

Blue Oceans



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MDB

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Welcome



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Welcome to the SSI Blue Oceans program, and thank you for your participation!

By registering for this program, you are taking the first steps toward joining a worldwide community of individuals dedicated to protecting one of the world's most valuable resources - the ocean.

It's no secret that our oceans face some daunting problems, from overfishing to climate change to plastic pollution.

News outlets regularly publish updates on climbing global temperatures as politicians make climate change into a political debate, despite a global consensus from the scientific community. Historical records of fish catches show declining populations and reduced sizes in mature adult species, even as we increase the caloric needs of our nations. Wildfires, hurricanes, typhoons and other natural disasters are increasingly common, and affect greater numbers of humans as our population grows.

It's understandable to feel that the situation has become impossible, and that there's no hope for humanity.

We believe otherwise.

The world is filled with incredible individuals, communities, and organizations who are doing amazing work toward reversing many of the negative impacts that the planet is experiencing. These people are not content to simply sit by and watch - they're taking action at every level of involvement to enact positive and progressive change for the better.

History



Image © Tom Huckert

SSI is a training organization that was started by recreational scuba retailers in the 1970s. Since then, it has grown to become a global organization of divers, freedivers, swimmers, and other water enthusiasts. As SSI Professionals, our office is literally the beach and the water - in fact, many of us go to work in flip flops every day!

SSI believes that our SSI Professionals and Training Centers have a responsibility to protect the planet's waterways, lakes, rivers and oceans.

After all, we depend on them for our livelihood!

We know that to protect our underwater world we must engage our peers and communities, participate in responsible in-water activities, and encourage others to learn more about the challenges that we face in today's modern world. You do not have to be a diver, a conservationist, or a training center operator to make an impact.

Blue Oceans Overview

This program introduces you to many of the global challenges that our ocean faces today. Each section will focus on a particular problem, like ocean plastics. We will describe how the problem developed, why it is an important issue, and what people like you are doing to reduce the problem's impact on the ocean.

Each section also includes stories that highlight the work of scientists, conservationists, SSI Training Centers, and other individuals or organizations making positive changes on a daily basis. As you read these stories, think about how you can apply their lessons to your everyday life, or how you can encourage your community to take action.

This manual should not be the final step in your marine conservation education. It is simply a tool that should help increase your awareness of the issues, but awareness isn't enough. We need to take actions to improve, protect, and preserve the marine environment for both this generation and the generations to come.

Even though the information in this manual might seem scary, the program is intended to be a fun and challenging learning experience. It presents modern scientific research and real-world case studies designed to train you to make intelligent, informed decisions.

As you read through the pages in this program, take notes, record your thoughts and feelings, and track any question you may have for your peers, your SSI Training Center or SSI Professional, or the people you work with. Hopefully you can create a dialogue with others that creates positive change for the ocean.

Three Levels of Environmental Involvement

There are many ways that you can promote environmentally-friendly practices and behaviors. We categorize these actions into three levels, based on the complexity of the action and who it affects. While a few examples are listed below, the opportunities are only limited by your imagination and effort.

The range of opportunities and the issues that the environment faces may seem overwhelming at times. Talk with your SSI Professional, your local SSI Training Center, and your friends and family to find a good place to begin.



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The Personal Change Level

This level is based on your personal behaviors, and involves simple, everyday actions that you take to enact positive change and behaviors.

For example, as you will learn in the first section, by avoiding single-use plastics like drinking straws, water bottles, and eating utensils, you prevent those plastics from entering the aquatic environment, where they become unsightly debris, kill marine organisms, and leach chemicals into the environment.

Even though actions at this level are small and easy to do, they can create a larger ripple effect, especially if you take the time to explain your behaviors to anyone who expresses interest. After watching you clean garbage off a reef, or use a metal water bottle instead of plastic, your peers may go home with a new appreciation of how their actions affect the world around them.

The Community Change Level

Actions at this level affect your immediate community. This could be your training center network, your social network, or simply the family and friends around you.

These actions are usually more formal and involved, and examples include starting a recycling program, conducting local beach cleanups, or hosting social gatherings focused around an environmental issue.

Many of these actions have the added benefit of meeting new friends that share your personal interests!

Your training center may already have environmentally-friendly policies that you can follow and promote to your community. You should also suggest areas for improvement if you see potentially damaging behaviors or policies. As an ocean ambassador, you are uniquely positioned to make a positive impact on the world, especially regarding aquatic conservation and awareness.

The Policy Change Level

They often involve working with local, regional, or even national governments to create environmentally-sustainable policies or laws.

Examples of individual actions at this level include writing letters to local politicians expressing support for environmental causes, donating or volunteering with non-governmental organizations dedicated to aquatic advocacy programs, or attending meetings or events to support conservation projects and policies.

The Future of Blue Oceans

The world is constantly changing, and new and improved ways of dealing with environmental problems are constantly being discovered as new challenges are overcome.

This manual is a living document. At periodic intervals, usually four to six months apart, we will introduce new content that focuses on new problems and highlights new organizations or individuals working to solve these problems. None of the people or organizations in this manual received or gave compensation.

This material will always be free of charge, so check back in on a regular basis to see what we have added. If there is a topic or organization that you think is worth writing about, please contact your local SSI Blue Oceans Training Center and let them know!

If they share this information, both through social media and their SSI Network, we can review it and see if it fits with the Blue Oceans mission statement and philosophy. If it does, we may include it with a future program update!

The First Three Sessions

Session 1: Coral Reefs

This session will review the state of the world's coral reefs, the challenges they face from climate change, pollution, and irresponsible tourism. You will learn about why coral reefs are important to humans, and how you can help protect them - even if you live far from the ocean!

Session 2: Shark Finning

This session will discuss shark-finning, which is a destructive fishing practice that kills millions of sharks each year. You will learn why shark finning occurs, why it is unsustainable, and how you can join millions of shark advocates around the globe to help protect this valuable apex predator.

You will learn about how celebrities and every-day people like yourself are taking action to eliminate the negative impacts of shark finning before it's too late.

Session 3: Ocean Plastics

This session covers a brief history of plastics, how they are made, and why they have become a part of our every-day lives. You will learn about how plastics make their way into the ocean, why this is a problem, and why plastic pollution is one of the most pressing environmental issues of our modern times.

You will also read a case study about a training center operator who has made some simple, common-sense changes to his business plan to reduce plastic waste on a small Caribbean island.

Digital Learning Goals

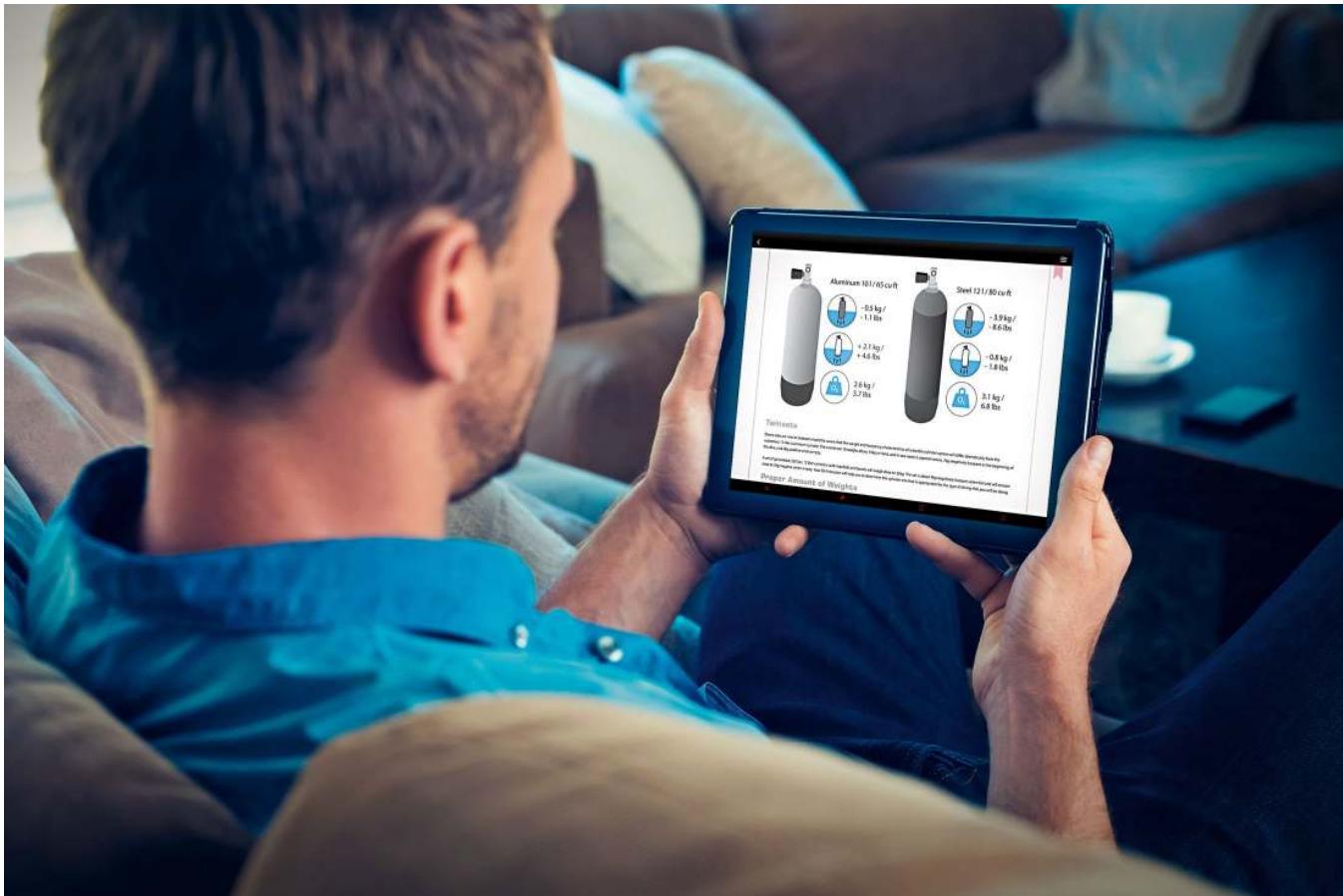


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The digital learning consists of sections that cover broad topics and are divided into lessons. Each lesson begins with a set of objectives (what you will learn), and detailed information on each objective, and usually ends with a short review to evaluate your understanding of the material.

Each lesson is designed to review and reinforce the content learned in the previous lesson, and to introduce new content in a logical and thoughtful manner. As you progress through the material, makes notes of any questions you have for your instructor. They will answer your questions and provide real-world examples during your time with them.

Accessing the Digital Learning Materials

Your materials give you access to first-rate videos, illustrations, animations and photos to make your learning process easy and enjoyable. They are available online through any web browser, or can be completed offline once you have downloaded them onto the MySSI app, which is available for iOS and Android smart devices.

Both the web version and the app version offer the following services:

- Add personal notes to remind you of key information or for further discussion with your SSI Dive Professional.
- Bookmark subjects for further review.
- New information is automatically updated at no additional cost.
- Free access to trial programs like Try Scuba, Try Freediving, and Scuba Diver.

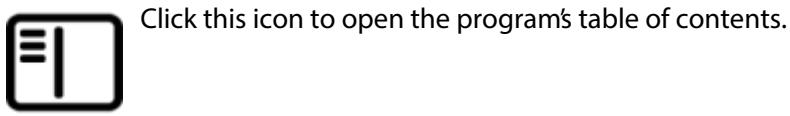
The MySSI app allows you to:

- **View your digital certification and recognition cards.**
- **Quickly log dives and add new dive buddies in your digital dive log.**
- **Share your dives on social media sites.**
- **Review your hand signals and dive tables before the dive.**
- **Watch 360-degree immersive videos of amazing dive sites around the world.**
- **And much more!**

Navigating the Digital Learning Materials

Table of Contents Menu

Overview Menu



Click this icon to open the program's table of contents.

Search Bar



Use this bar to search for specific words or phrases within the program.

Filter



Click this icon to filter the content to view only unseen pages, all review questions, or unanswered review questions.

Previously Viewed Pages



This icon identifies pages that you have already viewed.

Unseen Pages



This icon identifies any pages that you have not already viewed.

Completed Reviews



This icon identifies any pages with reviews that you have successfully completed.

Incomplete Reviews



This icon identifies any pages with reviews that you have not completed.

Open Book



This icon takes you back to the program Table of Contents.

The icon is highlighted when viewing the program menu.

Show Bookmarks



Clicking this icon shows you any pages that you have bookmarked.

The icon is highlighted when viewing the bookmarks.

The number over the icon shows how many pages have bookmarks.

Show Notes



Click this icon to view any pages where you have added a personal note.

The icon is highlighted when viewing the notes.

The number over the icon shows how many pages have user-generated notes.

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Right click on any block of text to add a personal note.

Bookmark



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Page Navigation Icons

Forward/Backward Arrows



Click these icons to navigate forward and backward through the materials.

Back to MySSI



Click this icon to return to the MySSI Programs dashboard.

Program Settings

Click on this icon to change the language, professional and student view, viewing mode, closed captions, and font size.



Pro/Student View

As an SSI Professional, you have access to both the student and professional digital materials.



Click this icon to switch between the student workbook and instructor manual content.

Responsible Tourism Guidelines



Image © iStock/South_agency

This manual will introduce you to a variety of marine conservation issues that we face today. You may have already experienced these during your travels, or you may be planning a trip to a destination that faces challenges based on one or more of these issues.

Regardless of your experience or travel opportunities, you can follow some basic guidelines to help do your part to protect our coastlines and waterways. These Guidelines were originally written for scuba diving, but the ideas and actions they encourage are applicable to everyone.

As you read each session, use the Responsible Tourism Guidelines on the following pages to think about the impacts of your actions.

Environmental Awareness

- Commit to personally protect the environment
- Prevent others from causing damage through positive action and motivation
- Support useful projects and organizations dedicated to marine protection
- If possible, collect garbage on your dives or trips, but only if it will not cause more damage to the environment
- If possible, cut hanging ropes and collect floating nets and plastics - inform your buddy or the crew on the surface if you were not able to remove the net
- Never eat shark fins, whale meat, turtle eggs, or other unsustainable marine species
- Immediately report violations of the ban on the use of marine animals as souvenirs to the proper authorities

Interacting with the Environment

- Only use a swim-through if you can do so without touching anything
- Do not swim or snorkel too close to the reef
- Do not touch or break corals
- Use labeled entrances/exits for the water
- Do not disturb the sand since it reduces visibility and smothers corals
- Do not hunt or bother animals
- Do not touch animals unless properly trained
- Do not feed animals
- Do not take souvenirs from the sea - broken coral pieces or empty snail shells still serve as useful habitat
- Only place a reef hook where it will not damage or disturb the reef
- Do not disturb animals or habitat to improve your photo opportunity

Waste Creation and Disposal

- Never throw inorganic waste into the sea – plastics decompose incredibly slowly
- Minimize the production of garbage:
- Avoid using plastic bags while shopping; bring a reusable shopping bag with you
- Try to buy fruits and vegetables without packaging; a small basket or a cloth bag can replace a plastic bag
- Buy your drinks in glass bottles or cans and try to avoid plastic bottles
- Use reusable metal or glass bottles for drinking
- Use a reusable coffee mug instead of a disposable mug
- Do not use aluminum foil and plastic bags to transport your food; use reusable lunch boxes instead
- Do not bring unnecessary packaging to the resort
- Dispose of your waste in as ecologically-friendly a manner as possible
- If you smoke, dispose of cigarette butts in the proper receptacle, not on the ground or in the water

Responsible Resource Use

- Shower only as long as required to get clean, especially in areas with little ability to store/purify water
- Wash your equipment in the provided container and only when necessary – often it's enough to clean equipment thoroughly at the end of the trip
- Turn off the lights when you aren't using them
- Use alternative transportation or walk instead of driving
- Avoid unnecessary waste - food plans and shopping lists help save you money, and prevent purchasing unnecessary food that may go to waste

Academic Session 1– Coral Reefs

Lesson 1.1: Overview



Image © iStock

Lesson Objectives

By the end of this lesson, you should be able to:

- Briefly describe what makes up a coral reef, and where the ocean's reefs are located
- Give at least three examples of why coral reefs are important to humans

Introduction

What Is A Coral Reef?



Image © iStock/strmko

Anyone who has spent time around the ocean can speak to its captivating wonder, beauty, and mystery, due in large part to coral reefs. Coral reefs are some of the most beautiful and diverse ecosystems in the world, and, even though they make up less than a tenth of a percent of the ocean floor, they are the backbone of our oceans and home to 25% of all known marine species. In addition, these valuable ecosystems are sources of food and income, support tourism economies in many nations, create the sand for our beaches, and protect shorelines from erosion and storms.

Coral reefs exist in the world's tropical oceans where the climate, temperature, chemistry, currents, and nutrients meet the narrow requirements corals need to survive. They typically grow in clear, high salinity (salty), waters between 73° and 84 degrees Fahrenheit. The water needs to be clear and low in nutrients so that symbiotic algae that live in the coral's tissues, called zooxanthellae, can photosynthesize and make food for the coral.

As habitat to over 800 types of corals and 4,000 fish species, these massive reefs can span hundreds of miles of oceans, all built from tiny calcium carbonate skeletons. Some of these reefs are even visible from space - a living testament to the amazing complexity of the reef ecosystem and the abilities of these tiny organisms.

Why They Matter

Protection

More than 275 million people live within 19 miles of coral reefs, and directly benefit from the related resources and services that reefs provide. From food to research, and jobs to protection, we have a lot to thank our reefs for.

Coral reefs play a key role in protecting coastal cities and communities. They reduce erosion by absorbing the energy of open-ocean waves and storms, and decrease the amount of damage that can be caused by storms and severe weather events.

Fish Habitat

One-third of all fish species spend part of their life on coral reefs. These fish populations support a \$150 billion (in US dollars) global seafood industry, support small-scale fishers, and provide a primary source of protein for over 2.6 billion people worldwide according to the United Nations. This means that millions of people, even those who live far from a tropical ocean, rely on healthy coral reefs for their livelihood, health, and wellbeing.

Tourism Industry

Healthy fish populations and high species diversity on coral reefs support a massive recreation and tourism industry in many tropical regions. People from all over the world visit these places for the specific purpose of enjoying these complex ecosystems and the beauty and beaches they create.

Tourism keeps the economies and communities of at least 94 countries thriving, particularly small-island states in the Pacific and the Caribbean. 23 of these nations rely on reef tourism for more than 15% of their gross domestic product, making reefs incredibly important for their survival.

Medical Benefits

Finally, there are many marine species that produce complex chemical compounds that have the potential to create life-saving medicines. Researchers are already exploring how coral reef related compounds can treat cancer, HIV, malaria, and other diseases.

Only a small number of marine species have been sampled, so there is an incredible amount of medicinal value yet to be discovered.

If you want to learn more about coral reefs, you should take the SSI Coral Identification Specialty program.



Academic Session 1 – Coral Reefs

Lesson 1.2: Threats and Challenges



Image © iStock/MichaelStubblefield

Lesson Objectives

By the end of this lesson, you should be able to:

- Briefly describe the relationship between corals, algae, and herbivorous fish
- Give at least two examples of indirect threats that coral reefs face
- Give at least three examples of direct threats to coral reefs

What is Happening?



Image © iStock/Edward Haylan

While coral reefs are among the most biodiverse marine ecosystems, they are also among the most threatened. There has been a dramatic degradation and loss in coral cover since the 1900s; many reefs have 40-50% less coral now than they did only 30 years ago.

As the ocean's "canary in the coal mine," coral loss shows that our oceans are struggling. As a variety of different threats increase, coral's ability to grow, reproduce, thrive, and support the ecosystem is compromised.

Ecosystems are quite complex and have co-evolved over long periods of time. When one species is impacted or a stressor is introduced, there are often cascading effects throughout the rest of the ecosystem. Different combinations of stressors can also have much worse effects on marine species than any one alone.

Coral Bleaching

While corals experience mortality from a range of factors, like disease and physical damage, there has been a dramatic loss due to mass bleaching events over the last few decades. Changes in temperature, light, and nutrients increase coral stress, often causing them to expel their colored symbiotic algae that lives in their tissue called zooxanthellae. This causes the coral to appear completely white, or "bleached." The coral is still alive and can recover, but without their symbiont it is harder for corals to survive for long, often leading to mortality.

Declining Reef Coverage

After a coral colony dies, turf algae will colonize the empty skeleton. Turf algae is a main competitor of corals, and often thrives in conditions where corals struggle, such as when there is an increase in nutrients or temperature. Once algae grows over a coral skeleton, it is even harder for the coral to out-compete the algae or grow back over a dead section. In addition, the algae creates a surface where coral larvae cannot anchor and grow, further inhibiting coral's ability to bounce back from mortality and degradation.

Over time, these overgrown skeletons will erode, disintegrating and turning into coral rubble, making the reef less structurally complex. This also means that the small shelters and habitats that local marine life depend on is lost. Healthy and structurally complex coral reefs are often associated with abundant and diverse fish communities, so as we lose this complexity for corals, we also risk losing the abundant marine life that inhabits these reefs.

