Keck & Near 2008, 2010; Near *et al.* 2011). Following Near and Keck (2005), we also recognize *Nothonotus* as a distinct genus, with seven species occurring in Alabama (Table 2). Similar to these changes, phylogenomic analyses of ddRAD-seq data by

MacGuigan and Near (2019) found darters corresponding to *Etheostoma* subgenus *Allohistium* to form a strongly supported monophyletic group that experienced ancient introgression with other darter lineages. As a result, they recognized *Allohistium* as a distinct genus containing three species/lineages (MacGuigan & Near 2019). Following their treatment, we recognize *Allohistium* as a distinct genus in our checklist, treating Ashy Darter as *Allohistium cinereum* and its presumed sister lineage and candidate species known from lower Tennessee River populations as "*A. cinereum* ESU 2."

Based on phylogenomic results from analyzing exon capture markers (1,004 loci; *cf.* Arcila *et al.* 2017) from *Notropis* minnows and their relatives (Leuciscidae), Stout *et al.* (2022) found that species of several genera, including *Notropis* and *Luxilus* among others, were not resolved as monophyletic. They proposed numerous taxonomic changes for minnows based on the phylogenetic positions of type species for different genera, of which those germane to the Alabama fish fauna are included in our checklist and reviewed here. First, the non-monophyly of *Luxilus* in Stout *et al.* (2022) agrees with a similar pattern in Schönhuth *et al.* (2018) and supports the two Alabama species of *Luxilus* as a distinct lineage of sister taxa. Accordingly, Stout *et al.* (2022) proposed renaming these taxa Warpaint Shiner, *Coccotis coccogenis*, and Bandfin Shiner, *Coccotis zonistius*, with *C. coccogenis* as the type species for the elevated genus *Coccotis* (Table 3). Second, Stout *et al.* (2022) proposed reassignments of taxa within the genus *Notropis* affecting 24 described and candidate species that occur in Alabama. They reassigned these taxa to (1) the valid genera *Alburnops*, *Miniellus*, or *Pteronotropis*, (2) the subgenus *Hydrophlox* (Cashner *et al.* 2011), which they elevated to genus level, or (3) the resurrected genus *Paranotropis* (Stout *et al.* 2022), as summarized in Table 3. Note that the names of seven Alabama minnows remain allocated to *Notropis*, including (with genus in single quotes for taxa with uncertain phylogenetic affinities) Popeye Shiner, '*Notropis*' *ariommus*, Emerald Shiner, *N. atherinoides*, Taillight Shiner, '*N.*' *maculatus*, Highland Shiner, *N. micropteryx*, Silver Shiner, *N. photogenis*, Silverstripe Shiner, *N. stilbius*, and Telescope Shiner, '*N.*' *telescopus* (Stout *et al.* 2022).

In a similar vein, the scientific name of the Redeye Chub is now recognized as *Pteronotropis harperi* rather than *Notropis harperi* based on molecular phylogenetic analyses of two nuclear genes by Mayden and Allen (2015), which showed that the latter was phylogenetically nested within the genus *Pteronotropis* with strong bootstrap support. Stout *et al.*

(2022) also resolved *Pteronotropis* as monophyletic and including *P. harperi*, with strong nodal support, based on analyses of a phylogenomic dataset employing hundreds of markers. Populations of *Macrhybopsis aestivalis* distributed from the Tennessee River drainage (in Alabama and elsewhere) north to the Ohio River drainage, which were originally described by Gilbert (1884) as *Nocomis hyostomus*, were recently redescribed as the Shoal Chub, *Macrhybopsis hyostoma*, by Gilbert *et al.* (2017) in their morphological and genetic study of the *M. aestivalis* species complex.

At the species level, Brownstein *et al.* (2022) showed that Bowfin, *Amia calva*, harbors cryptic genetic diversity within its range consistent with two distinct species of bowfins based on morphological differences and detailed phylogeographic and species delimitation analyses of genomic data from ddRAD-seq. They found that the two bowfin species/lineages diverged around ~2 million years ago in the Plio–Pleistocene. On the basis of their findings, Brownstein *et al.* (2022) redescribed Bowfin, *A. calva*, as corresponding to bowfin populations from the Pearl River, MS east along the Gulf Coast, throughout Florida, and north throughout Atlantic drainages into Virginia. They resurrected the name *Amia ocellicauda* Todd in Richardson 1836 for populations of bowfins found in Gulf Coast drainages from Lake Pontchartrain west throughout the Mississippi Basin, the Great Lakes, and the St. Lawrence and Connecticut rivers (Brownstein *et al.* 2022); therefore, bowfin populations in Alabama's portion of the Tennessee River Basin are recognized as Emerald Bowfin, *A. ocellicauda* (L.M. Page, pers. comm.).

Also at the species level, Kim *et al.* (2022a) showed that the Longear Sunfish (*Lepomis megalotis*) complex contained six geographically distinct lineages based on phylogenomics and species delimitation analyses of ddRAD-seq data. They treated each of these six *Lepomis* lineages as distinct species that diverged from one another around ~4–2.5 million years ago in the Plio–Pleistocene. Their results show that Longear Sunfish, *L. megalotis*, populations are only present in northwest Alabama in parts of the Tennessee River Basin located in Lauderdale and Colbert counties, while populations throughout the remainder of the state are included within a separate species, the Sunny Sunfish, *L. solis*, which they resurrected from the synonymy of *L. megalotis* (Kim *et al.* 2022a). *Lepomis solis* has a geographical range extending along Gulf drainages from Lake Pontchartrain, LA east to the Choctawhatchee River drainage, as well as the Altamaha River drainage in Georgia, which drains to the Atlantic Ocean (Kim *et al.* 2022a).

Also in Centrarchidae, ddRAD-seq phylogeography and species delimitation results for

black basses in the genus *Micropterus* have shown that robustly delimited species correspond to two clades within the Largemouth Bass complex, but that these did not match the type localities of recognized species (Kim *et al.* 2022b). In particular, specimens from the type locality of *Micropterus salmoides* nested within the Florida Bass lineage. This prompted Kim *et al.* (2022b) to refer to Florida Bass as *Micropterus salmoides* and to apply *Micropterus nigricans* (removed from synonymy of *M. salmoides*) for Largemouth Bass. We follow these changes in our checklist, and we have also adjusted all names for Largemouth Bass accordingly in our modified FishNet2 dataset (Bagley 2023).

At the subspecies level, the scientific name of the Gulf Sturgeon has been elevated from *Acipenser oxyrinchus desotoi* to the species-level name, *Acipenser desotoi*, as of Robins *et al.* (2018). The scientific name of western populations of the Creek Chubsucker, *Erimyzon oblongus*, has been elevated from *Erimyzon oblongus claviformis* to *E. claviformis* (Bailey *et al.* 2004; Page & Burr 2011). Likewise, a subspecies of Brook Silverside, *Labidesthes sicculus*, named *L. s. vanhyningi* was recently elevated to species level by Wernecke and Armbruster (2015). This species, the Golden Silverside, *L. vanhyningi*, occurs in Gulf and Atlantic slope drainages largely east of the Mississippi River, including Gulf and Atlantic tributaries from Neches River, TX east to Peedee River, SC (Wernecke & Armbruster 2015). Brook Silverside populations in the Mississippi River Basin and other Gulf tributaries from Brazos River, TX to Pascagoula River, MS are still recognized as *L. sicculus* (Wernecke & Armbruster 2015). As a result, *L. sicculus* occur in Alabama's portion of the Tennessee River Basin, while *L. vanhyningi* are found throughout the remainder of the state. Last, Baker *et al.* (2008) described Alabama Bass, *Micropterus henshalli*, from Mobile River Basin populations of Spotted Bass, *M. punctulatus*, that were formerly considered the distinct subspecies *M. p. henshalli* by Hubbs and Bailey (1940). As a result, the only populations recognized as *M. punctulatus* in Alabama occur in the Tennessee River drainage, as well as Gulf Slope drainages from the Escambia River east to the Chattahoochee River, but excluding Mobile Bay and its tributaries.

Marine Species Additions and Marine Invaders

On top of the new species descriptions and nomenclatural changes discussed above, another way in which the Alabama state fish checklist has changed in the present iteration is through the addition of marine species based on new data. Whereas Mettee *et al.* (1996) treated 28 marine and diadromous fish species, and Boschung and Mayden (2004) treated a total of 48 of these, our

list increases this number to a total of 128 marine and diadromous species known from the state's coastlines, bays, barrier island (Dauphin Island), and nearby waters of the Gulf of Mexico (Table 2). The reasons behind this expansion are that vouchered collections in our final FishNet2 dataset allowed us to add 56 species known from marine environments that otherwise may not have been included in our list, while our SEAMAP dataset confirmed several of these and also allowed us to add 15 new marine species to our list. Supplementary tables listing these 71 marine species additions are included in our Mendeley Data accession (Bagley 2023).

The updated list of fishes of Alabama herein contains 53 species with an 'F, M' habitat designation that are considered to be diadromous, occurring in (or potentially occurring in) fresh waters and brackish/marine waters. These include anadromous species that spend most of their lives in the sea but migrate back to fresh waters in the spring to spawn, as well as catadromous species that are predominantly freshwater taxa but migrate to marine habitats to spawn. The two main anadromous species are Gulf Sturgeon, *Acipenser desotoi*, and Alabama Shad, *Alosa alabamae*, while the only catadromous species is American Eel, *Anguilla rostrata* (Mettee *et al.* 1996; Boschung & Mayden 2004; Mettee 2008; Robins *et al.* 2018). A third category of diadromous species consists of marine fishes that have only been documented as occasionally entering fresh waters, e.g., at harbors or river mouths, and this group includes species that move northward no further than Mobile Bay, such as the Tiger Shark, *Galeocerdo cuvier*, and multiple gobies including Lyre Goby, *Evorthodus lyricus*, and Violet Goby, *Gobioides broussonetti*. The diadromous species also include 33 fish species that we consider to be 'marine invaders' of freshwater habitats, which we review below in roughly phylogenetic order.

Among cartilaginous fishes, the Bull Shark, *Carcharhinus leucas* (Carcharhinidae), is notable in being a euryhaline species that regularly invades fresh waters, including areas relatively far inland within Lake Nicaragua in Central America and the Mississippi River Basin in the US (e.g., Thorson 1971; Thomerson *et al.* 1977). In Alabama, *C. leucas* adults and juveniles have been observed to penetrate as far north as the mouth of the Mobile–Tensaw Delta (this study; Drymon *et al.* 2021), which provides a large input of fresh water into Mobile Bay. In light of its distribution in warm coastal waters worldwide as well as its physiological capacity for entering freshwater, these findings suggest that *C. leucas* may invade further into Alabama waters than previously thought, possibly entering the lower Mobile River Basin.

Atlantic Stingray, *Hypanus sabinus* (Dasyatidae), is a euryhaline species that can

withstand hypoxic conditions and is common to sand- or mud-bottomed beaches, bays, and estuaries around Alabama's coastlines (e.g., Snelson *et al.* 1988; Boschung & Mayden 2004). According to our database, *H. sabinus* invades the Mobile–Tensaw Delta as far north as Gravine Island (UAIC 16053.01, 30.78491° N, 87.92084° W), but it does not substantially invade Gulf Slope river basins.

Ladyfish, *Elops saurus* (Elopidae), is a largely pelagic fish that spawns at sea and maintains a distribution of resident populations in the western North Atlantic Ocean, primarily from Cape Hatteras, NC south throughout the Gulf of Mexico to the Yucatán Peninsula (e.g., McBride *et al.* 2010). Our northernmost record for *E. saurus* comes from Perdido Bay (UF 151607, 30.42389° N, 87.40028° W). However, GBIF records (http://www.gbif.org) show that, in Alabama, *E. saurus* invades the Mobile–Tensaw Delta as far north as Twelvemile Island and inland to around Gunnison Creek, a tributary to Sara Bayou located just east of Satsuma, AL.

Bay Anchovy, *Anchoa mitchilli* (Engraulidae), is a pelagic-coastal species whose distribution extends from Maine south around Florida, throughout the Gulf of Mexico, to the Yucatán Peninsula (Robins & Ray 1986). *Anchoa mitchilli* is highly abundant in shallow waters of the Northern Gulf of Mexico and serves as an important food source for commercial and sport fisheries (e.g., Morton 1989). Based on our dataset, *A. mitchilli* is one of the most prolific marine invaders of fresh waters in our study area and in the southeastern US, being commonly found throughout Alabama's nearshore areas, Mobile Bay, and the Mobile–Tensaw Delta. Others previously showed that populations also extended northward into the lower main-channel reaches of the Tombigbee and Alabama rivers, in which they have become generally distributed as far north as Coffeeville Lake (at Alabama State Route 10 crossing) and Claiborne Lock and Dam, respectively (Mettee *et al.* 1996; Boschung & Mayden 2004). However, a recent record from 2006 (AUM 46908, 32.65543° N, 85.58604° W) registered the inland- and northernmost occurrence of *A. mitchilli* to date at Loblockee Creek, a site located ~195 mi northeast of Mobile Bay and that is a tributary to Saugahatchee Creek in the Tallapoosa River system.

