

THE MAMMALS OF MALLECO PROVINCE, CHILE

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John Keever Greer
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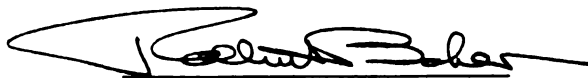
MAMMALS OF MALLECO PROVINCE, CHILE

presented by

John Keever Greer

**has been accepted towards fulfillment
of the requirements for**

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ABSTRACT
MAMMALS OF MALLECO PROVINCE, CHILE

by John Keever Greer

Various aspects of the distribution and ecology of mammals of Malleco Province in south central Chile were investigated for the purpose of contributing to the knowledge of the natural history of this region. The field study was sponsored by The Museum, Michigan State University, and the Museo Dillman S. Bullock, El Vergel, Angol, Chile, and was carried out from November, 1960 to May, 1962.

This investigation included the following: trapping and preserving for museum study 1,350 mammals from areas of different vegetation and topography; estimating field densities and movements of rodents based on records of live-trapping and recapturing; analyzing mammalian reproductive habits and age ratios; interviewing, by questionnaires, sportsmen living in towns and residents of rural areas to determine the utilization of mammals for sport, food, and other purposes; obtaining more than 1,800 collections of plants from 113 localities; collecting associated fauna; gathering climatological data; and photographing areas of different vegetation and topography.

Thirty-nine kinds (species and subspecies) belonging to 31 native species and five introduced species were collected or reported in Malleco. The 24 genera of native mammals may be arranged as follows: cosmopolites, 4; Nearctic-Neotropical varicants, 2; excurrent Neotropical regionalite, 2; and endemic Neotropical

regionalites, 16; of the latter, 11 are endemic to the Patagonian Subregion.

The mammalian species density in Chile is compared to that of the temperate South America and the species density of Malleco Province is compared to that of western Washington (U. S. A.). The impoverished mammalian fauna in Chile may be due in part to (1) the size of temperate South America; (2) the Andean barrier; (3) the Pleistocene glaciation; and (4) a "peninsula effect".

The relationship of the mammalian fauna to that of provinces north and south of Malleco seems to be correlated with climatic change and the transitional characteristics of the vegetation, i.e., the northern xerophilic vegetation interdigitating with the southern mesic vegetation. Twenty (65 per cent) of the 31 species in Malleco occupy areas in the provinces to both the north and south, whereas 11 (35 per cent) are identified with the mammalian fauna only to the north (4) or only to the south (7) of Malleco. Of the 25 polytypic species in Malleco, 11 are subspecifically indistinguishable from populations in the provinces both to the north and south of Malleco, whereas more than half (14) are distinguishable from the subspecies either to the north or south of Malleco.

Twenty-nine (94 per cent) of the 31 Mallecan species of mammals also occur east of the continental divide in Neuquen, Argentina; thus it appears that the Cordillera de los Andes in this region only slightly impedes the east-west movement of animals.

Of Mallecan mammals, Oryzomys longicaudatus, Akodon longipilis, and Akodon olivaceus are the most common and widespread rodents.

Oryzomys longicaudatus is the most ubiquitous rodent, and prefers a shrubby habitat, especially blackberry thickets, which are early invaders of cleared lands throughout Malleco. Akodon olivaceus is the most common rodent in the Central Valley grasslands; Akodon longipilis, common in mountainous areas and absent from the Central Valley, is most numerous in partially cleared forests which have denser ground cover than the virgin forests. Studies of movement and population densities of these rodents were carried out in 19 quadrat "plots" in selected habitats.

The specimens of vertebrate fauna are in the research collections of The Museum, Michigan State University, and examples of each of the common species are deposited in the Museo Dillman S. Bullock, El Vergel, Angol, Chile. Collections of plants are in the Beal-Darlington Herbarium at Michigan State University. The project was supported with funds provided by the Dillman S. Bullock Fellowship and a Grant-in-Aid from the Society of Sigma Xi.

THE MAMMALS OF MALLECO PROVINCE, CHILE

By

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INTRODUCTION

Field study of mammals in Malleco Province, Chile, sponsored by Michigan State University with funds provided by the Dillman S. Bullock Fellowship and a Grant-in-Aid from the Society of Sigma Xi, was carried out from November, 1960, to May, 1962. Various aspects of the ecology of mammals of this little studied part of south-central Chile were investigated for the purpose of contributing to the knowledge of the natural history of this region.

The first major work on the fauna of Chile, Molina's "Saggio sulla storia naturale del Chile" published in 1882 (see Osgood, 1943:12), lists 36 species of mammals living in Chile. Since then, collectors, including Darwin, Bridges, Gay, and Philippi, have added to our knowledge of Chilean mammals. Osgood (1943) succeeded in untangling some of the confused taxonomy of Chilean mammals and this outstanding report remains a most useful work today, both as a laboratory and a field guide to the mammals of Chile. Mann's "Mamíferos de Tarapacá" (1945) was the first time a major study of mammals was limited to a particular area of the country. Recently, Cabrera (1958 and 1961) listed all of the recognized species and subspecies of mammals living in Chile.

A study confined to a political boundary may be less useful to the scientist than a study limited by the natural boundaries of an ecological zone. However, an investigation of the mammals in Malleco Province, in south-central Chile, gives a useful cross-section of

one major animal assemblage occurring in a highly varied land where a thorough knowledge of fauna living there is lacking.

