



**B A C W A**  
**BAY AREA**  
**CLEAN WATER**  
**AGENCIES**

**SCAP**

SOUTHERN CALIFORNIA ALLIANCE OF  
PUBLICLY OWNED TREATMENT WORKS



April 20, 2018

*Submitted via e-mail to [COPCpublic@resources.ca.gov](mailto:COPCpublic@resources.ca.gov)*

Secretary John Laird, Chair, and Members  
California Ocean Protection Council  
1416 Ninth Street, Suite 1311  
Sacramento, CA 95814

Re: Comments on the Proposed Final Draft California Ocean Litter Prevention Strategy

Dear Chairman Laird and Members of the California Ocean Protection Council:

The California Association of Sanitation Agencies (CASA), Bay Area Clean Water Agencies (BACWA), and the Southern California Alliance of Publicly Owned Treatment Works (SCAP) (collectively referred to herein as "Wastewater Associations") appreciate the opportunity to comment on the Proposed Final Draft (April 13, 2018) of the "California Ocean Litter Prevention Strategy: Addressing Marine Debris from Source to Sea" (hereafter, "Final Draft Strategy"), a collaborative effort of the Ocean Protection Council (OPC) and the National Oceanic and Atmospheric Administration Marine Debris Program (NOAA MDP).

For 60 years, CASA has been the leading voice for public wastewater agencies on regulatory, legislative and legal issues. CASA is an association of local agencies, engaged in advancing the recycling of wastewater into usable water, generation of renewable energy, and other valuable resources. Through these efforts CASA's members help create a clean and sustainable environment for Californians. BACWA is a joint powers agency whose members own and operate publicly owned treatment works (POTWs) and sanitary sewer systems that collectively provide sanitary services to over 7.1 million people in the nine-county San Francisco Bay (SF Bay) Area. SCAP represents over 80 public agencies providing water and wastewater service for 19 million people in 7 counties of southern California.

The Wastewater Associations support statewide and nationwide efforts to reduce ocean litter and marine debris, and the OPC's efforts to update the State's 2008 Ocean Litter Prevention Strategy.

The Wastewater Associations thank the OPC and the NOAA MDP for their efforts to engage stakeholders and their support of science-based objectives to increase understanding of microplastics in the marine environment, and we appreciate the incorporation of the comments that we previously submitted in October 2017, January 2018, and February 2018. We support the Final Draft Strategy, which provides three goals to reduce land-based and ocean-based sources of ocean litter. The objectives in Goal 2 (Microplastics and Microfibers) use leveraged national and international resources and knowledge, where feasible, to first develop and validate standardized microplastic monitoring methods by 2021, then develop a

comprehensive research plan for microplastics by 2024 which includes characterizing microplastics' sources, pathways, concentrations, and risk assessment, followed by the identification of management actions to control sources as appropriate. This approach ensures that the objectives can be achieved using reliable data and robust science.

Many elements of the diverse strategy, including method development, engineering, ecosystem impacts, and human health risk assessment, will require OPC to collaborate with an array of experts. Coordinating efforts on significant peer-reviewed research currently happening nationally and internationally will contribute greatly to the OPC's ability to achieve the microplastics-related goals of the strategy.

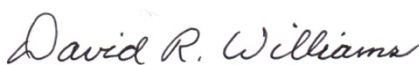
Although it will be a challenge to accomplish these objectives in the specified six-year timeframe recommended during the stakeholder workshop, thorough research is essential to ensure that resulting management actions can effectively address microplastics issues. The United States Environmental Protection Agency (USEPA) staff has noted that development of standardized methods can take up to ten years to complete; fortunately, USEPA has already begun development of microplastics methods in some relevant matrices. Sufficient funding and similar leveraging of ongoing work by experts in the field will help with timely completion of the objectives in the Strategy.

In conclusion, the Wastewater Associations would like to thank the OPC's staff and the team that led the update of the Strategy for their leadership and willingness to work with stakeholders, and for their consideration of our comments throughout the update process. The Wastewater Associations strongly support the adoption of the 2018 Update to the California Litter Prevention Strategy.

Sincerely,



Adam D. Link  
Director of Government Affairs  
CASA



David R. Williams  
Executive Director  
BACWA



Steven C. Jepsen  
Executive Director  
SCAP

cc: Holly Wyer, OPC Program Staff



Andrew Gray and Win Cowger  
University of California Riverside  
Department of Environmental Sciences  
Watershed Hydrology Lab  
900 University Ave.  
Riverside, California 92521  
Email: [agray@ucr.edu](mailto:agray@ucr.edu); [wcowg001@ucr.edu](mailto:wcowg001@ucr.edu)  
Telephone: (951)827-6159

April 20<sup>th</sup>, 2018

To the Ocean Protection Council,

We are writing in response to the solicitation for comments on the California Ocean Protection Council's (OPC) proposed Final Draft to Address Ocean Litter (4/2018). Please note that the comments below reflect our professional perspective and do not represent the view of the University of California.

We believe that the priorities and goals presented in this draft are generally in line with sound scientific knowledge. For example, prioritizing source reduction before cleanup and a focus on upstream research and policy is consistent with best practices for nonpoint source pollution management in general.

The document is well written and organized. One small comment for future edits is on page 24. The phrase "research will be based on best available data and the development of studies will include relevant stakeholders" is repeated multiple times in the text. We feel that phrase captures the theme of the entire section and should be mentioned in the introduction, not the bullet points.

We are excited to be a part of many of the action items, and in each case feel that we can make a meaningful contribution. The action items in Objective 4.4 "Assess the effectiveness of existing bans, policies, and programs." would greatly benefit from the inclusion of economists to lead the action items. We would be happy to actively engage with OPC and other stakeholders in an effort to recruit such expertise.

Thank you for the ongoing opportunities to participate in the development of the OPC's Ocean Litter Strategy. We look forward to remaining engaged with this important and challenging problem.

Sincerely,

A handwritten signature in black ink, appearing to read "A. Gray".

Dr. Andrew Gray  
Assistant Professor of Watershed  
Hydrology

A handwritten signature in black ink, appearing to read "W. Cowger".

Win Cowger  
Graduate Research Assistant

## Wyer, Holly@CNRA

---

**From:** CNRA COPC Public  
**Sent:** Friday, April 20, 2018 3:15 PM  
**To:** COPC Public Distro List  
**Subject:** FW: Proposed Final Draft Ocean Litter Strategy is now available

---

**From:** Genevieve Abedon  
**Sent:** Friday, April 20, 2018 3:14:52 PM (UTC-08:00) Pacific Time (US & Canada)  
**To:** CNRA COPC Public  
**Subject:** RE: Proposed Final Draft Ocean Litter Strategy is now available

Looking good!

Minor edit on Page 15:

“lost fishing and aquaculture gear” should be “abandoned, lost or otherwise discarded fishing and aquaculture gear”

---

**From:** Wyer, Holly@CNRA [mailto:Holly.Wyer@resources.ca.gov]  
**Sent:** Friday, April 13, 2018 4:59 PM  
**To:** Sherry Lippiatt <sherry.lippiatt@noaa.gov>; Schwartz, Eben@Coastal <Eben.Schwartz@coastal.ca.gov>; Angela Howe <ahowe@surfrider.org>; Nina Venuti <nvenuti@ucsd.edu>  
**Subject:** Proposed Final Draft Ocean Litter Strategy is now available

Dear Ocean Litter Stakeholders,

The Proposed Final Draft of the *California Ocean Litter Prevention Strategy: Addressing Marine Debris from Source to Sea* (Strategy) is now available. Please see the attached for the Strategy. The document is also available on the OPC website here: <http://www.opc.ca.gov/programs-summary/marine-pollution/ocean-litter-strategy-2018/>. **The Strategy will be discussed and considered for adoption by OPC at their April 24, 2018 meeting.** Please note that the Strategy has not gone through final design or copy-editing; these changes will be made after the OPC meeting. The adopted version of the Strategy will be considered final.

The Strategy is on the OPC meeting agenda as item #6, and the staff recommendation, and OPC meeting information are available here: <http://www.opc.ca.gov/2018/04/ocean-protection-council-meeting-april-24-2018/>. OPC welcomes comments on the Strategy; please note that the commenting procedure on the Proposed Final Strategy is different than what has been used for the Strategy update process in the past. This time, comments should be emailed to [COPCpublic@resources.ca.gov](mailto:COPCpublic@resources.ca.gov). **Written comments must be received by 5 PM on April 20, 2018 to be included in the materials provided to the Council at the meeting. Additionally, oral and written comments will be accepted at the meeting.**

Thank you for taking the time to participate in the Strategy update process. If you have questions about the Strategy or commenting procedures, please contact Holly Wyer at [Holly.Wyer@resources.ca.gov](mailto:Holly.Wyer@resources.ca.gov).

Sincerely,

The Strategy Update Planning Team

Angela Howe, Surfrider Foundation

Miho Ligare, CA Sea Grant  
Sherry Lippiatt, NOAA Marine Debris Program  
Eben Schwartz, California Coastal Commission  
Nina Venuti, CA Sea Grant  
Holly Wyer, Ocean Protection Council

## Wyer, Holly@CNRA

---

**From:** Carter, Russ@CalRecycle <Russ.Carter@CalRecycle.ca.gov>  
**Sent:** Friday, April 20, 2018 2:13 PM  
**To:** Wyer, Holly@CNRA  
**Cc:** Kolic, Paulina@CalRecycle  
**Subject:** RE: California Ocean Litter Strategy Support

Holly,

I hope there's still room/time for changes to be considered. We're a busy bunch over here but we have a handful of suggestions and potential edits for you to consider AND a correction to a footnote. We are waiting to hear back from higher-ups on whether CalRecycle should be represented on the Action Items and so I'll leave those out (hoping to hear back today, but might not).

The suggestions are not mandatory of course, but they do represent informed insights and a standardization of terms. Also, there's a footnote that needs to be corrected:

- Replace "~~single-use plastic carryout bag ban~~" with "**single-use carryout bag ban**" throughout the document (***unless a specific focus on 'plastic' is purposely desired, paper bags bring their own set of problems and the higher goal is to eliminate 'single-use' items entirely. Per the Coastal Cleanup data that is also cited in this document, paper bags were 3.3% of litter in 2010 and 0.75% in 2017. As a comparison, plastic bags were 7.42% and 2.82% in 2010 and 2017, respectively. Thus, suggest removing "plastic" when referring to the bag ban since paper bags are also part of the problem.***)
- 4 instances, suggest changing the phrase "~~single-use foodware~~" to "**single-use food serviceware**" as it's a more commonly used descriptor
- Page – 29, footnote 5 – change to sections 42280 – 42288

We are discussing whether we should be a more formal part of Action Items 2.1.3, 2.1.4, and 4.4.2 but may not hear back until Monday...still, I didn't want to miss any deadline. This latest iteration of the Strategy is a beautiful document and much improved from Version 1.

If we do get some approval to become a Lead & Partner Organization on the above Action Items, I'll let you know immediately.

Russ

## Wyer, Holly@CNRA

---

**From:** Patty Moore <Patty@PRCC.biz>  
**Sent:** Friday, April 20, 2018 1:52 PM  
**To:** Wyer, Holly@CNRA  
**Subject:** Re: Proposed Final Draft Ocean Litter Strategy is now available  
**Attachments:** Strategy\_ProposedFinal.pdf

Hello Holly,  
I've attached my comments. I took PRCC off of one action item and added our name to a few. I also made a few comments.  
Let me know if you have any questions,  
Patty

Patty Moore, Executive Director  
**Plastic Recycling Corporation of California (PRCC)**  
Office (707) 935-1997 x14 | Mobile (707) 815 7060 | [Patty@prcc.biz](mailto:Patty@prcc.biz)  
[www.PRCC.biz](http://www.PRCC.biz)

Note from OPC staff:

Comments are included on the following pages of this PDF 6, 17, 28, 30, and 31. Comments are in highlighted text bubbles and text changes are suggested in red strikethrough and underline.

*California Ocean Litter Prevention Strategy:  
Addressing Marine Debris from Source to Sea*

DRAFT  
***PROPOSED FINAL DRAFT***

*April 13, 2018*

*Acknowledgment: The California Ocean Litter Prevention Strategy was developed through expert input from numerous California stakeholders. Funding was provided by the California Ocean Protection Council (OPC) and NOAA Marine Debris Program (NOAA MDP). Many thanks go to the workshop participants and others who contributed to the Strategy and will participate in its implementation. We would also like to thank Miho Ligare and Nina Venuti of California Sea Grant, Eben Schwartz of the California Coastal Commission, and Angela Howe of the Surfrider Foundation for their participation on the workshop planning team. We also thank NOAA MDP staff for assistance with workshop facilitation and note-taking, and for their help preparing the document for publication. The Strategy was drafted by California Sea Grant (M. Ligare and N. Venuti) under the direction of OPC (Holly Wyer) and NOAA MDP (Sherry Lippiatt).*

Recommended citation: California Ocean Protection Council and National Oceanic and Atmospheric Administration Marine Debris Program. (2018). *California Ocean Litter Prevention Strategy: Addressing Marine Debris from Source to Sea*.

For more information, please contact:

California Ocean Protection Council  
Holly Wyer, Program Manager  
Holly.Wyer@resources.ca.gov  
916-653-0538

NOAA Marine Debris Program  
Sherry Lippiatt, California Regional Coordinator  
Sherry.Lippiatt@noaa.gov  
510-410-2602

# TABLE OF CONTENTS

## Contents

<b>LIST OF ACRONYMS AND ABBREVIATIONS .....</b>	<b>4</b>
<b>GLOSSARY OF COMMONLY USED TERMS .....</b>	<b>5</b>
<b>EXECUTIVE SUMMARY .....</b>	<b>7</b>
<b>SECTION I: 2018 CALIFORNIA OCEAN LITTER PREVENTION STRATEGY.....</b>	<b>10</b>
2018 STRATEGY UPDATE PROCESS .....	11
STRUCTURE OF DOCUMENT .....	12
SCOPE OF DOCUMENT .....	14
STRATEGY IMPLEMENTATION .....	18
<b>CALIFORNIA OCEAN PROTECTION COUNCIL PRIORITIES TO ADDRESS OCEAN LITTER.....</b>	<b>20</b>
<b>STAKEHOLDER GOALS, OBJECTIVES, AND ACTION ITEMS.....</b>	<b>26</b>
<b>CONCLUSION .....</b>	<b>36</b>
<b>SECTION II: BACKGROUND INFORMATION &amp; OCEAN LITTER LITERATURE SYNTHESIS .....</b>	<b>38</b>
THE GLOBAL PROBLEM AND SOURCES OF OCEAN LITTER .....	38
OCEAN LITTER AND PLASTICS .....	38
IMPACTS OF OCEAN LITTER .....	39
OCEAN LITTER AND WASTE MANAGEMENT IN CALIFORNIA .....	41
CONCLUSION .....	43
<b>REFERENCES.....</b>	<b>44</b>
<b>APPENDIX A: UPDATING THE 2008 STRATEGY .....</b>	<b>51</b>

## LIST OF ACRONYMS AND ABBREVIATIONS

AB	Assembly Bill
ACC	American Chemistry Council
BACWA	Bay Area Clean Water Agencies
BASMAA	Bay Area Stormwater Management Agencies Association
BMP(s)	Best Management Practice(s)
CalRecycle	California Department of Resources Recycling and Recovery
CASA	California Association of Sanitation Agencies
CCC	California Coastal Commission
CDFW	California Department of Fish and Wildlife
COPA	California Ocean Protection Act
CPSC	California Product Stewardship Council
CSU	California State University
CSUCI	California State University, Channel Islands
CSULB	California State University, Long Beach
DBW	California State Parks Division of Boating and Waterways
DTSC	California Department of Toxic Substances Control
EPA	United States Environmental Protection Agency
EPR	Extended Producer Responsibility
ESRM	Environmental Science and Resource Management
FGC	California Fish and Game Commission
FTIR	Fourier Transform Infrared
GPS	Global Positioning System
IGISc	Institute for Geographic Information Science
NOAA	National Oceanic and Atmospheric Administration
NOAA MDP	National Oceanic and Atmospheric Administration Marine Debris Program
OPC	California Ocean Protection Council
PRCC	Plastic Recycling Corporation of California
SB	Senate Bill
SCAP	Southern California Alliance of Publicly Owned Treatment Works
SCCWRP	Southern California Coastal Water Research Project
SDSU	San Diego State University
SFEI	San Francisco Estuary Institute
SFSU	San Francisco State University
State Water Board	California State Water Resources Control Board
UC	University of California
UNEP	United Nations Environment Programme
WTO	World Trade Organization

## GLOSSARY OF COMMONLY USED TERMS

Cleanup: To remove litter from waterways, beaches, and the ocean. Examples of cleanup methods include manual litter removal, installation of trash skimmers in ports, and diving to recover lost fishing gear.

