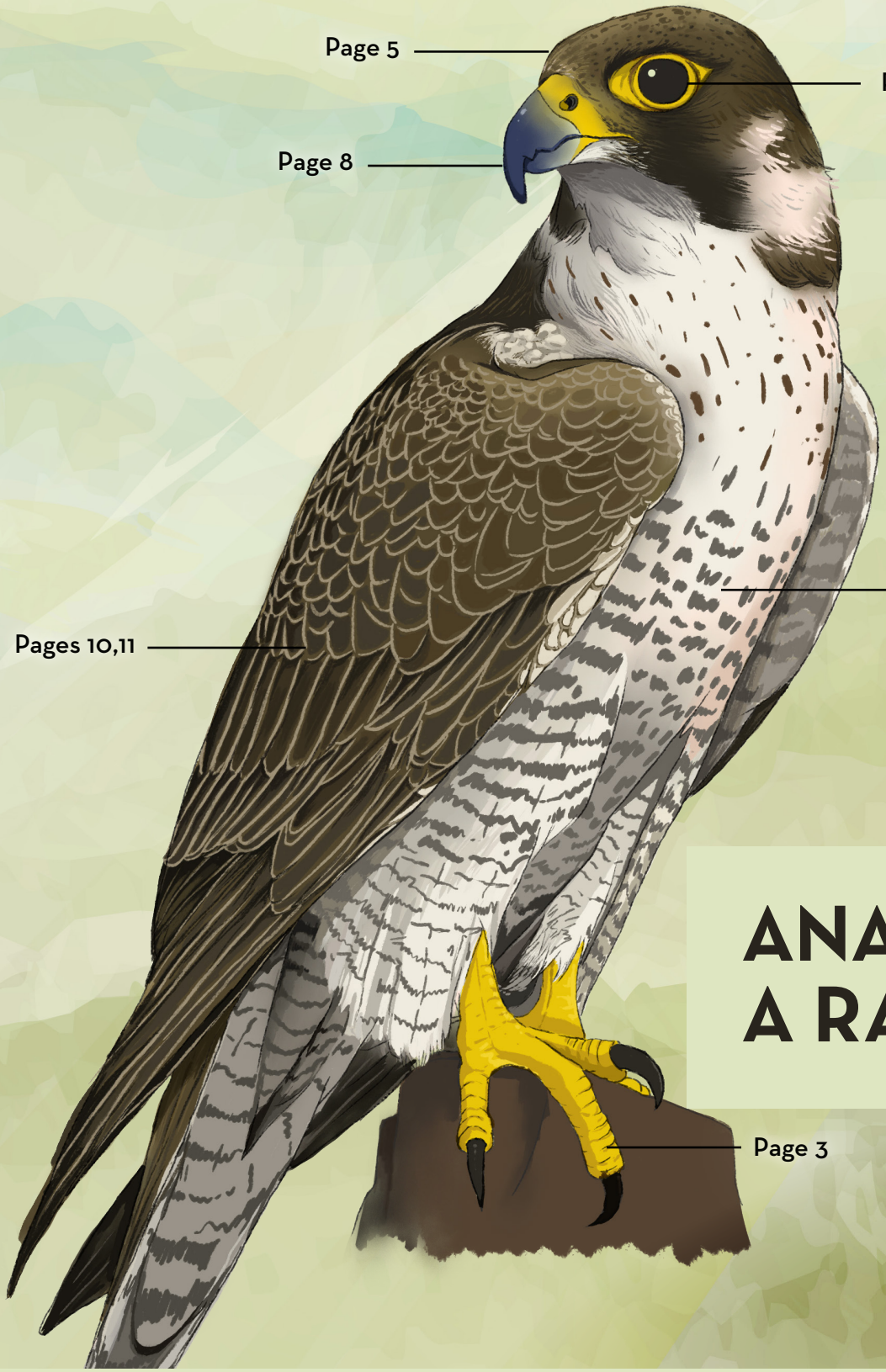
THE RAPTOR CENTER | *Ensuring the health of raptors and the world we share*

Raptor Release

Spring 2026



ANATOMY OF A RAPTOR

THE RAPTOR CENTER
UNIVERSITY OF MINNESOTA

Letter from the director

By Dr. Jonathan Sleeman

Dr. Jonathan Sleeman | Photo by TRC staff

How fascinating the world begins to look when you see it from the perspective of our raptors.

In my first quarter at The Raptor Center, I have been continuously inspired by the dedication of our staff, volunteers, and supporters, and the critical nature of our mission. Our ever-deepening knowledge of the minute details of raptor anatomy and physiology allows us to understand the conditions of the environment that they rely on, and helps us paint the picture of a healthy ecosystem—not just for birds, but for all life. Luckily, The Raptor Center has more than 50 years of understanding the intricacies of our incredibly fine-tuned birds of prey.

Our mission is directly linked to wider environmental health initiatives. Comprehensive wildlife health programs detect, assess, manage, and forecast avenues of harm prevention. The health of wild raptors serves as a crucial sentinel for the overall health of our planet.