The objectives of this report are to present the accumulated records of the kinds of extant mammals and their habits within the confines of Malleco Province, and to define the habitats where the mammals occur. It is hoped that this study may form a basis for more detailed investigations of the mammals and associated fauna and flora, and that it will encourage students of mammalogy to seek out and study the rarer mammals. This must be accomplished soon because many of the natural habitats in south-central Chile are being destroyed by present agricultural and lumbering practices.

METHODS

More than 1,350 mammals were taken between November 1960 and May 1962 in Malleco; these are deposited in the research collection at The Museum, Michigan State University.

Field trips were planned so that most of the localities chosen for study were accessible by Jeep. Poor road conditions prevented travel in some parts of Malleco in winter. Pack animals were necessary to reach at least one remote area in the Andes. Dr. Dillman S. Bullock provided information on the recent history of some mammals, and residents in many localities were questioned as to the occurrence and abundance of game, carnivores, and small mammals. Questionnaires were sent to members of the Angol Hunting Club to determine the utilization of mammals for sport, food, and other purposes; the same questionnaire was used as a guide to question residents of rural areas.

Mammals were collected by various means to determine their kinds, distributions, and relationships to the environment. Museum Special snap traps, baited usually with chewed rolled oats, were used to sample populations of small rodents in selected habitats throughout the province. Live traps made of wood and baited with dry rolled oats were placed in grids. These traps were used to capture small mammals alive for marking, releasing, and subsequent recapturing in order to study the areas occupied, movements, and population densities of the species involved. Mice captured in live traps were

marked by clipping toes and released at the station of capture. The area occupied by each marked animal was calculated by including the spaces between each trap station where the animal was caught (see explanation in Drake, 1958:121). When live-trapping projects were completed, the study plots were then snap-trapped for 2 to 3 days. Density estimates were made using the Lincoln Index (Lincoln, 1930). Density was also determined by the removal method described by Hayne (1949:407) in which the number of animals previously removed by snap-trapping is plotted against the catch per day.

A 16 gauge shotgun was used to obtain larger mammals, and mist nets were stretched over water sources and in wooded areas to snare bats. Mammals occasionally were maintained in captivity for various lengths of time; these were the following: Dromiciops australis, Myocastor coypus, Oryzomys longicaudatus, Akodon olivaceus, Akodon longipilis, Felis concolor, and Galictis cuja.

The arrangement of orders and genera in this report follows that of Simpson (1945); most species names are those of Cabrera (1958 and 1961) and for convenience are arranged alphabetically under the genus. Common names mostly follow Mann (1957) or Simpson (1941). Both regional Spanish and Indian names are listed by Bullock (1932). Specimens examined are listed under appropriate species and generally are by locality from north to south. Measurements of specimens are given in millimeters and grams. Distances are given in kilometers and elevations in meters. Maps showing the distribution of most mammals in Chile may be found in Osgood's (1943) work.

The vegetation in Malleco Province was studied to determine its relation to the distribution of mammals. More than 1,800 collections

of plants from 113 localities were obtained. The most useful references for identifying plants were descriptions by Urban (1934) and Reiche (1907), and keys by Muñoz (1959) and Robinson and Fernald (1908). Some plants were identified by personnel in the Department of Botany of the University of Concepción, Concepción, Chile.

Different vegetation types were photographed to illustrate the different habitats available to the fauna.

GAZETTEER OF LOCALITIES

Place names in Malleco Province used in text are listed below and are shown on the map in Figure 1. These names appear on the American Geographical Society of New York map No. S. J. - 19 (Concepción), scale 1:1,000,000; or on the following maps of the Instituto Geográfico Militar, Santiago, Chile, Carta Preliminar, scale 1:250,000: No. 3775 (Arauco-Lebu); No. 3773 (Los Angeles-Angol); No. 3771 (Laguna de Laja); No. 3874 (Puerta Saavedra); No. 3873 (Temuco); No. 3871 (Lonquimay). Each place name is followed by its approximate location in degrees and minutes of south latitude and west longitude.

	S. Latitude	W. Longitude
Angol	72° 43'	37° 47'
Baños Río Blanco	71° 40'	38° 33'
Capitán Pastene	73° 00'	38° 11'
Contulmo	73° 14'	38° 00'
Collipulli	72° 26'	37° 57'
Curacautín	71° 52'	38° 26'
Galvarino	72° 47'	38° 24'
El Vergel	72° 41'	37° 49'
Jauja	71° 55'	38° 04'
Lago Icalma	71° 17'	38° 48'

Lonquimay	71° 22'	38° 27'
Lumaco	72° 55'	38° 10'
Manzanar	71° 42'	38° 28'
Parque Nacional	73° 00'	37° 45'
Parque Turismo	73° 10'	38° 00'
Paso Las Raices	71° 27'	38° 26'
Paso Pino Hachado	70° 54'	38° 40'
Purén	73° 05'	38° 01'
Relún	73° 10'	38° 15'
Temuco	72° 36'	38° 44'
Troyo	71° 18'	38° 14'
Victoria	72° 20'	38° 14'

