Abstract

The pterosaur Quetzalcoatlus is analyzed and discussed. Bone structure is looked at as part of this analysis. Wing structure gives insight on to how Quetzalcoatlus may have flown, and how different parts of the wing could act as various different flight mechanics. Head structure gives insight on to how Quetzalcoatlus could have gotten its food. Different hunting theories are explored for Quetzalcoatlus. Theories on whether or not the pterosaur was a scavenger or a fishing predator are explored. The neck of Quetzalcoatlus is abnormally large, and its neck is examined to see how it affected the livelihood of Quetzalcoatlus. Various lifestyle characteristics are looked at as well. Comparisons are made to other pterosaurs as well as other sister groups to Quetzalcoatlus.

Introduction

Quetzalcoatlus is a pterosaur that was alive during the LC period. Finding its fossils is a rare occurrence due to the frailty and difficulty of preservation, with most of the fossils being found in Texas, which is why it is considered the “lone star pterosaur”. Quetzalcoatlus is massive. It is the largest flying creature in recorded history. It is so tall, that it can look a giraffe in the eye. It has a wingspan the size of two dorm rooms. Its neck is two meters long, as long as a giraffe’s neck. It’s an incredibly controversial animal, and it has paleontologists arguing amongst one another, trying to make conclusions on Quetzalcoatlus.

Pterosaurs

Peter Wellnhofer (1996) discusses the pterosaurs in his The Illustrated Encyclopedia of prehistoric Flying Reptiles: Pterosaurs, providing a wide array of
information with regards to pterosaurs. Pterosaurs became extinct around 65 million years ago (Wellnhofer, 1996). We know so much about the pterosaurs today mainly through casts, molds, and fossils (Wellnhofer, 1996). Fossils pterosaurs are rare due to the extreme fragility of the bones of these relatively light weighted creatures. In order for fossils to be preserved combined with paleontologists finding them would require extremely rare and gratuitous circumstances (Wellnhofer, 1996). Pterosaur fossils could not survive conditions on land, and instead they are primarily preserved in bodies of water, which is really the only place where reliable sources of pterosaur fossils were discovered (Wellnhofer, 1996). Because of these circumstances, it is evident that we only know of the pterosaurs that were living by the coast, and haven’t even scratched the surface of how many other pterosaurs there could have been living elsewhere (Wellnhofer, 1996). It is estimated that we only know about one percent of all pterosaurs in our fossil record, which means that there had to have been incredibly more pterosaurs roaming the Earth 65 million years ago (Wellnhofer, 1996).

Since they lived near water, it is safe to say that a large portion of their diet came from eating aquatic creatures; they could easily fly close to the water and snatch up something to eat, much like modern day birds do today (Wellnhofer, 1996). “They had numerous long, slender teeth in their long jaws, and used them to filter small aquatic organisms like the larvae of crustaceans out of the water” (Wellnhofer, 1996). Some pterosaurs are hypothesized to have been filter feeders, this is evidenced by a rare stomach fossilization of a pterosaur (Wellnhofer, 1996). The stomach contents also included scale of fish, as well as the bones, and worn teeth on the pterosaurs suggests that they had been dulled by chewing on fish (Wellnhofer, 1996). Many of the fish eating
pterosaurs had sharp teeth designed for chewing up fish and other hard crustaceans like snails and crabs (Wellnhofer, 1996). The jaws on certain fish eating pterosaurs like *Rhamphorhynchus longicaudus* could open up abnormally wide, much like a pelican, allowing it to swallow organisms whole as a digestive tactic, or to preserve food to bring back to its newborns (Wellnhofer, 1996). There are the more unique pterosaurs that did not have sharp teeth like *Quetzalcoatlus*, which didn’t have any teeth at all (Wellnhofer, 1996). Pterosaurs like these most likely focused on smaller aquatic organisms that didn’t require extensive jaw or tooth work to eat (Wellnhofer, 1996). While figuring out the diets of pterosaurs was made relatively easy due to fossilized stomachs, how they reproduced was a bit more controversial (Wellnhofer, 1996). The most commonly accepted method was that pterosaurs laid eggs (Wellnhofer, 1996). There were numerous amounts of eggs found that were claimed to be pterosaurs’, but none of them have provided definitive proof, and instead still leave a grey area (Wellnhofer, 1996). Scientists have concluded that female pterosaurs were proportionally smaller than males, which included a smaller pelvis that is predicted to have produced one egg, or a few at most (Wellnhofer, 1996).

