Gear Comparison Study for Sampling Nekton in Barataria Basin Marshes

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Technical Report Administrative Summary

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June 2020

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Table of Contents

Executive Summary

This project was funded by the Louisiana Trustee Implementation Group (LA TIG) to support decisions related to investments in long-term monitoring. The LA TIG seeks to ensure long-term monitoring informs coastal restoration activities with the goal of sustaining and improving fisheries impacted by the Deepwater Horizon (DWH) Oil Spill. The project objective was to compare nekton catch across an estuarine gradient using different sampling gear with the goal of identifying trade-offs among nekton sampling approaches. To accomplish this objective, Louisiana Department of Wildlife and Fisheries (LDWF), The Water Institute of the Gulf (the Institute), Dynamic Solutions, LLC, Louisiana State University Agricultural Center (LSU AgCenter), and the U.S. Geological Survey (USGS) completed a field gear comparison study from 2018 to 2019. This work compared electrofisher and seine sampling at 12 fixed stations in Barataria Basin using data collected by LDWF. In addition, and in conjunction with LDWF monthly sampling, the same 12 fixed stations were sampled in May 2019 using a throw trap to compare nekton catch and assemblages collected with the throw trap, seine and electrofisher. LDWF has been conducting seine sampling since 1986, and seine data are used by the State of Louisiana to assess juvenile shrimp, crab and fish abundances, sizes and overall assemblages. In 2018, LDWF began conducting electrofisher sampling at 12 Barataria Basin seine stations in order to determine if the two gear types sample similar species and assemblages for potential future replacement of long-term seine sampling with electrofishing. Throw traps were included as they provide density estimates, which are ultimately the desired statistic used in modeling trophic webs, and are used in assessing habitat restoration outcomes.

The project compared the nekton catch and assemblages collected using seine, electrofisher, and throw trap data from marsh edge habitats located across the estuarine gradient in Barataria Basin. Specifically, catch per unit effort (CPUE), species richness, species-specific total length (mm) distribution and nekton assemblages were compared between gear types. The first dataset was collected in May 2019 with throw trap (Appendix A), seine (LDWF data), and electrofisher (LDWF data) gear, and the second dataset (collected by LDWF) spanned 14 months of seine and electrofisher monthly sampling occurring from May 2018 through June 2019 at 12 stations in Barataria Basin.

Key findings include that gear bias was not evident across the range of water quality conditions (salinity, temperature, ºC, dissolved oxygen, mg L^{-1}, turbidity, NTU; Appendix B: scatter plots) captured during this pilot study, but differences in nekton catch per unit effort (CPUE) and assemblages were evident between gear types. However, those differences largely depended on the parameter examined. For example, the overall CPUE was highest for electrofishing, followed by seine, and then throw trap. When grass shrimp (the most abundant taxon collected) were removed from CPUE, the electrofisher and seine results were similar in CPUE. When CPUE was corrected for gear efficiency and total area sampled, the throw trap had the highest reported density of nekton sampled, followed by electrofisher and seine results. Electrofishing captured the highest number of species, which included more unique species compared to seine or throw trap catches, though all gear types captured at least one unique species. These highlight a need for caution in interpreting assemblage and density data when comparing datasets derived from different sampling methodologies.

These key findings can help inform implementation and interpretation of long-term monitoring data in Louisiana as management decisions are made about coastal restoration projects to sustain and improve fisheries. There are trade-offs in selecting gear types for estuarine nekton monitoring of density, abundance, species richness, and assemblages. The table below (Table 1) summarizes some considerations when selecting gear types for long-term monitoring of estuarine nekton. In addition to biological and ecological considerations, other important considerations include cost, the labor required to conduct sampling, logistics, and potential uncertainties related to how effective each gear type is for sampling the wide variety of conditions found across Louisiana's coastal habitats. For example, although electrofishing may capture higher CPUE, the equipment is more expensive to obtain and maintain compared to the other gear types. Most importantly, this table highlights differences in the nekton assemblages sampled by each gear type; this consideration is critical when designing the goals of a long-term monitoring program as it will inform how the data can be used and interpreted in the future.

This report provides caveats, assumptions, and recommendations that can help support the Louisiana Coastal Protection and Restoration Authority (CPRA), LDWF and the LA TIG in comparing data from different gear types, and in making decisions for future monitoring. Findings from this study are limited to the range of water quality conditions occurring during these data collection events; these data and analyses could benefit from sampling across a wider range of water quality conditions, and collection of habitat structure and bottom type data which are not routinely collected but critically influence nekton. Further investigation examining how relative differences detected in key species abundances between gear types might impact ecosystem indicators and energetics in a modeled food web would provide valuable input to understand outputs of the Comprehensive Aquatic System Model for Barataria Basin, including the potential impacts of nekton monitoring decisions on food web models.

Table 1. *Review of trade-offs of gear types for estuarine monitoring of density, abundance, biomass, and species richness of nekton assemblages. For a complete list of common and scientific names, see* Appendix C.

	Electrofisher	Seine	Throw trap
Catch and Species Specificity	• Most unique species • Highest CPUE • Dominant catch: Shrimp (grass, brown, white) and larger fish (redfish, bluegill, striped mullet)	• Unique species • Dominant catch: • Small-bodied fish (bay anchovy, Gulf menhaden)	• Unique species • Few large-bodied species • Provides density estimates
Trade-offs	• Equipment costs (including boats): > $100,000 and difficult to replace	• Equipment costs: < $1,000	• Equipment costs: < $1,000
	• Field gear use time: 90 sec per replicate	• Field gear use time: ~30 min per replicate	• Field gear use time: ~30 min per replicate
	• Ease of use: high once technicians are trained	• Ease of use: medium with training and physical demand	• Ease of use: low because of physical demands to throw the trap
	• No. field personnel: 3	• No. field personnel: 2	• No. field personnel: 3
	• Unclear how range of salinity, water depth or structure may impact effectiveness and species specificity	• Substrate type impacts effectiveness	• Substrate type & structure impacts effectiveness
Other Considerations	• Grass shrimp dominated CPUE; with grass shrimp removed, CPUE of electrofisher = seine • Need to better understand influence of fish size, water chemistry, electrode design, voltage, current, and pulse width and shape on sampling effectiveness • Need to assess potential operator bias or variable effectiveness with changing water quality (i.e., turbidity) • Need to evaluate if species specificity or bias with changing water quality (i.e., salinity, water depth, turbidity) occurs	• Large area covered; when CPUE converted to area the densities are low	• When corrected for area sampled, high densities • Requires in-water personnel; weather more a factor • Sampling restricted to < 1 m water depth • Requires high replication to obtain representative samples

Figures

Tables

1.0 Background

Multiple trade-offs exist for coastal managers in selecting appropriate gear for monitoring of nekton, particularly for use in determination of estuarine habitat quality and assessment of fisheries health. Complicating the selection and effectiveness of gear is the variation in estuarine bottom types, structured habitat (e.g., submerged or emergent aquatic vegetation, oyster reef), and environmental conditions, including their variation over time. For example, conditions for sampling along marsh edge habitats of an estuary can differ over space and time in terms of multiple variables including water depth, substrate, and salinity. This remains particularly true across coastal Louisiana where conditions are changing rapidly. For coast-wide sampling of nekton, selection of sampling gear to enable comparison through time and space with varying environmental and habitat conditions requires carefully weighing trade-offs in gear efficiency, logistics and cost. Ensuring that monitoring programs build off historic data but also adopt new technologies consistent with historic sampling is of primary importance to successful long-term coast-wide monitoring of key species and nekton assemblages within the estuaries.

Selection of gear for use in management and restoration activities responds to the goals or objectives of the identified data collection program (Rozas and Minello 1997). Short-term (< 5 years) nekton sampling programs have been conducted to investigate baseline or existing estuarine habitat quality (La Peyre and Gordon 2012; MacKenzie and Bruland 2012) or conducted in response to restoration activities (Neckles et al. 2002; Roman et al. 2002; Humphries and La Peyre 2015). These types of sampling programs more easily identify the most effective gear types for sampling as coastal conditions are more predictable at small spatial and temporal scales, and projects often have very explicit goals. Selection of gear for use in management and restoration activities responds to the goals or objectives of the identified data collection program (Rozas and Minello 1997). In contrast, long-term (>5 years) studies or monitoring programs are less common and may be impacted by decisions to change gear types, sample locations and monitoring intensity, as well as by more variation and extreme ranges of environmental conditions. For example, in Florida, fisheries independent monitoring of nekton within an estuary has been ongoing for many years in order to provide reference conditions which enable assessments on the effects of storms and altered salinity regimes on fisheries resources (Switzer et al. 2006). Similarly, in Texas, an 11-year study was conducted using data from a long-term monitoring program that assessed the effects of wetland loss and restoration activities on nekton assemblages (Rozas et al. 2007). Research efforts in Tampa Bay, Florida have relied upon fisheries-independent monitoring for over 10 years to assess long-term nekton trends; Flaherty and Landsberg (2011) address how differences in specific gear types are essential to consider when sampling various habitat types, water depths, and targeted nekton assemblages in that area. Specifically, bag seines were used to target juvenile fish and small-bodied nekton across shallow water habitat types, otter trawls were used in deep riverine habitats, and a larger seine was used to sample larger-bodied nekton in bays, based on their different effectiveness within these different habitats (Flaherty and Landsberg 2011). Many of these studies ultimately recommend that coastal managers clearly define the sampling goal or question prior to determining what gear type is used to monitor a given community or habitat (Raposa and Roman 2001).

The coast-wide fisheries-independent monitoring (FIM) conducted by the Louisiana Department of Wildlife and Fisheries (LDWF) has targeted specific fish and invertebrate species and life stages for more than 30 years (LDWF 2018). These focal species were targeted because of their historical abundance and importance to fisheries production in this region. The LDWF FIM program consists of bottom trawls, seines, gill nets and trammel nets. The bottom trawl monitoring consists of three different types of trawls (2 m, 4.8 m , and 6.1 m) which are used to sample deeper water for data on relative abundance and size distribution of adult penaeid shrimps, blue crab, and groundfish species; these data are used in the development of stock assessments and management recommendations (LDWF 2018). The bag seines sample juvenile life stages of shrimps, crabs, and finfish to monitor relative abundance, size distribution, and overall assemblages. The gill and trammel nets are used for collecting data on relative abundance, size distribution, and ancillary life history information for specific adult finfish species and for stock assessments (LDWF 2018).

More recently, the state of Louisiana Coastal Protection and Restoration Authority (CPRA) has supported the monitoring design (The Water Institute of the Gulf 2019; Steyer et al. 2006) and implementation (Raynie et al. 2020) of the System-Wide Assessment and Monitoring Program (SWAMP) for coastal Louisiana that uses existing monitoring programs including the fisheries-independent monitoring of LDWF to implement a long-term, comprehensive monitoring program to support development, implementation, and adaptive management of the State's coastal restoration and protection program. LDWF FIM data, collected since 1986, have been used for examining species, food webs and ecosystem responses to past and proposed management actions. These data are also routinely used by the State of Louisiana to evaluate long-term nekton trends in relation to salinity gradients, hurricanes and freshwater diversion operations, as well as to assess recovery from impacts of human disasters (Sable and Villarrubia 2011a; Sable and Villarrubia 2011b; Dynamic Solutions 2016; Hijuelos et al. 2017; Lewis et al. 2017; CPRA 2019). In addition, the LA TIG will be able to use these data to help assess long-term recovery of fish populations impacted by the DWH Oil Spill.

The LDWF FIM seine data have been used for fitting statistical-based habitat suitability indices (HSI) for targeted species that rely on marsh edge and shallow shoreline habitats (Hijuelos et al. 2017). The seine data have also been used to estimate biomasses (in grams per square meter) for an Ecopath with Ecosim (and then Ecospace) model (de Mutsert et al. 2012; Lewis et al. 2016) and used in the Comprehensive Aquatic Systems Model (CASM) to assess restoration and protection projects by the State of Louisiana (Dynamic Solutions 2016). The food web models were initialized and calibrated for juvenile shrimps, blue crab, and fishes using the observed biomass data estimated from the seine dataset, and the median sizes of juvenile taxa captured by the seines were used to parameterize juvenile consumption, growth and mortality for each species of interest. Overall, the long-term FIM seine data collected from these monitoring programs help inform decision-making by enabling long-term trend analysis including species-habitat relationships; these data are also used to initialize, parameterize, and calibrate models used to assess proposed restoration and management actions (de Mutsert et al. 2012; Dynamic Solutions 2016; Lewis et al. 2016; Hijuelos et al. 2017).

Despite 34 years of seine data, several state and federal agencies supported exploring the use of electrofishing as a potential means for sampling nekton along shallow shoreline and marsh edge habitats within Louisiana's estuaries. In response, LDWF began conducting electrofisher sampling in 2018 at a subset of the seine stations in Barataria Basin, LA with the goal of comparing nekton catch per unit effort (CPUE) and assemblages between seine and electrofisher sampling. Electrofishing was chosen in concert with the existing seine sampling because it has been shown elsewhere to be most effective in capturing greatest diversity, richness, and size distribution of nekton species, and may be logistically easier to conduct in the field. Comparative studies of data collected using electrofishing and other gear types generally support the premise that electrofishing is most effective for sampling small fish and invertebrates within shallow water habitats as measured by higher species richness, CPUE, and greater guild diversity compared to other sampling approaches (i.e., seine, fyke net, lift net, baited traps; Mueller et al. 2017). However, electrofishing requires equipment capable of sampling across conditions within the sample area (in Louisiana, and estuarine gradient), and acquiring the gear has a high up-front cost with additional costs for equipment maintenance. Furthermore, electrofishing may not be equally effective across different salinity gradients and for all species, and it has been shown to be potentially harmful to some organisms (i.e., Paukert 2004; Poos et al. 2007; Warry et al. 2013; Mueller et al. 2017; Teulier et al. 2018). In contrast, while seines can be highly effective and not affected by salinity gradients, they are generally constrained to firm, unstructured habitat (Hindell and Jenkins 2004). Enclosure samples (i.e., drop samplers, throw traps) can be highly effective in shallow habitats, but are labor intensive, sample very small areas thus requiring high replication, and are limited to water depths of less than 1-m (Connolly 1994; Rozas and Minello 1997). Throw traps, however, provide quantitative estimates of species densities and are considered to be most effective for capturing a wide breadth of small fish and invertebrate organisms in this region (Chick et al. 1992; Rozas and Minello 1997).

Although there are benefits and drawbacks to each type of gear used to sample estuarine nekton, differences between resulting nekton catch (i.e., CPUE, assemblages) remain critical to compare data collected by different methods (e.g., electrofisher to seine). Within estuarine zones, one study comparing fyke nets, seine nets and electrofishing catch found significant differences in nekton assemblages and size classes (Warry et al. 2013). Electrofishing may also disproportionately sample different fish taxa based on species-specific conductivity, thus inadvertently biasing estimates of nekton assemblages (Dolan and Miranda 2003). In addition to differences in species assemblages, results may be further influenced by environmental conditions during sampling, (e.g., water depth and salinity). Warry et al. (2013) found that electrofishing was less effective compared to nets as depth increased above 1.5 m and as salinity increased above ~15. These effects of depth and salinity suggest that an accurate comparison between gear types may require a thorough understanding of how each gear type performs across the range of conditions encountered throughout the year where this gear type is being proposed (i.e. seasonality, salinity, temperature, and water depths). Similar to the extensive testing of electrofishing within freshwater environments, examining electrofishing data within estuarine environments remains necessary to properly compare and interpret sampling efforts across estuarine conditions and between gear types (Miranda and Kratochvíl 2008; Warry et al. 2013).

Electrofisher sampling has been proposed in Louisiana as an alternative to the 15-m seine for sampling due to its potential ease of use, reduced labor cost, and increased effectiveness across the range of bottom types encountered in Louisiana estuaries. For coast-wide sampling of fish and invertebrates, selection of sampling gear to enable comparison through time and space with varying environmental and habitat conditions remains critical; ensuring that monitoring programs maintain continuity also remains important. Adopting new technologies to complement or replace historic monitoring strategies requires caution to ensure continuity and comparability of data. This report covers the pilot study requested by the LA TIG with the purpose to compare electrofisher and throw trap sample data to 15-m seine sample data within shallow water marsh edge habitats across Barataria Basin, Louisiana. This pilot study examined nekton sampled across multiple stations in Barataria Basin, Louisiana, using a snapshot (early summer) comparison of three gear types (throw trap, seine, and electrofisher), as well as a 14-month comparison between seine and electrofisher sampling conducted by LDWF across the same stations in Barataria Basin.

2.0 Methods

This study compared CPUE, species richness, and species assemblages across 12 LDWF long-term seine sampling stations within Barataria Basin, Louisiana, during (1) May 2019 sampling using three gear types ("May 2019 comparison"), and (2) monthly sampling over 14 months using two gear types ("14-month dataset").

2.1 STUDY AREA & FIELD DATA

The lower Barataria Basin is located in southeast Louisiana, south of New Orleans, Lake Salvador, and the Gulf Intracoastal Waterway. Monthly biological (nekton) and physical (water quality) data obtained from the LDWF Fisheries Independent Monitoring (FIM) Program were used to examine nekton assemblage data for twelve fixed stations in Barataria Basin (Figure 1). The seine data were collected by LDWF during their routine nekton sampling program. For comprehensive seine sampling protocols used by LDWF for nekton monitoring, see the most recent marine fisheries field manual (LDWF 2018). The technical specifications for the seines, throw trap, and electrofisher used in this study are described in Table 2. Notably, the use of the electrofisher was not part of the historic LDWF FIM sampling protocol within the marine environment and was only implemented in early 2018 within the lower Barataria Basin south of the Gulf Intracoastal Waterway.

