IEM Committee

IEM-5

From: Tracy Mills <tracy.emills@gmail.com>
Sent: Tuesday, November 15, 2016 7:31 AM
To: IEM Committee
Subject: Re: Polystyrene food service containers IEM -05

Aloha Respected Council Members,

I'm in support of IEM-05, prohibiting the use of disposable polystyrene food service containers.

We have environmentally better options for our restaurants and an obligation to our visitors, Ocean and aina to make more earth friendly choices.

We can and must do better for our Islands--please pass this very important measure!!

Mahalo for your consideration,

Ms.Tracy Mills
1209 W. Kuiaha RD.
Ha'iku,
HI 96708

IEM Committee IEM-5

From: Susan Douglas <sd3@hawaii.rr.com>
Sent: Tuesday, November 15, 2016 11:34 AM
To: IEM Committee
Subject: Please ban STYROFOAM to-go containers

Aloha Respected Council Members,

I'm in support of IEM-05, prohibiting the use of disposable polystyrene food service containers.
We have environmentally better options for our restaurants and an obligation to our visitors, Ocean and aina to make more earth friendly choices.

Please pass this very important measure.

Mahalo for your consideration.

Warmest Mahalo and Aloha!

Susan Douglas
Kihei, Maui, HI 96753
sd3@hawaii.rr.com

SAY NO T
STYROFOA

EMAIL:

IEMCOMMITTEE@MAUICO

IEM Committee IEM-5

From: phyllis robinson <pfierrorob@aol.com>
Sent: Tuesday, November 15, 2016 11:58 AM
To: IEM Committee
Subject: Ban Styrofoam containers

Subject: Please ban STYROFOAM to-go containers:

Aloha Respected Council Members,

I'm in support of IEM-05, prohibiting the use of disposable polystyrene food service containers. We have environmentally better options for our restaurants and an obligation to our visitors, Ocean and aina to make more earth friendly choices.

Please pass this very important measure.

Mahalo for your consideration.

Aloha,

Phyllis

Phyllis Robinson. Ed.D
Owner, Courageous Crossings
Vice President, Haleakala Chapter
Hawaii Farmers Union United

IEM Committee IEM-5

From: Lawrence Koss <LKoss1@hawaii.rr.com>
Sent: Tuesday, November 15, 2016 1:02 PM
To: IEM Committee
Subject: IEM-05

Aloha Respected Council Members,

I'm in support of IEM-05, prohibiting the use of disposable polystyrene food service containers.
We have environmentally better options for our restaurants and an obligation to our visitors, Ocean and aina to make more earth friendly choices.

Please pass this very important measure.

Mahalo for your consideration.

LNKoss

IEM Committee

IEM-05

From: Don Lax <donvlax@gmail.com> on behalf of Don V. Lax <donvlax@maui.net>
Sent: Tuesday, November 15, 2016 10:55 PM
To: IEM Committee
Subject: Please ban disposable polystyrene food service containers

Aloha Councilmembers-

I am writing in support of IEM-05, banning the use of polystyrene food service containers. This small island, the water and the ocean must be protected as much as possible from waste and harmful pollution. There are many safe and even biodegradable alternatives to styrofoam.

Thanks for your kind attention-

Don V. Lax

808-283-6942
1215 S Kihei Rd, Ste O, #503
Kihei, HI, 96753

IEM Committee IEM-05

From: marc350maui@aol.com
Sent: Tuesday, November 15, 2016 3:56 PM
To: IEM Committee
Subject: ban styrofoam containers

Aloha council members,

Please vote for IEM-05 to ban styrofoam to-go food containers.

Mahalo,

Marc Drehsen

IEM-5

IEM Committee

From: John Naylor <jdancer@kula.us>
Sent: Wednesday, November 16, 2016 12:09 PM
To: IEM Committee
Subject: Please ban STYROFOAM to-go containers

Aloha Respected Council Members,

Not only will this have a positive effect on the environment, but because take outs are often reheated in the microwave, it may also be better for the health of the consumer as polystyrene leaches into the food when heated.

I'm in support of IEM-05, prohibiting the use of disposable polystyrene food service containers. We have environmentally better options for our restaurants and an obligation to our visitors, Ocean and aina to make more earth friendly choices.

Please pass this very important measure.

Mahalo for your consideration,

John Naylor
Makawao

IEM-5

IEM Committee

From: Barbara Kaneshige <bkaneshige@outlook.com>
Sent: Thursday, November 17, 2016 9:26 AM
To: IEM Committee
Subject: IEM-05

Aloha Respected Council Members,

I'm in support of IEM-05, prohibiting the use of disposable polystyrene food service containers.
We have environmentally better options for our restaurants and an obligation to our visitors, Ocean and aina to make more earth friendly choices.

Please pass this very important measure.

Mahalo for your consideration

Barbara Kaneshige

IEM - 5

IEM Committee

From: romananda@aol.com
Sent: Friday, November 18, 2016 7:53 PM
To: IEM Committee
Subject: Please ban styrofoam

It makes no sense at all to live in such a beautiful place and pollute it with substances that cannot be recycled... It's just that simple. Banning plastic bags was great... and eliminating styrofoam will place us in a truly viable position, to live our love and respect for the environment and the world. Please do it...!
Thank You Very Much,
Reverend Roma Carlisle

IEM-5

IEM Committee

From: Kachina Palencia <kachinala@outlook.com>
Sent: Sunday, November 20, 2016 8:37 PM
To: IEM Committee
Subject: Banning STYROFOAM can make a real lasting difference

Pamela Palencia

IEM-5

IEM Committee

From: Jazmyne Koch <jazmyne.koch@gmail.com>
Sent: Monday, November 21, 2016 12:44 PM
To: IEM Committee
Subject: Nov 28th: Support for IEM-05: Prohibiting use of disposable Polystyrene

Aloha Council Members,

I'm writing you to share my support of IEM-05 (prohibiting the use of disposable polystyrene food service containers) being voted on November 28th.

I have seen many restaurants and businesses switch over to more environmental containers such as cardboard or recycled and recyclable plastic containers and they have worked great! There are still some restaurants/businesses out there that still use styrofoam containers though! Take-out food, or packing extras is a common practice in our community with our family-style way of eating and the portions of the food these days. While some may bring our own tupperware to store extras on the trip home, not everyone can/or does. These containers are most of the time just used for the short transportation time between restaurant and house/or hotel.

There are many papers and videos out there showing that Polystyrene can be recycled, but as the state of New York has described, it is not economically smart, as it costs a lot of time and resources to recycle this product. For Hawaii that would also mean shipping off Polystyrene waste (usually in foam form) that takes up a lot of space, or the state would have to invest in a machine that washes it and melts it down to its first liquid state. As we do not use as much styrofoam as we did in the past, it seems to be a waste. What would also have to be monitored is shipped items like electronics that are usually packed in styrofoam. Companies would have to find other solutions like molded cardboard containers or the such to deliver there packages to the islands. This would be a big movement! What makes the most sense for the Hawaiian Islands is to ban the use of Polystyrene so that this waste is not taking up space within our landfills as it DOESN'T break down in the earth.
I believe we are heading in the right direction, and if we had a ban, the rest of the community would have to follow suite. I believe we are ready as a community to make better choices and integrate more earth friendly practices into our lifestyle — just as we have with the ban on plastic bags!

It would be great to not see styrofoam floating in the ocean or on the side of the road.

I hope that you are in support of IEM-05, and that our community can make this change!

Mahalo for your time and efforts,

Jazmyne M.K. Geis
jazmyne.koch@gmail.com

IEM-5

IEM Committee

From: Lindsey Hoell <lindseyhoell@gmail.com>
Sent: Wednesday, November 23, 2016 10:59 AM
To: IEM Committee
Subject: Styrofoam Ban Maui

To Whom it May Concern,

I am a Hawaii resident and currently live in Honolulu. Last week, I went to Maui for a week, and I have to say, I was so impressed with the conservation attempts made by so many restaurants and businesses in Maui.

It made me realize two things.

1. It is very possible to have a successful business without the use of styrofoam. It seemed as though the restaurants that were the most eco-conscious were the busiest and most supported by the community. The community WANTS to support restaurants and businesses who care about our beautiful islands. It seems as though people, both residents and tourists alike, are more willing to patron businesses who care about the land and ocean. That is good for business, and that is also good for Hawaii.

2. Maui could be a leader for all of Hawaii, and potentially the rest of the US. Clearly, Maui has the type of resident who understand and support the efforts by businesses converting to more environmentally friendly alternatives. I was so proud of the environmental interest in many of the businesses in Maui.

Styrofoam is on this planet much longer than we are. We cannot force our children and grandchildren to clean up our mess. We must ban styrofoam as another step in protecting Hawaii and preserving its beauty and wildlife for our children.

Mahalo,
Lindsey Hoell

IEM -5

IEM Committee

From: Robert Zelkovsky <robert@bamboomoonvideo.com>
Sent: Wednesday, November 23, 2016 12:03 PM
To: IEM Committee
Subject: Styro Bill

aloha Council Members - I have lived on Kaua`i for 41 years and have been involved in many environmental efforts here. The idea of banning styro at this time makes perfect sense.
I understand styro is around 3% of the waste stream and all county landfills and solid waste facilities are strained. Styro never breaks down.
There are so many alternatives that have become affordable and, if all restaurants used them and more were imported, the price would be even cheaper, comparable to styro.
Styro is litter, it blows around very easily and ends up in the ocean causing potential harm to marine life.
Please ban styro!
Dr Robert Zelkovsky
Wailua Homesteads, Kaua`i
41 years

IEM-05

IEM Committee

From: Laura Berthold <lberthold@yahoo.com>
Sent: Friday, November 25, 2016 1:46 PM
To: IEM Committee
Subject: Fw: Support a Bill to Phase Out Polystyrene Food Containers

Please Support a Bill to Phase Out Polystyrene Food Containers

Polystyrene foam products are bad for human health and the environment. I often participate in beach cleanups and pick up trash on my own. I find this type of trash on the ground all of the time. Marine animals, birds, and children can consume these containers as they break a part and become smaller pieces. This product contains carcinogens, which are not good for our health. These products are often not recycled as well.

We can use better products such as recycled materials, papers, and compostable ones. This will be better for humans, animals, and the environment. Businesses can invest in better products, not just the cheaper options.

I appreciate you supporting the bill to phase out polystyrene food containers. This will be good for the overall community, our oceans, and the land!

Testimony by Laura Berthold, Zipcode: 96768

I can not attend the hearing. Thank you for submitting this on my behalf.

IEM Committee

From: Megan Lamson <lamson@hawaii.edu>
Sent: Friday, November 25, 2016 6:09 PM
To: IEM Committee
Cc: Douglas McCauley; Hannah Bandana; Robert Parsons
Subject: Fwd: Hawai'i Wildlife Fund SUPPORTS the proposed Polystyrene Reduction Bill (IEM-05)
Attachments: HWF_maui.foam_nov2016.pdf; PUBLISHED_Blickley et_al_2016_Marine Pollution Bulletin.pdf; Carson et al. 2013b.pdf

Aloha again,

I was just informed that the previous email I sent (see forward below) may have not reached you at the iem.committee@mauicounty.gov email address :/

Please confirm delivery of this testimony, mahalo!

Me ke aloha,
m

This iPhone made possible by a generous HWF donor!

Begin forwarded message:

> **From:** Megan Lamson <meg.HWF@gmail.com>
> **Date:** November 25, 2016 at 4:43:20 PM HST
> **To:** iem.committee@mauicounty.gov
> **Cc:** Hannah Bernard <wild@aloha.net>, Douglas McCauley <douglas.mccauley@ucsb.edu>
> **Subject: Hawai'i Wildlife Fund SUPPORTS the proposed Polystyrene Reduction Bill (IEM-05)**
>
> Aloha members of the Maui County Council,
>
> Please see attached for our letter of testimony for the hearing at 1:30PM on Monday, Nov 28th related to RESTRICTING THE USE AND SALE OF POLYSTYRENE FOOD SERVICE CONTAINERS on Maui.
>
> FYI we are also including two scientific publications that prove the local sources of some marine debris on our beaches. This is to solidify one of the many reasons to support this bill, to prevent these single-use products from becoming future marine debris that may affect our marine wildlife and threaten our island economy.
>
> We will follow this email with a second one and an informational packet that was compiled by a group of scientists with the McCauley Lab with the University of California (Doug is cc'ed here) for a foam reduction bill hearing on Hawai'i Island for the members of the Hawai'i County Council. It's a large document with lots of valid testimony on this very issue you are being asked to consider on Monday and we don't want it to bounce.
>
> Also, please don't hesitate to contact any of us for more information!

Me ka mahalo,
Megan Lamson & Hannah Bernard

Meg cell 808-217-5777
Hannah cell 808-280-8124

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<")))>< <*)))>< <")))>< >>(((*> <")))><<
Megan R. McWhite Lamson, M.S.
& HAWAI'I WILDLIFE FUND
http://www.wildhawaii.org/
Vice President & Hawai'i Island
Program Director
@wildhawaii - #wildhawaii
meg.HWF@gmail.com
debris hotline 808/769-7629

Join our HWF e-newsletter @ **http://eepurl.com/boAxvj**

Hawai'i Wildlife Fund
P.O. Box 790637
Paia, HI 96779
-
P.O. Box 70
Volcano, HI 96785

"Dedicated to the recovery of Hawai'i's native wildlife through research, education and conservation"

Maui County Council (iem.committee@mauicounty.gov)

25 November 2016

Re: County of Maui Polystyrene Foam Reduction Bill

Aloha County Council members,

Hawai'i Wildlife Fund is in unanimous support of the proposed County of Maui bill for an ordinance (IEM-05) regarding polystyrene food service containers. As you know, the Hawaiian Archipelago is the most isolated island chain in the world. As such, we need to protect the natural and cultural resources that these lands and seas provide, and avoid bringing in products (like polystyrene foam) that are environmentally toxic, bad for wildlife and human health, and difficult to dispose of.

It's simple, really. We live on an island. If we cannot properly recycle or reuse items in a safe way for our communities, then what are we doing bringing them here in the first place?

Hawai'i Wildlife Fund (HWF) is a community-driven and volunteered-based non-governmental organization. Founded in 1996 by two National Marine Fisheries Service scientists, we are committed to protecting native wildlife in Hawaiian coastal and marine ecosystems. For 20 years, we have been involved in dozens of projects to conserve native flora and fauna, educate and share mana'o with community members and local businesses, and to advocate for a healthier natural environment here in Hawai'i nei.

Two of these projects include marine debris removal and prevention. Over the years, HWF and 4,000+ volunteers have collected and removed over 211 tons of marine debris (or 465,000+ pounds!!) from the shores of Hawai'i Island, Maui, Midway, and French Frigate Shoals. In fact, **over 5 metric tons (11,763 lbs.) were removed in the last 3 months on Maui and Hawai'i Island alone.** We estimate that 85 – 90% of all the marine debris we've collected to date is made of plastic, including foam buoys, cups, bits and pieces.

This > 85% figure is especially scary because the vast majority of plastics do not biodegrade. Instead, they photodegrade, then get brittle and break into smaller and smaller pieces; pieces that resemble and are often mistaken for food by fish, seabirds, marine mammals and sea turtles. Microplastic debris, including tiny pieces of polystyrene, may be the most ecologically harmful marine debris constituents of all as they are more easily incorporated into the marine food web. A

recent journal article stated that over 690 different species of marine life were affected by marine debris (Gall and Thompson 2015[1]), and polystrene foam is a likely culprit.

Over this past school year, we visited 34 elementary-school classrooms on Hawai'i Island and reached over
733 students with our newly developed "Marine Debris Keiki Education & Outreach" curriculum (avail for download on our website) and we hope to bring this program to Maui County in the next year. Our children are advocating protecting our oceans by reducing our single-usage plastics consumption. In addition, we are continuing to educate community members and visitors alike on Maui and Hawai'i Island by hosting community cleanup efforts on debris-laden shorelines. We feel strongly that this bill is in concert with all these efforts, and in leading the state in bringing this innovative (but not novel!) reduction bill to the table.

The fact remains that as our islands population continues to increase, more people will create more waste, and unfortunately much of this waste is plastic debris. We are mindlessly using products like polystyrene
foam clamshells and plastic utensils for five minutes (or less!), and then throwing them "away" (out of sight and mind) where they will stay for generations.

Plastic pollution and marine debris are very serious and global problems. But they are people problems, and can be resolved by the steadfast commitment of people. As representatives of our island community, you are charged with protecting the interests of all of our residents and visitors alike. So we ask you to think twice about this important bill.

Yes, compostable, cardboard, or plant-based materials might be slightly more expensive initially. However, if we truly consider the exponential cost of environmental degradation, threats to native wildlife and
human health, plus the burden of our overflowing landfills, and continuous solid waste management challenges on this island, ... then we think not. **It's all about planning for a circular economy, and designing with zero waste in mind. Reducing polystyrene foam usage is an environmental necessity and an economically sound decision.**

We urge you to push this bill forward for the health of both our native wildlife and community members. HWF stands in strong support of IEM-05!

Thank you for your kind consideration.

Mahalo nui loa!

Me ke aloha pumehana,

Hannah Bernard (wild@aloha.net) &
Executive Director & Co-founder
808-280-8124

Megan Lamson (meg.HWF@gmail.com)
Vice President & Hawai'i Program Director
808-217-5777

[1] Avail from: http://www.sciencedirect.com/science/article/pii/S0025326X14008571

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Trends and drivers of debris accumulation on Maui shorelines: Implications for local mitigation strategies

Lauren C. Blickley *, Jens J. Currie, Gregory D. Kaufman

Pacific Whale Foundation, 300 Ma'alaea Road, Suite 211, Wailuku, Maui, HI 96793, USA

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Policy
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ABSTRACT

Marine debris, particularly plastic, is an identified concern for coastal areas and is known to accumulate in large quantities in the North Pacific. Here we present results from the first study to quantify and compare the types and amounts of marine debris on Maui shorelines. Surveys were conducted monthly between May 2013 and December 2014, with additional daily surveys conducted on Maui's north shore during January 2015. Debris accumulation rates, loads, and sources varied between sites, with plastics being the most prevalent type of debris at all sites. Large debris loads on windward shores were attributed to the influence of the North Pacific Subtropical Gyre and northerly trade winds. Daily surveys resulted in a significantly higher rate of debris deposition than monthly surveys. The efficacy of local policy in debris mitigation showed promise, but was dependent upon the level of enforcement and consumer responsibility.

1. Introduction

Marine debris is a serious concern for coastal communities across the world. Not only does marine debris pose considerable threat to marine life, biodiversity, and ecosystems, but additionally impacts human health, safety, and local and national economies (Sheavly and Register, 2007; Gregory, 2009; Secretariat of the Convention on Biological Diversity (SCBD), 2012). Marine debris can further translate into loss of tourism revenue and recreation value, as well as affect coastal industries such as shipping and commercial fishing (Sheavly and Register, 2007; SCBD, 2012). Overall, plastics are considered the most common type of marine debris (Coe and Rogers, 1997; Derraik, 2002), with recent studies estimating the amount of plastic currently in the ocean at 5.25 trillion particles (Eriksen et al., 2014). Buoyant, lightweight, and slow to degrade, plastics have the ability to travel thousands of miles on ocean currents and can be deposited even on remote, uninhabited shorelines (Slip and Burton, 1991; Barnes, 2002; Morishige et al., 2007).

In the North Pacific Ocean, significant amounts of plastics and other debris have been discovered to accumulate in zones of regional surface current convergence that result from the clockwise rotation of the North Pacific Subtropical Gyre (STG) (Kubota, 1994; U.S. EPA, 2011; Howell et al., 2012; Law et al., 2014). Colloquially termed "garbage patches", these areas have been identified in both the Eastern and Western North Pacific Ocean (Moore et al., 2001; Howell et al., 2012; Law et al., 2014). The Eastern and Western garbage patches themselves are linked by the Subtropical Convergence Zone (STCZ), a band of surface layer convergence that is located at the northern terminus of the STG (Pichel et al., 2007; U.S. EPA, 2011; Howell et al., 2012). Along with the garbage patches, the STCZ is known to concentrate marine debris (Pichel et al., 2007; U.S. EPA, 2011). In addition to surface currents, accumulation of debris on beaches is strongly influenced by wind speed and direction (Walker et al., 2006; Garcon et al., 2009; Eriksson et al., 2013).

The Hawaiian Archipelago is found within the STG and in close proximity to the STCZ, which likely contributes to the large amount of marine debris documented along Hawaiian shorelines (Ribic et al., 2012a). To date, the majority of marine debris accumulation studies in the Archipelago have focused on sites in the Northwestern Hawaiian Islands (NWHI), a string of uninhabited atolls stretching 1500 km northwest of the Main Hawaiian Islands (MHI) (Donohue et al., 2001; Henderson, 2001; Boland and Donohue, 2003; Dameron et al., 2007; Morishige et al., 2007; Ebbesmeyer et al., 2012; Ribic et al., 2012b). Despite the lack of large-scale human development, thousands of pounds of ocean-based marine debris have been removed from NWHI coastal areas (Donohue et al., 2001; Donohue, 2003).