**Quetzalcoatlus overview**

In the same book, Dr. Peter Wellnhofer (1996) gives a general overview of *Quetzalcoatlus*. *Quetzalcoatlus* was first found in 1971 in west Texas (Wellnhofer, 1996). Science published an article on the pterosaur in 1975 believing it to be the largest flying creature ever found, and some paleontologists were bewildered at its estimated 51-foot wing-span (Wellnhofer, 1996). The first traces of this pterosaur began in 1971 by a university of Texas student named Douglas A. Lawson, who found some thin, hollow
bones, which he believed to have belonged to a pterosaur (Wellnhofer, 1996). He later excavated the surrounding area in hopes of finding the whole creature, but could only find a wing, which was hypothesized to have detached from *Quetzalcoatlus* (Wellnhofer, 1996). Hundreds of different small bones and bone fragments were found, and eventually assembled to form the wing and lower arm (Wellnhofer, 1996). Lawson would eventually choose to name his discovery *Quetzalcoatlus* to pay tribute to the Mexican God Quetzlcoatl (Wellnhofer, 1996). The bone fragments created a new estimate of *Quetzalcoatlus* estimated to be around 36 to 39 feet long (Wellnhofer, 1996).

Its reconstruction added a plethora of knowledge regarding *Quetzalcoatlus* including information on its head, wings, and vertebrae (Wellnhofer, 1996). In addition to a reconstruction of *Quetzalcoatlus*, there were also hypothesized characteristics on how the pterosaur might have lived (Wellnhofer, 1996). The weight was estimated at around 190 pounds or less, and the build of *Quetzalcoatlus* was extremely efficient for air travel in relation to how big the creature was (Wellnhofer, 1996).

There were many different theories on how *Quetzalcoatlus* obtained its food; some thought it was a predator while others believed it to be a scavenger (Wellnhofer, 1996). The supporting evidence for this being that there weren’t any fossils found near the coast which would mean that *Quetzalcoatlus* probably didn’t go after fish or other crustaceans (Wellnhofer, 1996). Instead, *Quetzalcoatlus* could take advantage of its incredible flight ability to search for dead creatures to eat, and could then use its long neck to scavenge dead corpses (Wellnhofer, 1996). Others argue that it would be almost impossible for *Quetzalcoatlus* to be a scavenger because of its lack of teeth; it simply could not penetrate dead corpses easily enough for this to be a viable option (Wellnhofer,
1996). These scientists believe that *Quetzalcoatlus* may have been feeding on animals that lived underground or in small holes in trees, like crabs, insects, or other small organisms (Wellnhofer, 1996). The reasoning behind this hypothesis is that there are a large number of *Quetzalcoatlus* fossils that were found in these trees and holes in the ground, which could have been caused by *Quetzalcoatlus* getting stuck in these areas when a large flood hit (Wellnhofer, 1996).

**Quetzalcoatlus flight**

S. Weisburd’s “Learning how to fly, reptile style” (1985) provided some insight on how the massive pterosaur was able to fly (Weisburd, 1985). There are a number of different things to take into consideration when trying to make something airborne like the build of the wings, tail, and head. The tail is an integral part of organismal and structural flight, and since *Quetzalcoatlus* tail is relatively short, the complexity of the pterosaur’s wing structure compensates for the short tail (Weisburd, 1985). In addition to complex wing structure, *Quetzalcoatlus* ‘head was slim and maneuverable, which acted like a plane’s rudder, which added even more control and precision to *Quetzalcoatlus*’ flight (Weisburd, 1985). In *Quetzalcoatlus* wing itself, there are moveable fingers that lead to the pterosaur being able to control drag while in flight (Weisburd, 1985). It was hypothesized that due to *Quetzalcoatlus*’ massive size, that it could not simply flap itself from ground level to enter in to flight (Weisburd, 1985). This type of flight was much more better suited for smaller birds and flying animals, but not for *Quetzalcoatlus* (Weisburd, 1985). Instead, it was believed that the pterosaur was more of a soaring and gliding type of flying creature, with very minimal flapping, and only just enough to maintain a steady flight pattern (Weisburd, 1985).
Quetzalcoatlus wing structure

In 1992, Kevin Padian and Matt Smith’s “New Light on Cretaceous Pterosaur Material from Montana, (1992) they make it clear that making any conclusions or drawing connections to pterosaurs is incredibly difficult with limited wing fossils (Padian and Smith, 1992). It is often proven to be impossible to make certain conclusions about any wing bone because the amount of information is so limited (Padian and Smith, 1992).

