

ANNUAL PROCEEDINGS
of the
TEXAS CHAPTER
AMERICAN FISHERIES SOCIETY



23-25 February 2023

Volume 45

TEXAS CHAPTER

AMERICAN FISHERIES SOCIETY

The Texas Chapter of the American Fisheries Society was organized in 1975. Its objectives are those of the parent Society – conservation, development and wise use of recreational and commercial fisheries, promotion of all branches of fisheries science and practice, and exchange and dissemination of knowledge about fishes, fisheries, and related subjects. A principal goal is to encourage the exchange of information among members of the Society residing within Texas. The Chapter holds at least one meeting annually at a time and place designated by the Executive Committee.

MEMBERSHIP

Persons interested in the Texas Chapter and its objectives are eligible for membership and should apply at the Chapter's web page ([Membership | Texas Chapter - American Fisheries Society](#)) or contact the Chapter Secretary-Treasurer:

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ANNUAL PROCEEDINGS OF THE TEXAS CHAPTER AMERICAN FISHERIES SOCIETY

23-25 February 2023

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2023

Published by:
Texas Chapter, American Fisheries Society

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2023 TEXAS CHAPTER AWARDS AND SCHOLARSHIPS

Awards

Outstanding Fisheries Worker of the Year Award:

Education: Marsha Williams, University of Texas at Tyler

Student: Hayden Roberts, Texas A & M University, College Station

Student: Noah Santee, Texas A & M University, College Station

Fisheries Management: Lynn Wright, Blake Thornton, John Ingle, and Charles Cruz, Texas Parks & Wildlife Department, San Angelo

Special Recognition: Robert Wienecke, Texas Parks & Wildlife Department, Heart of the Hills Science Center

Research: Joshua Perkin, Texas A & M University, College Station

Technical Support: Jarrett Burnett, Texas Parks and Wildlife Department, Inland Fisheries Division

Administration: Robin Riechers, Texas Parks and Wildlife Department, Coastal Fisheries

Distinguished Service Award: Ray Matthews, Retired Fisheries Biologist, Receiver of the AFS Golden Membership Award

Best Presentation Awards: 2023 Annual Meeting

Professional Presentation: Benjamin Walther, Texas A&M–Corpus Christi

“Tracking Hypoxia Exposure and Consequences in the Northern Gulf of Mexico with Chemical Proxies”

Student Presentation: Emily Meese, Texas A&M University at Galveston

“Multivariate Analysis of Fish Communities in Matagorda Bay, Texas”

Professional Poster: David Peterson, Stephen F. Austin University

“A 70-year Regional Perspective of an East Texas Urban Fishery”

Student Poster: Olivia Reves, The University of Texas at San Antonio

“Evaluation of Fish Communities on an Urban-Rural Gradient in the San Antonio River Basin from 2016 to 2021”

Sport Fish Restoration Outstanding Project Award, American Fisheries Society, Fisheries

Administration Section: “Repatriation of Guadalupe Bass to the Blanco River”

Scholarships –

Texas Chapter American Fisheries Society

Undergraduate (B.S.) – Cassandra Rendon – Texas A&M University—Commerce
Graduate (M.S.) – David Creamer – Texas Tech University
Graduate (M.S.) – Isabelle Cummings – Texas A&M University—Corpus Christi
Graduate (Ph.D.) – Mikaela Feder – University of Texas Arlington

Guadalupe River Trout Unlimited

Graduate (M.S.) – Berit Batterton – University of Texas Marine Science Institute
Graduate (M.S.) – Garrett Tucker – University of Texas San Antonio

Harry Tennison (provided by the Sportsmen’s Club of Fort Worth)

Undergraduate (B.S.) – Jacob Wolff – Texas A&M University—College Station
Graduate (M.S.) – Hayden Roberts – Texas A&M University—College Station
Graduate (M.S.) – Lauren Soliz – Texas Tech University
Graduate (Ph.D.) – Wade Wilson – Texas Tech University

David Terre Student Scholarship

Michael Curtis – University of North Texas

Clark Hubbs Student Research Award

Kayla Dye – Texas A & M University Corpus Christi

Oral Presentations (in order of presentation)

Otolith Microchemistry Provides Insight into Habitat Plasticity of American Eel (*Anguilla rostrata*) in Texas

Michael Curtis, University of North Texas (Michaelcurtis3@my.unt.edu)

Dean Hendrickson and Adam Cohen, University of Texas at Austin; Melissa Casarez and Stephen Curtis, Texas Parks and Wildlife Department; Nate Miller, University of Texas at Austin; and Benjamin Walther; Texas A&M University Corpus Christi

Keywords: American Eel, otolith microchemistry, Ba:Ca, Sr:Ca

Previous studies have revealed that American Eel undertake lengthy migrations within and between freshwater and marine environments in temperate regions of its range with many individuals making multiple movements between these habitats throughout their lives. Despite an abundance of research investigating the life history of American Eel, there is a lack of studies that focus on the species' life history in sub-tropical and tropical regions. This research analyzed the trace element ratios of barium (Ba:Ca) and strontium (Sr:Ca) in American Eel otoliths sampled in sub-tropical Texas as a proxy to examine habitat use and plasticity in an understudied portion of the species' range. Otolith microchemistry has previously been used to delineate habitat use of American Eel, and its congeners, and has seen marked success in revealing shifts between elementally distinct habitat. Ba:Ca and Sr:Ca were used in concert to examine habitat use between marine and freshwater systems with initial peak Sr:Ca values providing a benchmark for values seen in marine residency. A breakpoint analysis was applied to individual life history transects to identify major transitions in Ba:Ca, used to quantify shifts between habitats with heterogeneous trace element composition. The combined analyses of Sr:Ca and Ba:Ca, and results from breakpoint analysis, suggest that individuals undertake varied life history strategies in Texas ranging from primarily freshwater or marine residency to seasonal migration between elementally distinct habitats. This research helps address the knowledge gap for American Eel in sub-tropical and tropical portions of its range and provides much needed information for American Eel life history in Texas.

Using Anonymous Location Data to Measure Changes in Natural Resource Usage

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Rebecca Krogman, Iowa Department of Natural Resources

Keywords: anonymous location data (ALD), Iowa

Anonymous Location Data (ALD) was investigated for use in measuring visitation and other behaviors at Iowa's significantly publicly-owned waters. ALD is collected when a smart device with location-based services enters a designated study area, and can include time spent within the area, home and work census block location, travel distance to the area, probable demographic characteristics, and weekday and time patterns. Raw ALD is able to be expanded, similar to a creel survey, to yield total estimates of visitation and effort. ALD may allow resource managers to understand how a resource is used across time and space for a relatively low cost. For instance, visitation patterns can show the importance of natural resources and how far people are willing to travel to recreate, even beyond the state's border. We conducted several case studies to better understand how people used Iowa's public natural resources and whether the ALD could measure known changes (e.g., renovations, stocking events). Specifically, we present examples of

using ALD to assess remote trout stream fishing efforts, urban river access and user demographics, visitation to a popular lake with multiple uses, visitation and behavior before and after a reservoir renovation, and response to the provision of specific trout stocking dates in an urban fishery. Each example will be compared to alternative data sources, and limitations and biases will be discussed.

How Does Red Drum Migration Behavior Change Their Exposure to Environmental Mercury or Hypoxia? Variations in Otolith Microchemistry and Mercury Accumulation in Red Drum (*Sciaenops ocellatus*) from Matagorda Bay, Texas

Jacob Oster, Texas A&M University Corpus Christi (joster@islander.tamucc.edu)

Jessica Myers and Benjamin Walther, Texas A&M University Corpus Christi

Keywords: Red Drum, Matagorda Bay, mercury, hypoxia, otoliths

Red Drum (*Sciaenops ocellatus*) are an important part of the saltwater recreational fishery in Texas and much effort has gone into the protection and management of this species. While Red Drum tend to migrate offshore around age three, not much is known about the variation in the timing of this offshore movement or the subsequent behavior once offshore. In addition, stress from exposure to hypoxia and mercury may change their migration and feeding patterns. Therefore, our research is investigating variation in migration and feeding behaviors in Red Drum captured near Matagorda Bay, Texas. Red Drum carcasses were collected from recreational anglers in Port O'Connor, Texas. Otoliths and muscle were taken from each fish. Otoliths were thin sectioned and analyzed for trace elements, including strontium, barium, magnesium, and manganese. Muscle tissue from each fish was analyzed for total mercury concentration. Here we present preliminary insights into the life history of juvenile Red Drum. This data suggests that individuals with high mercury concentrations in muscle tend to have otolith trace element profiles with elevated strontium to barium ratios, indicative of higher residence time in estuarine habitat. More time spent in estuaries may coincide with exposure to hypoxia, as indicated by manganese to magnesium ratios in the otolith.

FETA, a Flow-Ecology Trait Assessment Tool for Predicting Fish Assemblage Response to Hydrologic Alteration

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Ryan McManamay, Baylor University

Keywords: Flow Ecology Trait Assessment tool, FETA

Species' life histories, ecological preferences, behaviors, or reproductive strategies (broadly termed "traits") can put them at an advantage or disadvantage when it comes to surviving and thriving in human-altered systems. Because lotic communities and their trait composition are shaped and maintained by hydrologic conditions, alterations to flow can have profound and unexpected effects on the fish communities in these systems. To assist stakeholders in managing community- and population-level changes, a predictive model was developed to anticipate relative risk of species to existing or future alterations. At the core of the model is a matrix with established linkages among traits and hydrologic components of streamflow regimes. The matrix utilizes existing databases of fish traits and a literature review of environmental-flow studies to assign a risk per species based on their own suite of traits. While currently designed for freshwater fish in the United States, the Excel-based Flow-Ecology Trait Assessment Tool (FETA) can be expanded to account for any species with trait data at any location with hydrologic data. Though intended for predictive use, the model is validated here with case studies documenting hydrologic changes and their subsequent effects on fish assemblages in the following years.

Assessment of Common Dolphinfinch (*Coryphaena hippurus*) Trophic Ecology Across Ocean Basins using Bulk Stable Isotopes

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Brendan Gough, Antonietta Quigg, and Jay Rooker, Texas A&M University Galveston

Keywords: Common Dolphinfinch, stable isotope analysis, trophic ecology

Trophic relationships within marine food webs regulate energy transfer from primary producers to high level consumers, and changes in foraging patterns of consumers can influence ecosystem stability and resiliency. Pelagic predators, such as Common Dolphinfinch (*Coryphaena hippurus*), have high economic value but also influence the structure of coastal and offshore communities and associated food webs through top-down control. Stable isotope analysis, a widely used trophic ecology tool, can elucidate source(s) of organic matter supporting pelagic predators as well as their trophic position. In addition, regional variability in these dietary signatures may indicate broad foraging habits in trophic relationships and food web structure across regions or ocean basins. The purpose of the present study is to assess trophic relationships of the Common Dolphinfinch at the ocean-basin scale using two common dietary markers: $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$. Common dolphinfinch muscle biopsies were collected from the Gulf of Mexico ($n = 52$), Caribbean Sea ($n = 26$), Pacific Ocean ($n = 20$), and Atlantic Ocean ($n = 45$). Biopsies were analyzed for $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ stable isotopes and preliminary results indicated that regional variation in both dietary markers was pronounced and influenced by the size/age of individuals. Our findings are suggestive of a consumer with a high degree of trophic plasticity or breadth, which may allow this species to opportunistically exploit a wide range of prey to promote their existence in tropical and temperate waters at the global scale.

Evaluating the Effects of Intermittent Flow on the Resilience and Vulnerability of Fish Assemblage Structure

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Jane Rogosch, U. S. Geological Survey, Texas Cooperative Fish & Wildlife Research Unit, Texas Tech University; and Nate Smith and Clint Robertson, Texas Parks and Wildlife Department

Keywords: fish assemblage, South Llano River, Concho River, Onion Creek, flow (intermittent), drought

Supra-seasonal droughts are natural occurrences that can have economic and environmental consequences that are exacerbated by climate change and anthropogenic water use. These long-term droughts have a direct impact on fish and fisheries. Our study aims to assess the vulnerability and resilience of fish assemblages of the Colorado River Basin to drought-induced intermittent flows. Our objectives are to 1) document stream flow to determine the timing, duration, and severity of drying events in the tributaries of the Colorado River Basin, and 2) assess fish assemblage structure between intermittent and perennial stream reaches over differing seasonal flow conditions. Sites were sampled on four tributaries, focusing on logger deployment, habitat mapping, and fish assemblage surveys. HOBO loggers were converted to conductivity sensors, known as STIC loggers, to document water presence. The summer of 2022 experienced an extreme drought, whose onset was earlier than expected. Intermittent sites were identified via imagery, and most were dry when our first round of sampling occurred (June 2022). Only two of the four tributaries have regained connectivity. The South Llano experienced 60 days of disconnected intermittency and the Concho and Onion Creek have experienced 189 and 180 days (respectively) as recorded by our STIC loggers. Habitat surface area dramatically changed with the resumption of flow, almost doubling habitat availability on the South Llano at intermittent sites. In general, intermittent sites

had lower mean site species richness (mean = 9.6 species, sd = 2.6) than perennial sites (mean=13.6 species, sd = 1.2), across both sampling periods, and the average difference was significant (t-value = -5.43, df = 8, p-value = 0.0006). Continuing data collection will allow us to assess how fish assemblages differ based on changes in flow and connectivity, providing valuable baselines to inform management and conservation for SGCN.

Diet Habits and Trophic Relationships of Rio Grande Sucker and Rio Grande Chub in the Jemez River, New Mexico, USA

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Scott Collins, Texas Tech University

Keywords: Jemez River, Rio Grande Chub., Rio Grande Sucker, diet

Freshwater fishes are among the most imperiled organismal groups in the world. Efforts to conserve many fish species are hindered by a lack of basic biological information. Rio Grande Chub (*Gila pandora*) and Rio Grande Sucker (*Catostomus plebeius*) are two fish species that are data-deficient in terms of population vital rates, species interactions, and trophic ecology. The purpose of this study was to address knowledge gaps specific to the feeding habits and trophic relationships of these chub and sucker species in the Jemez River (New Mexico, USA). Specifically, we (1) underwent a literature review of the feeding habits of Rio Grande Chub and Rio Grande Sucker to synthesize existing information and (2) conducted a field study to quantify the diet composition of both fish species in five mountain streams during 2020 (July – late September). Examination of previously published literature revealed that no study had reported diet data for Rio Grande Chub and only two studies reported diet data for Rio Grande Sucker. In many texts, the feeding habits of each fish species were vaguely described and cited sources with only anecdotes and no empirical data. Our field study found that Rio Grande Chub fed on a diverse assortment of aquatic macroinvertebrates (46%) and bivalves (27%). In contrast, Rio Grande Sucker diets were largely comprised of stream periphyton (62%) among all streams. Overall, we detected no significant overlap in diet between chub and sucker species following ordination analysis (NMDS). Results from this study helped fill a key information gap concerning the feeding ecology of Rio Grande Chub and Rio Grande Sucker. Our findings can be used to inform future restoration and conservation efforts throughout the Middle and Upper Rio Grande basin.

Thermal Regimes of Groundwater Dependent Streams in South Texas: A Case Study of Temperature Monitoring in San Felipe Creek

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Matthew Troia, University of Texas at San Antonio

Keywords: San Felipe Creek, temperature loggers

The Edwards Plateau ecoregion of Texas is home to over 130 springs that support humans, flora, and fauna. These springs provide stable flow and thermal regimes necessary to harbor refugia critical for endemic biota. Specifically, spring-associated fishes are threatened in these ecosystems due to land use change, climate change, and excess groundwater pumping that reduces spring flows and disrupts temperature regimes. Currently, limited temperature monitoring data are available for springs and spring-fed streams of the Edwards Plateau; this gap in knowledge of temperature regimes may misrepresent potential vulnerabilities of habitats and endemic species in Texas. Our objective was to study the thermal regime of San Felipe Creek using a spatiotemporal network of in situ temperature loggers to quantify how habitat quality and quantity are subject to change by increasing temperature and decreasing water

availability. We deployed 35 temperature loggers along ~9 km of San Felipe Creek—the fourth largest spring complex in Texas. Preliminary monitoring data revealed that diel temperature cycling increased with increasing downstream proximity from the spring sources. Future endeavors with this temperature monitoring data will also be integrated with the thermal physiology data of spring-associated fishes (*Dionda diaboli*, *Etheostoma grahami*) to evaluate thermal vulnerability in San Felipe Creek.

