Comparison of two benthic assemblage sampling gears for use on intertidal oyster reefs in Louisiana

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Background. Estuarine biodiversity plays a vital role in supporting ecosystem functions yet remains threatened by climate change and anthropogenic activity. Tracking and identifying estuarine biodiversity trends helps management ensure long-term provisions of human and environmental benefits but is complicated by the fact that the sampling gear and biodiversity metric used can support different conclusions, which can lead to uncertainty. Sampling benthic biodiversity in complex estuarine habitats, such as oyster reefs, is challenging because no one gear type captures entire target assemblages with differences occurring when comparing results across gear types. Comparable biodiversity assessment across space and time depends on using similar sampling gears or accounting for differences due to alternative gears.

Methods. We investigated how estimates of oyster reef-associated benthic taxa abundance, richness, Pielou's evenness, and Shannon-Wiener diversity differed on *Crassostrea virginica* reefs in Louisiana between two common sampling gears, and how gear influenced comparisons across reefs. We recorded the reef assemblages collected on three oyster reefs in July 2022 using both suction samplers and substrate trays (3 reefs × 6 replicates × 2 gears).

Results. Abundance and richness were higher, and Pielou's evenness was lower in trays compared to suction samples at all reefs. Shannon-Wiener diversity was similar in suction samples and trays at two out of three reefs. Amphipod taxa were numerically dominant in trays, skewing the distribution of abundances and driving the reef assemblage differences between gears. Abundance and Shannon-Wiener diversity were similar across reefs within each gear. However, there were significant differences in richness across reefs in tray samples only, while evenness differed across reefs only in suction samples. Our results highlight that gear choices, along with biodiversity metrics tracked, can result in different conclusions in biodiversity trends, ultimately impacting conservation decisions and management.

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Abstract

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Introduction

Loss of estuarine biodiversity due to climate change and anthropogenic activities may negatively impact estuarine habitats' provisioning of ecosystem functions and services (Lotze et al., 2006). To address this loss, many local and global initiatives focus on preserving, restoring, and enhancing ecosystems to maintain biodiversity in estuaries (United Nations Environment Programme, 2021). The identification and development of robust monitoring tools and metrics are necessary to track and understand the impacts of these management efforts on biodiversity.

Monitoring biodiversity in estuaries is challenging due to the highly variable and often structurally complex habitats (e.g., shellfish reefs) encountered which can influence the efficiency of a sampling gear (hereafter gear; Flannery & Przeslawski, 2015; Mihoub et al. 2017; La Peyre et al., 2021). When sampling estuarine benthic assemblages (hereafter assemblages), the use of different gears, such as ponar grabs, trays, or suction samplers can result in different values for taxa abundances, assemblage structure, diversity, and richness (Stoner et al., 1983; Slack et al., 1986; Keklikoglou et al., 2019). Reefs built by the Eastern oyster *Crassostrea virginica* support significant biodiversity, but estimates of assemblage abundance and richness also vary between studies that have sampled reefs of different complexity and/or used different gears (Wells, 1961; Coen & Grizzle, 2007; La Peyre et al., 2019). These examples highlight that gear comparison is complicated by habitat characteristics which can affect a gear's ability to capture a representative proportion of the target assemblages (efficiency) and specific taxa and size classes (selectivity) across habitats. Consequently, researchers and managers still search for gear that maximize the taxa richness captured and minimize sampling time and effort.

To date, there are no studies in oyster reefs comparing the selectivity and efficiency of trays and suction sampler gears designed to sample assemblages. Trays are often used for sampling biodiversity on oyster reefs (La Peyre et al., 2019). They create minimal reef disturbance, minimize loss of escaping organisms, and collect organisms that reside in reef interstitial spaces (Beck & La Peyre, 2015). However, trays are time-consuming, have a high risk of gear loss due to long deployment times, and potentially bias results due to the added structure of the tray (Beck & La Peyre, 2015). In contrast, until recently the suction sampler was used

primarily on soft bottom (True et al. 1968) but is gaining popularity for sampling oyster reefs (Pinnell et al., 2021; Pollack et al., 2021). Comparatively, suction samplers require less time and have a lower chance of gear loss because samples are collected in one field event with no deployment time required. However, suction samplers are often limited to shallow water habitats, limited to capturing size classes as large as the suction diameter, and create a noise disturbance from the motor (Flannery & Przeslawski, 2015). It is also unclear how efficiently suction samplers capture organisms that reside in the interstitial space within reef substrate.

