



Khaled bin Sultan
Living Oceans
Foundation

STANDARDS

- **CCSS:** RI.6.8-8.8, RST.6-8.1, RST.6-8.8, RST.6-8.10, SL.6.1-8.1, SL.6.4-8.4, SL.6.5-8.5, WHST.6-8.8, WHST.6-8.9; RST.9-10.1, 2, 4, 5, 7, 8, 10; RST.11-12.1, 2, 4, 10; RI.9-12.8, SL.9.1-12.1, SL.9-12.4, SL.9-12.5, WHST.9-10.8, WHST.11-12.8, WHST.9-10.9, WHST.11-12.9
- **NGSS:** MS-LS2-3, MS-LS2-4, MS-LS2-5; HS-LS2-7, HS-LS-4.D, HS-ESS3-3, HS-ESS3.C, HS-ESS3.D, HS-ETS1.A-B, HS-ETS1-2, HS-ETS1-3
- **NGSS Practices:** 6, 7, 8
- **OLP:** (grades 6-8): 5.A.1, 5.A.3, 5.A.4, 5.A.6, 5.A.16, 5.A.21, 6.A.1-A.11, 6.B.1-B.4, 6.C.1-C.4, 6.D.1-6.D.21, 6.E.1-6.E.15; (grades 9-12) 6.A.1, 6.A.3-A.6, 6.B.1-B.6, 6.C.1-C.3, 6.D.1-D.19, 6.E.1-.14

ONLINE CONTENTS

- [*My Wish: Protect Our Oceans*](#) Dr. Sylvia Earle discusses the rapid decline of the ocean and the need for more protection.
- [*Corals and MPAs*](#) Learn about Marine Protected Areas and how they can help protect coral reefs.

CONSERVATION

This lesson is a part of the *Conservation* unit, which describes different actions that people can take to manage and conserve coral reefs. Below is a summary of what is included in the entire unit.

UNIT CONTENTS

A. [Background Information](#)

- Introduction
- Mitigating Threats
- Stakeholder Involvement
- Education & Outreach
- Monitoring
- Enforcement
- Restoration

B. Lessons

[Watch It! My Wish](#)

- A worksheet to accompany the [*My Wish: Protect Our Oceans*](#) video

[Watch It! Corals and MPAs](#)

- A worksheet to accompany [*Our Living Oceans, Episode 5: Corals and MPAs*](#) video.

[Lesson 1A: Explore a Hope Spot](#)

- An activity that explores an existing Hope Spot. Students learn about ecosystem disruptions and services, and the reasons that make this place special.

[Lesson 1B: Nominate a Hope Spot](#)

- An activity where students nominate a new Hope Spot that needs protection. Students present their proposed Hope Spot to their classmates who act as the “Hope Spot Council,” deciding if it should be approved.

[Lesson 1C: Advocate for MPA](#)

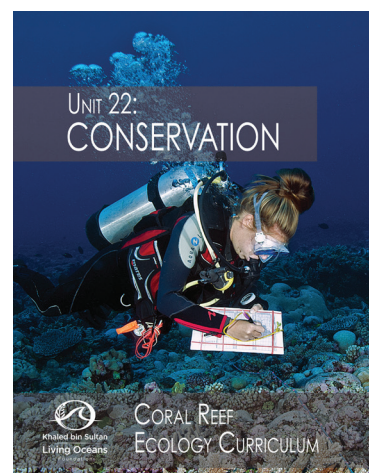
- Write a compelling letter that advocates for the creation of their proposed MPA to a stakeholder or group of stakeholders.

[Lesson 1D: Manage an MPA](#)

- An activity that creates a management plan for the three most important actions that are crucial to conserve their proposed MPA.

[Read It! Maori Conservation](#)

- A worksheet to accompany the [*Traditional Māori Conservation Methods Help Protect Reefs in the Cook Islands*](#) blog.



PRE-KNOWLEDGE

Before beginning these lessons, students should have a good understanding of the natural and anthropogenic threats to the ocean and the actions that can be taken to reduce these threats. They should also be able to explain the various ecosystem services that the ocean provides.

