CLASS OF 2023

Graduate

Willow Pawlak

Come and go at Shouldice Park (north side)
from 12:30-5:00 on Sunday, April 23

SHORT STORY PUBLICATION by Ambrose Literary Review

IN MEMORY OF A TREE

It was just one of those days. The alarm clock tears you from some dream, and all you can remember is that it was a good dream. For me, after I woke up, I struggled through another day of high school and finally, by some nasty chance, missed the bus. Which is how I ended up walking home, into a chill, damp wind, trying to beat the ever-darkening clouds which swirled overhead.

A fragment of bright orange fluttered in the yard ahead. It startled me, which caused me to stop and stare at the contrast it made against the muted greys, greens and browns of the tree it was tied to. After a couple of seconds of staring, I realized its significance.

Hoping that I had misinterpreted, I readjusted my path, turning off the sidewalk into Mr. Lichen's gravel driveway. At the end, I stopped under the carport, using the absence of wind to sort myself out. Then, I rang the doorbell. There were a few seconds where I worried that he was out, but then I heard the muffled trampling of feet. The door creaked as it opened and there was Mr. Lichen himself. I raised my hand and accompanied the small wave with a hesitant smile. For a moment, all he did was squint at me. Then, suddenly, his wrinkled face crumpled even more into a broad, gap-toothed smile.

"I've not seen the likes of you in many an afternoon. Come in!" He said.

I didn't bother to point out that it'd been nearly two years. There was no excuse to not visit a lonely old man who lived just a block away, and I hoped that he wouldn't bring it up.

"Come to the kitchen. I've only just heated some water. Fancy some apple cider?"

The weight on my shoulders reminded me of all the homework waiting in my backpack, but watching Mr. Lichen shuffling happily to the back of the house, I felt too guilty to not stay. The day hadn't been going my way up to that point, anyway, and stopping for one mug of apple cider wouldn't change much.

"Thanks, Mr. Lichen," I said as he set the steaming mug before me on the table.

“Oh, oh, it’s my pleasure, always!” He settled into place across from me. “Now. Seeing as my lot hasn’t changed much, why don’t you tell me how yours is going?”

The mug’s heat brought some sensation back into my fingers, which were still feeling the effects of walking through wind without gloves. I looked down at the amber liquid in my mug and said, “My life? Well, it’s been going, I guess.”

Mr. Lichen nodded, as if he understood. To be fair, he must have been a teenager at some point, even though I couldn’t imagine him any younger.

There was nothing more that I wanted to say about the matter, and I decided to cut to the chase. “Mr. Lichen? What’s with the tape wrapped around Oli - the oak?”

The gleam in Mr. Lichen’s eyes faded. “Ah. That. Well, it seems it’s just old Oliver’s time. As with people, dogs, cats...nothing lasts forever.”

“Oh.” Of course, I knew that trees weren’t immortal. Still, that beautiful old oak tree had seemed it. With nothing else to say, I took a quick sip of cider, scalded my tongue and tried to keep a straight face while setting the mug down.

“You made some memories with that old boy, didn’t you?”

“Not as many as you must’ve,” I said quickly. “Uh, no offence, I mean, it’s just that it’s your tree.”

Mr. Lichen chuckled, a cracked and merry sound, as he nodded. In silence, we both sipped our ciders. Once mine was gone, I slowly pushed the chair back. “I need to get home. Uh, thanks, for the cider.”

Again, Mr. Lichen said, “My pleasure.” We both stood up and he accompanied me to the door. “Thank you for coming. It shows that you still care about Oliver.”

“Oh?” I asked, then gave a short, nervous laugh. “Bye, Mr. Lichen.”

Outside, wind still howled and the leaves of Mr. Lichen’s yardful of trees rustled. The menacing clouds had begun spitting. I pulled up the hood of my jacket and stayed under the carport, waiting. For what, I wasn’t totally sure. A break in the wind or something.

My eyes strayed to Oliv-to the doomed tree. It's wide, sturdy trunk, twisting knots, and branches were perfect for climbing. Only the narrow upper branches were precarious, as I found out the hard way, a long time ago. As I thought of this, my hand strayed to my left arm.

In addition to the strip of orange plastic, there was a frayed rope, weathered to the grey colour of the bark, decorating the tree. A tire had hung from the end of that rope for many childhood summers.

All at once, the wind died and I decided to sprint up the street before the storm broke loose.

"Why care about some tree so much?" Connor asked, without looking away from the flashing colours on his laptop.

"Who says I care?" I asked.

"You're the one who keeps bringing it up."

"Yeah, well, I mean, it's the tree we used to play on all the time, and stuff."

"I guess it's a little sad. Oof!"

"What?"

"I lost."

My computer addict brother. If I could've done my homework anywhere else, I would've been done already, but I needed the other computer. In any case, the real distraction was myself, talking about that oak tree.

"I feel like we should do something." I finally said.

Connor wasn't paying attention, "What?"

"Like, I don't know, a remembrance or something."

"Wait. For the tree?"

"It's crazy."

"Yeah," he said.

I didn’t respond, pretending to be interested in my assignment and ignoring my brother’s mumbling about his game. Instead, I was thinking of my own strange idea, and getting excited.

The next thing to do was to get in contact with all the kids who used to play at Mr. Lichen’s with Connor and me.

Laura instantly agreed and promised that she, and her brother Alex, would be there. Samantha said, “I’ll think about it.” It turns out no one else still lived in the area.

It was Laura who ended up planning the whole deal and on a cloudless day just before the scheduled demolition, which she’d carefully discovered from Mr. Lichen without giving away the surprise, we all gathered under the leafless oak.

“Man,” Alex said. “I haven’t been here in ages.”

“It’s hardly changed,” Laura said reverently.

The same couldn’t be said for us. We were all taller, Alex had a beard coming in already, Laura wore glasses and braces I’d never seen before and Samantha’s hair was a bright purple. Still, we were all there. Standing in front of good old Oliver Oak, we began telling nearly every story we could remember. Stories of picnics under the great canopy, books read in the hollow where the trunk split, of climbing contests and the day I fell and broke my arm. We remembered how, every spring, we would help Mr. Lichen set up the tire swing. Every summer the nearby crab apple tree provided tart fruit to eat on the soft grass. Every fall, we’d rake leaves spread by Oliver and his neighbours. Winter’s snow meant snow forts, snowmen and snow angels. All of a sudden, we weren’t just talking about the oak, but about all of the trees and all the friends we’d had. Soon, there was as much laughter as speech.

