FISH COLLECTION

TCWC
The Collection of Fishes at the Biodiversity Research and Teaching Collections, Texas A&M University

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The Biodiversity Research and Teaching Collections (BRTC) was established in 1936 by the Department of Wildlife Management (now Department of Wildlife and Fisheries Sciences) at Texas A&M University, College Station Texas, USA. The BRTC was originally named the Texas Cooperative Wildlife Collection and we continue to use TCWC as our official collection abbreviation (Sabaj, 2016). Under the direction of William B. Davis (a mammologist and chair of the Dept. Wildlife Management) and ornithologist Walter P. Taylor, holdings of the BRTC grew rapidly through both the research activities of its curators and through the acquisition of regional material via the US Geological Surveys. Early accessions into the collection were predominantly specimens of mammals and birds and it was not until the Department of Wildlife Management hired its first ichthyologist in the 1970s (R. Kirk Strawn, 1959–1992) that the Collection of Fishes saw significant growth. Today, the BRTC is the largest collection of vertebrates in Texas and one of the largest University-based natural history collections in the United States (ranked 10th), with over one million preserved specimens divided across four sub-collections: (1) Fishes (Figure 1); (2) Amphibians and Reptiles; (3) Birds; and (4) Mammals.

The Collection of Fishes currently houses 828,178 specimens distributed across 57,530 catalogued lots. This equates to 3,940 species, 1,548 genera and 364 families of fishes, representing 54 of the 57 orders recognized by Nelson *et al.* (2016). This collection includes specimens from 71 countries, representing all continents and all major oceanic basins. Catalogued lots of fishes at the BRTC are divided almost equally between freshwater (50.4%) and saltwater (49.6%) taxa, but in terms of total numbers of specimens, freshwater fishes are more numerous and comprise 76.9% of the total collection (Table 1). All specimens housed within the Collection of Fishes at the BRTC are electronically databased using a Microsoft Access platform and can also be accessed online via FishNet2, VertNet, iDigBio, and GBIF. 97% of specimens in the collection are fluid preserved and stored in 70% ethanol. The remaining 3% of specimens are represented by skeletal preparations, including dry dermestid prepared skeletons (2%) or cleared and double stained specimens (1%) (Figure 3). 7% of our lots are accompanied by tissue samples suitable for genetic analysis and stored in ultra-cold (-80°C) freezers on site. In some cases, multiple specimens from the same lot have been sampled for tissues prior to fixation in 10% formalin and subsequent preservation in ethanol. The majority of our specimens are stored in glass jars up to 1 gallon in volume on metal shelving. Specimens that are too large to fit inside of 1 gallon jars are stored in metal,

Figure 1. One of the 22 rows of fish specimens in the TCWC Fish Collection.

plastic, or wooden coffins ranging from 16 to 3,500 gallons in volume.

Growth of the Collection. Accessions from the 1930s through the 1960s to the Collection of Fishes primarily included material from Texas and surrounding states, collected through field work associated with undergraduate student courses offered by the Department of Wildlife and Fisheries Sciences (WFSC), especially those instructed by Strawn. These classes added ca. 1500 lots of freshwater fishes from Arkansas, Florida and Texas. An expedition to Mexico in 1964 by students of WFSC resulted in a small collection of fishes from the Río Papaloapan in Veracruz, which also represent the first international specimens to be added to the collection. Under the direction of Willis and Linda Pequegnat, the Department of Oceanography at Texas A&M also established a collection of natural history specimens, including fishes and deep sea invertebrates from the Gulf of Mexico obtained through the research activities of the Research Vessel Alaminos, which was stationed in Galveston, Texas. After the retirement of the Pequegnats in the 80s, ca. 3,200 lots of marine fishes collected through the activities of the Research Vessel Alaminos (mostly from the Gulf of Mexico but also from the Caribbean) were transferred from the Department of Oceanography to the Collection of Fishes at the BRTC.

