Microplastics in Facial Exfoliating Cleansers

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ABSTRACT

Research regarding marine pollution has primarily emphasized macroplastics (>5mm diameter), but is increasingly focusing on the impacts of microplastics (<5mm) on the marine environment. In my study, I observed microplastic beads found in nine facial exfoliating cleansers that listed polyethylene as an ingredient. Three brands of nationally top-grossing facial cleansers available in American supermarkets (Clean & Clear, L'Oreal, Neutrogena) were used to characterize size, color, and mass of the polyethylene beads. The beads ranged from 60-800 μm in diameter, with a 264 μm overall mean, 102 standard deviation and a (254-274) 95% confidence interval. To determine consumer use habits for these products, I surveyed a population of 175 individuals over a period of three months via an online survey. I discovered that, though 35% of my sample population used the microplastic-containing cleansers, 50% used alternatives that did not include microplastics. Of those that did use microplastic-containing products, I used their usage rates and frequencies to calculate annual microplastic contribution to the wastewater stream. I found that Clean & Clear Daily Pore Cleanser contributed most microplastic to the waste stream per consumer per year (with 2.68g) while Neutrogena Oil-free Acne Wash Pink Grapefruit, contributed the least (0.539g/year). After modeling my survey results onto the UC Berkeley student residential hall population, I estimated that a total of 5000 g of microplastic was going into the waste stream annually. Knowing about microplastic pollution in the environment and choosing natural alternatives can divert microplastic from the waste stream and mitigate potential environmental risk.

KEYWORDS

polyethylene, market reports, consumer usage, wastewater stream, marine pollution

INTRODUCTION

Marine debris is any persistent, manufactured or processed solid material discarded, disposed of or abandoned in the marine and coastal environment (Galgani et al. 1996). A large proportion of marine debris consists of plastics sourced from land use, wastewater and industrial treatments, waste disposal, and shipboard dumping (Jeftic et al. 2009, Arthur and Baker 2011). Microplastics are generally considered to be plastic particles smaller than 5 millimetres in diameter (Arthur et al. 2009). These particulates are accumulating in habitats and outnumbering larger debris (Thompson et al. 2004, Browne et al. 2010). While studies have confirmed the detrimental effects of macroplastics on marine ecosystems, only recently has research started exploring the impacts of microplastics. The two sources of microplastic are fragments resulting from the degradation of larger items such as bags and containers, and pellets used as feedstock in the plastics industry and in certain applications such as abrasive cleansers (Bowmer and Kershaw 2010).

Abrasive scrub cleansers were developed when people realized that mechanical exfoliation – the process of removing the outermost layer of skin with an abrasive material– produces smoother skin (Decker and Graber 2012, Draelos 2005). Abrasive scrubs incorporate natural and synthetic materials including polyethylene beads, aluminum oxide, ground fruit pits, and sodium tetraborate decahydrate granules to induce various degrees of exfoliation (Mills 1979). According to the American Academy of Dermatology, polyethylene beads are commonly used because their smoothness causes less redness and damage to the skin than some other materials, such as ground fruit pits.

Polyethylene is the most commonly used plastic. Beads made of polyethylene in facial cleansers have been found to be from 4 μm to 1mm in size, which makes them a form of microplastics (Fendall and Sewell 2009, Piringer and Baner 2008). A 2009 study by the University of Auckland in New Zealand revealed that because the majority of facial cleansers now contain polyethylene microplastics, the average person is now likely to use cleansing products with microplastics on a daily basis. Consumers tend to focus on personal health benefits or hazards while purchasing products with less focus on the environmental impacts of their products. Plastic persists in the environment and has a slow degradation rate. If microplastics

from facial cleansers are entering the wastewater stream from consumer usage, whether they are filtered our may be a concern to the marine environment.

Microplastics that escape filtration have the potential to persist in the environment, travel long distances, serve as surface on which organisms grow, and attract organic contaminants (Arthur and Baker 2011). Research has shown that suspension-feeding sea cucumbers along with range of organisms including mussels, barnacles, lugworms, and tiny crustaceans do ingest plastic particles, though it is unknown if plastic ingestion adversely affects their physiology or fitness (Graham et al. 2009). New research also suggests that polyethylene is an excellent transporter of hydrophobic organic contaminants such as phenanthrene, a byproduct of fossil fuel burning that is a dangerous ocean pollutant (Teuten et al. 2007). The potential chemical impacts of the microplastics themselves are still unknown.

To date, no one has detected consumer cleansing product plastic beads in the environment, yet their presence is almost certain due to existing wastewater treatment filtration methods and observed sizes of the plastic beads. Barriers to detection lie mainly in the methodological challenges of quantifying tiny plastic fragments in the environment (Loe 2012, Browne et al. 2010). Thus, there is a need to take steps toward clarifying the risks on the natural environment of using products that contain microplastics. To address these gaps in knowledge, I will attempt to characterize the physical properties of the polyethylene beads, determine how much polyethylene from facial scrubs enters the wastewater stream by surveying consumer use, and explore the ramifications of microplastics going unfiltered into the ocean.

