An Ocean Planet: A Tale of Two Sunscreen Chemicals That Illustrates the Need for A Paradigm Shift in U.S. Law to Protect Ocean Ecosystem Integrity

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The ocean is under assault—physical, biological, and chemical—yet maintaining the functional and structural integrity of ocean and coastal ecosystems is imperative for global resilience in a changing climate. At present, U.S. environmental laws are not designed to value, nor readily capable of protecting, ocean ecosystem integrity. For example, certain chemicals contained in widely used personal care products, including sunscreens and cosmetics, are harmful to marine ecological health. Neither current nor proposed U.S. federal regulatory frameworks adequately regulate endocrine-disrupting chemicals in cosmetics and sunscreens for protection of the coastal marine environment; nor is state or local law capable of addressing this issue comprehensively at scale. This article traces how two endocrine-disrupting chemicals, oxybenzone and octinoxate, evade environmental scrutiny by slipping through gaps in the current U.S. legal framework, and suggests new approaches to the regulation of chemicals in personal care products that cause ecological harm. In conclusion, this article argues for a paradigm shift in environmental law that acknowledges the interconnectedness of ocean health with the health of all species—including humans—and upholds ocean ecosystem integrity as an important policy objective,

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rather than simply a means to a human-centric end.

TABLE OF CONTENTS

INTRODUCTION

"How inappropriate to call this planet Earth, when clearly it is Ocean."[1]

Ours is an ocean planet. Seventy percent of the planet's surface is ocean, and an estimated 50-80% of the oxygen we breathe is produced by oceanic plankton.[2] The ocean is integral to global food security[3] and is a vital and fast-growing component of both the global and American economy.[4] Not only does the ocean drive Earth's climate system,[5] but it has also absorbed more than 90% of the heat retained by the planet in the past fifty years[6] and serves as a crucial carbon sink.[7] Intact coastal ecosystems mitigate the impacts of anthropogenic[8] climate change through carbon sequestration and buffer seaside communities from extreme weather events that are increasing in frequency and severity due to climate change.[9] The ocean is vital to the structural and functional integrity of Earth's biosphere and hydrosphere—and consequently, to our existence.

As it currently faces the dual crises of climate change and biodiversity loss,[10] the ocean's struggle has dire consequences for the resilience of many species—including our own. Resilience of global social-ecological systems in a changing climate is predicated on the ability of ocean ecosystems to survive the barrage of chemical, physical, and biological assaults of climate change.[11] One way to

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[1] JAMES E. LOVELOCK, GAIA: A NEW LOOK AT LIFE ON EARTH 78 (1979) (attributing quote to Arthur C. Clarke).

[2] How Much Oxygen Comes from the Ocean?, Nat'l Ocean Serv., https://oceanservice.noaa.gov/facts/ocean-oxygen.html (Feb. 26, 2021).

[3] *See generally* Christopher Costello et al., *The Future of Food from the Sea*, 588 NATURE 95, (2020).

[4] Sumaila, U.R., Walsh, M., Hoareau, K. *et al*., *Financing a sustainable ocean economy*. NAT COMMUN 12, 3259 (2021), https://doi.org/10.1038/s41467-021-23168-y (stating global ocean economy was estimated at 1.5 trillion U.S. dollars in 2010 and is growing rapidly, with a pre-COVID-19 pandemic projection of reaching 3.0 trillion U.S. dollars by 2030); *How Important is the Ocean to Our Economy?*, NAT'L OCEAN SERV., https://oceanservice.noaa.gov/facts/ oceaneconomy.html (Feb. 26, 2021); NOAA Press Release & Rachel Christopherson, America's Blue Economy Worth Nearly $373 Billion, Middlebury Inst. of Int'l Stud. at Monterey: CBE News (June 2, 2020), https://www.middlebury.edu/institute/academics/centers-initiatives/center-blue-economy/cbe-news/americas-blue-economy-worth-nearly-373.

[5] A.P.M. Baede et al., *The Climate System: An Overview*, *in* CLIMATE CHANGE 2001: THE SCIENTIFIC BASIS 87, 87 (B. Bolin & S. Pollonais eds., 2001).

[6] Laure Zanna et al., *Global Reconstruction of Historical Ocean Heat Storage and Transport*, 116 PROC. NAT'L ACAD. SCIENCES 1126, 1126 (2019).

[7] Nicolas Gruber et al., *The Oceanic Sink for Anthropogenic CO_2 from 1994 to 2007*, 363 SCI. 1193, 1193 (2019).

[8] Anthropogenic means "human-caused." *Anthropogenic*, OXFORD ENGLISH DICTIONARY (3rd ed. 2016).

[9] *See, e.g.*, P. GLICK ET AL., THE PROTECTIVE VALUE OF NATURE: A REVIEW OF THE EFFECTIVENESS OF NATURAL INFRASTRUCTURE FOR HAZARD RISK REDUCTION 1, 14-15 (2020).

[10] *See e.g.* Eric Dinerstein et al., *A Global Deal for Nature: Guiding Principles, Milestones, and Targets*, 5 SCI. ADVANCES, April 2019, at 1.

[11] *See generally* Scott C. Doney et al., *Climate Change Impacts on Marine Ecosystems*, 4 ANN. REV. OF MARINE SCI. 11 (2012) (noting "aggregated effects" of sustained climate change impacts—

optimize the resilience and resistance of marine species to climate change impacts is to reduce, as much as possible, anthropogenic stressors within our control.[12]

Half of the planet's human population lives in the coastal zone.[13] This trend is mirrored in the United States, with just over half of all Americans living in coastal watershed counties.[14] Invariably, persistent chemical compounds used in consumer products within coastal communities—from pesticides and fertilizers to pharmaceuticals and cosmetics—end up in the ocean.[15] Many of these chemicals first enter waterways upstream, contaminating freshwater ecosystems and food webs on their path to the ocean.[16] The introduction of chemical pollutants into coastal waters from wastewater, stormwater, and water-based recreational activities is a major concern.[17]

One class of pollutants that has drawn recent attention is endocrine-disrupting chemicals (EDCs). EDCs are biologically active compounds that interfere with the endocrine system, which regulates the behavior, growth and development, metabolism, and reproduction of animals by secreting hormones.[18] Typically, EDCs act by binding to hormone receptors and either blocking or mimicking hormone effects, or by modifying the production, transport, metabolism, or secretion of hormones.[19] All animals have endocrine systems, although the degree of complexity differs between invertebrates and vertebrates.[20] As of 2014, the Endocrine Society estimated that about 1,000 manufactured chemicals have endocrine-disrupting properties.[21] EDCs are ubiquitous in consumer products,

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including higher temperatures, changes to circulation and stratification, eutrophication, acidification, and hypoxia—may "eventually impact[] the overall ecosystem functioning and services upon which people and societies depend").

[12] *See* Kristy J. Kroeker et al., *Assessing the Potential Role of Marine Protected Areas and Fisheries Management Approaches for Resilience Management in a Changing Ocean*, 32 OCEANOGRAPHY, Sept. 2019, at 117, 120.

[13] GARY GRIGGS, COASTS IN CRISIS: A GLOBAL CHALLENGE xxi (2017).

[14] NAT'L OCEANIC & ATMOSPHERIC ADMIN., NOAA'S STATE OF THE COAST NATIONAL COASTAL POPULATION REPORT: POPULATION TRENDS FROM 1970 TO 2020, 3 (2013).

[15] Jenny Howard, *Marine Pollution, Explained*, NAT'L GEOGRAPHIC (Aug. 2, 2019), https://www.nationalgeographic.com/environment/article/critical-issues-marine-pollution; ELLEN INGRE-KHANS ET AL., STOCKHOLM UNIV., DEPARTMENT OF ENVIRONMENTAL SCIENCE AND ANALYTICAL CHEMISTRY (ACES) REPORT 16: ENDOCRINE DISRUPTING CHEMICALS IN THE MARINE ENVIRONMENT 4 (2017) [hereinafter ACES REPORT].

[16] *See, e.g.*, Erinn K. Richmond et al., *A Diverse Suite of Pharmaceuticals Contaminates Stream and Riparian Food Webs*, 9 NATURE COMM. 1(2018).

[17] NAT'L RESEARCH COUNCIL, MANAGING WASTEWATER IN COASTAL URBAN AREAS 23-26 (1993).

[18] ACES REPORT, *supra* note 15, at 2.

[19] *Id.*

[20] *See generally* Peter L. deFur, *Use and Role of Invertebrate Models in Endocrine Disruptor Research and Testing*, 45 ILAR J. 484 (2004) (discussing the effects of various endocrine-disrupting chemicals on invertebrates).

[21] ANDREA C. GORE ET AL., INTRODUCTION TO ENDOCRINE DISRUPTING CHEMICALS (EDCS): A GUIDE FOR PUBLIC INTEREST ORGANIZATIONS AND POLICY-MAKERS 1 (2014).

from clothing and furniture to personal care products and pharmaceuticals.[22] They often serve as plasticizers, fragrance-carriers, and flame-retardants.[23]

Although the United States has a complex system of environmental laws, the current federal statutory framework is ill-equipped to address the unique challenges of contaminants like EDCs.[24] There are currently no regulatory requirements to systematically screen chemicals for endocrine disrupting effects.[25] Many EDCs cause reproductive toxicity at low levels and exhibit non-linear dose-response curves, defying traditional toxicological models.[26] Their risk profiles differ not only by individual chemicals and species, but also by the developmental stage at which exposure occurs.[27] EDCs are particularly pernicious because they can have transgenerational effects; harm to one generation can be passed to offspring through heritable changes in gene expression.[28] Harm caused by EDCs often manifests after a period of latency, complicating causal identification.[29] Moreover, many EDCs have cumulative and synergistic effects that single-chemical testing does not reveal.[30] Consequently, laboratory studies often underestimate the true harm caused by EDCs as they interact with other chemicals present in the environment.[31]

The only way to effectively prevent ecological harm from EDCs is to keep these chemicals out of commerce—and consequently, out of the environment. Due to their low level, cumulative, and synergistic effects, there are no "safe" thresholds for EDCs.[32] As this article demonstrates, lawmakers *could* apply strategic lessons from the Microbead Free Waters Act of 2015 to eliminate certain EDCs from personal care products manufactured and sold in the United States. However, legal scholars have opined in recent years that it is unlikely Congress will reach the bipartisan consensus necessary to pass significant new environmental legislation.[33] Moreover, given the roughly 2,000 new chemicals synthesized each

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[22] *See generally* C.D. Metcalfe et al., *An Introduction to the Sources, Fate, Occurrence and Effects of Endocrine*
Disrupting Chemicals Released into the Environment, 207 ENV'T RES. May 1, 2022 (discussing the sources, occurrences, and effects of specific classes of EDCs in the environment).

[23] ACES REPORT, *supra* note 15, at 3.

[24] *See* Laura N. Vandenberg et al., *Regulatory Decisions on Endocrine Disrupting Chemicals Should be Based on the Principles of Endocrinology*, 38 REPROD. TOXICOLOGY 1 (2013) (arguing risk assessments and regulation must be based on principles of endocrinology).

[25] ACES REPORT, *supra* note 15.

[26] *Id.* at 3.

[27] *Id.* at 4.

[28] *Id.*

[29] *Id.*

[30] *Id.* at 4, 8.

[31] *Id.* at 8.

[32] *Id.* at 3, 6; *see also* Vandenberg et al., *supra* note 24, at 11 ("EDCs have effects on laboratory animals, wildlife and humans at doses that are considered safe by traditional toxicology testing[.]")

[33] David A. Strifling, *The Microbead-Free Waters Act of 2015: Model for Future Environmental*

year[34] and the tens of thousands already in commerce,[35] sustainable protection of the environment from chemical threats to ecosystem resilience requires systemic change. Sustainable environmental protection requires restoring and protecting ecosystem integrity.[36] Extrapolating this concept to the planetary scale, the ocean must be at the center of any regulatory approach intended to foster Earth's resilience given its fundamental importance in maintaining an intact biosphere.[37]

An examination of how two particular EDCs—oxybenzone and octinoxate—slip through the cracks of the American regulatory regime reveals not only an important gap in the regulation of sunscreens, cosmetics, and other personal care products, but also a deeper, more fundamental flaw in the United States' approach to conceptualizing and regulating environmental risk. American valuation of nature as codified in law and policy references human benefit at every turn.[38] From cost-benefit analyses of ecosystem services to consideration of human health harm from bioaccumulation of toxins, we regulate the environment—and our impacts on it—to protect ourselves, not nature. In this time of climate crisis, we need to reconceptualize environmental risk regulation of chemicals by shifting our focus from human health impacts to the harm these products inflict on nonhuman species and ecosystems. A new paradigm of environmental protection is needed—one that recognizes the interconnectedness of the hydrosphere,[39] acknowledges that humans are just one part of the broader biosphere,[40] and affirms protection of *all* ecosystem components regardless of any perceived

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Legislation, or Black Swan?, 32 J. LAND USE & ENV'T L. 151, 159 (2016) ("Much ink has been spilled lamenting the difficulty of passing new environmental legislation in the modern era."). Not even the existential threat of climate change has increased the likelihood of bridging the bipartisan divide on environmental issues. *See* Zoya Teirstein & Shannon Osaka, *Democrats Flipped the Senate. So Why is a Green New Deal Still Unlikely?*, GRIST (Jan. 15, 2021), https://grist.org/politics/democrats-flipped-the-senate-so-why-is-a-green-new-deal-still-unlikely/.

[34] Mark Scialla, *It Could Take Centuries for EPA to Test All the Unregulated Chemicals Under a New Landmark Bill*, PBS NEWSHOUR: SCIENCE (June 22, 2016), https://www.pbs.org/newshour/science/it-could-take-centuries-for-epa-to-test-all-the-unregulated-chemicals-under-a-new-landmark-bill.

[35] Inst. of Med., *The Challenge: Chemicals in Today's Society*, *in* IDENTIFYING AND REDUCING ENVIRONMENTAL HEALTH RISKS OF CHEMICALS IN OUR SOCIETY: WORKSHOP SUMMARY 5, 8-9 (2014).

[36] *See* Klaus Bosselmann, *Losing the Forest for the Trees: Environmental Reductionism in the Law*, 2 SUSTAINABILITY 2424, 2441 (2010). Ecosystem integrity is defined as the ability of an ecosystem to recover from disturbance and reestablish its stability, diversity, and resilience. *Id.*

[37] Extending the concept of ecosystem integrity to planetary integrity necessarily places the ocean at the center because it is integral to the structure and function of the biosphere and hydrosphere, which, in turn, underpin resilience. *See generally* Doney, *supra* note 11.

[38] *See generally* Zygmunt J.B. Plater, *Human-Centered Environmental Values Versus Nature-Centric Environmental Values—Is this the Question?*, 3 MICH. J. OF ENV'T & ADMIN. L. 273 (2015) (noting "direct human-centered utility" takes precedence in governance).

[39] The hydrosphere is the dynamic mass of water in, on, and above the Earth's surface, including soil moisture and groundwater, surface water, and atmospheric water vapor. EDWARD J. TARBUCK & FREDERICK K. LUTGENS, EARTH SCIENCE 12 (13th ed. 2012).

[40] The biosphere includes all life on Earth and the environments that sustain such life. *Id.* at 13.

benefit to humans.

Part I of this article describes the marine ecological harm caused by oxybenzone and octinoxate after discussing their prevalence in consumer products and environmental persistence. It also introduces the concept of ecological resilience and explains how these two chemicals impair the resilience of ocean ecosystems to climate change. Part II illustrates the shortcomings of major federal environmental statutes in regulating this issue and details the relative strengths and weaknesses of state and local approaches. Part III examines how the Microbead Free Waters Act of 2015 could serve as a model for overcoming the structural and pragmatic hurdles explored in Part II to improve environmental protection from chemical constituents of personal care products in the U.S. legal system. Finally, Part IV argues that this issue highlights a need for deeper, more paradigmatic change. This article concludes by emphasizing the interconnectedness of species and systems on this planet, positing that the ocean must be at the heart of ecocentric efforts to reform environmental law, and calling for humility and precaution to anchor such efforts.

I. OXYBENZONE AND OCTINOXATE ARE UBIQUITOUS, ENVIRONMENTALLY PERSISTENT, AND DETRIMENTAL TO MARINE ECOLOGICAL RESILIENCE

The challenges of regulating ecologically harmful chemicals in personal care products are well-illustrated by two specific chemicals: oxybenzone and octinoxate. There is emerging evidence that these two chemicals are environmentally prevalent and persistent at harmful concentrations in coastal waters. Moreover, the type of harm caused by these compounds is particularly insidious because sustained exposure at low concentrations produces sublethal effects that span generations and undermine ecological resilience.

A. Oxybenzone and octinoxate are ubiquitous in sunscreens, cosmetics, and other personal care products.

Oxybenzone and octinoxate are organic compounds widely utilized as UV filters.[41] Alone or in combination, these two compounds comprise the active ingredient in 70-80% of sunscreens on the market.[42] Their ability to absorb broad spectrum ultraviolet (UV) radiation from the sun[43] has also led to their utilization

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[41] Kelly Czajka, *Is Your Sunscreen Harming Coral Reefs?*, PAC. STANDARD (Apr. 22, 2019), https://psmag.com/environment/is-your-sunscreen-harming-coral-reefs (explaining oxybenzone is not only found in sunscreen, but is also added to plastic bottles to protect contents from sun damage and to furniture and fabric to prevent discoloration).

[42] Robert B. Raffa et al., *Sunscreen Bans: Coral Reefs and Skin Cancer*, 44 J. OF CLINICAL PHARMACY & THERAPEUTICS 134, 137 (2019).

[43] Nat'l Libr. of Med., *Compound Summary: Oxybenzone*, PUBCHEM (last visited Oct. 15, 2021), https://pubchem.ncbi.nlm.nih.gov/compound/Oxybenzone.

in a wide variety of personal care products.[44] In recent decades, improved awareness of human health risks from solar radiation[45] has resulted in an explosion of cosmetic and sunscreen products containing UV filters.[46] Not only are these two chemicals the active ingredients in many sunscreens manufactured and sold in the United States, but they are also routinely included in: skincare lotions; cream and powder makeup foundation products; hair dyes, colorants, and styling products; nail polish and polish removers; eyeliners and mascara; lipsticks and lip balms; and shaving products.[47] Oxybenzone and octinoxate are also found in a variety of consumer products that do not boast sun-protectant benefits, ranging from laundry detergent and cleaning products to bath soaps and perfumes,[48] where they function as photo-stabilizers that prevent degradation of scents and colors[49] from exposure to light.[50]

B. Oxybenzone and octinoxate are environmentally persistent and prevalent at relevant concentrations.

Oxybenzone and octinoxate have an average half-life of several months in seawater.[51] However, they are continuously re-introduced via recreational

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[44] *Oxybenzone*, HAERETICUS ENV'T LAB., http://haereticus-lab.org/oxybenzone-2/ (last visited Oct. 15, 2021) [hereinafter Haereticus, *Oyxbenzone*] (noting that as of 2015, oxybenzone was reported in 912 products through the FDA's voluntary cosmetic regulation program); *see also* Xin Zhong et al., *The Toxicological Effects of Oxybenzone, an Active Ingredient in Suncream Personal Care Products, on Prokaryotic Alga* Arthrospira *sp. and Eukaryotic Alga* Chlorella *sp.*, 216 AQUATIC TOXICOLOGY 1 (2019) (stating oxybenzone is an ingredient in over 3000 personal care products).

[45] Mirabelle M.P. Tsui et al., *Occurrence, Distribution and Ecological Risk Assessment of Multiple Classes of UV Filters in Surface Waters from Different Countries*, 67 WATER RES. 55, 56 (2014).

[46] Cinzia Corinaldesi et al., *Impact of Inorganic UV Filters Contained in Sunscreen Products on Tropical Stony Corals (*Acropora spp.*)*, 637-38 SCI. OF THE TOTAL ENV'T 1279, 1280 (2018).

[47] Haereticus, *Oxybenzone*, *supra* note 44; *Octinoxate*, HAERETICUS ENV'T LAB., https://haereticus-lab.org/octinoxate/ (last visited Oct. 15, 2021) [hereinafter Haereticus, *Octinoxate*]; Craig A. Downs et al., *Toxicopathological Effects of the Sunscreen UV Filter, Oxybenzone (Benzophenone-3), on Coral Planulae and Cultured Primary Cells and Its Environmental Contamination in Hawaii and the U.S. Virgin Islands*, 70 ARCHIVES OF ENV'T CONTAMINATION & TOXICOLOGY 265, 266 (2016).

[48] Haereticus, *Oxybenzone*, *supra* note 44; Haereticus, *Octinoxate*, *supra* note 47; Downs et al., *supra* note 47.