ADDITIONAL INFORMATION

Ocean conservation efforts vary around the world. Perhaps one of the most effective ways to protect the ocean is by establishing Marine Protected Areas (MPAs). The path to creating an MPA is not always the same; however, the activities in Lessons 1A-1D illustrate one path that can lead to the creation of one.

Lesson 1 consists of four different activities:

- **Lesson 1A: Explore a Hope Spot**
- **Lesson 1B: Nominate a Hope Spot**
- **Lesson 1C: Advocate for MPA**
- **Lesson 1D: Manage an MPA**

Lessons 1A-D are meant to be completed consecutively as knowledge builds upon the previous lesson; however, lessons 1A and 1B are similar. Lesson 1A has students exploring an existing Hope Spot; whereas, Lesson 1B requires that students nominate a Hope Spot that does not yet exist. The latter lesson requires a solid comprehension of the background information and advanced skills in researching information. Depending on the abilities of the students, instructors may find that it is not necessary to complete Lesson 1A before beginning Lessons 1B-D. For individuals who need further differentiation, Lesson 1A is a good introductory lesson that exposes students to the information before they attempt more difficult activities.

Before beginning Lesson 1B, it is important that students understand the difference between Hope Spots and MPAs. A Hope Spot does not designate an area as an MPA. This can be confusing because some Hope Spots are already established MPAs that apply to be a Hope Spot because they require additional protections. For Hope Spots that are not existing MPAs, this designation can be the first step towards creating one. Hope Spots provide additional funding and support, and create global awareness for the protection of an area. The creation of a Hope Spot can lead to further pressure on the country(s) authorities who have the ability to create an MPA. In classes where Lessons 1C and/or 1D will be completed, inform students that they need to nominate Hope Spots that are not existing MPAs.

Once students have nominated a Hope Spot (Lesson 1B), and was hopefully approved by their classmates, they are ready to take the next step – advocate for the creation of an MPA. During Lesson 1C, students will be asked to write a letter to a stakeholder or group of stakeholders, advocating for the creation of their MPA. To aid students in writing their letter, you may choose to use the *The Message Box*, a tool that aids in effectively communicating scientific information to a specific audience. This tool can be especially useful when trying to distill a lot of information into a meaningful and impactful message such as a letter to a stakeholder(s).

In Lesson 1D, the students' MPA has been approved. Students will be asked to create a management plan for their MPA. Before writing their plan, students will be asked to use the knowledge learned from the previous lessons to choose three actions that are most important to the protection and preservation of their MPA. Students will incorporate these actions into their management plan. If time is limited, it is suggested that only one or two of the actions are included in their plan.

Grading rubrics are included for Lessons 1B-1D to evaluate these activities. Together, these lessons will require time to complete, so it may be best to think of them collectively as a long-term project that may extend throughout the duration of the entire course.

LESSON 1A

TEACHER'S NOTES

AUTHOR

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LEARNING OBJECTIVES

- Define and identify ecosystem services.
- Identify and describe threats to an ecosystem.
- Research actions that can reduce threats to ecosystems.
- Discuss the purpose of a Marine Protected Area.
- Propose a Hope Spot.
- Evaluate resources for credibility.
- Cite sources as textual evidence.

KEYWORDS

- Biodiversity
- Ecosystem
- Ecosystem Services
- Endemic
- Health
- Hope Spot
- Instability
- Marine Managed Area (MMA)
- Marine Protected Area (MPA)
- Threats

MATERIALS

- Lesson 1A: Explore a Hope Spot** student worksheet
- Marine Protected Areas with Sylvia Earle* Vimeo video
- Watch It! My Wish** student worksheet
- Internet

EXTENSIONS

- Prior to, or after, completing this lesson, students can learn more about Dr. Sylvia Earle and other marine biologists and oceanographers. Log in as an educator to the foundation's education unit called **Meet a Scientist** for *Background Information* and an accompanying lesson plan.