Compounding Threats

Coral reefs rarely experience one single threat, and when threats combine, they can cause even greater devastation. Disease compounds direct threats by weakening corals and their ability to recover. Climate change also compounds the threat of disease, as diseases spread faster and more easily in warmer and more acidic waters!

The Relationship between Coral and Fish



Example of a dead reef
Image © Adobe Stock/ead72

The decline in coral cover can be simplified into the relationship between corals, fish, and algae. Corals and algae are constantly competing for space, and algae typically thrives in conditions where corals struggle. On a healthy reef, herbivorous fish are able to keep the balance between the two by grazing on the fast-growing algae, giving corals a chance to keep up.

While corals need herbivorous fish, the fish also need corals; many fish species rely on the structural complexity and micro-habitats that coral reefs provide for a place to live and protection. When there is an imbalance in any one player, the rest of the ecosystem is affected and runs the risk of falling into a negative feedback cycle where algae dominates and there is a decrease in coral cover and fish populations.

Direct and Indirect Threats



Image © iStock/malivoja

Coral reefs are struggling all over the world due to many global threats, like rising temperature, and ocean acidification, and direct human actions like harmful fishing practices, pollution, and careless recreation.

Indirect Threats

Climate change is the greatest global threat to coral reefs. Humans have contributed to the increase in atmospheric carbon dioxide through the use of fossil fuels to heat our homes, drive our cars, and raise the food that we eat. Increased levels of atmospheric greenhouse gases have triggered a drastic change in our global climate as well as in our oceans. The associated threats of climate change include rising sea level, changing storm patterns, changes in precipitation, and altered ocean currents, but the two most pressing issues are increased ocean temperatures and ocean acidification.

Warming Oceans

Increased levels of carbon dioxide are associated with an increase in heat, more than 90% of which is absorbed by the oceans. Ocean warming threatens coral reefs because when corals experience thermal stress too frequently or for too long, mass bleaching events occur. As we discussed earlier, bleaching events often lead to death, algal overgrowth, and loss of reef structure and habitat.

Acidification

Not only have oceans gotten warmer, but they have also gotten more acidic. Ocean acidification is caused by a change in ocean chemistry, where carbon dioxide is absorbed into the water, which then becomes more acidic. These conditions make it more difficult for corals and other invertebrates to build their calcium carbonate skeletons and shells. As of 2018, we are still facing an increasingly acidifying ocean, with an average pH decrease of 26% since the start of the Industrial Revolution.

Direct Threats

Pollution, overfishing, and careless recreation are examples of direct human factors that affect the health of coral reefs. Pollution creates conditions where algae thrives and corals and fish suffer. Overfishing causes a decrease in abundance of herbivorous fish populations that keep algae populations in check. Careless recreation can degrade coral reefs through physical direct damage.

Overfishing



Image © iStock/mgokalp

Overfishing is the practice of harvesting fish at a faster rate than the population can naturally reproduce. Due to the growing global demand for seafood, almost 90% of global fish stocks are either overfished or fully exploited.

On coral reefs, overfishing and destructive fishing practices are the most immediate threat to reef health, and affect more than 55% of global reefs. This is partially due to local herbivorous fish species being overfished.

Herbivorous fish normally keep competitive algal populations in check, giving coral a chance to keep up with their fast-growing competitor. As herbivorous reef fish like parrotfish and surgeonfish are harvested at unsustainable levels, reef ecosystems soon become overrun with algae, smothering corals and decreasing reef resiliency.

In addition, illegal, unreported, and unregulated (IUU) fishing also occurs in many parts of the world. Without accurate measurements of what is being taken from the oceans, it is hard to understand the health of fish stocks and how to manage them properly.

Pollutants

Nutrient Pollution



Image © Adobe Stock/Carola Vahldiek

This type of pollution is often caused by an excess of nitrogen and phosphorus from sewage, and runoff of fertilizers from urban and agricultural land. Sewage is the most widespread pollutant and many countries with coral reefs have little or no sewage or water treatment options.

Untreated sewage and fertilizers eventually are washed into our ocean where they create environmental conditions where algae thrives. In extreme cases, excessive algal growth will deplete water oxygen levels so much that eutrophication or "dead zones" form.

Dead zones are not habitable for marine life and cause mass die-offs of marine species that cannot adapt or move to areas with higher concentrations of oxygen. Our coastal waters have seen a great amount of deterioration due to pollution and eutrophication in recent decades, increasing from 44 known cases in 1995 to 169 in 2007. At our current rate, there will be a 20% increase in coastal eutrophication in large marine ecosystems by 2050.

Chemical Pollution



Image © iStock/toddtaulman

This type of pollution occurs when chemicals enter our ocean that contain endocrine disruptors or other toxins, affecting local fish and coral populations.

Oil spills or dispersants, pesticides, medical waste, and sunscreen are all examples of chemical pollution that can affect coral reef health in a variety of ways. Most of these chemicals have short-term and long-term effects, causing tissue death, change in growth rate, expulsion of the zooxanthellae, and decreased reproductive health among other stress responses, disrupting overall ecological functions.

Sedimentation



Image © iStock/canaran

This occurs when sediments like soil, silt, and sand enter the ocean and cause the water to become murky. Sedimentation occurs from wind and runoff from degraded land, smothering corals and reducing the amount of light exposure they get.

This can also create ideal conditions for algae to thrive! Humans contribute to sedimentation by developing coast lines and cutting down mangrove tree ecosystems that typically filter water before it enters into reef ecosystems.

Plastic Pollution



Image © iStock/lindsay_imagery

This form of pollution results from dumping or the improper disposal of plastic materials. Plastic bags, bottle caps, cigarette butts, and fishing nets are examples of common plastic pollution. This form of pollution threatens marine life because it causes "ghost fishing," when lost nets or plastic trap and suffocate marine life.

Plastic also leaches toxins into the water as it breaks down, getting smaller and smaller and creating microplastics. Microplastics get so small that they are consumed unintentionally by many marine species, including corals! Microplastics make their way up the food chain and even into consumer grade sea salt.

We will talk more about plastic pollution in an upcoming session.

Coastal Development



Image © iStock/Art Wager

Coastal engineering, land filling, and coastal habitat destruction are all forms of coastal development, which can damage reefs through direct physical damage from dredging or indirectly through greater levels of pollution from run off and sewage discharge.

When mangroves or other coastal ecosystems are wiped out and replaced with a building or parking lot, water is not filtered and is funneled straight into the ocean, creating deadly conditions for corals. These ecosystems also have a particular balance, where corals, sea grass beds, and mangroves rely on each other to function at their best. Coast development threatens this balance.

Coastlines are developed to create human settlements, hotels, industry, aquaculture, agricultural land, and infrastructure each of which have their own environmental and coral reef impacts. When coasts are developed for the purposes of tourism, the local reefs become more susceptible to unsustainable tourism and careless recreation.

These are compounding threats, as climate change threatens to cause more frequent and heavier precipitation in many areas, which will worsen pollution runoff and increase risk of storm damage and erosion.

Increased Tourism

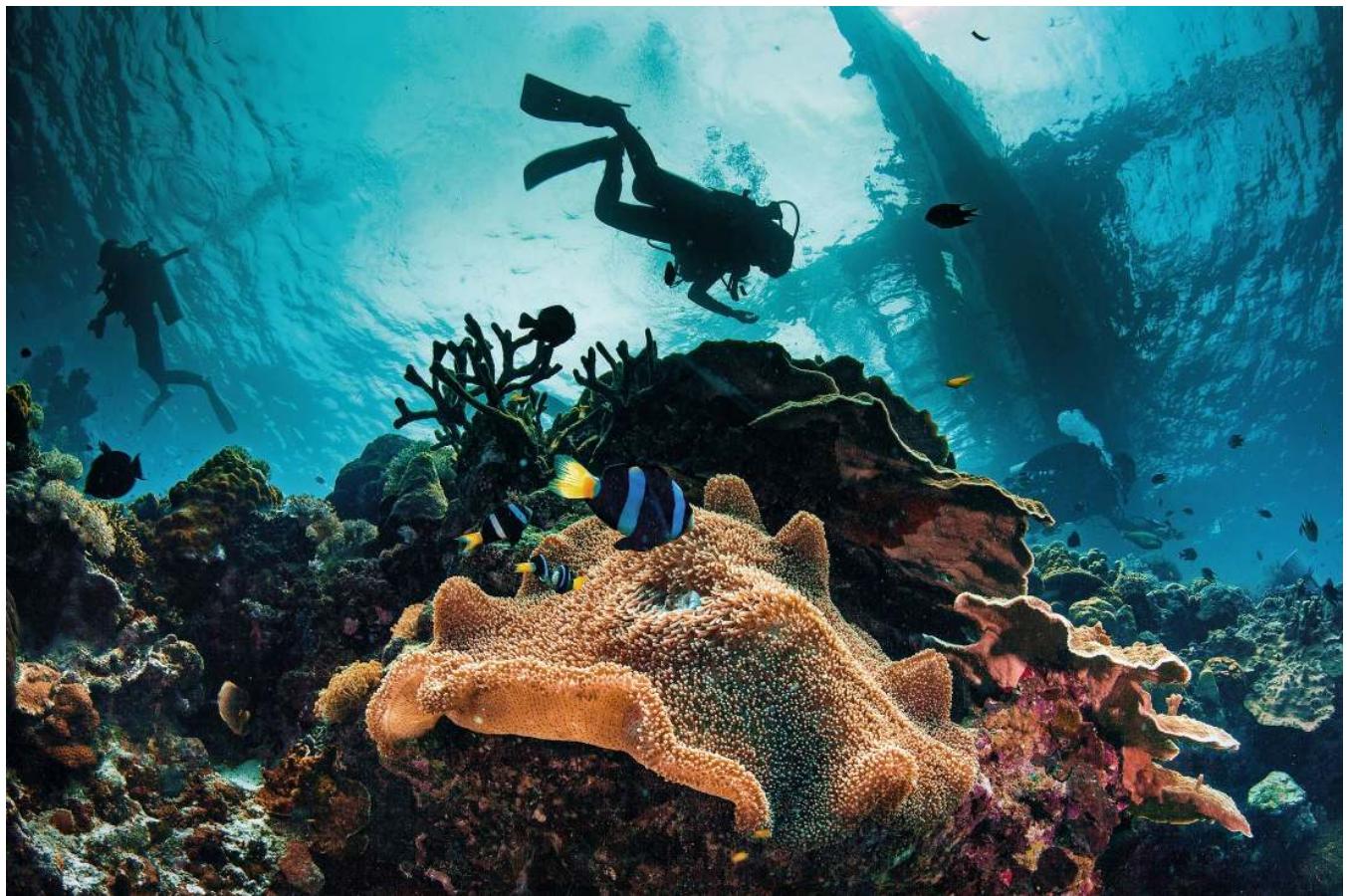


Image © Fotolia/paulcowell

Tourism damages coral reef ecosystems when tourists are unaware or do not understand the implications of their actions. Well-intentioned tourists can sometimes kick or stand on corals if they do not have good buoyancy, are careless, or get tired. Kicking or stepping on corals can also break branches off or crush the living tissue.

When boating, people often like to anchor on coral reefs to enjoy their beauty, but a poorly-deployed anchor can drop and drag along coral reefs, crushing everything in their way! Many coral reefs are also shallow, and are sometimes hit by boats trying to navigate in and out of the reef.

Academic Session 1– Coral Reefs

Lesson 1.3: The Good News

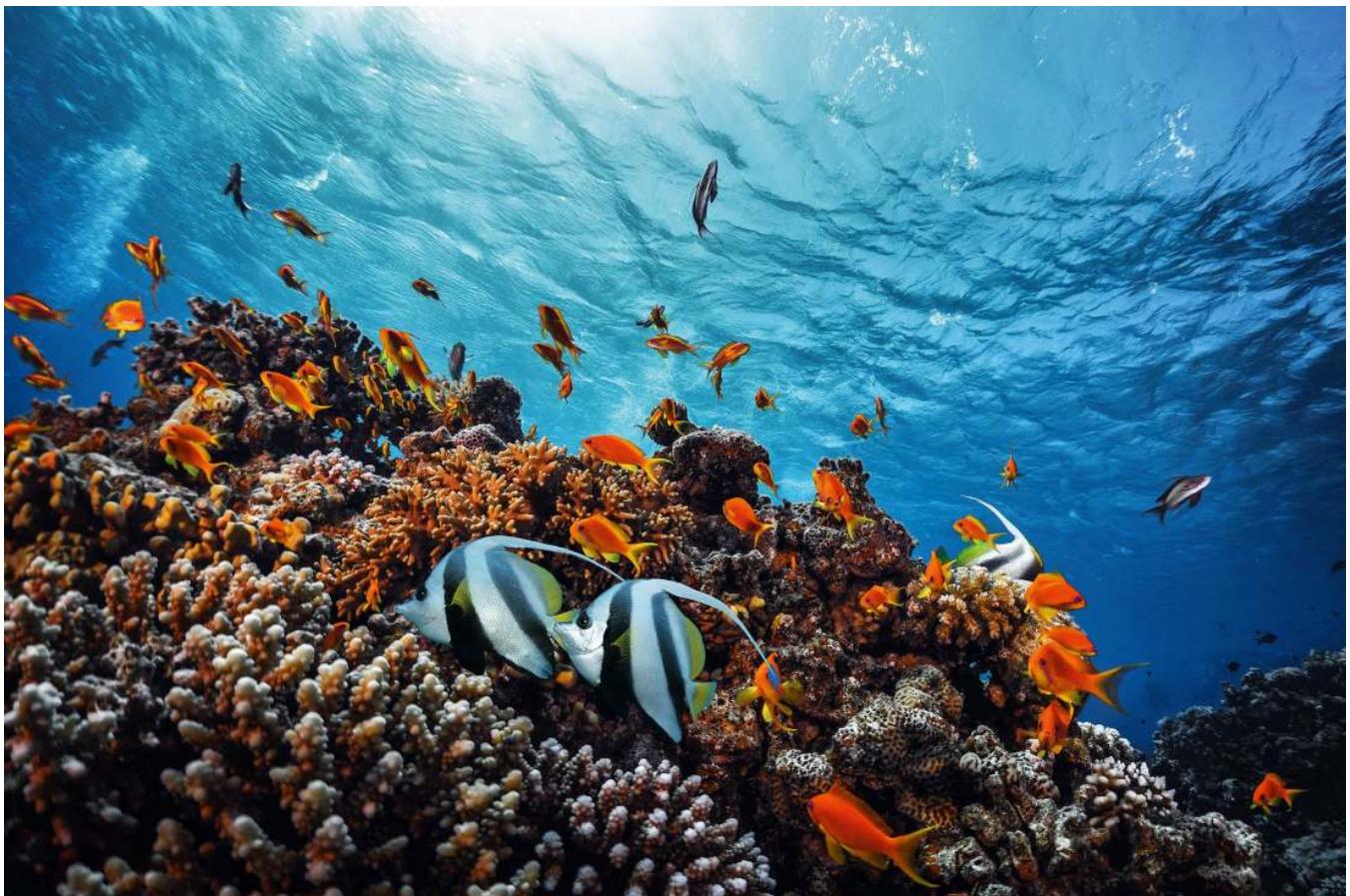


Image © iStock/mihiander

Lesson Objectives

By the end of this lesson, you should be able to:

- List at least two ways that human kind is taking positive action to protect coral reefs
- State the importance of marine protected areas
- Briefly describe how sustainable fishing practices benefits coral reefs
- List at least two ways scientists are researching coral reef protection techniques

What We Are Doing Right

While corals are facing a wide range of threats, there is still a lot we can do to help save these critical ocean ecosystems. Thankfully, people are taking action to find solutions that address these threats at the individual, community, and national or global levels.

The following pages describe actions that people are taking around the world to protect coral reefs and ensure that they continue to thrive.

Taking Action: Acknowledging the Problem

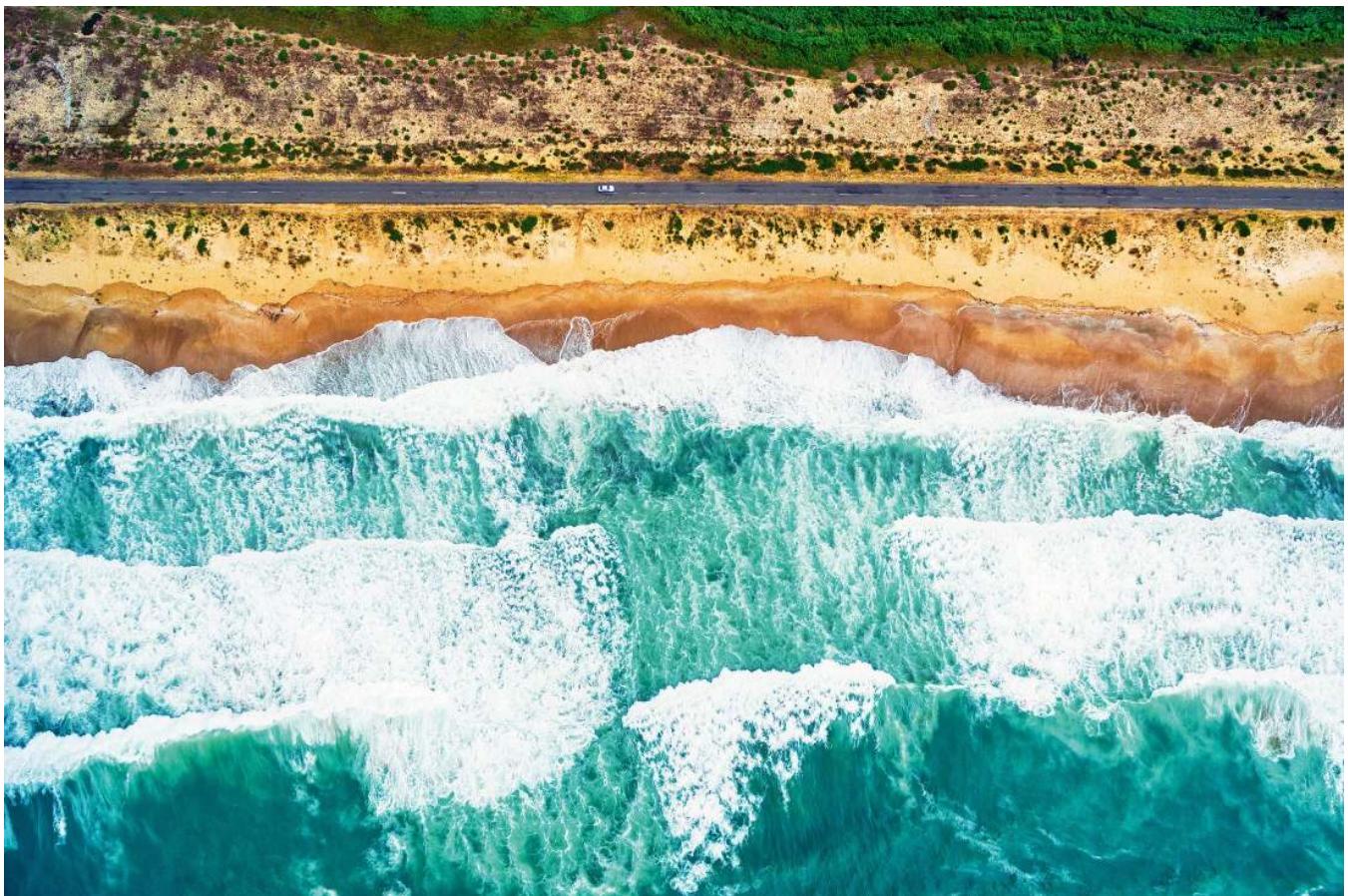


Image © iStock/valentinrussanov

Protecting the ocean's coral reefs seems like a monumental task. Fortunately, there is a growing global awareness of the issue and what it will take to create positive change. The problem is multi-faceted and complex, and will require the coordinated efforts of individuals, local communities, and regional and national governments.

Sustainable Development Goals

In 2015, the United Nations created the 2030 Agenda for Sustainable Development and its "17 Sustainable Development Goals (SDGs)". Among these goals was "Goal 14: Life Below Water" with the stated objective to,

"Conserve and sustainably use the oceans, seas and marine resources for sustainable development!"

While not directly targeted toward coral reefs, Goal 14 is a great step for coral reef conservation, as progress toward this goal is measured by mitigating many threats that effect coral reefs, like ocean acidification, pollution, and overfishing. The OurOcean conference also happens once a year, where global ocean conservation leaders come together to discuss progress and solutions.

Early Progress

Since the establishment of the Agenda in 2015, significant steps have been taken to protect the marine environment. As of January 2018, 16% (that's over 8.5 million square miles!) of coastal marine waters were conserved as protected areas, surpassing the target to conserve at least 10% by 2020. The establishment of such parks has helped to protect roughly 27% of all coral reefs in the world.

Importance of Marine Protected Areas

Effectively managed protected areas positively benefit the surrounding reefs by increasing fish populations and providing a safe place for marine species to develop into maturity.