Samantha walked up to the grey oak and gently touched it’s trunk, “Guess we’ll never make memories like that again.”

No one tried to contradict her. It was true. None of us were kids anymore and we were all busy with things like school, jobs, dates and college applications. And still we'd all found time to make it that day. One last chance to make memories.

"Hello, my friends!"

I swiveled on my heel and saw Mr. Lichen slowly walking towards us, holding a tray full of steaming mugs. "Thank you for coming," He said. "Would you all care for some apple cider?"

BEST IN CLASS PAPER ~ Theatre 101

Th 100 Critique 3

Willow Pawlak

Nov 22, 2022

Instructor: Professor J. Knight

All Aboard *Murder on the Orient Express*

Vertigo Theare's production of *Murder on the Orient Express* adapts Agatha Christie's mystery novel for the stage. It makes a successful transition from words on a page to an immersive performance that keeps audiences engaged from start to finish. Colourful performances and character design keep the cast of ten interesting and likable. A stage with a thorough design and props aids the story in being believable. And these elements produce a suspenseful tone to hold the audience's attention for an enjoyable story with a memorable cast.

Characters, with their many motivations and diverse behaviours, are a major focus of *Murder on the Orient Express*. Along with Poirot the audience gathers information on them to help decide who is responsible for the crime, as they all contribute to the environment formed by the play.

On the first introduction to many of the characters, they seem to be extras filling up the restaurant Poirot is in. But, as they interact with each other, it becomes clear that they are significant and that at least one of them will be the victim while another is the perpetrator. Each member's early impressions are bold ones that build expectations in the audience to influence who is suspect and why. From Mrs. Hubbard's loud, self centered behaviour to the Countess's dignified and calm demeanor, each one distinguishes themselves

from the start. Even the costumes, which are appropriate for the time period and social status of each character, provide hints about each character's values. The Princess's clothes are lavish, Mrs.Olsen's are modest, the secretary's clothes are casual and Poirot's suit gives him a professional appearance. All ten roles are distinct and memorable, with unique accents, styles and mannerisms attributed to each one.

Line delivery is easy to understand, and the emotions portrayed in each voice are appropriate to the scene. This is to the benefit of the story in instances such as the discovery of the murder, to which everyone's horror keeps Poirot and the audience unsure of the perpetrator. Humour, too, is maintained with instances like Monsieur Bouc's periodic, appalled outbursts or when Mrs. Hubbard's disruptive behaviour irritates other characters but amuses the audience.

Most of the characters seem unaware of the viewers, except for Hercule Poirot, which serves the story as the audience follows his lead in solving the crime. The play begins with him addressing the audience and ends in the same way, creating a connection between him and the viewers. Throughout, he also looks directly through the fourth wall, using expressions to convey his thoughts to which other characters are seemingly oblivious.

Through both visual details and personality, each actor makes their character distinct and unable to be overlooked as a potential suspect. And in the end, a series of emotional performances allow the audience to empathize with each character, even with the range of personalities they display.

While the characters appear to ignore the audience and the action stays contained within the proscenium arch of the stage, an interesting set helps keep viewers engaged, although it does take a few minutes for this to become evident. Particularly during the exposition, film and theatre are blended with the prologue being projected onto the empty wall behind a small stage area. The screen later contributes to the setting by

providing backgrounds as well as locations and dates. When these words are present, they help focus the audience's attention, either on the action onstage or away from it so the crew can prepare a new scene.

Light, sound and smoke effects aren't a major focus of the performance, but they do help to build up sets. In his first appearance, Poirot suddenly appears in the spotlight, surrounded by smoke that is at once reminiscent of a train platform and adds to the mystery of the show. Later, a flash of lights, noise and more smoke serve to transport the audience to a busy station and thoroughly hide the stage as props are removed and characters exchange places. In the early scenes, these effects provide depth to the otherwise small stage, although they are used less once the plot is underway.

After the exposition is through, the screen slides back to reveal a much larger stage built to resemble a passenger car. Screens in the windows create the sensation of movement when the train pulls out of the station. They also represent the passage of time as snow continues to fall on the dull landscape beyond. Partial walls suggest separation between different rooms while allowing the audience to see who's onstage and what they're doing. The entire set also slides to reveal even more of the car while characters walk up and down, and can exit from either side as if headed to another part of the train. It expands the space in which events occur while at the same time convincing the audience that the events are happening on one coach. By carefully avoiding places where a wall should be or pointing out invisible windows, the cast aids this representation. The crew, too, avoid being seen or heard as they arrange scenes behind walls before the stage slides to reveal the new setup.

The moving stage helps prevent the need for breaks between scenes and keeps the action moving by allowing new developments to be revealed just by shifting the stage. The detailed set also helps the audience to suspend belief and engage in the story. Dim lights and constant snowfall visible through the train windows produce a feeling of

claustrophobia. As different characters come to the front stage to phone for help, the audience can share the distress and suspense as the train runs low on food and heat and the murderer continues to walk among them.

Murder on the Orient Express is an entertaining story that has been translated well to theatre, in both performance and design. Distinctive characters provide amusement and gain the audience's empathy throughout the story. The stage and props present a world that is full of detail and believable. And the elements of these come together to produce a tone of suspense fitting for a mystery story.

Word Count: 1019

Sources:

Murder on the Orient Express. By Ken Ludwig, directed by Jovanni Sy, performances by Haysam Kadri and Luigi Riscaldino, Vertigo Theatre, Nov 17, 2022, Vertigo Theatre, Calgary.

EXEMPLARY EXPLICATION written for The Inklings course

EN 245 Tolkein Explication

Willow Pawlak

Jan 25, 2021

Instructor: Dr. D. Dyck

“And I reckon there’s Elves and Elves. They’re all Elvish enough, but they’re not all the same. Now these folk aren’t wanderers or homeless, and seem a bit nearer to the likes of us: they seem to belong here, more even than Hobbits do in the Shire. Whether they’ve made the land, or the land’s made them, it’s hard to say, if you take my meaning. It’s wonderfully quiet here. Nothing seems to be going on, and nobody seems to want it to. If there’s any magic about, it’s right down deep, where I can’t lay my hands on it, in a manner of speaking.” (p. 469; Bk. 2, Ch. 7)

The safety of Lothlorien, after the disastrous journey through Moria and before the fellowship splits, is the setting of this quote by Samwise Gamgee in J.R.R. Tolkein’s *The Lord of the Rings*. Having fulfilled his dream of meeting elves on the journey, Sam is asked for his thoughts and pensively says that “there’s Elves and Elves”. Though word choices such as “reckon” give the statement an informal tone, the speech shows great thoughtfulness. Carefully, Sam explains how the elves of Rivendell and of Lothlorien are “not all the same”. It’s a well considered statement, demonstrated by the fact that it is followed by an example and a comparison. The elves of Lorien are connected to their land, similar to how many of the Hobbits are to theirs. Yet the elves are more connected “even than Hobbits...in the Shire”. Sam refers to Hobbits as “us” at first, indicating ownership of the

identity and nostalgia for what is behind them, but the reference to “Hobbits” shortly after suggested a division between the adventurous members of the fellowship and the rest of their kind.

