Journal of Marine Science and Engineering

Article

The Effect of Environmental Dredging of Muck on an Assemblage of Benthic Amphipods

Nayan Mallick [1,*,†], Kevin B. Johnson [1] and Charles A. Jacoby [2]

[1] Department of Ocean Engineering and Sciences, Florida Institute of Technology, Melbourne, FL 32901, USA
[2] St. Johns River Water Management District, Palatka, FL 32177, USA
* Correspondence: nmallick@email.sc.edu
† Current address: Department of Biological Sciences, University of South Carolina, Columbia, SC 29208, USA.

Abstract: To yield environmental benefits, fine sediments with ~10% organic matter, termed muck, were dredged from a tributary to the Indian River Lagoon. Key changes were documented by sampling amphipods, sediments, and the water column near the bottom before dredging, and approximately one month and one year after dredging. Overall, muck yielded the fewest taxa, muck or sediments in creeks that were dredged yielded a moderate number of taxa, and undisturbed sediments in the lagoon yielded the highest number of taxa. Amphipods did not appear in areas with muck until one month and one year after dredging. In contrast, amphipods in sediments that were not muck decreased after dredging. Increases in the occurrence of amphipods paralleled increases in concentrations of dissolved oxygen and decreases in the water, silt/clay, and organic content of sediments. Overall, results indicated that conditions for amphipods were improved by removing muck, and that dredging sandier sediment led to decreased taxonomic richness and numbers of amphipods, which resembled the effects of navigational dredging. Thus, this study suggested that managers should consider the type of sediment to be dredged when permitting projects.

Keywords: benthic infauna; sediment; restoration; Indian River Lagoon

check for updates

Citation: Mallick, N.; Johnson, K.B.; Jacoby, C.A. The Effect of Environmental Dredging of Muck on an Assemblage of Benthic Amphipods. *J. Mar. Sci. Eng.* **2023**, *11*, 444. https://doi.org/10.3390/jmse11020444

Academic Editor: Panagiotis D. Dimitriou

Received: 8 December 2022
Revised: 12 February 2023
Accepted: 15 February 2023
Published: 17 February 2023

1. Introduction

Dredging commonly has been used to improve navigability by increasing the depth of a water column, and surveys of benthic fauna have documented detrimental changes from such activity at the population and assemblage levels. Following such dredging, numbers of individuals often were reduced (e.g., [1,2]), in some cases up to 95% [3]. For this reason, many agencies and coastal managers have required surveys of infauna, or instituted policies specifying methods that limit negative impacts from dredging [4–6].

In contrast, dredging to improve benthic habitats by removing polluted or inhospitable sediments has been designed to increase, rather than decrease, populations of infauna (e.g., [7]). For example, Fuller et al. (2021) [8] found that diversity and abundance of infauna were lower in organic-rich sediments, and Cox et al. (2018) [9] found that removing fine-grained sediments prone to hypoxia or anoxia, termed muck, induced colonization by polychaetes. Muck has been defined as sediment with >75% water by weight, >60% silt/clay, and >10% organic matter, with bacterial decomposition of organic matter often creating hypoxic or anoxic conditions (oxygen concentrations < 2 mg L^{-1}) in the sediments and overlying water column [10]. In addition to low concentrations of oxygen, hydrogen-sulfide gas produced by sulfur-oxidizing bacteria in the hypoxic and anoxic muck has been found to be toxic [11]. In fact, multiple studies indicated that hypoxia and toxicity reduced benthic diversity and productivity, constrained populations, altered food webs, and disrupted trophic links [12–21].

Until recently, muck covered approximately 10% of the bottom in the Indian River Lagoon (IRL), a diverse, shallow, subtropical estuary in Florida, USA [22–28]. Muck was targeted for removal because it potentially was associated with several undesirable effects, beyond creating low concentrations of dissolved oxygen and high concentrations of toxic hydrogen sulfide. It smothered benthic vegetation and infauna, and it fueled harmful algal blooms when bacterial activity released nitrogen and phosphorus into the water column [25]. In turn, algal blooms limited light availability and hampered photosynthesis by benthic macroalgae and seagrass, as was seen during the "superbloom" in 2011 [25,29–31]. The resulting extensive loss of seagrass contributed to an unusual mortality event for manatees, because toxic bacteria in their guts reacted to increased consumption of macroalgae [32]. Furthermore, mass mortalities of fish resulted from low concentrations of dissolved oxygen generated by the senescence and decomposition of some blooms [25]. Overall, muck in the lagoon created a detrimental feedback loop. Senescing and sinking algal cells combined with other particles to form muck that contained a reservoir of organic matter, and decomposition of this matter led to reduced concentrations of dissolved oxygen, increased concentrations of hydrogen sulfide, and increased fluxes of bioavailable nutrients that fueled additional algal blooms [20].

An opportunity to examine the effects of removing muck arose when Brevard County, a county that borders much of the IRL, conducted environmental dredging to remove muck and improve the health of an embayment at the mouth of a creek. As in other evaluations of dredging, the abundances and distributions of benthic fauna represented key measures of the system's health, due to their ecological importance and relatively limited mobility [33–40]. In particular, amphipods were of interest because previous work has shown: (a) they constitute a significant portion of many macroinvertebrate assemblages in the benthic and pelagic habitats of freshwater and marine environments [2,34,41–48]; (b) they fill multiple ecological roles as grazers, predators, parasites, or non-native invaders [41–43,49,50]; and (c) they serve as food for other invertebrates, fish, and seabirds [51]. Their simple life cycle, site fidelity, high abundances, broad environmental tolerances, and rapid growth have made amphipods good candidates for biological monitoring [1,2,52–55]. Furthermore, amphipods have been shown to be sensitive to environmental conditions, which led to their use in bioassays, including those testing the toxicity of sediments [44,56–61]. In fact, the U.S. Environmental Protection Agency recognized their importance and required data on amphipod populations before permitting projects that could impact benthic habitats [34].

Our goal was to detect changes in the assemblages of amphipods that were related to environmental dredging. Detecting changes associated with dredging, or any unreplicated disturbance, using a mensurative experiment based on sampling disturbed and control locations can be complicated by spatiotemporal variation that is not related to the disturbance and cannot be controlled to the same extent as in a manipulative experiment [62,63]. We anticipated such challenges, because dredging was limited to the mouth of a single creek and sampling was constrained by logistics. To address spatial variation in assemblages, we sampled several undisturbed locations at differing distances from the area that was dredged, and to address temporal variation, we sampled assemblages before, one month after, and one year after dredging.

Given this background, we tested the following null hypotheses: (a) sediments in different locations had similar characteristics before and after dredging, and (b) the assemblages of amphipods did not differ before and after dredging.

2. Materials and Methods

The IRL system comprises three lagoons—Mosquito Lagoon, Banana River Lagoon, and Indian River Lagoon proper—that span 40% of the east coast of Florida, USA and the transition from subtropical to temperate biogeographic regions [64–66]. The system is shallow (mean depth ~1.2 m) and relatively narrow (width 0.8–8.0 km) [66]. Concentrations of dissolved oxygen decrease with seasonal increases in water temperatures [66]. Salinities vary along the length of the system, being high in the northern portion due to limited freshwater inflows and higher rates of evaporation, high in the southern portion due to tidal exchange through four inlets, and lower in the central portion due to the lack of inlets and the presence of tributaries and canals that deliver fresh water [66]. Except for areas near the inlets, circulation and exchange are driven mainly by wind [66]. The resulting month-long to year-long residence times in most of the system means that nutrients accumulate, which can cause blooms of phytoplankton [25,66–70]. The restricted circulation and limited mixing also facilitate the accumulation of fine-grained organic-rich sediments, commonly called muck, which have accumulated on top of the natural sand and shell since the watershed was developed [7]. Muck becomes hypoxic or anoxic, and contains hydrogen sulfide due to bacterial decomposition of organic matter, which along with metals and organic toxins can inhibit use by infauna [7].