Fat Sleeper, *Dormitator maculatus* (Eleotridae), are a less common brackish-water species that have a patchy distribution in the study area. This species invades the Mobile–Tensaw Delta at least as far north as Gravine Island, and at least four records are known from the Delta region (Bagley 2023). Largescaled Spinycheek Sleeper, *Eleotris amblyopsis*, which is a close relative of *D. maculatus*, is included in our checklist but is not considered a marine invader

673 in Alabama, although records from elsewhere show it substantially invades fresh waters in
674 nearby states such as Louisiana (e.g., Doosey *et al.* 2021).
675 Five goby species in the family Gobiidae occur in nearshore marine, coastal, and fresh
676 waters of Alabama. These include Dater Goby, *Ctenogobius boleosoma*, which invades the
677 Mobile–Tensaw Delta as far north as Twelvemile Island; Freshwater Goby, *Ctenogobius*
678 *shufeldti*, and Naked Goby, *Gobiosoma bosc*, both of which invade the Mobile–Tensaw Delta to
679 the same point approximately ~25 mi inland northwest of Stockton, AL (e.g., AUM 21904,
680 31.037482° N, 87.955567° W); Highfin Goby, *Gobionellus oceanicus*, which invades the
681 Mobile–Tensaw Delta upstream in the Mobile River to an area near Big Briar Creek,
682 approximately 6.75 mi E of Satsuma, AL (UAIC 10418.07, 30.8402778° N, 87.9480556° W);
683 and Clown Goby, *Microgobius gulosus*, which are generally found up to the mouth of the
684 Mobile–Tensaw Delta but have one record registered from relatively far inland (~83 mi from
685 Mobile Bay) at Yellow Bluff on Coffeeville Lake, in the Tombigbee River system (UF 150131,
686 31.908610° N, 88.112500° W).
687 Among the eight species of pleuronectoid flatfishes that occur in Alabama with a number
688 and frequency of collections/observations to be included in our list, three of them are considered
689 marine invaders herein. These include Hogchoker, *Trinectes maculatus*, which occurs from
690 Massachusetts south to the Gulf of Campeche, Mexico, and which invades substantially inland in
691 the Mobile River Basin as well as Gulf Slope drainages west and east of Mobile Bay, including
692 the Apalachicola River system. The northernmost record of *T. maculatus* in Alabama comes
693 from Coffeeville Lake on the Tombigbee River (this study; Mettee *et al.* 1987); however, the
694 northernmost record from nearby regions appears to be from ~85 mi inland in the Chickasawhay
695 River in Mississippi. Blackcheek Tonguefish, *Symphurus plagiusa*, is abundant in coastal waters
696 and less abundant inland, but we found that it invades as far as Loxley, AL in the Weeks Bay
697 drainage of Baldwin Co. (TCWC 6822.19, 30.608890° N, 87.742497° W) based on our dataset,
698 and as far north into the Mobile–Tensaw Delta as Whitehouse Bend near Bucks, AL based on
699 GBIF data. Southern Flounder, *Paralichthys lethostigma*, prefers muddy substrate (Boschung &
700 Mayden 2004) and primarily inhabits brackish bays and estuaries, but it also invades past the
701 Mobile–Tensaw Delta and upstream into the Tombigbee River as far north as McIntosh Bluff,
702 ~3.5 mi east of McIntosh, AL. This species northernmost collection record in our database is
703 from around ~4.5 mi south of Claiborne Lock and Dam in the Alabama River (TU 103585,

31.558060° N, 87.512500° W).

Two mullet species (Mugilidae) occur in Alabama waters and both are euryhaline species that are considered invaders of freshwater habitats. Striped Mullet, *Mugil cephalus*, has a cosmopolitan distribution throughout warm and temperate waters worldwide but invades fresh waters along the Atlantic and Pacific coasts (Robins & Ray 1986; Fuller 2023). In Alabama, *M. cephalus* invades the Mobile–Tensaw Delta and the lower reaches of the Tombigbee and Alabama rivers and today it typically reaches as far north as Claiborne Lock and Dam; however, historical records from the 1950s and 1960s (e.g., UAIC 2035.01, 32.854722° N, 87.193056° W) demonstrate that *M. cephalus* once invaded as far north as the Cahaba River just south of Centreville, AL prior to widespread impoundment of Alabama's rivers. White Mullet, *Mugil curema*, occurs in the eastern Pacific Ocean, throughout the western Atlantic Ocean, from Maine south to Argentina, and in the eastern Atlantic Ocean (Robins & Ray 1986; Fuller 2023). *Mugil curema* is relatively less common and does not occur as far inland in Alabama as its congener *M. cephalus*. Based on our records, *M. curema* occurs at Dauphin Island and along nearby coastlines; however, based on GBIF records, this species historically may have invaded the Mobile–Tensaw Delta upstream in the Tensaw River as far north as Stockton, AL.

Atlantic Needlefish, *Strongylura marina* (Belonidae), is widely distributed along Atlantic coasts throughout the Americas, from Massachusetts south to Brazil (Robins & Ray 1986). This species is the single most prolific marine invader in the Alabama fish fauna, invading from marine waters into the Mobile–Tensaw Delta, and throughout the Mobile River Basin below the Fall Line, including virtually the entire main stem of the Tombigbee River. The northernmost collection record for *S. marina* in our database comes from Pool B above Glover Wilkins Lock and Dam near Smithville, Monroe Co., MS, which forms part of the Canal Section of the Tennessee–Tombigbee Waterway and is located an astounding ~235 mi inland from Mobile Bay. However, based on historical collections in Mettee *et al.* (1996) and the GBIF database, *S. marina* apparently invaded the Tennessee River system through the Tennessee–Tombigbee Waterway in the later part of the 20th Century, marking the inland-most region where *S. marina* might be encountered today.

Our records indicate nine fish species that, despite having patchy to common distributions along Alabama's coastlines, do not seem to disperse to inland areas of Alabama, but which we still consider to be marine invaders based on additional evidence. Here, the primary

example is Rough Silverside, *Membras martinica* (Atherinopsidae), which is recorded in our database as occurring throughout Mobile Bay, and which is distributed throughout the northwestern Atlantic Ocean. While not ranging substantially inland in Alabama, *M. martinica* also occurs several miles inland into the Escatawpa River near the Mississippi–Alabama border and has invaded substantially into the Escambia River in Florida, which suggests that it may also extend into fresh waters of Alabama but has not yet been detected outside of brackish or marine habitats. Other species whose distributions mirror many of these characteristics of *M. martinica* include Diamond Killifish, *Fundulus xenicus* (Fundulidae); Gray Snapper, *Lutjanus griseus* (Lutjanidae); four drum family species (Sciaenidae): Silver Perch, *Bairdiella chrysoura*, Spotted Seatrout, *Cynoscion nebulosus*, Gulf Kingfish, *Menticirrhus littoralis*, and Northern Kingfish, *Menticirrhus saxatilis*; as well as Pinfish, *Lagodon rhomboides* (Sparidae). For example, each of these species can be found around Alabama's coastlines from Grand Bay to Weeks Bay and also invades the Escatawpa drainage to near the Mississippi–Alabama border. The ninth species in this category is Southern Kingfish, *Menticirrhus americanus* (Sciaenidae), which does not occur in the Mobile–Tensaw Delta but occurs throughout coastal areas including Mobile Bay and has been detected several miles inland as far north as an area of the Perdido River system northeast of Bay Minette, AL.

Inland Silverside, *Menidia beryllina*, is also in the family Atherinopsidae, but unlike its counterpart *M. martinica*, *M. beryllina* is a prolific invader of inland fresh waters in Alabama. While *M. beryllina* is not as commonly encountered inland as other species such as *Strongylura marina*, it has been detected in patches of habitat as far north as the Tombigbee and Tennessee river drainages.

Spotfin Mojarra, *Eucinostomus argenteus* (Gerreidae), is a wide-ranging nearshore marine species found over variable substrates and reefs and occurring in the eastern Pacific Ocean as well as the northwest Atlantic Ocean, including the northern Gulf of Mexico to southeastern Brazil (Robins & Ray 1986). *Eucinostomus argenteus* occurs around Alabama's coastlines and invades the Mobile–Tensaw Delta in the Tensaw River as far north as Stockton, AL.

The next three species of marine invaders share in common the features of being sciaenids that have inland distributions in Alabama mirroring that of *Gobionellus oceanicus*, invading the Mobile–Tensaw Delta upstream to an area near Big Briar Creek east of Satsuma,

AL. These include Sand Seatrout, *Cynoscion arenarius*, Spot, *Leiostomus xanthurus*, and Atlantic Croaker, *Micropogonias undulatus*.

Two other sciaenids are considered marine invaders of Alabama waters. Black Drum, *Pogonias cromis* (Sciaenidae), is a benthic drum that is found in marine and brackish waters over variable substrate including reef edges and occurs throughout the western Atlantic Ocean, from Maine to Argentina (Robins & Ray 1986). Similar to *Elops saurus*, *P. cromis* invades Alabama waters including Mobile Bay and the Mobile–Tensaw Delta, reaching to the north side of Twelvemile Island. Red Drum, *Sciaenops ocellatus*, is an economically important game fish species that is commonly encountered in estuaries over sand and mud substrate and that is widely distributed in the western Atlantic Ocean, from Massachusetts to northern Mexico (Robins & Ray 1986). Similar to *Dormitator maculatus*, *S. ocellatus* invades the Mobile–Tensaw Delta at least as far north as Gravine Island based on historical collection records from GBIF; however, most recent collections in our database include captures or observations no further inland than Weeks Bay.

Sheepshead, *Archosargus probatocephalus* (Sparidae), is a primarily inshore marine fish species found in marine and brackish waters over rocky and other hard or soft bottom habitats, including jetties, armored banks, and rock pilings, and is distributed throughout the northwestern Atlantic Ocean, from Nova Scotia, Canada south to Brazil (Manooch 1984; Robins & Ray 1986). *Archosargus probatocephalus* is a game fish that is widely sought for human consumption and hence is a popular fishing target. In Alabama waters, this species invades the very southernmost portions of the Mobile–Tensaw Delta as far north as Blakeley River near Spanish Fort, AL (AUM 21914, 30.676977° N, 87.926130° W) and it also invades approximately ~13 mi inland in the Escambia River drainage in Florida.

Sampling Effort: Freshwater vs. Marine Collections

Overall, the final combined database that we curated in this study (Bagley 2023) highlights a longstanding history and extensive amount of effort put into sampling and exploration of Alabama's fishes (see also Mettee *et al.* 1996; Boschung & Mayden 2004). The value and extent of this undertaking over the past 169 years, from the oldest record from 1853 (*Hybopsis winchelli*, Smithsonian National Museum of Natural History, USNM 2, A. Winchell) to the youngest SEAMAP records from 2022, as well as more recent collections, cannot be overstated. However, while a larger number of studies have been conducted on Alabama's freshwater fish

assemblage as compared to its marine fish fauna, a pattern supported by the literature (unpublished results), our findings quantitatively demonstrate discrepancies in sampling effort for fishes from these two broad habitat categories. On one hand, the vast majority of records (n = 129,634; ~90%) and unique collection localities (n = 8,320; ~80.6%) in our final combined database were for taxa that we classified as primarily freshwater in habit. This seems roughly consistent with the observation that the majority (~72%) of all fish species in the state of Alabama are freshwater fishes (Table 2; Figs. 3 and 4). On the other hand, only ~7.6% of records (n = 10,930) corresponding to ~6.4% (n = 665) of unique collection localities corresponded to marine taxa. Thus, there is a general correlation between sampling effort and species diversity; however, the percentage of lots and observations for marine fishes is much lower than their actual representation of ~16% in the state's fish fauna (Table 2; Figs. 3 and 4). This situation is not desirable and suggests that targeted surveys are needed to bring Alabama marine fish collection records and specimen lots to a level commensurate with the representation of marine fishes in the state ichthyofauna.

Outstanding Taxonomic Issues: Undescribed Candidate Species

Despite much progress over the past ~20 years, many crucial research questions related to our understanding of the Alabama fish fauna remain unanswered. A number of these questions relate to outstanding systematic and taxonomic issues, which create lingering taxonomic uncertainty. Key issues surround our lack of understanding of species limits and formal description of species, a shortcoming known as the 'Linnean shortfall', as well as limitations to our understanding of species geographical distributions, a shortcoming known as the 'Wallacean shortfall' (reviewed by Lomolino 2004; Whittaker *et al.* 2005; Hortal *et al.* 2015). Both kinds of shortfall are scale-dependent and may cause issues for conservation planning and biodiversity accounting if not handled properly, for example if putative distinct forms are excluded from regional lists and conservation planning analyses. Here, we address the Linnean shortfall for Alabama's fishes as it relates to our revised checklist.

We find that ~13 distinct morphological forms of fishes identified by previous authors as candidate species warranting further study, and possibly formal description, are known from Alabama waters, and 100% of them are freshwater fishes (species listed as "sp." or "sp. cf." in Table 2). Conservation practitioners in the state have avoided underestimating freshwater fish species diversity at different spatial scales by recognizing these distinct, putative species.

