



Learning Activity:

Sharks: Overfished and Under Pressure

Sustainable Solutions

Activity Type	Constructing Explanations and Evaluating Solutions
Focus Area	Sustainability
Time Required	90–120 minutes (can be split between days/periods)

Overview

According to World Wildlife Fund's [Living Planet Report 2022](#), a comprehensive study of trends in global biodiversity and the health of the planet, 75% of shark and ray species are considered at risk of extinction due to unsustainable fishing practices. In this activity, students will learn the causes and effects of sharks and rays being overfished and evaluate current fishing solutions to determine which are the most sustainable, based on their social, economic, and environmental impacts.

Objectives

After completing this activity, students will be able to

- identify the human pressures that impact fish populations and ocean health
- understand the interdependent relationship that sharks and rays have with their marine ecosystems and how reducing their populations will change their ecosystem, including people/society
- understand some of the key terms and concepts of sustainability and sustainable fishing
- evaluate sustainable fishing solutions to determine what methods will stop the overfishing of sharks and rays while balancing the needs of humans and the needs of the marine ecosystem



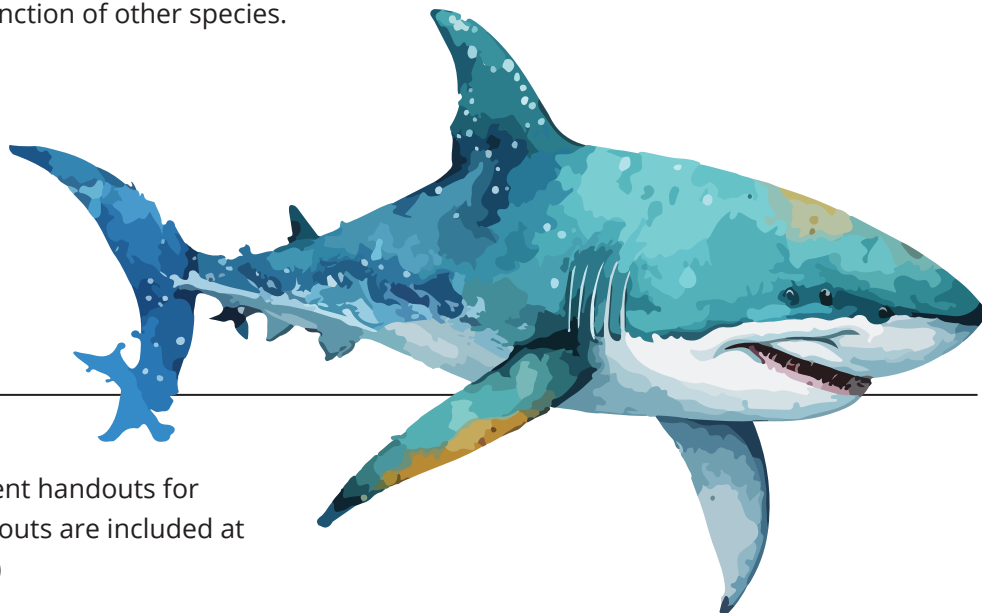
Caribbean reef sharks, Roatan, Bay Islands, Honduras



● Standards

Next Generation Science

- MS-LS2-5 Ecosystems: Interactions, Energy, and Dynamics
 - Evaluate competing design solutions for maintaining biodiversity and ecosystem services.
- MS-ESS3-3 Earth and Human Activity
 - Apply scientific principles to design a method for monitoring and minimizing a human impact on the environment.
- HS-LS2-7 Ecosystems: Interactions, Energy, and Dynamics
 - Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.
- HS-LS4-5 Biological Evolution: Unity and Diversity
 - Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.