METHODS

Selecting Product Samples

I characterized the leading skincare brands from Mintel Reports (academic.mintel.com), an online database of market reports on the beauty and personal care, drink, food, foodservice, health and wellbeing, household, lifestyles, retailing and apparel, consumer technology, and travel industries. Mintel is an independent, award-winning provider of world-leading market intelligence, delivering robust information, analysis and critical recommendations. I used the brand share information, which provided the annual top grossing brands of facial cleansers and

acne washes in the U.S., to determine from which brands to sample (Appendix A). I selected the three top grossing brands, which were Neutrogena, Clean & Clear, and L'Oreal Paris. To narrow down which products within these brands to sample, I observed the reviews and ratings of various products on Amazon.com. I also consulted the local Walgreens in Berkeley, CA to determine which products were available and accessible to the majority of my survey population. With the assumption that consumers purchased items online that received higher ratings and reviews, and bought items that were available in stores, I decided on 5 Neutrogena, 3 Clean & Clear and 1 L'Oreal Paris cleanser for a total of 9 product samples (Table 1). I selected these particular quantities of products within the three brands to sample according to their relative rankings in Mintel's top-grossing brand share report. All sample products listed polyethylene in their ingredient list.

Table 1. Product information. Selected product brands, names and approximate prices.

Brand	Product	Price (USD)
Clean & Clear	Morning Burst Scrub Oil-free	10
Clean & Clear	Deep Action Exfoliating Scrub Oil-free	6
Clean & Clear	Daily Pore Cleanser	6
L'Oreal	360 Go Clean	5
Neutrogena	Oil-free Acne Wash Daily Scrub	7
Neutrogena	Clear Pore Daily Scrub	6
Neutrogena	Deep Clean Gentle Scrub	6
Neutrogena	Deep Clean Invigorating Foaming Scrub	6
Neutrogena	Oil-free Acne Wash Pink Grapefruit	6

Microplastic Bead Quantification

To characterize the polyethylene beads in the cleansers, I separated beads from 3ml extractions of each product by washing with distilled water and vacuum filtering over coffee filters cut into 9 cm diameter circles. The microplastic beads characteristics I examined were (a) size, (b) color, (c) volume, (d) mass, and (e) concentration in product. I used a dissecting scope at

40X magnification with an ocular micrometer with 1000 marks calibrated to 1 mm to observe the size and colors of the beads. For each brand I measured the diameters in number marks, which I later converted to microns and millimeters, of the first 10 pieces of microplastic I encountered in each extraction, and did five measurement repetitions (Total N = 50 pieces per brand). Using R statistical analysis, I retrieved the mean, median, 95% confidence intervals (CI) and standard deviations (SD) for the bead sizes examined in each extraction. The bead sizes in microns were used for comparison to wastewater filter sizes, and the sizes in millimeters were used to calculate volume of microplastic in each extraction as well as in each entire bottle of product. I made my calculations with the assumption that each bead was a sphere. I used the mass of beads from each extraction along with consumer survey results to determine consumer contribution of microplastic through usage. To determine the concentration of beads in each product, I placed the filtered beads into a 36 cm^2 gridded square petri dish. The petri dish was shaken to distribute the beads. For each product, I chose three 1 cm^2 squares at random, and counted the number of beads that occurred in each square. I averaged the number of beads from the three counts and determined the mean number of beads that occurred in one square. I multiplied the mean by the total number of squares encompassing the petri dish for the number of beads per 3 ml of product. I scaled up the calculations to attain bead count for the whole bottle of each sample product.

Survey for Consumer Use

To obtain customer usage data, I used SurveyMonkey to compile a nine-question online survey (Appendix B), which I distributed through email and various social media including Facebook, Pinterest, Google+, and Twitter. The population consisted of mainly my peers, friends, family, and acquaintances. I surveyed 175 consumers over a span of 3 months. The survey asked participants for their demographics, including age, race and income, which brand of cleanser they used, how much of it they used, how often they used it, and if they knew there were microplastics in facial cleansers. I used the survey results to model onto a larger population with similar demographics in order to estimate consumer microplastic contribution into the wastewater stream.

Modeling Microplastic in Wastewater Stream

To estimate the amount of microplastic entering the East Bay wastewater treatment facility from consumer cleanser usage, I made calculations using the usage survey results and bead size data. In the consumer survey, I asked the frequency with which each consumer used the product, and how much they used during each application. I used photos imbedded in the survey to demonstrate three various amounts to select from (quarter, nickel, and dime-sized). To calculate how much microplastic was in each application amount of every sample product, I divided the mass of microplastic filtered from each 3ml extraction of product by 3, then multiplied by the volume of product that made up the size of each coin. For each survey response, I multiplied the selected usage frequency with its respective usage amount and scaled it up to grams per year for each survey participant's personal contribution of microplastic. I sorted all the responses and totaled them by sample types (A-I) to compare microplastic contribution across the products.

