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World Heritage biodiversity area:

Te Wahipounamu's Rivers of Ice

by Sonny Whitelaw

Showcased by Peter Jackson's *Lord of the Rings* trilogy, it's no surprise that *Te Wahipounamu*¹, the South West region of *Aotearoa* New Zealand, is listed as a World Heritage area. Encompassing more than 40 separate protected National Parks, Wilderness and Wildlife Management Reserves covering 2.6 million hectares; it stretches 280 miles along the western coastline of *Te Wai Pounamu* South Island, from the sea to an elevation of 12,349 feet (*Aoraki* Mt. Cook), and extending inland as far as 56 miles in places. Dominated by majestic, snow-capped peaks and dotted with countless sapphire lakes, waterfalls, fjords, and valleys reminiscent of Middle Earth's Rivendell, the region is home to hundreds of the world's most active glaciers. And the star attractions, two massive tongues of jumbled blue, black and white ice snaking down through wide valleys, are *Ka Roimata o Hine Hukatere*, Franz Josef Glacier and nearby *Te Moeka o Tuawe*, Fox Glacier.

Maori legend, history and culture

The entire region is of deep significance to the Ngai Tahu tribe, whose ancestral territories cover all except the extreme northern parts of South Island. According to legend, *Te Wahipounamu* was formed when the four sons of *Rakinui*, the Sky Father, descended from the heavens and set out on a voyage around *Papatuanuku*, the Earth Mother. Disaster struck when their canoe hit a reef, stranding them. An icy wind from the Tasman Sea froze the brothers into stone, and their canoe became the South Island, *Te Waka o Aoraki* (literally, ‘the canoe of Aoraki’) The tallest brother, Aoraki, is now the majestic *Aoraki* Mount Cook while his siblings and other crewmembers form the Southern Alps.

The Maori names for the Franz Joseph and Fox Glaciers, *Ka Roimata o Hinehukatere*, and *Te Moeka o Tuawe*, come from the legend of Hinehukatere, who loved climbing in the mountains and persuaded her lover, Tawe, to accompany her. An avalanche swept Tawe to his death, where he came to rest in *Te Moeka o Tuawe* (literally, ‘the bed of Tuawe’) Fox Glacier. Broken hearted, Hinehukatere cried many tears that froze to form Franz Joseph Glacier, *Ka Roimata o Hinehukatere* (‘the tears of Hinehukatere’).

The area was—and still is—an important source of *pounamu* greenstone (jade) a precious stone used for Maori tools, weapons and jewelry. Recent archeological evidence has revealed that that there were once large Maori settlements at Okarito, *Mahitahi* Bruce Bay, and *Makawhio* Jacobs River. However, fifteenth century earthquakes and tidal waves in this tectonically dynamic area most likely were responsible for the abandonment of permanent settlements until European times.

While retaining their rich cultural heritage, most Maoris now live a similar lifestyle to the *Pakeha* (non-indigenous) settlers. But few people—Maori or *Pakeha*—live in this

region, known locally as the ‘Wild West Coast’. Okarito, for example, has a permanent population of only 26 people, while the largest town, Hokitika, is supported by (mostly) Maori artisans who fashion greenstone into fabulous jewelry and decorative pieces. Even townships such as Fox and Franz Josef (total population 600) exist solely to service visitors to the glaciers, and everyone, Maori and *Pakeha* alike, proudly recognize the intrinsic worth of *Te Wahipounamu*’s astonishing, untamed beauty.

The region is listed as a World Heritage area not because of its cultural or historic significance, but because it is recognized as one of the world’s foremost natural landscapes with an extraordinarily rich biodiversity where the impact of humans is confined to a few small settlements and a narrow strip along the main highway, and where some of the best modern representatives of the original flora and fauna of Gondwanaland still exists today.