Although fewer studies have been conducted on marine debris in the MHI, results indicate that debris accumulation is an issue (McDermid and McMullen, 2004; Corcoran et al., 2009; Cooper and Corcoran, 2010; Ribic et al., 2012a). Long-term data sets from O'ahu demonstrate that Hawaiian shorelines experience higher debris loads than coastal areas along the U.S. Pacific Coast, particularly ocean-based debris such as fishing nets and floats/buoys (Ribic et al., 2012a). Variation in debris loads on O'ahu were further linked to environmental drivers, particularly fluctuations in the regional El Nino Southern Oscillation cycle (ENSO) (Ribic et al., 2012a). Small-plastic debris has also been recorded on remote beaches in both the NWHI and MHI

* Corresponding author.
E-mail address: LCBlickley@gmail.com (L.C. Blickley).

http://dx.doi.org/10.1016/j.marpolbul.2016.02.007
0025-326X/

(McDermid and McMullen, 2004). Although studies have demonstrated that local debris inputs can contribute to local debris accumulation in Hawai'i (Carson et al., 2013), there is little understanding of how local environmental conditions influence accumulation rates and debris loads in the MHI. In addition, the impact of sampling interval on estimated accumulation rate remains to be explored, not only in the MHI but on shorelines worldwide (Ryan et al., 2009).

This is the first study to quantify the types and amounts of marine debris found on Maui shorelines and the main objectives were: 1) to identify localized environmental factors that influence marine debris accumulation on Maui beaches; 2) investigate the effects of temporal scale on accumulation rates; 3) characterize the type of marine debris most prevalent on Maui beaches; 4) evaluate the effectiveness of local marine debris policy and programs in Maui County. It was hypothesized that a higher debris load and rate of debris accumulation would occur at sites situated along Maui's windward coastline, due to the shoreline's orientation to trade winds and/or large wave events.

2. Methods

2.1. Site selection

Maui's climate is dominated by northeasterly trade winds experienced approximately 80% of the year, with stronger more consistent winds during the summer months (Sanderson, 1993). To account for environmental variations across the island, three study sites were chosen to represent shorelines from three of the four main geographical areas of the island: Site 1 (Pu'unoa Beach) (20.88421; −156.68681) on the West Shore, Site 2 (Po'olenalena Beach) (20.66310; −156.44164) on the South shore and Site 3 (Lower Waiehu Beach) (20.924177; −156.493389) on the North shore (Fig. 1). Study constraints prohibited the ability to select an East Maui site. Survey sites were chosen according to the criteria of the NOAA Marine Debris Shoreline Survey Field Guide (Opfer et al., 2012). Furthermore, sites were chosen that did not immediately front resorts, and best attempts were made to survey beaches that were less impacted by human traffic.

2.2. Site surveys

Monthly and daily site surveys were conducted following the accumulation survey protocol outlined in the NOAA Marine Debris Shoreline Survey Field Guide (Opfer et al., 2012). Prior to initial surveys, debris from each site was collected and removed to develop a baseline for accumulation. After the initial cleanup, all collected debris items were sorted and classified according to the following general categories: plastic, rubber, processed lumber, clothing/fabric, metal, large debris (>30 cm) which were further broken down into 66 subcategories. Only debris items measuring greater than 2.5 cm were collected. To determine the origin of debris, items were divided into three indicator debris categories based on their likely source. Categories were based on Ribic et al. (2012a) and are presented in Table 1.

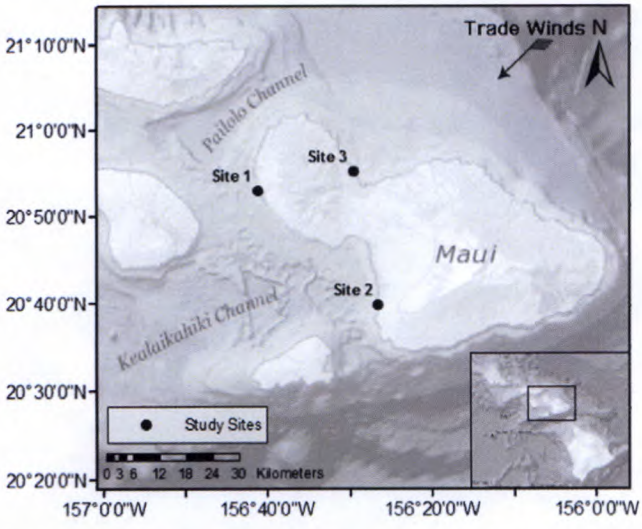

Fig. 1. Map showing the direction of prevailing trade winds and location of the three study sites on Maui. Site 1 = Pu'unoa Beach; Site 2 = Po'olenalena Beach; Site 3 = Lower Waiehu Beach.

2.2.1. Monthly accumulation

Monthly surveys took place at each site once every 28 days (±3 days) within ±30 min of low tide. Surveys were conducted within an established 100 m transect. Date, time, weather conditions, width of shoreline, and presence of storm activity within the past week were recorded for each survey. Each transect was traversed perpendicular to the water in 5 m increments, and covered the entire beach width from the water's edge to the vegetation line. Beach slope for each site was calculated using methods presented in Emery (1961). Surveys were conducted on a monthly basis from May 2013 through August 2014 for both Site 1 and Site 2 (17 total surveys) and from October 2013 through December 2014 for Site 3 (16 total surveys).

2.2.2. Daily accumulation

Site 3 was selected for additional daily accumulation surveys due to the large debris loads observed during monthly surveys. Accumulation surveys followed the same protocol as monthly surveys and were conducted daily for 28 consecutive days at Site 3 from January 2, 2015 through January 29, 2015.

2.3. Analysis

2.3.1. Monthly accumulation

A total of three monthly indices were calculated for each survey site to explain potential debris accumulation and retention. To summarize monthly wind speed and direction, a Relative Exposure Index (REI) was modified from Walker et al. (2006). A total of 8 wind directions determined by beach orientation were analyzed per site, each encompassing a total of 180°:

$$REI = \sum_{i=1}^{8} \frac{V_i P_i F_i}{100}$$

where V_i is the mean monthly wind speed (km h^{-1}) for wind directions categorized in 45° increments; P_i is the percent frequency from which the wind blew within each increment; and F_i is the fetch (USACERS, 1977) distance (km). Fetch lengths greater than or equal to 100 km were all set to 100 km and assumed to represent

Table 1
Indicator debris items classified by source category, as adapted from Ribic et al., 2012a.

Ocean-based	Land-based	General-source
Nylon rope/net fragments	Cigarette filters/cigars	Beverage bottles
Buoys/floats	Straws	Plastic bags
Fishing lures/line	Balloons	Packing straps
Spools	Fireworks	Bottle/container caps
Light sticks	Golf balls	Other jugs/containers
Oyster spacer tubes (large and small)*	Golf tees	
Hagfish traps*	Syringes	
	Personal care products	
	Flip-flops/slippers	
	Tires	
	Food wrappers	
	Clothing/shoes	

* Used only for analysis of daily accumulation debris.

unlimited fetch in the *i*th direction (Puotinen, 2005; Garcon et al., 2009).

To summarize monthly tide and wave activity, a Relative Tidal Range (RTR) was modified from Short (1996) and an Intertidal Area (IA) adapted from McLachlan and Dorvlo (2005):

$$RTR = \frac{H_t}{H_w}$$

$$IA = \frac{H_t}{S}$$

where H_t is mean monthly tide height in meters (m), H_w is the mean monthly wave height (m) and S is the beach slope. The initial model used to investigate debris per unit effort (DPUE) (count/100 m) included explanatory variables REI, RTR and IA, and non-significant variables that did not improve model fit were subsequently dropped.

Tide and wave height data for each site were extracted from the Center for Operational Oceanographic Products and Services (2015). Wind speed and directions were extracted for each site using the weatherData package (Narasimhan, 2014) in R.

To evaluate the efficacy of a recently introduced tobacco free beaches policy, which prohibits tobacco use on Maui beaches (County of Maui, 2014), the monthly accumulation of cigarette filter debris before and after the April 22, 2014 ban were compared. Owing to small sample size, a two sample equal variance t-test was used to determine if the mean monthly cigarette counts differed significantly before and after the ban.

2.3.2. Daily accumulation

The major daily beach forces of tide and wind (Eriksson et al., 2013) were recorded during debris collection to investigate environmental effects. Mean and max tide heights (m) as well as mean wave height (m), period (sec), and direction were obtained from Pacific Islands Ocean Observing System (PacIOOS) waverider buoy (Coastal Data Information Program, 2015). The buoy was located at N21.018°, W156.425°, approximately 10 km from the study site in 193 m of water. Daily wind data, including average wind speed (mph), highest wind speed (mph), and wind direction, were obtained from the National Climatic Data Center's (NCDC) automated weather observing system station (NCDC, 2015).

2.3.3. Model fitting

Generalized Linear Models (GLMs) were used to model the relationship between debris accumulation and environmental variables (McCullagh and Nelder, 1989):

$$y_i = \beta_0 + \beta x_i + \varepsilon_i$$

where $y_i, i = 1,\ldots,n$ is the response variable modeled as a linear function of the explanatory variable βx_i; β_0 is the intercept; and ε_i is the random error. Two different data sets were used in the GLM analysis, one for monthly debris accumulation at 3 sites and another at a selected site for daily accumulation. The response variable for the monthly analysis was a count of debris accumulation over ~30 days per 100 m of shoreline. The explanatory variables were all based on monthly summaries averaged over the 30 days prior to sample date and included REI, RTR and IA. The response variable for the daily analysis was a count of debris items collected per 100 m of shoreline each day. The explanatory variables were all summarized by day and included mean and max wind speeds, prevailing wind direction treated as factor, mean and max tide height, mean swell height, mean swell period and prevailing swell direction (treated as a factor). Models were initially fit assuming a Poisson distribution with a logarithmic link function. A Quasi Poisson distribution was fit when data were over-dispersed.

All computations were completed using the "mgcv" package in R (Wood, 2011). Final model selection was based on minimizing the Akaike Information Criterion, AIC (Sakamoto et al., 1986). Multicollinearity among predictor variables was tested by calculating the correlation coefficient and variables showing significant correlation were dropped. To ensure proper model fit and adherence to assumptions, model residuals were graphed and checked for violations (Augustin et al., 2012).

3. Results

3.1. Monthly accumulation

A total of 17 surveys were conducted at Sites 1 (May 16, 2013–August 29, 2014) and 2 (May 10, 2013–August 19, 2014), and a total of 16 surveys were conducted at Site 3 (October 4, 2013–December 22, 2014). Site 3 had the highest rate of debris accumulation per month (197.5 debris items/month) compared to Site 1 (96.76 debris items/month) and Site 2 (25.35 debris items/month). Surveys coincided between sites from October 2013 through August 2014. Due to the 28 day (±3 days) sampling interval, sites were sometimes sampled twice during a single month. Surveying overlap between sites is therefore shown graphically from October 2013–September 2014. Debris accumulation did not appear to show trends across months or seasons, and peak debris loads at each site did not overlap (Fig. 2).

Cumulative debris counts over the twelve month period (October 2013–September 2014) varied notably between sites (Fig. 3). The total number of debris items collected at Site 3 within this period (2446) was nearly twice the amount of debris collected at Site 1 (1232) and over nine times the amount collected at Site 2 (263) (Fig. 3).

Debris composition was similar among beaches, with plastic items being the most prevalent type of debris collected at each site: Site 1 (80%); Site 2 (71%); Site 3 (94%). Site 1 debris, however, was characterized by a significantly larger amount of cigarette filters (746) than either Site 2 (95) or Site 3 (102), with cigarette filters alone constituting 45% of Site 1's total debris load. In addition, Site 3 had larger amounts of hard, plastic fragments (1859) than either Site 1 (197) or Site 2 (60).

3.1.1. Site 1

The Relative Exposure Index (REI) at Site 1 averaged ~0.126 from June to November, after which it increased threefold to ~0.418 from December to May. Relative Tidal Range (RTR) and Intertidal Area (IA) showed no seasonal trends and had an average of 1.177 and 0.056 respectively. Results from General Linear Model (GLM) analysis showed a significant relationship between monthly debris accumulation and IA (Table 2).

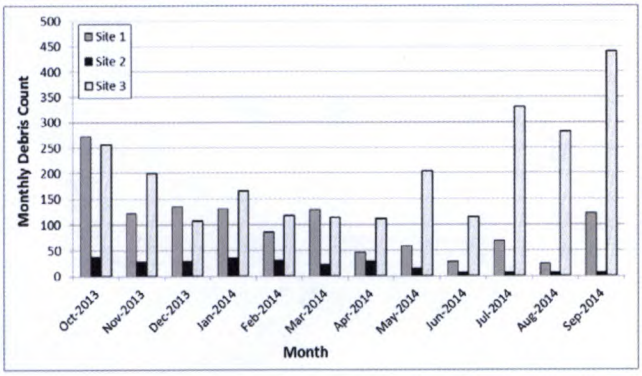

Fig. 2. Comparison of monthly debris counts at all sampling sites from October 2013 through September 2014. Note: Month labels represent date range within ±10 days of the last day of each month.

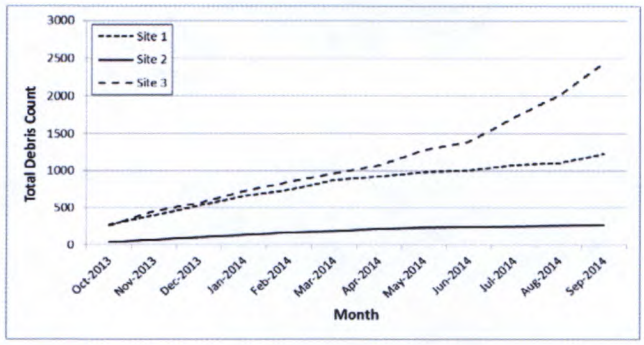

Fig. 3. Cumulative debris counts collected at each site over a 12 month period (October 2013–September 2014). Note: Month labels represent date range within ± 10 days of the last day of each month.

3.1.2. Site 2

The REI for Site 2 showed a clear increasing trend from April to August, peaking at 4.44. The lowest REI, of 2.54, was observed in February. RTR and IA showed no seasonal trends and ranged from 0.55–3.47 and 0.11–0.13 respectively. The GLM analysis on monthly debris accumulation found all three indexes to be significant (Table 3), with the most signification term being RTR.

3.1.3. Site 3

REI ranged from 6.2 (March) to 13.5 (August) with no clear seasonal trends. Site 3 experienced higher RTR from May to November (RTR ~ 0.38) and lower values from December to April (RTR ~ 0.24). Similar trends were observed for IA with a max of 0.06 occurring in November and a minimum of 0.05 occurring in May. None of the calculated indexes were found to significantly impact total monthly count.

3.1.4. Indicator debris

The total number of indicator debris items varied across sites. Site 1 had over twice as many indicator debris items (949) than Site 3 (551), and more than twelve times the amount as Site 2 (114). The increased number of indicator debris items at Site 1 is attributed to the significantly larger number of cigarette filters found at Site 1 as compared to Sites 2 and 3. Land-based debris items represented the highest proportion of debris items for both Site 1 (89%) and Site 2 (86%) (Fig. 4A and B). In contrast, Site 3 indicator debris was primarily ocean-based (54%), followed by land-based (26%) and general-source (20%) (Fig. 4C).

3.1.5. Tobacco free beaches policy

Mean monthly cigarette filter counts were not significantly different for Site 1: $t(15) = 0.38$, $p = 0.71$ and Sites 3: $t(15) = -0.65$, $p = 0.52$ before and after the county-wide ban on tobacco use at Maui beaches. Site 2 showed a significant decrease in mean monthly cigarette count ($t(15) = 2.68$, $p = 0.02$) after the ban was imposed.

3.2. Daily accumulation

A total of 5864 pieces of debris were collected during daily sampling of Site 3. Plastics accounted for 88% of the total debris collected, followed by glass (7%). Together, rubber, processed lumber, clothing/fabric, and large debris accounted for less than 5% of the total debris count. Hard plastic fragments comprised the greatest proportion of plastic debris (53%), along with fishing/aquaculture/shipping-related debris (23.7%) and food/beverage debris (9.8%). Specific plastic debris types, besides plastic fragments, accounted for 2059 debris items, with the most common being nylon rope/net (911), bottle/container caps (375), oyster spacer tubes (157), straws (77), and fishing line (70).

Table 2
Summary results of Site 1 GLM monthly accumulation analysis for best fitting model (Quasi Poisson family, log link function).

	Estimate	SE	T	Pr(>|t|)
Intercept	−2.106	1.895	−1.111	0.290
RTR	−0.673	0.549	−1.224	0.246
REI	−0.156	0.123	−1.268	0.231
IA	124.802	30.985	4.028	0.002

Table 3
Summary results of Site 2 GLM monthly accumulation analysis for best fitting model (Quasi Poisson family, log link function).

	Estimate	SE	T	Pr(>|t|)
Intercept	0.091	2.00	0.045	0.964
RTR	0.473	0.130	3.649	0.002
REI	−0.583	0.222	−2.623	0.021
IA	38.723	16.272	2.380	0.033

3.2.1. Indicator debris

A total of 1930 indicator items were collected during daily surveys at Site 3. Ocean-based indicator items represented 62% of all indicator items, followed by general-source items at 24% and land-based sources at 14% (Fig. 5).

3.2.2. Model fitting

The GLM analysis on daily debris accumulation revealed mean wind speed to be the most significant explanatory variables with wind direction (NE) and tide height less significant, but still selected in the final model (Table 4).

Model predictions based on mean tide heights and NE wind direction showed an increasing trend in debris accumulation with wind speeds. Model predictions based on mean wind speed and NE wind direction revealed a decreasing trend in debris accumulation with increasing tide heights (Fig. 6).

3.3. Comparison of monthly and daily accumulation rates

Debris counts at Site 3 averaged 197.5 items per month when sampled once every 30 days over a 16 month period. Increasing the sampling frequency to once per day at the same site resulted in a significantly higher monthly debris count of 5864 items.

4. Discussion

Debris accumulation rates, loads, and sources varied between study sites due to differences in environmental factors including geographic location, wind speed, wind direction, and tidal height, all of which have been shown to influence debris deposition (Coe and Rogers, 1997; Ribic et al., 2012a). An evaluation of debris loads between survey sites showed that the orientation of shorelines to the Subtropical Convergence Zone (STCZ) and trade winds influence debris accumulation. Site 3, which is most exposed to prevailing trade winds and the STCZ, exhibited the largest debris loads and the greatest proportion of ocean-based debris when compared to Sites 1 and 2, both of which are located on Maui's leeward shoreline and were dominated by land-based debris. These results correspond with findings from debris accumulation studies in the Northwest Hawaiian Island (NWHI) (Donohue et al., 2001; Ribic et al., 2012b). The high proportion of ocean-based debris at Site 3, particularly debris items such as oyster spacer tubes and hagfish traps that originate beyond the Hawaiian Archipelago, further speaks to the regional nature of marine debris. Differences between debris composition in the NWHI and MHI nevertheless suggest the need to better understand the influence of additional drivers (e.g. localized currents) on debris deposition, as well as the behavior of varying debris items within the marine environment. Plastics were the most common

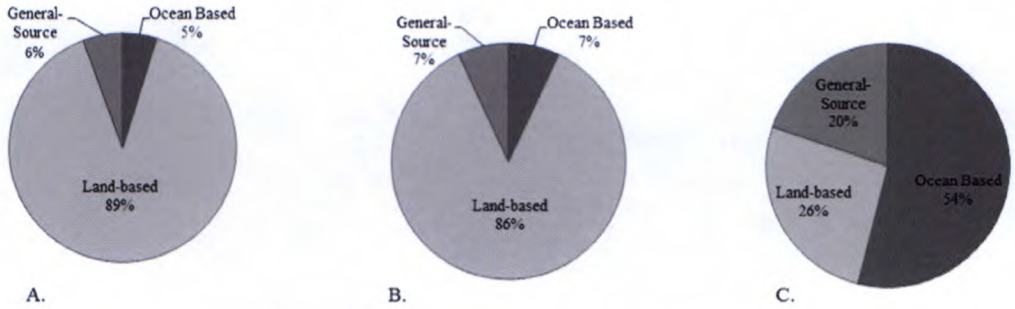

Fig. 4. Debris sources (%) as determined using indicator debris loads from Site 1 (A), Site 2 (B), and Site 3 (C).

debris item at each site, corroborating the prevalence of plastic debris in marine and coastal environments, as well as specifically within the MHI.

4.1. Monthly debris accumulation

Monthly debris surveys at Sites 1 and 2 were dominated by land-based debris, likely deposited by the movement of northeasterly trade winds across the island. This may explain the observed increase in debris deposition with decreased Relative Exposure Index (REI) at Site 1.

Previous debris accumulation studies have noted that the proximity of beaches to urban areas can influence debris loads (Ribic et al., 2012a; Carson et al., 2013; Leite et al., 2014). However despite its proximity to Maui's largest population center, Site 3 exhibited the least amount of land-based debris as compared to Sites 1 and 2. It is therefore likely that environmental variables, specifically trade winds, play a more significant role in debris deposition at the selected survey sites than proximity to urban areas, although debris deposition as it relates to local debris sources and sinks should be further explored.

Intertidal Area (IA) appears to influence debris accumulation through a combination of deposition of debris above the average tide height and removal of debris that is found below the high tide line. Increases in monthly IA, for example, were found to increase debris deposition at Sites 1 and 2, as higher tides deposited debris above the average tide line. The opposite trend was observed, however, during daily accumulation surveys at Site 3, where increased IA resulted in a decrease in debris deposition. These differences highlight the importance of temporal scale of sampling and the variation in results that are obtained when evaluating debris accumulation on a monthly versus daily basis (Smith and Markic, 2013).