To examine microplastic contribution on a larger scale, I modeled my results onto a population with similar demographics, the UC Berkeley student housing resident population. The student dormitories included Clark Kerr with 900 residents, Foothill with 791 residents, Bowles with 192 residents, Stern with 267 residents, and the Units 1, 2, and 3 with 1434, 1435, and 1240 residents for a total of 6259 residents (housing.berkeley.edu). Using the bootstrapping method in R, I was able to resample from my survey results data by simulating the sample size to 1000 for each product sample to estimate a more accurate usage mean (g/yr) to calculate usage from the entire student housing population. With estimated means for each product, I multiplied the percentages of my surveyed population who used each product by the total resident hall population as well as the means. These calculations gave me microplastic contribution from the resident hall population for a year given the assumption that they used the sampled products at similar rates and frequencies to my survey population.

RESULTS

Characteristics of Microplastic Beads

I observed variations in microplastic bead sizes, yet the means and medians of each product were relatively similar. Microbead sizes ranged from 60-800 μm in diameter, with an

overall mean of 264 microns and standard deviation of 102 microns (Table 2.) Products D, L'Oreal 360 Go Clean and F, Neutrogena Clear Pore Daily Scrub had the smallest beads at 60 microns, while Product E, Neutrogena Oil-free Acne Wash Daily Scrub had the largest at 800 microns. Product F, Neutrogena Clear Pore Daily Scrub had the largest variation in sizes (60-540) with a SD of 130 (Table 2, Figure 1, 2).

The SA/Volume ratios were consistently low (0.02-0.03) and bead mass per 1 ml of product varied little across the products (0.09-1 g). Product F, Neutrogena Clear Pore Daily Scrub contained the most volume of plastic at 149 m^3 per bottle while Product I, Neutrogena Oil-free Acne Wash Pink Grapefruit contained the least at 15.5 m^3 per bottle (Table 3).

Table 2. Microplastic Measurements. Size of microplastic beads in nine facial exfoliating cleansers. *N*=50 beads per product sample: (A) Clean & Clear Morning Burst Scrub Oil-free, (B) Clean & Clear Deep Action Exfoliating Scrub Oil-free, (C) Clean & Clear Daily Pore Cleanser, (D) L'Oreal 360 Go Clean, (E) Neutrogena Oil-free Acne Wash Daily Scrub, (F) Neutrogena Clear Pore Daily Scrub, (G) Neutrogena Deep Clean Gentle Scrub, (H) Neutrogena Deep Clean Invigorating Foaming Scrub, (I) Neutrogena Oil-free Acne Wash Pink Grapefruit

Product	Mean (microns)	SD	Range	Median	95% CI
A	272	89	100-500	240	247-297
B	271	81	120-520	260	248-294
C	183	58	80-400	200	167-200
D	215	98	60-420	200	187-242
E	317	110	200-800	300	285-350
F	265	130	60-540	260	230-301
G	274	120	120-600	250	241-307
H	286	120	100-600	240	256-316
I	293	120	180-600	270	264-322

