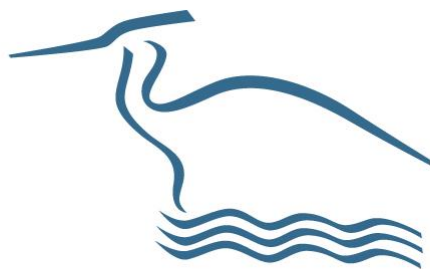


Galveston Bay Foundation's Oyster Shell Recycling Program

GLO Contract No. 20-032-000-B739

**FINAL REPORT
September 2021**

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I. Project Summary

In an effort to reestablish hard substrate in Galveston Bay, the Galveston Bay Foundation (GBF) partners with restaurants to collect shucked oyster shells. The shells are transported in recycling receptacles by GBF staff to upland storage sites where they are stockpiled and sun-cured for minimum of six months. The recycled shells are then returned to the bay through shoreline protection projects, reef creation projects and reef enhancement initiatives such as volunteer oyster gardening.

During CMP Grant Cycle 24, specifically from July 2020 through May 2021, 136 tons of oyster shells were recycled through GBF's Oyster Shell Recycling Program. These shells are being stored at curing sites where they are turned intermittently to allow for proper sun curing before being returned to the Bay. The shells will be utilized in GBF's Volunteer Oyster Gardening efforts and returned to Galveston Bay through (separately funded) oyster reef enhancement and restoration projects. Cycle 24 allowed GBF to purchase new shell recycling equipment, a heavy-duty truck equipped with a dump bed and bin lift, which facilitated the expansion of GBF's shell recycling operations to the inner loop of Houston. As a result of this purchase, GBF was able to increase shell recycling capacity and reduce staff time and labor.

II. Background Information

Oyster reefs are a vital component of a healthy estuary. Oysters filter contaminants from the water, protect shorelines, stabilize sediment, and provide habitat and food sources for other aquatic species. Unfortunately, oyster reefs are the most threatened marine habitat worldwide. Studies show that over 85% of oyster habitat has been lost on a global scale (Beck et al, 2011). In Galveston Bay, over 60% of the oyster reefs have been damaged, primarily as a result of Hurricane Ike (Hons and Robinson, 2010). Prior to 2008, Galveston Bay provided nearly 80% of the oyster harvest in Texas (Haby et al, 2009). However, the severe sediment deposition resulting from Hurricane Ike smothered oyster reefs across the bay system and eliminated a large portion of the hard substrate required for oyster development.

To help replenish hard substrate in the bay and support local oyster restoration efforts, GBF partnered with local restaurant owner Tom Tollett of Tommy's Restaurant and Oyster Bar in 2011 and began recycling oyster shells. Before GBF's Oyster Shell Recycling Program began, oyster shells were discarded along with other restaurant waste and sent to a landfill. To avoid the disposal this vital resource, GBF partners with multiple local restaurants to collect oyster shells and return them to the bay. The reclaimed shells will serve as new oyster habitat, thus enhancing the local oyster populations.

With the assistance of CMP funding, GBF has expanded the program from the pilot stage (Phase 1) with one restaurant and one curing site, through an initial expansion phase (Phase 2), resulting in eighteen restaurant partners and four curing sites from 2011 through May 31, 2021. During the evaluation phase (Phase 3), a Strategic Development Plan (SDP) was created with the goal of assessing alternative recycling methods to achieve a more sustainable program. The SDP led GBF to expand shell recycling operations to the inner loop of Houston to increase the volume of shell recycled. The second expansion phase (Phase 4) was initiated under Cycle 24 with the purchase of new recycling equipment in the spring of 2021 followed by the first shell collection in the inner loop of Houston in May 2021.

III. Project Implementation

A) Task 1: Shell Collection & Maintenance

A.1 Shell Collection Updates and Photos

Under Cycle 24, a total of 136 tons of recycled oyster shell was collected from July 2020 through May 2021. During this time, GBF staff collected shell from restaurant partners in the Clear Lake region and expanded operations in Houston. To help facilitate the Clear Lake and Houston shell collections, a part-time Oyster Shell Recycling Assistant was hired in March 2021.

Due to the COVID-19 pandemic and resulting staffing and funding changes, Texas A&M University at Galveston was no longer able to provide shell recycling services on Galveston Island. They ceased providing these services in the spring of 2020. However, in October 2020, GBF secured a new partner, Moody Gardens, to continue shell collection on Galveston Island. Moody Gardens also provides space on their property to store the recycled shell throughout the sun curing process. Shell recycling on Galveston Island resumed in October 2020.

As a result of Cycle 24 funds and private funds from Phillips66, GBF was able to purchase new shell recycling equipment in May 2021. The new equipment, a heavy-duty truck equipped with a dump bed and bin lift (Figure 5), allowed GBF to pursue the expansion of shell recycling operations in the inner loop of Houston, as well as increase shell recycling capacity and reduce staff time and labor. The Houston expansion officially began with the first shell collection using the new equipment in May 2021 (Figure 6).

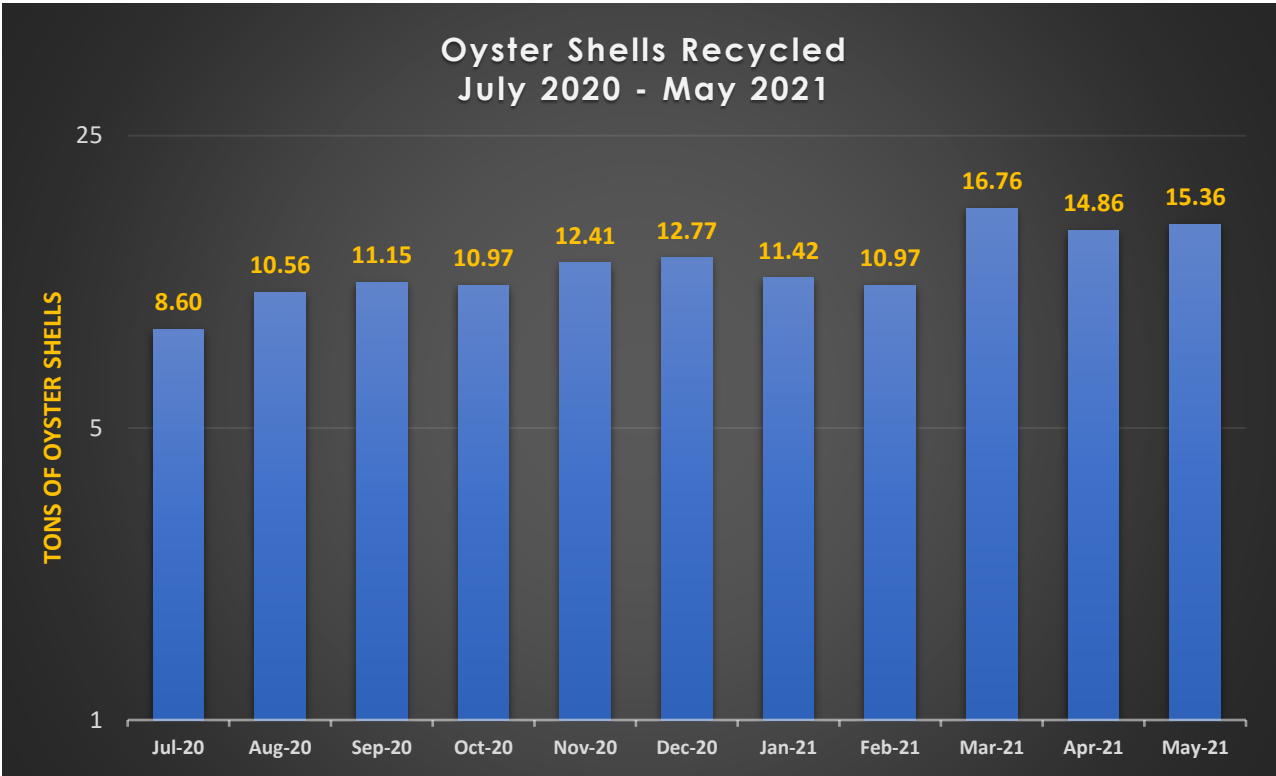
A total of five new restaurant partnerships (two within Clear Lake, two within Houston, and one in Galveston) were secured during Cycle 24. GBF and Moody Gardens staff collected oyster shells from a total of thirteen participating restaurants on a weekly basis to relieve the restaurants of their shell waste. Throughout the week, restaurant staff deposited shucked oyster shells in recycling receptacles. GBF and Moody Gardens staff transported the containers of shell to one of three curing sites. The shells were then left to sun cure or “bleach” for a minimum of six months. Following the curing process, the shells were ready to be used in oyster gardening, as well as (separately funded) oyster reef restoration and enhancement projects throughout Galveston Bay.

Please refer to Table 1, Chart 1, and Chart 2 below for the shell collection numbers and associated graphs, as well as Appendix A.1 for photos of the shell recycling process and equipment. A map of current restaurant partners can be found in Appendix B.1.

Table 1: Tonnage of Oyster Shells Recycled under Cycle 24

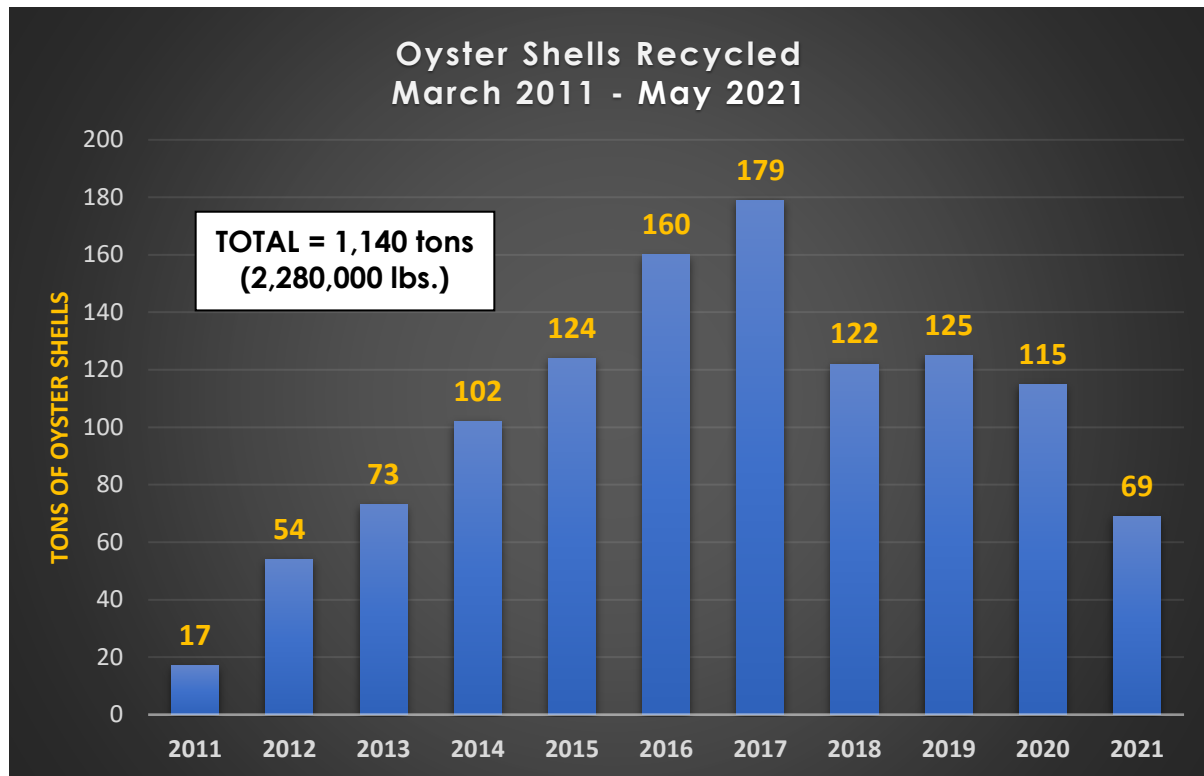
Month	Oyster Shells Collected (tons)
July 2020	8.60
August 2020	10.56
September 2020	11.15
October 2020	10.97
November 2020	12.41
December 2020	12.77
January 2021	11.42
February 2021	10.97
March 2021	16.76
April 2021	14.86
May 2021	15.36
Total	135.82

