Larger than Life: Communicating the Scale of Prehistoric CG Animals

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***Abstract* — Since the earliest days of cinema, toying with the perception of scale has given filmmakers the ability to create spectacular creatures that could never exist in the physical world. With the flexibility of CG visual effects, this trend has persisted in the modern day, and blockbuster movies featuring enormous monsters are just as popular as ever. The trend of scaling creatures to impossible proportions for dramatic effect becomes problematic when filmmakers use this technique on non-fictional creatures. Prehistoric animals in particular have very few scientifically accurate appearances in popular culture, which means that films such as *Jurassic Park* play an enormous role in determining the public's view of these animals. When filmmakers arbitrarily adjust the scale of dinosaurs to make them appear more fearsome, it can be detrimental to the widespread perception of prehistoric life on Earth.**

For my Digital Media Master's Thesis, I intend to create an accurate digital reconstruction of *Dreadnoughtus schrani*, a 77-million year old titanosaur with the largest calculable mass of any terrestrial animal ever discovered. This animation will target a general audience with the intention of appearing in documentaries. I propose to spend the next quarter researching effective monster cinematography and creating an animatic that successfully conveys the massive scale of *Dreadnoughtus* while still maintaining scientifically accurate proportions. My goal is to prove that despite the freedom of scale in computer graphics, there are more effective ways to demonstrate massive size than simply making the subject larger than it should be.

Keywords—scale; spectacle; cinematography; monster; paleontology; Dreadnoughtus shrani; Jurassic Park

I. INTRODUCTION

"The most obvious differences between different animals are differences of size, but for some reason, the zoologists have paid singularly little attention to them. In a large textbook of zoology before me I find no indication that the eagle is larger than the sparrow, or the hippopotamus bigger than the hare." [Haldane, 1928.]

This statement can hardly be applied to filmmakers, who have historically paid *great* attention to differences of size. The perception of scale is one of the most widely manipulated aspects of "movie magic," and has been so since the earliest days of cinema. Films featuring impossibly gigantic creatures have dominated the box office since the record-breaking release of *King Kong (1933)* [LaBarbera, 2003]. Perhaps unsurprisingly, the trend of giant monsters has only continued with the advancement of visual effects technology. Movie monsters are growing bigger and bigger, and moviemakers show no signs of stopping their ceaseless pursuit of cinematic gigantism.

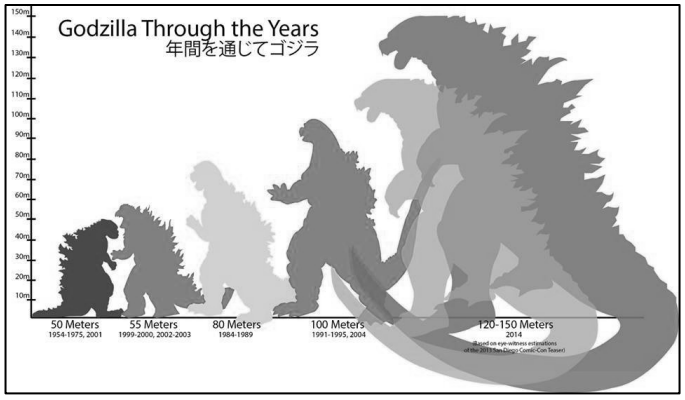

Fig. 1. Godzilla through the years, from 50 Meters in 1954 to 150 meters in 2014. [Holt 2014]

And why should they stop? As cities continue to be populated with skyscrapers that dwarf the skylines of the 1930s, the mighty monsters of Hollywood must play catch-up to maintain their intimidation factor [LaBarbera, 2003]. The flexibility of computer graphics allows for filmmakers to overcome the physical limitations of these creatures by scaling them up to impossible proportions, all while maintaining degrees of realism unachievable with traditional film techniques like forced-perspective and miniature models.

Gone is the dependence on optical tricks and illusion-aided cinematography to convey a sense of extreme scale. If the director wants the monster bigger, he simply tells the visual effects artists to *make* it bigger. Because there is no physical upper limit on the size of CG characters, the temptation exists to make "this year's monster" a more gigantic force than "last year's monster" [Davis 2014]. The result is a pantheon of Hollywood leviathans with impossible proportions, each hell-bent on devastating some unsuspecting city in the most spectacularly entertaining fashion possible.