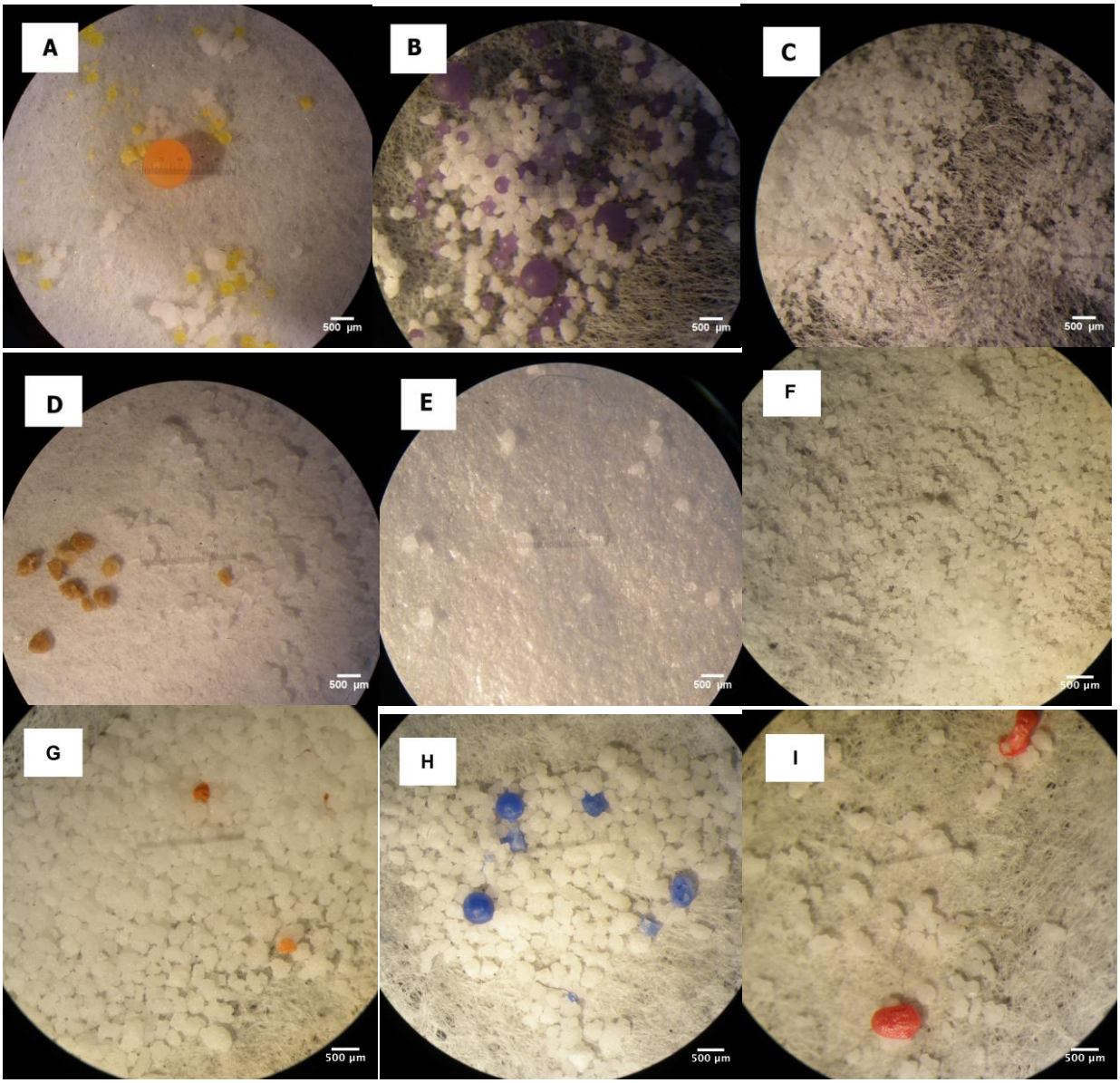

Figure 1. Photomicrographs of the microplastics and colored inclusions in facial cleanser products A-I. Scale bar in all panels 500 µm. All products included white, opaque microplastic beads. Brand D contained walnut husk fragments as additional abrasive material. Other colored material composition unknown.

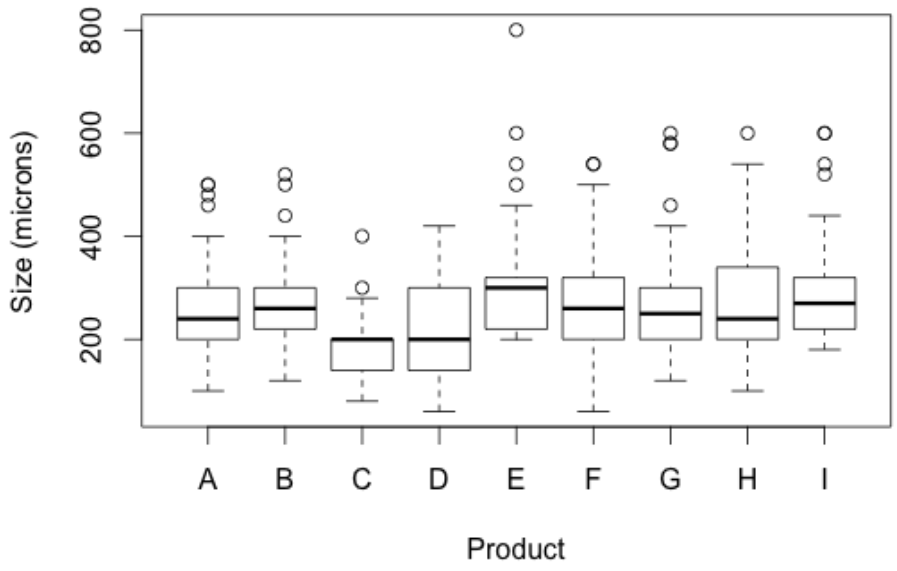

Figure 2. Box plot of bead sizes. Minimal variance between the means.

Table 3. Microplastic Surface Area to Volume Ratio, Concentration, and Mass.

Product	SA/Volume	Bead volume/bottle (m^3)	Bead mass/ 1ml product (g)
A	0.02	34.7	0.09
B	0.02	23.7	0.08
C	0.03	36.3	0.09
D	0.03	101	0.08
E	0.02	43.5	0.08
F	0.02	149	0.1
G	0.02	25	0.09
H	0.02	41.2	0.08
I	0.02	15.5	0.08

Survey results: Consumer Product Usage

I found that 75% of the surveyed consumers use facial scrubs, yet 72% of consumers are not aware that certain cleansers contained plastic (Table 4). Half of the surveyed consumers did not use any of the samples in my study. Of the 35% who did use my sample products, most (9%)

used Product E, Neutrogena Oil-free Acne Wash Daily Scrub, while none used Product D, L'Oreal 360 Go Clean. A trend I saw in the "Other" products used was that 9.7% of the total surveyed consumers used St. Ives Apricot scrub cleanser.