Morphological Divergence of an Undescribed Catostomid, the Llano River Carpsucker (*Carpiodes* sp. cf. *carpio*) in the Colorado River Basin of Texas

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Joshuah Perkin, Texas A&M University College Station; Preston Bean, Texas Parks and Wildlife Department; Kevin W. Conway and Gary Voelker, Texas A&M University College Station; and Henry Bart, Tulane University

Keywords: Llano River Carpsucker, Colorado River (Texas) basin, River Carpsucker

There is evidence of an undescribed species of carpsucker, the Llano River Carpsucker (*Carpiodes* sp. cf. *carpio*), within the Colorado River basin of Texas. The Llano River Carpsucker is thought to possess a more elongated body than the sympatrically occurring, broadly distributed River Carpsucker (*Carpiodes carpio*). The objective of this study was to assess morphological variation among members of the genus *Carpiodes* inhabiting the Colorado River basin of Texas. Sampling during the summer of 2022 resulted in the capture and preservation of 197 adult specimens. Photographs of the specimens were digitized, and 17 homologous landmarks were used to perform a morphological analysis assessing spatial gradients of body shape variation. A canonical multivariate analysis was performed on specimens pooled across the waterbodies sampled to determine shape features that best explained the morphological variation. We hypothesized that dorsal fin position, pelvic fin position, and caudal peduncle depth (CPD) were the most important variables in explaining morphological variation in body depth among the waterbodies. Shape variation was driven by a gradient in body depth that varied across the waterbodies sampled. Specimens collected from the Llano, San Saba, and Pedernales Rivers were the most elongated and had smaller CPD values, whereas specimens from the Concho and Colorado Rivers exhibited deeper bodies and larger CPD values. This study provides insight into the morphological variation among members of *Carpiodes* within the Colorado River basin of Texas. Further research investigating the covariance between morphological and genetic variation of these populations is ongoing and could provide evidence for multiple species of *Carpiodes* within the basin.

Thermal Vulnerability of Spring Associated Fishes in an Urbanizing, Groundwater Dependent Stream

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Matthew Troia, University of Texas at San Antonio

Keywords: temperature vulnerability, springs, Honey Creek

Anthropogenic climate and land use change is altering thermal regimes of freshwater habitats and causing thermal stress to aquatic organisms. Spring influenced streams are especially vulnerable to this change due to their reliance on groundwater, an increasingly valuable human commodity in urbanizing landscapes. Although stream temperature may be the most important abiotic factor affecting the physiology of stream dwelling fishes, there is a paucity of stream temperature data in the heavily groundwater dependent streams of the Edwards Plateau in Texas. In this study, 52 in-stream temperature sensors were deployed every 50 meters along the 2.1 km Honey Creek from the headwaters at Honey

Creek Cave to the mouth at the Guadalupe River. Additionally, continuous stage/flow measurements are gathered, and biological surveys are performed. These field data will be integrated with lab-based thermal tolerance data for three spring associated fish species endemic to the Edwards Plateau: Plateau Shiner, Guadalupe Roundnose Minnow, and Guadalupe Bass. Preliminary analysis of in-stream sensor data indicates that more stable diel temperature cycles near springs may provide thermal refuge in summer months. This information will help forecast future thermal vulnerability of spring-associated species of greatest conservation need and inform conservation and management of ecologically significant stream segments.

A Multiscale Conceptual Framework to Predict Movement and Habitat Associations of an Imperiled Megafish, the Alligator Gar (*Atractosteus spatula*)

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Hayden Roberts, Texas A&M University; Dan Daugherty and Paul Fleming, Texas Parks and Wildlife Department; and Joshua Perkin, Texas A&M University

Keywords: Alligator Gar, Brazos River, fish dispersal

Increasing popularity of Alligator Gar as a sportfish combined with changes to the riverscapes they inhabit create a need for greater information on the ecology of the species to enhance management. Ecological theory predicts that movement by riverine fishes at the population level is characterized by heterogeneous mixtures of stationary and mobile individuals that together contribute to a leptokurtic (i.e., high peak, long tails) distribution of movement distances. We evaluated movement and habitat associations of Alligator Gar in the Brazos River of Texas at fine (every 2 hours for 24 hours) and coarse (every month for 16 months) temporal scales to test for (1) the presence of leptokurtosis and (2) relationships between movement distance and habitat dissimilarity or the amount of time fish were at large. Dispersal by Alligator Gar with >8 relocations at coarse (n = 13 fish) and fine (n = 5) scales revealed leptokurtosis at the coarse but not fine scale. There was no relationship between dispersal distance and habitat at the fine scale, but dispersal was positively correlated with time. Movements by fish with >2 relocations at the coarse scale (n = 43) revealed highly mobile fish moved longer distances over longer time periods to access novel habitats. Our results revealed that Alligator Gar moved nearly constantly without strong habitat associations over short time periods (hours to days), but highly mobile members of the population moved long distances to novel habitats (e.g., from river mainstems to inundated floodplains) over longer time periods (seasons to years).

Testing Responsiveness of Stream Fish Functional Traits to Anthropogenic Riverscape Alterations

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Kevin Conway, Texas A&M University College Station; Weston Nowlin, Texas State University; David Smith, U.S. Army Corps of Engineers; and Joshua Perkin, Texas A&M University College Station

Keywords: fish functional traits, habitat alteration, flow regime homogenization, flow depletion, stream dewatering, Trinity River, Sabine River, Republican River (Kansas), Colorado River (Texas)

Natural environmental filters that regulate the distribution of fish functional traits across riverscapes are affected by anthropogenic alterations. These alterations can include water quality degradation, flow regime homogenization, flow depletion, and stream dewatering. The objective of this study was to conduct exploratory analyses to identify the traits most responsive to anthropogenic environmental changes using fish assemblage data from four case studies. We used fish community data and widely

available categorical trait data to calculate the occurrence and richness of trait strategist responses to environmental change documented in four case studies. We hypothesized that (1) fishes intolerant to anoxic conditions would be most responsive to improved water quality (Trinity River, Texas); (2) fishes that use rocky substrates and riffles would be most responsive to flow regime homogenization (lower Sabine River, Texas); (3) fishes considered to inhabit large rivers would be most responsive to groundwater overdraft (Republican River in Colorado, Kansas, and Nebraska); and (4) fishes occupying areas with lower temperatures would be most responsive to a strong aridity gradient (Colorado River basin, Texas). We used random forest models, variable importance plots, and partial dependence plots to determine trait-environmental relationships. Results from the models supported hypothesized relationships for H1, H2, and H3, but not H4. Our inclusion of multiple traits in each case study highlighted trait syndromes associated with anthropogenic alterations. For example, traits commonly associated with fish responsiveness to riverscape change were cruiser swimming, pelagic-broadcast spawning, preference for run habitats in mainstem rivers, and periodic-opportunistic life strategies.

Analysis of Gene Flow between Geographically Separated Populations of *Etheostoma radiosum* in Northeastern Texas and Southeastern Oklahoma

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Keywords: Orange bellied Darter, Red River basin, gene flow, genetic isolation

The genus *Etheostoma* has been found to be one of the most cryptic groups in North America today. In recent years there have been high rates of discovery of new species and lineages throughout the continent. Many darter species are habitat specialists that have limited dispersal in drainages across unsuitable conditions. *Etheostoma radiosum* is found in the Red River system of Oklahoma, Arkansas, and Texas, where it is more common in upland tributaries with gravel, indicating that the muddier main stem of the Red River may restrict gene flow patterns between systems. Additionally, the genetic population structure for this species in Texas at the southern edge of its range is relatively unknown. The purpose of this study is to use molecular markers to determine genetic population structure of this species in Texas populations and examine potential barriers and genetic isolation. We sampled 5 populations in Texas tributaries and 3 populations in Oklahoma in different tributary systems in 2022. Captured individuals had caudal fin clips taken in the field, followed by DNA extraction and amplification at 6 microsatellite loci. Pairwise F_{st} values, observed and expected heterozygosity, and STRUCTURE analyses were done to determine population genetic patterns in the region. Texas populations had similar genetic diversity compared with Oklahoma populations, but had higher genetic distance between populations and more population structure. This indicates that there are stronger barriers to gene flow and genetic isolation across sites in Texas, with more connectivity existing in Oklahoma. Understanding the amount of gene flow currently taking place and how environmental conditions in Texas cause genetic isolation can help to inform future conservation decisions regarding the species and other cryptic species who may face similar population related challenges.

Multiple Tracking Methods Reveal Guadalupe Bass Dispersal is Consistent with the Restricted Movement Paradigm

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Lindsey Elkins and Joshua Perkin, Texas A&M University College Station; Jessica Pease, Washington Department of Fish and Wildlife; and Timothy Grabowski, U.S. Geological Survey, Hawaii Cooperative Fishery Research Unit, University of Hawaii at Hilo; and Preston Bean and Nathan Smith, Texas Parks and Wildlife Department

Keywords: Guadalupe Bass, Restricted Movement Paradigm, Colorado River basin, Guadalupe River basin, fish dispersal

Fish movement and dispersal are critical factors influencing individual survival, metapopulation dynamics, and community structure. Movement of stream fishes was historically regarded as fundamentally restricted until research revealed populations of non-migratory fishes were composed of two components: a more abundant stationary component and a less abundant mobile component. Recognition of the existence of the mobile component led to development of the ‘restricted movement paradigm’, which is used to construct models predicting the movement of stream fishes, such as those implemented through the R statistical package ‘fishmove’. We tested the validity of the ‘fishmove’ model for predicting dispersal of Guadalupe Bass, *Micropterus treculii*, an imperiled black bass endemic to Texas. To achieve this goal, we assembled Guadalupe Bass radio telemetry data from three rivers in the Colorado River Basin of Texas as well as mark-recapture data from fish fitted with passive integrated transponder (PIT) tags from three rivers in the Guadalupe River Basin of Texas. Results revealed a consistent pattern of leptokurtic movement distances, a telltale sign of heterogeneous movements by stationary and mobile fish. Across rivers and repeated observations, predicted movement distances matched observed movement distances 56% (stationary components) and 67% (mobile components) of the time based on radio telemetry and 83% (for both stationary and mobile components) of the time based on PIT tag data. Our results provide evidence that the ‘fishmove’ package can be used to model Guadalupe Bass dispersal and ultimately improve management and conservation by informing habitat connectivity prioritization schemes and predicting colonization of restored habitats.

Survey of Biogeography and Community Ecology Concerning *Etheostoma radiosum* in Northeast Texas and Southeast Oklahoma

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Bjorn Schmidt, Texas A&M University Commerce

Keywords: Orange-bellied Darter, Red River basin, spatial occupancy

Etheostoma radiosum, the Orange-bellied Darter, is a small benthic fish found in the Red River system in Oklahoma, Arkansas, and Texas. Populations in Texas serve as the functional southern edge of the species geographic range and are rare in the region. Surveys were done to determine spatial occupancy patterns for *E. radiosum* in Texas and to examine specific habitat and community associations of occupied sites. Streams in Texas were also compared with streams in Oklahoma to assess potential niche shifts. 46 streams (34 Texas; 12 Oklahoma) were sampled for fish communities and stream environmental characteristics in 2021 and 2022. *Etheostoma radiosum* was rare in Texas sites, occurring in 5 out of the 34 streams. This species was more common in Oklahoma (10 out of 12 locations). Community patterns were assessed with non-metric multidimensional scaling (NMDS) and ANOSIM. There were three significantly different community groups in the data: Oklahoma present, Texas present, and absent ($R =$

0.361, $p < 0.00001$). Environmental variable data was fitted onto the NMDS ordination with the `envfit` function of the R package `vegan`, to determine which environmental variables significantly relate to the observed patterns of community differences. The analysis identified nine significant environmental variables, and *E. radiosum* present sites specifically had less mud, more coarse substrates, higher dissolved oxygen, higher slope, more riffles, and more annual flow stability. The TX present sites were intermediate between the other two groups in the ordination, indicating that the sites in Texas are suboptimal in gradient conditions compared with their core distribution in Oklahoma. Flow stability and coarse substrates with riffles were the main drivers of *E. radiosum* presence in the data, and specifically periodic drought (less stable flows) and rarity of coarse substrates in Texas tributaries likely combine to limit the occupancy patterns for this species in the state.

Predictability and Conceptual Repeatability of the Predator Associated Burst Speed Body Shape in Independently Evolved Populations of Western Mosquitofish

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Keywords: predator-associated burst speed, Western Mosquitofish

Predation is a driver of evolution and is often studied in freshwater fishes. A common morphological adaptation found in populations rich with pursuit predators is the predator associated burst speed (PABS) body shape. This body shape, which includes a smaller head, smaller body, and larger caudal region has been noted in many species of small freshwater fishes, including Western Mosquitofish (*Gambusia affinis*). The PABS body shape is predictive of fish morphology among populations with and without pursuit predators. However, the repeatability and transferability of the PABS has not been rigorously tested and the current literature provides vague methodological descriptions. This study focuses on testing the repeatability of tests of the PABS body shape and aims to develop a streamlined process that could be widely used by others. We studied 13 populations of Western Mosquitofish, including six populations included in previous studies of the PABS and seven new populations not previously studied. We collected and photographed fish from the wild, created 10 homologous landmarks representing body shape, and used Procrustes transformation of landmarks to correct differences in fish orientation and size. We used principal components analysis to produce latent shape factors representing linear combinations of landmark coordinates, used multivariate analysis of variance to test for differences in shape factors among populations with two predator status levels (i.e., centrarchid predators present or absent), and used linear discriminant function analysis (DFA) to test whether shape factors were predictive of predator status across previously studied and recently studied populations. The DFA results revealed that predator status was correctly classified for 92% of fish from the newly studied populations. Differences in body shape among the two predator statuses included shorter total length, smaller head, and larger caudal region when predators were present, supporting repeated observation of the basic tenets of the PABS body shape paradigm.

Nitrogen Loading and Harmful Algal Blooms in Warm, Monomictic Lakes of the Southcentral US

Crista Kieley, Texas A&M University Galveston (ckieley@tamu.edu)

Daniel Roelke, Royoung Park, Kathryn Campbell, Hagen Klobusnik, Jordan Walker, and Sierra Cagle
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Keywords: HABs, prymnesiophytes, microcystin, reservoirs

Lakes in the southcentral USA are warm-monomictic systems, many of which have become eutrophic or hypereutrophic, raising concerns about harmful algal blooms (HABs) and hypoxia. HABs associated with prymnesiophytes and cyanobacteria have been recurrently problematic and the frequency, magnitude and duration of HABs are likely to increase with climate change. Here, we seek to better understand the drivers of inland HABs and hypoxia in the southcentral USA, with a particular focus on nitrogen loading. Recent advances in understanding have shown a selection for prymnesiophytes and some toxic cyanobacteria at high N:P. We are sampling twenty reservoirs and their tributaries, spanning a pronounced east-west annual precipitation gradient across Texas. Samplings occur in the spring and summer of each year, and measured parameters include chlorophyll- α , microcystins, inorganic and total nutrients, microbial community composition (using metagenomics), microbial functions (using metatranscriptomics), and several water quality parameters. Inflows and nutrient loadings are being determined using the Hydrologic and Water Quality System (HAWQS) calibrated with USGS gauge data, as well as tributary nutrient samples. Principal component analysis of data collected thus far reveal a positive relationship between NO_3/NO_2 and total microcystins, though this trend was heavily driven by an ongoing bloom in one lake. Excluding this lake from analysis, a strong relationship still exists between NO_3/NO_2 and total microcystins in the bottom waters of shallow stations (6 meters, standardized sampling), demonstrating the persistence of these toxins even when mixed to aphotic depths of the water column. Our ongoing work explores whether microcystins are widespread in tributaries to these lakes, as is the case in other regions of the country. We are comparing tributary microcystins to in-lake microcystins to assess the scale of cyanotoxin loading, and comparing land-use practices in the watersheds of these lakes with a focus on agricultural, industrial and municipal practices.

