

HURDLES WITH NURDLES: GULF-WIDE CITIZEN SCIENCE PROJECT

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Mission-Aransas National Estuarine Research Reserve

April 17, 2019



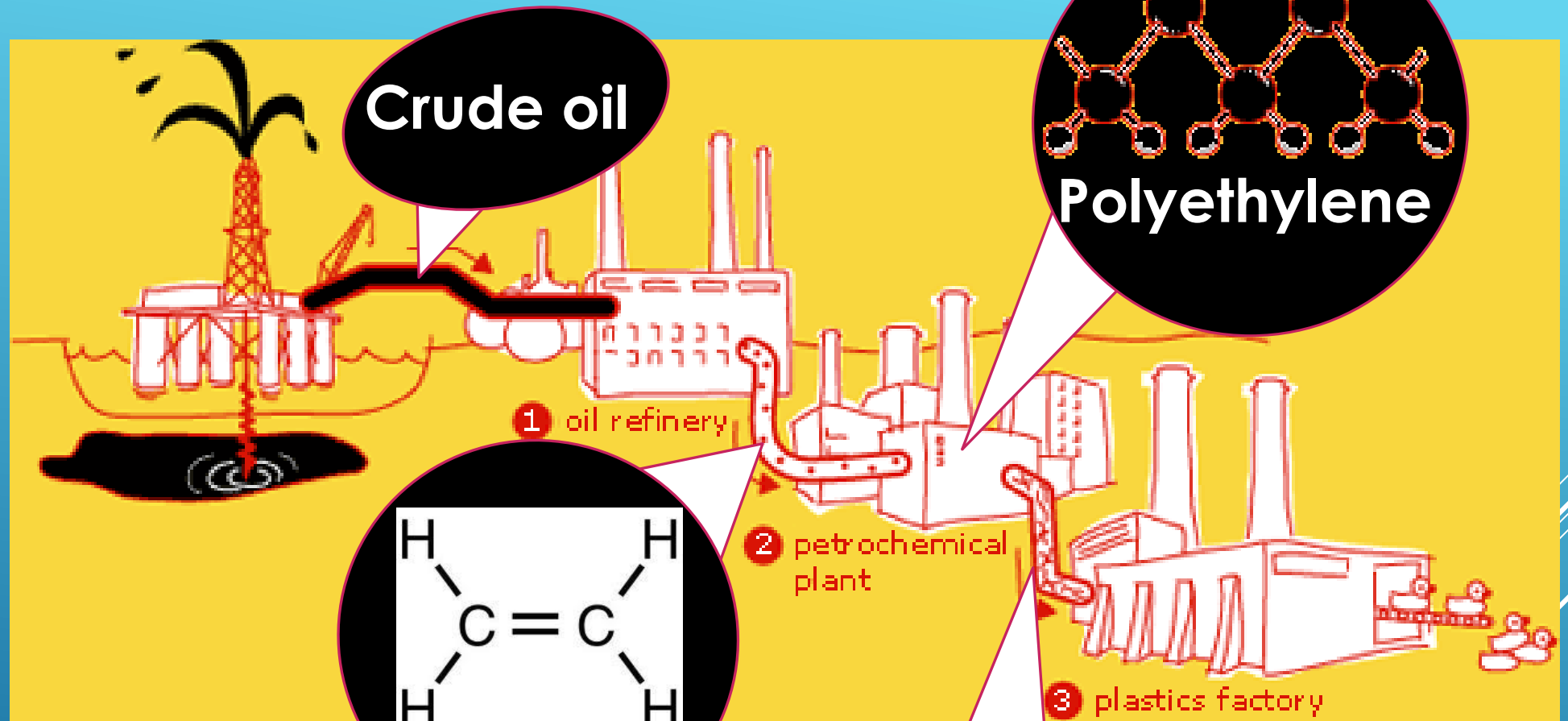
WHAT IS A NURDLE?

- ▶ **Nurdle – raw plastic**
- ▶ **Basis for everything plastic**

- PE =Polyethylene (bags)
- PP =Polypropylene (science beakers)
- PA =Polyamide (Nylons)
- PVC =Polyvinylchloride (Pipes)
- PS =Polystyrene (Styrofoam)

