

From Asia to the Americas

A BIOGEOGRAPHICAL DYNAMIC

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Our grand expedition from the northeastern regions of Asia into the American continents is recognised as a pivotal migration in human prehistory. These may have been the first people to place their footprints on these two landmasses, but they were by no means the first living things to cross from Asia to America.

For millions of years, there have been intermittent interchanges of plants and animals between the continents. Biogeography, the biological science that deals with the distribution of flora and fauna, is a complex field that draws evidence from several sources, and we can now begin to isolate some of the Asian influence on the ecology of the Americas.

The most obvious candidates for organisms with Asian origins are those that are currently living there, and a few of these – most notably agricultural crops, domesticated animals and feral weeds – have been brought in geologically recent times to the Americas with human assistance. There's a symmetrical story, of course, of American-evolved species, such as camels, coming into Asia from the other direction.

But the story begins much earlier than these recent developments. We'll pick up the narrative on the

supercontinent of Pangaea 200 million years ago, and move forwards from there.

The continents today

Three hundred million years ago, the continents were united in the single giant continental area of Pangaea, and there was one vast ocean called Panthalassa. It was not the first unified landmass, but it was the last. After one hundred million years, by the end of the Triassic period, Pangaea had broken up into Gondwana (to the south) and Laurasia (to the north).

South America left the other southern continents, as Gondwana broke up 180 million years ago. The link between South and North America at Panama was made approximately 10 million years ago; at this time, a great exchange of species began to occur between the two. At this tropical crossroads, species such as opossums, camels while porcupines moved north and bears, cats and dogs moved south.

North America was contiguous to the northwestern portion of Asia (Europe) until 60 million years ago, when the Atlantic Ocean began forming. Even as the continents moved apart, ice-covered regions and periods of low sea levels continued





LEFT The unusual twisted, knotty trunk of a legend of biogeography, the dawn redwood (*Metasequoia glyptostroboides*)

the biogeographical link. As the Pacific Ocean shrunk, the continents of Asia and North America came into contact – although this time on the far side of the previous connection. They are of such vast size that as they are rifting across the Atlantic, they are simultaneously merging at the Pacific side.

The North American tectonic plate may actually encompass a substantial portion of Siberia, and the actual meeting zone between these two plates could be well inland. This geological boundary is one of the least-studied on Earth, and one of the final puzzles of plate tectonics. Understanding its history is complicated by the nearby northern edge of the Pacific tectonic plate. Trapped between these three are the much smaller Bering and Okhotsk plates. This boundary is so indistinct that the North American (Laurentian) and the Eurasian plates are sometimes referred to in singular as the Laurasian plate.

At present, there is a major obstacle to terrestrial species between the two landmasses – the saltwater at the Bering Strait. But the distance between Siberia and Alaska is only 85 kilometres at the narrowest point, and for most of the last 60 million

years, lower sea levels have created a dry “land bridge” across the region. The Beringia Theory (also known as the Bering Strait Theory or Land Bridge Theory), first proposed by José de Acosta in 1590 and now widely accepted, maintains that this bridge offered a terrestrial path for humans, plants, animals, and other organisms between the landmasses.

It’s worth sparing a thought for the marine connections that were closed when the land bridge formed: the pathway for a migrating whale is a barrier for the migrating bison. In fact, it is High Arctic marine mollusc fossils found far south in Alaska, dated to five million years, that provide the first record of a marine

Bering Strait serving as a marine migration path.

So, Beringia was a region of dry land since around the same time that the Atlantic began forming on the other side of the planet. What we call a “land bridge” was actually a vast landscape that was returning to its normal state. The Beringia region has only been dry for a portion of the last 100,000 years. During dry intervals about 50,000 and 19,000 years ago, ancestors of the Native Americans traversed this link from Asia into the Americas.

A shared Pangaeian heritage

There is a biological heritage of the Asian and American continents: lineages of organisms that appear to

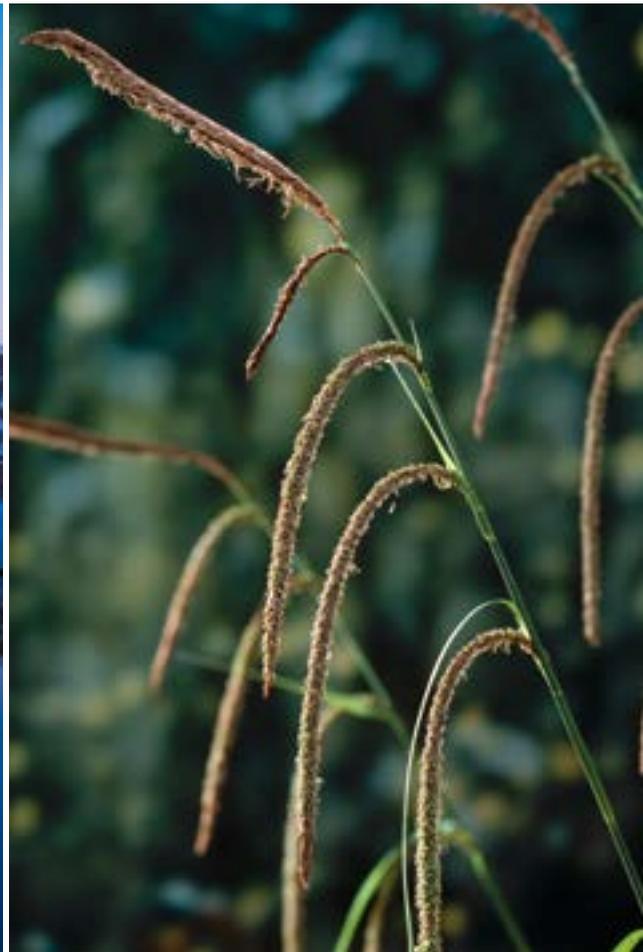
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have been present in Pangaea and were subsequently separated by the splitting of the continents. Over time, they developed into separate species.