The narrative then returns to Elves, with the thoughtful tone returning. There’s no answer to whether “they’ve made the land, or the land made them”, and even though Sam is somewhat apologetic of this statement, it doesn’t seem to be because he has no answers. Rather, its because he doesn’t have a better way to explain his idea. As the statement is quickly left behind, there’s no indication that an answer is necessary. Instead, it serves to relate the elves and Hobbits to the world and to create a more vivid image of the setting. It suggested that images and objects from nature dominate the place, and rightfully should. This contributes to the shifting tone of the next sentences, more observant than pensive. The “wonderfully quiet” setting is depicted by the relaxed and unrushed way in which it is described, as opposed to the suspense and fear that characterized the earlier journeys. The idea that “nothing seems to be going on, and nobody seems to want it to” is relaxed and idealist when the characters and readers alike know what faces the Hobbits as soon as they leave Lorien. The phrase is a sharp contrast to the action and destruction throughout the rest of the story.

Finally, and fitting for a character who has spent plenty of time around plants and gardens, Sam says that any magic in the area is “down deep”, out of reach as of something buried in the ground. And he is content to leave it there, accepting that Lothlorien alone is enough. The final words, “in a manner of speaking”, are once again apologetic of the fact that there isn’t anything more eloquent to say, yet still carry a tone of peace, as does the entire small speech.

BEST IN CLASS PAPER - BIO 301 Paper - Evolutionary Principles

Diversity and Evolutionary History in the Webbed Feet of Birds

Abstract

Waterbirds and shorebirds have convergently acquired webbed feet many times throughout their evolutionary history, which has allowed many species to successfully colonize and diversify in the aquatic environment. Webbed feet have taken on lobate, palmate, semipalmate and totipalmate forms, all of which are associated with the *Gremlin1* gene during embryonic development. They provide a variety of functions, most significantly different strategies for swimming but also adaptations for wading, heat retention and egg incubation in certain species. Despite the proficiency of webbed feet in water, they are associated with inefficient walking. Phylogenies from different sources support each other and indicate that webbed feet arose independently in several clades of birds. Fossilized tracks represent the majority of what is known of extinct web-footed birds and some studies attempt to develop criteria for distinguishing bird and dinosaur tracks and whether webbing is actually present in fossil tracks. Some behaviours have been identified based on these fossils, which contribute to an understanding of when and why webbed feet evolved.

Introduction

One of the most distinguishable features of aquatic birds is their webbed feet. This characteristic has emerged independently in eight extant clades, with diverse forms but a common purpose that responses to selection pressures in an aquatic environment and facilitated the success of birds in these habitats. These forms can be separated into four categories, lobate, palmate, semipalmate and totipalmate, and are associated with the *Gremlin1* gene during embryonic development. The most common use of webbed feet is for swimming, although birds have developed

different strategies for this as well as other uses for the trait. Phylogenetic evidence shows webbing emerged convergently multiple times and provides evidence of ancestral characteristics. The majority of the fossil record consists of tracks, which can be used to estimate when certain traits and behaviours emerged. As webbed feet are found in many taxa of birds, understanding what is known and how these features might have evolved can direct further studies and considerations of a variety of living and extinct species.

Forms

The webbed foot of a bird has an easily recognizable appearance. With only a few exceptions, birds share the "ancestral condition" (Pough and Janis 2019 p. 408) of tetradactyl. They have four toes that can be syndactyl, in which the second and third toes are partially fused (Pough and Janis 2019), zygodactyl, in which the first and fourth toes face backward and the second and third face forward (Pough and Janis 2019), or most commonly, anisodactyl (Falk *et al*. 2011). Only the first digit is oriented backwards in these birds, which include all species with webbed feet (Falk *et al*. 2011; Pough and Janis 2019). These feet can be further separated into four forms.

Lobate feet have separated toes with membranes that flare out to maximize surface area while swimming (Pough and Janis 2019). While some lobes open only on the backstroke and fold back to reduce drag on the forward stroke, those of grebes, *Podicipedidae*, are stiff (Pough and Janis 2019). Instead, on the forward stroke the third and fourth toes are rotated and the second is moved behind the leg to produce a shape that reduces surface area and resistance and cuts through the water (Pough and Janis 2019).

The most common type of webbed foot is palmate, in which the three forward-facing toes have complete webbing between them (Pough and Janis 2019; Tokita 2020). The semipalmate form has partial webbing in the same locations (Tokita *et al*. 2020), and the totipalmate form has complete webbing between toes one and two, two and three, and three and four (Pough and Janis 2019; Tokita *et al*. 2020).

Webbing forms during embryonic development in all birds with the structure, and how this occurs has helped to produce phylogenetic relationships. The gene *Gremlin1,* found in palmate and lobate birds, as well as totipalmate birds early in development, inhibits interdigital cell death which would otherwise result in free digits (Tokita *et al*. 2020). In palmate feet, *Gremlin1* is found in all interdigital tissues, and in lobate feet, it is present in the areas along the toes that correspond to where lobes form (Tokita *et al*. 2020). Because it is only present in totipalmate birds during the early embryonic stages, it has been suggested that fibroblast growth factors instead contribute to webbing (Tokita *et al*. 2020). This has also provided evidence that totipalmate birds may have diverged earlier than those that express *Gremlin1* in the same clade (Tokita *et al*. 2020).

Although there is significant variation between both forms of and species with webbed feet, some common characteristics have independently emerged several times. These include large foot sizes relative to the bird's body, legs in a posterior position, a narrow tarsometatarsus and metatarsus (Hinic-Frlog and Motani 2010) and a delta shape (Moller and Laursen 2019). These provide "large propulsive forces during the entire power stroke" (Norberg and Johansson 2003 p. 67) through drag on the backstroke and lift at the end of each stroke (Moller and Laursen 2019). Not only is the shape and purpose convergent among waterfowl and wading birds, but it is also found in the fins of arrow worms and fish, frog feet, seal flippers and the tail flukes of whales and dugongs. (Norberg and Johansson 2003).