Samples of sediment and infauna were collected near two tributaries: Turkey and Crane creeks (Figure 1). Dredging commenced in Turkey Creek in February 2016, and following a shutdown for manatee season, resumed in September 2016 and continued until January 2017 [7]. Sampling in both locations was undertaken one month prior to dredging (January 2016), approximately one month after dredging was completed (February 2017), and approximately one year after dredging was completed (December 2017). During each event, samples were collected at: (a) four stations in Turkey Creek where muck was dredged (TC1 to TC4); (b) two stations in Crane Creek where muck was present, but not dredged (CC1 and CC2); (c) two stations in Turkey Creek that lacked muck and were not dredged (TC5 and TC6); (d) two stations in Turkey Creek that lacked muck and were dredged (TC7 and TC8); and (e) four stations in the Indian River Lagoon proper that were near each tributary, lacked muck, and were not dredged (TC9 to TC12 and CC3 to CC6; Figure 1). Thus, logistics associated with dredging resulted in a sampling design that was unbalanced, with no data being available for sediments in the lagoon that were dredged (Table 1).

At each station, during each sampling event, two types of sampling were undertaken. Three replicate samples were collected to characterize infauna and an additional sample was collected to characterize properties of the sediment. These samples were taken with a petite ponar grab that sampled 225 cm^2. In addition, salinity, pH, temperature, and concentrations of dissolved oxygen were determined near the bottom using a Yellow Springs Instruments multimeter.

Samples of infauna were sieved through 0.5 mm mesh, and the material retained was bagged and frozen. Numbers of infauna in these samples obviated counts of entire samples. For this reason, one-eighth aliquots of thawed samples were examined via stereomicroscopy (8–35× magnification), a process that required an average of two hours of sorting per sample. Amphipods were identified to the lowest possible taxonomic level, and all individuals in the aliquots were counted. This approach yielded more than 100 individuals of abundant taxa per sample.

Samples collected to characterize sediments were analyzed for percentage of water by weight via drying at 135 °C for 24 h, percentage of silt/clay combined based on dry weights, and percentage of organic matter (via loss on ignition; [71]). To determine percentages of silt/clay, 10 g of muck or 30 g of sediments that were not muck were sieved through a 63 μm sieve. Material that was retained was heated at 135 °C for 24 h and re-weighed to obtain the weight of silt/clay.

Table 1. Sampling design showing the number of stations in categories used in analyses.

Location	Sediment	Treatment	Number of Stations
Lagoon	Not muck	Undisturbed	8
	Muck	Dredged	0
Creek	Not muck	Undisturbed	2
		Dredged	2
	Muck	Undisturbed	2
		Dredged	4
Total			18

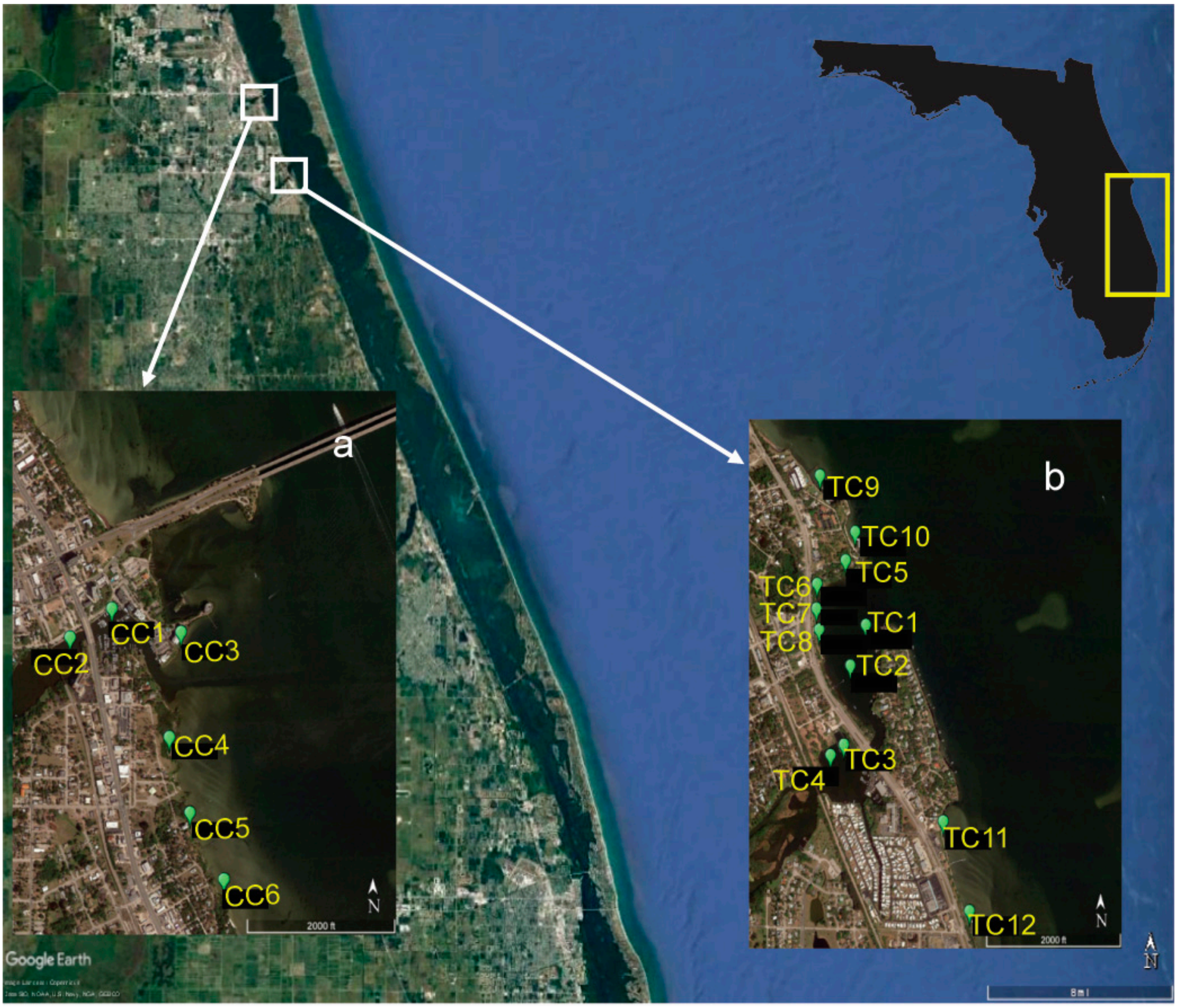

Figure 1. Florida and the region of interest in the Indian River Lagoon (box on inset), along with the stations in: (**a**) Crane Creek and the adjacent Indian River Lagoon, and (**b**) Turkey Creek and the adjacent Indian River Lagoon. CC1 and CC2 = stations in Crane Creek where muck was not dredged, CC3–CC6 = stations in the lagoon near Crane Creek where sediment that was not muck remained undisturbed, TC1–TC4 = stations in Turkey Creek where muck was dredged, TC5 and TC6 = stations in Turkey Creek where sediment that was not muck remained undisturbed, TC7 and TC8 = stations in Turkey Creek where sediment that was not muck was dredged, TC9–TC12 = stations in the lagoon near Turkey Creek where sediment that was not muck remained undisturbed.

Data characterizing sediments and counts of amphipods were analyzed with permutation analyses of variance (PERMANOVAs; [72]). The PERMANOVAs treated the muck, sediments in the creeks that were not muck, and sediments in the lagoon as levels of a fixed factor termed Sediment. The PERMANOVAs also treated dredged and undisturbed as levels of another fixed factor termed Treatment. Finally, the model treated before, one month after, and one year after as levels of a random factor, nested in the interaction of sediment and treatment, which was termed Event. The nesting acknowledged the repeated measures approach arising from sampling at fixed sites where abundances of amphipods were expected to follow potentially unique temporal trajectories [62,63], and the factor was treated as random in recognition of the fact that the chosen times were not the sole focus of the analysis. Before Euclidean distance was used to generate the required resemblance matrix, data characterizing sediments were range standardized across all samples ([value—minimum value]/range). Similarly, counts of amphipods were range standardized before Bray–Curtis distances were calculated, so that the focus was on patterns rather than absolute abundances. Due to the unbalanced design, Type III sums of squares were used in the PERMANOVAs [65]. To visualize similarity among different sediment types, non-metric multidimensional scaling was used [73].