Fig 1. The picture above shows various bone fragments making up a humerus from a pterosaur (Padian and Smith, 1992).

“Part of the reason is ontogenetic: we do not know how the relationships between bone end widths and bone lengths change through ontogeny in this group. Part of the reason is systematic: we do not know how many taxa are represented in the Texas sample currently assigned to Quetzalcoatlus, nor do we know much about intra- and intertaxic variation in the Azhdarchidae” (Padian and Smith, Padian and Smith, 1992). There are a few conclusions they were able to make about Quetzalcoatlus, like how it has a notarium, a vertebra that is fused, which is supported by the fossils and the angle of the fossil’s glenoid socket (Padian and Smith, 1992). Quetzalcoatlus’ scapula is believed to be rounded which aided in flight, and it wasn’t serrated or tapered at the ends like other pterosaurs’ scapulas (Padian and Smith, 1992).
Quetzalcoatlus head

In 1996, Alexander W.A. Kellner (1996) examines fossils of *Quetzalcoatlus* head in his “Cranial remains of *Quetzalcoatlus* from Late Cretaceous Sediments of Big Bend National Park, Texas. Part of *Quetzalcoatlus*’ beak can be inferred from its premaxillia bone, which is long in *Quetzalcoatlus*, and forms the anterdorsal overface of the pterosaur’s head (Kellner, 1996). A majority of pterosaurs skulls had a sagittal cranial crest on the top of the skull and is found to be a common distinctive feature among the pterosaurs (Kellner, 1996). *Quetzalcoatlus* however has the sagittal cranial crest, but the crest is located near the nasoantorbital fenestra, rather than on top of its skull (Kellner, 1996). Connections to other relatives of *Quetzalcoatlus* were made possible by the cranial remains found (Kellner, 1996). It is made apparent that the pterosaur has a sister group in tapejarids and azhdarchids due to the “low position of the orbit in the skull” (Kellner, 1996). *Quetzalcoatlus* has an extremely long head and snout in comparison to its sister groups, a distinctive feature (Kellner, 1996).

Information on *Quetzalcoatlus* jaw provides more insight than the rest of the skull (Kellner, 1996). Most pterosaurs had a special articular joint, which caused a spreading of the jaws, similar to that of a modern day pelican (Kellner, 1996). The pelican had a different joint, but still contained a gular sac, which aided in the spreading of the lower jaw (Kellner, 1996). Many pterosaurs contain this gular sac in their jaw structure, but it was still a question of whether or not *Quetzalcoatlus* did or not (Kellner, 1996). To figure this out the angle that the jaw created when opened was measured (Kellner, 1996). In pterosaurs like the *Peranodon* had a jaw gape of around 65 degrees, while *Quetzalcoatlus* had its jaw gape at around 52 degrees (Kellner, 1996). *Quetzalcoatlus*’ relatively small
jaw gape is surprising considering how long the lower jaw of *Quetzalcoatlus* is, (960mm) and was predicted to have a jaw gape of about 85 cm (Kellner, 1996). The reason the jaw gape is so reduced is because of a hindrance in the lower jaw. “Rather it was stopped by the peg-like process at the posterolateral corner of the glenoid fossa when the mandible was depressed to its maximum” (Kellner, 1996). Still, the jaw structure of *Quetzalcoatlus* supports the theory that *Quetzalcoatlus* was gathering its food through fishing, mostly through skimming across waters and scooping fish and other organisms into its jaw (Kellner, 1996). It also makes the hypothesis that *Quetzalcoatlus* was a scavenger feeder look a little less plausible, because the jaw structure that the pterosaur has would not be needed to simply be a scavenger (Kellner, 1996). Arguments against *Quetzalcoatlus* as a fishing creature state that all of the fossils of *Quetzalcoatlus* are found in arid regions and that there was no way that they could be fisherman (Kellner, 1996). The response to this is that while many of the fossils were found in areas with no water, *Quetzalcoatlus* was more than capable of flying vast distances in order to search for food, and some even believe that *Quetzalcoatlus* is a migratory species of pterosaur (Kellner, 1996).