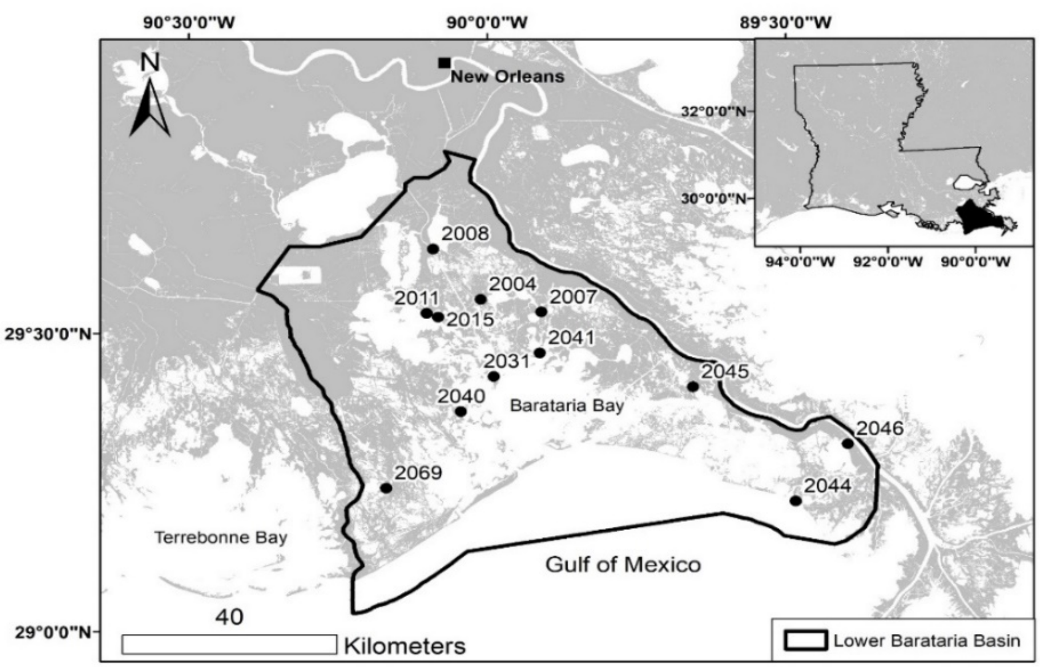

Figure 1. *Lower Barataria Basin, Louisiana outlined in black. The black dots indicate the 12 stations sampled for nekton in 2018 and 2019.*

Table 2. *Technical specifications of the gear types used for each nekton sampling method and the dates of each sampling period.*

Gear Type	Setup	Mesh Size	Dates Sampled
Electrofisher	Generator: 9.0 Generator Powered Pulsator (GPP) Electrofish System. Electrical power: 9 kW, voltage: 680 volts. Rated output max. current: 150 A, direct current	Dip net: 4 mm	Monthly May 2018 - June 2019
Seine	Knotless nylon mesh material, length 15 m, height 2 m; 2 x 2 m bag in the center of net; upper float line with buoys placed every 1 m; lower drag line with sinkers placed every 1 m	6 mm	Monthly May 2018 - June 2019
Throw Trap	1 x 1 x 0.6 m aluminum frame with vertical sides covered with knotless nylon mesh material; nylon mesh extension added to top using PVC sections joined into a square with floats attached) extended the vertical profile of the trap to a total height of 1.25 m	1.6 mm (cleared with 3 mm bar seine)	May 2019

Water quality measurements were taken in conjunction with nekton sampling using a YSI model 556 multiprobe or equivalent (Yellow Springs Instruments, Yellow Springs, OH). Salinity, water temperature (^{o} C), turbidity (NTU), and dissolved oxygen (mg L^{-1}) were measured to the nearest tenth of the appropriate unit and recorded. Physical habitat data, such as water depth and bottom substrate, are not routinely collected by LDWF.

Each electrofisher sampling event consisted of triplicate 90 second electrical pulses that followed the shoreline. A total distance track was recorded in meters using a GPS receiver for each of the three 90 second pulses. While moving along the shoreline, two individuals with 4-mm mesh dip nets collected stunned nekton and immediately placed the nekton on ice. Samples were taken to LDWF facilities for processing following LDWF protocols, outlined below (LDWF 2018).

Seine sampling was conducted as part of LDWF routine long-term monitoring and followed stated protocols (LDWF 2018) which consisted of one deployment along the shoreline at each site. For soft bottom sampling, a bridle was attached to 2 m long poles at each end of the seine net. Each bridle was connected to a line of 30 m with an anchor attached at its terminus at one end and tied to the vessel at the other. The seine net was deployed from the bow of the vessel, with a crewmember taking the haul line and anchor on shore. The vessel operator idled the vessel directly away from shore in a perpendicular manner until the 30 m haul line was deployed. The operator then turned the vessel 90 degrees and deployed the seine parallel to shore, ensuring the bag portion of the net was properly open and fishing. When the net was completely out of the vessel and parallel to the shoreline, the operator returned the vessel to shore on a perpendicular course. When on shore, each haul line was held by a crewmember, pulled in unison, and retrieved while keeping the lead line in contact with the bottom. Once both guide poles were at the shoreline, the seine was pulled ashore by grabbing the lead and float lines simultaneously and pulling the net ashore. Organisms caught within the wings of the net were shaken down towards the bag and collected. Contents were then removed, placed on ice, and taken to the LDWF facilities for processing following LDWF protocols, outlined below (LDWF 2018).

During the May 2019 sampling only, triplicate 1 m^2 throw trap samples were also collected at all stations. Throw traps were deployed within 1 meter of the marsh edge by throwing the trap from the bow of the boat. Once the throw trap was secured evenly within the substrate (with all sides flush against the bottom), water depth within the trap was determined using the average of 5 measurements (cm) taken from the middle and each corner of the trap. All nekton were collected from within the trap using a 1-m wide bar seine composed of 3-mm mesh. The trap was considered cleared when five consecutive sweeps produced no organisms. All nekton were then bagged and placed on ice for transport to the laboratory at LSU AgCenter for processing, following LDWF protocols outlined below (LDWF 2018).

All organisms collected by each sampling gear type (throw trap, seine, and electrofisher) were processed by LDWF (seine, electrofisher), or LSU AgCenter (throw trap), following LDWF protocols (LDWF 2018). Essentially, all collected individuals were identified to species, counted and total number recorded. Furthermore, following LDWF protocols (2018), up to 30 randomly selected individuals of select species were measured for total length (TL, mm) and biomass (g). Select species routinely measured by LDWF (2018) include: brown shrimp (*Farfantepenaeus aztecus*), white shrimp (*Litopenaeus setiferus*), blue crab (*Callinectes sapidus*), Gulf menhaden (*Brevoortia patronus*), Atlantic croaker (*Micropogonias undulatus*), spotted seatrout (*Cynoscion nebulosus*), sand seatrout (*Cynoscion arenarius*), red drum (*Sciaenops ocellatus*), largemouth bass (*Micropterus salmoides*), striped mullet (*Mugil cephalus*), bluegill (*Lepomis macrochirus*), and southern flounder (*Paralichthys lethostigma*). These 12 species, along with grass shrimp (*Palaemonetes spp*.,) bay anchovy (*Anchoa mitchilli*), pinfish (*Lagodon rhomboides*), bay whiff (*Citharichthys spilopterus*), naked goby (*Gobiosoma bosc*), and inland silverside (*Menidia beryllina*) are considered and referred to as “key species” for the purpose of this study, due to their economic and/or ecologic importance.

2.2 ANALYSES

Water quality data were examined to identify means and ranges of conditions during both the May 2019 sampling period as well as the 14-month sampling efforts. Total CPUE and species richness (of all species collected) were calculated for each subset of data defined by station, gear type, and sampling date. To compare nekton assemblages and CPUE across stations, samples were summed across within-station replicates. Due to differences in replication (seine hauls were conducted once, whereas triplicate samples were collected by electrofisher and throw trap), effort (CPUE) for each gear type and station was defined from the single seine sample and as the sum of the triplicate samples for electrofisher and throw trap. Unless indicated otherwise, mean ± standard error are presented throughout.

For the May 2019 dataset, CPUE and species richness were analyzed by gear type and blocked by station using generalized linear mixed models (GLMMs) with a Poisson or lognormal distribution. For the 14-month dataset analysis, CPUE and species richness were analyzed by gear type as well as season, and blocked by station, using the same GLMMs procedure. Each season is described as winter (January – March), spring (April – May), summer (June – August), and fall (October – December). For both data sets, total length distributions of species which had total length reported were compared. All analyses (unless otherwise noted) were conducted using SAS v9.2 and the proc glimmix program package (Schabenberger, n.d.).

To examine assemblages captured by the different gear types, resemblance patterns of sampled assemblages were compared among the gear types using non-metric multidimensional scaling (NMDS; Clarke 1993), an ordination technique appropriate for data with numerous zeroes. Where differences were indicated, an analysis of similarities (ANOSIM; Clarke 1993) was performed using untransformed data. An analysis of similarity of percentages (SIMPER; Clarke 1993) was also conducted to identify species most responsible for the observed patterns by gear types. ANOSIM and SIMPER analyses were conducted using R v3.5.3 and the vegan package (Oksanen et al. 2010). Additionally, the ratio of key species by each gear type was examined (i.e., electrofisher:seine, throw trap:seine). A ratio of 1 indicated that both gear types collected the same catch of key species, while ratios greater than one indicated that the electrofisher or throw trap collected more the species in question, compared to the seine.

2.3 SPECIES-ENVIRONMENT ANALYSIS

Linear regressions of CPUE and species richness by gear type and environmental variables were examined to evaluate relationships between gear type and environmental conditions.

2.4 GEAR TYPE CONVERSIONS

We examined gear type comparisons for total CPUE using a gear type conversion approach recently published in Hollweg et al. (2019). Specifically, this approach converts CPUE to a density corrected comparison by dividing the total abundance by the area sampled, and then multiplying the density by a gear type efficiency correction factor for the sampled habitat type. This approach accounts for both differences in the area sampled (estimated) and differences in the efficiency of the gear in sampling nekton within the estuarine environment. In this instance, CPUE was divided by total throw trap area sampled (3 m^2, the sum of the triplicate samples) and was used to divide the CPUE by the total area to generate a standardized number of individuals m^{-2}, and then multiplied by the reported gear-corrected efficiency factor (0.5 ± 0.0116, mean ± SE; Hollwegg et al. 2019). Similarly the seine CPUE was divided by the estimated area sampled (176.6 m^2; estimated based on the area of a half circle of 15 m radius) and multiplied by the gear correction factor provided in Hollwegg et al. (2019; 0.4 ± 0.055). No gear-corrected efficiency factor could be found for electrofisher sampling within estuarine environments, therefore a conservative value of 0.28 was used; this value is an average of several species and habitats as there are no data for gear efficiency of electrofisher for the environment we were working in (Peterson et al. 2004). We divided the linear area reported for each electrofisher run (~50 m, LDWF data), assumed a 1-m width based on ability to collect samples, and divided it by the literature value to generate the electrofisher density conversion. These conversions were applied to CPUE, although we recognize that there may be selectivity in gear types which this does not account for. These gear corrected nekton densities were then examined by gear type and season.

3.0 Results

For clarity, results of this study are separated by dataset. First, we present the results of the three gear type comparison (Section 3.1 Three gear type comparison (May 2019 dataset)) in which throw traps, seine, and electrofisher data are compared for *only* the month of May, 2019. Second, we present the results from the seine-electrofisher comparison (Section 3.2 Seine-electrofisher comparison (14-month dataset)) in which only seine and electrofisher were compared (not including any throw trap data). Catches are presented in *untransformed* CPUE unless otherwise noted in the Gear Type Conversion sections within each dataset analysis section.

3.1 THREE GEAR TYPE COMPARISON (MAY 2019 DATASET)

This section reports results only from the May 2019 dataset in which throw traps, seine, and electrofisher gear types were compared.

3.1.1 Environmental variables

Salinity ranged from a low of 0.3 to a high of 11.9 during the May sampling with all three gear types. Temperature during the May sampling varied from 25.1 ºC to a high of 30.0 ºC (Figure 2, shaded dark blue region for May 2019 sampling only). Turbidity (NTU) and dissolved oxygen (DO, mg L^{-1}) varied minimally, ranging from 0.3 to 2.0 NTU, and 5.2 to 7.8 mg L^{-1}, respectively. Water depth (cm), collected only from throw trap samples, ranged from 34.5 to 73.1 cm, likely reflecting local bathymetry at each station.

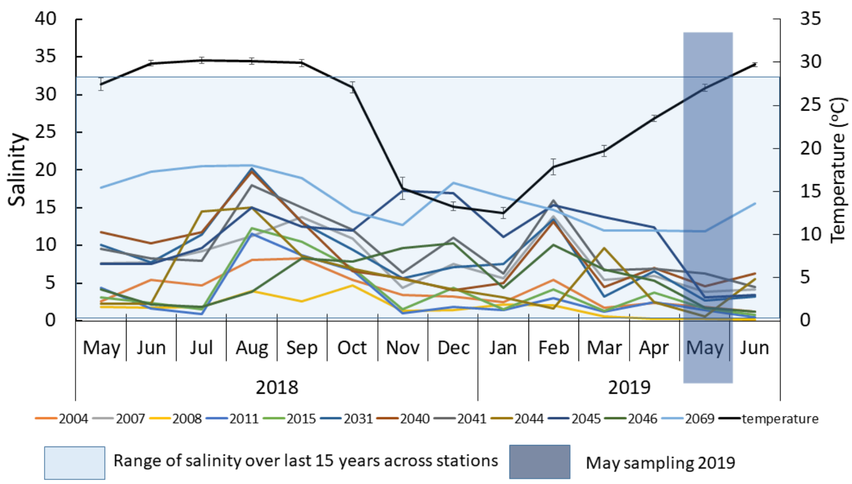

Figure 2. *Monthly salinity and temperature for Barataria Basin, Louisiana, from May 2018 to June 2019. May 2019, corresponding to nekton sampling for the three gear type comparison, is highlighted (dark blue box). Salinity is presented by individual station (individual colored lines) while temperature is presented as mean (SE) for all twelve stations (black line). The light blue shaded area represents the minimum and maximum values recorded for salinity across all 12 stations over the last 15 years.*

3.1.2 Nekton assemblages

A total of 12,750 individuals, consisting of 47 species, were collected across the 12 stations during May 2019 using the three gear types. Of the total individuals captured, the electrofisher captured the greatest number of individuals (9,592) followed by seine (2,698) and then throw trap (460). Key species accounted for 98.8% of the total catch, with grass shrimp accounting for 68.5% of the total catch. Of the remaining species, only three accounted for more than 1% of the overall catch: bay anchovy (13.1%), brown shrimp (11.8%) and Gulf menhaden (2%) (Table 3; see Appendix C for a list of common and scientific names of species referenced in this study). Overall, 13 of the 18 key species were captured during the May 2019 sampling event. As grass shrimp were a dominant part of the catch, data were examined with and without grass shrimp.

Table 3. *CPUE of key species by gear type from the May 2019 three gear comparison sampling effort. Total CPUE is all CPUE summed across the 12 sample sites. The "Total" column is the total CPUE for each species summed across gear types. The "Other" category listed under Species captures species that accounted for less than 1% of total CPUE within that gear type*. See Appendix C for *a complete list of common and scientific names of species referenced in this report.*

Species	Throw Trap	Seine	Electrofisher	Total
Grass shrimp	156	712	7870	8738
Bay anchovy	74	1315	275	1664
Brown shrimp	90	281	1136	1507
Gulf menhaden	54	192	19	265
Inland silverside	13	37	46	96
Sand seatrout	3	46	25	74
Atlantic croaker	0	50	13	63
Striped mullet	0	19	29	48
Blue crab	17	6	7	30
White shrimp	3	5	13	21
Largemouth bass	0	1	5	6
Blue gill	0	2	2	4
Spotted seatrout	0	1	2	3
Other	50	31	150	231
TOTAL CPUE	**460**	**2,698**	**9,592**	**12,750**

CPUE differed significantly by gear type, with the electrofisher samples having the highest CPUE (799.3 ± 241.0 ind m^{-2}; range: 65-4,466 ind m^{-2}) followed by seine (224.8 ± 67.8 ind m^{-2}; range: 4 - 929 ind m^{-2}), both of which were significantly higher than throw trap CPUE (38.3 ± 11.6; range: 3-119; $F_{2,33}$=13.14; p<0.0001) (Figure 3). When grass shrimp were removed, the CPUE from the seine and electrofisher were similar, with both having higher CPUE than the throw trap gear type (Figure 3; $F_{2,33}$=8.23; p=0.0013).

A comparison of species richness by gear type showed that the electrofisher method captured a total of 37 species, seine captured a total of 28 species, and throw trap captured a total of 22 species. Mean species richness differed significantly by gear type with highest richness captured by electrofisher (11.9 ± 3.9), followed by seine (6.8 ± 3.0) and then throw trap (5.8 ± 2.3; $F_{2,33}$=13.07; p<0.0001) (Figure 4). In addition, each gear type collected some unique species: electrofisher collected 10 unique species, seine collected 4 unique species, and throw trap collected 2 unique species (Table 4).

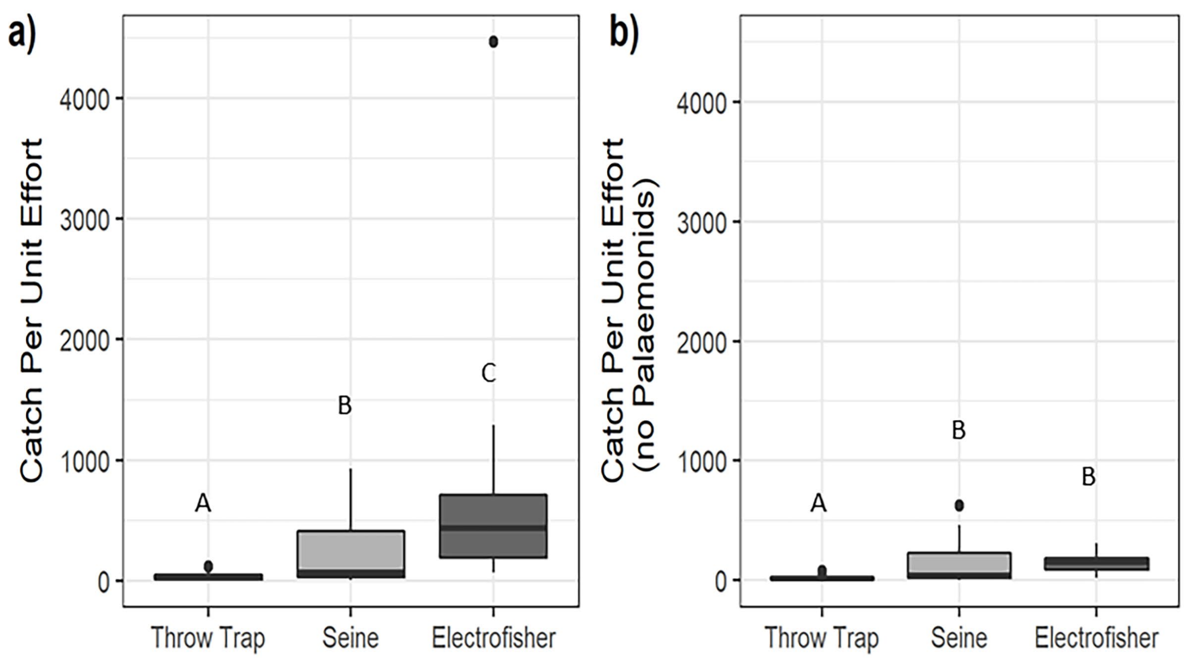

Figure 3. *Boxplots of CPUE by gear type (median, quartiles and outliers) (a) including all taxa, and (b) CPUE calculated without inclusion of* Palaemonetes spp. *for the May 2019 nekton sampling event. Different letters indicate significant differences between gear types.*

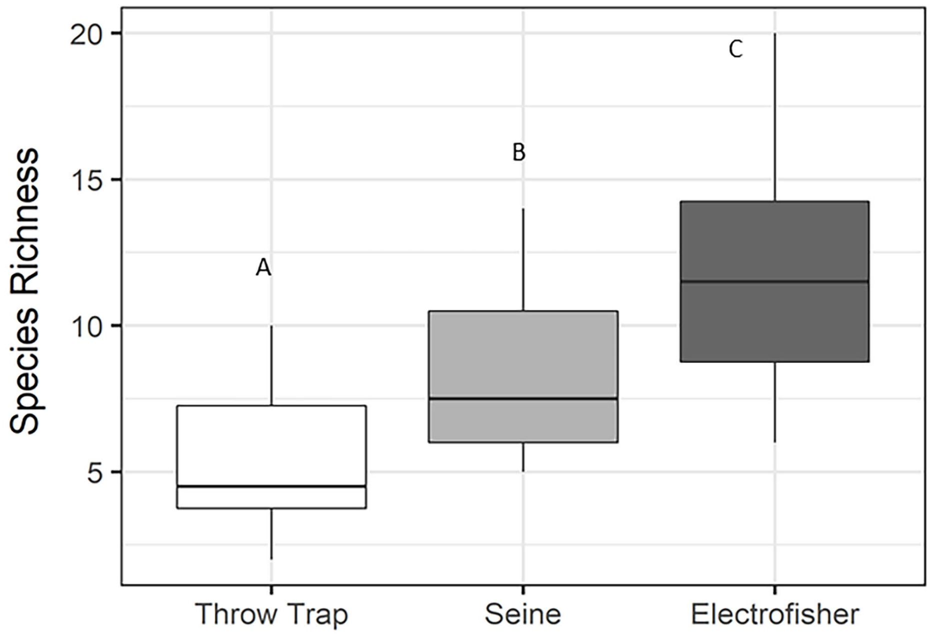

Figure 4. *Boxplot (median, quartiles, outliers) of species richness by gear type for the 12 stations sampled during the May 2019 sampling event (n=12 for each gear type). Different letters indicate significant differences between gear types.*

Table 4. *Unique species captured by each gear type during the May 2019 sampling event. See* Appendix C *for a complete list of common and scientific names of species referenced in this report.*

Throw Trap	Seine	Electrofisher
Chain pipefish	Least puffer	Atlantic needlefish
Striped anchovy	Blue catfish	Channel catfish
	Crested blenny	Clown goby
	Freshwater goby	Redspotted sunfish
		River shrimp
		Skilletfish
		Spotted gar
		American eel
		Lesser blue crab
		Southern flounder

Overall, species assemblages collected by the electrofisher was dominated by grass shrimp, which contributed to 80% of the total catch. Species assemblages from the seine data was dominated by bay anchovy (49%), while assemblages from the throw trap data was slightly more evenly distributed in terms of diversity, but still dominated by grass shrimp (34%) and brown shrimp (20%) (Figure 5). When examined after removing grass shrimp, catch composition from electrofishing was largely composed of brown shrimp (68%) and bay anchovy (17%). Catch from the seine was composed of bay anchovy (66%) and brown shrimp (14%). Nekton composition from the throw trap was composed of brown shrimp (30%), bay anchovy (25%) and Gulf menhaden (18%) (Figure 5). ANOSIM revealed only minimal groupings of samples by gear types (R=0.33; p<0.0001).