To conduct work on such a grand scale, one needs to have a deep knowledge of the small, and at times practically invisible, features that make up raptors. When we can see the whole picture of raptor natural history and their fine-tuned physiology at the same time, raptors become essential magnifying glasses into the workings of our shared environment.

In this issue, we will take a deep dive into many parts that make our raptors so unique. You'll find compelling features, including how the falcon's digestive tract teaches us about their food source and how the variety in raptor feet shows us how they navigate and survive in the environment.

I hope these articles spark your curiosity in the same way raptors sparked the curiosity and passion of our team. The Raptor Center plays a vital role in ensuring a healthy future for these magnificent creatures, and we are grateful to have you alongside us.

Sincerely,

– Dr. Jonathan Sleeman
Executive Director and Redig Endowed Chair
The Raptor Center

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Cover designed by Nathan Pasch and Pengxu Cheng

Best foot forward

The talons and feet of raptors are super tools that tell each species' story of survival

By Anthony Baffo

To successfully hunt, perch, build, and grip, raptors need a precise super tool. The feet and talons of a raptor are one of the key features that differentiate them from the rest of the bird world.

One might assume that with the immense force with which a raptor can grab and hold onto its prey, it must have muscular feet. The surprising truth is that raptors have no muscles at all in their toes, or digits as they are called.

Raptors possess a self-locking system of rachets in their toes that are controlled by strong tendons originating from muscles higher up on their legs. When the muscles contract, the leg is shortened and the toes are pulled closed and held in place by rachets. To release its grip, a raptor straightens its legs to release the rachets' lock.

Another notable feature of raptor feet is that the bottom has papillae (small fleshy bumps) that help with grip, like the tread of your shoes. Additionally, ospreys have small spiny projections called spicules that help them hold onto slippery fish.

For most species, digits 1 and 2 are considered the power toes, as they provide the strongest grip for securing prey. Bird-eating raptors, such as Cooper's hawks and peregrine falcons, have additional adaptations. Their third digit is extra long and has a protruding pad that wraps around and grips their avian prey in the air.

Once you look past their intimidating, sharp claws, an anatomical understanding reveals there is so much more than meets the eye.

Peregrine falcon | Photo by Harry Collins from Getty Images

Osprey | Photo by Harry Collins from Getty Images

Bird's eye view

Specialized vision allows raptors to detect tiny details, see in more colors, and judge distances with impeccable precision

By Dr. Jonathan Sleeman

Long before humans developed binoculars, telescopes, or drones, raptors evolved visual systems so powerful that they can spot a mouse from hundreds of feet in the air. Their vision is not just better than ours; it is fundamentally different and shaped by millions of years of hunting from the sky.

One of the most striking features of raptor vision is sharpness of sight. A hawk soaring high above a field can detect the subtle movement of a vole hidden among grass that looks completely still to us. Raptors have large eyes relative to their head size, packed with a high number of light-detecting cells, creating an image that is both crisp and precise. Raptors also have one or even two specialized areas in the retina called foveae, which act like built-in zoom lenses, allowing them to focus intensely on distant targets.

Color vision is another strength for many species. Unlike humans, who have three types of color-sensing cells, many raptors have four, allowing them to see a broader range of colors. Some species can even detect ultraviolet light, which is invisible to us. This ability can reveal urine trails left by small mammals or subtle feather markings on other birds, all useful clues when hunting for prey.

Depth perception is equally important. Like humans, raptors rely on forward-facing eyes, giving them excellent binocular vision, which is critical when diving at high speed or grasping prey with talons. A falcon hurtling toward its target must calculate distance, speed, and angle in a fraction of a second.

Not all raptors see the world in the same way. Owls, masters of low-light vision, have extremely sensitive eyes, allowing them to hunt at dusk or in near darkness. While owls trade some sharpness and color vision for light sensitivity, they compensate with incredible hearing, forming a powerful nighttime hunting toolkit.

Raptor vision is more than a biological marvel; it plays a vital role in ecosystems. By efficiently locating prey, raptors help regulate populations of rodents and other animals, contributing to ecological balance. Raptor vision is a stunning example of nature's engineering: Eyes designed to read the movement, color, distance, and detail of the world all at once, from the sky.

Closeup of a red-tailed hawk's eye. | Photo by TRC staff

Inside the raptor mind: Not bird-brained at all

By Rob Kulhanek

While many of us love raptors for their beauty, we often overlook their intelligence. Folks at The Raptor Center (TRC) can tell you all about how smart and savvy these birds can be. The power of these complex brains manifests in several ways through raptor behavior.

Raptors are often perched with little motion, have a "severe" expression, and appear calm and patient in their disposition. This perceived stoicism may mask their intelligence, as many types of raptors are also known for their problem-solving, memory, and associative learning skills.

The largest part of their brains, the telencephalon (/telənˈsefələn/), mainly processes visual and spatial information, especially in nocturnal hunters such as owls. They see, hear, and understand what they are sensing very quickly and can react rapidly to that information, critical to their survival in the wild.

Many raptor species have shown they are capable of remembering individuals and can work collaboratively with other members of their species. TRC's education team supports the collaborative nature of our raptor ambassadors as they care for and train them to be willing education partners. Ambassadors learn to associate a cue, most often a noise or sight, with a specific behavior, which is then reinforced with something positive, such as a food reward. This allows TRC to safely and respectfully display our ambassador raptors, who willingly engage with their handlers in a variety of educational settings.