[49] Petra Cuderman & Ester Heath, *Determination of UV Filters and Antimicrobial Agents in Environmental Water Samples*, 387 ANALYTICAL & BIOANALYTICAL CHEMISTRY 1343, 1344 (2007) (explaining addition of UV filters enables manufacturers to package products in clear glass or plastic).

[50] Czajka, *supra* note 41.

[51] Downs et al., *supra* note 47; Ryan A. Horricks et al., *Organic Ultraviolet Filters in Nearshore Waters and in the Invasive Lionfish (*Pterois volitans*) in Grenada, West Indies*, 14 PLOS ONE (2019); Samantha L. Schneider & Henry W. Lim, *Review of Environmental Effects of Oxybenzone and Other Sunscreen Active Ingredients*, 80 J. AM. ACAD. OF DERMATOLOGY 266, 267-68 (2018). Because the primary pathway through which these chemicals are degraded is photochemical transformation, the rate of degradation and impact of water chemistry changes with their depth in the water column (and thus light exposure) as well as seasonally and by latitude. *See* Davide Vione et al.,

activities and wastewater discharge, rendering them environmentally persistent.[52] The UV filter most frequently detected at the highest environmental concentrations is oxybenzone.[53] Oxybenzone's photostability under certain conditions slows its degradation;[54] this quality, along with its tendency to bioaccumulate (build up in the tissue of organisms) makes it an environmental contaminant of emerging concern.[55] Furthermore, its properties allow for both local and long-range transport of oxybenzone, potentially contributing to its documented presence in remote Arctic and Pacific ocean waters.[56]

An estimated 800-16,000 tons of sunscreen enter the ocean in proximity to coral reefs each year via direct transference from skin,[57] and additional sunscreen chemicals reach ambient water[58] through indirect inputs[59] (e.g., handwashing, showering, laundry). According to one study, just 4% of sunscreen is absorbed by the body; 96% of it is washed or rubbed off.[60] Oxybenzone, octinoxate, and other organic UV filters are also prevalent in waste from manufacturing facilities that produce sunscreens and cosmetics.[61] Not only are wastewater treatment plants ineffective at removing oxybenzone and octinoxate, but the compounds also react

Phototransformation of the Sunlight Filter Benzophenone-3 (2-hydroxy-4-methoxybenzophenone) under Conditions Relevant to Surface Waters, 463-464 SCI OF THE TOTAL ENV'T 243, 250 (2013).

[52] Downs et al., *supra* note 47; Ryan A. Horricks et al., *supra* note 51; Schneider & Lim, *supra* note 51. One study found higher concentrations of oxybenzone in the water supply in metropolitan areas associated with commercial, manufacturing, and industrial water runoff than at recreational water sites. *See* Schneider & Lim, *supra* note 51 at 267.

[53] Schneider & Lim, *supra* note 51, at 267.

[54] Sujin Kim & Kyungho Choi, *Occurrences, Toxicities, and Ecological Risks of Benzophenone-3, a Common Component of Organic Sunscreen Products: A Mini-Review*, 70 ENV'T INT'L 143, 145 (2014).

[55] *See* Fernanda Chaves Lopes et al., *Effect of the UV Filter, Benzophenone-3, on Biomarkers of the Yellow Clam*

*(*Amarilladesma mactroides*) Under Different pH Conditions*, 158 MARINE POLLUTION BULL. (2020); Downs et al., *supra* note 47; Jiaying Wang et al., *Recent Advances on Endocrine Disrupting Effects of UV Filters*, INT'L J. OF ENV'T RES. & PUB. HEALTH 1, 1 (2016).

[56] Tsui et al., *supra* note 45, at 59; Yasmine S. D. Watkins & Jonathan Brett Sallach, *Investigating the Exposure and Impact of Chemical UV Filters on Coral Reef Ecosystems: Review and Research Gap Prioritization*, 17 INTEGRATED ENV'T ASSESSMENT & MGMT. 967, 972 (2021).

[57] Joseph C. Dinardo & Craig A. Downs, *Dermatological and Environmental Toxicological Impact of the Sunscreen Ingredient Oxybenzone/Benzophenone-3*, 17 J. OF COSM. DERMATOLOGY 15, 17 (2018); *see also* David Fivenson et al., *Sunscreens: UV Filters to Protect Us: Part 2-Increasing Awareness of UV Filters and Their Potential Toxicities to Us and Our Environment*, 7 INT'L J. OF WOMEN'S DERMATOLOGY 45, 61 (2021) (estimating 14,000 tons of sunscreen are washed off swimmers in proximity to coral reefs each year).

[58] The EPA characterizes ambient water as waterways and ocean water. *Supplemental Module: Human Health Ambient Water Quality Criteria*, ENV'T PROT. AGENCY, https://www.epa.gov/wqs-tech/supplemental-module-human-health-ambient-water-quality-criteria, (last visited Nov. 11, 2022).

[59] *See* Kim & Choi, *supra* note 54, at 146

[60] DiNardo & Downs, *supra* note 57, at 17; Schneider & Lim, *supra* note 51, at 267.

[61] Schneider & Lim, *supra* note 51, at 267.

with chlorine, a wastewater disinfectant, to produce toxic by-products.[62]

Oxybenzone and octinoxate are harmful to coral reefs at extremely low concentrations. A review of current laboratory and field studies indicates that corals are visibly harmed at concentrations between 10 and 300 parts per billion (ppb) within 18-48 hours of exposure,[63] depending on the particular UV filter and coral species, with complete bleaching[64] occurring around 96 hours.[65] One team of researchers identified the median lethal concentration (the concentration that kills 50% of the organisms in a test sample) of oxybenzone for some coral species to be as low as 8 ppb in as few as four hours of exposure.[66] Concentrations as low as 62 parts per *trillion*, which is the equivalent of a single drop of water in six and a half Olympic-sized swimming pools put together, can induce sublethal physiological changes in corals at the cellular and organismal level.[67]

These two chemicals have been observed in coastal waters at concentrations relevant to marine ecological health. Studies have detected oxybenzone concentrations ranging from 580 to 1,395 ppb at crowded tourist destinations.[68] Depending on the species of coral exposed, this ranges from about two to 174 times the median lethal concentration.[69] Bays tend to accumulate higher concentrations of pollutants than open coastlines due to their shape, which can reduce mixing; one study detected an oxybenzone concentration of 2,947 ppb in

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[62] DiNardo & Downs, *supra* note 57, at 18; Schneider & Lim, *supra* note 51, at 268.

[63] Fivenson et al., *supra* note 57 (noting observable harm at concentrations of 10-300ug/L [equivalent to 10-300 ppb]).

[64] Coral bleaching is a stress-induced process in which corals expel the symbiotic algae (zooxanthellae) living in their tissue. As a consequence, corals lose their color, turning completely white, and are more susceptible to mortality due to loss of this autotrophic food source. *See What is Coral Bleaching?*, NAT'L OCEAN SERV., https://oceanservice.noaa.gov/facts/coral_bleach.html (last updated Dec. 1, 2021).

[65] Fivenson et al., *supra* note 57.

[66] Downs et al., *supra* note 47, at 279 (reporting LC50 for seven different coral species ranged from 8 to 340 µg/L [equivalent to 8-340 ppb]); *see also* Roberto Danovaro et al., *Sunscreens Cause Coral Bleaching by Promoting Viral Infections*, 116 ENV'T HEALTH PERSP. 441, 442, 445 (2008) (finding oxybenzone and octinoxate exposure produced bleaching at concentrations as low as 10 µg/L [10 ppb]).

[67] *See* Tyler J. Willenbrink et al., *The Effects of Sunscreen on Marine Environments*, 100 CUTIS 369, 369 (2017) (noting that oxybenzone concentrations as low as 62 ng/L, equivalent to 62 parts per trillion, induce harmful physiological changes in coral larvae). *See also* Arielle Levine, *Sunscreen Use and Awareness of Chemical Toxicity Among Beach Goers in Hawaii Prior to a Ban on the Sale of Sunscreens Containing Ingredients Found to be Toxic to Coral Reef Ecosystems*, 117 MARINE POL'Y (2020) (noting 63 ng/L, equivalent to 63 parts per trillion, is the threshold level at which toxicity is induced in corals); Sarah L. Romero et al., *Photobiological Effects of Sunscreens on Scleractinian Coral*, Acropora yongei, 34 FASEB J. 1-1 (2020) (noting "irreversible" decrease in coral fluorescence following exposure to diluted sunscreens containing oxybenzone).

[68] Downs et al., *supra* note 47, at 281 (describing concentrations ranging from 580 µg/L to 1.395 mg/L, which is equivalent to 580 and 1,395 parts per billion, respectively). *See also* Levine, *supra* note 67, at 4.

[69] Calculated by dividing upper and lower bounds (580 and 1,395, respectively) by LC50 of 340 and 8. *See* Downs et al., *supra* note 47, at 265.

the Big Island of Hawaii's Kahaluu Bay.[70] This concentration represents a risk level 262 times greater than what the Environmental Protection Agency (EPA) considers high risk[71] and 368 times the median lethal concentration of the most vulnerable coral species.[72] Although less data is available on octinoxate, researchers have measured concentrations sufficient to cause sublethal cellular harm to corals in a cove of Maui's Ahihi Kina'u Natural Area Reserve.[73]

The context of these data supports action in response to the concentrations of these two chemicals observed in coastal waters. Because oxybenzone and octinoxate bioaccumulate, testing seawater for the presence of these compounds may not accurately reflect their abundance in the environment or in marine life.[74] Moreover, recent research suggests that other ingredients in sunscreen products may increase the bioavailability of active ingredients, exacerbating toxicity at lower levels in the environment than those observed in single-chemical laboratory tests.[75] Understanding that environmental levels detected are likely underestimates of true exposures and may not accurately characterize synergistic risks underscores the urgency of acting to control these environmental contaminants now.

C. Oxybenzone and octinoxate are harmful to a variety of nearshore marine species.

Oxybenzone and octinoxate harm various marine species in a number of ways. Oxybenzone is a genotoxicant, meaning that it can damage DNA.[76] It is also a

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[70] Levine, *supra* note 67 (citing Max Dible, *Testing Finds Extremely High Oxybenzone Levels at Kahaluu Bay*, WEST HAW. TODAY (Apr. 28, 2019), https://www.westhawaiitoday.com/2019/04/28/hawaii-news/testing-finds-extremely-high-oxybenzone-levels-at-kahaluu-bay/).

[71] Levine, *supra* note 67, at 1. The EPA characterizes ecological risks using risk quotients, which integrate exposure, acute toxicity, and chronic toxicity. *Technical Overview of Ecological Risk Assessment: Risk Characterization*, ENV'T PROT. AGENCY, https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/technical-overview-ecological-risk-assessment-risk (last visited Jan. 6, 2022).

[72] *See* Downs et al., *supra* note 47, at 265 (citing LC50 as low as 8 ppb for some species).

[73] Haereticus, *Octinoxate*, *supra* note 47.

[74] *See* Horricks et al., *supra* note 51; *see also* Dimosthenis Giokas et al., *UV Filters: From Sunscreens to*

Human Body and the Environment, 26 TRENDS IN ANALYTICAL CHEMISTRY 366 (2007) ("The relatively high K_{oc} [organic carbon distribution coefficient] values indicate that these compounds will associate with solid particles, especially those with high organic matter content, so they may be removed from the water column via sorption and/or sedimentation.").

[75] *See* Tangtian He et al., *Toxicological Effects of Two Organic Ultraviolet Filters and a Related Commercial Sunscreen Product in Adult Corals*, 247 ENV'T POLLUTION 462, 468 (2019) ("[E]xposure to diluted sunscreen water which contain[ed] *lower levels* of [octinoxate] (e.g., 5%) than the single chemical tests . . . caused higher levels of coral bleaching and death.").

[76] Downs et al., *supra* note 47; Sara dos Santos Almeida et al., *Acute Exposure to Environmentally Relevant Concentrations of Benzophenone-3 Induced Genotoxicity in* Poecilia reticulata, 216 AQUATIC TOXICOLOGY 1, 3 (2019).

reproductive toxicant; although the various mechanisms in which oxybenzone acts differ by species, it has estrogenic and anti-androgenic effects in mammals.[77] In fish, oxybenzone acts as an endocrine-disruptor by modulating estrogen receptor signaling pathways, inducing reproductive pathologies, and reducing reproductive fitness.[78] Chronic exposure has been linked to reduced egg production and fewer viable hatchings in some fish species, and there is some evidence that exposure during certain developmental periods may induce gender shifts.[79] Although less data is available on octinoxate, it has been shown to increase the occurrence of developmental disorders in zebrafish by 80%.[80]

In corals, warmer water temperatures drive bleaching—a stress-induced process in which corals expel their algal symbionts.[81] UV filters make corals more susceptible to temperature-induced bleaching.[82] Oxybenzone has been shown to deform planulae (the larval stage of coral) and increase the rate of bleaching.[83] When corals are stressed, they are more vulnerable to mortality; recovery can only begin once the stressor is removed.[84] Ambient concentrations of oxybenzone can also impair the ability of coral to heal from lesions and diminish the survival and recruitment rate of juvenile coral—in one study to almost 0%[85]—indicating that population recovery from bleaching, infection, or other trauma in the continued presence of this contaminant is unlikely. Because reef-building corals are foundation species,[86] repeated bleaching events adversely affect the many marine biota for which they create habitat.[87]

Research also suggests that UV filters may alter the ratio of viruses to bacteria in the marine microbial environment, with potential ecological and

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[77] Downs et al., *supra* note 47 (noting oxybenzone causes both activation of estrogen receptors and inhibition of androgen receptors in mammals).

[78] Karen Kinnberg et al., *Endocrine-disrupting Effect of the Ultraviolet Filter Benzophenone-3 in Zebrafish*, Danio rerio, 34 ENV'T TOXICOLOGY & CHEMISTRY 2833, 2837 (2015).

[79] Downs et al., *supra* note 47, at 266-67; Fivenson et al., *supra* note 57, at 63.

[80] Daniel Kaiser et al., *Ecotoxicological Effect Characterisation of Widely Used Organic UV Filters*, 163 ENV'T POLLUTION 84, 88 (2012).

[81] *See What is Coral Bleaching?*, NAT'L OCEAN SERV., https://oceanservice.noaa.gov /facts/coral_bleach.html (Dec. 1, 2021).

[82] Fivenson et al., *supra* note 57 (explaining hypothesized mechanisms include creating localized increases in water temperature and impairing the transmission of sunlight algal symbionts need to photosynthesize); Tim Wijgerde et al., *Adding Insult to Injury: Effects of Chronic Oxybenzone Exposure and Elevated Temperature on Two Reef-building Corals*, 731 SCI. OF THE TOTAL ENV'T 1 (2020) (finding oxybenzone accelerated heat-induced mortality, impacted photosynthetic yield, and altered microbiome of species of stony corals in experimental study).

[83] Downs et al., *supra* note 47, at 265; Fivenson et al., *supra* note 57, at 61; Schneider and Lim, *supra* note 51, at 268.

[84] Fivenson et al., *supra* note 57, at 61.

[85] Downs et al., *supra* note 47, at 284.

[86] Foundation species are those that play an outsized role in structuring a community. *See* Aaron M. Ellison, *Foundation Species, Non-trophic Interactions, and the Value of Being Common*, 13 ISCIENCE 254, 255, 258 (2019).

[87] Fivenson et al., *supra* note 57, at 61.

biogeochemical consequences[88]—including reduced carbon sequestration.[89] These findings are consistent with evidence indicating that sunscreens contribute to rapid bleaching of stony corals,[90] even at low concentrations, by inducing the lytic viral cycle[91] in symbiotic zooxanthellae (the algae that live within corals) harboring latent infections.[92] Although more research is needed to better understand how sunscreen chemicals interact with microbes in the marine environment, these initial studies indicate that UV filters may disrupt ecosystem stability by benefitting viruses to the detriment of bacteria.

These two chemicals threaten the health of more than just fish and corals. One study concluded that oxybenzone presents an "appreciable environmental risk" for organisms at every trophic level (autotrophs, herbivores, and carnivores) of coastal ecosystems.[93] Adverse effects of each chemical have been documented in several species of marine phytoplankton,[94] microscopic organisms which not only form the foundation of the oceanic food chain, but also drive the world's largest carbon sink and produce at least half of the oxygen on our planet.[95] Research has

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[88] Roberto Danovaro & Cinzia Corinaldesi, *Sunscreen Products Increase Virus Production through Prophage Induction in Marine Bacterioplankton*, 45 MICROBIAL ECOLOGY 109, 110-117 (2003); *see* Anne da Silva et al., *Ethylhexyl Methoxycinnamate and Butyl Methoxydibenzoylmethane: Toxicological Effects on Marine Biota and Human Concerns*, 42 J. OF APPLIED TOXICOLOGY 73, 79 (2022) (noting octinoxate is among the most toxic commonly used UV filters to bacteria, capable of inhibiting microbial growth at just 1 ppm).

[89] *See* Lawrence Pomeroy et al., *The Microbial Loop*, 20 OCEANOGRAPHY 28, 29-30 (2007) (explaining bacteria play a dominant role in marine microbial loop and carbon sequestration because they have the highest relative metabolism).

[90] Stony corals (also referred to as hard corals) include corals in the family *Acropora*, which are important reef builders that provide habitat. Shaun McCosham et al., *Direct and Indirect Effects of Sunscreen Exposure for Reef Biota*, 776 HYDROBIOLOGIA 139, 140 (2016).

[91] The lytic viral cycle is the process through which a virus "hijacks" the host cell, degrades the host chromosome, and replicates viral genomes. *The Viral Life Cycle*, LUMEN: MICROBIOLOGY, https://courses.lumenlearning.com/microbiology/chapter/the-viral-life-cycle/ (last visited Apr. 8, 2022).

[92] Danovaro et al., *supra* note 66, at 445-46.

[93] Estefania Paredes et al., *Ecotoxicological Evaluation of Four UV Filters Using Marine Organisms from Different Trophic Levels* Isochrysis galbana, Mytilus galloprovincialis, Paracentrotus lividus, *and* Siriella armata, 104 CHEMOSPHERE 44, 44-48 (2014) (finding toxic effects on algae, mussels, sea urchins, and shrimp at concentrations as low as 52 μg/L).

[94] *See* Antonio Tovar-Sánchez et al., *Sunscreen Products as Emerging Pollutants to Coastal Waters*, 8 PLoS ONE (2013) (finding impact of oxybenzone on marine diatom *Chaetoceros gracilis*); Zhong et al., *supra* note 44 (finding inhibited photosynthesis in both *Chlorella* and *Arthrospira*); Samuele Caloni et al., *Sunscreens' UV Filters Risk for Coastal Marine Environment Biodiversity: A Review*, 13 DIVERSITY 374, 382 (2021) (observing oxybenzone impairs metabolism of green algae *Tetraselmis* sp.). *See also* McCosham et al., *supra* note 90, at 139-40 (documenting negative effects of oxybenzone on diatoms, a class of phytoplankton); Paredes, *supra* note 93, at 48 (finding observable effects on *Isochrysis galbana* at octinoxate concentration of 30 μg/L).

[95] Rebecca Lindsey, *What are Phytoplankton?*, NASA EARTH OBSERVATORY (July 13, 2010), https://earthobservatory.nasa.gov/features/Phytoplankton (explaining phytoplankton are comprised of bacteria, protozoa, and single-celled plants, and that phytoplankton form the foundation of the marine food web); Pomeroy et al., *supra* note 89, at 28 (noting approximately "one-half of the oxygen in every

also shown that exposure to octinoxate immobilizes, deforms, and inhibits the growth of certain zooplankton,[96] including shrimp larvae,[97] and induces toxicity in mussels, sea urchins, and shrimp at extremely low concentrations.[98] Additionally, flatworms and glass anemones experience negative effects following exposure to "nominal concentrations" of sunscreen chemicals.[99] Along with diatoms (a type of phytoplankton), these species have exhibited reduced population growth after exposure to oxybenzone, compared to unexposed control groups.[100] Because these low-trophic level organisms serve as food for many species of biota, impairment of their populations can have cascading ecosystem effects—including a reduction in overall biodiversity.[101]

D. The harm caused by these chemicals impairs marine ecological resilience to climate change impacts.

Harm caused by oxybenzone and octinoxate to individual species is particularly destructive because it impairs the capacity of marine ecosystems to withstand the effects of climate change. "Resistance" refers to the magnitude of disturbance an ecosystem can withstand without alteration to its structure and function, while "recovery" concerns the speed at which an ecosystem that has been disrupted reassumes its previous structure and function after a disturbance. [102] Together, these two properties comprise "resilience."[103] Resilience is generally higher in communities with high reproduction rates, robust populations with balanced age and size structures, and an absence of disease.[104] Strengthening marine ecosystem

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breath we take derives from photosynthetic bacteria" (which are phytoplankton)); Climate Action, *The Ocean -the world's greatest ally against climate change,* UNITED NATIONS, (last visited Nov. 11, 2022), https://www.un.org/en/climatechange/science/climate-issues/ocean (stating the ocean is the world's largest carbon sink).