Chart 1: Tonnage of Oyster Shells Recycled under Cycle 24



**Oyster shell tonnage is based on an average weight of 182lbs of shell/32-gallon bin and 30lbs of shell/5-gallon bucket and is subject to a variance of ± 5%.*

Chart 2: Tonnage of Oyster Shells Recycled to Date



**Oyster shell tonnage is based on an average weight of 182lbs of shell/32-gallon bin and 30lbs of shell/5-gallon bucket and is subject to a variance of ± 5%.*

A.2 Storage Site Logs

To track the amount of oyster shells recycled and where they are delivered for the sun curing process, GBF and Moody Gardens staff maintain Microsoft Excel spreadsheets in which the date, source of shell (e.g. restaurant name, special event, seafood lab, etc.), amount of shell (pounds, tons, and cubic yards), curing site name, pile location, and pile rotation is recorded for the oyster shell collected from each participating restaurant. GBF and Moody Gardens staff also document the date a shell pile is turned during the sun curing process and when cured shell is transported off the curing site property for restoration projects. This allows GBF to maintain an estimate of total shell available for use in reef restoration projects.

During the grant cycle, a total of 136 tons of recycled oyster shell was delivered to three curing sites (Texas City, Red Bluff, or Moody Gardens) from July 2020 through May 2021. Please refer to Table 2 for the storage site log. Most of the shell was deposited at Red Bluff as it is the largest property and near the majority of the Clear Lake and Houston area restaurant partners. All shell collected from restaurant partners on Galveston Island was delivered to the curing site located on Moody Gardens' property.

Table 2: Tonnage of Shells Delivered to Curing Sites during Cycle 24

STORAGE SITE LOG July 2020-May 2021	
Curing Site	Total Oyster Shells Onsite (Tons)
Texas City	1.27
Red Bluff	133.04
Moody Gardens	1.51
TOTAL	135.82

**Oyster shell tonnage is based on an average weight of 182lbs of shell/32-gallon bin and 30lbs of shell/5-gallon bucket and is subject to a variance of \pm 5%.*

A.3 Storage Site Maintenance Updates and Photos

GBF spent the grant cycle managing and maintaining two curing sites used for shell storage: Red Bluff Curing Site and Texas City Curing Site. The Red Bluff Curing Site is a leased property from the Port of Houston Authority that, under lease terms, GBF is responsible for all maintenance and management. As a 1.5-acre property, more time and effort are needed to ensure the Red Bluff site meets the standards for proper and efficient shell curing. GBF staff performed regular mowing and vegetation management for access, as well as shell turning, moving, and piling for proper shell curing. In years past, this site was taken out of circulation during the rainy months to prevent damage to the property by vehicular traffic. However, continuous improvements now allow for year-round use of the Red Bluff site. GBF staff developed a Sun Curing Protocol that provides a detailed shell storage plan for a more efficient and thorough sun curing process. On all properties, shell at different stages of the curing process (Phase 1 – Active Collection; Phase 2 – Curing; Phase 3 – Cured) is kept in individual piles separated by a 10-foot buffer. This allows GBF and Moody Gardens staff to track which shell is available for use in restoration projects. To better accomplish this, staff have divided sections of Red Bluff, Texas City, and Moody Gardens to monitor each phase of the curing process more precisely.

Please refer to Table 3 below for the curing site maintenance log, Appendix A.1 for photos of the curing sites, and Appendix E for the Sun Curing Protocol.

Table 3: Log of Curing Site Maintenance during Cycle 24

CURING SITE MAINTENANCE LOG July 2020-May 2021		
Date	Curing Site	Maintenance Conducted
07/14/20	Red Bluff	Weedeated around stakes/tree in middle area and around shell pile B
07/20/20	TX City	Moved shell; Pile B and C got moved to Pile A
07/23/20	TX City	Shell piles marked using wooden stakes with designated shell pile letter painted on top of stake
08/12/20	Red Bluff	Installation of new gate set back further from road
09/16/20	Red Bluff	Mowed
10/02/20	Red Bluff	Pile A, E, and F got rotated; main gate post reinforced from leaning; t-posts installed in middle section to replace broken wooden stakes
10/05/20	Red Bluff	Stakes with pile letters were secured to t-posts
10/06/20	Red Bluff	Herbicide sprayed on property with ATV; area around gate was weedeated
10/21/20	Red Bluff	Orange rope tied around t-posts to section off shell piles
04/28/21	Red Bluff	Moved shell from Pile D to E
05/03/21	Red Bluff	Moved shell from Pile A to E
05/03/21	Red Bluff	Rotated and smoothed out Pile H
05/03/21	Red Bluff	Rotated and smoothed out Pile I
05/04/21	Red Bluff	Moved shell from Pile F to E
05/13/21	Red Bluff	Removed dead trees/brush near Pile D (Created Pile M)

B) Task 2: Volunteer Oyster Gardening

B.1 Project Description

Since 2012, GBF has fostered relationships in bayfront communities to garden oysters. Waterfront homeowners in these communities volunteer as oyster gardeners and suspend mesh bags, cages, or metal lines containing recycled oyster shells (oyster gardens) from their piers to recruit oyster larvae. The oyster gardens are submerged in the bay during the spawning season (approximately May through November). Volunteers monitor and care for the oyster gardens throughout the summer and early fall to ensure successful growth of any baby oysters (spat) recruited on the recycled shell. In the fall, GBF staff collect the oyster gardens and spread the shells and spat on nearby restoration reefs to enhance the local oyster population. The volunteer oyster gardeners not only learn about the life cycle of the Eastern oyster and the importance of oyster reefs in the Galveston Bay ecosystem, but they are also exposed to a variety of marine life that find shelter in the oyster gardens. Furthermore, oyster gardening volunteers have the opportunity to participate in citizen science through GBF's spat recruitment studies.

B.2 Volunteer Oyster Gardening in 2020

Due to the COVID-19 pandemic in 2020, GBF staff were required to restructure the spring oyster gardening events. Rather than hosting in-person community events, GBF staff developed two instructional videos to allow volunteers to become oyster gardeners from the comfort and safety of their own homes. These videos can be accessed online via YouTube.

Video 1: Become an Oyster Gardener Today; https://youtu.be/0_ncnKyar1Y

Video 2: Oyster Gardener Training; https://youtu.be/r_nQO4y_nOc

All oyster gardens were built by staff and a few dedicated volunteers in the spring of 2020. Three garden types were utilized based on each volunteer's preference: bags, stringers, or cages (see Video 2). The gardens were delivered directly to each participating volunteer's bayfront home to prevent unnecessary contact and abide by social distancing requirements. Upon completion of the garden deliveries in June and July, nearly 100 bayfront residences deployed 386 oyster gardens all containing recycled oyster shell. Please refer to Table 4 for the results of the spring and summer volunteer recruitment and garden creation efforts.

Table 4: Oyster Garden Creation (Spring-Summer 2020)

Community	Oyster Gardens Created	No. of Volunteers
Bayou Vista	88	27
Galveston	94	22
Harborwalk	24	4
La Porte	32	2
San Leon		2
Tiki Island	148	41
TOTALS:	386	98

Throughout the remainder of 2020, volunteers documented spat recruitment and monitored their gardens on a weekly basis. Multiple tropical storms dislodged numerous gardens in the fall of 2020, but spat recruitment remained high in the communities located in West Galveston Bay. Figures 3 and 4 in Appendix A.2 show the abundance of spat recruitment throughout the summer and early fall in Tiki Island.

In December, GBF coordinated the collection of all remaining gardens with each gardening community. Volunteers delivered their gardens to designated drop-off sites within their community (or an adjacent community) to limit large gatherings. With assistance from additional GBF staff and multiple volunteers, GBF ensured all new oyster growth in each garden was documented. The total spat per garden, shown in Table 5, includes both live and dead oysters to provide documentation of the overall spat recruitment in each oyster garden.

Table 5: Oyster Spat Recruitment (Fall 2020)

Community	Gardens Collected for Transplant	Total Spat	Average Spat/Garden
Bayou Vista	57	374	6.56
Galveston	69	5,875	85.14
Harborwalk	24	1,259	52.46
La Porte	8	7	2.20
San Leon	17	37	2.18
Tiki Island	125	10,803	86.42
TOTALS:	300	18,355	61

With assistance from a separate funding source, all new oysters and recycled shells from the gardens were transplanted onto nearby restoration reefs. Table 6 shows the total number of spat and amount of oyster shell transplanted at each restoration site. Thanks to the 98 dedicated volunteers, 18,355 oysters were transplanted in December 2020 under separate grant funding.

Table 6: Spat Transplants

Transplant Date	Origin of Gardens	Transplant Location		Total Spat Transplanted	Tons of Shell Transplanted
		Sub-bay System	GBF Project		
12/04/20	Bayou Vista Tiki Island Harborwalk Galveston	Sweetwater Lake (West Galveston Bay)	Sweetwater Oyster Shell Breakwater	18,311	0.69
12/05/20					
12/11/20	San Leon La Porte	Dickinson Bay	Dickinson Bay Oyster Reef	44	0.06
TOTALS:				18,355	0.75

**Please note, all spat transplant activities were conducted under separate funding.*

B.3 Results

GBF's Volunteer Oyster Gardening Program emerged as an ideal volunteer opportunity in a time of social distancing. The training videos developed in 2020 were successful in both recruiting and training volunteers and provided a safe option for community involvement. These videos will be used for years to come to supplement in-person events.

