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by  
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Macquarie Island, Jewel in the Southern Ocean

**PHILLIP LAW LECTURE 17 June 2006 P.M. Selkirk**

**MACQUARIE ISLAND, JEWEL IN THE SOUTHERN OCEAN**

It is both an honour and a pleasure to be invited to give the 2006 Phillip Law lecture, the fifth in a series honouring the foundation Director of Australian Antarctic Division.

It is a pleasure to return, for the topic of the lecture, to the subantarctic, where ANARE activities began with the establishment of stations on Heard Island in 1947 and on Macquarie Island in 1948. It has been my privilege and very great pleasure to visit both of these subantarctic islands as a scientist contributing to the Australian Antarctic Program: Heard Island once in 2000, Macquarie Island on many occasions between 1979 and 2004.

When first I visited Macquarie Island, there was a billboard at the seal gate entry to the station, reading 'Welcome to Macquarie Island, Jewel of the South Pacific'. At the time, the notion of Macquarie Island as a South Pacific Island seemed to me comical. I was a teenager in the 1950s when "South Pacific" meant the Rodgers and Hammerstein musical, beautiful jungle covered mountains, coconut palms, the song 'Some enchanted evening' and Mitzi Gaynor 'washing that man right outta my hair'.

However the more I came to know of Macquarie Island, the more I came to realise that there is more to beautiful islands than jungle-covered mountains and palm-fringed beaches, and there is more to the Pacific than its tropical part. The Pacific extends far south of the tropics into the polar region, where, with the southern reaches of the Indian and Atlantic Oceans, the south Pacific becomes part of the Southern Ocean encircling the globe.

I now think of Macquarie Island as a jewel in that Southern Ocean.

Why a jewel? The Macquarie Dictionary (Delbridge et al 2002) defines a jewel as

1. a cut and polished precious stone
2. a gem
3. a precious possession
4. a thing of great worth or rare excellence

How does this definition fit Macquarie Island?

**The location of Macquarie Island**

Macquarie Island is about midway between Australia, New Zealand and Antarctica. More precisely, it is 1100 km south east of Tasmania, and 1500 km south west of New Zealand, at 54°S 159°E. It is one of very few small islands scattered in the vast Southern Ocean, where the prevailing ocean currents and atmospheric circulation are from the west.

In the days of sailing ships, the latitudinal bands of Southern Ocean were evocatively known as 'the roaring forties', 'the furious fifties' and 'the screaming sixties'.

Dr Phillip Law has written (and I agree with him) that

“John King Davis was arguably the greatest of the ships’ captains of the heroic age of Antarctic exploration. A seaman whose initiation was under sail and who advanced to obtain his master’s certificate under steam, his seven Antarctic voyages spanned the years 1907 to 1930.” (Law 1997).

J.K. Davis served his apprenticeship on a sailing ship the *Celtic Chief*, then went on to become chief officer of *Nimrod* that took Shackleton’s 1907-09 British Antarctic Expedition to Antarctica. He was master of the *Aurora* that took Mawson’s 1911-14 Australasian Antarctic Expedition to Macquarie Island and Antarctica and back, and that retrieved Shackleton’s Ross Sea party in 1917. He was later master of *Discovery* during Mawson’s 1929-30 BANZAR Expedition. Clearly John King Davis was a man who knew and respected the Southern Ocean.

In his dryly humorous way he wrote:

“I have in mind the weather conditions of the Southern Ocean where ships on passage to Australia went in search of a fair wind. In those high latitudes you were apt sometimes to get a little more breeze than you bargained for. Storms follow one another in quick succession and the wave-forms attain perhaps the greatest size and speed of any in the world as, unchecked by any great land mass, they are driven around the globe. It is not the place for spinning yarns during the middle watch and, even in the uneasy periods of comparative peace between successive storm systems, you learn to keep one eye on the barometer and one on the sky to windward the whole time. There are few better places to remember the truth that it does not pay to take the wind and the sea too cheaply.” (Davis 1962 page 22).