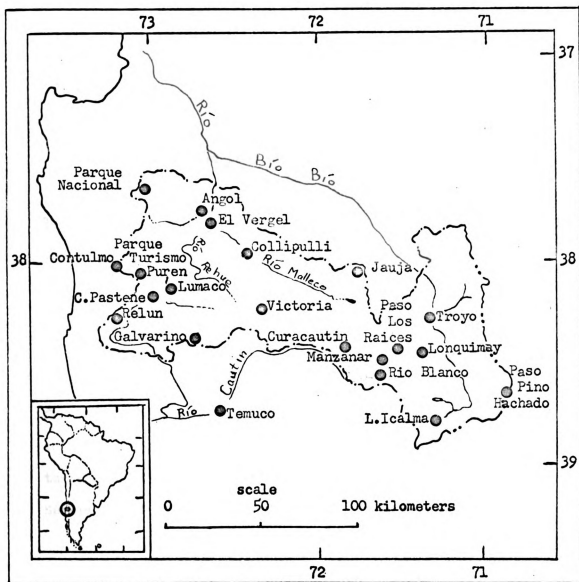


Figure 1. Map of Malleco Province, Chile, showing localities that are listed in the Gazetteer and the principal rivers.

BIOGEOGRAPHICAL CONSIDERATIONS

Physiography and Geology

Chile is a strip of land of 741,767 square kilometers in the southwestern part of the South American continent. It lies between 17°30' and 55°59' south latitudes, a distance of 4,183 kilometers, and between 66°30' and 75°40' west longitudes. It is 356 kilometers at its widest near Antofagasta, and 14 kilometers at its narrowest in the south, and averages about 175 kilometers in width.

The Central (Nucleo Central) and South Central Regions (Concepción y la Frontera) are the most inhabitable parts of Chile and extend from the southern edge of the Atacama Desert to the fjords of the south (Bohan and Pomeranz, 1960:31). For three and one-half centuries, central Chile was a battle ground for the war between the Spanish and Araucanian (Mapuche) Indians, with the Río Bío Bío forming the frontier between that part of Chile conquered by the Spanish and the territory still held by the Indians. Today, the area is divided into many large country estates, as well as some small farms acquired by soldiers late in the 19th Century.

The South Central Region comprises 7.3 per cent of the total area of Chile, and contains one-third of the arable land. In 1960, twenty per cent of the population of Chile lived there. One-third of the cattle population, and more than one-third of the cereal and lumber industries were established there. Fifteen to twenty per cent of all manufactured products were produced in the cities of

this area

Malleco Province, the area of the present study, is in the South Central Region and is composed of 14,277 square kilometers or 1.9 per cent of the total land mass of Chile. The province lies between 37°15' and 38°55' south latitudes and is approximately 210 kilometers wide east to west. Its western border meets Arauco Province at the summit of the Cordillera de Nahuelbuta and the continental divide in the Cordillera de los Andes forms the border between the province and Argentina. Its northern border in the Central Valley is formed by the Río Renaico, and its southern border by the Río Cautín and Río Quillén.

Physiography

Cordillera de los Andes.-- The Andes, the longest and second highest mountain chain in the world, form the boundary between Chile and Argentina. These mountains are non-volcanic in the north and central regions of Chile where there are 15 mountains more than 6,000 meters in elevation; in the South Central Region, the Andes are volcanic with many cone-shaped peaks rising to more than 3,000 meters. The highest mountains forming the front range of the Andes in South Central Chile are (from north to south) Volcán Callaqué, 3,079 meters (in Bío Bío Province); Volcán Tolhuaca, 2,780 meters; Volcán Lonquimay, 2,889 meters; Sierra Nevada, 2,560 meters; and Volcán Llaima, 3,060 meters (in Cautín Province). The continental divide between Malleco and Argentina is bridged by passes of about 1,800 meters in elevation and may be crossed by motor vehicles in summer.

Cordillera de Nahuelbuta.-- Coastal mountains extend the length of Chile, generally as well defined features. Between 27° south and 33° south latitudes, spurs of the Andes run to the coast and are almost inseparable from the coastal mountains. In the South Central Region, the coastal range is established as a series of moderate hills, except in Malleco where the Cordillera de Nahuelbuta is a well defined range. These mountains rise to 1,341 meters elevation; however, all field studies made in this high country were conducted below 1,200 meters elevation. After an abrupt rise from the Central Valley, most of the Nahuelbuta is more than 600 meters in elevation.

Central Valley.-- The Central Valley or "Longitudinal", between the Cordillera de los Andes and the Cordillera de Nahuelbuta, is approximately 25 kilometers wide and lies mostly between 60 and 300 meters above sea level. It has been described by Butler (in Bohan and Pomeranz, 1960:30) as being "a great central valley, poorly defined in the north, of decisive precision in the center, and drowned by the ocean in the south". The Central Valley is an area of intensive agriculture, but south of the Río Bío Bío low hills break up the landscape and the river valleys are deep.

The highest parts in the Andes and the Nahuelbuta are accessible by ox cart in summer by way of the canyons that face the Central Valley, but generally are inaccessible in winter. Bridges span the rivers crossed by the principal north-south highway passing through Malleco, while only ferries or fords are provided for the secondary roads. Some of the latter may be usable only in summer.