Geological history

To understand why this extraordinary landscape has come about, it’s necessary to step back in time 85 million years to when New Zealand separated from Gondwana, the super-continent comprising Antarctica, Australia, Africa, South America, and India. Sea floor spreading between New Zealand and Gondwana pushed much of the land underwater, but by 24 million years ago, the Pacific and Indian-Australia tectonic plates grinding against one another had created a massive rent in the Earth’s crust, referred to today as the Alpine Fault. Between 23 and 10 million years ago the western side of the Alpine Fault ground along in a northeasterly direction relative to the eastern side, at a rate of 0.5-4.5 inches annually, ultimately resulting in a displacement of some 280 miles. Geologists estimate that a staggering 15 miles of greywacke and argillite rock were pushed up from the sea floor

during this displacement, forming the Southern Alps, the majestic backbone of *Te Wahipounamu*. It's believed that the mountains retained the same height throughout the shaping of successive Pleistocene glacials; a fact that indicates the astonishingly high rate of mountain building was (and still is) matched by a similar rate of natural erosion.

A spectacular example of this erosion took place on the night of December 14, 1991, when the summit of *Aoraki Mt. Cook* collapsed, and an estimated 493 million cubic feet of rock and ice plunged 8,850 feet at speeds approaching 370 mph to the Tasman Glacier. The momentum carried the 1.25 mile wide avalanche across the Tasman and 230 feet up the slopes of the Malter Brun range on the far side—4.7 miles away.

The handiwork of glaciers and melt water is evident everywhere at the foot the mountains: smooth outwash plains and terraces, deposits of moraine, tarns (lakes) filling hollows once occupied by stagnant ice (kettle holes), and isolated rock monoliths with their faces scoured by passing ice.

Climate

These highly eroded landforms have come about largely because of climate. Water laden winds (averaging 28mph at 10,000 feet) blowing off the Tasman Sea are forced upward when they strike the mountains. The air abruptly cools, the water condenses and as much as 120 inches of precipitation falls on the coastal strip annually, while a staggering 394 inches—that's 33 feet—falls just a few miles inland in the alps. On the eastern side of the mountains, the dry, föhn winds have and continue to scour the braided riverbeds, carrying clouds of glacial silt and depositing it as loess on the eastern side of the mountain range.

Much of the precipitation, distributed uniformly throughout the year, is in the form of snow, however there are distinct seasonal changes in temperature. In winter, the snowline is usually 4-5,000 feet, retreating to 6,800-7,900 feet in summer. It is this massive snowfall on the western and upper regions of the alps that drives glaciers which in turn has resulted in the monumental scouring and shaping of the landscape.

Glaciers—rivers of ice

All glaciers begin to form up in the névé, where successive layers of snowfall eventually compress into firn, and then hard ice. Gravity forces the ice to move downhill, scouring out whatever surface over which it flows. Where the land is uneven or very steep, crevasses and seracs form. Regardless of whether the overall glacier is retreating or advancing (the difference being how much snow accumulates versus how much melts), the actual ice within the glacier itself continues to travel downhill, the rate of flow being dictated by the steepness of the valley. This process is assisted by basal sliding, whereby melt-water between the bottom of the ice and the ground acts to reduce friction—much the same way as an ice-skater slips across the surface ice.

A comprehensive survey of the South Alps in *Te Wahipounamu* revealed that 3,155 glaciers cover an area of 447.5 square miles. While Franz Josef and Fox Glaciers, which are within a few miles of one another, may not be the longest, they are arguably the most spectacular because they both terminate 980 feet into the temperate rainforest zone, just a short distance from the West Coast highway in the Westland National Park. Because of their situation Fox and Franz Josef are two of the most easily accessible glaciers in the world and can be seen from car parks less than forty minutes walk to the terminals. It's an

astonishing sight, moreso because these vast, thick tongues of blue-white ice travel through valleys flanked by verdant rainforest, where massive silver tree ferns vie for space between evergreens such as silver beech, and podocarps—some as old as 800 years.