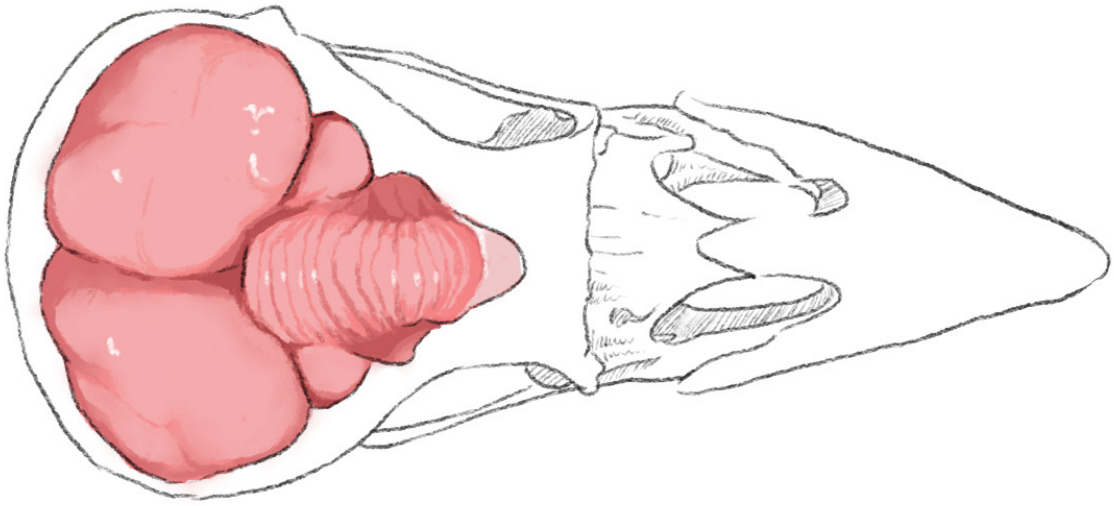


Illustration of a bald eagle's brain inside of its skull. | Illustration by Pengxu Cheng

Several raptor species adapt their hunting strategies based on the environment—golden eagles will use sun-blinding to disarm prey, red-tailed hawks will wait on the side of the road for car strikes, and Harris's hawks will hunt collaboratively in family groups to flush out their next meal. Some raptors, such as Egyptian vultures, have even demonstrated the ability to use tools.

Raptors, like most of their avian kin, have a complex brain structure with many components comparable to those of the mammalian brain. However, raptors have a high brain-to-body ratio and higher neuron density than mammals, which indicates their brains are more efficient at processing information.

Raptors' brains are much more complex and powerful than many people give them credit for. Their intelligence is essential to their success in both the wild and at TRC.

Kids Corner

The Peregrine Falcon:

A Speedy Flier with an Amazing Comeback Story

What's the fastest animal in the world? Lots of people would say it's the cheetah, which can run 75 miles per hour (mph). The cheetah is indeed the world's fastest animal on land.

But if we look to the skies, that's where we find the fastest animal in the world: the peregrine falcon. This amazing bird can dive at speeds of 200 mph to catch its prey.

Peregrine facts:

They live up high. Typically, they nest on cliffs or bluffs overlooking rivers and lakes.

But today, in the Midwest, 70% of peregrines are city birds. They nest on skyscrapers, towers, and bridges.

For thousands of years, people have been training falcons like the peregrine for use in the sport of falconry.

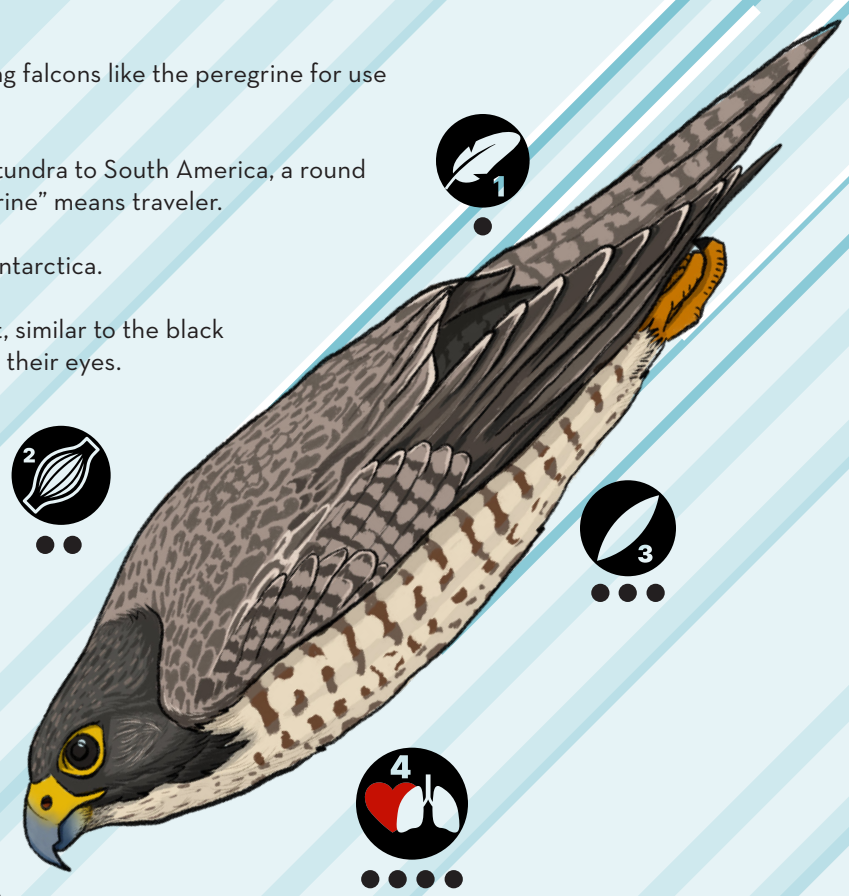
Some peregrine falcons migrate from the Arctic tundra to South America, a round trip of more than 15,000 miles. The word "peregrine" means traveler.