Parks such as Papahānaumokuākea Marine National Monument in the Northwestern Hawaiian Islands (139,000 square miles, or an area roughly the size of Germany) and the Phoenix Islands Protected Areas, which cover 158,000 square miles of the mostly uninhabited Phoenix Islands and surrounding waters are examples of some of the largest established marine protected areas in the world.

Coastal countries are also setting laws and regulations to help preserve their reefs. In the United States, Hawaii has banned toxic sunscreens containing oxybenzone, and New Caledonia setting regulations for fishing and tourism in the Natural Park of the Coral Sea.

As you will learn in the next session's case study on Misool Eco Resort, other countries are also creating marine preserves and taking action to protect their underwater resources.

Industry Innovation

In addition to governmental policies, industries are also taking action to protect marine resources from which they derive their income and profits.

The seafood industry in particular is taking action to increase the efficiency of fishing techniques and the traceability of its product. There is a growing demand among consumers for accountability in seafood; when consumers insist on understanding where their food comes from, the industry becomes more cautious in their collection methods.

One benefit of a more sustainable seafood industry is healthier reefs. By reducing the amount of by-catch, which is simply unwanted fish caught while fishing for a specific species, and using more-sustainable fishing methods that do not damage the reef, the seafood industry reduces the negative impact on the reef.

We will discuss overfishing and sustainable fishing practices in an upcoming release of the Blue Oceans program.



Research and Restoration



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Researchers at universities, nonprofits, laboratories, and institutes have led the way in developing methods and techniques to more effectively and efficiently restore coral reefs. As coral restoration methodology and technology evolves and matures, there is hope that we can restore coral reef ecosystem function.

Coral restoration research is a developing field that offers some interesting and promising solutions for protecting and managing coral reefs. Due to the complexity of marine ecosystems, and the relative newness of coral restoration research, we have yet to find a single solution to coral reef loss.

Some researchers have started to identify coral genotypes that are more resistant to the effects of climate change so that we can grow corals that will survive our changing oceans. Others are researching how corals mature and reproduce to provide better advice to policy makers and governments.

Academic Session 1– Coral Reefs

Lesson 1.4: How You Can Help



Image © iStock/sankai

Lesson Objectives

By the end of this lesson, you should be able to:

- List at least two ways to directly benefit coral reefs
- List at least two ways to indirectly benefit coral reefs
- Each session contains Instructor Content, an outline of the practical application session, and a Debriefing and Record Keeping page.
- Briefly describe how to get involved with coral reef conservation at a policy level

So, What Can You Do to Make a Difference?

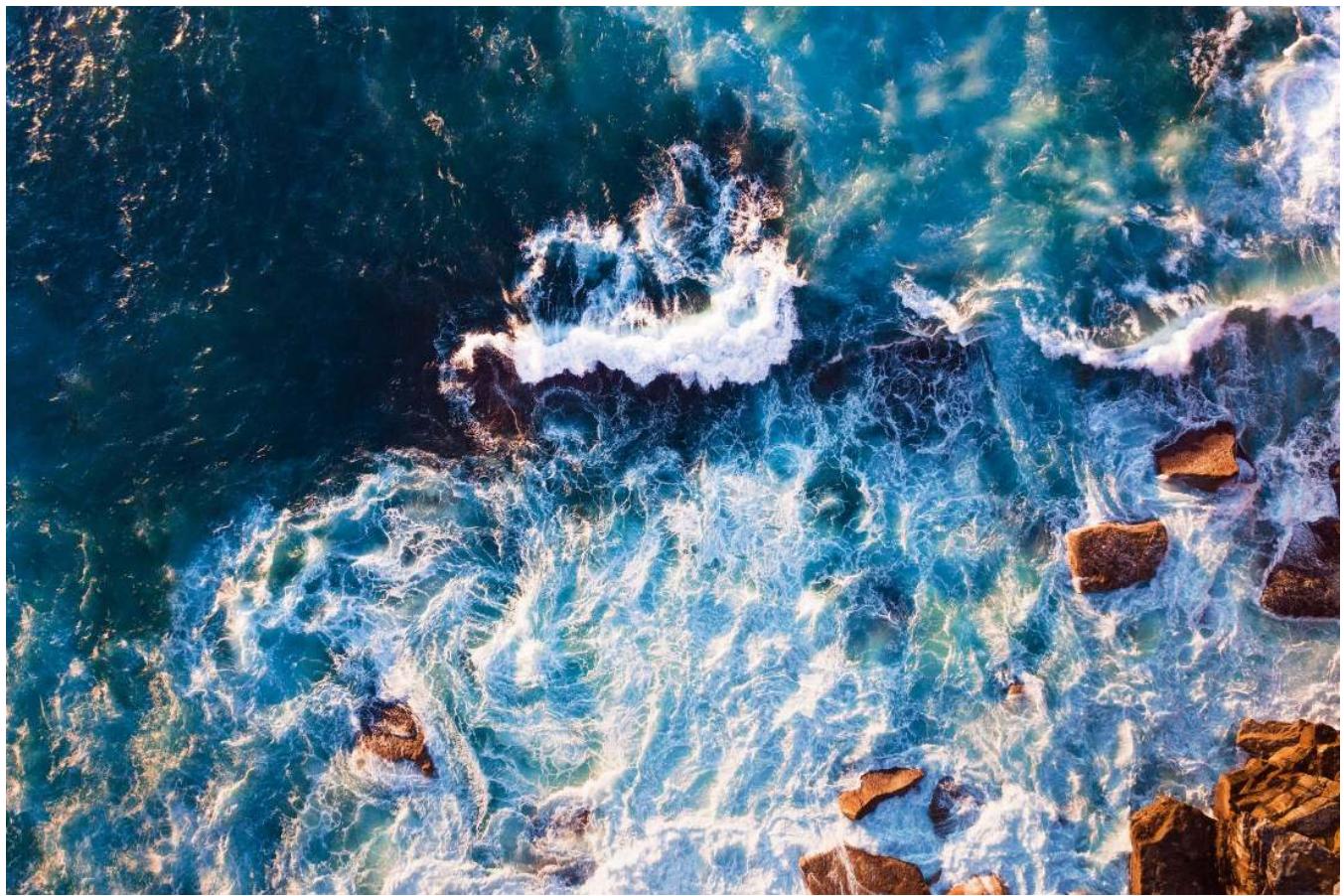


Image © iStock/ai_yoshi

It's easy to look at the problems facing our coral reefs and think, "what can I possibly do to help?", especially if you live far from the ocean, or in a colder climate.

Even if you cannot directly benefit to the cause, there are a number of decisions you can start making today that will indirectly help.

Responsible Food Choices

Something as simple as choosing an ethically- or responsibly-sourced seafood will help protect our reefs. By choosing seafoods from companies with a commitment to sustainability, you are using your purchasing power to make a statement in support of the ocean.

When a seafood company sees that their consumers want food that is caught using non-destructive fishing methods, or that reduces by-catch, they have an economic incentive to minimize their impact on the reefs that support so many of the species that end up on our dinner tables.

This indirectly benefits the reefs by decreasing the number of fishing nets that are lost at sea, minimizing destructive fishing practices like bottom trawling that destroy fragile corals, and decreasing the number of juvenile fish that are caught as unwanted by-catch.

It's amazing to think that something as simple as choosing a different brand of seafood can have a global impact!

Reduce, Re-Use, and Recycle

As we have discussed, pollution is another major threat facing our reef systems. Remember that all waterways are connected, from the high mountain rivers to low-lying swamps and rivers, and that everything eventually washes into the ocean.

By reducing our waste, including fertilizers and garbage that is improperly disposed of, we can reduce the amount of harmful nutrients and chemicals that eventually reach the ocean.

Whenever possible, reduce the amount of plastic waste you create, and ensure that garbage is properly disposed of, especially if you visit a beach or waterway.

Responsible Tourism

If you are one of the millions of people who enjoy our beaches, waterways, and marine environments every year, practice responsible tourism!

You may not think that your individual choices will have much of an impact, but when combined with the choices of millions of others (in 2016, Thailand alone has over 32 million visitors!), small decisions like choosing an environmentally-friendly sunscreen can have a huge effect on the health of the ocean.

If you visit a coral reef, do your best to avoid walking on the reef, and practice good buoyancy control if you are a diver. One accidental kick or misplaced anchor can destroy hundreds of years of coral growth. Choose a dive center or tourism provider with a proven track record of responsible environmentalism - online reviews are a great way to learn about other tourist's experiences.

You can also indirectly protect the reef by only buying souvenirs that are sustainable. Never buy products made from coral or marine species like turtles, and do not bring home items like shells, coral pieces, or other artifacts. These may become homes for marine organisms, or eventually become the beautiful sand that covers your favorite beach.

How your training center or Community can Help



Image © SSI

Protecting our ocean's coral reefs is also a community effort, whether it's your local community, the community of divers, freedivers, and other water enthusiasts at your local SSI Training Center, or your community of friends, family, and peers.

The SSI Family

Your local SSI Training Center may already be taking action to protect coral reefs. The next time you visit, ask if they have a recycling program, or if they use carbon credits to offset the carbon footprint of their travel programs.

If you're lucky enough to live near a coral reef, see if your community or training center has beach or underwater clean-up activities. These are a great way to make a local impact, and have the added benefit of improving the area where you live.

When you travel, look for destinations that have marine protected areas. The cost of entry is usually offset by the amazing natural beauty, and the money you spend for access often goes directly toward improving and supporting the area.

Education

This manual is only a brief overview of the issues facing our oceans and reefs. You can easily find more information on conservation topics that interest you by using the List of References at the end of each section, other SSI Ecology specialties like Coral Identification and Marine Ecology, and by research non-profits like the ones found in the last lesson in this section.

If a topic is interesting to you, it is probably interesting to others, especially if it directly applies to the

area where you live. You can introduce others to conservation efforts by sharing the information in this program - remember it's free to everyone - and by encouraging them to make conservation a part of their daily lives.

Getting Involved at a Policy Level



Image © iStock/HearttoHeart0225

If you are looking to take action at a larger level, start by getting more involved politically, or even pursuing marine conservation as a career.

Use your vote to elect government officials that support ocean conservation, or sustainable practice like plastic alternatives, renewable energy, and improved industry standards.

Once elections are completed, contact your representatives or government officials to tell them why coral reefs are important and why we should pass policies to protect them. Stay informed on relevant policies that could effect coral reefs and attend town hall meetings to voice your opinion. This will help push the right policies into action to meet our global ocean goals.

Ocean Advocacy

Become an ambassador for the oceans! Take part in campaigns that raise awareness for coral reef conservation to show your support and spread the word to your community.

Parley for the Oceans is a great resource to see who is running these kinds of campaigns. Social media is an effective way to spread awareness and promote organizations who are making positive changes. You can often participate through the use of hashtags or posting relevant petitions. Spreading the word

and discussing these issues with your friends and family is also an amazing way to create a more sustainable future for our oceans. You can lead by example and show people how to take action in their daily lives to have an impact on corals.

Stay current with ocean issues by joining newsletters from your favorite ocean conservation non-profits, or join ocean networks to be part of a community of people who also care about coral reefs. You can also spread this knowledge and engage with your friends, family, community, or school by running ocean awareness campaigns, or fundraising for a non-profit.

Make it a Career

If all of this still isn't enough, you should consider a career in marine conservation. There are plenty of opportunities for students or volunteers to get involved and gain experience in the marine sciences, whether through research, non-profit work, advocacy, policy, or technological innovation.

You can pursue almost any career path and apply your work to marine conservation - it's a growing field where new ideas and discoveries are made almost every day!

Academic Session 1– Coral Reefs

Lesson 1.5: Want to Learn More?



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Lesson Objectives

By the end of this lesson, you should be able to:

- Describe three organizations who are working on the problem and how to get involved
- Use the List of References to learn more about coral-related issues

Getting Involved

By the end of this session, you have learned about the scope of the problems facing our ocean's coral reefs, why they are a concern for humans, and how you can get involved at any or all levels to make a positive change.

Fortunately for us, there are already a large number of government agencies, non-profits, and community programs working to protect coral reefs. Use the following examples as a starting point to get you started in your coral reef conservation career.

Coral Restoration Foundation

Who Are They?

The Coral Restoration Foundation (CRF) is one of the largest coral reef restoration organizations in the world. They were founded in response to the widespread loss of the dominant coral species on the Florida Reef Tract and have since grown to Curacao, Roatan, and Bonaire. Working predominantly in the Caribbean, the Coral Reef Foundation works with multiple stony coral species, including staghorn, elkhorn, and boulder coral species and plan to eventually work with many more.

What Do They Do?

The Coral Restoration Foundation takes a multi-faceted approach to coral conservation, managing the issue of coral loss through education, science, and restoration. Their education programs are aimed at all age groups and their Key Largo, Florida location serves as an education center for visitors and locals.

The foundation engages in the international community by partnering with grassroots coral conservation programs around the world. They send restoration kits to help these groups build their own coral nurseries., and provide advice and feedback on best practices for coral nursery management.

How Can I Get Involved?

You can get involved with the Coral Restoration Foundation by volunteering or interning, or by participating in dive programs organized by the foundation. These dive programs allow anyone to experience coral restoration first-hand.

You can sign up with a local dive operator or approved coral restoration agency, and work in coral nurseries, or plant coral colonies onto local reefs. The Coral Restoration Foundation also offers school education programs at their Key Largo center or over Skype, so whether you live in Florida or abroad, you can still learn about coral reefs!

The Nature Conservancy

Who Are They?

The Nature Conservancy (TNC) works on a global scale to conserve the planet we live on. They employ over six hundred scientists, work in over seventy countries, and collaborate with many local and national governments. Based on over 70 years of ecological conservation, The Nature Conservancy works both on the land and in the water to protect our world's natural resources.

What Do They Do?

TNC works to conserve, protect, and restore coral reef ecosystems by establishing Marine Protected Areas (MPAs) and implementing large scale coral restoration programs.

A recent project lead by their Caribbean Program is a coral reef insurance program that helps to finance the protection and restoration of coral reefs. They do this by providing insurance to hotels, residents, and communities that rely on coral reefs for protection.

The Nature Conservancy also runs education programs and sustainable fishing certifications to help people in coastal communities learn about and protect their local corals.

How Can I Get Involved?

There are numerous ways to get involved with The Nature Conservancy. You can pick a chapter or program to donate to, such as their Ocean Program or Caribbean Chapter. You can also volunteer for your local chapter, as they are located in most countries and regions. You can also visit their public field sites near you or when you are traveling to show support for their work.

Coral Reef Alliance

Who Are They?

The Coral Reef Alliance (CORAL) protects coral reefs all over the world by working with a variety of stakeholders, ranging from fishermen to government leaders, and divers to scientists.

What Do They Do?

The Coral Reef Alliance takes a multi-pronged approach using science, policy, capacity building, and partnerships to ensure the effective conservation of coral reefs.

They lead holistic conservation programs that improve coral reef health and resilience through science, working with stakeholders, creating partnerships, providing informed solutions for communities, policy, and establishing effective and sustainable local management systems.

They implement these tactics to combat overfishing and nutrient pollution and also to establish "Adaptive Reefscares" which are networks of healthy reefs that can adapt to climate change because they are diverse, connected, and large.

Establishing Adaptive Reefscares helps to protect specific areas that will be pivotal in the efficient and effective conservation of coral reefs.

How Can I Get Involved?

The Coral Reef Alliance has field workers stationed all over the world, with their four main field sites in Honduras, Fiji, Indonesia, and Hawaii. They also run the Coral Prize Event where they highlight coral conservation champions in the world doing amazing work in places that need it the most.

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These are the sources we used to research coral reef conservation. If you want to learn more, these are a good starting point.

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Academic Session 2 – Shark Finning

Lesson 2.1: Overview



Image © Scubapro

"Sharks are beautiful animals, and if you're lucky enough to see lots of them, that means that you're in a healthy ocean. You should be afraid if you are in the ocean and don't see sharks." - Dr. Sylvia Earle

Lesson Objectives

By the end of this lesson, you should be able to:

- Describe the origin of shark finning
- Explain why the shark's reproduction cycle makes it vulnerable to shark finning

Introduction



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In an effort to preserve the ocean for future generations, marine conservationists have to address a wide range of threats. One of these threats is shark finning and requires international collaboration and a change to long-standing cultural traditions.

What is Shark Finning?

Shark finning is the practice of removing only a shark's fins and discarding the rest of the animal. The rest of the shark is often thrown back into the ocean, since the rest of the body has little value per kilogram compared to the fins. These animals inevitably die of suffocation, since they require constant movement to keep water flowing over their gills, or from the severity of their injuries.

Many countries have full or partial bans on shark finning, but unfortunately it is not enough to completely prevent shark finning. Some countries still consider shark fin a delicacy, serving shark fin soup as an indicator of status or respect during formal events like business meetings or weddings.

Origin of the Practice

While some cultures venerate sharks as protective spirits, other cultures have historically considered sharks as simply another commodity, like fish or grain.

The practice of using shark fins first became popular in China around the 14th century. Shark fins are traditionally cooked in a soup, and served during important events and ceremonies as a sign of status and privilege, and to show respect.

Despite national and international regulations and information campaigns, shark fin soup can still be found on menus around the world, and the dried fins may be found in traditional markets. Steeped in tradition and cultural significance, shark fins are a high-priced item on the black market. Experts estimate that millions of sharks die every year for their fins.

With the popularity of fishing sharks for sport, use of shark meat in Chinese medicine, and a taste for shark fin soup, sharks cannot reproduce as fast as humans take them out of the ocean.



Image © iStock/EXTREME-PHOTOGRAPHER

Oceanic sharks and rays are particularly vulnerable to the threats of finning and overfishing, and over three-quarters of species are at risk of extinction due to unsustainable practices. Oceanic sharks tend to reach maturity at an average age of 11 years old. They have long lifespans (up to 65 years!), and long gestation periods.

Low Reproductive Rates

They may carry their young between 9-18 months before giving birth. This factor, combined with the relatively low reproductive rates (some sharks only birth a few pups during each breeding cycle), means that they are easily overfished, leading to a steep decline in worldwide shark populations.

An Unsustainable Commodity

High seas fisheries are a big threat to shark populations. Often unregulated, or with minimal regulation, fisheries tend to catch oceanic sharks as by-catch. By catch is when wildlife, in this case sharks, is caught in addition to the targeted species, which would most likely be fish such as tuna or other billfish.

Shark fins are a valuable commodity, and are worth significantly more than the meat. The discrepancy between the value of the fins and the value of the meat often leads fishermen to cut off the fins and keep them, discarding the remains of the shark at sea. Historically, only a few species of sharks were targeted for their fins. But both a decline in food fish stocks, and an increasing demand for shark fin soup, has increased the number of targeted species.

The charismatic white shark is one of the least resilient species. In locations where they are not protected, they may be fished for recreation or trophy fishing, or targeted for their jaws and fins. White sharks are also particularly susceptible to exploitation due to their worldwide distribution and the ability to travel long distances when migrating.

While they have been awarded some protections by international governments, the high seas are a challenge for enforcement, and marine protected areas only afford protections to the wildlife that stays within the protected regions of the marine protected area. Animals that migrate, like many shark species, are at a greater risk of capture when they move beyond the boundaries.

More information about marine protected areas and the benefits to biodiversity and fish biomass will be available in the next SSI Blue Oceans release.



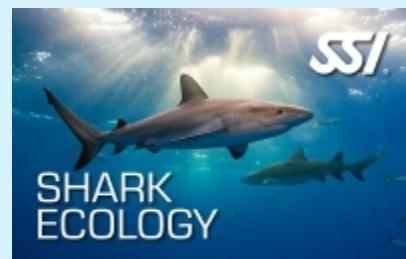
The Value of Sharks

Sharks are apex predators in the ocean food chain, meaning their presence helps keep ocean ecosystems in balance. When sharks are removed from the ecosystem, especially in habitats closer to shore, it may negatively impact the biodiversity of the ecosystem.

They keep smaller predators in check, so wildlife lower down the food chain can reproduce and grow to support healthy populations.

A study completed by researchers at Dalhousie University shows the effects of the loss of a top predator on a marine ecosystem. Their findings showed when large shark populations were depleted, the populations of their prey, smaller sharks, skates, and rays exploded, leading to the entire population of scallop beds being wiped out. The loss of the scallop beds was hugely detrimental, and effectively destroyed the bay scallop fisheries.

To learn more about sharks, skates, rays, and their marine cousins, and their critical role in our ocean's ecosystems, you can take the SSI Shark Ecology specialty program.



Academic Session 2 – Shark Finning

Lesson 2.2: Threats and Challenges



Image © Fotolia/Brandelet Didier

Lesson Objectives

By the end of this lesson, you should be able to:

- State how many sharks are killed per year for their fins
- Describe why lower shark populations have a negative impact on the environment
- Describe at least one economic impact of shark finning

What is Happening?

As National Geographic Explorer Dr. Sylvia Earle states, "Sharks are beautiful animals, and if you're lucky enough to see lots of them, that means that you're in a healthy ocean. You should be afraid if you are in the ocean and don't see sharks." Historically feared due to an undeserved reputation as a mindless man-eater, sharks are now becoming recognized as key factors in the ocean's health.