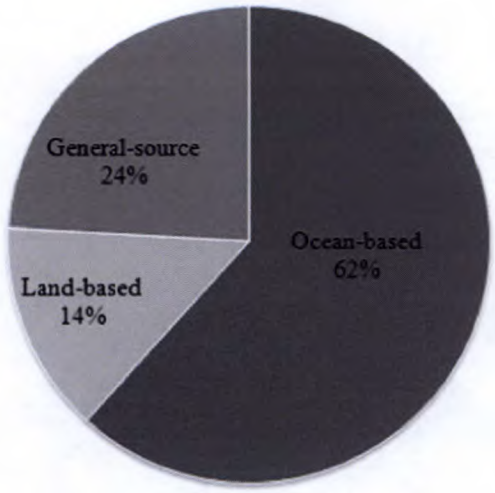

Fig. 5. Debris sources (%) as determined using indicator debris loads from daily accumulation surveys at Site 3.

Unlike Sites 1 and 2, none of the calculated indexes were found to significantly impact monthly debris loads at Site 3. This result is attributed to the frequent, large-scale changes in environmental conditions at Site 3, where northeasterly trade winds can vary daily from ~5 knots to ~30 knots. Drivers such as RTR and IA appear to average out over a monthly timeframe, as do the cumulative seasonal effects of large wave events and/or strong trade winds.

Debris accumulation did not exhibit seasonal trends at any site, despite the distinct seasonality of environmental variables such as large north swell events that occur in the winter and stronger, more consistent trade wind events that occur in the summer. Long-term accumulation studies conducted in the NWHI also found no link between debris deposition and seasonality, yet did find a positive relationship between debris deposition and El Niño events (Morishige et al., 2007). Additional studies have noted the seasonal migration of ocean fronts that tend to concentrate marine debris in the North Pacific, and suggest that shorelines in the Hawaiian Archipelago would experience higher debris loads during the winter (when fronts are closer to the islands) than in the summer (Pichel et al., 2007). It is likely, though, that seasonal variability has a more profound effect on debris loads in the NWHI than the MHI, as the NWHI are located in closer proximity to these fronts.

Further studies should evaluate the potential of seasonal debris trends in terms of increased sampling frequency, for example from monthly surveys to bi-monthly or weekly surveys, while also exploring the impact of decadal events such as El Niño and the seasonal migration of debris fronts.

4.2. Daily debris accumulation

Mean daily wind speed, direction, and tidal height were all determined to be significant factors when evaluating daily debris trends at Site 3. This supports the results presented in Eriksson et al. (2013), which identified wind and tide as the major drivers for daily debris accumulation. In this study, stronger winds appeared to transport a greater amount of debris from ocean areas with high debris concentration (such as the STCZ) to Maui's exposed shorelines, whereas higher

Table 4
Summary results of GLM daily accumulation analysis for best fitting model (Quasi Poisson family, log link function).

	Estimate	SE	T	Pr(>|t|)
Intercept	3.654	0.572	6.391	<0.001
Wind speed	0.207	0.044	4.649	<0.001
Wind direction (NE)	1.379	0.396	3.479	<0.01
Wind direction (NNE)	0.194	0.478	0.406	0.690
Wind direction (NW)	0.039	1.147	0.034	0.974
Wind direction (S)	−0.641	0.717	−0.894	0.383
Wind direction (SSW)	−1.143	0.685	−1.669	0.112
Wind direction (SW)	−0.245	1.196	−0.205	0.840
Wind direction (WSW)	−0.365	1.268	−0.288	0.777
Tide height	−4.120	1.843	−2.235	<0.01

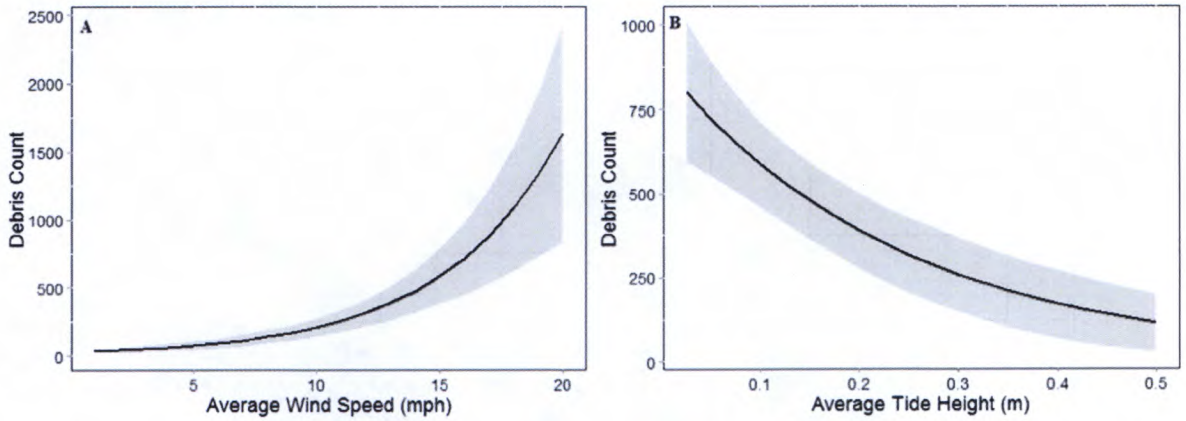

Fig. 6. Prediction of debris counts based on best fitting GLM for environmental covariates (A) wind speed and (B) tide height, where gray shaded areas represent confidence intervals.

tides redeposited debris back into the ocean, thereby decreasing debris deposition.

While Maui experienced large swell events at Site 3 during winter months, it is likely that daily sampling within this timeframe had minimal impact on data collection, and in fact may underrepresent debris loads. As wind, rather than tide height or wave height, was shown to be the most significant factor influencing daily debris accumulation at Site 3, authors postulate that large wave events may actually serve to remove debris from Maui shorelines, rather than deposit greater amounts of debris.

4.3. Impact of temporal sampling on accumulation rates

Monthly debris counts and proportion of ocean-based debris increased when sampling was undertaken on a daily versus monthly basis at Site 3. These findings support previous conclusions that debris turnover can occur rapidly and may be particularly influenced by variations in local conditions (Bowman et al., 1998; Ryan et al., 2009; Smith and Markic, 2013). The high turnover rate observed at Site 3 additionally supports the conclusion that tides serve to redeposit debris back into the ocean, and further reiterates the importance of daily sampling in not only assessing environmental variables, but also calculating at-sea debris loads.

4.4. Mitigation strategies

Results from this study indicate that local policies have varying success in mitigating marine debris. For example, although plastic grocery bags continue to rank as one of the top forms of litter in the state of Hawai'i (Ocean Conservancy, 2014), no plastic grocery bags were recorded in this study, a finding attributed to Maui's 2011 plastic bag ban. On the other hand, Maui's 2014 tobacco free beaches bill has had a variable impact on the amount of tobacco related debris items, with only Site 2 showing a significant decrease in cigarette filters after the bill's passage. The tobacco free beaches bill is inherently more difficult to implement as it relies heavily on local enforcement and a shift in social norms. This may explain the lack of reduced tobacco debris items found in this study. It is nevertheless recommended that the baseline cigarette filter loads established in this study be used to implement ongoing monitoring efforts, and that outreach and enforcement efforts target those beaches that are known to have a large amount of tobacco related debris (e.g. Site 1).

Some municipalities have moved to regulate marine debris as local level pollution in order to reduce the discharge of land-based debris, and the effectiveness of these types of efforts requires baseline debris loads (Ribic et al., 2012a). Community-based programs also show promise in terms of reducing local debris inputs. In 2013, a pilot fishing line recycling network was implemented at select Maui harbors for the disposal of discarded or unused fishing line (Pacific Whale Foundation, n.d.). Although bins were not located near study sites, and thus did not likely influence data collection, bins have been shown to be utilized by local fishers (pers. comm.), and expansion of the network could decrease fishing line debris on Maui beaches. Although the effectiveness of litter awareness campaigns were not evaluated in this study, it is likely that a reduction in local debris inputs will require a combination of targeted legislation, community-based waste reduction measures, and public outreach.

On a regional scale, previous studies suggest that North Pacific Ocean fisheries and ocean-based activities represent a primary input of debris to the NWHI (Donohue et al., 2001; Ribic et al., 2012b). From our results, it is clear that debris sources from the North Pacific also impact debris loads in the MHI. Elimination of these types of debris will require widespread action across hundreds of local municipalities, but efforts to address specific debris items, such as minimizing the loss of derelict fishing gear, will represent significant first steps.

5. Conclusions and recommendations

Results from this study demonstrate that a shoreline's orientation to the Subtropical Convergence Zone (STCZ) and local, environmental conditions (particularly wind speed and direction) drive debris deposition on Maui. The high incidence of ocean-based debris at sites exposed to the STCZ is further indication that debris originating from outside the Hawaiian Islands impacts local debris loads. Variations in debris deposition among sites are attributed to differences in both geographical location and local conditions between sites. Daily variation in environmental conditions showed to significantly impact debris accumulation rates. Comparisons between monthly and daily sampling reveal a high rate of debris turnover, attributed to extreme variation in local conditions, and also demonstrate the importance of sampling interval.

While not unattainable, solving the marine debris problem will require a holistic approach, one that combines debris removal projects, legislation, public outreach, and industry engagement with an enhanced understanding of marine debris and human behavior (Coe and Rogers, 1997; Sheavly and Register, 2007; Derraik, 2002). As knowledge gaps remain, it is recommended that long-term debris monitoring programs are established throughout the MHI to enhance our understanding of debris dynamics, monitor the efficacy of policy and local debris reduction efforts, and determine the fate and transport of common consumer debris items. Local mitigation actions should further be combined with regional efforts to address large debris item and those items (particularly plastics) that persist in the marine environment for extended periods of time.

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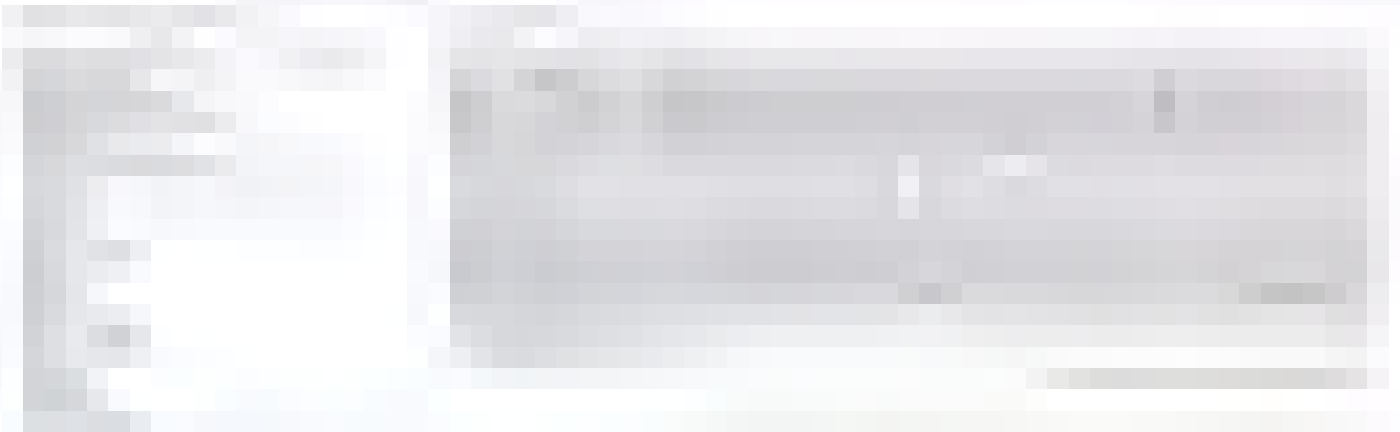

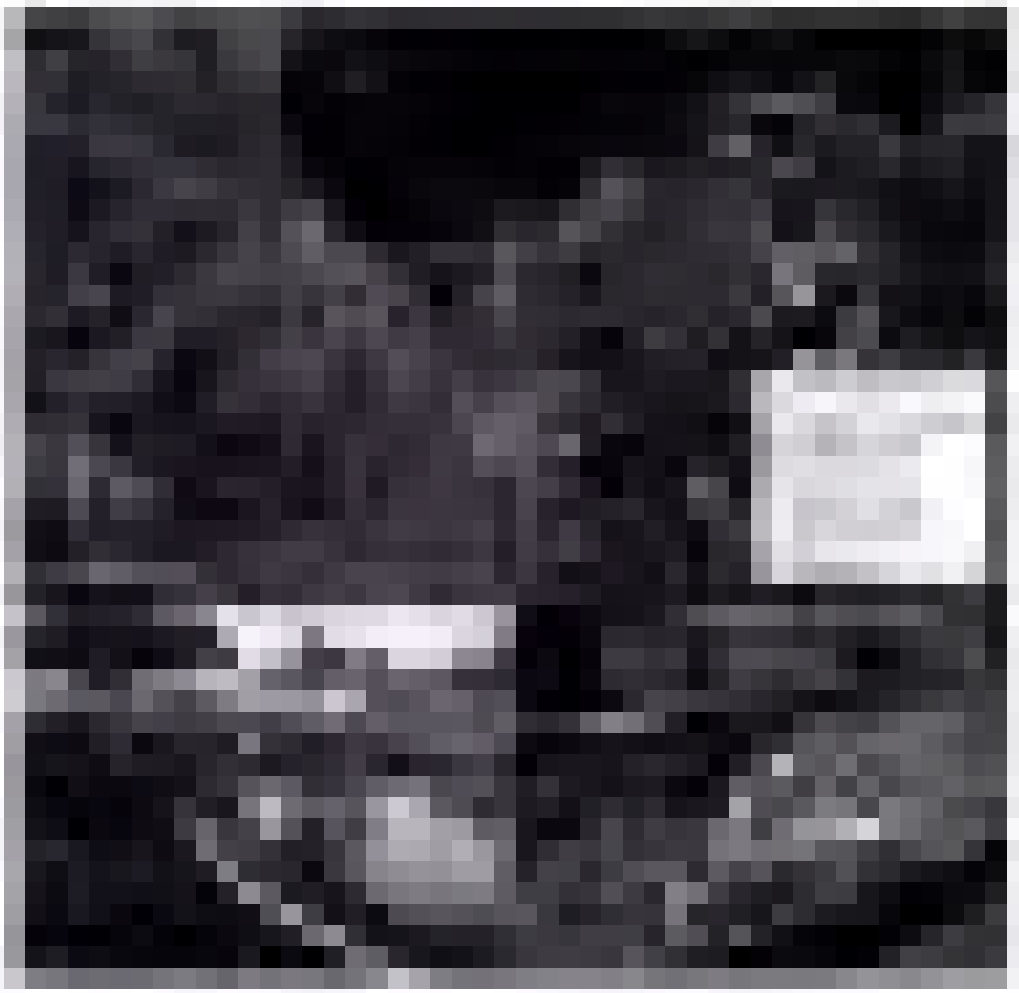

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Tracking the sources and sinks of local marine debris in Hawai'i

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ABSTRACT

Plastic pollution has biological, chemical, and physical effects on marine environments and economic effects on coastal communities. These effects are acute on southeastern Hawai'i Island, where volunteers remove 16 metric tons of debris annually from a 15 km coastline. Although the majority is foreign-origin, a portion is locally-generated. We used floating debris-retention booms in two urban waterways to measure the input of debris from Hilo, the island's largest community, and released wooden drifters in nearby coastal waters to track the fate of that debris. In 205 days, 30 kilograms of debris (73.6% plastic) were retained from two watersheds comprising 10.2% of Hilo's developed land area. Of 851 wooden drifters released offshore of Hilo in four events, 23.3% were recovered locally, 1.4% at distant locations, and 6.5% on other islands. Comparisons with modeled surface currents and wind were mixed, indicating the importance of nearshore and tidal dynamics not included in the model. This study demonstrated that local pollutants can be retained nearby, contribute to the island's debris-accumulation area, and quickly contaminate other islands.

1. Introduction

Plastic pollution in the marine environment impacts human communities directly through reduced tourism income, increased cost of cleanup, threats to navigation and safety, contamination of food sources, loss of aesthetic value, and other public health hazards (reviewed in Thompson et al. 2009). It impacts those same communities indirectly by threatening marine organisms and habitats though entanglement and ingestion by invertebrates, fishes, birds, turtles, and marine mammals, smothering of the benthos, leaching of plasticizers, concentration of persistent organic pollutants in seawater, changing the physical properties of sediment, and the transport of organisms via rafting (reviewed in Cole et al. 2011, Gregory 2009).

These effects are particularly acute in the Hawaiian Archipelago, in part because of its location proximal to the major debris accumulation zone of the North Pacific Gyre (Howell et al. 2012). In the northwestern portion of the island chain, the sensitive habitats of the Papahānaumokuākea Marine National Monument are threatened by marine debris, especially derelict fishing gear (Donohue et al. 2001). Marine debris also affects the marine environment and human communities on the southeastern inhabited islands. Residents are tied to the ocean, not only through a dependence on tourism and shipping, but also via aquatic activities (such as fishing, surfing, and canoeing) that are integral to their lifestyle and culture. Near the southern end of the archipelago's largest island, Hawai'i, lies Kamilo Point, an area famous for debris accumulation (Fig. 1). Since 2003, the Hawai'i Wildlife Fund (www.wildhawaii.org) has removed an average of 16 metric tons of debris per year from this 15 kilometer coastline.

The plastic debris at Kamilo consists of derelict fishing gear, miscellaneous large items, and a high, but patchily distributed, concentration of polyethylene and polypropylene fragments (Carson et al. 2011). The majority of identifiable items appear to be of non-Hawai'i origin, as evidenced by heavily degraded or fouled surfaces, foreign-language labels, markings, and logos on items not labeled for sale in the United States, or aquaculture and fishing industry equipment not in use on the islands (e.g. Ebbesmeyer et al. 2012). However, some items do appear to be of local origin, as evidenced by fresh, unfouled surfaces, and commonly used brand names. The local-origin debris is unlikely to have been littered directly on the coastline because the area is difficult to access and

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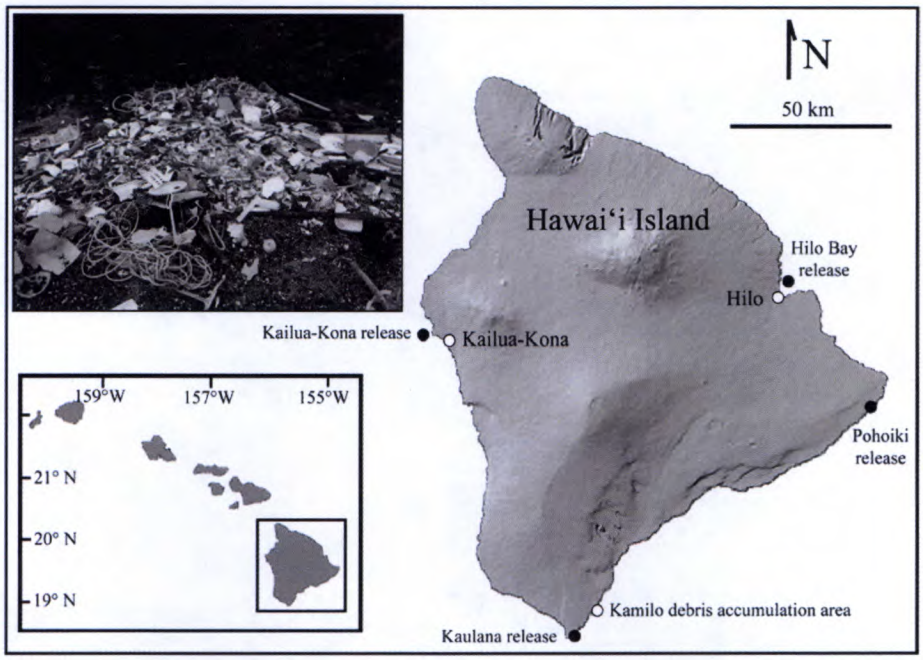


Fig 1. Map of the study areas around Hawai'i Island, and inset picture of typical debris accumulation on Kamilo Point.

not a tourist destination. Therefore, the same hydrodynamic forces which deposit large amounts of foreign debris on this coastline may also carry local debris. We hypothesize that prevailing northeasterly trade winds, and their associated surface currents (Jia et al. 2012), make the east coast of Hawai'i Island the most likely source of local debris to the Kamilo area.

Although plastic pollution from distant locations in the Pacific poses a great threat to Hawai'i (Brainard et al. 2001, Donohue 2005, Ebbesmeyer et al. 2012), this pollution is also more difficult to prevent with local action than Hawai'i-sourced debris. In this study, we test whether or not waste from the island's large population centers washes up on the island's main debris accumulation areas. Specifically, we investigate the following two questions:

1) What is the amount, composition, and timing of debris reaching the ocean from the island's largest population center, as measured by floating debris retention booms in two urban waterways?
2) What are the pathways of Hilo debris and debris from other island areas once it reaches the ocean, as traced by drifters and simulated by ocean models?

2. Design of experiments

2.1. Debris-retention Booms

One floating debris-retention boom was placed in each of two waterways in Hilo (Fig. 2), the largest population center on the island of Hawai'i (43,263 people as of the 2010 census). The first (#1 in Fig. 2) was placed in the Wailoa River watershed, which drains the predominantly residential southern portion of the city. The watershed area is 255.4 km^2 extending to the top of the massive Mauna Loa volcano; however, due to the highly porous nature of the basaltic rock, surface runoff only becomes a relevant factor in the movement of debris in the lower, developed 10.0 km^2 of the watershed (Parham et al. 2008). The boom spanned a 25-meter-wide concrete flood-control channel at the mouth of the river as it flows into Waiākea Pond. The pond is a brackish-water, tidally-influenced water body that opens to Hilo Bay 1.5 km north of the boom.