96 *See generally* Agnes Sieratowicz et al., *Acute and Chronic Toxicity of Four Frequently Used UV Filter Substances for* Desmodesmus subspicatus *and* Daphnia magna, 46 J. OF ENV'T SCI. & HEALTH, PART A: TOXIC/HAZARDOUS SUBSTANCES & ENV'T ENG'G 1311 (2011); *see also* Caloni et al., *supra* note 94, at 379 (noting octinoxate is "highly toxic" to planktonic crustacean (*Daphnia magna*) at concentrations > 1µg (1 ppb)). Zooplankton are tiny drifting marine animals, including the immature stages of larger animals, that together with phytoplankton, make up the food supply upon which almost all oceanic organisms are ultimately dependent. *Zooplankton*, ENCYC. BRITANNICA, https://www.britannica.com/science/plankton (last visited Apr. 8, 2022).

97 Haereticus, *Octinoxate*, *supra* note 47.

98 Paredes et al., *supra* note 93.

99 McCosham et al., *supra* note 90, at 139-40. The authors note that the experiment utilized concentrations "expected to be encountered by reef biota occurring at tourist destinations." *Id.* at 145.

100 *Id.* at 143.

101 *Id.* at 144.

102 Isabelle M. Côté & Emily S. Darling, *Rethinking Ecosystem Resilience in the Face of Climate Change*, 8 PLOS BIOLOGY 1, 1 (2010).

103 *Id.*

104 Elizabeth McLeod et al., *Designing Marine Protected Area Networks to Address the Impacts of Climate Change*, 7 FRONTIERS IN ECOLOGY & THE ENV'T 362, 363 (2008).

resilience requires preserving species richness and diversity,[105] which foster ecosystem complexity and maintain trophic linkages.[106] As trophic cascades (also referred to as "phase shifts"), invasions and range shifts of non-endemic species, and disease outbreaks become increasingly common in a changing ocean,[107] every effort must be made to guard the health and integrity of marine ecosystems.

Oxybenzone and octinoxate reduce coral resilience[108] by reducing the ability of corals to adapt to climate variation, impairing coral recruitment and recovery, and making corals more susceptible to heat-induced bleaching.[109] Juvenile coral (including larvae) and newly settled reefs are especially susceptible to pollutants,[110] and even small impacts on larval development and survival can have significant effects on coral demographics and community structure.[111] Loss of reef-building corals can simplify reef community assemblages, leading to "biotic homogenization."[112] In turn, reduced structural complexity in reef systems impairs ecosystem functioning and productivity.[113] Because of the vital role stony corals (genus *Acropora*) play in ocean ecosystem structural and functional integrity[114]—and the impact this, in turn, has on ocean ecosystem resilience[115]—risks to coral resilience, demographics, and community structure are far from trivial.

Reducing modifiable sources of stress now can buy marine ecosystems time while slower-acting efforts to reduce anthropogenic warming are implemented.[116] The survival of any species is inherently predicated on normal development and successful reproduction—both functions for which a healthy endocrine system is

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105 Sarah E. Lester et al., *Biological Effects Within No-take Marine Reserves: A Global Synthesis*, 384 MARINE ECOLOGY PROGRESS SERIES 33, 34-35 (2009). Species richness is the number of species within a defined region. *Id.*

106 Dinerstein et al., *supra* note 10, at 2; Kroeker et al., *supra* note 12, at 119.

107 McLeod et al., *supra* note 104, at 364; Kroeker et al., *supra* note 12, at 119–20.

108 Lydia Ouchene et al., *Hawaii and Other Jurisdictions Ban Oxybenzone or Octinoxate Sunscreens Based on the Confirmed Adverse Environmental Effects of Sunscreen Ingredients on Aquatic Environments*, 23 J. OF CUTANEOUS MED. & SURGERY 648, 648 (2019).

109 Wijgerde et al., *supra* note 82.

110 Schneider & Lim, *supra* note 51, at 268.

111 Downs et al., *supra* note 47, at 267.

112 Nuria Estrada-Saldívar et al., *Functional Consequences of the Long-term Decline of Reef-building Corals in the Caribbean: Evidence of Across-reef Functional Convergence*, 6 ROYAL SOC'Y OF OPEN SCI. 1, 11 (2019) (explaining how loss of reef-building corals leads to simplification and homogenization of reef community assemblages, and noting such changes have already been observed off the coast of southern Florida).

113 *Id.*

114 *Id.*

115 Dinerstein, *supra* note 10, at 2; Kroeker, *supra* note 12, at 119.

116 Intergovernmental Panel on Climate Change, *Special Report on the Ocean and Cryosphere in a Changing Climate*, at 76 (Hans-Otto Pörtner et al. eds., 2019) ("Long response times of decades to millennia mean that the ocean and cryosphere are committed to long-term change even after atmospheric greenhouse gas concentrations and radiative forcing stabilize.").

a "prerequisite."[117] To optimize resilience to climate change impacts like warming and acidification, controllable stressors like EDCs must be reduced to the greatest extent possible.[118] While there are other threats contributing in greater magnitudes to coral loss,[119] the opportunity to eliminate exposure to harmful chemicals for which there are reasonable and functionally equivalent alternatives[120] presents low hanging fruit to policymakers.

II. THE UNITED STATES' CURRENT ENVIRONMENTAL LAW FRAMEWORK CANNOT EFFECTIVELY REGULATE THESE CHEMICALS

The majority of the United States' statutory framework of federal environmental law was developed in the 1970's, largely in an effort to regulate conventional pollutants and protect public health.[121] The current framework of environmental law in the United States fails to effectively protect coastal marine ecosystems from oxybenzone and octinoxate. This failure occurs because the current federal statutory framework is inadequately designed to regulate environmentally harmful chemicals, like EDCs, that are present in personal care products like cosmetics and sunscreen. Nor have state and local laws generally proven effective in protecting coastal marine ecosystems from these chemicals. Shortcomings within the current system of U.S. law illustrate why change is needed in response to the environmental risks presented by EDCs, including oxybenzone and octinoxate, in consumer products.

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[117] ACES Report, *supra* note 15, at 2 (noting "disruption of the endocrine system can result in various developmental, reproductive, neurological, immune and metabolic diseases").

[118] *See* Jessica E. Carilli et al., *Local Stressors Reduce Coral Resilience to Bleaching* 4 PLOS ONE (2009); Kroeker et al., *supra* note 12; Jordan M. West & Rodney V. Salm, *Resistance and Resilience to Coral Bleaching: Implications for Coral Reef Conservation and Management*, 17 CONSERVATION BIOLOGY 956, 963 (2003) (explaining reefs protected from anthropogenic pollutants are likely to have higher resilience after bleaching event compared to reefs already suffering from multiple stressors).

[119] Fivenson et al., *supra* note 57. Contrary to what one scientist has referred to as "myopic," focusing on the reduction of chemical stressors is a prudent approach complementary to addressing other causes of coral bleaching. *Contra* Jay Sirois, *Examine All Available Evidence Before Making Decisions on Sunscreen Ingredient Bans*, 674 SCI. OF THE TOTAL ENV'T 211, 211 (2019).

[120] *See* McCosham et al., *supra* note 90, at 145 (discussing non-chemical sunscreen alternatives); Raffa et al., *supra* note 42, at 138 (discussing natural marine UV filters); Schneider & Lim, *supra* note 51, at 269 (discussing photoprotection strategies like sun-protective clothing and sunscreens with inorganic filters). Although some studies indicate temporary bleaching from zinc oxide, these impacts are reversible and the overall risk of zinc oxide sunscreens to the environment is low. Ouchene et al., *supra* note 108, at 649. Moreover, these minerals do not penetrate the skin, reducing human health concerns. *Id.*

[121] ROBERT V. PERCIVAL ET AL., ENVIRONMENTAL REGULATION: LAW, SCIENCE, AND POLICY 96, 99 (8th ed. 2018).

A. The Regulatory Gap: The Toxic Substances Control Act and the Food, Drug, and Cosmetics Act leave the environmental impacts of cosmetic and sunscreen ingredients unexamined and unregulated

The Food, Drug, and Cosmetics Act (FDCA) authorizes the Food and Drug Administration (FDA) to regulate cosmetics and sunscreen products[122] sold in interstate commerce in the United States.[123] The FDCA was passed chiefly as a consumer protection law; Congress aimed to eliminate deceptive labeling practices "for the purposes of safeguarding the public health [and] preventing deceit upon the purchasing public[.]"[124] As further explained below, neither sunscreens nor cosmetics are required to undergo environmental impact assessment under the FDCA.

Sunscreen is regulated as an over-the-counter drug, and as such, must conform to FDA "monographs" that specify acceptable ingredients, formulations, and labeling.[125] Although the FDA final sunscreen monograph from 1999 was stayed,[126] the FDA promulgated regulations adopting the ingredient concentrations specified therein; current regulations permit sunscreen products to contain up to 6% oxybenzone and up to 7.5% octinoxate by weight as active ingredients and also allow combinations of these ingredients.[127] In early 2019, the FDA issued a proposed rule concluding that current data is insufficient to support a determination that oxybenzone and octinoxate are "generally recognized as safe and effective" (a standard referred to as "GRASE").[128] The proposed rule discusses the potential danger of various oxybenzone metabolites[129] that are more

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122 21 U.S.C. § 301 *et seq.* (2018). Under the FDCA, sunscreens are regulated as over the counter drugs. *See* 21 U.S.C. § 360fff (2021); Over-the-Counter Sunscreen Drug Products; Required Labeling Based on Effectiveness Testing, 21 C.F.R. § 201.237 (2021).

123 *See* 21 U.S.C. § 393(d)(2) (2018); John Wood, *Can We Teach Old Laws a New Risk: Federal Environmental Law, Risk Management Theory, and Contamination of U.S. Water Supplies with Pharmaceutical and Personal Care Products*, 21 N.Y.U. ENV'T L.J. 193, 229 (2014).

124 H.R. REP. NO. 75-2716, at 1 (1938) (Conf. Rep.).

125 Lauren Jacobs, *Beauty Shouldn't Cause Pain: A Makeover Proposal for the FDA's Cosmetics Regulation*, 39 J. NAT'L ASS'N ADMIN. L. JUDICIARY 82, 101 (2019).

126 *Questions and Answers: FDA posts deemed final order and proposed order for over-the-counter sunscreens*, U.S. FOOD & DRUG ADMIN., https://www.fda.gov/drugs/understanding-over-counter-medicines/questions-and-answers-fda-posts-deemed-final-order-and-proposed-order-over-counter-sunscreen (Nov. 16, 2021) .

127 Sunscreen Drug Products for Over-the-Counter Human Use, Sunscreen Active Ingredients; Permitted Combinations of Active Ingredients, 21 C.F.R. §§ 352.10(j), (l), 352.20 (2021). Octinoxate is listed under its chemical name, Octyl methoxycinnamate.

128 Sunscreen Drug Products for Over-the Counter Human Use, 84 Fed. Reg. 6204, 6206 (Feb. 26, 2019) (noting that "oxybenzone is absorbed through the skin to a greater extent than previously understood and can lead to significant systemic exposure"). Although data are limited, the proposed rule notes that octinoxate has shown "systemic availability" in humans as well. *See id.* at 6221.

129 Metabolites are substances that are formed as the body breaks down chemicals that are ingested or absorbed. *See* National Cancer Institute Dictionary, https://www.cancer.gov/publications/dictionaries/cancer-terms/def/metabolite (last visited Nov. 2, 2022).

hormonally active than the parent compound itself[130] and notes data indicating that combining certain sunscreen active ingredients with the insecticide DEET "may increase absorption of either or both components."[131] Because DEET is a common and persistent contaminant of freshwater and marine ecosystems,[132] this synergistic effect underscores the need to eliminate ongoing environmental contamination with oxybenzone and octinoxate for wildlife protection purposes. However, the proposed rule was never finalized.[133] Until recently, oxybenzone and octinoxate remained classified as Non-GRASE III,[134] along with other UV filters,[135] and have effectively been treated as "Marketed Unapproved Drugs".[136]

In March 2020, Congress passed the Coronavirus Aid, Relief, and Economic Security Act (CARES Act). Although this legislation was primarily intended to provide economic relief from the impacts of the COVID-19 pandemic, the CARES Act also contained a provision amending the FDCA which required the FDA to update its list of designated safe active ingredients for OTC sunscreens in accordance with emerging science.[137] To streamline the regulatory process, the CARES Act replaced the notice-and-comment rulemaking process with an administrative order process for issuing, revising, and amending monographs.[138] On September 24, 2021, the FDA issued "Over-the-Counter Monograph M020: Sunscreen Drug Products for Over-the-Counter Human Use", a proposed administrative order issued pursuant to the new FDCA provision. Notably, the order does not change the concentrations of oxybenzone and octinoxate considered permissible as sunscreen active ingredients, and in fact declares

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130 Sunscreen Drug Products for Over-the Counter Human Use, 84 Fed. Reg. at 6224.

131 *Id.* at 6207.

132 *See* S.D. Costanzo et al., *Is There a Risk Associated with the Insect Repellent DEET (*N,N-*diethyl*-m-*toluamide) Commonly Found in Aquatic Environments?*, 384 SCI. OF THE TOTAL ENV'T. 214, 214 (2007).

133 *Rulemaking History for OTC Sunscreen Drug Products*, U.S. FOOD & DRUG ADMIN., https://www.fda.gov/drugs/status-otc-rulemakings/rulemaking-history-otc-sunscreen-drug-products (Aug. 30, 2019). The FDA missed the deadline to publish the final rule. Katherine Hupp, *Screening Sunscreen: FDA Regulation and State Bans*, 20 THE SANDBAR 11, 12 (2021).

134 Fivenson et al., *supra* note 57, at 48. Category III indicates that more data is needed to substantiate a GRASE finding. *Over-the-Counter (OTC) Drug Review: OTC Monograph Reform in the CARES Act*, U.S. FOOD & DRUG ADMIN., https://www.fda.gov/drugs/over-counter-otc-nonprescription-drugs/over-counter-otc-drug-review-otc-monograph-reform-cares-act (May 5, 2022).

135 In fact, only two sunscreen ingredients—zinc oxide and titanium dioxide—currently meet GRASE criteria. *See Spotlight on CDER Science: New FDA Study Shines Light on Sunscreen Absorption*, U.S. FOOD & DRUG ADMIN., https://www.fda.gov/drugs/news-events-human-drugs/spotlight-cder-science-new-fda-study-shines-light-sunscreen-absorption (July 8, 2019).

136 Fivenson et al., *supra* note 57, at 46 (explaining market unapproved drugs are those which lack rigorous testing required for GRASE but have "been in use for a long time").

137 *An Update on Sunscreen Requirements: The Deemed Final Order and the Proposed Order*, U.S. FOOD & DRUG ADMIN., https://www.fda.gov/drugs/news-events-human-drugs/update-sunscreen-requirements-deemed-final-order-and-proposed-order (Sept. 24, 2021).

138 *Id.*

sunscreens that conform to these formulations to be GRASE and not new drugs.[139]

Cosmetics are subject to even less regulation than sunscreens. With the exception of color additives, there is no pre-market approval of such products by the FDA,[140] and the reporting of product ingredients, formulations, and safety testing is entirely voluntary.[141] Although the FDA does have authority under the FDCA to ban or restrict the use of certain chemicals in cosmetics, it has exercised this power sparingly; only eleven chemicals are banned or restricted in cosmetics sold in the United States, compared to more than 1,300 chemicals in the European Union.[142] Rather, a manufacturer or distributor of a cosmetic is legally responsible for ensuring that a product is safe for consumers when used in accordance with the directions on the label or in the "customary or expected way".[143] The FDCA prohibits the sale of cosmetics that are "misbranded" or "adulterated."[144] However, violation of the Act is unlikely to result in enforcement,[145] and because the likelihood of misbranding or adulteration being discovered is so low, manufacturers have little incentive to comply.[146]

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[139] *See* § M020.10. ("[T]he final order for OTC sunscreen drug products incorporates the final monograph requirements, as specified by 505G(a)(2), from 21 CFR part 352 (as published on May 21, 1999) . . . ."). *But see* Amending Over-the-Counter Monograph M020: Sunscreen Drug Products for Over-the-Counter Human Use; Over the Counter Monograph Proposed Order; Availability 86 Fed. Reg. 53322, 53323 (Sept. 27, 2021), announcing a proposed order that would replace the September 24 final order for determining conditions under which nonprescription sunscreens would be considered GRASE, citing "substantively the same" requirements (and science) as in the February 2019 proposed rule. Effectively, the proposed order constitutes an acknowledgement by the FDA that it still lacks data for determining whether the eight sunscreen active ingredients, including oxybenzone and octinoxate, are GRASE, and would revert classification of these two chemicals to non-GRASE.

[140] *FDA Authority Over Cosmetics: How Cosmetics Are Not FDA-Approved, but Are FDA-Regulated*, U.S. FOOD & DRUG ADMIN., https://www.fda.gov/cosmetics/cosmetics-laws-regulations/fda-authority-over-cosmetics-how-cosmetics-are-not-fda-approved-are-fda-regulated (Mar. 3, 2022).

[141] Jacobs, *supra* note 125, at 105.

[142] Oliver Milman, *US Cosmetics are Full of Chemicals Banned by Europe – Why?,* THE GUARDIAN, (May 22, 2019). https://www.theguardian.com/us-news/2019/may/22/chemicals-in-cosmetics-us-restricted-eu ; *See also* Jacobs, *supra* note 125, at 83 ("Of the estimated 6,000 chemicals in personal care products . . . only nine have ever been banned for health reasons and . . . [that's] only because they are like . . . truly the equivalent of poisons.") (internal citations omitted).

[143] Nicholas J. Schroeck, *Microplastic Pollution in the Great Lakes: State, Federal, and Common Law Solutions*, 93 U. DET. MERCY L. REV. 273, 288 (2016).

[144] A cosmetic is considered "adulterated" if it "bears or contains any poisonous or deleterious substance which may render it injurious to users" under expected conditions of use; contains "any filthy, putrid, or decomposed substance"; was packaged, prepared or stored in insanitary conditions which may have rendered it "injurious to health"; or is sold in a container composed of any "poisonous or deleterious substance" which may render the contents "injurious to health," or if it contains color additives that do not comply with regulations promulgated under Section 379(e)(a) of the FDCA. *See* 21 U.S.C. § 361(a)-(e) (2018).

[145] Jacobs, *supra* note 125, at 103-04.

[146] *See id.* at 104.

1. A loophole allows environmental impacts of cosmetics and sunscreens to evade evaluation under the Toxic Substances Control Act and Food, Drug, and Cosmetic Act.

The Toxic Substances Control Act (TSCA) is a federal statute intended to regulate chemicals harmful to human health or the environment.[147] The Act provides EPA with comprehensive authority to regulate or prohibit altogether the manufacture, distribution, use, or disposal of chemical substances and mixtures that "present[] an unreasonable risk of injury to health or the environment."[148] However, TSCA removes from EPA's authority "any food, food additive, drug, cosmetic, or device,"[149] deferring to FDA's jurisdiction under the FDCA to regulate these products. This effectively creates a regulatory loophole: TSCA removes the chemicals in sunscreens and cosmetics from EPA's regulatory reach, and because the FDA does not examine the environmental impact of chemicals in cosmetics and sunscreens, environmental contaminants in these products are unexamined and unregulated. One legal scholar has described this gap as a "chink" in the United States' regulatory "armor".[150]

2. Without also modernizing the Toxic Substances Control Act's risk assessment framework to accommodate endocrine-disrupting chemicals, closing the statutory loophole would not address this problem.

Despite authorizing "the most explicitly far-reaching regulatory controls" on toxic substances among U.S. laws,[151] TSCA has been largely underutilized and ineffective. As originally enacted, the Act set a "prohibitively high" standard for regulatory action[152] while simultaneously limiting the EPA's ability to request from industry the data necessary to conclude that a chemical presented unreasonable risk.[153] Moreover, because TSCA formerly required EPA "to choose the least burdensome regulatory method necessary" to protect adequately against risk, it created "a presumption in favor of regulatory avoidance".[154] In effect, the

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147 *See* 15 U.S.C. § 2601 (2018).

148 15 U.S.C. § 2605(a) (2018).

149 15 U.S.C. § 2602(2)(b)(vi) (2018).

150 Wood, *supra* note 123, at 208 ("Since EPA defers to FDA on the regulation of [pharmaceutical and personal care product] chemical ingredients, and FDA fails to consider the environmental impacts of these substances once they accumulate and persist in the environment, there exists a chink in the armor of U.S. regulatory regimes with respect to PPCP chemical ingredients as environmental contaminants.").