- To extend this lesson, conduct **Lesson 2B: Nominate a Hope Spot**. Student groups can nominate a Hope Spot that is not currently recognized. They will fill out an application proposing why their Hope Spot should be protected and present their proposed Hope Spot to the class. Students who are not presenting will fill out a grading card to determine if the nomination should be accepted as a Hope Spot.

STANDARDS

- CCSS:** RST.6-8.1, RST.6-8.8, RST.6-8.10, SL.6.1-8.1, WHST.6-8.8, WHST.6-8.9; RST.9-12.1; RST.9-12.8, RST.9-12.10, SL.9.1-12.1, WHST.9-10.8, WHST.11-12.8, WHST.9-10.9, WHST.11-12.9
- NGSS:** MS-LS2-5; HS-LS4-D
- OLP:** Grades 6-8: 6.A.1-A.11, 6.B.1-B.4, 6.C.1-C.4, 6.D.1-6.D.21, 6.E.1-6.E.15; grades 9-12: 6.A.1, 6.A.3-A.6, 6.B.1-B.6, 6.C.1-C.3, 6.D.1-D.19, 6.E.1-E.14

NOTE: Not all Hope Spots will provide the same ecosystem services, have the same disturbances, or require protection for the same reasons. Therefore, it is possible that not all standards above will be met.

ATTRIBUTIONS

- The *Explore a Hope Spot* activity is based on Mission Blue's Hope Spot Nomination Form, which can be accessed at www.missionblue.org.

PROCEDURE

A. BACKGROUND KNOWLEDGE:

- Watch *Marine Protected Areas with Sylvia Earle* Vimeo video (<https://vimeo.com/639725084/c330641980>) and complete corresponding **Watch It! My Wish** worksheet.
- Before beginning this lesson, students should understand that high biodiversity often means that an ecosystem is healthy. They should also recognize that disruptions to the biological or physical components of an ecosystem can lead to shifts in all its populations. If necessary, reinforce these concepts before beginning this activity.
- Prior to starting the activity, explore the concept of ecosystem services. Coral reefs will be used as an example here, as students have learned about this ecosystem in prior activities.
- Throughout the activity, there are suggested prompts in blue boxes to engage students in learning. After each question (Q) are suggested answers (A). Begin the activity by asking:

Q: “Why is it important for us to keep ecosystems healthy?”

A: *Answers could include that healthy ecosystems protect the organisms living there and maintain high biodiversity. Another valid answer is that healthy ecosystems are also important for humans because we receive many benefits from them. Once students have provided answers such as these, introduce the term “ecosystem services.” Define ecosystem services as “the combined benefits that humans receive from healthy ecosystems.”*

Q: “What are the ecosystem benefits that we receive from coral reefs?”

A:

- *Jobs and income*
- *Food*
- *Medicine*
- *Coastal protection*
- *Tourism*
- *Traditional and cultural value*
- *Recreation opportunities*
- *Erosion prevention*

Q: “What actions threaten the biodiversity of this ecosystem?”

A: *There are many different threats to coral reefs including but not limited to:*

- *Overfishing*
- *Climate change and effects from it including coral bleaching and ocean acidification*
- *Destructive fishing methods*
- *Coral mining*
- *Boat anchor damage*
- *Unsustainable tourism*
- *Pollution*
- *Sunscreens*
- *Hurricanes/cyclones/typhoons*
- *Introduction of invasive species*

NOTE: *This is a review of coral reef threats from Lesson 1: Stringing It Together.*

Q: “What do you think happens to ecosystem services when biodiversity is threatened?”

A: *Changes to biodiversity can reduce ecosystem services, which in turn affects humans that depend on these services and resources. Choose one or two examples of ecosystem services and explain in more detail.*

B. EXPLORE A HOPE SPOT:

1. Begin this activity with a discussion using the same ecosystem example that was used in the *Background Knowledge* section. To break up the *Background Knowledge* and *Explore a Hope Spot* sections, students could research the answers to question 1a below before attending the next class. Discuss actions that we can take to maintain biodiversity. Any responses including the reduction of threats mentioned in *Background Knowledge* section (2c) are acceptable responses. There are additional suggested answers on the following page in *Table 1*; however, this list is not all inclusive.