A healthy ocean requires a healthy population of sharks. When sharks are removed from an ecosystem, there are documented losses to sea-grass beds, reefs, and even negative impacts to commercial fisheries. Other larger predators thrive and consume the herbivorous fish that keep algae from overwhelming the reefs. These consequences are almost always negative and can have far-reaching impacts that are felt beyond the local reef where the sharks were removed.

Economic Impacts

In addition to harming ecosystems, losing sharks also negatively impacts local economies that depend on tourism. A single shark may bring between \$250,000 to \$2 million U.S. dollars in tourism value over the course of its lifetime, far exceeding the one-time benefit derived from removing its fins.

One study in the Maldives indicated that a healthy shark population could increase dive-trip demand by 15%. Shark diving generates up to \$18 million per year in annual business revenue for Palau, and up to \$25.5 million per year in Australia.

In the Bahamas, a study completed in 2017 showed that the shark diving industry, including tourism, film, and research, generated over \$113 million, thanks in large part to conservation efforts set in place by the Bahamian government.

By removing sharks from these ecosystems, either intentionally through shark finning, or unintentionally as by-catch or through ghost fishing, world economics are losing millions in uncollected revenue.

How Big is the Problem?



Image © iStock/ShaneGross

Humans kill approximately 100 million sharks every year. This number includes both legally-landed sharks used for meat, sharks caught unintentionally as by-catch when fishing for other species, and sharks caught illegally for their fins.

Due to black market trading, the exact number of sharks slaughtered for the shark fin trade is difficult to determine. However, it is estimated that shark populations have decreased by 60-90% in the last two decades, due in part to the shark fin trade.

The Food and Agriculture Organization (FAO) of the United Nations reported that in 2000, global shark catches had increased three-fold from their 1950 numbers, reaching a peak of 888,000 tons. By 2014, the FAO reported that Thailand had passed Hong Kong as the largest global exporter of shark fins, and that the primary importers of shark fins included Malaysia and Japan.

Facing Extinction

The impact of the shark fin trade could cause some species of sharks to become extinct within the next ten years. The IUCN - Red List criteria categorized 16 species of sharks as Threatened or Near Threatened in 2008, and eleven of those species were recognized as having a higher risk of global extinction.

Unfortunately, the shark fin industry a multi-billion dollar industry, and enforcing shark protections against illegal fishing is a big challenge that can be incredibly difficult to enforce without large amount of resources.

The demand and prestige that come with shark fins make it an extremely profitable business, with the global shark fin trade valued at approximately 1.2 billion US dollars (USD). A shark fin can cost nearly \$400 USD per kilogram, with more exotic shark fins selling for up to \$10,000 USD per fin!

Academic Session 2 – Shark Finning

Lesson 2.3: The Good News



Image © Shutterstock/Fer Gregory

Lesson Objectives

By the end of this lesson, you should be able to:

- Describe at least two ways that public perception is changing in favor of shark conservation.
- Describe at least two examples of organizations or individuals actively protecting sharks.
- Briefly describe how changing cultural perceptions and behaviors will help protect sharks.

What We Are Doing Right

Approaches to conservation are not always black and white. The ability to work with a community to get at the root cause of harmful behavior allows a community and culture to shift toward preserving the natural world. In many cases, the damage stems from a lack of information or education.

Each of the case studies in this session describes an individual or organization working in shark conservation. In each of these examples, community involvement and government assistance are vital components, since without collaborative efforts, community engagement in conservation efforts usually fails to take hold.

Government Action

As mindset shifts happen, and protections are put in place, shark populations can rebound. In 2000, the United States enacted the Shark Finning Prohibition Act after global shark catches reached 888,000 tons per year. The law prohibited fishing vessels from shark finning in US waters and made it illegal for any U.S.-flagged vessel to have shark fins on board. After the law was passed, there was an 11% decrease in global shark catches.

This act was followed by the Shark Conservation Act in 2011, which required that all sharks, with one exception, be brought to shore with their fins naturally attached. The value of shark fins has continued to decrease, leading to a lower demand, and many countries realized the value of shark tourism and subsequently limited or banned shark fishing in their waters.

Armed with knowledge of how conservation can help wildlife, improve local economies, support ocean health, and even boost populations of food fish, communities are given tools they need to conserve their local environment and create an enduring future for themselves.

International Cooperation

There have been a series of international conferences and collaborative efforts in the past decade that aim to slow or reverse the decline of many marine species – sharks included. The details of each effort have filled pages of white papers and executive summaries.

If you want to learn more, start with the Convention on International Trade in Endangered Species (CITES) and the Convention of Migratory Species of Wild Animals (CMS). With a better classification of the level of risk to each species – like sharks – the conventions mandate protective guidelines and better restrictions for the legal fishing of many species.

Better Management

One of the biggest challenges facing shark conservationists is the lack of adequate data. Many shark species are highly migratory, which makes it difficult to accurately track the species across vast stretches of ocean.

An international effort of non-profits, government agencies, and industry stakeholders are working to better understand population numbers, animal behaviors, and appropriate regulations or restrictions for fishing. The goal is to sustainably balance the needs of industry with the health of the ocean, the demands of the tourism industry, and the economies and cultures of local communities.

Making a Difference: The Cook Islands



Image © Adobe Stock/Andrea Izzotti

Marine biologist Jessica Cramp is on a career path to save sharks. In 2011, she moved to the Cook Islands to create a shark sanctuary and help to ban the shark trade. Within 18 months, she helped establish a law that prohibited selling or moving shark parts within the Cook Islands' exclusive economic zone.

The minimum fine for breaking the law? A penalty of at least \$73,000. Now, she tags sharks with the help of volunteers to track their movements. According to Cramp, "[one] of the reasons we're studying sharks is because they're in trouble, and we want to know if the laws we have in the Cook Islands work."

Prior to the sanctuary and establishing the law, boats would catch up to six sharks a day. The smell of ammonia from the sharks' skin would give the fishing boats away to authorities looking for illegally caught sharks or shark fins. As soon as the zero-tolerance policy was established, it gave inspectors the power they needed to enforce shark protections.

Cramp says that engaging the community is key to saving the sharks. She has a list of young Cook Islanders who help her with her conservation efforts and is known around town as the "shark lady."

Working with local volunteers, she teaches them how to tag and track sharks to collect data. This data helps determine the effectiveness of a large-scale protected area for guarding shark populations. Ideally, this information can also be used to build more effective policies in the future.

The most challenging part of community-centric research is the long hours and long-term dedication required for an effective assessment. However, building relationships and weaving the passion for protection into younger generations can help sharks and other marine animals thrive, creating enduring futures for protected ecosystems.

The Economic Value of Sharks



Image © iStock/Predrag Vuckovic

Many fish species are caught by humans for sport or as a source of food. Few species have the ability to capture the imaginations of the millions of tourists traveling around the globe every year.

As global perceptions change, sharks are no longer considered the vicious monsters portrayed by movies and television. Instead, millions of people travel each year to destinations all over the world, from warm tropical water to the chillier waters, with the simple goal of diving with one of nature's most amazing apex predators.

Scientific studies are beginning to show that the economic value of a live shark greatly exceeds the single-use value of its fins. In some places, the shark tourism industry even attracts travelers who visited for other reasons, but were attracted by social media or marketing that highlights the unique features of sharks and the destination.

Shark Tourism

In a 2011 study, researchers calculated that the nation of Fiji earned over \$42 million USD from the shark diving industry. This income was earned indirectly from taxes collected from the tourism, and directly from the diving industry revenues as 78% of the divers visiting the country (49,000!) participated in some form of shark-diving activity.

Shark diving has even gained popularity in locations that are not traditionally known as shark diving destinations. Some inland aquariums are promoting shark dives in their exhibits.

These encounters may be small-scale compared to viewing sharks in their natural environment, but they offer an excellent opportunity for aquariums to deliver an environmental and ecological message to visitors who may not have the opportunity to experience sharks in the wild.

Whale Sharks

The whale shark, which is the world's largest fish - growing over thirty-three feet long at maturity - is a migratory species of shark that feeds on very small marine species like krill. Because of their large size, whale sharks are often the victim of by-catch or ghost fishing nets rather than shark finning efforts.

They are also one of the most popular sharks to swim with, due in large part to their incredible size and passive nature. According to the Pew Charitable Trust, the recreational diving industry earned an estimated \$47.5 million USD worldwide from whale shark experiences. Belize, a popular stop on many whale shark migratory routes, reported earning \$3.7 million USD in 2003 alone.

Shark's Cousins

Sharks are not the only member of the class of animals known as "elasmobranchii", or cartilaginous fishes that can draw tourists to a region. Skates and rays, including the magnificent manta ray, are also often caught for their fins, even though the economic value of a live animal greatly exceeds the one-time value of the fins.

A 2011 study of tourism in the Maldives, a beautiful island nation in the Indian Ocean, identified 91 dive sites where mantas were regularly present. After interviewing experienced divers and reviewing economic data for tourism numbers, the study concluded that 143,000 dives and 14,000 snorkel experiences were conducted during the 2006-2008 period on those sites.

The economic value gained from the mantas on these sites was estimated to be worth about \$8.1 million USD!

Making a Difference: Changing Opinions



Image © Fotolia/frantisek hojdzs

Identifying the Problem

One of the biggest drivers of shark finning is cultural opinion. As we mentioned at the start of this session, historical reasons for shark fin soup, and a growing middle class in China and Hong Kong, have contributed to the decline of worldwide shark populations.

Fortunately, demand for shark fin soup in traditional markets has declined in recent years, thanks in large part to the outreach efforts of individuals like basketball star Yao Ming, and international non-governmental organizations like WildAid.

Finding Solutions

Yao Ming teamed up with WildAid, an organization that uses community-focused solutions and modern scientific data, to use his fame to bring awareness and inspire a cultural shift away from shark fin soup in China.

After playing in the United States, Yao Ming returned home to China to battle misconceptions about shark-fin soup. Using the slogan, "When the buying stops, the killing can too" the campaign has led to a significant decrease in sharks killed for their fins.

Recognizing the Benefits

Using images of sharks dying post-fin removal, Yao Ming and WildAid have helped to inform the public about the devastation that shark-fin soup causes on shark populations. China has taken to banning shark fin soup at state dinners, and over 91% of the population support a ban on consuming shark fin dishes.

A research survey conducted in August of 2016 with over 1,500 residents of population centers in China found that 93% of the survey respondents had not knowingly consumed shark fin in the six years prior to the survey. The survey identified that two primary reasons for changing eating behaviors were the increased awareness of the cruelty of shark finning practices and a desire to protect sharks.

In 2017, China Southern, a major airline carrier in the country, followed the decision of many other carriers to ban shark fin shipments due to concerns about sustainability, legal risks, and damage to their brand due to public perception.

Academic Session 2 – Shark Finning

Lesson 2.4: How You Can Help

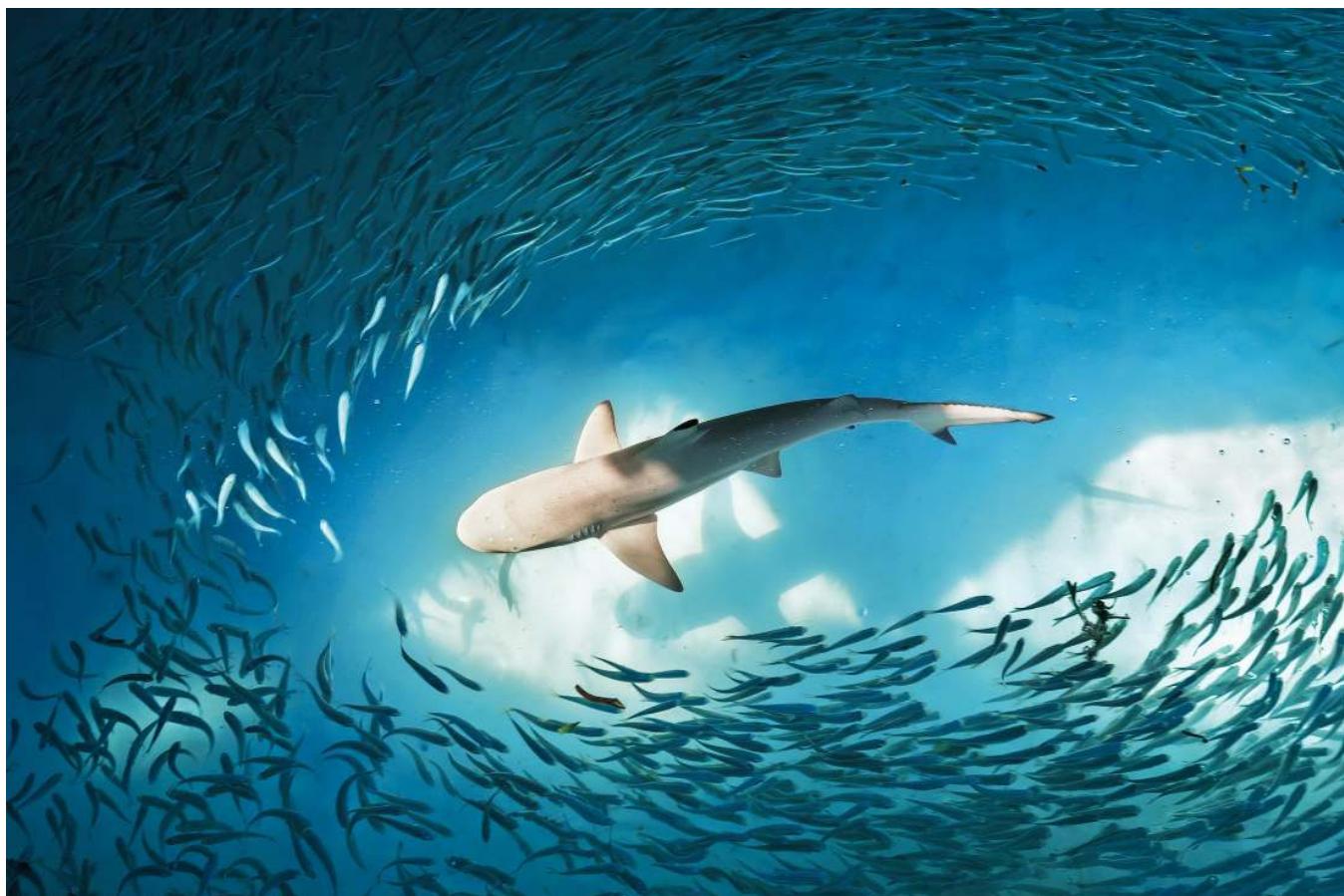


Image © Fotolia/Nikolai Sorokin

Lesson Objectives

By the end of this lesson, you should be able to:

- List three ways individuals can help prevent shark finning
- List three ways a community can help protect sharks
- Explain how to encourage policy changes that support shark conservation

So, What Can You Do to Make a Difference?

Hopefully by this point you have learned the economic value of sharks, and the threats they face from shark finning. While the global situation has improved over the past two decades, there is still a lot of work that must be done to prevent many shark species from going extinct.

As we stated at the start of this session, the changes that are needed to protect sharks will have to be collaborative, involving individuals, communities, regional and national governments, and international organizations. To be successful, we will all have to do our part.

Fortunately, there are a number of actions you can take at every level of involvement to help sharks.

Change at the Personal Level



Image © iStock/goc

The simplest action is one that you are probably already doing every day - avoiding all shark products, including shark fins, shark oils, and shark meat. By avoiding these products, and encouraging your friends and family member to do the same, you reduce the economic demand for shark fishing.

By reducing this economic demand, there is less profit in shark fishing, so fewer sharks will be caught - both legally and illegally - every year. This gives sharks a greater opportunity to grow to maturity. It has the added benefit of helping to protect our reefs, since sharks are an apex predator that is a critical component of the ocean's ecosystem.

You can also support measures that help protect sharks by donating to shark conservation efforts, sharing social media posts from campaigns that raise shark awareness, and by supporting destinations and businesses that have a history of responsible conservation.

Purchase seafood from companies that have responsible fishing practices, and avoid unsustainable fishing methods. Many hotels, resorts, airlines, and other tourist industries also recognize the benefits of shark conservation. Seek out these businesses when you travel, and encourage others to do the same.

Change at the Community Level

Image © SSI

Shark conservation may seem like an abstract concept to those of us who don't see them on a regular basis. For some people, it can be hard to get excited or motivated about a species that they may never see in their life.

It is our responsibility to share our knowledge with the rest of the world. You have already taken the first step by educating yourself using this manual - now you can spread the word about the importance of sharks with your friends and family, and encourage them to support the cause.

If you are fortunate enough to live and/or work near sharks, you probably already understand the economic and ecological benefits of a healthy shark population.

Consider sharing this unique perspective and knowledge with your local community. You can also spread the word to the rest of the world via social media and the internet to encourage others to visit and spend their tourist income on shark experiences.

Environmental Clean-Ups

We have talked about it in every session in this manual - a clean environment is a healthy environment. By supporting environmental policies and initiatives, and creating a healthier underwater ecosystem, you can indirectly benefit sharks as well as corals and other marine organisms.

Check to see if your SSI Training Center or other local organizations has already organized a coastal clean-up, or a local workshop on shark ecology, and share the efforts of like-minded businesses.

Change at the Policy Level

This is the really critical step for protecting sharks. Since many species are highly migratory, and many shark finning operations operate in foreign waters, national and international policies are needed to create effective protection efforts.

You can follow the example of Yao Ming, and join millions of other volunteers and supporters of organizations like WildAid. You can also support research and organizations that study the economic benefits of shark conservation, sustainable fishing efforts, and sustainable tourism efforts.

Encourage your elected officials and government, whether at the local, regional, or national level to participate in organizations and conventions that support shark and marine conservation. Policy makers are acutely aware of the opinions of their constituents, and hopefully vote in accordance with these desires.

This applies to all elected officials, even if they are part of a land-locked region or state. By sharing their opinions with fellow lawmakers, they can influence larger national and global policies.

Remember the actions taken by the United States in 2000 and 2010. A majority of the states do not have coastal waters, yet they still enacted shark conservation policy based on the overall desires of their voters.

Academic Session 2 – Shark Finning

Lesson 2.5: Want to Learn More?



Image © Fotolia/G. Russel Childress

Lesson Objectives

By the end of this lesson, you should be able to:

- Describe three organizations who are working on shark conservation, and how to get involved
- Use the List of References to learn more about shark-related issues that interest you

Getting Involved

By the end of this academic session, you have learned about the scope of the problems facing sharks, why they are a concern for humans, and how you can get involved at three different levels to make a positive change.

There are many local, national, and global organizations making positive changes that you can be a part of. We have already mentioned some, so here are a few more to get you started.

Making a Difference: Misool Marine Reserve

Who Are They?

Hidden deep in an archipelago of uninhabited islands, pristine reefs, and primary rain forests in the southern-most reaches of Raja Ampat Indonesia lies a private island resort called Misool. Misool was founded by Andrew and Marit Miners, who in 2005 were diving in this remote area when they discovered an active shark-finning camp.

The stark contrast between the tranquil haven they'd experienced underwater and the senseless destruction taking place at the surface jarred the pair into action. This catalyzing moment resulted in a mission to protect this exceptional ecosystem.

What Do They Do?

A lease agreement was forged with the local community in 2005, laying the groundwork for a privately managed marine protected area that has now expanded to 470 square miles, with the resort at its center.

Once the lease was finalized, the shark finners were displaced from that beautiful beach and a team of local and foreign workers was assembled. In two and a half years the team successfully transformed the former shark-finning beach into a high-end, private island resort, with a core mission to protect the heart of biodiversity. The resort was built from reclaimed wood, milled by the team in their portable sawmill.

After a day's construction work, the local crew would take to a plastic dinghy, chasing down Javanese long-liners by throwing pebbles at them. With the full support of local leaders, they hassled intruders and confiscated their gear and their catch. From these efforts, the Misool Ranger Patrol was born.

The patrol now consists of a 15-person unit of local rangers that monitors the Misool Private Marine Reserve without interruption. Rangers move between four stations using five dedicated patrol boats and work directly with the marine police and army, who have jurisdiction to impound vessels caught fishing illegally inside the reserve.

The team's conservation initiatives were formalized in 2011 with the establishment of the Misool Foundation. This registered Indonesian charity takes a broad approach to conservation and shares a joint mission with Misool Resort: to safeguard the most biodiverse reefs on Earth through the empowerment of local communities, providing a structure by which they are able to reclaim their traditional tenure-ship of reefs. At the core of the operation is the belief that sustainable tourism and community-based conservation are mutually beneficial.

How Can I Get Involved?

If you are part of a community or organization that is interested in creating safe sanctuaries like the Misool Marine Reserve, you can contact the foundation via their website.

Shark Savers

Who Are They?

Shark Savers is a non-profit organization that has recently merged with WildAid to combine the resources and operational capacities of both organizations to help protect endangered wildlife.

What Do They Do?