In this study, we compared four common metrics of benthic biodiversity on three natural intertidal *C. virginica* oyster reefs using trays and suction samplers. We hypothesized that the biodiversity metrics would be significantly higher in trays compared to suction samples consistently across all reefs. To test our hypothesis, we compared taxa abundance, richness, Pielou's evenness, and Shannon-Wiener diversity collected by trays and suction samples across three oyster reefs.

Materials & Methods

Study site

The study area encompassed approximately 1 km^2 of coastal habitats near Cocodrie, Louisiana (29°15′16.2124N, 90°40′04.8710W) which included *Spartina alterniflora* dominated marsh, microtidal channels, bayous, and ponds interspersed with oyster reefs (Figure 1.A). Over the past decade (2012-2022) water depth ranged from 1.0-2.5 m (mean = 1.7 SE0.009 n = 52,497), water temperature ranged from 1.5-35.2°C (mean = 23.0 SE0.01 n = 309313), and salinity ranged from 0.6-25.1 PSU (mean = 9.5, SE0.01 n = 241,430; http://weatherstations.lumcon.edu/index.html).

Sampling design

We selected three reef sites (30 m × 20 m; hereafter reef) located at least 100 m apart and centered over natural intertidal oyster reefs (Figure 1.B). At each reef, trays (n = 6) were deployed June 29, 2022, and collected July 11-12 and suction samples (n = 6) were collected July 14 to minimize reef disturbance from the collection of the trays. Temperature (°C), salinity (PSU), dissolved oxygen (mg L^{-1}), and water depth (m) were downloaded from the Louisiana Universities Marine Consortium (LUMCON; http://weatherstations.lumcon.edu/index.html) environmental monitoring station, located within 1000 m of all reefs, from July 11-14. All reefs were completely submerged where any samples were taken to minimize inconsistencies due to microtidal fluctuations.

Field Sampling

To characterize each reef, six 0.25 × 0.25 m quadrats were haphazardly placed within the reef and reef substrate was collected to 10 cm depth. For each quadrat, substrate volume (L), reef cluster volume (L; as a measure of complexity per Beck & La Peyre, 2015), and abundance and shell height (mm) of the live oysters were recorded. Both volume measurements were estimated via water displacement.

Trays (0.48 × 0.48 x 0.10 m; 20 L) lined with 3-mm chicken wire and 1-mm mesh bags were deployed on reefs ~2 weeks prior to collection to allow the assemblages to develop (Beck

& La Peyre, 2015). The trays were filled with ~3 L of oyster shells and topped with ~1.5 L of reef substrate taken from a single quadrat saved from the reef characterization. The trays were placed ~1 m apart in a row parallel to the marsh edge and centered on each reef (Figure 1.C). A lead line connected to the trays was secured to the marsh's edge using a PVC pole, ensuring relocation and recovery. At tray retrieval, the mesh bags lining the trays were cinched closed to reduce organism escape.

Suction samples were collected using a haphazardly placed 0.48 × 0.48 x 0.10 m throw trap that enclosed an identical area as the tray (Figure 1.C). Using a gas-powered, venturi suction sampler device with a 10.16 cm suction diameter similar to Glaspie et al. (2018), we suctioned the reef bottom for 10 seconds to 10 cm depth based on preliminary trials that suctioned the entire benthic floor within the throw trap. The suctioned material was discharged into 1-mm mesh bags. All tray and suction samples were rinsed through a 1-mm sieve and placed in sample bags on ice until they were stored at -20°C in the lab for later processing.