Inhabited areas in the mountains often are accessible only by horse or by foot.

A topographic transect (see Figure 2) across Chile and Argentina at the 38th parallel serves to illustrate the location and elevations of the mountains and Central Valley in Malleco and their relationship to Argentina. There is a gradual slope to the continental divide in Argentina and the western slopes in Chile are relatively steep. The north-south direction of the Río Bío Bío creates the broad valley between the front range in Malleco and the continental divide.

Rivers.-- There are two major drainage systems in Malleco, the larger Río Bío Bío in the north and the Río Imperial in the south. The Río Bío Bío courses in a north-south direction east of the front range in Malleco, and drains all parts in the interior of the Andes on the Chilean side of the continental divide. This river crosses the Central Valley in the Bío Bío Province (north of Malleco) and enters the ocean at Concepción 240 kilometers north of the mouth of the Río Imperial. Drainage for much of the Central Valley in Malleco, as well as for most of the eastern slope of the Cordillera de Nahuelbuta, is toward the northwestern corner of the province where the land is about 60 meters above sea level. The Río Vergara receives waters directly from the front range of the Andes via the Río Malleco and Río Renaico, and from the Nahuelbuta via the Río Picaicén. The Río Huequén and Río Rehue receive tributaries from the Nahuelbuta and high areas of the Central Valley and join also the Río Vergara near Angol. North of Malleco the Río Vergara enters the Río Bío Bío which eventually flows into the Pacific Ocean

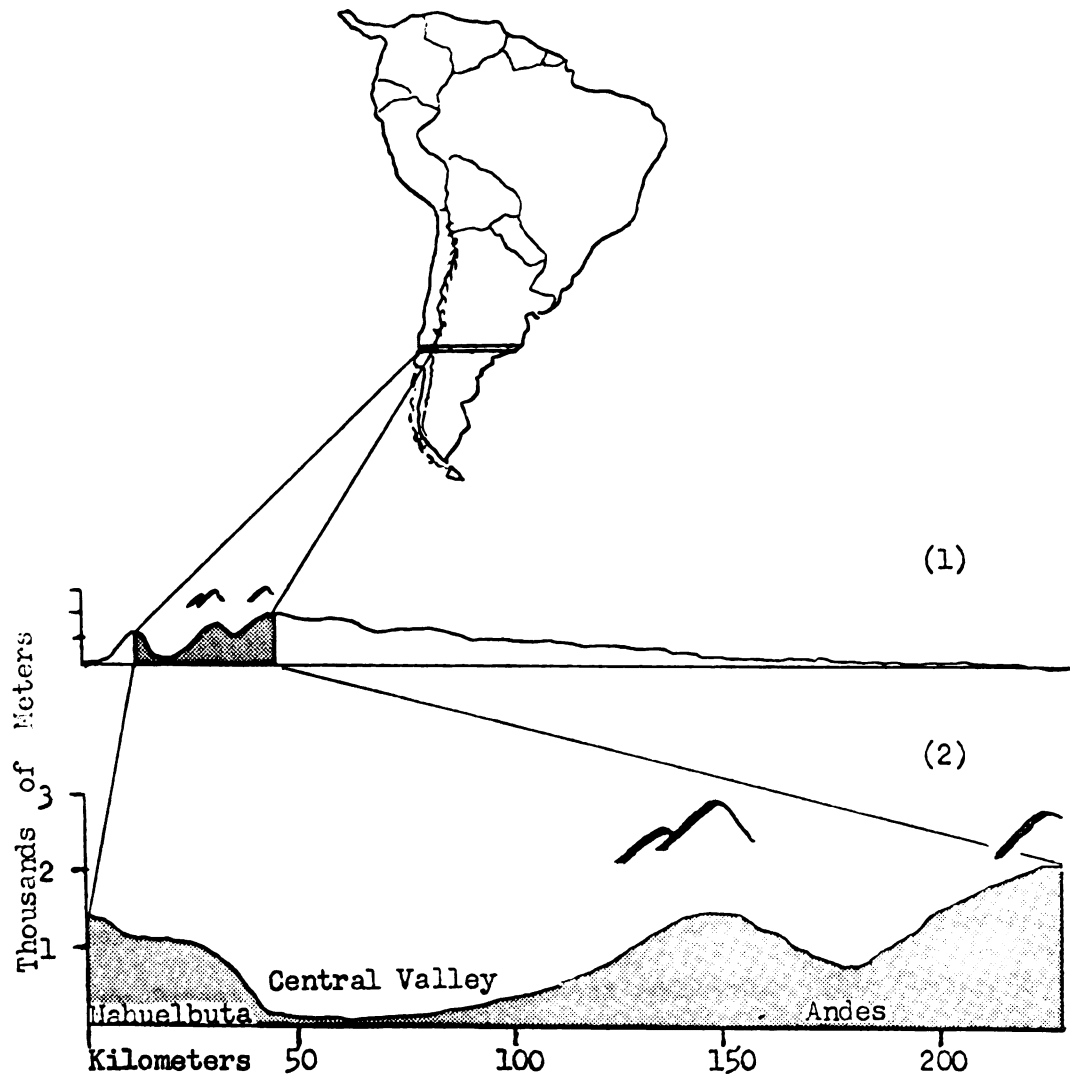


Figure 2. Transect across South America at 38° south latitude:
 (1) Chile and Argentina; (2) Malleco Province, Chile.

near Concepción. The Río Rehue and the Río Huequén which drain much of the Valley are muddy and slow-moving compared to the clear, rapidly flowing rivers, such as the Río Malleco, which originate in the front range of the Andes.

