



SHELLS IN TROUBLE—TURTLE ECOLOGY, CONSERVATION, AND THE ASIAN TURTLE CRISIS

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Turtles are more than just animals with shells. They have important jobs in nature, eating and being eaten by other living things. Tropical Asia is a biodiversity hotspot for turtles—more than one quarter of all turtle species on Earth are found here. Some sad news is that turtles are going extinct because of humans hunting the turtles and destroying their habitats. This situation has been named the Asian Turtle Crisis. Many professionals are working hard to conserve turtles, but most importantly you can help also. In this article, we give you some background on the ecology and conservation of turtles, and we hope to inspire you to help with turtle conservation.

THE SCOOP ABOUT TURTLES

What are the first three words you think of to describe a turtle? Most people think of “shell, slow, and green.” Shell is a great word to describe a turtle, because all turtles have shells. Even a cartoon turtle like Squirtle from

Pokemon has a shell. No other animal on Earth has a shell like a turtle. To transform your body into a turtle shell, you would have to put your shoulders and hips inside your ribcage! Slow and green are not such good words to describe turtles, because not all turtles are slow and green. If you saw a turtle swim, you would know that they can move quite fast. And only a handful of the turtle species in the world are green. Most turtles have dull colors, like brown, gray, and black, but many have bright red, orange, and yellow patterns (Figure 1).

There are 356 living turtle species on Earth [1]. Turtles come in all shapes, sizes, and colors. You can see a few examples of interesting turtles in Figure 1. Some of the differences between turtles may help them to survive better in their particular habitats. For example, the common box turtle (scientific name *Terrapene carolina*, Figure 1A) can pull in its head, arms, and legs, and completely close its shell for protection. Completely opposite, the big-headed turtle (*Platysternon megacephalum*, Figure 1D) has such a big head that it cannot pull its head into its shell. Its large head gives this turtle a strong bite, which is helpful for feeding and protection. Turtles can have interesting colors and patterns, too. The Beal's-eyed turtle (*Sacalia bealei*) has spots on the back of its head that look like eyes. Scientists are not sure if the spots have a function. Many believe these spots may be used to trick a potential predator into thinking it is being watched, but this is just a hypothesis.

BIODIVERSITY HOTSPOT

A geographic region that has a high number of species, and is threatened by habitat destruction. These regions have been identified as priorities for conservation.

FIGURE 1

Turtle diversity. Although all turtles have shells, the various species can look very different. **A.** The common box turtle (*Terrapene carolina*) can completely close its shell for protection. **B.** Oldham's leaf turtle (*Cyclemys oldhamii*) spends so much time in the water that algae may grow on its shell. **C.** The elongated tortoise (*Indotestudo elongata*) lives in dry, hot areas and has short, stubby feet like an elephant. **D.** The big-headed turtle (*Platysternon megacephalum*) has a big head that can't be pulled into its shell. **E.** The Beal's-eyed turtle (*Sacalia bealei*) has spots on the back of its head that look like eyes. **F.** The Malayan snail-eating turtle (*Malayemys macrocephala*) has bright white stripes on its black head (All photos by Yik-Hei Sung).

BIODIVERSITY HOTSPOTS FOR TURTLES

Species are not evenly spread across the Earth. There are some areas that have more species, and we call these areas **biodiversity hotspots**. A biodiversity

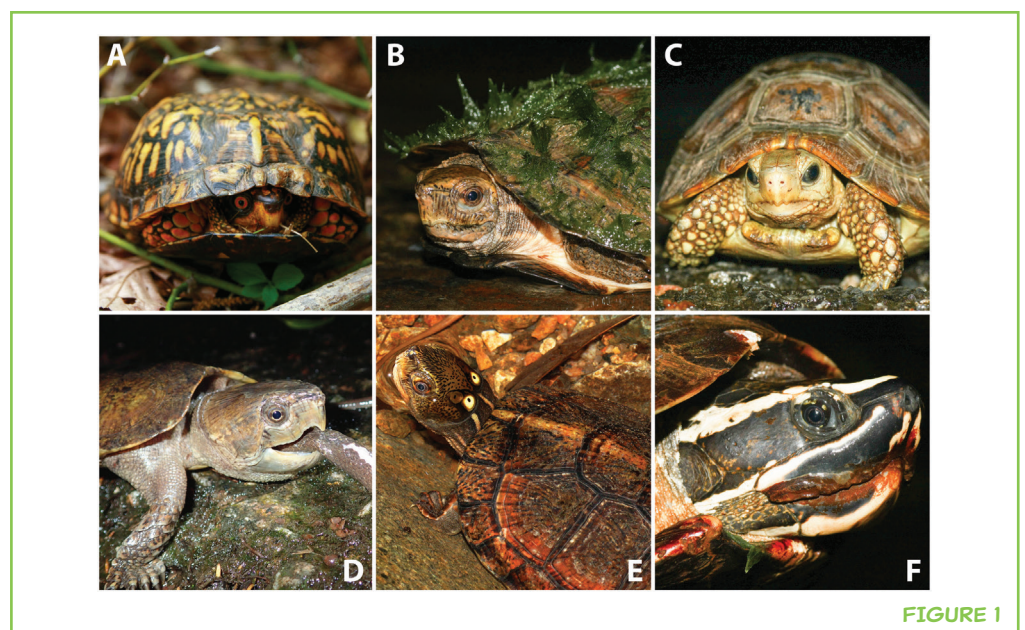


FIGURE 1

ENDEMIC

Being native to a particular geographic area. Usually this is used to refer to a species that is only found in a small area.