Functions

As birds have diverged, they have acquired adaptations for a variety of niches. These include feet suited to hopping, walking, running, climbing, wading or swimming in different environments (Pough and Janis 2019). Among the web-footed specimens, there is also a diversity of functions that come with trade-offs during terrestrial movement.

The primary function of webbed feet is to provide underwater propulsion for the nearly 400 species of bird that swim, with about half of these also diving (Pough and Janis 2019). The challenge of providing sufficient thrust underwater has led to the development of paddle-like feet

(Fish 2016; Tokita *et al*. 2020) that are posteriorly positioned for better steering control and streamlining than feet near the center of the body would allow (Pough and Janis 2019).

While diving species such as loons, auks, eiders, scoters and some ducks use a combination of foot and wing propulsion when underwater (Hinic-Frlog and Motani 2010; Moller and Laursen 2019; Pough and Janis 2019), in most species the majority of locomotion is provided by the foot alone. In order to accomplish this in a substance that produces significant drag (Fish 2016; Norberg and Johansson 2003), most waterfowl use thrust-based swimming in which they move the foot down to propel themselves forward (Norberg and Johannsen 2019; Pough and Janis 2019). However, this motion lacks propulsion on the recovery stroke, reducing efficiency relative to other strategies (Fish 2016). Hind-feet rowing produces thrust through lift-based symmetrical rowing and is observed in cormorants, grebes and loons both when at the water's surface and underwater (Fish 2016). There are a few exceptions, such as the Great Crested Grebe, *Podiceps cristatus*, which moves the foot "perpendicular to the swimming direction" (Norberg and Johansson 2003 p. 66) instead of parallel. This behaviour is more energy efficient (Norberg and Johansson 2003) then sweeping the foot down.

In diving species, foot size has been associated with increased diving ability and foraging success (Moller and Laursen 2019). Common eiders, *Somateria mollissima,* with larger feet have been found to exploit different food sources and consume more than those with smaller feet (Moller and Laursen 2019). Large foot size also contributed to an increased ability to evade predators and correlated to increased heart, breast and gizzard mass, greater beak volume and a better body condition than individuals with relatively smaller feet (Moller and Laursen 2019). Adaptations like these, if they provide a fitness advantage and are heritable, may be expected to increase in frequency in some populations.

The aquatic environment produces challenges other than locomotion. In wading birds, webbed feet can prevent them from sinking into wet mud, sand or silt (Falk *et al*. 2011). A wide angle between the second and fourth toes, an ancestral trait also seen in and used to identify

fossilized aquatic birds tracks, contributes to this snowshoe effect (Falk *et al*. 2011). This allows shorebirds and waterbirds to easily move and take off from wet shores (Falk *et al*. 2011).

Temperature differences between water and air, and heat transfer from the feet and body are another challenge. In the water, although the webbed foot is beneficial for swimming, it also exposes significant surface area from which heat can be lost (Van Sant and Bakken 2006). One strategy birds have developed to avoid this is to divert blood flow from the limbs while in water. In adult mallard ducks, *Anas platyrhynchos,* blood is blocked at the tibiotarsal joint (Van Sant and Bakken 2006). Ducklings have been found to do the same by three days of age, losing only 3% of their body heat through the foot at 15°C, compared to a 4% loss in adults at the same temperature (Van Sant and Bakken 2006). Although Van Sant and Bakken's study (2006) was limited by the use of calorimeters that did not expose the ducklings body to water, which could contribute to heat loss, the findings provide evidence that waterfowl have adaptations to retain heat from a very young age.

Some totipalmate birds are successful in using their feet to incubate eggs. This occurs in *Pelecaniformes*, which use the web membranes to surround the egg (Morgan *et al*. 2003). In Nazca boobies, *Sula granti*, the webbing between the second and third toe is most significant for this and acts as a barrier between the egg and the parent's body (Morgan *et al*. 2003). By using thermometers attached to albatross eggs, Morgan *et al*. (2003) found that eggs maintained a temperature greater than the surrounding air, around 28°C while the ambient temperature was 26.6°C (Morgan *et al*. 2003). It was also found that the foot itself was responsible for actively warming the egg, rather than only transferring energy from the abdomen, which occurred passively (Morgan *et al*. 2003). Compared to birds that do not use their webbing this way, Nazca boobies had "more vascular tissue in their webs" (Morgan *et al*. 2003 p. 365) which brought more blood to the incubating structure (Morgan *et al*. 2003). This behaviour has not been reported in other web-footed birds, which suggests that it and the associated morphological adaptations are a derived characteristic of *Pelecaniformes*.

While webbed feet are well adapted for swimming, in many waterfowl they are poorly suited for terrestrial locomotion. Because walking is not the primary mode of transportation

for these birds, there are few studies on the topic (Nudds *et al*. 2010). It is known that ducks and geese have short legs and thick tendons that reduce the efficiency of walking, and that walking speeds of webbed birds are slow compared to other birds (Nudds *et al*. 2010). They also have a relatively short stride length and large stride frequency compared to truly terrestrial birds such as *Galliformes* (Fujita 2004). Because Barnacle Geese, *Branta leucopsis,* moult all of their flight feathers at one time and must rely only on swimming and walking to find food and avoid predators during this time, Nudds *et al*. (2010) used this species to observe terrestrial locomotion at different speeds. The maximum walking speed recorded was 1.46 m/s^{-1}, which was determined to be due to morphological characteristics rather than energy availability (Nudds *et al*. 2010). They maintained the same waddling gait at every speed, a way of moving that is energetically costly when compared to flying or swimming. (Nudds *et al*. 2010) and a trade off in developing feet and legs for swimming.

Phylogeny

As many species of birds colonized water, they developed adaptations that allowed for faster and more efficient movement in and underwater. For some, such as penguins, symmetrical subaqueous flight fulfills this purpose (Fish 2016). In other birds, hind feet rowing emerged (Fish 2016). Webbed feet allowed birds to swim faster and more efficiently, and made their recolonization of the aquatic environments one of the most significant among tetrapod vertebrates (Fish 2016).