As shown in the spat recruitment data (Table 5 and Chart 4), the communities of Galveston, Tiki Island, and Harborwalk documented an average of at least 50 oysters in each oyster garden. Similar to previous years, Bayou Vista had mixed success. Gardening locations along the inner canals of the community recruited more mussels and barnacles than oysters, most likely due to limited water circulation. Spat recruitment in La Porte and San Leon remained low, possibly due to lingering impacts of freshwater events in previous years, including Hurricane Harvey. Overall, an average of 61 spat per garden was documented for the 2020 oyster gardening season.

GBF has implemented the use of three different garden types over the last three years. In 2020, the cages contained the most spat with an average of 95 spat per garden. On the other hand, the stringers and bags recruited an average of 56-57 spat per garden (Table 7 and Chart 3). While the differences in spat recruitment among the three garden types are not drastic, it appears the cages may be more effective. However, additional data collection will be necessary to confirm these findings. Based on volunteer and GBF observations, it appears the larger openings in the cages provide more water flow than the bags, but the bag structure prevents predation unlike the stringers. In addition, the cages can be reused for at least one to two years where as the bags and stringers become trash after a single use.

Please refer to Appendix B.2 for the oyster gardening project location map and Appendix A.2 for photos from the 2020 oyster gardening season.

Table 7: Spat Recruitment based on Garden Type

GARDEN TYPE A - BAGS			
Community	Bags Transplanted	Total Spat	Average Spat/Bag
Bayou Vista	26	111	4.27
Galveston	35	2,858	81.66
Harborwalk	14	589	42.07
La Porte	5	6	1.20
San Leon	11	29	2.64
Tiki Island	60	5,046	84.10
TOTALS:	151	8,639	57
GARDEN TYPE B - STRINGERS			
Community	Stringers Transplanted	Total Spat	Average Spat/Stringer
Bayou Vista	23	248	10.78
Galveston	25	1,957	78.28
Harborwalk	10	670	67.00
La Porte	2	0	0.00
San Leon	5	6	1.20
Tiki Island	50	3,605	72.10
TOTALS:	115	6,486	56
GARDEN TYPE C - CAGES			
Community	Cages Transplanted	Total Spat	Average Spat/Cage
Bayou Vista	8	15	1.88
Galveston	9	1,060	117.78
Harborwalk	0	0	0.00
La Porte	1	1	1.00
San Leon	1	2	2.00
Tiki Island	15	2,152	143.47
TOTALS:	34	3,230	95

Chart 3: Average Spat per Garden Type

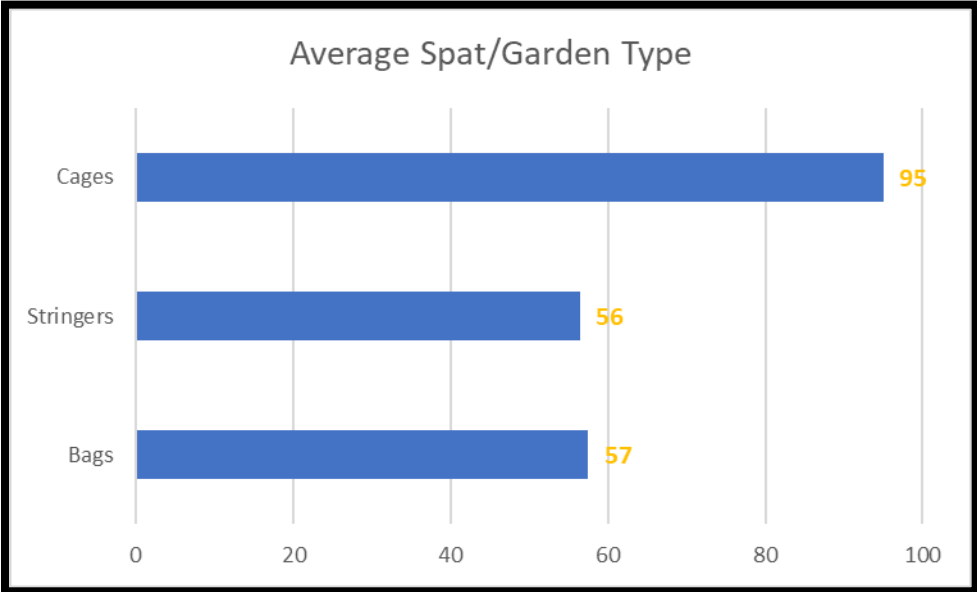
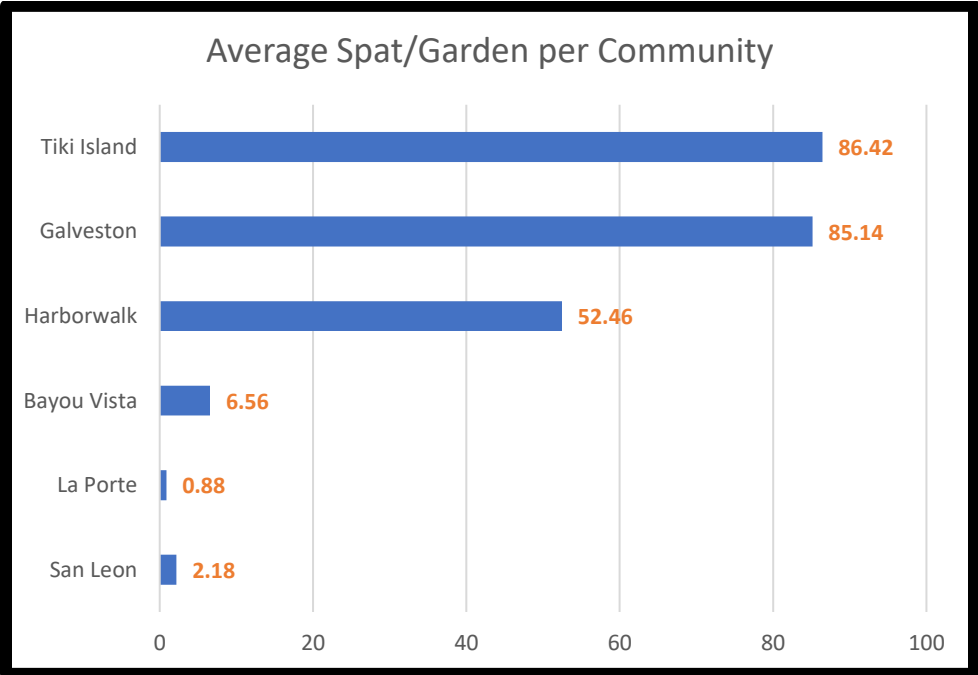


Chart 4: Average Spat per Garden based on Community



C) Task 3: Outreach & Participation

C.1 Outreach Materials

To inform the public about the Oyster Shell Recycling Program, approximately 200 rack cards explaining the Program were distributed at The Aquarium restaurant for their customers. Also, a total of sixteen window clings were distributed to all active restaurant partners that were interested. The window clings will be displayed on entry doors to advertise the restaurant is a participant of the Oyster Shell Recycling Program. In addition, a new sign displaying current restaurant partner logos was installed on the back gate of the oyster shell recycling trailer for advertisement for participating restaurants as well as the Program.

New signs were also designed for volunteer oyster gardeners in 2020. The signs provide an explanation of the gardening program and were mounted on volunteers' piers during the gardening season.

Please refer to Appendix C for depictions of the outreach materials.

C.2 List of Presentations, Exhibits, Conferences, etc.

Due to the COVID-19 pandemic, most outreach events and presentations were conducted virtually or postponed. However, GBF was still able to present at the virtual RAE Summit, hold a virtual Oyster Workgroup meeting, and attend other webinars and virtual presentations such as GBF's Bay Day Festival and the Galveston Bay Area Chapter of Texas Master Naturalists meeting. For GBF's Bay Day Festival an oyster filtration time lapse video was created and can be used for other outreach activities in the future. The Oyster Shell Recycling Program was featured in CMP's December 2020 newsletter (Appendix C.6). Table 8 below includes a list of all the outreach events that occurred in 2020.

Table 8: 2020 Outreach Events

No. of Events	Date	Event/ Activity	Description	Type of Outreach	Participants
1	1/20/2020	Galveston Island Nature Tourism Council monthly outreach	Presentation on Galveston Bay Foundation's Oyster Restoration Program	Community Outreach	16
2	1/22/2020	State of the Bay Symposium	Presentation on Uses of Recycled Oyster Shell in Reef Restoration	Presentation	~30
3	1/23/2020	State of the Bay Symposium	Presentation on Volunteer Oyster Gardening	Presentation	~30
4	1/25/2020	Barge 295 Oyster Cook-Off	One-time shell recycling event	Community Outreach	unknown
5	4/25/2020	GCOOS - GCAN Webinar Series	Virtual presentation on GBF's Habitat Restoration efforts including Oyster Reef Restoration	Presentation	32
6	5/16/2020	GBF's Bay Day Festival	Virtual presentation/booth on oyster ecology, shell recycling, & reef restoration	Presentation	2,491
7	6/29/2020	Become an Oyster Gardener Today- YouTube	Virtual presentation on oyster gardening	Community Outreach	511
8	6/29/2020	Oyster Gardening Training- YouTube	Virtual presentation on oyster gardening	Presentation	188
9	8/6/2020	Galveston Bay Area Chapter of TX Master Naturalists Meeting	Virtual presentation on the Oyster Shell Recycling Program	Presentation	88
10	9/30/2020	Virtual RAE Summit	Virtual presentation on Volunteer Oyster Gardening	Presentation	106
11	10/1/2020	Virtual RAE Summit	Virtual presentation on Uses of Recycled Oyster Shell in Reef Restoration	Presentation	79
12	10/28/2020	Oyster Workgroup Meeting	Meeting with restoration partners to discuss ongoing/future shell recycling and reef restoration activities	Regional Workgroup Meeting	~40
13	12/4/2020	Fall Volunteer Oyster Gardening Event(s)	Gardening collection, spat counts, spat transplants via volunteer assistance	Volunteer Event	98
14	12/5/2020				

C.3 Status of Restaurant Recruitment

Five new restaurant partners were added to the Oyster Shell Recycling Program during Cycle 24. As of May 2021, the Oyster Shell Recycling Program had a total of thirteen active restaurant partners. Please refer to Table 9 below for a list of active restaurant partners as of May 2021.

During Cycle 24, a restaurant located within the inner loop of Houston, Loch Bar, assisted GBF with a “pilot” to initiate the Houston expansion. GBF worked with Loch Bar for approximately one month to ensure shell collections were operating smoothly and to allow GBF staff to familiarize themselves with the new route. The “pilot” concluded once the new equipment for shell recycling was available which allowed for more restaurant participation and more frequent shell collections per week. Utilizing Cycle 25 funds, the expansion is ongoing with an additional five restaurant partners added in Houston.