Common Ocean Litter Items: Items that are most prevalent in ocean litter found in or on California's waterways, coastlines, or ocean, as defined by relevant datasets (e.g., California Coastal Cleanup Day data). Currently, based on Coastal Cleanup Day data, the most common ocean litter items in California are cigarette butts and food and beverage packaging (California Coastal Commission, 2017).

Control: To intercept litter before it ends up in waterways, on beaches, or in the ocean. Examples of litter control methods include street sweeping, stormwater capture devices, storm drain cleaning and maintenance, and additional options and opportunities for proper waste disposal.

Land-Based Ocean Litter: Items that became litter on land (via land-based activities) and subsequently entered the aquatic environment.

Lead Organization: Lead Organizations are committed to implementing an Action Item, given organizational and funding constraints. Lead Organizations will serve as the point of contact for NOAA and OPC for progress reports and check-ins throughout the Strategy's six-year timeframe, and will take a leadership role in communicating and coordinating with other collaborators/Partner Organizations on the Action Item.

Marine Debris: Any persistent solid material that is manufactured or processed and directly or indirectly, intentionally or unintentionally, disposed of or abandoned into the marine environment or the Great Lakes (15 C.F.R. Part 909 Section 909.1). For the purposes of this document, the term “ocean litter” will be used as a synonym for “marine debris.”

Ocean-Based Marine Debris: Items that entered the marine environment via activities that occurred at sea. Ocean-based items are typically referred to as “marine debris” rather than “ocean litter” in this document, as it is more appropriate to refer to larger items like vessels or gear as “debris” rather than “litter.”

Partner Organization: Partner Organizations will serve a supporting role in implementing an Action Item, in collaboration with Lead and other Partner Organizations.

Single-use product: An item that is conventionally disposed of after one use.

Source Reduction or Waste Prevention (used interchangeably): Practices that result in a net reduction in the generation of solid waste. Source reduction includes, but is not limited to, changes in the design, manufacture, purchase, or use of materials and products (e.g., reducing

I'd like to see an acknowledgment that items which actually GET recycled (not just technically recyclable, but those that have the infrastructure from collection to end use) are not single use.

packaging, replacing disposable products and materials with reusable products and materials). Source reduction does not include steps taken after the material becomes solid waste. (Definition taken from California's Public Resources Code Section 40196 and informed by EPA, 2016).

DRAFT

## EXECUTIVE SUMMARY

Ocean litter is a pervasive problem at local, regional, and global scales with a wide range of consequences to human health, the environment, and the economy. Immediate, collaborative action to reduce and prevent ocean litter will ensure that California communities, environments, and economies remain productive and vibrant. The Ocean Protection Council (OPC) and the National Oceanic and Atmospheric Administration's Marine Debris Program (NOAA MDP) present this update to OPC's 2008 *An Implementation Strategy for the California Ocean Protection Council Resolution to Reduce and Prevent Ocean Litter*. The 2018 *California Ocean Litter Prevention Strategy: Addressing Marine Debris from Source to Sea* (Strategy) will provide structure and guidance for OPC and California stakeholders to efficiently address this pressing issue over the next six years.

Much of OPC's work on ocean litter began in 2007, when OPC adopted a resolution entitled "Reducing and Preventing Marine Debris." OPC then initiated a steering committee to publish an Implementation Strategy in 2008, which laid out a plan to implement the resolution. The 2008 Strategy served as a powerful and effective document to promote action on addressing ocean litter in California. Since 2008, many of the actions described in the document have either been accomplished or are in progress. For example, the single-use plastic carryout bag ban was ratified by California voters in 2016, and the State Water Resources Control Board's Trash Amendments were adopted in 2015. While we have made great strides in addressing ocean litter in California, our understanding of the issue has changed considerably in the last decade. For example, the investigation of microplastics' presence in aquatic ecosystems and impacts on marine life has increased dramatically over the last ten years.

OPC and the NOAA MDP have partnered to update the 2008 Strategy. The NOAA MDP is authorized by the United States Congress through the Marine Debris Act, signed into law in 2006 and amended in 2012. The Act requires the program to "identify, determine sources of, assess, prevent, reduce, and remove marine debris and address the adverse impacts of marine debris on the economy of the United States, marine environment, and navigation safety." The NOAA MDP has prioritized supporting and facilitating the creation of collaborative action plans around the country. Similar to other regions, this 2018 update expands the previous Strategy to include projects of a variety of scales and scopes so that entities including government agencies, industry, academia, nonprofits, and tribes can collaborate on meaningful contributions to reducing ocean litter in California.

The content of the Strategy was generated from a wide range of stakeholder input, gathered during two workshops and two rounds of public comment between May 2017 and February 2018. The Strategy includes OPC Priorities to address ocean litter and stakeholder-identified Goals, Objectives, and Action Items to address ocean litter.

The OPC Priorities are tailored to how OPC works and outlines the activities OPC will take on over the next six years to address ocean litter. This means that the priorities are framed around

developing and implementing policy, coordinating among state agencies, providing funding for catalytic and innovative projects, and providing the best available science for government decision-making. The OPC Priorities were developed by OPC staff and were revised through stakeholder feedback and public comment. The OPC Priorities are meant to support and enhance many of the Goals, Objectives, and Action Items developed by California stakeholders. The OPC Priorities are structured into three goals:

1. **OPC Goal 1 – Land-based Ocean Litter:** Protect marine ecosystems and the communities that rely on them by promoting policies to prevent litter from reaching the ocean.
2. **OPC Goal 2 – Microplastics and Microfibers:** Increase understanding of the scale and impact of microplastics and microfibers on the marine environment and develop solutions to address them.
3. **OPC Goal 3 – Fishing and Aquaculture Gear:** Reduce debris from fishing and aquaculture-related activities in the ocean.

In contrast to the OPC Priorities, the Stakeholder Goals, Objectives and Action Items were developed and revised by a wide range of stakeholders including grassroots organizations, fishermen, scientists, wastewater treatment managers, and the plastics industry. Stakeholders were engaged through two workshops and through public comment periods on the draft document. The first workshop provided an opportunity to brainstorm Action Items, and the second workshop provided an opportunity to refine the Goals, Objectives, and Action Items in the first draft of the Strategy. The stakeholder section of the Strategy is structured around six Goals, five of which are dedicated to land-based litter, and one of which is dedicated to ocean-based debris. Nested under each of these Goals are Objectives, which outline approaches for achieving the Goals. Each Objective includes specific Action Items, which are concrete and measurable tasks that stakeholders can implement to contribute to an Objective and prevent or reduce ocean litter.

Broadly broken into land- and ocean-based litter categories, the six stakeholder Goals of this Strategy are as follows:

#### *Land-based Ocean Litter*

1. **Goal 1:** Reduce the use of common ocean litter items through mandates and incentives targeting public institutions and businesses.
2. **Goal 2:** Reduce the prevalence of common ocean litter items through changes in product production, design, and management.
3. **Goal 3:** Improve waste management and interception of litter on land before it enters the ocean.
4. **Goal 4:** Conduct and communicate research on existing and emerging issues related to land-based ocean litter.
5. **Goal 5:** Generate behavior change by educating and engaging communities and individuals to reduce ocean litter.

## *Ocean-based Marine Debris*

6. **Goal 6:** Reduce the sources of ocean-based debris and maximize the efficiency of ocean-based debris cleanup.

The Strategy prioritizes source reduction Goals and Action Items, as agencies and experts agree that source reduction is the most effective tactic to address ocean litter. The Strategy focuses primarily on land-based litter, because most of the litter found on Coastal Cleanup Day is land-based. Furthermore, the Goals, Objectives, and Action Items included in the Strategy are driven by the data we have on ocean litter. Many of the Action Items focus efforts on “common ocean litter items,” or ocean litter items that are most prevalent in or on California’s waterways, coastlines, or ocean, as defined by relevant datasets. The use of this terminology directs stakeholders to focus on the litter items that are most abundant in the environment, while also allowing for flexibility and adaptability, as the most common ocean litter items may change over time. This document relies on Coastal Cleanup Day data to define the most common ocean litter items found across the state. Currently, cigarette butts and food and beverage packaging are the most common ocean litter items found in California.

Most of the Strategy’s Action Items are accompanied by a list of Lead and/or Partner Organizations. These organizations have volunteered to implement the Action Items. Given the many dynamic and influential ocean litter stakeholders in California, the Strategy provides an opportunity for organizations to take a leadership role on Action Items that align with their respective goals and mandates. Additional organizations may contribute to Actions over the lifetime of the Strategy. OPC and NOAA MDP are committed to providing overall leadership and coordination of tracking Strategy implementation progress, facilitating communication between partner organizations, and sharing updates among interested stakeholders.

In summary, this document provides a holistic, collaborative strategy for addressing ocean litter in California, with a focus on reducing land-based litter at its source. It focuses on high impact Action Items that entities can commit to working on over the next six years. The document provides both guidance and flexibility so that Lead and Partner Organizations can work collaboratively to pursue funding (where needed) and implement these Action Items. Partnership across sectors is necessary to reduce and prevent ocean litter and ensure a healthy coast and ocean for current and future generations of Californians.

# Section I: 2018 California Ocean Litter Prevention Strategy

OPC Priorities and Stakeholder Goals, Objectives, and Actions to Address  
Ocean Litter in California



*Ballona Creek. Photo Credit: Bill MacDonald, Algalita Research Foundation*

## *2018 CALIFORNIA OCEAN LITTER PREVENTION STRATEGY: ADDRESSING MARINE DEBRIS FROM SOURCE TO SEA*

The ocean is an important part of California's economy, culture, and quality of life. California's ocean economy accounts for \$41.9 billion in gross domestic product (NOAA ENOW, 2014), and provides over 500,000 jobs. Sixty-eight percent of Californians live in a coastal county (NOAA OCM, 2015), and the state's beaches are iconic for both tourism and recreation. Despite the large scale of the ocean, human impacts, through changes in land use and pollution, may reduce the benefits the ocean provides. Many ocean pollution problems originate on land, and in some cases, far inland from the coast. These pollution problems can range from nutrients, to contaminants of emerging concern, to ocean litter.

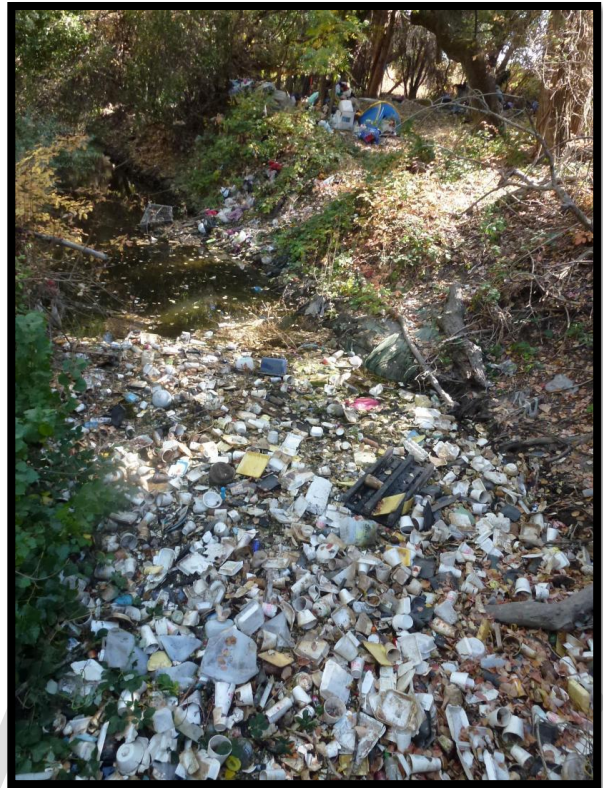
Ocean litter, like many other forms of pollution, is primarily land-based (Sheavly, 2007). Unlike other forms of pollution, ocean litter is very visible and its impacts are evident to stakeholders and the public. Ocean litter pollutes beaches and waterways, entangles marine life, smothers sensitive habitat, and is ingested by marine organisms. For more information on the impacts of ocean litter, please see "Impacts of Ocean Litter" in the Literature Synthesis in Section II.

### *2018 Strategy Update Process*

In 2016, the OPC and the NOAA MDP initiated a partnership with California Sea Grant to update the 2008 OPC Strategy to Reduce and Prevent Ocean Litter. The Strategy planning team also included California Coastal Commission and Surfrider Foundation. Representatives from organizations active in conservation, research, waste reduction, and education, as well as representatives from industries, tribes, local governments, and State and Federal agencies were invited to participate in two workshops in 2017 aimed at generating Action Items that would help solve the problem of ocean litter in California. All of the stakeholder Action Items included in this Strategy document were identified by workshop participants.

The first of the two workshops, held in May 2017 in Oakland, California, allowed participants to discuss the problems associated with ocean litter and brainstorm potential solutions to the

presence of ocean litter in California. One hundred and forty-eight Action Items to reduce and prevent ocean litter were identified during this workshop. Following the first workshop, the planning team reviewed the list of Action Items generated by participants and condensed similar ideas to create a list of 61 Action Items. The planning team then organized this new list into a draft Strategy, which was circulated among the workshop participants and posted on OPC's website for public review and comment in September 2017. The second of the two workshops, held in November 2017 in La Jolla, California, allowed for further discussion and refinement of the Strategy's Action Items, and gave organizations the opportunity to commit to taking a role in implementing proposed actions. At the second workshop, OPC provided stakeholders with an outline of its Priorities to address ocean litter to support and enhance the Goals, Objectives, and Action Items developed by the stakeholders. Each workshop was attended by approximately 50 participants. Materials from the two workshops, including agendas, participant lists, and a complete list of ideas for Action Items generated by workshop #1 participants are posted on the OPC website (<http://www.opc.ca.gov/programs-summary/marine-pollution/ocean-litter-strategy-2018/>).



*Coyote Creek, San Jose. Photo Credit: San Francisco Baykeeper*

Following the second workshop, the planning team revised the draft Strategy to incorporate public comment received after the first workshop, discussion generated during the second workshop, and feedback provided on OPC's Priorities. The second draft of the Strategy was posted on OPC's website and circulated to workshop participants for a second round of public comment in January 2018. The Strategy was revised and finalized based on this second round of public comment.

