2725 Judge Fran Jamieson Way
Viera, FL 32940

Agenda Report

New Business - Miscellaneous

J.2. 5/6/2021

Subject:

Discussion re: Microplastics in the Indian River Lagoon, District 2

Fiscal Impact:

Dept/Office:

District 2

Requested Action:

Consider and discuss the issue of microplastics in the Indian River Lagoon, and direct staff to prepare a memorandum on the issue (i.e., research, options, funding).

Summary Explanation and Background:

The Citizens Oversight Committee (hereinafter "COC") has, historically, prioritized SOIRL projects based upon the cost per pound of nitrogen containing molecule removed from (or kept out of) the lagoon. While preventing organics from entering the lagoon and removing those already in it is unquestionably beneficial, other concerns impacting water quality and aquatic health have not and do not have a clear fit into the existing SOIRL project prioritization methodology of looking at cost per pound of removed nitrogen.

A constituent (Elizabeth T. Baker of Merritt Island) recently approached the County Commission to express concerns regarding microplastics entering the lagoon, breaking down, and entering the bodies of aquatic animals, some of which are eaten by humans. A portion of this plastic originates from roadside litter being mowed over and, in the process, shredded. Some of this shredded plastic enters the lagoon and breaks down into microplastics.

Research into possible human health implications of microplastic consumption remains ongoing. Recent research has shown microplastics inside humans. See: Methods for microplastics, nanoplastics and plastic monomer detection and reporting in human tissues (American Chemical Society), https://www.acs.org/content/acs/en/pressroom/newsreleases/2020/august/micro-and-nanoplastics-detectable-in-human-tissues.html. Additional research indicates that microplastics also may be found in placental tissue. See: Plasticenta: First evidence of microplastics in human placenta (Science Direct), https://www.sciencedirect.com/science/article/pii/S0160412020322297.

I am not an expert in microplastics or on their relative impact to the lagoon in comparison to organics. As such, I have no means of immediately determining whether it may be appropriate to divert some percentage of funding from preventing the entry of organics and removing them from the lagoon to the potential competing goal of preventing microplastics from entering the lagoon.

As such, I ask that we direct staff, in Brevard County's Department of Natural Resources, to research the issue and prepare a memo for consideration by the COC and the BoCC.

Clerk to the Board Instructions:

BREVARD County
BOARD OF COUNTY COMMISSIONERS
FLORIDA'S SPACE COAST

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May 7, 2021

MEMORANDUM

TO: Commissioner Bryan Lober, District 2

RE: Item J.2., Microplastics in the Indian River Lagoon

The Board of County Commissioners, in regular session on May 6, 2021, discussed the issue of microplastics in the Indian River Lagoon, but took no action.

Your continued cooperation is greatly appreciated.

Sincerely yours,

BOARD OF COUNTY COMMISSIONERS
RACHEL M. SADOFF, CLERK

Kimberly Powell

Kimberly Powell, Clerk to the Board

/ns

cc: Commissioner Pritchett
Commissioner Smith
Commissioner Zonka
Commissioner Tobia

We recently had Sea turtle mortality event.

1 - MRC ~~makes~~ looks at sea grass ~~as~~ as measure of success. At their luncheon.

~~Thank you for considering~~ agenda item

2 ~~Very happy~~ to see looking at ~~other criteria than~~. microplastic.

Brevard County	
Save Our Indian River Lagoon ½ Cent Sales Tax Referendum	To restore the Indian River Lagoon through financing, planning, constructing, maintaining, and operating capital improvements and capital maintenance projects and programs designed to improve water quality, fish, wildlife and marine habitat, remove muck and reduce pollution, shall an ordinance be approved levying a ½ cent sales tax for ten years and requiring deposit of all revenue to a Save Our Lagoon Trust Fund solely for such projects, with citizen committee oversight and annual independent audits?