Significant effects in the PERMANOVAs were examined further using non-metric multidimensional scaling for the average characteristics of sediments, and a similarities percentages analysis (SIMPER) for counts of amphipods [65]. Data for amphipod taxa highlighted by SIMPER were used to prepare graphs showing the proportion of total individuals found in the appropriate set of samples.

3. Results

Analysis of the data characterizing sediments indicated that those characteristics varied among Events across the interaction between Sediment and Treatment, i.e., differing temporal trajectories among sites that could be distinguished by type of sediment and treatment accounted for a significant proportion of the variation in the data (Table 2). Non-metric multidimensional scaling applied to the relevant range-standardized mean values indicated that undisturbed creek sediments that were not muck were more similar to sediments in the lagoon, unless they were dredged, and then they became more similar to undisturbed muck shortly after dredging (Figure 2). In contrast, muck that was dredged became more similar to undisturbed sediments in the creeks (Figure 2). Creek sediments that were dredged exhibited a decrease in mean concentrations of dissolved oxygen (7.4 mg L^{-1} down to under 3.2 mg L^{-1}), an increase in mean organic content (8% to over 15%), and an increase in mean silt/clay content (31% to over 54%). In contrast, muck that was dredged exhibited an increase in mean concentrations of dissolved oxygen (<1 mg L^{-1} to 2 mg L^{-1}), a decrease in mean organic content (21% to 9%), and a decrease in mean silt/clay content (93% to 47%).

Table 2. Results of permutation analyses of variance. Se = type of sediment (muck in a creek, sediment that was not muck in a creek, and sediment in the lagoon), Tr = treatment (undisturbed or dredged), Ev = sampling event (before dredging, one month after dredging, and one year after dredging).

Data	Source	df	SS	MS	Pseudo-F Ratios	*p*	Unique Permutations
Sediment	Se	2	8.59	4.30	15.32	0.002	999
	Tr	1	0.16	0.16	0.67	0.501	997
	Se × Tr	1	1.32	1.32	5.67	0.021	998
	Ev(Se × Tr)	10	3.06	0.30	2.89	0.001	999
	Residual	39	4.13	0.10			
	Total	53	23.46				
Counts	Se	2	1230	615	1.08	0.414	999
	Tr	1	316	316	0.68	0.584	997
	Se × Tr	1	388	388	0.84	0.517	999
	Ev(Se × Tr)	10	6234	623	3.45	0.001	996
	Residual	147	26,499	180			
	Total	161	34,601				

The compositions of the assemblages of amphipods also varied significantly among sampling events, i.e., a significant proportion of the variation in the data was due to differing temporal trajectories among sites that could be distinguished by type of sediment and treatment (Table 2). According to SIMPER, all eight taxa found in samples contributed to significant differences, i.e., *Grandidierella* sp., *Cymadusa compta*, *Cerapus tubularis*, *Corophium* sp., *Grandidierella bonnieroides*, *Jassa* sp., *Eusirus cuspidatus*, and *Gammarus mucronatus* (Figure 3), with *Jassa* sp. found only in undisturbed sand one year after dredging

(Figure 3a). *Cymadusa compta* was the only amphipod found at stations with undisturbed muck (Figure 3d), and several taxa occurred primarily at stations in the lagoon where sediments were not disturbed (Figure 3a). Stations where muck was dredged showed an increase in the occurrence of three taxa, and the most taxonomically rich assemblage appeared one month after dredging (Figure 3e). Stations in Turkey Creek with sediments that were not muck, but were dredged, only yielded one taxon (*C. compta*), and it was less prevalent after dredging (Figure 3c).

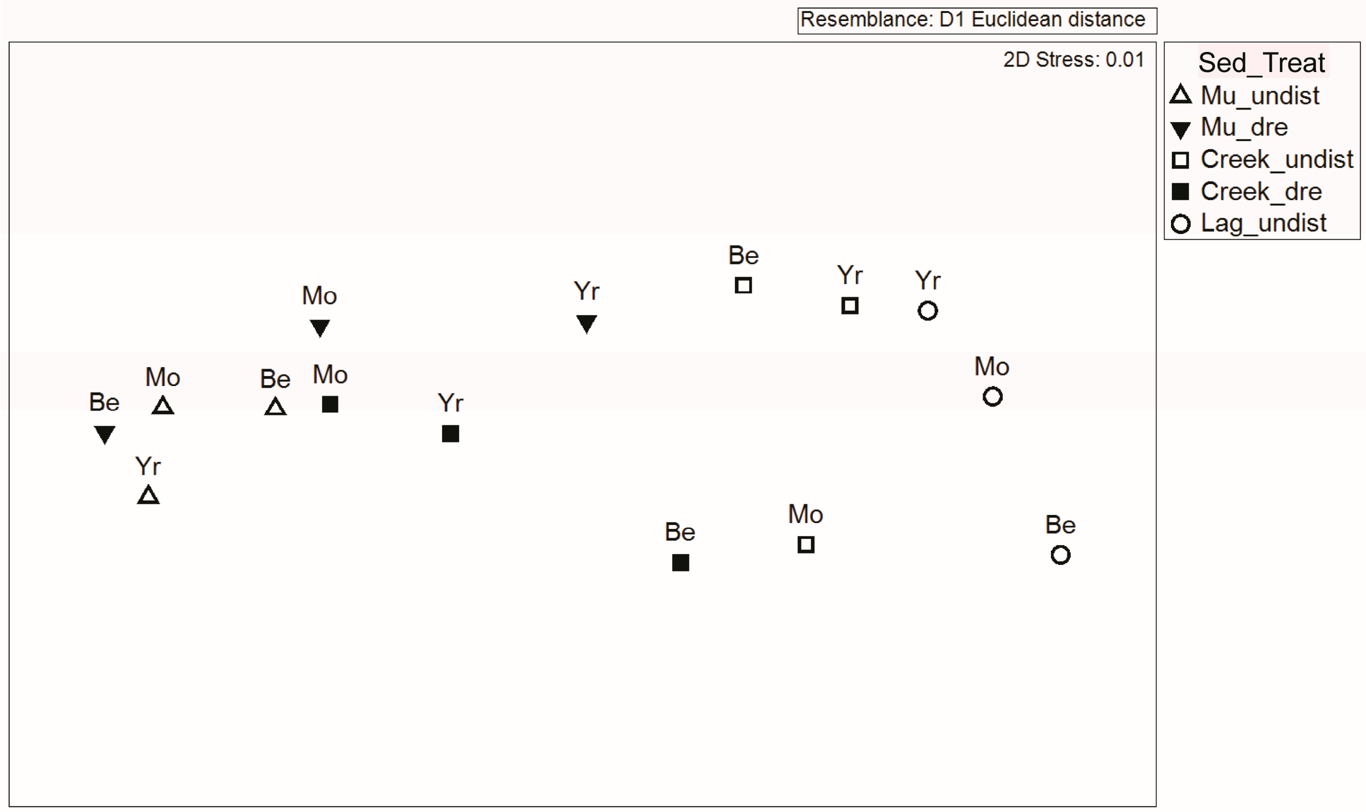

Figure 2. Non-metric multidimensional scaling based on mean values for characteristics of sediments. Mu_undist = muck that was not dredged, Mu_dre = muck that was dredged, Creek_undist = sediments in creeks that were not dredged, Creek-dre = sediments in creeks that were dredged, Lag_undist = sediments in the lagoon that were not dredged, Be = before dredging, Mo = one month after dredging, Yr = one year after dredging.

Although the amphipod assemblage varied in space and through time irrespective of dredging, the results indicated two important patterns. Dredging sandy sediments reduced the taxonomic richness and occurrence of amphipods as has been noticed in previous studies, whereas removing muck led to colonization by amphipods.