151 *See* Percival et al., *supra* note 121, at 99.

152 Wood, *supra* note 123, at 270.

153 Valerie J. Watnick, *The Lautenberg Chemical Safety Act of 2016: Cancer, Industry Pressure, and a Proactive Approach*, 43 HARV. ENV'T L. REV. 373, 384-5 (describing this aspect of TSCA as a "catch 22"); *see also* Sanne H. Knudsen, *Regulating Cumulative Risk*, 101 MINN. L. REV. 2313, 2371 (2017) (describing the high threshold required for testing as a "chicken and egg" issue for the EPA).

154 Knudsen, *supra* note 153, at 2373.

"least burdensome" requirement favored regulation through information disclosure rather than "substantive gatekeeping" such as chemical bans or use restrictions.[155] TSCA's structural flaws are epitomized by the fact that asbestos—a known carcinogen harmful both to humans and the environment—is not banned, "despite an intense court battle".[156] Following the Fifth Circuit's famous decision regarding asbestos in *Corrosion Proof Fittings*,[157] the EPA effectively concluded that TSCA's "unreasonable risk" standard was unenforceable.[158]

Acknowledging that "effective implementation of TSCA by [EPA] ha[d] been challenged by shortcomings in the statute itself, and by several key decisions of Federal Courts and the Agency's interpretation of those decisions," Congress recognized the need for reform of toxics regulation.[159] In June 2016, the Frank R. Lautenberg Chemical Safety for the 21st Century Act (Lautenberg Act) was enacted as an amendment to TSCA.[160] Consistent with TSCA's policy goals, Congress intended "to provide broad protection of human health and the environment," and "to improve availability of information about chemicals" through the Lautenberg Act.[161] The amendments explicitly clarified that EPA has the authority to regulate chemicals that "present an unreasonable risk of injury to health or the environment, *without consideration of costs or other nonrisk factors*," emphasizing Congress's objective of supporting health-based determinations under the Act.[162]

The Lautenberg Act sought to "restructure the way . . . chemicals are evaluated and regulated."[163] It made several positive changes, including requiring manufacturers to supply adequate data for EPA to find that a chemical is not likely to present an unreasonable risk of injury to health or the environment *before* they can start making and selling a new chemical.[164] This burden shift is one of the strongest aspects of the amendment; rather than requiring EPA to demonstrate,

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155 *Id.*

156 Watnick, *supra* note 153, at 387-88; Knudsen, *supra* note 153, at 2373 (noting that the court's ruling despite ten years of research and "thousands of pages of documentation" regarding the dangers posed by asbestos).

157 Corrosion Proof Fittings v. E.P.A., 947 F.2d 1201, 1222-23 (5th Cir. 1991), *opinion clarified* (Nov. 15, 1991) (holding that EPA did not properly apply statutory standard of "unreasonable risk" by balancing the cost of its regulation banning asbestos against the benefit).

158 Knudsen, *supra* note 153, at 2374.

159 Safer Chemicals, Healthy Families v. U.S. Env't Prot. Agency, 943 F.3d 397, 406 (9th Cir. 2019) (quoting S. REP. NO. 114-67, at 2 (2015)) (internal quotation marks omitted).

160 Knudsen, *supra* note 153, at 2375; *see also* Frank R. Lautenberg Chemical Safety for the 21st Century Act, Pub. L. No. 114-182, 130 Stat. 448 (2016) (codified at 15 U.S.C. §§ 2601-2629.).

161 Safer Chemicals, Healthy Families, 943 F.3d at 406 (quoting S. REP. NO. 114-67, at 6).

162 Knudsen, *supra* note 153, at 2386 (emphasis added).

163 Safer Chemicals, Healthy Families, 943 F.3d at 406 (quoting H.R. REP. NO. 114-176, at 13 (2015), *as reprinted in* 2016 U.S.C.C.A.N. 276, 277).

164 Knudsen, *supra* note 153, at 2387, n.263. This also applies to new uses of existing chemicals. *Id* at 2372.

often with insufficient data, that a chemical poses unreasonable risk, the Lautenberg Act requires manufacturers to provide sufficient data that a chemical does *not* produce an unreasonable risk.[165] If EPA concludes that a chemical does—or may—present an unreasonable risk, or that it lacks sufficient information to make this determination, it can issue an order or a rule to restrict that chemical's use.[166] Additionally, the Lautenberg Act ends the exemption of chemicals already in commerce from scrutiny. It requires EPA to categorize chemicals currently in use as high or low priority;[167] conduct a risk evaluation; and publish a final rule within two years of completing the risk evaluation, restricting the substance to the extent necessary for it to no longer present a risk.[168] As a nod to industry frustrations with the evolving patchwork of state chemical legislation, the Lautenberg Act also contains a preemption provision prohibiting states from regulating a chemical that EPA has deemed high priority.[169]

The Lautenberg Act's amendments to TSCA are a promising start, yet an incomplete remedy for modern risks. For example, the Lautenberg Act requires the EPA to review just twenty chemicals deemed "high priority" within three and a half years of its enactment.[170] With over 87,000 existing chemicals on the market today, more than 60,000 of which lack safety data, this is deeply problematic.[171] Even if EPA focused only on the 90 existing chemicals identified as high priority in 2014 (under the original TSCA framework), it would take decades for the agency to complete risk evaluations, finalize regulations, and implement the rules.[172] In light of resource limitations, budget cuts, and "well-funded industry opposition," EPA's selection of chemicals to review are thus likely to be "politically calibrated",[173] making it unlikely that EDCs in sunscreens and cosmetics will be a priority for evaluation—especially with the multitude of more acutely harmful chemicals in the market at present.

Moreover, the TSCA risk assessment framework must be amended to accommodate the unique risk profile of EDCs. While the originally proposed rule incorporated comments to consider aggregate exposures from all sources, including those regulated under other statutory regimes, when prioritizing existing

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165 *Id.* at 2387-88.

166 Watnick, *supra* note 153, at 392-93.

167 The Lautenberg Act "instructs EPA to designate a chemical high priority based on hazard and exposure potential; . . . persistence and bioaccumulation; the potential exposure of susceptible sub-populations, [like] . . . children and pregnant women; . . . conditions of use; and . . . volume of production." *Id.* at 393-94.

168 *Id.* at 392-93.

169 *Id.* at 389-90.

170 *Id.* at 394.

171 *Id.* at 404.

172 *Id.* Indeed, one scholar estimated "that it would take EPA 1,500 years to prioritize and evaluate . . . just ten percent of [chemicals] on the market today. *Id.*

173 *Id.* at 405; *see also* Wood, *supra* note 123, at 268 (noting the pharmaceutical industry is "one of the most effective lobbying organizations in the nation's capital").

chemicals,[174] the final rule allows EPA "to exclude consideration of uses purportedly regulated by other agencies."[175] This makes it easy to underestimate the impact of chemicals, like EDCs, found in many facets of our modern environment. In addition, the final rule does not incorporate comments suggesting that the agency designate certain classes of chemicals—like carcinogens and EDCs—high priority by default.[176] Designation of EDCs as high priority by default would have enhanced the Act's effectiveness because EPA's risk-assessment procedures and guidelines are not designed or well-suited to identify the risks posed by EDCs, which often have inverse bell curves of toxicity and present more danger at low-level exposures.[177] Despite the Lautenberg Act's mandate that EPA use the "best available science" in decision-making under TSCA,[178] the agency is unlikely to examine the effects of varying concentrations on different organism life stages since such research would expand the time and resources required to perform risk evaluations.[179] Additionally, even as amended by the Lautenberg Act, TSCA continues to fail to account for synergistic impacts and cumulative exposures.[180] Given these constraints, the EPA would face considerable barriers in assessing the risks posed by EDCs such as oxybenzone and octinoxate in sunscreens and cosmetics even if the statutory loophole[181] were closed.

3. Proposed personal care product legislation is human health centric and would not adequately protect the coastal marine environment.

The presence of thousands of chemicals with no health or safety data in personal care products like cosmetics has not gone unnoticed by Congress. In 2019, a flurry of legislation to regulate personal care products for public health and safety was introduced. The proposed laws included the Personal Care Products Safety Act,[182] the Safe Cosmetics and Personal Care Products Act of

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174 Watnick, *supra* note 153, at 394 (citing Procedures for Chemical Risk Evaluation Under the Amended Toxic Substances Control Act, 82 Fed. Reg. 7565, 7565-66 (2017); Procedures for Prioritization of Chemicals for Risk Evaluation Under the Toxic Substances Control Act, 82 Fed. Reg. 4826, 4829-30 (2017)).

175 *Id*. at 396.

176 *Id*. at 394.

177 *Id*. at 402. TSCA's focus on maximum exposures and dismissal of *de minimis* exposures is predicated on the assumption of a linear dose-response curve. Accordingly, TSCA's risk assessment framework fails to capture the risks of EDCs, which are known to have toxic effects at very low levels. *See id.*

178 15 U.S.C. § 2625(h) (2018).

179 Watnick, *supra* note 153, at 402.

180 Watnick, *supra* note 153, at 405 ("LCSA [the Lautenberg Act] does not give due weight to our mass exposure to EDCs and the problems described in relation to such exposure.").

181 *See* 15 U.S.C. § 2602(2)(b)(vi) (2018).

182 S. 726, 116th Cong. (2019). The Personal Care Products Safety Act was reintroduced in the 117th Congress by Senators Feinstein and Collins on June 17, 2021, *see* S. 2100, 117th Cong. (2021).

2019,[183] and the Cosmetic Safety Enhancement Act of 2019.[184] The Personal Care Products Safety Act would require disclosure of all cosmetic ingredients to the FDA and mandate the agency "to review five ingredients annually, starting with formaldehyde-releasing chemicals and parabens."[185] The Safe Cosmetics Act, like the Personal Care Products Safety Act, would have given the FDA the ability to recall products.[186] It also would have immediately prohibited the use of certain chemicals, including formaldehyde and parabens, in cosmetics.[187] Furthermore, the Safe Cosmetics Act would have established a new regulatory standard for evaluation of ingredient safety. To be deemed "safe" under the Safe Cosmetics Act, a chemical must have "reasonable certainty of [causing] no harm."[188] The Cosmetic Safety Enhancement Act would have required review on an ongoing basis of cosmetic ingredients and a determination of whether the chemical constituent is "(A) safe in cosmetic products without the need for specified conditions of use or tolerances; (B) safe in cosmetic products under specified conditions of use or tolerances; or, (C) not safe in cosmetic products."[189]

Each of these bills perished in committee during the 116th Congress,[190] and only the Personal Care Products Safety Act was reintroduced in the 117th Congress.[191] More recently introduced legislation includes the Toxic-Free Beauty Act of 2021[192] and the Cosmetic Fragrance and Flavor Ingredient Right to Know Act of 2021.[193] The former would amend the FDCA to classify cosmetics containing specific chemicals—including per-and poly- fluoroalkyl substances (PFAS), parabens, formaldehydes, and certain phthalates—*per se* "adulterated", while the latter centers on disclosure of chemicals currently classified as toxic or carcinogenic.[194]

Of these proposed laws, The Safe Cosmetics Act would have been the most capable of regulating EDCs like oxybenzone and octinoxate in personal care

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183 H.R. 4296, 116th Cong. (2019) (previously introduced as H.R. 6903, 115th Cong. § 614(a)(1) (2018)).

184 H.R. 5279, 116th Cong. (2019).

185 Jacobs, *supra* note 125, at 109.

186 *Id.* at 107, 110.

187 *Id.* at 107 (noting that toluene, certain phthalates, styrene, triclosan, benzophenones, formaldehyde, and parabens would be immediately banned from cosmetics if the Safe Cosmetics Act were passed).

188 *Id.* (citing H.R. 6903, § 611(9), the 2018 version of the current Safe Cosmetics and Personal Care Products Act).

189 H.R. 5279 § 608(d)(4).

190 H.R. 4296 and H.R. 5279 were referred to House Energy and Commerce Committee's Subcommittee on Health; S.726 was referred to the Senate Committee on Health, Education, Labor, and Pensions.

191 S. 2100, 117th Cong. (2021).

192 H.R. 5537, 117th Cong. (2021).

193 H.R. 5538, 117th Cong. (2021).

194 H.R. 5537 § 2(a); H.R. 5538 §§ 611, 612.

products if passed. Its "reasonable certainty of no harm" standard is defined as signifying "no harm will be caused to members of the general population or any vulnerable population by aggregate exposure to the cosmetic or ingredient, taking into account possible harmful effects from (A) low-dose exposures to the cosmetic or ingredient; (B) additive effects resulting from repeated exposure to the cosmetic or ingredient over time; or (C) cumulative exposure resulting from all sources, including both the cosmetic or ingredient and environmental sources."[195] By explicitly requiring consideration of additive (albeit not synergistic) effects along with low-dose and cumulative exposures, this legislation is better suited than the other proposed personal care product laws discussed above to capture the harms caused by EDCs. However, the proposed legislation requires no environmental impact assessment of products' chemical constituents or consideration of indirect harm to humans caused by environmental contamination. Given the scarcity of current research on the direct human health impacts of these two chemicals,[196] it is unlikely that either oxybenzone or octinoxate would be banned from personal care products under such a law, if enacted, in the near future. More acutely toxic ingredients in cosmetics[197] would likely take priority over those that cause endocrine disruption through long-term exposure. Moreover, the proposed legislation is inherently limited in scope to "personal care products"—a term that is not legally defined and may or may not be construed to include sunscreens.[198]

B. Environmental harm caused by chemicals in consumer products slips through the cracks of other major federal environmental laws.

Beyond TSCA and the FDCA, there are a number of federal environmental statutes that would seemingly have potential to reach this issue, yet do not—in some cases, due to practical, rather than legal obstacles. This section examines the inability of the Clean Water Act, National Environmental Policy Act, Endangered Species Act, Marine Mammal Protection Act, National Marine Sanctuaries Act, and Coastal Zone Management Act to address the ecological harm caused by EDCs, including oxybenzone and octinoxate, in sunscreens and cosmetics.

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195 H.R. 4296 § 611(9).

196 The FDA itself has acknowledged the scarcity of data. *See* 84 Fed. Reg. at 6221 (noting "the public record does not contain sufficient data to support a positive GRASE determination for cinoxate . . . octinoxate . . . [or] oxybenzone . . . at this time.").

197 Jacobs, *supra* note 125, at 97, 107 (mentioning chemicals of concern include formaldehyde, lead, toluene, and triclosan).

198 *Are All "Personal Care Products" Regulated as Cosmetics?*, U.S. FOOD & DRUG ADMIN., https://www.fda.gov/industry/fda-basics-industry/are-all-personal-care-products-regulated-cosmetics (June 16, 2022).

1. It is technologically difficult, prohibitively expensive, and administratively infeasible to regulate oxybenzone and octinoxate under the Clean Water Act.

The Clean Water Act (CWA) is often the first federal environmental statute that comes to mind when water pollution is at issue. The CWA's overarching goal is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters."[199] To that end, the Act prohibits the discharge of any pollutant from a point source[200] into waters of the United States except as in compliance with provisions of the Act.[201] As discussed in Part I, there is evidence to substantiate a finding that oxybenzone and octinoxate threaten the chemical, physical, and biological integrity of aquatic ecosystems.[202] However, there are several barriers to the regulation of chemicals like oxybenzone and octinoxate under the CWA.

The first challenge is that these two chemicals, as EDCs present in personal care products, are not easily addressed through the Act's technology-forcing design. Although swimmers may contaminate water bodies directly, "point and non-point sewage and treated wastewater effluent discharges are the largest source of [oxybenzone and octinoxate] contamination."[203] Removal of organic UV filters like oxybenzone and octinoxate from wastewater is very difficult—and costly—due to the low water solubility and high lipophilic properties of these chemicals.[204] "Even assuming technological availability, it would not be financially feasible to completely remove all EDCs,"[205] particularly since most domestic wastewater treatment facilities are owned and operated by municipal governments with competing budgetary priorities.

Nor are there water quality standards that would allow for water quality-based effluent limitations to serve as controls on endocrine-disrupting pollutants like oxybenzone and octinoxate.[206] Given the sheer number of EDCs, it would be administratively burdensome to establish and enforce individualized water quality

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199 33 U.S.C. § 1251(a) (2018).

200 A point source is a "discernible, confined and discrete conveyance." 33 U.S.C. § 1362(14) (2018).

201 *See* 33 U.S.C. § 1311(a). The main effluent permitting program under the CWA is the National Point Source Discharge Elimination System (NPDES) program established by Section 402 of the Act. *See* 33 U.S.C. § 1342.

202 Jacki Lopez, *Endocrine-Disrupting Chemical Pollution: Why the EPA Should Regulate These Chemicals Under the Clean Water Act*, 10 SUSTAINABLE DEV. L. & POL'Y 19, 20 (2010)("These EDCs [from pharmaceuticals and personal care products] are affecting the biological, chemical, and physical integrity of our water, including having profound effects on the flora and fauna that rely on clean U.S. waters.").

203 Haereticus, *Oxybenzone*, *supra* note 44.

204 Shanthi Narla & Henry W. Lim, *Sunscreen: FDA Regulation, and Environmental and Health Impact*, 19 PHOTOCHEMICAL & PHOTOBIOLOGICAL SCI. 66, 67 (2020).

205 Wood, *supra* note 123, at 244.

206 *Id.* at 243.

criteria for each EDC found in consumer products.[207] Nor would a generic water quality criterion encompassing all EDCs—or perhaps all organic UV filters—be appropriate in light of the scientific uncertainty concerning the dose-response curves of each chemical.[208] Compounding this issue is the fact that the concentration of these chemicals in wastewater effluent at the point of discharge may appear benign in laboratory studies, yet cause harm after sustained exposure at low levels, or to certain species during critical developmental stages, or upon bioaccumulation.

Section 403 of the CWA requires that permitted discharges made into the "territorial sea, the waters of the contiguous zone, or the ocean" must comply with specific ocean discharge criteria promulgated by EPA in addition to the technology or water quality-based requirements applicable to all discharges.[209] These additional regulatory protections "are intended to ensure that no unreasonable degradation of the marine environment" occurs as a result of such point source discharges and to protect sensitive ecological communities.[210] The criteria for determining unreasonable degradation of the marine environment is set forth in regulations promulgated by the EPA, and includes the "potential for bioaccumulation or persistence of the pollutants to be discharged; the potential transport of such pollutants by biological, physical, or chemical processes; and the composition and vulnerability of the biological communities that may be exposed."[211] However, because the ocean discharge criteria regulations are designed by EPA to take a back seat to state water quality standards,[212] the difficulties discussed above with respect to regulating EDCs such as oxybenzone and octinoxate under such standards remain an obstacle.

In addition to the challenges of regulating point sources of oxybenzone and octinoxate under the CWA, control of nonpoint sources of these chemicals is

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[207] *Id.* at 247-48.

[208] *Id.* at 247.

[209] 33 U.S.C. § 1343(a) (2018).

[210] EPA OFFICE OF WATER, CLEAN WATER ACT SECTION 403: A FRAMEWORK FOR ECOLOGICAL RISK ASSESSMENT (Feb. 1995) (defining "[u]nreasonable degradation to the marine environment" as "(1) Significant adverse changes in ecosystem diversity, productivity and stability of the biological community within the area of discharge and surrounding biological communities, (2) Threat to human health through direct exposure to pollutants or through consumption of exposed aquatic organisms, or (3) Loss of esthetic, recreational, scientific or economic values which is unreasonable in relation to the benefit derived from the discharge" and citing 40 C.F.R. § 125.121(e)).

[211] Determination of Unreasonable Degradation of the Marine Environment, 40 C.F.R. § 125.122 (2022).

[212] *See* Robin Kundis Craig & Sarah Miller, *Ocean Discharge Criteria and Marine Protected Areas: Ocean Water Quality Protection Under the Clean Water Act*, 29 B.C. ENV'T AFF. L. REV. 1, 31 (2001) (explaining EPA's ocean discharge criteria do not apply to the territorial sea falling within state jurisdiction (0-3 nautical miles from shore) where the state has water quality standards in place). *See also* 40 C.F.R. 125.122(b) (noting discharges in compliance with state water quality standards "shall be presumed not to cause unreasonable degradation of the marine environment" for any pollutants or conditions specified in the standard).

similarly elusive. Nonpoint source pollution programs under Section 319 of the CWA rely on pollutant-specific total maximum daily loads (TMDLs), which are not well-suited to capture the cumulative and synergistic adverse environmental effects caused by low levels of oxybenzone and octinoxate—or the numerous other EDCs in personal care products.[213]

2. The National Environmental Policy Act does not capture the impacts of endocrine-disrupting chemicals in sunscreens and cosmetics.