## Structure of Document

The 2018 *California Ocean Litter Prevention Strategy: Addressing Marine Debris from Source to Sea* includes OPC Priorities to address ocean litter and stakeholder-identified Goals, Objectives, and Actions to address ocean litter. The OPC Priorities outline the work OPC will take on over the next six years, and these Priorities complement and enhance the Goals, Objectives, and Actions identified by the stakeholders. OPC Priorities are structured into three goals:

1. **OPC Goal 1 – Land-based Ocean Litter:** Protect marine ecosystems and the communities that rely on them by promoting policies to prevent litter from reaching the ocean.
2. **OPC Goal 2 – Microplastics and Microfibers:** Increase understanding of the scale and impact of microplastics and microfibers on the marine environment and develop solutions to address them.
3. **OPC Goal 3 – Fishing and Aquaculture Gear:** Reduce debris from fishing and aquaculture-related activities in the ocean.

The stakeholder section of the Strategy is structured around six Goals, five of which are dedicated to land-based litter, and one of which is dedicated to ocean-based debris. Nested under each of these Goals are Objectives, which outline approaches for achieving the Goals. Each Objective includes specific Action Items, concrete and measurable tasks that stakeholders can implement to contribute to an Objective and prevent or reduce ocean litter.

Broadly broken into land- and ocean-based litter categories, the six stakeholder Goals of this Strategy are as follows:

#### *Land-based Ocean Litter*

1. **Goal 1:** Reduce the use of common ocean litter items through mandates and incentives targeting public institutions and businesses.
2. **Goal 2:** Reduce the prevalence of common ocean litter items through changes in product production, design, and management.
3. **Goal 3:** Improve waste management and interception of litter on land before it enters the ocean.
4. **Goal 4:** Conduct and communicate research on existing and emerging issues related to land-based ocean litter.
5. **Goal 5:** Generate behavior change by educating and engaging communities and individuals to reduce ocean litter.

#### *Ocean-based Marine Debris*

6. **Goal 6:** Reduce the sources of ocean-based debris and maximize the efficiency of ocean-based debris cleanup.

The 2018 Strategy document includes the following:

OPC Section

- **3 Goals:** The three Goals focus on land-based ocean litter, microplastics, and fishing and aquaculture gear.
- **3 Priority Objectives:** Each Goal is followed by a Priority Objective. They describe how OPC would approach achieving its Goals. These Priority Objectives are framed around how OPC works, and support and enhance the Goals, Objectives, and Actions developed by California stakeholders in the Stakeholder Section.
- **24 Action Items:** Listed under each Objective. These Actions are concrete and measurable tasks that OPC can implement to meet its Objectives.

Stakeholder Section

- **6 Goals:** The first five Goals are dedicated to land-based ocean litter, while the last Goal is dedicated to ocean-based litter. These Goals focus on source reduction, research, behavior change, control, and cleanup.
- **17 Objectives:** Nested under each Goal, these Objectives are approaches that may be taken to achieve a Goal.
- **64 Action Items:** Listed under each Objective, Action Items are concrete and measurable tasks that stakeholders can implement to contribute to an Objective and prevent or reduce ocean litter.

## Scope of Document

### *Data-driven Goals, Objectives, and Action Items*

The Goals, Objectives, and Action Items included in this document reflect the need to base actions taken to address ocean litter in California on the most accurate available data. The term “common ocean litter items” is used frequently throughout the document to refer to the most prevalent ocean litter items found in California’s waterways and ocean waters, and on its coastlines. The use of this terminology directs stakeholders to focus on the debris items that are most abundant in the environment, while also allowing for flexibility and adaptability, as the most common ocean litter items may change over time.

While the need for a comprehensive, statewide litter dataset is identified in the Action Item tables below (see Action Item 4.1.4), for now, this document relies on California Coastal Cleanup Day data to define the most common ocean litter items found in the state (see Table 1 for the list of the top 10 litter items removed from California’s coastlines and inland waterways on Coastal Cleanup Day from 1989-2014). While cigarette butts are the most prevalent ocean litter item in California, it is important to note that seven of

Table 1. Top ten litter items removed on California Coastal Cleanup Day, 1989-2014 (California Coastal Commission, 2017).

Litter Item	Count	Percentage
Cigarettes/Cigarette filters	6,992,106	37.76%
Food wrappers/Containers	1,940,013	10.48%
Caps/Lids	1,619,071	8.74%
Bags (paper and plastic)	1,462,726	7.90%
Cups/Plates/Utensils	1,014,229	5.48%
Straws/Stirrers	736,595	3.98%
Glass beverage bottles	600,871	3.24%
Plastic beverage bottles	475,799	2.57%
Beverage cans	455,433	2.46%
Construction material	330,711	1.79%

the ten most common litter items represent a form of food and beverage packaging (food wrappers/containers, caps/lids, cups/plates/utensils, straws/stirrers, glass beverage bottles, plastic beverage bottles, and beverage cans; see Table 1). Together, these items comprise 36.95% of the ocean litter found in California, making food and beverage packaging nearly as prevalent as cigarette butts. During implementation of this Strategy, stakeholders may also use more detailed, localized datasets, when available, to determine common ocean litter items in their region or to help define their scope of work.

#### *Focus on Land-based Litter and Lost Fishing and Aquaculture Gear*

The majority of the Strategy’s Goals focus on land-based litter. Approximately 54% of the debris found on California beaches is land-based (Sheavly, 2007), and a large portion of the marine debris community in California focuses their work on land-based litter. The remaining Goals are dedicated to ocean-based debris and focus almost entirely on lost fishing and aquaculture gear. The focus on fishing and aquaculture gear stems from the participation of fishing and aquaculture stakeholders at the workshops, and from targeting the types of ocean-based debris where NOAA and OPC can make the greatest impact.

#### *Emphasis on Source Reduction and Prevention*

This document prioritizes source reduction Goals and Action Items, as agencies and experts agree that source reduction is the most effective tactic for addressing ocean litter. Source reduction, or waste prevention, as defined by California’s Public Resources Code Section 40196, refers to practices that result in a net reduction in the generation of solid waste. Source reduction includes, but is not limited to, changes in the design, manufacture, purchase or use of materials and products. This may include, among other things, reducing packaging, and replacing

disposable products and materials with reusable products and materials (Public Resources Code Section 40196; EPA, 2016). According to the State of California, source reduction does not include steps taken after the material becomes solid waste, such as incineration or recycling (Public Resources Code Section 40196). Source reduction is considered by the US EPA to be the most preferred method for dealing with waste, and can help reduce ocean litter by decreasing the amount of trash there is to control, cleanup, and dispose (EPA, 2017).

Furthermore, source reduction creates significant opportunities for industry to take initiative and responsibility for the products they produce. By altering their production, operation, and raw material use, industries can prevent litter at the source. Institutions, businesses, and consumers can also play a role in source reduction. For example, the State is the single largest purchasing entity in California, purchasing billions of dollars of products each year (Suh *et al.*, 2017). As a result, the State can have a significant impact on, and set a good example for, preventing and reducing waste at the source through procurement policies that prioritize reusable items. Institutions and businesses can also benefit from these procurement changes, as they often lead to reduced costs associated with the purchase of disposable items, and the transportation, disposal, or recycling of waste (Maryland Department of the Environment, 2017; Clean Water Action, 2017). Consumers can contribute to source reduction by making changes in their own purchasing habits and supporting businesses that exhibit sustainable purchasing practices.

It is not just raw material, it is how it is used too, e.g., reusable vs disposable (a reusable cup could be made of the same material as a disposable one)

Efforts to engage in source reduction are occurring throughout California. Numerous local jurisdictions have passed restrictions on the use of expanded polystyrene in foodware, and single-use plastic carryout bag bans. An assessment of plastic in Southern California coastal waterways found that local jurisdictions with bag bans had significantly fewer plastic bags in their watersheds than jurisdictions without bans. On average, areas with ordinances had 1/3 of the number of plastic bags that were found in areas without ordinances (Moore *et al.*, 2016). In 2016 state voters ratified the statewide single-use plastic carryout bag ban, which prohibited stores from providing single-use plastic carryout bags, and required that stores charge a fee for a reusable bag. Although no formal analysis has been conducted, Coastal Cleanup Day data indicates that the prevalence of single-use plastic bags as a portion of the total number of items collected during Coastal Cleanup Day has decreased from 7.42% in 2010, when the first local bans were implemented, to 2.82% in 2017, after the statewide single-use plastic carryout bag ban went into effect (information provided by California Coastal Commission staff, 2018).

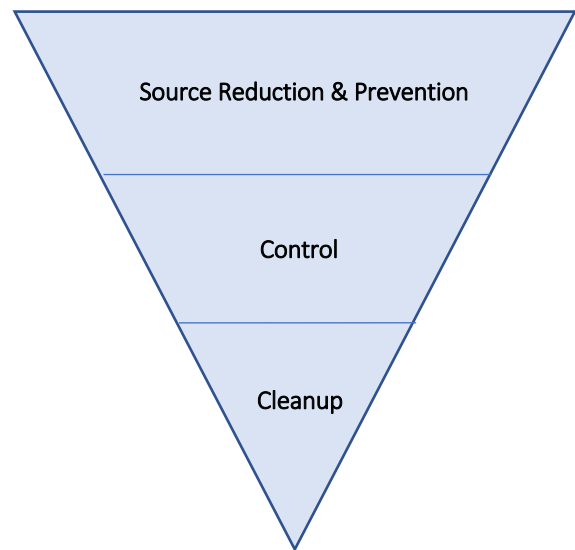
### *Control and Cleanup*

Controlling and cleaning up litter in the environment is important, but less efficient and effective in the longer term compared to source reduction and prevention. Control is used here to mean efforts taken to intercept litter before it ends up in waterways, on beaches, or in the ocean. Examples of litter control methods include street sweeping, stormwater capture devices, storm drain cleaning and maintenance, and increasing options and opportunities for proper waste disposal. Cleanup refers to efforts taken to remove litter from waterways, beaches, and the ocean. Examples of cleanup methods include manual litter removal on beaches, installation of trash skimmers in ports, and organizing divers and fishermen to remove lost fishing gear. The public cost burden of control and cleanup makes a compelling argument for accelerating the search for effective strategies to reduce and prevent trash streams that enter our waterways and contribute to ocean litter.

Efforts to improve litter control are occurring throughout California. One such effort is the California Fishing Line Recycling Program, led by the California State Parks Division of Boating and Waterways (DBW) and the California Coastal Commission (CCC), Keep the Delta Clean, and the BoatU.S. Foundation. To date, this program has installed 243 fishing line recycling stations in fishing areas throughout the state, and collected and recycled over 1,480 pounds of fishing line which may have otherwise become ocean litter (information provided by DBW and CCC staff, 2018).

Another ongoing statewide litter control effort is the implementation of the State Water Resources Control Board's (State Water Board's) Trash Amendments. In 2015, the State Water Board adopted a statewide water quality objective aimed at reducing the amount of trash that finds its way into rivers, lakes, and the ocean by prohibiting the discharge of trash into state surface waters. The water quality objective is commonly referred to as the "Trash Amendments." These Trash Amendments provide statewide consistency in efforts to reduce trash in state waters, and use a land use-based compliance approach that targets high trash generating areas such as high density residential, industrial, commercial, mixed urban and public transportation land uses. This program allows flexibility for local governments to come up with compliance approaches that work best for them to effectively eliminate trash discharge from their stormwater systems. Local governments may choose to increase trash capture in stormwater runoff, or use a combination of source reduction approaches that are equivalent to full trash capture. This Strategy provides a suite of source reduction approaches that may be cost-effective and useful to local governments as they develop their compliance approaches for the Trash Amendments. OPC and NOAA intend to align the Strategy implementation process with the

Fig. 3. Hierarchy of Efforts to Address Ocean Litter



Trash Amendments reporting timeline, to the extent possible, to avoid creating additional reporting burdens for local governments.

California also has a robust and successful network for organized cleanup efforts. From local nonprofits to municipalities, beach and waterway cleanups are held on a regular basis throughout the state. California Coastal Cleanup Day is a notable program held once a year, where approximately 60,000 volunteers pick up hundreds of thousands of pounds of trash and recyclables from beaches, lakes, and waterways. In 2016, 59,154 volunteers participated in California Coastal Cleanup Day and collected 710,781 pounds of litter (California Coastal Commission, 2016). California Coastal Cleanup Day is a part of International Coastal Cleanup Day, the world's biggest effort to clean up ocean litter. Annually, nearly 12 million people volunteer to pick up litter on this day in their communities (Ocean Conservancy, 2017).

It is important to note that waste management and ocean litter are inextricably linked. This Strategy is intended to be a complementary document to other waste prevention and management strategies (e.g., CalRecycle Packaging Reform Process), with a focus on the issue of ocean litter.

## Strategy Implementation

As described above, the scope and focus of this document were largely determined by the stakeholders involved in the two workshops held in 2017. Attendees of the second workshop devised the following Strategy implementation scheme:

**Six-year timeframe:** The operational cycle of this document is six years (2018-2024). Six years provides ample time for Action Item implementation, while also allowing for evaluation of progress and reevaluation of Strategy Goals and Objectives, if needed, throughout the process.

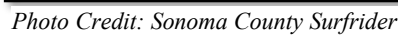
**In-person check-ins every two years:** Every two years, OPC and NOAA MDP will organize in-person meetings amongst stakeholders to discuss progress made on Strategy implementation, and to reevaluate the Strategy's Goals and Objectives, if necessary.

**Conference calls/webinars and newsletters every six months:** Every six months, OPC and NOAA MDP will organize and facilitate a webinar or conference call to allow stakeholders to discuss and share lessons learned from the Strategy implementation process. OPC and NOAA MDP will also create a newsletter to share updates on Action Item progress with stakeholders and the public; this newsletter will be populated by information provided by the organizations involved in Action Item implementation. OPC will also provide updates on its progress with implementing OPC Priorities via these webinars and newsletters annually. The form that these six-month check-ins take may change over the course of the document's six-year timeframe, depending on what stakeholders feel is most useful to facilitate communication and collaboration.

**Action Item timelines and metrics:** Stakeholders will form working groups around each Action Item, and will be responsible for devising implementation plans with rough timelines and metrics for each Action Item by the first six-month check-in webinar (which will be held in late 2018). OPC and NOAA MDP will provide some guidance and structure for how to set metrics and timelines for Action Items.

DRAFT

Recognizing the many benefits the ocean provides to Californians and the need to protect California's coastal and ocean resources, the state legislature passed the California Ocean Protection Act (COPA) in 2004. COPA acknowledges the interconnectedness of the land and sea, and tasks OPC with ensuring that California maintains a healthy, resilient and productive ocean and coastal ecosystem for the benefit of current and future generations. OPC works in four ways to protect ocean and coastal ecosystems, as mandated by COPA. OPC recommends and implements policy, leads and promotes coordination among state agencies, develops and implements innovative projects, and informs government



1. Implement a producer take-back (EPR) program for convenience food packaging.
2. Prohibit single-use products that pose significant ocean litter impacts where a feasible less damaging alternative is available. Products specifically called out included polystyrene food packaging and plastic bags.
3. Assess fees on commonly littered items.