In 1973, WFSC hired John D. McEachran as Ichthyologist and Faculty Curator of Fishes. McEachran obtained his Ph.D. from the Virginia Institute of Marine Sciences (VIMS) under the supervision of Jack Musick. McEachran's research interests were (and continue to be) focused on elasmobranch fishes (and batoids in particular) and this resulted in the growth of the elasmobranch material housed at the BRTC. This material was obtained largely from the Smithsonian Oceanographic Sorting Center and the Mediterranean Marine Sorting Center but McEachran also arranged a number of specimen exchanges with other collections, including the Natural History Museum, London (BMNH) and the National Museum of Nature and Science of Japan (NMST-P). One major product of McEachran's tenure at Texas A&M was the completion of the Fishes of the Gulf of Mexico (McEachran & Fechhelm, 1998, 2010), a two-volume set of books includes keys and illustrations to the species of marine and estuarine fishes known to occur in the Gulf of Mexico at that time. The addition of Kirk O. Winemiller, a prominent fish ecologist, to the WFSC faculty in 1992 resulted in major additions of neotropical fishes to the Collection of Fishes at the BRTC, most notably large collections of freshwater fishes from the Cinaruco River, Venezuela. Graduate students in the Winemiller lab continue to add material to the collection, including recent large collections from Brazil, Cambodia, Benin and Belize. In 2010, Conway replaced McEachran as WFSC Ichthyologist and Faculty Curator of Fishes. Conway's interests in freshwater and intertidal marine fishes have resulted in the addition of several new families, genera, and species to the