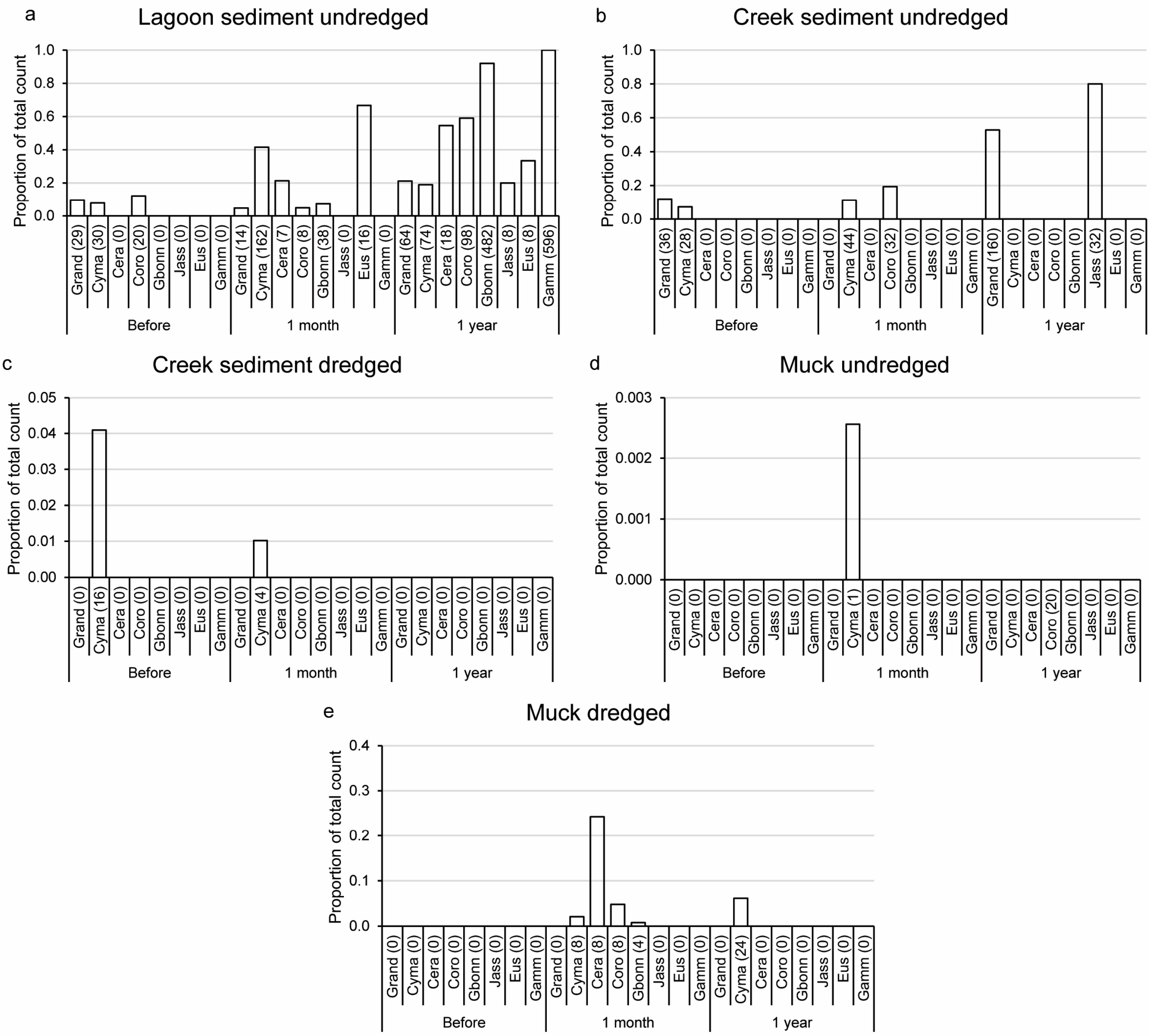

Figure 3. Proportion of each amphipod taxon found in (**a**) sediments in the lagoon that were not muck and were not dredged, (**b**) sediments in the creeks that were not muck and were not dredged, (**c**) sediments in Turkey Creek that were not muck and were dredged, (**d**) sediments in the creeks that were muck and were not dredged, and (**e**) sediments in Turkey Creek that were muck and were dredged, with the number of individuals in parentheses following the taxon. Note the differences in the y-axes. Grand = *Grandidierella* sp., Cyma = *Cymadusa compta*, Cera = *Cerapus tubularis*, Coro = *Corophium* sp., Gbonn = *Grandidierella bonnieroides*, Jass = *Jassa* sp., Eus = *Eusirus cuspidatus*, and Gamm = *Gammarus mucronatus*.

4. Discussion

Dredging to improve navigability has reduced populations of infauna in many cases (e.g., [1–3]). Such effects have prompted agencies and coastal managers to require surveys of infauna or enforce strict policies about how dredging occurs to limit detrimental impacts [4–6]. In contrast, environmental dredging of muck, such as that conducted in association with this study, has different objectives. The main goal of the environmental dredging in this study was to improve benthic habitats by removing sediments that were polluted or uninhabitable for most macrobenthic organisms, so that populations of infauna would increase [7]. Although the taxonomic richness, composition of assemblages, and densities of individual taxa varied independently of dredging, amphipods did colonize areas following the removal of muck.

Abundances of amphipods often have been associated with increased concentrations of oxygen and reduced amounts of organic matter. In fine sediments with high organic content, hypoxia has been a common phenomenon [9,15,20,74–76], and amphipods have been shown to be sensitive to high organic content and low concentrations of dissolved oxygen [44,56,77]. The environmental dredging in this study removed 160,000 m^3 of muck from Turkey Creek, and as a result, mean organic matter in the sediment (±standard error) was reduced from 20.8 ± 0.6% to 16.0 ± 1.9% immediately following dredging (2016–2017), and fell below the 10% operationally defined threshold for muck by one year after dredging [10]. As expected, removing muck increased concentrations of dissolved oxygen in the water near the bottom from 0.2 mg L^{-1} or almost anoxic to over 2.0 mg L^{-1} one year after the dredging. However, the organic content of dredged sediment was still above the 2% threshold that was shown to be conducive to healthy assemblages of benthic macrofauna [78].

The appearance of *C. compta*, *C. tubularis*, and *Corophium* sp. by one month after dredging suggested that the removal of organic matter improved the habitat. A tendency to colonize sandier sediments that support construction of tubes and dietary preferences may have fostered colonization of dredged habitats by amphipods [79,80]. After dredging, settlement of resuspended and newly oxidized organic matter should have offered new food resources to detritivorous and opportunistic amphipods [3,41,79–83]. In addition, mobile, opportunistic amphipods have exploited a variety of habitats. For example, *G. bonnieroides* in the IRL has been found in diverse soft sediments ranging from sandy to muddy and in areas dominated by algae [84]. Its varied diet included fungi, bacteria, detritus, and epiphytes [80,85], and this adaptability may have contributed to its presence in sediments in the lagoon and its colonization of areas where muck was dredged.

In general, the taxa that colonized areas where muck was dredged, i.e., *C. compta*, *C. tubularis*, *Corophium* sp., and *G. bonnieroides*, may have been those that were most adaptable. Although amphipods generally have been described as environmentally sensitive [86], some taxa have been considered tolerant of stress or pollution. For example, *Corophium ellisi* has been recorded in Sykes Creek, a polluted tributary of the IRL (Grizzle, 1984), and *Corophium lacustrae* was present and abundant in contaminated sediments in the Gulf of Mexico [86]. In contrast, *Corophium salmonis* recolonized sediments only after discharges of sewage effluent ceased [87], and abundances of *Medicorophium runcicorne* declined near sewage outfalls [77]. Overall, past work has underscored the fact that different taxa have different degrees of tolerance for stress [12].

Spatial variation often has been reported for benthic fauna [9,88–90], and stations in the lagoon tended to have more taxa and higher numbers of amphipods than stations in the mouths of the creeks, throughout this study. In addition, the significant proportion of the variation in the data accounted for by sampling events in an analysis of the occurrence of amphipods meant that changes likely were due to a combination of dredging and proximity to freshwater inputs, proximity to structural habitats, or other factors that altered the temporal trajectories of abundances at any site. For example, Nelson et al. (1982) [91] observed highly variable abundances of amphipods in the IRL, and time of year and proximity to seagrasses played roles in this variability. In this study, spatial variation influenced but did not obscure responses to dredging.