Table 9: Active Oyster Shell Recycling Restaurant Partners

Restaurant	Shell Recycling Start Date
Tommy’s Restaurant & Oyster Bar	March 2011
The Aquarium (Kemah)	August 2013
Crazy Alan’s Swamp Shack (Kemah)	November 2013
Captain Benny’s Seafood (Gulf Freeway)	October 2015
Tookie’s Seafood	June 2016
BLVD Seafood	January 2018
Crazy Alan’s Swamp Shack (Baybrook)	June 2019
Sam’s Boat (Seabrook)	March 2020
Barge 295	October 2020
Fisherman’s Wharf	November 2020
BB’s Tex-Orleans (Webster)	April 2021
Loch Bar	April 2021
Bludorn	May 2021

C.4 Restaurant Database

GBF staff update the Restaurant Database annually to analyze potential shell recycling partners. Please refer to Appendix D for the updated list of potential restaurant partners in the Houston, Clear Lake, and Galveston regions. Through analysis of restaurant location and menu items, GBF staff identified five restaurants in the Clear Lake region and eight restaurants in the Galveston region as priority future partners to pursue. Based on the Houston list, it appears most of the Houston region restaurants are in or near the inner loop. Since ten restaurants within that area have already expressed interest in joining the Oyster Shell Recycling Program, GBF staff plan to focus restaurant recruitment efforts in this vicinity of Houston, thus helping to inform expansion efforts under Cycle 25.

IV. Results

A total of 136 tons of oyster shell was collected and five new restaurant partnerships were secured with CMP Cycle 24 funds. In addition, GBF was able to purchase new shell recycling equipment, a F550 with a dump bed and bin lift, which facilitated the expansion of shell recycling operations into the inner loop of Houston in 2021. As of May 2021, GBF has recycled a total of 1,140 tons of oyster shells since 2011, in large part, through support and funding from CMP. All oyster shells collected during Cycle 24 are currently undergoing the sun curing process. Upon completion of the sun curing process, these shells will be utilized in GBF's Volunteer Oyster Gardening Program and oyster reef restoration efforts (separately funded).

Although the COVID-19 pandemic altered the normal community events associated with the Volunteer Oyster Gardening, 98 volunteers participated in oyster gardening during 2020. As a result of their efforts, 18,355 oysters were transplanted onto restoration reefs in December 2020 under separate grant funding.

V. Lessons Learned

Delays due to COVID-19

The start of oyster shell recycling operations under Cycle 24 was delayed due to the COVID-19 pandemic. When restaurants were required to suspend inside dining, oyster sales ceased. GBF decided to temporarily suspend shell recycling operations from March 21, 2020 through May 6, 2020. Shell recycling operations recommenced on May 7, 2020 as restaurants began reopening their dining rooms. Although the amount of oyster shell recycled in 2020 was slightly lower than previous years, it has increased again in 2021. GBF staff are collecting an average of approximately 15 tons per month as of September 2021.

The pandemic also delayed the purchase of new equipment necessary to expand shell recycling operations to the inner loop of Houston. As production of trucks and other equipment declined, vehicles and equipment were not readily available. Therefore, the purchase of GBF's new recycling equipment was delayed until early 2021.

GBF originally planned to launch the expansion of the Program in April 2020 with the Inaugural Houston Oyster Festival. Unfortunately, all large events were canceled in the City of Houston by March 2020 due to the COVID-19 pandemic. GBF made the decision to postpone the event in the interest of human health and safety. The event was postponed again in April 2021. GBF plans to host the event in April 2022 pending pandemic conditions.

Furthermore, most outreach events and presentations were conducted virtually or postponed during the pandemic, therefore time spent promoting the Program within the community decreased under Cycle 24. GBF's Habitat Restoration Technician reached out to the public by distributing outreach materials (such as rack cards and window clings) to all restaurant partners. In addition, a new sign, displaying current restaurant partner logos, was installed on the back gate of the oyster shell recycling trailer for advertisement. Hopefully in-person events will be allowed during Cycle 25 and additional time will be spent with the public to increase awareness of the Oyster Shell Recycling Program, as well as the General Land Office's commitment to these efforts.

Staffing Changes

To improve the daily operations of the Oyster Shell Recycling Program as well as oversee the new equipment purchase and expansion of the Program into Houston, the existing part-time Oyster Shell Recycling Assistant was promoted to a full-time position, Habitat Restoration Technician, in the fall of 2020. The promotion to full time allowed for complete dedication to thoroughly research the purchase of the new equipment and ensure GBF made the best decision and use of CMP and other private funds. The addition of this new full-time role helped improve the efficiency and productivity of GBF's Oyster Shell Recycling Program by combining the following responsibilities into a single role: oversight of shell recycling operations, restaurant partnership management, curing site management, and shell recycling assistant training and management.

Shell Recycling on Galveston Island

The new partnership with Moody Gardens has proved successful in reestablishing oyster shell recycling on Galveston Island. This success can be attributed to the dedication of participating staff at Moody Gardens and effective communication between the partners. Since the beginning of the partnership, Moody Gardens has allowed GBF to store all oyster shell collected in Galveston on their property during the curing process. They also maintain the shell piles for GBF in accordance with the Sun Curing Protocol. Furthermore, Moody Gardens has helped expand shell recycling efforts on the island through their local connections, resulting in the addition of three new shell recycling partners since October 2020. During Cycle 24 Fisherman's Wharf was secured. In addition, Moody Gardens assisted with the addition of Kritikos Grill and the Seafood Safety Lab at Texas A&M University at Galveston under Cycle 25 in early 2021. GBF would like to continue to increase restaurant participation on Galveston Island, but more funding will be required to obtain the appropriate equipment needed for expansion efforts.

Expansion

Although the COVID-19 pandemic delayed the start of the Program's expansion to the inner loop of Houston, GBF's Habitat Restoration Technician utilized Cycle 24 funds to begin the expansion in the spring of 2021. After meeting with Loch Bar's managers and chefs at the beginning of the pilot expansion, GBF quickly learned what new challenges might arise with Houston restaurant partners. Since real estate isn't as plentiful in Houston compared to Clear Lake, a lack of space to store the shell recycling bins is often a challenge. The property managers also have strict rules on where certain items can be stored due to fire safety codes, thus reducing bin storage space further.

Due to the low volume of shell recycled by Houston partners thus far, the shell collections in Houston could occur once or twice a week. However, most Houston restaurants are located in residential areas or high-rise office buildings, thus odor is a concern. Some Houston restaurants have requested shell collection on a daily basis to decrease the odor. Due to limited funding and staff availability, daily shell collections are not feasible at this time. In addition, the current restaurant partners in Houston appear to be satisfied with three shell collections a week.

To improve and continue expansion efforts over the next year, GBF plans to address these challenges by communicating with restaurant staff on a frequent basis and maintaining open discussions to identify possible solutions. As new restaurant partners in Houston are brought on board, these challenges will be discussed up front to ensure amenable terms are set from the beginning of each new partnership.

As GBF expands its efforts, additional and more dedicated restaurant relationships are required to ensure steady shell collection. The goal of the Program is to provide recycling services for the majority, if not all, of the Houston-Galveston region. Likewise, by expanding shell recycling efforts to the entire region, GBF aims to have enough oyster shell stockpiled to allow for ongoing gardening efforts as well as reef creation for years to come.

VI. References

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VII. Appendix

A) Project Photographs

A.1) Task 1 Photographs

A.2) Task 2 Photographs

B) Project Location Maps

B.1) Map of Current Restaurant Partners

B.2) Oyster Gardening Project Location Map

C) Outreach Materials

D) Restaurant Database

E) Sun Curing Protocol

APPENDIX A
Project Photographs

A.1) Task 1 Photographs



Figure 1. GBF staff delivering recycled shell to the Red Bluff curing site.



Figure 2. GBF staff delivering recycled shell to the Red Bluff curing site.



Figure 3. Shell collection from Loch Bar began in April 2021 to pilot the Houston shell recycling expansion.

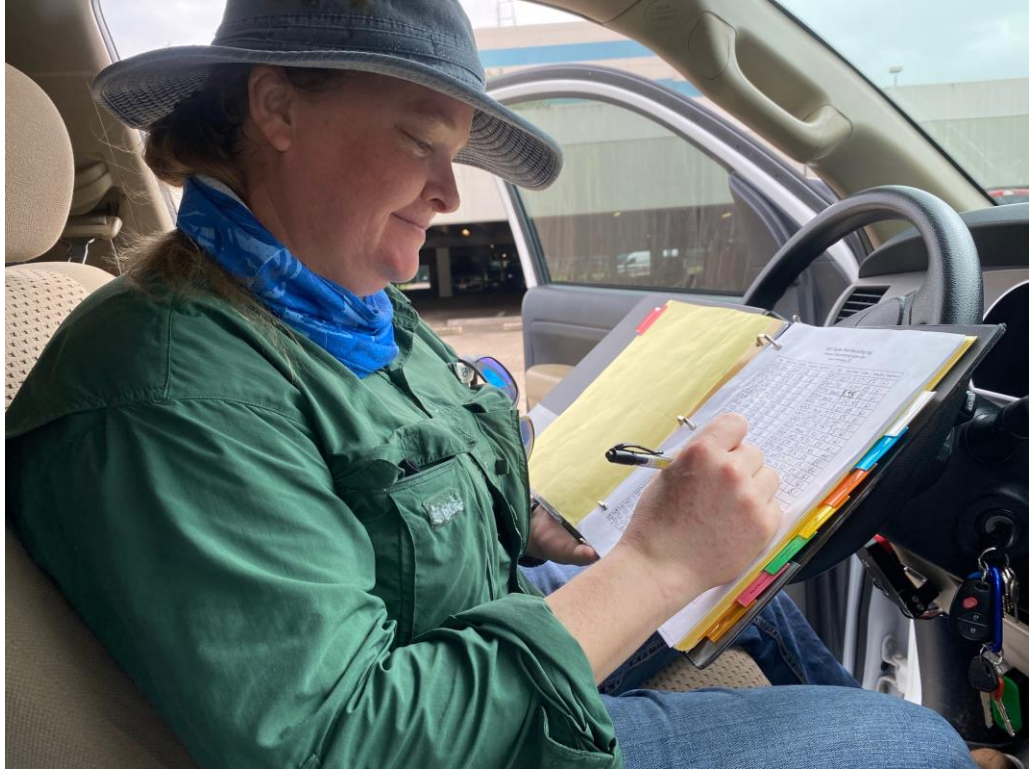


Figure 4. GBF staff recording amount of shell collected.



Figure 5. New shell recycling equipment with completed Oyster Shell Recycling Program decals.



Figure 6. The Houston expansion officially began with its first shell collection with the new equipment in May 2021.



Figure 7. GBF staff using the new equipment to collect oyster shell from a restaurant partner.



Figure 8. Recycled shell being delivered to the Red Bluff curing site with the new equipment.



Figure 9. New gate installed at Red Bluff Curing Site.



Figure 10. Aerial view of the Red Bluff Curing Site (February 2021).



Figure 11. GBF staff moving cured shell to consolidate piles and make space for future recycled shell.



Figure 12. GBF staff relocating recycled shell from Texas A&M University at Galveston to Moody Gardens' curing site.