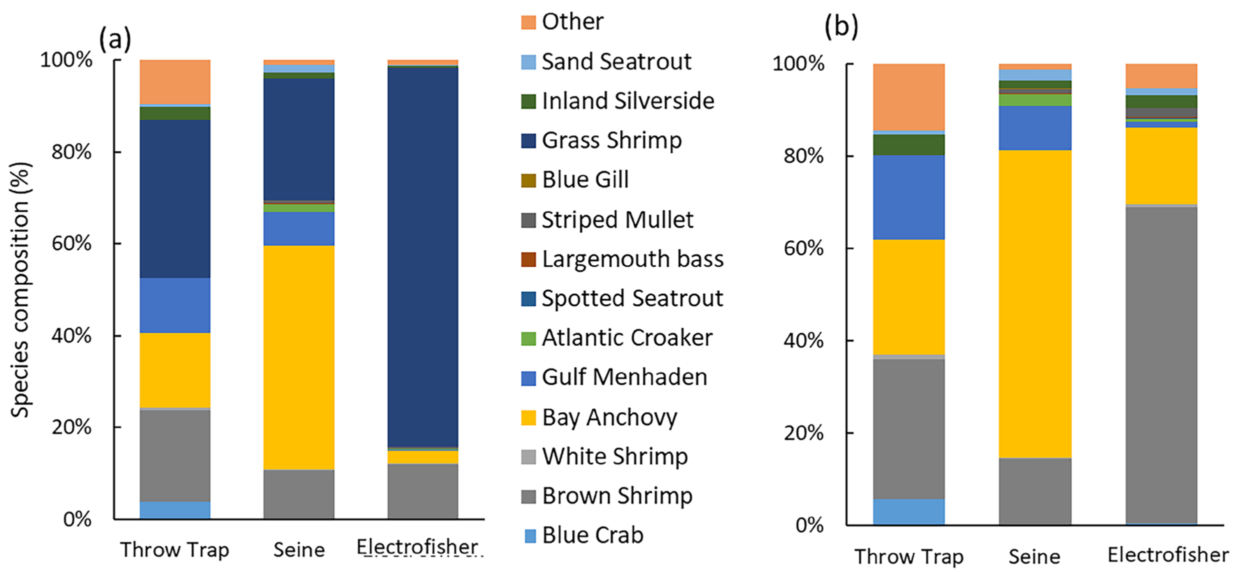

Figure 5. *Species composition (%) by gear type with (a) all species included, and (b) with grass shrimp removed. See* Appendix C *for a complete list of common and scientific names of species referenced in this report.*

Gear type comparisons using the ratio of the thirteen key species captured in throw trap compared to seine, and electrofisher to seine, indicated that electrofisher was more effective at capturing shrimp (white, brown and grass) as well as largemouth bass and spotted seatrout when compared to seines. In contrast, with the exception of blue crabs, seines were more effective at capturing all other key species as compared to throw traps (Figure 6).

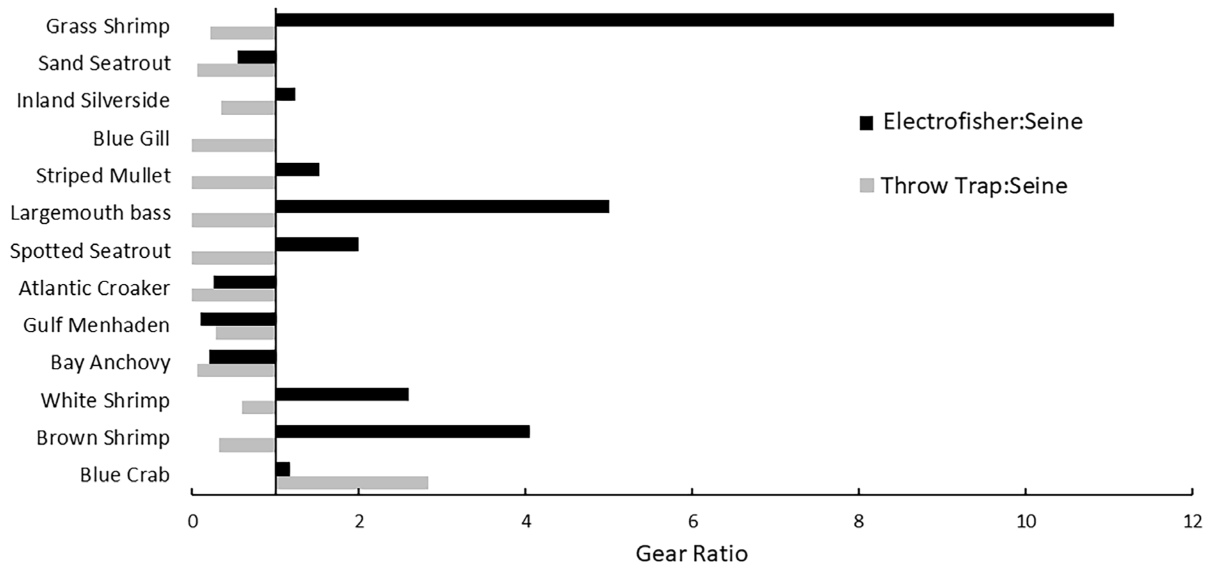

Figure 6. *Gear type ratio of throw trap:seine and electrofisher:seine for key species collected during the May 2019 sampling effort. For each species, a ratio of one indicates equal CPUE between gear types, whereas a ratio greater than one indicates that either throw trap or electrofisher sampling are more likely to collect that species compared to seine. See* Appendix C *for a complete list of common and scientific names of species referenced in this report.*

3.1.3 Species-environment relationships

Regressions of CPUE and species richness by gear type and environmental variables (salinity, temperature) showed no significant relationships (Appendix B, "Water Quality & Gear Types Slides).

3.1.4 Gear type conversion

Using gear type corrected densities (see section **2.4 Gear type conversions** in the Methods), nekton density differed significantly by gear type. The throw trap data indicate significantly greater densities of taxa (25.6 ± 7.1 individuals m^{-2}; range: 2-79.3) compared to the electrofisher data (19.0 ± 8.3 individuals m^{-2}; range: 1.6-106.3), and both support greater densities than the seine (3.2 ± 1.2 individuals m^{-2}; range: 0.1-13.2; $F_{2,33}$=159.6; p<0.001) (Figure 7a). When grass shrimp densities were omitted from the analysis, the densities of individuals sampled via seine (mean: 1.9 ± 0.7 individuals m^{-2}; range: 0.1-7.1) and electrofisher (mean: 3.4 ± 0.5 individuals m^{-2}; range: 0.5-7.4) were similar, whereas density was higher for throw trap samples (16.9 ± 4.5 individuals m^{-2}; range: 1.3-50.7; $F_{2,33}$=72.1; p<0.001) (Figure 7b).

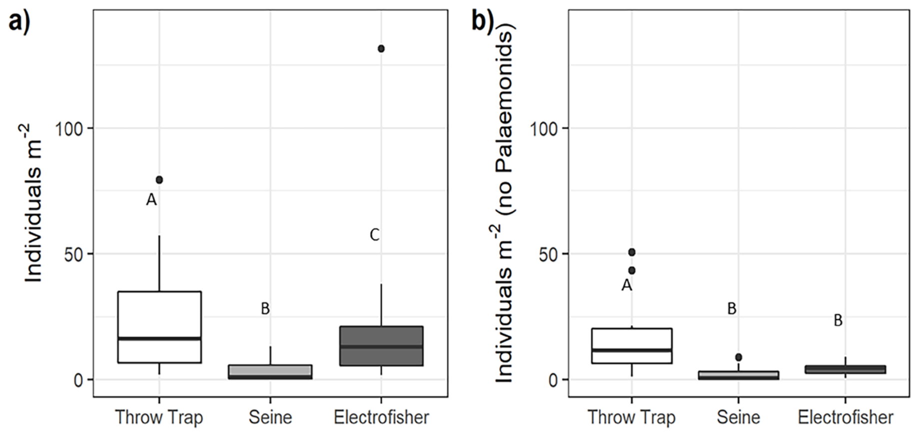

Figure 7. *Gear type corrected nekton densities presented by boxplots (median, quartiles, outliers) for (a) total nekton density, and (b) for total nekton density minus* Palaemonetes *spp. for the May 2019 dataset. Gear type correction following Hollweg et al., (2019). See* Appendix C *for a complete list of common and scientific names of species referenced in this report.*

3.2 SEINE-ELECTROFISHER COMPARISON (14-MONTH DATASET)

This section reports results *only* from the 14-month dataset in which seine and electrofisher data collected by LDWF (LDWF 2018) were compared.

3.2.1 Environmental variables

Turbidity and DO differed between gear types ($F_{1,308}$=4.54, p<0.0001; $F_{1,308}$=8.12, p=0.0047) only. Turbidity was higher with electrofisher samples (1.7 ± 0.06 NTU), compared to seine (1.3 ± 0.06 NTU). DO was higher in electrofisher samples (7.5 ± 0.2 mg L^{-1}) than seine (6.9 ± 0.2 mg L^{-1}). Salinity differed by station ($F_{11, 311}$=54.36, p<0.0001; Figure 2). Temperature followed expected seasonal patterns.

3.2.2 Nekton assemblages

A total of 108,338 individuals representing 93 different species were collected across the 12 stations over the 14-month sampling effort. Of the total individuals captured, the electrofisher CPUE was greater than seine CPUE (74,091 and 34,247 individuals, respectively). Key species accounted for 94% of the total catch, with grass shrimp accounting for 56% of the total catch. Of the remaining species, seven accounted for more than 1% of the overall catch: bay anchovy (10%), brown shrimp (7.0%), Gulf menhaden (7%), white shrimp (6%), Atlantic croaker (2%), Gulf menhaden (2%), striped mullet (1.9%), and inland silverside (1.4%) (Table 5, see Appendix C for a list of common and scientific names of species referenced in this study).

CPUE differed significantly by the single effects of gear type ($F_{1,22}$=8.88; p<0.0069) and season ($F_{3, 308}$=4011.9; p<0.0001), with no significant interaction effects. For gear type, electrofisher captured significantly higher CPUE (443.7 ± 42.8) as compared to seine (203.9 ± 28.1; $F_{1,22}$= 8.88; p=0.0069) (Figure 8). In terms of season, spring reflected higher CPUE (490.6 ± 67.2) over summer (208.9 ± 27.8), and both were significantly higher than winter (283.9 ± 39.5) and fall (291.0 ± 58.7) which did not differ significantly from one another. When grass shrimp were omitted from the analysis, seine and electrofisher CPUE did not differ significantly, but season remained a significant factor ($F_{3, 308}$=2645; p<0.0001; Figure 8). Spring CPUE (231.1 ± 36.5) was the highest, followed by fall (137.0 ± 24.0), summer (112.2 ± 12.7), and then winter (70.4 ± 9.2). Of species where size (TL) was measured, seine and electrofisher tended to capture similar size ranges, with the exception of several key species, namely, flounder, largemouth bass, and red drum (Figure 9). However, as the seine captured few of these specific species, no statistical comparison of size could be made.

Table 5. *CPUE of key species by gear type from the 14-month seine-electrofisher dataset. The "Total" column is the total CPUE for each species summed across gear types. The "Other" category listed under Species represents the sum of all species individually accounting for less than 1% of total CPUE. See* Appendix C *for a complete list of common and scientific names of species referenced in this report.*

Species	Seine	Electrofisher	Total
Grass shrimp	9242	51323	60565
Bay anchovy	9337	1659	10996
Gulf menhaden	6938	1022	7960
Brown shrimp	1549	6104	7653
White shrimp	670	6064	6734
Atlantic croaker	2027	25	2052
Striped mullet	343	1711	2054
Inland silverside	615	886	1501
Blue crab	743	148	891
Pinfish	115	357	472
Naked goby	97	108	205
Sand seatrout	148	126	274
Bay whiff	86	109	195
Redfish	9	210	219
Spotted seatrout	25	118	143
Largemouth bass	9	49	58
Southern flounder	1	41	42
Bluegill	13	28	41
Other	2280	4003	6283
Total Catch	**34,247**	**74,091**	**108,338**

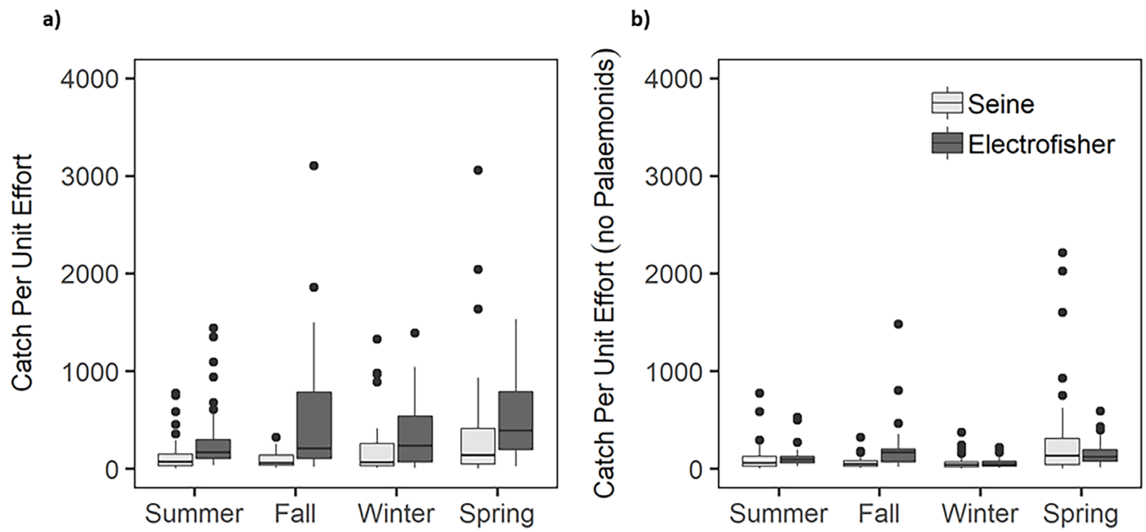

Figure 8. *Boxplot of CPUE by gear type (median, quartiles, and outliers) for the 14-month seine-electrofisher sampling effort for (a) overall CPUE and (b) overall CPUE minus* Palaemonetes *spp. See* Appendix C *for a complete list of common and scientific names of species referenced in this report.*

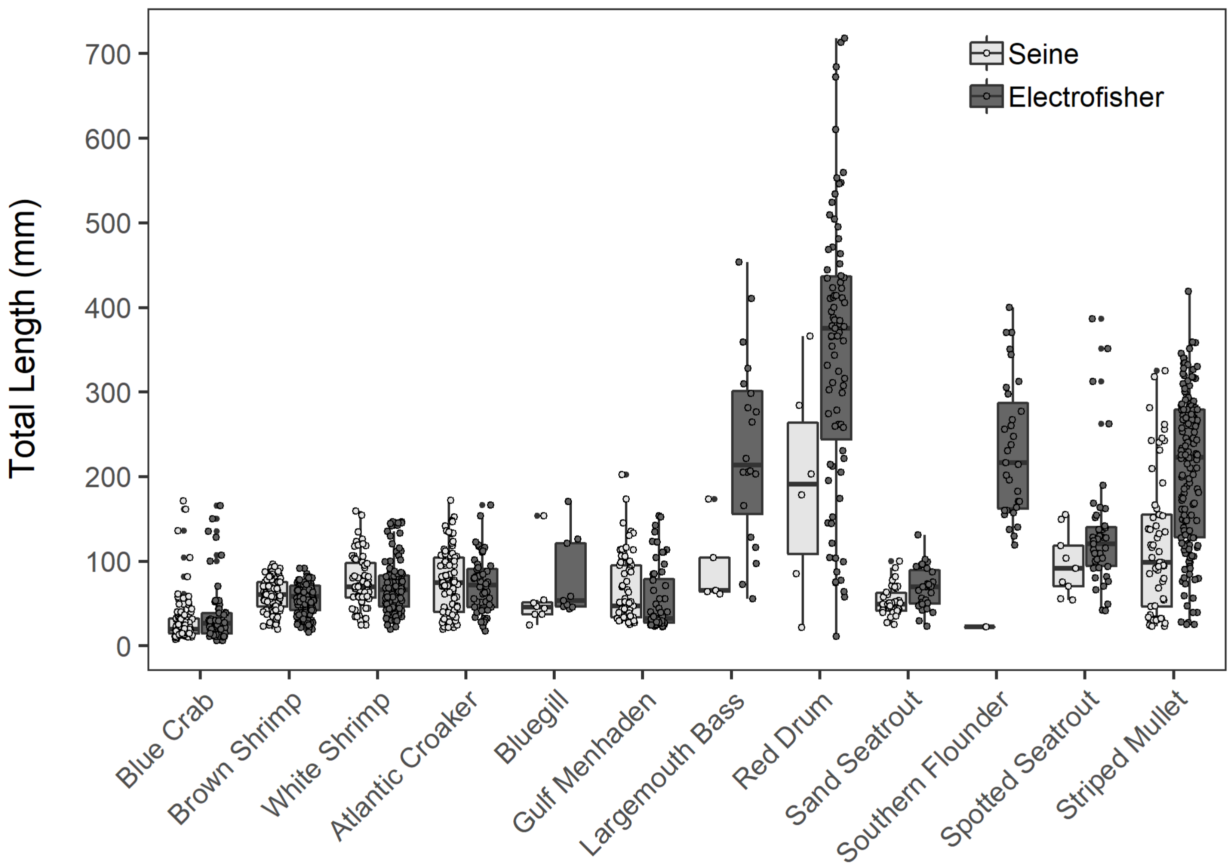

Figure 9. *Boxplots (median, quartiles, and individual data points) of total length (mm) of key species collected by seine and electrofisher during the 14-month seine-electrofisher sampling effort. See* Appendix C *for a complete list of common and scientific names of species referenced in this report.*

Of the 92 total species captured across all gear types, the electrofisher captured 83 and the seine captured 80 different species. Species richness differed significantly by the interaction of gear types by season ($F_{3,268}$=11.8; p<0.0001; Figure 10). Seine species richness was significantly greater for the electrofisher than for seines across all seasons except winter. Species richness for seines was similar across all seasons. Each gear type, however, also collected some unique species. The electrofisher captured 12 unique species and the seine collected 9 unique species (Table 6).