In addition to spatial variation, temporal variation appeared responsible for some of the differences in occurrences of amphipods, because a significant proportion of the variation in the data was accounted for by sampling events. For example, numbers of individuals differed in the second and third sampling events. In other studies, temporal variation among sampling events has made the comparison of affected and unaffected areas problematic, with dredged areas recovering after a few months and undisturbed control areas exhibiting variable abundances [3,53]. Short-term extreme events, such as hurricanes, storms, and monsoons, also have reduced abundances, and sometimes preceded the disappearance of particular taxa in other studies [92–95]. In this study, Hurricane Irma, which landed in central Florida in September 2017, and warmer water temperatures in December 2017, may have influenced densities of amphipods because similar temporal changes have been reported before [53,91]. Nevertheless, statistically significant variations in the temporal trajectories of amphipod assemblages were identified, i.e., amphipods colonized areas where muck had been dredged and became less prominent in areas where other sediments were dredged.

Time for colonization and recovery after disturbances has varied among studies, i.e., the temporal trajectories for abundances of amphipods at sites that were disturbed varied. After storm impacts on benthic habitats in the Swan–Canning Estuary, macrofauna recovered in three to four months [19]. Recovery from navigational dredging took six months for the infaunal assemblage in La Coruña Bay, Spain [96], nearly eight months in Danube harbors [97], and a full year for assemblages in the North Sea [98] and Guadalquivir Estuary, Spain [99]. Recovery from oil spills took longer. Nikitik and Robinson (2003) [100] reported that recovery of amphipods after the Sea Empress oil spill in 1996 in Milford Haven Waterway took five years. In addition, it took eight years for an ampeliscid amphipod to reappear after the Amoco Cadiz oil spill near the coast of Brittany, France in 1978, and full recovery took longer [101]. In this study, four amphipod taxa appeared at the stations where muck was dredged by one month after dredging (February 2017), but sediments in the mouths of creeks always yielded fewer taxa and individuals. Thus, a rigorous assessment of recovery awaits further sampling. Dissimilarities between this study and others suggested that removal of sediments with high organic content resulted in colonization by amphipods. Short-term improvements and recoveries suggested that focusing on removal of organically enriched sediments showed promise for restoring benthic habitats, although the assemblage did not achieve the taxonomic richness or numbers of individuals that characterized stations in the lagoon with sandier sediments within a year.

5. Conclusions

Environmental dredging of muck reduced sediment organic content and associated stressors (e.g., silt/clay content and low concentrations of dissolved oxygen in water near the bottom). Following these changes, amphipod taxa colonized stations where muck was dredged. In contrast, amphipods became less numerous at stations where creek sediments that were not muck were dredged. Overall, the results pointed to beneficial effects on amphipod assemblages from dredging that removed muck; therefore, managers should consider such dredging as different from traditional dredging of hospitable sediments to improve navigation [7–9].

Author Contributions: Conceptualization, N.M. and K.B.J.; methodology, N.M. and K.B.J.; formal analysis, N.M. and C.A.J.; investigation, N.M.; resources, K.B.J.; data curation, N.M.; writing—original draft preparation, N.M.; writing—review and editing, K.B.J. and C.A.J.; visualization, N.M. and C.A.J.; supervision, K.B.J.; project administration, K.B.J.; funding acquisition, K.B.J. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by a grant from the Florida Department of Environmental Protection administered by the Brevard County Natural Resources Management Department and awarded to Kevin B. Johnson, grant number NS005.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Data is available from authors upon request.

Acknowledgments: We thank Anthony Cox, Daniel Hope, Xiao Ma, Angelica Zamora-Duran, Danielle Juzwick for their help during field work.

Conflicts of Interest: The authors declare that they have no known competing financial interest or personal relationships that could have appeared to influence the work reported in this paper.

References

1. Lewis, M.A.; Weber, D.E.; Stanley, R.S.; Moore, J.C. Dredging Impact on an Urbanized Florida Bayou: Effects on Benthos and Algal-Periphyton. *Environ. Pollut.* **2001**, *115*, 161–171. [CrossRef]
2. Rehitha, T.V.; Ullas, N.; Vineetha, G.; Benny, P.Y.; Madhu, N.V.; Revichandran, C. Impact of Maintenance Dredging on Macrobenthic Community Structure of a Tropical Estuary. *Ocean. Coast. Manag.* **2017**, *144*, 71–82. [CrossRef]
3. Newell, R.C.; Seiderer, L.J.; Hitchcock, D.R. The Impact of Dredging Works in Coastal Waters: A Review of The Sensitivity to Disturbance and Subsequent Recovery of Biological Resources on the Sea Bed. *Oceanogr. Mar. Biol. Annu. Rev.* **1988**, *36*, 127–178.
4. New Jersey Department of Environmental Protection. *The Management and Regulation of Dredging Activities and Dredged Material in New Jersey's Tidal Waters*; New Jersey Department of Environmental Protection (NJDEP): Trenton, NJ, USA, 1997.
5. Lukens, J. *National Coastal Program Dredging Policies*; National Oceanic and Atmospheric Administration (NOAA): Washington, DC, USA, 2000; p. 320.
6. Fales, T. Safe Harbors: A Comparative Analysis of Dredging Regulation in New England. *Ocean Coast. Law. J.* **2016**, *21*, 245–264.
7. Fox, A.L.; Trefry, J.H. Environmental Dredging to Remove Fine-Grained, Organic-Rich Sediments and Reduce Inputs of Nitrogen and Phosphorus to a Subtropical Estuary. *Mar. Technol. Soc. J.* **2018**, *52*, 42–57. [CrossRef]
8. Fuller, K.M.; Fox, A.L.; Jacoby, C.A.; Trefry, J.H. Biological Abundance and Diversity in Organic-Rich Sediments From a Florida Barrier Island Lagoon. *Front. Mar. Sci.* **2021**, *8*, 1730. [CrossRef]
9. Cox, A.; Hope, D.; Zamora-Duran, M.A.; Johnson, K.B. Environmental Factors Influencing Benthic Polychaete Distributions in a Subtropical Lagoon. *Mar. Technol. Soc. J.* **2018**, *52*, 58–74. [CrossRef]
10. Trefry, J.H.; Metz, S.; Trocine, R.P.; Iricanin, N.; Burnside, D.; Chen, N.-G.; Webb, B. *Design and Operation of a Muck Sediment Survey*; St. Johns River Water Management District: Palatka, FL, USA, 1990; p. 68.
11. Levin, L.A.; Ekau, W.; Gooday, A.J.; Jorissen, F.; Middelburg, J.J.; Naqvi, S.W.A.; Neira, C.; Rabalais, N.N.; Zhang, J. Effects of Natural and Human-Induced Hypoxia on Coastal Benthos. *Biogeosciences* **2009**, *6*, 2063–2098. [CrossRef]
12. Pearson, T.H.; Rosenberg, R. Macrobenthic Succession in Relation to Organic Enrichment and Pollution of the Marine Environment. *Oceanogr. Mar. Biol. Annu. Rev.* **1978**, *16*, 229–311.
13. Bolam, S.G.; Fernandes, T.F.; Huxham, M. Diversity, Biomass, and Ecosystem Processes in the Marine Benthos. *Ecol. Monogr.* **2002**, *72*, 599–615. [CrossRef]
14. Dell'Anno, A.; Mei, M.L.; Pusceddu, A.; Danovaro, R. Assessing the Trophic State and Eutrophication of Coastal Marine Systems: A New Approach Based on the Biochemical Composition of Sediment Organic Matter. *Mar. Pollut. Bull.* **2002**, *44*, 611–622. [CrossRef] [PubMed]
15. Karlson, K.; Rosenberg, R.; Bonsdorff, E. Temporal and Spatial Large-Scale Effects of Eutrophication and Oxygen Deficiency on Benthic Fauna in Scandinavian and Baltic Waters—A Review. *Oceanogr. Mar. Biol. Annu. Rev.* **2002**, *40*, 427–489.
16. Kennish, M.J. Environmental Threats and Environmental Future of Estuaries. *Environ. Conserv.* **2002**, *29*, 78–107. [CrossRef]
17. Bricker, S.B.; Longstaff, B.; Dennison, W.; Jones, A.; Boicourt, K.; Wicks, C.; Woerner, J. Effects of Nutrient Enrichment in the Nation's Estuaries: A Decade of Change. *Harmful Algae* **2008**, *8*, 21–32. [CrossRef]
18. Sturdivant, S.K.; Brush, M.J.; Diaz, R.J. Modeling the Effect of Hypoxia on Macrobenthos Production in the Lower Rappahannock River, Chesapeake Bay, USA. *PLoS ONE* **2013**, *8*, e84140. [CrossRef]
19. Tweedley, J.R.; Hallett, C.S.; Warwick, R.M.; Clarke, K.R.; Potter, I.C.; Tweedley, J.R.; Hallett, C.S.; Warwick, R.M.; Clarke, K.R.; Potter, I.C. The Hypoxia That Developed in a Microtidal Estuary Following an Extreme Storm Produced Dramatic Changes in the Benthos. *Mar. Freshw. Res.* **2015**, *67*, 327–341. [CrossRef]
20. Gammal, J.; Norkko, J.; Pilditch, C.A.; Norkko, A. Coastal Hypoxia and the Importance of Benthic Macrofauna Communities for Ecosystem Functioning. *Estuaries Coasts* **2017**, *40*, 457–468. [CrossRef]
21. Ma, X.; Fox, A.; Fox, S.; Johnson, K.B. Phytoplankton and Benthic Infauna Responses to Aeration, an Experimental Ecological Remediation, in a Polluted Subtropical Estuary with Organic-Rich Sediments. *PLoS ONE* **2023**, *18*, e0280880. [CrossRef]
22. Sigua, G.C.; Steward, J.S.; Tweedale, W.A. Water-Quality Monitoring and Biological Integrity Assessment in the Indian River Lagoon, Florida: Status, Trends, and Loadings (1988–1994). *Environ. Manag.* **2000**, *25*, 199–209. [CrossRef]
23. Paperno, R.; Brodie, R.B. Effects of Environmental Variables upon the Spatial and Temporal Structure of a Fish Community in a Small, Freshwater Tributary of the Indian River Lagoon, Florida. *Estuar. Coast. Shelf Sci.* **2004**, *61*, 229–241. [CrossRef]
24. Lapointe, B.E.; Herren, L.W.; Debortoli, D.D.; Vogel, M.A. Evidence of Sewage-Driven Eutrophication and Harmful Algal Blooms in Florida's Indian River Lagoon. *Harmful Algae* **2015**, *43*, 82–102. [CrossRef]
25. Tetra Tech, I.; Close Waters, L. *Save Our Lagoon Project Plan for Brevard County, Florida*; Brevard County Natural Resources Management Department: Viera, FL, USA, 2018.
26. Johnson, K.B.; Roberts, J.L. Florida Inlets and Intertidal Biofouling Communities. *Mar. Technol. Soc. J.* **2017**, *51*, 7–21. [CrossRef]
27. Johnson, K.B.; Soltis, K.A. Larval Supply and Recruitment of the Ivory Barnacle Balanus Eburneus (Gould, 1841) on Oyster Cultch Used in Oyster-Reef Restoration. *J. Crustacean Biol.* **2017**, *37*, 243–248. [CrossRef]
28. Sweat, L.H.; Swain, G.W.; Hunsucker, K.Z.; Johnson, K.B. Transported Biofilms and Their Influence on Subsequent Macrofouling Colonization. *Biofouling* **2017**, *33*, 433–449. [CrossRef] [PubMed]
29. Morris, L.J.; Hall, L.M.; Miller, J.D.; Lasi, M.A.; Virnstein, R.W.; Jacoby, C.A. Diversity and Distribution of Seagrasses as Related to Salinity, Temperature, and Availability of Light in the Indian River Lagoon, Florida. *Fla. Sci.* **2021**, *84*, 119–137.

