Why Jurassic World could never work

April 14 2015, by John Long

Dinosaurs and people together in Jurassic World. Universal Pictures

When the first Jurassic Park movie hit the silver screens in 1993, I cried. Never before had dinosaurs, those magnificent creatures of bygone days, been brought to life so realistically. It was a palaeontologist's dream come true.

Jurassic Park and its sequels were huge hits, and dinophiles around the world are now anxiously awaiting the release of the next instalment, Jurassic World on June 4 this year.

These films give an impression that science might be really be capable of bringing back a living dinosaur. The latest outing goes even further than the previous films, where only dinosaurs that once existed were recreated. Jurassic World is about the "genetically modified hybrid" dinosaurs.

But is this all really possible?

The answer is a kind of "yes", but not in the same way that the Jurassic Park movies might suggest.

Can we ever find and use dinosaur DNA?

DNA is the building block of life. It's the veritable blueprint for how cells divide, multiply and eventually build an organism's body plan. We can clone genetically identical organisms from the DNA of a parent organism, including mammals such as Dolly the sheep.

When an organism dies, the soft tissues, including the DNA, break down and eventually are destroyed. But in some cases, parts of dead animals and plants are buried and preserved as fossils. And in very rare cases soft tissues of fossils can be preserved.

In some cases parts of the DNA can be extracted from well-preserved fossils, as in the recent case of two extinct Australian fossil kangaroos, whose DNA was dated between 40,000 to 50,000 years old.

In these cases only small sections of the extremely long DNA molecule are ever found. Although these short segments of fossil DNA can often give us valuable information about the relationships of the extinct animal to its living relatives, they are far too fragmentary to ever give us the full picture of the animal's genome.

For example, the human genome has 23 chromosomes composed of 3.2 billion base pairs of molecules. Reconstructing the full set of chromosomes is thus an impossible task if using just a few short segments of one chromosome as reconstructed from a fossil.

In their book The Science of Jurassic Park and The Lost World, Rob Desalle and David Lindley describe how the process shown in the movies for reviving a dinosaur from fragments of fossil DNA is fundamentally flawed.

The method used by the fictional genetics company, Ingen, involved finding dinosaur DNA still inside fossilised mosquitoes preserved intact in amber, which is sap that seeps from trees and often covers unwary insects.

While it's true we do find superb life-like insect fossils in amber the same age as when dinosaurs lived the insects do not contain even small fragments of their own DNA preserved, let alone the DNA of any dinosaur it may have bitten.

While in living mosquitoes it's possible to identify host blood from its DNA, if the mosquito has very recently taken the blood, survival of the DNA inside the insect gut is short-lived as it rapidly breaks down during digestion.

A mosquito trapped in amber has a slow death, allowing plenty of time for this digestive action to keep working and ultimately break down any traces of its last meal's DNA.

Another premise in the movie is Ingen using frog DNA to patch up the fragments of dinosaur DNA to make up a relatively complete dinosaur strand of DNA.

Frogs and dinosaurs are genetically a long way apart, separated in real time by about 360 million years, using a divergence calculator based on two living taxa, *Rana* (frog) and *Gallus* (chicken, as a living representative of a dinosaur).

The complex nature of DNA makes it impossible to ever reconstruct the exact DNA of an extinct animal using small fragments, especially when patched up using more than 99% of another distant relatives DNA!

Could we bring dinosaurs back another way?

So could we really create a dinosaur in this modern day and age? The idea of bringing back a dinosaur to life is complicated, but the idea of a genetically modified one as in the new Jurassic World is even more far fetched. The answer though does lie in genetic modification of our only living dinosaurs, the birds.

By breeding out the primitive features in birds we could ultimately breed them back to being dinosaurian like in appearance.

For exampl,e applying retinoic acid (derived from Vitamin A) at a certain stage of the chicken embryonic development gives a bird that has feathers on its legs and scales covering the body, reversing the feather-scale distribution. Already we have a more dinosaur-like living bird.

Well known American dinosaur palaeontologist, Jack Horner, has written a book with James Gorman entitled How to Build a Dinosaur: The New Science of Reverse Evolution.

This method suggests that with controlled breeding of birds, and by implanting them with surrogate tissues, we could produce more dinosaurian features in living birds, which technically are real dinosaurs.

Horner says that an Australian Emu would be the likely place to start breeding from, as it's already looking a lot like a dinosaur.

Many early fossil birds, such as the Jurassic *Archaeopteryx* had dinosaur-like teeth, so the loss of teeth is widely regarded as an advanced feature of modern birds.

Matthew Harris, of the Max Planck Institute in Germany, has already made a bird with real teeth. He did this by transplanting mouse dental tissue into a chicken's mouth to make a chicken with teeth.

Similarly, a long skeleton-supported tail was present on dinosaurs and some early fossil birds such as *Archaeopteryx*. The loss of a long bony tail is a feature seen in all living birds.

Could a 90 million year old fossil mosquito preserved in amber contain traces of

its last meal's DNA? Credit: Wikimedia/Brocken Inaglory, CC BY-SA

Chickens and other bird embryos have longer tails with several vertebrae that later fuse together as they develop, so the raw material needed is already present. It would just need an inhibitor to stop the embryonic fusion of the tailbones and we would have birds with longer, more reptilian tails.

But what about arms? Birds lack arms with digits, as their forearm is modified into a wing. Their digits have been highly modified in the evolutionary process.

Yet one primitive living bird, the Hoatzin, retains its digits exposed outside the wing, a condition not far removed from a dinosaur's hand. Perhaps with careful breeding we could reverse engineer a bird with a dinosaur-like forearm using this species as a starting point.

Using dinosaurs in today's world

As in Jurassic Park, the ethical question we need to ask is: why would we ever want to bring back dinosaurs to today's world? Would they have any purpose, or just be odd curiosities?

Even a seasoned palaeontologist like myself can't see any real need to ever do it apart from curiosity's sake.

Early fossil birds like this Jurassic Archaeopteryx (Berlin specimen) had dinosaurian features like teeth and long bony tails. Credit: Wikimedia/H Raab, CC BY-SA

We may never be able to bring the long extinct dinosaurs back to life, but we can enjoy their CGi animated forms on the big screen. And more importantly, we can use them for massive commercial enterprises and the global marketing of educational products.

Dinosaurs, after all, are usually a child's first introduction to the world of science. Indeed, some of us never grew out of the wonder of dinosaurs.