

RETURN OF THE MANATEES

FOCUS QUESTIONS

- How can the invasion of an aquatic microbe lead to the starvation of a population of manatees?
- Plants produce oxygen as a byproduct of photosynthesis. How can the presence of an aquatic plant *reduce* the oxygen concentration in an aquatic ecosystem?

WILDHOPE EDUCATOR GUIDE

• How do manatees maintain the community structure of their shallow aquatic spring-fed waterways?

OVERVIEW

In *Return of the Manatees* we meet Lisa Moore, community advocate and founder and President of Save Crystal River, a massive restoration project to restore Florida's Crystal River ecosystem. The film centers on the removal of an invasive aquatic plant and a suffocating aquatic microbe, the restoration of native eelgrasses, and the ultimate restoration and conservation of the Florida manatee. Crystal River has become a model for other communities along the west coast of Florida where the manatee populations are struggling to exist.

KEY CONCEPTS

- Threatened and Endangered Species: The International Union for the Conservation of Nature lists more than 44,000 species threatened with extinction. Habitat loss and destruction are the major threats for more than 85% of these species. The Florida manatee is a Federally protected species in the U.S. and is listed as threatened (downgraded from endangered in 2017) by the Endangered Species Act of 1973.
- Biodiversity: Controlling the growth of invasive aquatic plants and algae can help maintain the seagrass populations of Florida's coastal waters. Keeping seagrass habitat in a more natural state can help mitigate the starvation threats to manatees and provide habitat for other native species.
- Keystone Species: A keystone species is an organism that helps define an entire ecosystem and the community of other species that live there. Manatees function as a keystone species in their coastal habitats by being benthic (aquatic floor) herbivores with huge appetites. By consuming 10% of their body mass in seagrass every day Manatees control the types of species that can live in their habitats. Manatees are also considered keystone species because their presence or absence indicates the overall health of coastal waterways.
- Conservation biology: The practice of conservation biology recognizes the intrinsic value of the Earth's natural diversity of organisms. Conservation biology works to understand how the natural world operates, how humans affect nature, and how we can use collective scientific and cultural knowledge to conserve Earth's biological diversity.

BACKGROUND

In the *Return of the Manatees* film we meet Lisa Moore, a community advocate and founder and President of Save Crystal River. In 2012 Moore and other concerned residents and business professionals banded together to figure out a way to remove an invasive microbe called lyngbya (*Lyngbya wollei*), a large-celled, filamentous, matforming cyanobacterium (blue-green alga) from Kings Bay, the underwater spring-fed headwaters of the Crystal River. Their initial goal was to rehabilitate a local Florida waterway into a thriving ecosystem, but their efforts have become a model for other communities along the west coast of Florida where populations of the Florida manatee (*Trichechus manatus latirostris*) are struggling to exist.

The Florida manatee is a subspecies of the West Indian manatee (*Trichechus manatus*) and has been protected in Florida through Florida State Law since 1893. Florida manatees are now also protected by the Marine Mammal Protection Act of 1972, the Endangered Species Act of 1973, and the Florida Manatee Sanctuary Act of 1978. There have been three scientific surveys conducted to estimate the population size of the Florida manatee. The most recent estimate puts the statewide abundance for the 2021-2022 period at 8,350–11,730 manatees, with 3,960–5,420 on the west coast and 3,940–6,980 on the east coast. Because this latest estimate overlaps with the 2015-2016 survey (7,520–10,280 individuals) it is unclear whether the Florida manatee



population is currently increasing or shrinking. However, the Florida manatee population along the Atlantic coast has been experiencing what is called an unusual mortality event since 2020 with the main cause most likely a loss of food resources. This event has prompted conservationists to call for the Florida manatee to be upgraded once again to the status of Federally endangered.

Since the onset of human development of the shallow waters of Florida's coasts the main threat to manatees has been deadly collisions with boats, but public awareness has helped reduce this threat. However, in the film we learn that the most recent struggle for the manatees has been the appearance of an invasive exotic aquatic plant called hydrilla (*Hydrilla verticillata*) followed by the endemic invasive lyngbya alga. Hydrilla is an Asian species but has invaded U.S. coastal waters through the aquarium trade. Hydrilla released into local waterways can quickly outcompete other plants for space. While plants, including aquatic plants, do produce oxygen as a byproduct of photosynthesis, the warm waters along the coast have a low capacity for maintaining dissolved oxygen and the large populations of Hydrilla plants also remove a lot of dissolved oxygen from the water during aerobic respiration at night. This effect is coupled with additional oxygen depletion through the aerobic process of decay as the Hydrilla plants die. The choking presence of the hydrilla had already taken its toll on the manatee populations by the time the lyngbya alga became a problem. Lyngbya is a North American species that can produce large and long-lasting blooms, especially in areas with excess nitrogen and phosphorus pollution. The shallow, warm waters of Florida's spring-fed waterways that are subject to fertilizer runoff create an ideal, nutrient rich environment for lyngbya. Like hydrilla, lyngbya can choke out seagrasses, leading to further starvation of local manatee populations.