30. Morris, L.J.; Hall, L.M.; Jacoby, C.A.; Chamberlain, R.H.; Hanisak, M.D.; Miller, J.D.; Virnstein, R.W. Seagrass in a Changing Estuary, the Indian River Lagoon, Florida, United States. *Front. Mar. Sci.* **2022**, *8*, 2121. [CrossRef]
31. Hall, L.; Morris, L.; Chamberlain, R.; Hanisak, M.D.; Virnstein, R.; Paperno, R.; Riegl, B.; Ellis, L.R.; Simpson, A.; Jacoby, C. Spatiotemporal Patterns in the Biomass of Drift Macroalgae in the Indian River Lagoon, Florida, United States. *Front. Mar. Sci.* **2022**, *9*, 39. [CrossRef]
32. Landsberg, J.H.; Tabuchi, M.; Rotstein, D.S.; Subramaniam, K.; Rodrigues, T.C.S.; Waltzek, T.B.; Stacy, N.I.; Wilson, P.W.; Kiryu, Y.; Uzal, F.A.; et al. Novel Lethal Clostridial Infection in Florida Manatees (Trichechus Manatus Latirostris): Cause of the 2013 Unusual Mortality Event in the Indian River Lagoon. *Front. Mar. Sci.* **2022**, *9*, 195. [CrossRef]
33. Dauer, D.M. Biological Criteria, Environmental Health and Estuarine Macrobenthic Community Structure. *Mar. Pollut. Bull.* **1993**, *26*, 249–257. [CrossRef]
34. Thomas, J.D. Biological Monitoring and Tropical Biodiversity in Marine Environments: A Critique with Recommendations, and Comments on the Use of Amphipods as Bioindicators. *J. Nat. Hist.* **1993**, *27*, 795–806. [CrossRef]
35. Hyland, J.; Balthis, L.; Karakassis, I.; Magni, P.; Petrov, A.; Shine, J.; Vestergaard, O.; Warwick, R. Organic Carbon Content of Sediments as an Indicator of Stress in the Marine Benthos. *Mar. Ecol. Prog. Ser.* **2005**, *295*, 91–103. [CrossRef]
36. Ritnim, N.; Meksumpun, C. Influence of Environmental Factors on Abundance and Temporal Variation of Benthic Fauna Resources in the Eutrophic Tha Chin Estuary, Samut Sakhon Province, Thailand. *Water. Sci. Technol.* **2011**, *64*, 1261–1269. [CrossRef] [PubMed]
37. Hemery, L.G.; Politano, K.K.; Henkel, S.K. Assessing Differences in Macrofaunal Assemblages as a Factor of Sieve Mesh Size, Distance between Samples, and Time of Sampling. *Environ. Monit. Assess.* **2017**, *189*, 413. [CrossRef] [PubMed]
38. Luo, X.; Lin, S.; Yang, J.; Shen, J.; Fan, Y.; Zhang, L. Benthic Habitat Quality Assessment Based on Biological Indices in Xiaoqing River Estuary and Its Adjacent Sea of Laizhou Bay, China. *J. Ocean Univ. China* **2017**, *16*, 537–546. [CrossRef]
39. Seo, J.-Y.; An, S.-M.; Lim, D.; Choi, J.-W. Seasonal Variations in the Community Structures of Macrobenthic Fauna and Their Health Status in an Estuarine Bay, Gwangyang Bay in Korea. *Ocean Sci. J.* **2017**, *52*, 367–385. [CrossRef]
40. Wang, Z.; Leung, K.M.Y.; Li, X.; Zhang, T.; Qiu, J.-W. Macrobenthic Communities in Hong Kong Waters: Comparison between 2001 and 2012 and Potential Link to Pollution Control. *Mar. Pollut. Bull.* **2017**, *124*, 694–700. [CrossRef]
41. Conlan, K.E. Amphipod Crustaceans and Environmental Disturbance: A Review. *J. Nat. Hist.* **1994**, *28*, 519–554. [CrossRef]
42. Cruz-Rivera, E.; Hay, M.E. The Effects of Diet Mixing on Consumer Fitness: Macroalgae, Epiphytes, and Animal Matter as Food for Marine Amphipods. *Oecologia* **2000**, *123*, 252–264. [CrossRef]
43. Duffy, J.E.; Hay, M.E. Strong Impacts of Grazing Amphipods on the Organization of a Benthic Community. *Ecol. Monogr.* **2000**, *70*, 237–263. [CrossRef]
44. Gesteira, J.L.G.; Dauvin, J.-C. Amphipods Are Good Bioindicators of the Impact of Oil Spills on Soft-Bottom Macrobenthic Communities. *Mar. Pollut. Bull.* **2000**, *40*, 1017–1027. [CrossRef]
45. Ysebaert, T.; Herman, P.M.J.; Meire, P.; Craeymeersch, J.; Verbeek, H.; Heip, C.H.R. Large-Scale Spatial Patterns in Estuaries: Estuarine Macrobenthic Communities in the Schelde Estuary, NW Europe. *Estuar. Coast. Shelf Sci.* **2003**, *57*, 335–355. [CrossRef]
46. Mancinelli, G. On the Trophic Ecology of Gammaridea (Crustacea: Amphipoda) in Coastal Waters: A European-Scale Analysis of Stable Isotopes Data. *Estuar. Coast. Shelf Sci.* **2012**, *114*, 130–139. [CrossRef]
47. Ros, M.; Vázquez-Luis, M.; Guerra-García, J.M. Environmental Factors Modulating the Extent of Impact in Coastal Invasions: The Case of a Widespread Invasive Caprellid (Crustacea: Amphipoda) in the Iberian Peninsula. *Mar. Pollut. Bull.* **2015**, *98*, 247–258. [CrossRef] [PubMed]
48. Utsunomiya, T.; Hata, M.; Sugimoto, R.; Honda, H.; Kobayashi, S.; Miyata, Y.; Yamada, M.; Tominaga, O.; Shoji, J.; Taniguchi, M. Higher Species Richness and Abundance of Fish and Benthic Invertebrates around Submarine Groundwater Discharge in Obama Bay, Japan. *J. Hydrol. Reg. Stud.* **2017**, *11*, 139–146. [CrossRef]
49. Arocena, R. Effects of Submerged Aquatic Vegetation on Macrozoobenthos in a Coastal Lagoon of the Southwestern Atlantic. *Int. Rev. Hydrobiol.* **2007**, *92*, 33–47. [CrossRef]
50. Bueno, M.; Dias, G.M.; Leite, F.P.P. The Importance of Shore Height and Host Identity for Amphipod Assemblages. *Mar. Biol. Res.* **2017**, *13*, 870–877. [CrossRef]
51. Zakhama-Sraieb, R.; Sghaier, Y.-R.; Charfi-Cheikhrouha, F. Amphipod Biodiversity of the Tunisian Coasts: Update and Distributional Ecology. *Mar. Biodivers. Rec.* **2009**, *2*, e155. [CrossRef]
52. Hily, C. Macrozoobenthic Recolonization after Dredging in a Sandy Mud Area of the Bay of Brest Enriched by Organic Matter. *Oceanol. Acta* **1983**, 113–120.
53. Van Dolah, R.F.; Calder, D.R.; Knott, D.M. Effects of Dredging and Open-Water Disposal on Benthic Macroinvertebrates in a South Carolina Estuary. *Estuaries* **1984**, *7*, 28–37. [CrossRef]
54. Newell, R.C.; Seiderer, L.J.; Simpson, N.M.; Robinson, J.E. Impacts of Marine Aggregate Dredging on Benthic Macrofauna off the South Coast of the United Kingdom. *J. Coast. Res.* **2004**, *20*, 115–125. [CrossRef]
55. Manap, N.; Voulvoulis, N. Data Analysis for Environmental Impact of Dredging. *J. Clean. Prod.* **2016**, *137*, 394–404. [CrossRef]
56. Dauvin, J.C.; Ruellet, T. Polychaete/Amphipod Ratio Revisited. *Mar. Pollut. Bull.* **2007**, *55*, 215–224. [CrossRef]
57. Jackson, B.P.; Bugge, D.; Ranville, J.F.; Chen, C.Y. Bioavailability, Toxicity, and Bioaccumulation of Quantum Dot Nanoparticles to the Amphipod Leptocheirus Plumulosus. *Environ. Sci. Technol.* **2012**, *46*, 5550–5556. [CrossRef] [PubMed]