20

To further advance actions that will prevent and reduce ocean litter in California and guide funding priorities over the next six years, OPC's Priorities to address ocean litter are laid out in this section. These Priorities are meant to support and enhance many of the Goals, Objectives, and Action Items developed by California stakeholders which are outlined in the "Stakeholder Goals, Objectives, and Action Items" section. OPC's Priorities can be divided into three broad categories: land-based ocean litter, microplastics and microfibers, and fishing and aquaculture gear.

- **Land-Based Ocean Litter:** The majority of litter found on West Coast beaches originates on land (Sheavly, 2007). Land-based ocean litter (defined here as larger than 5 mm) fouls ocean ecosystems, entangles marine wildlife, and pollutes California's coastline. Furthermore, land-based ocean litter creates an economic burden for California communities, who spend more than \$428 million annually on control and cleanup. (Stickel *et al.*, 2013).
- **Microplastics and Microfibers:** Microplastics and microfibers (materials smaller than 5 mm) are of increasing concern in the marine environment as they can be ingested by marine organisms, including those targeted for human consumption. These microplastics can physically block the digestive tracts of marine species, and may accumulate up the food chain (NOAA MDP, 2014a). Additionally, chemicals associated with the microplastic may be absorbed by marine life through ingestion (NOAA MDP, 2014a).
- **Fishing and Aquaculture Gear:** Ocean-based sources of litter, including fishing and aquaculture gear, contribute to the problem of ocean litter along the West Coast (Sheavly, 2007). Lost or abandoned fishing and aquaculture gear can result in ghost fishing and habitat impacts, causing ongoing harm to marine ecosystems.

As a state agency, OPC works to advance and protect the interests of the public when addressing ocean litter. This means developing and recommending policies that reduce the negative costs associated with ocean litter. Most of these costs are currently born by the public through funding cleanup and capture. OPC prioritizes source reduction to prevent ocean litter because it is cost-effective and reduces cost burdens on the public. Many policies can be used to address common ocean litter items, ranging from voluntary to mandatory. OPC is open to using all the policy options available, as long as they are shown to effectively and substantially reduce ocean litter. The state has a number of initiatives and programs that will complement OPC's California Ocean Litter Strategy. OPC has coordinated with our agency partners throughout the development of this Strategy and OPC's Priorities. A brief list summarizing these agencies' programs and initiatives is below:

- State Water Resources Control Board: Trash Amendments Implementation
- CalRecycle: Packaging Reform Process
- California Department of Toxic Substances Control: Safer Consumer Products Program
- California Coastal Commission: Energy, Ocean Resources, and Federal Consistency Program, and Public Education Program
- Fish and Game Commission: Leasing of State Water Bottoms for Purposes of Aquaculture

- California Department of Fish and Wildlife: Aquaculture Program

Implementation of OPC Priorities will occur over the next six years. Stakeholders will receive updates on OPC's progress to implement these Priorities at least annually as part of the California Ocean Litter Strategy Implementation process. Please see the "Strategy Implementation" section for more details on the implementation process. Some of the priority actions outlined below are particularly timely, and OPC staff has assigned timelines to them. Other priority actions are written in a broad way to allow for adaptation over the next six years, and do not have specific timelines called out at this time.

## **OPC GOAL 1 – LAND-BASED OCEAN LITTER: Protect marine ecosystems and the communities that rely on them by promoting policies to prevent litter from reaching the ocean.**

***Priority Objective: Advance source reduction efforts through policy, research, and funding to prevent the production and consumption of common ocean litter items by supporting the following actions:***

**Policy Implementation:** Develop and recommend a variety of policy tools to prevent the production and consumption of common ocean litter items at their source, including single-use food and beverage packaging and cigarette filters. Examples of actions to support policy implementation include, but are not limited to:

1. Promote changes by 2020 in State purchasing and service contracts, to reduce the State's reliance on single-use foodware that typically becomes ocean litter.
2. Recommend state and local policies that encourage consumers to bring their own reusable food and beverage containers by charging for disposable packaging use for "to go" food service by 2024.
3. Promote comprehensive waste management approaches to prevent the production of common ocean litter items through CalRecycle's packaging reform efforts, and explore methods to share responsibility between producers and the public to fund the cleanup of beaches and inland waterways that are littered with these products.
4. Support policies that reduce expanded polystyrene litter, such as the inclusion of expanded polystyrene as a priority product in CalRecycle's packaging reform efforts and the prohibition of expanded polystyrene<sup>1</sup> in foodware.
5. Convene and foster innovative partnerships, use funding mechanisms, and recommend policies to redesign common ocean litter items such as connecting bottle caps to bottles.

---

<sup>1</sup> OPC previously prioritized a polystyrene food packaging ban in 2008. Expanded polystyrene in food packaging should be addressed for a number of reasons: Expanded polystyrene breaks apart into tiny pieces quickly once it reaches the environment, it is easily carried by wind, and mixes into beach sand and sediment. Although expanded polystyrene is technically recyclable, expanded polystyrene in use as food service ware is often too contaminated for the recycling stream.

6. Convene a working group to evaluate a ban on cigarette filters in California by 2020. The working group will investigate research and reports on cigarette filters, and the extent to which they impact human health. If the working group finds that cigarette filters provide no health protections to smokers, then OPC may make recommendations to the legislature to ban cigarette filters.

**Research and Funding:** Use research and funding to address knowledge gaps and better target policy efforts; examples of actions under this category may include, but are not limited to:

1. Fund assessments of policy effectiveness to determine whether the policies are acting as intended and what, if any, changes need to be made to increase effectiveness. If local policies or ordinances are demonstrated to be effective, consider recommending for statewide implementation.
2. Fund a report synthesizing lessons learned from waste management policies and tools implementation in other countries, including policy recommendations for California, with a focus on source reduction by 2020.
3. Fund research and partner with the Department of Toxic Substances Control to address chemical additives that are commonly associated with products found in ocean litter to determine their environmental impacts. Chemical additives may include, but will not be limited to fluorinated compounds, plasticizers, and antimicrobials.
4. Fund a report compiling and synthesizing the use of plastics in agricultural practices, and the extent to which this use of plastics may contribute to watershed pollution and ocean litter by 2023.
5. Fund innovative projects and programs that reduce the production and consumption of common ocean litter items, such as piloting the use of a reusable “to go” container exchange at food service providers.

**OPC GOAL 2 – MICROPLASTICS AND MICROFIBERS:** Increase understanding of the scale and impact of microplastics and microfibers on the marine environment and develop solutions to address them.

***Priority Objective: Advance research on the extent and impact of microplastics and microfibers in source waters and the ocean, assist in the development of technological solutions to reduce their prevalence in aquatic environments through the following actions:***

1. Fund the development and validation of standardized monitoring methods in California, leveraging national and international resources and knowledge, where feasible, to assess the concentration and flux of microplastics by 2021. Methods are needed for several

different environments where microplastics are found, including: wastewater effluent, ambient waters, stormwater, marine sediments, and tissues of fish, bivalves, and other organisms.

2. Convene scientists and experts to develop a comprehensive research plan by 2024 to characterize microplastics' sources, pathways, ambient concentrations, risk assessments, and impacts. Research efforts may include the following:
  - a. Quantify the concentration at which microplastics cause ecological impacts to marine life and ocean health at the population and community levels, as well as impacts to individual organisms' biology;
  - b. Improve the understanding of the sources and pathways associated with microplastic pollution, including polymer identification;
  - c. Determine whether additives associated with microfibers may cause impacts to the marine environment, research will be based on best available data and the development of studies will include relevant stakeholders;
  - d. Determine whether reformulated textiles can significantly reduce the loading of microplastics into the environment; research will be based on best available data and the development of studies will include relevant stakeholders.
  - e. If wastewater treatment plant loadings of microplastics are found to have a significant impact on the environment, research the feasibility and effectiveness of technical solutions for microfibers in wastewater treatment plants, washing machines, and other points in the wastewater management system, including source control.

### **OPC GOAL 3 – FISHING AND AQUACULTURE GEAR: Reduce debris from fishing and aquaculture-related activities in the ocean<sup>2</sup>.**

*Priority Objective: Promote improved fishing and aquaculture gear management and sustainable innovation to reduce the potential for lost gear; remove lost gear and legacy infrastructure from the ocean by pursuing the following actions:*

1. Provide best-available science and information to the California Department of Fish and Wildlife (CDFW) and the California Fish and Game Commission (FGC) as they work to develop improved fishing and aquaculture gear management, and maintain two-way information exchange between the CDFW, FGC, and OPC for data sharing and interagency staff coordination.

---

<sup>2</sup> Although there are many ocean-based sources of debris in the ocean, the scope of the California Ocean Litter Strategy focuses on fishing and aquaculture gear, and OPC Priorities reflect this scope.

2. Promote fixed-gear best practices, including how to minimize losing traps, in partnership with CDFW.
3. Promote the development and implementation of regulations requiring best management practice (BMP) plans for shellfish aquaculture in California by 2020, in partnership with CDFW, FGC, and the California Coastal Commission. The BMP plans should reduce the potential for loss of aquaculture gear and require the cleanup and recovery of lost gear.
4. Develop and promote fishery-funded gear retrieval programs through industry education and collaborations with non-governmental organizations, port and harbor districts and associations, and other partners.
5. Fund sustainable innovation in fishing and aquaculture gear to reduce the potential for lost gear, including new technologies, and ensure that any new and effective fishing and aquaculture gear innovation is an allowable technology in legislation and regulations.
6. Recommend the development and implementation of regulatory tools to allow for retrieval of lost gear or traps that belong to other fishermen.
7. Fund removal of fishing gear and abandoned aquaculture materials, disused creosote pilings, and illegal artificial reefs, where liable owners and responsible parties cannot be identified.



*Photo Credit: Santa Barbara Adventure Company*

## STAKEHOLDER GOALS, OBJECTIVES, AND ACTION ITEMS

As described above, the OPC Priorities complement and enhance Stakeholder Goals, Objectives, and Action Items described here. These Stakeholder Goals, Objectives and Action Items were developed and refined through two stakeholder workshops. The first workshop provided an opportunity to brainstorm Action Items, and the second workshop provided an opportunity to refine the Goals, Objectives, and Action Items from the first draft of the Strategy. This differs from the OPC Priorities, which were developed by OPC staff and revised by multiple rounds of stakeholder feedback. More details on the process of how the tables below were developed is available in the “2018 Strategy Update Process” section.

As mentioned in the “Strategy Implementation” section, these actions will be implemented over the next six years, with check-in conference calls or webinars every six months and in-person meetings every two years. Lead Organizations are expected to report on their progress at these events, as appropriate for the particular Action Item. Taken together, the OPC Priorities and the Goals, Objectives, and Action Items laid out below provide structure and guidance for OPC and California stakeholders to efficiently address this pressing issue over the next six years. In the tables below, Action Items to prevent and reduce ocean litter are grouped under broader Goals and Objectives. Definitions of the information in each column are as follows:



*Photo Credit: NOAA Marine Debris Program*

- **Action Items:** Outlines the task that will be implemented in order to prevent or reduce ocean litter.
- **Lead & Partner Organizations:** Identifies the organization(s) or individual(s) that volunteered to implement the Action Item.
  - **Lead Organizations** are **bolded** and listed alphabetically, before Partner Organizations, next to each Action Item. Lead Organizations are committed to implementing an Action Item, given organizational and funding constraints. Lead Organizations will serve as the point of contact for NOAA and OPC for progress reports and check-ins throughout the Strategy’s six-year timeframe, and will take a leadership role in communicating and coordinating with other collaborators/Partner Organizations on the Action Item.

- **Partner Organizations** are unbolded and listed alphabetically, after Lead Organizations, next to each Action Item. Partner Organizations will serve a supporting role in implementing an Action Item, in collaboration with Lead and other Partner Organizations.
- It is important to note that the list of organizations included here is not exclusive, and additional organizations may contribute to Actions over the lifetime of the Strategy.

## LAND-BASED OCEAN LITTER

**GOAL 1. Reduce the use of common ocean litter items through mandates and incentives targeting public institutions and businesses.**

Objective 1.1. Prohibit or discourage common ocean litter items in public institutions, retail, and food service establishments through government policies or mandates.	
Action Items	Lead & Partner Organizations
1.1.1. Pass and implement policies that prohibit or discourage common ocean litter items at the local level <sup>3</sup> and consider these policies for effectiveness assessment as described under Objective 4.4.	<b>CPSC, The Albatross Coalition, Zero Waste San Diego,</b> BASMAA, Clean Water Action/Clean Water Fund, <b>PRCC</b> , Surfrider Foundation, UPSTREAM
1.1.2. Pass and implement legislation that prohibits or discourages common ocean litter items at the state level and consider these policies for effectiveness assessment as described under Objective 4.4.	<b>CPSC, The Albatross Coalition, Zero Waste San Diego,</b> Californians Against Waste, Clean Water Action/Clean Water Fund, <b>PRCC</b> , Surfrider Foundation, UPSTREAM
1.1.3. Expand the single-use plastic carryout bag ban to apply to retail stores, restaurants, and food delivery, and amend the State's criteria for reusable bags to exclude bags made from plastic film <sup>4</sup> .	Californians Against Waste, <del>PRCC</del> , Surfrider Foundation
1.1.4. Promote reusable and refillable food and beverage packaging in the state bottle bill, and state and local packaging policies.	<b>CPSC, The Albatross Coalition, Zero Waste San Diego,</b> UPSTREAM <b>PRCC</b>
1.1.5. Change procurement of common ocean litter items on UC and CSU campuses, and share lessons	Clean Water Action/Clean Water Fund, CPSC

<sup>3</sup> Examples of local policies include excess litter fee programs such as that implemented in Oakland, California (City of Oakland, 2018), and local polystyrene food ware bans such as that implemented in San Francisco, California (San Francisco Department of the Environment, 2016).