Fall Run: Southern Flounder (*Paralichthys lethostigma*) Migration Timing and Trends in Texas Ship Channels

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Keywords: Southern Flounder, Port Aransas, Packery Channel, migration

Southern Flounder (*Paralichthys lethostigma*; hereafter flounder) are an economically important sportfish that are heavily targeted by commercial and recreational anglers in Texas. To maintain the Texas flounder fishery and minimize overfishing, the Texas Parks and Wildlife Department (TPWD) has implemented varying fishing regulations for flounder over the past few decades. Despite these regulations, TPWD fishery-independent monitoring data continues to suggest long-term population decline. The purpose of this study was to observe flounder migration timing and trends to evaluate current season closure regulations and better inform future fisheries management decisions for the flounder fishery. In this study, a flounder gigging boat was used to visually survey nine transect lines near Port Aransas ship channels and nine transects near Packery Channel. The number of flounder observed on each transect was recorded

weekly at night during the presumed migration period of flounder towards offshore waters to spawn (September-December). Flounder were gilled to determine sex and age, and environmental factors including measures of visibility (e.g., Secchi depth) were recorded nightly. The greatest number of migrating flounder was seen from mid-September throughout October with the greatest numbers per transect being observed in late October. Male abundance per transect peaked first, throughout October, with very few being observed during November and December. Almost three times more females were observed during the migration period, and more flounder were observed migrating through Port Aransas than Packery Channel. Greater numbers of flounder were observed following cold fronts. In conclusion, this study reinforces previously predicted trends of flounder migrating in waves following water temperature drops. In addition, it observed males migrating predominantly before females with the greatest movement occurring in October. This data and future flounder migration surveys are important for fisheries management to evaluate necessary season closures and fishing regulations to maintain the sustainability of the Texas flounder fishery

Using Capture-Recapture to Assess the Survivorship of Relocated Mussels in the Lower Sulphur River

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Keywords: mussels, mussel relocation, Sulphur River

Conservation efforts to preserve freshwater mussel communities have become more common as these animals become increasingly threatened by their changing habitats. As humans continue to shape and change the world around them, aquatic species living in modified and disturbed water systems can be negatively impacted leading to the ecosystem decline. Freshwater mussels work as habitat engineers acting as important filter feeders who stabilize the substrate, impact water clarity, and chemistry, and partake in nutrient cycling. During disturbance events involving a stream, river, or pond, the relocation of affected mussel beds is becoming more widespread. Although there are few of these studies, many of those that have been conducted are seen as successful in relocating and conserving their mussel communities. This study will focus on the growth, survivorship, and success of relocating a mussel community impacted by a dewatering event to repair a dam on the Wright Patman reservoir on the Sulphur River. We collected mussels along the bank following a receding water line and within the dewatered basin over a three-day period. Collected mussels were transported downstream to a predetermined relocation site. At the relocation site, all mussels were identified to species and a representative number of each species were measured and tagged. During our initial survey, we collected and relocated a total of 1,199 individual mussels from 11 different species. From the 1,199 total relocated, we tagged 229 mussels from 10 of the species we collected. Resampling events will take place over the next two years to assess the success of the relocation efforts using a capture-recapture approach.

Multivariate Analysis of Fish Communities in Matagorda Bay, Texas

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Keywords: Matagorda Bay, fish community, Spotted Seatrout, Red Drum, Bull Shark

Baseline information on species distribution, abundance, and community interactions is essential for effective management and conservation within valuable estuarine ecosystems. Fish distribution and abundance are influenced by both abiotic and biotic conditions, often resulting in their predictive presence within a given area based on a suite of suitable conditions. Thus, quantifying habitat use of dominant fishes within estuarine ecosystems can be indicative of protected and profitable feeding and refuge areas, essential to the success of many species and the overall community. Texas Parks and Wildlife Department (TPWD) Coastal Fisheries Division Long Term Monitoring Program has monitored fishes within Texas bays since 1975 using multiple sampling techniques. This study uses the bag seine, gill net, and bay trawl datasets to analyze trends of community and species level habitat associations from 1992-2018 in the Matagorda Bay ecosystem. Spatiotemporal differences in catch per unit effort for each gear type, and a collection of diversity measures (richness, diversity, and evenness) were assessed with permutational multivariate analysis of variance (PERMANOVA). To assess abiotic variables on community composition, non-metric multidimensional scaling (NMDS) is used to visualize community data and environmental correlates. Lastly, generalized additive models (GAMs) explore species-level spatiotemporal habitat use with environmental conditions using selected predator representatives including Red Drum (*Sciaenops ocellatus*), Spotted Sea Trout (*Cynoscion nebulosus*), Gafftopsail Catfish (*Bagre marinus*), and Bull Sharks (*Carcharhinus leucas*). By providing baseline community composition data with environmental variables, future conservation and management efforts can incorporate variability in climatic and environmental conditions when considering best practices for protecting habitats slated for future development in Matagorda Bay.

High Dominance of Invasive Armor Catfish Linked with Isotopic Space Shift and Compression of Native Species in Guatemala

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Keywords: Usumacinta River Basin, armored catfish, *Pterygoplichthys*, stable isotopes, San Pedro River, La Pasion River, diet

The Usumacinta River Basin is a globally important center for freshwater fish diversity and has high species endemism. Armored catfishes from South America (*Pterygoplichthys* spp.) invaded the Usumacinta River ~20 years ago and have become highly abundant through the basin. This invasive catfish can deplete basal resources (e.g., periphyton and detritus), with potential negative effects for native fauna. We explored isotopic space ($\delta^{13}\text{C}$, $\delta^{15}\text{N}$) overlap between armored catfish and native species, as well as the potential effect of armored catfish abundance on native fishes at a similar trophic level. The study was conducted in two large tributaries from the Usumacinta River -San Pedro River (SPR; low invasion) and La Pasion River (LPR; high invasion) in the dry season. Moreover, we evaluated relationships of environmental factors and invasive catfish biomass, with $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ signatures, the relative importance of benthic and water-column basal resources to fish biomass, and species trophic

position. Overall, *Pterygoplichthys* had lower isotopic overlap with native species in LPR (except for *Poecilia mexicana*), with native fish showing compressed isotopic spaces and higher trophic position relative to SPR. *Pterygoplichthys* biomass, conductivity, and water flow velocity were significantly associated with native fish $\delta^{13}\text{C}$; and water depth and sedimentation had a significant association with native fish $\delta^{15}\text{N}$. *Pterygoplichthys* mainly relied on benthic food resources in both rivers, and water-column resources had greater relative importance for native species in LPR. Findings provide evidence that invasive *Pterygoplichthys* and some environmental factors impact native fishes trophic ecology. Further research is needed to distinguish between the direct influence food resource depletion versus indirect effects via food web pathways or habitat alteration.

Mapping and Fish Abundance Estimates of East Bank Ridge, Gulf of Mexico using Sonar Imaging

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Keywords: East Bank Ridge, Big Seabree, fish abundance, sonar

Natural reef systems within the Gulf of Mexico are a scarce habitat for a variety of reasons. Overfishing and shrimp trawling further threaten these limited habitats along the Texas coastline. East Bank Ridge is one such natural reef formation located 18 nautical miles off the coast of South Padre Island. The formation sits at 40-45m depth and spans an area of over 80 km², with the southern portion extending into Mexico. Currently, there is no record of the structural composition or fish community present at this reef. The ridge was a well-known fishing site in the local community over the past decade but catch rates have decreased substantially according to accounts from local anglers. In this study, we aim to identify high relief structures and characterize the current fish abundance present at East Bank Ridge. The structures and fish abundance will be compared to Big Seabree, the natural reef system in closest proximity, approximately 20 nautical miles north. A side-scan sonar system was used to create a map of East Bank Ridge, while an existing multibeam map was used for Big Seabree. These maps were used to identify suitable habitat for reef fish species. Representative transects were run with a Simrad EK-80 split beam sonar and post processed in Echoview software to determine estimates of fish biomass and abundance at both sites. Biomass was compared using the nautical area scattering coefficient (NASC) calculated for each site. Fish abundance was compared using fish tracking and school detection counts based on target strength in Echoview. Individual fish tracks were used to compare representative fish sizes between the sites. Data comparisons from both reef sites will help inform how differences in reef condition and fishing pressure may impact fish abundance between natural reef formations that are at risk of further degradation.

Effects of Invasive Giant Reed on the Stream Food Web of San Felipe Creek, Texas

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Keywords: San Felipe Creek, giant reed, Suckermouth Catfish, Western Mosquitofish, West Texas Shiner, diet

Invasive riparian vegetation can greatly alter aquatic food webs by modifying the physical environment (i.e., shading) and alter the structure and function of ecological communities by altering resource availability. We conducted a field study in San Felipe Creek, a spring-fed tributary of the Rio Grande (Texas, USA), to examine the effects of an invasive riparian plant, Giant reed (*Arundo donax*), on the

stream food web. We sampled benthic algae and fishes at reaches with (invaded; n = 3 reaches) and without (control; n = 3 reaches) *A. donax* during the summer and fall of 2021. We found that total fish abundance was approximately two times greater in control reaches when compared to invaded reaches. However, these differences were only observed during the summer. At all sites, West Texas Shiner and mosquitofish dominated the fish community (~ 74% of all fish sampled). Invasive Suckermouth Catfish (*H. plecostomus*) comprised a greater percentage of the overall fish community in invaded reaches (~ 11%) when compared to control (~ 2%) reaches. Diets of fish species were similar between control and invaded reaches. Shiners and mosquitofish each fed on invertebrates (~ 14-22%) and algae (~ 43- 68%). Invasive suckermouth catfish fed primarily on benthic algae (~ 73%). Our preliminary results demonstrate seasonal differences in fish relative abundance between control and invaded reaches. Future analyses will assess differences at the base of the food web including algae and aquatic invertebrates.

Red Snapper Size, Growth, and Movement in the Rio Grande Valley Artificial Reef

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Keywords: Rio Grande Valley Artificial Reef, Red Snapper, growth rates, emigration

The Rio Grande Valley Artificial Reef is the largest artificial reef off the Texas coast at 2.5 square miles and is located 12 miles northeast of South Padre Island (26° 16.70' N, 97° 02.99' W). Construction of the reef began in 2015 to provide hard substrate habitat for reef fish and to enhance their declining populations. The reef includes graduated steppingstones of increasingly higher relief and complexity to carry multiple species of fish through their life cycles. The objectives of this study were to 1) Compare Red Snapper (*Lutjanus campechanus*) size at each reef configuration type. 2) Calculate growth rates from recaptured Red Snapper. 3) Determine whether Red Snapper are emigrating from the RGV reef. Three baited fish traps were deployed for one hour at each of the 51 patch sites. Patch sites consisted of three replicated configurations in the RGV reef: concrete pyramids, low-profile cinder block platforms, and mixed sites containing both cinder block platforms and pyramids. A total of 2,686 fish were captured in traps. Of these, 834 Red Snapper were measured, weighed and Floy tagged before release. Locations and measurements of recaptured Red Snapper from trapping and the recreational fishery were recorded. Red Snapper were significantly smaller at low-profile cinder block platforms as compared to mixed sites and pyramid only sites ($p < 0.001$). Growth rates for recaptured Red Snapper averaged 0.27 ± 0.08 mm per day. Thus far, all recaptures of Red Snapper have occurred within the RGV reef. The results of this study will aid our understanding of the optimal artificial reef configurations for Red Snapper along the Texas coast.

Integrative Taxonomic Investigation of *Cyprinella* sp. Nueces, a Putative Undescribed Species of Greatest Conservation Need in Texas

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Keywords: *Cyprinella lepida*, Nueces River, Frio River, Sabinal River

The Plateau Shiner (*Cyprinella lepida* Girard, 1856) is endemic to the upper reaches of the Nueces River drainage in TX. Previous genetic investigations of *Cyprinella lepida* revealed two divergent and geographically isolated groups based on mtDNA, including a group restricted to the upper Frio and Sabinal rivers (referred to as *C. lepida*) and a group restricted to the upper Nueces River, and more closely related to *C. lutrensis* than *C. lepida*. This later group has been referred to as either *C. sp. cf. lepida* or *C. sp. Nueces*, and is hypothesized to be the product of an ancient hybridization event between the historical upper Nueces River population of *C. lepida* and a lineage resembling *C. lutrensis*, resulting in introgression and replacement of ancestral *C. lepida* mtDNA in upper Nueces River. In addition to differences in mtDNA, *C. lepida* (Frio/Sabinal) and *C. sp. Nueces* (Nueces) also are reported to exhibit differences in color pattern, and the question of whether to recognize *C. sp. Nueces* as a distinct species has been raised on multiple occasions. Though no formal taxonomic conclusions have been published on the validity of *C. sp. Nueces*, this “putative” species has recently been listed as a Species of Greatest Conservation Need (SGCN) in Texas. We use a combination of qualitative osteological characters, traditional meristic characters, and landmark-based geometric morphometric characters to assess whether differences in morphology and body shape exist between *C. lepida* and *C. sp. Nueces*. We also investigate if there are significant differences in the nuclear genome of *C. lepida* and *C. sp. Nueces* by comparing hundreds of nuclear loci obtained using double digest restriction-site associated sequencing (ddRAD-seq). We discuss our findings in relation to the question: should *C. sp. Nueces* be recognized as a distinct species?

Flood Pulse and the Temporal Dynamics of Fish Metacomunities in the Floodplain of the Middle Paraná River (Argentina)

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Keywords: Paraná River, metacommunity, Moran eigenvector maps, hydrological connectivity, flood pulse

Metacommunity dynamics depend on the relative importance of dispersal and selective processes associated with environmental heterogeneity and species interactions. In floodplain rivers, the temporal variation in the hydrometric level determines ever-changing combinations of these processes over time and space. In this work, we evaluated the temporal dynamics of the fish metacommunity from 25 aquatic environments (floodplain lakes and rivers) of the floodplain of the middle Paraná River in Argentina. We carried out four surveys in different hydrologic and climatic situations during four consecutive years. In each waterbody, we sampled fishes using beach seine nets and gillnets, and measured 12 environmental variables. To evaluate the effect of alternative dispersal pathways on community structure, we generated nine spatial models using three different types of distances (straight distance and two by-water distances)

and three different connectivity patterns, using the technique of Moran eigenvector maps (MEMs). We used partial canonical correspondence analysis (pCCA) to estimate the relative influence of environmental and spatial variables on assemblage structure, allowing an inference about selection and dispersal in metacommunities. Fish assemblages were composed of 151 species, were associated with water transparency, and showed a strong differentiation between rivers and floodplain lakes. Spatial models built from distances by-water and higher connectivity between environments explained a higher percentage of the variation in assemblage structure in comparison with the remaining models. During low water periods, fish assemblages responded to spatially structured environmental variation, whereas a stronger pure environmental control was observed in early high waters and a high pure spatial control was observed in late, extraordinary high waters. In the Paraná River, the changes in hydrological connectivity and environmental heterogeneity driven by the flood pulse determine temporal changes in the relative importance of dispersal and selection over the time with an adjustment to different models of metacommunity functioning.

Assessment of Spatial Variation in Community Assemblages and Population Condition of ESA-proposed Guadalupe Orb (*Cyclonaias necki*) and False Spike (*Fusconaia mitchelli*) Mussels in Data Limited Portions of the Guadalupe and San Marcos Rivers

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Keywords: Guadalupe Orb, False Spike, Guadalupe River, San Marcos River

Three mussel species endemic to the Guadalupe River basin in central Texas were proposed to receive endangered status protections by the U.S. Fish and Wildlife Service (USFWS) under the Endangered Species Act (ESA) in August of 2021: 1) Guadalupe Orb (*Cyclonaias necki*); 2) False Spike (*Fusconaia mitchelli*); and 3) Guadalupe Fatmucket (*Lampsilis bergmanni*). A review of previous survey activity identified large portions of the river basin that fell within the historical reach of these species where surveys have not occurred. Additional data was needed to inform the development of the Guadalupe River Habitat Conservation Plan (GRHCP) to properly determine the effects of covered activities on ESA proposed species. Mussel surveys were conducted on a hydrologically stratified section of the Guadalupe River and San Marcos River tributary to assess the current population condition of ESA proposed species in these data limited areas as well as spatial variation of all mussel assemblages within the study reach. A total of 13,015 mussels represented by 12 species were observed during approximately 218 p-h of sampling effort across 60 sites in five river study segments. Results from Kruskal-Wallis tests failed to detect meaningful differences in species richness ($\chi^2 = 5.66$, $p = 0.13$), diversity ($\chi^2 = 6.98$, $p = 0.07$), and species evenness ($\chi^2 = 2.94$, $p = 0.40$) among study segments. Despite the lack of statistical differences in these community metrics, several notable trends were observed. Diversity and species evenness were generally higher in the San Marcos River as compared to the Guadalupe River segments. A permutational MANOVA analysis also revealed meaningful differences in assemblage structure among study segments ($SS = 4.84$, $F = 11.64$, $p < 0.001$). The results of this study extended the known distributional range of *C. necki* and *F. mitchelli* and revealed significant differences in ESA proposed species abundance and recruitment among study segments, with significantly higher recruitment rates in the San Marcos River (7.99%) as compared to the Guadalupe River segments (3.57%-4.35%). Results indicate that populations of *C. necki* in the San Marcos and Guadalupe rivers are healthier than previously documented and additional monitoring is needed to accurately describe their current distribution and population condition throughout the basin.

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Hydrology to Guide Conservation: A Gain-Loss Study in the Devils River, Texas

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Keywords: Devils River, Edwards-Plateau Aquifer, surface-groundwater interaction

In groundwater dependent streams that support stable habitats and highly endemic species, environmental heterogeneity along the stream gradient creates a mosaic of habitats that change through time and space. In karst settings, stream-aquifer interactions in the form of streamflow gains (springs) and losses (aquifer recharge) have been shown to influence habitat complexity and aquatic assemblages. The spatial and temporal patterns of gains and losses are important to understanding the relationship between groundwater and streamflow and for identifying factors that promote or limit species distribution. The Devils River, considered by many to be the most pristine and ecologically intact river in Texas, is home to federal and state listed fish and mussel species. Coarse streamflow studies have been previously conducted however, high spatial resolution gain-loss data is lacking, as are measurements recorded over various hydrologic conditions. This study provides a systematic, fine-resolution gain-loss study along 42

miles of the spring-fed Devils River of the Edwards-Plateau Aquifer in south-west Texas. Discharge measurements were repeated at 20 sites across five events in 2021 and 2022. Results indicate a spatially consistent pattern of gains and losses despite varying flow conditions with two significant gaining reaches and two losing reaches which decreased streamflow by approximately 10 and 70% respectively. This study supports refinements to the conceptual model of the aquifer and allows for a better understanding of surface-groundwater interactions for the Devils River, something critical to understanding the relationship between environmental conditions and available habitat for imperiled species. The implications suggest that groundwater conservation management should focus on springs and spring habitats and include losing reaches which are the most susceptible habitat to drying. This along with other hydrology and biology data collection efforts are critical in informing future water management strategies protective of native species habitats in this groundwater dependent system.