By creating sanctuaries and encouraging laws that prohibit trading shark fins, Shark Savers discourages the act of shark finning. The Shark Savers team works with community-based partners and helps them create outreach campaigns to grow community support for shark protection, including production of effective proposals to help establish legal protection for sharks.

Shark Savers know it is crucial to act quickly to protect remaining shark populations. Shark Savers has gained momentum for protecting sharks in many nations, and helped to establish multiple shark sanctuaries. In the United States, they led the charge on pushing measures to ban shark fin trades.

How Can I Get Involved?

Shark Savers offers a variety of ways to get involved, including signing petitions, volunteering in educational programs, or joining a shark counting network to track shark population at dive sites. Visit their website to learn more about their programs, or to get involved today.

Predators in Peril

Who Are They?

Predators in Peril work with three goals in mind: to draw attention to the plight of highly vulnerable shark and ray species, to provide images of undocumented species for conservation initiatives, and to channel support into productive conservation movements.

What Do They Do?

Predators in Peril works in the field with artisanal shark fisherman and scientists to get images and video of rare, endangered, and overlooked sharks and rays, using media to build awareness campaigns. Social media campaigns are useful for outreach and education, and creating awareness about the importance of shark populations in the ocean.

As we discussed earlier, many of these species are migratory, solitary, and poorly-understood, which makes conservation efforts more challenging. By using social media and publicity campaigns to share information, they can reach a large number of people in a short period of time.

How Can I Get Involved?

You can support the efforts of organizations like Predators in Peril by finding and sharing shark conservation awareness campaigns that you find in the news and on social media sites. Many images of shark finning operations are disturbing, but the strong visual impact can be more motivating than any written word.

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Academic Session 3 – Ocean Plastics

Lesson 3.1: What is Plastic?



Image © iStock/CasarsaGuru

Lesson Objectives

By the end of this lesson, you should be able to:

- Describe where plastic comes from, and how it is made
- List two early plastics used by humans and give two examples of how modern plastic has improved our lives
- List two major environmental costs of using plastic
- Describe the life-cycle of a plastic water bottle
- Describe the problem of single-use plastics and their disposal

"We're a thousand miles from anywhere, five days from land, right in the middle of the North Pacific Ocean. It starts when we spot a fragment, about the size of a 50 pence piece. Then, things we recognize. A toothbrush, a washing basket, a toilet seat, a garden chair. We begin to notice hundreds of fragments in between.

It gets to the point where a piece is floating past the hull every ten seconds. And when we get the trawl into the water to take a surface sample - handfuls of plastic come up, pieces we couldn't see on the water's surface; microplastics, smaller than our fingernails."

- Emily Penn, eXXpedition co-founder and expedition leader

What is Plastic?



Image © iStock/Irina Vodneva

Plastic is a man-made (synthetic or semi-synthetic) material. Its name comes from the Greek word "plastikos", which means "to mold" or shape. We use it everywhere: in our houses, factories, offices, our hospitals – even our clothes.

Plastic is lightweight and malleable, which means it can be shaped, cast, or pressed into lots of different and complex shapes. Because it has corrosion-resistant properties, it can be used in harsh environments (like water) that degrade other materials, and it has excellent thermal and electrical insulation properties.

How is it Made?

The raw materials of plastic are natural – it's made from organic materials such as crude oil, cellulose, coal, natural gas and salt. Most plastics start their life as crude oil, which is extracted from land or the sea bed using industrial rigs.

Using Oil to Make Plastic

It's impossible to make plastic from crude oil in its natural state, so the oil must be refined. Crude oil is a mixture of chemical substances called hydrocarbons: organic compounds of hydrogen and carbon. When oil is refined, these compounds are broken down using a process called "fractional distillation".

This process separates the liquid oil into other substances called "fractions". The hydrocarbon compounds break apart, causing some of the oil to evaporate into gas, and some to condense into other oils like diesel oil and kerosene. One of these substances, naphtha, is a flammable liquid that is the main raw material needed to make plastic.

Before plastic can be made, naphtha is processed into ethylene and propylene, which are refined even further through a process called polymerization. Polymerization creates long "polymer" chains, from which different plastics can be made depending on the size and structure of the polymers used.

There are two main plastic polymer groups: thermoplastics, and thermosets.

Thermoplastics

Thermoplastics will soften when heated and can be reshaped, hardening again when they cool.

Types of thermoplastics include nylon, acrylic and polystyrene. Often recyclable, they can be hard or soft, and are used for all sorts of products including clothing, bottles, signs, car lights, medical equipment, toys, and packaging.

Thermoset plastics

After they have been molded, thermoset plastics do not soften when heated.

Thermoset plastics are useful when heat resistance is needed. Usually non-recyclable, their uses include electrical fittings, hot water kettles, laminate surfaces and car tires.

The Plastic Timeline

Early Plastics from Natural Materials

Materials with plastic qualities have been around a long time, and early "plastic" actually came from natural materials.

Civilizations as far back as the Mayans used natural materials with plastic qualities such as gum, latex and shellac (resin from the lac insect) to create glues and rubber.

Records dating as early as the 1200s show that products such as natural horn and tortoiseshell were used for their plastic qualities: these were molded using heat and pressure into everyday items such as combs, beakers, buttons, drinking vessels and musical instruments.

As time went on, humans learned how to modify organic materials with naturally occurring chemicals to create the first semi-synthetic plastics like rubber, nitrocellulose, collagen and galalite: the building blocks of the plastics we use today.

The Beginnings of Synthetic Plastics: the 1800s

Serious development of early plastics began in the 19th century, when scientists began to chemically modify natural materials. In 1820s Britain, the first rubber raincoats were made, and in 1850 the first submarine cable was laid in the Channel between England and France using "gutta percha" (a kind of natural latex).

Midway through the century, scientists discovered how to make synthetic plastics. In 1855, the first man-made plastic was invented by Alexander Parkes in Birmingham, England, and was named "Parkesine". It looked like ivory, and hardened into a transparent and elastic material when heated. A few years later in 1872, American John Hyatt modified Parkesine into "celluloid", and invented the first injection molding machine.

As the century continued, more synthetic plastics were developed. Polyvinyl chloride (PVC) (the material that many of our modern window and door frames are made of) was accidentally created by German chemist Eugen Baumann in 1872. The first photographic film roll was produced in 1885, and viscose silk (rayon) appeared in 1892.

The Plastic Revolution: the 20th Century

The 1900s was the plastic revolution, and plastics began to appear in people's homes in the first part of the century. In 1907, American-Belgian chemist Leo Baekeland invented "Bakelite", the first plastic that was produced for the masses. Bakelite products were everywhere – radios, telephones, kitchenware, toys, even firearms – and their production set off a chain reaction of developments and discoveries that bring us to where we are today.

20th Century Inventions

- Viscose stockings manufactured in Germany (1910)
- Commercial production of polystyrene in Germany (1937)
- Nylon mass-produced in the USA (1938)
- "Tupperware" turn up in homes and kitchens, helping food last longer (1949)
- The fashion and textiles industry is revolutionized by non-drip polyester fibers (1950s)
- The polythene bag keeps products dry (1950s)
- Polystyrene foam is invented by Dow Chemical Company (1954)
- Children begin building with "Lego" (1958)
- "Barbie" is introduced at the American International Toy Fair (1959)
- Neil Armstrong plants a nylon flag on the moon (1969)
- The first portable mobile telephones appear (1979)
- The first artificial heart is given to a human (1982)
- The Dyson vacuum cleaner is marketed in Japan (1991)



Image © iStock/WestLight

The 21st Century

Plastic product use has exploded in the 21st century. Since 2000, we have created more plastic items than the previous two centuries combined!

Plastics have revolutionized our lifestyles. The 21st century has seen the development of nanotechnology, which has allowed us to create lightweight and affordable computers, and connected the world in a way it has never been before.

We have created the iPod, plastic commercial airplanes, bulletproof plastic, plastic blood, plastic solar cells, 3D printed body parts, LED plastic screens – and continue to make more discoveries and inventions every year.

Plastics and the Dive Industry

Plastics have also revolutionized the dive industry, making diving cheaper and more accessible to recreational divers. After the development of the diving bell, early modern divers used metal helmets (usually copper and brass) with glass portholes and bulky canvas suits connected to the surface with an air hose. These suits were heavy, and difficult to move around in or see from. The invention of plastics promoted recreational scuba diving by making scuba systems cheaper, safer, and more lightweight.

If you are a diver, take a look at your diving equipment. Apart from your air cylinders, almost every part of your equipment contains or is made of some kind of plastic – your mask, fins, regulator, buoyancy compensator and wetsuit, and probably any accessories you might use, too.

How We Use Plastic



Image © iStock/vchal

It is so versatile, that humans use plastic for almost everything.

We make it into boxes, bottles, films, plates and fibers. We integrate it with other materials such as electrical circuits and glass. Every day, we clothe ourselves with plastic fibers; it transports us, protects our houses and buildings, packages our food, houses our smart phones and televisions, helps us farm, and saves our lives with sterile and cheap medical equipment. In many ways it has improved our lives, making them cleaner, safer, cheaper and more fun.

However, using plastic has costs, and we're only just beginning to understand the implications of what they might mean for us.

Mining for Materials

For most plastic manufacturing, the materials used are derived from fossil hydrocarbons. This means that to get to them we need to use processes like drilling, fracking and mining. Each of these has an environmental cost, both on land and in the ocean.

Nowhere to Go

Plastic's synthetic nature means that it is virtually impossible to dispose of. Most plastics are not biodegradable, so the majority of plastic, even if it is initially recycled, ends up as garbage when it reaches the end of its useful life.

Recent estimates have stated that over 8 billion metric tons of plastic have been created by humans. Of that amount, about 2 billion tons are still in use. That means that the rest – over 6 billion tons – has already become waste.

So what's happened to it?

About 12 percent of the plastic waste has been incinerated, 9 percent has been recycled, and the rest – 79 percent – has ended up in landfill, or the natural environment.

Scientists think that if we continue producing plastic and fail to deal with the waste it produces, humans could be dealing with over 12 billion metric tons of plastic waste by 2050.

Scope of the Issue



Image © iStock/PhotoBylove

Plastic is everywhere. It's in every town and every city in the world. Every person on the planet consumes about an average of about 88 pounds of plastic each year, and if you live in North America or Western Europe, that figure rises to an average of over 220 pounds per person.

Plastic is now so much a part of our everyday lives that we rely on it for almost everything we do. While many of the plastics we use have a long-term benefit, too many of them are manufactured for short-term use: in the name of convenience, humans have created a throwaway society.

Single-Use Plastics

Estimates suggest that, of the 300 million tons of plastic that is produced globally every year, around 40-50 percent is manufactured to produce items that are used only once.

The largest market in plastics is for packaging: single-use containers for food and other products. These are items which are typically only used a few times at most, and have a "life" of an average of less than six months.

Think about the food packages you bought at the grocery store, and the plastic bag you may have carried them home in. That bag has an average life of about 15 minutes.

How Do We Get Rid of It?

Disposal

Without the benefit of history to show us, scientists think that most plastic would take centuries to degrade, and at the moment we have only a few options on what to do with it.

How we dispose of plastic depends on a lot of factors, and – if the money and incentive exists – many of these factors are within our power to change. Think about where you live. Do you have places where you can easily recycle plastic? Do you have the right information about what plastic can be recycled, and what must be thrown away?

Whether a community has access to proper disposal facilities can depend on whether it has the mechanisms and funds to dispose of them, whether programs to educate the public are sufficiently strong, and whether governments prioritize its correct disposal.

Recycling - Delaying Disposal

Only the smallest proportion of plastics are recycled (about 9 percent). However, even when it is recycled, the problem of its existence is not actually being dealt with. Recycling means that a plastic is reused or melted down to process it into another (plastic) product.

Because of various factors – including the plastic's chemical makeup, contamination, appropriate facilities, public knowledge or ignorance, and cost – not all plastics can be recycled.

Recycling never actually disposes of an item, it just delays its journey toward its final resting place: destruction, landfill, or dumping.

Thermal Destruction

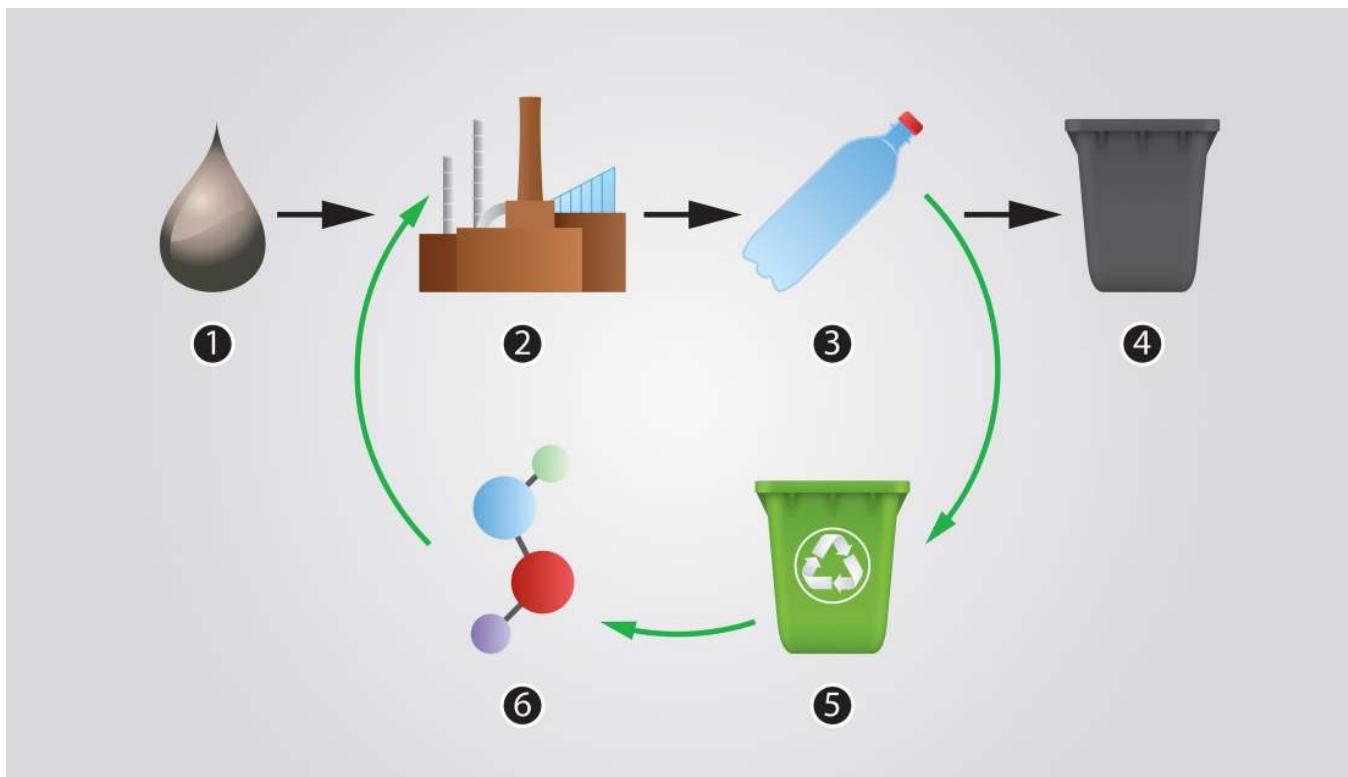
The 12 percent of plastics that are destroyed are incinerated at extremely high temperatures.

Incineration can contribute to environmental problems by contributing to greenhouse gases and causing pollution. There are some incinerators – usually those built with more modern technology and well-funded – that can limit the environmental impact of the toxic waste produced by burning plastic, even turning some of the process into new energy.

What Happens to the Rest?

The vast majority of plastics – about 79 percent – end up in landfill, uncovered dumps, or in our natural environment.

Life Cycle of a Plastic Water Bottle



Life Cycle of a Plastic Water Bottle: 1. Crude oil is extracted 2. Refined oil is turned into plastic 3. Plastic is heated and shaped into a bottle 4. The used bottle is thrown away 5. The used bottle is recycled 6. Bottle will be turned into something new

Image © SSI, Shutterstock/hobbit

1. Crude oil is extracted from the earth or sea bed
2. The oil is processed to create chemicals ready to make plastic
3. The refined oil is turned into plastic pellets
4. The plastic is heated and shaped into a bottle
5. The bottle is transported to the factory to be filled
6. The filled bottle is transported to a retail outlet
7. The filled bottle is consumed
8. The used bottle is either thrown away or recycled

Recycled bottles can be re-purposed into other plastic items, which will eventually end up in landfill or be incinerated at the end of their useful life.

Littered bottles which are not cleared up by waste organizations will end up polluting communities, countryside and rivers, eventually ending up in the ocean.

The Plastic Problem



Image © iStock/lindsay_imagery

Plastic is ending up in the ocean in record amounts, with single-use plastics playing a huge part of the problem.

It is estimated that there is already about 150 million metric tons of plastic waste in our oceans, and that every year, another eight (8) to 12 million tons of plastic garbage is added, making its way from our land and rivers – into our oceans.

Weather and currents sweep plastic waste in the oceans to every imaginable resting place. Plastic is now on the beaches of uninhabited islands, and on the sea floor in the deepest parts of our ocean. It litters paradise locations, and strangles marine life. It lines the stomachs of sea creatures – from the tiniest critters to the largest mammals. It's found in our seafood.

Plastic waste in the ocean is a problem... A big one.

Academic Session 3 – Ocean Plastics

Lesson 3.2: Threats and Challenges



Image © iStock/Placebo365

Lesson Objectives

By the end of this lesson, you should be able to:

- List two remote areas that plastic has been found in the ocean
- Describe how plastic gets into the ocean and is transported within it
- List five plastic items commonly found on beaches
- Describe what happens to plastic when it is in the ocean
- List two major effects of plastic on marine life
- Describe an effect of plastic on the environment
- Describe the potential effects of plastic on humans in the future

The Global Presence of Plastic



Image © iStock/johny007pan

Plastic has been found in every ocean basin, from the north pole to the south.

A single-use plastic bag, like the bags commonly used at grocery stores, was found at 35,755 feet at Challenger Deep in the Mariana trench in the western Pacific Ocean – the deepest known point on Earth. The expedition found a huge amount of plastic garbage (including single-use items) settled on the ocean floor, some with marine life entangled in it, and as some that had become habitat for other creatures.

The same study took a sample of marine organisms to look at how they might be being affected, and found that 100 percent of them were found to have ingested microplastics.

Environmental charity Ocean Conservancy thinks that by 2040, there could be over 250 million tons of plastic in our seas.

Movement of Plastics

Henderson Island is an uninhabited island in the middle of the remote South Pacific. It is 125 miles from the nearest population, and home to species of plants and birds that can be found nowhere else on Earth. It is also overrun with garbage, and has the highest density of plastic waste in the world.

Plastic items studied on the island have come from as far away as Russia, New Zealand, Asia, South America, and Europe. So why is Henderson Island collecting all this garbage?

It is in the middle of an ocean gyre - a series of surface ocean currents driven by wind and the Earth's rotation - and these currents pull and push the plastic on to the island.

Currents and Gyres

A "current" describes the motion of water in the ocean or other bodies of water. Ocean currents can occur through water density differences, winds, and tides.

Almost 90 percent of the world's currents are made up of deep ocean currents. Deep ocean currents occur when gravity causes cold and heavier or more salty water to sink, and it is replaced by less salty warm water. These changes in water density are known as thermohaline circulation.

Surface ocean currents are driven by wind moving the surface of the ocean. These are known as gyres, and they form huge circular patterns across both of the Earth's hemispheres. There are five commonly known ocean gyres: the Indian Ocean, The North and South Atlantic, and the North and South Pacific.

Gyres carry heat across the Earth and can affect water temperature. They also carry garbage, and once it's in the gyre, it becomes trapped within the circular current.

Where Does it Come From?



Image © iStock/tonyoquias

Some plastic waste may come from accidental dumping during shipping, but the majority of plastic waste originates from land and rivers. Helped by rain, snow, wind, and weather events like typhoons that cause flooding, this garbage travels from deep inland out to sea.

It's estimated that 90 percent of the garbage that litters our oceans comes from only ten rivers in Africa, South and East Asia. The Yangtze River in China (the world's third longest river at nearly 2,485 miles) is responsible for twice as much waste than the rest combined, conducting nearly 1,500,000 tons of garbage into the sea every year.

What Is In Plastic Waste?

The waste that ends up in our oceans and on our beaches is a mix of items, including residential and commercial litter, industrial waste and sewage.

A 2017 study by the Marine Conservation Society of 339 beaches across the United Kingdom found plastic cutlery, drinking straws, food trays, bottles, synthetic wipes, cotton swabs, medical syringes, TVs, car tires, nylon cord, caps, lids, film packets, cigarette ends, fishing line, and broken pieces of polystyrene and plastic known as microplastics - a picture that is reflected by other environmental studies across the world.

While microplastics are tiny, even harder to see is the presence of tiny synthetic fibers that are now increasingly found contaminating our water systems – including our drinking water.

How Does it Get There?