Laboratory analyses

Each sample was thawed, and all benthic organisms were identified to the lowest practical taxonomic unit. All taxa were enumerated, and wet weights were recorded (g). For amphipods and isopods only, a maximum of 50 individuals per sample were identified and the remaining amphipods/isopods were grouped, and total wet weight biomass was recorded. All taxa were dried at 60°C until a constant weight was achieved, and dry weight was recorded (0.0001 g). The grouped amphipod/isopod biomass was used in conjunction with the weights of the 50 identified amphipods and isopods to estimate the total number of amphipod and isopod taxa per sample (Equation S1).

When a taxon not previously identified by this research team was found, their wet weight was recorded, and a voucher specimen was taken. The voucher's dry weight was estimated based on the mean dry weight of the other individuals from that taxon. This weight was then added back into the taxon-specific dry weight for that sample. The wet weight was used as a biomass estimate for dry weight once because only one representative of the voucher taxon was found. All voucher specimens were catalogued and added to LUMCON Natural History Collection.

Statistical analysis

All taxa abundance and biomass per sample was divided by 0.2304 to standardized estimates to $1m^2$ for comparison among similar studies. We tested for differences in taxa abundance, richness, Pielou's evenness, and Shannon-Wiener diversity within a reef between gears, and among reefs within a gear using Kruskal-Wallis tests because the data did not meet normality assumptions for parametric tests. When comparing between gears we used separate tests for each reef because there were reef-specific differences and a Bonferroni adjustment to control for multiple comparisons. To compare among reefs within a gear, we used a Bonferroni adjustment and a Dunn test for post-hoc comparisons. Shannon-Wiener diversity was calculated based on abundance via the 'vegan' package (Oksanen et al., 2022) and Pielou's evenness was calculated by dividing the Shannon-Wiener diversity by the log of richness. Statistical analyses

were conducted in R version 4.1.0 (R Core Team, 2022). We chose to analyze abundance instead of biomass because our estimates of abundance and biomass were correlated ($r_s = 0.79$, $p < 0.001$; Table S1) and abundance m^{-2} was reported more frequently across similar studies.

This study was performed under the auspices of Louisiana State University Agricultural Center protocol # A2021-08.

Results

Throughout collection days water depth (mean = 1.85 m SE ± 0.01 n = 403), temperature (mean = 29.15°C SE ± 0.04 n = 384), salinity (mean = 5.96 PSU SE ± 0.06 n = 384), and dissolved oxygen (mean = 5.42 mg L^{-1} SE ± 0.05 n = 384) were typical for this region during the summer (Table S2).

Across the reefs, reef substrate (live + dead oyster material) volume ranged from 4-48 L m^{-2}, live oyster densities ranged from 0-144 ind m^{-2}, and cluster volume ranged from 3.2-32 L m^{-2} (Table S3). Reef 1 had the lowest live oyster density and substrate while reef 2 had the highest live oyster density and substrate.