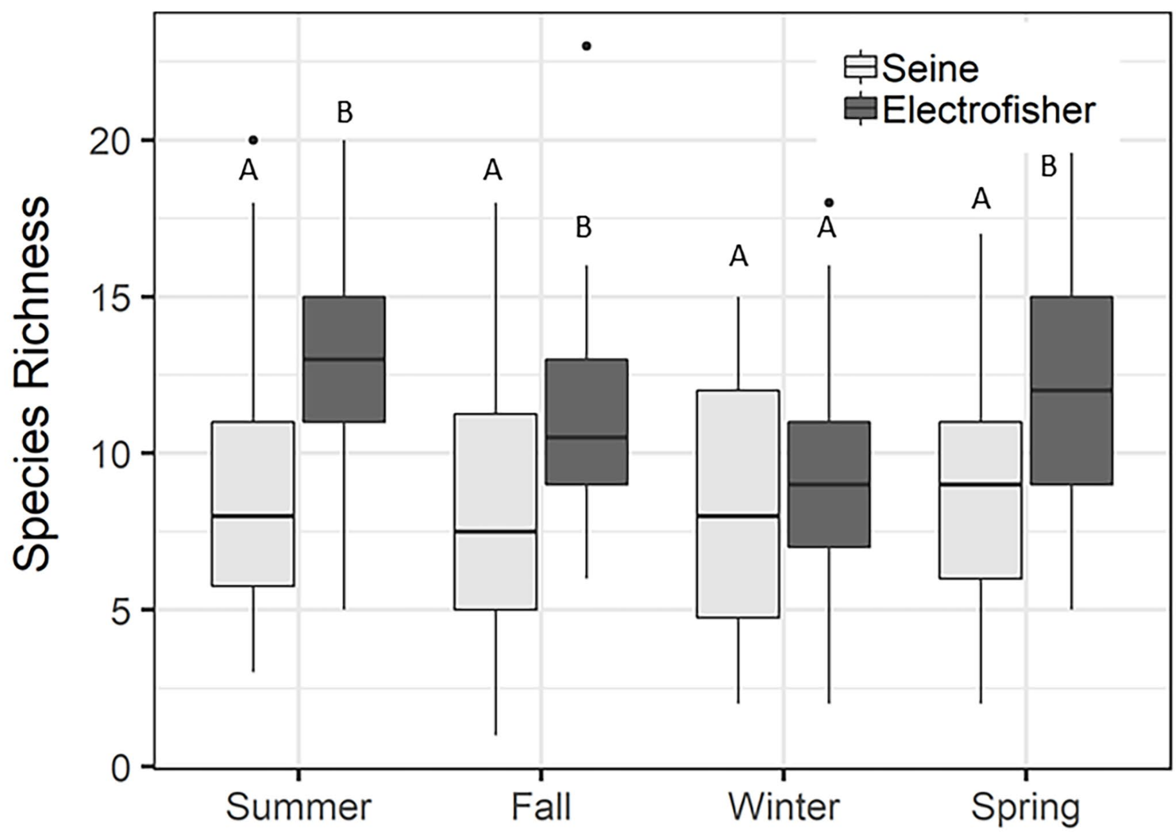

Figure 10. *Species richness by gear type and season represented with boxplots (median, quartiles, and outliers) from the 14-month sampling effort. Significant letters denote significant differences in species richness ($p<0.05$).*

While the dominant species across all samples was grass shrimp, accounting for 56% of the total catch, they composed only 27% of the total seine catch and 69% of the total electrofisher catch. The top three species sampled via electrofishing accounted for over 85% of the total catch: grass shrimp (70%), brown shrimp (9%) and white shrimp (7%) (Figure 11a). In contrast, the top three species collected using seines accounted for 74% of the total catch, and consisted of grass shrimp (26%), bay anchovy (28%) and Gulf menhaden (20%). With grass shrimp removed, total catch was 47,773 organisms, with 25,005 captured using the seine and 22,768 captured using electrofishing. For seine, bay anchovy and Gulf menhaden comprised 65% of the catch; for the electrofisher samples, brown shrimp and white shrimp comprised 53% of total catch (Figure 11b).

Table 6. *Unique species captured by gear type from the 14-month sampling effort. See* Appendix C *for a complete list of common and scientific names of species referenced in this study.*

Seine	Electrofisher
Gulf kingfish	Stone crab
Spanish sardine	Green snapping shrimp
Gulf butterfish	Feather blenny
Sargassum swimming crab	Lyre goby
Lookdown	White mullet
Pink shrimp	Spotted bass
Spanish mackerel	Gulf toadfish
Bluefish	Pistol shrimp
Bighead searobin	Speckled worm eel
Atlantic spadefish	Guaguanche
	Florida pompano
	Mosquito fish
	American eel

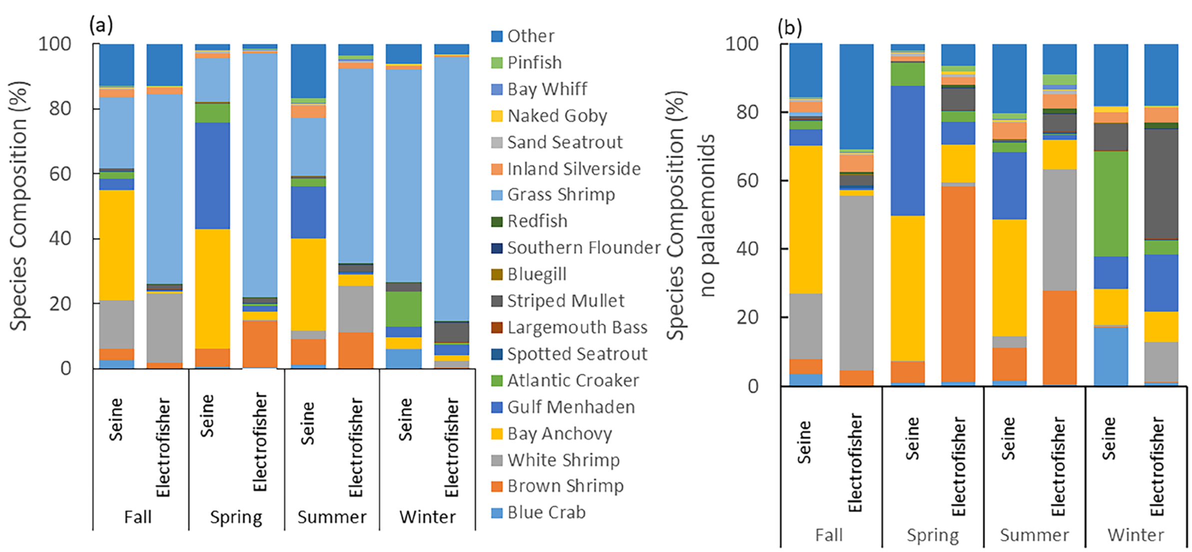

Figure 11. *Species composition (%) by gear type from the 14-month sampling effort. The panel on the left (a) shows composition of all samples and the panel on the right (b) shows the same data without grass shrimp (palaemonids). See* Appendix C *for a complete list of common and scientific names of species referenced in this report.*

Season influenced species assemblages and dominance in the 14-month dataset. NMDS ordination by season revealed groupings of samples by gear types for all seasons (stress <0.20; p<0.001; Figure 12). However, ANOSIM indicated minimal dissimilarity for all seasons (Table 7), with shrimp and small-bodied fish species contributing most to dissimilarity between gear type catches.

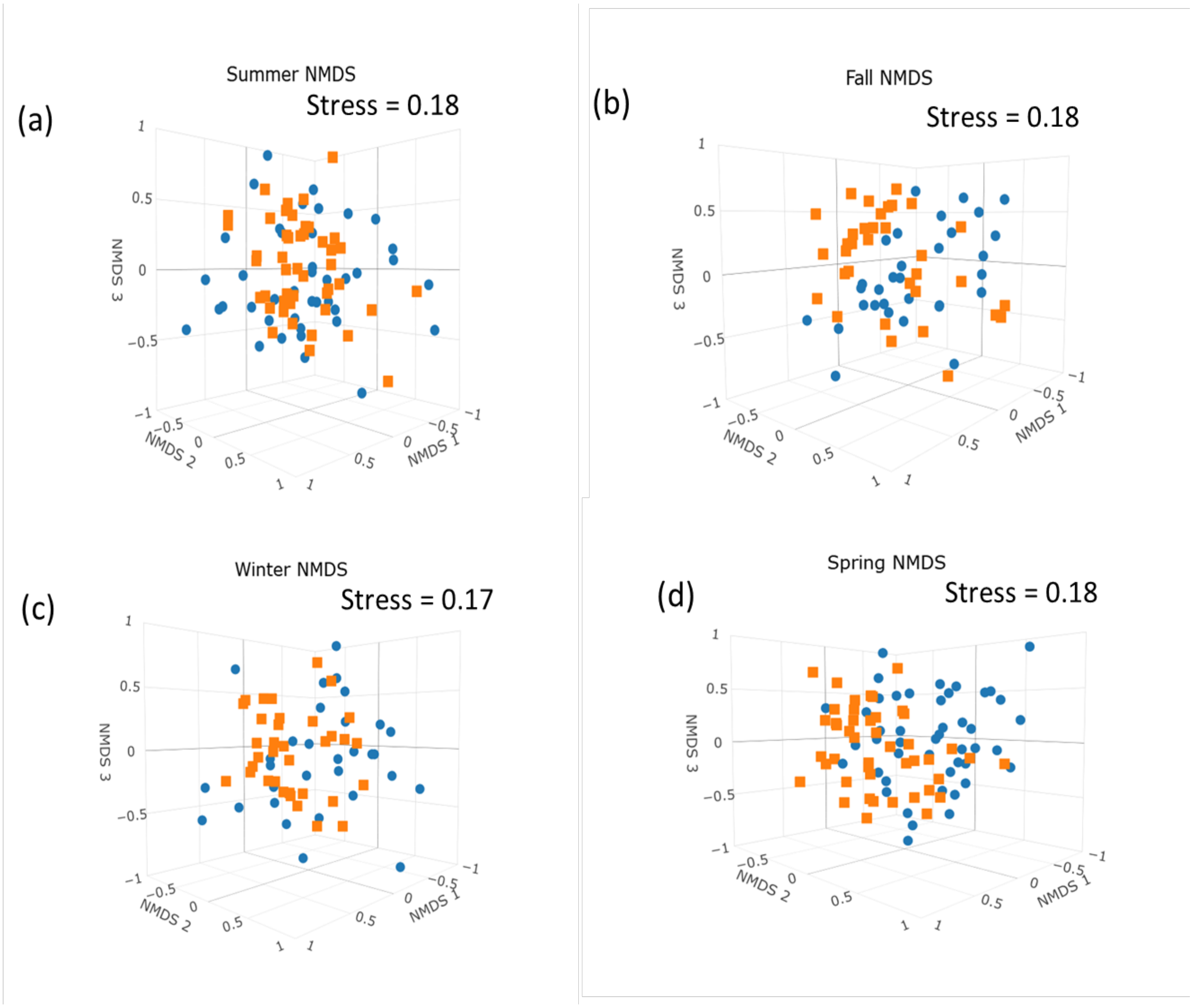

Figure 12. *NMDS Bray Curtis similarity between seine and electrofisher samples by season for the 14-month seine-electrofisher sampling effort for (a) summer, (b) fall, (c) winter, and (d) spring. Electrofishing values are denoted in orange, while seine values are in blue.*

Table 7. *Results of SIMPER analysis of the 14-month gear type comparison. For this analysis, abundance data was log-transformed by season. See* Appendix C *for a complete list of common and scientific names of species referenced in this study.*

Species	Contribution %	Cumulative %
Fall: Average dissimilarity = 30%		
Grass shrimp	12.3	12.3
White shrimp	10.6	22.9
Bay anchovy	8.1	31
Brown shrimp	6.2	37.2
Striped mullet	6.1	43.3
Winter: Average dissimilarity = 11%		
Grass shrimp	10.5	10.5
Striped mullet	8.5	19
Atlantic croaker	6.2	25.2
Bay anchovy	5.7	30.9
Blue crab	5.7	36.6
Spring: Average dissimilarity = 37%		
Grass shrimp	10.8	10.8
Brown shrimp	7.1	17.9
Bay anchovy	6.8	24.7
Gulf menhaden	6.5	31.2
Striped mullet	5.3	36.5
Summer: Average dissimilarity = 31%		
Grass shrimp	11.5	11.5
White shrimp	8.4	19.9
Brown shrimp	7.6	27.5
Bay anchovy	6.7	34.2
Striped mullet	5.1	39.3

Gear type comparisons using the ratio of taxa (electrofisher:seine) indicated that, compared to catches by the seine, electrofishing was more effective at capturing shrimp (grass shrimp, white shrimp, brown shrimp) and large fish species (red drum, spotted seatrout, largemouth bass and southern flounder; Figure 13). Seines were only slightly more effective in collecting blue crab, and small bodied fish species (bay anchovy, Gulf menhaden, Atlantic croaker).

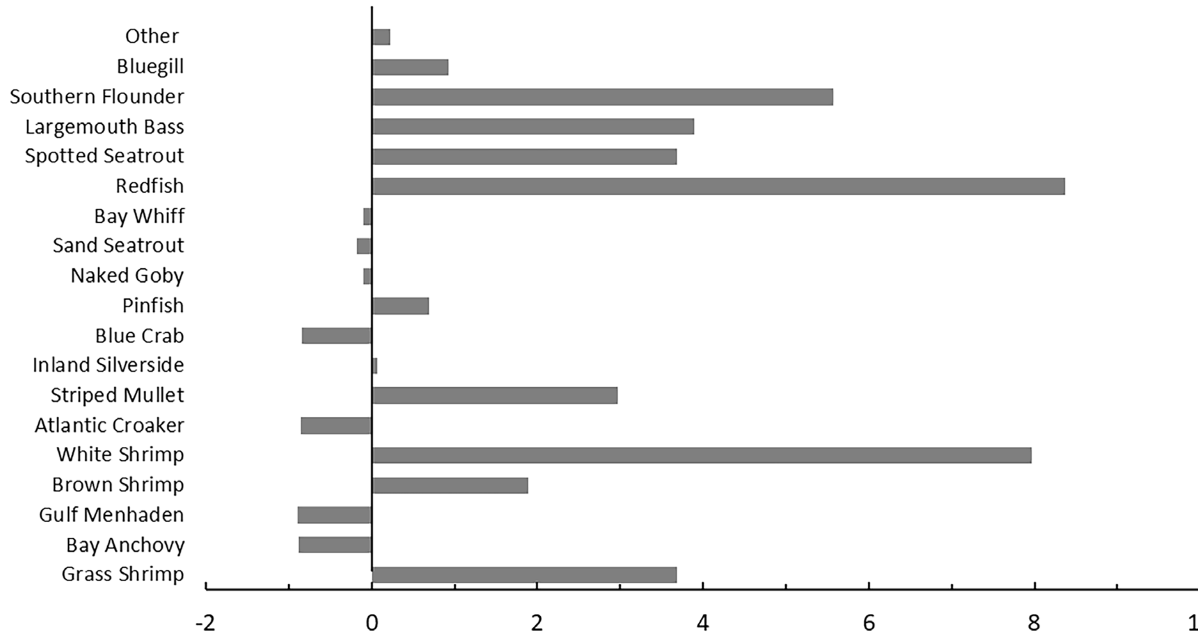

Figure 13. *Gear type ratio of electrofisher:seine for key species collected during the 14-month sampling effort. For presentation purposes, the ratio was corrected such that a ratio of zero indicates equal CPUE by gear type, whereas a ratio greater than zero indicates that the electrofisher is more likely to collect that species compared to the seine. See* Appendix C *for a complete list of common and scientific names of species referenced in this report.*

3.2.3 Species-environment relationships

Linear regressions with salinity, water depth and turbidity showed no significant relationships, regardless of gear type, between total CPUE or richness (Appendix B, "Water Quality & Gear" Slides).

3.2.4 Gear type conversion

Using gear type corrected densities (see section **2.4 Gear type conversions** in the Methods), density differed by single effects only for gear type ($F_{1,22}$=18.5; p=0.0003) and season ($F_{3, 308}$=39.7; p<0.0001; Figure 14). Specifically, electrofishing nekton density (10.0 ± 1.5 ind m^{-2}) was higher compared to seine density (2.9 ± 0.47 ind m^{-2}). For season, the densities in spring (10.0 ± 1.5 ind m^{-2}) were similar to fall (6.5 ± 1.4 ind m^{-2}), but significantly greater than winter (5.7 ± 0.8 ind m^{-2}) and summer (4.3 ± 0.6 ind m^{-2}). Densities in fall did not differ significantly from any other season. When grass shrimp densities were removed, only season was a significant driver ($F_{3, 308}$=6.4; p<0.0001; Figure 14). Densities in spring (4.0 ± 0.5 ind m^{-2}) were significantly greater than fall (2.9 ± 0.6 ind m^{-2}), which was greater than summer densities (2.1 ± 0.2 ind m^{-2}), which was greater than winter (1.3 ± 0.2 ind m^{-2}) for the conversions without grass shrimp.