However, certain tools in the state still do not reflect these taxonomic updates, including index of biotic integrity (IBI; Karr 1991; Barbour *et al.* 1999) calculations for quantifying human impacts on fish assemblages and water quality. Moreover, while candidate species status needs to be agreed upon, inventoried, and tracked through time to avoid confusion (Padial *et al.* 2010), the story of Alabama's candidate fish species has become fragmented across the literature since the last major update (Boschung & Mayden 2004). In this context, our checklist provides a much-needed, centralized update to species membership of the fauna, as well as signposts of candidate species to guide future research in species delimitation and alpha taxonomy of Alabama's freshwater fishes. Unfortunately, our checklist does not provide such signposts for Alabama's marine fish taxa, because the Linnean knowledge gap is more prominent for them. Hence, the following discussion emphasizes candidate species of freshwater fishes.

The undescribed candidate species in our accounting include the "Highlands Stonecat," *Noturus* sp. cf. *flavus*, which comprises morphologically distinct populations of *Noturus flavus* from Shoal Creek and the Elk River in the Tennessee River system and is thought to be distinct based on color patterns and distributional data (Page & Burr 1991, 2011). Subsequent to Mettee *et al.* (1996), who also noted geographically-based color differences rendering this form distinct in Alabama and Tennessee, a phylogeography study of *N. flavus* by Faber *et al.* (2009) noted that the Highlands Stonecat is a genetically divergent lineage but warranted "a more complete analysis of both genetic and morphological variability, as they may be a distinct species." Two additional metapopulations of catfishes distributed in Alabama are considered distinct, although whether they represent species-level entities remains to be determined. These include the disjunct western and eastern populations of the Frecklebelly Madtom *Noturus munitus*, which are considered ESUs, or historically isolated populations (Ryder 1986; Moritz 1994). *Noturus munitus* ESU 1 is composed of populations from the Cahaba River drainage and is referred to herein as the "Cahaba River Population" unit, while *N. munitus* ESU 4 is composed of populations from the Tombigbee River drainage and is referred to informally as the "Tombigbee River Population" unit (Table 2).

Among North American minnows in family Leuciscidae, we find five undescribed candidate species (Table 2), including forms that have been hypothesized as distinct for up to 40 years. These include (1) the "Coastal Chub," *Hybopsis* sp. cf. *winchelli*, known from coastal drainages east of the Mobile River Basin to the Apalachicola River (Mettee *et al.* 1996;

Boschung & Mayden 2004) and initially identified by Clemmer (1971); (2) the "Coosa Longnose Shiner" (informal terminology adopted herein), *Miniellus* sp. cf. *longirostris*, a presumed microendemic form known only from the upper Coosa River in northwestern Georgia (previously, "*Notropis* sp. cf. *N. longirostris*"; Straight *et al.* 2021); (3) "Sawfin Shiner," *Paranotropis* sp. cf. *spectrunculus*, distributed in the Tennessee River drainage in Alabama north to Cumberland River drainage in Kentucky, which was reported by Boschung and Mayden (2004; as "*Notropis* sp. cf. *N. spectrunculus*") in the Paint Rock River in Jackson Co., Alabama; (4) the "Mobile Mimic Shiner," *Paranotropis* sp. cf. *volucellus*, identified as morphologically and molecularly distinct by Mayden and Kuhajda (1989) and considered sympatric with the Mimic Shiner, *P. volucellus*, in the Cahaba River drainage (Mettee *et al.* 1996; Boschung & Mayden 2004); and (5) *Pteronotropis* sp. cf. *signipinnis*, comprising populations of *P. signipinnis* in coastal rivers of the Gulf Slope located east of Mobile Bay (Mayden & Allen 2015). A related area of taxonomic confusion in Alabama's minnow assemblage is the genus *Campostoma*, which molecular analyses suggest may hold undescribed biodiversity warranting taxonomic revision (Blum *et al.* 2008), and which some workers already informally consider distinct (e.g., *C.* sp. cf. *oligolepis*, the "Southeastern Largescale Stoneroller"; SFC 2022). However, additional morphological and genetic analyses based on broad spatial and taxonomic sampling will be needed to determine whether or not any new species are delimited within *Campostoma* and occur in Alabama.

The sucker family Catostomidae and the cavefish family Amblyopsidae share the feature of containing one potential candidate species each, and these will require further taxonomic study (Table 2). The undescribed catostomid is the "Apalachicola Redhorse," *Moxostoma* sp. cf. *poecilurum*, which is a form similar to *M. poecilurum* but having dusky gray fins and is known only from the Apalachicola River system in Alabama and Georgia (Page & Burr 2011). This form is sometimes referred to informally as "Grayfin Redhorse," for example by Mettee *et al.* (1996). In recent phylogenetic analyses, Bagley *et al.* (2018) inferred *Moxostoma* sp. cf. *poecilurum* as either sister to the Gray Redhorse, *M. congestum*, which is native to the Brazos to Rio Grande river drainages in central to southern Texas (Page & Burr 2011), or sister to a clade of *M. congestum* + *M. poecilurum*, but with only moderate Bayesian support. The undescribed cavefish is known as "Tennessee Cavefish," *Typhlichthys* sp. cf. *subterraneus*, and is considered to represent the distinct eastern populations of Southern Cavefish, *T. subterraneus*, from the

Tennessee River drainage in Tennessee into northern Alabama (see range maps in Boschung & Mayden 2004; Page & Burr 1991, 2011).

Within the Centrarchidae, approximately three forms of black basses from the genus *Micropterus* remain undescribed but are considered by scientists as morphologically or molecularly distinct candidate species. Only one of these candidate *Micropterus* species occurs in Alabama and thus is included in Table 2. This candidate form is "Choctaw Bass," *Micropterus* sp. cf. *punctulatus*, which was discovered by Bagley *et al.* (2011) and later Tringali *et al.* (2015) and was considered by these authors to comprise genetically distinct populations from coastal rivers west and just east of the Mobile River Basin along the Gulf Coastal Plain. Bagley *et al.* (2011) found that this form, represented in their Clade IV, was monophyletic and notably genetically distinct, with 3.4–12.9% mitochondrial DNA sequence divergence from other black basses. Tringali *et al.* (2015) subsequently also identified Choctaw Bass as genetically distinct and in need of conservation, and they noted morphological differences between populations of this form and *M. punctulatus*. Recent phylogenomic and species delimitation analyses by Kim *et al.* (2022) delimited this lineage as distinct and worthy of formal species-level recognition, but with a geographic range restricted to coastal rivers just east of the Mobile River Basin, from the Escambia River east to the Choctawhatchee River. Given multiple data types support the distinctiveness and delimitation of *Micropterus* sp. cf. *punctulatus*, additional genetic and morphological analyses should be conducted to formally describe this taxon. The other putative candidate species of *Micropterus* that need to be assessed in a formal morphological analysis are "Bartram's Bass," which is composed of populations currently allocated to *M. coosae* in the Savannah River drainage of Georgia and South Carolina (Bagley *et al.* 2011; Baker *et al.* 2013; B. Freeman, pers. comm.; Kim *et al.* 2022), and the newly delimited "Altamaha Bass", which is composed of *M. coosae* populations from the Altamaha River in Georgia (Kim *et al.* 2022).

Within the family Percidae, we are aware of at least four undescribed candidate species known from Alabama and in need of further attention from taxonomists (Table 2). These include two undescribed forms within the range of the Warrior Darter, *Etheostoma bellator*: *Etheostoma* sp. cf. *bellator* from Locust Fork of the Black Warrior River drainage, which is known informally as the "Locust Fork Darter," and *Etheostoma* sp. cf. *bellator* "Sipsey" from the Sipsey River arm of the Upper Tombigbee River, which we informally refer to as the "Sipsey Darter." Additionally, populations of Coldwater Darter, *E. ditrema*, from the middle reaches of the Coosa

River (to which it is endemic; Mettee *et al.* 1996; Boschung & Mayden 2004) are known as an undescribed form, *Etheostoma* sp. cf. *ditrema*, that we refer to as "Middle Coosa River Populations." *Etheostoma* sp. cf. *ditrema* from the middle or central Coosa River were initially identified as morphologically distinct in the 1970s and 1980s (e.g., Caldwell 1971; Utter 1984), and the same entity was identified as genetically distinct based on fixed alleles or allele frequency differences at allozyme loci in an analysis of several darters from the subgenus *Oligocephalus* by Mayden *et al.* (2005). Last, Walleye, *Sander vitreus*, populations from the southern parts of the species range in Mississippi and Alabama are considered morphologically distinct and are referred to informally as the "Southern Walleye," *Sander* sp. cf. *vitreus* (M.W. Sandel, pers. comm.). Southern Walleye are currently in the process of being formally described based on morphological and genetic data, in a paper that also uses next-generation sequencing data to shed light on the species demographic history of divergence and introgression (M.W. Sandel, pers. comm.).

We recommend new empirical studies treating the above candidate species as hypotheses to be tested in the spirit of 'integrative taxonomy' (*cf.* Padial *et al.* 2010), using analyses based on multiple data types, including combinations of morphology, molecules, and behavioral and ecological data. We believe that integrative taxonomy provides the best way to test the validity of these forms and to arrive at more robust species descriptions, increasing taxonomic stability in the system. At minimum, statistically rigorous analyses of morphological data (e.g., traditional counts and measures, morphometrics; Hubbs & Lagler 1964; Armbruster & Pera 2006; Armbruster 2012) should be conducted that test for significant differentiation of populations or lineages (e.g., using analysis of variance [ANOVA], multivariate analyses, or discriminant function analysis [DFA] combined with post-hoc tests). One novel approach that is currently gaining traction is the use of machine-learning algorithms, such as 'Random Forest' (guided regularized random forest, GRRF; Breiman 2001; Deng 2013), to identify diagnostic characters separating species, which can easily be used to complement more traditional analyses of morphology or genetic data (e.g., Breitman *et al.* 2018; Soares *et al.* 2021). Even so, recent phylogenomics and species delimitation studies discussed above (e.g., MacGuigan & Near 2019; Brownstein *et al.* 2022; Kim *et al.* 2022) demonstrate the kinds of resolution that can be achieved in sorting out species boundaries and taxonomy through rigorous analyses of genetic or combined genetic and morphological datasets, which can highlight areas for further detailed

studies using the approaches of integrative taxonomy and alpha taxonomy.

Our discussion of the above undescribed candidate species from the inland fresh waters of Alabama illustrates that the Linnean shortfall for the state's freshwater fish fauna has, at minimum, been probed and outlined roughly in extent. Major work has also been conducted on DNA barcoding of the North American freshwater fish fauna, including many species from Alabama, and has shown evidence of genetically distinct intraspecific lineages (e.g., *Lythrurus*, *Nocomis*; April *et al.* 2011). However, there is a relative paucity of information on candidate species of marine fishes. This likely reflects the smaller overall number of studies on nearshore marine fishes of North America as compared to that for the freshwater fishes of the continent, as well as the much lower sampling effort applied to marine fishes of Alabama's state waters as compared to our freshwater fishes (Fig. 3; 'Sampling Effort: Freshwater vs. Marine Collections' section above). The only way to buttress and close such knowledge gaps would be through direct investment in biodiversity inventories of Alabama's marine fishes, which we envision would be optimally designed to include targeted surveys of marine fish diversity at the genetic, morphological, community, and ecosystem levels. Yet, to date, only a single DNA barcoding study has been published that provides insight into nearshore fish species diversity and molecular species identification in marine regions bordering the state of Alabama, including parts of the Caribbean Sea and Western Atlantic Ocean (Weigt *et al.* 2012). A great deal more investment in this and related areas of research including environmental barcoding (e.g., Valentini *et al.* 2016), phenomics (e.g., Page *et al.* 2015), integrative taxonomy (e.g., Padial *et al.* 2010; Hartop *et al.* 2021), and next-generation DNA sequencing and biomonitoring (reviewed by Porter & Hajibabaei 2017) is recommended to identify groups of marine fishes known from Alabama whose species richness is likely underestimated by current taxonomy. Indeed, it would serve us well to simultaneously apply the new, cost-effective, and scalable "next-gen" approaches to biodiversity analysis listed above, in conjunction with rigorous alpha taxonomy (e.g., integrative taxonomy, expansion of taxonomic expertise), to Alabama's freshwater and marine fish assemblages, not just to fishes from one habitat or the other.

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Tables

TABLE 1. List of 37 partner institutions that provided data to FishNet2 that were used in the present study, along with their symbolic codes (Sabaj 2020, 2022), and the number of records (lots) from Alabama. Summary data shown here were calculated after removing a large set of over 2000 Tombigbee River records from Mississippi in order to focus on material sampled primarily from Alabama.