American Eel Recruitment in the Lower Colorado River (Texas)

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Keywords: American Eel, Colorado River

The American Eel (*Anguilla rostrata*) is a catadromous fish species found in drainages along the Atlantic and Gulf coasts of the US. It has been identified as a Species of Greatest Conservation Need in Texas. To date, limited research has been conducted on species recruitment specific to the Texas Gulf Coast and its drainages. Very few museum records of *A. rostrata* early life stages such as glass eels and elvers have been documented in Texas waters. Collecting regionally specific life history data can be used to improve future and current conservation efforts such as implementing seasonal fish passage. In the spring of 2022, a yearlong study was launched in partnership with the Lower Colorado River Authority (LCRA), the Texas Parks and Wildlife Department and University of Houston-Clear Lake utilizing ramp traps and qPCR-based eDNA sampling in several Texas waterways. The study aims to assess *A. rostrata* recruitment along the Texas coast by identifying the temporal window of annual eel migration into freshwaters. In addition, this study documents basic American Eel life history characteristics and life stages present. LCRA has constructed and deployed a ramp trap directly downstream of the first major impoundment in the lower Colorado River located in Bay City, TX, approximately 33 river miles upstream of Matagorda Bay. The project is currently ongoing. Dozens of yellow phase eels have been collected in the Bay City trap and relocated upstream of the bladder dam. In addition, the first elver documented in the Colorado River was collected from the Bay City trap in May of 2022. This finding refutes speculation that due to distance traveled from the Sargasso Sea, American Eels may mature to yellow phase before they reach Texas waterways.

Testing the Cold-water Climate Shield Model with Stream Fishes in the Middle Colorado River of Texas

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Keywords: cold-water climate shield model, Colorado River (Texas) basin, fish assemblage

Anthropogenically-driven climate change combined with existing ecosystem degradation is projected to cause future losses of global freshwater biodiversity, particularly in arid and semi-arid areas within temperate climate regions. It is therefore necessary to understand both contemporary drivers of freshwater biodiversity loss as well as how future climatic conditions might affect humans and nature. Analysis of existing environmental gradients has the potential to aid in projecting climatic influences on a variety of organisms. We present a multi-scale, spatiotemporal approach to predictive ecological modelling that ultimately demonstrates that an existing aridity gradient is a reasonable proxy for freshwater fish assemblage response to climate change projections for the same region. We conducted our study using fish collections from 100 sampling reaches distributed across the central Colorado River basin of Texas. We combined fish assemblage surveys, local habitat characteristics, remotely sensed geospatial riverscape data, and climate change projections for air temperature and precipitation to analyze: (1) spatial variation in fish-environment relationships under current conditions, and (2) variation in fish assemblage structure under multiple emissions scenarios. Our results revealed that spatial shifts in fish assemblage structure along an existing aridity gradient mirrored the modelled assemblage-level shifts under climate change projections for Representative Concentration Pathways 4.5 and 8.5 projected through 2100. The model predicts a general shift towards invasive, warm-water assemblages and potential loss of endemic, cool-water-dependent species. However, spring systems in the Edwards Plateau region are poised to provide potential refugia for stream fish assemblages because of the temperature buffering capacity of groundwater and the resulting cold-water climate shield. Our framework underscores the importance of multiscale, spatiotemporal modelling approaches that consider multiple dimensions of the total environment while assessing patterns and predictors of ecological change.

Species Distribution Modeling of Texas SGCN Fishes to Guide Landscape-level Conservation

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Keywords: Native Fish Conservation Areas, species distribution modeling, Fishes of Texas

The Native Fish Conservation Areas (NFCA) are a network of 20 freshwater systems across Texas, identified as priority areas for the conservation of fish species of greatest conservation need (SGCN) and the habitats they need to thrive. Conservation networks such as NFCAs are a primary tool in multi-species stream conservation at large spatial scales, provided that they are based on accurate predictions of species occurrence. Here we develop new species distribution models (SDMs) to update predicted occurrences of species, especially for SGCN. We chose an ensemble modeling approach because it reduces the sensitivity of predictions to model class, by maintaining lower variance and higher accuracy than single

models, which is especially important when producing predictions across multiple species. We generate an ensemble prediction of probability of occurrence derived from average results across model classes such as generalized linear models, generalized additive models, and machine learning methods (boosted regression trees, random forest models, etc.). Individual model fits are performed using occurrence data from the Fishes of Texas biodiversity database, which compiles information on species occurrence from museum collections, fish community field surveys, detailed biodiversity assessments (i.e., Bioblitzes) and citizen-based monitoring. In this presentation, we will talk about which environmental factors best predict the occurrence of fishes in Texas streams. We will describe the ensemble modeling approach we chose, with model validation steps, and detail resulting predictions, as well as accuracy and performance among species. This project is the first step in aligning conservation planning objectives and priority projects within NFCAs to the distributions of SGCN, with a goal to support the upcoming updating of the Texas Conservation Action Plan (i.e., the State Wildlife Action plan for Texas).

Effects of Shoreline Habitat on Nekton Communities Along the Lower Texas Coast

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Keywords: black mangrove, shore habitat

Shoreline habitat shifts, like the expansion of Black Mangroves, have been well-documented along the Texas coast in recent years. As these shifts occur, characterizing the association between shoreline habitat and nekton community structure is of particular importance for fisheries managers. Here, we used four years of in-situ habitat data paired with fishery-independent bag seine data collected by the Texas Parks and Wildlife Department Coastal Fisheries Division to investigate the effects of shoreline habitat type on fish communities along the lower coast of Texas (i.e., Aransas Bay, Corpus Christi Bay, Upper Laguna Madre, Lower Laguna Madre). Bag seine samples collected from July 2018 to September 2022 were grouped according to the dominant adjacent shoreline habitat type (bare, salt marsh, and mangrove) observed at the time of sampling. Multivariate analyses and biodiversity metrics were used to describe differences in nekton communities between bare-, salt marsh-, and mangrove-dominated shorelines. Overall, significant differences in nekton community composition were observed between each habitat type. The highest species richness and diversity were observed adjacent to mangrove habitat, while areas adjacent to bare shorelines had significantly lower richness and diversity. In addition, hot spot analyses were used to explore spatial variations in fish species richness. Richness hot spots were located primarily in areas with mangroves present along the shoreline or with denser salt marsh habitat, while cold spots were located primarily in areas adjacent to bare shorelines or with sparser salt marsh habitat. These results could be used to better inform fisheries managers as shoreline habitats continue to change and could help guide future shoreline restoration projects to maximize the positive impacts on nekton communities.

Persistence of Dermo (*Perkinsus marinus*) in Sun-Cured Eastern Oysters (*Crassostrea virginica*)

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Keywords: eastern oyster, Galveston Bay Foundation, oyster shell recycling, *Perkinsus marinus*, Dermo, Galveston Bay, sun curing, reef restoration

Reef restoration for the Eastern Oyster (*Crassostrea virginica*) is accomplished by introducing hard substrate, typically in the form of reclaimed shucked shells, back into the local environment to be colonized by native spat. The Galveston Bay Foundation (GBF) gathers shells from local seafood restaurants through the Oyster Shell Recycling Program for reuse in reef restoration in Galveston Bay, TX. The parasite, *Perkinsus marinus*, otherwise known as “Dermo” is a spore forming protozoan that negatively affects the fitness and longevity of Eastern Oysters. Dermo can be transmitted from one infected oyster to another, so sun-curing is used to minimize the prevalence of Dermo before reclaimed shells are returned to an estuary. There are currently no standardized curing procedures for restoration efforts to follow, however many groups sun-cure oyster shells for up to 6 months. This study aims to determine sun curing time needed to reduce the risk of infecting native oysters with Dermo, while not delaying the use of the material in reef restoration projects. Oysters used in the study were collected from Confederate Reef in Galveston Bay and had an 86.8% positivity rate for Dermo, with an average Dermo intensity rating of 0.87 for positive oysters. Half of oysters deployed in sun-curing piles were sampled weekly until no Dermo was detected via the standard fluid thioglycollate method. The other half were monitored for tissue decomposition. While this study is ongoing, Dermo intensity decreased by more than 80% following the first week of deployment at the curing site, however, presence of Dermo has persisted as long as tissue remained (10 weeks as of this writing). These preliminary results can be used to improve restoration practices by empirically informing sun-curing timelines needed to minimize the introduction of Dermo into local estuaries from reef restoration projects.

The Impact of Increasing Fishing Power: Live-imaging Sonar Use in Texas Reservoirs

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Keywords: sonar, live-imaging, anglers, crappie

The use of live-imaging sonar (also referred to as forward-facing sonar) has recently grown in popularity among anglers throughout the country, and specifically here in Texas. As this technology has presumptively increased angler catch and harvest efficiencies, Texas anglers have expressed growing concerns that technological advances may warrant regulation changes. With these concerns in mind, we sought to quantify live-imaging sonar utilization and compare harvest efficiencies for users and non-users. The Texas Parks and Wildlife Department routinely applies creel surveys throughout the state to generate estimates of catch, harvest, and effort. With an additional question soliciting whether anglers utilized live-imaging sonar during their fishing trip, we were able to subset our data into users and non-users during creel surveys on eight reservoirs strategically located throughout the state. Preliminary findings suggest that live-imaging sonar utilization varies from lake to lake; however, utilization occurs primarily among crappie anglers. As much as 57% of anglers targeting crappie within the reservoirs surveyed were

utilizing live-imaging sonar. Catch and harvest efficiencies among crappie anglers were significantly different among users and non-users, with approximately a two-fold increase in harvest efficiency on multiple reservoirs. Moving forward, we will apply crappie harvest estimates within an age-structured model to assess whether an increase in harvest efficiency has the potential to affect Texas crappie populations. This study provides a baseline understanding of live-imaging sonar utilization, a depiction of catch and harvest efficiencies for anglers using the technology, and a novel approach assessing the impacts of increased fishing power on fish population dynamics.

Recent Oyster Management in the Middle Coast of Texas

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Keywords: eastern oysters, Carlos Bay, Mesquite Bay, Ayres Bay, oyster harvest

Oyster resources in Texas have been heavily impacted in recent times. Severe droughts, record flooding, major hurricanes, and high harvest pressure have presented challenges to the commercial oyster industry, recreational anglers, oyster restoration practitioners, and resource managers. Since 2000, the majority of the oyster harvest has shifted from Galveston Bay to other bay systems, primarily San Antonio Bay and Aransas Bay. More recently in 2021, the Texas Parks and Wildlife Department (TPWD) became aware of increasing harvest efforts for oysters in the Carlos, Mesquite, and Ayres Bay complex, which generated concerns with respect to the long-term impacts to habitat within the complex. This area is characterized by both intertidal and deeper oyster reefs, expansive seagrass beds, and fringing salt marsh habitats making it an ecologically unique and sensitive area in the middle coast. With increased harvest pressure in the area accounting for over 30% of the coastwide landings (yet representing only 2.8% of the total oyster habitat) the department was contacted by members of the public concerned that the increased harvest activity had degraded the physical structure and vertical relief of the reefs in this complex. Subsequently, TPWD proposed a closure of the area (2,129 acres) to commercial oyster harvest and to protect oyster habitat from the negative biological impacts of increased harvest activity. The Texas Parks and Wildlife Commission approved the closure in November 2022. Looking forward, TPWD will continue to partner with various organizations and universities to restore oyster reefs in the area.

Assessment of Angler Harvest Diversity and Targeted Species Preference Across Two Regions of the Texas Coast

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Keywords: recreational angling, coastal waters, species preference

Shifts in angler preference and fishing pressure have significant implications for fisheries management. Here, we utilized over twenty years of fishery-dependent harvest data collected by the Texas Parks and Wildlife Department – Coastal Fisheries Division to describe patterns in fisheries landings from estuarine and Gulf of Mexico waters along the Texas coast. Boat ramp creel surveys were conducted from 2000-2021 to collect fish harvest, species sought and fishing pressure data. Angling trips were divided into region (upper coast vs lower coast) and catch location (inshore, nearshore, and offshore). Multivariate analyses were used to describe differences in the communities of fish harvested between upper and lower coast regions. Additionally, trends in catch diversity throughout the timeseries were determined for each catch location. Overall, significant differences in the community composition of fish harvested between the upper and lower coast were identified for each catch location. The diversity of catch remained steady for inshore and nearshore waters, but significantly decreased for anglers fishing offshore. SIMPROF

results were used to visualize how the most important species experienced shifts in landings over time. Decreased diversity in offshore catches coincided with an increased contribution of Red Snapper to offshore landings and an increase in angler preference for Red Snapper. These results highlight the utility of using multivariate analyses to describe large-scale trends in harvest data and provide community-level information pertinent to fisheries management decisions.

Status of the Blue Crab Fishery in Texas, Including Sex Ratio Patterns

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Keywords: blue crab fishery

The Texas Blue Crab fishery supports the fourth-most valuable commercial fishery in Texas behind shrimp, Eastern Oyster, and snapper accounting for 8.9% of total landings (pounds) and 2.7% of value (\$) during the ten-year period from 2011-2020. Texas Parks & Wildlife Department (TPWD) manages this fishery through bag limits, possession and size limits, gear restrictions and license buybacks. TPWD's Coastal Fisheries Division collects both fishery-independent and fishery-dependent data to support and inform management efforts. Fishery-independent monitoring data from bag seines, gill nets, bay trawls and Gulf trawls were analyzed for trends across sampling gears and by blue crab size classes collected in each sampling gear. Fishery-dependent monitoring data (landings, ex-vessel value, and effort) were reviewed coastwide from 1981-2021. Additionally, sex ratios from fishery-independent monitoring were analyzed for differences across time between gear and size class (1984-1987; 2006-2021). Long-term declines in relative abundance since the 1980's have levelled out or shifted to increasing trends in recent decades for some gears and size classes. These increasing trends were primarily observed in shore-based sampling gears (bag seines and gill nets) and in larger size classes (> 127 mm), while open water sampling gears (trawls) and relative abundance of smaller size classes tend to show less improvement. Similarly, commercial landings and values have shown increases since 2013, with an all-time high ex-vessel value of \$6.8 million reported in 2016. 2016 landings (5.3 million pounds) were the highest since 2002, though still down from the previous two decades. Although 65 commercial crab licenses were bought back by TPWD under its effort management program, there have been no buybacks since license year 2017. No discernable trends in sex ratio were observed across the timeseries.

What Determines Angler Satisfaction on The Texas Coast?

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Keywords: creel surveys, recreational angling

Recreational fisheries management includes understanding angler satisfaction to evaluate management strategies and the level of public participation. Texas Parks and Wildlife Department (TPWD) Coastal Fisheries Division strategies aim to maintain maximum sustainable limits of game fish species while benefiting coastal fishing communities. To assist in the management of recreational fisheries, the division has an extensive harvest monitoring program to collect anglers' catch and effort data. As a management evaluation strategy tool, anglers catch and non-catch related information collected from creel surveys could be useful to predict anglers behavior in response to fishing regulations. We examined both catch and non-catch related factors affecting angler satisfaction along the Texas coast using TPWD's coastal fisheries central database, which covered 1983 to 2021. Our results show that sport fishing was the primary purpose of the trip for 84% of the anglers interviewed (N = 558,948), and that 27 % of all anglers on the Texas coast were highly satisfied (10 on scale of 1 to 10) with their fishing trip. Anglers'

satisfaction varied significantly by major area, station, and purpose (activity type), whereas trip length, number of people on a fishing trip, and maximum fish size caught, regardless of species, directly influence anglers' level of satisfaction.

A Novel Multivariate Ecological Approach to Modeling Freshwater Mussel Habitats Verified by Ground-truthing

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Keywords: ecological niche modeling, *Fusconaia askewi*, *Fusconia lananensis*

Our study incorporates high-resolution, multivariate ecological niche modeling (ENM) to test whether two putative state-threatened mussel species in East Texas (*Fusconaia askewi* and *F. lananensis*) are ecologically differentiated. We forecasted suitable habitat to identify any differences in the taxa's habitat preferences, using a total of 60 environmental layers comprising climate, soil, and hydrology in a multivariate framework. We found the two species were not ecologically different, consistent with other work (e.g., morphology and genetics) suggesting that they are synonymous. We synonymized the two to make an ENM that was then ground-truthed by sampling 25 novel sites throughout East Texas. Our ENM significantly distinguished suitable from unsuitable habitat for these sites, identifying five new records. We compared model evaluation metrics using the original data versus the ground-truthed data, and we found that some metrics were more reliable than others. The verified ecological niche modeling approach that we present here can be applied in other studies in riverine environments, and has particular relevance to conservation science.