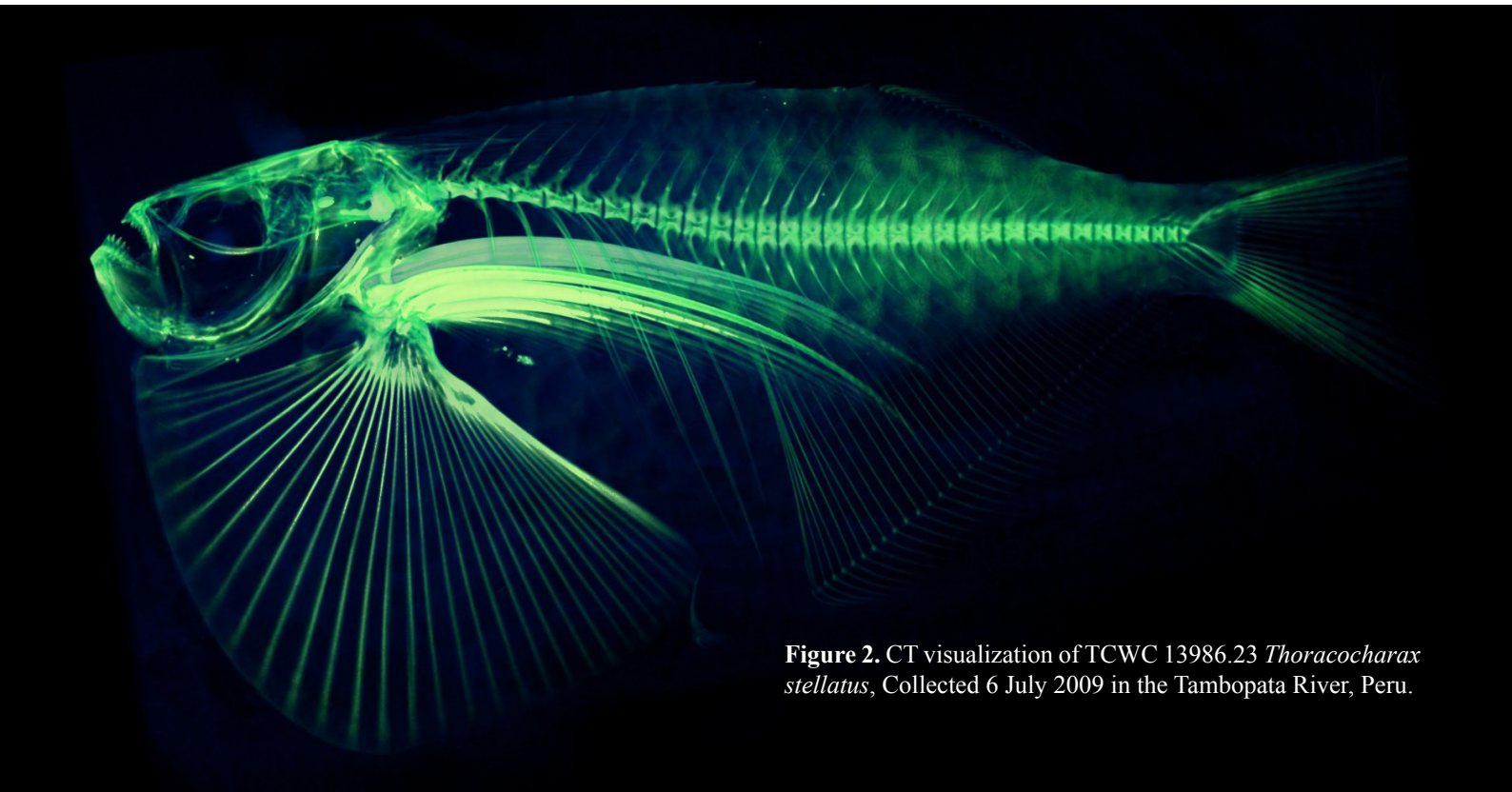

Figure 2. CT visualization of TCWC 13986.23 *Thoracocharax stellatus*, Collected 6 July 2009 in the Tambopata River, Peru.

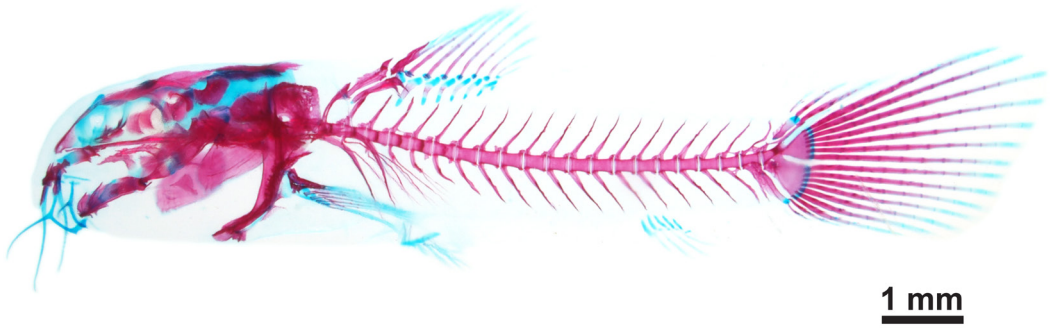

Figure 3. TCWC 19753.01 *Corydoras panda*, cleared and stained specimen. Photo courtesy of Kole Kubicek.

Collection of Fishes over the last nine years. Some of the products of Conway's research program include the description of new species, paratypes of which are typically deposited at the BRTC (e.g., Conway *et al*., 2011, 2017), and large numbers of skeletal preparations (e.g., Kubicek & Conway, 2017). Prestridge currently serves as the Staff Curator (equivalent of Collections Manager at other US institutions) for the Collection of Fishes at the BRTC and, together, Conway and Prestridge established the Ichthyological tissue repository in 2011 that contains muscle or fin clips obtained from vouchered specimens deposited within the collection. This genetic resource is growing rapidly and represents one of the largest ichthyological genetic resources in the southern United States, with tissues from 5,788 individual specimens, representing 438 species.

Neotropical Fishes at the BRTC. As of December 2018, the BRTC holds 144,885 specimens of freshwater and marine fishes from the Neotropics, distributed across 9,025 lots. This equates to 17.7% of the total number of specimens and 15.8% of the total number of lots. Neotropical holdings at the BRTC include material from South America (all countries excluding Paraguay and Uruguay), Central America (all countries excluding Guatemala), and the Caribbean (Cuba, Dominica, Dominican Republic, St. Lucia, Trinidad and Tobago, U.S. Virgin Islands and Puerto Rico). Major holdings from the Neotropics include over 83,000 specimens (3,945 lots) from the Orinoco drainage in Venezuela. These collections were amassed from the mid-1990s through the early 2000s by Kirk Winemiller and his students resulting in over 22 publications to date (e.g., Hoeinghaus DJ *et al*. 2004; Jepsen DB *et al*. 1997; López Fernández H & Winemiller KO, 2003). One recent and large accession of Neotropical material includes 5,595 specimens (1,336 lots) from the Brazilian Amazon (Pará state) resulting from the graduate research of Caroline Arantes on the effects of floodplain deforestation on species diversity (Arantes *et al*. 2018). Other neotropical highlights of the collection include the holotype of *Crenicichla zebrina* (Montaña, López-Fernández & Taphorn 2008; TCWC 16300.01; Venezuela; Rio Ventuari en el puerto del Campamento Cucurital, 26 June 2002, collected by C. Montaña), ~100 batoids representing nine families from freshwater and shallow coastal marine areas (Atlantic and Pacific) of South America, paratypes of *Heterandria tuxtalensis* (McEachran & Dewitt, 2008; TCWC 762.03; Mexico; Río Papaloapan drainage, 11 August 1964, collected by J. V. Conner and J. R. Meyer), and 2 historical specimens of *Pristis pectinata* (TCWC 13465.01 and 13466.01; Brazil, Bahia Collected in 1894 by Taylor, Zachary & Neighbor, Rev. R.E.).

