

# Education Carts 2014

Brandywine Zoo

## Two new carts



- We're introducing two new carts that will be used for the duration of the season.
- These carts are highly activity-based
- Different from old carts where there wasn't a direct script or story
- Incorporate Inquiry and STEM (Science, Technology, Engineering, Math) principles

# Cart Themes

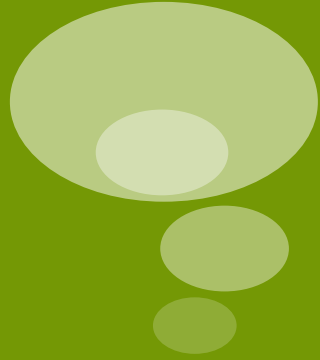


## Condors and Vultures

- This cart will focus on Andean condors, but also can be tied into New World and Old World vultures
- General messages
  - Condors and vultures are extremely well adapted for their jobs as 'garbage men' of the animal kingdom
  - Humans have greatly affected their populations

## BZ North American Carnivores

- This cart will focus on NA river otters, bald eagles, and American kestrels
- General messages
  - Specialized adaptations help these animals to find food
  - Humans have greatly affected their populations



# Condor Cart



# Condor Cart



- Guests will get to demonstrate the adaptations of a feather-less condor head
  - Goal: they will understand that condors and vultures are bald-headed as a hygiene adaptation.
- Guests will get to demonstrate the acidity of a condor/vulture's stomach
  - Goal: they will understand that the extremely acidic pH of their stomachs kills germs and keeps diseases from spreading as an ecosystem service
- Older guest adaptation
  - Guests will learn about how people have impacted condor/vulture populations by poisoning carcasses (for multiple reasons)
  - Goal: they will understand that people's misinformation or greed has inadvertently affected these critically important animals

# New World vs Old World

- **Vulture** is the name given to two groups of **convergently evolved**, scavenging birds of prey
  - Convergence is when animals from completely different populations and geographic areas evolve similar body shapes/adaptations due to similar ecosystem or dietary pressures. Think whales and fish-similar body shapes, different lineages. They're \*superficially similar\*.
- **Old World vultures** belong to the family Accipitridae, which also includes eagles, buzzards, kites, and hawks.
- **New World vultures** or **condors** belong to the family Cathartidae, which contains seven species in five genera. Includes Condors (Andean & California) and N/S American Vultures (like black & turkey)
  - The family's scientific name, Cathartidae, comes from *cathartes*, Greek for "purifier".





American turkey vulture



Lesser Yellow-headed vulture



Greater Yellow-headed vulture



American black vulture



King vulture

## New World Vultures

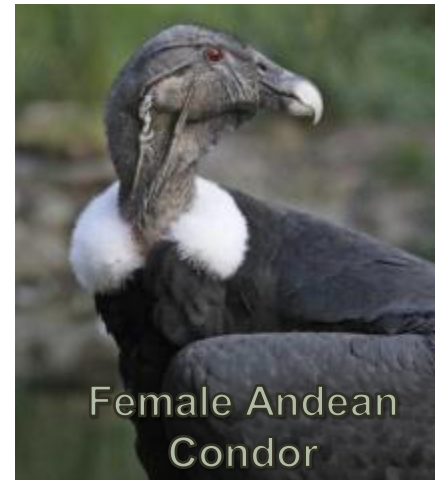
Black and turkey are the only two found in the US, and the only two in North America only.



California Condor



Male Andean Condor



Female Andean Condor

## New World Vultures (Condors)

The California condor is only found in California, Arizona and pockets of Baja, Mexico.

The Andean condor is only found in the Andes mountains, and males and females are dimorphically different.



# New World Vultures



## Classification

- Some taxonomists list Cathartidae as being closely related to *storks* and *herons*
  - Others want them listed as an entirely separate order
  - Still others would like to combine them with *accipiters* into a super-order.
  - Debate is still ongoing.
- All New World vultures have long, **broad wings** and a **stiff tail**, suitable for soaring
  - No New World vulture possesses a **syrinx**, the vocal organ of birds.
    - Vocalize in **hisses** and **grunts**
  - New World vultures have the unusual habit of **defecating** on their legs to cool them evaporatively.
    - This also, oddly, helps to purify their feet of bacteria from walking on contaminated meat due to their highly acidic feces/urine

# New World Vultures



- Their **beak** is slightly hooked and is relatively weak compared with those of other birds of prey (BoPs).
- This is because it is adapted to tear the weak flesh of partially rotted carrion, rather than fresh meat.