Peregrines are found all over the world except Antarctica.

The black markings on their faces reflect sunlight, similar to the black markings football and baseball players put under their eyes.

How do they fly so fast?

- 1. Pointed wings with stiff feathers
- 2. Powerful flight muscles
- 3. A streamlined shape
- 4. Strong hearts and lungs



The peregrine's dangerous decline and amazing comeback

This awesome bird nearly disappeared from the U.S. and Canada by the 1970s. The culprit: DDT, a chemical that was used to kill insects but also poisoned raptors (birds of prey) and harmed their eggs.

Fortunately, DDT was banned in the United States in 1973.

Falcon experts started to regrow the number of peregrines by breeding them in captivity and releasing them from cliffs, towers, and tall buildings.

They watched over the young birds as they learned to fly and become independent.

The Raptor Center (TRC) played a central role in bringing back the peregrine in the upper Midwest. The efforts of falcon lovers were so successful that in 1999, the peregrine falcon was no longer considered to be endangered.

The Raptor Center and our peregrine ambassador, Palisade

TRC's raptor hospital takes care of 15 to 20 sick or injured peregrine falcons each year.

TRC is also home to our own resident peregrine falcon, Palisade, one of our "ambassador" birds that helps people learn about raptors and the environment.

Palisade was hatched in 2019. She is named after Palisade Head, a large rock formation along the North Shore of Lake Superior, where peregrine falcons have long nested in Minnesota.

Palisade was part of a breeding program at Stillwater Area High School in Minnesota run by a falconer and biology teacher. By helping watch over the falcon chicks, the students learned about biology and conservation.

Thanks to breeding programs like the one Palisade came from and other efforts of people who love falcons, peregrines are now thriving—once again nesting, flying, and diving from high places, in an amazing comeback story.

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Arctic tundra
traveler
towers
South America
bridges
skyscrapers
bluffs
cliffs

Turkey vulture | Photo by Matt Cuda from Getty Images

Bald eagle | Photo by Alexas_Fotos from Pixabay

Battle of the beaks

It's the function and flare of an essential survival tool – so how do they differ between two of Minnesota's largest raptors?

By Jon Sicinski

Beak shape and function can vary greatly between bird species, including raptors. Some species are considered specialists–such as fish-eating osprey–that are particularly adapted for hunting certain prey. On the other hand, generalist species, such as red-tailed hawks or great horned owls, readily hunt a wide variety of prey.

In Minnesota, we share the land and sky with two large and beautiful species: the resident bald eagle and the migratory turkey vulture. Both species have different tactics for acquiring food. Yet, they are both known for scavenging on the carcasses of deceased wildlife. So when it comes to their beaks, what makes them so different in the ways that they scavenge and survive?

Bald eagles are primarily piscivores, otherwise known as fish-eaters. However, they will readily scavenge on carcasses, from small mammals and birds all the way up to white-tailed deer. Their larger skull and thicker beak allow them to hold on tight to slippery food items and their beak, which takes up a third of their skull, gives them an edge in tearing off scraps from decaying flesh. During Minnesota winters, this can be especially useful when deceased animals quickly become stiff or frozen. Turkey vultures are open-range scavengers that do not hunt for their food, and they have a differently tuned instrument. Their impressive beak is narrower, deeply hooked, and proportionate to their smaller skull. Areas on carcasses that are considered tighter and tougher can, with precision, be twisted, torn loose, and consumed by vultures, opening up carcasses and providing greater access to food for other wildlife. Their ability to quickly twist and pull off morsels comes in handy when scavenging in social situations with other vultures where competition can become fierce.

Despite their differences, both the bald eagle and the turkey vulture have finely crafted physical attributes that allow them to survive in the wilds of Minnesota.

Food for thought

The adaptations of a raptor's digestive system are vital for its active life

By Lori Arent

Raptors are amazing creatures designed to be effective aerial predators. Every part of their anatomy supports flight, including their digestive systems.

Efficient digestion is critical as it supplies the energy required for awe-inspiring aerial maneuvers, powerful bursts of speed, and, for some, long-distance travel.