The National Environmental Policy Act (NEPA) aims, in part, to "prevent or eliminate damage to the environment and biosphere[.]"[214] To that end, NEPA requires federal agencies to prepare a comprehensive Environmental Impact Statement (EIS) for "major Federal actions significantly affecting the quality of the human environment."[215] Because the FDA does not "approve" cosmetics,[216] this category of consumer products evades environmental impact assessment because there is no triggering federal action. Conversely, the FDA's 2021 issuance of a sunscreen monograph administrative order pursuant to the CARES Act constituted a major federal action with potentially significant environmental consequences, triggering NEPA obligations. On May 13, 2021, the FDA announced its intent to prepare an environmental impact statement (EIS) to evaluate the potential environmental effects of revised conditions[217] for marketing certain OTC sunscreen products without prior approval of a new drug application.[218]

Drugs estimated to enter the aquatic environment at a concentration of less than one part per billion are categorically excluded from the EIS requirement.[219] Due in part to this exemption, the FDA has not, to date, prepared an EIS when taking action on an over-the-counter monograph concerning sunscreen ingredients.[220] In departing from this precedent by commencing a public scoping process to consider any potential environmental impacts associated with the use of

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213 Wood, *supra* note 123, at 249-50.

214 42 U.S.C. § 4321 ("Congressional declaration of purpose").

215 42 U.S.C. § 4332(C).

216 FDA, *supra* note 140. The FDA "regulates" cosmetics insofar as it can pull misbranded or "adulterated" products off the market, but it does not "approve" them for sale as would trigger an EIS.

217 It is important to note that ultimately, the marketing conditions in the final monograph establish permissible concentrations of oxybenzone and octinoxate identical to those proposed in the 1999 monograph and codified in 21 C.F.R. part 352. *Compare* 21 C.F.R. §§ 352.10(j), (l), 352.20 (2021), *with* § M020.10(h), (k) (permitting up to 7.5% octinoxate and up to 6% oxybenzone as sunscreen active ingredients).

218 Intent to Prepare an Environmental Impact Statement for Certain Sunscreen Drug Products for Over-the-Counter Use, 86 Fed. Reg. 26224, 26224 (May 13, 2021).

219 Human Drugs and Biologics, 21 C.F.R. § 25.31(b) (2022).

220 *See Rulemaking History for OTC Sunscreen Drug Products*, *supra* note 133 (summarizing rulemaking actions concerning over-the-counter sunscreen ingredients over the past thirty years, none of which triggered environmental impact assessment under NEPA).

oxybenzone and octinoxate in sunscreens, the FDA cited "questions raised about the extent to which two sunscreen active ingredients (oxybenzone and octinoxate) may affect coral and/or coral reefs."[221] Despite this promising step taken by the agency, the NEPA process is unlikely to result in significant changes to sunscreen formulation—due, in part, to the characteristics of EDCs' environmental and human health effects previously discussed (e.g., non-linear dose-response curves, varying impacts at different life-stage exposures and across organisms, synergistic and cumulative effects). Additionally, the proposed sunscreen monograph has already been deemed final,[222] despite a lack of agency progress in assessing the environmental impacts of oxybenzone and octinoxate.

The categorical exemption is inappropriate in the context of sunscreen active ingredients. The concentrations of oxybenzone and octinoxate measured at popular beaches[223] indicate that nonpoint sources of the chemicals can exceed the one part per billion threshold in crowded recreational areas. Furthermore, oxybenzone has been detected in industrial wastewater effluent at concentrations ranging from 6 to 697 mg/L (equivalent to 6-697 parts per *million*).[224] Given the inability of most publicly owned wastewater treatment plants to remove UV filters from effluent, it is likely that oxybenzone and octinoxate enter the environment at concentrations above one part per billion from these outfalls, too.[225]

Moreover, exempting chemicals that enter the environment at low levels does not account for the cumulative and synergistic effects produced by continual exposure to low levels of multiple, interacting chemicals.[226] NEPA regulations require consideration of "cumulative effects," which are defined as "the effects on the environment that result from the incremental effects of the action when added to the effects of other past, present, and reasonably foreseeable actions . . . ."[227] The regulations acknowledge that cumulative impacts can result from "individually minor but collectively significant" actions taking place over a period of time[228] and require consideration of reasonably foreseeable "indirect

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221 Intent to Prepare an Environmental Impact Statement for Certain Sunscreen Drug Products for Over-the-Counter Use, 86 Fed. Reg. at 26224.

222 *OTC Monographs at FDA*, U.S. FOOD & DRUG ADMIN., https://www.accessdata.fda.gov/scripts/cder/omuf/index.cfm?event=reqOrders (last visited Sept. 19, 2022).

223 Downs et al., *supra* note 47, at 265-66 (noting oxybenzone contamination at coral reef sites in the U.S. Virgin Islands ranging from 75 μg/L to 1.4 mg/L (equivalent to 75-1400 parts per billion (ppb)) and at Hawaiian sites up to 19 ppb).

224 Giokas et al., *supra* note 43, at 365.

225 *See* Fivenson et al., *supra* note 57, at 62. Since concentrations are most often studied in relation to human recreational activity, little data is available on ambient levels near wastewater discharge outfalls. *Id.* at 61.

226 He et al., *supra* note 75, at 468-69 (discussing potential for synergistic effects among sunscreen ingredients).

227 Definitions, 40 C.F.R. § 1508.1(g)(3) (2022).

228 *Id.*

effects," defined as those "later in time or farther removed in distance[.]"[229] In order to assess cumulative and indirect effects of sunscreens on the environment, the categorical exclusion of their chemical constituents from the EIS requirement must first be eliminated.

Even if the FDA were to determine that the presence and persistence of certain drug constituents with endocrine-disrupting properties in U.S. surface waters constitutes "an 'extraordinary' circumstance justifying performance of an environmental assessment,"[230] requiring new drug applicants to assess the environmental impact of their products would do nothing to address sunscreen active ingredients—like oxybenzone and octinoxate—already on the market and not considered new drugs.

3. The Endangered Species Act has limited reach and could only protect listed species and designated critical habitat.

Congress passed the Endangered Species Act (ESA), in part, "to provide a means whereby the ecosystems upon which endangered species and threatened species depend may be conserved[.]"[231] Accordingly, the Act requires federal agencies to "insure" [sic] that agency action is "not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species."[232] The ESA also prohibits the "take" of endangered species within the United States or its territorial seas.[233] The statutory definition of "take" includes "to . . . harm",[234] and the U.S. Fish and Wildlife Service has defined "harm" to include "significant habitat modification or degradation" that "actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering."[235]

In U.S. territorial waters off the coasts of Florida, the U.S. Virgin Islands, and Puerto Rico, Elkhorn coral (*Acropora palmata*) and Staghorn coral (*Acropora cervicornis)* are threatened, along with the newly listed boulder, lobed, and mountainous star corals, pillar coral, and rough cactus coral.[236] Additional species

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229 *Id.* at (2).

230 Wood, *supra* note 123, at 235.

231 16 U.S.C. § 1531(b) (2018).

232 16 U.S.C. § 1536(a)(2) (2018). Section 7 of the ESA only applies to listed species and their designated critical habitat. *See* 50 C.F.R. § 402.14(h)(1)(iv)(A).

233 16 U.S.C. § 1538(a)(1)(B). The United States territorial sea extends 12 nautical miles from the low-water line of the Coast. *U.S. Maritime Limits & Boundaries*, NAT'L OCEAN SERV., https://nauticalcharts.noaa.gov/data/us-maritime-limits-and-boundaries.html (last visited July 31, 2022).

234 16 U.S.C. 1532(19) (2018).

235 Definitions, 50 C.F.R. § 17.3 (2022).

236 Endangered and Threatened Wildlife, 50 C.F.R. § 17.11 (2022). These species are threatened "wherever found," but are largely restricted in range to the above-named states and territories. *Id.*

of threatened corals include *Acropora speciosa*, *Acropora globiceps*, *Acropora jacquelineae*, *Acropora retusa*, and *Euphyllia paradivisa*, which are found in the coastal waters of American Samoa, the Northern Mariana Islands, and Guam—all U.S. territories.[237] As reef-building corals, these ecosystem engineers[238] provide valuable feeding and breeding grounds for various species of federally listed marine wildlife, including sharks,[239] sea turtles,[240] and giant manta rays.[241] Although no species of coral throughout the Hawaiian archipelago is currently listed under the ESA,[242] sharp declines in cauliflower coral coverage have made that species a likely candidate for designation.[243]

Because reef-building corals contain photosynthesizing zooxanthellae that require sunlight, they must live within the photic zone (between the surface and approximately 200 meters of ocean depth) and are thus in close proximity to coastal recreational users and wastewater outfalls.[244] Populations of Staghorn and Elkhorn corals, which were formerly abundant throughout the Caribbean and off

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[237] *Acropora speciosa Coral*, NOAA FISHERIES, https://www.fisheries.noaa.gov/species/acropora-speciosa-coral (Apr. 29, 2022); Acropora globiceps Coral, NOAA Fisheries, https://www.fisheries.noaa.gov/species/acropora-globiceps-coral (Sept. 15, 2022); Acropora jacquelinea Coral, NOAA Fisheries, https://www.fisheries.noaa.gov/species/acropora-jacquelineae-coral (Sept. 15, 2022); Acropora retusa Coral, NOAA Fisheries, https://www.fisheries.noaa.gov/species/acropora-retusa-coral (Sept. 15, 2022); Euphyllia paradivisa Coral, NOAA Fisheries, https://www.fisheries.noaa.gov/species/euphyllia-paradivisa-coral (Apr. 29, 2022).

[238] *See generally* Estrada-Saldívar et al., *supra* note 112.

[239] *See, e.g.*, *Scalloped Hammerhead Shark*, NOAA Fisheries, https://www.fisheries.noaa.gov/species/scalloped-hammerhead-shark (last updated Jan. 4, 2022) (stating species is listed as threatened under Endangered Species Act); Biology of Sharks and Rays, Reefquest Centre For Shark Research (last visited Nov. 11, 2022), http://www.elasmo-research.org/education/ecology/rocky-scalloped.htm (last visited Nov. 5, 2022) (stating habitat, particularly feeding grounds, includes rocky and coral reefs).

[240] *See, e.g.*, Christopher H.R. Goatley et al., *The Role of Turtles as Coral Reef Macroherbivores*, 7 PLOS ONE (June 26, 2012), https://journals.plos.org/plosone/article?id=10.1371/journal.pone.0039979. Green, Olive Ridley, and Loggerhead sea turtles are threatened in most of U.S. territorial waters, while the Kemp's Ridley, Hawksbill, and Leatherback are endangered. *See* 50 C.F.R. § 17.11.

[241] *See, e.g.*, Gregory Shuraleff II, *Manta birostris*, U. OF MICH. MUSEUM OF ZOOLOGY: ANIMAL DIVERSITY Web, https://animaldiversity.org/accounts/Manta_birostris/ (last visited July 31, 2022).

[242] *Marine Protected Species of the Hawaiian Islands*, NOAA Fisheries., https://www.fisheries.noaa.gov/pacific-islands/endangered-species-conservation/marine-protected-species-hawaiian-islands (May 20, 2022).

[243] Press Release, Center for Biological Diversity, Hawaii's Cauliflower Coral Moves Toward Endangered Species Act Listing (Sept. 19, 2018), https://www.biologicaldiversity.org/news/ press_releases/2018/cauliflower-coral-09-19-2018.php.

[244] *See* Brian Tissot et al., *Abundance and Distribution of Structure forming megafaunal invertebrates, including cold-water corals, on Heceta Bank, Oregon*, RESEARCH GATE (Sep. 2004), https://www.researchgate.net/profile/Brian-Tissot/publication/237434520_ABUNDANCE_AND_DISTRIBUTION_OF_STRUCTURE_FORMING_MEGAFAUNAL_INVERTEBRATES_INCLUDING_COLD-WATER_CORALS_ON_HECETA_BANK_OREGON_2000-2002/links/5776ea2d08aeb9427e2793fa/ABUNDANCE-AND-DISTRIBUTION-OF-STRUCTURE-FORMING-MEGAFAUNAL-INVERTEBRATES-INCLUDING-COLD-WATER-CORALS-ON-HECETA-BANK-OREGON-2000-2002.pdf at 1.

the coast of southern Florida, continue to decline in the nearshore waters of Puerto Rico and the Florida Keys.[245] Since their recovery is impeded by low reproductive success, the National Marine Fisheries Service has designated critical recruitment habitat for these species off the coasts of Florida, Puerto Rico, and the U.S. Virgin Islands.[246]

As a conservation-focused statute intended to protect threatened and endangered species "virtually irrespective" of cost,[247] the ESA could potentially be used to address the harm caused by oxybenzone and octinoxate to listed species. There is increasing evidence that EDCs, including oxybenzone and octinoxate, are significantly degrading habitat—including federally designated critical habitat—in a manner that impairs the ability of certain species to feed, reproduce, and shelter.[248] Evidence of harm to reef-building corals also indicates harm to—and thus a "take" of[249]—those endangered or threatened species that rely on coral reefs for feeding, breeding, and sheltering. Although the prohibition on taking does not apply automatically to all species listed as threatened,[250] it does apply to Elkhorn and Staghorn corals,[251] the West Indian manatee[252] and green sea turtles.[253] This evidence supports an argument that the FDA's 2021 final monograph order is not compliant with the Act.[254] However, the exception for incidental take—the taking of endangered or threatened species that is "incidental to, and not the purpose of . . . an otherwise lawful activity"[255]–would almost

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[245] *Staghorn Coral*, NOAA FISHERIES, https://www.fisheries.noaa.gov/species/staghorn-coral (Sept. 16, 2022); Elkhorn Coral, NOAA Fisheries, https://www.fisheries.noaa.gov/species/elkhorn-coral (Sept. 15, 2022) (noting elkhorn coral population in the U.S. Virgin Islands appears to be stabilizing, despite low abundance).

[246] NOAA Fisheries, *supra* note 242; NOAA Fisheries, *supra* note 245.

[247] Gabriel E. Eckstein & George William Sherk, *Alternative Strategies for Addressing the Presence and Effects of Pharmaceutical and Personal Care Products in Fresh Water Resources*, 15 U. DENV. WATER L. REV. 369, 411 (2012).

[248] Lopez, *supra* note 202, at 20.

[249] *See* Babbit v. Sweet Home Chapter of Communities for a Great Or., 515 U.S. 691, 708 (1995) (holding defining "harm," within statutory meaning of "take," to include "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering" consistent with Congressional intent as reflected in ESA text, structure, and legislative history).

[250] *See* 50 C.F.R. § 17.31(a).

[251] These coral species are covered by 50 C.F.R. §17.31(a) because they were listed prior to Sept. 26, 2019. *See* Endangered and Threatened Species: Final Listing Determinations for Elkhorn Coral and Staghorn Coral, 71 Fed. Reg. 26,852 (May 9, 2006).

[252] The West Indian manatee was reclassified from "endangered" to "threatened" in 2017. *See* Reclassification of the West Indian Manatee From Endangered to Threatened, 82 Fed. Reg. 16,668 (Apr. 5, 2017). Because it was listed as threatened prior to Sept. 26, 2019, it is protected from taking pursuant to 50 C.F.R. §17.31(a).

[253] 50 C.F.R. § 17.42(b).

[254] There is some precedent for such a suit. *See* Def. of Wildlife v. Adm'r EPA, 882 F.2d 1294, 1301-03 (8th Cir. 1989) (holding EPA's registration of certain pesticides an effective "taking" of endangered species).

[255] 16 U.S.C. § 1539(a)(1)(B) (2018).

certainly apply. Moreover, even if evidence of harm to endangered and threatened species could be linked to wastewater outfalls with National Pollutant Discharge Elimination System (NPDES) permits[256] and used to petition EPA for action,[257] citizen and environmental groups seeking to do so would be restricted to challenging the permits of outfalls in proximity to listed species' habitat on a piecemeal basis. The fact that these chemicals are most pernicious in the aggregate, over long periods of exposure and in combination with other chemical and physical hazards, further complicates and attenuates the requisite finding of causation.[258]

4. The Marine Mammal Protection Act and National Marine Sanctuaries Act are inadequate in scope to address this problem.

Two additional federal statutes that are specifically charged with protecting marine species and ecosystems fall short of reaching this issue.[259]

a. The species-specific Marine Mammal Protection Act excludes protection of non-mammal species and would be difficult to utilize in this context.

The Marine Mammal Protection Act (MMPA) prohibits the "take" of marine mammals; however, it does not define "take" as expansively as the ESA, and instead limits the definition to mean "harass, hunt, capture, or kill."[260] Because it is limited in scope to marine mammal species, the MMPA could not be used to directly protect the animals most impacted by oxybenzone and octinoxate: corals. Even if more data were available regarding the specific health effects of

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256 National Pollutant Discharge Elimination System (NPDES) permits are granted by the EPA pursuant to Section 402 of the Clean Water Act.

257 *Cf.* Schroeck, *supra* note 143, at 286 (explaining linkage of ecological harm from microbeads and microplastics discharged from NPDES-permitted wastewater treatment plants could be used to petition EPA to take action). (Schroeck writes:

> Microplastic pollution is a serious threat to the health of the Great Lakes basin and to the ecosystems and communities of the Great Lakes region. Therefore, a petitioner could effectively petition EPA to conduct an EIS with respect to microplastic pollution resulting from its decisions to grant NPDES permits to wastewater treatment facilities or authorizing state programs to grant such permits.)

258 *See* Aransas Project v. Shaw, 775 F.3d 641, 656-58 (5th Cir. 2014) (explaining proximate cause and foreseeability are required for ESA liability, and noting district court erred by failing to consider "remoteness, attenuation, or the natural and probable consequences of actions"). *See also Sweet Home Chapter of Communities for a Great Oregon*, 515 U.S. at 709 (1995) (O'Connor, J. concurring) ("[T]he regulation's application is limited by ordinary principles of proximate causation, which introduce notions of foreseeability.").

259 Another federal statute concerning ocean issues is the Ocean Dumping Act. However, the issue of oxybenzone and octinoxate contamination of coastal waters falls beyond the scope of the ODA because the definition of dumping explicitly exempts effluent from ocean sewage outfalls, which falls instead within the jurisdiction of the CWA. *See* 33 U.S.C. § 1402(f).

260 16 U.S.C. § 1362(13) (2018).

oxybenzone and octinoxate on marine mammals, it is unlikely that a court would consider endocrine disruption to fall within the meaning of a "take."[261] An argument could be made that pollution of waters with these chemicals is an act of "annoyance" with the potential to injure or disturb a particular type of marine mammal in the wild, such as by causing the disruption of behavioral patterns.[262] However, since the MMPA, like the ESA, provides for incidental takings—defined as non-intentional or accidental acts that result from, but are not the purpose of, carrying out an otherwise lawful action[263]—such an argument is unlikely to succeed.

b. The spatial management scheme of the National Marine Sanctuaries Act is ill-equipped to address this issue.

The National Marine Sanctuaries Act (NMSA) gives the Secretary of Commerce power to designate as marine sanctuaries areas of the marine environment that are "of special national significance."[264] To advance the "primary objective" of resource protection,[265] The Act's objectives include conserving "the natural biological communities" in sanctuary areas[266] and establishing a policy "to protect, and, where appropriate, restore and enhance natural habitats, populations, and ecological processes."[267] However, the NMSA is not well-suited to address the problem of oxybenzone and octinoxate pollution in coastal waters. The Act is inherently limited in spatial coverage; it is designed to protect a limited number of "special" areas rather than the majority of coastal waters.[268] Levels of protection vary, and even those areas with the highest level of protection ("no-take" marine protected areas) permit swimming and other types of non-extractive recreational activities[269] that allow for contamination with these chemicals. Because the factors pertaining to a designation include the value of living marine resources in the area, along with biological productivity, ecosystem structure, and aesthetic quality,[270] areas selected for protection are likely to be

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[261] *See* United States v. Hayashi, 22 F.3d 859, 864 (9th Cir. 1993) (noting principles of statutory interpretation suggest that for "harassment" to be a "take" under the MMPA, it must entail a "significant" level of "direct intrusion").

[262] *See* 16 U.S.C. § 1362(18)(A) (defining "harassment").

[263] 50 C.F.R. § 229.2.

[264] 16 U.S.C. § 1431(b)(1) (2018).

[265] *Id.* § 1431(b)(6) .

[266] *Id.* § 1431(b)(3)

[267] *Id.*

[268] *See* Holly Doremus, *The Special Importance of Ordinary Places*, 23 ENVIRONS Spring 2000, at 3, 10-12 (explaining protection of "special" places, such as reserves within artificially drawn boundaries, may actually undermine the ecological goals for which we set nature aside, like biodiversity).