The BRTC currently houses 482 tissues from Neotropical fishes. The majority of these samples are from Trinidad and Tobago (85 lots), with smaller portions from El Salvador (19 lots), Nicaragua (19 lots), Dominica (9 lots) and Peru (4 lots). Though not particularly large, this collection of tissues from the neotropics is diverse, representing 49 species from 27 families. BRTC is also one of 16 institutions involved with the NSF funded oVert project (lead institution University of Florida), which aims to CT scan 20,000 vertebrates based on material in US collections (Cross, R. 2017). CT scans of over 230 specimens from the BRTC Collection of Fishes have been completed to date and are freely available via MorphoSource.org. This includes a growing number of CT scans of species of neotropical fishes, ranging from osteoglossids to gobiesocids. The availability of these scans is allowing a broader audience of Ichthyologists and vertebrate morphologists to examine our material. For example, Marrama & Carnevale (2017) utilized the publically available CT scan of *Thoracocharax stellatus* (TCWC 13986.23) as part of their study examining the morphology of the extinct *Gasteroclupea*.

Around 20% of our material from the

Neotropics (especially Venezuela) has been identified only to the level of genus or family. This includes a number of smaller-bodied species such as the sleeper gobies of the genus *Microphilypnus*, smaller species of *Characidium,* aspredinids, and trichomycterids (many of which are identified only to the level of family). A few larger specimens also have yet to be identified to the species level, including some impressive gymnotiformes from Peru. We welcome visiting researchers to the BRTC and consider requests for specimen loans on a regular basis. For countries where shipping of specimens is difficult we are able to provide high quality images, x-rays and CT scans of specimens to facilitate research.

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Name and acronym	Biodiversity Research and Teaching Collections; TCWC
Institution	Texas A&M University, Department of Wildlife and Fisheries Sciences
Address	Biodiversity Research and Teaching Collections, Texas A&M University, 2258 TAMU, College Station, TX 77843 USA
Curator(s) and contact(s)	Dr. Kevin W. Conway; kevin.conway@tamu.edu; Ms. Heather L. Prestridge, hlprestridge@tamu.edu
Websites	brtc.tamu.edu
Year of foundation	1936
Facilities and area of the collection	~10,000 sq ft including wet lab and processing area.
Number of visitors per year (average of 2015, 2016, 2017)	920 (~20 research visitors; ~900 undergraduate students)
Number of loaned lots per year (average of 2015, 2016, 2017)	400
Specimens habitat (marine or freshwater, use percentage of lots)	Freshwater 50.39% (lots), 76.85% (specimens); Marine 49.61% (lots), 23.14% (specimens)
Specimens origin (mention Country and /or major river basins)	Freshwater fishes from 71 countries; marine fishes from all ocean basins
Current cataloguing method (software version in use if it is the case)	Microsoft Access 2016
Total number of lots and number of lots from Neotropical region	57, 073; 9,025 from Neotropical region.
Total number of specimens and number of specimens from Neotropical region	819,462; 144,885 from Neotropical region.
Total number of holotypes and number of holotypes from neotropical region	1 (from Neotropical region)
Total number of paratypes and number of paratypes from neotropical region	98; 49 from Neotropical region.
Number of tissue samples from Neotropical fishes	482
Number of C&S specimens	1,137; 133 form Neotropical region.
Number of dry skeleton specimens	1,889; 17 from Neotropical region.