### **The nature of Macquarie Island**

John King Davis, even after five visits to the island, was always relieved to see it (especially on his first visit there, when it proved to be 11 nautical miles south west of its position shown on the Admiralty’s chart), but he described it as “so desolate a place...damp, dark, forbidding and utterly forlorn” (Davis 1962 page 122).

I admire J.K. Davis very much, I respect the skills and judgement he showed when sailing around the Southern Ocean and the Antarctic coast—but I differ from him on the subject of Macquarie Island. Damp, dark, even bleak it can be when the wind and sleet blast from the west under a grey cloudy sky—but desolate and forlorn, no.

The difference in viewpoint probably arises because J.K. Davis was a seaman, a mariner of the first water. I am a plant biologist with a particular love of bryophytes, mosses and their relatives—small plants and often overlooked amongst grasses, shrubs and trees. Where better to enjoy them than where they are particularly important plants in their environment? The higher parts of Macquarie Island have moss dominated vegetation, with vigorous, beautiful mosses, glowing in jewel colours.

Let’s come back to the question, what is Macquarie Island like? My description is, of course, that of a biased plant biologist.

The island is elongate, narrow, essentially an undulating plateau between 200 and 300 m above sea level, surrounded by steep coastal slopes. In some places these slopes fall

directly to the sea, but in most places there are stony beaches or a coastal terrace. Some 23 named peaks dot the plateau. The highest, Mt Hamilton, rises to 433 m, and has fine mosses on its summit. Mt Law, close to the middle of the island, is named after Dr Law. Numerous lakes, ponds and mires dot the plateau and coastal terraces. Colloquially Macquarie Island is also known as “the great green sponge”—bryophytes are also abundant in its more moist areas, such as Green Gorge mire. Climatically, as a small island, Macquarie is strongly influenced by its surrounding ocean, that ocean where, as JK Davis wrote, there is “more breeze than you bargained for”, and “storms follow each other in quick succession”. Just so on the island. Windspeed averages 34 km per hour; the maximum gust recorded is 185 km per hour. Mean daily temperature is about 5 °C, and precipitation as rain, sleet, or snow totals 953 mm per year, falling on some 313 days of the year. Being out in the weather on Macquarie Island is somewhat like being in a fridge with the fan on and the sprinkler going.

## **The importance of Macquarie Island**

### **1. Intrinsic importance**

The island has intrinsic importance as home to its resident terrestrial biota, both plants and animals, and as a breeding site for visiting marine-based biota. The beaches and coastal areas are used seasonally by myriad seals and penguins during their breeding season. The slopes and lower plateau areas are used by other marine-based birds for breeding—burrow nesting petrels, surface nesting giant petrels, albatrosses, and others.

### **2. Historic importance**

Macquarie Island was discovered in 1810 by Captain Hasselburgh, seemingly a little off course on a sealing expedition to Campbell Island. An era of exploitation followed for about 100 years. During this time, hunting was intense: fur seals first, for skins and oil, until supplies were virtually destroyed within a decade. Elephant seals were next, hunted for oil from blubber, followed by royal and king penguins, boiled down for oil. Hunting stopped in 1920, and the island became a wildlife sanctuary in 1933.

We can never know the precise pre-1810 size of marine animal populations, nor the details of the complex ecological interactions that were in the seas around it. Since the top predators, namely humans, stopped predating, most populations have certainly increased in size, and breeding success of elephant seals and most penguins on Macquarie Island is now good. Fur seals were essentially eliminated from the island, and populations now number in the hundreds, rather than the tens of thousands before exploitation. They still have far to go.

### **3. Scientific importance**

Scientific interest in the island began soon after its discovery when in 1822 Captain Thomas Raine, of the sailing ship *Surrey*, wrote a description of the Natural History of Macquarie Island at the request of Edward Wollstonecraft of Sydney. Interest continues unabated to the present.

