Overview of Charleston Harbor Post 45 Mitigation Reef Monitoring

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Post 45 Project Background

Planning began in 2011 and was initiated to ensure safe navigation of the largest commercial vessels

Target depth: 52 feet (formerly 45 feet)

Completed December 2022

Charleston Harbor becomes
deepest port on U.S. East Coast

Environmental Impact Assessment:

• Estimated 28.6 acres of hard bottom adversely impacted

Impact Site Baseline Data

- Scientific divers documented fish and invertebrate taxa at impact site along 20 m transects in 2016 (Dial Cordy & Associates)
- Impact site characterized as relatively low species diversity
 - 13 finfish species
 - 8 sessile invertebrate species

ENTRANCE CHANNEL HARDBOTTOM SURVEYS AND BIOLOGICAL CHARACTERIZATION

CHARLESTON HARBOR POST 45 DEEPENING PROJECT

FINAL REPORT

JULY 2016

PREPARED FOR: SOUTH CAROLINA STATE PORTS AUTHORITY AND U.S. ARMY CORPS OF ENGINEERS CHARLESTON DISTRICT

PREPARED BY: DIAL CORDY AND ASSOCIATES INC.

Mitigation Reef: Background

- Two "mitigation" and Four "beneficial use" reefs created on North side of shipping channel using materials dredged from shipping channel during Post 45
- Two additional "beneficial use" reefs created on south side



Mitigation Reef: Background

Two "mitigation reefs" created on North side of shipping channel using materials dredged from shipping channel during Post 45

- 16 contiguous spatial cells per reef, each representing 90,000 ft² of seafloor
- MitReef construction completed in 2018, and a 5-year monitoring plan began in 2019



Mitigation Reef: Survey Site Selection

Bathymetry imagery revealed uneven distribution of rubble grids between reefs:

- "S" reef: two high density (HD), five medium density (MD), and nine low density (LD) grids.
- "J" reef: five MD and 11 LD grids
- Both HD grids were selected for monitoring, with stratified (MD, LD) random selection of remaining grids for monitoring. 12 total survey sites





Monitoring: **Diver Surveys**

- 3x 20 m transects placed at 0°, 120°, 240° headings from center
- Diver recorded ID's and counts of priority fishes and counts/ sizes of priority invertebrates
- Diver video transects for later review



Monitoring: Baited Camera Frames

- Devoid of diver presence and associated influence on species behavior
- 1 hr deployment at center reference mark for each site



Monitoring: Acoustic Telemetry

- Acoustic receivers installed (Innovasea) at 2 "S" reef Sites and 3 "J" reef sites, strategically arranged to provide full coverage
- Detection range ~ 250 m