Ichthyological Collection	Symbolic Code	No. Records
University of Alabama Ichthyological Collection	UA	55935
Auburn University Museum of Natural History	AUM	34147
Tulane University Museum of Natural History - Royal D. Suttkus Fish Collection	TU	25749
University of Michigan Museum of Zoology	UMMZ	4352
Florida Museum of Natural History	UF	3704
National Museum of Natural History, Smithsonian Institution	USNM	2940
Mississippi Museum of Natural Science	MMNS	2706
Cornell University Museum of Vertebrates	CUMV	2387
Texas A&M University Biodiversity Research and Teaching Collection	TCWC	1603
Illinois Natural History Survey	INHS	1583
University of Washington Fish Collection	UWFC	1476

Yale University Peabody Museum	YPM	1071
Ohio State University - Fish Division	OSUM	706
Academy of Natural Sciences at Philadelphia	ANSP	546
University of Kansas Biodiversity Institute - Specimens	KU	527
University of Kansas Biodiversity Institute - Tissues	KU	392
Harvard University	MCZ	368
Royal Ontario Museum	ROM	210
California Academy of Sciences	CAS	175
Field Museum	FMNH	151
North Carolina State Museum of Natural Sciences	NCSM	133
Texas Natural History Science Center - Texas Natural History Collections	TNHC	129
Louisiana State University Museum of Zoology	LSUMZ	120
Florida Fish and Wildlife Conservation Commission	FSBC	111
University of Tennessee - Etnier Ichthyological Research Collection	UT	75
Los Angeles County Museum of Natural History	LACM	74
Canadian Museum of Nature	CMN	61

Michigan State University Museum	MSUM	58
Museum of Southwestern Biology	MSB	16
Sam Noble Oklahoma Museum of Natural History	SNM	14
Fort Hays Sternberg Museum of Natural History	FHSM	11
Swedish Museum of Natural History	NRM	11
University of Alberta Museums	UAMZ	8
Oregon State University	OS	7
Scripps Institute of Oceanography	SIO	6
GBIF–Muséum National d'Histoire Naturelle	MNHN	5
University of Colorado Museum of Natural History	UCM	2

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TABLE 2. Checklist of marine and freshwater fishes known from inland and coastal waters of the state of Alabama and the Mobile River Basin. Following the order and family names, each species scientific name and author(s) is given along with its Common Name, Status (in Alabama), and Habitat details. Evolutionarily significant unit (ESU) names represent candidate species, modified after data from the Southeastern Fishes Council (SFC 2022). Abbreviations: Exstate, extirpated from the state; F, freshwater; I, introduced species; M, marine; N, native; N/A, not applicable (no state status because species does not occur within state borders); Reint, reintroduced in state.

Taxon	Common Name	Status	Habitat
Order Petromyzontiformes			
Petromyzontidae Bonaparte 1831–Lampreys			
Ichthyomyzon bdellium (Jordan 1885)	Ohio Lamprey	N	F
Ichthyomyzon castaneus Girard 1858	Chestnut Lamprey	N	F
Ichthyomyzon gagei Hubbs & Trautman 1937	Southern Brook Lamprey	N	F
Ichthyomyzon greeleyi Hubbs & Trautman 1937	Mountain Brook Lamprey	N	F
Lampetra aepyptera (Abbott 1860)	Least Brook Lamprey	N	F
Lethenteron appendix (DeKay 1842)	American Brook Lamprey	N	F
Order Orectolobiformes			
Ginglymostomatidae Gill 1862–Nurse sharks			

Ginglymostoma cirratum (Bonnaterre 1788)	Nurse Shark	N	M
Order Carcharhiniformes			
Triakidae Gray 1851–Houndsharks			
Mustelus canis (Mitchill 1815)	Smooth Dogfish	N	M
Carcharhinidae Jordan & Evermann 1896–Requiem sharks			
Carcharhinus acronotus (Poey 1860)	Blacknose Shark	N	M
Carcharhinus brevipinna (Valenciennes 1839)	Spinner Shark	N	M
Carcharhinus isodon (Valenciennes 1839)	Finetooth Shark	N	M
Carcharhinus leucas (Valenciennes 1839)	Bull Shark	N	F, M
Carcharhinus limbatus (Valenciennes 1839)	Blacktip Shark	N	M
Carcharhinus plumbeus (Nardo 1827)	Sandbar Shark	N	M
Rhizoprionodon terraenovae (Richardson 1836)	Atlantic Sharpnose Shark	N	M
Galeocerdonidae Poey 1875–Tiger sharks			
Galeocerdo cuvier (Péron & Lesueur 1822)	Tiger Shark	N	F, M
Sphyrnidae Bonaparte 1840–Hammerhead sharks			
Sphyrna lewini (Griffith & Smith 1834)	Scalloped Hammerhead	N	M
Sphyrna mokarran (Rüppell 1837)	Great Hammerhead	N	M

Sphyrna tiburo (Linnaeus 1758)	Bonnethead	N	M
Order Myliobatiformes			
Dasyatidae Jordan & Gilbert 1879–Whiptail stingrays			
Hypanus americanus (Hildebrand & Schroeder 1928)	Southern Stingray	N	M
Hypanus sabinus (Lesueur 1824)	Atlantic Stingray	N	F, M
Hypanus say (Lesueur 1817)	Bluntnose Stingray	N	M
Rhinopteridae Jordan & Evermann 1896–Cownose rays			
Rhinoptera bonasus (Mitchill 1815)	Cownose Ray	N	M
Mobulidae Gill 1893–Mantas or devil rays			
Mobula birostris (Walbaum 1792)	Giant Manta	N	M
Order Acipenseriformes			
Acipenseridae Bonaparte 1831–Sturgeons			
Acipenser fulvescens Rafinesque 1817	Lake Sturgeon	Reint	F
Acipenser desotoi Vladykov 1955	Gulf Sturgeon	N	F, M
Scaphirhynchus platorynchus (Rafinesque 1820)	Shovelnose Sturgeon	Exstate	F
Scaphirhynchus suttkusi Williams & Clemmer 1991	Alabama Sturgeon	N	F
Polyodontidae Bonaparte 1835–Paddlefishes			

Polyodon spathula (Walbaum 1792)	Paddlefish	N	F
Order Amiiformes			
Amiidae Bonaparte 1831–Bowfins			
Amia calva Linnaeus 1766	Bowfin	N	F
Amia ocellicauda Todd in Richardson 1836	Emerald Bowfin	N	F
Order Lepisosteiformes			
Lepisosteidae Agassiz 1832–Gars			
Atractosteus spatula (Lacepède 1803)	Alligator Gar	N	F
Lepisosteus oculatus Winchell 1864	Spotted Gar	N	F
Lepisosteus osseus (Linnaeus 1758)	Longnose Gar	N	F
Lepisosteus platostomus Rafinesque 1820	Shortnose Gar	Exstate	F
Order Elopiformes			
Elopidae Valenciennes 1847–Tenpounders and ladyfishes			
Elops saurus Linnaeus 1766	Ladyfish	N	F, M
Megalopidae Jordan & Gilbert 1883–Tarpons			
Megalops atlanticus Valenciennes 1847	Tarpon	N	M
Order Anguilliformes			

Anguillidae Linnaeus 1758–Freshwater eels			
Anguilla rostrata (Lesueur 1817)	American Eel	N	F, M
Ophichthidae Günther 1870–Snake eels and worm eels			
Myrophis punctatus Lütken 1852	Speckled Worm Eel	N	M
Ophichthus gomesii (Castelnau 1855)	Shrimp Eel	N	M
Ophichthus rex Böhlke & Caruso 1980	King Snake Eel	N	M
Order Hiodontiformes			
Hiodontidae Valenciennes 1847–Mooneyes			
Hiodon alosoides (Rafinesque 1819)	Goldeye	Exstate	F
Hiodon tergisus Lesueur 1818	Mooneye	N	F
Order Clupeiformes			
Alosidae Svetovidov 1952–Shads and sardines			
Alosa aestivalis (Mitchill 1814)	Blueback Herring	I	F, M
Alosa alabamae Jordan & Evermann 1896	Alabama Shad	N	F, M
Alosa chrysochloris (Rafinesque 1820)	Skipjack Herring	N	F, M
Brevoortia patronus Goode 1878	Gulf Menhaden	N	F, M
Dorosomatidae Gill 1861–Thread herrings			

Dorosoma cepedianum (Lesueur 1818)	Gizzard Shad	N	F, M
Dorosoma petenense (Günther 1867)	Threadfin Shad	N	F, M
Harengula jaguana Poey 1865	Scaled Herring	N	M
Engraulidae Gill 1861–Anchovies			
Anchoa hepsetus (Linnaeus 1758)	Striped Anchovy	N	M
Anchoa lyolepis (Evermann & Marsh 1900)	Dusky Anchovy	N	M
Anchoa mitchilli (Valenciennes 1848)	Bay Anchovy	N	F, M
Order Cypriniformes			
Cyprinidae Rafinesque 1815–Carps			
Carassius auratus (Linnaeus 1758)	Goldfish	I	F
Cyprinus carpio Linnaeus 1758	Common Carp	I	F
Xenocyprididae Günther 1868–East Asian minnows or sharpbellies			
Ctenopharyngodon idella (Valenciennes 1844)	Grass Carp	I	F
Hypophthalmichthys molitrix (Valenciennes 1844)	Silver Carp	I	F
Hypophthalmichthys nobilis (Richardson 1845)	Bighead Carp	I	F
Leuciscidae Bonaparte 1835–Minnows			
Alburnops asperifrons (Suttkus & Raney 1955)	Burrhead Shiner	N	F

Alburnops baileyi (Suttkus & Raney 1955)	Rough Shiner	N	F
Alburnops candidus (Suttkus 1980)	Silverside Shiner	N	F
Alburnops chalybaeus (Cope 1867)	Ironcolor Shiner	N	F
Alburnops edwardraneyi (Suttkus & Clemmer 1968)	Fluvial Shiner	N	F
Alburnops hypsilepis (Suttkus & Raney 1955)	Highscale Shiner	N	F
Alburnops petersoni (Fowler 1942)	Coastal Shiner	N	F
Alburnops texanus (Girard 1856)	Weed Shiner	N	F
Alburnops xaenocephalus (Jordan 1877)	Coosa Shiner	N	F
Campostoma oligolepis Hubbs & Greene 1935	Largescale Stoneroller	N	F
Campostoma pauciradii Burr & Cashner 1983	Bluefin Stoneroller	N	F
Chrosomus erythrogaster (Rafinesque 1820)	Southern Redbelly Dace	N	F
Clinostomus funduloides Girard 1856	Rosyside Dace	N	F
Coccotis coccogenis (Cope 1868)	Warpaint Shiner	N	F
Coccotis zonistius (Jordan 1880)	Bandfin Shiner	N	F
Cyprinella caerulea (Jordan 1877)	Blue Shiner	N	F
Cyprinella callistia (Jordan 1877)	Alabama Shiner	N	F
Cyprinella callitaenia (Bailey & Gibbs 1956)	Bluestripe Shiner	N	F

Cyprinella galactura (Cope 1868)	Whitetail Shiner	N	F
Cyprinella gibbsi (Howell & Williams 1971)	Tallapoosa Shiner	N	F
Cyprinella lutrensis (Baird & Girard 1853)	Red Shiner	I	F
Cyprinella spiloptera (Cope 1867)	Spotfin Shiner	N	F
Cyprinella trichroistia (Jordan & Gilbert 1878)	Tricolor Shiner	N	F
Cyprinella venusta Girard 1856	Blacktail Shiner	N	F
Cyprinella whipplei Girard 1856	Steelcolor Shiner	N	F
Ericymba amplamala Pera & Armbruster 2006	Longjaw Minnow	N	F
Erimonax monachus (Cope 1868)	Spotfin Chub	Reint	F
Erimystax dissimilis (Kirtland 1840)	Streamline Chub	N	F
Erimystax insignis (Hubbs & Crowe 1956)	Blotched Chub	N	F
Hemitremia flammea (Jordan & Gilbert 1878)	Flame Chub	N	F
Hybognathus hayi Jordan 1885	Cypress Minnow	N	F
Hybognathus nuchalis Agassiz 1855	Mississippi Silvery Minnow	N	F
Hybopsis amblops (Rafinesque 1820)	Bigeye Chub	N	F
Hybopsis lineapunctata Clemmer & Suttkus 1971	Lined Chub	N	F
Hybopsis winchelli Girard 1856	Clear Chub	N	F

Hybopsis sp. cf. *winchelli*	"Coastal Chub"	N	F
Hydrophlox chrosomus (Jordan 1877)	Rainbow Shiner	N	F
Hydrophlox lutipinnis Jordan & Brayton 1878	Yellowfin Shiner	N/A	F
Luxilus chrysocephalus Rafinesque 1820	Striped Shiner	N	F
Lythrurus alegnotus (Snelson 1972)	Warrior Shiner	N	F
Lythrurus atrapiculus (Snelson 1972)	Blacktip Shiner	N	F
Lythrurus bellus (Hay 1881)	Pretty Shiner	N	F
Lythrurus fasciolaris (Gilbert 1891)	Scarlet Shiner	N	F
Lythrurus fumeus (Evermann 1892)	Ribbon Shiner	N	F
Lythrurus lirus (Jordan 1877)	Mountain Shiner	N	F
Lythrurus roseipinnis (Hay 1885)	Cherryfin Shiner	N	F
Lythrurus umbratilis (Girard 1856)	Redfin Shiner	N	F
Macrhybopsis boschungi Gilbert & Mayden 2017	Mobile Chub	N	F
Macrhybopsis etnieri Gilbert & Mayden 2017	Coosa Chub	N	F
Macrhybopsis hyostoma (Gilbert 1884)	Shoal Chub	N	F
Macrhybopsis pallida Gilbert & Mayden 2017	Pallid Chub	N	F
Macrhybopsis storeriana (Kirtland 1845)	Silver Chub	N	F