Factoring in consumer usage frequencies and rates from the survey, I discovered that on an average per consumer rate, Product F, Neutrogena Clear Pore Daily Scrub contributed the most microplastic annually at 2.68 g/yr while Product I, Neutrogena Oil-free Acne Wash Pink Grapefruit contributed the least at 0.54 g/yr (Figure 3). Summing up all consumer responses for each product, I found that Product A, Clean & Clear Morning Burst Scrub Oil-free contributed the most microplastic annually at 10.5 g/yr while Product H, Neutrogena Deep Clean Invigorating Foaming Scrub contributed the least at 1.83 g/yr (Figure 4).

I determined that my surveyed population demographics (61% Asian race, 31% earning $0-$24,999/yr, and 69% aged 21-29) were similar to the demographics of the UC Berkeley student housing population (Table 5). Scaling up my survey responses, I calculated the total annual microplastic contribution from the student housing to be 5000 g (Table 6).

Table 4. Survey Responses. N=175 participants.

Question	**Percentage %**
Do you use a facial scrub?	
Yes	75%
No	20%
Product used	
Clean & Clear Morning Burst Scrub Oil-free	6.29%
Clean & Clear Deep Action Exfoliating Scrub Oil-free	4.00%
Clean & Clear Daily Pore Cleanser	1.71%
L'Oreal 360 Go Clean	0.00%
Neutrogena Oil-free Acne Wash Daily Scrub	9.14%
Neutrogena Clear Pore Daily Scrub	1.14%
Neutrogena Deep Clean Gentle Scrub	2.86%
Neutrogena Deep Clean Invigorating Foaming Scrub	1.71%
Neutrogena Oil-free Acne Wash Pink Grapefruit	8.00%
Other	49.7%
NA	15.4%

Are you aware that there are plastics in certain facial scrubs?	
Yes	28%
No	72%

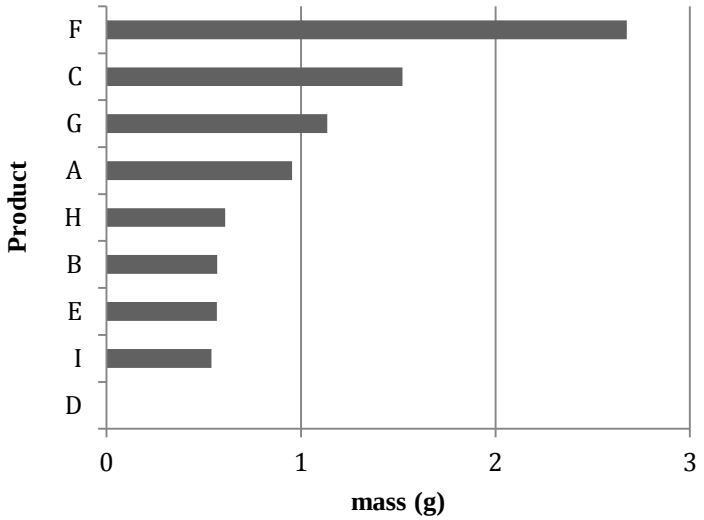

Figure 3. Average annual microplastic contribution per consumer by product. Product F contributes the most microplastic annually per individual consumer use.

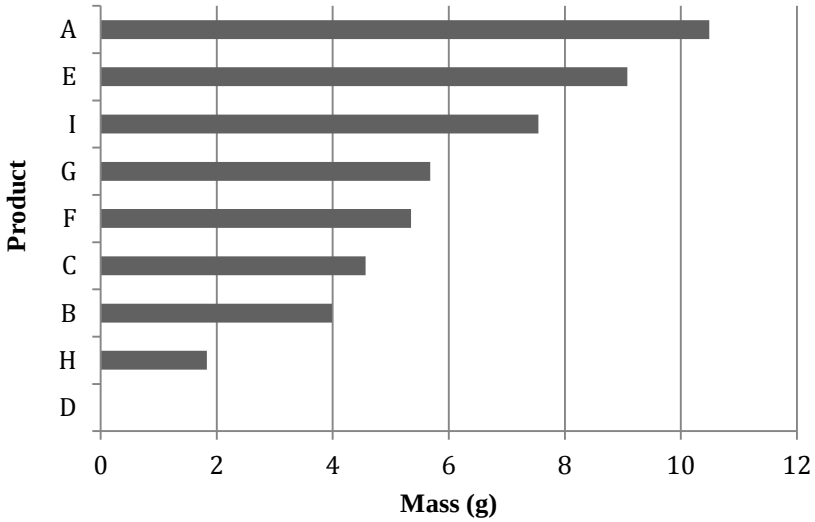

Figure 4. Total Annual Microplastic Contribution by Product. Sum of annual consumer usage according to brand.