Ka Roimata o Hine Hukatere Franz Josef Glacier

Its English name was given by German geologist Julius von Haast after Emperor of Austria, Franz Josef. The 7.5 mile long glacier curves down the Waiho Valley having started life in a névé estimated to be 1,000 feet deep. Like all glaciers, it has a cyclic advance and retreat pattern. During the last ice age (10-15,000 year ago) it extended all the way to the Tasman Seas 12 miles away. During the ‘little ice age’ between 1600-1750AD, it advanced a considerable distance out onto the coastal plain, leaving behind a tell-tail deposit of moraine when it later shrank. Between the 1940s-1980s it again retreated but then in 1984-9 it advanced at the phenomenal rate of up to 27.5 inches *per day*, and grew overall 500 yards.

It takes around five years for ice to flow from the névé to the terminal—a statistic confirmed when objects known to have fallen in the névé appear at the front of the glacier five years later. Melt-water from the glacier, the Waiho River, flows across the wide, scoured glacial Waiho Valley, aggrading the riverbed with moraine. As a result, when the river exits the valley onto the coastal plain, sections of the dry riverbed are as much as 7 feet above surrounding land, posing a potentially dangerous flood situation for the township of Franz Josef, particularly because movement of the glacier can release accumulated water without warning.

Te Moeka o Tuawe Fox Glacier

Named in 1872 after the Prime Minister of New Zealand, Sir William Fox, visited the area, the glacier is fed by four alpine glaciers, and drops 8,530 feet in height over a length of 8 miles. It takes around seven years for snow to advance from the névé, which is also around 1,000 feet deep, to the front of the glacier. Although retreating throughout most of the last 100 years, it has been advancing since 1985 at an average of about 3 feet a week and has gained about 500 yards overall. The outflow of the glacier forms the Fox River, which doesn't appear to pose the same dangers as the Waiho.

Ecosystems

The legacy of glaciation is so extensive that virtually every landform in the region and hence the soils, vegetation, and indirectly, wildlife, is a result of some glacial influence.

The massive erosion and nutrient leaching that has come about because of the rapid elevation and high precipitation has created extraordinarily diverse environments. Within a few hundred yards it's possible to see hardy alpine mosses, lichens and heathers, nitrogen-fixing shrubland and heather, and grasslands, with sharp ecotones between each. Pretty snow tussocks are the most common of the alpine grasses while foxgloves, mountain daisies, lilies, anemones, edelweiss, flowering heath and buttercups—including the largest buttercup in the world, *Ranunculus lyallii*—can all be seen.

Silver beech dominates the forest below the snow line, crowding massive tree ferns clinging to the edges of the glacial valleys. Perhaps the most distinctive feature of these forests are the podocarps—evergreen conifers—legacy of the period when parts of New Zealand were still joined to Antarctica. On the constantly wet forest floor are mosses and

liverworts, lichens and delicate ferns and riotous fungi, all of which would crinkle and die if exposed to direct sunlight.

The Franz Josef soil chronosequence reveals that within 20 years of surfaces being stripped bare by the glacier, nitrogen-fixing herbs and shrubs colonize the ground. Rata-Kamahi forest grows to around 65 feet high in 150 years, while tall podocarp trees—most commonly Rimu, Miro and Hall's totara—develop after about 1,000 years. The glacial moraine left behind subsequent to the 'little ice age' of the fifteenth and sixteenth centuries, for example, is easily spotted not so much because of its landform, but because of the vegetation.

New Zealand has no native species of land mammal (seals and dolphins are frequently seen in its fjords and along the coastline), however more than one hundred species of birds live in *Te Wahipounamu* including two of the three species of the flightless kiwis, wekas, rare takahe and the endangered whio (blue duck). It's also home to several parrots including the kakariki (red-crowned parrot), kaka and kea. With its penchant for neophilia, the incurably curious kea is the world's only alpine parrot. I can personally testify to its ability—and willingness—to break into just about anything, and steal and eat anything, including the rubber and paint on cars. Pests for locals, the keas are entertaining clowns for tourists.