The second boom (#2 in Fig. 2) was placed in the 'Alenaio Stream watershed, which drains a smaller portion of urban Hilo, including the southern end of the downtown commercial district. The watershed area extends 187.3 km^2 up the slopes of the Mauna Loa volcano; however, only the developed lower 4.3 km^2 (Parham et al. 2008) is likely to produce significant synthetic debris runoff. The boom crossed a six-meter-wide stone flood-control channel as the stream empties into Waiākea Pond. The bay entrance is located 1.2 km east of the boom.

The booms collected debris from only 10.2% of Hilo's developed land area, representing approximately 4,400 people. Northern portions of the city are drained by the Wailuku River, a large watershed (653.2 km^2) of forested land that experiences extreme flows during frequent storm events which would be likely to destroy attempted boom placements with the force of water and drifting logs. The majority of runoff from the downtown commercial district reaches the bay via a decentralized network of underground storm drains which are difficult to sample effectively. To the south of the study area, the Keaukaha area is also drained via groundwater and decentralized channels that would be impossible to sample effectively for debris. These logistical considerations prevented more of Hilo's drainage area from being studied. The boom placements at the point where the two study watersheds empty into Waiākea Pond are advantageous because standing water supports the booms during low flow while dissipating some of the energy from high flow events.

The booms were anchored to either side of the two drainage channels, and remained in place for 205 days from September 2011 to April 2012. They consisted of flotation chambers extending about 0.3 m above the water surface (Fig. 2), and a solid, impermeable curtain weighted with chain extending about 0.3 m below the water surface. Debris was removed twice a week during the study period, with additional checks after storm events. To collect the debris, the booms were detached from one shoreline and pulled across to encircle the debris close to the other shoreline where it

Professor Douglas McCauley
Marine Science Institute
University of California, Santa Barbara
Santa Barbara, California 93106

March 21, 2016

Dear Council Members,

I and my colleagues listed here would like to voice our support for the County of Hawaii Bill 140, the ordinance to reduce expanded polystyrene "styrofoam" food containers and food service ware.

Bill 140 would phase out the use of single-use styrofoam food containers on the Big Island over a multi-year period and greatly reduce threats to Hawaii's oceans and most iconic marine animals (like sea turtles, seabirds, manta rays), protect the island's economic interests as a clean and healthy coastal tourist destination, and align the island more closely with the Environmental Management Committee's own Zero Waste goals.

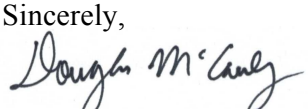
The passage of this bill is enthusiastically supported by local citizens, business owners, environmental groups, education organizations, legislators, and scientists within the Big Island community and across the Hawaiian Islands – we represent a handful of these community leaders in the attached informational packet.

We are very excited that the Big Island is considering joining more than 60 other states and cities across the United States and internationally that have passed almost identical ordinances against styrofoam products. These bans are quickly being adopted as local communities realize the inherent value (environmental, economic, human health) in transitioning to sustainable, biodegradable alternatives. Our marine ecology group recently organized a science education program to explore these issues with students from Waimea, HI (https://youtu.be/YGBpHYLNtRA). It is these Big Island youth who will be forced to inherit the pollution we leave for them on these lands and in this ocean. We surely have a better legacy to pass down to these future generations.

We ask that you examine some of the compelling science and economic reasons – compiled here – that motivated previous styrofoam bans, and consider how they align with Hawaii's traditions of environmental stewardship and value in showcasing the pristine nature of Hawaii's beaches and ocean to those that visit as tourists.

Thank you to the Environmental Management Committee and the Department of Environmental Management for the great work you do in managing the Big Island's incredible environmental treasures and taking bold leadership to ensure the continued stewardship of Hawaii for current and future generations. Please do not hesitate to contact us if any of the specialists in our delegation can assist in further answering any of your questions.

Sincerely,



Dr. Douglas McCauley
Professor of Biology, UC Santa Barbara

EXPLORING THE IMPACTS OF EXPANDED POLYSTRENE (EPS) OR "STYROFOAM" IN HAWAII

Dr. Douglas McCauley, Professor of Marine Science, UC Santa Barbara

"Polystyrene plastics have been shown to incorporate into marine food webs, and as humans sitting atop these food webs we have good reason to be concerned."

Dr. McCauley studies how marine ecosystems function and how human disturbances may affect healthy functioning of these communities. He has worked in Hawaii and the central Pacific Ocean while at Stanford University, UC Berkeley, and now UC Santa Barbara.

Expanded polystyrene (EPS) plastic or "styrofoam", is a class of single-use plastics that has been shown to negatively impact a wide variety of marine organisms from manta rays to turtles to fish, but these are only a handful of the more than 660 species that have been scientifically documented to have encountered marine plastic debris (United Nations Environmental Programme Report 2012).

The styrene monomers that make up styrofoam were deemed by the US National Academy of Sciences to be "reasonably anticipated to be a human carcinogen based on limited evidence of carcinogenicity from studies in humans…" (Report on Carcinogens 2014).

Polystyrene plastics have been shown to incorporate into marine food webs, and as humans sitting atop these food webs we have good reason to be concerned. A recent paper published in the scientific literature from a researcher at the University of Hawaii examined hundreds of pelagic fishes off Hawaii and found that a high percentage of them **had ingested single-use plastics** (Marine Ecology Progress Series 2013). **These were caught by commercial fishermen and included prize food fish like mahi mahi and opah**. Science tells us that styrofoam is capable of being incorporated into marine food webs and transferred between species.

Dr. Michele Barnes, National Science Foundation Research Fellow

"…the majority of respondents (81%) are in favor of a ban on EPS [styrofoam] takeout food containers"

Dr. Barnes is an environmental social scientist whose work focuses on the intersections between sociology and economics. She has previously worked in the Department of Natural Resources and Environmental Management at University of Hawaii Manoa and is currently an National Science Foundation Postdoctoral Research Fellow.

Expanded polystyrene (EPS), or "styrofoam", is a rapidly growing class of ocean pollution with estimates of more than 840,000 tons of EPS being used in the United States annually for food containers alone (EPA Municipal Solid Waste 2011). Residents and visitors to Hawaii consume the highest amount of takeout food per capita in the US, and frequently encounter styrofoam food containers. Thus consumers' willingness and preference for using non-styrofoam products should be an important factor in any decision related to styrofoam product usage.

Dr. Barnes published a study in the peer-reviewed Journal of Environmental Protection in 2011 that examined the willingness of consumers in Honolulu (the highest users of styrofoam in the state) to pay for non-styrofoam food containers. The study concluded that "the majority of respondents (81%) are in favor of a ban on EPS takeout food containers". The **study's results suggest that "local residents may be ready and willing to pay for alternative products that focus on long-term efforts to increase sustainability and reduce pollution".**

The study concludes by noting "making a switch to EPS alternatives could have an enormous effect on landfill capacity, could reduce oceanic debris, and improve air quality. **Even a small decrease in magnitude of EPS production and waste could help to reduce the global carbon footprint"**.

Elizabeth Elkjer, Director of Marketing, Sustainable Island Products

SUSTAINABLE ISLAND PRODUCTS

"…all realize the value and logic behind using compostable products and often tell us that their businesses have not only grown but flourished since switching to compostables."

Elizabeth has her degree in Environmental Science and her Master's degree in Global Leadership and Sustainable Development as well as a Certificate in Environmental Policy from Hawaii Pacific University.

Sustainable Island Products is located in Hilo with state-wide distribution and we specialize in providing a wide range of compostable products that can be easily substituted for our islands' current styrofoam uses. Unlike styrofoam which can easily take several hundred years or longer to break down, compostable products are plant based, made from agricultural by-products and renewable resources, and are non-toxic and non-polluting, and they could easily be incorporated into Hawaii's green waste stream. Additionally, unlike styrofoam, compostable products actually adhere to the County of Hawaii's Department of Environmental Management Committee's own Zero Waste plans.

Sustainable Island Products has been awarded the Hawaii Green Business Award three times. It is our mission to care for our island home by providing the community with eco-minded products that have little to no life cycle impact. Since 2007, we have

grown to have almost 300 customers throughout the Hawaiian Islands. Our customers, such as Island Naturals, Kilauea Lodge, Island Lava Java, Kohala Coffee Mill, Sweet Cane Café, Kaya's, Naung Mai Thai, Lilikoi Café, and Body Glove all realize the value and logic behind using compostable products and often tell us that their businesses have not only grown but flourished since switching to compostables. In fact, **the majority of consumers are more than willing to absorb the cost difference between styrofoam and the compostable alternatives**. There is often a misconception that compostable disposables are cost prohibitive, and in their infancy they were substantially more expensive. However, **today the majority of our new customers are pleasantly surprised at how reasonable and cost efficient the switch to compostable products is; for most it's a no-brainer decision**.

Dr. Lida Teneva, Science Advisor, Conservation International

"…bold leadership from national governments, state governments, and mayors is much needed to solve the problem"

Dr. Lida Teneva is a marine scientist with 10 years of experience in marine ecosystems, particularly the impacts of climate change, overfishing, and marine pollution on coral reefs, in Hawaii, Central, Western, and South Pacific, with her work through Stanford University and Conservation International.

Many studies have shown the longevity and durability of expanded polystyrene (EPS), or "styrofoam", in the environment and the associated harmful effects on animals, water quality, and coastal and marine habitats broadly.

EPS also has been shown to be very harmful to human health, as a neurotoxin and potential carcinogen, according to the US Department of Health and Human Services and the International Agency for Research on Cancer.

Conservation International is a member of the Plastics Pollution Coalition, which works on a variety of programs, including collaborating with private business on plastic-reduction solutions.

The plastic problem, including the persistence of EPS, in our global oceans, begins on land, with how much EPS is produced, used, and how it is dealt with after use. The problem is solvable and alliances of international non-profit organizations, private sector companies, and governments can work together to solve it, for the benefit of both people and oceans. While voluntary over-compliance from progressive environmentally-conscious businesses is necessary to stem the tide of EPS and other plastics, bold leadership from national governments, state governments, and mayors is much needed to solve the problem.

EPS ban policies in the United States have been shown to be effective. After one year of an EPS ban implementation in San Francisco, California, there was a

30% decrease in EPS litter, according to the City of San Francisco Streets Litter Re-Audit in 2008.

Dr. Hillary Young, Professor of Biology, UC Santa Barbara

"More than 180 marine species are known to eat plastics, and some of Hawaii's most charismatic and endemic species are highly vulnerable to plastics, including EPS styrofoam."

Dr. Young researches the ecology of seabirds and has worked extensively with iconic seabird species in the central Pacific Ocean while at UC Santa Barbara and previously at Harvard and Stanford University.

Expanded polystyrene or "styrofoam" is an important class of plastics that has a range of very negative environmental features for wildlife. It is highly resistant to biodegradation – easily persisting for 500 years and longer after manufacture. Seabirds, like most marine animals, are completely naive to polystyrene and other plastics and easily mistake it for food – to them it can look much like squid, fish, or fish eggs. Because styrofoam quickly breaks down to small pieces, even small prey can consume it, and so the plastics can even accumulate in seabirds and large marine animals even when consuming their normal prey. For these reasons **scientists project that styrofoam and other plastics will be found in 99% of seabirds by 2050** (Proceedings from the National Academy of Sciences 2015).

Plastic consumption can harm seabirds, and other marine wildlife in many ways. It can be immediately lethal if the plastic blocks their ability to breathe or feed chicks, thus reducing both adult survivorship and fledging success. Also, **styrofoam in particular is a sponge for extremely damaging toxins like mercury and polychlorinated biphenyls** (PCBs) that can cause secondary poisoning. More than 180 marine species are known to eat plastics, and some of Hawaii's most charismatic and endemic species are highly vulnerable to plastics, including EPS styrofoam.

Megan Lamson, Hawaii Island Program Director, Hawaii Wildlife Fund

"…over 186 tons of marine debris were removed from Hawaii Island alone and this figure includes thousands of fragments of EPS foam!"

Megan is HWF's Vice President and has coordinated the Hawaii Island Marine Debris Removal Project in southeast Hawaii since 2008. She has degrees in marine biology and conservation biology and environmental science from UC Santa Cruz and UH Hilo.

Hawaii Wildlife Fund (HWF) is a community-driven and volunteer-based non-governmental organization. Founded in 1996 by two former National Marine Fisheries Service scientists, we are committed to protecting native wildlife in Hawaiian coastal and marine ecosystems. For 20 years, we have been involved in dozens of projects to conserve native flora and fauna, educate and share mana'o with community members and local businesses, promote community based management, and to advocate for a healthier natural environment here in Hawaii nei.

Two of these projects include marine debris removal and prevention. Over the years, HWF and volunteers have collected and removed at least 204 tons of marine debris (or 408,000 lbs!) from the shores of Hawaii Island, Maui, Midway, and French Frigate Shoals. Of that, over 186 tons of marine debris were removed from Hawaii Island alone and this figure includes thousands of fragments of EPS foam! **We estimate that 85 – 90% of all the marine debris we've collected to date is made of plastic, including styrofoam buoys, cups, bits and pieces.**

This is especially frightening because the vast majority of plastics do not biodegrade. Instead, they photodegrade, get brittle and break into smaller and smaller pieces; pieces that resemble and are often mistaken for food by fish, seabirds, marine mammals, and sea turtles. Marine debris and plastic pollution are people problems that can be resolved by the steadfast commitment of people.

Kahi Pacarro, Executive Director, Sustainable Coastlines Hawaii

"highlights the harmful effects of marine debris on our coastal environments and focuses on the very real impacts that single-use plastics and styrofoam can have on Hawaii's coasts"

Kahi is the Executive Director of Sustainable Coastlines Hawaii.

Sustainable Coastlines Hawaii is a grassroots, local nonprofit centered around inspiring local communities to care for Hawaii's coastlines and keep its beaches clean. As one of

the state's largest beach-cleaning organizations, we coordinate educational programs and public awareness campaigns like waste diversion education and our Ocean Plastics Program. This program is an interactive experience that highlights the harmful effects of marine debris on our coastal environments and focuses on the very real impacts that single-use plastics and styrofoam can have on Hawaii's coasts.

Sustainable Coastlines Hawaii believes that education is essential for the health and sustainability of Hawaii's coastlines as a means of highlighting the myriad effects of trash on marine environments and also as a way to motivate communities to work on simple solutions to address these problems.

Doorae Shin, Waste Reduction Coordinator, Kōkua Hawaii Foundation

"…educating communities about the environmental and health benefits of going without plastics like styrofoam"

Doorae is community organizer for social and environmental justice. She served as University of Hawaii system's Student Sustainability Coordinator and has a degree in Sustainability Studies from UH Manoa.

The Kōkua Hawaii Foundation supports environmental education in the schools and communities of Hawaii. Our mission is to provide students with experiences that will enhance their appreciation for and understanding of their environment so they will be lifelong stewards of the earth.

Kōkua's programs include engaging with school communities on the importance of the 3R's (reduce-reuse-recycling) as a means of reducing Hawaii's waste output.

Our Plastic Free Hawaii program likewise promotes the benefits of a Hawaii free from single-use plastics like those commonly used in styrofoam food containers. This includes educating communities about the environmental and health benefits of going without plastics like styrofoam, and beach clean-ups of these single-use plastics commonly found on our island beaches.

Sarah Rafferty, Rise Above Plastics Coordinator, Surfrider Foundation Kona

"Making the switch to biodegradable containers is not only environmentally responsible, but economically feasible for establishments of all sizes."

Sarah is the Rise Above Plastics Coordinator with the Surfrider Foundation, Kona chapter.

The Surfrider Foundation seeks to find lasting solutions to the threats our ocean faces. Our Rise Above Plastics mission is to reduce the impacts of plastics in the marine environment by raising awareness about the dangers of plastic pollution and by advocating for a reduction of single-use plastics and the recycling of all plastics.

We are comprised of over 80 chapters and 250,000 supporters nationwide. The Kona Kai Ea Chapter believes that as an archipelago, waste reduction is especially relevant to Hawaii. Not only do our beaches suffer the effects of local single-use plastic consumption, but are also subjected to receiving discarded plastics from across the Pacific. **In 2015, Hawaii's Surfrider chapters collectively retrieved over 50,000 pounds of debris from Hawaii's beaches.** Of the various types of plastic found on our beautiful coastlines, **EPS styrofoam is an especially harmful form that can wreak havoc on birds and marine life, impacting our ecosystem for years to come**.

Our Ocean Friendly Restaurant Campaign seeks to reward restaurants that agree to self-regulated practices that decrease the amount of disposable plastic foodservice items that ultimately wind up as pollution on our beaches and in the ocean. A primary criterion for receiving this rating is being an EPS-free establishment. Over 150 restaurants on Oahu, Kauai, and Maui are already foam-free. **Over 100 cities and counties nationwide have already successfully eliminated single-use EPS styrofoam containers at their eateries**. Making the switch to biodegradable containers is not only environmentally responsible, but economically feasible for establishments of all sizes.

Julia Person, Sustainability Manager, Kona Brewing Company

"…our commitment to preserving Hawaii's natural resources. Kona Brewing Co. supports working with the local community to address the timely problem of styrofoam use."

Julia is the Sustainability Manager for the Kona Brewing Company.

For the past 22 years, the natural wonder of Hawaii and its remarkable people have made Kona Brewing Co. who we are. An integral component of our business plan is to grow with ecological integrity, reducing our environmental impact wherever possible.

Kona's pubs are Green Restaurant Association certified, earning 4-star designation for environmentally friendly practices. Ensuring we use compostable to-go products rather than other materials is key to our green accolades. Our commitment is further visible through over 50% of our power generated from 990 solar panels, capturing irrigation water from air conditioning condensate, and maximizing natural lighting or LED lighting. We understand the importance of viewing our operations through the lens of a life cycle impact, and **addressing the impact of material choices in the supply chain as well as end of life**.

We know our non-profit partners throughout Hawaii, such as the Surfrider Foundation and Sustainable Coastlines Hawaii, share our commitment to preserving Hawaii's natural resources. Kona Brewing Co. supports working with the local community to address the timely problem of styrofoam use.

COUNTY OF HAWAII'S ZERO WASTE MANAGEMENT PLAN

Information from the County of Hawaii's Department of Environmental Management (www.hawaiizerowaste.org/zero-waste/)

"Zero Waste" is a way of life that promotes the goal of **reducing the amount of material we throw away**. One way to achieve that goal is to re-imagine resource management whereby **instead of disposing of "waste" we reincorporate the by-products of one system to be used by another system**…. There is no such thing as "waste" in Nature. Ancient Hawaiian culture lived this sustainable way before the term "Zero Waste" came to be. We can live this way again through small shifts in our daily activities.

Here are some things you can do to reach our Zero Waste goal:
Avoid single-use disposables, e.g. polystyrene [styrofoam] foam cups and containers, plastic bags, plastic utensils.

- An estimated **275 million metric tons of plastic waste** was generated in 192 coastal countries in 2010, with **4.8 to 12.7 million tons entering the ocean** (Jambeck 2015).
- A 2014 study published in the Proceedings of the National Academy of Sciences estimated the **amount of plastic** in the *open-ocean surface* to be **between 7,000 and 35,000 tons.** That is the equivalent weight of between 212 – 1,060 adult humpback whales in pure plastic floating at the ocean's surface (Cózar 2014).
- Plastic tends to naturally accumulate in the global ocean gyres, or current zones. The North Pacific Gyre, of which Hawaii is at the center, contributes **importantly to the global plastic load (between 33 and 35%)** (Cózar 2014).

EXPANDED POLYSTYRENE (EPS) OR "STYROFOAM"

Expanded polystyrene foam (EPS), or "styrofoam", is a single-use plastic made from non-renewable petroleum sources. It is manufactured by linking styrene molecules together and expanding them with air. Styrofoam became increasingly popular during the 1950's – a time when single-use plastics were considered a "modern convenience" and the take-out food and beverage culture was increasing. Today, there is an increasing body of scientific evidence that point to the dangers, both to humans and animals, of styrofoam products. To compound problems, styrofoam can take upwards of several hundred years to degrade. **Fortunately, we have an increasingly wide availability of substitute products for our food ware and beverage needs.** These substitutes have

virtually the same functional properties as styrofoam, but are made from renewable, biodegradable materials and can be incorporated into many green waste streams.

Science – styrofoam versus animals

Bad for humans
The National Academy of Sciences ruled that the synthetic styrene monomers that make up styrofoam are "reasonably anticipated to be a human carcinogen based on limited evidence of carcinogenicity from studies in humans…" (Report on Carcinogens 2014).

Bad for marine animals
There are two primary pathways by which styrofoam can be harmful – mechanical and chemical.

> Mechanical – causes intestinal occlusion or blockage that can outright kill marine animals (e.g. sea turtles and seabirds; Fry 1987, Sileo 1990, Auman 1997, Lazar 2011, Gray 2012, Wilcox 2015).
>
> e.g. loggerhead sea turtles are an endangered species. 35% of loggerhead sea turtles in one study were determined to have eaten some kind of marine debris, 15% of these contaminated turtles had eaten styrofoam (Lazar 2011).
>
> Chemical – poisoning from contaminants native to styrofoam or much more commonly via pollutants that end up collecting on the styrofoam; e.g. mercury (Graca 2013) and polychlorinated biphenyls (PCBs). Styrofoam pieces essentially act like little pollution sponges, picking up and concentrating hazardous contaminants in the ocean – then something like a sea turtle comes along and eats this thinking it is a jellyfish. We have a lot yet to learn about the potential lethal and sub-lethal chemical poisoning effects of styrofoam.