[269] *Marine Protected Areas 2020*, NOAA'S MPA Ctr., https://marineprotectedareas.noaa.gov/aboutmpas/marine-protected-areas-2020.html (last visited July 31, 2022).

[270] *See* 16 U.S.C. § 1433 (2018).

pristine, rather than those already struggling or degraded. The Act is thus unlikely to reach areas in proximity to recreation hotspots or wastewater effluent outfalls. Furthermore, surface ocean currents and fluid dynamics like diffusion make it difficult to contain chemical components at their point of entry,[271] rendering spatial protections less effective against threats of chemical contamination.

5. The Coastal Zone Management Act cannot uniformly address this issue.

The Coastal Zone Management Act (CZMA) was enacted in 1972 "to establish a national policy and develop a national program for the management, beneficial use, protection, and development of the land and water resources of the nation's coastal zones."[272] The Act declares that it is the policy of the United States "to preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations."[273] The CZMA's main operative mechanism is the National Coastal Zone Management Program (NCZMP), a voluntary program through which states work with the National Oceanic and Atmospheric Administration (NOAA) to develop and implement coastal management programs that further the states' priorities and the objectives of the CZMA.[274] States are incentivized to join the program by gaining access to funding opportunities and the ability to exercise the process of federal consistency review[275] upon becoming approved members.[276] Of the nation's 35 "coastal states" (a category that includes states bordering the Great Lakes and all five U.S. territories), 34 are members of the NCZMP.[277]

Because states choose which issues to emphasize in their coastal management programs, implementation of the CZMA varies state to state.[278] The CZMA requires that state coastal management programs provide for "protection of natural resources, including . . . coral reefs, and fish and wildlife and their habitat, within the coastal zone"[279] and "management of coastal development to improve, safeguard, and restore the quality of coastal waters, and to protect natural resources and existing uses of those waters[.]"[280] However, modifications to

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271 Schneider & Lim, *supra* note 51, at 268.

272 EVA LIPIEC, CONG. RSCH. SERV., COASTAL ZONE MANAGEMENT ACT (CZMA): OVERVIEW AND ISSUES FOR CONGRESS 2 (2019) (citing the long title of the Coastal Zone Management Act of 1972, Pub. L. No. 92-583, 86 Stat. 1280 (1972) (codified at 16 U.S.C. §§ 1451-1467.)).

273 16 U.S.C. § 1452(1) (2018).

274 Lipiec, *supra* note 272, at 2-3.

275 Federal consistency review is the process through which states ensure federal actions within their jurisdiction are consistent with the approved coastal management program. *Id.* at 4.

276 DONNA R. CHRISTIE & ANASTASIA TELESETSKY, OCEAN & COASTAL LAW IN A NUTSHELL 102 (5th ed. 2019).

277 Lipiec, *supra* note 272, at 3 (noting Alaska withdrew from the program on July 1, 2011).

278 *See id.*

279 16 U.S.C. § 1452(2)(a) (2018).

280 *Id.* § 1452(2)(c).

approved coastal management programs must be proposed by the states; NOAA does not have the authority to require modification of a previously approved program by conditioning continued receipt of funding on alteration of the program.[281] Although NOAA may "suggest steps" that a state may take to better achieve the objectives of the CZMA,[282] the CZMA's delegation of substantive coastal policymaking to the states would produce a patchwork effect in regulation of oxybenzone and octinoxate even if some states did decide to ban use or sale of products containing these chemicals in the coastal zone.

The only mandatory component of the CZMA—the National Coastal Nonpoint Pollution Control program, added in 1990—focuses on land-use in the coastal zone,[283] as opposed to human activity, and is thus impractical to address the problem of chemicals introduced directly by swimmers (or as point source effluent from wastewater treatment plants).

C. State and local law is inadequate to solve this problem comprehensively.

The United States' current system of environmental law operates on a model of cooperative federalism; the federal government sets regulatory standards that serve as a "floor," above which states may regulate, provided they keep within the constitutional constraints of the Commerce Clause.[284] States may not regulate in areas in which they are federally preempted, and states may likewise preempt municipalities. In recent years, the state of Hawaii, the municipality of Key West, and the territory of the U.S. Virgin Islands have passed legislation banning sunscreens containing oxybenzone and octinoxate. Each of these laws and its implementation is described below.

1. Hawaii as a case study: the inadequacy of regulating oxybenzone and octinoxate in sunscreens at the point of sale.

In May 2018, Hawaii became the first state in the nation to ban the sale of over-the-counter sunscreens containing oxybenzone and octinoxate.[285] Concluding that the two chemicals have "significant harmful impacts on Hawaii's marine environment and residing ecosystems, including coral reefs that protect Hawaii's

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[281] California *ex rel.* California Coastal Comm'n v. Mack, 693 F. Supp. 821, 825 (N.D. Cal. 1988) ("Congress evidently intended that NOAA would play a passive role in this process, merely reviewing proposals put forth by the state.").

[282] *Id.* at 826.

[283] *See* 16 U.S.C. § 1455(b) (2018).

[284] *See* U.S. CONST. art. I, § 8, cl. 3 (giving Congress the exclusive power to regulate Commerce with foreign Nations, and among the several States . . . .").

[285] *See* S.B. 2571, 29th Leg. Reg. Sess. (Haw.2018). Legislation introduced in 2021 would have expanded the ban to include sunscreens containing avobenzone and octocrylene but died in the Consumer Protection and Commerce Committee of the state House of Representatives. *See* S.B. 132, 31st Leg. Reg. Sess. (Haw. 2021).

shoreline," the state legislature summarized the deleterious impacts of these chemicals on corals[286] and noted that they "degrade corals' resiliency and ability to adjust to climate change factors," along with inhibiting recruitment of new corals.[287] The bill extends beyond a narrow focus of protecting coral reefs, however; its purpose is "to preserve marine ecosystems" including but not limited to reef ecosystems. Accordingly, it describes the various endocrine-disrupting, teratogenic, and reproductive toxicity effects of oxybenzone and octinoxate on other marine invertebrate species (such as sea urchins and shrimp), vertebrate species (including wrasses, eels, and parrotfish), and mammals.[288] Moreover, it cites several species federally protected under the ESA that are likely to encounter oxybenzone and octinoxate contamination in Hawaii's waters, including sea turtles, Hawaiian monk seals, and various migratory birds.[289]

Hawaii's law went into effect on January 1, 2021. It prohibits the "sale, offer for sale, and distribution in Hawaii of sunscreen containing oxybenzone and octinoxate without a prescription from a licensed healthcare provider" by amending the Water Pollution section in Title 19 ("Health") of Hawaii's Revised Statutes.[290] Although the law prioritizes human health needs above marine ecosystem preservation by creating a carveout for individuals who require sunscreens containing these compounds for medical reasons, it faced vigorous opposition from the dermatological community. The American Academy of Dermatology and the Hawaii Dermatological Society claimed that the law could create a public health concern by reducing the availability of broad-spectrum UV protection and creating a public perception that sunscreen is generally unsafe.[291] The bill also faced backlash from the Hawaii Medical Association, the Hawaii Skin Cancer Coalition, and the Consumer Healthcare Products Association, along with manufacturers and retailers of sunscreen products, the Hawaii Food and Industry Association, and the American Chemistry Council.[292] Fortunately, the worry voiced by these groups—that sunscreen use might decline, increasing the risk of skin cancer among island residents and tourists[293]—did not dissuade legislators from passing the ban. One state lawmaker in support of the bill noted

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286 The bill states "Oxybenzone and octinoxate cause mortality in developing coral; increase coral bleaching that indicates extreme stress, even at temperatures below 87.8 degrees Fahrenheit; and cause genetic damage to coral and other marine organisms." Haw. S.B. 2571, *supra* note 285, lines 5-9.

287 *Id.*

288 *Id.*

289 *Id.; see* Haw. Rev. Stat. § 342D-21 (2018) (codifying 2018 Hawaii Laws Act 104 (S.B. 2571) into water pollution chapter of Title 19).

290 *Id.*

291 Fivenson, *supra* note 57, at 61.

292 Goldberg Segalla, LLP., *Hawaii's Ban on Oxybenzone and Octinoxate-Containing Sunscreen Takes Effect*, LEXOLOGY (Jan. 21, 2021), https://www.lexology.com/library/detail.aspx?g=dc777751-66bf-4b68-abe4-3176bb93a589.

293 *Id.*

"[h]ealthy reefs are a fundamental part of a larger ecosystem which is important to the health of our planet."[294] Another state legislator commented "[i]n my lifetime, our planet has lost about half its coral reefs. We've got to take action to make sure we can protect the other half as best we can because we know that time is against us."[295]

Despite the strength of the legislation's statement of purpose, it falls short of the comprehensive protection that elimination of these chemicals in commerce through a federal law could provide. First, it does not include "products marketed or intended for use as a cosmetic."[296] Thus, while it may help control introduction of these chemicals into the marine environment from sunscreens during direct contact recreation, it will not reach the issue of these chemicals in wastewater effluent—much of which, given the Hawaiian archipelago's geography, is discharged directly[297] or indirectly[298] in proximity to coral reefs. Interestingly, the bill does acknowledge that "these chemicals are not removed by the State's wastewater treatment system" and lists sewage contamination of coastal waters from cesspools, leaking septic systems, and municipal wastewater collection and treatment systems as sources.[299]

Additionally, as point-of-sale regulation, Hawaii's ban is powerless to stop individuals from using sunscreens purchased out of state. According to one study, slightly over half of U.S. and international visitors to Hawaii's beaches purchased their sunscreen outside of Hawaii.[300] This means that a significant portion of sunscreens being used in the state (the study author estimates about half)[301] are not subject to the chemical ban. Nor does the Act provide an enforcement mechanism.[302] One approach to remedying this problem is to raise awareness, through public outreach and education campaigns, of the harm to marine ecosystems that sunscreens containing oxybenzone and octinoxate cause.

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294 Press Release, Governor David Ige Signs Bill Making Hawaii First in the World to Ban Certain Sunscreens (July 3, 2018), https://governor.hawaii.gov/newsroom/latest-news/office-of-the-governor-news-release-governor-david-ige-signs-bill-making-hawaii-first-in-the-world-to-ban-certain-sunscreens/.

295 *Id.*

296 Haw. S.B. 2571, *supra* note 285.

297 *DOH Advises Public to Avoid Kailua Bay after Large Discharges of Wastewater*, HAW. NEWS NOW (Feb. 27, 2021 6:28 PM), https://www.hawaiinewsnow.com/2021/02/27/doh-advises-public-avoid-kailua-bay-after-large-discharges-wastewater/ (explaining Kailua Regional Wastewater Treatment Plant discharges up to 15.25 million gallons (equivalent of 27 Olympic-size swimming pools) of treated wastewater effluent a day into Kailua Bay).

298 *See generally* Cty. of Maui v. Haw. Wildlife Fund, 140 S. Ct. 1462 (2020).

299 Haw. S.B. 2571, *supra* note 284.

300 Levine, *supra* note 67, at 5.

301 *Id.* at 1.

302 Claire Caulfield, *Hawaii Has a Ban on Sunscreen Chemicals But No One's Sure Who Should Enforce It*, HAW. CIV. BEAT (Aug. 3, 2021), https://www.civilbeat.org/2021/08/hawaii-has-a-ban-on-sunscreen-chemicals-but-no-ones-sure-who-should-enforce-it/ ("The bill doesn't outline any penalties for breaking the law or designate an agency to enforce the ban.").

However, since sunscreens that are not "reef safe" cost less per ounce than those free of oxybenzone and octinoxate (and other harmful chemicals),[303] leaving the issue up to consumer choice is unwise.[304]

2. Florida as a case study: the vulnerability of local environmental protection measures to state preemption.

Following Hawaii's lead, the Key West City Commission voted in February 2019 to prohibit the sale and distribution of sunscreens containing oxybenzone and octinoxate.[305] Noting that the Great Florida Reef—the largest reef in the continental U.S. and home to several species of threatened corals[306]—is vital not only to the regional ecosystem, but also to the local tourist economy, the Mayor of Key West explained "[t]here are thousands of sunscreens out there, and we have one reef. And we have an opportunity to do one small thing to protect that. I believe it's our obligation."[307] Although, like Hawaii's bill, the ordinance would ban the *sale* (not use) of sunscreens containing the two chemicals within Key West, proponents hoped it would also raise consumer awareness about sunscreen's environmental impact.[308]

The law would have gone into effect the same day as Hawaii's ban: January 1, 2021. However, in June 2020, Florida's governor signed legislation amending the Florida Drug and Cosmetic Act that preempts any municipal effort to regulate over-the-counter drugs and cosmetics, including sunscreen products, by reserving that authority expressly for the state.[309] Although such preemption runs contrary to the state's home rule doctrine,[310] it is the latest in a slew of state laws preempting local environmental protection ordinances[311] that has been upheld as

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[303] John Tsatalis et al., *Evaluation of Reef Safe Sunscreens: Labeling and Cost Implications for Consumers*, 82 J. AM. ACAD. DERMATOLOGY 1015, 1016 (2020).

[304] *See* Bosselmann, *supra* note 36, at 2434 ("Experimental research has shown that humans strongly favor avoidance of immediate costs over the risk of less immediate, long-term costs, even if they will be much higher.").

[305] Ouchene et al., *supra* note 108, at 649.

[306] Chelsea Harvey, *The Biggest Coral Reef in the Continental U.S. is Dissolving into the Ocean*, THE WASHINGTON POST (May 4, 2016), https://www.washingtonpost.com/news/energy-environment/wp/2016/05/04/the-largest-coral-reef-in-the-continental-u-s-is-dissolving-into-the-ocean/ (stating Florida reef system is largest in continental U.S. and third largest in world); NOAA Fisheries, *supra* note 245 (noting Staghorn coral is found off the coast of Florida); NOAA Fisheries, *supra* note 245 (noting Elkhorn coral is found in the Florida Keys).

[307] Lindsey Beaver, *'We Have One Reef': Key West Bans Popular Sunscreens to Help Keep Coral Alive*, THE WASHINGTON POST (Feb. 6, 2019, 5:01 PM), https://www.washingtonpost.com/climate-environment/2019/02/06/we-have-one-reef-key-west-bans-popular-sunscreens-help-keep-coral-alive/.

[308] *Id.*

[309] *See* S.B. 172, 2020 Leg. Reg. Sess. (Fla. 2020) (codified as amended at FLA. STAT. § 499.002(7) (2020)).

[310] *See* FLA. STAT. § 166.011 *et seq.* (2020).

[311] *See, e.g.*, Lindsey Leake, *Florida Supreme Court Won't Hear Foam Ban Case; Stuart Says*

consistent with the state's constitution by the Florida District Court of Appeals.[312] Key Wests' short-lived ordinance banning oxybenzone and octinoxate—along with the fact that a state bill largely resembling Hawaii's ban died in committee[313]—illustrates why federal law on this issue is needed.

3. The U.S. Virgin Islands as a case study: a model law for territories, yet unenforceable at the national scale.

In June 2019, the U.S. Virgin Islands legislature unanimously passed Act 8185, a law banning sunscreens containing oxybenzone, octinoxate, and a third ingredient (octocrylene) identified by NOAA as harmful to marine life.[314] While the law contains substantially similar language to Hawaii's S.B. 2571 and purports to "preserve marine ecosystems," it was passed as an amendment to the section of the territory's legal code governing business.[315] This marks a departure from Hawaii's and Florida' passage of sunscreen legislation as amendments to human health-focused laws. Like the other two bans, the U.S. Virgin Islands' ban exempts cosmetics (despite acknowledging that many personal care products contain these chemicals) and prescription sunscreens.[316]

Although the U.S. Virgin Islands' law was passed after Hawaii's and Key Wests' bans, it was the first among the three to be implemented. On December 31, 2019, a ban on importation of sunscreens containing any of the three prohibited ingredients became effective, and on March 30, 2020, the ban on sale and distribution of such sunscreen products went into effect.[317] In addition to broadening the scope of chemicals banned, the law extends an additional degree of protection through its unique phase-in structure. As of January 1, 2021, the prohibition expanded to include transportation of sunscreen products containing any of the banned ingredients into the territory, as well as possession of the same.[318] This measure addresses the problem of tourists bringing sunscreens that

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Straw Ban Not Impacted, TCPALM (Feb. 12, 2020, 5:26 PM), https://www.tcpalm.com/story/news/2020/02/12/foam-polystyrene-ban-florida-supreme-court-coral-gables-case/4743879002/ (describing preemption of local ordinances prohibiting use of polystyrene and plastic bags).

312 *See, e.g.*, Fla. Retail Fed'n, Inc. v. City of Coral Gables, 282 So. 3d 889 (Fla. Dist. Ct. App. 2019), *review denied*, No. SC19-1798, 2020 WL 710303 (Fla. Feb. 12, 2020).

313 *See* S.B. 318, 2020 Leg. Reg. Sess. (Fla. 2020).

314 *Skincare Chemicals and Coral Reefs*, NAT'L OCEAN SERV., https://oceanservice.noaa.gov/news/sunscreen-corals.html (last updated Aug. 17, 2022).

315 *See* Act. No. 8185, 33rd V.I. Leg. Reg. Sess. (Jul. 20, 2019) (amending Title 27, chapter 9 of the U.S. Virgin Islands code).

316 *Id.*

317 Kelley Czajka, *The U.S. Virgin Islands Bans Potentially Dangerous Sunscreen Chemicals*, PACIFIC STANDARD (JUL 5, 2019), https://psmag.com/news/the-us-virgin-islands-bans-potentially-dangerous-sunscreen-chemicals; Hillary Bonner, *USVI Makes History with First Sunscreen Ban in the US*, NEWS OF ST. JOHN (Dec. 16, 2020), https://newsofstjohn.com/usvi-makes-history-with-first-sunscreen-ban-in-the-us/.

318 Fivenson, *supra* note 57, at 61.

are not reef-safe into the territory. Additionally, the Act requires disposal of sunscreens containing the banned chemicals as hazardous waste, to further ensure that they will not end up contaminating coastal waters. Finally, the law contains an explicit enforcement mechanism whereby first-time violators may be fined up to $1,000, with a penalty of $2,000 for each subsequent offense.[319]

With its explicit penalty provision, progressive phase-in structure, and inclusion of octocrylene, Act 8185 creates the strongest protections for marine ecosystems from UV filters in the United States.[320] Although it remains to be seen how costly the transportation and possession component of the ban will prove to be in terms of monitoring and enforcement, the legislation is likely to be more effective at eliminating these contaminants from coastal waters than Hawaii's point-of-sale ban. As such, Act 8185 should serve as a model bill for states and territories seeking to protect their marine ecosystems in the absence of current federal legislation. However, federal legislation remains preferable to achieve comprehensive protection for marine ecosystems throughout all U.S. territorial waters. The most feasible approach would be to remove these chemicals from commerce, since the resources required to enforce a prohibition on transport into and possession of such products in the U.S. make the Virgin Islands' approach logistically impractical at the national scale.

III. THE MICROBEAD FREE WATERS ACT OF 2015 ILLUSTRATES HOW OXYBENZONE AND OCTINOXATE COULD BE BANNED FROM SUNSCREENS AND COSMETICS

This section explores how marine environmental contamination with oxybenzone and octinoxate from sunscreens and cosmetic products could be addressed by eliminating the pollutants at their source. A ban on the production, sale, and distribution in interstate commerce of all cosmetic products and non-prescription (i.e., "over-the-counter") sunscreens containing either of the two chemicals could be enacted as an amendment to the Food, Drug, and Cosmetics Act (FDCA) by emulating the strategies used to pass the Microbead Free Waters Act of 2015.

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319 *Id.*

320 As of October 1, 2022, the use, sale, and distribution of non-mineral sunscreens is prohibited in the county of Maui. *See Mineral Only Sunscreen Maui County*, COUNTY OF MAUI HAWAII (last visited Nov. 11, 2022), https://www.mauicounty.gov/2483/Mineral-Only-Sunscreen-Maui-County. While this new county-level ordinance casts a wider net in including all non-mineral sunscreens in the ban, it does not prohibit their importation; consequently, Act 8185 remains the most robust legislation in terms of likely impact. *See* Levine, *supra* note 67, at 1 (noting approximately half of sunscreens in use were brought in from out of state, and thus not subject to ban).

A. The Microbead Free Waters Act of 2015 achieved comprehensive environmental protection while positioned as a health bill.