Trays consistently contained higher abundances compared to suction samples (Kruskal Wallis tests: Reef 1 $\chi^2 = 8.34$, df = 1, p = 0.004; Reef 2 $\chi^2 = 8.31$, df = 1, p = 0.004; Reef 3 $\chi^2 = 8.34$, df = 1, p = 0.004) and no significant differences in abundance were detected among reefs for either gear (Kruskal Wallis tests: suction $\chi^2 = 5.37$, df = 2, p = 0.07; tray $\chi^2 = 4.26$, df = 2, p = 0.12; Figure 2.A). Similarly, trays consistently contained higher richness than suction samples (Kruskal Wallis tests: Reef 1 $\chi^2 = 8.49$, df = 1, p = 0.004; Reef 2 $\chi^2 = 8.49$, df = 1, p = 0.004; Reef 3 $\chi^2 = 6.70$, df = 1, p = 0.0096; Figure 2.B). In trays, there was significantly lower richness at reef 1 compared to reef 2, and no differences between these reefs and reef 3 (Post Hoc Dunn tests: Reefs 1-2 Z = -2.75, p adj. = 0.02; Reefs 1-3 Z = -1.00, p adj. = 0.95; Reefs 2-3 Z = 0.75, p adj. = 0.24). No differences in richness among reefs were detected from suction samples (Kruskal Wallis tests: suction $\chi^2 = 5.30$, df = 2, p = 0.07). Trays consistently contained lower Pielou's evenness compared to suction samples (Kruskal Wallis tests: Reef 1 $\chi2 = 7.52$, df = 1, p = 0.006; Reef 2 $\chi2 = 8.37$, df = 1, p = 0.004; Site 3: $\chi2 = 8.34$, df = 1, p = 0.004; Figure 2.C). In suction samples, there was significantly higher evenness at reef 1 compared to reef 2, and no differences between these reefs and reef 3 (Post Hoc Dunn tests: Reefs 1-2 Z = 2.58, p adj. = 0.02; Reefs 1-3 Z = 0.92, p adj. = 1.00; Reefs 2-3 Z = -1.66, p adj. = 0.29). No differences in evenness among reefs were detected from tray samples. For tray and suction samples, Shannon-Wiener diversity did not differ between gears at reefs 1 and 2 but was significantly higher in suction samples than trays at reef 3 (Kruskal Wallis test: $\chi^2 = 8.43$, df = 1, p = 0.004; Figure 2.D). However, no differences in Shannon-Wiener diversity were detected among reefs for either gear.

Discussion

Ensuring comparable data is collected across projects and locations enables the development of robust databases to inform biodiversity protection (Flannery & Przeslawski, 2015). Here, we compared suction sampler and trays to assess benthic biodiversity metrics on and between oyster reefs and found significant differences in biodiversity metrics between gears, along with gear-

specific differences across individual reefs that varied by metric. Gear selectivity and efficiency, which can differ by habitat characteristics, likely contribute to differences in gear outcomes, further indicating that tray and suction sampling are not comparable biodiversity sampling gears on oyster reefs.

Biodiversity metrics often differ based on the targeted assemblages collected. Here, the average organism abundance of 1,806 ind m^{-2} (SE ± 318 m^{-2} n = 18) and 23 total taxa collected in trays was higher than majority of average fish and/or decapod crustacean abundance (ranging from 57-1,579 ind. m^{-2}) and total taxa (ranging from 8-22) per study in an oyster reef assemblage meta-synthesis across the Northern Gulf of Mexico (nGoM; La Peyre et al., 2019). Only two studies in the meta-synthesis, both from Texas reefs, reported higher numbers of abundance (2856 ind m^{-2}; Rezek et al., 2017) or total taxa (25; Blomberg et al., 2018). The meta-synthesis studies only included fish and/or decapod crustaceans, while here we also include smaller taxa such as amphipods, isopods, and polychaetes. When removing the smaller taxa from this dataset, average abundance (mean = 698 SE ± 51 m^{-2} n = 18) and total taxa (15) were more comparable to studies in La Peyre et al. (2019). Additionally, tray modifications, such as lining trays with mesh drawstring bags, can impact gear efficiency. We lined trays with a smaller mesh size (1mm) compared to past studies which likely contributes to the higher abundance observed (Beck & La Peyre, 2015). The inclusion of amphipods, which were numerically dominant in our trays along with our gear modification likely drove the higher abundances and richness captured but does not explain lower suction sampling results as suction sampling has largely focused on smaller fauna.

The use of suction sampling in reef environments is sparse but assemblage metrics are similar to trays in the nGoM likely because of the epifauna and infauna target assemblages. In contrast, our suction sample abundances ranged from 17-204 ind m^{-2} and richness from 2-10 which are lower than the few similar studies' ranges of abundance (241- 8,800 ind m^{-2}) and richness (6-12) per sample (Pinnell et al., 2021; Pollack et al., 2021). Differences in gear efficiency can create discrepancies across gears and is further impacted by gear modifications, such as modifying the amount of time used to suction a given area (Brown et al., 1987). We suctioned 0.23 m^{-2} area for 10 seconds, which is lower than 0.0625 m^{-2} area for 30 seconds in Pinnell et al. (2021), likely contributing to the lower abundance and richness in this study. Although Pinnel et al. (2021) collected organisms in a different geographic region (Pacific coast) compared to this study (nGoM), the cutoff size (>500 µm vs > 1mm in this study) of organisms and gear modifications used likely drove the comparatively higher assemblage metrics. Additionally, Pollack et al. (2021) combined gears on Texas reefs, using suction samplers to suction reef habitat placed within trays, whereas we used suction samplers and trays separately. Differences in reported abundance and richness between studies may partially stem from variations in gear design and methods (gear combinations, mesh size), resulting in differences in gear selectivity.