● Materials Needed

- Paper and writing utensils
- Printed copies of the student handouts for each participant (the handouts are included at the end of the lesson plan)
 - *Is It Sustainable?*
 - *Evaluating Overfishing Solutions* (printed two-sided, if possible, with *Is it Sustainable?*)
 - *Overfishing: Stakeholders* (optional)
- Printed copies of the section “Disappearing oceanic sharks and rays” (pages 42–45) in WWF’s [Living Planet Report 2022](#) for each individual or group. These pages are included at the end of the lesson plan (printed two-sided, if possible)
- Internet access (so the facilitator can show video clips, specifically [Do We Need Sharks?](#) and [Vanishing Sharks](#), and for students to conduct research)



Vocabulary

Biodiversity: all the different kinds of life found in one area, including animals, plants, fungi, bacteria, and genetic material

Bycatch: the portion of a commercial fishing catch or other intentional marine capture that consists of marine animals caught unintentionally, such as dolphins, marine turtles, and seabirds

Ecosystem: the living (e.g., humans, bears, fish) and nonliving (e.g., air, water) components of an area that interact with each other in an interconnected way

Food web: the whole group of interacting food chains in an ecological community

Longline fishing: a fishing technique in which hundreds of thousands of baited hooks are hung at intervals along a single fishing line

Marine protected area: a section of an ocean, estuary, or lake where a government has set restrictions around human activity to protect it

Overfishing: fishing to the detriment of a fishing ground or to the depletion of a kind of organism

Quota: a share or part assigned to each member of a group

Renewable resource: typically refers to a resource that can either continue to exist while being used or can be self-replenishing over time (examples are solar, wind, hydro, and geothermal energy)

Secondary consumer: eats primary consumers for energy, usually carnivores

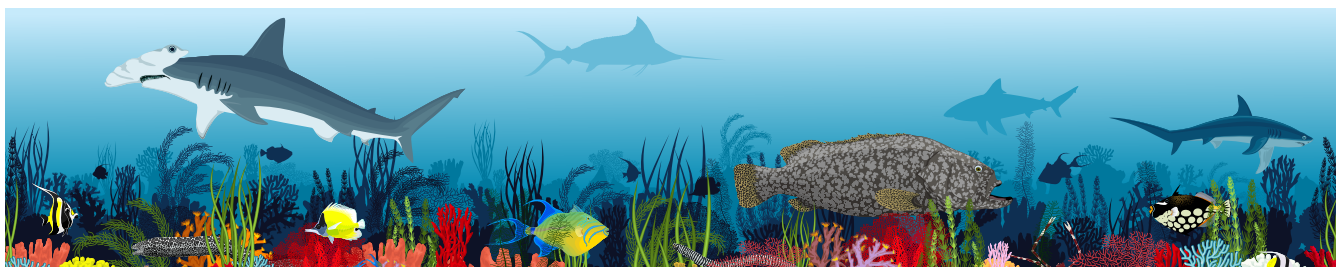
Stock assessment: the scientific process of collecting, analyzing, and reporting on the condition of a fish population and estimating its sustainable yield (e.g., how much can be harvested without causing a decline)

Supply and demand: an economic term; the amount of goods or services available for people to buy (supply) compared to the amount that people want to buy (demand); the less a product is produced, the more money can be charged for it

Sustainable: when a method of harvesting or a natural resource is used so that the resource is not depleted or permanently damaged; a condition in which an effective way to efficiently use natural resources and ensure their continued supply is being employed

Tertiary consumer: eats primary and secondary consumers for energy; is usually at the top of the food chain

Trawling: a practice whereby a fishing boat drags a large net along the seabed, catching almost everything in its path





● Activity Procedure

Teacher Preparation

- This activity focuses on the material covered on pages 42–45 of WWF's [Living Planet Report 2022](#). WWF's *Living Planet Report* is a comprehensive study of trends in global biodiversity and the health of the planet. Published every two years, it serves as a report card for Earth that examines the species and regions showing the most severe loss due to human activity and what can be done to reverse the declining trends. These pages are included at the end of the lesson plan. You may choose to have copies of these pages printed and available for individuals or groups to read and reference. These pages can also be accessed online using the link provided.
- Print copies of the *Is It Sustainable?* and *Evaluating Overfishing Solutions* handouts, one per participating individual. To reduce paper use, please print these two-sided, if possible.
- It is recommended, as part of the lesson plan, to show two video clips that are accessible online, so it is ideal to have a projector, smart board, or other means of projecting your computer screen to a display for students to watch.