Drainage of the southern parts of the front range of the Andes in Malleco is toward the southwest via the Río Cautín; high areas at the southeastern edge of the Nahuelbuta drain toward the southeast via the Río Quillén and Río Chol Chol. These rivers join the Río Imperial (in Cautín Province) which empties into the Pacific Ocean.

Geology

The Cordillera de Nahuelbuta and the Cordillera de los Andes have deposits of Andean diorite of the Middle Cretaceous. The Cordillera de Nahuelbuta shows extensive areas of Pre-Cambrian metamorphic sediments, whereas the Andes are composed mainly of younger Jurassic and Lower Cretaceous sediments. The foothills of the Andes are composed of andesites and basites. The adjacent Central Valley is composed mostly of glacial sediments. The head waters of the Río Bío Bío arise from areas of continental sediments and from Lower Cretaceous and Jurassic Quartzphyritic and Porphyritic sediments of the Andean geosyncline. In the Central Valley, river sediments parallel the river valleys in areas of glacial sediments (Christi and Williams, 1950).

At the headwaters of the Río Bío Bío, two lakes, Lago Icalma and Lago Gallatúé, are formed by the snow melting on the eastern

slope of the Cordillera de Litrancura and front range of the Andes. Lago Icalma was reported not to freeze in the winter regardless of the low temperatures and plentiful snow. The temperature of the water flowing from the lake as it formed the Río Bío Bío was 15°C. in February; it may be that thermal springs which are common in the Chilean Andes contribute to the warmth of the lakes.

Soils.-- The distribution of major soil types in the Central Valley in Malleco Province is diagrammed in Figure 3. The data for this map were obtained from records in the office of the agricultural engineers of Angol, Chile. Brief descriptions of these soils follow.

Nahuelbuta soils: Chains of hills in the Cordillera de Nahuelbuta with slopes of more than 30%; colluvial origin; top soil, clayey, dark brown, granular structure, rich in organic material; useful only for forests, danger of erosion.

Mirador soils: Descriptive information unavailable.

Trintre soils: High hills in the Central Valley, more than 15% slope; sandy clay, brownish-yellow, hard but friable; poor soils in upper layers; useful for eucalyptus and pine, erodible with poor land use.

Collipulli Lomos soils: Rounded hills, slopes greater than 15%, good drainage; glacial origin with sub-stratum semi-consolidated; clayey with gravel, reddish, hard when dry but friable; suitable for cultivation, erosion a problem.

Collipulli Cerros soils: Descriptive information unavailable.

Santa Barbara soils: Gentle hills, slopes 4-10%, moderate erosion with gullies on the greatest slopes, drainage good, no

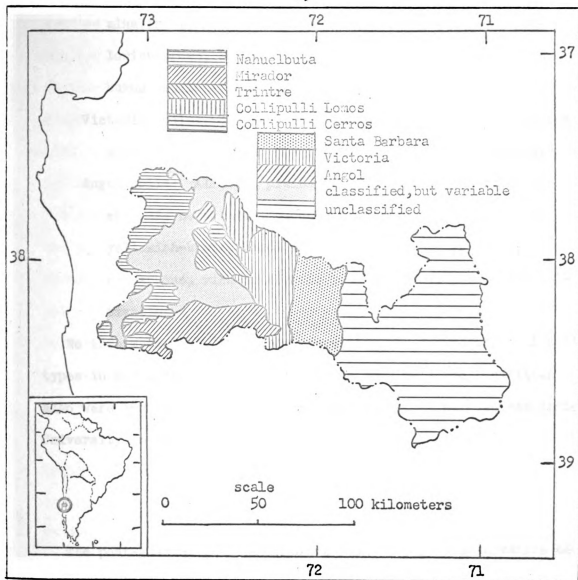


Figure 3. Distribution of soil types in Malleco Province, Chile.

alkalinity; volcanic origin, secondarily alluvial; yellowish-brown, muddy and fine, pH 6.2, top layer rich in humus; suitable for cultivation.

Victoria soils: Slightly undulating plain, erosion on slopes along rivers; blackish, somewhat sandy, porous texture.

Angol soils: Alluvial plains by the Río Malleco with slopes of 2-3%, no alkalinity, good drainage; alluvial origin; yellowish-brown, black when wet, muddy and granular, not calcareous, rich in organic material; well-suited for cultivation.

No information was available concerning the distribution of soil types in the Andes. Soil samples taken from selected localities also were analyzed by the Soil Testing Laboratory at Michigan State University in 1963 (see Appendix 1).

