

available to determine natural areas, if such exist:

1. Degree of endemism present in the whole fauna of a area.

2. Analysis of distribution of selected genera.

3. Position of replacement from one species to another or from one subspecies to another.

4. Position of changeover from one group of common forms to another.

5. Take over the system already worked out for another group, e.g., flowering plants, and fit the new patterns to that.

6. Discover the exact distributional range of every species concerned and analyse them to determine either;

(a) Limits.

(b) Mid-points of range.

All these methods have been used for different groups in different parts of the world—and seldom is there much agreement. Perhaps the unscientific "Look and Say" method is the best—Look at the evidence and say where the boundaries are.

In the land snails much remains to be done, both as regards systematic revision and exact knowledge of distribution before we can be sure of boundaries, if such exist. In some areas, e.g., the east coast of the South Island this may no longer be possible.

The following areas are "broad areas" with no subdivisions and little indication of the relationship of the areas to one another. They are possibly not all equal in value. The best analysed areas are those in the extreme

north and south. The areas are named for convenience, but the names are as non-committal as possible.

A. *Three Kings*: 24 species and subspecies of which 21 are endemic. These include one group of the genus *Placostylus*. The three non-endemic species are widely distributed on the mainland.

B. *North Cape*: Total fauna not yet listed, somewhere over 25 species of which 16 are endemic. The endemic forms include some 10 subspecies of one group of *Placostylus*.

C. *Northland*: Some 62 species have been recorded of which 24 are endemic. Includes one group of *Placostylus*, one of *Paryphanta* and a large number of *Liarea*.

D. *Central North Island*: a rather generalised fauna with some "spot endemics." Central volcanic area still being colonised.

E. *Wellington*: Napier south including the Ruahines. Fauna not well studied but includes *traversi* group of *Paryphanta*. Some relationships with the Marlborough Sounds.

F. *Nelson*: contains the *hochstetteri* group of *Paryphanta*.

G. *West Nelson*: contains the *gilliesi* group of *Paryphanta*.

H. *West Coast*: contains *lignaria* and *rosiana* groups of *Paryphanta*.

I. *East Coast South Island*: Poorly known but rather generalised.

J. *Fiordland*: 33 species of which 11 are endemic. Shows some relationship with East Coast South Island and stronger with Stewart Island.

K. *Stewart Island*: 33 species of which 11 are endemic.

Natural Areas in the Distribution of Freshwater Fish

K. Radway Allen

New Zealand possesses some twenty species of native freshwater fish, but they have been so little studied that natural areas based on their distribution cannot yet be defined. More is known of the distribution of the introduced fish and this paper deals with the two main species.

These are brown and rainbow trout. They were introduced about 1870 and 1884 respectively and rapidly became established so that by 1900 a clear distribution pattern had emerged. Each species became dominant in part of the country and four main geographical regions can be distinguished—two dom-

inated by rainbow trout and brown trout respectively and two practically devoid of trout.

The *northern troutless area* includes the Northland and Coromandel peninsulas and possibly the tip of the East Cape region. Its location, and the absence of trout from waters which seem otherwise suitable, indicate that high temperatures have prevented the establishment of trout. The *eastern troutless area* includes nearly all of the North Island east coast river systems except those entering Hawkes Bay. These rivers lack the hard gravels which trout require for successful spawning.

The *rainbow trout area* comprises the central part of the North Island. It is bounded on the north and east by the troutless areas and on the south by an almost straight line from north Taranaki to southern Hawkes Bay. The *brown trout area* occupies the rest of New Zealand. Within each area the appropriate species is usually dominant and balanced stocks occur only near the dividing line. The chief exceptions are in some large South Island lakes, where rainbow trout dominate mixed stocks.

Although in each area the now dominant species was the first to be liberated, it seems likely that biological and not only historical

factors have determined the present distribution.

As a result of environmental differences, trout vary greatly in growth rate and in size usually reached. Hence, where controlling factors are distributed in a broad pattern, areas with characteristic trout stocks arise. In the South Island three such areas have been identified, but in the North Island the more complex structure prevents their appearance.

The *large fish area* comprises the South Island west of a line from Cape Campbell to Te Waewae Bay. The area is mainly mountainous and the characteristic occurrence of fish large in size but few on numbers seems related to the nature of the terrain. The *small fish area* occupies the rest of the South Island. The country is generally flat or rolling, and apparently as a result, trout are usually abundant but relatively small.

The *low yield area* is part of South Otago where the average angling catch is less than is usual in the rest of the South Island. It corresponds almost exactly with the area occupied by schist and it may be that the flattened schist gravels are less productive of the bottom fauna upon which trout feed than are the more rounded gravels which predominate in most other trout waters.

The Distribution of New Zealand Reptiles

Y. M. McCann

The Reptilia, in New Zealand, are represented by four groups: the marine turtles (Testudinales), the tuatara (Rhynchocephalia), the marine snakes (Ophidia), and the lizards (Sauria). The marine turtles and snakes being stragglers have little bearing on the subject.

The tuatara once inhabited almost the entire area, but today is more or less restricted to sixteen islands.

The lizards are represented by the Gekkonidae and the Scincidae. The endemic gekkonids are peculiar in that they are the only viviparous species known; *Gehyra oceanica*, a comparatively recent introduction to the fauna, is egg-laying.