hotspot can be even more special if it has a lot of **endemic** species. An endemic species is special because it is *only* found in that place. For example, the emperor penguin is endemic to Antarctica—it isn't found anywhere else on Earth. Three biodiversity hotspots for turtles are found in tropical and subtropical Asia: the Ganges–Brahmaputra floodplains, the Indo-Burma hotspot, and the Sundaland hotspot. The Ganges–Brahmaputra floodplains hotspot includes Bangladesh, Bhutan, China, India, and Nepal. The Indo-Burma hotspot includes Cambodia, China, Myanmar, Laos, Thailand, and Vietnam. The Sundaland hotspot includes Indonesia and Malaysia. More than one quarter of the world's turtles are found in these three hotspots [2].

THE ASIAN TURTLE CRISIS

Human actions are pushing turtles toward extinction. There are three main causes. First, the natural habitats that turtles live in are being destroyed. Many turtles move back and forth between dry land and water, so damaging either of these habitats can be bad for turtles. Second, turtles are being hunted to be used as food. In many countries in Asia, turtles are eaten as food because there is a cultural belief that eating turtle meat can heal and protect the body. There is no scientific evidence to suggest that turtle meat is any different from other meats and seafood [3], but people in Asia still prize turtles for food. The third thing pushing turtles toward extinction is that turtles are hunted to be sold as pets. Often, turtle species that are rare and exotic are the most popular. The situation for Asian turtles is especially serious. This serious situation has been given the name “The Asian Turtle Crisis” [4]. The destruction of habitats and the huge demand for turtles as food and pets are putting Asian turtles in danger of extinction.

The life cycle of a turtle also puts it at high risk of going extinct (Figure 2). There are four main stages in a turtle's life cycle—egg, hatchling, juvenile, and adult. Turtles lay eggs just like birds and many other reptiles. In fact, turtles and birds are closely related, but that is a story we will leave for another article. Just like the name sounds, a hatchling is the baby that hatches out of the egg. As the hatchling grows bigger, it becomes a juvenile. This is like a teenager for humans.

FIGURE 2

General life cycle of a turtle. There are four main stages in the life cycle of a turtle—egg, hatchling, juvenile, and adult. Many individuals die as eggs and hatchlings. Changing from a juvenile to an adult takes a long time. Once an adult, the turtle can reproduce many times in its lifetime. Hunting usually targets adults. It is hard for a turtle population to survive when adults are taken away, because there are no turtles left to reproduce.

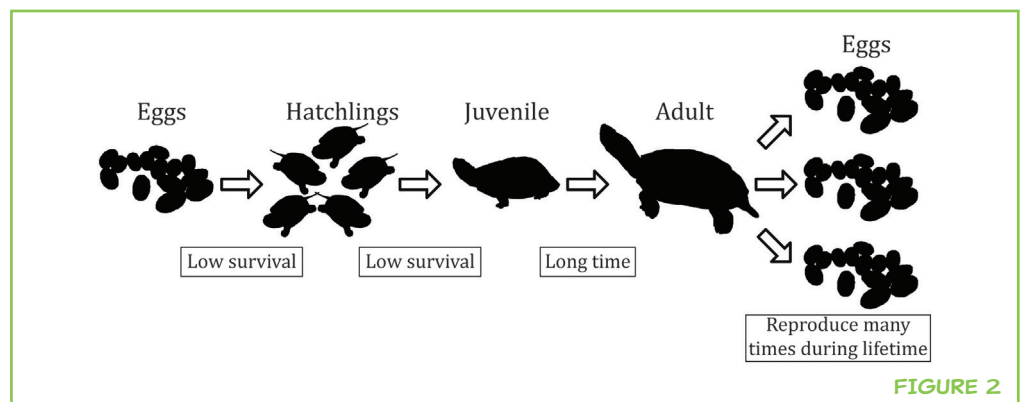


FIGURE 2

Lastly, the juvenile becomes an adult when it can reproduce. During the egg and hatchling stages, many turtles die (Figure 2) [5]. Juveniles and adults can survive well because their shells are so good for protection. Changing from a juvenile to an adult takes a long time—often more than 10 years. But once an adult, a turtle can live a long time and reproduce many times in its lifetime (Figure 2). Turtle populations survive because a few adults keep reproducing. Why does hunting put turtles at a high risk of extinction? It is because hunters usually take adults. Once the adults are taken, there are fewer turtles that can reproduce and the population starts to disappear.

WHY ARE TURTLES IMPORTANT?