A.2) Task 2 Photographs



Figure 1-2. Garden creation by Tiki Island volunteers (Spring 2020)



© Kym Keller



© Patti Britton Polensky

Figure 3-4. Newly recruited, young oysters (spat) on recycled shell from volunteers' oyster gardens (July & September 2020)



Figure 5. Tiki Island volunteers dropping off their gardens for spat counts (December 4, 2020)



Figure 6. Volunteers from Tiki Island counting spat recruited in gardens (December 4, 2020)



Figure 7-8. New oyster growth on recycled shell on stringers from Tiki Island (December 4, 2020)



Figure 9. New oyster growth on recycled shell in cage from Tiki Island (December 4, 2020)



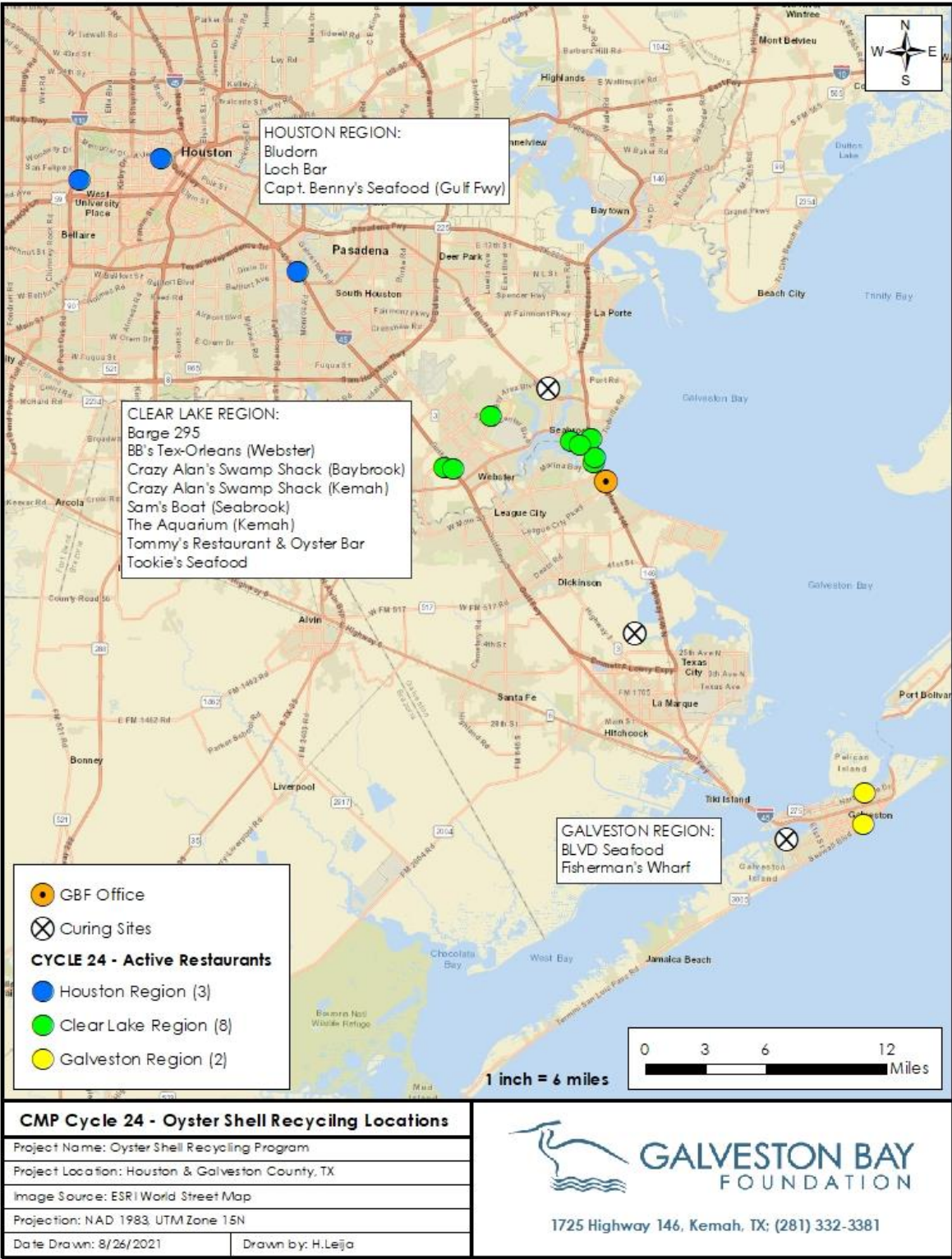
Figure 10. Oyster recruitment on Galveston volunteer's garden (December 5, 2020)



Figure 11-12. Volunteers assisting with garden collection and spat counts (December 5, 2020)

APPENDIX B
Project Location Maps

B.1.) Map of Current Restaurant Partners



B.2) Oyster Gardening Project Location Map



2020 Oyster Gardening Locations	
Project Name: Volunteer Oyster Gardening Program	
Project Location: Galveston Bay & adjacent Sub-bay Systems	
Image Source: ESRI World Street Map	
Projection: NAD 1983, UTM Zone 15N	
Date Drawn: 12/29/2020	Drawn by: H.Leija

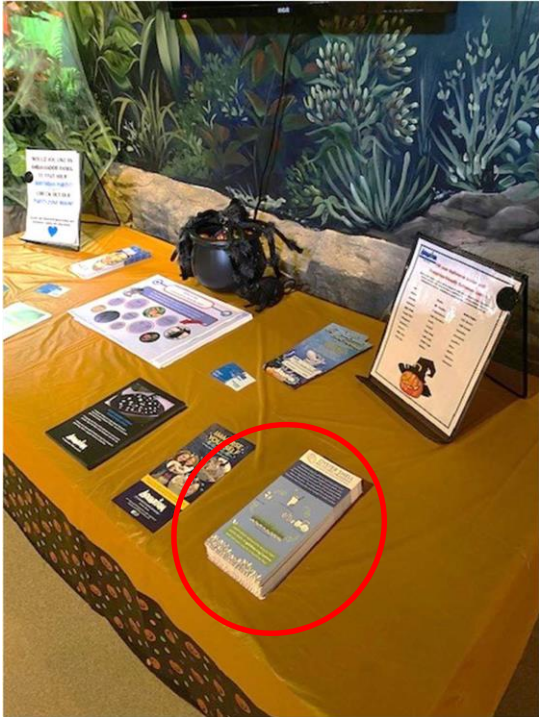


GALVESTON BAY
 FOUNDATION

1725 Highway 146, Kemah, TX; (281) 332-3381

APPENDIX C
Outreach Materials

C.1) Oyster Shell Recycling Program Rack Cards



OYSTER SHELL RECYCLING PROGRAM
A GALVESTON BAY FOUNDATION PROGRAM

Galveston Bay Foundation partners with local restaurants to collect shucked oyster shells after patrons enjoy a tasty meal. The empty oyster shells are sun-bleached for a minimum of six months to rid them of bacteria. The shells are then returned to Galveston Bay to provide new homes for baby oysters.

Shell Collection → **Sun Curing** → **Reef Restoration** → **New Life!** → **Shell Collection**

Learn which restaurants recycle their oyster shells at galvbay.org/oysters and eat your way to a healthier Bay!

WHY ARE OYSTERS SO IMPORTANT?

- Oysters clean the water
- Oyster reefs create homes for fish, shrimp, crabs, and many other species
- Oyster reefs help protect the shoreline
- Oysters are food for people, birds, & crabs

WHY RECYCLE OYSTER SHELLS?

Oyster larvae need a hard surface on which to attach so that they may begin to grow. While baby oysters can attach to just about anything, they prefer other oyster shells!

Galveston Bay lost more than 50 percent of its oyster reefs as a result of Hurricane Ike. To help restore the Bay's oyster population, keep our water clean, and provide habitat for aquatic life, Galveston Bay Foundation returns all recycled oyster shells to the Bay through Volunteer Oyster Gardening efforts and Oyster Restoration Workdays.

Interested in becoming an Oyster Program **Volunteer? Sponsor? Partner?**
Call 281-552-3381 or email info@galvbay.org

This project is funded, in part, by the Texas Coastal Management Program grant approved by the Texas Coastal Commission & managed by the National Oceanic & Atmospheric Administration. GALVESTON BAY FOUNDATION

C.2) Oyster Shell Recycling Program Window Cling



We proudly recycle our shells through



**OYSTER SHELL
RECYCLING PROGRAM**

**GALVESTON BAY
FOUNDATION**

THIS PROJECT FUNDING PART OF A BEACH COASTAL MANAGEMENT PROGRAM GRANT APPROVED BY THE TEXAS LAND COMMISSIONER. FUNDING TO NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION ASHWI-00-01A-BY-02-B-0704

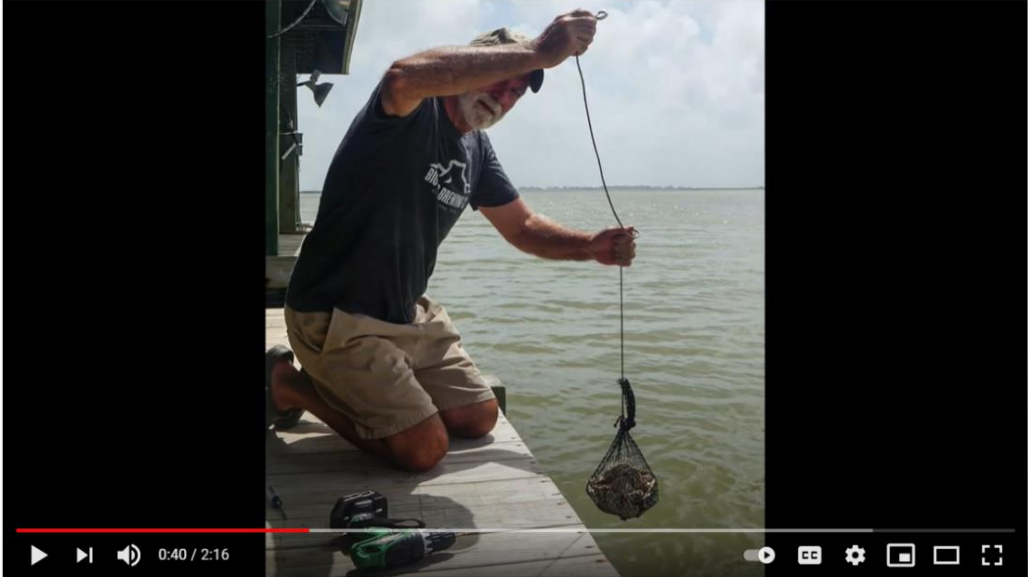
C.3) Trailer Sign



C.4) Oyster Gardening Sign



C.5) Oyster Gardening Videos



Become an Oyster Gardener Today!

486 views • Jun 29, 2020

8 0 SHARE SAVE ...

This video shows a man in a dark t-shirt and khaki shorts kneeling on a wooden boat deck. He is holding a long rope that is attached to a mesh net filled with oysters. The background shows a body of water under a cloudy sky. The video player interface at the bottom shows a progress bar at 0:40 / 2:16 and various control icons.

https://youtu.be/0_ncnKyar1Y



Oyster Gardener Training

180 views • Jun 29, 2020

1 0 SHARE SAVE ...