Both suction samplers and trays captured taxa that the other did not (tray = 8, suction = 6). Generally, suction samples captured more sessile invertebrates (e.g., *Ameritella mitchelli*)

associated with mud-bottom habitat than trays, while trays captured more mobile reef-associated taxa that suction samples did not (e.g., *Gobiesox strumosus*, Table 1). The average number of taxa captured only in trays (mean $_{\text{richness}}$ = 3.77 m^{-2} SE ± 0.68 n = 144 $_{\text{individuals per sample}}$) were more abundant than average taxa captured only in suction samples (mean $_{\text{richness}}$ = 0.56 m^{-2} SE ± 0.17 n = 108 $_{\text{individuals per sample}}$). These gear-specific taxa contributed to the higher tray abundance and richness compared to suction samples and is logical based on how each gear operates. Our two-week tray deployment time was not long enough for sessile invertebrates to settle and grow large enough to identify. Additionally, mobile taxa can escape the enclosed suction sampling area on uneven oyster reef substrate, likely explaining the fewer mobile taxa caught. In suction sampling studies within seagrass, a drop net is used to prevent mobile taxa from escaping and is not inherently a limitation of suction sampling (Ralph et al., 2013). However, it appears the use of drop nets with suction sampling has not translated to reefs yet. Reporting gear modifications and standardized (m^{-2}) biodiversity metrics allows for the comparison of assemblages across reefs and gears for biodiversity monitoring.

Our findings suggest tray and suction sampling are not comparable on oyster reefs and comparing biodiversity estimates across studies using these gears should be approached with caution. Differences in reef characteristics (e.g., structural complexity) can drive differences in the assemblage patterns among reefs (Pinnell et al., 2021). Tray and suction samples detected contrasting differences among reefs for richness and evenness and different relative rankings across space (e.g., tray average richness: reef 2 > reef 3 > reef 1, suction average richness: reef 3 > reef 2 > reef 1; Table S3). Additionally, when considering unique taxa (i.e., a taxon represented by a single individual within a sample), on average 51% of the taxa collected in a suction sample were unique, whereas only 17% of taxa within a tray were unique. More unique taxa collected in suction samples was likely due to a lack of abundance of common taxa also collected in trays in higher abundance. All trays had at least one numerically dominant taxa whose abundance was more than two times the sample-specific mean, but this only occurred in 44% of suction samples. The lower proportion of unique taxa and higher proportion of numerically dominant taxa in trays here explain the differences in Pielou's evenness and Shannon-Wiener diversity observed between the gears. Contrasting gear results of richness and abundance with Pielou's evenness led to the similarity in Shannon-Wiener diversity between gears. The samples collected via trays consistently contained more individuals, more dominant taxa, and had significantly different patterns among reefs compared to suction samples, highlighting the incomparable biodiversity metric results generated from these gears on oyster habitat.