Scientists are slowly gathering evidence of the important role turtles play in the ecosystem. One way to calculate the importance of an animal in an ecosystem is to measure the **total biomass**. If you could collect all the animals of one species and weigh them together, this would be the total biomass of that species. This kind of measurement is impossible, so scientists have found ways to estimate total biomass, such as multiplying the estimated population size with the average body weight. Studies have found that the total turtle biomass is one of the highest for vertebrates (which include mammals, amphibians, reptiles, fish) [6]. Based on this, if you think mammals are important in an ecosystem, turtles may be even more important.

An important function of turtles in an ecosystem is as both prey and predator [7]. Turtle eggs and hatchlings are prey for many animals. Fish, snakes, crocodiles, birds, mammals, and other turtles are known to eat eggs and hatchlings [7]. One reason for the low survival of turtle eggs and hatchlings (Figure 2) is because they are food for other animals. If turtles disappear, many animals will need to find new sources of food. As predators, many turtle species eat both plants and animals. Turtles that eat fruits can help the plant disperse its seeds [8]. If turtles disappeared, these plant species may have trouble reproducing and may also disappear. Turtles that eat meat often scavenge for dead animals. By eating dead animals, turtles keep an ecosystem clean and help the decomposition process [7].

TURTLE CONSERVATION AND YOU

Conservation is never easy, but we believe there are four main ways to protect and preserve turtles around the world and especially in Asia. The first is education. Before reading this paper, did you know that turtles around the world are going extinct? Most people in the world know that pandas and polar bears are going extinct, but few know about turtles. Public awareness of the possibility of turtle extinction could reduce the demand for turtles as food and pets.

TOTAL BIOMASS

The mass of a group of individuals from an area at one time. This measurement is often used to understand how important an organism is to the ecosystem.

NON- GOVERNMENTAL ORGANIZATION

Any non-profit, voluntary citizens' group. These groups are independent of the government and focus on specific issues, such as human rights, environment, or health.

The second way to preserve turtles is to protect the environment. To preserve turtles, we must preserve the habitat that they live in. Many turtle species live both on land and in water, so both land and water need to be protected. Important steps include keeping the water clean and not cutting down forests. Preserving the land and water in the turtle biodiversity hotspots [2] is a good first step.

The third way to protect turtles is legislation. In addition to the governments of countries, **non-governmental organizations** (NGOs) can help to make laws to protect turtles. NGOs are organizations that work independently of the governments, are non-profit, and usually work to address a social or political issue. Two important NGOs working on the conservation of biodiversity are the International Union for Conservation of Nature (IUCN) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Governments and NGOs can work together to pass new laws or strengthen old laws to protect turtles. For example, IUCN and CITES have lists that indicate how endangered a species is. Almost all countries around the world are members of IUCN and CITES and follow their rules. The turtle specialist group in IUCN has reevaluated how threatened turtle species are and has submitted a proposal to raise the protected status of many species [1].

The fourth action to preserve turtles is research. We need to understand the turtle species to protect them. A few basic things we need to know are where they live, what they eat, and how they reproduce. We can use this information to help with conservation. For example, the major threat to many endangered turtle species is hunting, so understanding where the turtles live can help us decide where to crack down on illegal hunting. Some turtle species have become too rare in the wild, so breeding and releasing turtles into the wild is needed to restore their populations. Breeding is usually done by zoos, but there are NGOs that anyone can join to help with breeding. Studying turtles to understand what they eat and how they reproduce is essential for successful breeding and conservation of turtles.

There are many things that you can do to help turtle conservation. First, you can teach others about turtles. If you have a project in your science class, you can choose to study and present information about the Asian Turtle Crisis. Second, if you want to keep a turtle as a pet, do some research beforehand so you don't choose a rare or endangered turtle species. An even better choice is to adopt a turtle. Many people buy turtles for pets when they are cute and small, then discard the turtle when it gets too big and takes too much work to care for. If you want to adopt a turtle, you can go to your local animal shelter or search online for local organizations that rescue abandoned turtles. But make sure you are ready for the big responsibility of caring for a turtle. The third thing you can do to help turtles is to keep studying hard in school. For your future job, maybe you will become a scientist that studies turtles. Maybe

you will be a politician and help pass laws to protect turtles. Maybe you will join an NGO that protects turtles. There are many jobs in which you can help protect turtles!

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This article was reviewed by the students of Desmond Middle School in Madera, California. The school is located in a rural part of the San Joaquin Valley of California and strives to provide scholastic opportunities to lower income families that they would otherwise not have access to. The class that reviewed this article is an engineering elective offered at Desmond that brings students closer to possible future career paths in the sciences and engineering.

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I am an assistant professor in the Science Unit at Lingnan University, Hong Kong. For research, I am interested in evolution and how it shapes the biodiversity on Earth. By using DNA data, we can understand how closely related populations/species are and connect it to geography. These results can be applied to protecting endangered species. I am particularly interested in amphibians and reptiles, but have also worked on bacteria, fungi, and invertebrates. *jonfong@ln.edu.hk



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