The ponds and wetlands have their own unique habitats, with seventeen species of native fish, while the insect population of the area includes some 700 species of moths, and the usual annoying collection of biting midges and mosquitoes. Glowworms (which are actually insect larvae) inhabit the damp under-story and can be seen at night as you walk through the forest, like fairy lights strung across rotting logs and around miniature

waterfalls. On the glaciers themselves, tiny black ice worms—annelid or segmented worms—about .25 inches long, live on glacial algae.

You can visit *Te Wahipounamu*, and specifically, Fox and Franz Josef year round following a six-hour drive from the international gateway, Christchurch. Access to beautifully maintained walking paths along the valley floor and through the forest is free, but for safety, you cannot walk onto the glaciers without a guide. Of course the best way—and in my opinion, the only way—to truly appreciate the stunning beauty of *Te Wahipounamu*'s rivers of ice is to take a helicopter flight. It's an unforgettable experience to see this extraordinary World Heritage area.

Glossary

Aotearoa: Maori name for New Zealand. Literally, 'land of the long white cloud'.

Aoraki: tallest son of the Sky Father, *Rakinui*, and Maori name for Mt. Cook.

Argillite: also known as black slate, a sedimentary rock transitional between slate and shale.

Chronosequence: a sequence of soils that differ from one another because of the way they were formed.

Ecotones: a transitional zone or overlap between two ecological niches that contain some characteristics of both.

Föhn, Foen or Foehn: dehydrated air that descends on the leeward side of mountains, they can raise temperatures very fast, as much as 54 degrees F in a few hours.

Firn: compacted snow-ice with a volumetric density of 550g/cubic meter, usually after several seasons of compaction from successive layers of *névé*.

Gondwana: or Gondwanaland was an ancient supercontinent that included Australia, Antarctica, Africa, South America, India (south of the Ganges River), and parts of New Zealand. Driven by plate tectonics, Gondwana began to fragment and drift apart during the early Triassic and ended in the late Cretaceous.

Greenstone: jade.

Greywacke: dark Paleozoic sandstone consisting of poorly sorted, angular grains of quartz and feldspar, and small rock fragments set in a clay-fine matrix. Believed to have been formed in turbid, underwater locations.

Ka Roimata o Hinehukatere: tears of Hinehukatere, Maori place name for Franz Josef Glacier.

Loess: a fine-grained soil deposited by wind.

Neophilia: A love of novelty and new things.

Névé: young, granulated snow that acts as the source of a glacier. Minimum density of 500g/cubic meter.

Moraine: rubble carved out by advancing glaciers and left behind when they retreat, generally at the front (terminal) or along the sides (lateral). Oddly shaped deposits in the middle are called **tills**.

Pleistocene: epoch from 1.8 million years ago to 11,500 years ago.

Podocarp: literally means ‘seeds with foot’ – stalked conifers.

Serac: from the Swiss French word sérac, a crumbly pale cheese; it is a large chunk of ice (sometimes as large as a small office building) that forms when glacial crevasses intersect, or at the edge of very steep or hanging glaciers.

Sea floor spreading: occurs when two tectonic plates separate because magma, which is more buoyant than the surrounding cold (unmolten) rock rises toward the plate edges. As the plates move apart, more magma accumulates and the plate gradually gets bigger.

Tarn: small glacial lake generally formed in a cirque—a hollow scoured out by glacial erosion.

Te Moeka o Tuawe: the bed of Tuawe, Maori name of Fox Glacier.

Te Wahipounamu: the place of greenstone, Maori name for the South West New Zealand World Heritage Area.

Te Waka o Aoraki: literally, the canoe of Aoraki, Maori name for South Island.

Tectonic plates: the Earth's crust is made up of a series of plates. Where they bump and grind against each other, mountain building occurs, and earthquakes and volcanoes are common. New Zealand lies at the edge of one such plate, part of what is commonly known as the Pacific Ring of Fire.

¹ The officially recognized names of mountains, national parks, glaciers, and many other South Island places have been changed to their original Maori names as part of a 1998 settlement between the government and the Ngai Tahu tribe. They are commonly referred to in both Maori and English.