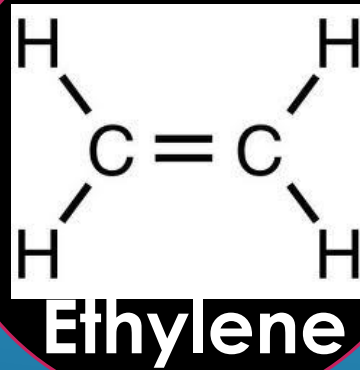


NURDLE PRODUCTION



Crude oil

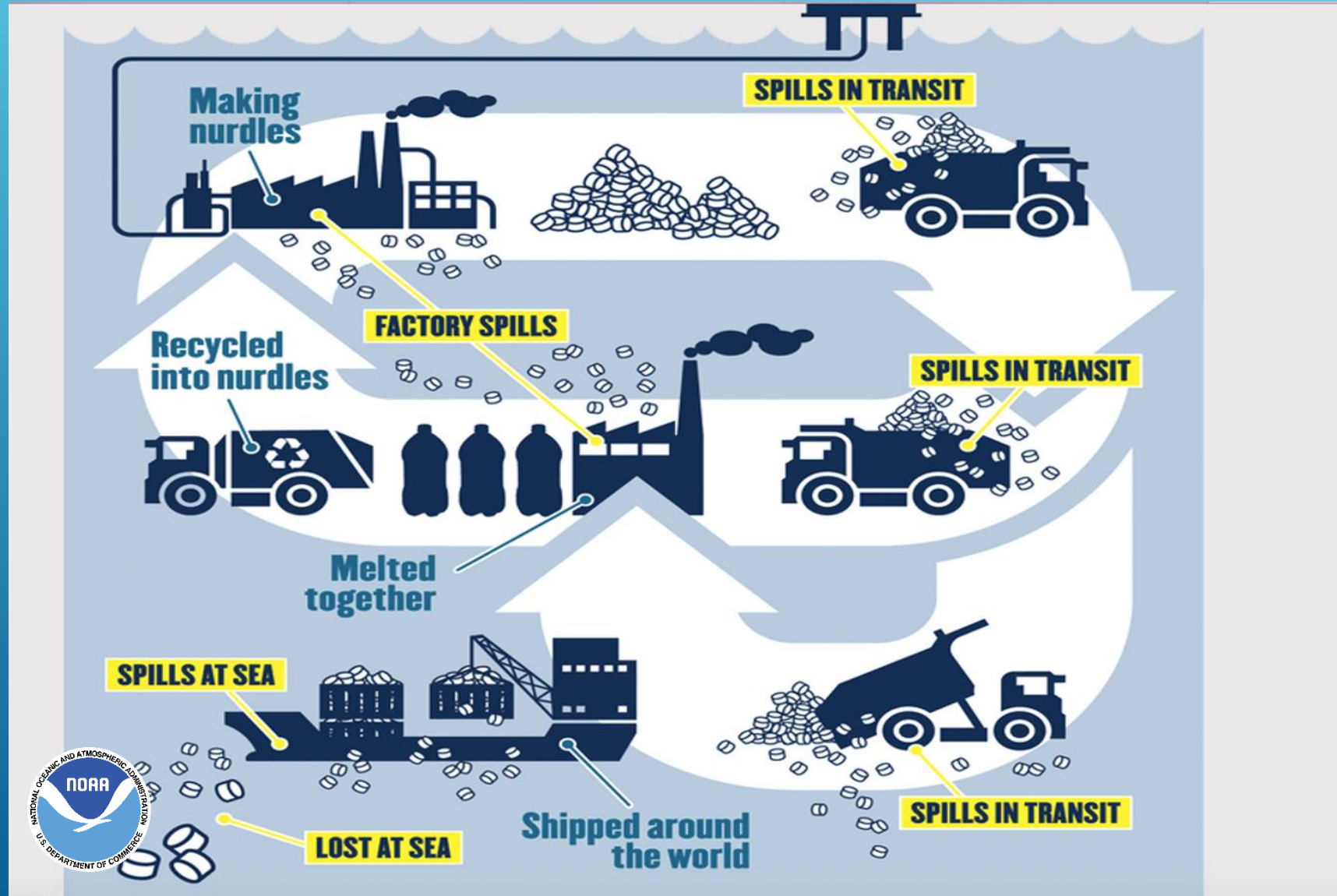
Polyethylene



“Nurdles”

Image source: www.nobelprize.org

RELEASE TO ENVIRONMENT

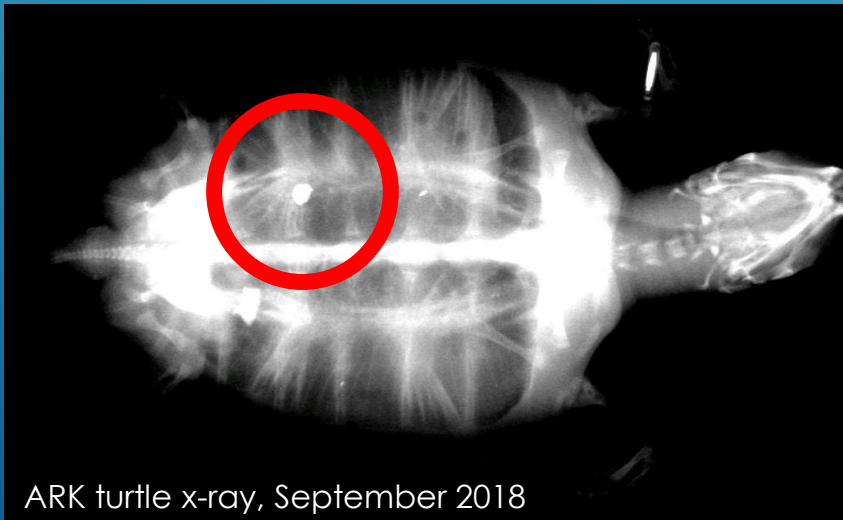


RELEASE TO ENVIRONMENT



IMPACTS

- ▶ Wildlife eat
- ▶ Toxins
- ▶ Human health
- ▶ Aesthetics



ARK turtle x-ray, September 2018

1992 EPA Report on Plastic Pellets

samples (Table 7), in CSO samples of both cities, and in the storm sewer samples collected in Philadelphia (Table 6). No storm sewers were sampled in Boston. [Note: One pellet was found in the CSO discharge in Philadelphia; these data should be viewed with caution because it was not determined that the CSO had discharged during the study.] The data from this study indicate that pellets are entering municipal sewerage systems from land-based sources, and are subsequently entering the aquatic environment through CSO and storm sewer discharges.

3.3 FATE AND IMPACTS

There are several documented accounts describing pellet and other plastic debris ingestion by wildlife, most notably by seabirds and sea turtles (Table 8). Generally, impacts or biological effects of the pellets have not been clearly defined in most wildlife, and, to date, direct correlations between pellet ingestions and effects have not been demonstrated conclusively. This may be attributable to the fact that the studies typically use stranded and beached animals, and most animals that die at sea either sink to the bottom or are consumed by predators before they are found by humans (Laist, 1987).

3.3.1 Birds

The ingestion of pellets by seabirds has been reported worldwide (Table 8), and seabirds ingest plastic pellets more frequently than do any other taxon (Ryan, 1990). Sileo *et al.* (1990) reported that 80 species, or approximately one-quarter of all seabird species, are known to ingest plastic debris. Pellets are the most common form of plastic debris ingested by seabirds (EPA, 1990a; Ryan, 1990). Day



Figure 5. Pellets Ingested by a Seabird. (Photograph by Robert Day, Alaska Biological Research, College, Alaska)

(1980) estimated that polyethylene pellets remain in the digestive tracts of birds for 10 to 15 months (Figure 5).

Several factors affect the vulnerability of a seabird population to the presence of pellets.

- **Frequency of regurgitation** — Birds with a limited ability to regurgitate are most likely to be effected by pellet ingestion. Debris loads in birds are a function of the ratio of the rates of ingestion and regurgitation (Ryan, 1990).
- **Foraging habits** — Birds that feed by pursuit diving are the most likely to ingest pellets, and birds that feed by plunging and piracy are the least likely to ingest pellets (Day *et al.*, 1985).
- **Pellet color** — Seabirds are more likely to ingest pellets that are light-

colored (e.g., white, tan, brown, yellow) than those of any other color (Sileo *et al.*, 1990; Day *et al.*, 1985). This color preference has been attributed to the pellet's similarity to common food sources, such as fish eggs, crustaceans, etc. (Day *et al.*, 1985).

- **Prey type** — Pellets pose the greatest threat to plankton-feeding species, such as shearwaters, petrels, prions, phalaropes, and auklets (Fry *et al.*, 1987).
- **Proximity to pellet sources** — Logically, the closer that a seabird is to a release point, the more likely it is to encounter and ingest pellets (EPA, 1990a; van Franeker and Bell, 1988).
- **Proximity to areas where pellets accumulate** — Species that feed at the ocean surface are more likely to ingest plastic, most probably because they are more likely to be exposed to floating plastic (Sileo *et al.*, 1990).

The effects on seabirds of ingested pellets and other plastic debris were summarized recently by Ryan (1990) at the Second International Conference on Marine Debris (Shomura and Godfrey, 1990). Ryan (1990) stated that anthropogenic debris may have three specific effects on seabirds: (1) diminished foraging ability or a decreased foraging efficiency, (2) physical damage (e.g., intestinal blockage), and (3) physiological effects from the absorption of toxic chemicals associated with the pellets.