~~Simple propanganda.~~ What we voted on includes pollution. Herbicides are being found in manatees at increasing levels. Restoring the lagoon means looking further than just fertilizer. "Glyphosate was present in 55.8% of the sampled Florida manatees' plasma. The concentration of glyphosate has significantly increased in Florida manatee samples from 2009 until 2019. "https://www.sciencedirect.com/.../pii/S0160412021001185

Copper is high in the canals being dredged in South Patrick shores. "Dwarf eelgrasses (Zostera noltei) populations have decreased since 2005 in Arcachon Bay (southwest France). Various stressors have been pointed out, however the role of xenobiotics like pesticides or copper (Cu) and of parameters like water temperature warming have not yet been explored. "
https://www.sciencedirect.com/.../abs/pii/S0025326X17308421

"Glyphosate and 2-4D have also been found to have an effect on seagrasses at very high concentrations. These high concentrations are occurring in areas where a genetically modified crop is designed to be resistant to the pesticide, and the crops are sprayed liberally and often, with much of the chemical traveling with the stormwater run-off. " So what about the Sand Point park plants being sprayed, ditches in the County and homeowner applications? Herbicides with Photosystem II (PSII) Inhibitors are commonly used to control broadleaf weeds.
https://www.sebastiandaily.com/.../manatee-deaths-in.../

"This study demonstrates glyphosate is moderately persistent in the marine water under low light conditions and is highly persistent in the dark. Little degradation would be expected during flood plumes in the tropics, which could potentially deliver dissolved and sediment-bound glyphosate far from shore." https://www.sciencedirect.com/.../pii/S0025326X14000228

Marine Pollution Bulletin
Volume 85, Issue 2, 30 August 2014, Pages 385-390

Glyphosate persistence in seawater

Philip Mercurio [a, b], Florita Flores [b], Jochen F. Mueller [a], Steve Carter [c], Andrew P. Negri [b]

https://doi.org/10.1016/j.marpolbul.2014.01.021

Highlights

- This is the first study of glyphosate persistence in seawater.
- Half-lives in "simulation" flask tests ranged from 47 to 315 days.
- Glyphosate degraded most rapidly under low light and most slowly in the dark.
- AMPA, the biodegradation metabolite of glyphosate was detected in each treatment.
- This persistence increases the potential for transport into the marine environment.

Abstract

Glyphosate is one of the most widely applied herbicides globally but its persistence in seawater has not been reported. Here we quantify the biodegradation of glyphosate using standard "simulation" flask tests with native bacterial populations and coastal seawater fro

Barrier Reef. The half-life for glyphosate at 25 °C in low-light was 47 days, extending to 267 days in the dark at 25 °C and 315 days in the dark at 31 °C, which is the longest persistence reported for this herbicide. AMPA, the microbial transformation product of glyphosate, was detected under all conditions, confirming that degradation was mediated by the native microbial community. This study demonstrates glyphosate is moderately persistent in the marine water under low light conditions and is highly persistent in the dark. Little degradation would be expected during flood plumes in the tropics, which could potentially deliver dissolved and sediment-bound glyphosate far from shore.

Previous

Next

Keywords

Glyphosate; Persistence; Degradation; Seawater; Tropical; Microbial

1. Introduction

1.1. Water quality and pesticides in the Great Barrier Reef

There has been increasing concern over the global loss of corals and seagrass and this has been particularly well documented for the World Heritage listed Great Barrier Reef (GBR) (De'ath et al., 2012, Orth et al., 2006). Management of this vast resource requires balancing coastal pressures from port and urban development, the extensive agriculture industry in GBR catchments, and needs to consider potential impacts on water quality from these activities (Brodie et al., 2013). Nearshore water quality around reefs and seagrass beds is most heavily impacted during the summer wet season from November to March when heavy rains deliver river runoff containing excess sediments, nutrients, and pesticides (Brodie et al., 2012a, Brodie and Waterhouse, 2012, Lewis et al., 2009). Satellite imagery effectively captures these events and their associated flood plumes migrating up to 50 km offshore as far as the midshelf coral reefs (Bainbridge et al., 2012).

A wide spectrum of pesticides have been detected in waters of the GBR, but herbicides are often more water soluble and mobile than contemporary insecticides and fungicides, and as a consequence, are more frequently detected in the river mouths and GBR lagoon (Brodie et al., 2012b, Davis et al., 2011, Lewis et al., 2009). The photosystem II herbicides have been the primary group detected in GBR waters; however, glyphosate (CAS number 1071-83-6) is the most widely used herbicide in Australia, in the GBR catchments and elsewhere, with approximately 15,000 tonnes applied annually to control agricultural, urban and roadside weeds (Beeton et al., 2006, Radcliffe, 2002). The popularity of glyphosate has increased steadily since its intro

Marine Pollution Bulletin
Volume 134, September 2018, Pages 66-74

Can pesticides, copper and seasonal water temperature explain the seagrass *Zostera noltei* decline in the Arcachon bay?

