Bingie Landscape Notes

The Bingie landscape is the product of a long geological history extending back to about 490 million years ago (approximately the last 11% of the earth’s existence). The present landforms are largely determined by rocks that were formed during a continuum of events extending over the 490-million-year period (click to read more detail about the Bingie geology) and the processes they have been subjected to. The modern vegetation patterns have not only been shaped by the local geology, landforms and climates but also by changing land use over at least 20,000 years of Aboriginal history and, very dramatically, by European settlement.

1. **Landscape Forming Processes**

The major processes that have influenced the formation of landscapes have been happening continuously over billions of years & are still happening today. Perhaps the most significant one is continental drift, which involves the movement of large continental landmasses both away from and towards each other. When these masses come together, the edge of one is dragged below the edge of the other, resulting in the formation of mountains in the upper mass (uplift) & rocks in the lower mass being dragged down to depths that bring them in contact with molten magma of the earth’s mantle (subduction). The rocks of the mountainous upper mass are then subjected to weathering (chemical and physical alteration by water and temperature variations that usually makes them soft and friable and contributes to the production of soils), erosion (removal of material by flowing water, ice movement and wind or wave action), transportation and deposition of the eroded material to different localities such as flood plains, lakes, glacial moraines and the ocean floor.

Weathering and erosion begin as soon as land has been uplifted. At that time the landscape is characterised by high mountains and ridges separated by deep, steep sided valleys. After long periods of erosion, the landscape is reduced to the low rolling hills and valleys that exist east of the Great Dividing Range in New South Wales, including the Moruya-Bingie-Tuross area.

Large changes in climate have occurred during the long period of the earth’s history and have also had a significant influence on past and present landscapes. Five major ice ages have taken place over the past 2.4 billion years with the most recent peaking about 20,000 years ago (see more detail about this one later). The average global temperature during the most severe of these dropped to about 10°C, cold enough to cause the planet’s entire surface to freeze over. In the intervening periods they have risen to about 24°C when there were no ice sheets at all. Currently the average global temperature is about 13°C and rising as the earth emerges from the most recent ice age. Fluctuations in average global temperatures have a major effect in the rise and fall of sea levels. It is likely that the current increase of greenhouse gases in our atmosphere is causing acceleration of the naturally rising global temperature.

Other significant factors that contribute to the nature of landscapes include the introduction and continued development of plants and animals on the land (beginning about 420 million years ago). Living plants absorb carbon dioxide (CO2) and contribute to cooling the atmosphere by reducing the greenhouse effect. They also produce oxygen which, when dissolved in water, can increase the severity of weathering. Dead plants rot and produce humus which increases the fertility of soils. Animals disturb soil cover and can contribute to erosion, while their droppings can increase the fertility of the soil. Humans, particularly during the development of modern civilisations, have contributed to the current landforms by activities such as land clearing, farming, road building, mining and housing in villages, towns and cities.

1. **Rock Types**

All of the rocks found in the Bingie area have been exposed to the above land forming processes to some extent. However, only glimpses of the approximate 490-million-year period since the oldest local rocks were deposited have survived, resulting in only five types of rocks being exposed in the area. These are:

* **Meta-sediment.** Metamorphosed (altered by heat & pressure) & tightly folded finely bedded sandstone & siltstone that were originally deposited as sand & silt in deep water about 490 million years ago (the Abercrombie Formation – early to mid-Ordovician Period). These now exist in several places along the coast from Batemans Bay to Bermagui, including the headlands at Mullimburra Point. They are composed mainly of quartz with small amounts of mica and are fairly resistant to weathering & erosion. They have formed thin sandy soils which support scrubby eucalypt forests away from the coast & casuarinas, banksia & coastal wattle on coastal headlands. When those forests were cleared for farming during early European settlement the soils were poor, so the land was allowed to revert to forest, and these are the forest patches that remain today, many now within the Eurobodalla National Park.
* **“Granites”.** Two types of co-existing granitic rocks (a light-coloured type called tonalite & a dark coloured type called gabbroic diorite) have intruded the meta-sediment and slowly cooled at depths of about 10-15 kilometres below the surface of the land in a subduction zone, about 390 million years ago (the early Devonian Period). In the following 350 million years continental drift continued and the granites, meta-sediments and overlying material were uplifted. Substantial thicknesses of rock that once covered them have since been eroded, leaving only the exposures that exist today.