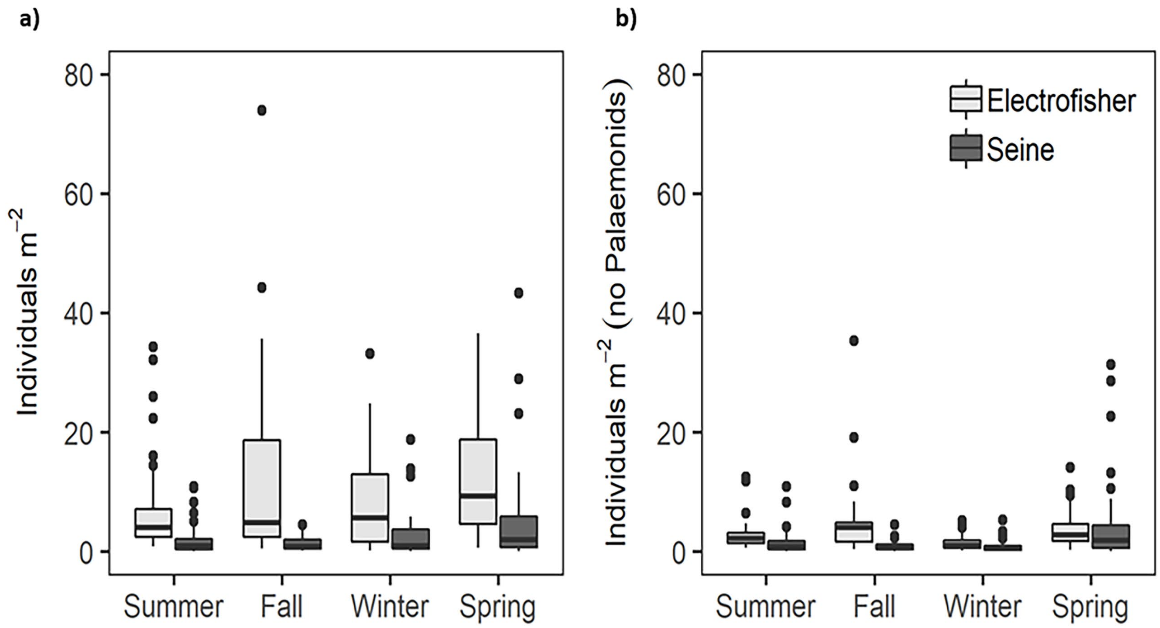

Figure 14. *Gear type corrected nekton densities represented as boxplots (median, quartiles, outliers) for (a) total nekton density (ind m^{-2}) and (b) total nekton density minus* Palaemonetes *spp* (Palaemonids). *Gear type correction following Hollweg et al. (2019) and is detailed in methods section 2.4 Gear type conversions.*

4.0 Summary

This pilot study compared two sets of nekton data: 1) a one-time sample event comparing throw trap, seine and electrofisher sampling (the May 2019 dataset), and 2) a dataset of seine and electrofisher sampling (the 14-month dataset). Data from both efforts provided similar results, summarized below in key findings, and indicated trade-offs to balance when considering gear types for estuarine nekton monitoring (Table 8).

Key Finding 1: Across the range of water quality conditions sampled, no gear type bias was evident. Only salinity and temperature differed across the stations and sample dates. Temperature differences reflected seasonal differences which often related to species life histories and use of the estuary. Salinity measured during this sampling period was on the lower end of salinities when compared to a 15-year time frame for these stations, preventing a full test of electrofishing efficiency in higher salinity waters. High freshwater inflow and precipitation in 2018 and 2019 resulted in lower than average salinities at many stations. Within this limited range, linear regressions of total and individual species CPUE against environmental variables demonstrated no evidence of gear type bias or variations in efficiencies resulting from different salinities or temperature was evident. This fits with past work indicating that electrofishing remains effective at salinities reaching to a salinity of 15 (Warry et al. 2013).

Key Finding 2: Lack of physical habitat data in long-term sampling programs limits our ability to evaluate impacts of bottom type, structure, or water depth. Water depth has been shown to impact electrofishing effectiveness (Warry et al. 2013). However, water depth is not routinely collected in long-term FIM sampling. When sampling was conducted in May 2019, water depth data collected while sampling via throw traps indicated that most stations were shallower than 1-m in water depth, below the 1.5 m threshold identified by Warry et al. (2013) for effective electrofishing. Bottom substrate type, a factor that may also influence the effectiveness or efficiency of all three gear types used, is also not routinely collected as part of long-term sampling protocols. Measuring physical characteristics of bottom habitat type remains an essential component in understanding species assemblages, however this information is not collected during routine monitoring. With extensive and rapidly changing estuaries, the State of Louisiana would be challenged to maintain accurate bottom habitat type maps.

Key Finding 3: Differences in measures of CPUE, abundance, and density existed between gear types and were dependent on the statistic examined:

> ***a. Greatest overall CPUE was collected using the electrofisher method, followed by seine, and then throw trap.*** Mean CPUE was highest using electrofishing, based on the station effort used by LDWF (2018) of one seine, and three 90 second electrofisher samples.

b. When CPUE was corrected for grass shrimp, CPUE for the electrofisher and seine gear types were similar. Grass shrimp represented over 65% (May 2019 dataset) and 55% (14-month dataset) of the total catch, but ~ 70% of electrofisher samples. When grass shrimp were removed from analyses, electrofisher and seine samples captured similar densities. In contrast, throw trap samples consisted of only ~30% grass shrimp.
c. When CPUE was corrected for gear type efficiency and area covered, nekton density was highest for throw trap, followed by electrofisher and seine catch. Using estimated gear efficiencies from the literature, the highest density of organisms (corrected) was captured by the throw trap gear type compared to electrofisher and seines. Gear efficiencies are gear- and habitat-specific, however, and were only estimated from best available data which was highly limited for electrofishing in estuarine environments. Furthermore, efficiencies for seine and throw trap were not calibrated at the species-specific level and specific efficiencies for electrofishing were not available within an estuarine setting.

Key Finding 4: Electrofisher samples captured higher species richness and more unique species compared to seine or throw trap samples, although all gear types captured at least one unique species. The highest mean species richness, and number of unique species was captured using electrofishing. Unique species captured included taxa often associated with structured habitats, such as the feather blenny, speckled worm eel, and stone crab, indicating that the electrofisher gear type may be more effective than other gear types at capturing cryptic species along and within structured habitats such as marsh edge.

Key Finding 5: Distinct differences in species assemblages were found with each gear type capturing different species and different proportions of species. Species assemblages differed significantly between gear types. Electrofisher samples were dominated by shrimp (grass, white, brown) species, and larger fish. Seine samples captured more small-bodied fish (i.e., bay anchovy, gulf menhaden). Throw trap catches were less weighted towards any one species and did not include larger individuals. Some of these differences are likely due to gear capture efficiency as larger fish likely outrun seines and throw traps, while smaller fish may be more difficult to spot and net when electrofishing.

Key Finding 6: The comparison of CPUE, the use of ratios, and gear type conversions provide insight into gear type comparisons but highlight a need for caution in interpreting assemblage and density data when changing gear types. Results of CPUE comparisons between gear types differed depending on the actual statistic or measure used. Due to species-specific gear type biases, and potential (but unmeasured) physical habitat impacts on gear type effectiveness, developing gear type conversion factors could require both species and habitat-specific measures.

These key findings can help inform implementation of long-term monitoring in Louisiana and across coastal areas of the northern Gulf of Mexico as management decisions are made about coastal restoration projects to help sustain and improve fisheries. There are trade-offs in selecting gear types for basin-wide estuarine nekton monitoring in terms of overall catch and species assemblages. Table 1 summarizes the trade-offs of each gear type evaluated in this study as well as other considerations when selecting gear types for long-term monitoring of estuarine nekton. Aside from biological and ecological considerations, each gear type listed in the table also has important trade-offs related to cost, necessary labor to conduct the sampling, logistical considerations, and potential uncertainties related to how effective each gear type is for sampling the wide variety of conditions found in Louisiana's coastal habitats (see Appendix B for CPUE-salinity response curves). For example, although the nekton data collected using electrofishing methods may reflect higher CPUE, the equipment is more expensive to obtain and maintain compared to the other gear types. Throw traps provide density estimates of nekton which are often used in modeling, but high sample replication is necessary to account for the small areas sampled, catch is biased towards small bodied species, and are not effective in highly structured bottoms. Seines poorly sample structured habitats. When comparing different gear types, caution must be used in interpreting or relating nekton assemblages due to these inherent biases; this consideration is critical when designing the goals of a long-term monitoring program as it will inform how the data can be used and interpreted in the future.

Along with gear related biases, ensuring collection of critical drivers of nekton assemblages would provide for robust long-term monitoring programs. In particular, physical habitat structure of shallow water estuarine environments often impacts nekton use. For example, within these shallow-water estuarine areas, water depth, tidal cycle and bottom substrate can influence the effectiveness of the gear type; accounting for variability in these parameters helps explain variability in catch both within and between different gear types. Furthermore, if the intent is to use these data to inform Habitat Suitability Indices (HSIs) and food web models (CASM and EwE), then understanding how the differences in nekton assemblages and abundances by gear type might influence model development and output remains important. Comparisons of different gear types across the range of environmental conditions that are commonly observed within this region, and over a longer period of time (e.g., more than one month) would be invaluable to ensure results from this pilot study are more broadly transferable.

Despite these limitations, the findings from this report provide useful insight that can support decisions regarding long-term monitoring in this region, particularly for the LA TIG's goal of sustaining and improving fisheries across Louisiana estuaries. In general, these gear comparisons indicate that monitoring outcomes of estuarine nekton species can be highly gear dependent, and the most appropriate gear to use for sampling nekton may depend largely on the specific question or assessments identified by LA TIG to support their goals and budgets. For example, the LA TIG may decide to focus on a subset of nekton species (as representative of fisheries in general) to assess recovery from human activities such as oil spills or restoration projects. Selection of these species (i.e., indicator species) may depend on their economic or ecologic importance to the region and using the ratios by gear type might help inform decision-makers in selecting a more targeted sampling gear type. Alternatively, further understanding as to how the differences in species assemblages collected by these gear types may drive food-web models (CASM, EwE) or HSI's, would be invaluable in understanding and interpreting the outputs of these models, and in extrapolating the findings to other systems. For example, how does a 70% versus a 30% grass shrimp catch composition (collected by electrofisher and seine, respectively) ultimately impact these food web models, including growth of higher trophic level species? Similarly, if the LA TIG is interested in how restoration projects which alter substrate and structure impact estuarine fisheries, investment in collection of bottom habitat type and structure data alongside nekton sampling remains necessary. This report, the key findings, and Table 1 will hopefully aid the LA TIG in moving forward in regards to their decisions and investments in long-term monitoring.

Acknowledgements

We thank Nicholas Coxe for significant help in sampling the throw trap and working up the throw trap samples. We also thank Chris Schieble (LDWF) for his input in sample design, logistics for sampling, and discussions related to this project and the data. Danielle Aguilar Marshall provided help with data management and figures. Alyssa Dausman (The Water Institute of the Gulf) provided comments on drafts of this report. Sarai Piazza (U.S. Geological Survey) and David Lindquist (CPRA) provided comments which helped improve this report. This project was supported by the Louisiana Coastal Protection and Restoration Authority (CPRA, contract CPRA-2019-TO65-SB01-MB) with funding from the Louisiana Trustee Implementation Group (LA TIG). We appreciate the insight about the use and application of nekton sampling gear types for long-term monitoring as well as comments on earlier drafts of this report from various organizations including: CPRA, Louisiana Department of Wildlife and Fisheries, U.S. Department of the Interior, U.S. Environmental Protection Agency, National Oceanic and Atmospheric Administration, U.S. Fish and Wildlife Service, U.S. Department of Agriculture, and National Fish and Wildlife Foundation. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. Government. This study was performed under the auspices of Louisiana State University Agricultural Center IACUC protocol # A2018-07. Photos of the marsh and blue crabs on the front cover were taken by The Water Institute of the Gulf and used with permission.

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Appendices

APPENDIX A

Nekton data collected by the throw trap in May 2019. Associated seine and electrofisher data are available from LDWF through their fishery independent monitoring program. STATION refers to the station sampled. REP is the sample number within 3 replications. TIME is the time samples were deployed, and DATE is the sample DATE. TAXA refers to the LDWF code for specific species. Scientific name refers to the species nomenclature. T_NUM is the total number of species caught within each sample. Num_Meas refers to the number of each specific species measured. LEN_MEAS mm refers to the total length or carapace width of species measured. WT_MEAS refers to the amount of individuals of a species that was weighed, while T_WT refers to the weight measured for species grouped within each sample.

STATION	REP	TIME	DATE	TAXA	Scientific_Name	T_NUM	Num_Meas	LEN_MEAS mm	WT_MEAS	T_WT
2004	2	923	20190514	2019	*Citharichthys spilopterus*	1	0	.	.	1.39
2004	1	906	20190514	2003	*Callinectes sapidus*	9	9	8	.	83.75
2004	1	906	20190514	2003	*Callinectes sapidus*	.	.	15	.	83.75
2004	1	906	20190514	2003	*Callinectes sapidus*	.	.	16	.	83.75
2004	1	906	20190514	2003	*Callinectes sapidus*	.	.	20	.	83.75
2004	1	906	20190514	2003	*Callinectes sapidus*	.	.	23	.	83.75
2004	1	906	20190514	2003	*Callinectes sapidus*	.	.	23	.	83.75
2004	1	906	20190514	2003	*Callinectes sapidus*	.	.	28	.	83.75
2004	1	906	20190514	2003	*Callinectes sapidus*	.	.	32	.	83.75
2004	1	906	20190514	2003	*Callinectes sapidus*	.	.	107	.	83.75
2004	2	923	20190514	2003	*Callinectes sapidus*	1	1	23	.	0.9
2004	3	935	20190514	2003	*Callinectes sapidus*	3	3	14	.	1.5
2004	3	935	20190514	2003	*Callinectes sapidus*	.	.	19	.	1.5
2004	3	935	20190514	2003	*Callinectes sapidus*	.	.	20	.	1.5
2004	1	906	20190514	2001	*Farfantepenaeus aztecus*	14	14	25	.	9.1
2004	1	906	20190514	2001	*Farfantepenaeus aztecus*	.	.	25	.	9.1
2004	1	906	20190514	2001	*Farfantepenaeus aztecus*	.	.	26	.	9.1
2004	1	906	20190514	2001	*Farfantepenaeus aztecus*	.	.	27	.	9.1
2004	1	906	20190514	2001	*Farfantepenaeus aztecus*	.	.	28	.	9.1
2004	1	906	20190514	2001	*Farfantepenaeus aztecus*	.	.	30	.	9.1
2004	1	906	20190514	2001	*Farfantepenaeus aztecus*	.	.	33	.	9.1
2004	1	906	20190514	2001	*Farfantepenaeus aztecus*	.	.	35	.	9.1
2004	1	906	20190514	2001	*Farfantepenaeus aztecus*	.	.	36	.	9.1
2004	1	906	20190514	2001	*Farfantepenaeus aztecus*	.	.	37	.	9.1
2004	1	906	20190514	2001	*Farfantepenaeus aztecus*	.	.	41	.	9.1

STATION	REP	TIME	DATE	TAXA	Scientific_Name	T_NUM	Num_Meas	LEN_MEAS mm	WT_MEAS	T_WT
2004	1	906	20190514	2001	*Farfantepenaeus aztecus*	.	.	50	.	9.1
2004	1	906	20190514	2001	*Farfantepenaeus aztecus*	.	.	77	.	9.1
2004	1	906	20190514	2001	*Farfantepenaeus aztecus*	.	.	82	.	9.1
2004	2	923	20190514	2001	*Farfantepenaeus aztecus*	5	5	30	.	10.6
2004	2	923	20190514	2001	*Farfantepenaeus aztecus*	.	.	35	.	10.6
2004	2	923	20190514	2001	*Farfantepenaeus aztecus*	.	.	53	.	10.6
2004	2	923	20190514	2001	*Farfantepenaeus aztecus*	.	.	85	.	10.6
2004	2	923	20190514	2001	*Farfantepenaeus aztecus*	.	.	94	.	10.6
2004	3	935	20190514	2001	*Farfantepenaeus aztecus*	5	5	30	.	4.4
2004	3	935	20190514	2001	*Farfantepenaeus aztecus*	.	.	32	.	4.4
2004	3	935	20190514	2001	*Farfantepenaeus aztecus*	.	.	35	.	4.4
2004	3	935	20190514	2001	*Farfantepenaeus aztecus*	.	.	66	.	4.4
2004	3	935	20190514	2001	*Farfantepenaeus aztecus*	.	.	67	.	4.4
2004	1	906	20190514	2126	*Syngnathus louisianae*	2	0	.	.	0.42
2004	3	935	20190514	2126	*Syngnathus louisianae*	2	0	.	.	0.7
2004	1	906	20190514	2392	*Palaemonetes* spp.	30	30	21	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	22	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	23	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	24	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	25	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	25	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	27	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	28	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	28	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	28	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	29	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	32	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	33	.	.

STATION	REP	TIME	DATE	TAXA	Scientific_Name	T_NUM	Num_Meas	LEN_MEAS mm	WT_MEAS	T_WT
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	33	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	34	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	35	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	36	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	37	.	.
2004	1	906	20190514	2392	*Palaemonetes* spp.	.	.	41	.	.
2004	2	923	20190514	2392	*Palaemonetes* spp.	10	10	27	.	.
2004	2	923	20190514	2392	*Palaemonetes* spp.	.	.	28	.	.
2004	2	923	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2004	2	923	20190514	2392	*Palaemonetes* spp.	.	.	33	.	.
2004	2	923	20190514	2392	*Palaemonetes* spp.	.	.	35	.	.
2004	2	923	20190514	2392	*Palaemonetes* spp.	.	.	35	.	.
2004	2	923	20190514	2392	*Palaemonetes* spp.	.	.	35	.	.
2004	2	923	20190514	2392	*Palaemonetes* spp.	.	.	36	.	.
2004	2	923	20190514	2392	*Palaemonetes* spp.	.	.	36	.	.
2004	2	923	20190514	2392	*Palaemonetes* spp.	.	.	42	.	.
2004	3	935	20190514	2392	*Palaemonetes* spp.	14	14	27	.	.
2004	3	935	20190514	2392	*Palaemonetes* spp.	.	.	27	.	.
2004	3	935	20190514	2392	*Palaemonetes* spp.	.	.	28	.	.
2004	3	935	20190514	2392	*Palaemonetes* spp.	.	.	28	.	.
2004	3	935	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2004	3	935	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2004	3	935	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2004	3	935	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2004	3	935	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2004	3	935	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2004	3	935	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2004	3	935	20190514	2392	*Palaemonetes* spp.	.	.	35	.	.
2004	3	935	20190514	2392	*Palaemonetes* spp.	.	.	36	.	.
2004	3	935	20190514	2392	*Palaemonetes* spp.	.	.	40	.	.
2004	2	923	20190514	2007	*Brevoortia patronus*	2	2	25	.	0.15
2004	2	923	20190514	2007	*Brevoortia patronus*	.	.	25	.	0.15
2004	1	906	20190514	2062	*Lagodon rhomboides*	1	1	48	.	1.68
2004	1	906	20190514	2009	*Cynoscion arenarius*	1	1	41	.	0.42
2004	1	906	20190514	2061	*Archosargus probatocephalus*	1	1	20	0.11	0.11
2004	1	906	20190514	2425	Xanthidae	8	8	5	.	.
2004	1	906	20190514	2425	Xanthidae	.	.	6	.	.
2004	1	906	20190514	2425	Xanthidae	.	.	7	.	.
2004	1	906	20190514	2425	Xanthidae	.	.	11	.	.
2004	1	906	20190514	2425	Xanthidae	.	.	12	.	.
2004	1	906	20190514	2425	Xanthidae	.	.	15	.	.
2004	1	906	20190514	2425	Xanthidae	.	.	16	.	.
2004	1	906	20190514	2425	Xanthidae	.	.	18	.	.
2004	2	923	20190514	2425	Xanthidae	7	7	6	.	.
2004	2	923	20190514	2425	Xanthidae	.	.	8	.	.
2004	2	923	20190514	2425	Xanthidae	.	.	10	.	.
2004	2	923	20190514	2425	Xanthidae	.	.	13	.	.
2004	2	923	20190514	2425	Xanthidae	.	.	15	.	.
2004	2	923	20190514	2425	Xanthidae	.	.	15	.	.
2004	2	923	20190514	2425	Xanthidae	.	.	20	.	.
2004	3	935	20190514	2425	Xanthidae	3	3	8	.	.