Regulating Urban Fisheries: Using Angler Attitudes and Practices to Develop Harvest Regulations for Small Urban Impoundments

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Keywords: Community Fishing Lakes, recreational angling, Largemouth Bass, Rainbow Trout

Texas Parks and Wildlife Department recognizes over 850 Community Fishing Lakes (CFLs) of which approximately 77% are less than 10 acres with nearly 70% of the impoundments within major metropolitan areas. Their proximity to urban areas and ease of access can cause these small waterbodies to be heavily utilized leading to high fishing pressure and potential overharvest under current regulations. We sought to develop a regulation that would be easy to understand and enforce with the goal of enhancing fishing opportunities in growing communities by protecting fish stocks. To better understand angler attitudes and practices, a statewide CFL Angler Survey was conducted from March through June 2021. A total of 887 interviews were conducted at 152 CFLs. Catfish (29.7%), Anything (27.7%), and Largemouth Bass (26.3%) were the three most sought-after species groups among interviewed anglers. Average angling catch rate was 0.85 fish/hr across all lakes and species. Catfish (59.9%) and Rainbow Trout (76.4%) anglers were the most likely to harvest fish, while intent to harvest was low for anglers fishing for Anything (26.5%), Largemouth Bass (4.3%), and Sunfish (35.3%). Anglers who indicated intent to harvest rarely (<9%) indicated a desire to harvest over five fish. Desired harvest numbers indicated by interviewees were below current bag limits for all species examined. Therefore, we proposed the new CFL fishing regulation to allow an aggregated bag limit of five fish of any species, with

only 1 black bass >14 inches allowed to be retained. The proposed regulation may reduce potential overfishing improving the quality of CFL fisheries.

Physiological Adaptations of Fishes and Aquatic Animals

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Keywords: acid-base physiology, microcystins

Freshwater and marine animals are often subjected to daily or seasonal changes in their environment. The physiological tolerances of organisms underpin their ability to successfully inhabit an environment, contributing to the overall success of the population. Here, I will discuss our work examining the physiological responses to abiotic factors, such as dissolved gases, water chemistry, toxins, and temperature – many of which are relevant to aquatic systems in Texas. First, I will discuss acid-base physiology in response to high CO₂. Many fishes (e.g. Largemouth Bass, Channel Catfish, gar) inhabit freshwater systems, including aquaculture ponds and recirculating systems where partial pressure of CO₂ (PCO₂) can range from 3 – 20 kPa (30,000 – 200,000 µatm). These high PCO₂ create severe acid-base challenges that require tight regulation of intracellular tissue pH to maintain normal whole-animal function. The cellular and molecular mechanisms that underlie intracellular acid-base regulation during high CO₂ conditions remain largely unknown and are currently being investigated. The second area I will discuss is the physiological responses of fishes to algal toxins. Algal toxins, including microcystins which are produced by blue-green algae (cyanobacteria), induce severe liver damage leading to morbidity and mortality in freshwater and marine fishes. In aquaculture settings, such as marine net-pens containing salmonids, microcystins can pose significant economic costs for producers. We are currently investigating biomarkers of microcystin toxicity to assist aquaculture producers mitigate the consequences of toxin exposure. Our other projects I will discuss include dissolved gas supersaturation in paedomorphic salamanders from the Edwards Plateau and thermal tolerances of crayfishes endemic to Texas. Together, these studies will inform on the physiological limits and strategies of aquatic animals in diverse environments. Understanding the responses to existing and future environments are important for developing conservation or management strategies for species of interest, including threatened or endangered species.

The Impacts of Winter Storm Uri on Texas Coastal Forage Fish

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Keywords: Winter Storm Uri, fish kill, forage

The 2021 Texas winter storm Uri was truly an unprecedented event that not only impacted the lives of thousands of Texans, but it also impacted our sensitive natural resources. Following the storm, quick actions were taken by the TPWD Coastal Fisheries (CF) division in a coastwide effort to rescue cold stunned sea turtles and protect recreational fish by implementing freeze closures. In addition to these efforts, fish kill assessments were conducted to estimate the number of fish killed by the storm. The results from the fish kill assessments estimated that 61 species were impacted by the freeze and an estimated 3.8 million fish were killed by the prolonged frigid temperatures. Of the total fish killed coastwide, 98% consisted of non-recreational species such as Silver Perch (*Bairdiella chrysoura*), Pinfish (*Lagodon rhomboides*), Striped Mullet (*Mugil cephalus*), Atlantic Croaker (*Micropogonias undulatus*), Spot (*Leiostomus xanthurus*), and Gulf Menhaden (*Brevoortia patronus*), which contribute to the diet of large recreational predatory fish such as the Spotted Sea Trout. This study will use TPWD Coastal Fisheries long-term resource management data to examine the effects of the 2021 winter storm Uri on these important forage species. Preliminary analysis indicates that despite the large number of non-

recreational fish killed during the 2021 freeze event, little impact was observed on the six fish populations listed above, showing their resilience and recovery from these freeze events.

Calcium Signaling in Progesterone Induction of Sperm Hypermotility in Southern Flounder (*Paralichthys lethostigma*)

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Keywords: sperm, calcium signaling, Southern Flounder

Progesterone-induced sperm hypermotility is regulated through membrane progesterone receptor alpha (mPR α) in several teleost species including the Southern Flounder (*Paralichthys lethostigma*). However, the relationship between calcium signaling and second messenger pathways downstream of mPR α : (1) Acy/cAMP, (2) Pi3K/Akt/Pde, and (3) Egfr/Erk1/2 remain unclear. A better understanding of the mechanisms regulating calcium signaling in sperm hypermotility could provide techniques to improve fertilization outcomes in Southern Flounder brood stock. The present study utilized the specific mPR α agonist, 10-ethenyl-19-norprogesterone (100 nM Org OD 02-0), as it has been previously shown to mimic the stimulatory effects of the endogenous progesterone hormone 17, 20 β , 21-trihydroxy-4-pregnen-3-one (20 β -S) on sperm motility in Southern Flounder and Atlantic Croaker (*Micropogonias undulatus*). Intracellular calcium responses in progesterone-induced hypermotility were quantified with a calcium indicator, Fura-2 AM and detected by fluorescence microscopy. Two second messenger drugs (10 μ M forskolin and 0.1 nM EGF), which activate the Acy/cAMP and Egfr signaling pathways, respectively, mimicked the intracellular calcium increase produced by Org OD 02-0. Inhibition of the Acy/cAMP pathway with 50 μ M dd-ADO blocked the progesterone-induced calcium increase. Additionally, inhibition of Pi3K/Akt/Pde with 10 nM Wortmannin and 25 μ M ML-9 abrogated the progesterone-induced calcium increase. Treatment with the Egfr/Erk1/2 inhibitor U0126 (500 nM) and AG1478 (5 μ M) also eliminated the progesterone-induced calcium increase. These results suggest Acy/cAMP, Pi3K/Akt/Pde, and Egfr/Erk1/2 pathways are involved in the progesterone-induced calcium increase in Southern Flounder sperm.

The Cats Out of the Bag—Gafftopsail Catfish Abundance and Length Trends in Texas Estuaries

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Keywords: Gafftopsail Catfish

Gafftopsail Catfish (*Bagre marinus*) are one of two common Ariidae catfishes in the western Atlantic and Gulf of Mexico—ranging as far north as Cape Cod and as far south as Panama. They are a ubiquitous estuarine species that are typically found in deeper bays and channels. While there is little recreational or commercial harvest of this species, they function as a generalist, mid-level predator in the estuarine ecosystem feeding on a variety of fish and invertebrates. Thus, they have the potential to exert some trophic influence on estuarine food webs. The objectives of this study were to assess the status of Gafftopsail Catfish populations in Texas estuaries (Sabine Lake through Laguna Madre) by assessing trends in relative abundance and length for this species. We examined fishery independent trawl (juveniles) and gill net (adults) data collected by Texas Parks and Wildlife Department—Coastal Fisheries Division from 1983-2020. In general, both juvenile and adult Gafftopsail Catfish were found to be increasing in relative abundance for most Texas estuaries—especially estuaries on the central Texas coast (Galveston to Aransas Bay). In these estuaries, Gafftopsail Catfish were often among the most common

species captured in gill net surveys in the most recent years. Average length for this species was also found to be decreasing across the timeseries for most of these estuaries. This concurrent decrease in length could be indicative of population-level density-dependent impacts for some areas. Given the generalist trophic role of Gafftopsail Catfish, managers should be vigilant of ecosystem impacts this species may be having, especially for actively managed prey species (e.g., Blue Crabs).

High Post-operative Mortality of Largemouth Bass at Colder Water Temperatures

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Keywords: Largemouth Bass, electronic tags, immunosuppression, *Saprolegnia*

Biotelemetry via surgical implantation of an electronic tag is common in fisheries science, and potential effects on fish mortality should be considered. Water temperature can influence the surgical process, but few studies have examined post-operative effects (all recommend surgeries at colder temperatures due to slower metabolism, decreased infections, and no documented mortality). We initially implanted transmitters in 26 adult Largemouth Bass (*Micropterus salmoides*) at colder and declining water temperatures (14-17°C) to investigate fish movement at Toledo Bend Reservoir, Texas. Within four weeks post-surgery, these fish experienced 100% mortality. Post-operative mortality was also high from two subsequent exploratory trials at 13°C (100%, N = 5 fish; 58%, N = 12 fish) and all fish that died developed external fungal infections. Immunosuppression of Channel Catfish (*Ictalurus punctatus*) and mortality from *Saprolegnia* has been documented during colder and declining water temperatures, and fish required 6-8 weeks of acclimation to recover immunity. We suggest that immunosuppression due to lack of acclimation to colder water temperatures (coupled with surgical stressors and high virulence conditions for *Saprolegnia*) likely caused 100% mortality of 31 largemouth bass from Toledo Bend Reservoir (no acclimation period) and our first trial (only three weeks of acclimation). This hypothesis is supported by considerably lower post-operative mortalities observed from our second trial at 13°C, a third trial at 24°C (no saprolegniosis or mortality), and two years of surgeries at 22-30°C at Toledo Bend and Lake Fork reservoirs. This study is the first to associate Largemouth Bass mortality with colder, declining water temperatures. However, our trials should be viewed as preliminary due to low sample sizes and design constraints (conducted when unaware of the potential immunosuppression/*Saprolegnia*/acclimation dynamic). Additional controlled trials are needed to confirm Largemouth Bass immunosuppression and related post-operative mortality.

Blotchy Bass Syndrome in the Lone Star State: A Synergistic Approach to Citizen and Agency Science Integration

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Keywords: blotchy bass syndrome, citizen science

Recent studies have determined that blotchy bass syndrome (BBS) in black basses in the northeastern United States has been associated with a family of viruses. In 2022, Texas Parks and Wildlife (TPWD) partnered with the United States Geological Survey (USGS) and West Virginia University (WVU) to collect distribution and prevalence data on blotchy bass syndrome in black bass species in Texas. For this effort, we implemented a two-pronged approach leveraging state agency biologists and anglers. Each of

the 15 Inland Fisheries and River Studies districts received sterile swabs from USGS and WVU to collect DNA samples from fish displaying blotchy bass syndrome collected during standard electrofishing surveys. At the time of this abstract, five districts have collected and shipped swabs to USGS for analysis. The effort is expected to continue until the end of the calendar year, and additional sample collections are anticipated. Simultaneously, we solicited anglers' reports via social media, ultimately requesting they submit photos and catch location information to us via email. At the time of this abstract, almost 900 individual submissions have been submitted. The majority of submissions have been Largemouth Bass, though presumptive cases of BBS have been documented in all four black bass species found in Texas. In the coming months, the team at USGS and WVU will determine the presence and novelty of viruses in Texas black basses.

Study-design Tradeoffs and Detection Error of Camera Traps to Monitor Endangered Comanche Springs Pupfish Populations

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Keywords: Comanche Springs Pupfish, Balmorhea State Park, camera trap

Noninvasive fish sampling methods are important to long-term population monitoring, particularly for imperiled species. Comanche Springs Pupfish (*Cyprinodon elegans*) is a federally endangered desert species endemic to west Texas. Camera traps were employed at 40 sites in Balmorhea State Park, where most remaining Comanche Springs Pupfish populations occur, as a monitoring technique with both no mortality risk and minimal habitat disturbance. As with any sampling method, camera trap detection is imperfect and can vary across environmental conditions. Further, analyzing resulting video to observe and count individuals is extremely time consuming. We evaluated the ability to observe both species presence and maximum pupfish counts at occupied sites relative to using all information in the videos (i.e., observations at 1-second intervals) with a range of subsampling designs. Detection was low across sites using designs that observed <40% of the video. On average, detection was high using designs that observed >60% of the video, but highly variable across sites. Comanche Springs Pupfish went undetected at only one occupied site when observing 70% of the video. Our results show that only the 1-second observations ensure that all population information via camera traps is retained; however, the ideal time interval is both site-dependent and subject to the study objective (e.g., species presence-absence versus population size). We also overview applicable modeling methods for Comanche Springs Pupfish occurrence and abundance estimation that allow for variable detection error using camera trap datasets.

Early Life Stage Exposure to Deepwater Horizon Crude Oil Impairs Teleost Osmoregulation by Altering Kidney Development and Function

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Keywords: Deepwater Horizon, PAH, pronephros, Zebrafish, Red Drum

The 2010 Deepwater Horizon (DWH) disaster oiled large portions of the northern Gulf of Mexico that overlapped in space and time with the spawning of ecologically and commercially important fish species. This confluence of events likely resulted in exposure during the sensitive early life stages (ELs) of the

developing offspring to toxic crude oil constituents, including polycyclic aromatic hydrocarbons (PAHs). Aside from acute impacts on survival, such exposures may have also imparted latent or chronic developmental and physiological effects on survivors with ensuing ramifications of ecological importance. While most studies have focused on cardiac endpoints, evidence from whole-animal transcriptomic analyses and studies with individual PAHs indicate that the developing kidney (i.e., pronephros) is also at risk of injury from crude oil exposure. Considering the role of the pronephros in osmoregulation, and the common observance of edema in oil-exposed ELS fishes, surprisingly little is known regarding the effects of oil exposure on pronephros development and function. Using the freshwater Zebrafish (*Danio rerio*) and saltwater Red Drum (*Sciaenops ocellatus*), we assessed the transcriptional, morphological and functional responses of the pronephros following exposure to dilutions of high-energy water accommodated fractions (HEWAF) of crude oil from the DWH spill. Our results revealed clear morphological and functional effects on the pronephros following HEWAF exposure, including reductions in fluid clearance capacity and glomerular filtration integrity. Such results likely explain, or at least contribute, to the observed increases in edema and mortality of HEWAF-exposed larvae following acute osmotic challenges in uncontaminated waters. These findings may have important management implications for future oil spills, particularly those affecting estuarine environments where osmolarity can change rapidly.

Posters

1. Lunar Periodicity in Reproduction of Red Drum in Aquaculture

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Keywords: lunar periodicity, Red Drum,

Lunar periodicity in spawning is documented in several marine species. Red Drum (*Sciaenops ocellatus*) are in Sciaenidae, or the drum family. Red Drum use acoustics in their courtship and spawning behavior, and their acoustical spawning activities have been recorded in wild populations and linked to the lunar phase. Texas Parks and Wildlife has fish hatcheries for stock enhancement along the Texas coast of the Gulf of Mexico. Broodstock are housed in recirculating aquaculture systems indoors with controlled photoperiods and thermal cycles to induce volitional spawning. These broodstock tanks have no lunar phase illumination, yet lunar phase has a significant effect on the number of spawning events recorded by this species at the Sea Center Texas facility in Lake Jackson. An ANOVA test was run, producing a p-value of 0.0317. Using the Fisher's Least Significant Difference test (alpha of 0.05), it was found that Red Drum spawning events are significantly more frequent during the full lunar phase when compared to the new and first phases. This information can be used to maximize production. By working with the lunar cycle, thermal fluctuations can be used in conjunction with the lunar phase to increase spawning events on a schedule. Strategically preparing fertilized ponds to have zooplankton blooms when larvae are at first feeding stage can ensure that resources are successfully utilized.