Part 1: Engage

- Show students the clip titled "[Do We Need Sharks?](#)" from *Our Planet*, a Netflix series created in collaboration with Silverback Productions and WWF.
- Hold a brief discussion about the interdependent relationship that sharks have with their marine ecosystem and what changes would happen if they were to disappear. Be sure to review food web relationships and how predators such as sharks are vital to maintaining balance and allowing all organisms making up the ecosystem to have access to food and other resources. If there were no sharks, then their prey would become overpopulated and deplete their own food source, which would then have a "domino effect" (i.e., have a succession of similar events) on the rest of the food web.
- Pose this question to students: *In addition to upsetting the balance of their marine ecosystem, how would the disappearance of sharks affect humans?* As you collect volunteered ideas, encourage learners to consider ways that people depend on the ocean and how that would be affected.



A female southern stingray swimming over a shallow sand bank, North Sound, Grand Cayman, Cayman Islands



Part 2: Explore

- Organize students into small groups and distribute copies of the student handout, instructing learners to start with the side titled *Is It Sustainable?*
- Review the definition of sustainability and explain the three areas of sustainability as outlined in the handout: environmental, economic, and social. For more information on the three sustainability principles, visit the WWF webpages [Sustainability](#) and [Sustainability 101: What is Sustainability?](#)
- Allow students 10–15 minutes in their groups to discuss the examples provided in the handout and determine whether the action is sustainable and then record their explanations in the chart.
- Review and discuss examples as a class, inviting learners to share their perspectives on how each example does or does not meet the criteria to be considered socially, economically, and/or environmentally sustainable. A sample answer key is included.

Part 3: Explain

- Now that students have an introductory understanding of sustainability, tie that concept back to the topic of sharks. Begin by showing the short video clip "[Vanishing Sharks](#)" from the *Our Planet* series.
- Next, distribute copies of (or have students access online) pages 42–45 of [Living Planet Report 2022](#). While they are reading, students should identify the problem, making note of the causes and effects as outlined in those pages.
- Discuss as a class why sharks are in trouble. Encourage students to explain the current shark crisis in terms of sustainability, keeping in mind what they learned in the previous activity.



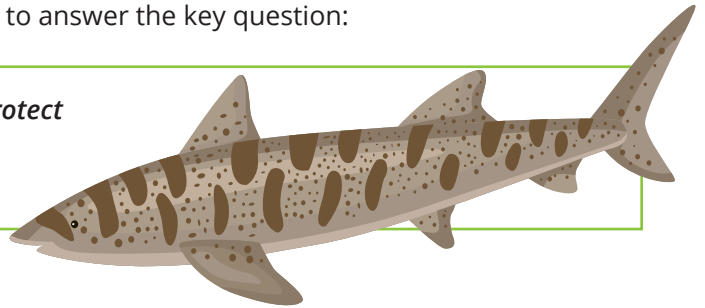
- **The Problem:** The population size of sharks and rays worldwide has dropped by 71% over the last 50 years. By 2020, more than three-quarters of all ocean-dwelling species (24 out of 31) of shark and ray were at risk of extinction.
- **Causes:** Sharks have been increasingly targeted by fishers due to a steady increase in value and demand for shark meat, for use either in medicine or in food (particularly the fins, which are used in soup primarily in Asia). Overfishing to keep supply up with demand often goes unnoticed if the fishing is not regulated or monitored. In addition, fishing practices such as trawling and longline fishing, which are often used to catch other popular fish species, frequently result in bycatch, the accidental capture of non-targeted species such as sea turtles and sharks. Intentional shark fishing (overfishing) and unintentional shark fishing (bycatch) are examples of unsustainable fishing.
- **Effects:** In addition to their loss being felt in their ecosystem as top predators, sharks are important to communities and economies that rely on fishing. The loss of sharks can lead to changes in the behavior of other species that would usually restrict their own movements and actions to avoid being preyed on by sharks. Without the tertiary consumer (predator) sharks, these secondary consumers can overpopulate an area and severely reduce the population of other species (causing fishing nets to come up empty.)



- How do we balance the needs of the ecosystem with the needs of people? We must implement sustainable solutions that allow shark populations to be restored while continuing to provide for a growing human population. Students will work together to evaluate current solutions to the overfishing crisis by determining how each one meets the three principles of sustainability.

