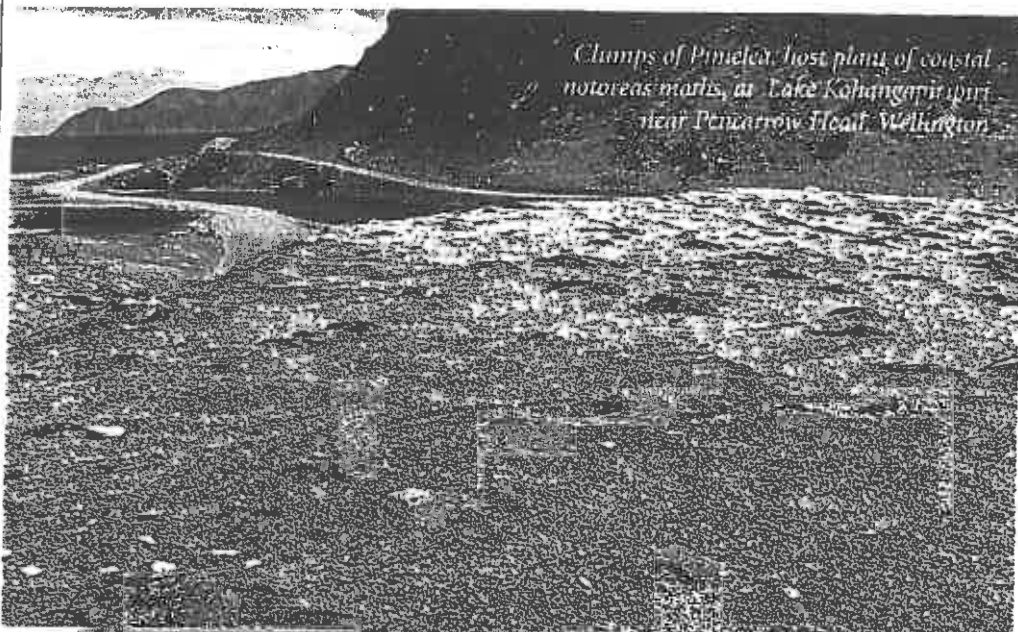


Coastal Moths: In of Butterflies

A group of day-flying moths is a clue to our past and future, according to BRIAN PATRICK



Clumps of *Pimelea*, host plant of coastal *notoreas* moths, at Lake Kohangapiripiri near Panmure near Wellington

Moths are what they eat

Up till recently the coastal and inland *Notoreas* moths which depend on *Pimelea* as a food plant have been grouped under the name *Notoreas perornata*. The missionary botanist, William Colenso, first collected *N. perornata* during his extensive travels, probably from Hawkes Bay. He sent it to England where it was described and became the type specimen of the genus. This species name is still applied to a moth found in montane and alpine habitats in the central and eastern North Island.

The coastal species, however, are now

known to be different. Eight of the nine coastal species of *Notoreas* are still undescribed by scientists. In contrast, around half of the inland and upland members of the genus have been scientifically classified, with 12 species named.

All the coastal species feed as larvae on various *Pimelea* species. The other host genus, *Kelleria*, is only found at one New Zealand coastal site — Bluff Hill, Southland, although it comes close to sea level at Shag Point, Otago. Both *Kelleria* and *Pimelea* are host plants in the alpine zone.



Notoreas larva

A group of colourful moths that fly by day hold important clues to the geological history of New Zealand. They also act as an indicator of the health of our coastal environment, showing it is in serious decline.

The moths in question are in the genus *Notoreas*, a word of Greek derivation alluding to their southern hemisphere distribution. There are about 33 species of them, all peculiar to New Zealand — the number is approximate as more have been discovered in recent times and scientists are still working on their classification.

Species of *Notoreas* moths are found from Stewart Island to the north of the North Island, and from coastal to high-alpine habitats. It is this distribution, towards the extremes of altitude, that suggests they have been here a long time, some species rising as the land was uplifted from near sea level to the mountain tops.

Notoreas moths are characterised by brightly-coloured adults that fly by day. They are extremely active and elusive, with wings vibrating rapidly even when pausing on bare ground to sunbathe, or on the flowers of their preferred foodplants. Always they are ready to take off at the slightest disturbance.