As carnivores, raptors depend on diets rich in protein and fat to fuel their active lifestyles. Just as different cuts of meat vary in nutritional value for humans, different prey species provide varying levels of calories and nutrients.

A raptor's anatomy, primary flight style, and diet are closely connected. Wing length, shape, and width influence how a raptor flies, which in turn affects the type of prey it can capture. The digestive system is then adapted to extract the maximum energy from that specific diet.

For example, fast, active hunters, such as many species of falcons, have shorter small intestines than species that use more search-based hunting strategies, such as owls and soaring raptors. Shorter intestines reduce body weight, increasing speed and agility. To compensate, these birds often consume energy-rich, easily digested prey—often other birds—and absorb nutrients more quickly.

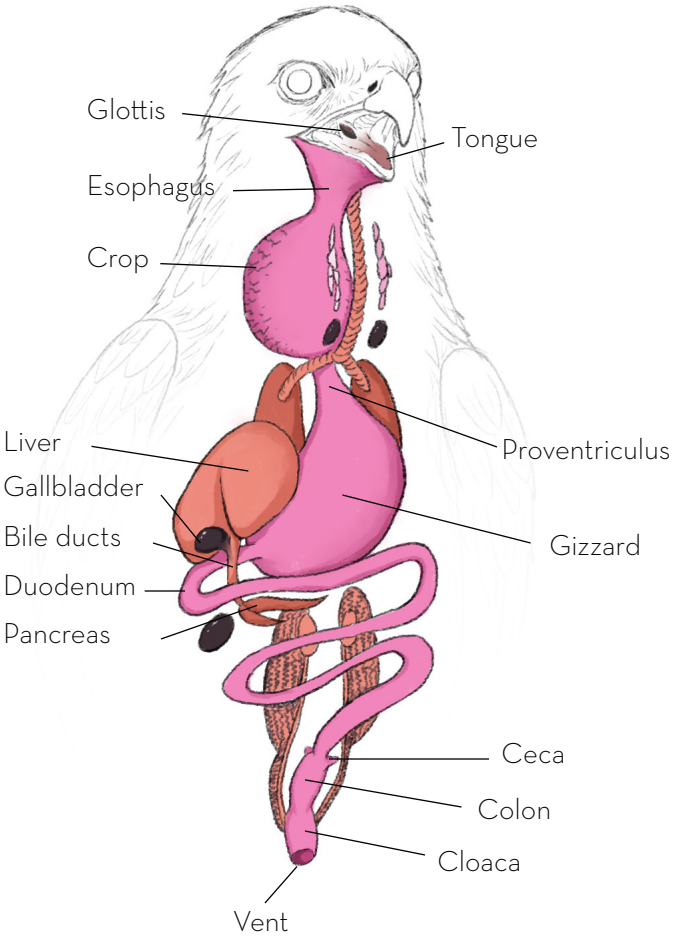


Diagram of the digestive system of a diurnal raptor. | Illustration by Pengxu Cheng

Compacted indigestible material or pellet collected from a great horned owl. | Photo by Lori Arent

Raptors also share several digestive traits common to other birds. Diurnal raptors (hawks, eagles, osprey, vultures, etc.) possess a crop, an enlarged section of the esophagus that allows food to be stored temporarily. This adaptation lets them eat a large meal quickly and retreat to a safer location to digest. Owls, on the other hand, lack a crop and often swallow prey whole, minimizing time spent exposed on the ground.

In addition, all raptors have a two-part stomach. Strong acids in the upper part begin to chemically break down the food, while the lower part mechanically grinds food and compresses indigestible material (fur, feathers, and large bones) into pellets that are later regurgitated. Like other body systems, the digestive system of raptors is brilliantly designed to support these powerful, agile hunters of the sky.

Structured for success

The characteristics of flight feathers drive raptor species' style, speed, and more

By Dr. Dana Franzen-Klein

If you were a raptor, would you pick feathers to optimize silence, speed, or soaring? The structure of a raptor's feathers tells us the story of their airborne behaviors.

A raptor's main flight style depends on its uniquely adapted flight feathers. Raptors have 10 primary flight feathers on each wing, attached to one of the outermost bones, the major metacarpal bone. Each feather is unique, and specific features vary between species.

The elusive reputations of owls are thanks, in part, to silent flight, made possible by their feathers. Serrated, forward-facing edges on their outer primary feathers break up air turbulence into tiny micro currents that are less noisy as they swoop in to catch prey. But that's not all. The top and back edges of their feathers also have a thin layer of fuzzy fringe, soft to the touch.

Compare an owl to the fastest living animal on earth, the peregrine falcon. This falcon trades silence for propulsion. Rigid, smooth, and pointed feathers provide high-speed thrust and reduced drag, allowing it to dive (stoop) at speeds over 200 miles per hour and snatch birds right out of the sky. The peregrine's tail feathers are also stiff and more rigid than those of other species, aiding in steering and maintaining balance at high speeds.

Many raptor species are gifted with the ability to soar for long periods without flapping their wings, an efficient energy-saving flight strategy. The best example of this is the turkey vulture. Notches (slots) in its outer primary feathers reduce turbulence at the wing tips, reducing drag and increasing lift. This allows it to spend hours soaring in search of carcasses to feast on. Without this feather adaptation, a raptor simply could not soar.