Diminished foraging ability appears to be the most serious effect of pellets on seabirds. The presence of pellets in the stomachs of seabirds may create false feelings of satiation, decrease the storage volume of the stomach, and reduce foraging. Ultimately, this will reduce the ability of the seabirds to accumulate the energy (fat) reserves necessary for migration, reproduction, molting, and survival of adverse environmental conditions (Day *et al.*, 1985; Ryan, 1988a, 1990). These effects would

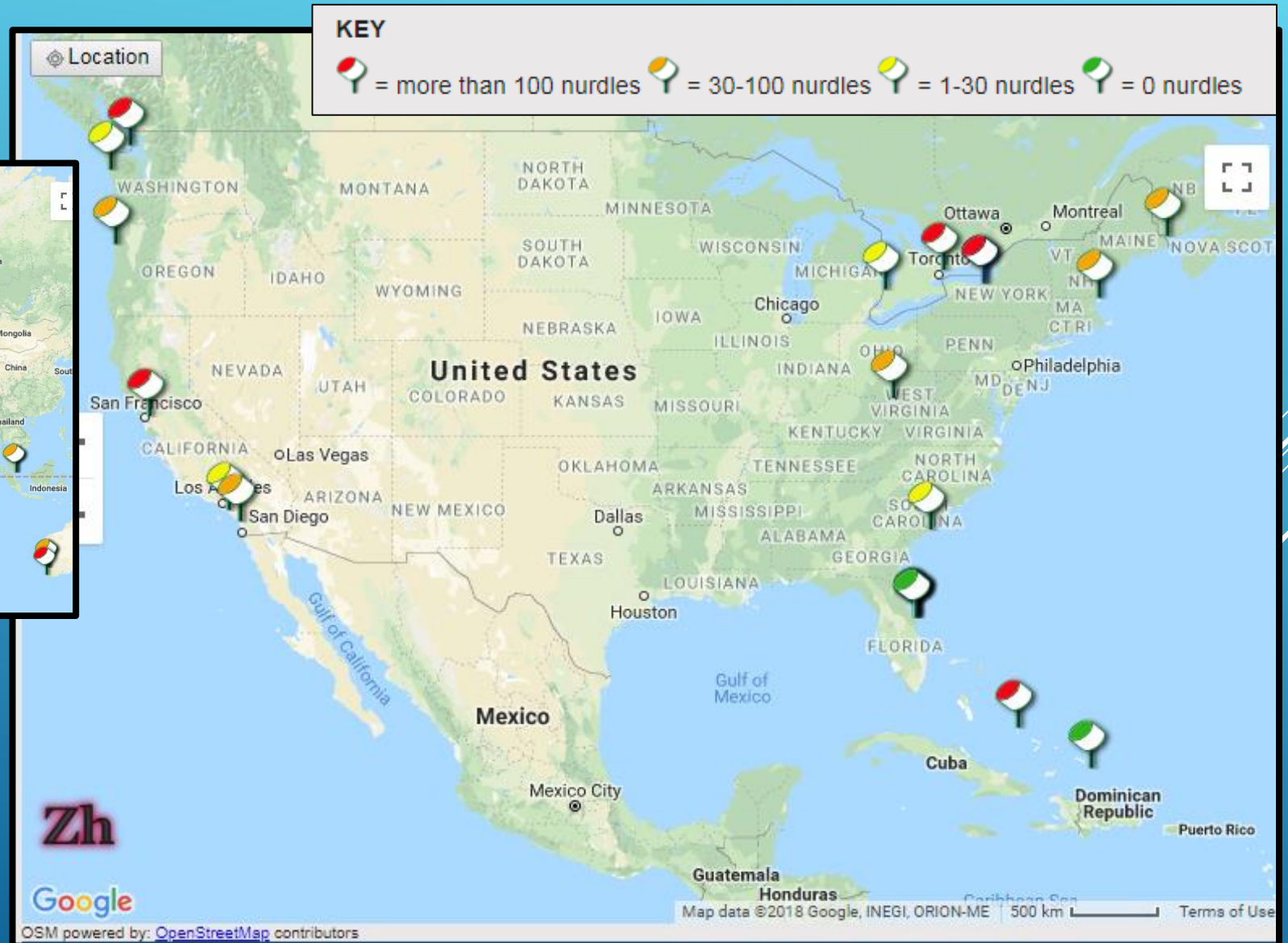
occur most likely in procellariiform seabirds, which, compared to other seabirds, experience the highest incidence of plastic ingestion (Ryan, 1988a). However, a few pellets in a bird's stomach are not likely to have an adverse affect, primarily because many seabirds retain indigestible materials in their stomachs to aid in digestion (Furness, 1985; Ryan, 1988a, 1990), although Wallace (1985) believed that the birds could be chronically stressed. Studies to determine a critical pellet volume have not been reported.

Studies of potential impacts caused by pellet ingestions generally have indicated that physical damage probably occurs in only a small number of seabirds. Day (1980) reported that ingestions increased the gizzard volumes of some auklets, resulting in the full distension of the gizzards and a potential reduction in hunger. Where individuals that had ingested large numbers of pellets, the pellets were found embedded in sockets in the gizzard wall, but no effects (good or bad) were noted. Day *et al.* (1985) subsequently reported that ingested pellets reduce the storage volume of seabird stomachs.

In a controlled study of the effects of large numbers of PE pellets in white-chinned petrels, Ryan and Jackson (1987) reported no significant changes in digestive efficiency between test and control birds. Several authors have document lacerations by sharp debris (e.g., Day *et al.*, 1985; Fry *et al.*, 1987; Ryan and Jackson, 1987); however, because pellets are generally round and smooth, it is unlikely that pellets lacerate stomach linings in seabirds.

Finally, plastic pellets in the environment may contain chemicals that are toxic to seabirds. These toxic substances may be additives that were intentionally mixed into the resin to achieve specific properties, or contaminants that were adsorbed by the pellets from the environment. Carpenter *et al.* (1972) reported the adsorption by pellets of organochlorine

DISTRIBUTION



www.nurdlehunt.org.uk



NURDLE SPILL ON BEACH

- ▶ September 28, 2018
- ▶ Nueces County, Bob Hall Pier
- ▶ Called Emergency Spill # - Coast Guard
- ▶ TCEQ met on site, took samples
- ▶ TCEQ followed up 3 days later and said they weren't going to investigate any further
- ▶ TCEQ had Nueces County take lead on cleanup
- ▶ TCEQ, Nueces County, TPWD, GLO Oil Spill, TWDB said they don't know how to cleanup



SPILL RESPONSE

- ▶ Similar to oil spill, time sensitive
- ▶ Who and what now?



ISSUES

- ▶ Beach maintenance
- ▶ High tides
- ▶ Driving on beach
- ▶ Wind blowing sand
- ▶ Similar with oil spill
- ▶ Time sensitive to clean up



CITIZEN SCIENCE PROJECT

NURDLE PATROL

Pick up plastic pellets (nurdles)
at your beach for 10 minutes.

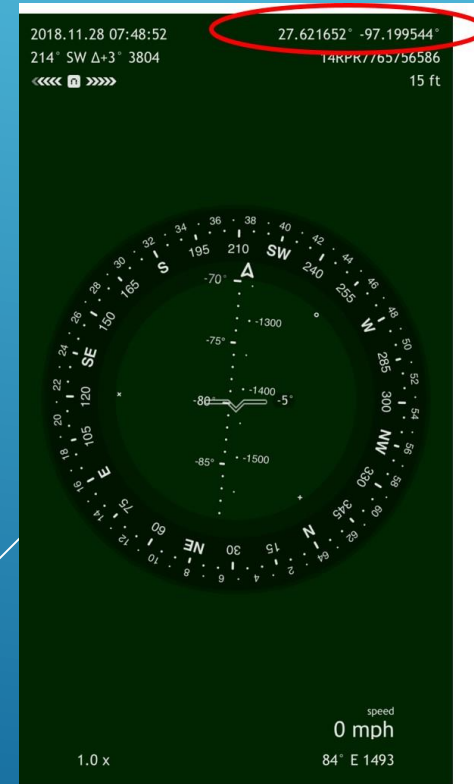
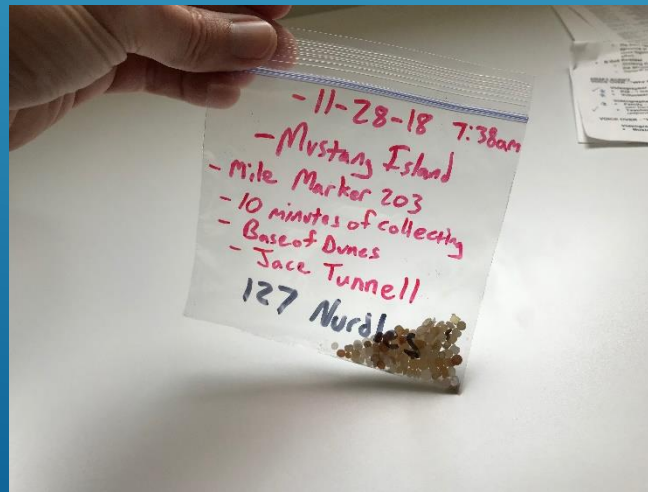
Send location, date, pics, and
number found to
jace@utexas.edu

Done!