<sup>4</sup> Currently, the State allows reusable grocery bags, as defined in SB 270 Chapter 5.3 Article 2, to be made from plastic film, as long as the bags meet a number of requirements, including being "capable of carrying 22 pounds over a distance of 175 feet for a minimum of 125 uses and be[ing] at least 2.25 mils thick, measured according to the American Society of Testing and Materials (ASTM) Standard D6988-13." This Action Item follows the example set by the City and County of Honolulu, Hawai'i, which, in 2017, amended Oahu's plastic bag ban so that by January 1, 2020, plastic film bags will no longer be considered reusable bags (Mattison, 2017).

learned with other learning institutions (e.g., community colleges, K-12).	
1.1.6. Change procurement to minimize the use of common ocean litter items in local and state government buildings and events, and share lessons learned with other public institutions (e.g., federal facilities, jails, hospitals).	<b>OPC, BASMAA, Californians Against Waste, Clean Water Action/Clean Water Fund, CPSC, UPSTREAM</b>
1.1.7. Require permits for new construction of dine-in restaurants to include dishwashing facilities on-site to accommodate reusable food ware.	Californians Against Waste, Clean Water Action/Clean Water Fund, UPSTREAM
1.1.8. Develop a toolkit with materials and strategies to share with local and out-of-state advocates to a) aid in the process of banning common ocean litter items, and b) to aid in the process of switching local governments and communities to reusable items.	<b>Plastic Pollution Coalition, UPSTREAM</b>
<b>Objective 1.2. Incentivize institutions, businesses, and events to transition away from common ocean litter items.</b>	
<b>Action Items</b>	<b>Lead &amp; Partner Organizations</b>
1.2.1. Perform audits before and after institutions implement efforts to minimize the use of common ocean litter items.	Clean Water Action/Clean Water Fund
1.2.2. Incentivize businesses and corporations to transition to reusables (e.g., film industry craft services, corporate dining, water refill stations) through sharing case studies and demonstrating cost-savings.	Amcor Limited, Clean Water Action/Clean Water Fund, Surfrider Foundation, UPSTREAM
1.2.3. Promote certification for events (e.g., music festivals, concerts, sports competitions, film production) that achieve zero waste principles.	<b>The Albatross Coalition, Zero Waste San Diego, Clean Water Action/Clean Water Fund, Surfrider Foundation</b>
1.2.4. Engage with companies that are already using alternative products and materials to help advocate for transition away from common ocean litter items.	PRCC, Surfrider Foundation

## **GOAL 2. Reduce the prevalence of common ocean litter items through changes in product production, design, and management.**

**Objective 2.1. Support and promote extended producer responsibility (EPR) and other waste management strategies to reduce the generation of common ocean litter items, and create a**

mechanism for producers to fund common ocean litter item capture, cleanup, and recycling infrastructure.	
Action Items	Lead & Partner Organizations
2.1.1. The Ocean Protection Council and other stakeholders will promote EPR as a policy to consider as part of CalRecycle's Packaging Reform Effort, and support giving CalRecycle legislative authority to create mandatory packaging reform policies.	OPC, Californians Against Waste, CPSC, PRCC, Save Our Shores, UPSTREAM
2.1.2. Create a report synthesizing lessons learned from waste management policy and tool implementation in other countries, including recommendations for California with a focus on source reduction.	CPSC, UPSTREAM
2.1.3. Include performance measures in EPR programs for both prevention and recycling of common ocean litter items, with prevention being a higher priority.	CPSC, Californians Against Waste, PRCC, Save Our Shores, UPSTREAM
2.1.4. Ensure that all film and wrap plastics eligible for recycling (plasticfilmrecycling.org) are accepted at all drop-off locations (e.g., grocery stores), and enforce the recycling requirements that are part of the single-use plastic carryout bag ban <sup>5</sup> .	Can the Flexible Film Recycling Group (FFRG) to take the lead?
<b>Objective 2.2. Support product redesign with the aim of preventing ocean litter through design changes and avoiding harmful substitutions<sup>6</sup>.</b>	
Action Items	Lead & Partner Organizations
2.2.1. Engage corporations in common ocean litter item redesign by implementing design challenges, and creating a venue for sharing innovative designs with brands and corporations.	The Albatross Coalition, Think Beyond Plastic, Zero Waste San Diego, ACC, Amcor Limited, Californians Against Waste, PRCC
2.2.2. Redesign and produce bottles with caps attached ("connect the cap"), and ensure that all components of these products are recyclable at all facilities in California.	The Albatross Coalition, Zero Waste San Diego, ACC, Californians Against Waste, PRCC, Surfrider Foundation, Think Beyond Plastic, UPSTREAM

<sup>5</sup> The single-use plastic carryout bag ban, SB 270 (Sections 42250-42257), requires stores that make plastic carryout bags available to their customers to establish at-store recycling programs that allow customers to return clean plastic carryout bags to stores to be recycled. This Action Item calls for the enforcement of the recycling requirements outlined in SB 270, as well as an expansion of the recycling programs established at stores to accept all film and wrap plastics eligible for recycling, as defined by plasticfilmrecycling.org (including bags used for produce, bulk goods, and other products, which, while not covered under SB 270, are often single-use plastic and end up in the environment).

<sup>6</sup> The term "harmful substitutions" is used here to mean: 1) products that may take the place of common ocean litter items and continue to contribute to the problem of ocean litter, rather than reduce ocean litter, and 2) products that may take the place of common ocean litter items, and contain components, additives, or contaminants that are detrimental to human health and/or the environment.

2.2.3. Redesign plastic products to be circular and entirely recyclable in California, through voluntary or legislative action <sup>7</sup> .	CPSC, The Albatross Coalition, Zero Waste San Diego <b>PRCC</b>
---	--

### GOAL 3. Improve waste management and interception of litter on land before it enters the ocean.

Objective 3.1. Support the State Water Resources Control Board's Trash Amendments.	
Action Items	Lead & Partner Organizations
3.1.1. Create a mechanism for local governments to fund stormwater trash programs through public or private sources.	ACC, BASMAA, Clean Water Action/Clean Water Fund, OPC, PRCC, Save Our Shores, UPSTREAM
3.1.2. Implement a statewide Adopt-A-Storm Drain program.	City of Oakland, PRCC, Save Our Shores
3.1.3. Educate the public about the Trash Amendments.	BASMAA, CPSC, Clean Water Action/Clean Water Fund
Objective 3.2. Improve waste management in public places.	
Action Items	Lead & Partner Organizations
3.2.1. Establish and improve management of trash, recycling, and compost receptacles in high use areas.	Amcor Limited, ACC, California Coastal Commission, OPC, PRCC, Save Our Shores
3.2.2. Increase industry investment in infrastructure improvements to address waste management at schools and other public areas.	ACC
3.2.3. Support packaging policies that develop and expand infrastructure for recycling in California.	CPSC <b>PRCC</b>
3.2.4. Engage with municipalities and social programs to assess how to reduce ocean litter from encampments, as one strategy to improve the health, wellbeing, and safety of homeless communities.	BASMAA

<sup>7</sup> In July 2017, China informed the World Trade Organization (WTO) that by the end of 2017, it would ban the import of 24 types of waste, including "plastics waste from living sources" (Reuters, 2017). China's new policy has put pressure on California's recycling infrastructure (which currently relies on the export of about one-third of the recyclable materials generated in the state to other countries), as in 2016, 62% of the 15 million tons of recyclable materials exported by California went to China (CalRecycle, 2018). China's policy change has emphasized the need to promote waste prevention in California, as well as expand California's own recycling infrastructure, to reduce the amount of recyclable waste that is exported each year (CalRecycle, 2018).

**GOAL 4. Conduct and communicate research on existing and emerging issues related to land-based ocean litter.**

<b>Objective 4.1. Conduct a comprehensive characterization of microplastics and macro-debris.</b>	
<b>Action Items</b>	<b>Lead &amp; Partner Organizations</b>
4.1.1. Convene an expert workgroup to develop a matrix of standard sample collection, processing, and characterization methods for measuring temporal changes in microplastics and macro-debris in different environments.	<b>Algalita, SCCWRP, SFEI, 5 Gyres Institute, ACC, CASA/BACWA/SCAP, Clean Water Action/Clean Water Fund, Dr. Andrew Gray's Laboratory, University of California, Riverside, Dr. Erika Holland at CSULB, ESRM Program at CSUCI (including Dr. Clare Steele), NOAA MDP, PRCC, Surfrider Foundation</b>
4.1.2. Develop and test laboratory methods to identify the most common macro- and micro-plastic debris polymer types through molecular techniques (e.g., FTIR, Raman, forensics).	<b>Dr. Andrew Gray's Laboratory, University of California, Riverside, ESRM Program at CSUCI (including Dr. Clare Steele), ACC, CASA/BACWA/SCAP, Dr. Erika Holland at CSULB</b>
4.1.3. Develop a watershed-scale program to model and monitor microplastics and macro-debris flux, transport, degradation, and fate according to a variety of endpoints (e.g., street litter, stormwater, wastewater, and direct discharges).	<b>SFEI, 5 Gyres Institute, ACC, California Coastkeeper Alliance, CASA/BACWA/SCAP, Dr. Andrew Gray's Laboratory, University of California, Riverside, Dr. Natalie Mladenov at SDSU</b>
4.1.4. Create a comprehensive litter dataset to identify the most common item types according to volume, weight, flux, material, product, source, brand, and other units of importance.	<b>Dr. Andrew Gray's Laboratory, University of California, Riverside, Surfrider Foundation, California Coastal Commission, Clean Water Action/Clean Water Fund</b>
4.1.5. Work with Ocean Conservancy to capture brand data during Coastal Cleanup Day.	<b>California Coastal Commission</b>
<b>Objective 4.2. Quantify microplastics pathways within watersheds and develop technological solutions.</b>	
<b>Action Items</b>	<b>Lead &amp; Partner Organizations</b>
4.2.1. Identify and quantify microfibers and microplastics from wastewater, stormwater, airborne, and agricultural sources.	<b>SCCWRP, SFEI, 5 Gyres Institute, CASA/BACWA/SCAP, Dr. Andrew Gray's Laboratory, University of California, Riverside, Dr. Natalie Mladenov at SDSU, ESRM Program at CSUCI</b>
4.2.2. Research innovative solutions to address microfibers in textiles and apparel.	<b>CASA/BACWA/SCAP, CPSC</b>
4.2.3. Research technological solutions to address microfibers at wastewater treatment plants or in washing machines.	<b>CASA/BACWA/SCAP</b>

<b>Objective 4.3. Research ecological and toxicological impacts of commonly found ocean litter on marine resources and human health.</b>	
<b>Action Items</b>	<b>Lead &amp; Partner Organizations</b>
4.3.1. Advance research on the chemical components of common ocean litter items (by resin type) and the potential for pollutants to migrate into the environment and aquatic organisms via ocean litter.	OPC, ACC, California Lost Fishing Gear Recovery Project at UC Davis, Dr. Erika Holland at CSULB, DTSC, ESRM Program at CSUCI (including Dr. Clare Steele), Graduate School of Public Health at SDSU, UPSTREAM
4.3.2. Assess population and community-level impacts to economically important and/or especially vulnerable species from exposure to plastics and adsorbed pollutants.	
4.3.3. Research impacts to human health via direct consumption of microplastics and seafood exposed to plastic debris.	ACC, California Lost Fishing Gear Recovery Project at UC Davis, UPSTREAM
<b>Objective 4.4. Assess the effectiveness of existing bans, policies, and programs.</b>	
<b>Action Items</b>	<b>Lead &amp; Partner Organizations</b>
4.4.1. Conduct cost-benefit analyses for implementation of different common ocean litter item reduction policies/strategies and provide them to cities and businesses (i.e., local ordinances to ban expanded polystyrene, deposit schemes, packaging redesign).	BASMAA, Dr. Andrew Gray's Laboratory, University of California, Riverside
4.4.2. Analyze the impact of the single-use plastic carryout bag ban on reducing disposable bag use, preventing ocean litter, and reducing government costs.	ACC, California Coastal Commission, Dr. Andrew Gray's Laboratory, University of California, Riverside, Surfrider Foundation
4.4.3. Conduct research into consumer behavior to assess attitudes toward reusable and disposable items, convenience, willingness to pay, and incentives to avoid commonly littered items (e.g., cigarette filters).	Clean Water Action/Clean Water Fund, CPSC, Dr. Sean Anderson at CSUCI, PRCC, Save Our Shores
<b>Objective 4.5. Improve coordination among California organizations conducting ocean litter research.</b>	
<b>Action Items</b>	<b>Lead &amp; Partner Organizations</b>
4.5.1. Improve communication among ocean litter research entities in California through participation in the Ocean Litter Strategy implementation process.	NOAA MDP, OPC, The Albatross Coalition, Zero Waste San Diego

4.5.2. Increase dissemination of research results to the public and management agencies (e.g., California Department of Fish and Wildlife).	OPC, NOAA Marine Debris Program (MDP)
---	---------------------------------------

**GOAL 5. Generate behavior change by educating and engaging communities and individuals to reduce ocean litter.**

<b>Objective 5.1. Increase formal and informal science-based education to raise awareness of ocean litter.</b>	
<b>Action Items</b>	<b>Lead &amp; Partner Organizations</b>
5.1.1. Compile and share a database of existing resources and curriculum for formal education on ocean litter.	NOAA MDP
5.1.2. Integrate standards-based ocean litter curriculum into school programs.	Algalita, 5 Gyres Institute, California Coastal Commission, IGISc at SFSU, Monterey Bay Aquarium, NOAA MDP, PRCC, Save Our Shores
5.1.3. Develop and distribute toolkits to empower high school and college students to educate people on their campuses and in their communities.	Algalita, The Albatross Coalition, Zero Waste San Diego, Monterey Bay Aquarium, NOAA MDP, PRCC
<b>Objective 5.2. Educate consumers about the sources of ocean litter, to drive behavior change in purchasing.</b>	
<b>Action Items</b>	<b>Lead &amp; Partner Organizations</b>
5.2.1. Implement coastal and inland public education campaigns about common ocean litter items, to drive changes in purchasing.	5 Gyres Institute, California Coastal Commission, Californians Against Waste, ESRM Program at CSUCI, PRCC, Save Our Shores, Surfrider Foundation
5.2.2. Develop messaging for consumers and producers on microfibers given our current state of knowledge on this emerging issue.	Californians Against Waste, CASA/BACWA/SCAP, CPSC, ESRM Program at CSUCI
5.2.3. Implement a public education campaign about cigarette filters.	BASMAA, California Coastal Commission, Californians Against Waste, CPSC, Save Our Shores, UPSTREAM

## OCEAN-BASED MARINE DEBRIS

**GOAL 6. Reduce the sources of ocean-based debris and maximize the efficiency of ocean-based debris cleanup.**

<b>Objective 6.1. Leverage industry knowledge to prevent lost fishing gear.</b>	
<b>Action Items</b>	<b>Lead &amp; Partner Organizations</b>
6.1.1. Leverage commercial and recreational fishermen’s knowledge to develop strategies for preventing and dealing with gear loss, and share these strategies among the commercial and recreational fishing communities.	<b>NOAA MDP</b> , California Lost Fishing Gear Recovery Project at UC Davis, Channel Islands National Marine Sanctuary
6.1.2. Share lessons learned from the fishing industry with management agencies and other stakeholders to focus policy and funding on prevention and recovery of lost gear.	California Lost Fishing Gear Recovery Project at UC Davis, Channel Islands National Marine Sanctuary, The Nature Conservancy
6.1.3. Work with the fishing community to design gear that is less likely to be lost, and less harmful to the environment once lost.	
<b>Objective 6.2. Implement Best Management Practice (BMP) Plans for reducing lost gear within the aquaculture industry.</b>	
<b>Action Items</b>	<b>Lead &amp; Partner Organizations</b>
6.2.1. Compile key outcomes desired for effective BMP Plans for the aquaculture industry through a collaborative process with, and between, growers.	<b>CDFW, FGC</b>
6.2.2. Update Fish and Game Commission policies to include BMP Plans in permitting considerations such as the issuance of aquaculture leases, and educate growers and stakeholders about BMP Plans to help in the implementation process.	<b>CDFW, FGC</b>
6.2.3. Include aquaculture BMP Plan implementation requirements in coastal development permits, where appropriate.	<b>California Coastal Commission</b>
<b>Objective 6.3. Improve tracking of lost fishing and aquaculture gear in order to better understand lost gear patterns and impacts, and to facilitate removal.</b>	
<b>Action Items</b>	<b>Lead &amp; Partner Organizations</b>

6.3.1. Improve lost fishing gear data collection and database systems to facilitate the prevention, tracking, and recovery of lost gear.	California Lost Fishing Gear Recovery Project at UC Davis, Channel Islands National Marine Sanctuary, Dr. Andrew Gray's Laboratory, University of California, Riverside, The Nature Conservancy
6.3.2. Implement a pilot project to assess the effectiveness of different tagging and marking methods for aquaculture gear.	
6.3.3. Include aquaculture gear marking and debris collection reporting requirements in coastal development permits, where appropriate.	<b>California Coastal Commission</b>
<b>Objective 6.4. Increase the removal of ocean-based debris.</b>	
<b>Action Items</b>	<b>Lead &amp; Partner Organizations</b>
6.4.1. Research and provide recommendations to overcome policy barriers to lost gear removal and ocean-based marine debris cleanup.	California Lost Fishing Gear Recovery Project at UC Davis, Channel Islands National Marine Sanctuary, The Nature Conservancy
6.4.2. Support and expand existing programs for the prevention and removal of abandoned or derelict vessels (e.g., expansion of recreational vessel removal, funding for removal of commercial vessels).	
6.4.3. Implement and/or expand voluntary buyback, return, and/or recycling programs for old and unused recreational and commercial fishing gear.	California Lost Fishing Gear Recovery Project at UC Davis, California State Parks Division of Boating & Waterways and California Coastal Commission, The Nature Conservancy
6.4.4. Implement a fishing gear recovery program, as mandated in SB 1287, for the Dungeness crab fishery. Build or expand gear recovery programs for other fisheries while considering lessons learned in the implementation of SB 1287.	<b>CDFW</b>
6.4.5. Identify and remove, when deemed appropriate, legacy debris from California's coastal ocean (e.g., legacy aquaculture debris, anchorage debris).	FGC, NOAA MDP
6.4.6. Engage and partner with boaters, fishermen, divers, growers, local communities, and other ocean stakeholders to implement regional cleanup programs (e.g., in bays, ports, or harbors).	<b>Channel Islands National Marine Sanctuary</b> , California State Parks Division of Boating & Waterways and California Coastal Commission, ESRM Program at CSUCI
6.4.7. Place and maintain large receptacles at ports and harbors for fishermen to dispose of trash that has been collected while fishing.	