The habits of some geckos and skinks, including their ability to withstand long per-

iods of fast, are conducive to accidental transportation in cargo or on oceanic drift. The viviparity of the gekkonids suggests a long period of isolation which would be necessary for their evolution to have advanced so far.

Among the geckos, one species, *Hoplodactylus pacificus*, is found almost throughout the area. *Hoplodactylus duvauceli*, our largest gecko, has a curious discontinuous range, some off-shore islands in the northern portion of the Dominion and some islands in Cook Strait, which suggests that this species, like the tuatara, once ranged throughout the North Island. Both *pacificus* and *duvauceli* are more or less terrestrial, seeking shelter under stones and logs. *Hoplodactylus granulatus* and *Naultinus elegans* are arboreal

KEYS TO CLIMATE AND SOIL MAPS

MAIN CLIMATIC DISTRICTS

(See map)

- A. Very warm humid summers, mild winters. Annual rainfall 45-60 inches with maximum in winter. Prevailing wind south-westerly but occasional strong gales and heavy rain from east or northeast from Auckland northwards and about Coromandel Peninsula.
- A₂ Similar to type A but much wetter; rainfall 60-100 inches.
- B. Sunny, rather sheltered areas which receive rains of very high intensity at times from the northeast and north. Very warm summers and mild winters. Annual rainfall 40-60 inches with maximum in winter.
- C. Very warm summers, day temperatures occasionally above 90°F with dry Foehn NW wind blowing. Rainfall 40-60 inches per annum; marked decrease in amount and reliability of rain in spring and summer; moderate winter temperatures with maximum rainfall in this season.
- C₀ Drier than type C—rainfall 25-35 inches. Very sunny.
- C₂ Cooler and wetter hill climates. Very heavy rains at times from east or southeast; annual rainfall mainly 60-80 inches.
- D. West to northwest winds prevail with relatively frequent gales. Mean annual rainfall 35-50 inches; rainfall reliable and evenly distributed through the year. Warm summers, mild winters.
- D₂ Wetter than D—rainfall 50-80 inches.
- E. Mild temperatures, high rainfall increasing rapidly inland with height, minimum rainfall in winter especially in the south. Prevailing winds SW but gales not frequent at low levels in spite of exposed coastline.
- F. Low rainfall, 23-30 inches; in the south slightly more in summer than in other seasons. Warm summers with occasional hot Foehn north-

westerlies giving temperatures above 90°F, cool winters with frequent frosts and occasional light snowfalls. Prevailing winds NE near the coast, NW inland.

- F₂ Cooler and wetter hill climates. Rainfall 30-60 inches. NW winds prevail with occasional very strong gales specially along river courses. Snow may lie for several weeks in winter.
- F₀ Semi-arid areas, rainfall 13-20 inches. Very warm, dry summers; cold winters.
- G. Warm summers, cool winters. Rainfall 25-35 inches, evenly distributed except for slight falling off in winter.
- G₂ Wetter and slightly cooler than G climates; rainfall 35-50 inches; in coastal districts cloudy, windy conditions and frequent showers.
- M. High rainfall, mountain climate.

“NATURAL AREAS” OF NEW ZEALAND SOILS.
(Boundaries generalized from Soil Map of N.Z. 1948.)

SOILS IN WHICH THE ENVIRONMENT IS

FULLY EXPRESSED:

1. Soils of the cool semi-arid zone, developed under tussock grasses.
2. Soils of the mild sub-humid zone developed mainly under tussock grasses.
3. Soils of the humid zone developed mainly under forest.

SOILS IN WHICH THE ENVIRONMENT IS NOT FULLY EXPRESSED, DUE TO THE DOMINANCE OF CERTAIN FACTORS:

4. Skeletal soils on steep slopes dominated by the topography factor.
5. Recent soils from alluvium or volcanic ash, dominated by their youth—the time factor.
6. Soils from old volcanic ash, dominated by their abnormal parent material.
7. Soils from younger volcanic ash, dominated by their youth and their abnormal parental material.

Excursion

On Saturday, May 12th, there was an excursion by bus from Wellington, over the Rimutaka Range, to the southern portion of the Wairarapa district.

During the excursion stops were made at the following places:

1. Summit of Rimutaka Range: Mr. A. L. Poole and Mr. A. P. Druce pointed out features of the vegetation, which consists of scrub (manuka and some sub-alpine species) and remnants of the red beech and silver beech forest which formerly covered the area.

2. Western Lake Forest Reserve: Beech forest here comes down to the edge of Lake Wairarapa. Mr. Poole and Mr. Druce explained some features of the forest.

3. Lake Pounui: This is a small lake which is a bird sanctuary, and since the shooting

season was in progress considerable numbers of waterfowl were seen. A stop was made at this point for lunch.

4. Top of hill above Lake Onoke: From this point an excellent view was obtained of Palliser Bay, Lake Onoke, which is separated from the sea by a long narrow shingle spit, Lake Wairarapa, and the southern portion of the Wairarapa district, bounded on the east by the Aorangi Range.

5. Lake Onoke: Most of those present walked along the narrow spit and examined contrasting conditions on the seaward and landward sides.

From Lake Onoke the bus returned to Wellington over the same route. Commentaries on points of interest near the road were given throughout the excursion by various members, using the loudspeaker system in the bus.