Sharp beaks are used to open carcasses and tear meat for swallowing in chunks

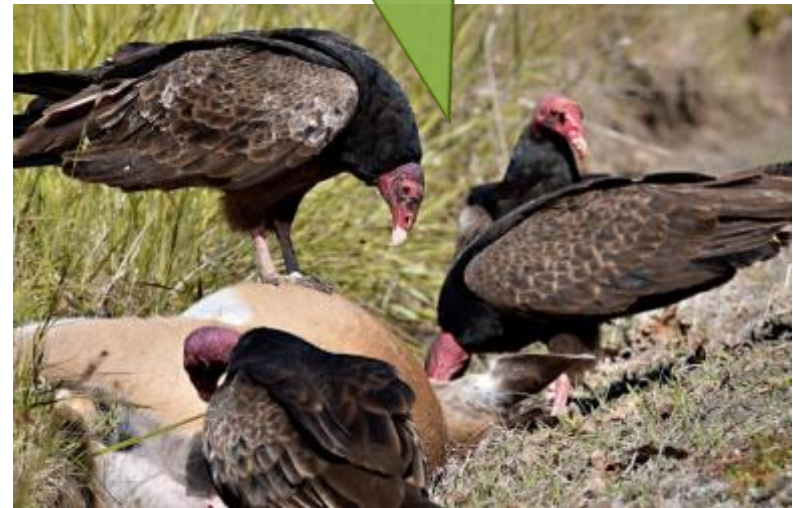




# New World Vultures

- A particular characteristic of many vultures is a **bald head**, devoid of normal feathers.
  - This helps to keep the head clean when feeding.
- Research has shown that the bare skin may play an important role in thermoregulation.

Their bald heads keep their heads free of debris while cleaning a carcass



# New World Vultures



- A group of vultures is called a *wake*, *committee*, *venue*, *kettle*, or *volt*.
- The term *kettle* refers to vultures in flight
- *Committee*, *volt*, and *venue* refer to vultures resting in trees.
- A *Wake* is reserved for a group of vultures that are feeding.



# Andean Condors



- **Largest** flying land-bird (10' wingspan)
  - 2<sup>nd</sup> **heaviest** flying bird (after Dalmatian pelican)
- Keen **eyesight** (can see in color)
  - Scavenging birds' eyesight is not as acute as other BoPs
- New World vultures have a well developed sense of **smell** (unusual for birds)
  - Old World vultures find carcasses exclusively by sight.

Their large eyes are not shaded by a bony brow bone, unlike those of eagles, hawks and falcons.





# Andean Condors



- When condors find a meal, they settle down and **gorge** themselves, as they are unable to carry anything along with them to save for later
  - Partly due to decay of raw meat, and their feet are **unable to grasp** anything
- **Talons** are relatively blunt
- Condors regurgitate food for their young, rather than carrying it back to the nests for these same reasons



Their back toe is so stubbed that it does not really have the capability to grasp

# Andean Condors



They can soar for hours on end with hardly any flapping of their wings



- Condors are **soaring birds**
  - Lack a sternum, like other soaring birds
- They prefer to roost on high places from which they can launch without major wing-flapping effort.
- Andean Condors are often seen **soaring** near rock cliffs, using the heat thermals to aid them in rising in the air
- Vultures sunning themselves with outstretched wings are warming their muscles in preparation for hours of flight ahead.

# Dimorphism in Condors



## Males

- The male condor is slightly bigger (unlike most BoPs) and has a pinkish head, like a turkey.
- The flappy mohawk is called a comb and is unique to each condor.
- They have dark-honey/golden colored eyes.



## Females

- The female condor is slightly smaller and has a darker, more black head.
- Females have no combs
- They have red eyes.





# Vulture stomach acid



- The pH of a **human's gastric juices** is between 1 and 2. The pH of a **vulture's gastric juices** is between 0 and 1.
  - **Vinegar** has a pH of 2.4 and **battery acid** is 0.8.
  - **Acid rain** has a pH of 4-5
  - It is also more acidic than the stomach contents of other carnivorous birds, including herons and barn owls.
- A vulture's stomach acids are so strong, they can even dissolve metal!
- Vulture stomach acid is so exceptionally corrosive, that they can **safely digest putrid carcasses** infected with *Botulinum toxin*, *hog cholera*, and *anthrax* bacteria that would be lethal to other scavengers.
- A vulture's **blood** is packed with antibodies, which will attack any bacteria that happen to survive in its stomach.