Webbed feet are represented in the clades *Anseriiformes, Gruiformes, Gavisformes, Splenisciformes, Procellariiformes, Ciconiiformes, Suliformes* and *Pelecaniformes* (Tokita *et al*. 2020). Among these, selection pressures have caused all four forms of webbing to convergently arise at least fourteen times (Fish 2016; Pough and Janis 2019; Tokita *et al*. 2020; Tuinen *et al*. 2001). An example is the lobate condition, which is found in both grebes, *Podicipediformes,* and coots, *Fulica*, despite these clades being distantly diverged (Tokita *et al*. 2020). Grebes instead share a recent common ancestor with flamingos (Ksepka *et al*. 2013) that is thought to have been palmate (Tokita *et al*. 2020). The sister taxa of coots are the unwebbed moorhen, and the recent common ancestor of these groups was anisodactyl and unwebbed (Tokita *et*

al. 2020). Similarly, there is molecular evidence that the sister taxa of totipalmate pelicans is the unwebbed shoebill (Tuinen *et al*. 2001).

Some clades acquired webbed feet secondarily. Although the clades *Ciconiiformes, Suliformes* and *Pelecaniformes* all include species with webbing, their shared common ancestor lacked this feature, despite it being an ancestral trait (Tokita *et al*. 2020).

Observing genes such as *Gremlin1*, as mentioned previously, has provided evidence that *Anatidae* and *Fulica* both developed webbed feet independently, as both of them have sister taxa that lack any webbing (Tokita *et al*. 2020). Conversely, grebes and flamingos, and possible cormorants, all retained the trait from a common ancestor (Tokita *et al*. 2020).

Fossil Record

In addition to morphological and genetic data, fossils can provide information about the evolution of webbed feet in birds. Although there are few fossilized bones from any aquatic bird clade (Fish 2016; Ksepka *et al*. 2013) tracks have been widely reported on (Falkingham *et al*. 2009). Throughout the Cretaceous, the majority of bird tracks came from shorebirds since the environments they lived in were well suited for fossil formation (Falk *et al*. 2011; Falkingham *et al*. 2009; Fish 2016). They occur in what were water-margin environments in mud and silt (Falk *et al*. 2011), as well as volcanic ash in one report (Lockley *et al*. 2009).

In order to distinguish between bird and dinosaur tracks, the angle of divarication, a characteristic influenced by tarsometatarsal morphology, can be examined (Falk *et al*. 2011). In birds, this angle, between the second and fourth toe, is usually between 110° and 120°, while it is less than 100° in dinosaurs (Falk *et al*. 2011). In addition, trackways left by birds with webbing often have a wide pace width, short stride length and footprints facing slightly inward due to the waddling gait (Falk *et al*. 2011).

One point of caution that has been brought into examinations of webbed tracks is the possibility that sediment failure could cause an appearance of webbing that isn't present in the bird (Falkingham *et al*. 2009). The conditions in which many tracks were produced was often soft

enough to push sediment between the birds toes and leave web-like impressions. This has been demonstrated using computer simulations of tracks from *Sarjeantopodus semipalmatus* (Falkingham *et al*. 2009). These tracks appear to be semi-palmate, but only the webbing between the second and third toes is prominent in the fossil, and this appearance differs along the trackway (Falkingham *et al*. 2009). By simulating a fine, waterlogged substrate such as that in which the original track was formed, and increasing and decreasing the angle of the digits, the webbing became less obvious or absent (Falkingham *et al*. 2009). Falkingham *et al*. (2009) concluded that the sedimentary environment, foot morphology and digit position can all lead to the appearance of webbing that isn't actually there. Because birds with webbed feet are expected to inhabit the same areas where sediment failure is most likely to occur, this conclusion is uncertain (Falkingham *et al*. 2009) but has been considered by other researchers.

In Lockley *et al*.'s (2009) description of the semi-palmate *Ignotornis mcconnelli,* preservational artifacts as Falkingham *et al*. (2009) describes were eliminated as a possibility because the sample included over 360 footprints with the same semi-palmate appearance (Lockley *et al*. 2009). This sample, which represents both one of the best preserved bird trackways and the first known Mesozoic bird trackway, came from what was a small shorebird (Lockley *et al*. 2009). Its foot morphology, which shows webbing between the second and third, and third and fourth digits, is convergent with *Ciconiiformes* (Lockley *et al*. 2009). Characteristics of the track also show that *Ignotornis* may have foraged using foot stirring (Lockley *et al*. 2009) to bring invertebrates to the surface of the substrate, a behaviour also seen in extant gulls and herons (Lockley *et al*. 2009). This, as well as what fossilized bones have been found, shows the emergence of various traits that facilitate or require the development of webbed feet. Bones can be used to determine behaviours of a species, such as swimming and diving, which can indicate the presence of webbing even when feet are not preserved (Fish 2016).

Conclusion

There is a large body of literature regarding webbed foot types, their significance in different types of swimming, the phylogenetic relationships of species with the feature and descriptions of fossil tracks. But there are also topics that could benefit from further consideration. This includes the embryonic development of webbing and the genes involved. Alternative uses for webbed feet in different species could be considered, as well as replicates of existing studies such as Van Sant's experiment on duckling heat retention, in which the authors indicated that their results did not include heat loss when the duckling's body is in contact with water. Phylogenies from Tokita *et al*. (2020), Ksepka *et al*. (2013) and Tuinen *et al*. (2001) support each other, but further research may be useful to uphold or refute these evolutionary relationships. Finally, fossil tracks can be evaluated with consideration for the angle of divarication and potential sediment failure. This can contribute to the knowledge of a widely represented feature that has allowed birds to successfully recolonize the aquatic ecosystem.

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AIWC Blog Fall 2021

Overwintering Wildlife of Alberta

The sight of geese flying southward in v-shaped flocks, sometimes numbering in the hundreds, is a sure sign of autumn. During this season, many species of birds leave the province for warmer regions near the equator, while some land-bound animals prepare for hibernation. Others continue to be seen throughout the winter and although most are well suited to survive even the harshest weather, there are still some ways to help them.

What can I expect to see during winter?

While most birds migrate, grouse, crows, magpies, chickadees, cedar-waxwings, certain sparrows and many owls are year-long residents.[1] Other species, like mallards and Canada geese, take advantage of city cores warmed by exhaust and sunlight reflecting from buildings to enjoy the resultant open water and skip migration.[2] Still others, like snowy owls and gyrfalcons, use Alberta as a mild winter retreat from their tundra homes.[2]

As long as food and shelter are available, it can be advantageous for certain birds to avoid migration. They save energy, can spend more time raising last spring's chicks and keep their own territories safe from other birds.[3] These species often have adaptations that allow them to stay, such as growing more feathers, flocking up and standing on one foot at a time while the other is warmed under their down.[3] A few are even able to reduce their metabolic rate to save energy,[3] much like hibernators.