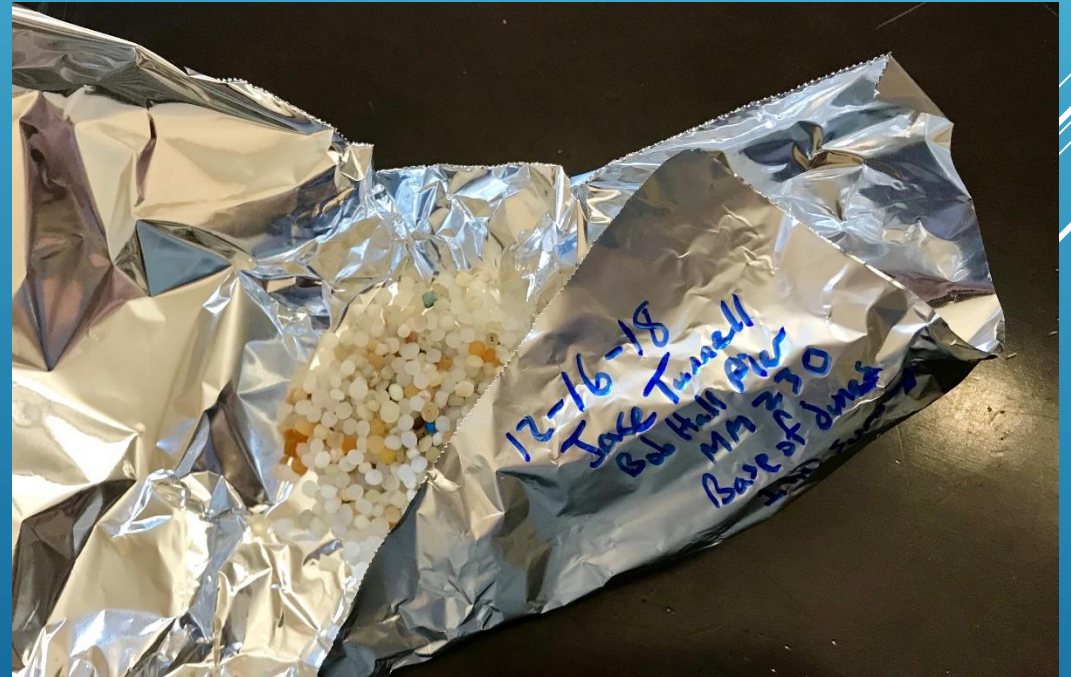
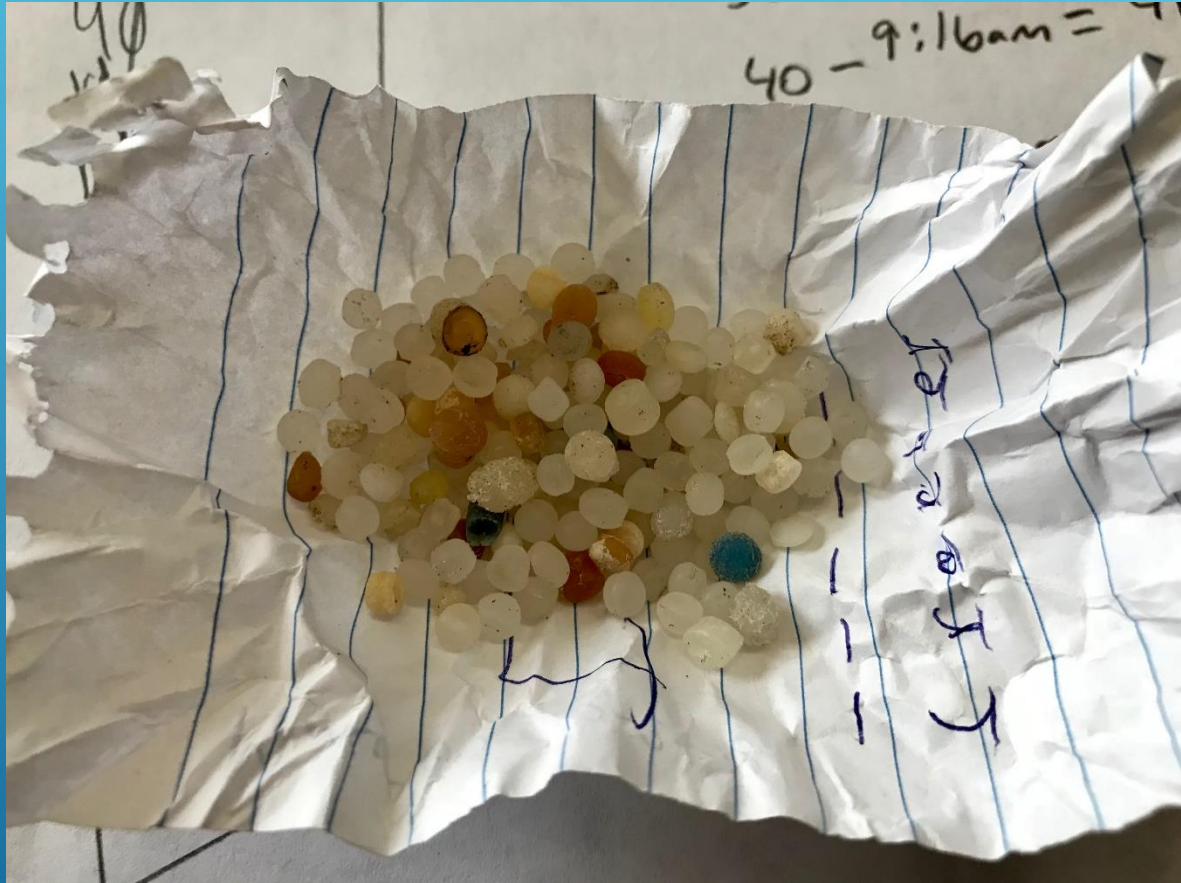


NURDLE PATROL

- ▶ Find nurdles, then collect for 10 minutes
- ▶ Put in container or bag and label
- ▶ Add location, date, time, how many nurdles
- ▶ Take pictures of nurdles found and beach
- ▶ Email Jace@utexas.edu