A prime example of just how important every single flight feather is on these apex predators is The Raptor Center hospital's feather imping practice. When a raptor has damaged primary, secondary, or tail feathers, we replace them with matching donor feathers. Having even a couple of damaged feathers can put strain on a patient's flight, having adverse effects on the reconditioning flight phase of its rehabilitation. Eventually, it will molt the donor feathers and regrow its own.

An apex aerial predator depends on its primary flight feathers for its very survival. The features of these feathers, down to the tiniest detail, are species-specific and dictate a raptor's flight style, the type of prey it is capable of catching, and the habitat in which it can thrive. Whoever thought that something as seemingly simple as a feather has that much impact in shaping lives?

Photos by Les Conrad, TRC volunteer

The primary flight feather of a turkey vulture feature a notch that allows them to soar for long periods of time.

Above is a peregrine falcon tail feather with a more rigid feather structure. Below is a red-tailed hawk tail feather with a softer feather structure.

The primary flight feathers of falcons are narrow and stiff, providing a streamlined shape for speed.

The outer primary flight feathers of bald eagles have deep notches to help them soar.

Owl feathers are designed for silent flight, with fringed leading edges and a softer, fuzzy covering.

HOW IT ALL COMES TOGETHER

Take an inside look at the body of a bald eagle.

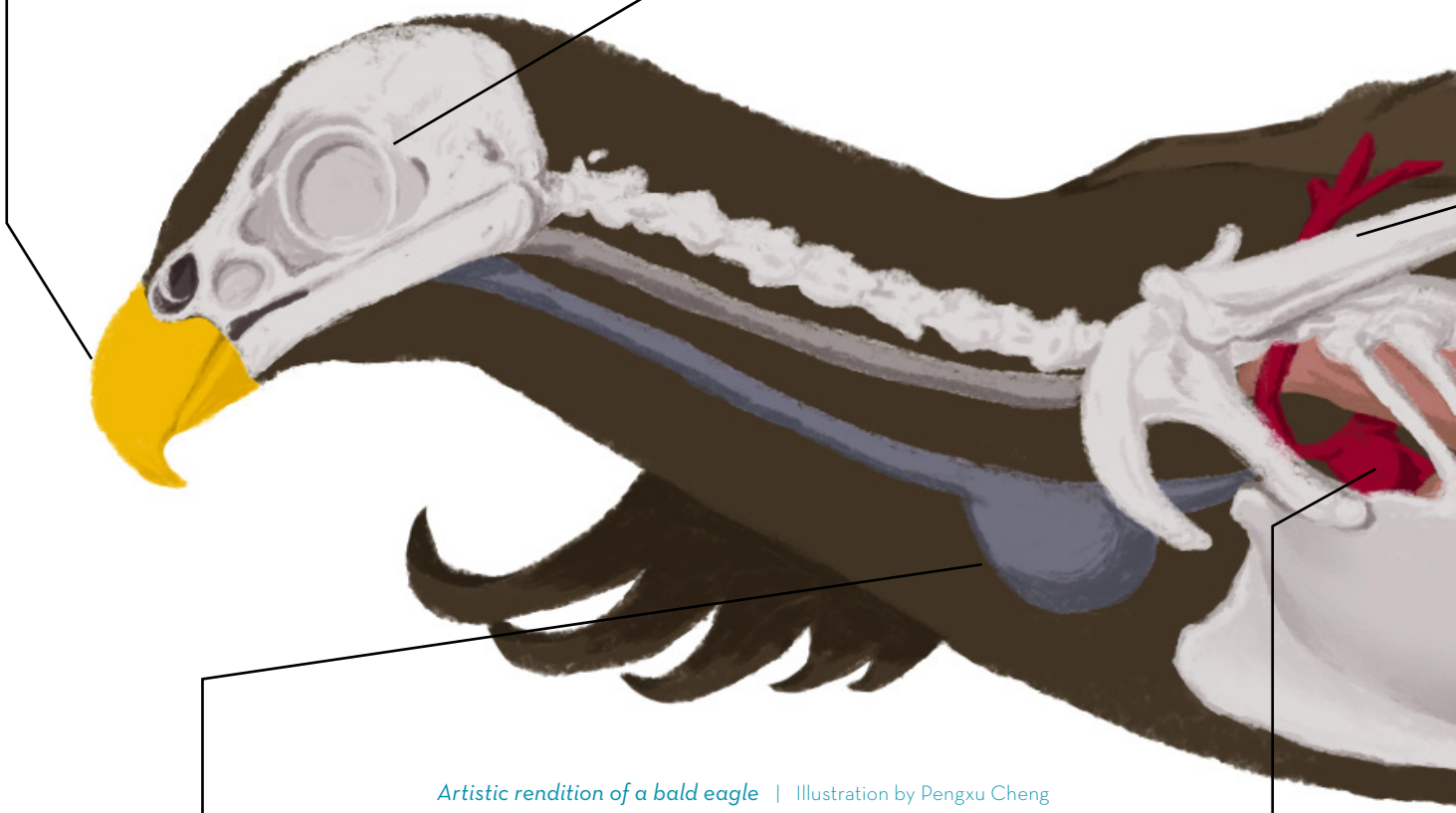
by Anthony Baffo

Beak

- A bald eagle's beak is roughly one-third the size of its head. The yellow beak is a sheath over the skull bone (maxilla) and is made of keratin, the same material as human fingernails. The sheath continuously grows and is worn down naturally with use.