Among other animals, only some bats and certain populations of deer and elk may migrate. Many others stay here but are unlikely to be seen as they enter a state of hibernation. Their body temperature, heart and breathing rates and metabolism are reduced to allow the animal to sleep for extended periods of time while surviving off body fat acquired during summer and autumn.[4] True hibernators such as red squirrels and bats sleep so deeply that they almost never wake up.[4] Light sleep hibernators such as bears, raccoons and skunks occasionally wake up in response to environmental changes, or if they get too hungry.[4] For example, the Calgary Zoo's bears have made winter appearances during chinooks, when warm air can raise daytime temperatures to 20 degrees in February.[5]

Cold-blooded reptiles and amphibians experience brumation, which is similar to hibernation.[4] To avoid freezing, they move underground or to the bottom of water bodies that are deep enough to not freeze solid.[4] Like light sleep hibernators, it's normal for them to wake up during warm periods.[4]

Finally, wildlife like deer, mountain sheep, coyotes, cougars, rabbits and porcupines continue business as usual throughout the cold months. Fat reserves and thick coats acquired during autumn, as well as a larger overall body size than the same animals in southern regions, help them survive.[6] In particularly harsh winters, deer might form large groups and seek agricultural leftovers as easy-to-access food,[6] but these species are generally good at fending for themselves.

What About Other Animals?

In rural areas with plenty of natural space, most animals can get through winter without assistance. If you do wish to help them, creating a brush pile from branches and yard trimmings, and your Christmas tree, is a great way to shelter birds and small mammals.[7] The same can be done in city backyards if you have the space.

Songbirds that overwinter in urban spaces can benefit more from human intervention than other groups. Food can be difficult to find in our concrete habitat, and they need a lot of it to stay warm, so bird feeders are incredibly beneficial.[3] Sunflower seeds, suet and mealworms provide the most nutritional value for chickadees, goldfinches, woodpeckers, sparrows and more.[3] Remember to keep the feeder clean to avoid the spread of illness and place it away from windows and roads to avoid collision risks.[3] If you have a brush pile, it can help attract visitors to the feeder.

Providing water in birdbaths can also help, but a wire mesh is needed to keep birds out of the water.[3] If even a small part of their body or feathers gets wet, the risk of them freezing is high.[3] A mesh over the bath allows them to drink without diving or falling in.[3]

Birdhouses or even simple windbreaks can keep flocks warm.[3] It's best to clear old nesting material out of birdhouses to allow the most adults to comfortably fit inside.[3]

Ducks and geese often hang around because they've learned that people will feed them.[2] However, this can cause them to become dependent on humans for food and lose their natural fear of us.[8] In addition, many human foods are unhealthy for them.[8] Depending on the species, they'll find food in aquatic plants, minnows, aquatic invertebrates, agricultural leftovers and even bird feeder leftovers that have fallen to the ground.[8] If you can't resist feeding them, birdseed is the most suitable option.[8]

Even in winter, Alberta has much to offer by way of wildlife viewing! If you find any wildlife that may be in distress, contact AIWC's hotline at 403-946-2361.

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AIWC Blog Spring 2023

Moulting Season: Why Waterfowl Don't Fly in Summer

For a few weeks every summer, ducks, geese and swans won't be seen flying. This makes sense if they're trying to protect young, but occasionally a lone bird will be found wandering and grounded. For animals that are known to make long migrations and are a common sight in the sky, this can look unusual. But it's due to a normal process called simultaneous moulting. It occurs between May and July when waterfowl shed and regrow their feathers, including those needed for flight.

Why Do Birds Moult?

To understand moulting, it helps to know why birds replace their feathers. There are different reasons for different species, but all birds experience their first moult when chicks develop juvenal plumage, which looks like regular feathers but may have different patterns than adults (Dunn and Alderfer, 2008). They can end up looking a bit funny as fluffy down pokes out among new, sleek feathers, but it doesn't pose any danger to them (Luther, 2010). Once all the baby down is gone, some birds retain this plumage for just a few weeks, while others take years to develop adult colours (Dunn and Alderfer, 2008).

Feathers wear out throughout a bird's lifespan, which leads to the second reason to moult. For some species, this complete moult is a relatively quick process (Dunn and Alderfer, 2008). Others take several months or even years (Jaramillo, 2017). Since it includes their flight feathers, birds that rely on being airborne to find food and avoid predators gradually lose and regrow these one at a time, and are called sequential moulters (Jaramillo, 2017). This ensures that the loss doesn't disrupt normal behaviour.

For waterfowl, the complete moult is different. Since they can forage and evade predators on the ground or in water, they lose all their flight feathers at once, which is called simultaneous moulting (Ouimet, 2022).

Certain birds undergo another type of moult twice a year once they reach breeding age. Called a partial moult, it allows them to take on different appearances throughout the year (Dunn and Alderfer, 2008). Many species have a specific breeding plumage that is bold and colourful, especially in males (Dunn and Alderfer, 2008). It helps attract mates by demonstrating physical health. Outside of breeding times, the same birds take on a duller appearance to better blend into their environments (Dunn and Alderfer, 2008). This is particularly noticeable in ducks, and their first partial moult of the year coincides with the period of flightlessness (Ouimet, 2022).

Simultaneous Moulters

By the time eggs are hatching in mid-May, waterfowl have begun to shed their feathers. It's an ideal time for it, as many adult birds must stay close to flightless offspring anyways (Gooders, 1984). And developing a new set of feathers takes energy, so having it occur when food is abundant in the form of grasses, duckweed, aquatic insects and minnows is beneficial (Jaramillo, 2017).

Simultaneous moulters have adaptations to help them survive this process. Duck drakes undergo this moult at the same time that they exchange flashy body feathers for the grays and browns of eclipse plumage (Ouimet, 2022). Just as with hens and ducklings, these muted colours help them camouflage along grassy banks and in shaded ponds (Gooders, 1984). In addition, many drakes make their way to wetlands in Canada's boreal forest or Arctic regions (Baschuk and Slattery, n.d.) Here, they prepare for the second partial moult in later summer which restores their breeding plumage (Baschuk and Slattery, n.d.). Hens and ducklings remain at breeding ponds where there is less competition for food (Baschuk and Slattery, n.d.).

In geese and swans, breeding pairs stay together and retain their feather patterns (Gooders, 1984). Although this can make them stand out in their surroundings, physical size and defensive behaviour help keep threats away, even on land (Gooders, 1984).