In the *Return of the Manatee* film we learn that by 2012 the degradation of the Kings Bay habitat had gotten so bad that the only option for saving the waterway and its species was to vacuum up the mats of algae and replant the seagrasses. This community effort has reversed the Crystal River's decline and manatees are once again thriving. Unfortunately, this hopeful success story for the Florida manatee is not universal. In the Indian River Lagoon on the east coast of Florida there has been a gradual seagrass loss followed by a huge brown tide bloom that has starved the grass of sunlight. The seagrass die-off has caused a starvation crisis for the manatees. To help conserve the manatee population while the Indian River Lagoon recovers, the Manatee Critical Care Center at Zoo Tampa has taken on the task of collecting and feeding the starving mammals. Once rehabilitated, the recovered individuals are released into the already restored Crystal River waterway.

BIODIVERSITY THREATS

The major threats to the Earth's biodiversity can be grouped into seven categories that spell the easily recalled acronym H.I.P.P.O.: Habitat destruction and fragmentation, Introduced species, Pollution, Population growth, and Overharvesting. Many species are threatened by a combination of these factors, but habitat loss is the greatest threat to biodiversity. In *Return of the Manatees* we learn the destruction of seagrass habitat through the accidental introduction of invasive species leads to the starvation and poisoning of Florida's manatee populations. But increased human development has also led to the deaths of manatees from deadly collisions with boats in the shallow waters manatees need to thrive.

DISCUSSION QUESTIONS

- [Before showing the film] Have students brainstorm what they already know about manatees and their ecology.
- In the film we learn that manatees act as the "lawnmowers" of the shallow seagrass waterways. Have students go online and search "blue wildebeest lawnmowers" then compare what they learn about the foraging behavior of the wildebeest and how it compares to that of the manatees.
- Ask students to create a visual model that illustrates the plight of the manatees and the efforts to restore their populations.



RETURN OF THE MANATEES

Curriculum Connections

NGSS

- HS-LS2 Ecosystems: Interactions, Energy, and Dynamics
 - o LS2.A: Interdependent Relationships in Ecosystems
 - o LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
 - o LS2.C: Ecosystem Dynamics, Functioning, and Resilience
 - LS4.D: Biodiversity and Humans
- HS-LS4 Biological Evolution: Unity and Diversity
 - o LS4.C: Adaptation
- ETS1.B: Developing Possible Solutions

AP Biology (2021)

•

- Enduring Understandings
 - Energetics (ENE)
 - ENE-1: The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.

WILDHOPE EDUCATOR GUIDE

- ENE-4: Communities and ecosystems change on the basis of interactions among populations and disruptions to the environment.
- Systems Interactions (SYI)
 - SYI-1: Living systems are organized in a hierarchy of structural levels that interact.
 - SYI-3: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

IB Biology (First Exam May 2025)

A. Unity and Diversity: Common ancestry has given living organisms many shared features while evolution has resulted in the rich biodiversity of life on Earth.

- A1.1 Water
- A3.1 Diversity of organisms
- A4.2 Conservation of biodiversity

B. Form and Function: Adaptations are forms that correspond to function. These adaptations persist from generation to generation because they increase the chances of survival.

- B4.1 Adaptation to environment
- B4.2 Ecological niches

C. Interaction and Interdependence: Systems are based on interactions, interdependence and integration of components. Systems result in emergence of new properties at each level of biological organization.

- C1.2 Cell respiration
- C1.3 Photosynthesis
- C4.1 Populations and communities
- C4.2 Transfers of energy and matter

D. Continuity and Change: Living things have mechanisms for maintaining equilibrium and for bringing about transformation. Environmental change is a driver of evolution by natural selection.

• D4.2 Stability and change



RETURN OF THE MANATEES

REFERENCES

Florida Fish and Wildlife Conservation Commission. (2022). Living with Florida Manatees. https://myfwc.com/conservation/you-conserve/wildlife/manatee/. Accessed 26 May 2024.
Hudon, C., De Sève, M., & Cattaneo, A. (2014). Increasing occurrence of the benthic filamentous cyanobacterium Lyngbya wollei: a symptom of freshwater ecosystem degradation. Freshwater Science, 33(2), 606-618.
International Union for the Conservation of Nature. (2024). Florida Manatee. https://www.iucnredlist.org/species/22106/9359881. Accessed 26 May 2024.

WILDHOPE EDUCATOR GUIDE

National Invasive Species Information Center. (2023). Hydrilla.

https://www.invasivespeciesinfo.gov/aquatic/plants/hydrilla. Accessed 26 May 2024.

CREDIT

Written by Paul K. Strode, Ph.D., Fairview High School, Boulder, Colorado