CONTAINER OPTIONS



TRAINING VIDEO

Mission-Aransas Reserve



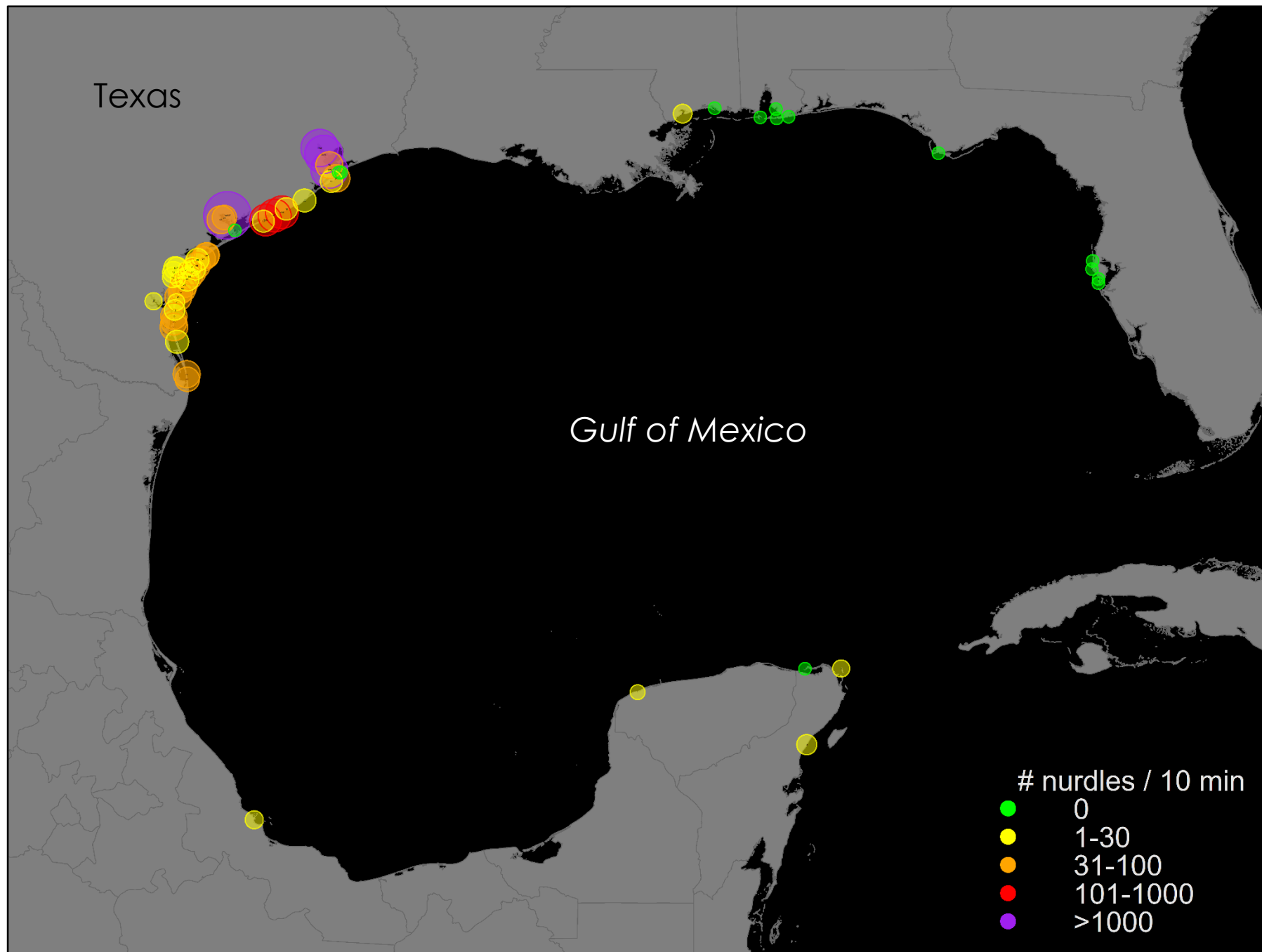
TYPES BEING FOUND

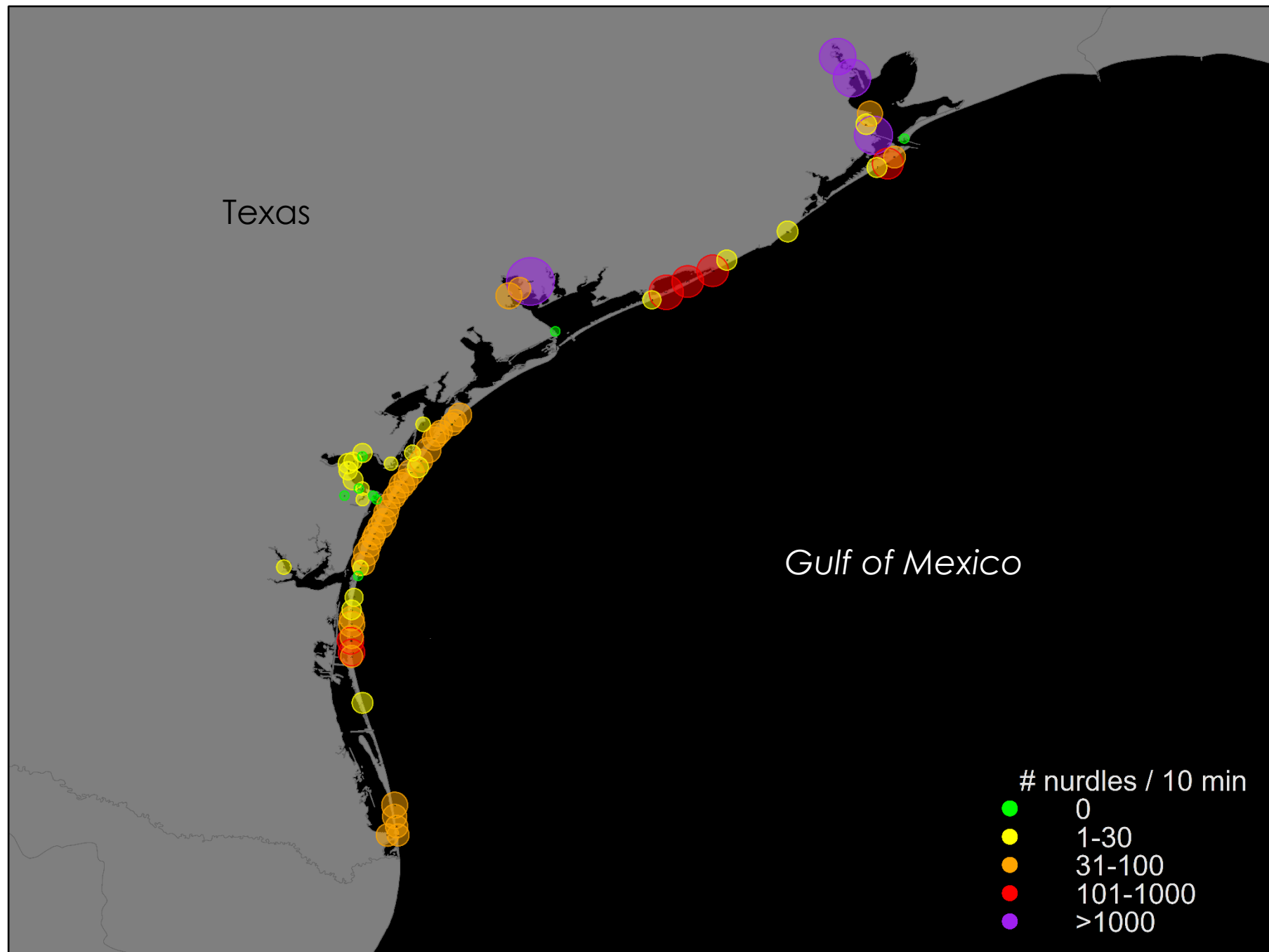


Facebook

The screenshot shows the Facebook interface for the 'Nurdle Patrol' group. The group is a 'Closed group' with a cover photo of a person in a red shirt and blue gloves picking up plastic pellets. The post text reads: 'Pick up plastic pellets at your beach for 10 minutes. Send me the location, date, and number found. Take pics. Done!'. The left sidebar shows group navigation options like 'About', 'Discussion', 'Chats', 'Announcements', 'Members', 'Events', 'Videos', 'Photos', 'Files', 'Group Insights', and 'Moderate Group'. The right sidebar shows 'ADD MEMBERS' with a search bar and 'MEMBERS' with 400 members. The main content area shows an announcement by Jace Tunnell dated January 4 at 11:42 AM, stating: 'The first month of Nurdle Patrol data is out: For December 2018, we had 55 surveys completed by 75 citizen scientists, picking up 12,339 nurdles from beaches in 3 different states along the Gulf of Mexico. These nurdles have been found on Gulf facing beaches as well as in some bays. Total time collecting by all citizen scientists equals 664 minutes, which equates to 11 hours and 4 minutes time. Thanks to you all!'. Below the text are two maps of the Gulf of Mexico showing survey locations and the number of nurdles found. The bottom of the page shows a 'DESCRIPTION' section stating: 'Nurdle Patrol is a citizen science project lead by the Mission-A... See More' and a 'LOCATION' section showing a map of the Gulf of Mexico, United States of America.

The screenshot shows the Mission Aransas website. The header features the 'MISSION ARANSAS' logo and the text 'NATIONAL ESTUARINE RESEARCH RESERVE'. The navigation bar includes links for 'About', 'Coastal Training', 'Education', 'Science', 'Stewardship', 'News', 'Get Involved', and 'Visit'. The 'Stewardship' link is highlighted. The main content area shows a list of stewardship activities: 'Amos Rehabilitation Keep', 'Cleanup & Recycling', 'Fennessey Ranch', 'For Managers', 'Land Conservation', 'Marine Debris', 'Nurdle Patrol', and 'TX Plastic Pollution Symposium'. The 'Nurdle Patrol' link is highlighted. Below the list is a large image of a person in a red shirt and blue gloves picking up plastic pellets, with the text 'Nurdle Patrol' and 'Pick up plastic pellets at your beach for 10 minutes. Send me the location, date, and number found. Take pics. Done!'. The email address 'Jace.Tunnell@austin.utexas.edu' is displayed at the bottom of the image. The footer contains the text: 'What are nurdles? Nurdles are very small plastic pellets used in the manufacture of plastic products.'