# Vulture stomach acid

## Story Framing:



- The vulture's stomach acid also explains how it survives off its odd diet of rotting meat.
  - Vultures will stay healthy even after eating the carcass of a sick animal.
  - The bird's stomach acid is so powerful that it breaks down the meat quickly, before any pathogens have a chance to infect it.
- Vultures' taste for rotting flesh serves an important purpose of preventing the spread of diseases and bacteria.
  - In areas where vultures have died off, diseases such as **rabies** and **anthrax** are rampant.

# Vulture stomach acid

- When vultures feel threatened, they have a handy way of reacting: They induce vomiting.
  - While they don't 'projectile vomit' on their attacker as a deliberate defense, vomiting does lighten their stomach load to make take-off easier. Plus, the vomited meal residue may distract a predator, allowing the bird to escape.
- This is often why we see vultures as road-kill-their first reaction is to vomit to get away, since they're often too heavy to fly off quickly. However, they often cannot do this fast enough to get away safely.



# Stomach Acid Activity



- Setup
  - Activity
  - Break-down
- General Activity Guidelines
    - Guests will get to crush dried pasta, which represents bones
    - They will then add pieces of antacid tablets and get to see the chemical reaction that occurs in the condor stomach.



- Discuss general comparisons between vulture stomach acids and other acids
- Conservation message:
  - **Vultures are critical to controlling the spread of disease in our ecosystems**

# Carcass demonstration activity



- Setup
- Activity
- Break-down
- Guests can put on condor puppet and pull food out of the carcass
- Explain that condors will strip carcasses of rotting meat and can even digest bone material.
- Conservation message:
  - **They are the ‘garbage men’ of the ecosystem, and prevent the spread of disease**



# Carcass demonstration activity



*For older audiences:*

- **Mass accidental poisonings**
- Farmers and ranchers commonly poison the carcasses of animals to kill predators which prey on their livestock
- Vultures, which are carrion eaters and feed exclusively on dead animals, are inadvertently poisoned.
  - **Poison is cheap, easy and effective**
- This is happening worldwide

To read more:

<http://www.pbs.org/wnet/nature/episodes/the-beauty-of-ugly/why-is-the-cape-griffon-vulture-going-extinct/420/>

- In Asia, mass accidental poisonings from the use of a veterinary drug used on cattle for inflammation and is fatal to vultures
  - In Hindu areas, cattle are not consumed when they die, and are left in the field to be cleaned by scavengers
  - In Asia: 10 million birds dead in just over 10 years (farmers will poison carcasses of livestock that die in the field)
  - Some populations have dropped by 99.7%
- Consequences:
  - Drinking water has become seriously contaminated
  - Rats and wild dogs #s have increased
  - Spread of diseases such as rabies, anthrax, and the plague

# Carcass demonstration activity



*For older audiences:*

- **Mass accidental poisonings**

- Andean condors are endangered in part because farmers in S. America thought they were hunting their livestock

- Farmers would see them feeding on the carcasses of livestock that died in the field or were killed by other carnivores, like pumas or jaguars

- Farmers would shoot the condors, or, worse, leave out poisoned carcasses for them to feed on.
- The practice of poisoning carcasses still happens around the world when due to farmers misunderstanding the role of vultures

- Read more:

- <http://www.decodedscience.com/carbofuran-poisoning-threatens-andean-condor-recovery-project/18688>

# Carcass demonstration activity



*For older audiences:*

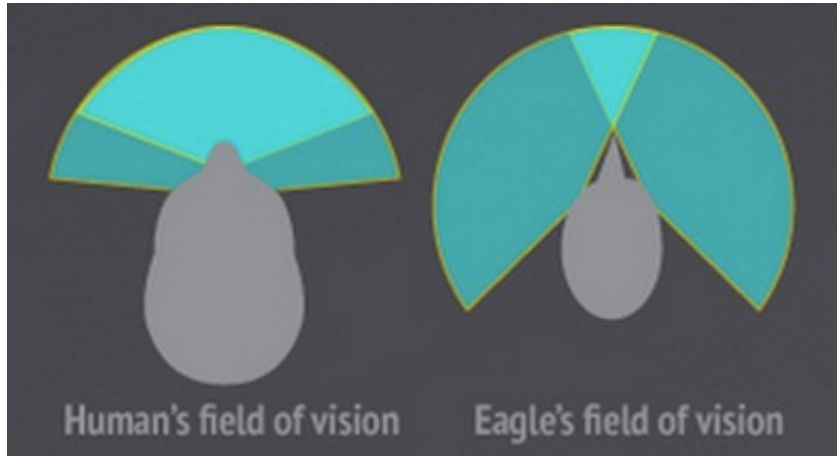
- Poaching
- Around the world, poaching still takes place. Often, poachers are only after a specific part of an animal, such as rhino horn or elephant tusk.
- Game wardens can often identify a poach site because of the presence of vultures circling the carcass.
  - Poachers, in an effort to hide their activities, will poison carcasses so that they can continue to work in an area without attracting attention by officials.
  - Unfortunately, this often results in the death of hundreds, if not thousands of scavengers annually.
- **What you can do:**
  - Contribute to condor conservation-education programs financially.
  - Refuse to buy wildlife products, even if they seem legally acquired. i.e. ivory (US is the 2<sup>nd</sup> largest market for illegal ivory trade, after China, due to our lax laws and difficulty in identifying sources)