2. Identification of Biomarkers of Sub-lethal Algal Toxin Exposure in Atlantic Salmon (*Salmo salar*) and Chinook Salmon (*Oncorhynchus tshawytscha*) using Differential Gene Expression Analysis

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Keywords: Atlantic Salmon, Chinook Salmon, microcystin, algal toxin, biomarker, gene expression

Atlantic Salmon (*Salmo salar*) and Chinook Salmon (*Oncorhynchus tshawytscha*) are important culturally, recreationally, and economically, and represent an important species for aquaculture in Canada and the United States. In the Pacific Northwest, blooms of toxic algae result in millions of dollars annually in losses for salmonid aquaculture producers. One group of toxins that are particularly problematic are microcystins (MC), which bioaccumulate in the liver where they disrupt normal cellular activity by inhibiting protein phosphatases leading to sublethal effects on growth, immune status, and cardiac function. To minimize economic loss and improve animal welfare, salmonid producers are interested in using biomarkers of sub-lethal MC exposure to mitigate these challenges. Our objective is to identify molecular biomarkers that can be used to inform producers about toxin exposure. Using liver samples from Atlantic and Chinook Salmon fed algal paste containing MC, RNA-sequencing was performed in order to evaluate changes in gene expression caused by toxin exposure. Gene expression will be examined at several time points following exposure to determine most useful candidate biomarkers. These biomarkers can serve as early detection warning signs that will allow aquaculture managers to decide to harvest early to avoid large mortality events caused by these algal toxins.

3. Cellular Mechanism of Intracellular pH Regulation during Exposure to High CO₂ in Rainbow Trout (*Oncorhynchus mykiss*) and Channel Catfish (*Ictalurus punctatus*)

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Keywords: pH regulation, coupled, pH regulation uncoupled, Rainbow Trout, Channel Catfish

This study will investigate two different strategies of pH regulation among fish called coupled and uncoupled pH regulation (preferential pHi regulation). Within freshwater systems around the world CO₂ averages are roughly 0.3 kPa (~3100 μ atm), which is approximately 8-fold higher than atmospheric partial pressure. Under the two strategies for pH regulation within fish, those with coupled pH are less tolerant of high aquatic CO₂ partial pressures. As these fish experience acid-base challenges, their blood bicarbonate levels increase to buffer the acidification. Tissue pH closely follows the patterns of the blood pH during these hypercapnic events. Alternatively, under preferential pHi regulation the blood is allowed to drop causing acidification while tissue pH remains tightly regulated, thus maintaining intracellular homeostasis. The cellular and molecular mechanisms underlying the differences in pHi regulation between the two strategies of acid-base regulation are currently unknown. This study will investigate the mechanisms of these two strategies of pH regulation in fishes using Rainbow Trout (*Oncorhynchus mykiss*) and Channel Catfish (*Ictalurus punctatus*) which use coupled and uncoupled pH regulation, respectively. This will be done by exposing fishes to high CO₂ and examining cellular and molecular changes. It is hypothesized that differences in sodium-coupled bicarbonate transporters (NCBT) are associated with the different strategies of acid-base regulation. Identification and expression patterns of NCBT gene transcripts in response to high CO₂ will be examined using qPCR and in situ hybridization. Immunofluorescence will be used to reveal the presence (or absence) of cellular transporters following exposure to high CO₂ conditions. These results will inform on the physiological responses associated with acid-base recovery under different environmental conditions with elevated CO₂ tensions such as hatcheries and natural freshwater systems where these fish are found.

4. Role of Second Messenger Pathways Involved in Progesterin-induced Sperm Hypermotility through mPR α in Southern Flounder

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Keywords: Southern Flounder, sperm motility, progesterin

Commercial aquaculture has not been well established for some flatfish species, such as Southern Flounder (*Paralichthys lethostigma*), largely due to their poor reproductive success. Low sperm motility in Southern Flounder is one of the central causes of reduced breeding outcomes. In Southern Flounder, sperm hypermotility is induced by progesterin hormones through the membrane progesterin receptor alpha (mPR α); however, the second messengers downstream of mPR α remain unclear. In the present study, the role of the adenylyl cyclase (Acy)/cyclic adenosine monophosphate (cAMP) pathway in progesterin induction of sperm hypermotility was investigated using in vitro treatment with forskolin, which stimulates Acy activity. Similarly, the role of the epidermal growth factor receptor (EGFR)/mitogen-activated protein kinase (MAPK) pathway was investigated using epidermal growth factor (EGF), which activates EGFR. Sperm motility experiments were captured with light microscopy and analyzed using motion analysis software. Both forskolin and EGF treatments mimicked the stimulatory effects of the endogenous progesterin hormone, 17, 20 β , 21-trihydroxy-4-pregnen-3-one (20 β -S) and a selective mPR α agonist, 10-ethenyl-19-norprogesterone (Org OD 02-0) on flounder sperm hypermotility. Inhibition of EGFR/MAPK with AG1478 and AG825 blocked progesterin-induced hypermotility. Collectively, these

results indicate that progesterone induction of flounder sperm motility is mediated through activation of Acy/cAMP and EGFR/MAPK pathways. The finding that direct in vitro treatment with drugs that stimulate these messenger pathways, forskolin and EGF, stimulates flounder sperm hypermotility, suggests their potential for enhancing sperm motility and fertility in Southern Flounder. This research was supported by USDA NIFA grant 2018-67015-27574 to PT.

5. The Potential for Carbon Sequestration in a Nearshore Artificial Reef

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Keywords: blue carbon, Rio Grande Valley Reef, carbon sequestration

Along with marine reef habitat loss, increased carbon emissions from human activities are a growing concern for climate change and ocean health. Given that the oceans retain approximately one-third of the world's excess carbon emissions, they are negatively affected by this increased flux of carbon. Blue carbon, defined as the carbon captured by the world's ocean and coastal ecosystems, is a rapidly expanding research topic. However, few studies have quantified how much blue carbon can be captured when providing new habitat for marine reef fish. The focus of this study is to determine the amount of blue carbon held in the Rio Grande Valley Reef, the largest artificial placement on the Texas coast. We hypothesized that the Rio Grande Valley Artificial Reef captures carbon through the new ecosystem provided by the artificial reef, and that this carbon accumulates in the sediments. Thus, we expect these levels of carbon to be higher than the surrounding areas without artificial reef habitat. Sediment samples were collected using an Outland 2000 ROV with a specialized manipulator arm sediment sampler at several reef patch locations within the reef. Samples were dried, then combusted in a muffle furnace to determine the ratio of organic to inorganic carbon. Samples were then processed in a Perkin Elmer elemental analyzer to determine carbon content. Preliminary sediment samples from the reef have shown higher organic carbon ratios as compared to previous studies of carbon levels in the Gulf of Mexico. In addition to providing additional reef fish habitat, this study in the Rio Grande Valley Reef will provide insight into the benefits that artificial reefs have to offer in terms of blue carbon sequestration in the marine environment.

6. Addressing Uncertainty in Fish Assemblage Responses to Increased Stream Drying

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Keywords: fish assemblage, flow reduction, Leuciscidae, ratcheting model, environmental filtering model, metacommunity dynamics continuum model, environmental filtering of life history strategies model

Anthropogenic water withdrawals coupled with expected increases in drought severity under climate change will cause streams and rivers to experience future dewatering. Designing management plans to address the deleterious effects of stream dewatering is critical for conservation of stream fishes but developing projections for fish responses to drying can be challenging. Ecological traits of fishes coupled with hydrologic gradients underpinned by anthropogenic (groundwater extraction) or natural (drought, stream intermittency) processes might provide some insight into predicting fish assemblage changes. I present four conceptual models useful for developing and testing predictions for fish assemblage responses to water reductions in small streams and medium rivers. These models include a ratcheting effect model and an environmental filtering of reproductive modes model focused on Leuciscidae fishes in medium-sized Great Plains rivers, as well as a metacommunity dynamics continuum model and an

environmental filtering of life history strategies model in small streams. The ratcheting model captures interactions between static fragmentation of rivers and temporally dynamic drying regimes that result in species extirpations during drying but no opportunity for recolonization after rewetting. The environmental filtering model describes filtering of reproductive modes during extreme drought, when natural flow regimes are desiccated, and three-dimensional hydrologic connectivity (longitudinal, lateral, vertical) is fragmented. The metacommunity dynamics continuum model posits that intermittent stream fish assemblages transition between nested subsets (drying and dry periods) to longitudinal turnover (wet periods) as water is in place for longer and species sorting emerges. Finally, the environmental filtering of life history strategies model predicts that drought conditions in mountain streams select for opportunistic strategists over equilibrium-periodic strategists because flows are unpredictable during drought. Each of these models emphasize the importance of management actions aimed at maintaining or restoring stream connectivity and coordinated water conservation efforts aimed at maintaining natural or rehabilitating altered flow regimes.

7. Mesohabitat and Macroecological Correlates for Blue Sucker (*Cycleptus elongatus*) Occurrence in Regulated Rivers

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Keywords: Blue Sucker, Angelina River, river regulation, habitat fragmentation

Blue Sucker (*Cycleptus elongatus*) occurs in large rivers in North America and is negatively affected by habitat fragmentation by dams and the resulting alterations to natural flow regimes. During fish assemblage surveys in August of 2022 we found five specimens of juvenile Blue Sucker (312-428 mm total length) in the Angelina River upstream of Sam Rayburn Reservoir. Our goal for this paper was to analyze Blue Sucker distribution in Texas and the mesohabitat and macroecological settings that correlated with the collections. The first objective was to research occurrence records for Blue Sucker in databases at global, national, state, and basin scales to confirm specimens were from a previously undocumented location. The second objective was to quantify mesohabitat variables and compare them to conditions reported in the literature. The third and final objective was to compare the macroecological correlates (habitat fragmentation and degree of river regulation) for the collection location with the broader distribution of the species during historical (1950-1980) and contemporary (1981-2022) time periods. Results revealed the Blue Sucker population in the Angelina River upstream of Sam Rayburn Reservoir was previously unknown, though it was within the presumed native range of the species. Mesohabitats (i.e., fast velocity, shallow depth, coarse substrates) were consistent with habitats used by the species in other rivers. The low degree of river regulation (19% of natural runoff is stored by upstream reservoirs) and high degree of habitat connectivity (280 km of mainstem habitat) for the Angelina River upstream of Sam Rayburn Reservoir were consistent with Blue Sucker occurrence on a national scale. Our results suggest the occurrence of Blue Sucker upstream of Sam Rayburn Reservoir was predictable based on mesohabitat and macroecological attributes of the species. Our findings ultimately provide additional insight into how river regulation and fragmentation might be managed to benefit the species

8. Southern Flounder in Texas Estuaries: An Examination of Size Specific Catch Rate Trends in the Context of Climate Related Population Impacts

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Keywords: Southern Flounder

Southern flounder (*Paralichthys lethostigma*) are a commercially and recreationally important marine flatfish found throughout the Gulf of Mexico and along the United States' southeastern Atlantic coast that are experiencing well documented range-wide declines. Recent research elsewhere in the range of the species has focused on concerns of climate change related factors including the possibility of temperature dependent masculinization and resulting shifts in size structure of the population. In the context of these recent studies, we examined Texas Parks and Wildlife Department (TPWD) gill net sampling data from 1983-2021 to assess long-term changes in size specific catch rates for each bay system along the Texas coast. We also examined TPWD recreational and commercial fisheries dependent data for the same time series to review trends in flounder landings. Although sex data was not collected with this long-term monitoring data, we made use of available size frequency and sex ratio data from a separate nested study to infer a coarse understanding of sex specific trends across binned size classes ($\leq 300\text{mm}$, $301\text{-}400\text{mm}$, $>400\text{mm}$) representative of changing percentages of males. While specific catch rate patterns varied by bay system and size class, and the data showed substantial interannual variation for much of the timeseries, we generally observed a decrease in fishery independent catch rate compared to historic highs in most bay systems. Landings (commercial and recreational) showed decreasing trends across the timeseries as well, at least partially a result of increasingly stringent harvest regulations, though, to note, nighttime recreational landings are not captured during routine harvest surveys. Regardless, catch rate trends by size class didn't suggest shifts in sex ratio across the timeseries, though we recognize sex ratio is only estimated with our current analysis. This data synthesis helps to identify limitations of currently collected flounder monitoring data and highlight needs for further research.

9. Evaluation of Fish Communities on an Urban-Rural Gradient in the San Antonio River Basin from 2016 to 2021

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Keywords: urbanization, land use, San Antonio River Basin

Our freshwater resources are becoming increasingly impaired by the effects of urbanization. Even at small amounts, the results of anthropogenic activities, such as an increase in urban land cover, can significantly alter a riverine landscape. Further, fish communities reflect these negative effects of urbanization, and are exceptional indicators for biological health. Their species evenness, richness, and relative abundance within a community is often related to disturbances imposed on their physical habitat; in turn, studying the composition of fish communities can answer questions about the true quality of a river basin. This study aimed to examine the relationship between land use and fish community composition across an urban-rural gradient in the San Antonio River Basin (SARB) using a variety of variables relating to the environment, community, and diversity. Overall, most variables that we tested were significant to compare ($p\text{-value} < 0.05$). While discovering a noteworthy urban-rural gradient for the SARB, we determined that species richness was higher in suburban and rural sites (both $n=15$) than urban sites ($n=13$). The presence of isolated communities proved the importance of the River Continuum Concept; this was identified in trends such as headwater-favoring communities, as well as non-native

species being present most often in urban sites. This study also emphasized the significance of the “suburban area”, which were sites that were often more forested, had a high Index for Biotic Integrity (IBI) and supported just as much biodiversity as rural sites. We stress that urban river systems continue to be more complex; for example, rural agricultural sites differed from rural forested sites, and the multiple stressor syndrome at play brought up the existence of a distance gradient, or perhaps some more unknown gradients that need to be tested. We push for Texas to act to further conserve and understand other basins in the state.

10. Taxonomic and Functional Diversity of an Urban Stream Fish Assemblage: a 30-year Perspective

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Keywords: urbanization, Blue Tilapia, Redbreast Sunfish, Blacktail Shiner, Sabine Shiner, fish assemblage

Traditional approaches to understand the dynamics of fish assemblages is traditionally focused on taxonomic diversity, one aspect among many dimensions of biodiversity. However, using complementary analytical methods, such as functional diversity, can help researchers to develop a stronger predictive framework on the effects of the species loss or gains in response to urbanization. We assessed temporal changes of fish assemblages in an urban stream in East Texas between four seasonal surveys of 1989-1990 and 2018-2019. We explored the similarities and differences in species richness, composition, and functional diversity of fishes. Although the species richness and functional richness between the two time periods were similar, we observed changes in species composition. We also observed higher functional dispersion and evenness in the 2018-2019 assemblage compared to 1989-1990 assemblage. Some fish species were locally extirpated, while others colonized the system, increasing the functional diversity of the current assemblage. Urbanization has commonly been associated with declines in diversity and richness, however, our findings suggest that the addition of a few invasive generalist species (e.g., Blue Tilapia) and native tolerant (e.g., Redbreast Sunfish, Blacktail Shiner) in this stream system could be associated with increased human activities in this small, urbanized area in East Texas. Streams in East Texas support very diverse fish assemblages, with some sentinel species (e.g., imperiled shiners: Sabine Shiner, a habitat-affinity, broadcast spawner) rapidly responding to stream alterations. Multiple stressors can underlie the dynamics and composition of fish assemblages; thus, it is essential for more comparative studies of current and historical data of fish assemblages. Likewise, studies targeting sentinel fish species may have more utility for the evaluation of freshwater ecosystems.

11. Multiscale Stream Fish Species-Discharge Relationships: The Relative Roles of Evenness, Density, and Spatial Aggregation

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Keywords: species-discharge relationships, Colorado River basin (Texas), Measurement of Biodiversity, fish assemblage

Riverine flow alterations represent an increasing threat to global freshwater fish diversity. Species-discharge relationships (SDR), characterized by a positive correlation between river discharge and fish richness, are used to forecast fish diversity responses to changes in discharge. However, SDR are scale-dependent and subject to effects caused by differences in evenness of fish abundances among sampling locations (“evenness effects”), the number of individuals collected during sampling (“density effects”), and spatial autocorrelation caused by collections nearer to each other having more similar richness (“aggregation effects”). We used a hierarchical nesting structure to collect stream fish assemblage data so that seine hauls ($n = 1,000$) were nested within sampling reaches ($n = 100$), nested within segments ($n = 20$), nested within tributaries ($n = 5$), nested within the central Colorado river subbasin. We then used the Measurement of Biodiversity (MoB) framework to assess the relative roles of spatial scale and evenness, density, and aggregation effects on stream fish SDR. To address spatial scale, we analyzed assemblage data compiled by reach (10 seine hauls in 100 reaches), segment (50 seine hauls in 20 segments), and tributary (200 seine hauls in 5 tributaries) scales and repeated the same MoB framework for each scale. Total observed species richness correlated with discharge magnitude at the tributary scale, but not the segment nor the reach scales. At the reach scale, small positive density effects were offset by equally small negative evenness effects, while at the segment scale small negative density effects were offset by equally small positive evenness effects. At the tributary scale, the SDR was driven by positive aggregation effects and evenness effects among sites with high discharge. Our findings suggest the SDR at the broadest scale was driven largely by the fact that fish assemblages in rivers with higher discharge have higher evenness among assemblage members.