Eye socket

- The eye of a bald eagle occupies around 50% of the skull's total volume, compared to less than 5% to that of humans.



Artistic rendition of a bald eagle | Illustration by Pengxu Cheng

Crop (esophagus bulge)

- The crop is the enlarged section of the esophagus for storing food temporarily. This lets it eat a large meal quickly and retreat to a safer location to digest.

Heart and vascular system

- Raptor vascular systems are very efficient and support the respiratory system's delivery of oxygen throughout the body. This supports the high-performance demands of its flight.

Lungs and air sacs

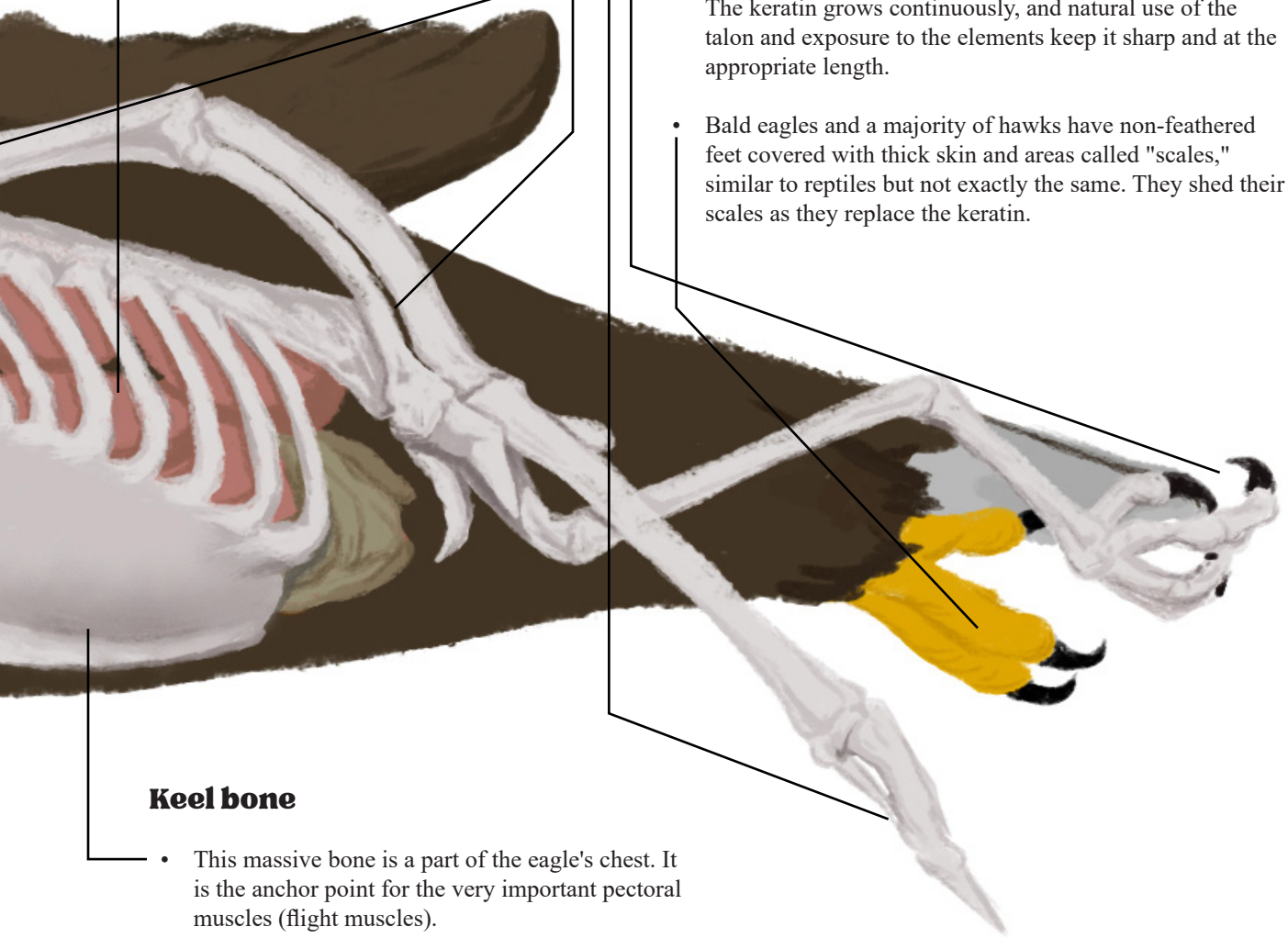
- Bird lungs, unlike those in mammals, are rigid and immobile. Birds do not possess a diaphragm; instead, air is drawn into the respiratory system by the movement of their ribcage and sternum.
- In raptors, it takes two full breaths (inspirations and expirations) for one breath of air to move through the respiratory system. Air is pulled by flexbile air sacs, acting as bellows that create a vacuum.