As noted above, much of the United States' environmental legislation originated in the 1970's. Several prominently publicized environmental catastrophes sparked public consciousness and concern, and lawmakers on both sides of the aisle found it politically advantageous to embrace the issue of environmental protection in response.[321] In the decades that have followed, Congress has, on occasion, amended the major environmental laws passed during this burst of momentum; however, the Clean Air Act Amendments of 1990 are considered by many as the last "significant environmental legislation" to get through Congress.[322] Law scholars and political analysts have remarked that a burgeoning partisan divide on environmental issues makes comprehensive new legislation in this policy area unlikely.[323]

The Microbead Free Waters Act of 2015 (MFWA) defies this expectation, as well as presumptions of Congressional gridlock and the glacial pace of policymaking in general.[324] Though framed as a health bill, the MFWA surmounted legislative stalemate to achieve substantial environmental protection by eliminating an ecologically harmful ingredient in personal care products. The bill was introduced in the House of Representatives on March 4, 2015, and became law less than a year later, passing in the Senate with unanimous consent and without amendment.[325] The Act is concise and straightforward. It prohibits "[t]he manufacture or the introduction or delivery for introduction into interstate commerce of a rinse-off cosmetic that contains intentionally-added plastic microbeads."[326] It features a phase-in approach; the manufacturing ban on cosmetics became effective July 1, 2017, and the manufacturing ban on nonprescription drugs took effect on July 1, 2018.[327] The ban on introduction into commerce for each class of products took effect exactly one year after the

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321 Richard J. Lazarus, *The Greening of America and the Graying of United States Environmental Law: Reflections on Environmental Law's First Three Decades in the United States*, 20 VA. ENV'T L.J. 75, 79-80.

322 Strifling, *supra* note 33, at 160.

323 DAVID KAROL, PARTY POLARIZATION ON ENVIRONMENTAL ISSUES: TOWARD PROSPECTS FOR CHANGE 1 (2018); Strifling, *supra* note 33, at 151, 159 ("Much ink has been spilled lamenting the difficulty of passing new environmental legislation in the modern era."). Not even the existential threat of climate change has increased the likelihood of bridging the bipartisan divide on environmental issues. *See* Teirstein & Osaka, *supra* note 33.

324 *See* John Schwartz, *Ban on Microbeads Proves Easy to Pass Through Pipeline*, N.Y. TIMES (Dec. 22, 2015), https://www.nytimes.com/2015/12/23/science/ban-on-microbeads-proves-easy-to-pass-through-pipeline.html.

325 H.R. 1321, CONGRESS.GOV (last visited Jun. 20, 2022), https://www.congress.gov/bill/114th-congress/house-bill/1321/actions (chronicling legislative actions leading to passage of Microbead Free Waters Act of 2015, Pub. L. 114-114, 129 Stat. 3129 (2015)).

326 21 U.S.C. § 331(ddd)(1) (2018).

327 Microbead Free Waters Act of 2015, § 2, 129 Stat. 3129.

corresponding ban on manufacturing.[328] The Act also preempted state and local bans on plastic microbeads to the extent that they were not identical to the federal law.[329]

The MFWA's successful passage has been attributed to several factors. One is its simplicity and narrow focus.[330] Increased scientific understanding of the environmental and human health hazards posed by microbeads and broad stakeholder support from grassroots programs also played key roles. Industry support was pivotal in the Act's success, as was the legislative trend of state and local bans. Increasing public awareness and consumer demand for microbead-free products helped solidify the Act's appeal to lawmakers and manufacturers alike. Ultimately, due to well-publicized benefits and few apparent drawbacks, there was "no real opposition" to the law.[331]

If the turbulent response to Hawaii's state ban and Florida's swift preemption of Key West's local ban are any indication, it is unlikely that a bill banning oxybenzone and octinoxate in sunscreens and cosmetics would encounter such smooth sailing in Congress. However, there are lessons to be learned—and leveraged—from the MFWA's success. First, keeping a proposed ban on these two chemicals "tightly focused and of modest scope" could help build support amongst a broad coalition of stakeholders and increase the likelihood of passage.[332] For example, just as the MFWA "ma[de] no effort to address the situation [of anthropogenic plastic pollution in waterbodies] in its entirety,"[333] an act banning oxybenzone and octinoxate from cosmetics and sunscreens could likewise be positioned as targeting one discrete aspect of the much larger, overarching problem of EDCs in personal care products. One legal scholar describes this as a "fundamental tradeoff," noting that although the MFWA fell short of addressing the problem of plastics pollution in one fell swoop, it likely would not have passed had it aspired to do so.[334]

Another angle that aided in the MFWA's success was its positioning as a human health bill, rather than an environmental protection bill. Since 1973, every resolution introduced in Congress has been tagged with a "policy area field code" summarizing its purpose or primary effect; proponents of the MFWA chose to label the law as a "Health" bill, rather than selecting the label "Environmental Protection" (which includes water quality measures) or "Animals" (which

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328 *Id.*; Strifling, *supra* note 33, at 158.

329 Strifling, *supra* note 33, at 158.

330 *Id.* at 159 ("[H]ad the Act included broader provisions to, for example, limit the usage of plastic bags, one can surmise that it would never have seen the floor, let alone passed both houses of Congress.").

331 *Id.* at 161.

332 *Id.*

333 *Id.*

334 *Id.* at 162.

includes wildlife conservation and habitat protection).[335] Classification of the law as a health bill was certainly not unfounded, since microbeads concentrate pathogens and chemicals hazardous to public health, are susceptible to bioaccumulation in food chains, and are frequently ingested by aquatic organisms that humans consume.[336] Moreover, it was logical to classify the bill under "Health" because it amended a statute primarily focused on consumer health and safety. However, the decision to situate the bill as a health law was also strategic in that it helped avoid partisan opposition[337] and the minefield of obstacles environmentally-purposed legislation often encounters, such as critiques of placing the health of non-human species over the health of humans, or accusations of prioritizing environment over economy.[338] Furthermore, scholars have suggested that because humans are evolutionarily programmed for self-preservation, it is easier to garner support against a threat we believe will harm us imminently and directly, rather than indirectly in the distant future through some chain of events with numerous causal links and a degree of scientific uncertainty.[339]

Industry support was garnered for the MFWA in part by frustration over the "patchwork" of state and local regulations restricting microbeads in inconsistent ways.[340] By late 2015, nine states had passed some form of microbead ban, and

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[335] *Id.* at 164; *Policy Areas — Field Values*, CONGRESS.GOV, https://www.congress.gov/help/field-values/policy-area (last visited June 20, 2022). This is particularly interesting since the Committee Report on the bill states as its purpose "to prevent [microbeads] from getting into waterways across the United States," and cites the fact that these pollutants "make their way into our waterways and wildlife" as evidence of the need for legislation—omitting any discussion of the potential for human health impacts. H.R. REP. NO. 114-371, at 2 (2015).

[336] *See* Strifling, *supra* note 33, at 164.

[337] *See id.* ("[I]dentification of these public health aspects of the issue may well have eliminated–or at least rendered surmountable–the ordinary partisan blockade to new environmental legislation.").

[338] *See, e.g.*, Laura Westra, *The Link Between Ecological Integrity and Human Health in the Present and the Future: Second-Order Principles*, in LIVING IN INTEGRITY: A GLOBAL ETHIC TO RESTORE A FRAGMENTED EARTH 23 (1998) ("Ecocentric environmentalists have often been accused of caring so much for wild animals and wild areas that they leave human concerns out of the equation."); *see also* Jim Turner, *Senate Ties Tourism Funding to Sunscreen*, THE ST. AUGUSTINE REC. (Mar. 20, 2019), https://www.staugustine.com/story/news/state/2019/03/20/senate-ties-tourism-funding-to-sunscreen/5662261007/ (quoting Florida Senate Transportation, Tourism, and Economic Development Appropriations Subcommittee Chairman Travis Hutson on excluding communities that had banned certain sunscreens from state tourism funding: "I don't want [our] brand to be changed from the Sunshine State to the melanoma capital of the world").

[339] *See Why Climate Change Threats Don't Trigger an Immediate Response from Human Brains*, NPR (Dec. 12, 2019), https://www.npr.org/2019/12/12/787552712/why-climate-change-threats-dont-trigger-an-immediate-response-from-human-brains (explaining human brains are designed to respond to threats that are personal and imminent); Art Markman, *Why People Aren't Motivated to Address Climate Change*, HARVARD BUS. REV. (Oct. 11, 2018), https://hbr.org/2018/10/why-people-arent-motivated-to-address-climate-change (explaining why threats perceived to be future, abstract, and uncertain, like climate change, do not trigger our instinctual threat-aversion response).

[340] Strifling, *supra* note 33, at 162.

more were considering such action.[341] In fact, one industry representative openly welcomed the passage of "one uniform policy across the country."[342] Since Hawaii and the U.S. Virgin Islands are the only U.S. jurisdictions at present with any form of a ban on oxybenzone and octinoxate in place, this aspect does not aid much in the push for a federal ban on these chemicals in personal care products. However, another dynamic observed in the MFWA's legislative trajectory could play a helpful role: companies that already produce sunscreens, cosmetics, or other personal care products free from oxybenzone and octinoxate may welcome a ban as an opportunity to level the playing field among manufacturers. As one professor of environmental policy has observed, nearly all public regulation is "private-interest rent-seeking in disguise."[343] In other words, companies that already manufacture their products free from these chemicals—perhaps motivated by corporate social responsibility or eco-consciousness—may support a federal legislative ban to eliminate the competitive advantage that other manufacturers derive from using these cheaper chemicals (and consequently, selling at a lower price point).[344]

Campaigns to increase public awareness and generate support for microbead-free products further aided the MFWA's passage. The United Nations Environment Programme published a report calling the widespread use of microbeads "[a]n emerging global environmental issue" and urging adoption of a "precautionary approach" in microbead regulation.[345] Informal, grassroots public information campaigns raised awareness of the issue, and a non-profit organization based in Amsterdam[346] designed a smartphone application ("app") that allowed consumers to scan an item's barcode at the point of purchase to see if it contained microbeads.[347] Increasing consumer pressure on companies to eliminate microbeads from their products and the cultivation of demand for microbead-free brands and products led some companies to remove microbeads from their products voluntarily. This, in turn, reinforced industry interest in the bill based on a desire to eliminate other companies' commercial advantages. Likewise, a multi-sector campaign to increase public awareness about the

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341 *Id.* at 163 n.47.

342 *Id.* at 163.

343 *Id.* at 163 (quoting Jonathan Wiener, *On the Political Economy of Global Environmental Regulation*, 87 GEO. L.J. 749, 754 (1999)).

344 *See* Strifling, *supra* note 33, at 163.

345 *Id.* at 156–57 (quoting UNEP, *Plastics in Cosmetics: Are we polluting the environment through our personal care?*, at 7, 9 (2015), https://wedocs.unep.org/bitstream/handle/20.500.11822/9664/-Plastic_in_cosmetics_Are_we_polluting_the_environment_through_our_personal_care_-2015Plas.pdf?sequence=3&amp%3BisAllowed=).

346 *See Who Are We?*, PLASTIC SOUP FOUND., https://www.plasticsoupfoundation.org/en/about-us/ (last visited Jul. 16, 2022).

347 *See* About Us, BEAT THE MICROBEAD, https://www.beatthemicrobead.org/about-us/ (last visited Jul. 16, 2022).

environmental impacts of oxybenzone and octinoxate could potentially stimulate greater consumer demand for products free from these chemicals, increasing the economic incentive for sunscreen and cosmetics manufacturers to remove these ingredients.

B. The same strategies could be applied to prohibit the manufacture and sale of cosmetics and over-the-counter sunscreens containing oxybenzone and octinoxate.

Like the Microbead Free Waters Act of 2015, a law banning the manufacture, sale, and distribution in commerce of sunscreens and cosmetics containing oxybenzone and octinoxate could—and should—be passed as an amendment to the FDCA. Similar to the MFWA, such an act could achieve broad environmental protection by eliminating a major source of the pollutants of interest. This approach would not only be more cost-efficient and effective than end-of-pipe regulation, but would also be consistent with the Congressional declaration of policy in the Pollution Prevention Act (PPA), which advocates "a common-sense approach to risk management that attempts to eliminate adverse impacts at their source whenever feasible."[348] In fact, the PPA explicitly defines source reduction to include "reformulation or redesign of products"[349]—although it creates no legally enforceable mandate to do so.[350] Additionally, prohibiting inclusion of these chemicals in sunscreens and cosmetics would be more equitable than the current regulatory approach of information-disclosure, which places the onus of avoidance on consumers—leaving those unaware of the risks of these chemicals, along with those who cannot afford "reef safe" sunscreen, disproportionately exposed to endocrine-disrupting UV filters.

Several parallels between the two contaminants make this strategy sensible. Prior to the MFWA, microplastics were, as oxybenzone and octinoxate currently are, ubiquitous in personal care products.[351] Each pollutant may be considered harmless in the amount found in individual consumer products, yet has significant environmental impacts in the aggregate.[352] Both types of pollutants "slip through the cracks" of wastewater treatment plants[353] and are virtually impossible to

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348 Wood, *supra* note 123, at 263–64.

349 42 U.S.C. § 13102(5)(A)(ii).

350 *Id*. at 265.

351 Nancy McCormack, *The Problem with Microbeads; or How the Cosmetics You Use One Day End Up in the Sushi You Eat Next*, 26 AUSTL. L. LIBR. 171, 171 (2018).

352 Strifling, *supra* note 33, at 154 ("[E]ven if a fraction of those products contain small percentages of plastic ingredients, the total emission from this source is still quite significant.") (quoting H.A. Leslie, *Plastic in Cosmetics*, U.N. ENV'T PROGRAMME 6 (2015)).

353 Guy Graney, *Slipping through the Cracks: How Tiny Plastic Microbeads are Currently Escaping Water Treatment Plants and International Pollution Regulation*, 39 FORDHAM INT'L L.J. 1023, 1026 (2016).

remove from the environment once they are there.[354] Filters that could remove microbeads from wastewater effluent are "prohibitively expensive" and incapable of capturing all microplastics,[355] as is the case with methods to remove oxybenzone and octinoxate from wastewater.[356] Perhaps the most important—and useful—similarity between microbeads and these two chemicals is that both bioaccumulate in the marine food chain, creating a risk to human health via seafood consumption.[357]

1. Oxybenzone and octinoxate present human health risks through direct absorption, drinking water contamination, and bioaccumulation in aquatic food sources.

Like the MFWA, a bill to ban oxybenzone and octinoxate from sunscreens and cosmetics could emphasize the proximate public health risks posed by continued failure to comprehensively regulate this source of pollution.[358] This would increase its prospect of successfully navigating the lawmaking process by avoiding partisan and other obstacles to the passage of environmental legislation, as described above.

There are several exposure routes through which oxybenzone and octinoxate present human health risks. New research shows that oxybenzone is dermally absorbed from direct application to a greater extent than previously understood,[359] and experts agree that more toxicological studies are needed to understand the health risks of this significant systemic exposure.[360] Although research remains limited at this time, oxybenzone, like other contaminants of emerging concern, has also been detected in drinking water sources[361]—likely due to its presence in

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354 Strifling, *supra* note 33, at 156 (noting "the beads cannot be effectively removed" once in the environment); Wood, *supra* note 123, at 244 (discussing technological and cost challenges of treating water to remove EDCs). One distinction is that oxybenzone and octinoxate, though continually re-introduced and thus environmentally persistent, *will* degrade over time, whereas microplastics will not. *Compare id.* at 154 ("Regardless of their size, most [plastic] particles typically used in cosmetics are non-biodegradable.") *with* Vione et al., *supra* note 51 (discussing photodegradation of oxybenzone).

355 Strifling, *supra* note 33, at 155.

356 Wood, *supra* note 123, at 244 ("Even assuming technological availability for adequate water treatment [to remove EDCs like oxybenzone and octinoxate from water], it would not be financially feasible to remove *all* EDCs.") (emphasis in original).

357 *See* Strifling, *supra* note 33, at 155-56; Fivenson, *supra* note 57, at 64. *See also* da Silva et al., *supra* note 88, at 78 (reporting octinoxate has one of the highest bioaccumulation factors among UV filters tested).

358 *See* Strifling, *supra* note 33, at 161.

359 Sunscreen Drug Products for Over-the Counter Human Use, 84 Fed. Reg. at 6206.

360 *See* Lydia Ouchene et al., *Systemic Absorption of Common Organic Sunscreen Ingredients Raises Possible Safety Concern for Patients*, 23 J. OF CUTANEOUS MED. & SURGERY 449, 449 (2019); Ouchene et al., *supra* note 108, at 649.

361 Int'l Agency for Res. On Cancer, *Some Chemicals Present in Industrial and Consumer Products, Food and Drinking-water*, 101 IARC Monographs on the Evaluation of Carcinogenic Risks

effluent discharged from wastewater treatment plants into receiving water bodies.[362]

As discussed in Part I, organic UV filters tend to bioaccumulate in organisms due to their chemical and physical properties—namely, persistence, stability, and propensity to dissolve in lipids .[363] Bioaccumulation of organic UV filters, including oxybenzone and octinoxate, has been documented in various marine and freshwater species.[364] In one study, oxybenzone was found in 50% of cod and shrimp samples,[365] while another detected octinoxate and oxybenzone in 79% and 100%, respectively, of oysters from Chesapeake Bay.[366] Similar results have been observed in white fish, rainbow trout, perch, crayfish, and mussels.[367] Although more research is needed to better understand the bioaccumulation of these chemicals, current evidence, combined with the finding that concentrations of UV filters correlate to trophic levels of aquatic food webs, suggests that these compounds may be biomagnified[368] to an extent harmful to human health.[369] As with the accumulation of other harmful chemicals in seafood,[370] the human health impacts of oxybenzone and octinoxate bioaccumulation are likely to disproportionately burden vulnerable populations, including pregnant women and communities that rely on traditional practices of subsistence fishing.

While uncertainty remains concerning the degree of harm this bioaccumulation causes to humans and animals, such uncertainty is not a reason to withhold action.[371] On the contrary, a central tenet of conservation biology is that the less

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to Humans 287-88 (2013).

362 Daiana Seibert et al., *Occurrence, Statutory Guideline Values and Removal of Contaminants of Emerging Concern by Electrochemical Advanced Oxidation Processes: A Review*, 748 SCI. OF THE TOTAL ENV'T, 1, 3-4 (2020).

363 Wang et al., *supra* note 55, at 1.

364 Fivenson, *supra* note 57, at 64.

365 Katherine H. Langford et al., *Environmental Occurrence and Risk of Organic UV Filters and Stabilizers in*

Multiple Matrices in Norway, 80 ENV'T INT'L 1, 1 (2015).

366 Ke He et al., *Occurrence of Antibiotics, Estrogenic Hormones, and UV-filters in Water, Sediment, and Oyster Tissue from the Chesapeake Bay*, 650 SCI. OF THE TOTAL ENV'T 3101, 3106-08 (2019) (citing 100% detection frequency of BP-3 (oxybenzone) in oysters sampled and indicating detection of 2-ethylhexyl-4-methoxycinnamate (octinoxate) in approximately 80% of samples).

367 *See id.* at 3107; Fivenson, *supra* note 57, at 64.

368 Narla & Lim, *supra* note 204, at 68 (explaining that bioaccumulation is a phenomenon by which levels of chemicals become higher in organisms over time through exposure to their environment, whereas biomagnification is the process through which chemical levels become higher and more concentrated as one moves up the food chain).

369 Fivenson, *supra* note 57, at 64.

370 *See, e.g.*, Percival et al., *supra* note 121, at 27 (explaining indigenous persons and communities of color are disproportionately affected by mercury water quality standards based on an assumed average exposure that does not align with lived experience of some population subsections, leading to pregnancy exposures impacting over 600,000 infants born annually).

371 *See* McCormack, *supra* note 351, at 171 (noting that despite uncertainty concerning impacts of microbead bioaccumulation on human and animal health, many countries have banned them).

data available or more uncertainty involved in evaluating a risk, the more cautious any plan aspiring to preserve species should be.[372] In dealing with ecological health, just as with human health, it is safer and more prudent to "risk erring on" the side of precaution.[373] The mere *potential* for bioaccumulation of microbeads (and the toxic chemical loads they carry) in species consumed by humans, with attendant human health impacts, was a sufficient basis for Congress to pass the MFWA.[374] The potential for bioaccumulation in seafood is an equally valid justification for banning oxybenzone and octinoxate in sunscreens and cosmetics.[375]

2. The impacts of these chemicals on marine ecological health indirectly harm human health.

In this era of climate crisis, we need to expand our conception of what it means to be "injurious to health."[376] As Thomas Berry wrote, "[t]he well-being of each member of the Earth community is dependent on the well-being of the Earth itself."[377] Impairing the health of phytoplankton—which supply us with every other breath we take, serve as the foundation of marine food webs that sustain us, and form the largest carbon sink on the planet—is injurious to human health. Weakening reefs that serve as buffers, shielding coastal communities from the direct force of storm surges, is injurious to human health. Jeopardizing the sustainability of seafood stocks and destabilizing intact trophic systems is injurious to human health. We cannot predict with precision the cascading effects of seemingly minor impacts on marine species, nor know which might cause the extinction of species on which we rely for food, recreation, or medicine.[378] We—

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372 Reed F. Noss, *Some Principles of Conservation Biology, as They Apply to Environmental Law*, 69 CHICAGO-KENT L. REV. 893, 898 (1994).