*Geologically*, we now know that the island is a piece of seafloor, formed at a spreading ridge, subsequently squeezed up above the surface of the Southern Ocean as part of the long submarine Macquarie Ridge. It is a fascinating piece of land, above the sea surface for only some 6 to 700 000 years, and rising still, its shape and surface

modified by tectonic and erosive forces to the present day. For geologists, it provides opportunity to investigate the structure of the earth's submarine crust, but on land, and to investigate tectonics in a particularly active area.

**Biologically** too, this tiny piece of land in a vast ocean is fascinating. It is land that is strongly influenced by its surrounding ocean. For seals and birds that depend on the ocean for food—fur seals, elephant seals, penguins, albatross, petrels, prions, cormorants—it provides land on which to breed (and moult, for elephant seals), although they are part of the marine ecosystem. When they are ashore, they transfer nutrients from the ocean (where they acquire them) to the land (where they excrete them)—they form an important link between the marine and terrestrial ecosystems.

Ashore, there is a well-developed terrestrial ecosystem. The coastal slopes are clothed in tussock grass and megaherbs. Valleys and the plateau surface variously support ferns, shorter herbs and grasses, cushion plants, mosses and their relatives, liverworts. On parts of the plateau there is spectacular patterning in the vegetation, terraces in which there are alternating stripes of plants (including cushion plants and mosses) and gravel. The patterning is a result of the interplay between the plants and topography, aspect, wind, freeze-thaw and overland flow of water. Amongst this vegetation, in the soil beneath it, and in the lakes, invertebrates and micro-organisms contribute to the terrestrial ecosystem.

Having appeared so recently from beneath the sea, the island has never been closer than it is now to any other land mass. All species of terrestrial and freshwater organisms have arrived by airmail. Southern Ocean Airmail Post has delivered an astonishing diversity of organisms:

- flowering plants 42 species,
- ferns 5 species,
- bryophytes 130 species (mosses 81 + liverworts 50),
- terrestrial invertebrates approximately 300 species,
- freshwater invertebrates 85 species,
- diatoms approximately 200 species,
- fungi approximately 200 species,
- lichens approximately 150 species,
- viruses an unknown number of species.

This diversity is fascinating in itself, but even more fascinating is that a surprising number of these species are endemic to Macquarie Island, meaning they occur nowhere else in the world. This implies one of two mechanisms—either that the species was formerly much more widespread but became extinct everywhere else, or, an ancestral species arrived by airmail on Macquarie Island followed by on-island mutation, evolving into the present-day endemic species we now find.

The finding of new species on Macquarie Island is very much a current research activity. The endemic species known on Macquarie Island include flowering plants, diatoms, terrestrial and freshwater invertebrates and a plant virus:

- flowering plants 4 species, cushion plant *Azorella macquariensis*, orchid *Nematoceras dienemum*, orchid *Nematoceras sulcata*, grass *Puccinellia macquariensis*,

- freshwater diatom 1 species, *Gomphonema isabellae*
- freshwater invertebrates 7 species, tubificid worm 1 species *Macquaridrilus bennettiae*; water fleas 2 species, *Pleuroxus macquariensis*, *Daphnia gelidus*; flatworm 1 species *Duplominona amnica*; insects 3 taxa *Erioptera (Trimicra) pilipes macquariensis*, *Ephydrella macquariensis*, *Telmatogeton macquariensis*,
- terrestrial invertebrates 37 species,
- plant virus 1, SMBV (*Stilbocarpa mosaic bacilliform badnavirus*).

In **Climatology**, Macquarie Island is tremendously important for the meteorological records that have been kept and continue to be gathered on this island. During this time of recognised global climate change, the importance of land based records from part of globe that is predominantly ocean is huge.