TABLE 1:

Threat	Action(s) to Reduce Threat
Overfishing	<ul style="list-style-type: none"> Limit the number of fish species caught Stop fishing for species until their population size has increased Implement species size limits Prohibit fishing at breeding sites Restrict the number of people allowed to fish
Threat	Action(s) to Reduce Threat
Coral bleaching (due to climate change)	<p>This threat is due to climate change. Ways to reduce climate change include:</p> <ul style="list-style-type: none"> Reduce carbon footprint (individuals): <ul style="list-style-type: none"> Take public transport or ride a bike Eat less meat Reduce home energy consumption (e.g., turn off lights and appliances, replace lightbulbs with LED lights, choose renewable energy supplier) Plant kelp, seagrass, and mangroves, which help to capture and store carbon dioxide Use renewable energy
Ocean acidification	<ul style="list-style-type: none"> This threat is due to climate change. See coral bleaching answers.
Destructive fishing methods	<ul style="list-style-type: none"> Ban destructive fishing methods such as blast/dynamite fishing, cyanide fishing, and bottom trawling.
Coral mining	<ul style="list-style-type: none"> Stop mining corals and use different building materials.
Boat anchor damage	<ul style="list-style-type: none"> Install mooring buoys so boaters do not have to anchor.
Unsustainable tourism	<ul style="list-style-type: none"> Limit the number of people that can snorkel and scuba dive in a specific area. Limit the number of boats accessing a coral reef. Fine patrons who feed and harass wildlife. Create programs that require tourism operators to educate patrons before they enter the water.
Pollution	<ul style="list-style-type: none"> Reduce agriculture, sewage, and industrial run-off. Use less fertilizers & pesticides on lawns, golf courses, and in agriculture. Recycle and eliminate single-use plastic. Use reusable bags and food containers. Donate working electronics and recycle broken ones Properly dispose of trash. Shop sustainably Use ecofriendly cleaning products and soaps
Sunscreens	<ul style="list-style-type: none"> Encourage the use of reef-safe sunscreens. Prohibit the sale and use of sunscreens that contain oxybenzone and octinoxate.
Hurricanes/cyclones/ typhoons	<ul style="list-style-type: none"> Climate change is fueling these storms which are becoming larger and more powerful. See coral bleaching answers.
Invasive species	<ul style="list-style-type: none"> Create removal programs Hold derbies to help remove invasives Sell invasive fish to restaurants (if edible) Create regulations for ballast and bilge water
Solutions for all threats	<ul style="list-style-type: none"> Educate others Volunteer with an environmental organization Vote on policies that protect the environment Create Marine Protected Areas (MPAs)