Major US states and cities with styrofoam bans
For an extensive list visit http://www.surfrider.org/pages/polystyrene-ordinances

- Berkeley 1988.
- Maine, statewide 1993.
- San Francisco & Oakland 2007.
- Portland 2008.
- Seattle 2009.
- Miami Beach 2014.
- Washington, DC 2014.
- New York City 2015.
- Massachusetts, statewide. In consideration at the House under Bill H.2066.

Internationally:

- Antarctica 1992. Adopted under The Madrid Protocol.

    - The Protocol relates to the protection of the Antarctic environment. Annex III, Waste Disposal and Waste Management, prohibits polystyrene use as a "particularly harmful product" (The Madrid Protocol 1998).
- Toronto, Canada. 2008.
- Haiti 2012 & 2013.
- Manila, Philippines 2013.
- Guyana 2016.
- Canberra, Australia. In consideration by the Australian Capital Territory and Municipal Services Minister.
    - ACT and Municipal Services Minister Rattenbury: "US cities such as New York have found that single-use polystyrene containers cannot be recycled economically. They're bulky and they're non-degradable so they take up a significant amount of landfill" (Shirley 2015).

Styrofoam use and waste output in Hawaii

- Styrofoam products in Hawaii are either sourced from the mainland US, China, or from a few local Hawaiian producers.
    - "The American Chemistry Council – which represents chemical manufacturers – estimates that the United States produces about 850,000 tons of polystyrene [styrofoam] each year" (Castele 2011).
- In 2006, the City and County of Honolulu commissioned a study on island waste streams – it estimated 7,056 ± 1,371 tons of polystyrene [styrofoam] waste was produced every year. That's about **38,663lbs of polystyrene [styrofoam] waste per day**. And Oahu is only about 70% of the total population of Hawaii (Final Report: 2006 Waste Characterization Study 2006).

Can styrofoam be recycled?

- Yes, it is technically possible to recycle styrofoam, **BUT recycling styrofoam is economically unfeasible and rarely done**. **It is simply cheaper to produce new styrofoam, most processing stations cannot accept soiled styrofoam (e.g. if food has even touched it), and there is virtually no market for recycled product.** Recycling styrofoam requires collection and shipping, which is very expensive due to its low density. It just burns more fossil fuels to transport it to the handful (none of which are in the state of Hawaii) of facilities that can recycle clean styrofoam. And usually it can only be remade into a handful of items with little market demand.
- The nearest place to Hawaii that recycles styrofoam is California – and most places in California will only accept styrofoam packing "filler" or clean (non-food contaminated) styrofoam.
- "[New York City] officials said on Wednesday that the foam [styrofoam], known as expanded polystyrene, was not recyclable and that they had not found any established markets where it could be sold" (Flegenheimer 2015).
- "There's not a single major city in the nation that has successfully implemented a recycling program for used polystyrene [styrofoam] food containers, and the

reason is simple: It doesn't make economic sense," Mr. Goldstein (National Resources Defense Council; Mueller 2015).

- See "Containing the Containers" article by L. Consentino 2015, for additional information about the non-feasibility of recycling styrofoam.

Alternatives to styrofoam food and beverage containers

The best non-reusable alternatives are biodegradable, compostable paper or plant-based materials: sugarcane, plant starch, PLA (polydactyl acid) from cornstarch, wheat straw, etc. Some of these products handle much like petroleum-based EPS, are soak proof, and can handle temperatures up to 220F (>boiling temp of H_2O), and are microwave safe.

Elizabeth Elkjer, Director of Marketing, Sustainable Island Products

Sustainable Island Products is located right here on the Big Island and is a family owned and operated business that first began selling compostable disposable products in 2007 and now serves over 300 customers. My parents purchased the business in October and we have since seen a 40% growth. We attribute this growth to a change in our island consciousness. As a company, **we have the most diverse inventory of compostable products in the state and we are constantly bringing in new items that have been requested by our customers, from cups and plates, to sushi trays and grocery packaging. We carry products for all current consumers of polystyrene to seamlessly transition to compostable products.**

While, and although that may have been true in the infancy of compostable packaging, **the increase in demand for compostable products has driven the cost down substantially enabling them to be competitively priced**. Additionally, many of our customers have seen an increase in profitability after switching to our products because their clients want to support businesses that believe in sustainability.

Our compostable products require less energy to produce than their polystyrene counterparts, they are non-toxic and non-polluting, and they are made from agricultural by products and renewable resources. **This means that regardless of whether or not our island has commercial composting facilities in place, compostable products are still better for the planet from start to finish.** If one of our cups finds its way into the ocean, it will degrade and disappear, unlike all polystyrene "styrofoam" which simply breaks into smaller and smaller pieces, impacting the planet forever.

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SUPPLEMENTAL INFORMATION

Consumer preferences and willingness to pay for non-plastic food containers in Honolulu, USA. 2011. Michelle Barnes et al. Journal of Environmental Protection.

This study was published in the international, peer-reviewed Journal of Environmental Protection. Dr. Barnes and her colleagues used rigorous sampling methods to quantify support amongst Honolulu residents to pay more for non-styrofoam containers. They found that over 80% of respondents were in favor of a ban against styrofoam food containers and were willing to pay extra for biodegradable containers.

Containing the Containers. 2015. Lawrence Cosentino. City Pulse.

This article explores the realities of why so few places in the United States recycle styrofoam – it is just economically unfeasible. Even in the backyard of the major styrofoam producer, Dart Container Co., few recycling centers will even accept styrofoam waste, especially soiled (or food contaminated) styrofoam.

Styrene reasonably anticipated to be a human carcinogen, new report confirms. 2014. National Academy of Sciences.

Press release from the National Academies which upheld the listing of styrene (the chemical component of sytrofoam) as "reasonably anticipated to be a human carcinogen". The committee considered available scientific research on the matter and concluded that "compelling evidence exists in human, animal, and mechanistic studies to support listing styrene, at a minimum, as reasonably anticipated to be a human carcinogen".

The 25ft-high tidal wave of rubbish that highlights just why plastic shopping bags and Styrofoam food containers are banned in Manila from today. 2013. Jilly Reilly. Daily Mail.

News report highlighting Manila, Philippines ban on styrofoam food containers and single-use plastic bags. The magnitude of single-use plastics here has become especially visible, in the form of a 25-foot high wave of plastic trash. Tourism in this island nation, like Hawaii, plays an important role in the economy and is most successful with a clean and healthy ocean and beaches.

Change.org petition for a Big Island county-wide ban on single-use "styrofoam" containers.

Petition to ban styrofoam containers on the Big Island signed by over 4,000 supporters across the Big Island and neighboring Hawaiian Islands.

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Scientific Research

Consumer Preference and Willingness to Pay for Non-Plastic Food Containers in Honolulu, USA

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ABSTRACT

Expanded polystyrene (*EPS*), *a petroleum based plastic polystyrene*, *has an immense environmental impact with a degradation rate of over* 500 *years*, *and is a possible human carcinogen that may cause cancer in humans. Nonetheless*, *EPS is the most commonly used material to produce takeout food containers*, *a single use item that is quickly discarded. With growing recognition of the high environmental costs of EPS products and their pressure on landfill resources*, *EPS food container bans have become increasingly popular in jurisdictions across the globe. Similar legislation has been introduced in the state of Hawaii*, *USA. However*, *since EPS is currently more cost effective than its alternatives*, *the widespread adoption of food containers produced with biodegradable materials remains a challenge. This study employs Conjoint Choice Experiment* (*CCE*) *to determine consumer preference and willingness to pay for plant-based EPS alternative takeout food containers and their various product attributes in the urban center of Honolulu*, *Hawaii. Latent Class Analysis* (*LCA*) *is used to cluster respondents into four distinct classes based on their observable attributes of choice. Results show that the majority of respondents* (81.0%) *are in favor of a ban on EPS takeout food containers. As an alternative*, *the majority of respondents prefer a container constructed out of a sugarcane material* (66.49%) *that is microwaveable* (88.94%), *water resistant* (100%), *and locally produced* (51.23%). *Moreover*, *this study demonstrates an increase in consumer's willingness to pay for more environmentally friendly food containers*, *which may allow businesses to offset the costs of substituting EPS for biodegradable materials. These findings provide valuable information for farmers*, *manufacturers*, *and natural resource managers*, *and can help to guide decision makers when considering socially responsible and environmentally sustainable policies.*

Keywords: *Expanded Polystyrene* (*EPS*), *Plastic Food Containers*, *Conjoint Choice Experiment* (*CCE*), *Latent Class Analysis* (*LCA*), *Consumer Preference*, *Honolulu*

1. Introduction

Expanded polystyrene (EPS), a form of the petroleum based plastic polystyrene, is the most commonly used material to produce takeout food containers, often used once and then discarded. However, the continued use of EPS faces a number of challenges regarding its chemical composition, inefficient recycling process, and life-cycle longevity, which make it a serious hazard to the environment [1-3].

EPS and other plastics were the fastest-growing fraction of the United States municipal waste stream from 1970 to 2003 [1], which was largely a result of a society shifting from reusable, biomass based materials to synthetic, disposable materials. In 1960, American consumers used approximately 270,000 tons of disposable plates and cups [4]. However, this number jumped three-fold to 2.07 million tons in 2009, of which 710,000 tons, or one-third, were made with EPS [5]. Furthermore, EPS and other plastic containers and packaging increased from 120,000 tons in 1960 to 12.5 million tons in 2009, 470,000 of which were made from expanded polystyrene [5].

With a degradation rate exceeding 500 years [6], EPS has substantial long-term impacts. Although EPS can be recycled, the actual recycling process can only achieve a 40:1 compression ratio and is hindered with high transportation costs and low market value, making recycling cost-prohibitive [4,7]. New technology that can achieve a 90:1 compression ratio has recently been tested [8], but even if the technology is established, EPS is made from non-renewable resources and will continue to be a long-term challenge to waste-stream management and the global environment.

Due to their life-cycle longevity and widespread use,

EPS and other plastics also currently make up 60% - 95% of marine debris worldwide, have been found in the stomachs of 44% of marine bird species, and have otherwise harmed 267 species of marine organisms including turtles, sea lions, and cetaceans [1]. In Hawaii, 72% of all marine debris by weight consists of plastics [9].

Moreover, styrene, the basic building block of EPS, is classified as a possible human carcinogen by the EPA and by the International Agency for Research on Cancer (IARC), and the manufacturing process of EPS has been reported by the EPA as the fifth largest creator of hazardous waste in the US [10].

Such concerns have been the basis of numerous legislative actions worldwide to limit or ban the use of EPS takeout food containers and other EPS products. In 1999, China's State Economic and Trade Commission prompted Chinese cities to enact legislation limiting the use of EPS products [8,11]. In the US, several cities such as Minneapolis (Minnesota), Freeport (Maine), Portland (Oregon), Malibu (California), and San Francisco (California) have banned EPS takeout food containers [12]. In 2008, Hawaii joined the states of New York and California in considering a statewide ban on EPS takeout food containers [13].

As awareness about the long-term effects of EPS and resulting EPS food container bans increase, there is a need to find cost-effective substitutes. This is particularly pertinent in the state of Hawaii. According to the Economic Census of the US Census Bureau, Hawaiian citizens consume the highest amount of takeout food per capita than any other state in the US [14]. In addition, the landfills of Hawaii are at or near capacity [15], with the overflow of waste presenting such a problem that city officials have even considered the short-term and expensive avenue of shipping trash outside of Hawaii [16]. Landfill capacity is equally a concern in other small island states, such as Taiwan, Japan, and the United Kingdom [4].

There are a number of plant-based alternative substitute materials to produce food containers such as paper, as well as other biodegradable agricultural resources such as sugarcane or corn. However, EPS is currently more cost effective than its alternatives [4], with the average takeout order costing an additional $0.15 - $0.20 USD to be packaged with biodegradable EPS alternative products [17]. Recognizing this, when a ban was proposed in Hawaii, the State Health Department testified that the practical impacts of substituting EPS based food containers with other materials relating to the food industry and consumers needed further examination [18].

However, there have been no published studies to date on consumer preferences and economic trade-offs among EPS alternative takeout food containers. Although, studies show that concern for the environment has become a key issue for the packaging and container industry, with an increasing number of consumers seeking ecologically minded and biodegradable products [19-23]. Therefore, a study on consumer preference for substitute food container materials would be helpful to the food and container industry and decision makers worldwide.

The purpose of this study is to determine consumer preference for more environmentally friendly plant-based EPS alternative takeout food containers in the city of Honolulu, and their willingness to pay for substitute materials and trade-offs among important food container attributes. Exploring consumer preference and willingness to pay (WTP) for more environmentally friendly food containers in Honolulu could be useful for policy makers and the container industry, particularly in Hawaii and similar small island states, as well as in other coastal and urban areas.

If, in fact, consumers prefer alternatives to EPS and are willing to pay for EPS substitutes, businesses and the takeout food container industry may be able to minimize the potentially adverse effects of an EPS ban and begin producing and offering more preferred environmentally friendly options. Moreover, an increased amount of compostable and biodegradable containers substituted for EPS containers could lessen the environmental impact of packaging, decrease dependence on foreign oil, and shrink landfill requirements [4].

The specific objectives of this study are as follows: 1) determine the public's preferences for takeout food containers made with alternative plant-based materials; 2) explore different plant-based food container market segments using latent class analysis; 3) calculate the willingness to pay (WTP) for plant-based alternative food containers and the preferred food container attributes; 4) provide market and industry implications for food container producers, policy makers, and other decision makers.

2. Methodology

2.1. Research Design

In order to investigate consumer preference and WTP for plant-based alternative takeout food containers and their attributes, a survey questionnaire was designed. The questionnaire consists of three parts: 1) information on preferences and habits related to takeout food consumption; 2) socio-economic profile of respondents; and 3) preference for alternative plant-based takeout food container attributes. For the first part of the survey, five general questions were asked: a) the frequency of takeout food consumption; b) the frequency of takeout food container use; c) the frequency of recycling or composting; d) the respondent's decision to recycle or compost their

takeout food container if provided with that option; e) the respondents support for a local ban on EPS takeout food containers. These questions were asked in order to explore the respondent's general attitude toward recycling, composting, and the use EPS takeout food containers to determine the impact of the willingness to substitute EPS containers with alternative materials. In order to effectively communicate the purpose of the study to the respondents, EPS was referred to as 'Styrofoam®' on the questionnaire [2].

The second part of the survey questionnaire collected socio-demographic information of respondents, while the third part utilized Conjoint Choice Experiment (CCE) to produce efficient survey takeout food container profiles that were presented to respondents to state their takeout food container choice. CCE, originally developed by Louviere and Woodworth [24], is an indirect method for studying hypothetical markets and product preferences that has been used in a number of environmental studies in recent years for valuing non-market assets [22,25-28]. CCE is based on the idea that any good can be described in terms of its product attributes, or characteristics, and the levels that these attributes take [29]. For example, takeout food containers have product attributes such as the type of material used to produce them, along with other functional food container attributes such as whether it is water resistant or microwaveable, etc. Using CCE, these attributes can be combined into different takeout food container profiles for respondents to choose from. Respondents are then given a choice set comprised of a number of tasks. Each task contains a number of profiles comprised of varying combinations of the product attributes, and respondents are asked to choose which product profile they most prefer from each task.

One of the greatest advantages of CCE is that it imitates real world decision making by forcing the respondent to make tradeoffs between product attributes [30]. Preferences for estimated part-worth utilities, or perceived benefits, for each attribute can then be estimated based on the profiles chosen by the respondent [28].

This study follows the stages of CCE design summarized by Chan-Halbrendt *et al*. [30], where the attributes are selected and the attribute levels assigned, followed by the construction of choice sets, data collection, and finally, data analysis. The selected attributes were based on current market options for EPS alternatives and extensive literature review of similar case studies in U.S. cities and institutions for important functional food container characteristics [8,31-33]. A summary of the selected attributes and their levels is shown in **Table 1**.

Product Attributes and their Levels for this study:

1) Type of Material. The purpose of this study is to determine consumer preference for takeout food containers made from more environmentally friendly materials than EPS. Therefore, type of material was selected as one of the attributes. Currently, plant based materials such as sugarcane and corn are being used as substitutes for EPS by companies marketing more environmentally friendly foodware products, including takeout food containers [17,34]. Paper is another alternative, which has been found to be preferred by some consumers over plastics [35]. As a result, sugarcane, corn, and paper were selected as the best choices for the materials to be used in this study. Thus, paper, corn and sugarcane made up the three levels of the 'type of material' attribute in the CCE.

Table 1. EPS alternative takeout food container attributes and levels.

Attributes	Levels			
Type of Material	Paper	Corn	Sugarcane	
Microwaveable	Yes	No		
Water Resistant	Yes	No		
Locally Produced	Yes	No		
Price per Container	\$0.10	\$0.20	\$0.30	\$0.40

2) Microwaveable. EPS food containers have been reported to leach toxic chemicals into foods under the action of microwaves [36] and are therefore not microwavable. However, being microwaveable is a commonly marketed characteristic of food containers made from EPS alternatives [37-39]. Furthermore, having a microwaveable food container may be important to consumers ordering hot takeout food that may cool before they are able to consume it. Thus, microwaveable was chosen as an attribute. This attribute consisted of only two levels: yes or no, meaning the container in question was either microwaveable or not.

3) Water Resistant. Though there are no previous publications specifically on consumer preference for takeout food container attributes, studies on packaging and containers show that functionality characteristics are important for consumers [28]. Having a water resistant container is an important basic functional characteristic of food containers that may hold any sort of liquid or sauce, and water resistance is a highly advertised attribute of food containers currently on the market [37-39]. Therefore, water resistant was included as an attribute in this study, with two levels: yes or no, meaning the container was either water resistant or not.

4) Locally Produced. Due to the extreme isolation of Hawaii and the high reliance on imported products, locally produced was included as an attribute in order to investigate its importance to consumers. This attribute consisted of two levels: yes or no, indicating that the product was either locally produced or not.

5) Price. Product cost is known to be a key economic factor for consumer choice [27], therefore, price was included as an attribute. The levels for price were determined by reviewing the cost of currently produced EPS food container alternatives, where it was determined that \$0.10 - \$0.40 USD per container was a reasonable range for more environmentally friendly alternatives. Thus, there were 4 levels for the cost attribute: \$0.10, \$0.20, \$0.30, and \$0.40.

Previous studies have shown that age, gender, and education level can all be important factors affecting consumer preference for more environmentally friendly packaging [21]. To explore how these socio-economic factors might affect consumer choices for EPS food container alternatives, and how well the study population matches the population of Honolulu (75% of the population), this data was also collected from respondents.

2.2. Statistical Design and Analysis

When administering a CCE experiment, respondents are asked to choose from different profiles of goods made up of each attribute and one of its differing levels. In this study there are five attributes. The type of material attribute has three levels, while price has four. The remaining attributes have only two levels. Therefore, a complete factorial design including all possible combinations of attributes and levels would use 96 (3*2*2*2*4) profiles, which is commonly accepted as being too overwhelming for respondents to evaluate and formulate decisions from. Thus, a fractional factorial design using a sample of attribute levels from the complete factorial design was used to reduce the profile number using Sawtooth Software SSI web version 6.0. The method utilized by the software is the orthogonal array most commonly used in conjoint analysis, which develops highly fractional designs by selecting profiles that balance the independent influences of all the attribute effects [27,40].

Orthogonal array designs are known to be statistically efficient [41] and allow researchers to collect data on a large amount of profiles using a relatively small number of profile scenarios, thus ensuring the effects of the attributes on the respondent's preferences can still be effectively tested [30]. In total, Sawtooth Software generated 7 choice set versions of the survey, each version consisting of 12 tasks, each task containing 3 different profiles. An example of a task in a choice set is given in **Table 2.**

Surveys were randomly administered to Honolulu residents at various locations in the spring of 2011. An effort was made to ensure all suburbs or districts within the city were represented. Specifically, data was collected from west Honolulu, east Honolulu, downtown and in the central city center Waikiki at shopping centers and parks. Shopping centers were chosen because 1) they often contain food courts where people may be ordering takeout food, thus relating to the study, and 2) they are a central place where people of various backgrounds tend to gather naturally, thus enabling us to survey a demographically diverse sample of the city's population. Parks are also a common place that various individuals gather, and were chosen in an attempt to broaden the study to those who may not eat out often or frequent shopping centers.

Table 2. Example of a choice set.

Attributes	Choice A	Choice B	Choice C
Type of Material	Sugarcane	Paper	Corn
Microwaveable	No	No	Yes
Water Resistant	No	Yes	Yes
Locally Produced	No	Yes	Yes
Price per Container	\$0.20	\$0.40	\$0.30

The sample consisted of 244 respondents, which was determined to be sufficient for the number of attributes and levels utilized in this study according to Johnson and Orme's [42] formula for sample size for CCE.

Socioeconomic demographics of the sample are presented and compared to the census data and the State of Hawaii's population estimate for Honolulu in **Table 3**, which show that our sample is fairly representative of Honolulu's population. In general, gender matched well with the census data. The survey respondents were slightly younger, with 19% of our respondents in the 18 - 25 age group, and 45% in the 26 - 40 age group, compared to the actual 10% and 21%, respectively, of Honolulu's population falling in these age groups. This discrepancy is not much of a concern for our topic, since younger age groups dine out more frequently [43] and are therefore more likely to use takeout containers. The comparison also shows that the respondents were somewhat more educated than Honolulu's population, with 45% holding an associate or bachelor's degree, and 25% holding a graduate degree, compared to the 31.1% and 13.1%, respectively, that make up Honolulu's population. However, the U.S. census data for educational attainment is only given for those in Honolulu's population that are above 25 years of age. This study also included the 18 - 25 age group, which may explain this discrepancy. Furthermore, this issue has had legislation introduced locally in the past, so the impact of the possibly skewed education level may not be of much concern since the topic is familiar to the general public.