Climate

The post-glacial climate in Chile reached its maximum warmth between 6,000 and 4,000 years ago (see Dunbar, 1949:457) and the last dry period may have been as recent as 100 years ago (Auer, 1960:533). Counterparts of the three main post-glacial periods in New Zealand may have occurred in southern Chile (Godley, 1960:465). The first period had a severe climate allowing for grasslands in the dying stages of glaciation; then followed a wet, probably warm climate which accommodated a podocarp forest; and finally a period of cooling when the present Nothofagus forest-grassland came into being. The distribution of relict islands of southern vegetation

such as the forest of Fray Jorge in Coquimbo Province, several hundred kilometers north of the present northern border of the southern forests, suggests that the climate in central Chile in the recent past was colder and wetter than at present (Goodspeed, 1945: 148). Today, a temperate climate prevails except in alpine regions.

The climate of the central regions of Chile may be classified as Mediterranean, characterized by dry summers and rainy winters, with the vegetation typically composed of small trees with coriaceous leaves, and lacking epiphytes. The major factor influencing the climate of Chile is, of course, the proximity of the Pacific Ocean. Mean temperatures decline from north to south in Chile, and the summers in the Central and South Central Regions are mild and the winters are not cold, due to the moderating effects of the cold Humboldt Current which parallels the coast of Chile from near 40° south latitude northward. The characteristic cool, moist inland breeze creates a 365-day growing season for much of the Central Valley. The Río Bío Bío appears as a natural boundary separating the area characterized by warm dry summers and mild winters north of the river from the region of cool, wet summers and stormier winters south of the river. Malleco Province has mild summers and stormy winters.

In Malleco, the Cordillera de Nahuelbuta (between the Central Valley and the Pacific Ocean) functions as a rain-shield against the inland breezes, creating conditions in parts of the Central Valley in which rainfall and humidity are consistently lower than on the coast in Arauco Province. Rain forest conditions are observed in the Nahuelbuta as clouds form and cool mist circulates

through the forests on the summit and western edge of this mountain range.

The "front range" of the Cordillera de los Andes acts as a rain-shield to the parts of Malleco east of the front range. Winds carrying moisture from the Pacific Ocean deposit this moisture as snow during winter months or as rain in summer, on the western face of the front range. As seen from the Central Valley, the Andes appears as a solid wall of snow in winter and as a broken snowy skyline in summer, with snow remaining the year around on the high volcanos and protected high areas in the Andes. The eastern side of the front range has little snow in summer except on the high and protected slopes. The lower limit of snowline in summer in Malleco was estimated to be at 1,800 meters elevation on southern exposures.

In the Central Valley, the prevailing wind during winter blows from the northwest bringing in moist air and resulting in the rainy season. Occasionally, during winter, the winds shift and then southerly Antarctic winds bring freezing temperatures and clear, dry days to the Central Valley.

Weather observations were made at El Vergel between May 14 and July 24, 1961. There were 33 days of rain, 15 of which were consecutive, causing a moderate flood in the region. During this rainy period, the wind came predominantly from the north and/or west. Generally, the winds blew less than 40 kilometers per hour, but on at least four occasions, the winds gusted to an estimated 80 kilometers per hour. Frequently, during these northern storms the sun shone through the low, thin clouds. Heusser (1960:564) reported similar occurrences of storm winds ("frontal passages") from the north.

Following several days of steady northerly winds, there were periods of calm when the winds shifted 180 degrees; on these clear days there is an impressive sight of new snow glittering on the front range of the Andes.

Between May 14 and July 24, 1961, there were 32 days which were mostly cloudy with little wind when the sun appeared at least for a short duration, and there were 7 days which were completely cloudless. On these clear days the average morning low temperature 6 meters above ground was -2°C .; the coldest recorded was -7°C . Frost stayed on the ground in the shadows until late in the morning at these times. During rainy periods, on the other hand, the lowest morning temperature was 7°C .

At El Vergel, the maximum daytime temperature in winter generally reached 11°C , and in summer occasionally reached 33°C .

Information about rainfall at the Laguna Malleco from 1956 to 1961 revealed that the driest months of the Andean area are December and February and that May, June, and July have the most precipitation (Table 1). The forest ranger at the reserve provided this information in 1961.

In summary, the climate in Malleco is affected by the moderating influence of the Pacific Ocean. Winds generally blow from the coast ---from the northwest in winter, and southwest in summer---creating temperate conditions. There is a rain-shadow effect created on the eastern slopes of the Cordillera de Nahuelbuta and the Cordillera de los Andes. Nearly all of the rainfall occurs in winter, but snow persists at higher elevations in the Andes in summertime.

Table 1. Rainfall in millimeters at the Laguna Malleco, 25 kilometers north of Curacautín, 980 meters elevation, 1956 through 1961.

Year	Driest and wettest months	Amount per month	Total for year	Average per month (12 month basis)
1956	December February May July	14 43 440 606	2756	215
1957	February March July August	0 34 777 764	3572	310
1958	December March May June	0 25 929 792	3681	306
1959	December November April July	4 26 772 772	4118	343
1960	February November June July	2 75 725 451	2731	227
1961	December Feb. and Nov. June July	18 29 971 605	4124	344

Vegetation

The derivation of the Chilean flora is not as clearly defined as is the derivation of the mammals. According to Kuschel (1960: 550), the flora and some associated fauna (mostly insects) show a close relationship (affinity) with flora and fauna in New Zealand, Tasmania, Australia, New Guinea, South Africa, and the subantarctic islands, suggesting that Antarctica has been an important center of dispersion especially during the Cretaceous. Couper (1960:499) has suggested the existence of a land bridge between South America, Antarctica, and the Australia-Malasia Region, but that the flora may have dispersed from South America to the other regions (from evidence of past stratigraphic and geographic distribution of Nothofagus and some groups of Podocarpaceae). On the other hand, Good (1964:267) has suggested continental drift as a possible solution to the distribution of southern hemisphere flora.