2. Ask students to read the *Background Information* on their **Lesson 3A: Nominate a Hope Spot** student worksheet. If Marine Protected Areas (MPAs) were not brought up as a method to reduce threats, make sure that students understand this concept.
3. Break students into groups. **NOTE:** This lesson can also be assigned to individuals.
4. The way in which this lesson plan is implemented depends on different factors such as the abilities of the class and time allotted for the assignment. There are two suggested methods for implementation. 1) Assign each group the same Hope Spot or 2) allow students to choose any existing Hope Spot. It is important to note that not all Hope Spots contain the same amount of information on the [Mission Blue™](https://mission-blue.org/) website. Therefore, students will need to be able to research external resources to learn more about these Hope Spots. The Exmouth Gulf and Ningaloo Coast World Heritage Area is one Hope Spot that has a lot of information on the Mission Blue website and other external ones; therefore, it is used as an example in this lesson plan.
5. Depending on the students' needs, this lesson may need to be differentiated further. Students who do not require additional support can begin the lesson by searching for their Hope Spot on Mission Blue website (<https://mission-blue.org/hope-spots/>). For students that require additional support, provide students with resources to complete the activity. Here are some resources for the Exmouth Gulf and Ningaloo Coast World Heritage Area:
 - Hope Spot Webpage: <https://bit.ly/3yxSdP1>
 - 2019 Exmouth Gulf Report: <https://bit.ly/3xE8qkF>; the report can be downloaded for free by entering your email address on this page: <https://www.oceanwise.com.au/subscribe>. Consider providing this report to all students regardless of differentiation, so that they do not have to enter their email address to access the report.
 - Ningaloo Management Plan 2005-2015: https://www.dpaw.wa.gov.au/images/documents/parks/management-plans/decarchive/ningaloo_mp_01_2005_withmaps.pdf
 - Protect Ningaloo – Save Exmouth Gulf: <https://www.protectningaloo.org.au/>
 - Ocean Wise: <https://www.oceanwise.com.au/exmouth-gulf>
 - Reef Check Australia: <https://www.reefcheckaustralia.org/ningaloo>
 - Ningaloo Turtles: <http://www.ningalooturtles.org.au/index.html>
 - Australian Marine Conservation Society: <https://www.marineconservation.org.au/ningaloo-marine-park/>
 - Australia Institute of Marine Science: <https://www.aims.gov.au/species-at-risk>
 - Sharks and Rays Australia: <https://www.sharksandraysaustralia.com/>
 - Australia Marine Parks: <https://parksaustralia.gov.au/marine/parks/north-west/ningaloo/>
 - UNESCO World Heritage: <https://whc.unesco.org/en/list/1369/>
6. Explain to students that they will use resources from the Mission Blue Hope Spots webpage and external resources to complete *Explore a Hope Spot* on their student worksheet. Students should list their sources on their student worksheet.
7. After all groups have filled out their worksheets, review the information with the class and write their answers on the board to the following questions (see next page):



Q: “What ecosystem(s) are a part of the Hope Spot?”

A: *Coral reefs, oyster beds, sand-mud flats, mangroves, salt flats, seagrass, algae, underground subterranean karst limestone waterways, sponges, soft corals*

Q: “What threats can cause the marine ecosystem(s) in the Hope Spot to become unstable?”

A: *Climate change, which leads to an increase in the frequency and strength of cyclones; destructive fishing due to bottom trawling; no recreational fishing regulations, which can lead to overfishing*

Q: “What ecosystem services do we get from these marine ecosystems?”

A: *Coastal protection (mangroves), carbon storage (seagrass and mangroves), food production (all ecosystems), ecotourism, and cultural heritage*

Q: “What are the current protections for this Hope Spot (if any)?”

- A:**
- 1999 Environment Protection and Biodiversity Conservation Act 1999
 - 2004 Western Australian Government designated Ningaloo as a marine sanctuary
 - 2011 UNESCO designated Ningaloo coast as a World Heritage Site

Q: “Are all marine ecosystems conserved in the same way?”

A: *No. Although there may be similarities, every ecosystem is different. For example, coral reefs that are in different ocean basins have different biotic and abiotic factors. Lionfish exist naturally in the Indo-Pacific, but they are invasive species in the Atlantic Ocean. Therefore, different actions are necessary to manage these two coral reef ecosystems. Using the term MPA does not mean that the actions taken to reduce threats and maintain a healthy ecosystem are the same. Each MPA must have a tailored plan because each one has different biotic and abiotic factors that influence it.*

LESSON 1A

EXPLORE A HOPE SPOT

BACKGROUND INFORMATION

Around the world, approximately 12% of land is protected. However, only about 6% of the ocean is currently protected in any way. In the United States, national parks serve to protect special places on land. In the same way we can safeguard the ocean. Perhaps the most recognized around the world is called a **marine protected area (MPA)**, sometimes called a **marine managed area (MMA)**, which is a defined area of the ocean with set rules that state what is, and what is not, allowed in the area. MPAs around the world vary greatly in size, level of protection, and how they are managed and enforced. Some MPAs focus on protecting an entire ecosystem, while others focus on the protection of individual species or preserving a cultural or historical site.