Perrine Gamain [a], Agnès Feurtet-Mazel [a], Régine Maury-Brachet [a], Isabelle Auby [c], Fabien Pierron [a], Angel Belles [b], Hélène Budzinski [b], Guillemine Daffe [a], Patrice Gonzalez [a]

https://doi.org/10.1016/j.marpolbul.2017.10.024

Highlights

- *Zostera noltei* decline in the Arcachon Bay (southwest France)
- Molecular effects of Copper and Pesticides cocktail used alone or mixed
- Cu and Pesticides decreased the mitochondrial metabolism and photosynthesis

Abstract

Dwarf eelgrasses (*Zostera* noltei) populations have decreased since 2005 in Arcachon Bay (southwest France). Various stressors have been pointed out, however the role of xenobiotics like pesticides or copper (Cu) and of parameters like water temperature warming have not yet been explored. To determine their impact, *Z. noltei* individuals were collected in a pollution-free site and transferred to the laboratory in seawater microcosms. This dwarf eelgrass was exposed to a pesticide cocktail and copper, alone or simultaneously, at temperatures (10 °C, 20 °C, 28 °C) representative of different seasons. After a two-week contamination, leaf growth, leaf bioaccumulation of Cu, and differential expression of target genes were studied. Eelgrasses bioaccumulated Cu regardless of the temperature, with reduced efficiency in the presence of the Cu and pesticide cocktail at the two higher temperatures. High temperature also exacerbated the effect of contaminants, leading to growth inhibition and differential gene expression. Mitochondrial activity was strongly impacted and higher mortality rates occurred. Experimental results have been confirmed during field survey. This is the first report on the impacts on *Z. noltei* of pesticides and Cu associate to temperature.

Previous

Next

Keywords

Zostera noltei; Arcachon Bay; Pesticides; Copper; Cellular impacts

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Environment International
Volume 152, July 2021, 106493

Chronic exposure to glyphosate in Florida manatee

Maite De María [a, b], Cecilia Silva-Sanchez [a], Kevin J. Kroll [a], Michael T. Walsh [b], Mohammad-Zaman Nouri [a], Margaret E. Hunter [c], Monica Ross [d], Tonya M. Clauss [e], Nancy D. Denslow [a, f]

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https://doi.org/10.1016/j.envint.2021.106493

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Highlights

- Florida manatees exposed to glyphosate have increasing body burdens since 2009.
- Glyphosate and AMPA were ubiquitous in Florida water bodies.
- Concentrations of glyphosate and AMPA were higher, before and during sugarcane harvest.
- Florida manatees were continuously exposed to both compounds in 2019–2020.

Abstract

Florida manatees depend on freshwater environments as a source of drinking water and as warm-water refuges. These freshwater environments are in direct contact with human activities where

FEEDBACK

The objective of the present study was to determine the concentration of glyphosate and its breakdown product, aminomethylphosphonic acid (AMPA), in Florida manatee plasma and assess their exposure to manatees seeking a warm-water refuge in Crystal River (west central Florida), and in South Florida. We analyzed glyphosate's and AMPA's concentrations in Florida manatee plasma (n = 105) collected during 2009–2019 using HPLC-MS/MS. We sampled eight Florida water bodies between 2019 and 2020, three times a year: before, during and after the sugarcane harvest using grab samples and molecular imprinted passive Polar Organic Chemical Integrative Samplers (MIP-POCIS). Glyphosate was present in 55.8% of the sampled Florida manatees' plasma. The concentration of glyphosate has significantly increased in Florida manatee samples from 2009 until 2019. Glyphosate and AMPA were ubiquitous in water bodies. The concentration of glyphosate and AMPA was higher in South Florida than in Crystal River, particularly before and during the sugarcane harvest when Florida manatees depend on warm water refuges. Based on our results, Florida manatees were chronically exposed to glyphosate and AMPA, during and beyond the glyphosate applications to sugarcane, possibly associated with multiple uses of glyphosate-based herbicides for other crops or to control aquatic weeds. This chronic exposure in Florida water bodies may have consequences for Florida manatees' immune and renal systems which may further be compounded by other environmental exposures such as red tide or cold stress.