At the completion of the activity, learners should be able to answer the key question:

Key Question: *How do sustainable fishing practices protect overfished species such as sharks and rays and reduce the pressure on our oceans?*



Part 4: Elaborate

- Divide the learners into four groups. Assign each group one of the following current overfishing solutions being explored by conservationists and scientists to help conserve marine species such as sharks and rays:

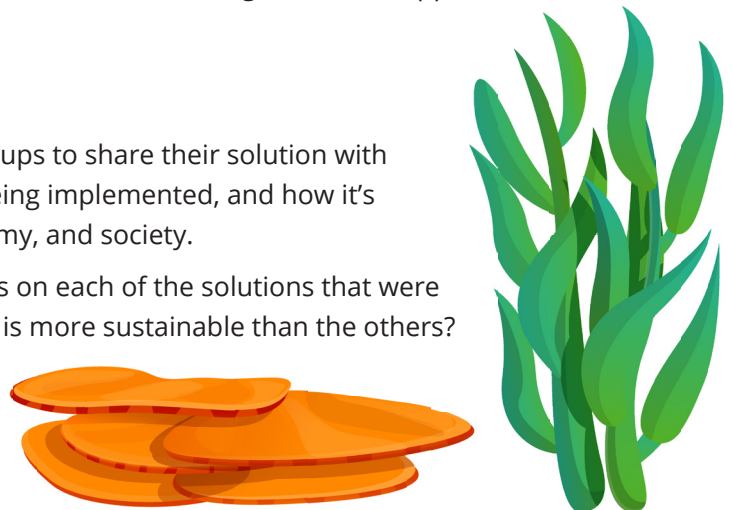


- Establish catch limits
- Establish marine protected areas
- Ban trawling and implement new fishing methods that avoid bycatch
- Monitor fishing activities at sea (e.g., conduct stock assessments)

- Allow student groups at least 20–30 minutes to conduct internet research on their assigned solution to learn more about how the solution works so they can determine how sustainable it is. Recommend that they include a [WWF webpage](#) as one of their resources.
- Using their research, students should complete the side of their student handout titled *Evaluating Overfishing Solutions*. Remind them to reference the *Is it Sustainable?* diagram on the opposite side of the handout to help guide their explanation.

Part 5: Evaluate

- Ask at least one volunteer from each of the four groups to share their solution with the class, describing what the solution is, how it's being implemented, and how it's sustainable in terms of the environment, the economy, and society.
- Hold a short discussion as a large group that reflects on each of the solutions that were researched. Do the students think that any solution is more sustainable than the others? What kinds of challenges do they foresee with each solution? Which solutions stand the best chance of recovering shark populations in the long term?





Extended Learning Opportunities

- Lead a follow-up group activity that challenges students to take a closer look at the various groups of people affected by overfishing. Overfishing can not only cause ecosystems to crumble but also affect many people's lives. Distribute copies of the handout *Overfishing: Stakeholders*. After reading each stakeholder's description, have student groups discuss the following questions:

- Who affects whom?
- Who has the most power?
- Whom do you think YOU would have the power to influence?

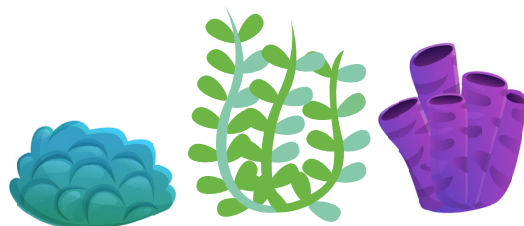
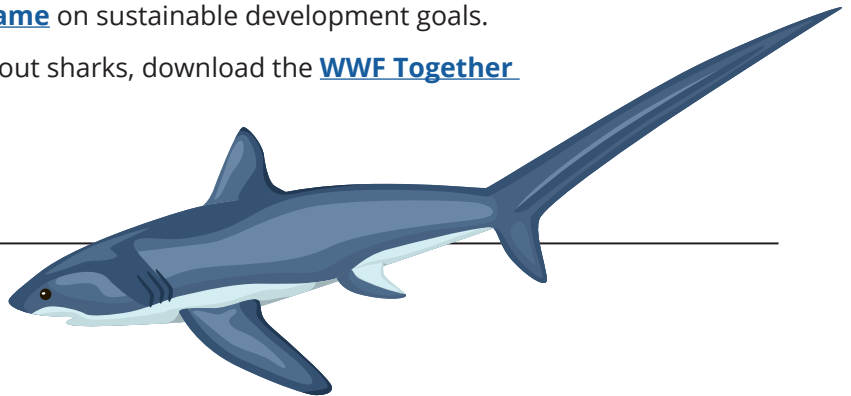


- Although overfishing may feel like a conservation issue that is far from most of our daily lives, there are things we can all do to help. Making sure to buy and eat only sustainable seafood, reaching out to political representatives to share your concern for sharks and the need to put a halt on overfishing, and simply advocating for sharks and their protection by sharing what you've learned with others are all examples of ways to make a difference.

