FOCUS QUESTIONS

- What are some key life history strategies that sea turtles evolved that have allowed them to become the most widely distributed reptile group on the planet?
- Why are sea turtles now threatened with extinction throughout their global distribution?
- What are some key approaches for protecting and restoring sea turtle populations?

OVERVIEW

Sea turtles are the most widely distributed reptile on the planet, but they are also one of the most endangered reptile groups. Fortunately, conservation and protection efforts by local communities and research institutions is providing hope for the future success of sea turtles. ***Turtle Trackers*** tells the important and inspirational story of three species of sea turtle that depend on Florida's sandy beaches for nesting, some of the people driving their restoration, and the impactful strategies they are using.

KEY CONCEPTS

- Threatened and Endangered Species: Due to population declines of sea turtles across their global ranges the International Union for the Conservation of Nature (IUCN) has designated six of the seven sea turtle species as threatened by extinction (see Table 1). Some Caribbean species of sea turtle have lost up to 97% of their pre-Colonial numbers and all six species of sea turtle that spend all or part of their life cycles in U.S. waters are protected by the U.S. Endangered Species Act of 1973.
- Biodiversity: The International Union for the Conservation of Nature lists more than 44,000 species threatened with extinction and habitat loss and destruction is the major threat for more than 85% of these species. Female sea turtles spend an average of 20 years at sea before using their natural homing ability to return to the beaches where they were born to lay their own eggs. When they return the turtles often find that their birth beaches have been substantially transformed by coastal development, making it often impossible to find adequate nesting sites. Identifying and protecting nesting hotspots in the long term can help mitigate this threat but also provide critical habitat for other species that depend on beach habitat. For example, the presence of the turtles and what they leave behind–egg shells, unhatched eggs, and excess hatchlings as prey–function as fertilizer for beach vegetation and food for predators.
- Climate Change: Rising temperatures are driving sea level rise across the globe. Higher sea levels are predicted to threaten turtle nesting sites by reducing sandy beach habitat. Sex determination in sea turtles is also temperature dependent–more hatchlings are female at warmer temperatures–so rising temperatures may alter the ratio of males to females in sea turtle populations.
- 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

Sea turtles are a globally distributed group that includes seven species: Kemp's ridleys (*Lepidochelys kempii*), olive ridleys (*Lepidochelys olivacea*), green turtles (*Chelonia mydas*), hawksbills (*Eretmochelys imbricata*), loggerheads (*Caretta caretta*), flatbacks (*Natator depressus*), and leatherbacks (*Dermochelys coriacea*). The survivorship of adult sea turtles is quite high with most adults living for 50 to 100 years. However, the survivorship of their eggs and young is staggeringly low, with at most only one in 1,000 surviving to adulthood. Natural deaths of sea turtle young include nest and hatchling predators like racoons, birds, and crabs that roam turtle beach nesting sites, as well as various ocean predators. These predation threats have driven sea turtles to evolve extremely large clutch sizes of over 100 eggs per nest and the ability of females to produce two to eight nests per breeding season.

Among others, these two life history strategies have led to at least 110 million years of success for this unique group of marine reptiles. Unfortunately, since the beginning of the 20th Century sea turtles have suffered significant population declines due to the harvesting by humans of turtle adults and eggs for food and shell ornaments. But sea turtle populations have also declined as a result of bycatch, the accidental capture of sea turtles by ocean fishing operations. For example, in ***Turtle Trackers*** we learn that some Caribbean species have lost up to 97% of their pre-Colonial numbers. Since the 1950s these declines have motivated conservation efforts that have included bycatch regulations but also various beach protection measures such as the protection of individual sea turtle nesting sites (rookeries).

Turtle Trackers introduces us to some of the key players in protecting and restoring Florida's sea turtles, including biologists at the Boca Raton Gumbo Limbo Nature Center, biologists at the Marine Sciences Laboratory of Florida Atlantic University, and the nonprofit conservation group Upwell which focuses on turtle conservation at sea. The coordinated effort of these three groups is having a significant impact on restoring and conserving some of the most vulnerable sea turtle populations while also generating new knowledge about the ecology of critically endangered species like the leatherback during the "lost years" of their adult sea life.

Table 1. International Union for the Conservation of Nature Red List data for sea turtles.

Species	Red List status
[a]Hawksbill (*Eretmochelys imbricata*)	Critically endangered
[a]Kemp's ridley (*Lepidochelys kempii*)	Critically endangered
[a]Leatherback (*Dermochelys coriacea*)	Critically endangered
[a]Green (*Chelonia mydas*)	Endangered
[a]Loggerhead (*Caretta caretta*)	Endangered
[a]Olive ridley (*Lepidochelys olivacea*)	Vulnerable
[b]Flatback (*Natator depressus*)	Data deficient

[a]Protected in U.S. waters by the Endangered Species Act of 1973
[b]Not enough population data are available on the flatback sea turtle for the species to have a conservation status

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.: **H**abitat destruction and fragmentation, **I**ntroduced species, **P**ollution, **P**opulation growth, and **O**verharvesting. Many species are threatened by a combination of these factors, but habitat loss is the greatest threat to biodiversity. In ***Turtle Trackers*** we learn that the overharvesting of sea turtle eggs and the hunting of adults is what initially led to their population declines. But even with hunting and harvesting restrictions in place sea turtles have been further impacted by coastal development driven by human population growth that destroys their nesting habitats as well as chemical pollution and the accidental consumption of plastic debris.

DISCUSSION QUESTIONS

- [Before showing the film] Have students brainstorm what they know about the life cycle of sea turtles, including some of the strategies they use to survive.
- [Before showing the film] Have students investigate the legal status of sea turtle species that are designated as threatened and endangered by the Endangered Species Act of 1973.
- [After showing the film] Have students describe the life cycle of a sea turtle and explain why sea turtles are most vulnerable during the terrestrial part of their life cycle.

- In the film we learn that conservation strategies for green and loggerhead turtles on the Florida coast are working while conserving and restoring leatherbacks is more challenging. Have students discuss the "lost years" and why a one-size-fits-all approach does not work for all sea turtle species.
- Ask students to discuss why we need to plan 20, 30, and even 100 years into the future to provide adequate protections for the global sea turtle populations.

Curriculum Connections

NGSS

- HS-LS2 Ecosystems: Interactions, Energy, and Dynamics
  - LS2.A: Interdependent Relationships in Ecosystems
  - LS2.B: Cycles of Matter and Energy Transfer in Ecosystems
  - LS2.C: Ecosystem Dynamics, Functioning, and Resilience
  - LS4.D: Biodiversity and Humans
- HS-LS3 Heredity: Inheritance and Variation of Traits
  - LS3.B: Variation of Traits
- HS-LS4 Biological Evolution: Unity and Diversity
  - LS4.C: Adaptation
- ETS1.B: Developing Possible Solutions

AP Biology (2021)

Enduring Understandings

- Evolution (EVO)
  - EVO-2: Organisms are linked by lines of descent from common ancestry.
- Energetics (ENE)
  - ENE-3: Timing and coordination of biological mechanisms involved in growth, reproduction, and homeostasis depend on organisms responding to environmental cues.
  - 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
- A4.1 Evolution and speciation
- 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.

- C4.1 Populations and communities

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.

- D3.1 Reproduction
- D4.2 Stability and change
- D4.3 Climate change

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CREDIT

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