This video features a man with a full beard and a black cap, wearing a grey polo shirt and black gloves. He is standing behind a table covered with various oyster gardening supplies, including oysters, a mesh net, and tools. The background is a green wall with two metal brackets. The video player interface at the bottom shows a progress bar at 0:19 / 7:29 and various control icons.

https://youtu.be/r_nQQ4y_nOc

C.6) 2020 CMP Newsletter

CMP Success Story

Galveston Bay Foundation's Oyster Shell Recycling Program Adapts to COVID-19 // HAILLE LEIJA

Recycled oyster shells have been in quarantine long before we were! Even though the 2020 COVID-19 pandemic has interfered with many of our plans, Galveston Bay Foundation's (GBF) Oyster Shell Recycling Program is still going strong. Since 2011, GBF has collected shucked oyster shell from local restaurant partners to use in reef restoration. This shell is a valuable resource as it provides a surface for oyster larvae to attach and begin to grow. Prior to being returned to the Bay, all recycled oyster shell is stored at one of GBF's "curing sites" where it is strategically piled and turned, allowing the shells to be thoroughly exposed to the sun. This six-month quarantine process ensures the shells are rid of bacteria and other pathogens before being returned to the Bay as new oyster habitat.

GBF has collected over 2,000,000 lbs. of oyster shell to date and returned approximately 530 tons of shell to Galveston Bay to help sustain the local oyster populations. In the spring of 2020, shell recycling was put on hold for six weeks due to pandemic-related regulations that required restaurants to suspend inside dining. But now, the program's restaurant partners are open and shucking again, and have helped GBF collect over 156,000 lbs. of shell thus far in 2020!

Not only are shells being saved from the landfill, but GBF's Volunteer Oyster Gardening Program has emerged as an ideal volunteer opportunity in a time of social distancing. Rather than hosting in-person community events, GBF staff developed a series of instructional videos to allow volunteers to become oyster gardeners from the comfort of their home. During June and July, more than 100 bayfront residences deployed over 380 oyster gardens all containing recycled oyster shell. These volunteers have documented amazing results, with multiple new oysters growing on the recycled shell in their gardens! Soon GBF staff will collect the oyster gardens with the new baby oysters (aka spat) and transplant them onto nearby restoration reefs where the oysters can continue their important water filtration work. To learn more, visit galvbay.org/oysters today!



Volunteers create and deploy stringer oyster gardens from their docks to give oyster larvae a surface to attach and grow. Photo courtesy of Lynn Wright.



Oyster shells collected from restaurant partners must undergo a six-month quarantine/sun curing process before returning to the Bay. Photo courtesy of Galveston Bay Foundation.

THE DEEPER DIVE

Promoting Living Shorelines to Preserve the Texas Coast

The GLO is committed to promoting ecologically and economically sound coastal management practices. With this goal in mind, the GLO is promoting the use of living shorelines as an alternative to traditional shoreline stabilization techniques along the Texas coast. A living shoreline is a natural shoreline stabilization approach designed to mimic nature and serve as an alternative to bulkheads, seawalls, and other hard stabilization methods. These features utilize natural materials along with the strategic placement of plants and organic material to reduce erosion and protect property. In the right setting, they can prevent land loss and provide the aesthetic benefits of a natural shoreline. They can be designed in a variety of sizes, configurations, and dimensions and can be successful in both smaller residential locations and along larger sections of the coast.

To help coastal property owners install a living shoreline, the GLO has developed "A Guide to Living Shorelines in Texas". This guidance document is meant to be a one-stop educational resource that provides streamlined information on designing, permitting, and constructing viable living shoreline projects. The guide also contains a link to the Living Shoreline Site Suitability Model (LSSM) developed by the Harte Research Institute. Learn more about the tool in the "New Tools and Tech" section below.

In addition to creating the guide, the GLO has hosted a series of informative living shoreline workshops over the last two years. The 2019 workshops provided introductory information on living shorelines and the 2020 workshops presented technical information on how to install a living shoreline and debuted the guidance document. The GLO hopes this newly available information will help coastal landowners build a living shoreline on their property that is resilient to coastal hazards and can protect their piece of Texas for generations to come.

Download the guide and workshop materials here: <https://www.glo.texas.gov/coast/coastal-management/permitting/index.html>



Volunteers plant marsh grass as part of a living shoreline in Lake Pasadena, Harris County. Photo courtesy of Galveston Bay Foundation.

APPENDIX D
Restaurant Database

RESTAURANT DATABASE
Houston Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Oysters Purchased (Sacks per week?)	Contacted?	Interested?	Point of Contact	POC Title	Restaurant Phone #
			Raw (Y/N)	Cooked						
1	1751 Sea and Bar	Houston	Y	2		No				(832) 831-9820
2	A'Bouzy	Houston	Y	1		No				(713) 722-6899
3	Acadian Coast	Houston	Y	3		No				(713) 432-9651
4	Acme Oyster House	Houston	Y	2		No				(346) 571-2071
5	B&B Butchers & Restaurant	Houston	Y	1		No				(713) 862-1814
6	B.B. Lemon	Houston	Y	0		No				(713) 554-1809
7	BB's Tex-Orleans	Houston- Briargrove	Y	0		Yes	Yes	Adam Gilvarry	VP of Operations	(713) 339-2566
8	BB's Tex-Orleans	Houston- Heights	Y	0	10-15 sacks/wk	Current Partner	Yes	Adam Gilvarry Brady Porter	VP of Operations General Manager	(713) 868-8000
9	BB's Tex-Orleans	Houston- Montrose	Y	0		Yes	No	Adam Gilvarry	VP of Operations	(713) 524-4499
10	BB's Tex-Orleans	Houston- Upper Kirby	Y	0	8 sacks/wk	Current Partner	Yes	Adam Gilvarry Jasmine Bryant	VP of Operations General Manager	(713) 807-1300
11	BB's Tex-Orleans	Houston- Pearland	Y	0		Yes	Yes	Adam Gilvarry	VP of Operations	(832) 856-3200
12	BB's Tex-Orleans	Houston- Oak Forest	Y	0		Yes	Yes	Adam Gilvarry	VP of Operations	(832) 318-6533
13	Bludorn	Houston	Y	2	28 sacks/wk	Current Partner	Yes	Aaron Bludorn Chase Voelz	Chef Chef De Cuisine	(713) 999-0146
14	Brasserie 19	Houston	Y	1		No				(713) 524-1919
15	Brennan's of Houston	Houston	Y	2		No				(713) 522-9711
16	Cajun Kitchen	Houston	Y	4		No				(281) 495-8881
17	Captain Benny's Seafood	Houston	Y	4	20 sacks/wk	Current Partner	Yes	Adam Baker Elida Reyes	Part Owner	(713) 643-0589
18	Captain Benny's Seafood	Houston	Y	4		No				(713) 666-5469
19	Captain Benny's Seafood	Stafford	Y	4		No				(281) 498-3909
20	Captain Benny's Seafood	Houston	Y	4		No				(713) 680-1828
21	Captain Tom's Seafood & Oyster	Houston	Y	0		No				(713) 451-3700
22	Caracol	Houston	Y	1		No				(713) 622-9996
23	Chilos Seafood & Oyster Bar	Houston	Y	No menu online		No				(713) 947-8700
24	Christie's Seafood & Steaks	Houston	Y	2		No				(713) 978-6563
25	Drunken Oyster	Spring	Y	0		No				(832) 843-6196
26	Eddie V's Prime Seafood	Houston- West Ave	Y	4		No				(713) 874-1800
27	Eddie V's Prime Seafood	Houston- CityCentre	Y	4		No				(832) 200-2380
28	Eugene's Gulf Coast Cuisine	Houston	Y	5		No				(713) 807-8889
29	Eunice	Houston	Y	2	40 sacks/wk	Current Partner	Yes	Justin Solomon	Manager	(832) 491-1717
30	Field & Tides	Houston	Y	1		No				(713) 861-6143
31	Floyd's Cajun Seafood and Steakhouse	Sugar Land	Y	6		No				(281) 240-3474
32	Floyd's Cajun Seafood and Steakhouse	Pearland	Y	6		No				(281) 993-8385
33	Frank's Americana Revival	Houston	Y	Unknown		Yes				(713) 572-8600
34	Georgia James	Houston	Y	1		No				(832) 241-5088
35	Good Vibes Burgers & Brews	Pearland	Y	1		No				(832) 569-4141

RESTAURANT DATABASE
Houston Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Oysters Purchased (Sacks per week?)	Contacted?	Interested?	Point of Contact	POC Title	Restaurant Phone #
			Raw (Y/N)	Cooked						
36	Goode Company- Seafood	Houston	Y	4		Yes				(713) 523-7154
37	Hugos	Houston				Yes	Yes	Chris Loftis	Manager? Chef?	(713) 524-7744
38	Julep	Houston	Y	Unsure		No				(832) 371-7715
39	Kata Robata	Houston	Y	0		No				(713) 526-8858
40	LA Crawfish	Houston- Greenway	Y	3		No				(832) 767-1533
41	LA Crawfish	Houston- Memorial	Y	3		No				(713) 461-8808
42	LA Crawfish	Houston- Willowbrook	Y	3		No				(281) 809-5722
43	LA Crawfish	Houston- Langwood	Y	3		No				(832) 491-1121
44	LA Crawfish	Houston- Wallisville Rd & Beltway 8	Y	3		No				(281) 416-5352
45	LA Crawfish	Katy	Y	3		No				(346) 251-5902
46	LA Crawfish	Pearland	Y	3		No				(832) 781-4946
47	LA Crawfish	Houston- Gulfgate	Y	3		No				(832) 804-6901
48	LA Crawfish	Missouri City	Y	3		No				(281) 208-7759
49	La Lucha	Houston	Y	3	100 sacks/wk	Current Partner	Yes	Bobby Matos	Executive Chef	(713) 955-4765
50	Liberty Kitchen & Oysterette	Houston- River Oaks	Y	2		No				(713) 622-1010
51	Liberty Kitchen at the Treehouse	Houston- Memorial	Y	2		No				(713) 468-3745
52	Loch Bar	Houston- River Oaks District	Y	5	30 sacks/wk	Current Partner	Yes	Andrew Ojeda	General Manager	(832) 430-6601
53	Mambo Seafood	Houston- 45S & Edgebrook	Y	0		No	Maybe			(713) 946-0000
54	Mambo Seafood	Houston- 290 & Tidwell	Y	0		No				(713) 462-0777
55	Mambo Seafood	Houston- 45N & West Rd	Y	0		No				(281) 820-3300
56	Mambo Seafood	Houston- Airline & Tidwell	Y	0		No				(713) 691-9700
57	Mambo Seafood	Houston- Gessner & Long Point	Y	0		No				(713) 465-5009
58	Mambo Seafood	Houston- Hillcroft & Bellaire	Y	0		No				(713) 541-3666
59	Mambo Seafood	Houston- I-10 & Federal	Y	0		No				(713) 637-0553
60	Mambo Seafood	Katy	Y	0		No				(832) 391-6644
61	Mannie's Seafood	Houston	Y	2		No				(713) 641-5003
62	Marcos Seafood & Oyster Bar	Houston	Y	0		No				(713) 946-1168
63	Mastro's Steakhouse	Houston	Y	1		No				(713) 993-2500
64	McCormick & Schmick's Seafood & Steaks	Houston- Town & Country Village	Y	4		Yes				(713) 465-3685
65	McCormick & Schmick's Seafood & Steaks	Houston- Uptown Park, Galleria	Y	4		Yes				(713) 840-7900
66	McCormick & Schmick's Seafood & Steaks	Houston- Downtown	Y	4		Yes				(713) 658-8100
67	Musafer	Houston	Y	1		No				(713) 242-8087
68	Nick's Fish Dive & Oyster Bar	Woodlands	Y	1		No				(281) 419-8885
69	One Fifth Southern Comfort	Houston	Y	1		No				(713) 955-1024
70	Orleans Seafood Kitchen	Katy	Y	1		No				(281) 646-0700
71	Ostioneria Michoacan Seafood and Oyster Bar	Houston- #11	Y	1		No				(713) 921-1800
72	Ostioneria Michoacan Seafood and Oyster Bar	Houston- #1	Y	1		No				(281) 999-3995