When these creatures are rooted within the realm of fantasy, the physical impossibilities of their anatomy seem to be of negligible importance. Why would an average movie- watcher care that Mothra, the moth-like nemesis of *Godzilla*, would require an impossible amount of tracheal tubes to maintain a sufficient oxygen supply for flight [LaBarbera, 2003]? Why does it matter that the titular giants in *Jack the Giant Killer* would realistically be crushed by gravity before Jack ever made an entrance [Haldane, 1928.]? Or that King Kong, the very archetype of the movie monster, could likely attribute his bad attitude to the fact that his spine was on the verge of shattering every time he stood upright [LaBarbera 2003]?

The issue with this method of thought becomes apparent when filmmakers apply the same concessions of scale to creatures based in *reality*, in order to elicit a familiar (and lucrative) sense of spectacle from their audience. By introducing a realistic creature to a work of fiction, the filmmaker implicitly gives the viewer the expectation that the creature in question is the right size, unless explicitly stated otherwise. Scaling up a realistic creature to make it seem more imposing, dangerous or spectacular invites confusion and perpetuates misinformation.

This practice is *especially* detrimental when considering the cinematic treatment of dinosaur anatomy, where there is no solid baseline understanding of an animal's size, appearance or behavior. If a director decided to scale a cat to three times its size for dramatic effect, most of the audience would recognize the alteration as an embellishment because they have seen other cats before. If a director were to scale up a Velociraptor to three times its size for dramatic effect, most of the audience would continue to believe that Velociraptors were six feet tall, despite this being incorrect [Calhoun 1993].

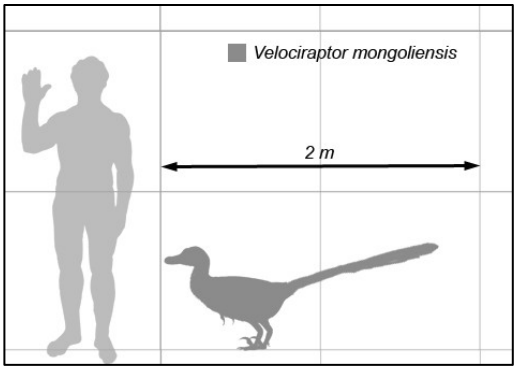

Fig. 2. Scale-accurate representation of a Velociraptor. [Vergano 2014]

Conveying a sense of spectacular scale without sacrificing the accuracy of a creature's size is particularly relevant to my research goals. My intended thesis project is a digital reconstruction of *Dreadnoughtus schrani*, an 85-ton Cretaceous titanosaur with the largest calculable mass of any terrestrial animal ever discovered [Lacovara 2014]. My goal for this project is to successfully convey the spectacular size of this creature with an effectiveness that rivals the modern "monster movie" while presenting it with all the scientific accuracy available to modern paleontologists.

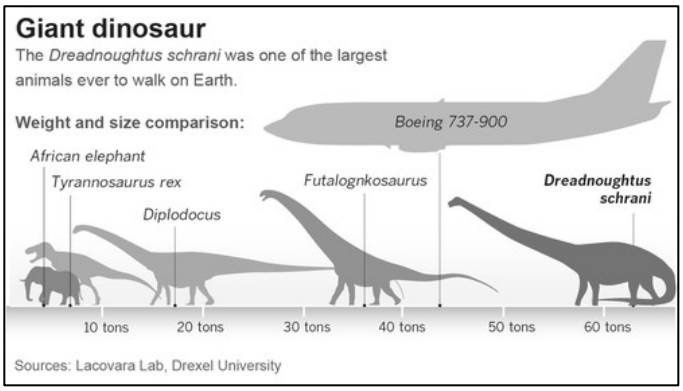

Fig. 3. Dreadnoughtus shrani scale comparison. Featured next three other dinosaurs, an African Elephant, and a Boeing 737. [Lacovara 2014]

My proposed New Media project for next quarter is the creation of a 3D animatic for my *Dreadnoughtus schrani* animation, with a focus on cinematography to demonstrate its massive scale. I will be working with Dr. Lacovara of the paleontology department to develop the story. I will then create low-fidelity, accurately scaled models of the animal and its environment, and research the most effective methods of conveying its size with camera angles and storytelling methods. By regularly seeking audience feedback via questionnaires, I will be able to carefully construct a shot sequence for my Master's Thesis that conveys a sense of massive scale while accurately portraying the animal in its natural habitat.