The basic assumption of the Conjoint Choice Model, which is used in this study, is that when respondents are presented with different product profiles in the choice sets, they will choose the product profile, either choice A,

Table 3. Socio-demographic comparison of the survey respondents and Honolulu's population.

	Description	Honolulu Population[1]	Survey Respondents
Gender	Male	50.6	53.0
	Female	49.4	47.0
Age[2]*	18 - 25	13.8	19.0
	26 - 40	25.0	45.0
	41 - 60	35.6	25.0
	over 60	25.6	11.0
Educational Attainment**	Some High School	5.3	1.0
	High School	28.3	11.0
	Some College	21.0	18.0
	Associate or Bachelor's Degree	30.0	45.0
	Graduate Degree	10.4	25.0

*Percentage estimated by controlling for the exclusion of the under-18 age group to allow comparison to 100% of the sample; ** Educational attainment for Honolulu's population is presented for the above 25 age group only.

B, or C in our case, that generates the highest utility. The individual's utility function can be presented as follows:

$$U_{in} = U\left(A_{in}\right) \quad (1)$$

where, U_{in}, utility of the individual *n* from the profile *i* can be considered as a function of the attributes A. Assuming that the utility function can be divided into two parts, one deterministic observable part, $V\left(A_{in}\right)$, and one random and unobservable part, $\varepsilon\left(A_{in}\right)$, Equation (1) can be rewritten as follows:

$$U_{in} = V\left(A_{in}\right) + \varepsilon\left(A_{in}\right) \quad (2)$$

As previously discussed, the respondent was assumed to choose the profile that gives them the highest utility, so the respondent's choice of profile *i* rather than profile *j* can be written:

$$P\left(i|C\right) = P\left(\left(U_{in}\right) > \left(U_{jn}\right),\ all\ \ j \in C\right) \quad (3)$$

where *C* is all the profiles in the choice set. Using equation (2), $\left(U_{in}\right) > \left(U_{jn}\right)$ can be rewritten as:
$V\left(A_{in}\right) + \varepsilon\left(A_{in}\right) > V\left(A_{jn}\right) + \varepsilon\left(A_{jn}\right)$, and therefore:
$\varepsilon\left(A_{jn}\right) - \varepsilon\left(A_{in}\right) < V\left(A_{in}\right) - V\left(A_{jn}\right)$.

It follows that equation (3) can be rewritten as:

$$P\left(i|C\right) = P\left(\varepsilon\left(A_{jn}\right) - \varepsilon\left(A_{in}\right) < V\left(A_{in}\right) - V\left(A_{jn}\right), all\ \ j \in C\right) \quad (4)$$

A basic assumption is that the random term ε follows the Gumbel distribution [44] $F\left(e < t\right) = \exp\left(\exp\left(-t\right)\right)$, where *F* is the function, *e* is the error term and *t* can be any number. If A_{in} is a linear function of different attributes, Equation (4) can be specified as:

$$P\left(i|C\right) = \frac{\exp\left(\beta L_{in}\right)}{\sum_{j \in C} \exp\left(\beta L_{jn}\right)} \quad (5)$$

where, β is the parameter to be estimated and the L_{ni} is the levels of the attributes. The simple version of equation (5) showing only the basic relationship between the respondent's choice and the attributes can be stated as:

$$P = f\left(M, MI, W, L, PR\right) \quad (6)$$

where *M* is the type of material, *MI* is microwavable, *W* is water resistant, *L* is locally produced, and *PR* is price per container.

Latent Class Analysis (LCA) is a model-based probabilistic clustering approach that considers the heterogeneity of respondents and allows them to be grouped into separate classes based on their observable attributes of choice [45]. Equation (7), provided by Magidson [45], shows the probability of respondents in class *t* choosing choice *j*:

$$P_{j.t} = \exp\left(V_{j,t}\right) \Big/ \sum_{k \in A'} \exp\left(V_{j.t}\right) \quad (7)$$

where the whole population is divided into T classes, and $t = 1, 2, \cdots, T$.

3. Results

Results for the first part of our survey regarding takeout food container consumption and attitudes about EPS takeout food containers showed that 99% of the respondents surveyed eat out and use takeout food containers regularly. 97% of the respondents surveyed would recycle or compost their food container if provided with that

[1]U.S. Census Bureau, 2005-2009 American Community Survey 5-Year Estimates, Honolulu, Hawaii, 2010.
[2]State of Hawaii, Department of Business, Economic Development & Tourism: 2009 Civilian Population Estimate, 2011.

option. Significantly, 81% of survey respondents stated that they are in support of a ban on EPS takeout food containers in the city of Honolulu.

Latent Gold Choice TM, Version 4.0 software was used to analyze the conjoint choice data. The first step in Latent Class Analysis is to determine the number of classes for the model. This is commonly done using Bayesian Information Criterion (BIC) [45], where the model with the lowest BIC value is chosen as the best fit model. In this case the 4-class model was chosen due to its BIC value. The estimated parameters for the 4-class model are shown in **Table 4**.

Class 1 has 37.71% of the survey respondents. This group shows a significant positive preference toward paper and sugarcane materials as opposed to corn for their takeout containers. They also show significant preferences toward microwavable and water resistant containers. A lower price was also significantly preferred.

Class 2 has 29.39% of the respondents and the majority of parameters are statistically significant. Respondents in class 2 show a significant positive preference toward sugarcane as the type of material for alternative takeout containers and a negative preference toward paper. They also show a significant positive preference toward the containers being microwavable, water resistant, locally produced; and a negative preference toward price. Demographics for respondents in class 2 revealed that this class significantly represented a younger age group.

Class 3 has 21.85% of respondents. This class significantly prefers microwavable, water resistant, locally produced takeout containers as well as a lower price. This class shows no significant preference for container materials. Demographics for respondents in class 3 showed that they have a higher education level.

Class 4, which has 11.06% of the survey respondents, significantly prefers a water resistant takeout container and a lower price.

All the respondents show negative preferences concerning the price of takeout food containers, which is consistent with economic theory. Water resistant containers are also preferred by all four classes, indicating that all respondents consider water resistance as a basic function of takeout food containers.

Microwavable, on the other hand, is significantly preferred by class 1, class 2 and class 3 (88.94% of total respondents), indicating that a large proportion of the respondents would want to microwave their takeout food containers. Within this sub study population, respondents in class 2 and class 3 (51.23% of respondents) show a significant preference toward locally produced containers.

The type of material used to produce takeout food containers was statistically significant for classes 1 and 2, both showing strong preferences toward sugarcane and paper.

Next, the relative importance of each attribute is cal-

Table 4. Estimated parameters of the 4-class model.

	Class 1	Class 2	Class 3	Class 4
Class Size	37.71%	29.39%	21.85%	11.06%
Material				
Corn	–0.359***	–0.1143	–0.158	0.0045
Paper	0.1206***	–0.356***	0.0156	–0.1913
Sugarcane	0.2385***	0.4703***	0.1425	0.1868
Microwaveable				
No	–0.1067***	–0.2578***	–1.6067***	–0.1776
Yes	0.1067***	0.2578***	1.6067***	0.1776
Water Resistant				
No	–0.2952***	–0.3763***	–0.6759***	–0.4561***
Yes	0.2952***	0.3763***	0.6759***	0.4561***
Locally produced				
No	–0.0539	–1.5773***	–0.4719***	0.0239
Yes	0.0539	1.5773***	0.4719***	–0.0239
Price per Container	–1.9649***	–8.6078***	–8.3414***	–23.8403***
Age	0.2424	–0.4427***	–0.148	0.3483
Education	–0.0083	–0.0516	0.308**	–0.2481

Note: *** significant at 0.01 level, ** significant at 0.05 level.

culated to measure how important each attribute is to each class [46] using the following formula:

$$RI_i = 100 \times \frac{UR_i}{\sum_{i=1}^{n} UR_i} \quad (8)$$

where RI_i is the relative importance for attribute i, and UR_i is the range of utility change when attribute levels change.

Table 5 reports the relative importance of the attributes within the four different latent classes. The most important attribute varies for each class. For class 1 it is the type of the material (28.47%), followed by water resistant (28.13%) and price per container (28.09%). Class 2 places the most importance on locally produced containers (40.28%), followed by price per container (32.97%). The takeout food container attribute most important to class 3 is microwaveable (38.66%), followed by price per container (30.11%). Class 4 choose price per container (80.86%) as the most important attribute.

Willingness to pay (WTP) was also calculated, which shows the maximum amount respondents in each class are willing to pay to switch from one attribute level of the good to another. Using methods consistent with those described in Orme [47], we determined WTP using the following equation:

$$CS = -\frac{1}{\beta m}\left(V^1 - V^0\right) \quad (9)$$

where, βm is the parameter estimate of price, V^0 is the initial utility, and V^1 is the desired utility. Results showed respondents in class 1, who consider type of material and water resistant as the most important attributes, are willing to pay \$0.30 to switch from non-water resistant to water resistant and \$0.24 and \$0.06 from corn to paper and from corn to sugarcane takeout food containers, respectively. Respondents in class 2 place locally produced as the most important attribute, and they are willing to pay \$0.37 to switch from a non-locally produced product to a locally produced product. Class 3 considers microwavable as the most important attribute, and they are willing to pay \$0.39 per container to switch from a non-microwavable container to a microwavable one. Respondents in class 4 were primarily concerned with price, thus their willingness to pay for a level switch is very low. For example, class 4 respondents are willing to pay only \$0.04 for switching from non-microwavable to microwavable. A summary of the WTP for each class is presented in **Table 6**.

Table 5. Estimated relative importance of attributes in percent.

	Class 1	Class 2	Class 3	Class 4
Type of Material	**0.2847**	0.1055	0.0362	0.0427
Microwaveable	0.1017	0.0658	**0.3866**	0.0402
Water Resistant	0.2813	0.0961	0.1626	0.1031
Locally produced	0.0514	**0.4028**	0.1135	0.0054
Price per Container	0.2809	0.3297	0.3011	**0.8086**

Table 6. Willingness to pay for switching from one attribute level to another.

	Class 1	Class 2	Class 3	Class 4
From Corn to Paper	0.2441			
From Corn to Sugarcane	0.0600	0.0960		
From Non-Microwavable to Microwavable	0.1086	0.0599	0.3852	
From Non-Water Resistant to Water Resistant	0.3005	0.0874	0.1621	0.0383
From Non-Locally Produced to Locally Produced		0.3665	0.1131	

4. Discussion

Significantly, our results show that a majority of respondents (81%) support a local ban on EPS takeout food containers in the city of Honolulu. These results suggest that local residents may be ready and willing to pay for alternative products that focus on long-term efforts to increase sustainability and reduce pollution. This is further substantiated by our results that showed nearly every respondent (97%) would recycle or compost their food container if provided with that option.

In general, respondents seem to prefer a takeout container made with a sugarcane material (66.49%) that is microwaveable (88.94%), water resistant (100%), locally produced (51.23%) and price competitive, as their alternative. Furthermore, all classes had a very strong preference for lower prices, which highlights the importance of being price competitive in this industry.

Specifically, classes 1 and 2, which make up the majority of our respondents (66.49%), prefer a sugarcane-based product. Currently there are several sugarcane takeout food containers on the market that are accessible in local restaurants within Honolulu. In fact, the fiber bagasse, a byproduct of sugar production, is commonly referred as the most suitable plant-based EPS substitute, which has the least competitive use impact, is biodegradable and microwavable, and the production process is known to be less harmful than those of the other options. Moreover, in the case of Hawaii, the ban of EPS could present an economic opportunity due to the history of sugarcane production in the state, with sugarcane being an important part of the agricultural sector during last century.

It is unclear if respondents are aware of these advantages. However, class 2 may have made this connection,

as they significantly prefer a locally produced container with a sugarcane material and are willing to pay an additional $0.08 per container made from sugarcane, and an additional $0.37 per container that is locally produced.

The use of paper as a substitute for EPS is disregarded by some who point to a study reporting that the production of EPS uses half as many raw materials, and much less energy than the production of paper [48]. EPS production has also been cited to release 35% fewer chemicals into the environment than the production of paper [49]. However, respondents were not given any information about EPS or the advantages and disadvantages of its alternatives prior to completing the survey and it is possible that this information is not well known. In fact, our results show that class 1, though they ultimately prefer sugarcane takeout food containers, still prefer the use of paper over the use of corn for the type of material attribute. Surprisingly, none of our classes significantly prefer the use of a corn material for their takeout food container, though corn-based containers have been obtainable on the market recently. The use of starch-based materials, such as corn or potato, may be confronted due to the competitive use of the material for food, with opponents concerned over possible price increases of these dietary staples.

As new cities and jurisdictions are faced with environmental legislative proposals such as EPS product bans, consumer choice information such as the data and results provided in this study can assist policy makers in the development of laws that reflect the environmental preferences of the public. Additionally, this information can be used by the producers of takeout food containers when considering substituting new materials to target the market segments that consumers prefer and are willing to pay for.

5. Conclusions

The negative health effects and environmental concerns associated with the use of EPS are currently being widely publicized on a global scale. While EPS bans continue to be discussed and enacted globally, this study provides evidence of support for a similar ban in the city of Honolulu, with 81% of respondents in favor.

As consumers become more aware of their impact on the environment, demand for more sustainable alternatives to EPS single use items is likely to rise. Using CCE and LCA, our results offer crucial market information on the public's preference for plant-based EPS food container alternatives in the city of Honolulu. Furthermore, our results show an additional willingness to pay for more environmentally sustainable options among consumers. This willingness to pay information suggests that businesses would be able to offset any additional cost effects of a local ban on EPS takeout food containers for certain market segments.

Though the preferred food container attributes, for example the type of material, may fluctuate across states and countries, our results have global implications by showing that consumers are generally concerned with the increased use of EPS and are willing to pay for more environmentally friendly materials in the case of takeout food containers. Locally produced materials such as sugarcane and local manufacturing are important to the majority of the respondents. This could be reflective of the current sentiment of local food and job security.

This study provides valuable information for policy makers, farmers, manufacturers and natural resource managers. Through education on the effects of EPS, an increasing number of individuals will value the benefits of more sustainable alternatives greater than the damage costs of discarded EPS takeout food containers, and will be willing to switch to more environmentally friendly materials. Furthermore, this study helps to shed light on how informed consumers are concerning EPS and its alternatives, and can provide insight to policy makers on where to increase consumer information and education. Finally, making a switch to EPS alternatives could have enormous effects on landfill capacity, could reduce oceanic debris, and improve air quality. Even a small decrease in the magnitude of EPS production and waste could help to reduce the global carbon footprint and the increasing rate of environmental degradation.

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CITYPULSE

Containing the containers

By Lawrence Cosentino

Dart hustles to recycle itself after New York City bans plastic foam

Tour the Mason headquarters of Dart Container Co., the world´s largest maker of foam cups and take-out food containers, and you´d think the corporate cup runneth over.

The glassy 110,000-square-foot administration building that opened last fall still smells of new carpet and wood. It houses Dart´s offices, engineering and IT departments, a fitness center and dining complex. Nearby, a new half-millionsquare-foot warehouse is almost finished. Renovations and additions are going on everywhere you look.

"We´ve doubled our size," Michael Westerfield, Dart´s director of recycling programs, declared. "The campus is bursting at the seams."

Dart Container bought its chief competitor, Solo Cup Co., in 2012. The combined colossus has about 15,000 employees and over 40 production, distribution and office complexes in eight countries.

But somebody is poking a pencil into the bottom of the cup.

In January, New York City banned single-use polystyrene containers for food and drinks, despite intense lobbying by Dart. ("Styrofoam," the most common word used for the stuff, is a misnomer. Expanded polystyrene, or EPS, is the correct term. Styrofoam is a different kind of foam, and is trademarked by Dow Chemical. It´s extruded, not expanded, and used mainly for insulation.)

The stakes are high. Nationwide, dozens of other cities, including San Francisco, Seattle, and Washington, D.C., have passed similar bans. No cities in Dart´s home state of Michigan have done so yet.

"This is a political decision," Westerfield said of the New York ban. "To say it´s not recyclable is flat-out wrong. We have not given up on New York."

TRUCKING AIR

For all its globe-spanning reach, Dart Container is a castle made largely of air. Polystyrene, a petroleum-based plastic foam, is ultra-light and insulates like a fluffy down jacket, thanks to the molding process invented by William A. Dart in the late 1950s, just in time for the explosion of take-out food and beverage culture in the United States.

Lightweight polystyrene looked like a gift to humanity back in 1960, when Dart Container was founded. Restaurants, schools, hospitals and diners couldn´t get enough of them. Dart´s first invoice, enshrined on the wall of its new corpo- rate digs, is an order for 50,000 cups from a paper company in Jackson, Miss. Only 2,000 were shipped because Dart couldn´t keep up with demand.

The problem is, the gift never stops giving. After a brief walk-on role in somebody´s lunch or coffee break, every one of the billions of cups and takeout clamshells Dart Container has made since that first order in April 1960 is still around somewhere — in a landfill, most likely, or crumbled to tiny bits and swirling around in a lake or ocean. That coffee cup Richard Dreyfuss crushed to prove his masculinity in the 1975 movie "Jaws" is probably still knocking around off the coast of Martha´s Vineyard.

Like most plastics, polystyrene is a petroleum-based product, making it environmentally problematic from cradle to grave — and beyond the grave.

Matt Fletcher, recycling/composting coordinator of Michigan´s Department of Environmental Quality, put it this way: "It just doesn´t make sense to send valuable resources on a one-way trip to a landfill."

Dart´s Westerfield played down the challenges of recycling polystyrene.

"It´s 95 percent air," Westerfield said breezily. "Other than that, it´s like recycling any other product."

New York didn´t see it that way. Before the January ban, the city commissioned a study from the National Resources Defense Council on the feasibility of recycling polystyrene cups and clamshell containers.

The report concluded that if New York added foam containers to its recycling program, "the City would be moving into more or less uncharted territory," adding that "the economics are not favorable and the markets unreliable."

Air is the main culprit, according to Kerrin O´Brien, director of the Michigan Recycling Coalition, a professional association for public and private recyclers in Michigan.

"Every recycler recognizes that there are real significant challenges in dealing with polystyrene," O´Brien said. "The challenge is that it´s very voluminous material, and the volume is air."

Friedland Industries of Lansing recycles tons of metal, paper and plastics at a sprawling complex in north Lansing, but doesn´t deal in polystyrene and has no plans to do so. "We do not do polystyrene, and that is from a purely economical standpoint," marketing manager Lancour said, citing "the amount of equipment and personnel it takes to segregate, sort, bale, crush, market and ship."

About 15 years ago, Friedland collected a semi truck full of loose polystyrene from state offices to run out to Dart Container.

"The weight of the semi load barely registered on the scales," Lancour said. "It was maybe 500, 600 pounds."

Without special equipment to compress or chemically alter foam, O´Brien said, "you´re basically trucking air."

In another experiment, Friedland collected and baled a load of styrene foam similar to polystyrene from General Motors, but the material cost much more to process than it was worth. Besides the light weight, Lancour said sorting is a big problem. "Plastics do not like each other," Lancour said. "It´s not like metals, where there´s an allowable mix of different melt levels. They have to be marked and sorted carefully."

In theory, all of these problems can be surmounted, but it takes capital. A hydraulic "densifier" can crush foam to a fraction of its size, but they run from $20,000 to $100,000.

Recology is the huge private company that handles municipal waste in San Francisco, where single-use polystyrene containers are banned. Bob Besso, recently retired waste reduction and recycling manager of Recology San Mateo, put the cost of recycling a 40-pound bale of poly- styrene at $35, not including the cost of a densifier. At a revenue of 25 cents a pound, Besso reported, the bale costs $25 more to recycle than it generates in revenue.

Lori Welch, environmental coordinator for Lansing, said there is no plan for curbside recycling of polystyrene in Lansing. Ann Arbor-based ReCommunity, the company that handles Lansing´s recycling, doesn´t accept it.

"Consider using an alternative that´s recyclable," Welch advised.

(Welch said polystyrene and many other materials will be accepted at the city´s biggest recycling event, Recycle-Rama, coming up April 18.)

Welch said Dart hasn´t approached the city with a plan for curbside recycling. The closest of Dart´s 40 polystyrene drop off sites in Michigan is at Dart headquarters in Mason.

"The standby answer is, ´Drive it to Mason. It´s not that far,´" Welch said.

Westerfield said Dart encourages cities to apply for a grant through the Food Service Packaging Institute to include polystyrene in single stream recycling, but Welch hadn´t heard of it.

"I would consider looking at it," Welch said. "But curbside recycling is problematic."

FOAM TO FRAMES

Sensing a tipping point in the polystyrene wars, Dart offered to pay for special equipment to help process New York´s polystyrene waste and teamed up with an Indiana company, Plastic Recycling Inc., or PRI, to build a state-of-the-art recycling facility in Indianapolis.

Great heaps of polystyrene waste are already sorted, washed, compressed and turned into hard pellets at Dart´s Mason complex. A row of drop-off bins outside the recycling facility fill up every day, not only with cups and clamshell containers manufactured by Dart, but also egg cartons, packing foam used for TVs and electronics and other assorted foam.

Dart wants to beef up the operation to a New York scale, using the latest equipment, in Indianapolis.