Conclusions

Sampling gear choice can be based on time frame, equipment, funding, field standards and target assemblages. For oyster reef-associated assemblages, biodiversity metrics and detection of differences across reef characteristics differ between gears. While Pollack et al. (2021) captured taxa abundance and richness via suction samples that were similar to previous data captured using trays, we did not, indicating that other factors are contributing to the

differences detected in this study. Oyster reefs are structurally complex and difficult to sample, yet important biodiversity hotspots within estuarine environments (Coen & Grizzle, 2007). Because suction sampling has gained recent popularity to sample assemblages on oyster reefs, it remains unclear how habitat complexity, area sampled, and suction duration impact estimates of biodiversity generated from suction samples. Thus, continuing to innovate new methods for sampling biodiversity on oyster reefs may not reconcile discrepancies with past data, rather comparing and standardizing field methods may provide more benefits to future research and monitoring. Understanding biodiversity metrics and associated trade-offs for selecting a gear remains critical because the gear's effectiveness is dependent on the project goals and target assemblages (Yi et al., 2012). Our results provide managers, researchers, and practitioners with additional data to make decisions about gear selection and data interpretation for targeted studies and monitoring programs.

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References

Beck S, La Peyre MK. 2015. Effects of oyster harvest activities on Louisiana reef habitat and resident nekton communities. *Fishery Bulletin* 113:327–340.

Blomberg BN, Palmer TA, Montagna PA, Beseres Pollack J. 2018. Habitat assessment of a restored oyster reef in South Texas. *Ecological Engineering* 122:48–61.

Brown AV, Schram MD, Brussock PP. 1987. A vacuum benthos sampler suitable for diverse habitats. *Hydrobiologia* 153:241–247.

Coen L, Grizzle RE. 2007. The importance of habitat created by molluscan shellfish to managed species along the Atlantic coast of the United States. *Atlantic States Marine Fisheries Commission.*

Flannery E, Przeslawski R. 2015. Comparison of sampling methods to assess benthic marine biodiversity. Are spatial and ecological relationships consistent among sampling gear? *Geoscience* Australia.

Glaspie CN, Seitz RD, Ogburn MB, Dungan CF, Hines AH. 2018. Impacts of habitat, predators, recruitment, and disease on soft-shell clams *Mya arenaria* and stout razor clams *Tagelus plebeius* in Chesapeake Bay. *Marine Ecology Progress Series* 603:117–133.

Keklikoglou K, Chatzigeorgiou G, Faulwetter S, Kalogeropoulou V, Plaiti W, Maidanou M, Dounas C, Lampadariou N, Arvanitidis C. 2019. 'Simple' can be good, too: testing three hard bottom sampling methods on macrobenthic and meiobenthic assemblages. *Journal of the Marine Biological Association of the United Kingdom* 99:777–784.

La Peyre MK, Marshall DA, Lindsay S. Miller, Humphries AT. 2019. Oyster reefs in northern Gulf of Mexico estuaries harbor diverse fish and decapod crustacean assemblages: a meta-synthesis. *Frontiers in Marine Science* 6:1–13.

La Peyre MK, Sable S, Taylor C, Watkins KS, Kiskaddon E, Baustian M. 2021. Effects of sample gear on estuarine nekton assemblage assessments and food web model simulations. *Ecological Indicators* 133:108404.

Lotze HK, Lenihan HS, Bourque BJ, Bradbury RH, Cooke RG, Kay MC, Kidwell SM, Kirby MX, Peterson CH, Jackson JBC. 2006. Depletion, degradation, and recovery potential of estuaries and coastal seas. *Science* 312:1806–1809.

Mihoub J-B, Henle K, Titeux N, Brotons L, Brummitt NA, Schmeller DS. 2017. Setting temporal baselines for biodiversity: the limits of available monitoring data for capturing the full impact of anthropogenic pressures. *Sci Rep* 7:41591.

Oksanen J, Blanchet FG, Friendly M, Kindt R, Legendre P, McGlinn D, Minchin PR, O'Hara RB, Simpson GL, Solymos P, et al. 2022. Vegan: Community Ecology Package.

Pinnell CM, Ayala GS, Patten MV, Boyer KE. 2021. Seagrass and oyster reef restoration in living shorelines: effects of habitat configuration on invertebrate community assembly. *Diversity* 13:246.

Pollack JB, Palmer TA, Williams AE. 2021. Medium-term monitoring reveals effects of El Niño Southern Oscillation climate variability on local salinity and faunal dynamics on a restored oyster reef. *PLOS ONE* 16:e0255931.

R Core Team. 2022. R: A language and environment for statistical computing.