STATION	REP	TIME	DATE	TAXA	Scientific_Name	T_NUM	Num_Meas	LEN_MEAS mm	WT_MEAS	T_WT
2004	3	935	20190514	2425	Xanthidae	.	.	9	.	.
2004	3	935	20190514	2425	Xanthidae	.	.	11	.	.
2007	1	1145	20190514	2005	*Micropogonias undulatus*	2	2	60	.	4.54
2007	1	1145	20190514	2005	*Micropogonias undulatus*	.	.	70	.	4.54
2007	1	1145	20190514	2004	*Anchoa mitchilli*	1	0	13	.	0.77
2007	3	1211	20190514	2004	*Anchoa mitchilli*	3	0	22	.	2.65
2007	2	1158	20190514	2001	*Farfantepenaeus aztecus*	11	11	41		22.3
2007	2	1158	20190514	2001	*Farfantepenaeus aztecus*	.	.	42		22.3
2007	2	1158	20190514	2001	*Farfantepenaeus aztecus*	.	.	46		22.3
2007	2	1158	20190514	2001	*Farfantepenaeus aztecus*	.	.	62		22.3
2007	2	1158	20190514	2001	*Farfantepenaeus aztecus*	.	.	73		22.3
2007	2	1158	20190514	2001	*Farfantepenaeus aztecus*	.	.	75		22.3
2007	2	1158	20190514	2001	*Farfantepenaeus aztecus*	.	.	79		22.3
2007	2	1158	20190514	2001	*Farfantepenaeus aztecus*	.	.	82		22.3
2007	2	1158	20190514	2001	*Farfantepenaeus aztecus*	.	.	84		22.3
2007	2	1158	20190514	2001	*Farfantepenaeus aztecus*	.	.	85		22.3
2007	2	1158	20190514	2001	*Farfantepenaeus aztecus*	.	.	94		22.3
2007	3	1211	20190514	2001	*Farfantepenaeus aztecus*	6	6	36		13.1
2007	3	1211	20190514	2001	*Farfantepenaeus aztecus*	.	.	39		13.1
2007	3	1211	20190514	2001	*Farfantepenaeus aztecus*	.	.	42		13.1
2007	3	1211	20190514	2001	*Farfantepenaeus aztecus*	.	.	55		13.1
2007	3	1211	20190514	2001	*Farfantepenaeus aztecus*	.	.	55		13.1
2007	3	1211	20190514	2001	*Farfantepenaeus aztecus*	.	.	66		13.1
2007	1	1145	20190514	2392	*Palaemonetes* spp.	21	21	21	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	24	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	27	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	28	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	28	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	28	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	29	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	29	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	29	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	29	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.

STATION	REP	TIME	DATE	TAXA	Scientific_Name	T_NUM	Num_Meas	LEN_MEAS mm	WT_MEAS	T_WT
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	32	.	.
2007	1	1145	20190514	2392	*Palaemonetes* spp.	.	.	36	.	.
2007	2	1158	20190514	2039	*Menidia beryllina*	1	0	.	.	0.28
2007	2	1158	20190514	2425	Xanthidae	1	1	12	.	.
2008	3	1132	20190523	1659	*Lucania parva*	1	0	.	.	0.55
2008	1	1102	20190523	2425	Xanthidae	1	1	10	.	.
2008	2	1123	20190523	2425	Xanthidae	1	1	13	.	.
2011	1	925	20190523	2004	*Anchoa mitchilli*	5	0	.	.	3.72
2011	2	930	20190523	2004	*Anchoa mitchilli*	6	0	.	.	5.33
2011	3	940	20190523	2003	*Callinectes sapidus*	1	1	15	.	0.41
2011	3	940	20190523	2001	*Farfantepenaeus aztecus*	2	2	28	.	0.3
2011	3	940	20190523	2001	*Farfantepenaeus aztecus*	.	.	33	.	0.3
2011	1	925	20190523	2039	*Menidia beryllina*	1	0	.	.	0.47
2011	3	940	20190523	2098	*Gobiosoma bosc*	2	0	.	.	0.31
2011	3	940	20190523	2098	*Gobiosoma bosc*	2	0	.	.	0.31
2015	1	1015	20190523	.	.	0	0	.	.	.
2015	2	1001	20190523	2004	*Anchoa mitchilli*	3	0	.	.	2.29
2015	2	1001	20190523	2001	*Farfantepenaeus aztecus*	3	3	50	.	3.68
2015	2	1001	20190523	2001	*Farfantepenaeus aztecus*	.	.	60	.	3.68
2015	2	1001	20190523	2001	*Farfantepenaeus aztecus*	.	.	63	.	3.68
2015	3	1020	20190523	2001	*Farfantepenaeus aztecus*	3	3	55	.	6.1
2015	3	1020	20190523	2001	*Farfantepenaeus aztecus*	.	.	69	.	6.1
2015	3	1020	20190523	2001	*Farfantepenaeus aztecus*	.	.	74	.	6.1
2015	2	1001	20190523	2392	*Palaemonetes* spp.	1	1	32	.	.
2031	1	1141	20190515	.	.	0	0	.	.	.
2031	3	1204	20190515	2004	*Anchoa mitchilli*	5	0	33	.	3.02
2031	3	1204	20190515	2001	*Farfantepenaeus aztecus*	2	2	53	.	2.49
2031	3	1204	20190515	2001	*Farfantepenaeus aztecus*	.	.	65	.	2.49
2031	2	1150	20190515	2126	*Syngnathus louisianae*	3	0	65	.	0.57
2031	2	1150	20190515	2392	*Palaemonetes* spp.	28	28	20	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	23	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	23	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	24	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	24	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	25	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	25	.	7.04

STATION	REP	TIME	DATE	TAXA	Scientific_Name	T_NUM	Num_Meas	LEN_MEAS mm	WT_MEAS	T_WT
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	25	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	25	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	26	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	26	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	26	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	28	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	28	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	29	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	29	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	30	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	30	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	30	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	30	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	32	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	34	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	35	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	37	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	38	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	39	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	40	.	7.04
2031	2	1150	20190515	2392	*Palaemonetes* spp.	.	.	40	.	7.04
2031	3	1204	20190515	2392	*Palaemonetes* spp.	8	8	21	.	2.5
2031	3	1204	20190515	2392	*Palaemonetes* spp.	.	.	25	.	2.5
2031	3	1204	20190515	2392	*Palaemonetes* spp.	.	.	27	.	2.5
2031	3	1204	20190515	2392	*Palaemonetes* spp.	.	.	28	.	2.5
2031	3	1204	20190515	2392	*Palaemonetes* spp.	.	.	30	.	2.5
2031	3	1204	20190515	2392	*Palaemonetes* spp.	.	.	35	.	2.5
2031	3	1204	20190515	2392	*Palaemonetes* spp.	.	.	39	.	2.5
2031	3	1204	20190515	2392	*Palaemonetes* spp.	.	.	40	.	2.5
2031	3	1204	20190515	2007	*Brevoortia patronus*	10	10	28	.	2.77
2031	3	1204	20190515	2007	*Brevoortia patronus*	.	.	30	.	2.77
2031	3	1204	20190515	2007	*Brevoortia patronus*	.	.	30	.	2.77
2031	3	1204	20190515	2007	*Brevoortia patronus*	.	.	31	.	2.77
2031	3	1204	20190515	2007	*Brevoortia patronus*	.	.	32	.	2.77
2031	3	1204	20190515	2007	*Brevoortia patronus*	.	.	32	.	2.77
2031	3	1204	20190515	2007	*Brevoortia patronus*	.	.	33	.	2.77
2031	3	1204	20190515	2007	*Brevoortia patronus*	.	.	34	.	2.77
2031	3	1204	20190515	2007	*Brevoortia patronus*	.	.	36	.	2.77
2031	3	1204	20190515	2007	*Brevoortia patronus*	.	.	36	.	2.77
2031	3	1204	20190515	2039	*Menidia beryllina*	5	0		.	1.7
2031	2	1150	20190515	2021	*Bairdiella chrysoura*	7	0		.	1.24
2040	3	1105	20190515	2004	*Anchoa mitchilli*	4	0	.	.	0.86
2040	1	1056	20190515	2001	*Farfantepenaeus aztecus*	2	2	67	.	9.3
2040	1	1056	20190515	2001	*Farfantepenaeus aztecus*	.	.	105	.	9.3
2040	2	1102	20190515	2001	*Farfantepenaeus aztecus*	1	1	50	.	0.9
2040	3	1105	20190515	2001	*Farfantepenaeus aztecus*	1	1	47	.	0.7
2040	3	1105	20190515	.	*Evorthodus lyricus*	1	1	58	.	2.46
2040	2	1102	20190515	2026	*Anchoa hepsetus*	1	0	17	.	0.34
2041	1	1036	20190514	2004	*Anchoa mitchilli*	5	0	24	.	2.58

STATION	REP	TIME	DATE	TAXA	Scientific_Name	T_NUM	Num_Meas	LEN_MEAS mm	WT_MEAS	T_WT
2041	3	1106	20190514	2004	*Anchoa mitchilli*	3	0	20	.	1.18
2041	2	1053	20190514	2003	*Callinectes sapidus*	1	1	23	.	1.23
2041	2	1053	20190514	2001	*Farfantepenaeus aztecus*	6	6	53	.	12.2
2041	2	1053	20190514	2001	*Farfantepenaeus aztecus*	.	.	55	.	12.2
2041	2	1053	20190514	2001	*Farfantepenaeus aztecus*	.	.	55	.	12.2
2041	2	1053	20190514	2001	*Farfantepenaeus aztecus*	.	.	56	.	12.2
2041	2	1053	20190514	2001	*Farfantepenaeus aztecus*	.	.	56	.	12.2
2041	2	1053	20190514	2001	*Farfantepenaeus aztecus*	.	.	65	.	12.2
2041	3	1106	20190514	2001	*Farfantepenaeus aztecus*	3	3	56	.	6.2
2041	3	1106	20190514	2001	*Farfantepenaeus aztecus*	.	.	84	.	6.2
2041	3	1106	20190514	2001	*Farfantepenaeus aztecus*	.	.	94	.	6.2
2041	1	1036	20190514	2392	*Palaemonetes* spp.	13	13	26	.	.
2041	1	1036	20190514	2392	*Palaemonetes* spp.	.	.	27	.	.
2041	1	1036	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2041	1	1036	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2041	1	1036	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2041	1	1036	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2041	1	1036	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2041	1	1036	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2041	1	1036	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2041	1	1036	20190514	2392	*Palaemonetes* spp.	.	.	32	.	.
2041	1	1036	20190514	2392	*Palaemonetes* spp.	.	.	33	.	.
2041	1	1036	20190514	2392	*Palaemonetes* spp.	.	.	36	.	.
2041	1	1036	20190514	2392	*Palaemonetes* spp.	.	.	36	.	.
2041	2	1053	20190514	2392	*Palaemonetes* spp.	8	8	26	.	.
2041	2	1053	20190514	2392	*Palaemonetes* spp.	.	.	29	.	.
2041	2	1053	20190514	2392	*Palaemonetes* spp.	.	.	29	.	.
2041	2	1053	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2041	2	1053	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2041	2	1053	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2041	2	1053	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2041	2	1053	20190514	2392	*Palaemonetes* spp.	.	.	40	.	.
2041	3	1106	20190514	2392	*Palaemonetes* spp.	8	8	25	.	.
2041	3	1106	20190514	2392	*Palaemonetes* spp.	.	.	26	.	.
2041	3	1106	20190514	2392	*Palaemonetes* spp.	.	.	26	.	.
2041	3	1106	20190514	2392	*Palaemonetes* spp.	.	.	28	.	.
2041	3	1106	20190514	2392	*Palaemonetes* spp.	.	.	28	.	.
2041	3	1106	20190514	2392	*Palaemonetes* spp.	.	.	29	.	.
2041	3	1106	20190514	2392	*Palaemonetes* spp.	.	.	30	.	.
2041	3	1106	20190514	2392	*Palaemonetes* spp.	.	.	31	.	.
2044	2	1055	20190522	.	.	0	0	.	.	.
2044	3	.	20190522	2004	*Anchoa mitchilli*	2	0	.	.	0.61
2044	1	1105	20190522	2392	*Palaemonetes* spp.	1	1	29	.	.
2044	3	.	20190522	2392	*Palaemonetes* spp.	2	2	24	.	.

STATION	REP	TIME	DATE	TAXA	Scientific_Name	T_NUM	Num_Meas	LEN_MEAS mm	WT_MEAS	T_WT
2044	3	.	20190522	2392	*Palaemonetes* spp.	.	.	37	.	.
2045	1	1317	20190522	2004	*Anchoa mitchilli*	1	0	.	.	0.13
2045	3	.	20190522	2004	*Anchoa mitchilli*	12	0	.	.	1.24
2045	1	1317	20190522	2019	*Citharichthys spilopterus*	1	0	.	.	0.17
2045	3	.	20190522	2019	*Citharichthys spilopterus*	1	0	.	.	1.48
2045	1	1317	20190522	2001	*Farfantepenaeus aztecus*	4	4	27	.	2.16
2045	1	1317	20190522	2001	*Farfantepenaeus aztecus*	.	.	34	.	2.16
2045	1	1317	20190522	2001	*Farfantepenaeus aztecus*	.	.	47	.	2.16
2045	1	1317	20190522	2001	*Farfantepenaeus aztecus*	.	.	52	.	2.16
2045	2	1329	20190522	2001	*Farfantepenaeus aztecus*	4	4	40	.	7.2
2045	2	1329	20190522	2001	*Farfantepenaeus aztecus*	.	.	60	.	7.2
2045	2	1329	20190522	2001	*Farfantepenaeus aztecus*	.	.	71	.	7.2
2045	2	1329	20190522	2001	*Farfantepenaeus aztecus*	.	.	74	.	7.2
2045	3	.	20190522	2001	*Farfantepenaeus aztecus*	1	1	64	.	1.8
2045	1	1317	20190522	2094	*Dormitator maculatus*	1	0	.	.	0.4
2045	3	.	20190522	2392	*Palaemonetes* spp.	2	2	30	.	.
2045	3	.	20190522	2392	*Palaemonetes* spp.	.	.	34	.	.
2045	2	1329	20190522	2120	*Gobionellus oceanicus*	1	0	.	.	14.9
2045	2	1329	20190522	2009	*Cynoscion arenarius*	1	1	65	.	2.4
2045	1	1317	20190522	2002	*Litopenaeus setiferus*	1	1	30	.	0.6
2045	2	1329	20190522	2002	*Litopenaeus setiferus*	1	1	33	.	0.6
2045	3	.	20190522	2002	*Litopenaeus setiferus*	1	1	27	.	0.6
2046	1	1154	20190522	2004	*Anchoa mitchilli*	2	0	.	.	1.77
2046	2	1201	20190522	2004	*Anchoa mitchilli*	11	0	.	.	1.04
2046	3	.	20190522	2004	*Anchoa mitchilli*	11	0	.	.	7.26
2046	1	1154	20190522	2003	*Callinectes sapidus*	2	2	15	.	0.46
2046	1	1154	20190522	2003	*Callinectes sapidus*	.	.	15	.	0.46
2046	1	1154	20190522	2001	*Farfantepenaeus aztecus*	1	1	56	.	1.13
2046	2	1201	20190522	2001	*Farfantepenaeus aztecus*	5	5	30	.	4.7
2046	2	1201	20190522	2001	*Farfantepenaeus aztecus*	.	.	33	.	4.7
2046	2	1201	20190522	2001	*Farfantepenaeus aztecus*	.	.	47	.	4.7
2046	2	1201	20190522	2001	*Farfantepenaeus aztecus*	.	.	55	.	4.7

STATION	REP	TIME	DATE	TAXA	Scientific_Name	T_NUM	Num_Meas	LEN_MEAS mm	WT_MEAS	T_WT
2046	2	1201	20190522	2001	*Farfantepenaeus aztecus*	.	.	74	.	4.7
2046	1	1154	20190522	2392	*Palaemonetes* spp.	5	5	28	.	.
2046	1	1154	20190522	2392	*Palaemonetes* spp.	.	.	34	.	.
2046	1	1154	20190522	2392	*Palaemonetes* spp.	.	.	34	.	.
2046	1	1154	20190522	2392	*Palaemonetes* spp.	.	.	35	.	.
2046	1	1154	20190522	2392	*Palaemonetes* spp.	.	.	41	.	.
2046	2	1201	20190522	2392	*Palaemonetes* spp.	3	3	30	.	.
2046	2	1201	20190522	2392	*Palaemonetes* spp.	.	.	31	.	.
2046	2	1201	20190522	2392	*Palaemonetes* spp.	.	.	34	.	.
2046	3	.	20190522	2392	*Palaemonetes* spp.	2	2	30	.	.
2046	3	.	20190522	2392	*Palaemonetes* spp.	.	.	40	.	.
2046	2	1201	20190522	2007	*Brevoortia patronus*	41	30	32	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	33	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	36	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	37	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	38	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	38	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	40	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	41	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	42	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	42	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	45	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	45	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	45	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	45	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	45	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	45	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	45	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	46	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	46	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	46	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	47	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	47	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	47	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	48	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	48	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	49	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	51	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	52	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	55	.	36.29
2046	2	1201	20190522	2007	*Brevoortia patronus*	.	.	58	.	36.29
2046	3	.	20190522	2007	*Brevoortia patronus*	1	1	60	.	2.65
2046	3	.	20190522	2062	*Lagodon rhomboides*	1	0	.	.	2.24
2046	3	.	20190522	2009	*Cynoscion arenarius*	1	1	30	.	0.32
2069	2	957	20190515	.	.	0	0	.	.	.
2069	1	950	20190515	2001	*Farfantepenaeus aztecus*	2	2	66	.	4.4
2069	1	950	20190515	2001	*Farfantepenaeus aztecus*	.	.	73	.	4.4
2069	3	1001	20190515	2001	*Farfantepenaeus aztecus*	9	9	46	.	19.3

STATION	REP	TIME	DATE	TAXA	Scientific_Name	T_NUM	Num_Meas	LEN_MEAS mm	WT_MEAS	T_WT
2069	3	1001	20190515	2001	*Farfantepenaeus aztecus*	.	.	60	.	19.3
2069	3	1001	20190515	2001	*Farfantepenaeus aztecus*	.	.	64	.	19.3
2069	3	1001	20190515	2001	*Farfantepenaeus aztecus*	.	.	65	.	19.3
2069	3	1001	20190515	2001	*Farfantepenaeus aztecus*	.	.	66	.	19.3
2069	3	1001	20190515	2001	*Farfantepenaeus aztecus*	.	.	67	.	19.3
2069	3	1001	20190515	2001	*Farfantepenaeus aztecus*	.	.	70	.	19.3
2069	3	1001	20190515	2001	*Farfantepenaeus aztecus*	.	.	75	.	19.3
2069	3	1001	20190515	2001	*Farfantepenaeus aztecus*	.	.	84	.	19.3
2069	3	1001	20190515	2039	*Menidia beryllina*	6	0	.	.	5.81

Presentation of study and findings made on February 10, 2020 to project partners.