The New York study acknowledged a "genuine effort" on Dart´s part, but it went on to cite a long list of concerns, large and small. Bits of foam would fall through screen sorters and contaminate glass. Black clamshell containers (Denny´s uses them) might be invisible to the optical sorter. Bales would sit in the warehouse for 20 days or more before "sufficient quantities are available to fill a rail car load."

Most of the plastic recovered at PRI´s Indianapolis facility is clean stuff, including bales of Walmart coat hangers and egg cartons from Publix. Bales of greasy foam from New York, the report suggested, would take up warehouse space and possibly cause a

"significant rodent problem."

Dart contends its new wash systems will improve recovery rates, but the New York study was skeptical. Clamshell containers are so light (5 to 10 grams) that "a relatively small amount of food residual, or oils and fats on the clamshell could mean a yield loss rate on a weight basis of roughly 50 percent of the incoming EPS material."

In sum, the report anticipated a chain of losses, mostly from unusable dirty foam, that would shrivel the recovery rate to only 15 to 17 percent of the estimated 16,000 tons of polystyrene waste generated in New York City.

But the highest hurdle to recycling polystyrene is the uncertain market for the end product.

"It did not make environmental sense to try and separate it out because there´s no place to sell it," Kathryn Garcia, New York´s sanitation commissioner, told The Wall Street Journal.

What can you do with recycled polystyrene foam?

The EPS Industry Alliance, a national organization that touts polystyrene recycling, runs about 200 recycling centers around the country, along with a mail-in recycling program. The Alliance´s Web site states that foam can be "easily be recycled into new foam packaging or durable consumer goods like cameras, coat hangers, CD jewel cases and more."

But even the Industry Alliance doesn´t get its hands dirty with recycling egg cartons, takeout containers and cups: "Food service materials are usually NOT accepted," the site warns.

Friedland´s Lancour compared the overwhelming supply and underwhelming demand for polystyrene to another ubiquitous commodity. "When somebody finds an unending use for old automobile tires, they´ll become a millionaire," Lancour said. "How many playgrounds can you mulch or high school tracks can you build?"

Polystyrene, Lancour said, has an even more lopsided supply and demand curve.

"Your supply of foam is enormous," Lancour said. "That´s why you´re looking at bans."

Westerfield said Dart´s recycling partner, PRI, proved there was enough demand to satisfy "a 100 percent recycling rate for New York City six times over," but New York didn´t buy the claim.

Before the battle of New York, Dart has been concentrating much of its lobbying in California, where 77 cities have banned single-use polystyrene containers, according to Sue Vang, a policy analyst for Californians Against Waste.

"We have conversations with [Dart]," Vang said. With Dart´s help, over 60 cities in California have added polystyrene to their recycling programs, but Vang said the results have been mixed.

"If it´s packaging for TVs or computers, there are less issues, but the issues with food packaging remain," Vang said. "It isn´t easy to recycle, especially if it´s been contaminated with food." Vang said the undeveloped market is the biggest obstacle.

"There are some companies that process it, but very limited in terms of what they´ll do with it," Vang said. "One company uses it to make photo frames and another company in New Jersey does something similar."

Those frames come up a lot when you ask about recycled polystyrene. A Dart promotional video shows a man holding up a "premium picture frame" made of pelletized recycled polystyrene.

In the control room at Dart´s Mason recycling facility, there is a small table with canisters of pellets of recycled foam and samples of products made from the pellets. The most prominent is a photo frame with an award given to Dart Container. Dart

spokeswoman Margo Burrage also showed me a clipboard and handed me a 6-inch ruler I got to keep. Crown molding — pic ture frames in long form — is often cited as another use.

The market problem is obvious wherever you turn. Westerfield suggested that any city interested in getting a polystyrene recycling program going consult the industry´s "home for foam" Web site, but the site only lists three buyers of recycled polystyrene in Michigan: Jacobs Plastics of Adrian, JML Recycling of Grandville and Styrecycle of Highland Park. Under the question "Pays for foam?" all three businesses answered, "No."

FEELING THE PRESSURE

Despite Dart´s push for curbside recycling in California, bans are spreading in that state.

"If Dart can meet acceptable goals for something they advertise is recyclable, then that´s great," Vang said. "But if they can´t — and based on the local experience, we haven´t seen really great numbers — then we think they should be prohibited."

Deference to Dart, a major regional employer, is still the default mode in mid- Michigan.

Kerrin O´Brien, director of the Michigan Recycling Coalition, said it´s good that Dart has been "working to develop local markets for that material" and "make their whole operation more green." (The MRC is a professional association for public and private sector recyclers in Michigan. Cheryl Schmidt, an employee of Dart´s Government Affairs and Environment Department, sits on its board of directors.)

But the New York ban has added some heft to the principle of extended producer responsibility, whereby manufacturers own up to the consequences of their products, from birth to death.

"[Dart] is beginning to — and should — feel the pressure to make sure the product they produce can be appropriately managed at the end of its life," O´Brien said.

O´Brien acknowledged that "it´s going to take some capital" to scale up polystyrene recycling. "Even though Dart is developing that infrastructure, I´m waiting to see real progress on helping recycling programs make that change," she said.

If that doesn´t happen fast enough, she predicted more polystyrene bans "as people absorb the New York decision."

Matt Fletcher, recycling/composting coordinator of Michigan´s Department of Environmental Quality, predicted "reverberations through the industry" from the New York ban.

Fletcher said he knows of no curbside polystyrene collection in Michigan.

"Polystyrene is a challenging material," Fletcher said. "Curbside programs say, ´Heck, no.´"

Dart has about 80 foam recycling dropoff points around the United States, half of them in Michigan. "it´s just a drop in the bucket of the amount of material that´s out there," Fletcher said.

Like O´Brien, Fletcher diplomatically called the situation a "big opportunity" for Dart. Local governments or material recovery facilities shouldn´t have to bear the added cost, Fletcher said.

"It should be on the shoulders of the people that produce the product to figure out how to close the loop and get that product into something new, and Dart isn´t sending this stuff on a one-way trip to the landfill," he said.

Fletcher didn´t advocate a ban, but he is following the polystyrene wars carefully.

"Some places are saying, ´Dart, you can either have a voluntary way of managing this material or we´re going to come up with a

mandatory way for you to manage it,´" he said.

I asked Fletcher what outcome he´d like to see in five or 10 years.

"Convenient access to recycling for every resident and business," he said. "We´re a long, long, long way from that."

Among the Lansing-area citizens who shleps her polystyrene waste to Mason is Anne Woiwode, director of the Sierra Club´s Michigan chapter. Like Fletcher and O´Brien, Woiwode cast the polystyrene problem as an opportunity for Dart — at first. "If [recycling] is something they want to show their actual commitment on, doing it in their home town, and advocating it in their home state, seems like the least they should be doing," she said.

But she´s not holding her breath.

"Dart has done a fine job of making money doing what they´ve done," Woiwode said. "But there are a lot of industries that have disappeared because they´re no longer the right thing to do. This is one that I suspect should fit that bill at some point."

NEWS FROM THE NATIONAL ACADEMIES

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INSTITUTE OF MEDICINE
NATIONAL RESEARCH COUNCIL

Styrene Reasonably Anticipated to Be a Human Carcinogen, New Report Confirms

A new report from the National Research Council has upheld the listing of styrene as "reasonably anticipated to be a human carcinogen" in the National Toxicology Program's 12th Report on Carcinogens (RoC). The committee that wrote the report found that the listing is supported by "limited but credible" evidence of carcinogenicity in human studies, "sufficient" evidence from animal studies, and "convincing relevant information" in mechanistic studies that observed DNA damage in human cells that had been exposed to styrene. The committee reached the same conclusion after conducting both a peer review of the RoC and an independent assessment of the styrene literature.

The NTP is an interagency program that produces the RoC. Styrene is a substance of interest for the RoC because many people in the United States are exposed. It is an oily, colorless to yellow liquid and it is found in many consumer products such as plastic packaging, food containers, and household goods. Sources of environmental exposure include cigarette smoke and vehicle exhaust. Occupational exposure can occur during the industrial processing of styrene.

Based on RoC listing criteria, a substance can be classified as reasonably anticipated to be a human carcinogen based on sufficient evidence in animals or limited evidence in human studies. In its peer review of the 12th RoC, the committee examined the primary literature cited in the document as well as other research published before June 10, 2011, and found that the RoC identified the most important studies and described the limitations and strengths of each, and that the arguments supported listing styrene as reasonably anticipated to be a human carcinogen.

In its independent assessment, the committee considered additional research published through Nov. 13, 2013. It found that "compelling evidence" exists in human, animal, and mechanistic studies to support listing styrene, at a minimum, as reasonably anticipated to be a human carcinogen.

The committee noted, however, that there was ambiguity with respect to weighing the mechanistic evidence when applying the listing criteria, and that a strong argument could be made to support the listing of styrene as a known human carcinogen if data derived from the study of human tissues or cells alone were considered sufficient. Further clarification and expanded guidance by the National Toxicology Program regarding the types and strength of mechanistic evidence and how it is used in the context of the RoC listing criteria is needed, the report says.

DETAILS:
Review of the Styrene Assessment in the National Toxicology Program 12th Report on Carcinogens is available for immediate release at http://www.nap.edu/catalog.php?record_id=18725. Media inquiries should be directed to the Office of News and Public Information; tel. 202-334-2138 or e-mail news@nas.edu.

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Monday, Mar 7th 2016 4PM 57°F 7PM 57°F 5-Day Forecast

The 25ft-high tidal wave of rubbish that highlights just why plastic shopping bags and Styrofoam food containers are banned in Manila from today

- **The move comes as part of escalating efforts across the nation's capital to curb rubbish blamed for deadly flooding**
- **Makati City's Plastic Monitoring Task Force were out on the streets looking for vendors ignoring the new rules**

By Jill Reilly

Published: 09:58 EST, 20 June 2013 | Updated: 01:45 EST, 21 June 2013

The Philippines financial capital has banned disposable plastic shopping bags and Styrofoam food containers from today.

The move comes as part of escalating efforts across the nation's capital to curb rubbish blamed for deadly flooding.

Just hours after the ban was introduced, members of Makati City's Plastic Monitoring Task Force were out on the streets looking for vendors that were ignoring the new rules.

A 25ft-high tidal wave of rubbish: The Philippines financial capital banned disposable plastic shopping bags and styrofoam food containers as part of escalating efforts across the nation's capital to curb rubbish that exacerbates deadly flooding

IEM - 5

IEM Committee

From: Katherine Ciccarelli <kaciccarelli@gmail.com>
Sent: Friday, November 25, 2016 7:26 PM
To: IEM Committee
Subject: Polystyrene Testimony

Aloha,

I am a 2nd and 3rd grade teacher at Kihei Charter School. I learned from Robert Parsons that the bill for regulated polystyrene will be discussed at the next meeting on November 28th. Unfortunately, my students are at school at this time as am I so we cannot speak in person. However, I did want to tell you what my students have been doing in efforts to regulate polystyrene. Students learned about decomposing rates, what happens to waste, and what recycling and composting can do to benefit our community. Then, my students chose projects they wanted to work on in small groups to help their school reduce waste and help the environment. A small group of my 3rd grade students at Kihei Charter have been working to reduce the styrofoam at our school by giving speeches to the other elementary classrooms about why it is bad, creating posters to put on display, and sending an online book about styrofoam to the administrators because the 4th and 5th grade students have styrofoam lunch trays and they want to stop the use of those trays and instead use renewable, recyclable, or compostable resources. They chose this topic and how they wanted to approach it so it was something they truly cared about changing. Hopefully it will be more regulated in our county soon.

Mahalo,
Katherine Ciccarelli
Kihei Charter 2nd and 3rd Grade Teacher

IEM Committee

From: TSB <sixtytwocents@gmail.com>
Sent: Friday, November 25, 2016 7:49 PM
To: IEM Committee
Subject: Written Testimony pertaining to POLYSTYRENE DISPOSABLE FOOD SERVICE CONTAINERS (IEM-05)

My name is Feather Blangiardo and I have a Bachelor's degree in Environmental Studies from Wellesley College.

Considering the wide array of sea life surrounding the islands of Maui, Molokai and Lanai, restricting the use of expanded polystyrene foam is a no-brainer. This material is not only physically hazardous for marine life to ingest, but chemically toxic as well. And considering that we are a part of this food web too, I think we can all agree that we don't want to be ingesting this plastic either.

Expanded polystyrene products are extremely light-weight, just like plastic bags. This causes expanded polystyrene products to fly out of garbage receptacles, oftentimes right next to the beach. Accordingly, it's so clear that we need to restrict the use of EPS products as much as possible, just like hundreds of cities and counties have done across the nation.

The journey towards ecological sustainability is going to be a long one. And that's why we need to implement as many regulations as we can, as fast as we can, to protect our fragile environment, especially if these regulations are not going to put anyone out of business.

The price difference in switching to eco-friendly, non-toxic containers is going to be nominal, (between a few pennies to 15 cents per container) and this cost will be a pass-through cost which customers will gladly pay.

I personally use pulp-based containers every time I go to Down to Earth in Kahului, even for hot, greasy food, and have no problems with the containers leaking. Down to Earth also uses large, thick paper cups for their soups, so the argument that non-EPS containers "don't hold up" for hot foods is simply not true. I'm so tired of hearing that blatantly false argument.

I truly look forward to the passing of this important environmental bill for the environment's sake and because then we can get working on other important environmental bills. As the human population continues to grow, we need to work harder than ever to lessen our ecological footprint, and policy changes are the most effective way to do just that.

IEM Committee

From: chinchester@gmail.com
Sent: Friday, November 25, 2016 10:27 PM
To: IEM Committee
Subject: Styrofoam Bill

Please outlaw all styrofoam products.

Styrofoam is not accepted at recycling facilities, so they end up in our landfill; releasing toxins into the environment as the sun heats them up.

Thank you,
Joyce Chin

IEM-5

IEM Committee

From: Kahi Pacarro <kahi@sustainablecoastlineshawaii.org>
Sent: Sunday, November 27, 2016 11:10 AM
To: IEM Committee
Subject: EPS Ban

After working with a coalition of community groups and community members on Maui, we have seen first hand the detriments of EPS foam during our large scale coastal cleanups. From an environmental and a health standpoint, the elimination of EPS use in Maui County will have long lasting positive effects that could ripple statewide. We encourage Maui County to lead by example once again as we aim to push this effort to eliminate EPS use statewide.
Aloha,
K

Kahi Pacarro

Executive Director

kahi@sustainablecoastlineshawaii.org

808.221.7678

www.sustainablecoastlineshawaii.org

sustainable coastlines Hawaii

You can find us on Facebook and Instagram @sustainablecoastlineshawaii.

IEM-5

IEM Committee

From: y u r i <yurichop@gmail.com>
Sent: Sunday, November 27, 2016 3:11 PM
To: IEM Committee
Cc: Robert Parsons
Subject: Testimony in support of IEM-05 for hearing on 11/28

Dear Respected Council Members,

I am in support of IEM-05, prohibiting the use of disposable polystyrene (plastic foam) food service containers. Please pass this very important measure.

More than 100 municipalities across the country have banned the use of polystyrene takeout containers, citing health and environmental concerns. I understand the plastic foam companies lobby against this ban. I am sorry to hurt their business. However plastic foam is unnecessary, potentially harmful to our health, and wasteful, so please ban it now.

I would like to address the points raised by the Chamber of Commerce:

1. That some businesses still need polystyrene containers because the recyclable containers simply do not hold up for hot plate lunches that are heavy and for food items with a lot of liquids like sauce or soup,

This is simply untrue. There are many compostable options that 'hold up' for hot plate lunches that are heavy and for food items with a lot of liquids like sauce or soup. On Maui there are at least three vendors, VIP Maui, Sustainable Island Products, and Hansen Maui, that carry reliable compostable options. There are also online vendors such as WorldCentric, Be Green Packaging, and Eco Products.

2. That despite this, many restaurants are already moving towards these recyclable containers on their own as they can, that use of the recyclable containers is already on the rise and that many are participating in the Ocean Friendly Restaurants Hawaii Initiative which is a positive driving force so we are questioning whether this is even needed,

I am pleased to see Ocean Friendly Restaurants get recognition as a positive driving force. But this is a bit of a joke. Ocean Friendly Restaurants is a campaign just starting out, run by a handful of volunteers, currently celebrating restaurants that have already stopped using plastic foam. This does not address the restaurant owners who continue to carry plastic foam. I would LOVE if all the restaurants that use plastic foam were making the switch to compostable containers on their own. But there is a lack of awareness among many restaurant owners. I have had feedback from restaurant owners who carry plastic foam that they aren't aware there is any problem.

3. The primary importance that we found is that the biggest culprit is litter when it comes to marine animals and not just polystyrene and that we on the polystyrene task force as well as many other groups, offered to create a litter control campaign which the County has not yet taken us up on.

Litter is only one part of the problem with polystyrene. The creation of polystyrene containers is actually the most toxic part. One suggestion may be that the Maui Visitors Bureau, which receives around $4M annually in a County grant, should have a proviso that $50-$75K of their grant goes to litter awareness, education and clean up.

We have environmentally better options for our restaurants and an obligation to our visitors, Ocean and ama to make more earth friendly choices.

We can and must do better for our Islands--please pass this very important measure!!

Mahalo for your consideration,

Yuri Cardenas

IEM-5

IEM Committee

From: Shannon Davidson <photowooh@icloud.com>
Sent: Sunday, November 27, 2016 3:36 PM
To: IEM Committee
Subject: Styrofoam free

Aloha Respected Council Members,

I'm in support of IEM-05, prohibiting the use of disposable polystyrene food service containers.

We have environmentally better options for our restaurants and an obligation to our visitors, Ocean and ama to make more earth friendly choices.

We can and must do better for our Islands--please pass this very important measure!!

Mahalo for your consideration,
Shannon Davidson

Sent from my iPhone

IEM Committee

From: Stuart Coleman <scoleman@surfrider.org>
Sent: Sunday, November 27, 2016 4:54 PM
To: IEM Committee
Subject: Strong Support for Bill to Reduce Polystyrene (IEM-5)
Attachments: SF-Maui-FoamBan-Testimony-Nov.29,'16.pdf

Nov. 27, 2016

RE: Strong Support for Bill Relating to Reduction of Polystyrene Disposable Food Containers (IEM-5)

Maui County Hearing on Mon., Nov. 28, 1:30pm.

Dear Council Members,

As the Hawaii Manager of the Surfrider Foundation, I am writing in strong support of IEM-5, the bill to regulate and reduce the use of polystyrene food containers. With thousands of Surfrider members in Hawaii, we are committed to reducing the litter and environmental hazards of single-use plastics as part of our popular Rise Above Plastics campaign.

Polystyrene food products are one of the most littered items in our Islands, and Maui is no exception. Our Hawaii Chapters support this bill because of the health and environmental threats that affect all of us in Hawaii. Expanded polystyrene (EPS) foam containers are the most toxic and least recycled form of plastic, yet Hawaii has the highest per capita use in the country.

The foam industry opponents will say it's recyclable, but less than 1% is ever recycled. They will also say that it's a "litter problem," but the plastics industry has been using this tactic and blaming the public for decades without producing products that are not recyclable. An EPS foam ban was implemented in San Francisco, and there was a 30% decrease in EPS litter within one year (San Francisco Street Litter Re-Audit, 2008). Over 100 cities and counties across the country have enacted EPS foam bans. For an extensive list see: http://www.surfrider.org/pages/polystyrene-ordinances.

The plastic industry will also say that banning polystyrene food containers will hurt small businesses, but there are many restaurants that have dropped these products and are doing just fine. In fact, the new Ocean Friendly Restaurants Hawaii program has certified almost 100 restaurants that are foam-free just in the last seven months!

During our monthly beach cleanups around the state, EPS foam products are among the top items we find every time. In fact, as part of International Coastal Cleanup Day last year, 17,383 cups, plates and pieces of EPS foam were removed from Hawaii's beaches in a single day on Sat., Sept. 19th, 2015! That's why we need this bill, which would help reduce these litter problems and environmental issues by requiring restaurants and food service vendors to stop using toxic EPS foam containers.

We embrace a policy of "1, 2, C," meaning products should be recyclable #1 & #2 plastics or compostable, which is in line with the County's Zero-Waste Policy. There are many compostable or non-toxic plastic alternatives that can be recycled. This bill provides vendors and restaurants enough time to use their remaining inventory and transition to safer products, which hundreds of restaurants have already done without any problems. Although foam products may be cheaper to buy, they have a hidden cost that counties and citizens have to pay to clean them up.

Although the FDA approved EPS foam products in 1958, the science since then has shown that these are toxic products. Here are some top reasons why EPS foam food service products are dangerous and wasteful:

1. EPS foam is a toxic form of plastic made from non-renewable fossil fuels and synthetic chemicals like styrene that leach out over time, especially in contact with hot, greasy or acidic food.

2. According to the National Institutes of Health (NIH), styrene is a dangerous carcinogen and neurotoxin that can lead to cancer, lymphoma and leukemia. The EPA says 100% of humans have styrene in their fat tissues.

3. Because EPS foam food service products are more than 90% air, they break apart easily and are often blown onto our coastal areas and out to sea, where they are listed as one of the top 5 items collected at beach cleanups.

4. EPS foam never biodegrades but only breaks into smaller micro-plastics. These pieces act like sponges for toxic chemicals in the ocean and are consumed by marine creatures who mistake them for food. More than 180 marine species are known to eat plastics, including endangered species like sea turtles and albatross.

5. Hawaii has the highest per capita rate of take-out food in the country, and many food containers are made of EPS foam products whose toxic chemicals threaten the health of humans and the environment.