It seems like an obvious statement, but people are responsible for the presence of plastic waste in our oceans, which arrives accidentally or through deliberate dumping.

Trash from Individuals

With such a cheap way of packaging products, and with consumers attracted to conveniences like food lasting a lot longer, it's not surprising that manufacturers have turned to plastic for packaging.

Sometimes, disposing of waste has a financial cost for a consumer. If domestic facilities don't exist for taking away your old TV, an irresponsible person may decide that dumping it somewhere on the road is a better option for them than paying a waste company to pick it up.

Some people know where they should be putting their garbage, but litter it anyway – they'll throw a plastic bottle out of the car window, because it's of no value now it's used, and they don't have to deal with the consequences of what happens to it. In the Mediterranean, tourism has been identified as a major source of plastic waste.

Waste from Businesses and Industry

Government, industrial and business organizations also have a responsibility to appropriately dispose of waste.

Irresponsible businesses may dump their waste in the sea or in water systems for convenience or to avoid paying fees and taxes for disposal. Shipping and fisheries have been identified as contributing to significant amounts of plastic in the Southern North Sea and in the water around East Asia.

Government

As you might expect, there is a link between urban and densely populated areas and the amount of plastic waste that comes from them. A lot of waste can be attributed to a lack of awareness, but this is often compounded by a lack of choice in disposal systems.

In affluent areas where local governments have waste facilities for the public and for businesses, people may be able to make use of recycling programs and return schemes – when they know those programs exist.

In poorer places, people don't necessarily have the benefit of such facilities in the first place, and if they do, they may not know about them – or why they should be using them. The same often happens on islands, where waste ends up being burnt in open dumps – or dumped in the ocean.

What Happens Next?

Decomposition

While plastic can degrade over time, the majority of plastics produced for mass consumption do not biodegrade. Plastic hasn't been around long enough to test the theory, but depending on the type of plastic, scientists estimate that it could take hundreds of years for plastic to degrade from its original form. This means that fishing line discarded from a boat could float around in the ocean for up to 600 years.

Microplastics



Image © Sustainable Coastlines

Large plastic items are easily seen, but the presence of plastic isn't always obvious.

Although plastic doesn't decompose, it degrades in other ways. When plastic is immersed in the ocean and rivers, over time sunlight, bacteria and water movement causes it to break down into tiny particles a few millimeters long (and some even smaller than that). These particles are known as microplastics.

Microplastics float around on the surface, sink, or are washed on to shore. A 2018 report by National Geographic recorded that on the Big Island of Hawaii, "as much as 15 percent of the sand is actually grains of microplastic".

The impact of microplastics on the environment around us is only just becoming understood.

Effects on Marine Life



Image © iStock/gemredding

Plastic and Marine Animals

The impact plastic waste has on our marine life is now firmly in the public eye. Over the past few years, there has been outcry across the world on social media about stories that have disturbed us – from images of seahorses attached to cotton swabs to a video of a turtle with a plastic straw being pulled painfully out of its nose.

The impact microplastics has on marine life is less visible. Environmental charity Ocean Conservancy reports that plastic particles have been found in 59 percent of sea birds and 100 percent of turtles studied around the world.

National Geographic records that nearly 700 species of animal have been affected in some way by the presence of plastic waste.

Plastic as a Food Source

Studies on the behavior of tiny amphipods in the Mariana Trench found that they actively consumed plastic particles. Having a high fat content, amphipods are a popular food source for other species – so microplastic particles travel from one animal to the next until they reach the top of the food chain.

Plastic itself becomes a mistaken food source for sea birds, and for animals as tiny as plankton up to the largest whale. Studies of albatross have found adults feeding their chicks with plastic pieces, and one whale in Thailand was found to have died after consuming 80 plastic bags.

Little is known about how the chemicals in microplastics affect marine life, but on a basic level the consumption of plastic on larger animals is clear: it causes starvation, blocking animals' digestive systems and tricking them into thinking they have eaten food.

Habitat Destruction

Plastic waste in the ocean creates a toxic habitat for marine life. Toxic chemicals leach from the plastic into the water, plastic particles transport alien species to areas they would not otherwise inhabit, animals become entangled in ghost fishing nets, and insects lay their eggs on plastic particles out in the open ocean.

On a microscopic level, coral polyps have been seen to consume microplastics in the same way as they would consume zooplankton. The effect that this may be having on coral reefs and the wider ecosystems they support is not yet understood.

Tourism

For most people, the visible impact of plastic waste is most evident on the immediate environment around us.

Tourists visiting coastal destinations see first-hand how ocean waste can litter waterfronts and marinas. Plastic bottles wash up on beaches, and if visitors look closely, in some places they will see evidence of microplastics in the sand. Volunteer beach cleaners trying to tackle the problem regularly pick up unsanitary garbage, but they are only dealing with the end of the chain, not the source.

Plastic waste is not just unpleasant for holiday makers – it has a real cost on local economies who may rely on tourism. People do not want to swim in seas full of garbage, and if an area is seen to be polluted, they will stop visiting.

Paradise Lost

Many islands have few options for what to do with their garbage.

The Maldives is a paradise with gorgeous beaches and blue waters, chosen by many vacationers as a once-in-a-lifetime destination. But: it has a dark side, and one that most tourists will not see. As visitors increased in the 1990s, garbage began to increase as well. Each tourist created an estimated 8 pounds of garbage per day – and it had nowhere to go.

To deal with the problem, the Maldives government created an artificial island called Thilafushi, which today receives an estimated 330 tons of garbage, every day that is dumped and burned – and, with queues of boatmen waiting to unload their garbage – often ends up in the ocean.

The Economic Impact

Although the cost of a plastic item may be initially cheap, the impact has a long-term financial impact on humans. Local governments are having to spend more to deal with the waste problem, and more and more resources are now needed to deal with the growing problem of plastic waste in our oceans.

Pioneering manufacturers are looking to alternative sources such as bamboo, rice and other plant-based materials that might be used in place of synthetic materials, but the funding for this is small, and

until such items become cheaply available to mainstream consumers, they will remain the luxury of the better-off.

Food Sources



Image © iStock/AlexRaths

The ocean is critical as a food source for human beings, and as populations rise, more pressure will be put on seafood to provide nourishment. However, studies on seafood are identifying the presence of things that humans probably really don't want to eat.

A 2016 report by Brunel University and the University of Hull found that in samples of mussels taken from United Kingdom waters and supermarkets, 100 percent of them contained microplastics. Another study found that it was possible that frequent consumers of shellfish in Europe might find themselves ingesting around 11,000 pieces of microplastic every year.

Removing seafood as a food source for humans would have a huge impact on a world with a growing and hungry population. We don't know much about how much plastic passes from seafood to humans, nor about how the toxic chemicals they contain could affect us.

But with plastic now found in 25 percent of fish sampled from seafood markets globally, are we really sure we want to wait around to find out?

Academic Session 3 – Ocean Plastics

Lesson 3.3: The Good News

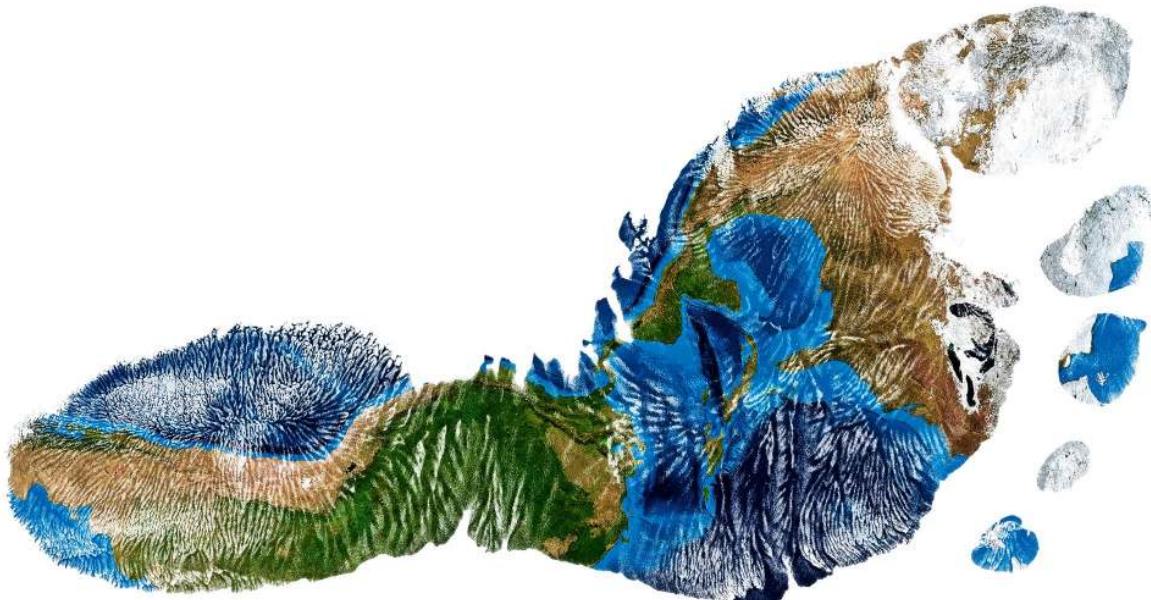


Image © iStock/Creativemarc

Lesson Objectives

By the end of this lesson, you should be able to:

- Explain how raising awareness is starting to highlight the problem
- Describe what governments and businesses are doing to tackle the issues of plastic pollution
- Explain how bans and levies could help have an effect on the plastic problem
- List four alternatives to plastic that are being used or developed
- Describe how the circular economy can improve the management of waste before a product is made

What We Are Doing Right

The monumental mess that plastics have made of our oceans may seem like an insurmountable problem. But across the world, people are starting to act, and there is actually a lot to be positive about.



Image © Sustainable Coastlines

Raising Awareness: Acknowledging the Problem

Environmental campaigners, social media, news, and documentaries like the BBC's Blue Planet II have brought the plight of the oceans from being a distant idea to a reality in our living rooms. People are ready for change, and perhaps for the first-time, consumers are demonstrating that they are willing to change their shopping habits – maybe even spend more – to reduce their plastic waste.

Retailers and manufacturers are at a critical time in choosing how they will deal with the problem, and how they will respond to the increasingly environmentally concerned views of their consumers. Huge corporations that produce hundreds and thousands of plastic products every year are now looking at how they can increase rates of recycling and – more crucially – how they can produce more environmentally-sustainable products and reduce their reliance on plastic.

There are a multitude of charitable organizations, foundations and campaigns whose sole purpose is to educate and effect positive change. Environmental campaigners and non-government organizations (NGOs) across the world like the Ocean Conservancy, Plastic Change, Oceana and the Marine Conservation Society, as well as many others, work across communities to help raise awareness on the problems faced by our oceans.

They are lobbying governments for appropriate legislation, working with business and the fishing industry, and engaging the public through education programs, campaigns and activities like wildlife surveys and national beach cleans.

So, What's Changing?

The problem of plastic waste is now firmly in our view. There are better and increased recycling options, and across the board, a raised awareness, better education, and changes in governments, businesses and individuals' behavior is resulting in positive changes.

Top Down Change

Government Policy

Governments across the world are realizing that they need to create laws to regulate and reduce the use of plastic. A 2018 report by the World Economic Forum concluded that governments need to improve almost everything to do with the plastic problem.

This means improving waste management practices, motivating consumers, retailers and manufacturers to change their habits, better education and engagement with everyone from the individual to the largest business, and finding a way to promote a sustainable model of designing and producing plastics.

But policy changes take time and governments move slowly. Some legal changes are already in place, some have a future deadline, and many are still under consideration by government committees across the world.

Action on Plastic Products

Historically, a lot of countries have exported their garbage. But countries like China, who previously imported 7.3 million tons of garbage from countries like the US, Japan and the United Kingdom, are now refusing to take "foreign garbage", and nations are under extra pressure to take responsibility for their own waste.

An obvious way for governments to effect change is by putting rules in place that charge levies on the use of plastic, or ban it outright. Around 60 countries have now introduced some kind of ban or levy to try and tackle the plastic problem.

Amongst the many single use plastics that cause problems, a single range of products has been identified worldwide as being a huge problem: plastic bags.

Bans for Single Use Plastic Bags



Image © iStock/clu

Plastic bags – the same ones found at the bottom of the deepest part of the world's ocean – are used in huge numbers across the world for packaging and carrying all kinds of products. It's estimated that between one and five trillion plastic bags are consumed annually across the world – that's over two million used every minute.

Countries all over the world are acknowledging the problems their disposal is causing, and are putting bans in place to curb their use. Africa is leading the way with the largest number of countries banning plastic bags: between 2014 and 2017, over 50% of countries introduced or pledged to introduce a ban.

In Europe, Italy and France have agreed to implementing plastic bag bans, with other countries pledging to curb their use. Australia has banned the use of lightweight plastic bags. Lightweight plastic bags are now banned in Montreal and the American states of California and Hawaii.

India – the fastest growing economy in the world – has promised to ban the use of all single use plastic (not just bags) by 2022.

Where bans are not in place, many countries have introduced levies to try and reduce their use.

Taking Action For Other Products

It's not just plastic bags that need to be addressed – many other plastic products also cause problems.

Deposit return schemes for things like plastic bottles are in place in some countries and being considered by others, and some governments have said they would like to see entire plastic-free aisles in supermarkets in the future.

Microbeads used in cosmetic products (typically for their exfoliating effects) and medical supplies have also been targeted. Since 2015, an increasing number of US states along with countries like New Zealand, the United Kingdom, Sweden and India, among others, have banned (or are in the process of banning) the use of microbeads.

Plastic straws are in the spotlight too. In 2018, Seattle became the first city in the United States to completely ban the use of plastic straws and plastic cutlery, and Scotland has pledged to ban them by the end of 2019.

The European Union has pledged to ban all single use plastic products by 2021, and reduce plastics where there is no alternative material by 25% by 2025.

Businesses Shaping the Future

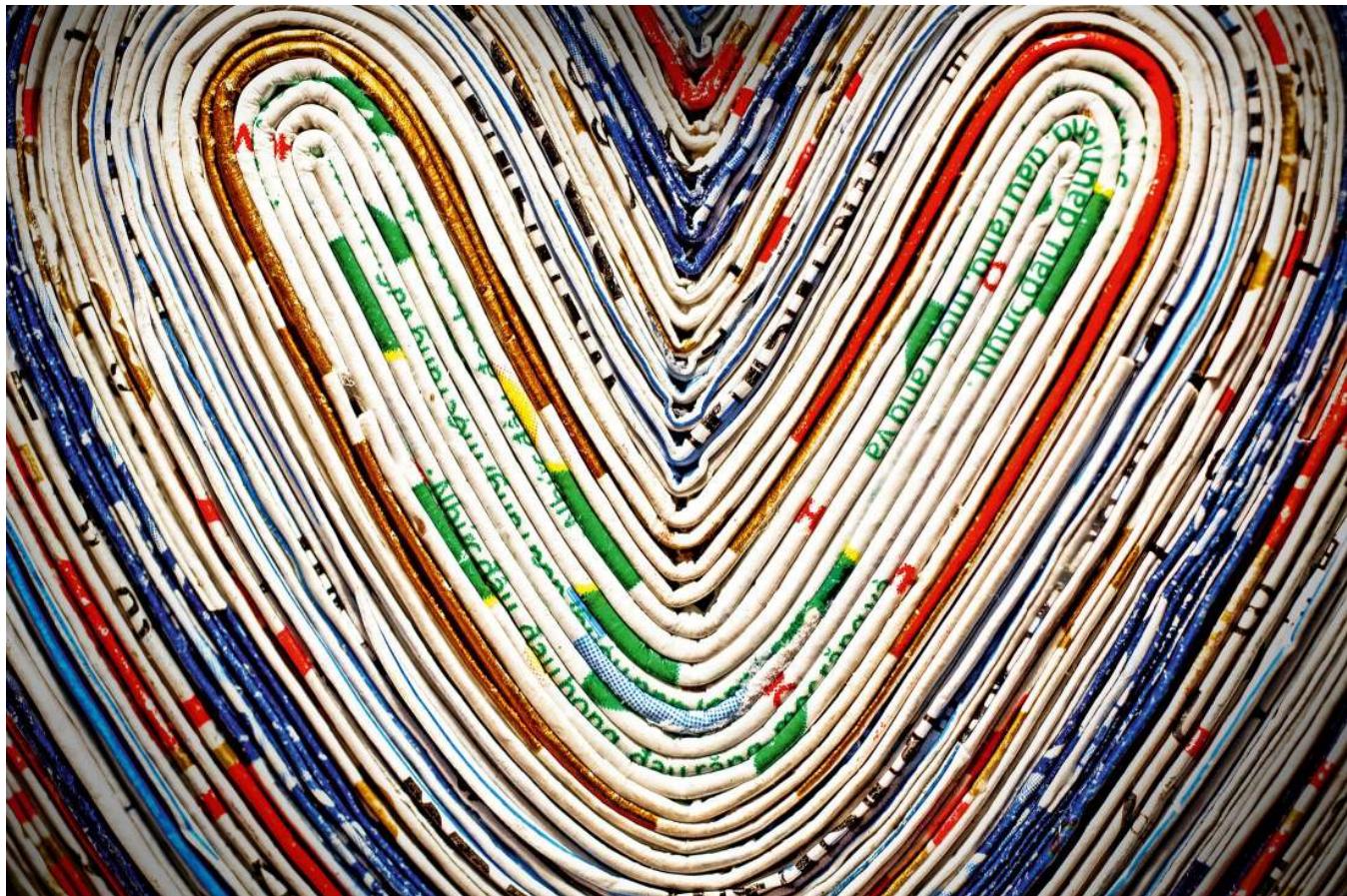


Image © iStock/Karl-Friedrich Hohl

Government policies don't achieve much if corporations and businesses aren't behind them. Making change is time-consuming and expensive, and it's not surprising that lots of businesses are resistant to change.

Some governments are giving businesses time to make voluntary changes before turning their recommendations into law. Businesses are being asked to look at how they can improve the sustainability of their products, and many companies now being asked to contribute funding towards the recycling of packaging that they produce.

Luckily, a few big corporations are leading the way and demonstrating that they're willing to start making changes. Many businesses have followed public mood (and impending government legislation) and taken steps to look at how they can reduce their reliance on plastic.

Some drinks manufacturers have committed to getting rid of unnecessary plastic, such as film sleeves around drinks bottles and the plastic rings keeping drinks cans together. Restaurants, cafes and shops are increasingly banning plastic straws, and huge providers of these items like airlines and theme parks are now announcing bans of single use plastic items.

How This Helps

The scale of the problem, and the effect it is having on local economies and the environment, is a huge incentive for us to clean up, but global acknowledgment of the plastic problem is only just becoming mainstream. While some countries acted early on, others are still figuring out what policies they need to tackle the issue.

Hope for Bans and Levies

A 2018 United Nations Environment report shows that in the countries that have adopted environmental policies on dealing with plastic bags (such as levies or bans), there is not much information yet on how those policies are doing.

Reports on those countries estimate that about half of them have only recently put plastic waste policies in place, or that they don't have robust enough reporting to work out what's actually been working.

The positive news is, where we do have data, it shows that legislation on plastic bag bans and levies is starting to have some effect.

Of the other half of countries that have been working on the problem, about 30 percent of them have seen a big drop in use.

Levies in Action

Since October 2015, there has been a small charge in England for the use of all single-use plastic bags in large retail stores. Government data for the following year found that at the end of 2016, the levy had resulted in a drop of usage of these bags by 83 percent. It didn't remove the use of bags completely – over 2 billion were still sold – but the tax was enough to make consumers stop and think: do I really need this today?

Bans Making A Difference

In 2016 the state of California in the United States voted to ban single use plastic bags, taking their distribution across the region from 19 billion down to zero.

Every fall, tens of thousands of people take part in "Coastal Cleanup Day", picking up litter from coastlines and from the surface and from under the water. Volunteers collectively cover thousands of miles, and collect thousands of pounds in weight of waste - in 2010 collecting over 65,000 plastic bags.

After the ban took effect, the following year's clean up noticed a difference: the litter collected showed that there had been a 66 percent drop in the collection of plastic bags.

Alternative Options to Plastic

Retailers are seeing that consumers are increasingly asking for alternatives to plastic, and that it might even be a positive sales opportunity for them if they can fill a gap in the market by meeting that need.

Manufacturers and researchers are turning to other materials, and while they may currently be more expensive options, they will become more cost-effective the more people that use them.

- Glass bottles are easily reusable and recyclable.
- Canvas and cotton can be used to create strong carrier bags.
- Bamboo is being used to create fabrics, and as an alternative for household products such as toothbrushes.
- Milk protein is being explored for its potential to aid in the production of a biodegradable plastic.
- Instead of looking for ways to dispose of them, scientists have discovered that the keratin in chicken feathers has properties that mean it can potentially create a biodegradable plastic.
- Byproducts from paper mills are being researched for ways to make bio-plastics known as "liquid wood".



Image © SSI

The Circular Economy

There is also more attention being given to the idea of a "circular economy", which aims to improve the management of waste before a product is even made. This has the dual benefit of being environmentally-sustainable as well as economically beneficial for businesses.