By summer's end, both adults and young of all species have developed a fresh set of flight feathers ahead of the southward migration (Ouimet, 2022).

What Can I Do?

Conflicts can arise when waterfowl encounter people. Canada Geese and Mallard ducks are especially common in urban areas, where they might spread out across bike paths and wander onto front lawns (Luther, 2010). During encounters, the best thing to do is to give them space, or if that is impossible, proceed slowly so they have time to get out of the way.

Occasionally, these birds can be found far from their usual habitat while flightless. It's quite a feat for one to get into a neighbourhood or downtown core without swimming or flying, but it does happen. Reasons they might travel this distance on foot is to find backyard ponds and fountains or food, like seeds scattered from bird feeders (Luther, 2010). Both ducks and geese have even been known to nest nearly 2 kilometres from water, so they may also have eggs nearby (Gooders, 1984). If they get really stuck, such as in an area completely enclosed by fencing, a call to AIWC's hotline could be necessary (Luther, 2010). Otherwise, giving them time and space is often all that's needed for them to find food, avoid threats and successfully complete the moulting process.

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AIWC Article April 2023

Wildlife and Agriculture: How Native Animals Can Benefit Crop Growth

Although some animals are considered a nuisance in gardens and crop fields, their presence, and that of other wildlife, can be useful. The natural behaviours of many species benefit the plants and environments they forage in and travel through, an example of ecosystem services.

Ecosystem Services

As animals, plants, water and weather interact, the planet is kept healthy. Marshes filter and store water, global temperatures are regulated by heat absorption in the oceans and sediments weathered down by rain and wind add minerals to the soil[1]. These are ecosystem services: any natural process that supports a clean, well-functioning environment[1]. They are especially noticeable when absent - air and water are dirtier, crops fail and costly replacements might be necessary. In places where biodiversity has decreased, the efficacy of ecosystem services can suffer[1]. That's one reason why the conservation of individual animal and plant species, as well as entire communities, is so important.

Among these services, those provided to farmers and gardeners are notable as they help feed the human population. Pollination, nutrient cycling and pest control performed by animals contributes to strong crops and reduce costs associated with agriculture.

Pollination

In order for seed-bearing plants to reproduce, pollen grains need to travel to and fertilize the ovules of the same species. This process is called pollination. Two types of pollination occur: self-pollination, which only requires one individual, and cross-pollination, in which the genes of two individuals must combine[2]. Cross-pollination can be accomplished by wind and water in some species[2]. But for most trees, grasses and flowers, animals are required to transport the pollen grains from one plant to another[2]. While bees are the best-known and most significant pollinator worldwide, other insects, bats and birds such as hummingbirds contribute[2]. As they forage for pollen, nectar or insects on flowers, microscopic spines on the pollen grains adhere to their hair, feathers and skin[2]. When the animal rubs against another object - like the sticky end of the carpel, a tube-like part of a flower - pollen drops off[2]. Pollen that enters the carpel encounters female gametes, fertilizes them, and develops seeds[2].

Though grains are self-pollinating, fruit and alfalfa require manual pollination to produce. Without animals to do the job, the cost to the farmer can be devastating. A real-life example began in Sichuan, in southwest China, in the 1980s[3]. Apple orchards were abundant at a time when pollinator populations were decreasing[3]. To make up for it, farmers hired extra workers to collect pollen by hand and transfer it between blossoms[3]. Though the endeavour was initially successful, it was costly and time-consuming[3]. Over time a lack of willing labourers and difficulty keeping up with the narrow timeframe for pollination caused apple production to decline[3]. Today, most farmers in the region raise self-pollinating crops instead[3]. Pollinators are specially adapted to do this job efficiently, and maintaining their populations is essential where cross-pollinating crops are raised.

Nutrient Cycling

Crops and native grasses grazed by livestock require key nutrients like nitrogen, phosphorus and carbon to grow and produce energy[4]. These enter an ecosystem through weathering sediments, water, or animals[4]. Although herbivores like deer aren't always welcome in crop fields and gardens, they are useful for carrying nutrients from place to place. As they feed, they take in nutrients and what isn't incorporated into their bodies for growth and energy is removed as scat or urine[4]. As deer and similar large animals move across the landscape, the nutrients they eat can be distributed across a large area and replenish crop-growing soils[4]. And when animals pass away, decomposition releases large concentrations of nutrients stored in their bodies[4].

Pest Control

Keeping invertebrates parasites and other animals that spread disease, dig up or eat crops out of agricultural areas is difficult, especially at large scales. However, many native pests have natural predators, for example, ladybugs, which are used to control aphids. Among vertebrates, frogs, birds, bats, skunks, badgers, foxes and coyotes are examples of animals that feed on insects, both adults and larva, or rodents and other pests. Having just a few of these predators regularly hunting in an area can limit populations and gradually discourage prey from frequenting the same places[5].

Conservation of wildlife helps preserve healthy ecosystems, which provide invaluable services for a functioning planet. In agriculture, wildlife help support crops through pollination, contribution to nutrient cycles and pest control.

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AIWC Mallard Article

Nesting Mallards: What Happens and How Can We Help?

About Mallards

The shiny blue wing speculum and bright green head of breeding males make mallards one of the most recognizable duck species in Alberta. From late March until autumn, they can be found in any open water, including ditches, dugouts and city fountains. Some even live-year round in city ponds [1].

When it's time to nest, mated pairs return to the area where the hen was born [2] and build up to 1.7 kilometres from water. Ground nests are most common, but they also choose trees, nest boxes, the tops of boulders and buildings and even floating nests. Grass and underbrush provide both building material and shelter [1].

The hen incubates eggs and cares for offspring alone. She lays one grey-green egg daily but won't stay and sit on the nest until a complete clutch of eight to twelve has been laid. Some hens have been known to lay eighteen eggs themselves, but any more usually means that two hens are using the same nest. When she's away, she covers the eggs with nesting material and down. While this provides some camouflage, nests can still be preyed on or accidentally disturbed, or the hen may decide that the location is no longer safe. When this happens, she'll move on and lay a new clutch somewhere else [1].

Incubation begins when the last egg is laid and lasts about twenty-eight days [1]. Once the ducklings hatch, they abandon the nest and follow their mother to water, a journey that can pass through backyards, parks, fields, roads and fences [2].