RESTAURANT DATABASE
Houston Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Oysters Purchased (Sacks per week?)	Contacted?	Interested?	Point of Contact	POC Title	Restaurant Phone #
			Raw (Y/N)	Cooked						
73	Ostioneria Michoacan Seafood and Oyster Bar	Houston- #3	Y	1		No				(713) 330-4419
74	Ostioneria Michoacan Seafood and Oyster Bar	Houston- #4	Y	1		No				(281) 447-5061
75	Ostioneria Michoacan Seafood and Oyster Bar	Houston- #5	Y	1		No				(713) 974-6828
76	Ostioneria Michoacan Seafood and Oyster Bar	Woodlands- #6	Y	1		No				(281) 292-6811
77	Ostioneria Michoacan Seafood and Oyster Bar	Houston- #7	Y	1		No				(713) 463-5410
78	Ostioneria Michoacan Seafood and Oyster Bar	Houston- #8	Y	1		No				(281) 877-8855
79	Ostioneria Michoacan Seafood and Oyster Bar	Houston- #15	Y	1		No				(281) 477-7697
80	Ostioneria Michoacan Seafood and Oyster Bar	Houston- #16	Y	1		No				(832) 672-4139
81	Pappadeaux Seafood Kitchen	Houston- Hobby Airport	Y	1		No				(713) 847-7622
82	Pappadeaux Seafood Kitchen	Houston- Galleria	Y	1		No				(713) 782-6310
83	Pappas Bros. Steakhouse	Houston- Galleria	Y	0		No				(713) 780-7352
84	Pappas Seafood House	Houston- Shepherd	Y	1		No				(713) 522-4595
85	Perry's Steakhouse & Grille	Houston- Champions	Y	0		No				(281) 970-5999
86	Perry's Steakhouse & Grille	Katy	Y	0		No				(281) 347-3600
87	Perry's Steakhouse & Grille	Houston- Memorial City	Y	0		No				(832) 358-9000
88	Perry's Steakhouse & Grille	Houston- River Oaks	Y	0		No				(346) 293-8400
89	Perry's Steakhouse & Grille	Sugar Land	Y	0		No				(281) 565-2727
90	Perry's Steakhouse & Grille	Woodlands	Y	0		No				(281) 362-0569
91	Ragin' Cajun	Houston- The Original	Y	1		No		Kelli Anderson	Senior General Manager	(713) 621-3474
92	Ragin' Cajun	Houston- Westchase	Y	1		No				(832) 251-7171
93	Relish Restaurant & Bar	Houston	Y	1		No				(713) 599-1960
94	Riel	Houston	Y	1		No				(832) 831-9109
95	Sam's Boat	Pearland	Y	0		No				(713) 436-0201
96	Sam's Boat	Houston	Y	0		No				(713) 781-2628
97	State of Grace	Houston	Y	1	~80 sacks/wk	Current Partner	Yes	Bobby Matos	Executive Chef	(832) 942-5080
98	Steak 48	Houston	Y	0		No				(713) 322-7448
99	The Annie Café & Bar	Houston	Y	0		No				(713) 804-1800
100	The Chalet at Rosie Cannonball	Houston	Y	0		No				(832) 380-2471
101	The Crawfish Pot & Oyster Bar	Houston	Y	2		No				(713) 360-6547
102	The Hay Merchant	Houston	Y	1		No				(713) 528-9805
103	The Oceanaire	Houston	Y	1		Yes				(832) 487-8862
104	The Original Ninfa's	Houston- Navigation	Y	1		No				(713) 228-1175
105	The Original Ninfa's	Houston- Uptown	Y	1		No				(346) 335-2404
106	The Oyster Bar at Prohibition	Houston	Y	6		No				(832) 301-8833
107	The Pearl Restaurant & Bar at The Sam Houston Hotel	Houston	Y	3		No				(832) 200-8817
108	The Rouxpour	Sugarland	Y	4		No				(281) 240-7689

RESTAURANT DATABASE
Houston Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Oysters Purchased (Sacks per week?)	Contacted?	Interested?	Point of Contact	POC Title	Restaurant Phone #
			Raw (Y/N)	Cooked						
109	The Rouxpour	Katy	Y	4		No				(281) 394-5013
110	The Rustic	Houston	Y	2		No				(832) 321-7775
111	Tobiuo Sushi & Bar	Katy	Y	1		No				(281) 394-7156
112	Tony Mandola's Gulf Coast Kitchen	Houston	Y	2		No				(713) 528-3474
113	Toulouse	Houston	Y	1		No				(713) 871-0768
114	Traveler's Table	Houston	Y	3		No	Yes	Thy Mitchell		(832) 409-5785
115	Truluck's Seafood Steak & Crab House	Houston	Y	1		No				(713) 783-7270
116	Truluck's Seafood Steak & Crab House	Woodlands	Y	1		No				(281) 465--7000
117	Turner's	Houston	Y	1		No				(713) 804-1212
118	UB Preserv	Houston	Y	1		No				(346) 406-5923
119	Weights + Measures	Houston	Y	1		No				(713) 654-1970
120	Willie G's	Houston	Y	8		No				(713) 840-7190
121	Winnie's	Houston	Y	Unknown		No				Not open yet
122	Xochi	Houston	Y	1		No				(713) 400-3330

LEGEND
Current Partner
Priority
Contact for Houston Oyster Festival
Low Priority

RESTAURANT DATABASE
Clear Lake Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Oysters Purchased (Sacks per week?)	Contacted?	Interested?	Point of Contact	POC Title	Restaurant Phone #
			Raw (Y/N)	Cooked						
1	Barge 295	Seabrook	Y	5	10-12 sacks/wk	Current Partner	Yes	Jose Castillo Jeff Schafer	Kitchen Manager General Manager	(281) 549-7603
2	BB's Tex-Orleans	Webster	Y	0	5 sacks/wk	Current Partner	Yes	Adam Gilvarry Richele Potts	VP of Operations GM of Webster	(281) 767-9644
3	Captain Benny's Seafood	Deer Park	Y	4		No				(281) 476-1513
4	Crazy Alans Swamp Shack	Kemah	Y	4	About 3 sacks/wk	Current Partner	Yes	Alan Franks Robert (Bob) Deering (GM)	Owner	(281) 334-5000
5	Crazy Alans Swamp Shack	Friendswood	Y	4	About 3 sacks/wk	Current Partner	Yes	Alan Franks Bettina Noel (GM)	Owner	(832) 284-4895
6	East Star Chinese Buffet	Webster	Y	0		No				(281) 280-8822
7	Flippers Coastal Seafood	Dickinson	Y	2		No				(832) 340-7340
8	Floyd's Cajun Seafood and Steakhouse	Webster	Y	6		No				(281) 332-7474
9	Flying Dutchman	Kemah	Y	4		Yes	No - see notes	Sean Smith	Manager	(281) 334-7575
10	Gilhooley's Restaurant	San Leon	Y	4		Yes	See Notes			(281) 339-3813
11	Hibachi Grill & Supreme Buffet	Webster	Y	0		No				(832) 932-5795
12	Jackie's Brickhouse	Kemah	Y	1		No				(832) 864-2459
13	La Costa Seafood Grill	Alvin	Y	3		No				(281) 824-4384
14	LA Crawfish	Webster	Y	3		No				(832) 905-5154
15	LA Crawfish	Baytown	Y	3		No				(832) 479-8081
16	LA Crawfish	Pasadena	Y	3		No				(832) 288-4494
17	Landry's Seafood House	Kemah	Y	1		Yes	Past partner	Brandy Carter	Manager	(281) 334-2513
18	Little Daddy's Gumbo Bar	League City	Y	2		No				(281) 524-8626
19	Lowens Seafood	Friendswood	N	2		No				(832) 569-2765
20	Mambo Seafood	Baytown	Y	0		No				(832) 926-7551
21	Marais	Dickinson	Y	4		No				(281) 534-1986
22	Monument Inn	La Porte	Y	0		No				(281) 479-1521
23	Noah's Ark Bar & Grill	Bacliff	Y	4		No				(281) 339-2895
24	O2 Bistro	Clear Lake Shores	Y	1		No				(281) 532-6860
25	Opus Ocean Grill	Clear Lake Shores	Y	4		Yes		Charlie Felts	Owner	(281) 334-0006
26	Pappas Seafood House	Webster	Y	1		No		Steve Sims		(281) 332-7546
27	Perry's Steakhouse & Grille	Friendswood	Y	0		Yes	See Notes	Patrick Niemeyer		(281) 286-8800
28	Pier 6 Seafood & Oyster House	San Leon	Y	4		No				(281) 339-1515
29	Sam's Boat	Seabrook	Y	0		Current Partner	Yes	Kris Zachmeyer	Assistant General Manager	(281) 326-7267
30	Schafer's Coastal Bar & Grille	Clear Lake Shores	Y	3		No				(281) 532-6860
31	The Aquarium Restaurant	Kemah	Y	0		Current Partner	Yes	Jim Prappas	Director of Biology	281-334-2521 (Bio and Edu Dept.) 281-334-9010 (Restaurant)
32	The Reef Seafood House	Texas City	Y	0		No				(409) 945-6151