12. Investigation of Man-Made Dredge Material Placement Compartment as Potential Nursery Habitat in Sabine Lake

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Keywords: Sabine Lake, dredge material placement area, Pleasure Island

Estuaries along the Gulf coast provide nursery habitat (e.g., seagrass beds, coastal marshes) which serve as a refuge for larval and juvenile fishes and invertebrates and are therefore essential in maintaining the ecological integrity of marine ecosystems. The Texas shoreline of Sabine Lake, a bay supplied by the Neches and Sabine River, has been heavily altered by hydrological diversions, ship channels and revetments resulting in a greatly reduced connection between the estuary and the surrounding marshland nursery habitat. Despite this, there is a highly productive, local recreational fishery located on Pleasure Island, Port Arthur Texas that is centered around a dredge material placement area enclosed within the island revetment. The enclosed compartment maintains a connection with the open waters of Sabine Lake via tidal flow through two sets of large diameter pipes, allowing marine organisms to move freely between the two. Given the site’s highly productive fishery, it is possible that this manmade enclosure

serves as an important nursery habitat for the surrounding bay system. The goal of this study is to determine whether the dredge compartment acts as a supplementary nursery habitat along the highly modified Texas shoreline of Sabine Lake. To accomplish this, we are conducting population inventories of the enclosure via otter trawls, bag seining and gill netting following the methods of the TPWD Coastal Fisheries division. Data collected from these surveys will be compared to that collected by TPWD for the Sabine Lake System to determine if there is a significant difference in the abundance of juveniles and recruits in the north levee enclosure compared to the surrounding estuary. We present our preliminary findings on data from ongoing monthly collections started in November 2022.

13. Spatial-Temporal Habitat Variation of Three Stream Dwelling Cyprinids: the Blacktail (*Cyprinella venusta*), Blackspot (*Notropis atrocaudalis*) and Sabine (*N. sabiniae*) in Texas Streams

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Keywords: Blacktail Shiner, Blackspot Shiner, Sabine Shiner, La Nana Bayou

Understanding how fish assemblages are structured in stream ecosystems can provide useful information in developing effective conservation measures. We examined the population structure of three sympatric shiners: Blacktail Shiner *Cyprinella venusta*, Blackspot Shiner *Notropis atrocaudalis*, and Sabine Shiner *N. sabiniae* in La Nana-Banitat stream complex system within La Nana Bayou in East Texas across three seasons (spring, summer and fall) in 2022. These cyprinid species are stream-dwelling, generalist invertivores, known for co-occurring in similar stream types. Given the broader habitat tolerance, Blacktail Shiner is expected to be more abundant than its conspecifics. To investigate species-habitat association and spatial-temporal distribution, we examined population structure across seasons and three habitats: pools, riffles, and runs within this stream complex. Species individual body size was measured across the three habitats. The Blacktail Shiner was most abundant across all seasons, with greater abundance in pool habitats during the fall season. The Sabine and Blackspot shiners were present across all seasons, but were overall less abundant compared to the Blacktail. Pool habitats were deeper than riffles and runs. In the spring season, abundance of the Blacktail Shiner was correlated with deeper pools, while Sabine and Blackspot shiners were correlated with flow and substrate type, dominated by gravel. In the summer and fall, when flow was reduced due to the drought, the three species were collected in deeper pool habitats with a more mixed substrate. Among the three shiner species, the Blacktail Shiner showed a large range of body size (~30-80mm) variation across each habitat and seasons compared to Sabine and Blackspot, while the Sabine Shiner had the smallest body size (<50mm). Overall, the three species occurred together in similar habitats during the spring season when habitats were connected. Despite the severe 2022 summer-fall drought, populations of Blacktail Shiner dominated in pool habitats, the only habitat available in La Nana-Banita system during these two surveyed seasons.

14. The Use of Environmental DNA (eDNA) as a Tool for Assessing the Presence of Marine Finfish in the Coastal Waters of Texas

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Keywords: eDNA, Cedar Lakes, Red Drum, Alligator Gar, Gulf Menhaden, Striped Mullet, Sheepshead, Spot, Southern Flounder, Sand Seatrout

Recently, environmental DNA (eDNA) has emerged as tool to assess aquatic communities. This tool has the ability to detect species diversity in the marine environment through the use of a minimally invasive methodology, water sampling. The focus of this study was to compare community structure data obtained from eDNA samples to similar data obtained via one of the Texas Parks & Wildlife Department's traditional fisheries sampling gears, gill nets. During the 2022 spring and fall 10-week gill net sampling seasons, 40 surface water samples were collected in the Cedar Lakes area alongside 20 individual gill net deployments (10 nets in each season). A total of 18 species were detected in the gill nets themselves, compared to eDNA detection of 42 species. Rates of detection varied between the two methods, but Redfish (*Sciaenops ocellatus*) and Alligator Gar (*Atractosteus spatula*) were the most common in both the methods. Common species such as Gulf Menhaden (*Brevoortia patronus*), Striped Mullet (*Mugil cephalus*), Sheepshead (*Archosargus probatocephalus*), Spot (*Leiostomus xanthurus*), Southern Flounder (*Paralichthys lethostigma*), and Sand Seatrout (*Cynoscion arenarius*) were found to have a higher detection rate with eDNA compared to gill nets. Species richness and rarefaction analysis confirmed higher rates of individual species detection using eDNA compared to gill nets. The size-selectivity of gill nets is a limitation for fishes that do not achieve larger sizes (e.g. > 200 mm), resulting in advantages for the use of eDNA in those cases. On the other hand, gill nets may provide more robust estimates of abundance. Counts of eDNA sequence reads among species and samples varied across nearly 7 orders of magnitude, confounding estimates of relative abundance. Continued comparison between eDNA and traditional sampling gears is ongoing.

15. Quantifying Movement of Seven Imperiled Pelagic-Broadcast Spawning Fishes in Three Great Plains Rivers

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Keywords: pelagic broadcast spawning, Canadian River basin, Brazos River basin, Red River basin, Plains Minnow, Prairie Chub, Shoal Chub, Peppered Chub, Smalleye Shiner, Sharpnose Shiner, Arkansas River Shiner

Dam-building, barrier construction, water diversion, groundwater pumping, and drought events cause habitat loss and fragmentation in large rivers, particularly in the Southern Great Plains ecoregion. These river alterations negatively affect cyprinids belonging to the Pelagic-Broadcast Spawning (PBS) reproductive guild characterized by production of nearly neutrally buoyant ova that are swept downstream potentially long distances during development. In this study, we used mark-recapture to quantify movement behaviors of seven imperiled Great Plains PBS fishes distributed among the Canadian, Brazos, and Red river basins including Plains Minnow (*Hybognathus placitus*; 3,580 tagged, 76 recaptured), Prairie Chub (*Macrhybopsis australis*; 5,771, 213), Shoal Chub (*Macrhybopsis hyostoma*; 1,535, 47), Peppered Chub (*Macrhybopsis tetranema*; 2,944, 378), Smalleye Shiner (*Notropis buccula*; 3,306, 63), Sharpnose Shiner (*Notropis oxyrhynchus*; 3,778, 306), and Arkansas River Shiner (*Notropis girardi*;

2,231, 95). Fishes were captured by seine, tagged using visual implant elastomer to code the location and date of capture, and then movement was tracked over 5-7 months during spring and summer (between 2019-2022). Results revealed movement patterns were leptokurtic for all species except Shoal Chub, suggesting populations represented heterogeneous mixes of stationary and mobile individuals. The movement distances by mobile components of each species were 1-2 orders of magnitude greater than expected for fishes of similar size in rivers of similar size, highlighting long distance movements by mobile members of populations (300-1,200 m/d). Biased upstream movement was evident for Sharpnose Shiner, Peppered Chub, and Arkansas River Shiner, but not the remaining four species. Estimated movement distances by the mobile component of all seven species was predictive of the minimum estimated stream fragment length species require for persistence (derived from literature), revealing a link between dispersal and habitat fragmentation. Our results provide insight into the appropriate spatial scales for management actions aimed at conserving multiple species of highly imperiled PBS fishes.

16. Preliminary Results from the Upper Galveston Bay Sustainable Oyster Reef Restoration Project: The Influence of ENSO on Monitoring Results and Project Performance

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Keywords: Upper Galveston Bay, oyster restoration, ENSO

The Upper Galveston Bay Sustainable Oyster Restoration Project is a partnership between The Nature Conservancy, Texas Parks and Wildlife Department, and the Galveston Bay Foundation where partners restored ~25 acres of harvestable oyster reef and ~13 acres of “sanctuary” reef (protected from oyster harvest) in upper Galveston Bay, Texas. This creates a “source-sink” dynamic where the protected broodstock within the sanctuary reef (“source”) supply larvae to the harvestable (“sink”) reefs. Quarterly monitoring was conducted to assess restoration success and inform adaptive management and future design of other similar “landscape-scale approach” restoration projects. Monitoring results indicate that seasonality and salinity regime can impact short-term project success, but long-term success can be achieved as natural salinity and climatic cycles shift to favorable conditions. The project’s location experiences wide fluctuations in salinity driven by the ENSO (El Niño/Southern Oscillation) cycle in the Eastern Equatorial Pacific. During El Niño periods, increased rainfall can depress salinity, while La Niña periods produce drought conditions causing salinity to increase. Construction of the reefs occurred in early 2021 during an El Niño period and the persistence of low salinity conditions in the area caused concern about the project’s success, as spat and oysters were absent from the restored reef. In 2022, a shift to La Niña conditions caused salinity to increase resulting in increased oyster and spat abundance on the restoration sites. No additional adaptive management strategies (e.g., additional cultch placement or seeding) were required to overcome short-term apparent failure; the reef naturally recruited oysters when conditions improved. Not only can the results of this study inform the timing of cultch placement for oyster restoration projects, but it also indicates that long-term monitoring may be required to adequately assess project success in areas with highly variable climatic and salinity regimes.

17. Population Trends of Red River Pupfish (*Cyprinodon rubrofluviatilis*) in Three River-Segments of the Upper Brazos River, Texas: Does Abundance Correlate with Habitat Conditions?

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Keywords: Red River Pupfish, Salt Fork of the Brazos River

The Red River Pupfish (*Cyprinodon rubrofluviatilis*) is a native cyprinodontid found in saline streams of the upper Red and Brazos River systems of western Oklahoma and Texas. Red River Pupfish is listed as a threatened species in Texas and given the ongoing anthropogenic threats in the upper Brazos River for this species, we aimed to investigate the occurrence and population size structure of the Red River Pupfish in three sites in the Salt Fork of the upper Brazos River that appear to vary in local environmental conditions. We expected that high occurrence of Red River Pupfish would correlate with suitable sites containing water with high conductivity and salinity. We analyzed water quality and physical habitat variables to examine how they correlate with species occurrence and individual body size. Overall, we observed differences in environmental conditions among the three sites. Water conductivity and flow was high at one of the sites (Site 3) and correlated with the high occurrence of Red River Pupfish, but also larger individuals were found at this site. This site (Site 3) also differed from the other two sites on substrate composition, dominated by mud and sand, and potential traces of oil. Despite these conditions observed in Site 3, our preliminary findings suggest the Red River Pupfish is a very euryplastic fish, and physical or chemical stream characteristics may not be a major limiting factor of its abundance/occurrence. Further research will continue to better inform conservation status of this species in the Brazos River.

18. Winter Storm Uri's Impacts on Gray Snapper (*Lutjanus griseus*) in the Corpus Christi Bay Ecosystem

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Keywords: Winter Storm Uri, Gray Snapper, Corpus Christi Bay

Multiple species of recreationally important marine organisms were negatively affected by Winter Storm Uri which struck Texas in February of 2021. The Texas Parks and Wildlife Department (TPWD) collects population abundance and angler catch data for Gray Snapper (*Lutjanus griseus*) through long-term resource and harvest monitoring programs. These data were analyzed for the Corpus Christi Bay ecosystem to evaluate localized trends after this thermally sensitive species was impacted by the drastic and sustained drop in water temperature. Low catch rates in gillnets were recorded directly following the freeze of February 2021 with below average catches in the spring of 2021 and well below average catch rates in fall of 2021. Analysis of the 20-year mean fall gillnet catch of *L. griseus* shows that fall 2020 catches were 39.5% (n=52) below the mean. Fall rates after Winter Storm Uri were 91.9% (n=7) below mean, and a year later in fall of 2022, the catch was 27.9% (n=62) below the 20-year mean. Angler harvest data during the peak angling season (May – November) shows angler catch rates and angler harvest of Gray Snapper decreasing after Winter Storm Uri with anglers landing 505 in 2020 and only 25 in 2021 as recorded during TPWD angler interviews. TPWD data shows rebounding numbers in 2022, and a total of 214 harvested gray snapper. TPWD will continue to monitor Gray Snapper population and angling trends. With rising mean annual surface water temperatures and mild winters being more common, this semi-tropical species will likely continue to thrive in South Texas ecosystems and be able to

recover after extreme winter weather events, providing a unique angling opportunity for Coastal Bend anglers.

19. Zebra Mussel Invasion Risk: Estimating the Likelihood of Spread and Establishment of an Aquatic Invasive Species

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Keywords: Zebra mussels, network analysis, invasive species

One of today's greatest conservation challenges is the proliferation of invasive species. A particularly ecologically and economically damaging invasive species is the zebra mussel (*Dreissena polymorpha*). Zebra mussels are already present within parts of Texas and if current trends persist, this invasion front may reach New Mexico. Our study aims to assess the invasion risk of Texas and New Mexico's water bodies to facilitate early detection and mitigation strategies. We assessed risk with a combination of network analysis and habitat suitability indices. Network analysis was used to estimate landscape connectivity and how the spatial arrangement of water bodies may facilitate the spread and introduction of zebra mussels to new habitats. Our network consisting of water body nodes and connecting roadway edges, showed a high level of connectivity in eastern and central Texas. Connectivity rapidly declined further west, as water bodies became more isolated from each other. This isolation may impede the western spread of zebra mussels. Using graph analysis, we identified water bodies along I-45 and I-20 that act as "stepping-stones" and aid in the spread of zebra mussels from north Texas to the Gulf Region and West Texas. We will also create habitat suitability indices of each water body to estimate zebra mussel establishment. Water bodies with high connectivity and high habitat suitability pose the greatest risk of zebra mussel invasions. Identifying high risk water bodies can help resource managers guide the allocation of limited time and resources for early detection and outreach campaigns.

20. Trait-mediated Species Interactions Drive Co-occurrence of Invasive and Native Species

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Keywords: community assembly theory, virile crayfish, Colorado River system (Arizona), null models

Trait-based community assembly theory can elucidate mechanisms by which invasive species establish populations and impact native species. Invasive crayfish are globally pervasive, but the mechanisms underlying their impact on native fishes remains equivocal. Here, we use community assembly theory to understand the abiotic and biotic drivers of co-occurrence of fishes and invasive virile crayfish (*Faxonius virilis*). We surveyed both taxa from 5,104 quadrats nested within 117 wadeable stream reaches in the lower Colorado River system (Arizona and New Mexico) in the summers of 2021 and 2022. Next, we used null models to quantify co-occurrence patterns between crayfish and seven native and ten non-native fish species. Finally, abiotic niche dissimilarity with crayfish, functional traits indicating strength of competition (e.g., diet and foraging behavior) or predation (e.g., spawning behavior and reproductive ecology), and provenance (native vs non-native) were tested as mechanisms driving these co-occurrence patterns using generalized linear mixed effects models. Two key patterns emerged from our analysis. First, fish species that occupy increasingly dissimilar niche positions were more likely to segregate from crayfish, indicating that abiotic filtering is the ecological mechanism driving co-occurrence patterns between fish and crayfish. Second, native fish species were more likely to segregate from crayfish than

non-native fish species, indicating that biotic interactions between crayfish and native fish may be particularly important drivers of co-occurrence. Our inability to detect effects of predation and competition suggests that cryptic traits related to ecological naiveté may drive negative co-occurrence between invasive crayfish and native fishes. The niche-corrected segregation scores provide a quantitative vulnerability ranking for native fishes which can guide spatial prioritization of crayfish management (e.g., eradication) to protect native fish communities in the lower Colorado River system. More generally, we show that trait-based community assembly theory can inform research on aquatic invasive species and their impacts on freshwater biodiversity.