# BZ North American Carnivores



# Bird of Prey Eyesight

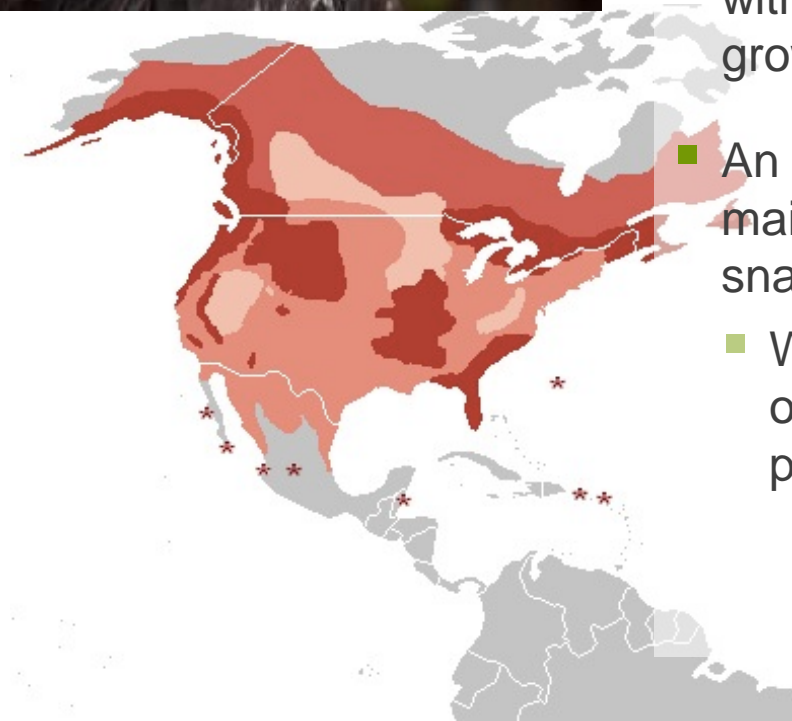


- The placement of their eyes gives them excellent binocular vision, which allows for superb depth perception when hunting their prey.
- Good binocular vision also enables extremely accurate judgment of distances.
- The eye of BoPs is tube-shaped to produce a larger retinal image with high density of receptors.
  - The more receptors an animal has, the **higher its ability to distinguish individual objects at a distance**
- BoPs have three types of color receptors in the eye
  - They probably have similar color perception to humans.



## Bald Eagles

- Is a bird of prey found in North America.
- It is found near large bodies of open water with an abundant food supply and old-growth trees for nesting.
- An opportunistic feeder which subsists mainly on fish, which it swoops down and snatches from the water with its talons.
- Will eat carrion, or even steal food from other carnivores if the opportunity presents itself



# Bald Eagle



- Bald Eagles are not actually bald; the name derives from an older meaning of "white headed"
- Latin name:

*Haliaeetus leucocephalus*

*hali* = sea, *aeetus* = eagle,

*leuco* = white, *cephalis* = head



# Bald Eagle

## Growth and Development



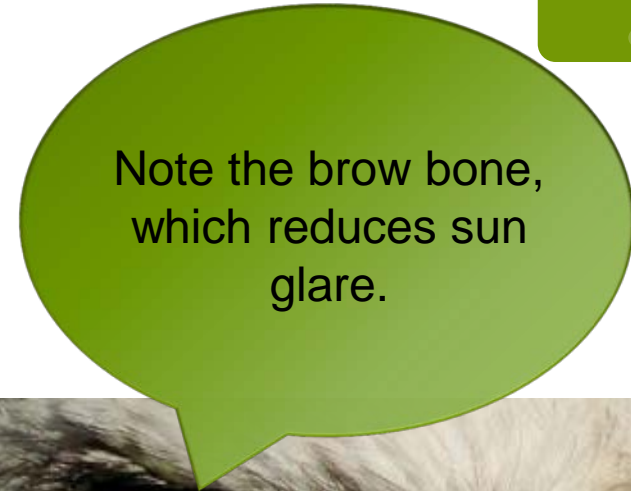
- **Eaglet:** A newly hatched eaglet weighs around 3.2 oz, or about 18 nickles!
- **Fledgling:** (12 weeks) a chick that has completed its first flight, but is still cared for by its parents
- **Juvenile:** (1-4 years) a fully grown, but still immature eagle.
- **Adult:** (5+ years) fully mature bald eagles have their distinct white heads and tails
- The plumage of the immature is a dark brown overlaid with messy white streaking until the fifth year, when it reaches sexual maturity





# Eagle eyesight

- An eagle's eye is almost the same size as a human's, but its vision is **at least 4 times sharper** than that of a person with perfect eyesight, some say 6-8 times.
  - The old saying is that if an eagle could read, it would be able to read a newspaper at 100 yards!
- Birds have the **largest eyes relative to their size within the animal kingdom**, and movement is consequently limited within the eye's bony socket.



Note the brow bone, which reduces sun glare.





# Eagle eyesight

- Movement
- BoPs eyesight allows them to pursue agile prey and avoid objects in their flight path at high speed; to humans such a chase would appear as a blur.
- To obtain steady images while flying or when perched on a swaying branch, BoPs hold the head as steady as possible with compensating reflexes.



# Eagle eye

- Eagles have two types of eyelids, their normal outer pair, made of an 'upper' and 'lower' lid.
  - They also have special, 'internal' eyelid called the **nictitating membrane**.
  - Eagles can blink by closing the outer upper and lower lids like we do.



- The **nictitating membrane** is a transparent membrane that is moved back and forth over the surface of the eye, often times very rapidly.
  - It functions *to keep the surface moist and to clear off debris* while protecting it when grabbing prey
  - Reptiles and birds have these membranes, humans do not.



# Bald Eagle

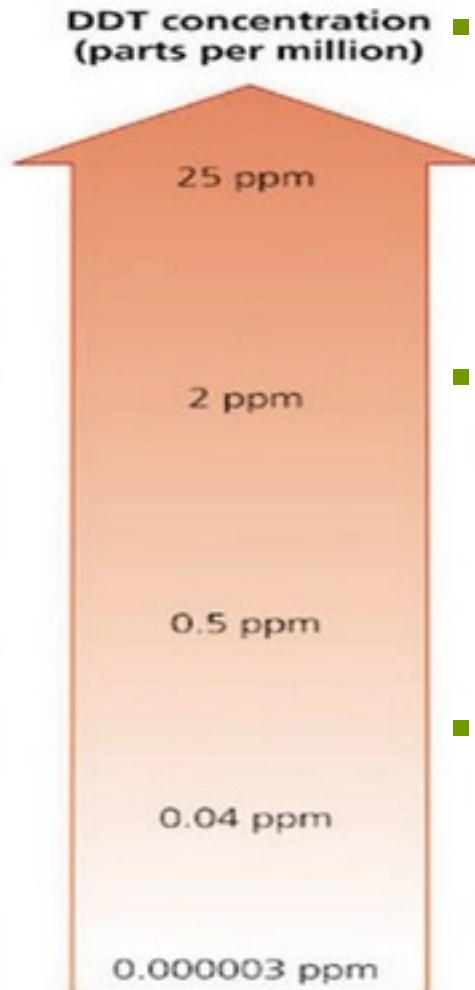
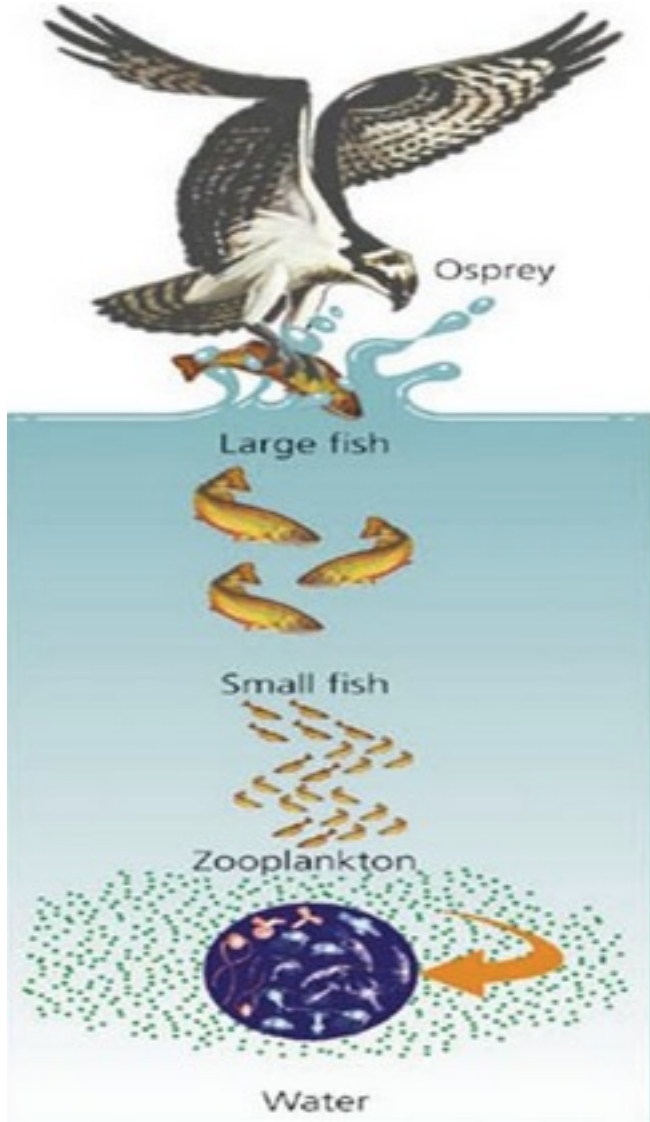
## Conservation and Recovery