In an effort to create more protection for the ocean, Dr. Sylvia Earle launched Mission Blue and started a global conservation campaign called “**Hope Spots**,” which are special places that are scientifically identified as critical to the health of the ocean. Often these are areas in need of new protection, but they can also consist of existing MPAs that require additional action. Like MPAs, Hope Spots come in all different sizes and are nominated for different reasons. Here are a few reasons they are nominated:

- A special abundance or diversity of species, unusual or representative species, habitats, or ecosystems
- Particular populations of rare, threatened, or endemic species
- A site with potential to reverse damage from negative human impacts
- The presence of natural processes such as major migration corridors or spawning grounds
- Significant historical, cultural, or spiritual values
- Particular economic importance to the community

Dr. Earle’s goal is to safeguard 30% of the ocean by 2030. You don’t have to be a scientist or a government official to nominate a Hope Spot. Anyone can nominate a site that gives them “hope” for the future of our oceans, a place that preserves biodiversity and is essential for ocean health.

A. EXPLORE A HOPE SPOT

INSTRUCTIONS: Research an established Hope Spot and answer the questions below. Information about Hope Spots can be found here: <https://mission-blue.org/hope-spots/>. If you use additional resources to research your Hope Spot, please make sure to list your resources under question #10.

1. What is the name of the Hope Spot? _____
2. Where is the Hope Spot located? _____

3. How large is this Hope Spot (estimated size)? _____

4. What ecosystem(s) are a part of the Hope Spot?

5. What are the current or potential threats to this Hope Spot? Explain.

6. List five ecosystem services that are provided by this Hope Spot.

7. What are the current protections for this Hope Spot (if any)?

8. What type of human activities take place in this Hope Spot?

9. Explain why this Hope Spot is special. For each question please list yes/no/unsure and explain the answers to each question.

Does the area	Yes	No	Not sure	Explain
Hold significant or representative populations of rare or endemic species				
Hold a wide diversity of species				
Hold a significant process or ecosystem here (e.g., phytoplankton bloom, reefs, kelp forests)				
Contain the site of significant event (breeding/spawning)				



Does the area	Yes	No	Not sure	Explain
On or part of a migration route				
Contains organisms that are threatened or endangered				
A site that contains economic/touristic appeal				
Potentially encouraging scientific research projects				
Significant historical, cultural or spiritual values				

10. What resources did you use while conducting this activity? Cite your resources here.

LESSON 1A

EXPLORE A HOPE SPOT

BACKGROUND INFORMATION

Around the world, approximately 12% of land is protected. However, only about 6% of the ocean is currently protected in any way. In the United States, national parks serve to protect land. In the same way we can safeguard the ocean. Perhaps the most recognized around the world is called a **marine protected area (MPA)**, or sometimes called a **marine managed area (MMA)**, which is a defined area of the ocean with set rules that state what is, and what is not, allowed in the area. MPAs around the world vary greatly in size, level of protection, and how they are managed and enforced. Some MPAs focus on protecting an entire ecosystem, while others focus on the protection of individual species or preserving a cultural or historical site.

In an effort to create more protection for the ocean, Mission Blue started a global conservation campaign called “**Hope Spots**,” which are special places that are scientifically identified as critical to the health of the ocean. Often these are areas in need of new protection, but they can also consist of existing MPAs that require additional action. Like MPAs, Hope Spots come in all different sizes and are nominated for different reasons. Here are a few reasons they are nominated:

- A special abundance or diversity of species, unusual or representative species, habitats, or ecosystems
- Particular populations of rare, threatened, or endemic species
- A site with potential to reverse damage from negative human impacts
- The presence of natural processes such as major migration corridors or spawning grounds
- Significant historical, cultural, or spiritual values
- Particular economic importance to the community

Dr. Earle’s goal is to safeguard 30% of the ocean by 2030. You don’t have to be a scientist or a government official to nominate a Hope Spot. Anyone can nominate a site that gives them “hope” for the future of our oceans, a place that preserves biodiversity and is essential for ocean health.

A. EXPLORE A HOPE SPOT

INSTRUCTIONS: Research an established Hope Spot and answer the questions below. Information about Hope Spots can be found here: <https://mission-blue.org/hope-spots/>. If you use additional resources to research your Hope Spot, please make sure to list your resources under question #10.

NOTE: There are many potential answers to these questions. Below are sample answers.