RESTAURANT DATABASE
Clear Lake Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Oysters Purchased <small>(Sacks per week?)</small>	Contacted?	Interested?	Point of Contact	POC Title	Restaurant Phone #
			Raw (Y/N)	Cooked						
33	The Rouxpour	Friendswood	Y	4		Yes	Maybe			(281) 480-4052
34	Tommy's Restaurant & Oyster Bar	Houston	Y	5		Current Partner	Yes	Tom Tollett	Owner	(281) 480-2221
35	Tookie's Seafood	Seabrook	Y	6	40-60 sacks/wk Use 8-10 sacks of oysters per day and 15 sacks of oysters on Fridays and Saturdays (8/27/18)	Current Partner	Yes	Adam Newell	Manager	(281) 942-9445
36	Topwater Grill	San Leon	Y	5		Yes	<i>Past partner</i>	Robert Jackubus Joshua (GM)	Owner	(281) 339-1232
37	Valdo's Seafood House	Seabrook	Y	4		No				(281) 326-3866

LEGEND
Current Partner
Priority
Contact for Houston Oyster Festival
Low Priority

RESTAURANT DATABASE Galveston Region

No. of Restaurants	Restaurant Name	Location	Oyster Items on Menu		Oysters Purchased <small>(Sacks per week?)</small>	Contacted?	Interested?	Point of Contact	POC Title	Restaurant Phone #
			Raw (Y/N)	Cooked						
1	Black Pearl Oyster Bar	Galveston	Y	4		Yes	Yes			(409) 762-7299
2	BLVD Seafood	Galveston	Y	3		Current Partner	Yes	Aubree Martorell	Manager	(409) 762-2583
3	Cajun Greek	Galveston	Y	0		Yes	Yes			(409) 744-7041
4	Fish Tales	Galveston	Y	0		No				(409) 762-8545
5	Fisherman's Wharf	Galveston	Y	0	About 14-20 boxes/sacks/wk	Current Partner	Yes	Patrick Loughran	Assistant General Manager	(409) 765-5708 (940) 300-9571 (Patrick)
6	Gaido's Seafood Restaurant	Galveston	Y	0	300-500 lbs/week	Yes	Yes	David Sosa	Manager	(409) 761-5500
7	Katie's Seafood House	Galveston	Y	2		Yes	Yes			(409) 765-5688
8	Kritikos Grill	Galveston	Y	0	2 sacks/wk	Current Partner	Yes	Wendy Hartman	Manager	(409) 539-5915
9	Landry's Seafood House	Galveston	Y	1		No	Maybe			(409) 744-1010
10	Little Daddy's Gumbo Bar	Galveston	Y	2		No				(281) 524-8626
11	Number 13	Galveston	Y	0		Yes	<i>Past partner</i>	Marita Schultz		(409) 572-2650
12	The Spot	Galveston	Y	0		No		Lauren Desormeaux		(409) 621-5237
13	Willie G's	Galveston	Y	1		No				(409) 762-3030

LEGEND
Current Partner
Priority
Contact for Houston Oyster Festival
Low Priority

APPENDIX E
Sun Curing Protocol



GALVESTON BAY
FOUNDATION

Sun Curing Protocol for Recycled Oyster Shell

**Prepared by the Galveston Bay Foundation's
Oyster Shell Recycling Team:**

Shannon Batte, Haille Leija, and Michael Niebuhr

May 2020

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Disclaimer

This protocol was developed in May 2020 to provide guidance for the Galveston Bay Foundation's Oyster Shell Recycling Program. The Texas Parks and Wildlife Department recommended the Foundation use best management practices for ensuring only clean, dry shell be placed in Galveston Bay for restoration purposes. More specifically, the Texas Parks and Wildlife Department stated that a minimum timeframe of 6 months of land-based sun curing should be implemented for all recycled oyster shell collected by the Foundation. This recommendation is based on the study conducted by Bushek et al in 2004, with the goal of providing high quality, clean substrate for spat settlement without spreading pathogens from the former inhabitant of that shell.

The proposed practices included in this document are based on the experiences of the Foundation's staff in oyster shell recycling operations since 2011. While the Bushek et al (2004) study was used as an initial reference for this protocol, additional research is needed to confirm ideal sun curing specifications in the state of Texas. These specifications include, but are not limited to, the curing timeframe, shell pile height, shell pile buffer width, and the frequency of turning the shell piles to ensure maximum sun exposure during the specified sun curing timeframe.

I) SUN CURING PROCESS

Phase 1 - Active Collection

- Collect fresh oyster shell and place the shell at a designated curing site
- Document each placement of shell accordingly (refer to Table 1)
 - Documentation should include:
 - Date
 - Source of the shell (e.g. restaurant name, dealer’s name, etc.)
 - Amount of fresh shell placed on that date (pounds, tons, and/or cubic yards)
 - Curing site name
 - Pile location
 - Pile rotation
- Place shell no more than 18 inches high during active collection
- Maintain, at minimum, a 10-foot buffer between shell piles
- Continue to collect and place shell in this manner until an adequate amount of shell is generated for a given project, the shell encroaches on the 10-foot buffer, or the shell pile exceeds the 18-inch height limit
- Shell in this condition, active collection and placement of fresh shell, is designated as “Active”

Phase 2 - Curing

- After placement of fresh shell ceases in a select pile, the curing timeline begins
- No additional fresh shell may be added to this pile upon the start of Phase 2
- A minimum of 6 months of sun exposure is required for proper curing
 - Curing time does not accrue during active collection and placement (Phase 1)
 - If the curing phase occurs during the wet season or during extreme weather conditions (e.g. hurricanes, floods, freezing temperatures), additional weeks or months of curing time may be required
- Shell must be turned (i.e. rotated and piled with a tractor or skid steer) at least once during the curing phase
 - Ensure the turned shell is piled in the designated curing pile location and does not encroach on the 10-foot buffer of any adjacent shell piles
 - Document the date each time a shell pile is turned (refer to Table 2)
 - Do not pile the shell higher than 6 feet
- Shell in this condition is designated as “Curing” and no new, fresh shell should be added

Phase 3 - Cured

- Upon completion of Phase 2, the shell pile is considered fully cured
- The cured shell may be strategically piled to save space and allow for easier access as needed
- Ensure a 10-foot buffer is maintained between the fully cured shell and all other “Active” and “Curing” shell piles
- Shell in this condition is designated as “Cured” and ready to be used as cultch material in reef restoration efforts
- Document all cured shell transported off the curing site (refer to Table 3)

II) RECOMMENDATIONS

- Curing sites should not be located directly adjacent to any waterbodies or drainage features that flow into waterbodies, in order to avoid contamination from uncured shell.
- Curing sites should not be located directly adjacent to residential communities to avoid nuisance odors and conflicts.
- Ideal locations for a curing site include, but are not limited to, construction yards, undeveloped property in industrial/commercial areas, and preserves such as the Galveston Bay Foundation's Texas City Preserve.
- If cattle or other livestock share the curing site property, ensure the shell curing area is properly fenced to avoid contamination of the shell.
- Maintain a map and/or chart to differentiate and track the status of each individual shell pile at the curing site (refer to figure 7 and 8). This map or chart should correlate with the documentation referred to in the table templates below (Table 1, 2, and 3) and should be updated quarterly at a minimum.
- Install signage at each shell pile, labeled with the appropriate shell "pile location" identification (e.g. A, B, C, etc.) to ensure proper documentation.
- To assist with sun bleaching, keep fresh shell spread out during the collection process, Phase 1, and at a maximum height of 18 inches.
- To avoid cross-contamination between cured and uncured shell, all shell piles should be separated by at least 10 feet.
- All shell piles should be turned at least once during the 6-month curing timeframe (Phase 2) to ensure maximum exposure of the shells to sunlight. A tractor or skid steer with a front-end loader is recommended to turn the shell.
- It is recommended that shell turning be conducted quarterly if feasible, weather and site conditions permitting.
- When turning shell in Phase 2, it is recommended that the shell pile height does not exceed 6 feet to allow for adequate exposure to the air and sun.

III) PHOTOGRAPHS



Figure 1. Galveston Bay Foundation's Texas City Curing Site
**please note, these piles do not represent the required 10ft buffer; these shell piles are all fully cured and consolidated to conserve space at the curing site*



Figure 2. Galveston Bay Foundation's Red Bluff Curing Site



Figure 3. Fresh oyster shell placement at Galveston Bay Foundation's Red Bluff Curing Site (Phase 1)



Figure 4. Fresh oyster shell spread out upon placement (Phase 1)



Figure 5. Turning a shell pile during the curing stage (Phase 2)



Figure 6. Consolidating a cured shell pile (Phase 3)



Figure 7. Galveston Bay Foundation's Texas City Curing Site shell pile locations and status



Figure 8. Galveston Bay Foundation's Red Bluff Curing Site shell pile locations and status

IV) TABLE TEMPLATES

Table 1. Incoming Shell Documentation

Collection Date	Source of Shell	Pounds of Shell	Tons of Shell	Cubic Yards of Shell	Curing Site ID/Name	Shell Pile Location	Shell Pile Rotation	Data Entered by

Table 2. Shell Pile Documentation

Curing Site ID/Name	Shell Pile Location	Shell Pile Rotation	Curing Start Date*	Turn Date 1	Turn Date 2	Turn Date 3	Turn Date 4	Curing Complete Date**

*Start of Phase 2; **End of Phase 2

Table 3. Outgoing Shell Documentation

Transport Date	Curing Site ID/Name	Shell Pile Location	Shell Pile Rotation	Pounds of Shell	Tons of Shell	Cubic Yards of Shell	Project Name/ Shell Destination

V) GLOSSARY

<u>Active</u>	Shell pile designation indicating the placement of fresh shell is ongoing at that location; a shell pile will remain “active” until fresh shell placement is concluded at the specific pile location
<u>Cured</u>	Shell pile designation indicating the oyster shell has been sun bleached for a minimum of 6 months since fresh shell was last placed at that location; “cured” oyster shell is considered fully quarantined and ready to be returned to a waterbody as cultch material
<u>Curing</u>	Shell pile designation indicating the oyster shell is in the process of sun bleaching and the introduction of fresh shell has ceased at that location; the “curing” stage should be a minimum of 6 months and include the rotation of the shell pile at least once
<u>Curing Site</u>	An upland location where recycled oyster shell is stockpiled and quarantined (sun bleached) in preparation for use as cultch material in reef restoration
<u>Fresh Shell</u>	Oyster shell recently collected from restaurants, commercial dealers, or by other means; recycled oyster shell that has <u>not</u> been cured (sun bleached)
<u>Pile Location</u>	The specific location of a pile of recycled oyster shell at a curing site; each pile location should be assigned a letter (e.g. A, B, C, etc.) to differentiate multiple shell piles at one curing site
<u>Pile Rotation</u>	A number assigned to each new mound of shell at a specific pile location; a single “rotation” captures the life of a shell pile from active collection through the cured state when it is hauled off site to be used as cultch (Phases 1 through 3); a rotation begins when fresh shell is first placed at a curing site and ends when that entire pile of cured shell is transported offsite
<u>Shell Pile</u>	An individual mound of recycled oyster shell placed at a specific curing site; each shell pile should be identified by its location and rotation (e.g. A-1)
<u>Sun bleaching</u>	The process of exposing fresh oyster shell to natural sunlight and weathering to eliminate pathogens, grease, and any other foreign substance on the shell including the presence of any invasive species



VI) REFERENCES

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