II. BACKGROUND

While the primary goal of a filmmaker should always be to make a great movie, the profound effect that Hollywood has on the public's worldview cannot be ignored. Fiction is fiction, and no amount of appealing to scientific integrity will prevent filmmakers from exaggerating for dramatic effect. That being said, when a filmmaker publicly goes through pains to ensure the scientific accuracy of prehistoric creatures, the audience is going to expect accurate prehistoric creatures. Any lapse in accuracy for the sake of drama can (and will) create widespread misinterpretations between fact and fiction.

The prime example of this problem can be seen in Steven Spielberg's *Jurassic Park* (1993). *Jurassic Park* is often lauded for changing the public view of dinosaurs, in many ways it for the better. Mark "Crash" McCreery, the lead concept artist of *Jurassic Park*, described his process:

> "I wanted to get as far away from people's preconceptions of dinosaurs as possible --the upright, bulky, clumsy kinds of creatures that have been seen in previous movies. The idea was to show that we were up-to-date on the current thinking that dinosaurs were probably warm-blooded and birdlike rather than cold-blooded and lizardlike." [Shay, 1993]

The influence that *Jurassic Park* has had on the public perception of dinosaurs can be considered a double-edged sword. Spielberg's effort to consult with paleontologists and create realistic dinosaurs helped bring an awareness of current paleontological research to his audience in 1993 [Olheiser 2014]. The film also had the unfortunate effect of presenting dramatized material, such as the aforementioned Velociraptor scale issue, with an equal degree of validity to the same audience.

Over two decades later, the trailer for a new film titled *Jurassic World* has been released, and Spielberg's audience is eagerly awaiting the release of another high-octane dinosaur-filled adventure. There's only one problem -- the dinosaurs in *Jurassic World* look exactly the same as they did in *Jurassic Park*. Steven Spielberg decided to eschew over 20 years of paleontological research in favor of film continuity. The Velociraptors are still 6 feet tall, still featherless, and still incorrect. This only reinforces the public illusion that Spielberg's representation of dinosaurs is factual, as it has remained unchanged in for so long. As paleontologist Thomas Holtz commented:

> "The original movies brought the dinosaur research of the 1980s to 1990s viewers, and the latest one seems to bring the dinosaur research of the 1980s to the 2010s viewers," [Vergano 2014].

The raptors aren't the only inaccurate animals that viewers of *Jurassic World* will have impressed upon them. The newest addition to the Park appears to be a *Mosasaurus maximus*, a marine reptile closely related to the extant Komodo dragon. The *Mosasaurus* in the *Jurassic World* trailer is nearly the size of a Boeing 747 -- over double the size of the actual animal [Vergano 2014]. Because this the first time that many viewers will have heard of a *Mosasaurus*, *Jurassic World* is setting up another generation of prehistoric fallacies in popular culture.

The matter of scale is not the only scientific inaccuracy present in *Jurassic Park*, of course. Even the name itself is a fallacy, as all but two of the animals in the film are from the Cretaceous period [Shay 1993]. There will be many other topics to research before I begin my own dinosaur reconstruction, but I believe that an in-depth exploration of scale would be appropriate in scope and importance for a 10-week research project.

III. PROJECT

The final deliverable of my 10-week research block will be a 3-to-5 minute 3D animatic of my intended *Dreadnoughtus schrani* thesis project.

I propose an in-depth exploration of cinematography for a subject of extreme scale, utilizing classic, remediated camera techniques to convey a sense of spectacle to the viewer. The final *Dreadnoughtus* animation will be targeted at a general audience with the intention of being featured in documentaries, so the animal must be created with scientifically accurate proportions. I intend to demonstrate that it is not necessary to exaggerate the size of a prehistoric creature in order to achieve a dramatic effect.

Dreadnoughtus schrani is already an internationally recognized name associated with Drexel University, and I have been working on this specimen for over two years. This project is very near and dear to my heart, which is why I want to spend next term carefully planning out the pre-production of my final animation.

First I will meet with Dr. Lacovara to determine a narrative for this project, and then create a beat sheet of important moments. I will then research cinematography techniques used throughout film history to effectively convey a sense of scale. Then I will create low-fidelity, scale-accurate models of Dreadnoughtus and its environment, and spend the majority of the quarter placing cameras in the scene and evaluating their effectiveness.