1. What is the name of the Hope Spot? Exmouth Gulf and Ningaloo Coast World Heritage Area

2. Where is the Hope Spot located? Along the coast of Western Australia approximately 1,200

kilometers north of Perth

3. How large is this Hope Spot (estimated size)? Exmouth = 2,500 kilometers squared (km²); Ningaloo

Reef: 2,435 kilometers squared (km²)

4. What ecosystem(s) are a part of the Hope Spot?

Coral reefs, oyster beds, sand-mud flats, mangroves, salt flats, seagrass, algae, underground karst limestone waterways, sponges, soft corals

5. What are the current or potential threats to this Hope Spot? Explain.
- **Climate change is a main threat to this area. Increases in ocean temperature have caused corals to bleach. Climate change has caused an increase in the frequency and strength of cyclones, which has negatively impacted mangrove, seagrass, and coral reef ecosystems. After these storms, dugongs have been found stranded on salt flats and their seagrass feeding grounds have been partially lost.**
 - **Prawns, also known as shrimp, are commercially fished using bottom trawling, which is a destructive fishing method that drags nets along the seafloor to catch seafood. This method can destroy the seafloor and can lead to overfishing. Frequent bottom trawling causes devastating effects to the environment such as destroying habitats, changing the chemistry of the water, and suspending sediment in water which can block organisms from being able to photosynthesize. Sea snakes and sea turtles are also vulnerable to this type of fishing method and end up in the nets as bycatch.**
 - **Currently, there are no recreational fishing regulations for molluscs, which are soft bodied organisms that usually have a shell for protection. Many molluscs are collected for their shells, while others, such as the day octopus, are used for bait. Lack of regulations could lead to overfishing.**

Potential threats include:

There are two types of coastal development activities that threaten this area:

- **A company wants to build a deep-water port near Exmouth. This would require dredging the seabed to put in a 1-kilometer-long wharf, so that large vessels could enter the Gulf of Exmouth. Allowing this type of activity to occur would threaten the Gulf's ecosystem.**
- **A different company wants to construct a salt production and barging operation. The proposed area to construct salt ponds encompasses an area that is over 675 million square meters (about roughly 34 km long x 20 km wide. This type of infrastructure would destroy the ecosystems by changing the flow of water, removing seagrasses and algae, and reducing primary productivity.**

As climate change continues to melt the polar ice caps, the entire coastal area of this Hope Spot may also become threatened by sea level rise.

6. List five ecosystem services that are provided by this Hope Spot.
- **Coastal Protection: The mangroves provide coastal protection from storms and cyclones.**
 - **Carbon Storage: Mangroves and seagrass capture and store carbon dioxide, reducing the amount of carbon dioxide that fuels climate change.**
 - **Food Production: Prawns (AKA shrimp) are one of the largest commercial fisheries in Western Australia. Millions of dollars are generated each year, which adds to Australia's economy and provides jobs for locals.**
 - **Ecotourism: Each year millions of dollars are spent on ecotourism in this area. One of the main attractions is swimming with endangered whale sharks. Other activities include snorkeling, scuba diving, and kayaking.**
 - **Cultural Heritage: This region has long been an important cultural heritage site for aboriginals, who want to maintain social, religious, and personal bonds with their traditional lands. Some tribes still own and manage lands in this region, while others visit their ancestral lands. Tribes still access marine ecosystems to hunt, fish, and teach youth their cultural heritage.**

7. What are the current protections for this Hope Spot (if any)?
- **1999 Environment Protection and Biodiversity Conservation Act 1999**
 - **2004 Western Australian Government designated Ningaloo as a marine sanctuary**
 - **2011 UNESCO designated Ningaloo coast as a World Heritage Centre**
 - **2013 Ningaloo Marine Park was established under the EPBC Act; there are six areas in the park that are established as Fish Habitat Protections Areas (FHPA) that provide special protection to the fish and their habitats in these areas.**
 - **1950 Wildlife Conservation Act protects mammals, birds, amphibians, and reptiles.**
8. What type of human activities take place in this Hope Spot?
- **Ecotourism (whale shark excursions; diving and snorkeling coral reefs; manta ray diving, kayaking)**
 - **Recreation and commercial fishing**
 - **Boating, surfing, and swimming**
 - **Citizen science projects**
 - **Aboriginal traditional heritage activities such as fishing and hunting**
9. Explain why this Hope Spot is special. For each question please list yes/no/unsure and explain the answers to each question. Does the area:

Does the area	Yes	No	Not sure	Explain
Hold significant or representative populations of rare or endemic species	X			Cowrie (<i>Zoila</i> species), echinoderms (sea cucumbers, sea urchins, sea stars, and sand dollars), 2 fish species endemic to Karst limestone system, 11 endemic sea snakes
Hold a wide diversity of species	X			This area is extremely biodiverse, containing over 200 coral species, 600 different molluscs, over 750 species of fish, over 60 species of sharks and rays, almost 100 species of birds, 8 known marine mammals, over 15 species of sea snakes, 6 species of sea turtles
Hold a significant process or ecosystem here (e.g., phytoplankton bloom, reefs, kelp forests)	X			<ul style="list-style-type: none"> • Cyanobacterial mats provide extensive nutrient exchange. • Large numbers of crustaceans exist in the intertidal area. They help to break down organic matter, which provides a major source of organic matter for this region. • Nursery for shrimp and other crustaceans, dugong, humpback whales • Mangrove creeks and the intertidal habitats provide protected areas for juvenile fish
Contain the site of significant event (breeding/spawning)	X			<ul style="list-style-type: none"> • Feeding and mating habitat for Western Australian dugong



Does the area	Yes	No	Not sure	Explain
On or part of a migration route	X			<ul style="list-style-type: none"> Nursery habitat for Western Australian humpback whales Key habitat for 36 species of migratory shorebirds
Contains organisms that are threatened or endangered	X			<ul style="list-style-type: none"> Dugongs (endangered) Several sea cucumber species (vulnerable & endangered) 2 species of fish endemic to Karst limestone system (vulnerable) 2 species of sawfish (critically endangered) Many species of sharks are listed (from vulnerable to critically endangered); whale sharks (endangered) 2 species of sea snakes (critically endangered) Shorebird species (4 endangered, 11 near threatened, and 2 vulnerable)
A site that contains economic/touristic appeal	X			<ul style="list-style-type: none"> Provides shrimp for commercial fisheries Recreational fishing allows for game fishing, which is regulated Many ecotourism activities conducted here including whale shark and manta ray excursions, snorkeling and scuba diving coral reefs, kayaking
Potentially encouraging scientific research projects	X			<p>Many different people conducting research here. Notable research by:</p> <ul style="list-style-type: none"> Australia Institute of Marine Science James Cook University Oceanwise Sharks and Rays Australia
Significant historical, cultural or spiritual values	X			<ul style="list-style-type: none"> This area is known for its geologic history, which provides evidence about how the geology of the area has changed over time. It is a particularly important place to study fossilized coral reefs. Important cultural heritage site for Aboriginals

10. What resources did you use while conducting this activity? Cite your resources here.

Answers will vary; however, here is a list of resources that are useful to use during this activity. These resources may be needed to differentiate the lesson.

- Protect Ningaloo – Save Exmouth Gulf: <https://www.protectningaloo.org.au/>
- Ocean Wise: <https://www.oceanwise.com.au/exmouth-gulf>
- Reef Check Australia: <https://www.reefcheckaustralia.org/ningaloo>
- Ningaloo Turtles: <http://www.ningalooturtles.org.au/index.html>
- Australian Marine Conservation Society: <https://www.marineconservation.org.au/ningaloo-marine-park/>
- Australia Institute of Marine Science: <https://www.aims.gov.au/species-at-risk>
- Sharks and Rays Australia: <https://www.sharksandraysaustralia.com/>
- Australia Marine Parks: <https://parksaustralia.gov.au/marine/parks/north-west/ningaloo/>
- UNESCO World Heritage: <https://whc.unesco.org/en/list/1369/>