Miniellus albizonatus (Warren & Burr 1994)	Palezone Shiner	N	F
Miniellus ammophilus (Suttkus & Boschung 1990)	Orangefin Shiner	N	F
Miniellus boops (Gilbert 1884)	Bigeye Shiner	N	F
Miniellus longirostris (Hay 1881)	Longnose Shiner	N	F
Miniellus sp. cf. *longirostris*	"Coosa Longnose Shiner"	N	F
Miniellus melanostomus (Bortone 1989)	Blackmouth Shiner	N	F
Miniellus uranoscopus (Suttkus 1959)	Skygazer Shiner	N	F
Nocomis leptocephalus (Girard 1856)	Bluehead Chub	N	F
Nocomis micropogon (Cope 1865)	River Chub	N	F
Notemigonus crysoleucas (Mitchill 1814)	Golden Shiner	N	F
Notropis ariommus (Cope 1867)	Popeye Shiner	N	F
Notropis atherinoides Rafinesque 1818	Emerald Shiner	N	F
Notropis maculatus (Hay 1881)	Taillight Shiner	N	F
Notropis micropteryx (Cope 1868)	Highland Shiner	N	F
Notropis photogenis (Cope 1865)	Silver Shiner	N	F
Notropis stilbius Jordan 1877	Silverstripe Shiner	N	F
Notropis telescopus (Cope 1868)	Telescope Shiner	N	F

Opsopoeodus emiliae Hay 1881	Pugnose Minnow	N	F
Paranotropis buchanani (Meek 1896)	Ghost Shiner	N	F
Paranotropis cahabae (Mayden & Kuhajda 1989)	Cahaba Shiner	N	F
Paranotropis leuciodus (Cope 1868)	Tennessee Shiner	N	F
Paranotropis sp. cf. *spectrunculus*	"Sawfin Shiner"	N	F
Paranotropis volucellus (Cope 1865)	Mimic Shiner	N	F
Paranotropis sp. cf. *volucellus*	"Mobile Mimic Shiner"	N	F
Paranotropis wickliffi (Trautman 1931)	Channel Shiner	N	F
Phenacobius catostomus Jordan 1877	Riffle Minnow	N	F
Phenacobius mirabilis (Girard 1856)	Suckermouth Minnow	N	F
Phenacobius uranops Cope 1867	Stargazing Minnow	N	F
Pimephales notatus (Rafinesque 1820)	Bluntnose Minnow	N	F
Pimephales promelas Rafinesque 1820	Fathead Minnow	I	F
Pimephales vigilax (Baird & Girard 1853)	Bullhead Minnow	N	F
Pteronotropis cummingsae (Myers 1925)	Dusky Shiner	N	F
Pteronotropis euryzonus (Suttkus 1955)	Broadstripe Shiner	N	F
Pteronotropis grandipinnis (Jordan 1877)	Apalachee Shiner	N	F

Pteronotropis harperi (Fowler 1941)	Redeye Chub	N	F
Pteronotropis hypselopterus (Günther 1868)	Sailfin Shiner	N	F
Pteronotropis merlini (Suttkus & Mettee 2001)	Orangetail Shiner	N	F
Pteronotropis signipinnis (Bailey & Suttkus 1952)	Flagfin Shiner	N	F
Pteronotropis sp. cf. *signipinnis*	"Eastern Flagfin Shiner"	N	F
Pteronotropis welaka (Evermann & Kendall 1898)	Bluenose Shiner	N	F
Rhinichthys obtusus Agassiz 1854	Western Blacknose Dace	N	F
Scardinius erythrophthalmus (Linnaeus 1758)	Rudd	I	F
Semotilus atromaculatus (Mitchill 1818)	Creek Chub	N	F
Semotilus thoreauianus Jordan 1877	Dixie Chub	N	F
Catostomidae Agassiz 1850–Suckers			
Carpiodes carpio (Rafinesque 1820)	River Carpsucker	N	F
Carpiodes cyprinus (Lesueur 1817)	Quillback	N	F
Carpiodes velifer (Rafinesque 1820)	Highfin Carpsucker	N	F
Catostomus commersonii (Lacepède 1803)	White Sucker	N	F
Cycleptus elongatus (Lesueur 1817)	Blue Sucker	N	F
Cycleptus meridionalis Burr & Mayden 1999	Southeastern Blue Sucker	N	F

Erimyzon claviformis (Girard 1856)	Western Creek Chubsucker	N	F
Erimyzon sucetta (Lacepède 1803)	Lake Chubsucker	N	F
Erimyzon tenuis (Agassiz 1855)	Sharpfin Chubsucker	N	F
Hypentelium etowanum (Jordan 1877)	Alabama Hog Sucker	N	F
Hypentelium nigricans (Lesueur 1817)	Northern Hog Sucker	N	F
Ictiobus bubalus (Rafinesque 1818)	Smallmouth Buffalo	N	F
Ictiobus cyprinellus (Valenciennes 1844)	Bigmouth Buffalo	N	F
Ictiobus niger (Rafinesque 1819)	Black Buffalo	N	F
Minytrema melanops (Rafinesque 1820)	Spotted Sucker	N	F
Moxostoma anisurum (Rafinesque 1820)	Silver Redhorse	N	F
Moxostoma breviceps (Cope 1870)	Smallmouth Redhorse	N	F
Moxostoma carinatum (Cope 1870)	River Redhorse	N	F
Moxostoma duquesnei (Lesueur 1817)	Black Redhorse	N	F
Moxostoma erythrurum (Rafinesque 1818)	Golden Redhorse	N	F
Moxostoma lacerum (Jordan & Brayton 1877)	Harelip Sucker	Extinct	F
Moxostoma lachneri Robins & Raney 1956	Greater Jumprock	N	F
Moxostoma macrolepidotum (Lesueur 1817)	Shorthead Redhorse	N	F

Moxostoma poecilurum Jordan 1877	Blacktail Redhorse	N	F
Moxostoma sp. cf. *poecilurum*	"Apalachicola Redhorse"	N	F
Cobitidae Swainson 1838–Spined loaches			
Misgurnus anguillicaudatus (Cantor 1842)	Pond Loach	I	F
Order Siluriformes			
Ictaluridae Gill 1861–North American freshwater catfishes			
Ameiurus brunneus Jordan 1877	Snail Bullhead	N	F
Ameiurus catus (Linnaeus 1758)	White Catfish	N	F
Ameiurus melas (Rafinesque 1820)	Black Bullhead	N	F
Ameiurus natalis (Lesueur 1819)	Yellow Bullhead	N	F
Ameiurus nebulosus (Lesueur 1819)	Brown Bullhead	N	F
Ameiurus serracanthus (Yerger & Relyea 1968)	Spotted Bullhead	N	F
Ictalurus furcatus (Valenciennes 1840)	Blue Catfish	N	F
Ictalurus punctatus (Rafinesque 1818)	Channel Catfish	N	F
Noturus crypticus Burr, Eisenhour & Grady 2005	Chucky Madtom	Exstate	F
Noturus eleutherus Jordan 1877	Mountain Madtom	N	F
Noturus exilis Nelson 1876	Slender Madtom	N	F

Noturus flavus Rafinesque 1818	Stonecat	N	F
Noturus funebris Gilbert & Swain 1891	Black Madtom	N	F
Noturus gyrinus (Mitchill 1817)	Tadpole Madtom	N	F
Noturus leptacanthus Jordan 1877	Speckled Madtom	N	F
Noturus miurus Jordan 1877	Brindled Madtom	N	F
Noturus munitus Suttkus & Taylor 1965	Frecklebelly Madtom	N	F
Noturus munitus ESU 1	"Cahaba River Population"	N	F
Noturus munitus ESU 4	"Tombigbee River Population"	N	F
Noturus nocturnus Jordan & Gilbert 1886	Freckled Madtom	N	F
Noturus phaeus Taylor 1969	Brown Madtom	N	F
Pylodictis olivaris (Rafinesque 1818)	Flathead Catfish	N	F
Ariidae Bleeker 1858–Sea catfishes			
Ariopsis felis (Linnaeus 1766)	Hardhead Catfish	N	F
Bagre marinus (Mitchill 1815)	Gafftopsail Catfish	N	F
Order Esociformes			
Esocidae Rafinesque 1815–Pikes			
Esox americanus Gmelin 1789	Redfin Pickerel	N	F

Esox niger Lesueur 1818	Chain Pickerel	N	F
Order Salmoniformes			
Salmonidae Jarocki / Schinz 1822–Trout and charr			
Oncorhynchus mykiss (Walbaum 1792)	Rainbow Trout	I	F, M
Salmo trutta Linnaeus 1758	Brown Trout	I	F, M
Salvelinus fontinalis (Mitchill 1814)	Brook Trout	N/A	F, M
Order Percopsiformes			
Amblyopsidae Bonaparte 1845–Cavefishes			
Speoplatyrhinus poulsoni Cooper & Kuehne 1974	Alabama Cavefish	N	F
Typhlichthys subterraneus Girard 1859	Southern Cavefish	N	F
Typhlichthys sp. cf. *subterraneus*	"Tennessee Cavefish"	N	F
Aphredoderidae Bonaparte 1845–Pirate perches			
Aphredoderus sayanus (Gilliams 1824)	Pirate Perch	N	F
Order Gadiformes			
Phycidae Swainson 1838–Phycid hakes			
Urophycis floridana (Bean & Dresel 1884)	Southern Codling	N	M
Order Aulopiformes			

Synodontidae Gill 1861–Lizardfishes			
Synodus foetens (Linnaeus 1766)	Inshore Lizardfish	N	M
Order Batrachoidiformes			
Batrachoididae Jordan 1896–Toadfishes			
Opsanus beta (Goode & Bean 1880)	Gulf Toadfish	N	M
Order Gobiiformes			
Eleotridae Bonaparte 1835–Sleepers			
Dormitator maculatus (Bloch 1792)	Fat Sleeper	N	F, M
Eleotris amblyopsis (Cope 1871)	Largescaled Spinycheek Sleeper	N	F, M
Gobiidae Cuvier 1816–Gobies			
Ctenogobius boleosoma (Jordan & Gilbert 1882)	Darter Goby	N	F, M
Ctenogobius shufeldti (Jordan & Eigenmann 1887)	Freshwater Goby	N	F, M
Evorthodus lyricus (Girard 1858)	Lyre Goby	N	F, M
Gobioides broussonetii Lacepède 1800	Violet Goby	N	F, M
Gobionellus oceanicus (Pallas 1770)	Highfin Goby	N	F, M
Gobiosoma bosc (Lacepède 1800)	Naked Goby	N	F, M
Microgobius gulosus (Girard 1858)	Clown Goby	N	F, M

Microgobius thalassinus (Jordan & Gilbert 1883)	Green Goby	N	F, M
Order Syngnathiformes			
Syngnathidae Bonaparte 1831–Pipefishes and seahorses			
Syngnathus louisianae Günther 1870	Chain Pipefish	N	M
Syngnathus scovelli (Evermann & Kendall 1896)	Gulf Pipefish	N	M
Order Scombriformes			
Pomatomidae Gill 1863–Bluefishes			
Pomatomus saltatrix (Linnaeus 1766)	Bluefish	N	M
Scombridae Rafinesque 1815–Mackerels, tunas, and bonitos			
Scomberomorus maculatus (Mitchill 1815)	Atlantic Spanish Mackerel	N	M
Stromateidae Rafinesque 1810–Butterfishes			
Peprilus burti Fowler 1944	Gulf Butterfish	N	M
Peprilus paru (Linnaeus 1758)	American Harvestfish	N	M
Trichiuridae Rafinesque 1810–Cutlassfishes			
Trichiurus lepturus Linnaeus 1758	Largehead Hairtail	N	M
Order Carangiformes			
Sphyraenidae Rafinesque 1815–Barracudas			