- For additional assessment tools on sustainability, visit the [Wild Classroom Kahoot! page](#) and check out the [UN's Go Goals board game](#) on sustainable development goals.
- For a fun, interactive way to learn more about sharks, download the [WWF Together app](#) and explore the shark segment.

Additional Resources

- WWF webpage: [Overfishing](#)
- WWF webpage: [Sustainability](#)
- WWF webpage: [From Bait to Plate](#)
- WWF story: [Overfishing puts more than one-third of all sharks, rays, and chimaeras at risk of extinction](#)



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Student Handout:

Sharks: Overfished and Under Pressure

Is It Sustainable?

An activity is considered sustainable if it can be continued in the same manner long into the future. There are three principles of sustainability.

ENVIRONMENTAL

does not consume resources faster than they are naturally replenished

ECONOMIC

is cost-effective, with its benefits exceeding its costs in the long run

SOCIAL

strives toward a stable, healthy, just society

Example	Sustainable?	Why/Why Not?
A paper company that clears a section of forest in Brazil but plants an equal number of trees in American neighborhoods		
Anti-poaching campaigns that bring in ecotourism opportunities		
College credit for university students who provide free tutoring in subjects including math and science for K-12 children from low-income families		
School cafeterias serving lunch on single-use Styrofoam™ trays		
A coffee shop that allows customers to bring their own cups		
Producing more food by plowing up native grasslands		

Sample Answer Key:

Sharks: Overfished and Under Pressure

Is It Sustainable?

Example	Sustainable?	Why/Why Not?
A paper company that clears a section of forest in Brazil but plants an equal number of trees in American neighborhoods	NO	A forest is made up of more than its trees; it's a delicate ecosystem that supports local wildlife and communities. A tree planted in a neighborhood does not serve the same function. A more sustainable alternative would be to selectively harvest trees within a managed forest, rather than clear an entire area.
Anti-poaching campaigns that bring in ecotourism opportunities	YES	Although not directly generating profit, anti-poaching campaigns often provide alternative income opportunities such as wildlife safaris that will bring in revenue.
College credit for university students who provide free tutoring in subjects including math and science for K-12 children from low-income families	YES	Inclusive and equitable education is a big part of social sustainability, ensuring that all people are provided equal opportunities to learn and grow their skills. This can also result in more environmentally minded individuals! It would also benefit both the university students and the families, helping to sustain the program in the long term.
School cafeterias serving lunch on single-use Styrofoam™ trays	NO	Styrofoam™ is not recyclable and is made from fossil fuels, a nonrenewable resource. A more sustainable alternative would be using reusable, washable trays.
A coffee shop that allows customers to bring their own cups	YES	Allowing customers to bring their own cups (and rewarding them for doing so) cuts down on the amount of waste (which is good for the environment) and saves the company money (which is good for the economy).
Producing more food by plowing up native grasslands	NO	Grasslands are critical habitats for pollinators and help mitigate climate change. As we currently waste about one-third of the food we produce, a more sustainable solution is to prevent waste and make full use of the food we already produce.

Student Handout:

Sharks: Overfished and Under Pressure

Evaluating Overfishing Solutions



My solution: _____

Description (how it works): _____

How is it environmentally sustainable?	How is it economically sustainable?	How is it socially sustainable?

Disappearing oceanic sharks and rays

The global abundance of oceanic sharks and rays has declined by 71% over the last 50 years, due primarily to an 18-fold increase in fishing pressure since 1970.

Nathan Pacoureau
and Nicholas K Dulvy
(Simon Fraser University)

Sharks and rays are important to the health of our oceans, yet they have become increasingly valued for their meat, for parts used for their purported medicinal properties (e.g. manta and devil ray gill plates), or for use in dishes such as shark fin soup^{63,64}.