Graphical abstract

Florida manatees were found to be chronically exposed to glyphosate and AMPA present in freshwater water bodies. This exposure was greater before and during the sugarcane harvest, when glyphosate is sprayed as a sugarcane ripener, but it is also used to control aquatic weeds, or to prepare farms before planting. AMPA's concentration is directly associated with the presence of glyphosate in the environment, suggesting a constant input of glyphosate. Glyphosate can breakdown into AMPA during the warmer months of the year due to bacterial degradation. Florida manatees depend on freshwater resources all year round, but more intensively during the cold weather (December to January). Water sampling periods are shown in black.

fibers are among the most common.

More than a third, 35%, originate from synthetic textiles, according to Henkel, a German chemical company, with car tires accounting for 28%, city dust 24%, road markings 7%, marine coatings 3.7%, personal care products 2%, and plastic pellets 0.3%.

Metals, toxins and harmful additives associated with plastics build up on the tiny plastic bits. And when consumed on oysters or other food and water, those toxins can build up in us.

These fibers from our clothes, tires, city dust and other sources stunt oyster growth and reproduction. Some oysters die from the plastics. Others pass them seemingly without harm.

In one of the first studies to address the risk of exposure of different types of microplastics, this year researchers at the University of Connecticut and Oregon State University, with support from a NOAA Marine Debris Program Research grant, are conducting field studies in Long Island Sound and lab studies to examine microplastic ingestion by oysters.

As scientists learn more, the long-term implications of all these microscopic plastics on the oyster and seafood industry could be huge, scientists such as Walters warn.

Sewage and stormwater are sources

These plastics are so puny they slip through sewer plant filters and into the gray water we sprinkle to green our lawns, likely pathways for plastics into the lagoon, the UCF researchers say.

So conservation biologists are urging us to take steps at home to filter plastic fibers from our laundry and temper our plastic use. Meanwhile, their science keeps signaling to sewer and stormwater utilities to do a better job filtering out the countless trillions of ubiquitous plastic bits that defy the naked eye.

Where there are sewage and septic tank issues, microplastics can be even worse in lakes than in estuaries like the lagoon, recent research is showing. A study of Illinois lakes last year found 100% of gizzard shad and largemouth bass had microplastics in them, with sewer plants and septic tanks as the primary suspected sources.

With some some 100,000 septic tanks and aging sewage infrastructure along the lagoon, the UCF researchers say some unknown portion of the 1.4 trillion plastic bits are coming from our wastewater. That's enough microplastic to fill most residential pools, the researchers estimate, and up to a third of an Olympic-sized swimming pool.

How much would all that plastic weigh?

"It's really hard to pin down. I would definitely be willing to estimate it's more than 1,000 pounds," said Casey Craig, a UCF graduate student in Walters' lab, who coordinated the citizen-science oyster project and data analysis. "Any organism that's in the Indian River Lagoon is at risk of ingesting microplastics."

UCF and other researchers are trying to describe baseline levels of microplastics in the lagoon and other habitats, and to determine thresholds for biological harm, which could guide future federal regulations.

"We're really close to that brink to say, 'hello, we have a problem here, we need to pay attention,' " Craig said.

Biologists say some recent studies have found toxic chemicals known to cause a host of ill-effects in humans clinging to the plastics. Substances such as Bisphenol A and phthalates — which can cause cancer and endocrine disruption in humans — and other plasticizers used to increase flexibility, durability and transparency of plastics also have shown up in whales and other marine life.

How UCF did it

UCF partnered with the Florida Department of Environmental Protection and several nonprofits and research institutions to sample the lagoon from microplastics beginning in March 2019. They drew lagoon water monthly at 35 locations, and oyster samples quarterly through February 2020. They wanted to know how fast oysters excrete the plastics. They found oysters can excrete one piece of microplastic per hour. But not all of the plastics pass through the shellfish.

The researchers trained 84 citizen scientists who dedicated 1,605 hours to training, sampling and analysis.

They sampled oysters lagoon-wide in May, August, and November 2019, and February 2020.