The granites are part of an extensive suite of rocks (called the Moruya Granite Suite) that occur widely in the district at or near the surface & are particularly well exposed on the coastal headlands at Bingie Point and Grey Rocks. The granite used in the Sydney Harbour Bridge pylons are from part of this suite. Numerous granite dykes that can be found along our coast are also part of this suite that has squeezed its way through cracks into the older metasedimentary rocks. The light coloured tonalite is composed mainly of quartz, feldspar and black mica (biotite). It weathers to a clay containing grains of quartz and forms poor soils similar to those derived from the meta-sediment. The dark coloured gabbroic gabbro contains iron and magnesium bearing minerals (amphiboles and pyroxenes), minor or no quartz and weathers to iron and magnesium bearing clays which form more fertile soils. Where the two granitic rocks are close together the soil is also reasonably fertile. The forests on these soils were logged for timber and cleared early during white settlement and continued to be cut to maintain pastures, so only isolated remnants of the original forests now remain.

* **Basalt.** Basalt is a dark coloured fine textured rock, with a composition similar to gabbro but having cooled rapidly from vast flows of volcanic lava (up to 33 metres thick) at the surface of the land. The basalt at Bingie (the Coila Basalt) formed about 30 million years ago in the Tertiary Period and once extended east beyond the present coastline, as shown by the coastal cliffs between Congo and Meringo. Like gabbro, basalt weathers to form clay rich, generally fertile soils. The forests on these soils were also logged for timber and cleared early during white settlement and continued to be cut to maintain pastures, especially for dairying.
* **Pebbly Sandstone.** Poorly consolidated sediments, mainly sands and quartz-rich gravels deposited about 25 million years ago in the flood plains of major rivers, have consolidated to form a ‘soft’ sandstone (Meringo Creek Formation). Since its formation the land has been uplifted so that they are now found on the highest parts of the Bingie landscape. Water percolating through these porous sediments has dissolved silica and re-deposited it in places as Silcrete, a favoured rock used by Aboriginal people to flake to make sharp cutting and scraping tools. Several silcrete quarries are in the Bingie-Congo area. Today, the percolating water is blocked by the less permeable basalts and granites below, so flowing springs are common at the base of the sandstone, for instance in Spring Place. The soils on these deposits are poor, so like similar areas on the older Abercrombie Formation meta-sediments, they were abandoned for farming early on and extensive areas of regrowth woodland and forest were re-established, most noticeably along Bingie and Congo Roads.
1. **Rivers**

Rivers provide the major means of transport and deposition of weathered rock in the Moruya- Tuross Head region.

The larger rivers have their sources in the hills west of us, where a more diverse mixture of rock types exists. In this hilly country the rivers are fast flowing and actively erode the rocks and soils and transport the material downstream. They begin as a fan of creeks and rivulets that converge to form major streams and finally rivers. As the rivers reach the foothills they begin to lose energy and deposits the larger, heavier pebbles as gravels. Further downstream the river occupies wide valleys such as the Moruya and Tuross River flood plains where they carry mainly sand, silt, mud and humus. During heavy rainfall events the rivers spread across the flood plains and as the flooding recedes these fine materials are deposited, forming the most fertile soils in our region.

Numerous small creeks (e.g. Meringo, Stinky and Kelly’s creeks) form small flood plains with fairly fertile soil. Though fertile, these soils are generally not as rich as those of the major rivers as they have passed through a less diverse mixture of rock types.

When the rivers are not in flood, the fine sediment is carried through the flood plains to finally reach the coast. Under these conditions the sand and finer sediments are separated with the sand being deposited in the river bed and in the ocean near the river mouth, and the silt and mud being dispersed and deposited away from the coast and deep on the ocean floor.

1. **The Coastal Landscape – Beaches and Headlands**

During the hundreds of millions of years since the last major uplift of the land in the Moruya – Tuross Head region, vast amounts of rock has been eroded, transported and deposited on the adjacent ocean floor. Sediment carried by rivers, creeks and possibly glaciers has been added to by erosion caused by surface waves and large forces of ocean currents have moved them great distances along the eastern coastline of New South Wales.