Sphyraena barracuda (Edwards 1771)	Great Barracuda	N	M
Sphyraena guachancho Cuvier 1829	Guachanche Barracuda	N	M
Carangidae Rafinesque 1815–Jacks			
Caranx crysos (Mitchill 1815)	Blue Runner	N	M
Caranx hippos (Linnaeus 1766)	Crevalle Jack	N	M
Chloroscombrus chrysurus (Linnaeus 1766)	Atlantic Bumper	N	M
Hemicaranx amblyrhynchus (Cuvier 1833)	Bluntnose Jack	N	M
Oligoplites saurus (Bloch & Schneider 1801)	Leatherjacket	N	M
Selene setapinnis (Mitchill 1815)	Atlantic Moonfish	N	M
Selene vomer (Linnaeus 1758)	Lookdown	N	M
Trachinotus carolinus (Linnaeus 1766)	Florida Pompano	N	M
Echeneidae Rafinesque 1810–Remoras and sharksuckers			
Echeneis naucrates Linnaeus 1758	Sharksucker	N	M
Echeneis neucratoides Zuiew 1789	Whitefin Sharksucker	N	M
Remora remora (Linnaeus 1758)	Remora	N	M
Rachycentridae Gill 1896–Cobias			
Rachycentron canadum (Linnaeus 1766)	Cobia	N	M

Achiridae Rafinesque 1815–American soles			
Achirus lineatus (Linnaeus 1758)	Lined Sole	N	F, M
Trinectes maculatus (Bloch & Schneider 1801)	Hogchoker	N	F, M
Cyclopsettidae Campbell *et al.* 2019–Large-toothed flounders			
Citharichthys spilopterus Günther 1862	Bay Whiff	N	M
Etropus crossotus Jordan & Gilbert 1882	Fringed Flounder	N	M
Cynoglossidae Jordan 1888–Tonguefishes			
Symphurus plagiusa (Linnaeus 1766)	Blackcheek Tonguefish	N	F, M
Paralichthyidae Regan 1910–Sand flounders			
Ancylopsetta quadrocellata Gill 1864	Ocellated Flounder	N	M
Paralichthys lethostigma Jordan & Gilbert 1884	Southern Flounder	N	F, M
Paralichthys squamilentus Jordan & Gilbert 1882	Broad Flounder	N	M
Order Mugiliformes			
Mugilidae Jarocki 1822–Mullets			
Mugil cephalus Linnaeus 1758	Striped Mullet	N	F, M
Mugil curema Valenciennes 1836	White Mullet	N	F, M
Order Cichliformes			

Cichlidae Bonaparte 1835–Cichlids			
Oreochromis aureus (Steindachner 1864)	Blue Tilapia	I	F
Oreochromis mossambicus (Peters 1852)	Mozambique Tilapia	I	F
Oreochromis niloticus (Linnaeus 1758)	Nile Tilapia	I	F
Order Gobiesociformes			
Gobiesocidae Bleeker 1859–Clingfishes			
Gobiesox strumosus Cope 1870	Skilletfish	N	M
Order Beloniformes			
Belonidae Bonaparte 1835–Needlefishes			
Strongylura marina (Walbaum 1792)	Atlantic Needlefish	N	F, M
Order Atheriniformes			
Atherinopsidae Fitzinger 1873–New World silversides			
Labidesthes sicculus (Cope 1865)	Brook Silverside	N	F
Labidesthes vanhyningi Bean and Reid 1930	Golden Silverside	N	F
Membras martinica (Valenciennes 1835)	Rough Silverside	N	F, M
Menidia beryllina (Cope 1867)	Inland Silverside	N	F, M
Menidia peninsulae (Goode & Bean 1879)	Tidewater Silverside	N	M

Order Cyprinodontiformes

Cyprinodontidae Wagner 1828–Killifishes

Cyprinodon variegatus Lacepède 1803	Sheepshead Minnow	N	F

Fundulidae Günther 1866–Topminnows and killifishes

Fundulus albolineatus Gilbert 1891	Whiteline Topminnow	Extinct	F
Fundulus bifax Cashner & Rogers 1988	Stippled Studfish	N	F
Fundulus blairae Wiley & Hall 1975	Western Starhead Topminnow	N	F
Fundulus catenatus (Storer 1846)	Northern Studfish	N	F
Fundulus chrysotus (Günther 1866)	Golden Topminnow	N	F
Fundulus cingulatus Valenciennes 1846	Banded Topminnow	N	F
Fundulus confluentus Goode & Bean 1879	Marsh Killifish	N	M
Fundulus dispar (Agassiz 1854)	Starhead Topminnow	N	F
Fundulus escambiae (Bollman 1887)	Russetfin Topminnow	N	F
Fundulus grandis Baird & Girard 1853	Gulf Killifish	N	M
Fundulus jenkinsi (Evermann 1892)	Saltmarsh Topminnow	N	F
Fundulus notatus (Rafinesque 1820)	Blackstripe Topminnow	N	F
Fundulus nottii (Agassiz 1854)	Bayou Topminnow	N	F

Fundulus olivaceus (Storer 1845)	Blackspotted Topminnow	N	F
Fundulus pulvereus (Evermann 1892)	Bayou Killifish	N	F
Fundulus similis (Baird & Girard 1853)	Longnose Killifish	N	F
Fundulus stellifer (Jordan 1877)	Southern Studfish	N	F
Fundulus xenicus (Jordan & Gilbert 1882)	Diamond Killifish	N	F, M
Leptolucania ommata (Jordan 1884)	Pygmy Killifish	N	F
Lucania goodei Jordan 1880	Bluefin Killifish	N	F
Lucania parva (Baird & Girard 1855)	Rainwater Killifish	N	F
Poeciliidae Bonaparte 1831–Livebearers			
Gambusia affinis (Baird & Girard 1853)	Western Mosquitofish	N	F
Gambusia holbrooki Girard 1859	Eastern Mosquitofish	N	F
Heterandria formosa (Girard 1859)	Least Killifish	N	F
Poecilia latipinna (Lesueur 1821)	Sailfin Molly	N	F
Order Acanthuriformes			
Ephippidae Bleeker 1859–Spadefishes and batfishes			
Chaetodipterus faber (Broussonet 1782)	Atlantic Spadefish	N	M
Gerreidae Bleeker 1859–Mojarras			

Eucinostomus argenteus Baird 1855	Spotfin Mojarra	N	F, M
Eucinostomus gula (Quoy & Gaimard 1824)	Silver Jenny	N	M
Lobotidae Gill 1861–Tripletails and tigerfishes			
Lobotes surinamensis (Bloch 1790)	Atlantic Tripletail	N	M
Order Perciformes			
Cottidae Bonaparte 1831–Sculpins			
Cottus bairdii Girard 1850	Mottled Sculpin	N	F
Cottus carolinae (Gill 1861)	Banded Sculpin	N	F
Cottus paulus Williams 2000	Pygmy Sculpin	N	F
Cottus tallapoosae Neely, Williams & Mayden 2007	Tallapoosa Sculpin	N	F
Percidae Rafinesque 1815–Perches and darters			
Allohistium cinereum (Storer 1845)	Ashy Darter	Exstate	F
Allohistium cinereum ESU 2	"Lower Tennessee River Populations"	N	F
Ammocrypta beanii Jordan 1877	Naked Sand Darter	N	F
Ammocrypta bifascia Williams 1975	Florida Sand Darter	N	F
Ammocrypta meridiana Williams 1975	Southern Sand Darter	N	F
Ammocrypta vivax Hay 1882	Scaly Sand Darter	N	F

Crystallaria asprella (Jordan 1878)	Crystal Darter	N	F
Etheostoma artesiae (Hay 1881)	Redspot Darter	N	F
Etheostoma bellator Suttkus & Bailey 1993	Warrior Darter	N	F
Etheostoma sp. cf. *bellator* 1	"Sipsey Darter"	N	F
Etheostoma sp. cf. *bellator* 2	"Locust Fork Darter"	N	F
Etheostoma blennioides Rafinesque 1819	Greenside Darter	N	F
Etheostoma blennius Gilbert & Swain 1887	Blenny Darter	N	F
Etheostoma boschungi Wall & Williams 1974	Slackwater Darter	N	F
Etheostoma brevirostrum Suttkus & Etnier 1991	Holiday Darter	N	F
Etheostoma caeruleum Storer 1845	Rainbow Darter	N	F
Etheostoma chermocki Boshung, Mayden & Tomelleri 1992	Vermilion Darter	N	F
Etheostoma chlorosoma (Hay 1881)	Bluntnose Darter	N	F
Etheostoma colorosum Suttkus & Bailey 1993	Coastal Darter	N	F
Etheostoma coosae (Fowler 1945)	Coosa Darter	N	F
Etheostoma corona Page & Ceas 1992	Crown Darter	N	F
Etheostoma crossopterum Braasch & Mayden 1985	Fringed Darter	N	F
Etheostoma cyanoprosopum Near & Kozal 2017	Blueface Darter	N	F

Etheostoma davisoni Hay 1885	Choctawhatchee Darter	N	F
Etheostoma ditrema Ramsey & Suttkus 1965	Coldwater Darter	N	F
Etheostoma sp. cf. *ditrema*	"Middle Coosa River Populations"	N	F
Etheostoma duryi Henshall 1889	Blackside Snubnose Darter	N	F
Etheostoma edwini (Hubbs & Cannon 1935)	Brown Darter	N	F
Etheostoma flabellare Rafinesque 1819	Fantail Darter	N	F
Etheostoma fusiforme (Holbrook 1855)	Scalyhead Darter	N	F
Etheostoma gracile (Girard 1859)	Slough Darter	N	F
Etheostoma histrio Jordan & Gilbert 1887	Harlequin Darter	N	F
Etheostoma jessiae (Jordan & Brayton 1878)	Blueside Darter	N	F
Etheostoma kennicotti (Putnam 1863)	Stripetail Darter	N	F
Etheostoma lachneri Suttkus & Bailey 1994	Tombigbee Darter	N	F
Etheostoma lynceum Hay 1855	Brighteye Darter	N	F
Etheostoma neopterum Howell & Dingerkus 1978	Lollypop Darter	N	F
Etheostoma nigripinne Braasch & Mayden 1985	Blackfin Darter	N	F
Etheostoma nigrum Rafinesque 1820	Johnny Darter	N	F
Etheostoma nuchale Howell & Caldwell 1965	Watercress Darter	N	F

Etheostoma nuchale ESU	"Roebuck Spring Population"	N	F
Etheostoma parvipinne Gilbert & Swain 1887	Goldstripe Darter	N	F
Etheostoma phytophilum Bart & Taylor 1999	Rush Darter	N	F
Etheostoma phytophilum ESU 1	"Turkey Creek Population"	N	F
Etheostoma phytophilum ESU 2	"Upper Locust Fork Population"	N	F
Etheostoma phytophilum ESU 3	"Sipsey Fork Population"	N	F
Etheostoma proeliare (Hay 1881)	Cypress Darter	N	F
Etheostoma ramseyi Suttkus & Bailey 1994	Alabama Darter	N	F
Etheostoma rupestre Gilbert & Swain 1887	Rock Darter	N	F
Etheostoma scotti Bauer, Etnier & Burkhead 1995	Cherokee Darter	N/A	F
Etheostoma stigmaeum (Jordan 1877)	Speckled Darter	N	F
Etheostoma swaini (Jordan 1884)	Gulf Darter	N	F
Etheostoma tallapoosae Suttkus & Etnier 1991	Tallapoosa Darter	N	F
Etheostoma tennesseense Powers & Mayden 2007	Tennessee Darter	N	F
Etheostoma trisella Bailey & Richards 1963	Trispot Darter	N	F
Etheostoma tuscumbia Gilbert & Swain 1887	Tuscumbia Darter	N	F
Etheostoma zonale (Cope 1868)	Banded Darter	N	F

Etheostoma zonifer (Hubbs & Cannon 1935)	Backwater Darter	N	F
Etheostoma zonistium Bailey & Etnier 1988	Bandfin Darter	N	F
Nothonotus camurus (Cope 1870)	Bluebreast Darter	N	F
Nothonotus chuckwachatte (Mayden & Wood 1993)	Lipstick Darter	N	F
Nothonotus douglasi (Mayden & Wood 1993)	Tuskaloosa Darter	N	F
Nothonotus etowahae (Mayden & Wood 1993)	Etowah Darter	N/A	F
Nothonotus jordani (Gilbert 1891)	Greenbreast Darter	N	F
Nothonotus rufilineatus (Cope 1870)	Redline Darter	N	F
Nothonotus wapiti (Etnier & Williams 1989)	Boulder Darter	N	F
Perca flavescens (Mitchill 1814)	Yellow Perch	I	F
Percina antesella Williams & Etnier 1977	Amber Darter	N/A	F
Percina aurolineata Suttkus & Ramsey 1967	Goldline Darter	N	F
Percina austroperca Thompson 1995	Southern Logperch	N	F
Percina brevicauda Suttkus & Bart 1994	Coal Darter	N	F
Percina burtoni Fowler 1945	Blotchside Logperch	N	F
Percina caprodes (Rafinesque 1818)	Logperch	N	F
Percina crypta Freeman, Freeman & Burkhead 2008	Halloween Darter	N	F