- Due to the effects of DDT and lead shot, as well as habitat loss, bald eagle numbers fell in the 20<sup>th</sup> century to less than 500 in the US.
- Thanks to the banning of DDT, farming and hunting reform, as well as legislative tools such as the Endangered Species Act, the Migratory Bird Treaty Act and other programs instituted by US Fish and Wildlife, bald eagles have made an enormous recovery.

# Bald Eagle

## Conservation and Recovery



- **What is DDT?**

- DDT (dichlorodiphenyltrichloroethane) is a powerful **insecticide** used by farmers to protect their crops from insects. This chemical would wash into waterways and contaminate fish.

- Because eagles eat lots of fish, DDT built up in their bodies, a process called **bioaccumulation**, and caused them to lay eggs with very thin shells. When the parents would sit on their eggs, they would crack, resulting in very low reproduction.

- Other carnivorous birds like osprey and brown pelicans were also greatly affected by bioaccumulation of DDT.



# Eagles on the cart

- Materials
- Biofacts
  - Skull
  - Talon
  - Egg
- Binoculars
- Eagle stuffed animal
- Roll of nickles
- Show guests skull, talon, and egg
- Explain the acuteness of eagle eyesight
  - Point to sign by goat pen, or another sign at least 30' away, and ask guests if they can read it.
  - Allow them to look through the binoculars and try again.
    - Eagles eyes are constantly in focus
- Conservation Message
  - **Eagles are our national symbol, and a conservation success story**
  - **Shows what can be accomplished with legislation and commitment.**

# North American River Otters



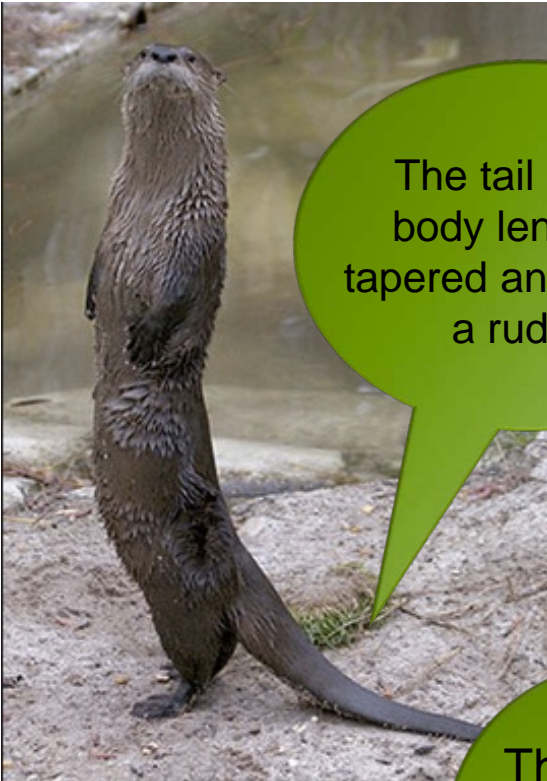
- North American river otters occur throughout Canada and the United States, except for areas of southern California, New Mexico, and Texas, and the Mohave Desert of Nevada and Colorado.
- Otters can live in both marine and freshwater temperate environments. Found in rivers, lakes, marshes and other inland waterways