6. Most of these products are hauled to our overflowing landfills where they never degrade but begin to leach toxic chemicals like styrene, a known carcinogen.

Along with the facts above, there have been many scientific studies showing the harmful effects of polystyrene foam. That is why we don't want to delay taking action to reduce foam use and litter. In 2008, the Hawaii Senate passed SR78 SD1 to create a voluntary compliance program to switch from foam products to healthier alternatives, but nothing was ever done to move this forward. And in 2014, the Honolulu City Council passed Resolution 14-175, to study the effects of foam and other single-use products, but the study was never done.

The amount of testimony in both resolutions was overwhelmingly in favor of bills to reduce polystyrene food containers. But those legislative bodies seemed to have been swayed by the exaggerated claims of lobbyists for local foam producers and distributors. The irony is that these same companies already carry and distribute more eco-friendly recyclable and compostable products because they see the writing on the wall against foam litter. Scientific research and public sentiment have created a compelling case against their foam products, and more than 100 cities and counties have already enacted successful foam bans.

We appreciate that this County Council has been an environmental leader in the state in moving forward policies like the bills to ban plastic bans and create smoke-free parks & beaches, and we ask you to assert that same leadership on this issue. Because Polystyrene food service products are toxic to the environment and human health, their use should be reduced and eventually banned. There are many available and affordable alternatives that are non-toxic, biodegradable and pose no threats to the environment or human health and will cost the counties less to clean up.

Protecting our land and people should be our top priority, not allowing a few companies to profit from outmoded products that harm the environment and our wildlife. Mahalo for your time and leadership on this issue and please feel free to contact me if you have any questions.

Sincerely,

Stuart Coleman

--
Stuart H. Coleman | Hawaiian Islands Manager | Surfrider Foundation
808-381-6220 | scoleman@surfrider.org

SURFRIDER FOUNDATION

Nov. 27, 2016

RE: Strong Support for Bill Relating to Reduction of Polystyrene Disposable Food Containers (IEM-5)

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Dear Council Members,

As the Hawaii Manager of the Surfrider Foundation, I am writing in strong support of IEM-5, the bill to regulate and reduce the use of polystyrene food containers. With thousands of Surfrider members in Hawaii, we are committed to reducing the litter and environmental hazards of single-use plastics as part of our popular Rise Above Plastics campaign.

Polystyrene food products are one of the most littered items in our Islands, and Maui is no exception. Our Hawaii Chapters support this bill because of the health and environmental threats that affect all of us in Hawaii. Expanded polystyrene (EPS) foam containers are the most toxic and least recycled form of plastic, yet Hawaii has the highest per capita use in the country.

The foam industry opponents will say it's recyclable, but less than 1% is ever recycled. They will also say that it's a "litter problem," but the plastics industry has been using this tactic and blaming the public for decades without producing products that are not recyclable. An EPS foam ban was implemented in San Francisco, and there was a 30% decrease in EPS litter within one year (San Francisco Street Litter Re-Audit, 2008). Over 100 cities and counties across the country have enacted EPS foam bans. For an extensive list see: http://www.surfrider.org/pages/polystyrene-ordinances.

They will also say that banning polystyrene food containers will hurt small businesses, but there are many restaurants that have dropped these products and are doing just fine. In fact, the new Ocean Friendly Restaurants Hawaii program has certified almost 100 restaurants that are foam-free just in the last seven months!

During our monthly beach cleanups around the state, EPS foam products are among the top items we find every time. In fact, as part of International Coastal Cleanup Day last year, 17,383 cups, plates and pieces of EPS foam were removed from Hawaii's beaches in a single day on Sat., Sept. 19th, 2015! That's why we need this bill, which would help reduce these litter problems and environmental issues by requiring restaurants and food service vendors to stop using toxic EPS foam containers.

We embrace a policy of "1, 2, C," meaning products should be recyclable #1 & #2 plastics or compostable, which is in line with the County's Zero-Waste Policy. There are many compostable or non-toxic plastic alternatives that can be recycled. This bill provides vendors and restaurants enough time to use their remaining inventory and transition to safer products, which hundreds of restaurants have already done without any problems. Although foam products may be cheaper to buy, they have a hidden cost that counties and citizens have to pay to clean them up.

Although the FDA approved EPS foam products in 1958, the science since then has shown that these are toxic products. Here are some top reasons why EPS foam food service products are dangerous and wasteful:

1. EPS foam is a toxic form of plastic made from non-renewable fossil fuels and synthetic chemicals like styrene that leach out over time, especially in contact with hot, greasy or acidic food.

Surfrider Foundation Hawaii Chapters * 2927 Hibiscus Pl. * Honolulu, HI 96815
808-381-6220 * scoleman@surfrider.org * www.surfrider.org

SURFRIDER FOUNDATION

2. According to the National Institutes of Health (NIH), styrene is a dangerous carcinogen and neurotoxin that can lead to cancer, lymphoma and leukemia. The EPA says 100% of humans have styrene in their fat tissues.
3. Because EPS foam food service products are more than 90% air, they break apart easily and are often blown onto our coastal areas and out to sea, where they are listed as one of the top 5 items collected at beach cleanups.
4. EPS foam never biodegrades but only breaks into smaller micro-plastics. These pieces act like sponges for toxic chemicals in the ocean and are consumed by marine creatures who mistake them for food. More than 180 marine species are known to eat plastics, including endangered species like sea turtles and albatross.
5. Hawaii has the highest per capita rate of take-out food in the country, and many food containers are made of EPS foam products whose toxic chemicals threaten the health of humans and the environment.
6. Most of these products are hauled to our overflowing landfills where they never degrade but begin to leach toxic chemicals like styrene, a known carcinogen.

Along with the facts above, there have been many scientific studies showing the harmful effects of polystyrene foam. That is why we don't want to delay taking action to reduce foam use and litter. In 2008, the Hawaii Senate passed SR78 SD1 to create a voluntary compliance program to switch from foam products to healthier alternatives, but nothing was ever done to move this forward. And in 2014, the Honolulu City Council passed Resolution 14-175, to study the effects of foam and other single-use products, but the study was never done.

The amount of testimony in both resolutions was overwhelmingly in favor of bills to reduce polystyrene food containers. But those legislative bodies seemed to have been swayed by the exaggerated claims of lobbyists for local foam producers and distributors. The irony is that these same companies already carry and distribute more eco-friendly recyclable and compostable products because they see the writing on the wall against foam litter. Scientific research and public sentiment have created a compelling case against their foam products, and more than 100 cities and counties have already enacted successful foam bans.

We appreciate that this County Council has been an environmental leader in the state in moving forward policies like the bills to ban plastic bans and create smoke-free parks & beaches, and we ask you to assert that same leadership on this issue. Because Polystyrene food service products are toxic to the environment and human health, their use should be reduced and eventually banned. There are many available and affordable alternatives that are non-toxic, biodegradable and pose no threats to the environment or human health and will cost the counties less to clean up.

Protecting our land and people should be our top priority, not allowing a few companies to profit from outmoded products that harm the environment and our wildlife. Mahalo for your time and leadership on this issue and please feel free to contact me if you have any questions.

Sincerely,

Stuart Coleman

Stuart H. Coleman, Hawaii Manager

Surfrider Foundation Hawaii Chapters * 2927 Hibiscus Pl. * Honolulu, HI 96815
808-381-6220 * scoleman@surfrider.org * www.surfrider.org

IEM Committee

From: Vickie Conmy <vconmy@aol.com>
Sent: Sunday, November 27, 2016 5:13 PM
To: IEM Committee
Subject: IEM-05

Aloha Respected Council Members,

I'm in support of IEM-05, prohibiting the use of disposable polystyrene food service containers.

We have environmentally better options for our restaurants and an obligation to our visitors, Ocean and ama to make more earth friendly choices.

We can and must do better for our Islands--please pass this very important measure!!

Mahalo for your consideration,

Vickie Conmy

Sent from my iPad

IEM-5

IEM Committee

From: Carl Berg <cberg@pixi.com>
Sent: Sunday, November 27, 2016 7:33 PM
To: IEM Committee
Cc: robert.parsons@co.maui.hi.us
Subject: Maui Foam Bill

Aloha,

I am strongly in favor of the ordinance for a ban on polystyrene food service containers. The use of polystyrene is unhealthy for people eating food in those containers and extremely unhealthy as it breaks down in the marine environment. Small particles of polystyrene and other plastics are ingested by coral polyps, tiny plankton and up the food chain. It kills marine life by both filling the gut, allowing no room for food, and by leaching toxic chemicals. Litter control is manifestly ineffective. The only solution is to stop polystyrene from being used in the first place. Many other cities and areas have already enacted bans.
It is unlikely that our State government cares enough about each island to inact a ban. It is the community on each island to protect themselves and their environment.
Please pass the bill.

Mahalo,

Carl J. Berg, Ph.D. marine ecology

IEM-5

IEM Committee

From: Sarah <sarahrafferty@gmail.com>
Sent: Sunday, November 27, 2016 8:02 PM
To: IEM Committee
Subject: Testimony: IEM-5 Polystyrene Reduction

November 27th, 2016

Re: Strong Support for Bill to Reduce Polystyrene Food Containers

To the Maui County Council Members:

I am sharing with you several important reasons why I support a reduction in the distribution of EPS foam and why I believe you should do the same.

1) Use of EPS is unnecessary.
There are many alternative products and materials that businesses can easily use in place of polystyrene. They are able to seal, hold liquid, and insulate hot food without leaching toxins into it. Despite false claims, these materials are not cost-prohibitive for businesses to supply and use- I know because I use them. No pragmatic business plan will collapse from a cost-of-goods adjustment measured in pennies.

In other areas of the country that depend heavily on their natural coastal resources, EPS has been banned for as long as 26 years. Managing the disbursement of this toxic product is not groundbreaking - it is long overdue.

2) Waste management and marine-debris control are necessary.
This archipelago with a deep cultural history of respect for the land and sea happens to lie in the global cradle of marine debris. A massive portion of our local economy (dive operators, snorkel tours, surf instructors, commercial fisherman, aquarists, etc.) depends very heavily on the health and beauty of our oceans and beaches. Whether it is now or it is later, these issues will inevitably need to be addressed head-on by our local government.

3) Our islands are worth it.
We are home to countless species, both endemic and endangered. We have miles and miles of untouched coastline and world-class coral reef. Thousands call Hawaii home and would love for their future generations to do so as well.

"We are responsible for the decisions we make today for a better tomorrow... we all must be mindful of the responsibilities we have as trustees of the land to do everything we can to protect our island home."

Mahalo nui loa for making choices that reflect an investment in the health and future of our islands and community.

Sarah Rafferty
Big Island Divers, Sales & Public Relations Manager
Surfrider Kona Kai Ea, Rise Above Plastics Coordinator
PO Box 4513
Kailua Kona, HI
(207) 939-0835

IEM-5

IEM Committee

From: Faith Chase <mauifaith@gmail.com>
Sent: Sunday, November 27, 2016 8:15 PM
To: IEM Committee
Subject: IEM-05 Styro Ban

Aloha Maui County Council Infrastructure and Environmental Management Committee,

Please vote YES on the IEM-05, the Maui Styrofoam ban because Maui's trash landfills cannot tolerate any more rubbish that does not decompose. Please also support Maui's packaging wholesalers in any way that they may need to help them supply eco-friendly packaging for their customers. Our landfills are at capacity, we have been fined repeatedly for non compliance. Styrofoam is toxic on all levels. Please be the positive change and be proud to lead it.

Mahalo, Faith Chase

IEM-5

IEM Committee

From: Tulsi Greenlee <tulsigreenlee@icloud.com>
Sent: Sunday, November 27, 2016 8:17 PM
To: IEM Committee
Cc: County Clerk
Subject: IEM-05

Aloha Maui County Council,
Infrastructure and Environmental Management Committee,

Please vote YES on the IEM-05, the Maui Styrofoam ban because Maui's trash landfills cannot tolerate any rubbish that does not decompose. Please also support Maui's packaging wholesalers in any way that they may need to help them supply eco-friendly packaging for their customers. Our landfills are at capacity, we have been fined repeatedly for non compliance. Styrofoam is toxic on all levels.

Please be the positive change and be proud to lead. Maui needs to be protected.

Thank you for your time and consideration, Tulsi Greenlee Sent from my iPhone

IEM Committee

IEM-5

From: Greg Payton <bighivibe@gmail.com>
Sent: Sunday, November 27, 2016 8:19 PM
To: IEM Committee
Subject: Polystyrene

Aloha Respected Council Members,

I'm in support of IEM-05, prohibiting the use of disposable polystyrene food service containers.

We have environmentally better options for our restaurants and an obligation to our visitors, Ocean and ama to make more earth friendly choices.

We can and must do better for our Islands--please pass this very important measure!!

Mahalo for your consideration.
Greg

#protectwhatyoulove #bethechange #foamfreehi #styrofoamfreekauai #riseaboveplastic

IEM-5

IEM Committee

From: Carey Usher <careyusher@yahoo.com>
Sent: Sunday, November 27, 2016 8:35 PM
To: IEM Committee
Subject: Styrofoam

Aloha Respected Council Members,

I'm in support of IEM-05, prohibiting the use of disposable polystyrene food service containers.

We have environmentally better options for our restaurants and an obligation to our visitors, Ocean and ama to make more earth friendly choices.

We can and must do better for our Islands--please pass this very important measure!!

Mahalo for your consideration,

Carey

IEM-5

IEM Committee

From: sylvia@kolealea.com
Sent: Sunday, November 27, 2016 9:13 PM
To: IEM Committee
Subject: IEM-05

Aloha Maui County Council Infrastructure and Environmental Management Committee,

Please vote YES on the IEM-05, the Maui Styrofoam ban because Maui's trash landfills cannot tolerate any more rubbish that does not decompose. Please also support Maui's packaging wholesalers in any way that they may need to help them supply eco-friendly packaging for their customers. Our landfills are at capacity, we have been fined repeatedly for non compliance. Styrofoam is toxic on all levels. Please be the positive change and be proud to lead it.
Mahalo,

Sylvia Cenzano

IEM-5

IEM Committee

From: Cynthia J. Clark <cynthia@chameleontalent.com>
Sent: Sunday, November 27, 2016 9:24 PM
To: IEM Committee
Subject: Voting YES on the IEM-05

Aloha Maui County Council Infrastructure and Environmental Management Committee,
Please vote YES on the IEM-05, the Maui Styrofoam ban because Maui's trash landfills cannot tolerate any more rubbish that does not decompose. Please also support Maui's packaging wholesalers in any way that they may need to help them supply eco-friendly packaging for their customers. Our landfills are at capacity, we have been fined repeatedly for non compliance. Styrofoam is toxic on all levels. Please be the positive change and be proud to lead it.
Mahalo,
Cynthia Clark
P.O. Box 959
Kihei, HI 96753

IEM-5

IEM Committee

From: Jennifer Milholen <milholen.jennifer@gmail.com>
Sent: Sunday, November 27, 2016 10:27 PM
To: IEM Committee
Subject: RE: Strong Support for Bill Relating to Reduction of Polystyrene Disposable Food Containers (IEM-5)

Maui County Hearing on Mon., Nov. 28, 1:30pm.

Dear Council Members,

As the President of Styrophobia, I am writing in strong support of IEM-5, the bill to regulate and reduce the use of polystyrene food containers. We are committed to reducing the litter and environmental hazards of single-use plastics as part of our popular Rise Above Plastics campaign. Polystyrene food products are one of the most littered items in our Islands, and Maui is no exception.

Styrophobia supports this bill because of the health and environmental threats that affect all of us in Hawaii. Expanded polystyrene (EPS) foam containers are the most toxic and least recycled form of plastic, yet Hawaii has the highest per capita use in the country.

The foam industry opponents will say it's recyclable, but less than 1% is ever recycled. They will also say that it's a "litter problem," but the plastics industry has been using this tactic and blaming the public for decades without producing products that are not recyclable. An EPS foam ban was implemented in San Francisco, and there was a 30% decrease in EPS litter within one year (San Francisco Street Litter Re-Audit, 2008). Over 100 cities and counties across the country have enacted EPS foam bans. For an extensive list see: http://www.surfrider.org/pages/polystyrene-ordinances.

The plastic industry will also say that banning polystyrene food containers will hurt small businesses, but there are many restaurants that have dropped these products and are doing just fine. In fact, the new Ocean Friendly Restaurants Hawaii program has certified almost 100 restaurants that are foam-free just in the last seven months! In addition, California has studied the economic impacts of their foam bans and found NO NEGATIVE IMPACT TO BUSINESSES.

During monthly beach cleanups around the state, EPS foam products are among the top items we find every time. In fact, as part of International Coastal Cleanup Day last year, 17,383 cups, plates and pieces of EPS foam were removed from Hawaii's beaches in a single day on Sat., Sept. 19th, 2015! That's why we need this bill, which would help reduce these litter problems and environmental issues by requiring restaurants and food service vendors to stop using toxic EPS foam containers.

We embrace a policy of "1, 2, C," meaning products should be recyclable #1 & #2 plastics or compostable, which is in line with the County's Zero-Waste Policy. There are many compostable or non-toxic plastic alternatives that can be recycled. This bill provides vendors and restaurants enough time to use their remaining inventory and transition to safer products, which hundreds of restaurants have already done without any problems. Although foam products may be cheaper to buy, they have a hidden cost that counties and citizens have to pay to clean them up.

Along with the facts above, there have been many scientific studies showing the harmful effects of polystyrene foam. That is why we don't want to delay taking action to reduce foam use and litter. In 2008, the Hawaii Senate passed SR78 SD1 to create a voluntary compliance program to switch from foam products to healthier alternatives, but nothing was ever done to move this forward. And in 2014, the Honolulu City Council passed Resolution 14-175, to study the effects of foam and other single-use products, but the study was never done.

The amount of testimony in both resolutions was overwhelmingly in favor of bills to reduce polystyrene food containers. But those legislative bodies seemed to have been swayed by the exaggerated claims of lobbyists for local foam producers and distributors. The irony is that these same companies already carry and distribute more eco-friendly recyclable and compostable products because they see the writing on the wall against foam litter. Scientific research and public sentiment have created a compelling case against their foam products, and more than 100 cities and counties have already enacted successful foam bans.

We appreciate that this County Council has been an environmental leader in the state in moving forward policies like the bills to ban plastic bans and create smoke-free parks & beaches, and we ask you to assert that same leadership on this issue. Because Polystyrene food service products are toxic to the environment and human health, their use should be reduced and eventually banned. There are many available and affordable alternatives that are non-toxic, biodegradable and pose no threats to the environment or human health and will cost the counties less to clean up.

Protecting our land and people should be our top priority, not allowing a few companies to profit from outmoded products that harm the environment and our wildlife. Mahalo for your time and leadership on this issue and please feel free to contact me if you have any questions.

Sincerely,

Jennifer Milholen

Styrophobia

IEM-5

IEM Committee

From: Shay Chan Hodges <shay.chanhodges@gmail.com>
Sent: Sunday, November 27, 2016 10:48 PM
To: IEM Committee
Subject: Maui Styrofoam Ban

Aloha Maui County Council Infrastructure and Environmental Management Committee,

Please vote YES on the IEM-05, the Maui Styrofoam ban because Maui's trash landfills cannot tolerate any more rubbish that does not decompose. Please also support Maui's packaging wholesalers in any way that they may need to help them supply eco-friendly packaging for their customers. Our landfills are at capacity, we have been fined repeatedly for non compliance. Styrofoam is toxic on all levels. Please be the positive change and be proud to lead it.

Mahalo,
Shay Chan Hodges

Author, Lean On and Lead, Mothering and Work in the 21st Century Economy
Catalyst, Family-Centered Design℠ thinking
Twitter: @LeanOnAndLead
Facebook: Lean On and Lead
Download the iBook:

IEM-5

IEM Committee

From: Ashlei Limbaga <ashlei.limbaga@gmail.com>
Sent: Sunday, November 27, 2016 11:26 PM
To: IEM Committee
Subject: IEM-05

Aloha Respected Council Members,

I'm in support of IEM-05, prohibiting the use of disposable polystyrene food service containers.

We have environmentally better options for our restaurants and an obligation to our visitors, Ocean and ama to make more earth friendly choices.

We can and must do better for our Islands--please pass this very important measure!!

Mahalo for your consideration,
Ashlei Limbaga

IEM-5

IEM Committee

From: Rachelle Akoi <rachellekakoi@gmail.com>
Sent: Sunday, November 27, 2016 11:28 PM
To: IEM Committee
Cc: Rachelle Akoi

Aloha Maui County Council Infrastructure and Environmental Management Committee,
Please vote YES on the IEM-05, the Maui Styrofoam ban because Maui's trash landfills cannot tolerate any more rubbish that does not decompose. Please also support Maui's packaging wholesalers in any way that they may need to help them supply eco-friendly packaging for their customers. Our landfills are at capacity, we have been fined repeatedly for non compliance. Styrofoam is toxic on all levels. Please be the positive change and be proud to lead it.

Mahalo,

Rachelle K. Akoi

text_0

Aloha Respected Council Members,

I'm in support of IEM-05, prohibiting the use of disposable polystyrene food service containers.

We have environmentally better options for our restaurants and an obligation to our visitors, Ocean and ama to make more earth friendly choices.

We can and must do better for our Islands--please pass this very important measure!!

We need to do more to join in the interest in climate change. Our wildlife deserves clean water and if we can do one small step at a time our efforts will be seen and won't feel like such huge problems. Let's make a difference together!!!

Mahalo for your consideration,

Virginia Branco
808-756-5090

#protectwhatyoulove #bethechange #foamfreehi #styrofoamfreekauai #riseaboveplastic