Nekton assemblages quantified by different sampling gear highlight trade-offs for long-term monitoring programs

February 10, 2020 Presentation

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1

General Approach

1) Compare CPUE, species richness and nekton community composition of two data-sets:
   - May 2019: throw trap (LSU AgCenter), seine (LDWF data), electroshock (LDWF data)
   - May 2018-June 2019: seine, electroshock (LDWF data)

2) Examine data by comparing water quality, habitat, and gear ratios and conversions
   - Species specific selectivity?
   - Water quality – gear interactions?
   - Gear efficiency and density estimation corrections

2

Gear comparisons & conversions: gears used

Method	Gear	Mesh Size	Dates Sampled	Estimated Area Covered (m)	Estimated gear efficiency
Electrofishing	Generator: 9.0 GPP Electrofisher System. Electrical power: 9 kW, voltage: 680 volts. Rated output max. current: 150 A, direct current (D.C), anode diameter x, anode length x, dip net diameter x, dip net length x	Dip net 4 mm	Monthly May 2018 - June 2019	LDWF measured distance (m) * 1 m (width of sampling)	0.28 From: Peterson et al. 2004
Bag Seine	Knotless nylon mesh material, length 15 m, height 2 x 2 m; 2 x 2 m bag in the center of net; upper float line with buoys placed every 1 m; lower drag line with sinkers placed every 1 m	6 mm	Monthly May 2018 - June 2019	176.2 m^2	0.40 (0.055) From: Hollwegg et al. 2019
Throw Trap	Knotless nylon mesh material; 1 x 1 x 6 m aluminum frame; nylon mesh extension with 1 x 1 m PVC with floats extended above frame to total height of 1.25 m; 1.6 mm mesh	cleared with 3mm bar seine	May 2019	1 m^2	0.50 (0.116) From: Hollwegg et al. 2019

3

Gear comparisons & conversions: general notes

Water quality & habitat variables known to influence gear effectiveness.

Gear types have species and size selectivity biases.

- Electroshock: salinity, water depth, bottom type/vegetation/debris
    - Decreased effectiveness as depth increases above 1.5 m
    - Decreased effectiveness as salinity increases above 15
- Seine: bottom type/debris/vegetation decrease effectiveness
- Throw trap: bottom type; water depth
    - Decreased effectiveness/success in dense vegetation/structure
    - Designed for > 1.5 m water depths
    - Generally capture small bodied organisms only.

i.e., Warry et al. 2013, Lapointe et al. 2006, Clement et al. 2014

4

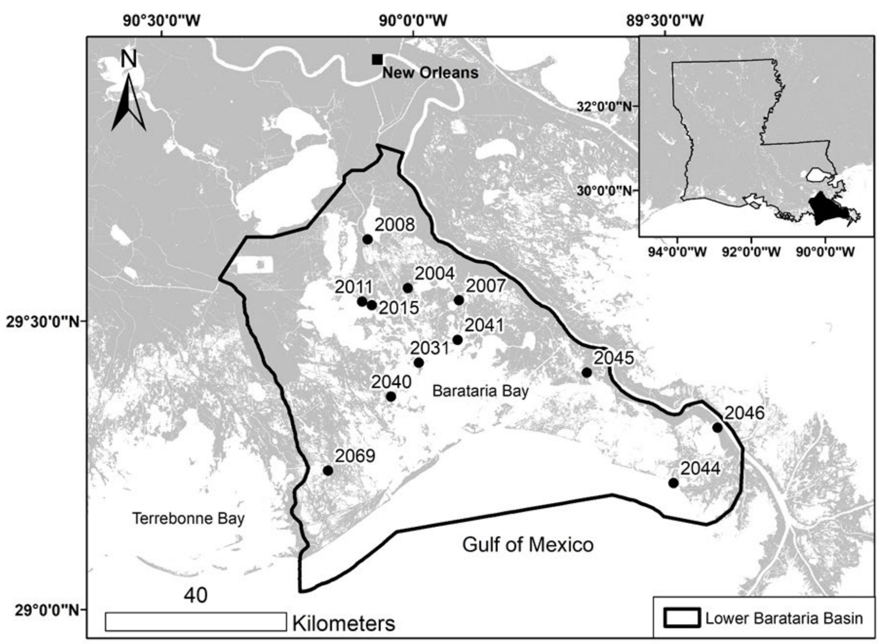
1) Water quality & physical habitat
- Data available = salinity, temperature, turbidity, DO
- Range of conditions captured vs long-term ranges across estuary

2) Comparisons of gear types
- Three gear: CPUE, richness, species composition
- Two gear: CPUE, richness, TL, species composition

3) Water quality & gear
- CPUE, richness
- Species specific

4) Gear ratio, conversion, and common units
- Patterns to relate to environment/habitat for extrapolation…
- Comparing "ratio" of catches by gear
- Gear conversion (Hollwegg et al. 2019)

5



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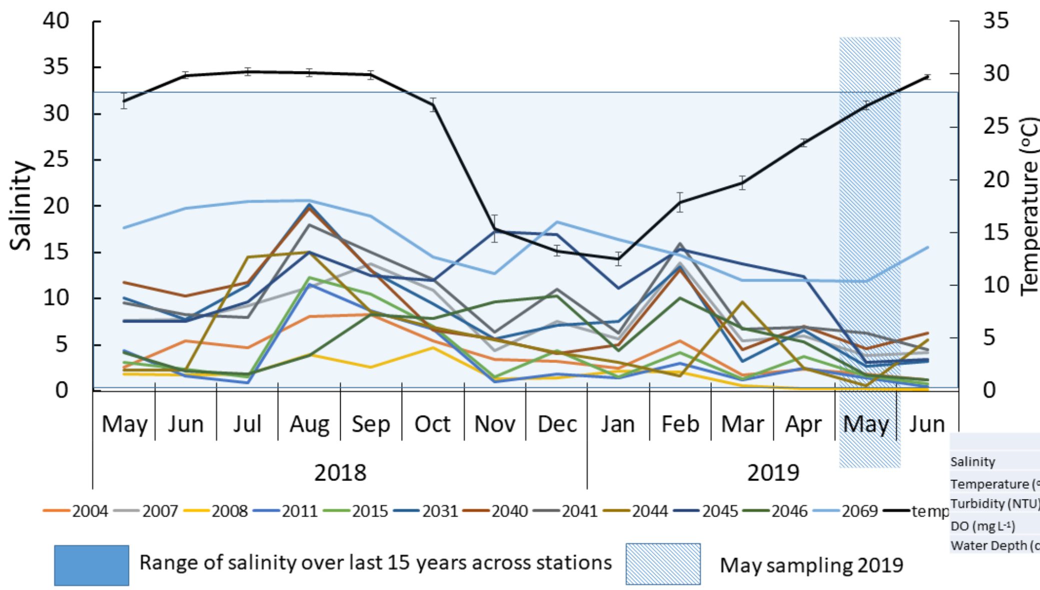
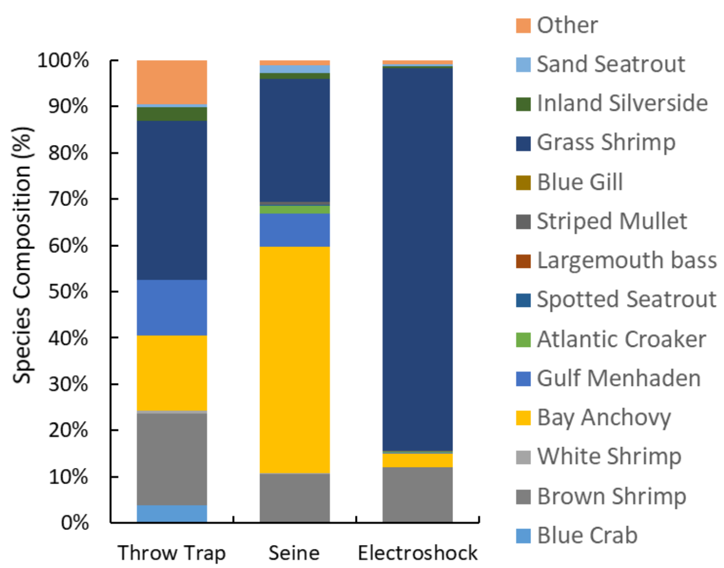
Water quality and physical habitat – ranges captured

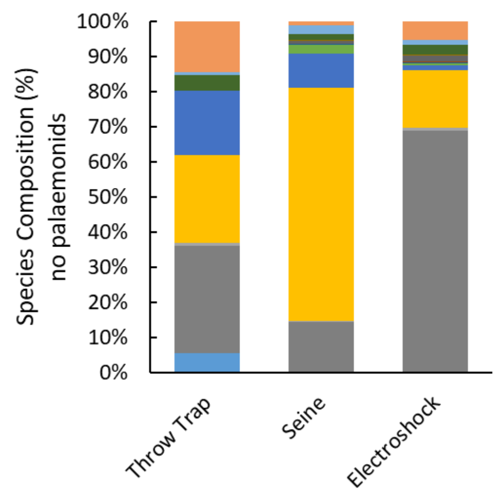


	Mean (SE)	Range
Salinity	3.3 (0.9)	0.3-11.9
Temperature (°C)	26.9 (0.4)	25.1-29.4
Turbidity (NTU)	1.4 (0.1)	0.8-2.0
DO (mg L^{-1})	6.8 (0.2)	5.2-8.0
Water Depth (cm)*	55.9 (8.7)	34.5-73.1

7

Comparison of gear types: May 2019





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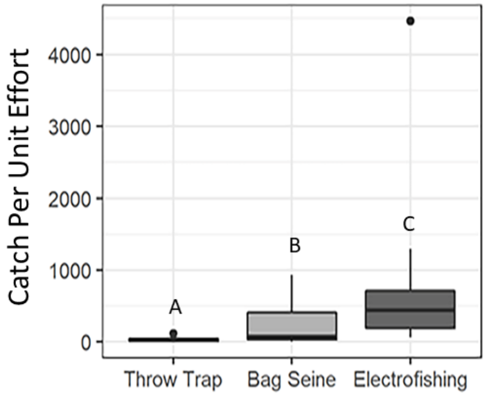
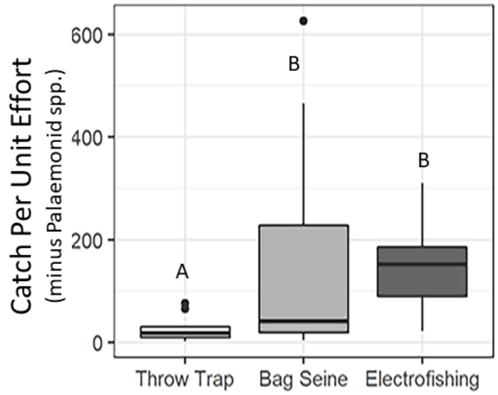
Nekton catches: May 2019

Throw Trap	460	340
Seine catch	2 698	1 986
Electroshock catch	9 592	1 722
Total catch	12 750	4 012

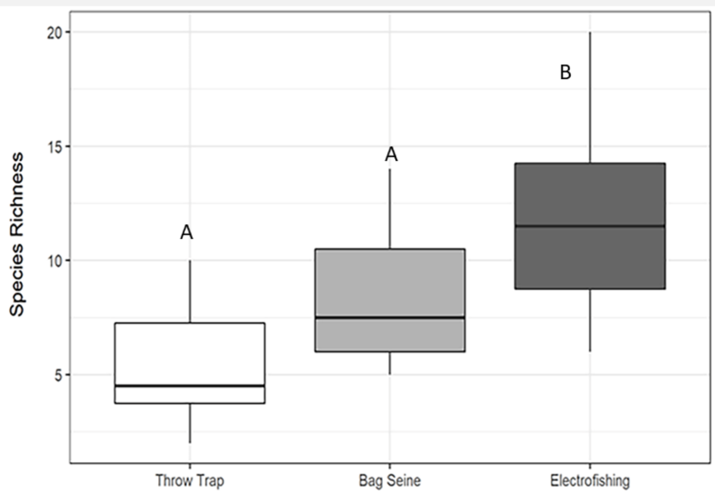




9

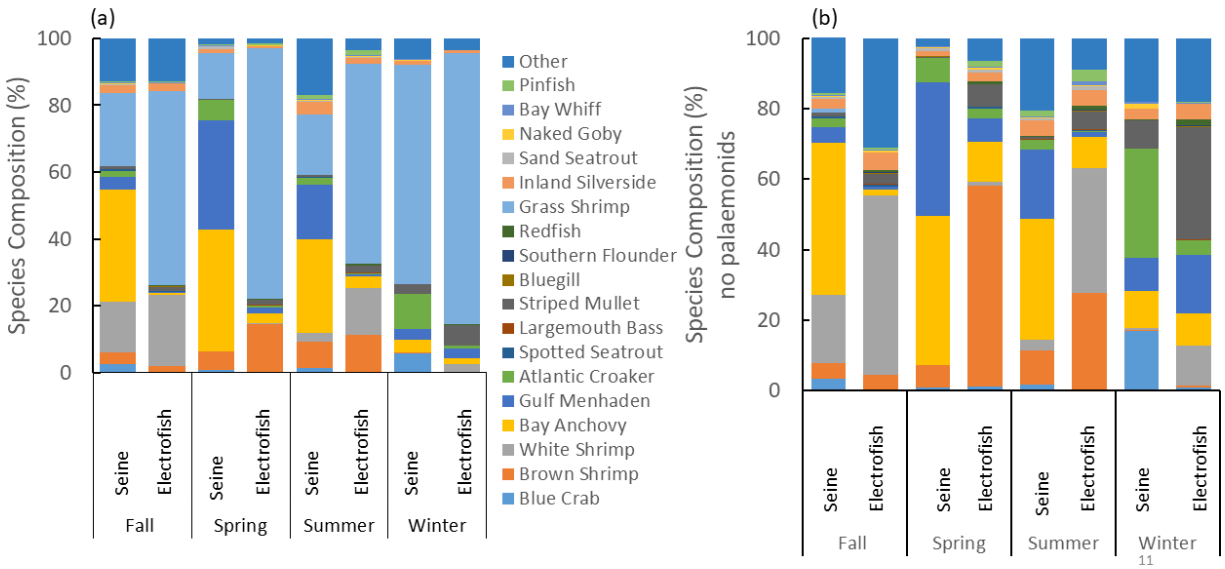
Comparison of gear types: May 2019

# Unique Species	**2**	**4**	**10**



10

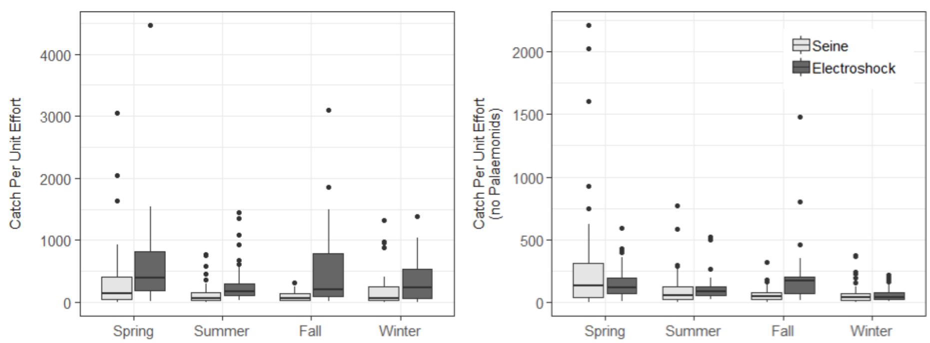
Comparison of gear types: May 2018-June 2019



11

Comparison of gear types: May 2018-June 2019

Seine catch	34 247	25 005
Electroshock catch	74 091	22 768
Total catch	108 338	47 573