I will evaluate the effectiveness of my chosen camera angles by issuing regularly scheduled surveys to a population of test viewers. I will ask questions about their perception of Dreadnoughtus's size in each shot, and use this feedback to iterate on my camera choices until the end of the term. Finally, I will render out a rough animatic of shot sequence as my end-of-term deliverable.

IV. WORKPLAN

- **Week 1**: Create project proposal, contact Dr. Lacovara
- **Week 2**: Create rough proxy models of Dreadnoughtus and environment
- **Week 3**: Research monster cinematography, place cameras
- **Week 4:** Create & distribute Survey #1, implement feedback, place new cameras
- **Week 5**: Buffer week: depending on the chosen narrative, additional models and environments may be necessary. Make them this week
- **Week 6**: Research more cinematography, place more cameras, playblast WIP animatic
- **Week 7:** Issue Survey #2, implement feedback.
- **Week 8**: Consult Dr. Lacovara, work with him to adjust current work as necessary
- **Week 9**: Issue survey #3, implement feedback.
- **Week 10**: Render out final animatic

V. REFLECTION

Since the beginning of my New Media Theory class last quarter, I knew that I wanted to pursue an exploration of scale for this project in order to aid in my future *Dreadnoughtus* thesis. I had originally intended to create a completely different, purely research-driven animation that did not feature any dinosaurs, but after many fruitless brainstorming sessions I still couldn't think of a solid enough research angle. I was researching scale with the hope of finding some element of scale that was worth researching, because I knew it was important but I couldn't quite figure out *why*. I decided to take a step back and really consider why I thought researching scale was important to the success of my thesis project, other than the patently obvious reason of "*Dreadnoughtus* is big so I need to make it look big."

I realized that the main problem I have with scale is how often it is used as an easy way out for visual storytelling. If you want to make something look intimidating, just make it bigger! CG animation removes the issue of physical plausibility in character design, so there really is no upper limit on how big a modern movie monster can get. And from *Godzilla* to *Cloverfield* to *Pacific Rim* to *Godzilla* (again), they just keep getting bigger. While this does make for a spectacular visual display on the big screen, the resulting creatures are all insanely unrealistic. Which is fine, of course, if you're making a science fiction monster movie with insanely unrealistic creatures.

Then I saw the trailer for *Jurassic World*, and I immediately knew what I was going to write about.

Mosasaurus maximus, a creature I briefly referenced earlier in this proposal, was an absolutely terrifying marine predator from the Late Cretaceous. Its skull was bigger than that of a *Tyrannosaurus rex,* it measured two busses in length, and it had two rows of razor-sharp teeth. The second row was located far back in its gullet and pointed backwards, like a stockade, to prevent anything it swallowed whole from swimming back out of its mouth.

Isn't that intimidating enough as it is? Why did Spielberg need to make it twice as big for *Jurassic World*? Most people watching this movie have never heard of a *Mosasaurus* before, and now they're going to have a completely skewed perception of what this amazing animal was like.

Dinosaurs (and other prehistoric animals; *Mosasaurus* isn't a dinosaur) have the unique ability to capture the attention of young children and genuinely get them engaged in science. I occasionally volunteer at a Cretaceous marine fossil pit in New Jersey, and roughly once a year the dig site holds a "Community Dig Day" where thousands of kids show up and dig for marine fossils. My favorite thing to do at these events is to find a group of enthusiastic, wide-eyed children with shovels and tell them all about the giant swimming lizard-monster that used to rule this part of New Jersey.

Every single time I get to the part about the second row of teeth, I'm rewarded with astonished gasps and delighted screams. Every single time, the kids are impressed with the spectacle of the *Mosasaurus*.

After *Jurassic World* comes out, I'll have to be the disappointing, wet-blanket paleontologist lady who ruins their day with science by saying "Well, *ACTUALLY*, the real *Mosasaurus* was less than half the size of movie one. But it's still kind of cool… right?" Paleontology shouldn't be disappointing! Real science is awesome, and it's important to present it as such.

This all made me realize that I care a lot about preserving accuracy where accuracy is due, and that it's possible to adhere to physically-plausible character design while still making the final subject appear larger than life. With this *Dreadnoughtus* project, I have the opportunity to help shape the public perception of one of the largest animals ever to walk the Earth. I want this project to have all the spectacle of *Godzilla* and all the accuracy of a David Attenborough documentary, and for it to help inspire kids to care about the science behind their favorite movies.

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