## CONCLUSION

Since 2008, Californians have made great progress in addressing ocean litter through a number of different activities and policies including the single-use plastic carryout bag ban, the State Water Board's adoption of the Trash Amendments, Coastal Cleanup Day, and the ongoing efforts of grassroots organizations to clean up their local waterways and educate the public. Looking forward, the 2018 Strategy continues the State's focus on source reduction and brings renewed attention to how broad waste management policies can be used to address ocean litter, while providing a suite of options to take action on ocean litter at different scales and scopes. This document provides structure and guidance for OPC, NOAA, and California stakeholders to efficiently collaborate on efforts to address this pressing issue over the next six years, helping protect California's vibrant coast and ocean resources for the intrinsic, ecological and economic values they provide to the state.



*Photo Credit: Santa Barbara Adventure Company*

## Section II: Background Information



*Santa Rosa Island. Photo Credit Michaela Miller, CSUCI*

# OCEAN LITTER LITERATURE SYNTHESIS

## The Global Problem and Sources of Ocean Litter

Ocean litter, or marine debris, is a persistent, well-documented problem of global scale. Anthropogenic (human-caused) litter has been observed on seafloors and in submarine canyons, in sediments, surface waters, and the water column, and on beaches and shorelines worldwide (Galgani *et al.*, 2015)<sup>8</sup>. While there are many ways to classify ocean litter, it is common to characterize it as either land-based or ocean-based, depending on how it enters the marine environment (Galgani *et al.*, 2015). Most marine debris is thought to come from land-based sources, though ocean-based debris can be significant in some areas (e.g., Sheavly, 2007; Jang *et al.*, 2014). Land-based litter can enter the ocean through poor or inefficient waste management systems, or intentional or unintentional littering by individuals and industries (UNEP and GRID-Arendal, 2016; Galgani *et al.*, 2015). Furthermore, land-based litter may be discharged directly onto coastlines through coastal tourism or recreation, or it may make its way to the marine environment through wastewater treatment systems, storm drains, rivers, or by wind (UNEP and GRID-Arendal, 2016; Galgani *et al.*, 2015; Rech *et al.*, 2014). Ocean-based litter is generated by the intentional or unintentional discharge of debris directly into the ocean. Marine activities that generate ocean-based litter include commercial shipping, recreational and commercial fishing, aquaculture, research and military endeavors, and offshore drilling (UNEP and GRID-Arendal, 2016; Galgani *et al.*, 2015).

## Ocean Litter and Plastics

Whether land-based or ocean-based, most of the litter found in the world's ocean is plastic (Galgani *et al.*, 2015; Derraik, 2002). Globally, between 4.8 and 12.7 million metric tons of plastic waste enter the ocean from land every year (Jambeck *et al.*, 2015). This plastic waste escapes waste management systems to enter the environment, so the amount of plastic waste found in the ocean and the amount of plastic waste generated are linked. The exact percentage of plastic waste that escapes into the environment is unknown, and merits further scientific study. However, both plastics in the ocean and plastic waste generated have increased significantly since the 1950s, and examining trends in plastic waste disposal provides relevant context to the ocean litter discussion (Galgani *et al.*, 2015; Geyer *et al.*, 2017). Between 1950 and 2015, 6,300 million metric tons of primary and secondary plastic waste was produced worldwide (Geyer *et al.*, 2017). Approximately 12% of this plastic waste was incinerated and 9% was recycled, while 79% was discarded and is currently sitting in landfills or the environment (Geyer *et al.*, 2017). Currently, 42% of the primary non-fiber plastic produced comes in the form of packaging, most of which is used and disposed of within the same year it is produced (Geyer *et al.*, 2017). See Figure 1 below for historical and projected levels of plastic waste production and disposal.

---

<sup>8</sup> For additional sources documenting anthropogenic litter in marine and coastal habitats, please see Pham *et al.* (2014), Lee *et al.* (2006), Claessens *et al.* (2011), Mistri *et al.* (2017), Isobe *et al.* (2017), Suaria *et al.* (2016), Law *et al.* (2010), Lattin *et al.* (2004), Ocean Conservancy (2017), and Browne *et al.* (2011).

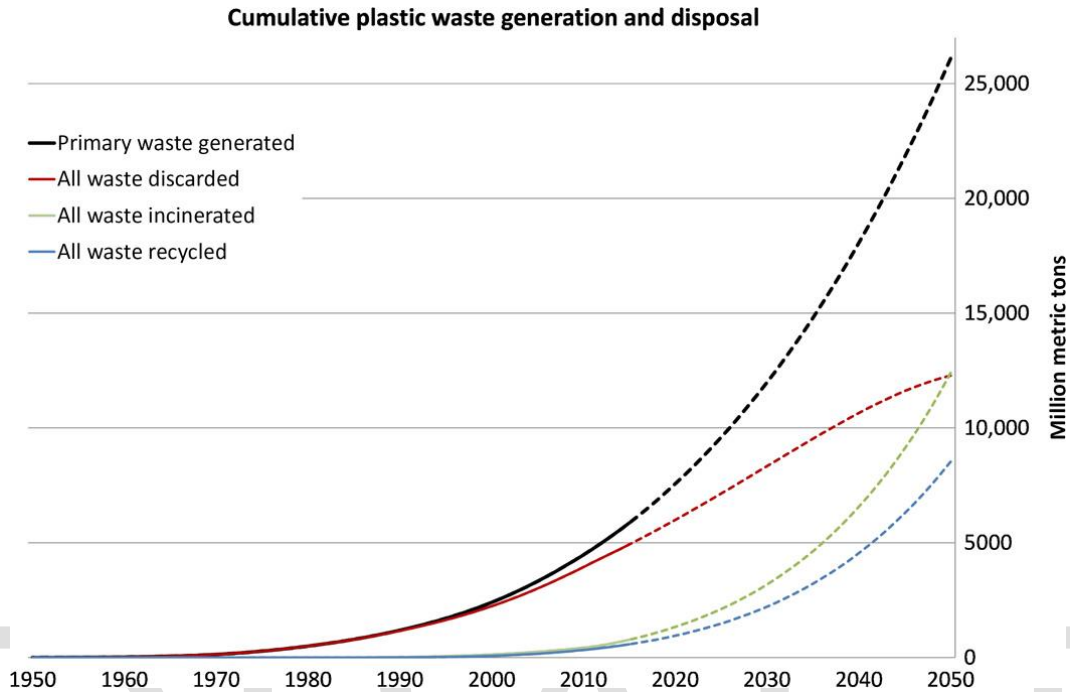


Fig. 1. Historical and projected global cumulative plastic waste generation and disposal. Disposal refers to how plastic waste is managed – either through incineration, recycling, or discard into landfills or the environment. Solid lines show historical data from 1950 to 2015, dotted lines show projections of historical trends to 2050. It is estimated that by 2050, 26,000 million metric tons of primary plastic waste will have been generated, 9,000 million metric tons of plastic waste will have been recycled, 12,000 million metric tons will have been incinerated, and another 12,000 million metric tons will have been discarded in landfills or the environment. The total amount of plastic waste disposed is higher than the amount of primary waste generated because the amount of plastic waste disposed includes both primary and secondary plastic waste. Figure from Geyer *et al.* (2017).

## Impacts of Ocean Litter

### Ecological Impacts

Ocean litter has detrimental ecological, economic, and social impacts. Marine species, including seals, sea birds, sea turtles, whales, and dolphins can become entangled in debris, resulting in hindered movement, decreased feeding ability, injury, and death (NOAA MDP, 2014b; Kühn *et al.*, 2015). Marine debris smothers and shades coral reefs and salt marshes, disrupting growth and surface cover (Richards & Beger, 2011; Uhrin & Schellinger, 2011). Fish, crustaceans, shellfish, and zooplankton ingest microplastics, and some of these organisms consume less food and have decreased energy for growth as a result (Boerger *et al.*, 2010; Murray & Cowie, 2011; Browne *et al.*, 2008; Cole *et al.*, 2013; Watts *et al.*, 2015; Cole *et al.*, 2013). Furthermore, microplastics adsorb organic contaminants and trace metals from their surrounding environments (Rochman *et al.*, 2013a; Holmes *et al.*, 2012). In some cases, microplastics may

transfer contaminants to marine organisms, inducing harmful health effects (Browne *et al.*, 2013; Rochman *et al.*, 2013b). Plastics have recently been found in the digestive tracts of fish and shellfish and the soft tissues of shellfish sold at markets for human consumption (Rochman *et al.*, 2015; Li *et al.*, 2015; Van Cauwenberghe & Janssen, 2014). A serving of six oysters grown off the coast of France could contain as many as 50 plastic particles, indicating that plastic litter that we produce and allow to leak into the environment may end up back on our plates (Van Cauwenberghe & Janssen, 2014).

### *Economic Impacts*

The economic impacts of ocean litter include costs associated with beach and harbor cleanup, loss of coastal tourism and recreation, impacts to the fishing and aquaculture industries, and other impacts to human welfare and ecosystem services (Newman *et al.*, 2015). The United Nations Environment Programme (UNEP) estimates that the impacts of plastic pollution on the world's ocean amount to about \$13 billion a year, accounting for time spent on cleanup and revenue lost by the fishery and tourism sectors (UNEP, 2014). Ghost fishing<sup>9</sup>, one consequence of lost fishing gear, can also be extremely costly – both ecologically and for the fishing industry (Bilkovic *et al.*, 2016). Lost gear can decrease the efficiency of active gear and lead to lower catch rates (Bilkovic *et al.*, 2016). In one case from the blue crab fishery, every derelict crab pot removed from Chesapeake Bay was estimated to increase blue crab harvest by an average of 868 pounds (Bilkovic *et al.*, 2016).

A number of studies have examined the economic impacts of ocean litter in California and have found that litter creates a significant financial burden for taxpayers<sup>10</sup>. Prior to the adoption of the Trash Amendments<sup>11</sup> in 2015, California communities were spending more than \$428 million annually to cleanup and control ocean litter through waterway and beach cleanup, street sweeping, installation of stormwater capture devices, storm drain cleaning and maintenance, manual litter cleanup, and public education (Stickel *et al.*, 2013). Ocean litter control and cleanup continues to be costly for State and local governments. Additionally, the ongoing presence of ocean litter on California beaches creates its own costs for state residents. A study done in Orange County found that residents go out of their way to avoid trash-littered beaches, spending extra time and money in order to visit a cleaner beach or engage in other recreational activities. The study estimated that removing 100% of the litter on Orange County beaches could save California residents \$148 million during the three months of summer (Leggett *et al.*, 2014).

Finally, in addition to financial costs, cleaning up litter also costs volunteers their time. From July 2012 to June 2016, California Adopt-A-Highway participants removed over 77,000 cubic yards of litter that may have otherwise ended up in the ocean. This volunteer service is valued at \$18 million annually (Caltrans, 2017).

---

<sup>9</sup> Ghost fishing is the continued catch of marine species by lost or discarded gear. "

<sup>10</sup> Little data is available regarding the economic impacts of ocean litter on California's tourism, fishing, or aquaculture industries. "

<sup>11</sup> The Trash Amendments refer to a statewide water quality objective that requires local governments to stop trash larger than 5 mm from "reaching State waters through their stormwater system. The Trash Amendments were adopted by the State Water Board in 2015 and OPC is working with the State Water Board to assist with implementation. "

### *Social and Health Impacts*

The social impacts of ocean litter extend beyond economic losses. Ocean litter reduces ecosystem services, including seafood production, through ghost fishing (Bilkovic *et al.*, 2016). Ocean litter also reduces the psychological benefits gained from coastal recreation in a pristine or clean environment (Wyles *et al.*, 2016). Although there is interest in research on the potential human health effects from the presence of



*Photo Credit: Santa Barbara Adventure Company*

microplastics in seafood, these potential health effects are largely unknown. However, research from other fields, such as pharmaceutical delivery, suggests that micro- and nano-plastics have the potential to enter, circulate, and bioaccumulate within the body after being ingested (Galloway, 2015). The extent and impact of human exposure to contaminants and additives through ingestion of microplastics in seafood is also largely unknown and merits further scientific study.

### **Ocean Litter and Waste Management in California**

Ocean litter is prevalent in California watersheds and ocean waters. For example, 78% of Southern California river miles<sup>12</sup> and about one third of seafloors and seafloor sediments in the Southern California Bight contain trash (Moore *et al.*, 2016). Plastic is the most prevalent type of litter found across all habitats in the Southern California Bight, with wrappers, bags, plastic pieces, and expanded polystyrene being the most commonly found plastic items (Moore *et al.*, 2016). Seventy-three water bodies throughout the State of California are listed as having impaired water quality due to the presence of large amounts of trash (State Water Board, 2015). The California coast and ocean are also impacted by lost fishing gear. Between May 2006 and early 2018, the California Lost Fishing Gear Recovery Project retrieved more than 100 tons of gear from California's coastal ocean, and collected more than 1,400 pounds of recreational gear from public fishing piers from Santa Cruz to Imperial Beach (SeaDoc Society, 2018). From 2001 to 2006, 31.1% of the reported cases of injured California brown pelicans at five California wildlife rehabilitation centers were fishing gear-related, while 11.1% of injured gull cases and 2.9% of injured California sea lion cases were fishing gear-related (Kaplan Dau *et al.*, 2009). According to the 2007 National Marine Debris Monitoring Program Report, 54.3% of the ocean litter found on California's beaches is land-based, while about 10.2% is ocean-based (Sheavly, 2007). The

<sup>12</sup> A river mile is a measure of distance in miles from the mouth of a creek or river.

remaining 35.0% is characterized as general-source debris, or items that could be either land-based or ocean-based<sup>13</sup> (Sheavly, 2007).