Vegetation zones in Chile have been described by various authors. Mann (1960) divided Chile into climax community types with moisture gradients determining pre- and post-climaxes. Oberdorfer (1960) used the floristic composition basis of the Zurich-Montpellier system emphasizing the ecological-pedological-climatic factors to determine the association. He pointed out that south of the Río Bío Bío and Río Renaico which form the northern boundary of Malleco in the Central Valley there is a rapid change from xerophilic to mesic vegetation, but with the xerophilic forms persisting south of the rivers in areas of low precipitation. Osgood (1943) classified Chile, excluding the Puna, as south temperate based on its climate

and fauna. He stated that in the transitional zone (which includes Malleco Province) the southern (Valdivian) forests are represented in some areas in the Cordillera de los Andes and Cordillera de Nahuelbuta where humidity is high. Osgood described the Puna Zone in the Andes as excessively arid, high in altitude (above timberline), having greatly reduced fauna, and, between 36° south latitude and the southernmost reaches of the continent, limited to isolated peaks. None of the above authors described in detail the vegetation of the transition region from the central xerophilic vegetation to the southern humid vegetation.

Areas of the transitional zone and the southern zone now under heavy land use once were covered by primeval forests (Oberdorfer, 1960 and Goodspeed, 1961:307) which stretched from the sea to the Andean timberline. On the other hand, Stein (1956:156) suggested that the forests that once covered the Central Valley may have developed subsequent to the Spanish invasion.

Roble (Nothofagus obliqua) is the most characteristic tree of Malleco Province, and occurs singly and in small stands throughout the Central Valley; as scrub cover in some of the more arid regions, such as on the eastern slopes of the Nahuelbuta; and in dense stands in the higher, moist areas of the Nahuelbuta and Andes. Mann (1960) considered pockets of this species north of 38° south latitude as relicts of the northward migration of forests during the glacial advances; normally this region is too arid to support the southern forest types. I found, as did Oberdorfer (1960), that robles occur with broadleaved evergreen trees typical of the southern forests,

as well as in almost pure stands in the drier regions of the Central Valley north of 38° south latitude.

The distribution map of major vegetation types in Malleco (see Figure 4) was constructed from observations made in the field in 1960, 1961, and 1962. The vegetation types with corresponding plates showing typical aspects are as follows:

Vegetation Type	Plate
<u>Araucaria-Nothofagus dombeyi</u>	1b
<u>Araucaria-N. dombeyi / N. pumilio</u>	4b
<u>Nothofagus antarctica-grassland</u>	6a
<u>Nothofagus alpina-N. obliqua</u>	4a
<u>Nothofagus alpina-N. dombeyi</u>	6b, 7b
<u>Nothofagus obliqua</u>	1a
Central Valley agriculture	2b, 3a, 3b, 8b
Broadleaf evergreen	2a
Río Bío Bío Valley	5b
Alpine	5a

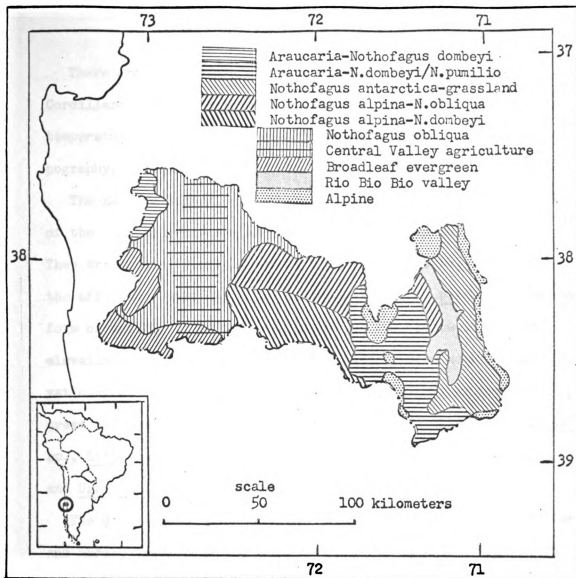


Figure 4. Distribution of vegetation types in Malleco Province, Chile.

Cordillera de Nahuelbuta

There are three distinct vegetation associations in the Cordillera de Nahuelbuta; their specific characteristics depend on temperature, humidity, and other factors governed by altitude, topography, rainfall, and land use.

The Eastern Slopes.-- The eastern slopes are in the rain-shadow of the coastal range and are the driest areas in the mountains. They are covered sparsely with low trees and shrubs, and exhibit the effects of heavy grazing. Roble (Nothofagus obliqua) takes the form of scrubby trees on these slopes at low (below 152 meters) elevations; this tree gradually increases in size with higher elevations, and is larger where land use is less. Other prominent trees and shrubs on the dry slopes include: Baccharis sp., Colletia sp., Lithraea caustica, Lomatia hirsuta, Peumus boldus, Sophora sp., and Ugni molinae.