We must remember that the Macquarie Island we know hasn't always been as it is now: it was, after all, under the water  $\frac{3}{4}$  million years ago. Changes in its climate have been recorded, and further progressive changes are to be expected. Since temperatures were first recorded by the AAE researchers that J.K. Davis delivered to the island in 1911, mean daily temperatures have risen about 1 C°. Temperature increases, (by increases in daily maximum rather than minimum temperatures, and most pronounced in late summer) are forecast to continue at a rate of a little over one degree per 100 years. This is a rapid rate of change in world terms. Precipitation has been diminishing in parts of the subantarctic over the last 50 or so years. Along with increases in wind speed noted on Macquarie Island over the past 20 years, this has meant higher rates of evapotranspiration (water loss from plants), meaning a drier environment for plants.

### **Future changes**

As global and local climate inevitably changes, what will happen to the nearby marine ecosystems? What will happen to the terrestrial and freshwater ecosystems on Macquarie Island? Will interactions between existing species change? Will species distributions change? Will species numbers change? Will the numbers go down by extinctions or will they go up by evolution of new species on the island or by arrival of additional species naturally from elsewhere? How will any such new species interact with existing ones?

All these are unknowns, but a few observations and predictions can be made. In the marine environment, at nearby Campbell Island, numbers of rockhopper penguins have dramatically declined over the last 60 years. What the penguins eat hasn't changed, but the quantity available has—something in the marine environment has changed to reduce quite drastically the available amount of krill, their preferred food. On Macquarie Island there has been no recent census of rockhopper penguins, but anecdotal evidence suggests populations may be falling—we can guess that the cause also lies in a change in the marine environment, part of the global changes in the world's oceans.

One consequence of a drier environment for plants has been reduction in the area of *Sphagnum* moss on the island—and likely to diminish further if these trends continue into the future. There are likely to be other bryophyte species that follow suit.

At present, Macquarie Island vegetation does not include any upright woody shrubs or trees, but nearby Auckland and Campbell Islands' do. It is generally thought that woody shrubs can grow where three summer months average above 10°C—on Macquarie they are now around 7°C. At the predicted rate of temperature rise, 500 years might see a big change in the island's vegetation to include thickets of woody shrubs, and all the associated changes that will go with that.

Macquarie Island is a fascinating place, and these are fascinating times!

### **Macquarie Island, jewel in the Southern Ocean, as it is now**

A jewel is, first, a cut and polished precious stone. Macquarie Island is of geological importance, uplifted seafloor material (the best example in the world) cut and polished by erosive wave action.

A jewel is, second, a gem. As the Tasmanian Parks and Wildlife Service Management Plan (2006) puts it, “Macquarie Island is of exceptional natural beauty and aesthetic importance and contains superlative natural phenomena”, comprising spectacular steep escarpments; a large number of lakes, tarns and pools; dramatic changes in vegetation cover due to climatic conditions; extensive congregations of wildlife, including Royal and King penguins, especially during the breeding season; majestic albatross (4 species) nesting on cliffs; impressive colonies of elephant seals, allowing ability to view breeding and mating behaviour; the remote, dramatic and essentially undisturbed location.

A jewel is, third, a thing of great worth or rare excellence. Macquarie Island is one of the very small number of subantarctic islands dotting the Southern Ocean—it is a very rare commodity. In the equivalent part of the northern hemisphere, tundra vegetation covers vast areas of Siberia and northern Canada. In the southern hemisphere, much of the latitudinal zone 50-60°S is Southern Ocean.

A jewel is, fourth, a precious possession, to be cherished, understood and protected. Cherishing includes sharing Macquarie Island, making its important values and attributes known to others. The various exhibitions during this Midwinter Festival are making a great contribution to cherishing and sharing. Responsibly-conducted ship-based tourism helps to spread knowledge and appreciation of Macquarie Island in the global community.

Understanding includes ongoing fundamental and management-based research that increases understanding of Macquarie Island as it is now, and of future changes to it.