Increasing the options and quality of recycling is extremely important, but reducing the use of plastic and the impact of manufacturing is crucial if we are to solve the problem. The circular economy aims to:

- Use fewer raw materials at the beginning of production.
- Design products to last longer and to be more easily recycled.
- Use less energy to manufacture them.
- Improve choices made by consumers, and encourage retailers to extend a product's life by offering refurbishments and repairs.
- Make producers responsible for packaging and recovering reusable materials when a product is disposed of.
- Improve waste management systems, aiming for more product materials to be used again, and the least amount possible being discarded as waste.

Academic Session 3 – Ocean Plastics

Lesson 3.4: How You Can Help



Image © iStock/SolStock

Lesson Objectives

By the end of this lesson, you should be able to:

- Describe at least one way to make a difference as an individual
- Explain how your community or SSI Training Center can help minimize plastic waste
- Describe how to get involved in ocean plastic reduction at a higher or national level

How Can You Make a Difference?

With a wave of plastic waste in front of your eyes, it can be hard sometimes to see how you could change the tide. But if everyone played their part, we could make a big difference. At the simplest level, plastic use is a personal decision that can lead to large positive changes.

Consider the Bigger Picture

Take a look at how you live your life. Are there things that you could change right now to improve what you do with your garbage? Think about your daily routine, and challenge it.

Do an audit of the items you use at home:

- What is in your garbage can?
- What can you do to reduce what you put in there?
- Is there anything you do not need?
- What could you change?

Look outside of yourself too. Can you volunteer for a local charity, or help with cleanups or campaigns with your local dive center? Don't just assume that litter on the street will be picked up – pick it up and put it in a garbage can. And always take your own garbage home with you.

Minimize Personal Plastic Use

Increasing the amount of plastic you recycle may seem like the best solution. Recycling is a great first step, but it does not address the larger problem of plastic creation.

Reducing what you use is the first step to consuming less plastic. Here are a few ideas to get started:

- Stop using single use plastic bags. Get a small bag you can easily store in your purse or backpack, and carry this with you every day for any purchases.
- Stop using plastic drinks bottles or cups. Buy a reusable one and refill it from taps and fountains.
- Choose items with less packaging. If you buy loose vegetables or groceries, do not use a disposable plastic bag to pack them – use a paper bag or take your own.
- Can't do anything until you have had your daily coffee? Stop using disposable cups and take your own coffee cup to the store – some places will even give you a discount.
- Get refills of products where you can instead of buying a new container. Some zero-waste stores will sell you items without packaging. Take your own bottle and refill your detergent!
- Store and save food in reusable containers. Make lunch and take it with you instead of buying it in a plastic box.
- Do not buy cosmetics or personal care products that contain plastic microbeads.

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OUR PHILOSOPHY

BE A RESPONSIBLE DIVER AND HELP PROTECT OUR OCEANS

WE PROTECT THE ENVIRONMENT

WE MONITOR OUR DIVE SITES

WE USE ENERGY RESPONSIBLY AND MINIMIZE OUR WASTE

WE PREVENT WASTE FROM ENTERING THE WATER

WE AVOID ACTIONS THAT HARM THE OCEAN AND ITS INHABITANTS

WE DO NOT FEED, TOUCH OR HARASS ANY UNDERWATER LIFE

WE COLLECT OCEAN WASTE, LOST NETS, AND DEBRIS

WE PARTICIPATE IN CLEANUPS

WE FOLLOW THE PHILOSOPHY AND TOURISM GUIDELINES

WE EDUCATE AND MOTIVATE OTHERS

Image © SSI

Recycle What You Can

It's inevitable that there are some things you need to dispose of, and wherever possible you should use the recycling options available to you. Not every place in a country may offer the same recycling options as others, and some public authorities are better at explaining your options than others.

Good recycling means being informed about what you can recycle. Just because something has a recycling symbol on it, this does not guarantee you can recycle it. You may not have a local recycling facility, or the local facility may not be able to process some types of plastic.

Take the time to find out what you can do with your waste. If you don't properly sort your recycling, you may "contaminate" the whole batch – meaning the whole lot goes to landfill.

Say No to Unwanted Plastics

We do not always choose to use plastic. Ordering a drink in a restaurant often means it comes with a straw. It is perfectly OK for you to tell people that you do not want a straw.

- Say no to straws in your drinks, and if asked, explain why you choose not to use one.
- Say no if offered a plastic bag when shopping – you have brought your own.
- Tell shops you do not want their packaging, and ask them to dispose of it for you.

Change at the Community Level



Image © Sustainable Coastlines

Your local SSI Training Center or community may already be running education or awareness campaigns. If you want to get involved in something local, ask to see what others are already doing, and if there is anything they might need help with.

Support Local Initiatives

Many organizations run campaigns on local issues. You can get involved in these by sharing news on social media, getting involved with events, and supporting them through fundraising activities.

Try researching what's going on in your local area and seeing if there are any campaigns you can follow or help with. You might be surprised at the amount of work already being done!

Litter Collection and Beach Clean-Ups

Among many other practical activities, litter collection events (and beach clean-ups, if you live near the coast) are great ways of getting involved with your local community, and provide real and useful help by helping to clear up your "back yard".

It is a great way to highlight to your local area how well (or badly) they might be doing with managing their waste – and potentially a fun way to make friends too!

Find the Simple Fixes

Community change does not have to be a long or complex process. Look for simple solutions that can have wide-ranging benefits to your community. The following story is a perfect example of a simple solution that benefited the business, the community, and the environment.

Making a Difference: Dive BVI

How Dive BVI Reduced Their Water Waste

Jeff McNutt arrived in Virgin Gorda, the third largest of the British Virgin Islands, in 2003 with a bag of dive gear, a lot of energy, and a desire to do more with his life.

Jeff is the Director of Special Operations with Dive BVI, who run scuba programs and excursions from locations across the British Virgin Islands, and he's very familiar with the problem islands face in properly disposing of waste.

Identifying the Problem

"Everything we have on the island has to be shipped or flown in," Jeff says. "Everything." And when those items are done with, there's not many places for the waste to go.

The BVI has a problem with waste disposal, with much of its waste regularly being burned in open dumps across the islands. "The only waste removal was an open pit on the side of the mountain, where it was all burned."

Along with many island residents, Jeff was concerned about the negative effects of burning waste and the resulting pollution it causes, and looked at ways that his business could make changes to reduce the amount of waste they were producing.

"One of the biggest ways we made a change was in how we dealt with water."

Previously, the dive center bought drinking water for their dive boats from a distributor on the island. This water would be delivered in six plastic gallon jugs per box, coming in 20 boxes at a time. Staff would take these jugs out of the boxes, and try to figure out how to store 120 plastic jugs in their limited space in the dive shed, after which the boxes would be knocked flat and taken to a dumpster for disposal.

When the dumpster was full (or, most likely, overflowing), it would be driven up to the garbage pit and the waste burned. Jeff was also concerned about how it was affecting his business. "I thought this was a giant waste of time, money and resources."

Finding Solutions

Jeff thought about how he could reduce the impact and cost of the water problem. "Our first attempt," Jeff describes in reflecting on how he tried to tackle the problem, "was to get five-gallon jugs (like office water coolers) and refill them at local machines. We'd haul down our gas cylinder carts with four of these jugs at a time, and pay \$4 for five gallons of water."

It took an hour each day to transport this water and pour it into the sterilized water coolers on the boats, and removed an employee from duties on the dive boat or the shop.

While the process was initially time and labor intensive, Jeff began to see the positives of making these changes.

"We immediately realized a cost saving and tremendously reduced our waste production."

All the plastic jugs were reused, and they started using a dedicated ice bucket to obtain ice from the marina, cutting down on an average of six plastic bags of ice that were used every morning for boat excursions.

While Jeff was pleased with the first results of the changes, he felt they could do more to improve things. Virgin Gorda uses a process called reverse osmosis to turn salt water into drinking water, so they installed an additional water filtration system to enable them to fill their own water jugs without having to visit the community water sources.

Recognizing the Benefits

The new system reduced their cost per gallon even more, and cut down the labor time. "We don't have long waits to fill jugs," Jeff says, and there's "no more lugging 20 gallons of water (weighing 8 pounds per gallon), and no waste going into the dumpster!"

They've even got their dive shed storage space back, although he says "we do still keep a few full jugs to cover the times that the public water supply is not available."

As well as demonstrating corporate social responsibility as a business, Jeff also encourages his customers to dive by the SSI Responsible Diver Code and be environmentally-responsible on every dive, taking responsibility for their waste as well. "We encourage divers to bring their own water bottles on to the boats so that we can fill them and not use single use plastic cups."

As a result of their efforts, Dive BVI has cut their water costs from almost \$4,000 US dollars per year to less than \$150.

Jeff is also aware of the impact that one business may have had in protecting his island and his patch of the ocean. "It may not seem like a lot, but over the course of eight years, we have stopped about 8,000 gallon-sized plastic jugs, 1,300 cardboard boxes, and hundreds (possibly thousands) of plastic cups from being burned or blown into the ocean."

The Virgin Islands is trying to address the problem of plastic waste, recently announcing plans to curb the importation of single use plastics, and as awareness of the problem grows, things are looking up.

Dive BVI's efforts are just one example of how everyone benefits by working together to find easy, cost-effective ways to conserve resources and minimize waste. Their efforts can be easily replicated by other business, allowing small changes to have a large positive impact.

Getting Involved at a Policy Level

It may seem like governments and larger organizations already have the plastic problem solved. But for any constructive changes to work, they need your help.

Get Involved With National Campaigns

National campaigns for change need the help of individuals like you to be successful. You can support the promotion of conservation work and research by making your voice heard – add your name to petitions, sign up to get involved with consultations, share your thoughts on social media. Together, a lot of small voices makes a loud noise.

Support Government Policy

If your local or national government has a good policy on managing waste in place, support it by acting on your responsibilities as an individual, and by encouraging others to do so too. This might involve spreading the word about items that can be recycled, or reporting waste dumped by the side of the road.

Remember, your local government representative is there to do what they're named to do: represent you. If you think something could be done better, contact them, tell them what the problem is, and ask them how they intend to act on it for you.

Take a Stand with Retailers and Manufacturers

Make producers responsible for their waste. Contact them and ask them how they are addressing the plastic problem. If they are producing items that you think use too much plastic, tell them you don't want packaging you don't need – and ask them whether they're helping to fund any programs to recycle or reuse it.

Academic Session 3 – Ocean Plastics

Lesson 3.5: Want to Learn More?



Image © iStock/strmko

Lesson Objectives

By the end of this lesson, you should be able to:

- Describe three organizations who are working on the plastic problem and how to get involved
- Use the List of References to learn more about ocean plastic issues that interest you

Getting Involved

By the end of this academic session, you have learned about the scope of the ocean plastic problem, why it is a concern for humans, and how you can get involved at three different levels to make a positive change.

There are many local, national, and global organizations making positive changes that you can be a part of. We have already mentioned some, so here are a few more to get you started.

5 Gyres

Who Are They?

The 5 Gyre Institute is a non-profit organization who want to empower people to act against plastic pollution through science, education and adventure. Based in California and with a special consultative status on the United Nations Economic and Social Council, they work with a global alliance of leaders and organizations for a plastic-free future.

What are they Doing to Reduce Plastic Waste?

5 Gyres' whole focus is on how to address the problem of plastic pollution in the world's oceans. They provide and collaborate on scientific research, run education programs, host and participate in events, and run "Take Action" pledges, encouraging people to make changes in their day to day lives.

How Can I Get Involved?

Visit their website for ideas on how to shop plastic-free, and to find out about events and initiatives you can participate in.

United Nations Environment Programme

Who Are They?

The United Nations Environment Programme brings experts together from across the globe to form the leading authority advocating on the global environment agenda, and promotes sustainable development amongst United Nations countries. They work closely with UN member states as well as other major stakeholders, businesses and communities, providing assessment work, tools and resources covering climate change, disasters and conflicts, ecosystem management, environmental governance, chemicals and waste and resource efficiency.

What are they Doing to Reduce Plastic Waste?

As well as other fantastic environmental programs such as their "Clean Seas" campaign, the UN Environment Programme spearheads initiatives such as the Beat Plastic Pollution campaign as part of World Environment Day. As part of the campaign, the UN Environment encourages citizens, companies and community groups to organize cleanups in their local areas.

How Can I Get Involved?

Visit their website to find out more about how you can help beat plastic pollution, or to find an event near you.

Healthy Seas

Who Are They?

Healthy Seas are a joint venture of European non-governmental organizations and businesses who want to remove and recycle marine litter from the ocean. They are a coalition formed by an expert on ghost fishing nets, a European center for biodiversity and sustainability, an Italian nylon producer and a Dutch sock producer – all of whom work together to look at how plastic waste can be recovered from the ocean and re-purposed into something else.

What are they Doing to Reduce Plastic Waste?

Healthy Seas works together with divers and volunteers to recover fishing nets and other plastic waste from the ocean, regenerates it into recycled yarn, and creates new products such as socks, swim wear, carpets and other textiles with the result.

How Can I Get Involved?

To find out how you can get involved with Healthy Seas as a volunteer, buy recycled plastic products, donate or attend an event, click the link to visit their website.

Sustainable Coastlines

Who Are They?

Sustainable Coastlines is an award-winning New Zealand charity that runs coastal clean-up events, educational programs, public awareness campaigns and planting projects along rivers and coastlines.

They take a grass-roots approach to managing plastic pollution, combining education with practical outreach and positive messaging practices.

What are they Doing to Reduce Plastic Waste?

Sustainable Coastlines runs beach clean-ups encouraging individuals, communities and local authorities to pick up marine debris and prevent it from washing into the sea. Since 2008 they have engaged over 86,000 participants, and collected over 1,400,000 liters of garbage.

How Can I Get Involved?

Visit their website or social media pages for information and resources and to see how you can get involved in events and workshops.

List of References

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The story of plastic is the story of all of us:

Plastic Change

Plastic Oceans

The Facts:

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Plastics Europe

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Academic Session 4 - Marine Protected Areas

Lesson 4.1: Overview



Image © iStock/mevans

Lesson Objectives

By the end of this lesson, you should be able to:

- Define the term "marine protected area"
- Describe the purpose of a marine protected area
- Briefly describe the history of marine protected areas

Introduction



Welcome to the wonderful world of marine protected areas!

From the coasts of California to the chilling waters of the Antarctic, marine protected areas are found throughout the ocean. They are the front line of ocean protection and an enormous tool to safeguard the blue heart of the planet. Marine protected areas are one of the most effective methods used to protect the ocean. They are a policy-driven effort to protect ocean habitats, wildlife, and cultural resources. They can also be excellent dive sites! Protecting ecosystems within the ocean can allow biodiversity to rebound and damaged habitats to recover.

From the Protected Planet website, managed by the United Nations Environment World Conservation Monitoring Centre and supported by the IUCN, 7.6% of the ocean is within a protected area. There are 14,894 marine protected areas that cover 27,738,316 square kilometers (10,709,824 square miles).

This section of Blue Oceans dives into the value of marine protected areas, stories of ocean champions, and most importantly, what you can do to promote marine protected areas.

What is a Marine Protected Area?



Image © iStock/R.M. Nunes

'Marine protected area' is a term used to describe an area conserved for its natural or cultural resources. They are also called marine parks, marine reserves, nature reserves, or locally managed areas.

Any level of government can be responsible for managing a marine protected area. The area may encompass combinations of different types of habitats and ecosystems, like estuaries, coral reefs, kelp forests, and open ocean.

Marine protected areas are classified by protection status. Fully protected areas are no-take marine reserves, and afford the highest level of protection to the ecosystems they cover. These marine reserves do not permit the removal of any wildlife or objects, and prohibit activities like fishing and shell collecting. They tend to experience the fastest and greatest recoveries and have the highest levels of resiliency. Successful marine protected areas also tend to be old, well-enforced, and isolated.

What do Marine Protected Areas Protect?



Image © Fotolia/Brandelet Didier

Marine protected areas benefit wildlife, habitat, and the communities that depend on them. These areas can improve biodiversity, and allow for safe reproduction and habitat for offspring. They can sequester carbon, create resilience to threats like sea level rise and storms, and protect critical habitats.

Healthy ecosystems provide opportunities for ecotourism and its associated economic benefits. They can also create a baseline to study the ability of protected areas to rebound, creating examples of healthy ecosystems to refer to when creating new protected areas.

Biodiversity

To function well, an ecosystem needs all the components - from herbivores to omnivores to keystone species. For example, if sharks are removed from an ecosystem, it can negatively impact seagrass and coral reef health. Sharks keep populations of their prey in check. Their prey may consume seagrass or animals that keep algae off of coral reefs. A healthy shark population can maintain a healthy population of prey. The protection extends to the entire community within a habitat, from prey to predators, and benefits the whole ecosystem.

Fisheries

Marine reserves can have limited protection or full protection. The highest level of protection a marine protected area can have is being designated as a "no-take" zone, meaning that no wildlife (fish, habitat, or other resources) can be removed.

Research has shown that the more remote a marine protected area is, the more effective the protection will be. Overfishing occurs when a population of fish is depleted to the point where they cannot recover if extraction continues. Fully protected and enforced marine protected areas offer protection for spawning, larvae, and juvenile fish habitats. This habitat safeguarding is important for key life cycle

stages. Fish that reach adult stages within these reserves may spill-over into unprotected areas and increase the availability of fish for local fishermen.

How is a Marine Protected Area Established?

Enric Sala, from the National Geographic's Pristine Seas project, states,

"Science says half of the ocean must be protected to make a real difference."

So how do we get to protecting half of the ocean? By evaluating and creating one marine protected area at a time.

Policy

Marine protected areas are established when governments create policies for the protective management of an ocean habitat or ecosystem. The goal of this policy is to keep the protected area as close to its natural state as possible. Using science-based evidence, policymakers may work with researchers to determine the optimal perimeter for a marine protected area. Policy for marine protected areas can also be determined by a desired outcome, such as habitat recovery or protecting fish stocks.

Size and Location

The size of a marine protected area is influenced by which species live within the area, mating seasons, habitat features like reefs or seagrass, and economic benefits. For example, fish allowed to spawn within the boundaries of a marine protected area that restricts fishing may result in a bigger catch outside of the marine protected area.

Remoteness also impacts the effectiveness of marine protected areas. Research demonstrates that more remote sites are better suited for protection. Being able to establish marine protected areas in locations considered remote may play a role in protecting them from future threats as accessibility continues to become easier.

Marine protected areas come in all shapes and sizes, from millions of square miles down to a single cove or beach. Large-scale marine protected areas can be beneficial—when well enforced—in protecting migratory species such as manta rays, whales, and sharks. They have also demonstrated the ability to build more resistance to climate change than smaller marine protected areas. However, they are also significantly harder to enforce due to their large size. Smaller, shore-side marine protected areas are useful to protect critical habitat for biodiversity, are easier to protect, and can help mitigate against storm surge and sea level rise.

Community

Community movements to protect a marine area has proven to be incredibly effective. Examples of communities working together to create and enforce marine protected areas are found in places like Cabo Pulmo, in Baja California Sur, and Misool, Indonesia.

14 years after the fishing community came together in Cabo Pulmo to create Cabo Pulmo Marine Reserve, there was an increase in biomass—the cumulative amount of mass of all the living animals in the reserve—of 463%! At Misool Marine Reserve, biomass increased by 250% in just five years. These numbers prove that a community working together to protect a marine habitat can heal the ocean in big ways.

Academic Session 4 - Marine Protected Areas

Lesson 4.2: Threats and Challenges



Lesson Objectives

By the end of this lesson, you should be able to:

- Give at least two examples of direct threats to marine ecosystems
- Give at least two examples of indirect threats to marine ecosystems
- Describe at least one economic cost of lower marine biodiversity

Direct Threats to Marine Ecosystems

Every ecosystem in the ocean faces many anthropogenic threats, including a changing climate, plastic pollution, habitat degradation, and overfishing. Research has demonstrated that areas with full protection can be more resilient to the impacts of these threats, except for plastic pollution. Safeguarding ocean habitats is one of the most effective tools for protecting the ocean.

Plastic Pollution



Plastic pollution is a catastrophic threat to each food chain found within the ocean. Over 80% of ocean plastic pollution stems from land-based sources. Evidence of plastics touched every marine habitat, even including those in the deep sea.

Plastic pollution that enters the ocean ends up in drinking water and on dinner plates. After plastic is discarded and reaches the ocean, either from direct sources like lost fishing nets or from indirect sources like washing down storm drains from residential areas, it breaks down into tiny pieces called microplastics. These microplastics are consumed by zooplankton and some corals. Zooplankton is at the bottom of the food web and is consumed by small fish and other animals. These small animals are then consumed by bigger wildlife, including fish that are familiar on menus, like swordfish and tuna. It's estimated that each person is consuming a credit card's worth of plastic every week.