**Quetzalcoatlus neck**

In 2012, Wilkinson and Ruxton did some research on different long necks across the animal kingdom, as well as in pterosaurs. *Quetzalcoatlus* has one of the largest neck to body size ratios of any pterosaur, or any creature ever (Wilkinson and Ruxton, 2012). They claim that since most *Quetzalcoatlus* fossils were found on land rather than in marine deposits, that they probably weren’t fishing (Wilkinson and Ruxton, 2012). To take advantage of their long necks they speculated that they used the length to dig deep into carcasses, which means they supported the theory that *Quetzalcoatlus* was a scavenger.
(Wilkinson and Ruxton, 2012). They are unsure though, and much of their speculation revolves around pterosaur flight “Two key questions are could they take off from a water surface following diving for fish and could the very large species fly - if not this would appear to conclusively rule out carrion feeding, as finding carcasses would be energetically too costly without flight” (Wilkinson and Ruxton, 2012).

**Quetzalcoatlus hunting limitations**

In 2007, Riddihough discussed how *Quetzalcoatlus* could have obtained its food (Riddihough, 2007). They discuss one of the main theories behind *Quetzalcoatlus*, and how it is possible how the pterosaur could have been a “skimmer” and flew close to water to catch prey (Riddihough, 2007). A normal modern day “skimmer” loses about 20% of its ability to fly when its mouth is dipped into the water (Riddihough, 2007). A small modern day shore bird only weighs a few pounds, which allows them to do this successfully (Riddihough, 2007). As you grow in size, the more the “skimming” hinders your flight ability; since the inability to fly successfully is relative to size, some scientists concluded that it would be nearly impossible for *Quetzalcoatlus* to utilize this method to feed (Riddihough, 2007). They even went as far to say that any creature over about five pounds is not able to “skim” successfully (Riddihough, 2007).

**Discussion**

My analysis of *Quetzalcoatlus* has left me with a much better understanding of this pterosaur, as well as pterosaurs in general. I had no idea how hard pterosaur fossils are to find than other cretaceous creatures. It makes sense why they are so hard to find though, due to the brittleness of the bones because of their need to fly. The fact that we only know of the tiniest fraction of all the pterosaurs there once were is astonishing. The
possibilities of the amounts of different pterosaurs are enormous, and we will only continue to discover and learn about more of them in the future.

During this research I found almost nothing definitive about *Quetzalcoatlus*, and most of the information we have on it seems to be speculative. For instance, the wingspan of *Quetzalcoatlus* is massive, but no one seems to have exact specifications. Instead, there are a number of different ranges of wing size, all of it being speculation. We don’t even know how the creature reproduced, whether it was by laying eggs or not.

Clearly, the biggest controversy about *Quetzalcoatlus* comes from how the pterosaur got its food. There were differing opinions amongst the paleontologists and they each had different evidence to back up their arguments. I don’t believe that there is a definitive answer to how *Quetzalcoatlus* ate, but there are some theories that can be eliminated. The notion that *Quetzalcoatlus* could be a scavenger is moot, because it has a toothless beak, which isn’t necessarily the best tool to scavenge through a dead corpse. This leaves the “skimming” theory as good possibility. While it sounds plausible, the evidence provided that explains the lower jaw limitations lead me to believe that this isn’t possible either. I believe that *Quetzalcoatlus* was feeding on smaller organisms, and used its long beak to its advantage in catching the smaller organisms. More controversy came from the geographical location of *Quetzalcoatlus*. Many argue whether or not it was a shore bird, or if it were located in the mid west region. In actuality, it could go both ways but we may never know. I think it is very likely that they were shore birds, but the locations of many of the fossils found were due to their migration patterns, which is why many of them are found in the southwest.
The neck of *Quetzalcoatlus* is still an interesting subject area. If anything, the neck causes more questions than answering questions. Some scientists claim that the neck helped *Quetzalcoatlus* dig deeper into corpses, but this still doesn’t make up for the fact that they have no teeth. So this still leaves the question unanswered as to what the purpose of their long necks were.

*Quetzalcoatlus* is a polarizing figure amongst paleontologists. There are opposing debates on nearly every subject relating to *Quetzalcoatlus*. It may be a while before there are definitive answers to some of the questions surrounding *Quetzalcoatlus*, but one thing is for sure; there will continue to be more contrasting debates until more definitive evidence surfaces.
Works Cited