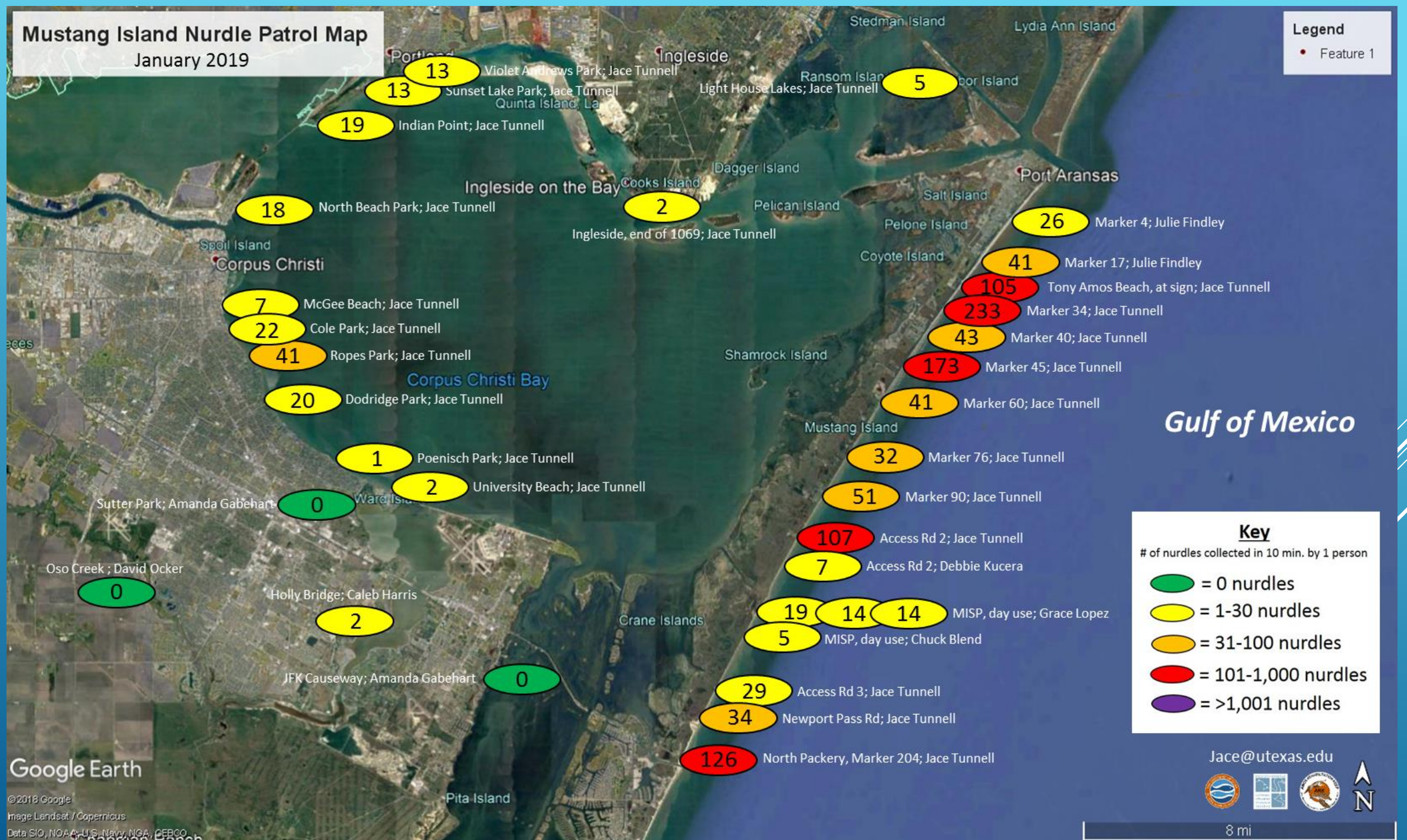


Mustang Island Nurdle Patrol Map

January 2019

Legend

• Feature 1



Gulf of Mexico

Google Earth

©2018 Google
Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO

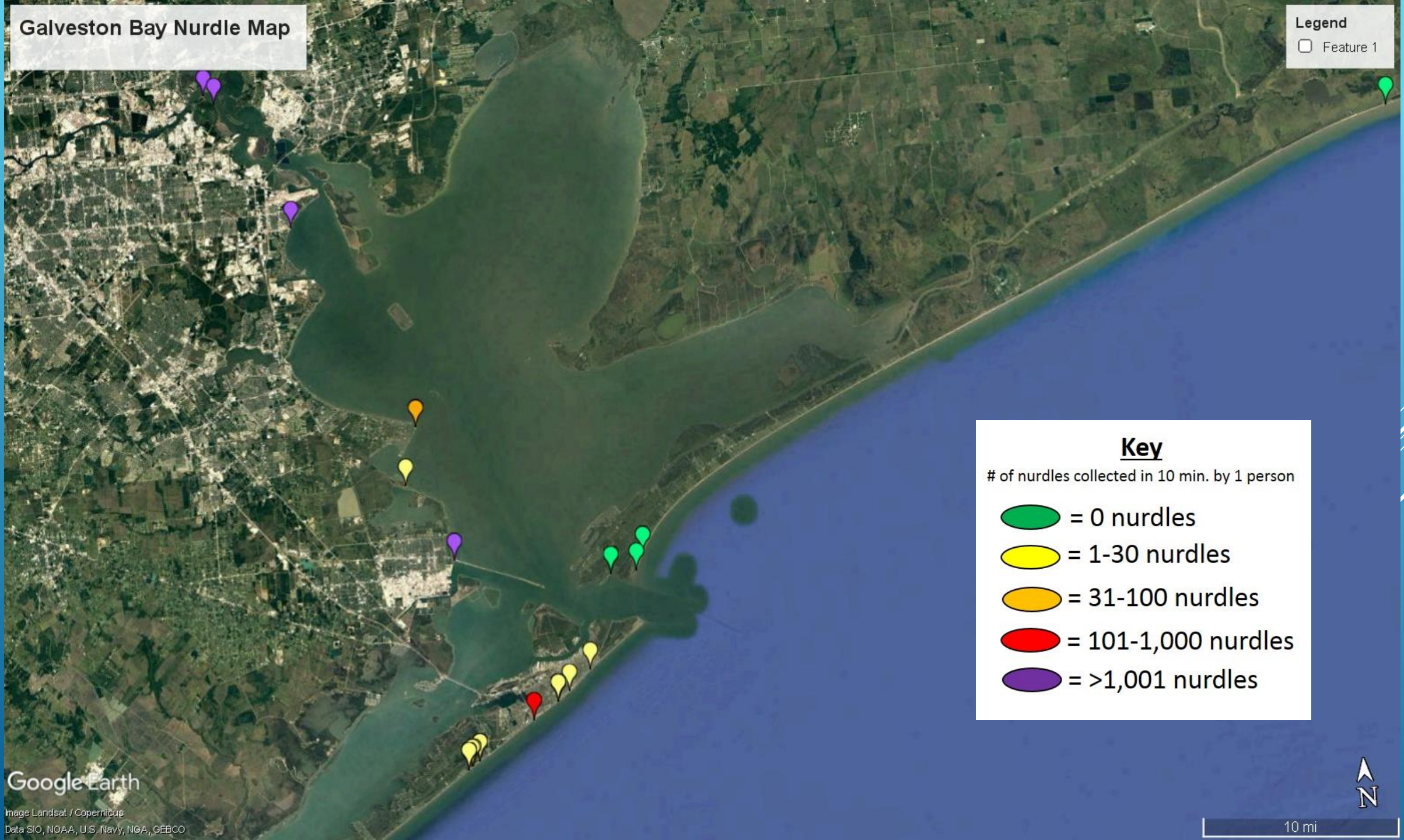
Jace@utexas.edu



8 mi

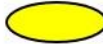

Galveston Bay Nurdle Map

Legend
□ Feature 1



Key

of nurdles collected in 10 min. by 1 person

-  = 0 nurdles
-  = 1-30 nurdles
-  = 31-100 nurdles
-  = 101-1,000 nurdles
-  = >1,001 nurdles

Google Earth

Image Landsat / Copernicus
Data SIO, NOAA, U.S. Navy, NGA, GEBCO



10 mi

FUTURE OF PROJECT

- ▶ New website for Nurdle Patrol
- ▶ Expanding partnerships
- ▶ Create Microplastics Science Team
- ▶ Work with environmental agencies



GULF OF MEXICO NURDLE EXPEDITION



The Mission-Aransas Reserve and Nueces River Authority are conducting Nurdle Patrol presentations and surveys around the Northern Gulf of Mexico to document presence of plastic pellets on Gulf beaches.

Meet us at one of these locations to help collect data!

(follow us on Facebook- **Nurdle Patrol**)



Join Us Here!

- ★ 1 May 19th – 1pm, Rettilon Rd, Bolivar Peninsula, TX, (survey)
- ★ 2 May 20th - 1pm, Grand Isle State Park, LA (survey)
- ★ 3 May 21st – 11:30am, Grand Bay NERR, MS (presentation)
5pm, Public Beach, Dauphin Island, AL (survey)