# North American River Otter (NARO)

Equipped for Aquatics

- The river otter is physically well-equipped for aquatic life.
- The ears are short, the neck is the same diameter as the head, leading to a stream-lined body.
- Legs are short and powerful



The tail (1/3 of body length) is tapered and acts as a rudder

The toes are fully webbed





# North American River Otter

Equipped for Cold

- The otter's fur is composed of short 'down' fur and long 'guard' hairs
  - This multi-layer system creates air pockets, which protect the otter's skin from cold water
- NAROs have the 2<sup>nd</sup> most dense fur of any mammal on the planet (#1=sea otters)
  - 370,000+ hairs per square inch
  - Humans average 100,000 on their entire scalp!

Short, dense fur acts as an insulator



Natural oil-coating adds water resistance

# Otter senses

- Otters hunt for food using touch and sight
  - They use their eyes, whiskers and hands to hunt
  - Using their hands and whiskers, otters comb the riverbed for food



They're near-sighted, a consequence of vision adapted for underwater sight

- Eyes have transparent nictitating membranes to protect them while swimming
- New research suggests they may even be able to smell underwater:
  - By exhaling bubbles and sniffing them back in, they could be analyzing scents in the water around it

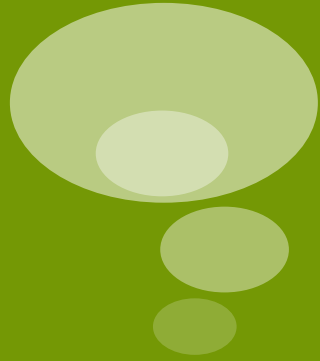


# Otters on the Cart



- Materials
- Biofacts
  - Otter pelt
  - Water table
    - Objects to find
- Discuss how otters use their senses of touch and sight to find their food under water
  - Sometimes the water is so murky, though, they can only use their hands and whiskers to find food.
- Instruct guests that they will get to hunt for otter food
  - They will put their hands into the tub and get to feel around for food, just like otters.





# Kestrel Cart

Additional cart that may be used this  
year



# American Kestrel

- Diurnal bird of prey
- Smallest species of falcon in N America
- Primarily eat insects, but will hunt small rodents, small reptiles, and birds



# Kestrel dimorphism



## Males

- The rump and tail are bluish grey and unbarred



## Female

- In females rump and tail are brownish-red with dark barring



# Kestrel Eyesight

Avian hovercrafts



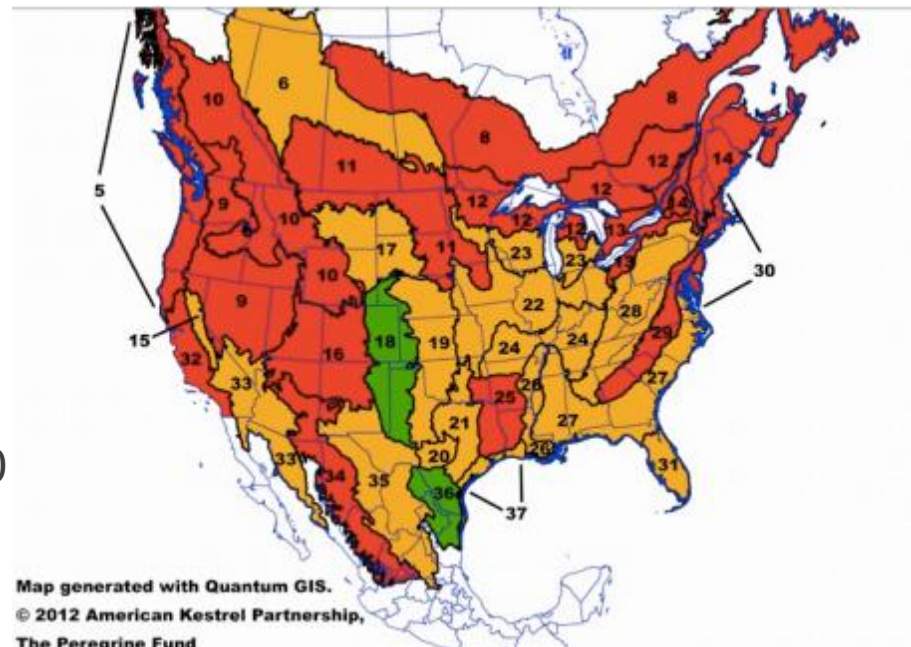
- The American Kestrel hunts by hovering in the air with rapid wing beats or perching and scanning the ground for prey.
- Great eyesight: An American Kestrel can see a 2–mm insect from the top of an 18–m tree