They found 3,181 plastics in 1,440 oysters (70% of total), with a mean of 2.26 microplastics per individual oyster. The mean length was 2.79 millimeters.

Forty-four percent of water samples contained microplastics. They found a mean of 1.47 microplastics per liter of lagoon water, ranging from zero to 25 bits of plastic per liter.

Synthetic fibers were the dominant plastic, 95.6%.

Water from the southern lagoon had significantly more plastics, which also were smaller in length. The researchers suspect more plastics pops up there because there's relatively more urban runoff there, from the St. Lucie River and rainy season releases from Lake Okeechobee.

UCF is studying microplastics under two grants from the Indian River Lagoon Program totaling $156,000. Next, they plan to study the microbes that live on microplastics and the role of stormwater outfalls in delivering the plastics to the lagoon.

More plastic than fish in oceans by 2050

Meanwhile, the problem keeps growing worse. Plastic production ramped up after World War II. By 2013, plastic pollution into oceans reached 30 million tons per year, globally, up from 0.5 million tons annually in the 1960s, the UCF researchers note in their study.

Now, 90% percent of the world's plastic pollution comes from 10 rivers, eight of them in Asia. Production of cheap, light plastics is expected to double over the next two decades, according to the Ellen Macarthur Foundation.

But just 14% of plastic packaging is recycled, the foundation says. That results in a loss of up to $120 billion a year, the foundation estimates, and if current trends persist, by 2050 there could be more plastic than fish (by weight) in the ocean.

Potential harm to humans

Not much research on commercially harvested shellfish has happened in North America. Most has been in Europe and Asia.

As of late 2019, only one study had examined human feces for microplastics. Austrian researchers in 2018 found fecal samples contained up to nine different types of plastic.

We excrete about 90% of the microplastics we ingest, research shows. But some studies have found what remains can trigger inflammatory responses, transfer toxic chemicals clinging to the plastics to our tissues, and disturb the healthy balance of gut microbes.

Viruses, bacteria and toxic chemicals, such as polybrominated diphenyl ethers (PBDEs) enter the food chain via microplastics. Studies of rats and mice show exposure to PBDE causes thyroid hormone effects, neuro-developmental toxicity, cancer-causing potential and other symptoms, according to the U.S. Environmental Protection Agency.

Wildlife impacts

Microplastics also are taken in by zooplankton and the tiny fish that eat them. Whatever metals or toxins they carry can then work their way up the food chain, ultimately to us.

Plastics pop up in just about every lifeform where biologist look — typically as small synthetic fibers in a creature's gut. Researchers have documented more than 220 animal species that ingest microplastics, including sea turtles. In several species, plastics block the digestive tract, damage organs and result in reduced feeding, growth and reproduction.

Birds eat plastic bits, think they're full, and then starve. Plastics lodge in crab gills, decreasing their ability to respire. Microplastic has shown up in the circulatory systems of wild animals as well.

Our tires drive the problem as well. A University of Washington study in the journal *Science* this past December found that coho salmon in the Pacific Northwest were being killed by a toxicant, called 6PPD-quinone, which leaches out of the particles tires shed onto pavement. The chemical is used to guard tires from ozone, a reactive atmospheric gas.

While microplastics speckle every busy road in the nation, the Washington State researchers from the recent salmon study say the simplest solution could entail tire manufacturers switching to an environmentally benign alternative.

Another way to protect salmon and other fish might be to cleanse stormwater via soil. But local utilities would have to put in ample infiltration basins to filter road runoff before it gets to fish spawning areas, the WSU researchers told *Science*, and that's a pricey proposition, they acknowledged.

While solutions from sewer and stormwater utilities could be costly, the much cheaper fixes stare right back at us from the mirror, the UCF researchers say.

There are special bags on the market that people can wash their clothes in, designed to capture microplastics.

"Always be mindful of your consumption," Craig said. "Bears in the woods are not using plastics. Think of how much plastic you touch in a day. Plastic is everywhere."

florida today

Idea – scholarship for high school students

LAGOON

Love oysters? It's likely you're eating lots of plastic too as ecological threat grows

Jim Waymer Florida Today
Published 6:01 a.m. ET Apr. 28, 2021

Oysters, the humble bivalve mollusk known for its decorative shell, pearls and its deliciousness, is at the center of a toxic environmental health puzzle that could have huge implications for the creatures and the humans who love them so.