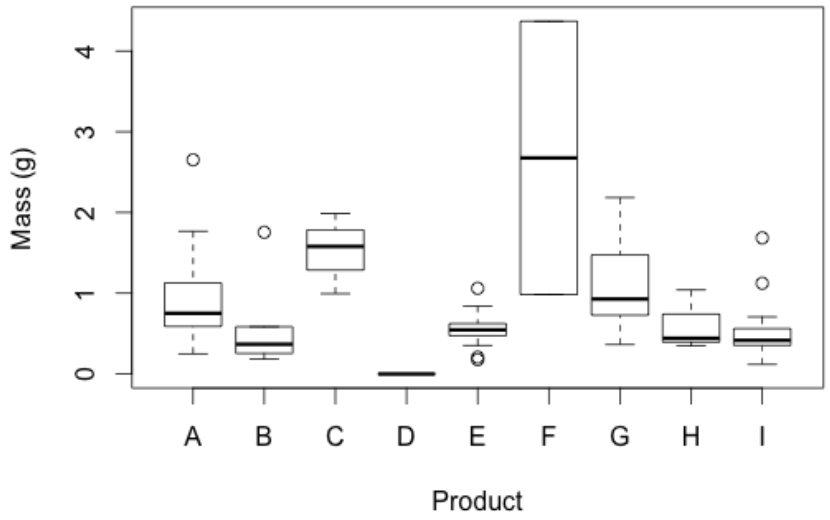

Figure 5. Box plot Annual Consumer usage rates by brand

Table 5. Survey Demographics

Background Variable	**Sample %**	**Background Variable**	**Sample %**
Age		Income	
17 and under	1%	$0-$24,999	31%
18-20	18%	$25,000-$49,999	17%
21-29	69%	$50,000-$74,999	13%
30-39	6%	$75,000-$99,999	7%
40-49	4%	$100,000-$124,999	6%
50-59	2%	$125,000-$149,999	5%
		$150,000-$174,999	6%
Race		$175,000-$199,999	4%
White	22%	$200,000 and up	11%
Asian	61%		
Black or African American	2%		
Native Hawaiian or Other Pacific Islander	3%		
American Indian or Alaska Native	1%		
Other	11%		

Table 6. Modeling survey usage rates on UC Berkeley student residential hall population.
Total population = 6259 residents. Total annual microplastic contribution 5000 g.

Product	Usage rate	Dorm users	Bootstrap mean	Dorm use (g/yr)
A	18.03%	1130	0.95	1070
B	11.48%	718	0.57	412
C	4.92%	308	1.51	465
D	0.00%	0	0	0
E	26.23%	1640	0.57	931
F	3.28%	205	2.66	545
G	8.20%	513	1.14	585
H	4.92%	308	0.61	188
I	22.95%	1440	0.54	783

DISCUSSION

Polyethylene in facial scrubs as a source of microplastic marine pollution is poorly understood. By characterizing the physical properties of microplastic beads found in a sample of products, I found little variation in sizes and colors across brands. This suggests that producers may have a uniform standard. The bead sizes in the products I sampled were all small enough to bypass filtration in certain wastewater treatment facilities. From my survey, I discovered that though my sample population was using the microplastic-containing cleansers, many used alternatives that did not include microplastics. The majority of my survey population did use a facial scrub, but were not aware that it contained plastic particles. Combining microplastic characterization with consumer use and opinion, I gathered from this study new insights into an unexpected source of potential plastic pollution.

Microplastic characterization

The microplastics I found in the facial scrub products had sizes close to the overall mean, signifying that there is minimal variation across brands. Particle size is most likely kept to a roughly standard size because an abrasive on the skin that is too large can be too harsh on the skin, while a one that is miniscule could prove to be ineffective as an abrasive. While measuring the microplastics size, beads often got caught in the syringe I used; thus the volume of

microplastics may have been underestimated. It was also difficult to replicate exact amounts of product in each sample as the products differed in viscosity.

I found that the microplastic beads were all white and opaque in colors, which fall under the color categories of microplastics commonly found in the North Pacific Central Gyre (NPCG). These colors are similar to those of the area's plankton, a primary food source for surface feeding fish (Boerger et al. 2010). In one study, white, opaque spherules were selectively consumed by 8 species of fish out of 14 species examined (Carpenter et al. 1972); thus, there is a high likelihood that cleanser microplastics making it to the ocean could be mistaken for plankton by a number of fish species. Though the exact physiological effects of plastic ingestion still require further study, ingestion of plastics may lead to intestinal blockage in smaller fish and risk of polychlorinated biphenyls absorption. (Derraik 2002) The low surface to volume ratio indicates a slower degradation rate, which is concerning, since polyethylene takes years to break down.