# Kestrels in decline

- Data from the [US Geological Survey's Breeding Bird Survey](#), [National Audubon Society's Christmas Bird Count](#), [nestbox monitoring programs](#), and [Raptor Population Index \(migration counts\)](#), collectively indicate long-term declines of American Kestrel populations in numerous regions of North America.
- New England/Mid-Atlantic has seen an **88% decline** in populations between 1966-2010

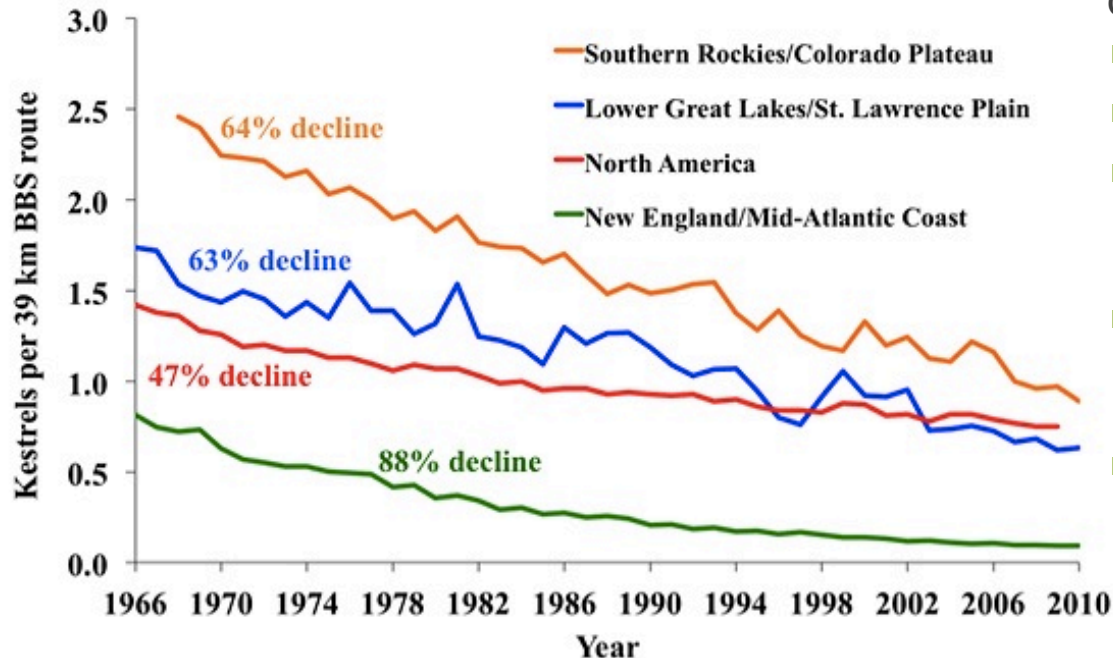
- **Red** - Population decline
- **Green** - Population growth
- **Orange** - Population trend uncertain





# Kestrels in decline

*BBS data indicate long-term population declines*



- Reasons for population declines may include:

- Land use
- Climate change
- Depredation by Cooper's Hawks and other birds of prey
- Competition with European Starlings for nesting cavities
- Environmental contaminants such as **rodenticides**, heavy metals, and brominated flame retardants (used in electronics and textiles)

- However, researchers do not have sufficient data to understand why these long-term, wide-spread population declines are occurring.



# Nest Box Monitoring



- The Brandywine Zoo is starting a kestrel nest box monitoring program in 2014
- Boxes will be placed around New Castle County and monitored by BZ staff and volunteers
- More info to come over the course of the season

# What people can do



- Stop using rodenticides (rat/mouse poison) to control rodent pests.
  - These pesticides can be consumed by birds of prey and make them sick or even kill them
- Become a BZ volunteer to monitor nest boxes
  - Contact Jacque Williamson, Curator of Education, for more information.

# Kestrels on the cart



- Materials
- Biofacts
- Kestrel box
- Show guests skull and egg in comparison to eagle skull
- Talk about nest box program
- Show how nest boxes are opened and checked