Scientists have discovered that oysters are the latest ecological bellwether of the scourge of plastic in our environment. As filter feeders, it appears that oysters are taking on trillions of tiny bits of plastic worldwide with unclear long-term consequences. And it's happening locally as well as around the world.

* A new study by University of Central Florida has found, in the Indian River Lagoon, an estimated 1.4 trillion microscopic plastic fibers clog the oysters — seven in 10 of them — and litter the waters throughout the lagoon.

Enough plastic to stretch for miles

That's a lot of plastic. Line it all up and it would stretch the length of the 156-mile-long lagoon 11,153 times, or from New York City to Miami 1,274 times. It's enough to fill most residential-sized pools and weighs more than 1,000 pounds.

But it's the potential ecological and health burdens represented by that detritus from our modern lives that weigh heaviest on the minds of those studying the problem.

"How did we as humans let that happen? It's just shocking," Linda Walters, a UCF biologist, said of the plastic she and her students find — typically one or two pieces per liter of lagoon water, sometimes up to 25 pieces.

Because they are filter feeders and eaten whole, including their guts, oyster consumption may represent the biggest microplastic risk to humans of all seafood, scientists say.

"It's not just what's in the water," Walters said. "The oysters have more than the surrounding water does. They are accumulating what's in the water."

Walters calls the implications of their findings "huge and global."

"This type of work is needed to document this is a global problem and that global action on plastic pollution is needed to reduce/reverse it," she said.

UCF's study is the latest in multiple lines of evidence that microplastics plague coastal waters and pose health risks the world over. But as with other pollutants, the threat here is heightened by the stagnant, closed nature of a lagoon system with few-and-far-between openings to the ocean. While the science is in its infancy, proof of the broad-scale of the problem keeps mounting:

- A recent review by British researchers of 50 studies found plastic fragments in fish, shrimp and crabs globally.
- The fragments also have been found in human lungs, gastrointestinal tracts and stools, and in plastic baby bottles.
- Researchers estimate that a top European shellfish consumer eats about 11,000 plastic particles per year. And a 2018 University of Minnesota study found the average person ingests more than 5,800 plastic particles combined annually from beer, water and sea salt. Other studies estimate yearly exposures of 11,000 and 110,000 microplastics for seafood consumers in Europe and China, respectively

But what it all means for human health is unknown. The mixture of so many different polymers makes their risk inherently difficult to assess, scientists say. It's known that plastics and the chemicals they carry affect us at the cellular level. What's not known: the dose it takes to cause ill, long-lasting effects and how many oysters and other seafood does someone have to eat to deliver such doses.

What are microplastics?

Most microplastics are invisible to the naked eye, but their consequences are gradually emerging into plain scientific sight.

They are defined as bits of plastic less than five millimeters — about the size of a pencil point. They're all the broken-down shards of our synthetic surroundings. Nylon and polypropylene

Jim Waymer is environment reporter at FLORIDA TODAY.

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Who did the microplastics research?

The UCF research was conducted under a $99,797 grant from the Indian River Lagoon National Estuary Program (NEP), with partners including Florida Department of Environmental Protection; Marine Discover Center; Florida Oceanographic Society; and Smithsonian Marine Station. Next, under a second $56,941 grant from the NEP program, the researchers plan to study microplastics in stormwater and the microbes that live on microplastics. Partners on that project include MDC, DEP and Smithsonian.

What you can do to help

Reuse, reduce and recycle plastics

- Skip the disposables and try to use reusable products as much as possible. Reusable water bottles, grocery bags, and food containers are easy places to start, but be creative.
- Avoiding single-use plastic items (including drinking straws, shopping bags, water bottles, foam dishes/cups, utensils and even personal care products like cotton swabs that have plastic sticks).
- Reduce plastic microfiber production (much of which is generated by wearing/laundering synthetic fabrics). Some groups are trying to develop devices that would be added to a load of laundry to trap these fibers. The tiny size of the fibers makes them difficult to remove using filters, as the filters would clog very easily.
- Buy clothes made of cotton, wool or other natural material.
- Use bags made of "bioplastics" such as those made from plants or other biological materials.

Source: NOAA Marine Debris Program; University of Florida (IFAS)