Like many insects, these moths are fussy feeders, depending on just one family of plants for their life cycle. The host plants are of the family *Thymelaeaceae*, of which New Zealand has just two genera — *Pimelea* and *Kelleria*. Both contain shrubs of varying size related to the garden daphne. All nine *Kelleria* species, along with many of the lower-growing shrub and sub-shrub *Pimelea* species, are hosts to the various *Notoreas* larvae. The adult moths reciprocate their host by pollinating the sweet-scented flowers.

Typically the larvae of the various *Notoreas* moths are uniform in appearance, being a pinkish-purple colour with a herring-bone dorsal pattern of various colours including black, white or green. From eggs laid, hidden and crowded amongst the developing buds of the host plant, the larvae emerge and begin boring into the fresh leaves. This leaf-mining behaviour is unknown in other geometrid moths.

Place

In succeeding developmental stages, the larvae greedily devour the buds and leaves. Larger larvae are usually found under trailing mats of stems and leaves close to the ground. The pupa is contained in a loose cocoon of soil and silk under the food-plant. In time, the adults of each generation emerge in unison.

For coastal species, in warmer parts of New Zealand, emergence is twice a year — from September to November and then again in March to April. In alpine areas and cooler parts of New Zealand the norm is only one generation a year. While the emergence time is uniform for each species, the hatch of various species is spread so there exist separate species of spring, early summer, or mid-summer moths.

Notoreas moths are in the family Geometridae sub-family Larentiinae — a group distinguished by looper caterpillars and adults with slender bodies and triangular-shaped wings. The shape, size and colour pattern of the wings are informative characters in distinguishing the various species.

The females have a telescopic ovipositor to deposit the eggs deep within the developing buds of the foodplant on which they depend. The males also have distinctive genitalia, and these can be examined to separate the species.

It can be quite a challenge to find Notoreas in the field. The distinct seasonality of their life cycles, and the strictly localised distribution, dependent on a few plants, makes them difficult to discover. It may seem surprising that new species of such conspicuous moths as these are still being found. Late 1996 saw a new species discovered at Castlepoint on the Wairarapa coast. Then the range of a Wellington coastal species was found to be more extensive, and a species thought to be confined to the south Taranaki coast

PHOTOGRAPHY BY BRIAN PATRICK



Typical Notoreas moths, from top: at Mason Bay, Stewart Island; Shag River, North Otago; *Notoreas simplex*, Kaitoreke Spit, Canterbury; southern Wellington coast.



Castlepoint, Wairarapa, where a new species of *Notoreas* moth (above) was discovered in November 1996 close to the lighthouse. The area has two *Pimelea* - one 'threatened' the other 'undescribed'.



Life on the Edge

Notoreas moths occupy extreme habitats at the edges of the land. While no part of New Zealand has more than one coastal species of the genus, most alpine areas have four to six. Each species emerges at a particular time of year and at a favoured altitude.

The Kakanui Mountains in North Otago with nine *Notoreas* species is the richest area — a biological hot spot. In close proximity is the Lammermoor Range, where not only are there eight species of *Notoreas* but also six different species of the host plant *Kelleria*. This is the place of highest diversity for these plants; a genus broadly distributed from Borneo to Adams Island in the subantarctic.

In Place of Butterflies

Day-flying moths are an important component of the New Zealand insect fauna. To a large extent they occupy the place of butterflies and are quite closely related to them.

New Zealand has 82 day-flying species in the family Geometridae known as geometrid moths. They are important both in terms of numbers and range. Their often colourful wings enliven many habitats from the coastal to the high-alpine, and from northern New Zealand to the subantarctic.