- ★ 4 May 22nd – 2pm, Apalachicola NERR, FL (presentation)
- ★ 5 May 23rd – 7pm, Lido Key Beach, Sarasota, FL (survey)
- ★ 6 May 24th – 11:30am, Rookery Bay NERR, FL (presentation)
- ★ 7 May 25th – 12pm, Long Key State Park, FL (survey)
- ★ 8 May 26th – 1pm, Fort Jefferson, FL (survey)

Contact us: jace@utexas.edu or 361-244-8665



WHY SHOULD WE CARE?

► New Polyethylene projects

North America PE expansions

Company	C ₂ capacity (kt/year)	Downstream (kt/year)	Location	Start-Up
Dow Chemical	750	ELITE PE (400kt), LDPE (350kt)	Freeport, Texas	Mid-2017 (mech complete Q1)
Chevron Phillips Chemical	1,000	Bimodal HDPE (500kt), mLLDPE (500kt)	Sweeny, Texas	Mid-2017
ExxonMobil Chemical	1,300	mLLDPE plus LLDPE (2 x 650kt)	Mont Belvieu, Texas	End 2017
INEOS/Sasol	470	HDPE	LaPorte, Texas	Q4 2017
Formosa Plastics	1,150	PE unspec (525kt), LDPE (625.5kt)	Point Comfort, Texas	H2 2018
Sasol	890	LLDPE (470kt), LDPE (420kt)	Lake Charles, Louisiana	H2 2018 (LLDPE), 2019 (LDPE)
LyondellBasell	500	HDPE	LaPorte, Texas	Mid-2019
Total/Borealis/NOVA*	625	Borstar PE	Bayport, Texas	End 2020
Shell	1,600	HDPE/LLDPE (2x 550kt), HDPE (500kt)	Monaca, Pennsylvania	Early 2020s
PTT Global Chemicals*	700	HDPE (2x 350kt)	Belmont County, Ohio	2021
NOVA Chemicals*	450	LLDPE	Sarnia, Canada	2022
SABIC/ExxonMobil*	NA	PE unspec (2 units)	US Gulf Coast	NA