As mentioned earlier, ocean litter is waste that has escaped our waste management systems, and the amount of waste produced is linked to the amount of ocean litter found in marine ecosystems. In 2016, California generated approximately 76.5 million tons of waste, 35.2 million tons of which were disposed of in landfills, and another 7.5 million tons of which went to disposal-related activities such as beneficial reuse at solid waste landfills and waste to energy conversion (CalRecycle, 2017b). This means that California had a disposal rate of 6.0 pounds of trash per resident per day in 2016 (CalRecycle, 2017b). Roughly 24.5 million tons of the total trash produced in 2016 were diverted through source reduction and recycling, and another 9.2 million tons were diverted through composting and mulching (CalRecycle, 2017b). Overall, about 56% of California's waste went to disposal or disposal-related activities and about 44% was diverted through source reduction, recycling, and composting in 2016 (CalRecycle, 2017b). Though diversion has come a long way in 20 years, over the last three years, California's source reduction, composting, and recycling rate has declined, from 50% in 2014, to 47% in 2015, to 44% in 2016 (CalRecycle, 2017b). Through AB 341, California has declared a goal that by 2020, 75% of the solid waste generated in the state should be source reduced, recycled, or composted (as compared to 1990-2010 waste generation levels<sup>14</sup>). This translates to a reduction in per capita disposal from the current 6.0 pounds per person per day to 2.7 pounds per person per day in 2020 (CalRecycle, 2017b). See Figure 2 below for a visualization of statewide disposal and recycling from 2010 to 2016.

---

<sup>13</sup> Sheavly (2007) bases its definition of ocean-based, land-based, and general-source litter items on previous studies (Ribic, 1998; Escardó-Boomsma *et al.*, 1995), and lists plastic bags, strapping bands, plastic beverage bottles, and plastic cleaner bottles as examples of general-source debris items.

<sup>14</sup> AB 341 requires that 1990-2010 waste generation levels (10.7 pounds per person per day) be used as baseline data. The amount of total waste generated in California in a year is estimated by multiplying the State's population in that year by the 1990-2010 per person baseline. Source reduction is also calculated using these baseline data.

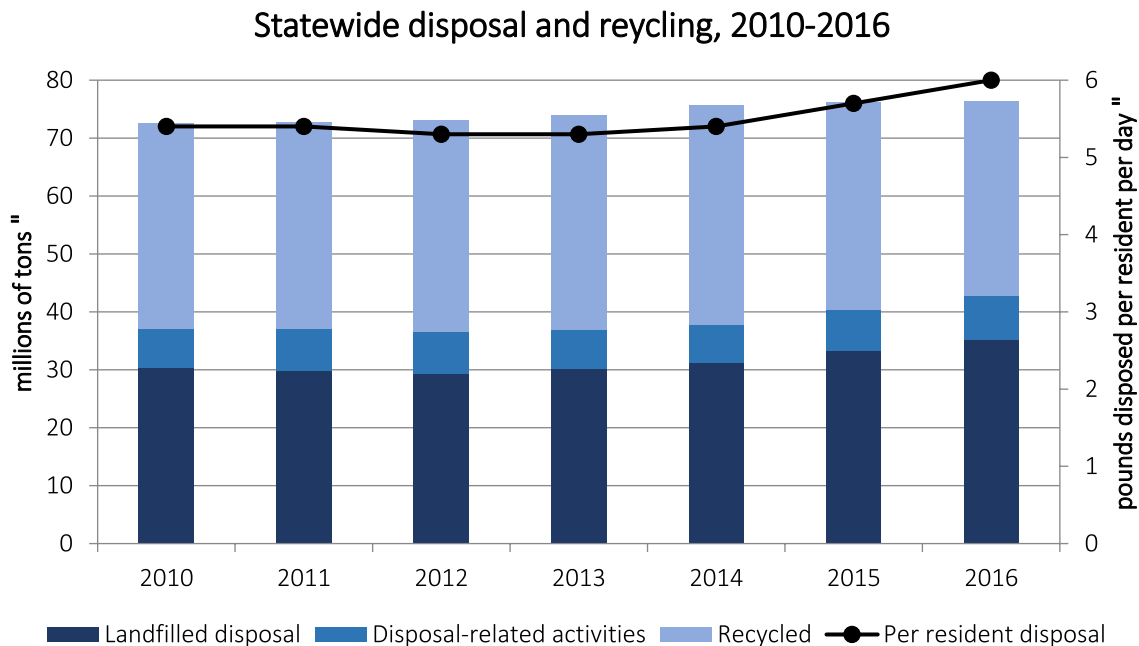


Fig. 2. Amount of waste disposed and recycled in California, from 2010 to 2016. Included in this figure are estimates of the amount of waste disposed in landfills, the amount of waste managed through disposal-related activities, and the amount of waste recycled (which includes source reduction, recycling, and composting) every year in millions of tons (left axis). Also shown is the per resident disposal rate (pounds per resident per day) for each year (right axis). Since 2013, California's source reduction, composting, and recycling rate has declined, landfill disposal has increased, and the pounds disposed per resident per day have increased. Figure adapted from CalRecycle's webpage "California's Statewide Recycling Rate" (CalRecycle, 2017a).

California currently estimates the amount of waste that is source reduced and recycled by subtracting the quantities of waste disposed in landfills and through other disposal-related activities, and the quantities of waste that is managed through composting and mulching, from the estimated total amount of waste generated in the state (CalRecycle, 2017b). This method of calculation assumes that all waste that is not disposed is source-reduced or recycled (CalRecycle, 2017b). There is currently no way to know how much of California's waste leaks into the environment and becomes ocean litter every year. However, Jambeck *et al.* (2015) estimated that in 2010, the United States as a whole had 0.25-1 million metric tons of mismanaged plastic waste available to enter the ocean, based on waste generated by populations within 50 km of the coast.

## Conclusion

In conclusion, ocean litter is a pervasive problem both globally and in California. Ocean litter also has a wide range of consequences for human health, the environment, and the economy. The actions outlined for both the OPC and stakeholders to reduce and prevent ocean litter in Section I will ensure that California communities, environments, and economies remain productive and vibrant for current and future generations.

## REFERENCES

Bilkovic, D. M., Slacum Jr., H. W., Havens, K. J., Zaveta, D., Jeffrey, C. F. G., Scheld, A. M., Stanhope, D., Angstadt, K., & Evans, J. D. (2016). Ecological and economic effects of derelict fishing gear in the Chesapeake Bay: 2015/2016 final assessment report. Prepared for the National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program. Contract DG133E-10-CQ-0034, Task Order 007.

[https://marinedebris.noaa.gov/sites/default/files/publications-files/DFG\\_Effects\\_Chesapeake\\_Bay\\_Final\\_Report\\_2016.pdf](https://marinedebris.noaa.gov/sites/default/files/publications-files/DFG_Effects_Chesapeake_Bay_Final_Report_2016.pdf)

Boerger, C. M., Lattin, G. L., Moore, S. L., & Moore, C. J. (2010). Plastic ingestion by planktivorous fishes in the North Pacific Central Gyre. *Marine Pollution Bulletin*, 60(12), 2275-2278.

Browne, M. A., Dissanayake, A., Galloway, T. S., Lowe, D. M., & Thompson, R. C. (2008). Ingested microscopic plastic translocates to the circulatory system of the mussel, *Mytilus edulis* (L.). *Environmental Science & Technology*, 42(13), 5026–5031.

Browne, M. A., Niven, S. J., Galloway, T. S., Rowland, S. J., & Thompson, R. C. (2013). Microplastic moves pollutants and additives to worms, reducing functions linked to health and biodiversity. *Current Biology*, 23(23), 2388-2392.

Browne, M. A., Crump, P., Niven, S. J., Teuten, E., Tonkin, A., Galloway, T., & Thompson, R. (2011). Accumulation of microplastic on shorelines worldwide: Sources and sinks. *Environmental Science & Technology* 45(21), 9175-9179.

California Coastal Commission. (2016). Coastal Cleanup Day 2016.

[https://documents.coastal.ca.gov/assets/publiced/ccd/2016\\_CCDRecap.pdf](https://documents.coastal.ca.gov/assets/publiced/ccd/2016_CCDRecap.pdf)

California Coastal Commission. (2017). California Coastal Cleanup Day: Past cleanup results.

<https://www.coastal.ca.gov/publiced/ccd/history.html#top10>

California Department of Resources Recycling and Recovery (CalRecycle). (2017a). California's statewide recycling rate. <http://www.calrecycle.ca.gov/75Percent/RecycleRate/default.htm>

California Department of Resources Recycling and Recovery (CalRecycle). (2018). National Sword, China's new policy on recyclable material imports.

<http://www.calrecycle.ca.gov/Markets/NationalSword/>

California Department of Resources Recycling and Recovery (CalRecycle). (2017b). State of disposal and recycling in California: 2017 update. Publication #DRRR-2017-01612.

[http://www.calrecycle.ca.gov/Publications/Documents/1612/2017%20State%20of%20Recycling%20and%20Disposal%20Report\\_01612.pdf](http://www.calrecycle.ca.gov/Publications/Documents/1612/2017%20State%20of%20Recycling%20and%20Disposal%20Report_01612.pdf)

California Department of Toxic Substances Control (DTSC). (2013). Safer Consumer Products Program overview. <http://www.dtsc.ca.gov/SCP/SaferConsumerProductsProgram.cfm>

California Department of Transportation (Caltrans). (2017). Caltrans Adopt-A-Highway Program fact sheet. <http://adopt-a-highway.dot.ca.gov/aah-fact-sheet-7-2016.pdf>

City of Oakland. (2018). What is the Excess Litter Fee Program? <http://www2.oaklandnet.com/Government/o/CityAdministration/d/NA/OAK057469>

Claessens, M., De Meester, S., Van Landuyt, L., De Clerck, K., & Janssen, C. R. (2011). Occurrence and distribution of microplastics in marine sediments along the Belgian coast. *Marine Pollution Bulletin* 62, 2199-2204.

Clean Water Action, & Clean Water Fund (Clean Water Action). (2017). Institutional case study: University of San Francisco's Market Café. [https://www.cleanwateraction.org/sites/default/files/CS\\_USF\\_10.03.17\\_web%20%281%29.pdf](https://www.cleanwateraction.org/sites/default/files/CS_USF_10.03.17_web%20%281%29.pdf)

Cole, M., Lindeque, P., Fileman, E., Halsband, C., Goodhead, R., Moger, J., & Galloway, T. S. (2013). Microplastic ingestion by zooplankton. *Environmental Science & Technology* 47(12), 6646-6655.

Derraik, J. G. B. (2002). The pollution of the marine environment by plastic debris: A review. *Marine Pollution Bulletin* 44(9), 842-52.

Environmental Protection Agency (EPA). (2016). Pollution prevention law and policies. <https://www.epa.gov/p2/pollution-prevention-law-and-policies#define>

Environmental Protection Agency (EPA). (2017). Sustainable materials management: Non-Hazardous materials and waste management hierarchy. <https://www.epa.gov/smm/sustainable-materials-management-non-hazardous-materials-and-waste-management-hierarchy>

Escardó-Boomsma, J., O'Hara, K., & Ribic, C. A. (1995). National Marine Debris Monitoring Program, volumes 1-2. Final Report, U.S. EPA Office of Water, Washington DC. 130 pp.

Galgani, F., Hanke, G., & Maes, T. (2015). Global distribution, composition and abundance of marine litter. In M. Bergmann, L. Gutow, & M. Klages (Eds.), *Marine anthropogenic litter* (pp. 29-56). Cham, Switzerland: Springer. [https://link.springer.com/chapter/10.1007/978-3-319-16510-3\\_2](https://link.springer.com/chapter/10.1007/978-3-319-16510-3_2)

Galloway, T. S. (2015). Micro- and nano-plastics and human health. In M. Bergmann, L. Gutow, & M. Klages (Eds.), *Marine anthropogenic litter* (pp. 343-366). Cham, Switzerland: Springer. [https://link.springer.com/chapter/10.1007/978-3-319-16510-3\\_13](https://link.springer.com/chapter/10.1007/978-3-319-16510-3_13)

Geyer, R., Jambeck, J. R., & Law, K. L. (2017). Production, use, and fate of all plastics ever made. *Science Advances* 3(7), e1700782.

Holmes, L. A., Turner, A., & Thompson, R. C. (2012). Adsorption of trace metals to plastic resin pellets in the marine environment. *Environmental Pollution* 160, 42-48.

Isobe, A., Uchiyama-Matsumoto, K., Uchida, K., & Tokai, T. (2017). Microplastic in the Southern Ocean. *Marine Pollution Bulletin* 114(1), 623-626.

Jambeck, J. R., Geyer, R., Wilcox, C., Siegler, T. R., Perryman, M., Andrady, A., Narayan, R., & Law, K. L. (2015). Plastic waste inputs from land into the ocean. *Science* 347(6223), 768-771.

Jang, Y. C., Lee, J., Hong, S., Lee, J. S., Shim, W. J., & Song, Y. K. (2014). Sources of plastic marine debris on beaches of Korea: More from the ocean than the land. *Ocean Science Journal* 49(2), 151-162.

Kaplan Dau, B., Gilardi, K. V. K., Gulland, F. M., Higgins, A., Holcomb, J. B., St. Leger, J., & Ziccardi, M. H. (2009). Fishing gear-related injury in California marine wildlife. *Journal of Wildlife Diseases* 45(2), 355-362.

Kühn, S., Bravo Rebolledo, E. L., & van Franeker, J. A. (2015). Deleterious effects of litter on marine life. In M. Bergmann, L. Gutow, & M. Klages (Eds.), *Marine anthropogenic litter* (pp. 75-116). Cham, Switzerland: Springer. [https://link.springer.com/chapter/10.1007/978-3-319-16510-3\\_4](https://link.springer.com/chapter/10.1007/978-3-319-16510-3_4)

Lattin, G. L., Moore, C. J., Zellers, A. F., Moore, S. L., & Weisberg, S. B. (2004). A comparison of neustonic plastic and zooplankton at different depths near the southern California shore. *Marine Pollution Bulletin* 49(4), 291-294.

Law, K. L., Morét-Ferguson, S., Maximenko, N. A., Proskurowski, G., Peacock, E. E., Hafner, J., & Reddy, C. M. (2010). Plastic accumulation in the North Atlantic subtropical gyre. *Science* 329(5996), 1185-1188.

Lee, D.-I., Cho, H.-S., & Jeong, S.-B. (2006). Distribution characteristics of marine litter on the sea bed of the East China Sea and the South Sea of Korea. *Estuarine, Coastal and Shelf Science* 70(1-2), 187-194.

Leggett, C., Scherer, N., Curry, M., Bailey, R., & Haab, T. (2014). Final report: Assessing the economic benefits of reductions in marine debris: A pilot study of beach recreation in Orange County, California. Prepared for the National Oceanic and Atmospheric Administration (NOAA) Marine Debris Program. Industrial Economics, Incorporated.

Li, J., Yang, D., Li, L., Jabeen, K., & Shi, H. (2015). Microplastics in commercial bivalves from China. *Environmental Pollution* 207, 190-195.

Maryland Department of the Environment. (2017). Source reduction.

[http://mde.maryland.gov/programs/Land/RecyclingandOperationsprogram/Pages/source\\_reduction.aspx](http://mde.maryland.gov/programs/Land/RecyclingandOperationsprogram/Pages/source_reduction.aspx)

Mattison, S. (2017). Honolulu mayor signs expanded plastic bag ban bill into law on Oahu. Khon2.

<http://khon2.com/2017/07/23/honolulu-mayor-to-sign-expanded-plastic-bag-ban-bill-for-oahu/>

Mistri, M., Infantini, V., Scoponi, M., Granata, T., Moruzzi, L., Massara, F., De Donati, M., & Munari, C. (2017). Small plastic debris in sediments from the Central Adriatic Sea: Types, occurrence and distribution. *Marine Pollution Bulletin* 124(1), 435-440.