The global abundance of 18 of 31 oceanic sharks and rays has declined by 71% over the last 50 years⁶⁵. This collapse in their abundance reflects an increase in extinction risk for most species. By 1980, nine of the 31 oceanic sharks and rays were threatened. By 2020, three-quarters (77%, 24 species) were threatened with an elevated risk of extinction. For example, the oceanic Whitetip Shark has declined by 95% globally over three generation lengths, and has consequently moved from Vulnerable to Critically Endangered on the IUCN Red List⁶⁶.

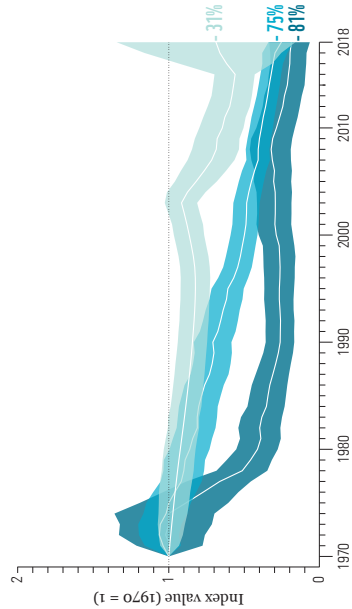
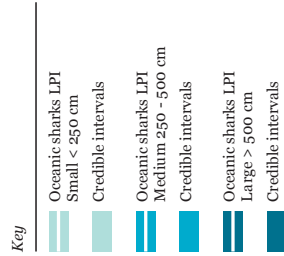


Figure 9a: Living Planet Index from 1970 to 2018 disaggregated by body size (maximum total length divided into three categories: small, ≤250 cm; medium, 250–500 cm; large, >500 cm). The overfishing of sharks and rays has followed a classic pattern of serial depletion. The large-bodied species were caught first and therefore initially declined faster than smaller species, as they are generally more valuable with a greater volume of meat and fins. But critically these larger-bodied species live longer and are late-maturing, hence they have less capacity to replace the numbers lost due to unrestrained fishing pressure. Smaller sharks and rays have faster life histories and can withstand greater fishing mortality than larger sharks. Source: Pacoureau et al. (2021)⁶⁶.

Scalloped hammerhead sharks (*Sphyrna lewini*), Cocos Island, Costa Rica, Pacific Ocean.