Living With Mallards

Occasionally, a breeding pair will show interest in a backyard pool or fishpond. To encourage them to nest somewhere else, removing potential food sources like bird feeders is usually all that's needed. Where local bylaws allow them, streamers, scarecrows, airhorns, sirens and propane bangers provide a stronger incentive to leave, but should only be a last resort. If the ducks are injured or already have ducklings with them, a call to AIWC or another rehabilitation organization may be necessary [3].

It's unlawful to tamper with migratory bird nests or eggs, so if one is found in a dangerous location, call AIWC or your local Fish and Wildlife office instead of attempting to move it. Keep in mind that eggs cannot be rehabilitated, so the nest should be left alone if it appears to be abandoned. The hen has most likely renested and the eggs will provide food for other animals [4].

Surprisingly, the top of a medium-height building is not a bad nesting location, as ducklings can jump from significant heights without being harmed and have no need to return to the nest after hatching [4].

Hens are usually very diligent about bringing their entire clutch to water safely, and it's uncommon to find ducklings alone. If you do, immediately check for nearby adults. The hen could have left her young after perceiving a threat such as a well-meaning human. She may be nearby, faking an injury, flapping her wings and squawking to distract a potential predator, but given enough space, she will reclaim her offspring. Don't worry if you see a female mallard behaving oddly - she could be protecting her ducklings, and not actually injured [2].

Due to the dangers of busy roads and highways, duck-related concerns should be reported to Fish and Wildlife. Only on quiet streets, private driveways and pedestrian paths is it suitable to escort ducks to water [3] and to cover storm drains with plywood to prevent falls. If you find ducklings in a drain or trapped by a curb, it's fine to gently lift them out. Contrary to popular myth, most birds will still recognize their babies even if they've been handled by humans [4]. If water isn't accessible, Ducks Unlimited Canada (DUC) suggests that you "put young in an open box and carry on top of your head in view of the mother to the nearest water source". However, if no dangers are present, ducklings with their mother are best left alone. Don't offer food, even if they seem to want it [3].

If there are more than four ducklings without an adult, according to DUC "put them in an open box with a shallow pan of water" and monitor them [3]. If a hen doesn't reclaim them within 45 minutes, call AIWC or bring them to the nearest emergency veterinary clinic [4]. Not only is it illegal to keep them, but they have a better chance of survival with specialized care [3]. If four or fewer ducklings are confirmed to be without a parent, skip the wait and immediately contact AIWC [3].

Mallard ducklings grow up fast and are independent by late summer. In the fall, they'll join other ducks and migrate south, where they'll seek a mate and prepare to start a new generation [2].

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Congratulations!

Claudia Lawrence

Heather Limb

Joan Bailey

Roberta Davies

Amy Hilton

AMBROSE UNIVERSITY

More Congratulations to Willow!

December 20, 2023

So proud of this girl who, yesterday, wrote her last exam, completing 4.5 years at Ambrose University and obtaining a Biology degree with an English concentration. 👩🏻‍🎓
She did all that while saving up almost half her tuition by working at 5 different places over 5 years. Highlights of those jobs include: shelf stocking (likely a low light—😂), cooking for large numbers at a camp, transporting fawns, moose calves, ducklings, and geese (in my car!), discussing bat rescue techniques with drunk housewives (not me!), doing political phone campaigning, and most recently and lucratively, herding pheasants at night into crates for shipping around Alberta. She has volunteered with a number of organizations over the summers and has kept me entertained with her anonymous political satire page.
She gets callbacks for all her jobs, amazed her advisor with the variety of employment opportunities she could find, was praised for the wonderful readability of her essays and was asked to be able to use her work as examples for future years. She was published in one school paper and earned scholarships for some of her writings.
Schooling during covid, changing church groups and developing new sets of friends refined her resiliency, sharpened her boundaries, aspirations and goals and boosted her confidence. Who knows what is next but we are looking forward to watching it unfold. Praying for the next stepping stone to be a wonderful launch into the future.
Our new worship pastor has observed that Willow seems to be a collector of people and we are very proud that she seeks to include those who typically aren't. 💕

We love you and are so proud of you, Willow!

Wow! Well done Willow. I also think you are amazing! ~ Roberta Davies

Way to go! Procrastination pays off! ~ Penny Rathwell

Way to go Willow! Your future looks bright! ~ Tanya Seibel

That's awesome! Congratulations Willow ~ Amy Flitton

Congratulations Willow! All that hard work has been paying off! The best to you in your future. You will do awesome! ~ Trish Glazier

Congratulations Willow! I always expected great things from you! ~ Ms. Dona

Congratulations, Willow! Awesome job on this wonderful achievement ~ Karina Erhardt

Fantastic! ~ Michelle Wade Awesome! ~ Scott Wade

Wow! That's incredible! ~ Kim Johnson (Buha)

Congratulations Willow and all the best with your next adventures. ~ Norm Downs

So awesome! ~ Joy Nelson

Yay!! So proud of Willow. Love to you all!! ~ Sunde Daughrity

We are so proud of you and your parents!! ~ Claudia Lawrence

That's amazing! ~ Christy Komar

Job well done. ~ Diane Bien

Nice job Willow! Congrats on achieving your goals! ~ Glenda Brown

Many accomplishments. ~ Shirley Lidbury

Way to go! ~ Mike & Michelle Muirhead

Wow!! That's amazing - not surprising because you are awesome! ~ Suneetha Banco

She is just great, as well she should be, with all the examples she has had in her life to follow! ~ Jim Johnson

That is just awesome. ~ Wanda Roberts

Joan Bailey - Love you, Willow, you are a very impressive young woman. ~ Joan Bailey

That is so awesome! Congratulations, I can't wait to hear about your new adventures. Good luck! ~ Michele Downs

So thrilled to see you blossoming, Willow. I greatly enjoyed reading your winning article and am sure you will accomplish GREAT things for God's kingdom. Blessings to you!! ~ Heather Limb

April 16, 2023

Congratulations on receiving your Biology degree!! 🥳 *I'm sure it has been a challenging road to get there with everything that has happened in the last couple years. Your perseverance and determination have paid off. Wishing you God's guidance and many blessings as you move forward into your future. You will do great!!* 😃

Cal and Wanda

Wish we could come!! ~ Seibels

We wish we could be there ~ Muirheads

Congratulations on your successes, Willow! ~ Shirley Lidbury

Congratulations on your graduation. We wish you much happiness. ~ Janice Tucker

Oh Willow, sorry I will still be away. But we must have a little celebration when I am back. Congratulations to an amazing young woman. - Joan Bailey

Way to go Willow and congratulations! You will do great things in this world. ~ Heather Limb