• Overall, greater invertebrate diversity at MitReef than impact site



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			Com	bined a	bundar	ice	
Group	Code	ScientificName	2019	2021	2022	2023	
Hard coral	H039	Astrangia danae		17707	22912	586	
Hard coral	H305	Seleractinia		21526	1	23	
Soft coral	H002	Leptogorgia virgulata	146	552	33	113	
Soft coral	H275	Leptogorgia hebes	1	20	193	12	
Soft coral	H351	Titanideum sp.	1	310	687	175	
Sponge	C324	Microciona prolifera	4	32			
Sponge	C357	Cliona celata	50	117	208	135	
Sponge	C374	Porifera	118	282	1		
Sponge	C375	Cliona sp		329			
Sponge	C400	Poecilosclerida			117	34	
Sponge	C402	Demospongea			95	65	
Sponge	C414	Haliclona sp.		447	2900	279	
Sponge	C428	Ircinia sp.		2			
Algae	Q004	Algae		370		1530	
Algae	T265	Polysiphonia sp.		144			
Anemone	H288	Actiniaria		2			
Ark	X002	Arcoida	1				
Barnacle	E316	Cirripedia	60005	13188	5527	22	
Bryozoan	M545	Schizoprella floridana	2	23			
Crustacean	D112	Calappa flammea	1				
Crustacean	D195	Stenorhynchus seticorni		1			
Echinoderm	J001	Asterias forbesi		2			
Echinoderm	J072	Lyttechinus variegatus	1				
Echinoderm	J085	Arbacia punctulata	2003	3512	3826	375	
Echinoderm	J090	Echinaster sp.	2	1	8	1	
Hydroid	H300	Hydroidolina	192	197	549	66	
Jellyfish	H246	Aurelia aurita		1			
Molluse	N001	Nudibranchia			1		
Molluse	N112	Pleuroploca gigantea	1				
Molluse	N227	Crassostrea virginica		14	444	70	
	Group Hard coral Hard coral Soft coral Soft coral Soft coral Sponge Sponge Sponge Sponge Sponge Sponge Sponge Sponge Algae Algae Anemone Ark Barnacle Bryozoan Crustacean Crustacean Crustacean Echinoderm Echinoderm Echinoderm Hydroid Jellyfish Mollusc Mollusc	GroupCodeHard coralH039Hard coralH305Soft coralH275Soft coralH275Soft coralH351SpongeC324SpongeC357SpongeC374SpongeC400SpongeC402SpongeC414SpongeC428AlgaeQ004AlgaeT265AnemoneH288ArkX002BarnacleE316BryozoanM545CrustaceanD112CrustaceanD195EchinodermJ001EchinodermJ090HydroidH300JellyfishH246MolluscN011MolluscN112MolluscN227	GroupCodeScientificNameHard coralH039Astrangia danaeHard coralH305ScleractiniaSoft coralH002Leptogorgia virgulataSoft coralH275Leptogorgia hebesSoft coralH351Titanideum sp.SpongeC324Microciona proliferaSpongeC357Cliona celataSpongeC374PoriferaSpongeC375Cliona spSpongeC400PoeciloscleridaSpongeC402DemospongeaSpongeC428Ircinia sp.SpongeC428Ircinia sp.AlgaeQ004AlgaeAlgaeT265Polysiphonia sp.AnemoneH288ActiniariaArkX002ArcoidaBarnacleE316CirripediaBryozoanM545Schizoprella floridanaCrustaceanD112Calappa flammeaCrustaceanD195Stenorhynchus seticorniEchinodermJ001Asterias forbesiEchinodermJ090Echinaster sp.HydroidH300HydroidolinaJellyfishH246Aurelia auritaMolluscN01NudibranchiaMolluscN112Pleuroploca giganteaMolluscN227Crassostrea virginica	GroupCodeScientificName2019Hard coralH039Astrangia danae2019Hard coralH305Scleractinia146Soft coralH275Leptogorgia virgulata146Soft coralH275Leptogorgia hebes1Soft coralH351Titanideum sp.1SpongeC324Microciona prolifera4SpongeC377Cliona celata50SpongeC374Porifera118SpongeC375Cliona sp50SpongeC400Poecilosclerida50SpongeC402Demospongea50SpongeC428Ircinia sp.1AlgaeT265Polysiphonia sp.1AlgaeT265Polysiphonia sp.1AnemoneH288Actiniaria2ArkX002Arcoida1BarnacleE316Cirripedia60005BryozoanM545Schizoprella floridana2CrustaceanD112Calappa flammea1CrustaceanD195Stenorhynchus seticorni1EchinodermJ001Asterias forbesi1EchinodermJ090Echinaster sp.2HydroidH300Hydroidolina192JellyfishH246Aurelia aurita1012MolluscN001Nudibranchia192JellyfishH246Aurelia aurita1012	GroupCodeScientificName20192021Hard coralH039Astrangia danae17707Hard coralH305Scleractinia21526Soft coralH002Leptogorgia virgulata146552Soft coralH275Leptogorgia hebes120Soft coralH351Titanideum sp.1310SpongeC324Microciona prolifera432SpongeC375Cliona celata50117SpongeC375Cliona sp329SpongeC400Poecilosclerida329SpongeC402Demospongea329SpongeC428Ircinia sp.2AlgaeQ004Algae370AlgaeT265Polysiphonia sp.144AnemoneH288Actiniaria2ArkX002Arcoida1BarnacleE316Cirripedia60005BryozoanM545Schizoprella floridana2CrustaceanD112Calapa flammea1CrustaceanD112Calapa flammea1EchinodermJ001Asterias forbesi2EchinodermJ085Arbacia punctulata2003Jo90Echinaster sp.21HydroidH300Hydroidolina192JellyfishH246Aurelia aurita1MolluseN001Nudibranchia1MolluseN001Nudibranchia1	GroupCodeScientificName201920212022Hard coralH039Astrangia danae1770722912Hard coralH305Scleractinia215261Soft coralH002Leptogorgia virgulata14655233Soft coralH275Leptogorgia hebes120193Soft coralH351Titanideum sp.1310687SpongeC324Microciona prolifera432SpongeC377Cliona celata50117208SpongeC375Cliona sp329329SpongeC400Poecilosclerida117SpongeC402Demospongea95SpongeC414Haliclona sp.2AlgaeQ004Algae370AlgaeT265Polysiphonia sp.144AnemoneH288Actiniaria2ArkX002Arcoida1BamacleE316Cirripedia60005GrustaceanD112Calappa flammea1CrustaceanD195Stenorhynchus seticorni1EchinodermJ001Asterias forbesi22EchinodermJ090Echinaster sp.21BydroidH300Hydroidolina192197JellyfishH246Aurelia aurita1MolluscN001Nudibranchia1	Group GroupCode CodeScientificName ScientificName2019 20212022 20232023 2021Hard coralH039Astrangia danae1770722912586Hard coralH305Scleractinia21526123Soft coralH275Leptogorgia virgulata14655233113Soft coralH351Titanideum sp.1310687175SpongeC324Microciona prolifera43232SpongeC375Cliona celata50117208135SpongeC375Cliona sp329329329SpongeC400Pociclosclerida11734SpongeC402Demospongea9565SpongeC428Ircinia sp.22AlgaeQ004Algae3701530AlgaeT265Polysiphonia sp.144AnemoneH288Actiniaria22ArkX002Arcoida11BarnacleE316Cirripedia6000513188552722BryozoanM545Schizoprella floridana22323CrustaceanD112Calappa flammea111CrustaceanD112Lyttechnus variegatus11EchinodermJ001Asterias forbesi222EchinodermJ090Echinaster sp.2181Hydroid<

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- Greater Sponge and hard coral density than baseline site, but species composition differed
- Lower soft coral recruitment: Significantly lower densities and smaller sized specimens of both *Titanideum* and *Leptogorgia* spp.