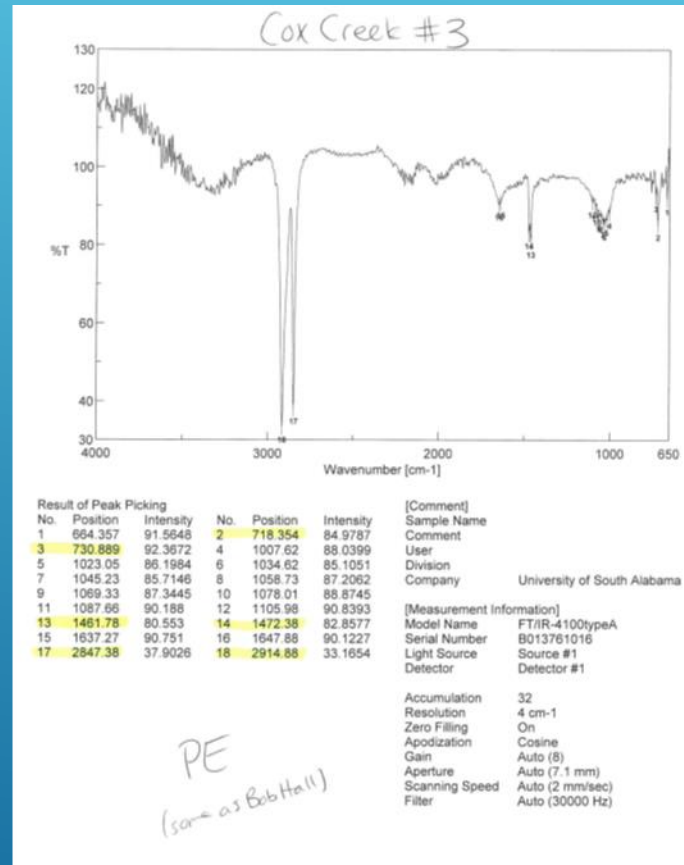
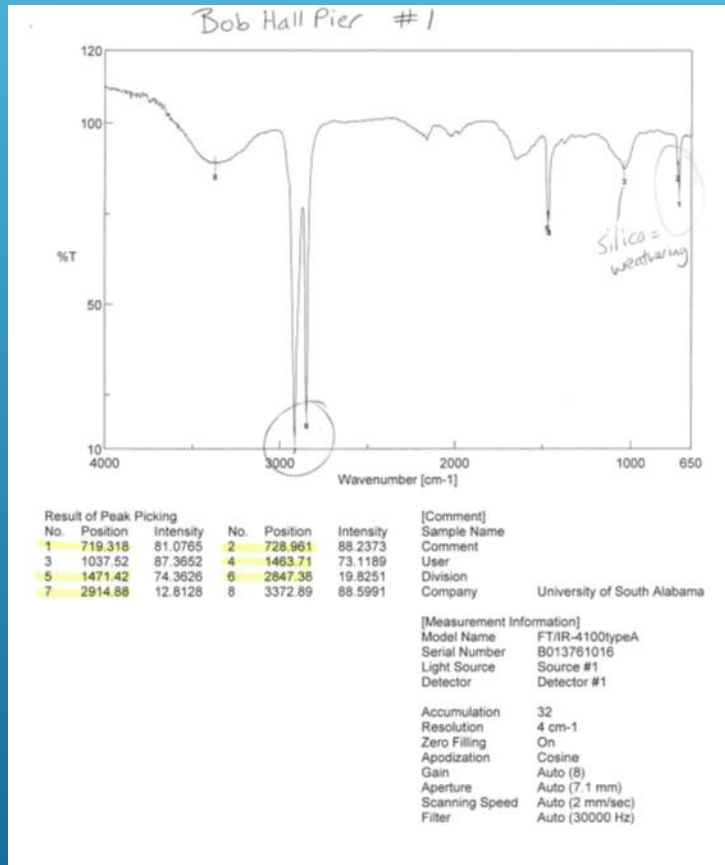
*No FID yet

** Assuming 1,300kt PE for SABIC/ExxonMobil, start-up by 2022

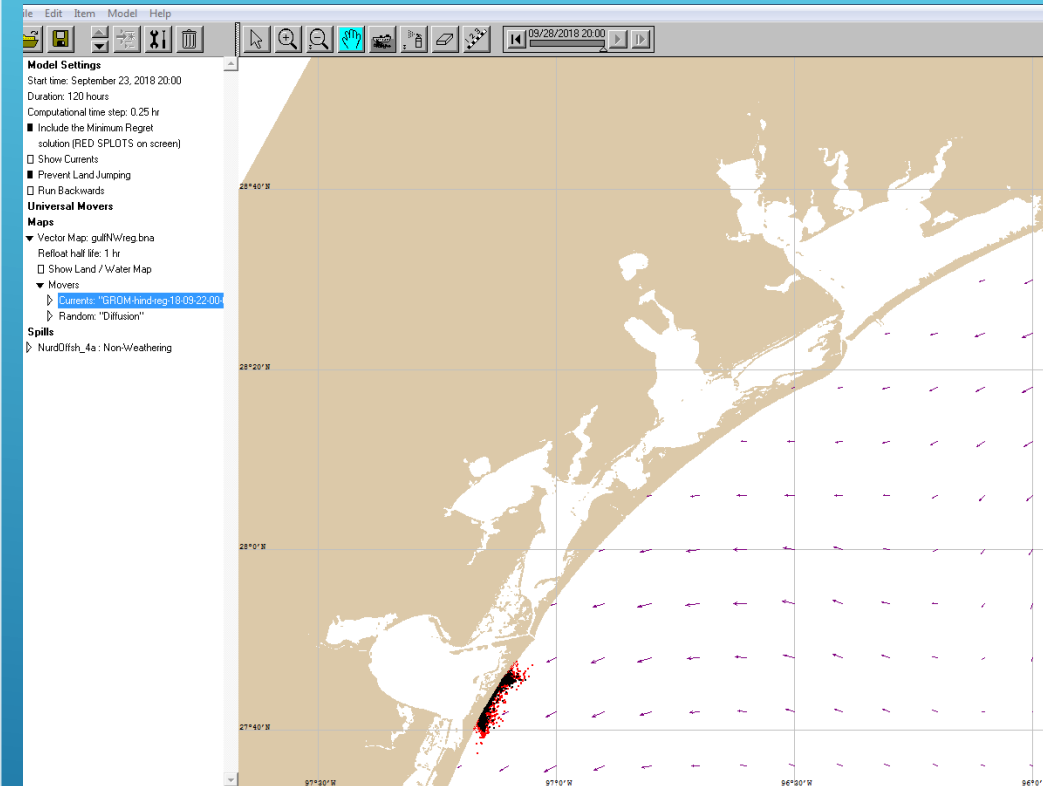
Through 2019 = 6.1m tonnes/year
Through 2022 = 10.7m tonnes/year**

WHAT CAN BE DONE?

Match nurdles to manufacturer



Hind-cast modeling



WHAT CAN BE DONE?

- ▶ Follow the guidance of Operations Clean Sweep.
- ▶ Develop data base to link nurdles to manufactures.
- ▶ Create chain of custody for nurdles being shipped.
- ▶ Stricter stormwater permits.
- ▶ Onsite spill containers.
- ▶ Quick accountability by plastic pellet industry.
- ▶ At home, we can refuse, reduce, reuse, repurpose, recycle.

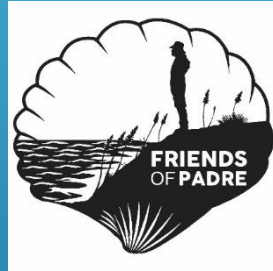
WHY? OUR NEXT GENERATION



THANK YOU!

All Citizen Scientists

Partners:



Katie Swanson
Jacob Augs
Dr. Lindsay Scheef
Dr. Zhanfei Liu
Dr. Kelly Dunning



Jace@utexas.edu