Consumer Survey

I surveyed 175 individuals through an online survey, which yielded results I did not anticipate. Forty-nine point seven percent of surveyed consumers did not use any of the products I chose to sample; instead, these people used alternatives, most of which did not contain microplastics. My survey population was made up of primarily friends and family as my survey was distributed through social media. There could have been bias as my target audience mostly resided in the Bay Area, a community of more environmentally conscious individuals and not quite an accurate portrayal of the nationwide consumer use. (Svoboda et al. 2008)

From those who did use the products I sampled, I modeled product use onto the UC Berkeley student residential hall community nationwide scale and found that 5000 g of microplastic was going into the wastewater stream per year. If consumers switched over to natural alternative cleansers, 5000 g of microplastic - the equivalent of 2500 Ziploc sandwich bags (16.5 cm x 14.9 cm) - could be diverted from the wastewater stream every year.

Of the alternatives listed by my survey respondents, St. Ives Apricot Scrub was the most popular brand used instead of Neutrogena, Lo'real, and Clean & Clear. Instead of microplastic, St. Ives uses crushed walnut husk as an abrasive material. To explore this trend, I asked several

people why they found St. Ives appealing and they specified that the inviting image of the apricot, the packaging, and the price seemed attractive to them.

To gather more insight on consumer buying behavior, I conducted a quick follow-up survey (Appendix C) asking consumers what motivated them towards their purchasing decisions. Using a Likert scale of importance, I found that the majority of consumers considered price as moderately important, product effectiveness as very or extremely important, product packaging as slightly important, and were highly influenced by graphics as well as the bottle shape. Consumers specified that within the graphics, they paid attention to layout of text, text color (particularly bright colors), description of effectiveness, pictures, and creative and visually appealing patterns. They also mostly considered having knowledge of the ingredient list as slightly important and the environmental impacts of the product as moderately important, while all consumers considered their products safe to use. Knowing that there is plastic in the product, most consumers are not at all likely to purchase it, and would very likely stop using a product that they now know contains plastic.

Cosmetic and personal care product packaging has evolved from simple utilitarian containers to commercial works of art that entice the consumer to purchase the contents. Consumers have become more aware of environmental issues and have now become increasingly aware of the negative impact of superfluous packaging, opting for more "eco-friendly" or "green packaging". Not only does the package have to be visually and sensually appealing, but it must also encompass the essence of naturalness, environmental compatibility, and healthfulness (Rosette et. al 2012).

Wastewater Treatment

Knowing the potential amount of microplastic that is entering the wastewater stream, I wanted to know how it would be treated by wastewater facilities. East Bay Municipal Utilities District's (EBMUD) provides water and sewage treatment for customers in portions of Alameda County and Contra Costa County in California, on the eastern side of the San Francisco bay, which are the primary residential areas of my survey population.

A maximum of 2.2 million gallons per day (MGD) of the annual average daily plant flow of 62 MGD can be processed through the EBMUD's East Bayshore Water Recycling Plant,

which includes a microfiltration system in its tertiary treatment process with a filter size of 0.1 microns. The remaining flow receives secondary treatment only and does not undergo filtration prior to discharge to San Francisco Bay. EBMUD allows 96% of its 62 million gallons to go unfiltered every day. Therefore, microplastics are highly likely to bypass filtration and go straight into the wastewater stream; in the Bay Area, most of this wastewater is diverted directly to the ocean (Vincent De Lange, EBMUD Senior Civil Engineer).

A previous study found that the largest recorded abundance and mass of plastic found in the surface layer of the Pacific Ocean was 334,271 pieces/km^2 and 5114 g/km^2 2, respectively. Plankton abundance was approximately five times higher than that of plastic, but the mass of plastic was approximately six times that of plankton. (Moore et al. 2001) Clearly, plastics have been escaping wastewater filtration and going into the ocean.

Future directions

Given the evidence from my current study that a large volume of microplastics may be entering the environment, further studies should be done to quantify these amounts. The most easily accessible places to begin would be with urban beaches to determine if any particulates found are sourced from facial scrubs. These particulates would be analyzed and compared to the beads I found in my study samples according to size and color. A nationwide survey of product use would be helpful to determine the volume of plastic being used by a more diverse demographic. An opinion survey could also be useful to see what motivates consumers to purchase certain brands and if behavior changes can be made if plastic in facial cleansers is made more explicit to consumers.

Broader Implications and Conclusions

My study explored a source of plastic pollution and its journey from consumer to wastewater stream. Now that facial scrubs are recognized as potential sources of microplastics pollution with the risk of ingestion by marine organisms, wastewater facilities should take note and adjust their filtering practices accordingly. Consumers should educate themselves and avoid microplastic-containing cleansers to minimize their contribution to plastic pollution. Plastics

affect marine biota and take a long time to degrade. Perhaps increasing the appeal of alternative organic facial scrubs and alerting people to the damage microplastics can do to the marine environment can be used to shift consumer behavior and usage.