Percina evides (Jordan & Copeland 1877)	Gilt Darter	N	F
Percina jenkinsi Thompson 1985	Conasauga Logperch	N/A	F
Percina kathae Thompson 1997	Mobile Logperch	N	F
Percina kusha Williams & Burkhead 2007	Bridled Darter	N/A	F
Percina lenticula Richards & Knapp 1964	Freckled Darter	N	F
Percina maculata (Girard 1859)	Blackside Darter	N	F
Percina nigrofasciata (Agassiz 1854)	Blackbanded Darter	N	F
Percina palmaris (Bailey 1940)	Bronze Darter	N	F
Percina phoxocephala (Nelson 1876)	Slenderhead Darter	N	F
Percina sciera (Swain 1883)	Dusky Darter	N	F
Percina shumardi (Girard 1859)	River Darter	N	F
Percina sipsi Williams & Neely 2007	Bankhead Darter	N	F
Percina smithvanizi Williams & Walsh 2007	Muscadine Darter	N	F
Percina suttkusi Thompson 1997	Gulf Logperch	N	F
Percina tanasi Etnier 1976	Snail Darter	N	F
Percina vigil (Hay 1882)	Saddleback Darter	N	F
Percina westfalli (Fowler 1942)	Westfalls Darter	N	F

Sander canadensis (Griffith & Smith 1834)	Sauger	N	F
Sander vitreus (Mitchill 1818)	Walleye	N	F
Sander sp. cf. *vitreus*	"Southern Walleye"	N	F
Serranidae Swainson 1839–Sea basses			
Centropristis philadelphica (Linnaeus 1758)	Rock Sea Bass	N	M
Diplectrum formosum (Linnaeus 1766)	Sand Perch	N	M
Triglidae Rafinesque 1815–Searobins			
Prionotus longispinosus Teague 1951	Bigeye Searobin	N	M
Prionotus rubio Jordan 1886	Blackwing Searobin	N	M
Prionotus scitulus Jordan & Gilbert 1882	Leopard Searobin	N	M
Prionotus tribulus Cuvier 1829	Bighead Searobin	N	M
Uranoscopidae Bonaparte 1831–Stargazers			
Astroscopus y-graecum (Cuvier 1829)	Southern Stargazer	N	M
Order Centrarchiformes			
Centrarchidae Bleeker 1859–Sunfishes and black basses			
Acantharchus pomotis (Baird 1855)	Mud Sunfish	N	F
Ambloplites ariommus Viosca 1936	Shadow Bass	N	F

Ambloplites rupestris (Rafinesque 1817)	Rock Bass	N	F
Centrarchus macropterus (Lacepède 1801)	Flier	N	F
Enneacanthus gloriosus (Holbrook 1855)	Bluespotted Sunfish	N	F
Enneacanthus obesus (Girard 1854)	Banded Sunfish	N	F
Lepomis auritus (Linnaeus 1758)	Redbreast Sunfish	N	F
Lepomis cyanellus Rafinesque 1819	Green Sunfish	N	F
Lepomis gulosus (Cuvier 1829)	Warmouth	N	F
Lepomis humilis (Girard 1858)	Orangespotted Sunfish	N	F
Lepomis macrochirus Rafinesque 1819	Bluegill	N	F
Lepomis marginatus (Holbrook 1855)	Dollar Sunfish	N	F
Lepomis megalotis (Rafinesque 1820)	Longear Sunfish	N	F
Lepomis microlophus (Günther 1859)	Redear Sunfish	N	F
Lepomis miniatus Jordan 1877	Redspotted Sunfish	N	F
Lepomis solis (Valenciennes 1831)	Sunny Sunfish	N	F
Micropterus cahabae Baker, Johnson & Blanton 2013	Cahaba Bass	N	F
Micropterus cataractae Williams & Burgess 1999	Shoal Bass	N	F
Micropterus chattahoochae Baker, Johnson & Blanton 2013	Chattahoochee Bass	N	F

Micropterus coosae Hubbs & Bailey 1940	Redeye Bass	N	F
Micropterus dolomieu Lacepède 1802	Smallmouth Bass	N	F
Micropterus henshalli Hubbs & Bailey 1940	Alabama Bass	N	F
Micropterus nigricans (Cuvier 1828)	Largemouth Bass	N	F
Micropterus punctulatus (Rafinesque 1819)	Spotted Bass	N	F
Micropterus sp. cf. *punctulatus*	"Choctaw Bass"	N	F
Micropterus tallapoosae Baker, Johnson & Blanton 2013	Tallapoosa Bass	N	F
Micropterus warriorensis Baker, Johnson & Blanton 2013	Warrior Bass	N	F
Pomoxis annularis Rafinesque 1818	White Crappie	N	F
Pomoxis nigromaculatus (Lesueur 1829)	Black Crappie	N	F
Elassomatidae Jordan 1877–Pygmy sunfishes			
Elassoma alabamae Mayden 1993	Spring Pygmy Sunfish	N	F
Elassoma evergladei Jordan 1884	Everglades Pygmy Sunfish	N	F
Elassoma zonatum Jordan 1877	Banded Pygmy Sunfish	N	F
Order N/A–Eupercaria *incertae cedis*			
Moronidae Jordan & Evermann 1896–White basses			
Morone chrysops (Rafinesque 1820)	White Bass	N	F

Morone mississippiensis Jordan & Eigenmann 1887	Yellow Bass	N	F
Morone saxatilis (Walbaum 1792)	Striped Bass	N	F, M
Lutjanidae Gill 1861–Snappers			
Lutjanus campechanus (Poey 1860)	Red Snapper	N	M
Lutjanus griseus (Linnaeus 1758)	Gray Snapper	N	F, M
Lutjanus synagris (Linnaeus 1758)	Lane Snapper	N	M
Haemulidae Gill 1885–Grunts			
Orthopristis chrysoptera (Linnaeus 1766)	Pigfish	N	M
Sciaenidae Cuvier 1829–Croakers and drums			
Aplodinotus grunniens Rafinesque 1819	Freshwater Drum	N	F, M
Bairdiella chrysoura (Lacepède 1802)	Silver Perch	N	F, M
Cynoscion arenarius Ginsburg 1930	Sand Seatrout	N	F, M
Cynoscion nebulosus (Cuvier 1830)	Spotted Seatrout	N	F, M
Cynoscion nothus (Holbrook 1848)	Silver Seatrout	N	M
Larimus fasciatus Holbrook 1855	Banded Drum	N	M
Leiostomus xanthurus Lacepède 1802	Spot	N	F, M
Menticirrhus americanus (Linnaeus 1758)	Southern Kingfish	N	F, M

Menticirrhus littoralis (Holbrook 1847)	Gulf Kingfish	N	F, M
Menticirrhus saxatilis (Bloch & Schneider 1801)	Northern Kingfish	N	F, M
Micropogonias undulatus (Linnaeus 1766)	Atlantic Croaker	N	F, M
Pogonias cromis (Linnaeus 1766)	Black Drum	N	F, M
Sciaenops ocellatus (Linnaeus 1766)	Red Drum	N	F, M
Stellifer lanceolatus (Holbrook 1855)	Star Drum	N	F, M
Order Spariformes			
Sparidae Rafinesque 1818–Porgys and seabreams			
Archosargus probatocephalus (Walbaum 1792)	Sheepshead	N	F, M
Lagodon rhomboides (Linnaeus 1766)	Pinfish	N	F, M
Order Lophiiformes			
Antennariidae Jarocki 1822–Fibonacci frogfishes			
Fowlerichthys radiosus (Garman 1896)	Singlespot Frogfish	N	M
Order Tetraodontiformes			
Balistidae Rafinesque 1810–Triggerfishes			
Balistes capriscus Gmelin 1789	Gray Triggerfish	N	M
Canthidermis maculata (Bloch 1786)	Rough Triggerfish	N	M

Diodontidae Billberg 1833–Porcupinefishes and burrfishes			
Chilomycterus schoepfii (Walbaum 1792)	Striped Burrfish	N	M
Monacanthidae Nardo 1843–Filefishes			
Stephanolepis hispida (Linnaeus 1766)	Planehead Filefish	N	M
Tetraodontidae Bonaparte 1831–Puffers			
Sphoeroides parvus Shipp & Yerger 1969	Least Puffer	N	M

1398

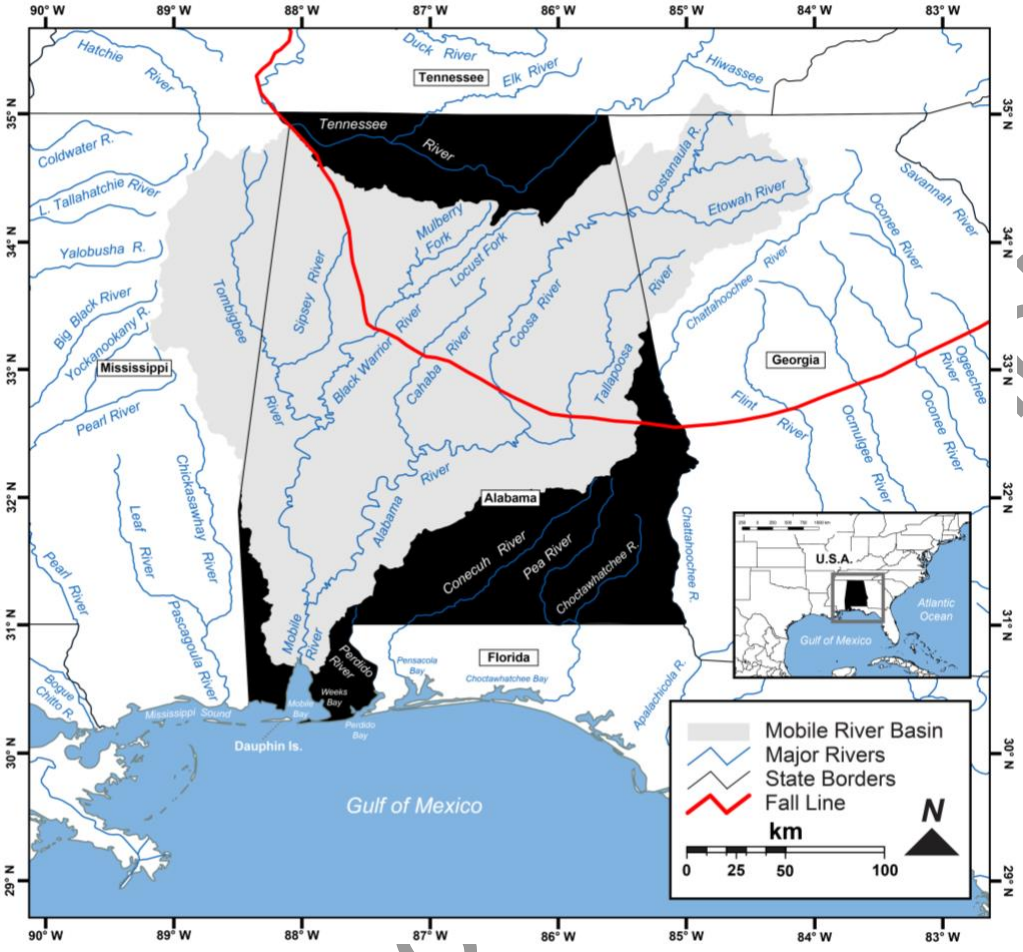
TABLE 3. Summary of recent taxonomic changes proposed by Stout *et al.* (2022) for 26 Alabama minnow species (Leuciscidae) formerly assigned to the genera *Luxilus* and *Notropis*. This list includes proposed changes for described species and candidate species. New species names are given under "Proposed Name," and type species for genera are indicated by asterisks (*).