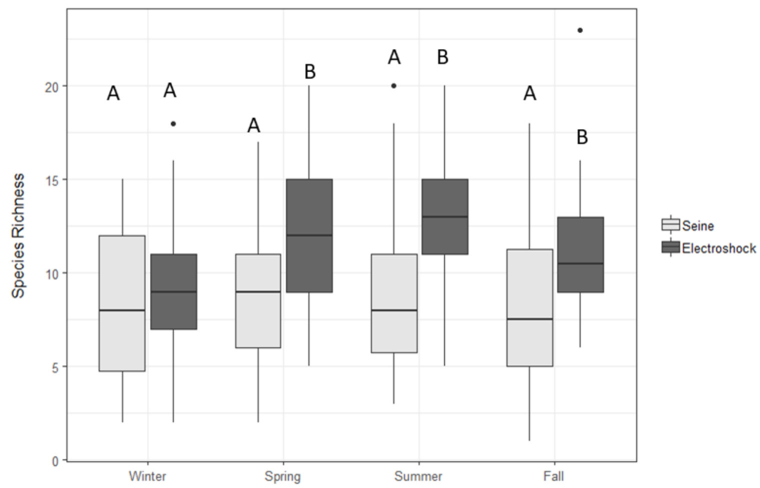


Gear: $F_{1,22}=8.88$; $p<0.0069$
Season: $F_{3,308}=4012$; $p<0.0001$

Gear: NSD
Season: $F_{3,308}=2645$; $p<0.0001$

12

Comparison of gear types: May 2018-June 2019

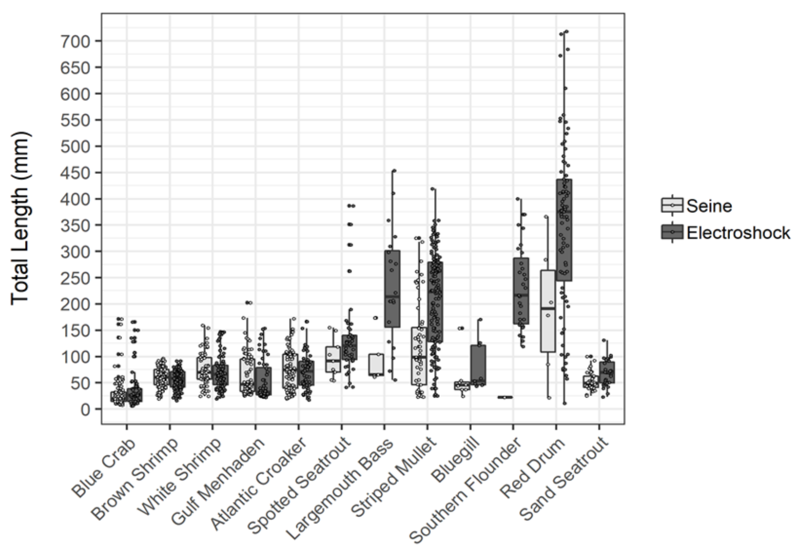


 # Unique Species

10
13

13

Comparison of gear types: May 2018-June 2019



14

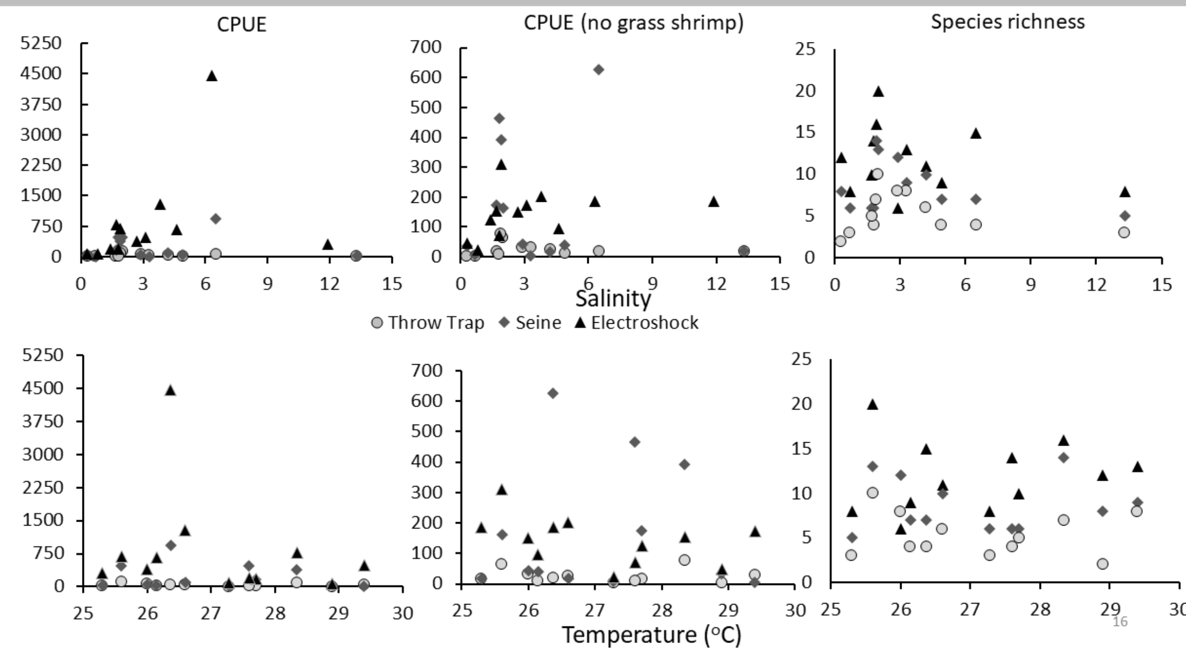
Water quality, physical habitat & gear: framework

- Assumptions:
  - sample water depths < 1.5 m
  - bottom types homogeneous within estuarine locations (i.e., limited woody debris, structure)

- Approaches:
  - Examine catch & species data by water quality captured by long-term data sets (salinity, temperature, turbidity, DO)
  - Examine location –specific catches, using location as a proxy for potential physical characteristics
  - Examine conversions based on habitat specific gear correction factors

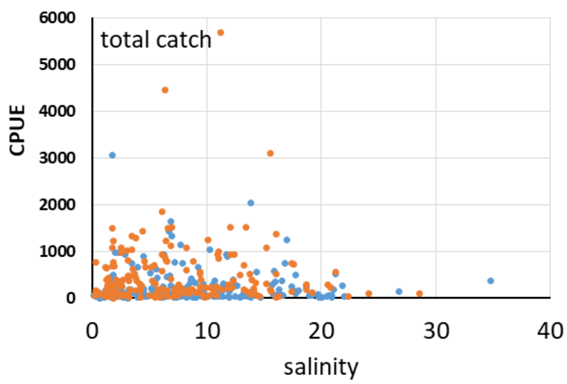
15

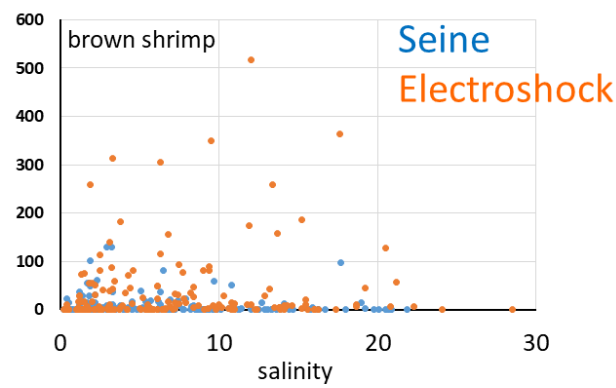
Water quality & Gear: May 2019



16

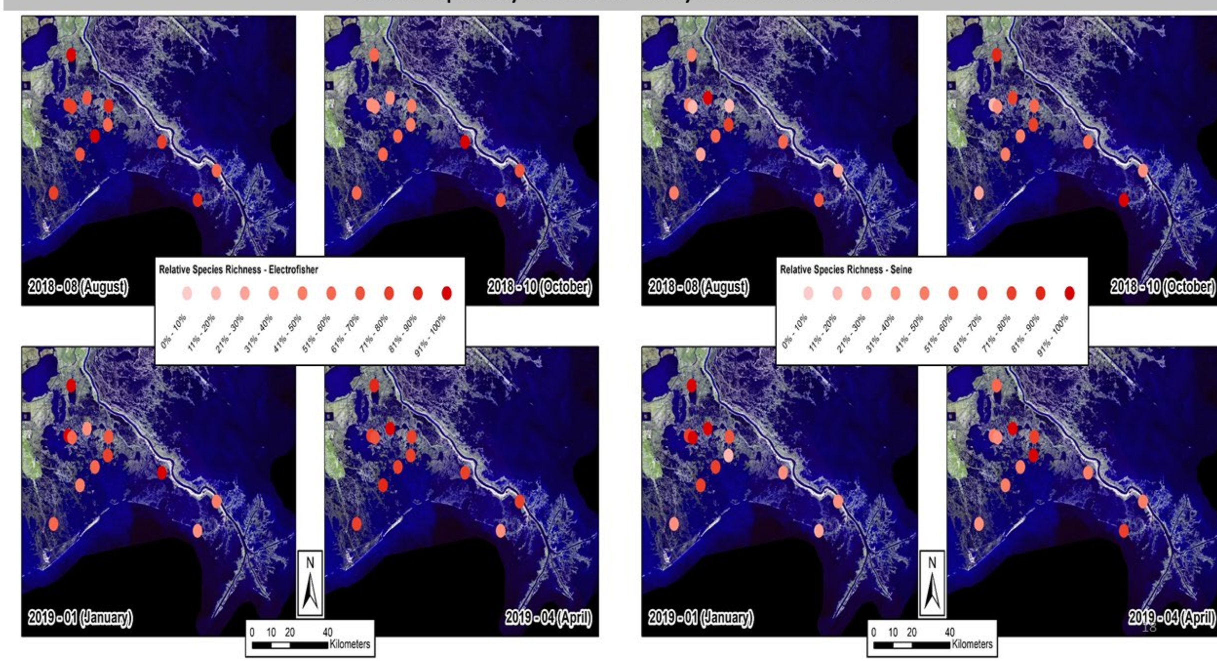
Water quality & Gear: May 2018-June 2019





17

Water quality & Gear: May 2018-June 2019



18

Exploring ratios & conversions: Approach

Ratios

- Used to identify potential species-specific conversion factors
  - Assume no species bias of gear types
  - Assume no size bias within species
  - Assume no environmental bias

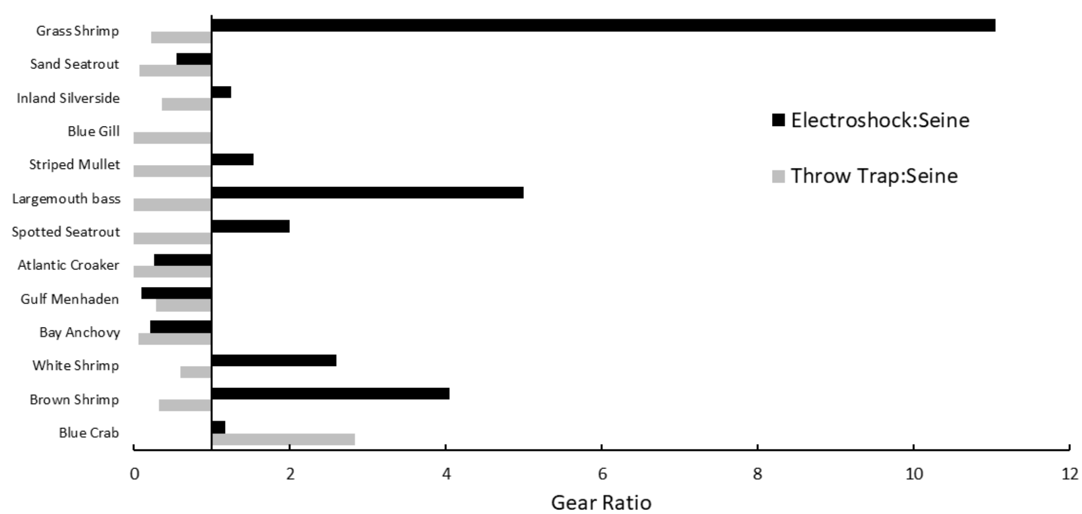
Gear Conversions

- Used approach published by Hollwegg et al. (2019)
  - Hollwegg et al. (2019) provides average values of gear efficiency by habitat type for seine, throw trap
  - Used literature values for electroshock, but all reported values are species specific

- Correct gear efficiency for area sampled to provide comparable units (ind m^{-2}) for gear comparisons following Hollwegg et al. (2019)

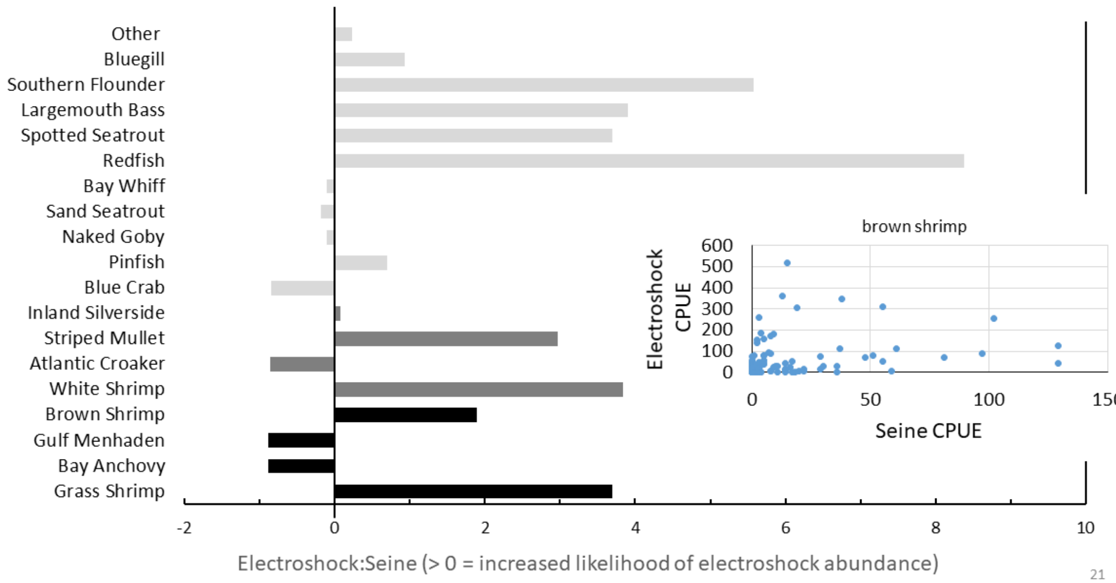
19

Exploring ratios & conversions: May 2019, Ratios of catch



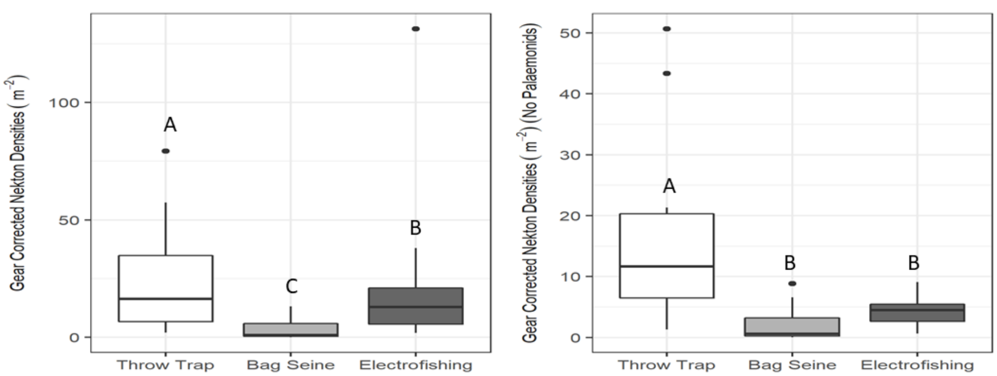
20

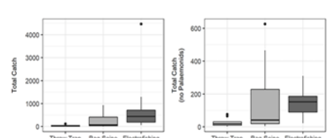
Exploring ratios & conversions: May 2018-June209, Ratios of catch



21

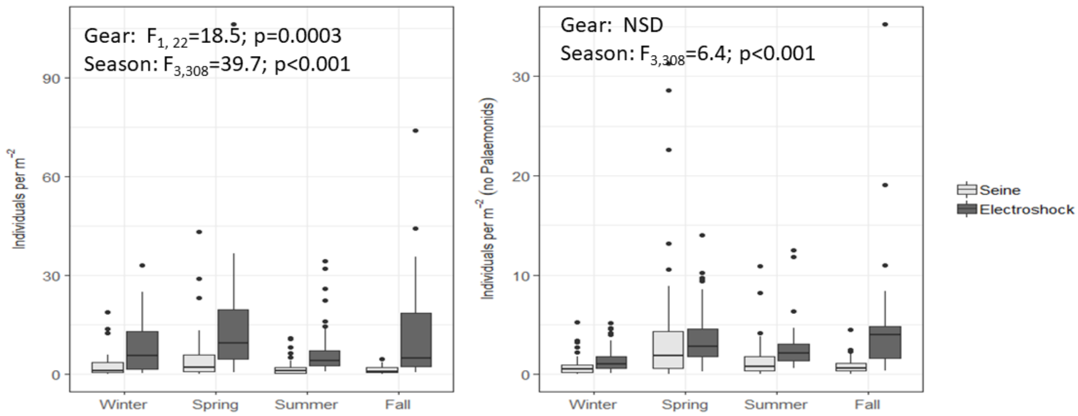
Exploring ratios & conversions: May 2019, Conversion (Hollwegg et al. 2019)

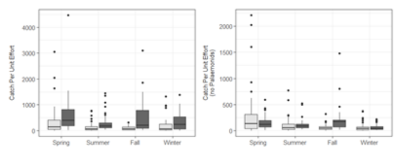




22

Exploring ratios & conversions: May 2018-June 2019 Conversion (Hollwegg et al. 2019)





23

Main findings

Water quality & physical habitat

- Range of conditions captured during the sampling period on lower end of salinities
- Physical habitat data not available long-term.
- For the ranges captured, no evidence of water quality impact on gear bias for assemblage statistics.

Comparisons of gear types

- Similar patterns for both data sets.
- Uncorrected CPUE highest overall for electrofish, but Palaemonetes account for this difference; when removed, electrofish and seine CPUE were not different.
- All gears captured a diversity of species, including unique species. Lower richness accounted for by lower sample effort (area sampled).

Gear ratio, conversion, and common units

- Differences in gear bias by species evident. Gear-specific species bias evident, and supported in literature:
  - Electrofish captured more shrimp.
  - Seine captured more small bodied fish (bay anchovy, gulf menhaden).
  - Throw trap tended to have assemblages that were more evenly distributed.
- When corrected using a gear efficiency, and total area covered conversion, throw traps provided higher density estimates compared to electrofish and seine.

24

APPENDIX C

Complete list of all species referenced in this report, including both scientific and common names. Those highlighted in gold are species identified as "key species" in section **2.1 Study area & field data**.

Common Name	**Scientific Name**
American eel	*Anguilla rostrata*
American freshwater goby	*Ctenogobius shufeldti*
Atlantic croaker	*Micropogonias undulatus*
Atlantic needlefish	*Strongylura marina*
Atlantic spadefish	*Chaetodipterus faber*
bay anchovy	*Anchoa mitchilli*
bay whiff	*Citharichthys spilopterus*
bighead sea robin	*Prionotus tribulus*
blue catfish	*Ictalurus furcatus*
blue crab	*Callinectes sapidus*
bluefish	*Pomatomus saltatrix*
bluegill	*Lepomis macrochirus*
brown shrimp	*Farfantepenaeus aztecus*
chain pipefish	*Syngnathus louisianae*
channel catfish	*Ictalurus punctatus*
clown goby	*Microgobius gulosus*
crested blenny	*Hypleurochilus geminatus*
fat sleeper	*Dormitator maculatus*
feather blenny	*Hypsoblennius hentz*
Florida pompano	*Trachinotus carolinus*
grass shrimp	*Palaemonetes spp.*
green snapping shrimp	*Alpheus euphrosyne*
guaguanche	*Sphyraena guachancho*
Gulf butterfish	*Peprilus burti*
Gulf kingfish	*Menticirrhus littoralis*
Gulf menhaden	*Brevoortia patronus*
Gulf toadfish	*Opsanus beta*
highfin goby	*Gobionellus oceanicus*
inland silverside	*Menidia beryllina*
largemouth bass	*Micropterus salmoides*
least puffer	*Sphoeroides parvus*
lesser blue crab	*Callinectes similis*
lookdown	*Selene vomer*
lyre goby	*Evorthodus lyricus*
mosquitofish	*Gambusia affinis*

mud crabs (family)	*Xanthidae*
naked goby	*Gobiosoma bosc*
pinfish	*Lagodon rhomboides*
pink shrimp	*Farfantepenaeus duorarum*
pistol shrimp	*Alpheus heterochaelis*
rainwater killifish	*Lucania parva*
red drum	*Sciaenops ocellatus*
redspotted sunfish	*Lepomis miniatus*
river shrimp	*Macrobranchium* spp.
sand seatrout	*Cynoscion arenarius*
sargassum swimming crab	*Portunus sayi*
sheepshead	*Archosargus probatocephalus*
silver perch	*Bairdiella chrysoura*
skilletfish	*Gobiesox strumosus*
southern flounder	*Paralichthys lethostigma*
Spanish mackerel	*Scomberomorus maculatus*
Spanish sardine	*Sardinella aurita*
speckled worm eel	*Myrophis punctatus*
spotted bass	*Micropterus punctulatus*
spotted gar	*Lepisosteus oculatus*
spotted seatrout	*Cynoscion nebulosus*
stone crab	*Menippe mercenaria*
striped anchovy	*Anchoa hepsetus*
striped mullet	*Mugil cephalus*
white mullet	*Mugil curema*
white shrimp	*Litopenaeus setiferus*