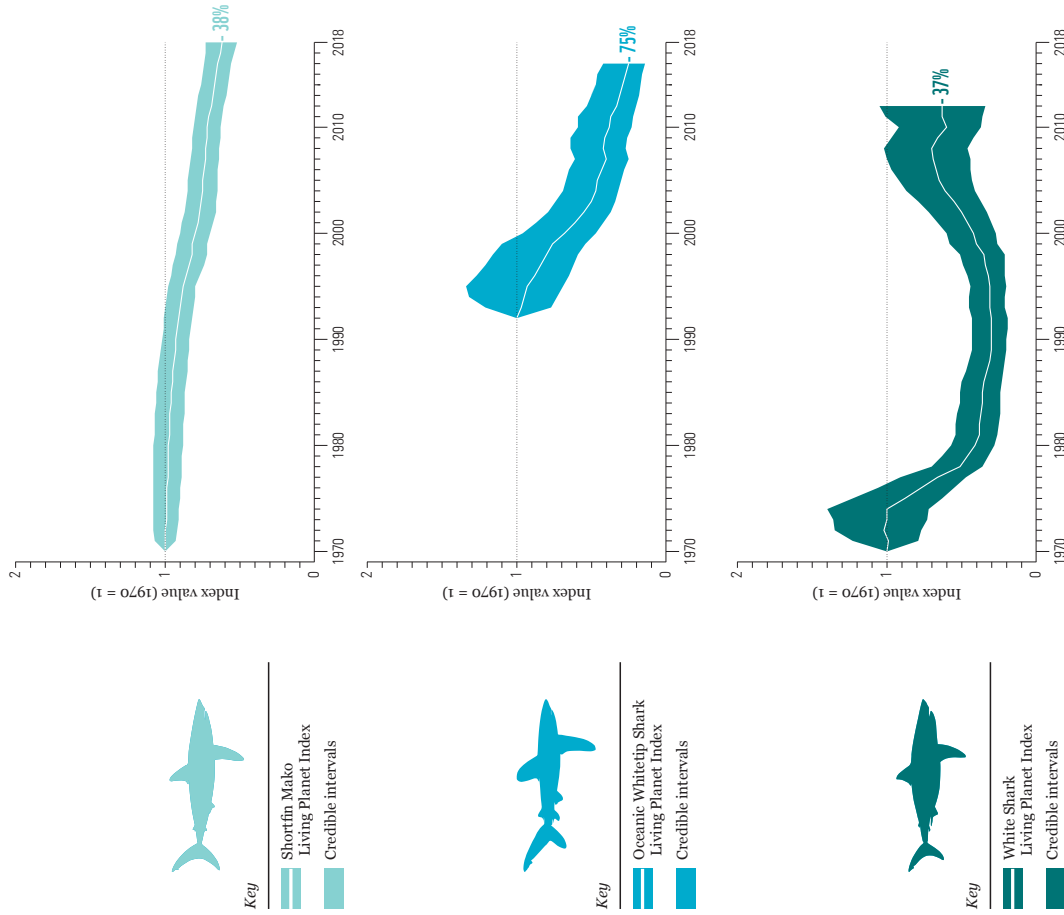


Figure 9b: Living Planet Index from 1970 to 2018 for three species of oceanic sharks. Some formerly abundant, wide-ranging shark species have declined so steeply that they now fall into the two highest threat categories on the IUCN Red List. For example, the commercially valuable Shortfin Mako shark was recently classified as Endangered, while the iconic oceanic Whitetip Shark is now considered Critically Endangered. White Shark numbers had declined on average by an estimated 70% worldwide over the last five decades, but they are now recovering in several regions, including off both coasts of the US (where their retention has been banned since the mid-1990s). Source: Pacoureau et al. (2021) ⁶⁶.

Due to the complexity and scale of oceanic food webs, the impact of the decline in oceanic sharks and rays on the ecosystem is uncertain ^{67,69}, however the profound effects of depleting these predatory species are becoming apparent. For example, the decline of large apex predators such as sharks and tunas can result in significant functional changes to oceanic food webs ^{69,70}.

Sharks and rays are also critical to many local communities and economies ⁷¹. The severe declines reported also threaten food security and income in many low-income nations ⁷². Subsistence fisheries for a variety of sharks and rays have existed in these countries for hundreds of years ⁷³, and the development of alternative livelihood and income options for fishers could significantly ease transitions to sustainability. Halting declines and rebuilding populations to sustainable levels through catch limits will help secure the future of these iconic predators, as well as the ecosystems and people that depend on them.


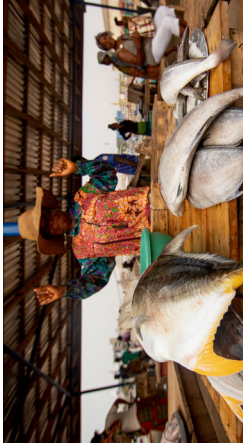






Spotted eagle ray (*Aetobatus narinari*) swimming near the ocean floor near Darwin Island, Galapagos Islands.



Student Handout:

Sharks: Overfished and Under Pressure

Overfishing: Stakeholders

Commercial Fisher	Seafood Market Worker	Local Restaurant Owner	Distant Consumer
 <ul style="list-style-type: none"> • Livelihood depends on catching fish • May report to a higher-level organization and be held to quotas to maintain their job 	 <ul style="list-style-type: none"> • Livelihood depends on selling fish • Relies on what the fishers bring in • Must keep up with the demand of what local consumers want 	 <ul style="list-style-type: none"> • Relies on what the fishers bring in • Must keep up with the demands of what local consumers want 	 <ul style="list-style-type: none"> • May pay more money if the seafood is rare or a delicacy or difficult to import
Conservationist	Politician	Local Consumer	Indigenous Person
 <ul style="list-style-type: none"> • Wants to protect the fish and balance the needs of animals and people 	 <ul style="list-style-type: none"> • Creates policies for their community to ensure it is economically stable and safe 	 <ul style="list-style-type: none"> • May expect to have the seafood available; their culture or diet may depend on it 	 <ul style="list-style-type: none"> • Harvested fish sustainably for generations until commercial industries depleted the stocks