373 *Id.* at 897.

374 *See* Strifling, *supra* note 33, at 153 (noting "significant open research questions" and conceding that "although the possible transfer of plastic absorbed toxins to humans via consumption of aquatic species is 'of concern, it has yet to be demonstrated'"); *see also id.* at 156 (describing *potential* threat to human health posed by microbead contamination of waterbodies).

375 *See* Westra, *supra* note 338, at 13 (noting that in light of the "gravity and the urgency" of certain environmental crises, awareness of threats is sufficient grounds to take action before scientific certainty becomes available). *See also id.* at 15 (explaining that in the context of "diffuse problems" like climate change and biodiversity loss, "the previously expected precise requirements for legal proof are no longer applicable in the face of multiple threats and uncertain and unpredictable consequences").

376 21 U.S.C. §361 (2018) (codifying "injurious to health" as the standard for "adulterated" cosmetics under the FDCA).

377 Thomas Berry, *Legal Conditions for Earth Survival*, *in* EVENING THOUGHTS: REFLECTIONS ON EARTH AS SACRED 109 (Mary-Evelyn Tucker ed., 2006).

378 *See* L.E. Fleming et al., *Oceans and Human Health: A Rising Tide of Challenges and Opportunities for Europe*, 99 MARINE ENV'T. RES. 16, 17 (2014); *see also* NOAA, *Why Should We Care About the Ocean*, NAT'L OCEAN SERV., https://oceanservice.noaa.gov/facts/why-care-about-ocean.html (last updated Feb. 26, 2021); National Ass'n of Homebuilders v. Babbit, 130 F.3d 1041,

especially those most vulnerable due to socioeconomic circumstances, systemic racism, and gender oppression[379]—need an ocean that is as healthy as possible to withstand the crucible of climate change. When the ocean's delicate systems become unbalanced, humans inevitably suffer.[380]

IV. A MORE SUSTAINABLE SOLUTION: THE ARGUMENT FOR A PARADIGM SHIFT THAT VALUES AND CENTERS OCEAN ECOSYSTEM INTEGRITY

Emulating the strategy of the MFWA to ban oxybenzone and octinoxate from over-the-counter sunscreens and cosmetics is a viable route around the structural hurdles that prevent addressing this issue through existing environmental statutes or the passage of new state or local laws. However, this strategy would only address one aspect of marine environmental protection—and just two of the hundreds of EDCs in commerce today. Considering the thousands of new chemicals synthesized each year[381] along with the tens of thousands already in commerce,[382] this approach does not yield an effective method of environmental protection from chemicals that debilitate ecological resilience. A more comprehensive approach is needed to shape regulation for the purpose of protecting the biosphere's ecological integrity from harmful chemicals, and the ocean must be at the center of that approach.[383]

The fact that legislation to achieve environmental protection by eliminating certain ingredients in personal care products can only be passed by emphasizing human health impacts reveals a problematic undercurrent in U.S. environmental law. Justifying environmental protection measures by their benefit to human beings delegitimizes the intrinsic value of nature. It also places humans at the

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1053 (1997) (discussing the "option value" of species whose worth, in terms of utility to humans, is "still unmeasured").

379 *See, e.g.*, Beth Gardiner, *Ocean Justice: Where Social Equity and the Climate Fight Intersect*, YALE ENV'T360 (July 16, 2020), https://e360.yale.edu/features/ocean-justice-where-social-equity-and-the-climate-fight-intersect (interviewing Dr. Ayana Elizabeth Johnson, a marine biologist, on the connection between climate change, racial justice, gender equality, and the ocean).

380 This connection is becoming more commonly understood and expressed. *See* NOAA, *supra* note 378 ("When we think of public health risks, we may not think of the ocean as a factor. But increasingly, the health of the ocean is intimately tied to our health."). *See also* Westra, *supra* note 338, at 23 (quoting Anthony J. McMichael) ("Once you start destabilizing large-scale natural systems, you are tinkering with the very foundations of life support.").

381 Scialla, *supra* note 34.

382 ROUNDTABLE ON ENVIRONMENTAL HEALTH SCIENCES, RESEARCH, AND MEDICINE, INST. OF MED., *Identifying and Reducing Environmental Health Risks of Chemicals in Our Society: Workshop Summary* 9 (Oct. 2, 2014), https://www.ncbi.nlm.nih.gov/books/NBK268889/ (noting, as of 2014, "somewhere between 25,000 and 84,000 chemicals in commerce in the United States").

383 *See* Bosselmann, *supra* note 36 (explaining that protecting ecosystem integrity means guarding the ability of an ecosystem to recover from disturbance and reestablishing its stability, diversity, and resilience). Because the ocean's ecological stability, diversity, and resilience is integral to the functional and structural integrity of the entire biosphere, it must be centered in regulatory efforts intended to protect the biosphere from chemical (and other) threats. *See* Doney, *supra* note 11.

center of environmental considerations. This is not only hubris, but also scientifically inaccurate; we are just one part of the biosphere, connected through the hydrosphere to the ocean along with all other living things.[384] Although there is a compelling body of legal scholarship and literature advocating for an ecocentric perspective on moral, philosophical, and spiritual grounds,[385] one scholar has explained that:

> [T]he unfortunate pragmatic reality is that in the realm of societal governance practice, direct human-centered utility, not nature-centric value, is almost always a subordinating consideration . . . . It is strategic references to the *human* repercussions of ecological integrity . . . that inevitably reinforce the invocation of ecocentric values.[386]

Anthropocentric utilitarianism in environmental law sabotages any aspiration of ecosystem integrity by creating compartmentalized and fragmented regulatory systems[387] blind to the interconnectedness and fluidity of nature.[388]

In fact, a focus on human utility pervades the legislative history of even the most ecologically focused of U.S. laws, the Endangered Species Act. As stated in the House Committee on Merchant Marine and Fisheries Report on the Endangered Species Conservation Act, a bill substantively similar to the Endangered Species Act of 1973,[389] biological diversity is of "incalculable" value, in part, because it is "in the best interests of mankind."[390] Noting that all plants and animals are "potential resources," the report eloquently describes nonhuman organisms as "keys to puzzles which we cannot solve, [that] may provide answers

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384 Berry, *supra* note 377, at 112 ("The planet Earth is a single community whose members are bound together with interdependent relationships."); *see also* ALDO LEOPOLD, A SAND COUNTY ALMANAC 192 (1949) ("The individual is a member of a community of interdependent parts").

385 *See, e.g.*, ECOLOGICAL APPROACHES TO ENVIRONMENTAL LAW (Klaus Bosselmann & Prue Taylor eds., 2017).

386 Plater, *supra* note 38, at 277 (emphasis in original). As Zygmunt Plater, one of the lead attorneys of the famous snail-darter case, *Tennessee Valley Association v. Hill*, has pointed out, the tiny fish at the heart of the case served as a "canary-in-the-coal mine[.]" Had the plight of the snail darter not served as a warning signal that *human* welfare was threatened by the same actions that had imperiled the fish, the case might have turned out differently—or may not been brought at all; *see id.* at 284, 286-87.

387 Bosselmann, *supra* note 36, at 2425.

388 *See, e.g.*, Robin Kundis Craig, *Re-Valuing the Ocean in Law: Exploiting the Panarchy Paradox of a Complex System Approach*, 41 STAN. ENV'T. L. J. Spring 2022, at 3, 7, 56 (explaining that the ocean is a "system of systems" comprised of marine ecosystems "linked across multiple scales by the flow of water and species movements" and observing that managing individual threats rather than adopting a system-wide approach "ha[s] not worked").

389 H.R. REP. NO. 93-412, at 4-5 (1973); H.R. 37, 93rd Cong.– *Endangered Species Conservation Act*, CONGRESS.GOV (1973) https://www.congress.gov/bill/93rd-congress/house-bill/37 (noting S. 1983, colloquially known as the ESA, passed "in lieu"). In *Tennessee Valley Auth. v. Hill*, the Supreme Court noted that the proposed legislation "contained the essential features of the subsequently enacted [Endangered Species] Act of 1973[.]" Tennessee Valley Auth. v. Hill, 437 U.S. 153, 178 (1978).

390 H.R. REP. NO. 93-412, at 4-5.

to questions which we have not yet learned to ask."[391] It also posits that "[s]heer self-interest impels us to be cautious" and advocates for the "institutionalization" of such caution in the law.[392] Yet overwhelmingly, incorporation of the precautionary principle[393] into U.S. environmental law has been stifled by business interests.[394]

We need a paradigm shift in environmental law. Legislatively, this could take shape in the U.S. in a number of different ways. One legal scholar, Klaus Bosselmann, has suggested that remedying the current design flaw of environmental law may be as deceptively simple as embracing a new fundamental rule across all sectors and silos of the current legal system: the prohibition of harm to the integrity of ecosystems.[395] Bosselmann's definition of ecological integrity as "the ability of an ecosystem to recover from disturbance and re-establish its stability, diversity and resilience" underscores the criticality of ecological resilience.[396] Ecological integrity is useful as a guiding principle in public policy and law because it is tangible and quantifiable, as opposed to abstract.[397] Moreover, focusing on integrity as a public policy goal naturally leads to the incorporation of the precautionary principle in law.[398] This "simple" change in reorienting the goal of the legal system to the protection of ecosystem integrity would have sweeping consequences across many areas of law and environmental decision making; as such, it holds far more promise than a piecemeal approach. It is a radical approach that matches the drastic circumstances with which the Earth—and ocean—presently contend.[399]

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391 *Id*.

392 *Id*.

393 The precautionary principle is a decision-making framework oriented towards proactive avoidance or minimization of risks "[w]here risks of serious or irreversible damages are identified but conclusive evidence is not available[.]" Stephen G. Wood et al., *Whither the Precautionary Principle? An American Assessment from an Administrative Law Perspective*, 54 AM. J. COMP. L. 581, 581 (2006) (internal citations omitted). *See* Westra, *supra* note 338, at 16 (noting the scientific imprecision supports application of the precautionary principle in an approach focused on global integrity).

394 Plater, *supra* note 38, at 279.

395 Bosselmann, *supra* note 36, at 2425. A similar approach rooted in ecological integrity as a "fundamental principle of law" is urged in the *Oslo Manifesto for Ecological Law & Governance*, a proposal by the Ethics Specialist Group of the World Commission on Environmental Law of the International Union for Conservation of Nature (IUCN). Ecological L. & Governance Ass'n, Oslo Manifesto for Ecological Law & Governance § 6 (2016).

396 Bosselmann, *supra* note 36, at 2441.

397 Westra, *supra* note 338, at 8-9; Bosselmann, *supra* note 36, at 2439.

398 *See* Westra, *supra* note 338, at 12-13 (explaining that embracing application of the precautionary principle naturally follows from appreciation of scientific basis for setting ecological integrity as a policy objective).

399 *See id*. at 15-16 (stating that climate change and biodiversity loss present "incalculable and irreversible risks"); Sarah Kaplan, *Ocean Animals Face a Mass Extinction from Climate Change, Study Finds* (Apr. 28, 2022), https://www.washingtonpost.com/climate-environment/2022/04/28/mass-marine-extinction-event-science/ ("Not since an asteroid wiped out the dinosaurs . . . has life in the ocean been so at risk.")

Nonetheless, due to the challenges of passing environmental legislation in the U.S. and even more laborious process of transforming culture and values,[400] interim approaches are useful stepping-stones on the path toward a complete paradigm shift. One such approach might be promulgation of a new regulatory standard under the FDCA requiring close examination of the transport, fate, and ecological impacts of chemical constituents in consumer products, including over-the-counter drugs and cosmetics. Alternatively, because such an approach would be constrained by the regulatory jurisdiction of the FDA, a more comprehensive approach might be passage of a new federal law designed to protect ocean ecosystem integrity from harmful constituents of products in interstate and foreign commerce that ultimately end up at sea. Such a law would more broadly encompass chemicals in products currently regulated under either the FDCA or TSCA and would also capture other types of product constituents that threaten ocean ecosystem integrity, like microfibers.[401]

Replacing the standards of "injurious to health"[402] and "unreasonable risk to health or the environment"[403] with the "reasonable and prudent" standard of the ESA—the one U.S. law that endeavors to prioritize environmental conservation above all else—is a good place to start in aligning environmental decision-making concerning chemicals with Bosselmann's "ecological integrity". Such a shift in language alone is not enough, however; it must be accompanied by changes in risk assessment to account for the unique properties of contaminants of emerging concern, like EDCs, that cause cumulative harm in the aggregate via exposure at low levels, over long periods of time and through synergistic interactions.[404] It must also be infused with the "institutionalized caution"[405] an understanding of

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[400] *See* Sanford E. Gaines, *Reimagining Environmental Law for the 21st Century*, 44 ENV'T L. REP., 10188, 10192 (2014) (noting "law, in the narrow sense of rules or standards of conduct enforceable by state authority, serves to express and vindicate established or emerging social values") (internal quotation marks omitted).

[401] *See, e.g.*, S*cientists Name New Deep-Sea Species* Eurythenes plasticus *to Highlight Pollution*, THE N.Z. HERALD (Mar. 5, 2020), https://www.nzherald.co.nz/lifestyle/scientists-name-new-deep-sea-species-eurythenes-plasticus-to-highlight-pollution/HMHIAV7NWPULK7A2IIQUA7IX5M/?c_id=6&objectid=12314371 (explaining newly discovered deep-sea amphipod name intended to make a statement "that we're now at the point where we are looking at a new species from an unexplored habitat and it's already contaminated with plastic"). *See also What You should Know About Microfiber Pollution*, ENV'T PROT. AGENCY, https://www.epa.gov/sites/default/files/2020-07/documents/article_2_microfibers.pdf (explaining ingestion of microfibers can cause direct harm to small organisms and indirect harm due to presence of toxic chemicals (both from microfiber manufacturing and absorbed from ocean)).

[402] "[I]njurious to health" is the standard for "adulterated" cosmetics, which are prohibited for sale in interstate commerce under the FDCA. 21 U.S.C. §§ 331(a), 361(a)-(e) (2018).

[403] "[U]nreasonable risk" is the standard under TSCA for when EPA may regulate a substance. 15 U.S.C. § 2605(a) (2018).

[404] *See* Plater, supra note 38, at 280 (discussing challenges of chemicals with long latency periods and "exposures [that] are typically indirect, diffuse, opaquely synergistic, and cumulative over long spans of time, with unclear or unknown paths of causation").

[405] H.R. REP. NO. 93-412, at 5 (1973).

conservation biology and appreciation of scientific uncertainty implores, along with the humility and respect humans owe to our fellow species on this planet.[406]As the conservation biologist Reed Noss has explained, an appreciation of the complexity of nature, combined with the acknowledgement that we will never know precisely how it "works," yields a simple rule of thumb: "We had better be as cautious and gentle as possible" in the changes we make to the natural environment.[407]

Under this proposed standard, the decision to allow chemicals like oxybenzone and octinoxate in consumer products like sunscreen and cosmetics is easily recognizable as neither reasonable nor prudent. There are ample alternatives[408] to using sunscreens with these ingredients for sun protection, whereas potentially irrevocable harm may result from their continued use. As Noss wrote, "Human cultural systems are far more adaptable than biological systems . . . thus, although sociological and economic concerns must enter into any planning exercise, the vital needs of nonhuman species must not be compromised."[409] Removing these two nonessential chemicals from personal care products is a modest change we can make to reduce our burden on the natural environment and maximize its chances of withstanding the barrage of other anthropogenic threats already set in motion. At the same time, such action symbolizes the long-overdue acknowledgement that human health impact should not be the fulcrum of environmental risk regulation.

Dramatic progress in environmental law often emerges from an environmental crisis.[410] Regardless of whether such a paradigm shift is motivated by self-interest or some deeper belief, a system of environmental law and policy that values ocean ecosystem integrity and places it at the center of an ecocentric approach to

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406 Respect due to nature arises from its "inherent worth". LAURA WESTRA, AN ENVIRONMENTAL PROPOSAL FOR ETHICS: THE PRINCIPLE OF INTEGRITY 85 (1995).

407 Noss, *supra* note 370.

408 *See, e.g.*, *Skincare Chemicals and Coral Reefs*, NAT'L OCEAN SERV., https://oceanservice.noaa.gov/news/sunscreen-corals.html (last updated Nov. 10, 2021) (suggesting clothing and shade-seeking during peak solar intensity hours as alternatives to using sunscreen); Yixing Lu et al., *Hydrogel Sunscreen Based on Yeast/Gelatin Demonstrates Excellent UV-Shielding and Skin Protection Performance*, 205 COLLOIDS & SURFACES B: BIOINTERFACES (2021) (reporting efficacy of yeast and gelatin-based hydrogel as safe, eco-friendly UV protection); Alfonsina Milito et al., *From Sea to Skin: Is There a Future for Natural Photoprotectants?*, 19 MARINE DRUGS 379, 379 (2021) (suggesting natural marine compounds hold promise for use in biocompatible, eco-friendly sunscreens).

409 Noss, *supra* note 372, at 899.

410 Lazarus, *supra* note 321, at 79 (noting the role of prominently publicized crises in 1969, including the Santa Barbara oil spill and Cuyahoga River fire, in catalyzing public consciousness and political will necessary for the "dramatic legal transformation" of environmental law in the 1970's).

environmental decision-making has clear justification in the present moment.[411] The ongoing climate crisis and biodiversity loss so pronounced it has been coined the "sixth mass extinction"[412] are unequivocal indications that a new approach to environmental law and policy is urgently needed. Rather than viewing the problem as one of choosing between a human-centric or ecocentric view, we must recognize that this is a false dichotomy: all species are part of the same biosphere, connected by one hydrosphere, with the ocean at its heart. An ecocentric framework of environmental law that considers impacts on ocean ecological integrity as the litmus test for impacts on planetary health would set a more reasonable and prudent threshold for regulation than the current human-centric approach.[413] Each and every component of ocean ecosystems—from microscopic plankton to miles-long coral colonies and fish of all sizes—is integral to the whole. In evaluating the impacts of our actions and products on ocean ecological integrity, we would be well-reminded that "the first rule of intelligent tinkering is to save all the parts."[414]

CONCLUSION

Unique obstacles impede the regulation of two endocrine-disrupting chemicals, oxybenzone and octinoxate, found in a number of personal care products. Although it is possible to strategically navigate the current system of U.S. law to achieve the ecologically desirable policy outcome—banning oxybenzone and octinoxate from sunscreens and cosmetics—by emphasizing human health harms, the hurdles in this path highlight the need for deeper, more systemic change. The present crises of climate change and biodiversity loss require a paradigm shift in environmental law that (1) incorporates an ecocentric ethic; (2) embraces scientific principles, including the prudence of a precautionary approach; and (3) imbues humility in environmental decision-making. Such reform must replace the current anthropocentric utilitarian approach with acknowledgment of the interconnectedness of all species and the central role of the ocean in maintaining Earth's ecological integrity.

Recognizing the interconnectedness of human and non-human species and leveraging public health concerns as a strategy to pass environmental legislation

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411 *See generally*, Justin L. Penn & Curtis Deutsch, *Avoiding Ocean Mass Extinction from Climate Warming*, 376 SCI. 524 (2022) (predicting a marine "mass extinction" on the horizon if current climate change trends continue unchanged).

412 Dinerstein et al., *supra* note 10, at 14.

413 Such a holistic approach would also better protect human health. *See* Westra, *supra* note 338, at 36 (explaining that "the practice of considering environmental problems and human health problems separately leads to misunderstanding and incomplete knowledge").

414 Paul Ehrlich, *The Negative Animal*, SATURDAY REVIEW (June 5, 1971), 58, 59. Ehrlich is paraphrasing Aldo Leopold: "To keep every cog and wheel is the first precaution of intelligent tinkering." These quotes refer to the importance of supporting an ecosystem by keeping all its parts, i.e., saving all the species.

is an important first step towards improved environmental protection. Human health consequences, however, should not be the sole justification for banning substances in consumer products that cause marine ecological harm. Such a system is myopic; anything harmful to the ocean will ultimately be harmful to humans. There is no need to extend the causal chain and trace each link, faltering at data gaps or uncertainties, before acting. We can instead move proactively to preserve the ocean—and by so protecting our planet's health, safeguard our own. Attempting to protect ourselves by putting humans at the center of risk regulation and environmental decision-making frameworks is counterproductive. Our focus must instead shift to the global system of which we are a part. Perhaps paradoxically, de-centering ourselves will benefit us most in the long term. If we make simple, sound choices—guided by reasonableness, prudence, precaution, and humility—to help protect the health and ecological integrity of the ocean, it just might save us.