58. Whiteway, S.A.; Paine, M.D.; Wells, T.A.; DeBlois, E.M.; Kilgour, B.W.; Tracy, E.; Crowley, R.D.; Williams, U.P.; Janes, G.G. Toxicity Assessment in Marine Sediment for the Terra Nova Environmental Effects Monitoring Program (1997–2010). *Deep. Sea. Res. II Top. Stud. Oceanogr.* **2014**, *110*, 26–37. [CrossRef]
59. Dauvin, J.C.; Andrade, H.; de-la-Ossa-Carretero, J.A.; Del-Pilar-Ruso, Y.; Riera, R. Polychaete/Amphipod Ratios: An Approach to Validating Simple Benthic Indicators. *Ecol. Indc.* **2016**, *63*, 89–99. [CrossRef]
60. Hartzell, S.E.; Unger, M.A.; McGee, B.L.; Yonkos, L.T. Effects-Based Spatial Assessment of Contaminated Estuarine Sediments from Bear Creek, Baltimore Harbor, MD, USA. *Environ. Sci. Pollut. Res.* **2017**, *24*, 22158–22172. [CrossRef]
61. Moran, P.W.; Nowell, L.H.; Kemble, N.E.; Mahler, B.J.; Waite, I.R.; Van Metre, P.C. Influence of Sediment Chemistry and Sediment Toxicity on Macroinvertebrate Communities across 99 Wadable Streams of the Midwestern USA. *Sci. Total Environ.* **2017**, *599–600*, 1469–1478. [CrossRef]
62. Underwood, A.J. Beyond BACI: Experimental Designs for Detecting Human Environmental Impacts on Temporal Variations in Natural Populations. *Mar. Freshw. Res.* **1991**, *42*, 569–587. [CrossRef]
63. Underwood, A.J. On Beyond BACI: Sampling Designs That Might Reliably Detect Environmental Disturbances. *Ecol. Appl.* **1994**, *4*, 3–15. [CrossRef]
64. Dybas, C.L. Florida's Indian River Lagoon: An Estuary in Transition. *BioScience* **2002**, *52*, 554–559. [CrossRef]
65. Sigua, G.C.; Tweedale, W.A. Assessing Redesigned Effectiveness of the Water Quality Monitoring Program in the Indian River Lagoon, Florida. *Aquat. Conserv.* **2004**, *14*, 49–64. [CrossRef]
66. Indian River Lagoon National Estuary Program. *Indian River Lagoon: An Introduction to a National Treasure*; St. Johns River Water Management District: Palatka, FL, USA, 2007.
67. Smith, N.P. Tidal and Nontidal Flushing of Florida's Indian River Lagoon. *Estuaries* **1993**, *16*, 739–746. [CrossRef]
68. Sweat, L.H.; Alexander, H.; Phlips, E.J.; Johnson, K.B. Mesozooplankton Community Dynamics and Grazing Potential Across Algal Bloom Cycles in a Subtropical Estuary. *Front. Mar. Sci.* **2021**, *8*, 734270. [CrossRef]
69. Ma, X.; Jacoby, C.A.; Johnson, K.B. High Densities of a Prochlorophyte (Unresolved Species) Inhibit Grazing by the Herbivorous Copepod *Parvocalanus crassirostris*. *Front. Mar. Sci.* **2021**, *8*, 1476. [CrossRef]
70. Ma, X.; Jacoby, C.A.; Johnson, K.B. Grazing by the Copepod *Parvocalanus crassirostris* on *Picochlorum* sp. at Harmful Bloom Densities and the Role of Particle Size. *Front. Mar. Sci.* **2021**, *8*, 963. [CrossRef]
71. Heiri, O.; Lotter, A.F.; Lemcke, G. Loss on Ignition as a Method for Estimating Organic and Carbonate Content in Sediments: Reproducibility and Comparability of Results. *J. Paleolimnol.* **2001**, *25*, 101–110. [CrossRef]
72. Anderson, M.J.; Gorley, R.N.; Clarke, K.R. *Guide to Software and Statistical Methods*; PRIMER-E: Plymouth, UK, 2008.
73. Ma, X.; Johnson, K.B.; Gu, B.; Zhang, H.; Li, G.; Huang, X.; Xia, X. The In-Situ Release of Algal Bloom Populations and the Role of Prokaryotic Communities in Their Establishment and Growth. *Water Res.* **2022**, *219*, 118565. [CrossRef]
74. Diaz, R.J.; Rosenberg, R. Marine Benthic Hypoxia: A Review of Its Ecological Effects and the Behavioural Response of Benthic Macrofauna. *Oceanogr. Mar. Biol. Annu. Rev.* **1995**, *33*, 245–333.
75. Dauer, D.M.; Ranasinghe, J.A.; Weisberg, S.B. Relationships between Benthic Community Condition, Water Quality, Sediment Quality, Nutrient Loads, and Land Use Patterns in Chesapeake Bay. *Estuaries* **2000**, *23*, 80–96. [CrossRef]
76. Gray, J.S.; Wu, R.S.; Or, Y.Y. Effects of Hypoxia and Organic Enrichment on the Coastal Marine Environment. *Mar. Ecol. Prog. Ser.* **2002**, *238*, 249–279. [CrossRef]
77. de-la-Ossa-Carretero, J.A.; Del-Pilar-Ruso, Y.; Giménez-Casalduero, F.; Sánchez-Lizaso, J.L.; Dauvin, J.-C. Sensitivity of Amphipods to Sewage Pollution. *Estuar. Coast. Shelf Sci.* **2012**, *96*, 129–138. [CrossRef]
78. Hope, D.C. The Tolerance of Benthic Infauna to Fine-Grained Organic Rich Sediments in a Shallow Subtropical Estuary. Ph.D. Thesis, Florida Institute of Technology, Melbourne, FL, USA, 2016.
79. Baird, H.P.; Stark, J.S. Spatial and Temporal Heterogeneity in the Distribution of an Antarctic Amphipod and Relationship with the Sediment. *Mar. Ecol. Prog. Ser.* **2014**, *502*, 169–183. [CrossRef]
80. de-la-Ossa-Carretero, J.A.; Del-Pilar-Ruso, Y.; Giménez-Casalduero, F.; Sánchez-Lizaso, J.L. Amphipoda Assemblages in a Disturbed Area (Alicante, Spain, Western Mediterranean). *Mar. Ecol.* **2016**, *37*, 503–517. [CrossRef]
81. Dickinson, J.J.; Carey, A.G. Distribution of Gammarid Amphipoda (Crustacea) on Cascadia Abyssal Plain (Oregon). *Deep Sea Res.* **1978**, *25*, 97–106. [CrossRef]
82. Nielsen, M.; Kofoed, L. Selective Feeding and Epipsammic Browsing by the Deposit-Feeding Amphipod Corophium Volutator. *Mar. Ecol. Prog. Ser.* **1982**, *10*, 81–88. [CrossRef]
83. Grizzle, R.E. Pollution Indicator Species of Macrobenthos in a Coastal Lagoon. *Mar. Ecol. Prog. Ser.* **1984**, *18*, 191–200. [CrossRef]
84. Nelson, W.G. Amphipod Crustaceans of the Indian River Lagoon: Current Status and Threats to Biodiversity. *Bull. Mar. Sci.* **1995**, *57*, 143–152.
85. Zimmerman, R.; Gibson, R.; Harrington, J. Herbivory and Detritivory among Gammaridean Amphipods from a Florida Seagrass Community. *Mar. Biol.* **1979**, *54*, 41–47. [CrossRef]
86. Rakocinski, C.F.; Brown, S.S.; Gaston, G.R.; Heard, R.W.; Walker, W.W.; Summers, J.K. Macrobenthic Responses to Natural and Contaminant-Related Gradients in Northern Gulf of Mexico Estuaries. *Ecol. Appl.* **1997**, *7*, 1278–1298. [CrossRef]
87. Arvai, J.L.; Levings, C.D.; Harrison, P.J.; Neill, W.E. Improvement of the Sediment Ecosystem Following Diversion of an Intertidal Sewage Outfall at the Fraser River Estuary, Canada, with Emphasis on Corophium Salmonis (Amphipoda). *Mar. Pollut. Bull.* **2002**, *44*, 511–519. [CrossRef]