***Beaches:*** Where valleys meet the coast, ocean currents combine with wave action to move sand to the edge of the land and deposit it to form beaches. Beachgoers will be familiar with the continuous movement of sand on beaches. Exposed rocks become covered with sand, only to be exposed again within days, small sand cliffs are formed and washed away and sand is blown inland by wind to form sand dunes. As the sand is deposited and moved across the mouths of creeks and rivers it often completely covers their outlets, causing lakes and lagoons to form. During flooding, the sand is sometimes breached by the force of the flooding water, allowing fresh water to reach the ocean and salt water to come inland. These intermittently closed and open bodies of water are called ICOLLs. Coila Lake is the largest ICOLL in our area, with smaller examples being Kelly’s Lake and Meringo Lake.

***Headlands:*** Where the higher ground meets the ocean, rocks are weathered by salty oxygen bearing water which penetrates them in cracks and alters the hard minerals to softer clayey minerals. The action of waves pounding on these weakened rocks causes them to break up and fall into the sea as boulders and gravel. The gravel and boulders then add to the erosion as they are moved by wave action, particularly during storms, to physically grind away rock that remains at sea level and form rock platforms. The power of the waves was demonstrated recently when boulders the size of small cars were picked up and deposited on the footpath along the northern break wall of the Moruya River.

1. **Climate Change and Ice Ages**

The last 2.3 million years (the Quaternary Era) was the most recent time of long global ice ages with shorter episodes of warmer climates. During this period there have been many cycles with cold temperatures when much of the earth’s water was held as ice, and sea levels were lower, alternating with warm phases when the ice melted and the sea rose. About 120,000 years ago the temperature was about 2 degrees warmer than it is today, the sea level about 5 metres higher and the shoreline a little further inland. Just south of Bingie Point there are remnants of the old dunes formed at this time, now bleached to white sand with a brown hardened basal layer formed as iron-rich minerals washed down through the dunes. Such sediments are uncommon south of the Shoalhaven River. The only wombat colony known east of the Princes Highway occurs here, where the animals have burrowed into those lower hardened sands.

After that time the last ice age began and as it cooled sea level fell, reaching its lowest level about 20,000 years ago when the level was about 125 metres lower and shoreline was tens of kilometres east of where it is today. As the earth began to warm again, the sea level rose, the low-lying land was covered and the coastline receded, reaching its present position about 6,000 years ago. The recently covered land provided additional sand to be moved by currents and waves and deposited onto the shoreline to form the beaches we see today. South-easterly winds have reworked some of that sand to form high dunes with deep blowouts along the coastline.

1. **People in the Landscape**

People have also affected the local landscape. Modern humans evolved in Africa during the Quaternary, and moved out to other areas. We know that by 50,000 years ago people were moving through northern parts of Australia, but the coastline was further offshore and archaeological evidence may lie under water. The oldest known archaeological site on the NSW south coast is a big rock shelter at Burrill Lake, where the oldest deposits are about 25,000 years old. The next oldest is an open site at Bass Point dated to about 18,000 years ago. At that time both these sites would have been 15-25 km inland. As the climate warmed sea level rose and it reached its present level by about 6,000 years ago. Numerous archaeological sites, aged from about 5,000 years ago, are known along the NSW coast. They show people’s economy has always been focused on the rich coastal resources (fish and shellfish) but plant foods and forest animals were also important. Before European occupation, most of the items people used in their daily and spiritual life were made of stone, wood, other plant materials, bone and shell and apart from stone and some shell, these seldom survive in the archaeological record of this region. Aboriginal burning may have affected the vegetation patterns by reducing wet forest zones and extending drier eucalypt forests and heathlands, but the evidence for this is sparse.

European farmers first settled the area in the late 1840s. By the 1880s the original rich forest vegetation on the granite headland at Bingie and basalt hilltops behind were cleared for dairy farming, cattle raising and crops. Timber such as woolybutt and blackbutt was shipped from Moruya and ironbark was milled for railway sleepers. The coastal wattle that covers much of the area near Bingie is an intermediate stage as forest becomes re-established on land that was cleared for dairy farming, and recently people living on smaller blocks have been instrumental in re-establishing forest patches.