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APPENDIX A: Brand Share Information

Figure 1. Annual top-grossing facial cleansers brands, 2011-12. Data from Mintel Reports.

Company	Brand	Rolling 52 weeks ending February 20, 2011 $million	Rolling 52 weeks ending February 19, 2012 $million
Johnson & Johnson	Total	198	221
	Neutrogena	31	39
	Neutrogena Deep Clean	32	32
	Johnsons Clean & Clear Morning Burst	22	26
	Johnsons Clean & Clear	16	15
	Johnsons Clean & Clear Deep Action	14	15
	Neutrogena Naturals	1	15

Figure 2. Annual top-grossing acne treatment brands, 2011-12

Company	Brand	Rolling 52 weeks ending February 20, 2011 $ million	Rolling 52 weeks ending February 19, 2012 $ million
Johnson & Johnson	Total	196	201
	Neutrogena Oil Free Acne Wash	46	49
	Aveeno Clear Complexion	20	19
	Johnsons Clean & Clear Advantage	16	17
	Neutrogena Acne Stress Control	17	16
	Neutrogena Rapid Clear	14	14
	Neutrogena Clear Pore	10	12

APPENDIX B: Consumer Survey

Figure 1. Online Survey Questions. 9-question survey created with SurveyMonkey and distributed over a period of 3 months to 175 individuals.

Plastics in Facial Scrubs

***1. Do you use a facial scrub?**

Yes

No

***2. Which category below includes your age?**

17 or younger

18-20

21-29

30-39

40-49

50-59

60 or older

3. Which facial scrub do you use?

Clean & Clear Morning Burst Facial Scrub

Clean & Clear Deep Action Exfoliating Scrub

Clean & Clear Daily Pore Cleanser

L'Oreal Paris Go 360* Clean Deep Exfoliating Scrub

Neutrogena Oil-Free Acne wash Daily Scrub

Neutrogena Clear Pore Daily Scrub

Neutrogena Deep Clean Gentle Scrub

Neutrogena Deep Clean Invigorating foaming scrub

Neutrogena Oil-free Acne wash Pink Grapefruit

Other (please specify)

4. How many times a WEEK do you use your product?

1x

2x

3x

5. How many times a DAY do you use your product?

1x

2x

3x

Product use approximate

A

B

C

6. How MUCH product do you use each time? Select from images above

A

B

C

***7. What is your approximate average household income?**

$0-$24,999

$25,000-$49,999

$50,000-$74,999

$75,000-$99,999

$100,000-$124,999

$125,000-$149,999

$150,000-$174,999

$175,000-$199,999

$200,000 and up

***8. What is your race?**

White

Black or African American

Asian

Native Hawaiian or Other Pacific Islander

American Indian or Alaska Native

Other

***9. Are you aware that there are plastics in certain facial scrubs?**

Yes

No

Done

APPENDIX C: Follow-up survey

Figure 1. Follow-up online survey on consumer purchasing behavior.

5/6/13 What do you look for in your exfoliating cleanser? Survey

What do you look for in your exfoliating cleanser?

***1. Which product did you use for the previous survey?**

- Clean & Clear Morning Burst Facial Scrub
- Clean & Clear Deep Action Exfoliating Scrub
- Clean & Clear Daily Pore Cleanser
- L'Oreal Paris Go 360* Clean Deep Exfoliating Scrub
- Neutrogena Oil-Free Acne wash Daily Scrub
- Neutrogena Clear Pore Daily Scrub
- Neutrogena Deep Clean Gentle Scrub
- Neutrogena Deep Clean Invigorating foaming scrub
- Neutrogena Oil-free Acne wash Pink Grapefruit
- Don't remember
- Other (please specify)

***2. How important is price when choosing this type of product?**

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not at all important

***3. How important is product effectiveness when buying a product?**

- Extremely important
- Very important
- Moderately important
- Slightly important
- Not at all important

***4. How important is product packaging (how much does it influence your purchasing decision)?**

- Extremely important
- Very important
- Moderately important
- Slightly important

www.surveymonkey.com/s/2GD72BL 1/3

Not at all important

5. Which aspects of the product packaging influence your purchasing decision?

Graphics

Shape of the bottle

Packaging materials

If graphics, specify if it is picture and/or text. What attracts your attention

***6. How important is knowing the ingredient list when buying your product?**

Extremely important

Very important

Moderately important

Slightly important

Not at all important

***7. In general, I trust that the product I use is safe.**

Yes

No

***8. Importance of environmental impacts associated with your product**

Extremely important

Very important

Moderately important

Slightly important

Not at all important

***9. Would you purchase a product if you knew there was polyethylene (plastic) in it?**

Not at all likely

Slightly likely

Moderately likely

Very likely

Completely likely

***10. Would you stop using a product you now know has polyethylene (plastic) in it?**

Not at all likely

Slightly likely

Moderately likely

Very likely

Completely likely

Done