Ralph GM, Seitz RD, Orth RJ, Knick KE, Lipcius RN. 2013. Broad-scale association between seagrass cover and juvenile blue crab density in Chesapeake Bay. *Marine Ecology Progress Series* 488:51–63.

Rezek RJ, Lebreton B, Roark EB, Palmer TA, Pollack JB. 2017. How does a restored oyster reef develop? An assessment based on stable isotopes and community metrics. *Marine Biology* 164:54.

Slack KV, Ferreira RF, Averett RC. 1986. Comparison of four artificial substrates and the ponar grab for benthic invertebrate collection. *Journal of the American Water Resources Association* 22:237–248.

Stoner AW, Greening HS, Ryan JD, Livingston RJ. 1983. Comparison of macrobenthos collected with cores and suction sampler in vegetated and unvegetated marine habitats. *Estuaries* 6:76–82.

True MA, Reys J-P, Delauze H. 1968. Progress in sampling the benthos : the benthic suction sampler. *Deep Sea Research and Oceanographic Abstracts* 15:239–242.

United Nations Environment Programme [UNEP]. 2021. First draft of the post-2020 global biodiversity framework, in Proceedings of the United Nations Environment Programme Conference of the Parties (COP) to the UN Convention on Biological Diversity, (Nairobi: UNEP).

WeatherStations [Internet]. Cocodrie, LA: Louisiana Universities Marine Consortium;, 20 February, 2023. Available from: *http://weatherstations.lumcon.edu/index.html*

Wells HW. 1961. The fauna of oyster beds, with special reference to the salinity factor. *Ecological Monographs* 31:239–266.

Yi Z, Jinchao F, Dayuan X, Weiguo S, Axmacher JC. 2012. A comparison of terrestrial arthropod sampling methods. *Jore* 3:174–182.

Table 1(on next page)

Table of taxa (scientific and common names) that were only captured by either trays or suction samples.

Scientific name	Common name	Average abundance m^{-2}
Trays		
Diptera Chironomidae	Midge larvae	2.41
Pachygrapsus gracilis	Dark shore crab	0.24
Ctenogobius boleosoma	Darter Goby	3.86
Gobiesox strumosus	Skillet fish	20.01
Hypsoblennius hentz	Feather blenny	1.69
Isopoda Ancinidae	Isopod family	0.72
Nemertea	Ribbon worm	0.48
Alpheidae spp	Snapping shrimp	0.72
Suction samples		
Ampelisca abdita	Amphipod spp	0.96
Mytilopsis leucophaeata	Conrad false mussel	0.96
Ameritella mitchelli	Mollusc spp	0.24
Arcuatula papyria	Atlantic paper mussel	0.48
Pleuronectiformes	Young of the year flatfish	0.48
Gobionellus oceanicus	Highfin goby	0.24

1

Figure 1

Experimental design set up.

Image of Louisiana with a black circle indicating the study area (A) Image of study area with black circles indicating the location of each reef (B). Example of one reef where trays and suction samplers were located(C). Trays were placed in a row parallel to the marsh edge, centered on each reef, and spaced ~1 m apart. Suction samples were taken haphazardly on each reef.