Climate Change



Image © iStock/malivoja

Let's quickly review what exactly climate change is and its causes. As the amount of carbon dioxide and other greenhouse gases fluctuate in the atmosphere, it directly impacts changing climates. Currently, as humans engage in activities that increase carbon dioxide output, such as burning fossil fuels, the amount of carbon dioxide and other greenhouse gases increase, creating a blanket in the atmosphere that gets thicker over time. As the blanket becomes more dense, it prevents the sun's heat from escaping, creating a phenomenon called global warming. As the planet warms, climates are changing from a variety of secondary influences, such as ice caps melting and currents beginning to shift speed and direction. Changing currents could shift ocean temperatures and cause species and habitats to migrate to new waters.

Excess amounts of carbon dioxide mix with seawater, increasing the acidity of the water. This action causes something known as ocean acidification. For some species of coral and animals that rely on elements like carbonate to build shells, ocean acidification is bad news. It prevents animals with shells from being able to create shells with a solid structure, which in turn impacts their ability to protect themselves. Wildlife such as lobsters, crabs, oysters, abalone and scallops are particularly susceptible to ocean acidification.

Many species in the ocean rely on a narrow range of environmental conditions to reproduce and thrive. Fluctuations in temperature and acidity can be hugely detrimental to wildlife from fish larvae, animals that rely on shells to survive, and coral reefs and the surrounding ecosystems.

Overfishing

Overfishing impacts the targeted fish species populations and directly influences the whole food chain. The wildlife that depends on healthy populations of those fish are left without food and the species that are usually consumed by the targeted species are left unchecked. Extracting huge amounts of resources

from the ocean, like industrial-scale fishing and trawling, can have long-term consequences on the marine ecosystem and economic impact. If there are no fish left to catch, there is no more room for a fishing industry or the fishermen whose livelihoods depend on it.

Indirect Threats to Marine Ecosystems



Image © iStock/D-Keine

Habitat Loss

Habitat loss is a huge issue directly impacting many different species of land and marine wildlife. Without space to reproduce, develop, and flourish, wildlife may compete for resources that are becoming less available with area loss. Areas of the ocean are being wiped clean in order to extract wildlife, such as industrial scale fishing and trawling. Warming ocean waters cause kelp beds to die and coral reefs to bleach. The removal of mangroves for development can make coastal waters more susceptible to storms and strong currents.

Land-Based Non-Point Source Pollution

Over 80% of ocean pollution starts on land. Land-based non-point source pollution, including runoff, can include fertilizers, pesticides, trash, and sewage, as well as bacteria and parasites that can be harmful to ocean wildlife. Marine protected areas are usually created off of the goal to protect against what humans extract from the ocean, such as overfishing and habitat loss, but do not consider as strongly what humans put in to the ocean.

Land-based non-point source pollution—including runoff—can include fertilizers, pesticides, trash, and sewage, as well as bacteria and parasites that can be harmful to ocean wildlife.

Academic Session 4 - Marine Protected Areas

Lesson 4.3: The Good News



Image © iStock/RainervonBrandis

Lesson Objectives

By the end of this lesson, you should be able to:

- List at least three ways that humans are taking positive action to create marine protected areas
- Briefly describe how marine protected areas increase marine biodiversity
- Describe at least two direct benefits that marine protected areas provide to humans
- Describe at least two indirect benefits that marine protected areas provide to humans

Humans Can Help: Case Studies

Marine protected areas would not come to fruition without passionate people and organizations to support them. Dr. Sylvia Earle, mentioned in the first case study, was with President George W. Bush when he established Papahānaumokuākea Marine National Monument in 2006, the largest marine reserve of its kind at that time, after she'd helped advise him.

President Obama then quadrupled the size of the no-take marine reserve to over half a million square miles. Palau's President—Tommy Remengesau, Jr.—created a no-take marine reserve in its maritime territory that encompasses 193,000 square miles. He stated that, "Island communities have been among

the hardest hit by the threats facing the ocean. Creating this sanctuary is a bold move that the people of Palau recognize as essential to our survival" (Nat Geo, April 2017)

Non-profits, such as the Waitt Foundation, Mission Blue, and the Nature Conservancy focus on protected areas to benefit biodiversity and ocean conservation. Collaborating with local communities and government entities can help develop support for protected areas and ensure enforced protections - one of the biggest hurdles when establishing large-scale marine protected areas.

Large-scale marine protected areas come with the benefits of protecting significant amounts of ocean, but have an added challenge of figuring out how to monitor and enforce the protections. Creating a network of passionate people within the community, non-profit, and government components of a marine protected area can help promote healthy enforcement of legal protections.

Case Study 1: Dr. Earle's Hope Spots

Dr. Sylvia Earle is an oceanographer on a mission to protect as much of the ocean as possible through a network of "Hope Spots." Hope Spots can be officially recognized marine protected areas, and if not, Hope Spot recognition provides encouragement to local government to increase protection for these areas.

In 2009, Earle won a TED prize with an aim to start a network of marine protected areas, Hope Spots, around the world. To date, there are 114 Hope Spots and quickly growing. These Hope Spots help highlight areas that need more protection, whether they are close to pristine or have experienced destruction and need safe guards put in place in order to heal. They range from remote spots in the Arctic Ocean to the populated coastal Southeast Florida. By bringing attention to these special places, Dr. Earle hopes to highlight the importance of marine protected areas and their value for the ocean, and humankind.

Case Study 2: Cabo Pulmo, Mexico



Cabo Pulmo is a shining example of what happens when a community comes together with the common mission of protecting an ocean habitat. Located in Baja California Sur, Cabo Pulmo was once a prolific fishing village. After decades of overfishing, the small community banded together to create the Cabo Pulmo National Park in 1995. The marine protected area covers over 27 square miles and currently has a fully no-take status.

Cabo Pulmo took some time to rebound, but rebound it did in a glorious fashion. In just 14 years, biomass (the estimated total mass of all wildlife in an area) was up by 463%. Fishing around the reserve improved dramatically, and Cabo Pulmo became a tourist destination for premium diving. Divers may see enormous and endangered gulf groupers, sharks, and giant schools of fish.

The success of the park lead to its designation as a UNESCO World Heritage Site in 2005. To be selected as a UNESCO World Heritage Site, a park must meet at least two qualifications. According to the UNESCO World Heritage Center website, the first qualification is the site, "must be of outstanding universal value". There is also a list of ten criteria, including areas of significant natural beauty or areas that are important natural habitats for biodiversity and science or conservation, of which the protected area must have met at least one. UNESCO World Heritage Sites are a tool for preserving and protecting habitats and endangered species, and creates a way to gain international attention and action.

Case Study 3: The Ross Sea, Antarctica



As Earth experiences a warming ocean and a changing climate, the polar regions of the Arctic and Antarctica become more accessible to shipping routes and industrial fishing practices. In 2016, 24 countries banded together to form a marine protected area in Antarctica's Ross Sea. Over 579,000

square miles are protected, and 425,000 square miles of that area are now closed to commercial fishing for 35 years.

When the Ross Sea Marine Protected Area was established, it was the largest marine protected area on Earth. It is a beautiful example of countries coming together to take action on ocean protection. This area provides an opportunity to research the impacts of climate change in the polar region in an area that is remote and minimally touched by humans. The Ross Sea provides habitat to over 16,000 species of wildlife, including whales, penguins, and seals.

Helping Fix the Problem

Marine protected areas offer a tremendous number of benefits from rebounding fish populations, the return of keystone predators, and a wide range of ecosystem services. In marine protected areas with no-take policies and strong enforcement, like Cabo Pulmo, ecosystems can rebound from a multitude of negative impacts.

Direct Benefits of Marine Protected Areas

Marine protected areas offer a variety of benefits for the marine environment, fisheries, and local economies. When protected from overfishing, marine protected areas have shown the remarkable ability to halt population declines and allow the fish populations to rebound. In some cases, these populations spillover into non-protected areas, increasing the catch availability of fish for local fisheries.



*Unhealthy Reef / Healthy Reef
Image © Fotolia*

Marine Biodiversity

Healthy marine biodiversity provides many benefits for fishing and tourism, and mitigates the impacts of climate change. Pharmaceutical benefits may also be derived from biodiverse regions - the higher the availability of biodiversity, the increase in likelihood some pharmaceutical benefit can be found.

Biodiversity is defined as the amount of different species within a given area. Healthy marine biodiversity has a wide variety of carnivores and herbivores - predators that consume other animals, and wildlife that eats algae. There should be enough predators to keep animals lower down the food chain in check. For example, sea otters consume sea urchins who consume kelp. Left alone, sea urchins may wipe out entire kelp forests, removing habitat for other animals that rely on healthy kelp forests to survive. When there is a healthy sea otter population, it maintains the sea urchin population at a level that keeps the kelp forest healthy and happy. Another example, mentioned earlier, is sharks as keystone predators keeping the ecosystems healthy by keeping prey populations under control.

Climate Change

Well-enforced marine protected areas offer many benefits to fighting against climate change. They can be good carbon sinks, especially sea grass meadows, mangroves and wetlands, which means they absorb carbon dioxide from the air and reduce the amount of carbon dioxide in the atmosphere. Shoreline marine protected areas can guard against rising sea levels, coastal erosion, and increased storm surge, protecting habitats and local seaside communities. With over half of the population residing along the coast, its important to consider these ecosystem services when determining protected areas.

Indirect Benefits of Marine Protected Areas

A bustling marine ecosystem also leads way to a multitude of indirect benefits.

Economic Benefits

A healthy ecosystem can yield several economic benefits including greater fisheries yield, opportunities for ecotourism, and recreational activities. Healthy biodiversity and ecosystem recovery can boost local tourism revenue in addition to benefiting fisheries. A thriving ecosystem builds opportunity for ecotourism.

Ecotourism

When it comes to top-notch combinations of tourism and marine protected areas, Misool Eco Resort sets a shining example of integrating local communities, tourism, and sustainable practices. The Misool Marine Reserve safeguards over 300,000 healthy, biodiverse reefs. Protections were put in place in 2005, and when the reefs were surveyed in 2013 the results reported between a 250% and 600% increase in fish biomass. A 2015 study showed the amount of sharks in the reserve was 25 times greater than when it was established, and reported sightings of oceanic manta rays was over 25 times greater in 2016 than 2010.

Ecotourism can economically benefit local communities. With a healthy ecosystem drawing in visitors, hotels and local shops benefit from tourism.

Fisheries

A healthy marine protected area provides habitat for spawning fish species as well as ample room for fish larvae to grow. Research has shown that fish hatched in a marine protected area may later move to areas outside of it, creating something known as a spillover effect. Once outside of marine protected areas, they are able to be caught by fisheries.

Academic Session 4 - Marine Protected Areas

Lesson 4.4: How You Can Help



Image © Tom Huckert

Lesson Objectives

By the end of this lesson, you should be able to:

- Describe at least three ways you can support marine protected areas as a resident or tourist
- Describe the two post-incident record keeping duties
- List at least two ways that you can support marine protected areas in your region or at destinations you want to visit

So, What Can You Do to Make a Difference?



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As an individual, there are several ways you can take to support marine protected areas and ocean protection. Here are some ideas to get you started:

Examples

Educate family and friends

Engage family and friends in discussions about the importance of marine protected areas. This guide should provide a good foundation to support open discussions, and the benefits that come with robust marine protected areas.

Speak up about a place that is important to you

One way to highlight an area that deserves protection is to start talking about it and drawing attention.

After learning about Dr. Sylvia Earle and her non-profit Mission Blue, you can take the next step and nominate a place that is important to you. The application is available on the Mission Blue website. If you would prefer, look up the current Hope Spots and find out ways to support ones that are important to you and the well-being of the ocean.

Support well-done ecotourism in marine protected areas

Before booking that plane flight, look into opportunities that may benefit communities that support marine protected areas. As mentioned earlier, the Misool Eco-resort provides both protection for local ocean areas, as well as jobs for the nearby community. By supporting ecotourism opportunities—like the Misool Eco Resort—communities can afford to keep protections in place. Another bonus is some excellent diving opportunities!

Don't touch wildlife

It's important to remember not to touch wildlife when diving in general, and especially not within marine protected areas. Be familiar with the rules of the protected area before splashing in to make sure that your diving experience is the best it can be for both you and the wildlife.

Your SSI Training Center or Community Can Help

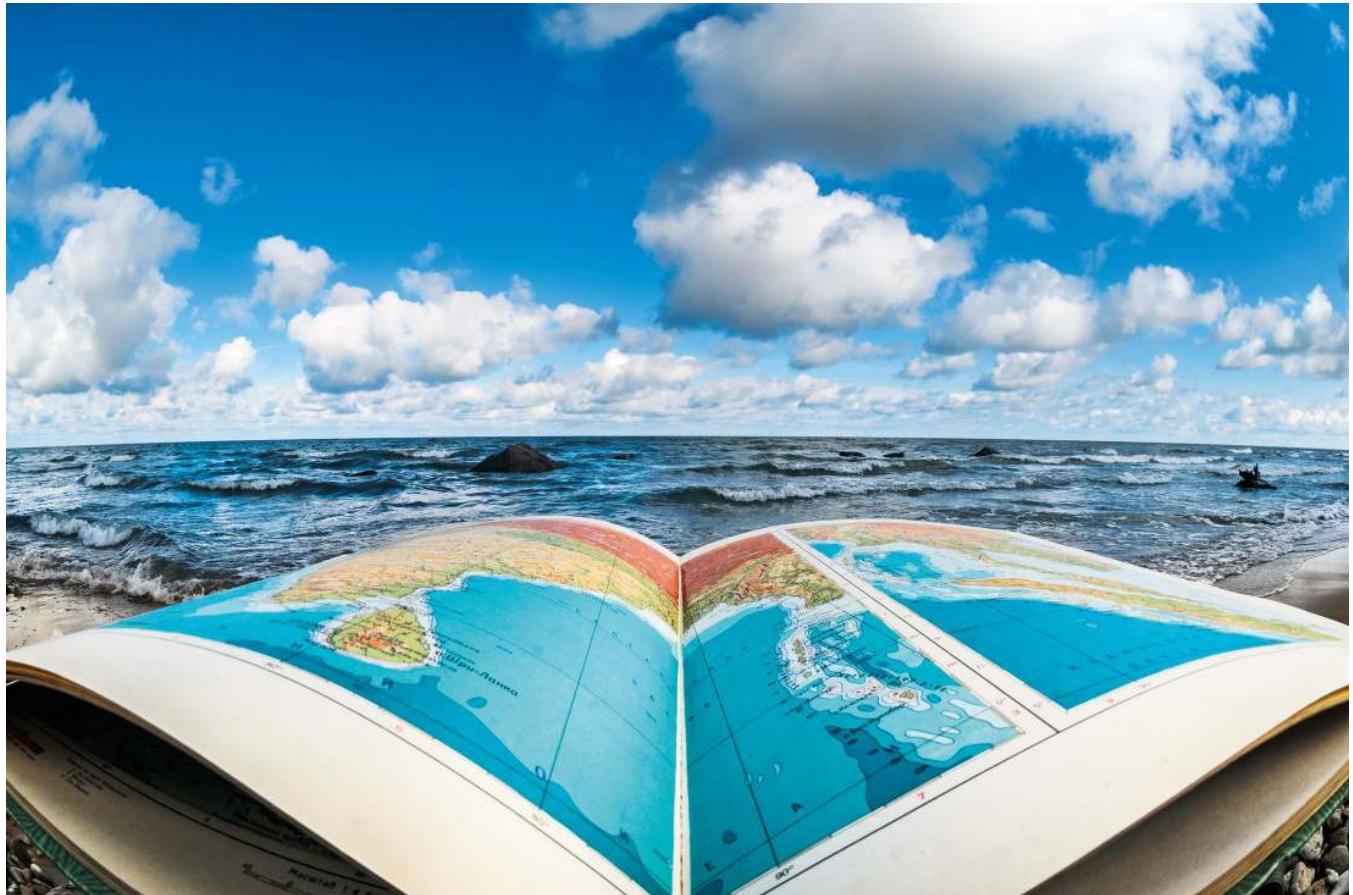


Image © iStock

Examples

Responsible Tourism

Before embarking on a diving expedition, do some research on the dive shop or tourism group to ensure they engage in responsible ecotourism practices. As the dive shops what steps they take to protect their dive sites. Don't hesitate to shop around for a location that aligns with your ecological beliefs and is known for sustainable business practices.

Education

As policies and rules change for marine protected areas, it's important to stay up to date on the latest information. Recognize good sources of information and understand what makes a marine protected area valuable from ecological, cultural, and economical standpoints.

Do Your Research

Similar to education, know information about any marine protected areas or reserves that you may be visiting. Be prepared to ask any tour operators or dive shops questions about the area you'll be diving in, and any particular rules you may need to follow.

How to Support Government Policy

Vote for policies that help establish marine protected areas. When election time rolls around, do homework on candidates most likely to support policy that establishes marine protected areas. If there may be a change in protected area status on the government level, reach out to your local representative to ask them to support creating protections, continuing protections, or increasing protections.

Academic Session 4 - Marine Protected Areas

Lesson 4.5: Want to Learn More?



Image © Alamy/Nature Picture Library

Lesson Objectives

By the end of this lesson, you should be able to:

- Describe three organizations who are working on marine protected area initiatives
- Describe how you can get involved with marine conservation initiatives that interest you
- Use the List of References to learn more about issues that interest you

Getting Involved

By the end of this session, you have learned what marine protected areas are, and how they benefit both humans and marine ecosystems. You should also have a better understanding of how you can get involved at three different levels to support marine protected areas, either in your local area or at some of your favorite travel destinations.

There are many local, national, and global organizations who are already hard at work creating, maintaining, and expanding marine protected areas around the world. Some of them were discussed earlier in this session.

Here are a few more to get you started.

Waitt Foundation

The Waitt Foundation has contributed over \$50 million to ocean conservation and protected over 1.2 million square miles of habitat. Working with local communities and non-profits and businesses, the Waitt Foundation builds protected areas from the ground up.

Marine Conservation Institute – GLORES Awards

The GLORES awards from the Marine Conservation Institute highlight the marine reserves that are the best in ocean protection. Anyone can nominate a marine reserve for a GLORES award. Through positive reinforcement, they hope to help support reaching the goal of 30% of the ocean protected by 2030.

Conservation International

Conservation International works with local communities to create protected areas that are long-lasting and benefit the local citizens as well as the ocean ecosystem. Conservation International works closely with vested partners to create marine protected areas that endure into the future.

How to Get Involved

There are a number of ways you can get involved with organizations working to build marine protected areas. Financial contributions can go a long way - and could include corporate matching offered by some companies, or even a social media fund-raiser.

Many organizations also enlist the help of volunteers or citizen scientists. If you happen to be traveling to a protected area that is working closely with a non-profit, consider sharing any underwater images or video from the trip. They may find them useful in assessing the health of the region, or possibly for promotional media.

List of References

MPAs benefiting manta rays:

<https://earther.gizmodo.com/first-manta-ray-nursery-ever-discovered-shows-marine-pr-1826997962>

Misool Foundation:

<https://www.misoolfoundation.org/>

Waitt Institute:

<http://waittinstitute.org/>

https://www.pewtrusts.org/en/research-and-analysis/articles/2019/03/07/research-key-to-boosting-benefits-of-large-marine-protected-areas?amp=1&fbclid=IwAR13CLAHfrAiCXVhBcPBn2INnPPPvVobIANGQkWbizOX5_gSyTnU7DomSeA

Lesson 4.1

<https://oceanservice.noaa.gov/facts/mpa.html>

<https://www.iucn.org/theme/marine-and-polar/our-work/marine-protected-areas>

Lesson 4.2

<https://www.oceanunite.org/issues/marine-plastic-pollution/>

Lesson 4.3

<https://ocean.si.edu/ecosystems/coral-reefs/cabo-pulmo-giving-optimism-coral-reefs>

<https://www.lonelyplanet.com/mexico/cabo-pulmo>

<https://www.fisheries.noaa.gov/national/international-affairs/marine-protected-area-antarcticas-ross-sea>

<https://www.sciencedaily.com/releases/2019/04/190401171345.htm>

<https://www.environment.gov.au/system/files/resources/5eaad4f9-e8e0-45d1-b889-83648c7b2ceb/files/benefits-mpas.pdf>

https://www.thegef.org/sites/default/files/publications/LBPS_SYN_Final_1.pdf

<https://go.galegroup.com/ps/>

Congratulations!

You have reached the end of the Blue Oceans digital learning!

Now that you have a foundation of knowledge about coral reefs, shark finning, ocean plastics and marine protected areas, it's time to take this information into the world. Visit your local SSI Training Center to see what kind of activities, training, or travel opportunities are available, and ask how you can be part of the global ocean conservation movement.

Remember, knowledge is power.

Use the resources available in this manual to find out more about the topics that interest you. Use social media, news outlets, and conservation organization newsletters and websites to stay up to date on the latest news and accomplishments.

Follow the Responsible Tourism Guidelines from this manual, and support businesses and destinations with a proven history of conservation and sustainable business practices.

Check back periodically to see if we have added new information to this program, and stay positive! The problems we face are complex and multi-faceted, but as a species, we humans have already made great improvements in how we manage our most valuable resource - the ocean.