This “shared heritage” concept is especially well developed in the botanical reconstruction of a now-vanished forest, the Arcto-Tertiary Geoflora. This hypothesised forest spanning the Northern Hemisphere accounts for the close relationships among the flora of China, Europe and the Eastern United States, including maples, sycamores, oaks, birches, walnuts and pines.

One particularly notable plant found in the fossils of both Asian and American regions is the dawn redwood, *Metasequoia glyptostroboides*. This tree genus



is known from fossils throughout the Northern Hemisphere, but only survived to modern times in a single province of China. Like many other once-widespread organisms, it now exists in a fraction of its former range.

Beringian travellers

Let's turn the globe around to the other side of the planet, and look at the much more recent links across the North Pacific. It's important to remember that for at least 50 million years until relatively recently, northeast Asia and northwestern America were linked by dry land and covered by vast forests. The water is a much more recent development.

The most recent land connections at Bering have allowed species to

travel more easily into the Americas from Asia. Even when the water formed an obstacle, plants could travel by wind and flotation, and animals could swim, fly or ride the ice floe between the two regions. The prevailing winds move from west to east, aiding Asian species in coming to the Americas.

There is Alaskan fossil evidence, approximately 50 million years old, of Asian-affiliated palms, laurels and nutmegs. There are a number of plants from the Asian steppes that are now found in eastern Beringia, including species of the sagebrush genus *Artemisia* and the sedge genus *Carex*.

Woolly mammoths, American lions, bison, musk ox and lemmings also traversed (and inhabited) Beringia in recent geological times. The now-

TOP The pendulous sedge (*Carex pendula*), a plant from the Asian steppe that is now found in eastern Beringia

CENTRE Provideniya, Russia: Ice clogs the passage to Provideniya Bay right through to late June. Provideniya is the closest official port to the Bering Strait in Russia's Far East

FAR LEFT Reed canary grass (*Phalaris arundinacea*), an invasive species with Asian origins that is commonly found in the West

The now-extinct mammoths and lions were, like humans, descended from African ancestors that traversed Asia. Dogs came to North America from Asia as companions to humans.



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The Columbian exchange

Over the last five centuries, the European conquest of the Americas via the Atlantic has brought over many plants and animals to the New World. Some of these have been of great benefit to humanity, but many have caused great disruption to natural ecosystems.

Within this migration were the cultivated and domesticated species from Eurasia: animals such as horses, cows, chickens, sheep, goats, pigs and honeybees; and plants, such as wheat, peas, lentils, olives, apples and citrus. At the same time, invasive species around the world often have a Eurasian origin: the largest landmasses are also ecologically the most competitive, and smaller landmasses often have organisms that lose to that competition.

Some of the worst-offending Asian invasive plants of the Western Hemisphere include Himalayan blackberries, reed canary grass, thistles, knotweed and pampas.





1

Chukotka, Russia:
A Chukchi herder out on
the tundra

2

Alaska, USA:
An elder female Yupik woman
sitting outside her house

There are also unwanted species of earthworm, fish, starlings, mynahs, doves, and other animals. Worst of all are the uncountable insects and the ecologically devastating fungal infections that ravage entire landscapes. These can be considered global pathogens that have an important ecological niche in their home ranges, but cause a horrific rampage when in a new environment.

Indeed, all of the continents and oceans of the world are undergoing wrenching, dramatic change as organisms travel around the world at the evolutionary equivalent of light speed. Still, it's important to remember that the migrations earlier in geological time also had strong impacts on their new environments. The difference is that they happened much more slowly and much more rarely.

Returning home

Not all of these modern ecological migrations from Asia to the Americas are unprecedented. Some of the Asian arrivals to the Americas are actually returning to their ancestral home.

The dawn redwood, the ancient redwood tree that somehow survived in China, has managed to return to

the North American region where it grew many millions of years ago. After scientists from China and the USA recognised these trees as “living fossils”, they were planted as ornamental trees around the world. You can find dawn redwood growing in cities not too distant from sites harbouring their fossils.

If you travel to the eastern US state of North Carolina, you can find an afforestation project seeking to re-establish dawn redwoods on the continent it once called home. This raises some difficult questions: Is this an ecological restoration of a forest that disappeared long before humanity, or a quixotic effort that detracts from more obvious conservation efforts?

Asians in America

While our distant ancestors had a long and arduous journey from Africa, across Asia, across Beringia, along to South America, we can now travel that distance by air in a matter of hours. Whereas organisms were once blocked by waterways and land barriers, we now build roads, canals, bridges and transport networks that facilitate the arrival of wild species into new environments.

It's clear that we are living in the most dynamic period of biogeographical exchange to ever occur on Earth. The “out of Asia” story is actually more prevalent than, for example, the “out of Australia” one. Due to its size and connectivity, the Asian continent has been involved in more biological transactions – inwards and outwards – than the other landmasses.

The fact that North America and Asia are separated by water in the present day is anomalous – during much of geological history these continents were linked. The American and Asian continents share a common ecological heritage, trading species, ideas and people since they were part of Pangaea. With our transportation technology, we are bridging the straits and leaping oceans; today's world is a biogeographical supercontinent. ♦ AG

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