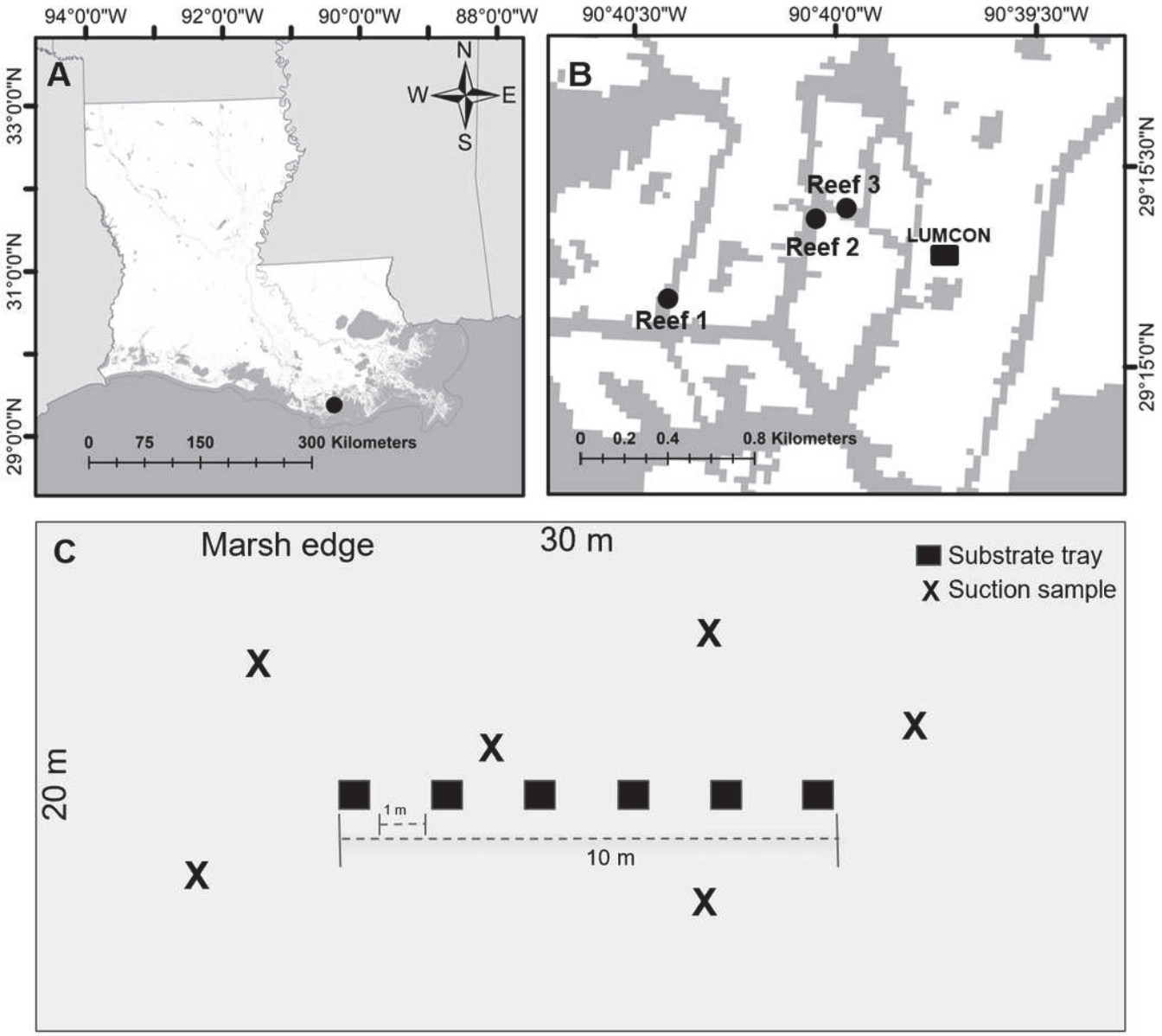
94°0'0"W
92°0'0"W
90°0'0"W
88°0'0"W
33°0'0"N
31°0'0"N
29°0'0"N
A
N
W
E
S
0 75 150 300 Kilometers
90°40'30"W
90°40'0"W
90°39'30"W
29°15'30"N
29°15'0"N
B
Reef 3
Reef 2
LUMCON
Reef 1
0 0.2 0.4 0.8 Kilometers
C
Marsh edge
30 m
Substrate tray
Suction sample
20 m
1 m
10 m

Figure 2

Boxplots of biodiversity metrics by reef and grouped by sampling gear (i.e., suction samples or trays).

Black dots indicate each sample replicate, horizontal lines through the boxes indicate the median, lower and upper extents of the boxes correspond to the first and third quartiles (Q1 and Q3). The upper whisker represents Q3 ×1.5 × interquartile range (IQR; inter-quartile range, or distance between the first and third quartiles) and the lower whisker represents Q1 ×1.5 × IQR.