Former Name	Proposed Name	Common Name
Luxilus coccogenis (Cope 1868)	*Coccotis coccogenis* (Cope 1868)*	Warpaint Shiner
Luxilus zonistius Jordan 1880	*Coccotis zonistius* (Jordan 1880)	Bandfin Shiner
Notropis albizonatus Warren & Burr 1994	*Miniellus albizonatus* (Warren & Burr 1994)	Palezone Shiner
Notropis ammophilus Suttkus & Boschung 1990	*Miniellus ammophilus* (Suttkus & Boschung 1990)	Orangefin Shiner
Notropis asperifrons Suttkus & Raney 1955	*Alburnops asperifrons* (Suttkus & Raney 1955)	Burrhead Shiner
Notropis baileyi Suttkus & Raney 1955	*Alburnops baileyi* (Suttkus & Raney 1955)	Rough Shiner
Notropis boops Gilbert 1884	*Miniellus boops* (Gilbert 1884)	Bigeye Shiner
Notropis buchanani Meek 1896	*Paranotropis buchanani* (Meek 1896)	Ghost Shiner
Notropis cahabae Mayden & Kuhajda 1989	*Paranotropis cahabae* (Mayden & Kuhajda 1989)	Cahaba Shiner
Notropis candidus Suttkus 1980	*Alburnops candidus* (Suttkus 1980)	Silverside Shiner
Notropis chalybaeus (Cope 1867)	*Alburnops chalybaeus* (Cope 1867)	Ironcolor Shiner
Notropis chrosomus (Jordan 1877)	*Hydrophlox chrosomus* (Jordan 1877)	Rainbow Shiner
Notropis cummingsae Myers 1925	*Pteronotropis cummingsae* (Myers 1925)	Dusky Shiner

Notropis edwardraneyi Suttkus & Clemmer 1968	*Alburnops edwardraneyi* (Suttkus & Clemmer 1968)	Fluvial Shiner
Notropis hypsilepis Suttkus & Raney 1955	*Alburnops hypsilepis* (Suttkus & Raney 1955)	Highscale Shiner
Notropis leuciodus (Cope 1868)	*Paranotropis leuciodus* (Cope 1868)*	Tennessee Shiner
Notropis longirostris (Hay 1881)	*Miniellus longirostris* (Hay 1881)	Longnose Shiner
Notropis lutipinnis (Jordan & Brayton 1878)	*Hydrophlox lutipinnis* Jordan & Brayton 1878	Yellowfin Shiner
Notropis melanostomus Bortone 1989	*Miniellus melanostomus* (Bortone 1989)	Blackmouth Shiner
Notropis petersoni Fowler 1942	*Alburnops petersoni* (Fowler 1942)	Coastal Shiner
Notropis sp. cf. *spectrunculus*	*Paranotropis* sp. cf. *spectrunculus*	"Sawfin Shiner"
Notropis texanus (Girard 1856)	*Alburnops texanus* (Girard 1856)	Weed Shiner
Notropis uranoscopus Suttkus 1959	*Miniellus uranoscopus* (Suttkus 1959)	Skygazer Shiner
Notropis volucellus (Cope 1865)	*Paranotropis volucellus* (Cope 1865)	Mimic Shiner
Notropis wickliffi Trautman 1931	*Paranotropis wickliffi* (Trautman 1931)	Channel Shiner
Notropis xaenocephalus (Jordan 1877)	*Alburnops xaenocephalus* (Jordan 1877)	Coosa Shiner

1402

1403 **Figures and Figure Legends**

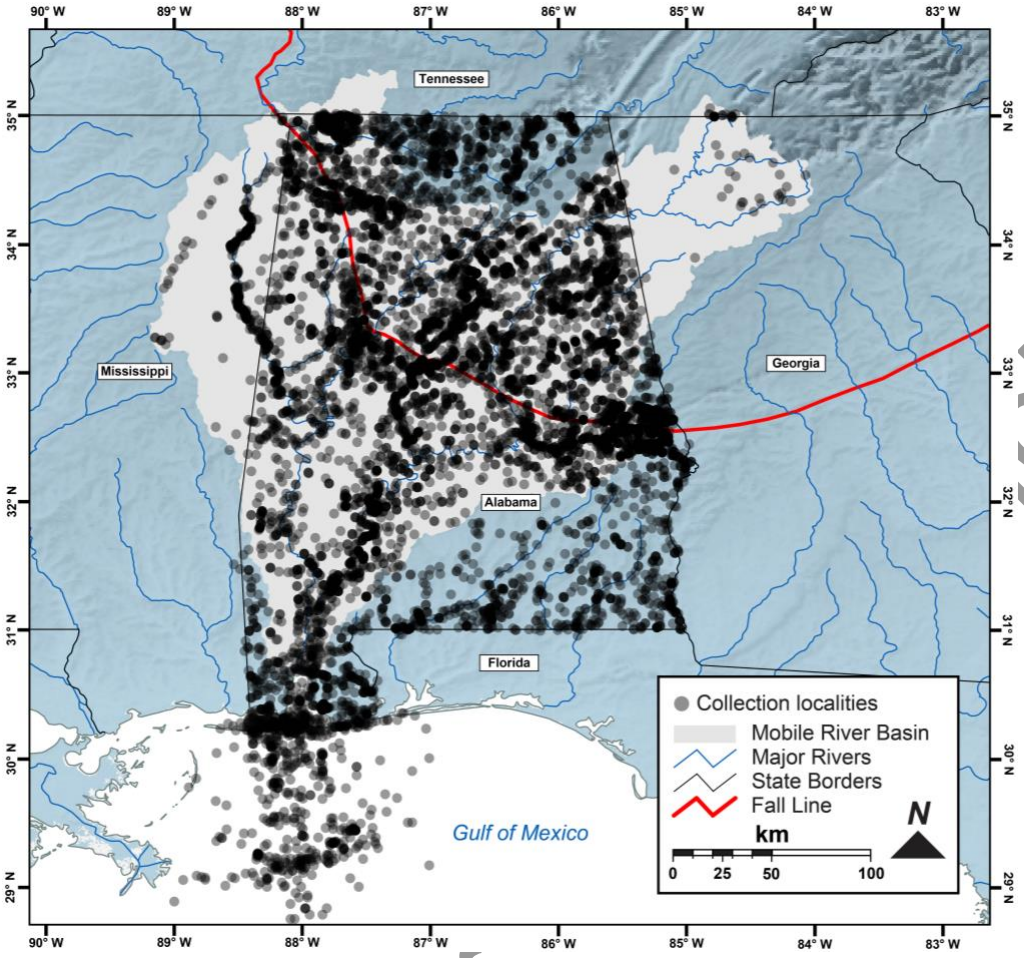


1404

1405 **FIGURE 1.** Map of the study area. Boundaries of Alabama and neighboring states are shown (thin black and gray lines; names in bold

1406 inside white boxes) along with some major physiographic elements, including the Fall Line (thick red line), major river courses (blue

1407 lines), and the outline of the Mobile River Basin (light gray shading). Tick marks along figure margins are 1-degree graticules. The
1408 inset map shows an overview of the study area in the context of Central–Eastern North America and the Gulf of Mexico as a whole,
1409 and Alabama is shaded black in the main map and inset.
1410



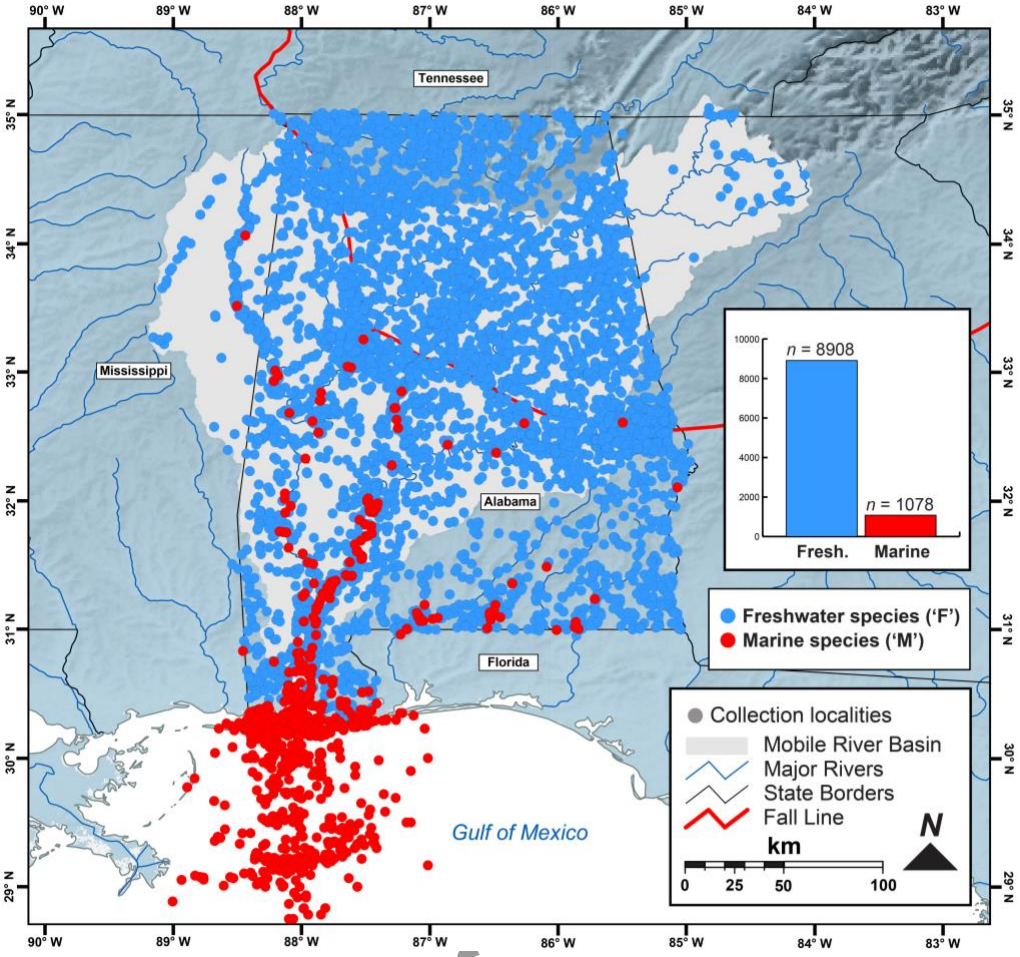
1411

1412 **FIGURE 2.** Map of the study area and specimen records for marine and freshwater fishes of Alabama in the final combined database

1413 of FishNet2 and SEAMAP records collated herein. Boundaries of Alabama and neighboring states are shown (thin black and gray

1414 lines), and the background includes a 30 s-resolution digital elevation model from WorldClim v2.1 (Fick & Hijmans 2017) rendered in

a continuous green–black palette with increasing elevation, as well as gray hill shade layers (shaded relief). The Fall Line (thick red line) and the outline of the Mobile River Basin (light gray shading) are shown for reference. Tick marks along figure margins are 1-degree graticules. Points (50% transparent black circles) represent *n* = 10,325 unique, georeferenced localities corresponding to fish collections and observations in our final combined database (see text and accompanying Mendeley Data accession for additional details; Bagley 2023).



1421

1422 **FIGURE 3.** Map of collections records for freshwater fishes ('F' designations; blue circles) vs. primarily marine fish species ('M'

1423 designations; red circles) known from Alabama based on our final combined database. Map extent, data layers, and physiographic

1424 features are the same as in Fig. 2 (see captions of Figs. 1 and 2 for additional details).

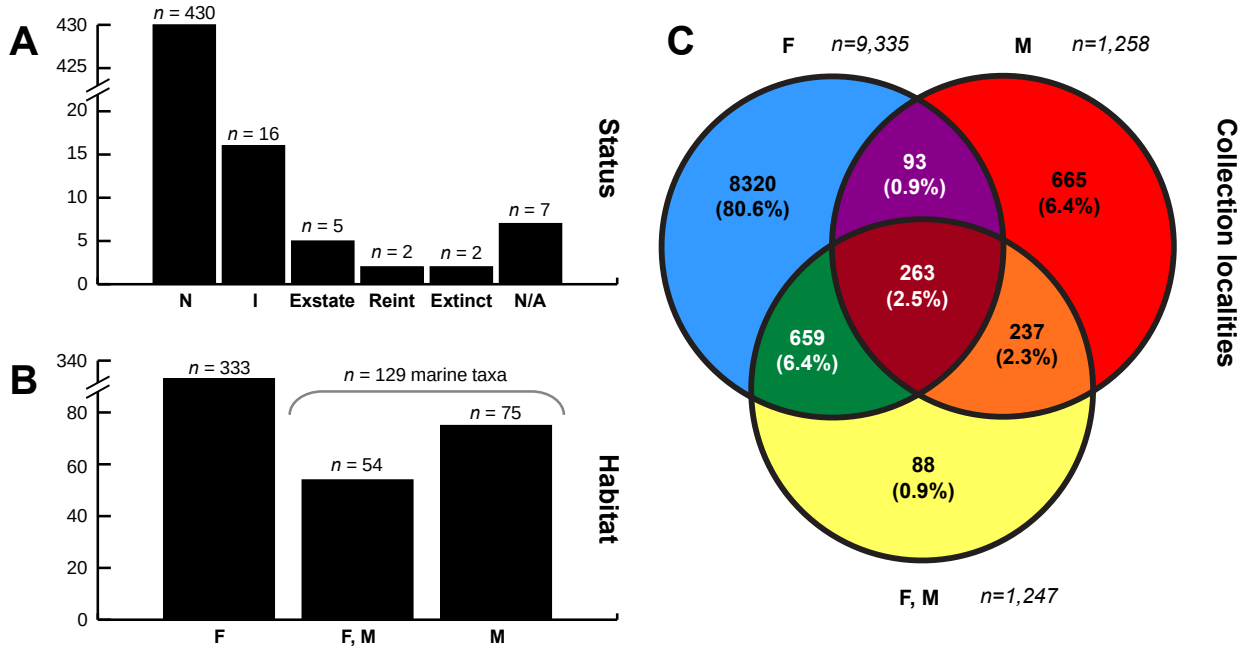


FIGURE 4. Summary of state status (A), habitat classifications (B), and collection localities by habitat classification (C) of marine and freshwater fishes of Alabama in the present checklist. Non-duplicate collection localities for species that were classified as primarily freshwater ('F' designations), primarily marine ('M' designations), and freshwater and marine ('F, M' designations) in habit are summarized in a Venn diagram in panel C, where the total number in each area sums to the total number of unique collection localities in our final dataset (*n* = 10,325). Abbreviations: Exstate, extirpated from the state; F, freshwater; I, introduced species; M,

1432 marine; N, native; N/A, not applicable (no state status because species does not occur within state borders); Reint, reintroduced in

1433 state.