88. Kanaya, G. Recolonization of Macrozoobenthos on Defaunated Sediments in a Hypertrophic Brackish Lagoon: Effects of Sulfide Removal and Sediment Grain Size. *Mar. Environ. Res.* **2014**, *95*, 81–88. [CrossRef] [PubMed]
89. Kanaya, G.; Nakamura, Y.; Koizumi, T. Ecological Thresholds of Hypoxia and Sedimentary H2S in Coastal Soft-Bottom Habitats: A Macroinvertebrate-Based Assessment. *Mar. Environ. Res.* **2018**, *136*, 27–37. [CrossRef] [PubMed]
90. Vadher, A.N.; Millett, J.; Wood, P.J. Direct Observations of the Effect of Fine Sediment Deposition on the Vertical Movement of Gammarus Pulex (Amphipoda: Gammaridae) during Substratum Drying. *Hydrobiologia* **2018**, *815*, 73–82. [CrossRef]
91. Nelson, W.G.; Cairns, K.D.; Virnstein, R.W. Seasonality and Spatial Patterns of Seagrass-Associated Amphipods of the Indian River Lagoon, Florida. *Bull. Mar. Sci.* **1982**, *32*, 121–129.
92. Mallin, M.A.; Posey, M.H.; Shank, G.C.; McIver, M.R.; Ensign, S.H.; Alphin, T.D. Hurricane Effects on Water Quality and Benthos in the Cape Fear Watershed: Natural and Anthropogenic Impacts. *Ecol. Appl.* **1999**, *9*, 350–362. [CrossRef]
93. Balthis, W.L.; Hyland, J.L.; Bearden, D.W. Ecosystem Responses to Extreme Natural Events: Impacts of Three Sequential Hurricanes in Fall 1999 on Sediment Quality and Condition of Benthic Fauna in the Neuse River Estuary, North Carolina. *Environ. Monit. Assess.* **2006**, *119*, 367–389. [CrossRef] [PubMed]
94. Engle, V.D.; Hyland, J.L.; Cooksey, C. Effects of Hurricane Katrina on Benthic Macroinvertebrate Communities along the Northern Gulf of Mexico Coast. *Environ. Monit. Assess.* **2008**, *150*, 193. [CrossRef]
95. Srinivas, T.; Sukumaran, S.; Mulik, J.; Dias, H.Q. Community Structure of Benthic Amphipods in Four Estuaries of Northwest India. *Reg. Stud. Mar. Sci.* **2019**, *27*, 100532. [CrossRef]
96. López-Jamar, E.; Mejuto, J. Infaunal Benthic Recolonization after Dredging Operations in La Coruña Bay, NW Spain. *Cah. Biol. Mar.* **1988**, *29*, 37–49.
97. Moog, O.; Stubauer, I.; Haimann, M.; Habersack, H.; Leitner, P. Effects of Harbour Excavating and Dredged Sediment Disposal on the Benthic Invertebrate Fauna of River Danube (Austria). *Hydrobiologia* **2018**, *814*, 109–120. [CrossRef]
98. Coates, D.A.; van Hoey, G.; Colson, L.; Vincx, M.; Vanaverbeke, J. Rapid Macrobenthic Recovery after Dredging Activities in an Offshore Wind Farm in the Belgian Part of the North Sea. *Hydrobiologia* **2015**, *756*, 3–18. [CrossRef]
99. Donázar-Aramendía, I.; Sánchez-Moyano, J.E.; García-Asencio, I.; Miró, J.M.; Megina, C.; García-Gómez, J.C. Maintenance Dredging Impacts on a Highly Stressed Estuary (Guadalquivir Estuary): A BACI Approach through Oligohaline and Polyhaline Habitats. *Mar. Environ. Res.* **2018**, *140*, 455–467. [CrossRef] [PubMed]
100. Nikitik, C.C.S.; Robinson, A.W. Patterns in Benthic Populations in the Milford Haven Waterway Following the 'Sea Empress' Oil Spill with Special Reference to Amphipods. *Mar. Pollut. Bull.* **2003**, *46*, 1125–1141. [CrossRef] [PubMed]
101. Dauvin, J.-C. Evolution à Long terme (1978–1986) des populations d'Amphipodes des sables fins de la pierre noire (baie de morlaix, manche occidentale) aprsѐ la catastrophe de l'Amoco Cadiz. *Mar. Environ. Res.* **1987**, *21*, 247–273. [CrossRef]