21. Status Survey of Nine Rare Aquatic Macroinvertebrates in East Texas and Louisiana

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Keywords: *Sparbarus couchatta*, *Tricorythodes curvatus*, *Isoperla sagittata*, *Cheumatopsyche morsei*, *Chimarra holzenthali*, *Hydroptila ouachita*, *Neotrichia mobilensis*, *Phylocentropus harrisi*

Freshwater is essential to human existence. The health of each freshwater source is connected to the prosperity of pollution intolerant species of aquatic macroinvertebrates in the orders Ephemeroptera, Plecoptera, and Trichoptera (EPT taxa). Higher presence of EPT taxa equates to better water quality because their water bound larvae assist in maintaining clean freshwater environments and will not survive in highly polluted water. Human disruption to natural environments is causing increases in polluted freshwater, leading to decreases in the presence of EPT taxa. Texas Parks and Wildlife documentation shows major concern for the populations of eight EPT taxa species of critical concern in East Texas (*Sparbarus couchatta*, *Tricorythodes curvatus*, *Isoperla sagittata*, *Cheumatopsyche morsei*, *Chimarra holzenthali*, *Hydroptila ouachita*, *Neotrichia mobilensis*, and *Phylocentropus harrisi*). A field status survey of each species is planned based on an extensive literature review and their documented historical county locations. A pollution intolerant species of critical concern from the order Odonata (*Somatochlora margarita*) is also being surveyed because this species has been found in historical county locations that overlap with three of the target EPT taxa (*Sparbarus couchatta*, *Tricorythodes curvatus*, and *Phylocentropus harrisi*). Presence or absence of each target species in East Texas is revealed after completion of sample identification. Statistical analysis shows the significance of species findings in comparison to each other, their habitats, and water quality of each sample location.

22. Fishes of Texas Project Update, and Thoughts About Where to Go Now

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Keywords: Fishes of Texas Project

The Fishes of Texas Project (www.fishesoftexas.org), a collaborative UT Austin Fish Collection – Texas Parks and Wildlife Inland Fisheries project, started compiling and cleaning specimen-based fish occurrence records for Texas freshwaters in 2006. Recent updates expand the project’s geographic scope to the complete extent of all of Texas’ major river basins (so now also parts of Louisiana, Arkansas, Oklahoma, Colorado, New Mexico, Chihuahua, Coahuila, Nuevo León & Tamaulipas). We’ve also added coastal marine records. This new version (Track 3) has 895,591 records from 134,087 localities from which 3,602 species were collected between 1850 and 2017. These totals now include non-specimen-based occurrences from new sources including citizen science websites, angler observations, literature, molecular data, researcher, federal & state agency databases. A massive effort has been devoted to quality control, particularly vetting formerly questionable species determinations (by examining specimens), as well as addressing earlier georeferencing and date errors (focusing on pre-1930 records), etc. “Suspect”

records and estimates of native ranges were re-determined. All occurrences can be explored and summarized in the online mapping system in the context of political and Hydrographic units (NHDPlus and Mexican equivalent). Species checklists for political and hydrographic units have been improved and data summaries have been expanded via new, more comprehensive and dynamic data dashboards, and many new images have been added. We are excited to enter a new chapter in the evolution of the project via collaboration with a newly formed private non-profit team of IT professionals collaborating with us to further improve the website and data, and help us make it easier to convert the project into a more community-based product with increased help from the still-growing community of data generators and users.

23. High-Resolution Species Distribution Modeling of Texas Crayfish Species

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Keywords: crayfish, East Texas

Crayfish are an understudied group; however, they play important roles in their ecosystems. This study will focus on field collections of East Texas crayfish, followed by species distribution modeling to create a map showing how the landscape varies in its suitability for a particular species. The objective is to identify key riparian areas in East and Central Texas for crayfish species, and to compare the habitat requirements of the species to one another to understand their ecological differences and potential competitive interactions.

24. Texas Aquatic Bioblitz Initiative: 10 Years of Gap Sampling to Inform Native Fish Conservation Efforts in Texas

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Keywords: Aquatic Bioblitz Initiative, Native Fish Conservation Areas, Fishes of Texas Project, Biodiversity Center University of Texas Austin

The Texas Aquatic Bioblitz Initiative has worked over the past ten years to fill critical data gaps in the state's fish distribution dataset with a focus on Texas Native Fish Conservation Areas (NFCAs). The Texas NFCAs Network includes 20 priority watersheds identified as strongholds for the preservation of Species of Greatest Conservation Need (SGCN) and overall freshwater fish diversity throughout the state. An analysis of data gaps using the Fishes of Texas Project helped determine locations for bioassessments and supplemental fish sampling in select NFCAs. Since 2012, 14 watersheds/basins spanning 13 NFCAs have been sampled to support this effort. Fish assemblage data have been collected at 388 locations which have documented over 96,000 individuals consisting of 165 species. Specimens are cataloged into the Ichthyology Collection (TNHCi) of the Biodiversity Center at the University of Texas-Austin, and their data immediately published to the publicly accessible Global Biodiversity Information Facility. Later, the same data are also integrated into the public Fishes of Texas Project online database/website. These data have been used to support management plans and interpretive programs at state-owned properties; to document range expansions and reductions of fishes, new records of rarely collected species and a new addition to the state's freshwater fish checklist; and to help refine SGCN and State Threatened and Endangered species lists in Texas. Additionally, data from these efforts have supported multiple conservation efforts including the development of instream flow needs in northeast Texas, Guadalupe

Bass restoration in Central Texas, and an updated status assessment of prairie minnows in North Texas. This project has been extended through 2024 with plans to conduct three more bioassessment and gap sampling events to fill additional data gaps in remaining NFCAs in Texas.

25. Phylogenetic Analysis of Four Closely Related Species of Crayfish in Central Texas

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Keywords: White River crayfish, *Procambarus acutus*, *Procambarus texanus*, *Procambarus nueces*, *Procambarus fayettei*

The White River Crayfish, *Procambarus acutus*, is fairly widespread within the United States, and has now spread to other countries across the oceans. Here in Texas the White River Crayfish has speciated into *P. texanus*, *P. nueces*, and *P. fayettei* which are frequently confused with *P. acutus* as the morphological differences are extremely minor. While these three species were derived from the speciation of *P. acutus*, some still consider all three to be subspecies of *P. acutus*. When planning for future studies land use, understanding species distribution is vital. To do so, a species must be defined as such. As some are still unclear as to whether these three crayfish species should be considered species within their own right or simply subspecies of the *P. acutus* crayfish, a phylogeny would aid in such distinctions. In creating these phylogenies and running the necessary data analyses, the hope is that a more definitive answer to the true speciation of these organisms can be found. If these species are in fact considered separate species entirely, the conservation of their habitats would be, potentially, more of a priority, as their ranges are very small. Overall, the taxonomic resolution and phylogenetic analysis of these species are important because productive conservation requires an accurate record of species and their habitats.

26. Assessment of Headwater Catfish (*Ictalurus lupus*) Genetics in Texas & New Mexico

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Keywords: Headwater Catfish, Gila River, Beaver Creek, Balmorhea State Park

Putative Headwater Catfish (*Ictalurus lupus*) were collected from drainages in Texas and New Mexico and sequenced at the Cytochrome b gene (Cyt b) to determine taxonomic status. Populations were also assessed for hybridization with Channel Catfish. Catfish samples collected from the Gila River and Beaver Creek in New Mexico produced two haplotypes among all samples - one associated with Headwater Catfish and one associated with Channel Catfish. Assessment of the Balmorhea State Park population in Texas revealed 20% of samples were hybrids of Headwater Catfish and Channel Catfish and all hybrids took the form of potential F1s. Population assessment will also be presented for other Texas populations.

27. Assessing the Feeding Habits of an Imperiled Prairie River Fish Assemblage

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Keywords: Red River, Plains Minnow, Prairie Chub, Red River Shiner, Red River Pupfish, prairie rivers, stable isotope analysis, food habits

Anthropogenic disturbances have degraded prairie river habitats throughout the Southern Great Plains. The Red River is emblematic of an altered prairie system, impacted by flow manipulation, habitat fragmentation, climate change, invasive species incursions, and decreased habitat heterogeneity. Decreased habitat heterogeneity is associated with declining abundance of four prairie fish species native or endemic to the upper Red River, including Plains Minnow (*Hybognathus placitus*), Prairie Chub (*Macrhybopsis australis*), Red River Shiner (*Notropis bairdi*), and Red River Pupfish (*Cyprinodon rubrofluviatilis*). Consequently, each species is listed as Species of Greatest Conservation Need (SGCN) by the Texas Parks and Wildlife Department (TPWD) and the Oklahoma Department of Wildlife Conservation (ODWC). The effects of anthropogenic disturbance on prairie fish movement ecology and reproductive ecology are well documented. However, there is little information describing the effects of habitat degradation on the feeding habits of Red River SGCN fishes. Habitat degradation may alter food resource inputs, homogenize instream and riparian food resources, simplify food web complexity, and increase competition between and among species. We propose to characterize spatial-temporal variation in the feeding habits of Plains Minnow, Prairie Chub, Red River Shiner, and Red River Pupfish, and evaluate the relative contribution of aquatic (autochthonous) and riparian (allochthonous) food resources in prairie fish diets. We will use stable isotope analyses (SIA) of (13C:12C, or $\delta^{13}\text{C}$) to trace food resources to either autochthonous or allochthonous origin. Specific diet composition will be assessed through diet analyses and will supplement SIA. Nitrogen stable isotopes (15N:14N, or $\delta^{15}\text{N}$) will be used to estimate the trophic positions of SGCN fishes in aquatic food webs. New information about the feeding habits of Red River SGCN fishes will supplement current understanding of prairie fish life histories. Results may inform and help prioritize habitat restoration efforts to assist with conservation of Red River fishes.

28. Monitoring Comanche Springs Pupfish, Pecos Gambusia, and Leon Springs Pupfish Populations in West Texas

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Ryan Smith, The Nature Conservancy

Keywords: Comanche Springs Pupfish, Pecos Gambusia, Leon Springs Pupfish

Initial genetic assessments and population monitoring has been conducted for several endangered species in several locations including Comanche Springs Pupfish, Pecos Gambusia, and Leon Springs Pupfish.

29. Determining the Viability of Reconstructed Wetlands

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Keywords: wetlands, reconstructed; Benthic Community Index, fish assemblage

This project will evaluate fish and macroinvertebrate assemblages and their relationships with constructed wetlands and natural wetlands. There will be five natural wetland sites sampled to create a baseline for wetland structure and function, and an additional thirty-five reconstructed wetland sites will be sampled to determine their structure and function. The objective of this project is to create a national-scale ecological monitoring and assessment framework for wetland structure and function with hopes that these analyses can be performed for future projects assessing wetland structure and function. Macroinvertebrate community sampling and analysis will closely follow the Benthic Community Index (Butcher et al., 2003). Fish community sampling and analysis will be largely associated with a traditional fish IBI. Although fish are not typically key indicators for wetlands, their communities will be sampled as a complement to the macroinvertebrate communities collected. Canonical correspondence analysis (CCA) and variance partitioning will be used to relate fish and macroinvertebrate assemblages to environmental variables such as water and soil chemistry, hydrology, general vegetation cover and types, algae/periphyton biomass, and bird and amphibian communities.

30. Using Eel Ramps and eDNA to Detect Recruitment of American Eel (*Anguilla rostrata*) in Texas

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Keywords: American Eel, eDNA,

The American Eel (*Anguilla rostrata*) is a facultative catadromous fish. Data are lacking related to juvenile (glass eel and elver) recruitment into the bays and estuaries of the Gulf of Mexico. The goal of the study is to document glass and elver American Eel to understand their recruitment timing and distribution in Texas. The study implements year-round monitoring using eel ramps, and environmental DNA (eDNA) to increase the likelihood of detecting even highly sporadic recruitment events. Twelve eel ramp sites were identified based on connectivity to coastal estuarine waters, in proximity to an impediment to upstream movement, and ability to support a gravity fed eel ramp. Ramps were deployed in June-July 2022 and are being checked weekly for American Eel and bycatch for one year. A subset of eight ramp sites are also being monitored for eDNA during each ramp check. After 22 weeks of continuous sampling, our ramps have captured 354 bycatch fishes representing 16 species from 10 families. To date, one elver American Eel was captured prior to ramp installation and two glass eels have been captured using the eel ramps. These findings suggest that eel ramps are a suitable method for capturing juvenile American Eel and have provided the first documentation of glass American Eels in Texas. A positive detection of American Eel DNA has been confirmed in 38 of the 210 eDNA samples collected to date. We predict the highest probability of American Eel detection will be in late-winter and early-spring. This project will continue through the end of June, 2023. Data collected from this study can be used to assist natural resource agencies to determine the conservation and management needs of American Eel in Texas.

31. Sexual Dimorphism of Tuberculation Patterns in *Macrhybopsis* Chubs

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Keywords: *Macrhybopsis*, Shoal Chub, tubercles

The genus *Macrhybopsis* contains 12 species of benthic, barbeled cyprinids that are distributed throughout central and eastern North America (including Canada, Mexico and the US). In a recent published study, we documented a novel tubercle type (unculiferous tubercle) on the surface of the head, body, and fins of the Shoal Chub, *Macrhybopsis hyostoma*. Unculiferous tubercles are roughly ovoid aggregations of keratinized epidermal cells, each with a keratinized projection (unculus) at the surface. Unculiferous tubercles are present in juveniles of at least 18 mm SL and are present also in adults of both sexes. In addition to unculiferous tubercles, male shoal chubs also possess typical conical (“nuptial”) tubercles on the dorsal surface of the pectoral fin in association with the anterior rays. Based on this information, we hypothesized a non-reproductive (potentially hydro-dynamic) function for unculiferous tubercles and predicted that they would be present also in other members of the genus. Using a combination of scanning electron and light microscopy, we examined specimens of each species of *Macrhybopsis* to better understand the distribution of unculiferous tubercles within the genus and assess levels of variation in this character within and between species.

32. Seasonal Stream Surveys to Address Project Impacts—Is One-and-Done Enough?

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Keywords: Angelina River basin, Neches River basin, Sabine River basin,

Single-effort fish surveys can provide fundamental information to assess biological integrity and biodiversity parameters at a particular site and time. However, freshwater fish assessments for non-resource projects on public lands typically rely on a one-time spot survey to quantify overall species occurrence. The Texas register of Species of Special Concern (SGCN) lists at least 14 fish species of conservation concern as well as 6 Threatened (T) species within Texas most diverse fisheries ecoregion, the Western Gulf Coastal Plain (WGCP). Major rivers within the WGCP include the Angelina, Neches and Sabine basins. In this work, we examined existing stream-fish datasets from these three river basins to make inferences as to whether one-time sampling methods were sufficient determinants of fish incidence, when annual samples encompassing four seasons appeared to show variance in species occurrence. Through analysis of historic (1990-2002) and contemporary (2017-2021) fish data, we sought to parse out and explain seasonal gaps in species occurrence and changes in temporal diversity among the river systems. These results could be beneficial to surveyors seeking compliance with laws and policies that require proposed sensitive projects on public lands to be scoped to assess their potential impacts on federal/state listed and indicator species in terms of occurrence, distribution range, and overall diversity.

33. Anatomical Survey of the Olfactory Apparatus in the Walking Catfishes (Siluriformes: Clariidae)

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Keywords: Clariidae, walking catfish, *Gymnallabes typus*, olfactory apparatus

The Family Clariidae is a diverse group of facultative airbreathing catfishes (Siluriformes) distributed throughout Africa and Asia, as well as introduced into the southeastern US. Members of this group are often referred to as walking catfishes due to the ability of some species to travel short distances across land. Clariid catfishes exhibit remarkable variation in body shape and length, and exhibit a range of ecological strategies, ranging from stout-bodied “generalist” species to highly elongate, eel-like “specialist” species that inhabit shallow water and make nocturnal excursions onto land to hunt terrestrial prey. Despite this ecological diversity, information on the sensory organs of clariids is limited and available only for a small number of generalist species. To provide new information on clariid sensory organ anatomy, we surveyed the olfactory apparatus of thirty-nine clariid catfishes representing eight genera (including both stout-bodied generalists and elongate specialists). Using a combination of light and scanning microscopy techniques, we document the gross anatomy of the olfactory apparatus, including the olfactory rosette and the accessory chamber, and for the first time document micro-surface structure and cellular composition of the olfactory lamellae. Our preliminary results suggest that eel-like clariids possess fewer lamellae than their stout-bodied relatives. In addition, *Gymnallabes typus* exhibits a potentially unique configuration of the olfactory rosette for Clariidae, involving elongation of lamellae located at the posterolateral region of the rosette which extend laterally into the opening of the adjacent accessory chamber. The basic information that we have collected on the olfactory organs of walking catfishes should provide a foundation for future studies on the sensory ecology of the Clariidae.

34. Examination of Feeding Ecology of Non-Native Naked Goby (*Gobiosoma bosc*) in the Concho River Using Gut Contents Analysis

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Keywords: Naked Goby, Concho River, food habits

The Naked Goby, *Gobiosoma bosc*, is an estuarine species that has become established in inland freshwaters in Texas, namely in the Colorado River basin and San Antonio River basin. While *G. bosc* has been studied throughout its native distribution, very little is known about the ecology of the species in invaded habitats. We examined the resource use of the Concho River *G. bosc* population across seasons using gut content analysis. The gut content analysis revealed Diptera, Ostracoda, and aquatic insects making up over 80 percent of the total gut content volume. The impact that Naked Gobies might have on native species is not known, but it is possible that the non-native species may occupy a niche similar to that of other small-bodied benthic fishes in the Concho River, such as Logperch (*Percina carbonaria* and *Percina macrolepida*).

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