A precious possession is to be protected—what protection does Macquarie Island have? Politically, Macquarie Island is part of Huon Municipality, State of Tasmania. Macquarie Island Nature Reserve is a restricted area, for which the Director, Tasmanian National Parks and Wildlife is the managing authority. Macquarie Island World Heritage Area (1997) includes the island plus surrounding ocean to 12 nautical miles. Macquarie Island Marine Park (1999) extends to 200 nm around the island. Environment Australia is the managing authority. Macquarie Island does have quite a few people and organisations looking out for it.

## **Threats to Macquarie Island, jewel in the Southern Ocean**

What threats are there to this precious possession Macquarie Island and its important values, threats to it as it is now, and as it will naturally become?

**1. Legacy of the era of exploitation.** There has been good recovery of most of the seal and penguin species that come ashore to breed. Inland of the beaches, however, the story is a little different. Many ships visited Macquarie Island during that century of exploitation, and many people spent months, sometimes years ashore trying to earn a living in their grisly trade. This era has been well documented by John Cumpston (1968) in his book *Macquarie Island*. Reductions in the numbers of seals and penguins were the obvious consequence of the sealing and oiling industries—but there were less obvious, unintended consequences that have had and are still having profound effects on Macquarie Island and its terrestrial biota.

Along with the sealers and oilers, the people who lived ashore, came dogs and cats, rats and mice, wekas and rabbits, and three species of plants.

Rabbits and wekas were evidently introduced for food, rats and mice came ashore from ships uninvited, dogs and cats presumably were taken for company and in the event, proved useful as hunters of rats, mice and rabbits. There were never a lot of dogs on the island—they seem always to have been someone's pet, companion or working dog. Cats, rats, mice, rabbits and wekas all became feral, and persisted to become problems when Macquarie Island became recognised to have intrinsic values, and became a Nature Reserve. In the recent past, native ground nesting birds were at risk from feral wekas and cats.

Wekas were eradicated in the late 1980s and cats by 2002 by Tasmanian Parks and Wildlife Service. Following cat eradication, there was an exciting initial rise in breeding success by burrow-nesting birds, but nothing is simple, and many parts of an ecosystem are connected.

Vegetation is suffering considerable damage from grazing and burrowing by feral rabbits. Vegetation damage in turn poses threats to ground nesting birds whose habitat is, at best modified, at worst destroyed. The result is bad news for burrow-nesting birds. There is the need also to consider mice and rats. Rats are known to harvest, store and eat *Pleurophyllum* seed, reducing the supply of seedlings in the season after flowering. On Marion Island, mice are active in seed harvesting and in seed predation. They are likely to do the same on Macquarie Island.

**2. Threats in the present.** New introductions by human agency of organisms could endanger the native island biota. Native invertebrates are at risk of being out-competed or eaten by introduced potentially feral invertebrates such as flatworms and collembolans. Native plants are at risk of being out-competed by introduced plants. On South Georgia, there are as many species of naturalised introduced flowering plants, effectively weeds, as there are native species. Indigenous plants are at risk from introduced plant pathogens such as fungal dieback.

**3. Threat of neglect in the future.** This could pose the greatest threat of all. What are the implications of Australian Antarctic Division's plans to withdraw logistic support from Macquarie Island so it can concentrate its subantarctic interests on Heard Island?

What are the implications for ongoing and future research on the island? What are the implications for ongoing management and care?

### **How can Macquarie Island and its important values be protected against these threats?**

There needs to be, first, on-going control of vertebrate pests, then eradication—of rabbits, rats and mice.

Second, there needs to be strict enforcement of Quarantine for entry of persons and goods to Macquarie Island to prevent introduction of additional alien plants, animals and micro-organisms including pathogens.

Third, there needs to be on-going access to the island for research (to follow naturally-occurring changes) and management (of its important values): if we don't know what's there, and how the ecosystem works, how can it be effectively managed?

Finally, most importantly, and underlying the specific practical details of averting threats, is the need to recognise Macquarie Island not as John King Davis did, as “a desolate and forlorn place” to be passed quickly on the way to somewhere else, but for the jewel that it is, to be cherished for the precious possession that it is, a thing of great worth and rare excellence.

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