Temporal succession evident

 Hard encrusting organisms > soft encrusting (sponges) and echinoderms> soft corals



Results: Fish

 12 of 13 (92%) target finfish species seen by divers in the impact area in March 2016 were also seen at MitReef sites



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Species	<u>Diver slate</u>	<u>Diver video</u>	Baited frames
Batfish	0	0	0
Belted Sandfish	7	3	<1
Black Sea Bass	99	30	22
Cubbyu	1	<1	<1
Gag grouper	<1	<1	<1
Oyster Toadfish	<1	<1	<1
Pinfish	27	<1	20
Scad	4	0	0
Sheepshead	26	1	4
Slippery Dick	8	3	1
Southern Flounder	<1	<1	<1
Southern Hake	<1	0	<1
Spottail Pinfish	5	<1	1

Results: Fish

- 12 of 13 (92%) target finfish species seen by divers in the impact area in March 2016 were also seen at MitReef sites
- Additional 9 elasmobranch and 66 finfish species (5x as many species) were observed at MitReef sites than at the impact area

	Baited frames					Diver video				
	2019 - 2022		2023		2019	2019 - 2022		2023		
Common Name	Freq	Sum	<u>BU</u>	MR	Freq	Sum	BU	MR		
White shark	1	1			0	0				
Southern stingray	2	2			0	0				
Roughtail stingray	6	6			0	0				
Tiger shark	1	1	*		0	0				
Smooth butterfly ray	1	1			0	0				
Bullnose ray	5	5			0	0				
Atlantic guitarfish	3	3			1	1				
Atlantic sharpnose shark	12	13			0	0				
Hammerhead shark	1	1			0	0				
Yellow Jack	6	17			0	0				
Blue runner	14	1259			3	11				
Bank Sea Bass	0	0			1	1				
juvenile black sea bass	12	25			2	. 9				
Atlantic spadefish	29	163			5	28				
Reef butterflyfish	0	0			0	0 0				
Striped burrfish	5	6			2	2				
Atlantic bumper	10	707			0	0 0				
UnID Herring	4	320	*		0	0 0				
Weakfish	7	14			0	0				
Dwarf sand perch	1	1			0	0 0				
Sand perch	17	30			18	45				

Results: Fish Acoustic Telemetry

22 species tagged by other research groups detected

• 88 - 446 deployment days across 5 upload cycles

Species	N codes	N days	N detections	Gross day/code
Atlantic sharpnose				
shark	1	1	4	1
Atlantic sturgeon	199	354	3,845	2
Black sea bass	32	5,111	593,602	160
Blacknose shark	2	4	94	2
Blacktip shark	12	15	71	1
Bonnethead shark	1	1	4	1
Bull shark	5	8	24	2
Cobia	19	29	528	2
Cownose ray	11	19	118	2
Finetooth shark	2	2	7	1
Gag grouper	1	153	18,083	153
Leatherback sea turtle	1	1	15	1
Lemon shark	2	4	92	2
Little tunny	1	1	31	1
Manta ray	1	1	3	1
Red drum	8	19	446	2
Roughtail stingray	1	1	11	1
Sand tiger shark	9	19	1,005	2
Sandbar shark	6	13	160	2
Tarpon	2	2	9	1
Thresher shark	2	5	96	3
Tiger shark	10	31	231	3
White shark	71	106	674	1

Results: Fish Acoustic Telemetry

Black Sea Bass Tagging Study

- 34 telemetered fish 27.9 38.5 cm TL
- Fish detected between 1 and 567 days post-release (median 166 days)
 - Only 2 fish never detected



MitReef considered successful:

 Overall 167,361 organism counts across 17 broad taxonomic groupings observed



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 - Visibility highly variable
 - Video analysis methods differed



Questions?

Supplemental Slides

Success Criteria: Invertebrates

- No departure from octocorals comprising threequarters of benthic invertebrates.
- No departure from an inverse correlation between octocoral and sponge abundance.
- No departure from *Titanidium* sp. being 2.9 times more abundant than *Leptogorgia* sp.
- No departure from *Titanidium:Leptogorgia* transect ratios spanning 0.6 (T2) to 40.3 (T5)
- No departure from a mean of 5.3 (±3.0 95% CI) octocoral colonies per square meter.
- No departure from sponges being the third most prevalent "functional group" and represented by the following genera: *Ircinia; Spirastrella; Chondrilla; Desmapsamma*.
- No departure from a mean of 1.7 (±2.0 95% CI) stony coral colonies per square meter
- No difference in size distributions for octocorals, sponges, and stony corals relative to baseline



Success Criteria: **Fish**

- Minimum 10 of 13 (75%) baseline species
- Relative abundance for each species statistically similar to baseline