Wing

- The humerus bone acts as the powerful connection between the wing and the shoulder. Its lightweight structure, like many of the eagle's bones, helps reduce weight.
- The radius and ulna are the forearm bones of a bird's wing. The secondary flight feathers are anchored to the surface of the ulna.
- The carpometacarpus makes up the wing tip and would be comparable to multiple fused bones of the wrist and hand in a person; the primary flight feathers are anchored to the surface of these bones.

Feet

- The talon has a bony core surrounded by a keratin sheath. The keratin grows continuously, and natural use of the talon and exposure to the elements keep it sharp and at the appropriate length.
- Bald eagles and a majority of hawks have non-feathered feet covered with thick skin and areas called "scales," similar to reptiles but not exactly the same. They shed their scales as they replace the keratin.



Keel bone

- This massive bone is a part of the eagle's chest. It is the anchor point for the very important pectoral muscles (flight muscles).

Raptor Spotlight

Meet our new bald eagle

By Anthony Baffo

Introducing our newest juvenile bald eagle ambassador! This young fellow is a bald eagle born in Florida and was admitted to a rehabilitation facility after injuring himself while fledging from the nest. He sustained a severe, life-threatening eye injury that required expert orthopedic care. The eagle was transported from Florida to The Raptor Center's (TRC) renowned raptor hospital here in St. Paul, Minnesota, where our veterinarians removed his eye and saved his life.

Removing this young eagle's eye meant he was no longer releasable and able to care for himself in the wild. Instead, he has been welcomed into TRC's education team as a raptor ambassador and spent the last year training to inspire people with a love for these birds.

If you get the chance to meet him, you may notice he is smaller than our other bald eagles. Eagles in the south are 15-20% smaller than their northern counterparts. This is thought to be for energy efficiency and follows Bergmann's rule: larger animals have a smaller surface-area-to-volume ratio, which helps them retain body heat in cold temperatures. Smaller bodies are better for cooling down in warmer climates.

Bald eagle | Photo by TRC staff

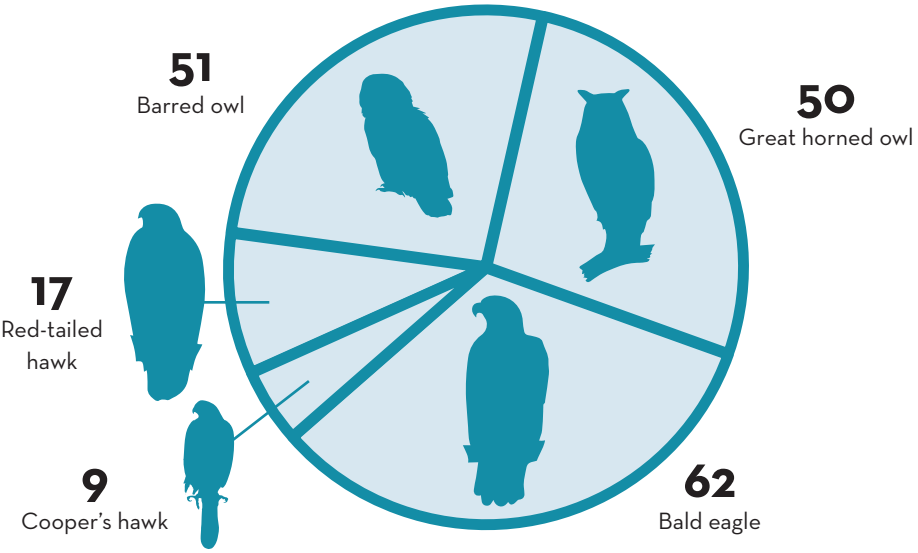
We will soon be announcing a name for our little bald eagle, one that helps capture the majesty of his natural history.

Clinic statistics

Coming off the heels of our busiest year ever in 2025, this current year is following similar admission trends. After a cold 2026 winter compared to the previous milder winters, admissions started at a slightly slower pace. With baby season underway, we are once again admitting a high number of young raptors.

2026 admissions

Top 5 species as of June 1, 2026



Barb Walker holding Topaz, a golden eagle | Photo by TRC staff

Remembering Barbara Walker

Barb Walker, a pillar of The Raptor Center's (TRC) acclaimed history, sadly passed away in 2025. As one of TRC's earliest employees and its first education director, she inspired hundreds of thousands of people to develop a greater appreciation for raptors. She later continued her work at Interstate Park in St Croix Falls, where she educated countless others about nature and the important role raptors play. Throughout her life, Barb was devoted to caring for raptors as part of her educational efforts and shared that love with her community and beyond. The Raptor Center is profoundly grateful for Barb's lasting contributions and the role she played in shaping its history.

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Thanks to your overwhelming support, we have increased our goal to help baby raptors to $75,000! $50,000 matched by loyal donors Ann and Tom Schwalen.

Scan here to give or contact Courtney Barrette for more information at 612-626-5482 or barr0396@umn.edu