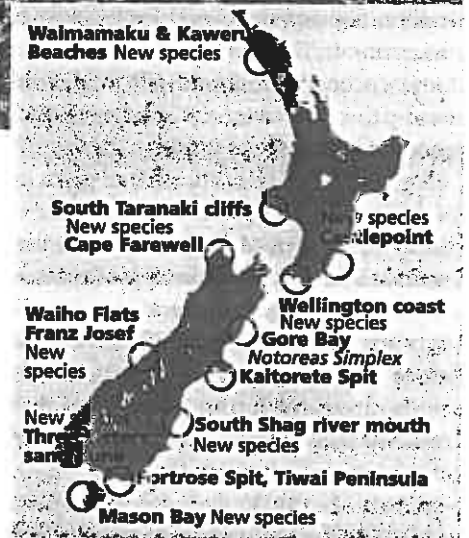
Surprisingly, the number of day-flying species in the sub-families of Geometridae in New Zealand are greater than those found in Europe, North America or Australia.

was discovered in northwest Nelson.

Survey work has so far turned up nine coastal species of *Notoreas*, all very localised, and some threatened by various activities of mankind. Declining distribution and rarity is a cause for concern as it reflects the degraded state of much of the New Zealand coastline.

The plight of many coastal *Pimelea* species on which the moths depend was highlighted by a DSIR report in 1992. Another problem the host plants share with the moths is that they are badly in need of scientific study and classification. Here we have eight 'undescribed' native moths feeding on several 'undescribed' native plants, and most threatened with extinction.

Many of the coastal populations of *Notoreas* are affected by degraded habitat, caused by grazing stock. In particular stock hooves break off the delicate branches of the host plant *Pimelea*. They also alter the soil structure in a number of ways. While natural disturbance is an important factor in the evolution of both *Notoreas* and *Pimelea*, the stock cause extreme and rapid change that neither plant nor insect can cope with. This threat to habitat is exemplified by the plight of a small species of *Notoreas* moth recently rediscovered on the broad river flats of the Waiho near Franz Josef: it is in danger of extinction by grazing animals. At Castlepoint the population is probably stable, but its small size means it is vulnerable to extinction from chance events. A Department of Conservation scientist, Lisa Sinclair, has intensively surveyed the *Notoreas* population on the Taranaki coast and found a severely fragmented population that is just hanging on. Only in northwest Nelson is the habitat relatively undisturbed and secure.



The existence of *Notoreas* moths at the altitudinal extremes of coastline and mountain top, is a reminder that New Zealand is gradually rising out of the sea. The uplift that began with the Kaikoura Orogeny, five million years ago, continues to build our mountains today. So mountain-top species have been slowly uplifted, albeit at the rate that our fingernails grow, for millions of years.

Because of this, *Notoreas* moths, and the communities of which they are an integral part, can give an insight into where New Zealand's alpine ecosystems originated. While some species of *Notoreas* moths still live on the coast others have been slowly lifted to the high alpine zone on the mountain tops.

This gradual elevation has produced species of plants and animals which are highly specialised to live there.

All nine coastal *Notoreas* species are found in communities that have much in common with alpine ecosystems. The environment is harsh and plants adapt to the extreme conditions in similar ways. Coastal communities can have upland affinities in terms of both the types of plants and the insects that share the habitat.

Take a look at the rugged and extensive south Wellington coast, with its dunes, rock cliffs and gravel beaches, a landscape of similar harshness to that encountered in the alps.

Its climate too is at times akin to upland areas. These exposed places, with their inhabitants, show clearly that you do not need mountains to have insects which have the physical features of mountain dwellers. Looked at this way, perhaps alpine communities are just uplifted open-country ecosystems: a combination of coastal herbfield, saltmarsh, coastal cliffs and inland grassland, raised above the limit of tree growth over millions of years..

The Notoreas moths are a group of native insects that tell us plenty about the tectonic and geological history of our

country. They also demonstrate the evolution of relationships between insects and their host plants. More survey work is required in almost all areas to attempt to extend known distributions of Notoreas moths and perhaps find new species.

Keeping an eye on these localised and vulnerable populations is an ongoing but rewarding job. Local botanists and entomologists need to get together to design appropriate monitoring programmes. For, unfortunately, the Notoreas moths highlight the sad state of conservation on our coastline.

BRIAN PATRICK is general manager of collections and research at Otago Museum and was formerly advisory scientist to the Department of Conservation in Otago. His study of the Notoreas moths extends from their distribution, classification and biology to conservation.



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