Moore, S., Sutula, M., Von Bitner, T., Lattin, G., & Schiff, K. (2016). Southern California Bight 2013 regional monitoring program: Volume III. Trash and marine debris. Southern California Coastal Water Research Project (SCCWRP) Technical Report 928.

[ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/928\\_B13\\_Debris.pdf](ftp://ftp.sccwrp.org/pub/download/DOCUMENTS/TechnicalReports/928_B13_Debris.pdf)

Murray, F., & Cowie, P. R. (2011). Plastic contamination in the decapod crustacean *Nephrops norvegicus* (Linnaeus, 1758). *Marine Pollution Bulletin* 62(6), 1207–1217.

National Oceanic and Atmospheric Administration, Economics: National Ocean Watch (NOAA ENOW). (2014). ENOW Explorer. <http://coast.noaa.gov/digitalcoast/tools/enow>

National Oceanic and Atmospheric Administration Office for Coastal Management (NOAA OCM). (2015). <https://coast.noaa.gov/data/digitalcoast/pdf/california-ocean-economy.pdf>

National Oceanic and Atmospheric Administration Marine Debris Program (NOAA MDP). (2014a). 2014 report on the occurrence and health effects of anthropogenic debris ingested by marine organisms. Silver Spring, MD. 19 pp.

National Oceanic and Atmospheric Administration Marine Debris Program (NOAA MDP). (2014b). Report on the entanglement of marine species in marine debris with an emphasis on species in the United States. Silver Spring, MD. 28 pp.

Newman, S., Watkins, E., Farmer, A., ten Brink, P., & Schweitzer, J.-P. (2015). The economics of marine litter. In M. Bergmann, L. Gutow, & M. Klages (Eds.), *Marine anthropogenic litter* (pp. 367-394). Cham, Switzerland: Springer. [https://link.springer.com/chapter/10.1007/978-3-319-16510-3\\_14](https://link.springer.com/chapter/10.1007/978-3-319-16510-3_14)

Ocean Conservancy. (2017). Together for our ocean: International Coastal Cleanup 2017 report. Prepared by Y. Belhouari, B. Farnum, C. Jenkins, J. Kieser, A. López de Román, D. McCauley, C. Rochman, R. Schreiber, E. Schwartz, H. Taylor, & S. Trott. [https://oceanconservancy.org/wp-content/uploads/2017/06/International-Coastal-Cleanup\\_2017-Report.pdf](https://oceanconservancy.org/wp-content/uploads/2017/06/International-Coastal-Cleanup_2017-Report.pdf)

Pham, C. K., Ramirez-Llorda, E., Alt, C. H. S., Amaro, T., Bergmann, M., Canals, M., Company, J. B., Davies, J., Duineveld, G., Galgani, F., Howell, K. L., Huvenne, V. A. I., Isidro, E., Jones, D. O. B., Lastras, G., Morato, T., Gomes-Pereira, J. N., Purser, A., Stewart, H., Tojeira, I., Tubau, X., Van Rooij, D., & Tyler, P. A. (2014). Marine litter distribution and density in European seas, from the shelves to deep basins. *PLoS ONE* 9(4), e95839.

Rech, S., Macaya-Caquilpán, V., Pantoja, J. F., Rivadeneira, M. M., Jofre Madariaga, D., & Thiel, M. (2014). Rivers as a source of marine litter - A study from the SE Pacific. *Marine Pollution Bulletin* 82(1-2), 66-75.

Reuters. (2017). China notifies WTO of ban on plastic, paper, textile waste imports. <https://www.reuters.com/article/china-environment/china-notifies-wto-of-ban-on-plastic-paper-textile-waste-imports-idUSL5N1K94IS>

Richards, Z. T., & Beger, M. (2011). A quantification of the standing stock of macro-debris in Majuro lagoon and its effect on hard coral communities. *Marine Pollution Bulletin* 62(8), 1693-1701.

Ribic, C. A. 1998. Use of indicator items to monitor marine debris on a New Jersey beach from 1991 to 1996. *Marine Pollution Bulletin* 36(11), 887-891.

Rochman, C. M., Tahir, A., Williams, S. L., Baxa, D. V., Lam, R., Miller, J. T., Teh, F.-C., Werorilangi, S., & Teh, S. J. (2015). Anthropogenic debris in seafood: Plastic debris and fibers from textiles in fish and bivalves sold for human consumption. *Scientific Reports* 5, 14340.

Rochman, C. M., Hoh, E., Hentschel, B. T., & Kaye, S. (2013a). Long-Term field measurement of sorption of organic contaminants to five types of plastic pellets: Implications for plastic marine debris. *Environmental Science & Technology* 47(3), 1646-1654.

Rochman, C. M., Hoh, E., Kurobe, T., & Teh, S. J. (2013b). Ingested plastic transfers hazardous chemicals to fish and induces hepatic stress. *Scientific Reports* 3, 3263.

Ryan, P. G. (2015). A Brief history of marine litter research. In M. Bergmann, L. Gutow, & M. Klages (Eds.), *Marine anthropogenic litter* (pp. 1-25). Cham, Switzerland: Springer. [https://link.springer.com/chapter/10.1007%2F978-3-319-16510-3\\_1](https://link.springer.com/chapter/10.1007%2F978-3-319-16510-3_1)

San Francisco Department of the Environment. (2016). Polystyrene foam and the food service and packaging waste reduction ordinance. <https://sfenvironment.org/polystyrene-foam-food-service-packaging-waste-reduction-ordinance>

SeaDoc Society. (2018). California Lost Fishing Gear Recovery Project. Karen C. Drayer Wildlife Health Center, University of California, Davis School of Veterinary Medicine. <http://www.seadocsociety.org/california-lost-fishing-gear-removal-project/>

Sheavly, S. B. (2007). National Marine Debris Monitoring Program: Final program report, data analysis and summary. Prepared for the U.S. Environmental Protection Agency by Ocean Conservancy, Grant Number X83053401-02. 76 pp.

State Water Resources Control Board (State Water Board). (2015). Final 2012 California Integrated Report (Clean Water Act Section 303(d) List/305(b) Report).  
[http://www.waterboards.ca.gov/water\\_issues/programs/tmdl/integrated2012.shtml](http://www.waterboards.ca.gov/water_issues/programs/tmdl/integrated2012.shtml)

Stickel, B. H., Jahn, A., & Kier, B. (2013). Waste in our water: The annual cost to California communities of reducing litter that pollutes our waterways. Prepared by Kier Associates for the Natural Resources Defense Council (NRDC).  
[https://www.nrdc.org/sites/default/files/oce\\_13082701a.pdf](https://www.nrdc.org/sites/default/files/oce_13082701a.pdf)

Suaria, G., Avio, C. G., Mineo, A., Lattin, G. L., Magaldi, M. G., Belmonte, G., Moore, C. J., Regoli, F., & Aliani, S. (2016). The Mediterranean plastic soup: Synthetic polymers in Mediterranean surface waters. *Scientific Reports* 6, 37551.

Suh, S., Bergesen, J., Choudhary, S. T., & Broeckx-Smith, S. (2017). Life cycle assessment of California state spend for the fiscal years 2012-15: Spend analysis summary report. Prepared by Industrial Ecology Research Services, LLC (IERS) for the Department of General Services. Contract No. 3181902.  
[https://www.documents.dgs.ca.gov/pd/epp/spendanalysis/20170216\\_Spend\\_Analysis\\_Summary\\_Report\\_FINAL.pdf](https://www.documents.dgs.ca.gov/pd/epp/spendanalysis/20170216_Spend_Analysis_Summary_Report_FINAL.pdf)

Uhrin, A. V., & Schellinger, J. (2011). Marine debris impacts to a tidal fringing-marsh in North Carolina. *Marine Pollution Bulletin* 62(12), 2605-2610.

United Nations Environment Programme (UNEP). (2014). Valuing plastics: The business case for measuring, managing and disclosing plastic use in the consumer goods industry.  
<https://wedocs.unep.org/rest/bitstreams/16290/retrieve>

United Nations Environment Programme (UNEP), & GRID-Arendal. (2016). Marine litter vital graphics. Nairobi and Arendal. <http://staging.unep.org/docs/MarineLitter.pdf>

Van Cauwenberghe, L., & Janssen, C. R. (2014). Microplastics in bivalves cultured for human consumption. *Environmental Pollution* 193, 65-70.

Watts, A. J. R., Urbina, M. A., Corr, S., Lewis, C., & Galloway, T. S. (2015). Ingestion of plastic microfibers by the crab *Carcinus maenas* and its effect on food consumption and energy balance. *Environmental Science & Technology* 49(24), 14597-14604.

Wyles, K. J., Pahl, S., Thomas, K., and Thompson, R. C. (2016). Factors that can undermine the psychological benefits of coastal environments: Exploring the effect of tidal state, presence, and type of litter. *Environment and Behavior* 48(9), 1095-1126.

DRAFT

## Appendix A: Updating the 2008 Strategy – *An Implementation Strategy for the California Ocean Protection Council Resolution to Reduce and Prevent Ocean Litter*

Recognizing the serious threats of ocean litter to communities, the economy, and the environment, in 2007 the OPC adopted a resolution entitled “Reducing and Preventing Marine Debris.” In 2008, the OPC initiated a steering committee to publish an Implementation Strategy, which outlined three Priority Actions and 13 other Actions for addressing ocean litter in the state. This Strategy was designed to provide a pathway to implement the recommendations in the OPC Resolution. The three Priority Actions were as follows:

1. Implement a producer take-back (EPR) program for convenience food packaging.
2. Prohibit single-use products that pose significant ocean litter impacts where a feasible less damaging alternative is available. Products specifically called out included polystyrene food packing and plastic bags.
3. Assess fees on commonly littered items.

Since the original Strategy was developed, many of the actions described in the document have either been accomplished or are in progress. The box below titled “Status of Actions in the 2008 OPC Strategy to Reduce and Prevent Ocean Litter” provides a summary of the progress made on the 2008 Strategy. In some cases, the State’s regulatory or agency landscape has changed. For example, some items that were listed out separately in the Strategy are now being addressed under a single program, though there may be elements of those items that still need to be addressed. For instance, separate actions focused on minimizing toxics in packaging and developing sustainable alternatives are now addressed by the California Department of Toxic Substances Control’s (DTSC’s) Safer Consumer Products Program. This Program examines product-chemical combinations that may have negative impacts on human health and the environment, and requires manufacturers of priority products to perform an alternatives analysis to determine whether such products can be made without the chemical of concern (DTSC, 2013). In other cases, our understanding of the ocean litter problem has changed considerably since 2008. For example, over the last decade a large body of research has examined microplastics’ impacts on marine life and their interaction with persistent organic pollutants (Ryan, 2015). Thus, the 2008 Strategy does not completely address current issues of emerging concern, such as microplastics and microfibers, and may no longer be the best way to tackle ocean litter.

The 2018 Strategy reexamines the issue of ocean litter in California, and outlines Action Items for preventing and reducing ocean litter over the next six years in light of the needs that have been identified, the knowledge that has been gained, and the advances that have been made over the last decade.

### Status of Actions in the 2008 OPC Strategy to Reduce and Prevent Ocean Litter

Below is a brief summary of the progress that has been made on the Action Items included in the 2008 Strategy. Some of these Action Items were written in an open-ended or ongoing way. This makes it somewhat difficult to determine whether an action is “complete.” See the Comments column for more detail on the status of each Action.

Strategy Action	Update	Comments
<b>Priority Action 1:</b> Implement a producer take-back (EPR) program for convenience food packaging.	In Progress	CalRecycle is developing a comprehensive, statewide framework for managing all packaging that provides flexibility to apply different policy tools. Extended producer responsibility is one of those policy tools. Note that new legislation is required to give CalRecycle the authority to implement a framework.
<b>Priority Action 2:</b> Prohibit Single-Use Products that pose significant ocean litter impacts where a feasible less damaging alternative is available.	See below under each action	See below under each action
<ul style="list-style-type: none"> <li>Polystyrene food packaging prohibition</li> </ul>	In Progress	Local polystyrene bans have passed, but a statewide ban has not.
<ul style="list-style-type: none"> <li>Plastic Bag Fee</li> </ul>	Complete	The voters ratified the single-use plastic carryout bag ban in November 2016.
<b>Priority Action 3:</b> Assess fees on commonly littered items.	In Progress	Local jurisdictions have passed litter fees, but this has not been implemented on a statewide level.
<b>Minimize toxics in packaging:</b> Determine which plastic additives threaten human health and the marine environment, educate the public, and prepare a plan for a possible prohibition.	In Progress, but continuing opportunities for further action or projects	Initial OPC-funded project is complete. DTSC now has a Safer Consumer Products program that examines product-chemical combinations that may impact human health or the environment.
<b>Develop alternative products and promote sustainable alternatives.</b>	In Progress	This action is currently part of the Safer Consumer Products program. The regulations require that manufacturers perform an alternatives analysis to determine whether they could make their product without the chemical of concern.
<b>Increase enforcement of pre-production plastic laws.</b>	Complete	The Water Board has trained their enforcement staff and industrial permit staff on how to correctly implement the law banning release of pre-production plastic pellets.

Strategy Action	Update	Comments
Increase enforcement of anti-litter laws.	In Progress	This is an ongoing activity. Some local jurisdictions have increased litter fines in problem areas (e.g., Main Beach in Santa Cruz).
<b>Public education:</b> Coordinate an education and outreach campaign.	Complete, but continuing opportunities for additional programs and a need for evaluation of impact to date	OPC has partnered with NOAA on the Thank You Ocean campaign, which includes a lot of public outreach on marine debris.
<b>Public education:</b> Direct state funds for litter education to the Environmental Education Initiative.	Incomplete	This remains incomplete, the Environmental Education Initiative provides model curriculum to teachers on environmental issues.
<b>Engaging the public:</b> Develop an ocean litter data card to be used by Adopt-A-Beach volunteers throughout the year, and an online database to house data.	Complete	The Coastal Commission encourages Adopt-A-Beach volunteers to use the Coastal Cleanup Day data card and database.
<b>Engaging the public:</b> Develop an Adopt-A-Beach Advisory Committee and work with local beach managers to provide necessary support for Adopt-A-Beach efforts.	Complete	The Adopt-A-Beach program is supported and organized on a county-by-county basis. (You can find more information on the Coastal Commission website).
Ensure municipalities prevent litter from entering the storm drain system.	In Progress	In 2015, the State Water Board adopted the statewide Trash Amendments which prohibit discharge of trash from storm drain systems; OPC is now assisting the State Water Board with implementing the policy, through developing trash monitoring methods and through the Proposition 1 funding program.
Increase lost fishing gear cleanup by creating a deposit program on fishing gear; conduct outreach to the fishing community and publicize SeaDoc Society's hotline.	Complete, but continuing opportunities for further action or projects	Legislative action has created a program that requires owners to pay for lost gear for one fishery (the Dungeness crab fishery).  OPC has funded the SeaDoc Society to perform cleanups of fishing gear off the coast, and their hotline is available to report lost gear.
Work with the West Coast Governor's Agreement participants and invite the participation of Alaska, Hawaii, British Columbia, Baja California, and Baja California Sur.	Complete	This action evolved into an Action Team under the West Coast Governor's Agreement, and now into the West Coast Marine Debris Alliance, which includes British Columbia.