The dry eastern slopes are interrupted by streams, moist ravines, and marshy areas in which are found the following: Drimys winteri, Guevina avellana, Lomatia dentata, Nothofagus alpina, and Persea lingue of southern forest origin. Cane (Chusquea sp.) is prominent in the shrub level, and there are woody vines, including Boquila trifoliata, Lapageria rosea, and Lardizabala biternata. In low, marshy areas formed where streams meander through flat lands, Myrceugenia spp. usually are dominant, with associated plants, such as Cyperus sp., Equisetum sp., and Juncus sp.

The National Park.-- Due largely to the efforts of Dillman S. Bullock and Elbert Reed, both of El Vergel, the Chilean government

in 1939 purchased and set aside a 5,000 hectare portion of the highest area of the Cordillera de Nahuelbuta as the "Parque Nacional de Nahuelbuta". The land surrounding this area was "parceled" into small farms. Since 1939, the vegetation in the park has remained relatively undisturbed, except for a few cattle and occasional illegal cutting of trees. There, Araucarian pine (Araucaria araucana) and Chilean beech forests of roble (Nothofagus obliqua) and coihue (N. dombeyi) are thought to be primeval, or nearly so. The park provides a unique opportunity to carry out studies of vegetation and animals in an environment relatively unmolested by man.

Roble draped with Spanish moss (Tillandsia sp.) is found throughout the park (see Plate 1a) and species of Berberis are outstanding in the shrub layer in the roble woods. The rodents Akodon longipilis and Aconaemys fuscus, were trapped where Berberis buxifolia (about 30 centimeters high) was abundant; it was thought to be a source of food for Aconaemys.

Trees and other shrubs associated with roble forests are the following: Azara spp., Drimys winteri, Embothrium coccineum, Lomatia hirsuta, Nothofagus alpina, N. dombeyi, Ovidia sp., Pernettya sp. (or Gaultheria?).

The higher areas in the park where collections of plants were obtained and mammals were trapped are marked by evergreen forests of Araucarian pine and large coihue similar in physiognomy to the forests in the Andes (see Plate 1b). These Araucarian forests are often enshrouded in mist. Araucarian pine forms the uppermost canopy and coihue forms a tall (25 to 28 meters high) sub-canopy. The trees are widely spaced and there is little stratification between

the canopy and the shrub level. Few saplings or small trees of either species are present. There is a dense shrub cover of Pernettya sp., and to a lesser extent Berberis spp. In these forests, where the air is charged with moisture, Spanish moss grows on the shrubs and roble, and more rarely on the branches of the Araucarian pine.

Southern Sector.-- Tongues of southern forests extend into the southern sector of the Nahuelbuta (south of about 38° south latitude) in areas which have escaped clearing. A forest reserve, "Parque Turismo", located near the 460 meter high roadway pass between the Central Valley in Malleco and the coastal plains of Arauco, is thought to be one of these pockets of southern forest. There is a dense shrub cover of the cane (Chusquea sp.) and of a large fern (Lophosoria quadripinnata), both reaching a height of four meters. Only by cutting a path through the stocks of the plants can one pass through this dense vegetation. An herb layer is lacking and the ground is covered with litter.

The tallest trees (reaching 30 meters) in the reserve are the following: Aextoxicon punctatum, Drimys winteri, Eucryphia cordifolia, Laurelia spp., Nothofagus obliqua, Persea lingue, and Weinmannia trichosperma. Smaller trees, also in open areas on the periphery of the reserve, include these: Aristotelia chilensis, Caldcluvia paniculata, Guevina avellana, Lomatia ferruginea, Myrceugenia planipes, Nothofagus dombeyi, and Rhaphithamus spinosum. Other woody plants are the following: Azara lanceolata, Baccharis sp., Fuchsia sp., Lomatia dentata, Pernettya rigida, Ribes sp., and Ugni molinae.

Land use.-- In 1961, intensive lumbering of Araucarian pine and coihue was being carried out on the western slopes of the Cordillera de Nahuelbuta in Arauco Province. On the Eastern slopes and in the southern sector, much of the original forest has been removed and the land is utilized heavily for agriculture or grazing.

Wheat and corn are cultivated on slopes too steep for the use of tractors for plowing; these areas are worked with oxen. At elevations of 610 meters and higher there are occasional plantations of Monterrey pine (Pinus radiata syn. P. insignis), as well as small fruit orchards and truck gardens. There is some cleared or thinly wooded land where livestock, mainly cattle, are pastured. Roads that pass through cleared and often burned-over lands in the southern sector of the Nahuelbuta often are lined with massive hedge rows of blackberry (Rubus sp.) and sometimes gorse (Ulex europaeus) and rose (Rosa sp.). These thickets harbor high populations of rice rats (Oryzomys longicaudatus).

A long-time resident reported that his farm at Relún (see Plate 2a) was covered with roble forests twenty years ago, and that coihue, avellano (Guevina avellana), ulmo (Eucryphia cordifolia), and palo santo (Weinmannia trichosperma) still were being removed from the higher areas of his farm. Here in cleared or otherwise disturbed areas the original vegetation was replaced with blackberry, wild rose, cane, maqui (Aristotelia chilensis), and lingue (Persea lingue), and, where there was sufficient moisture, canelo, or "Winter's bark" (Drimys winteri). The most common rodents in these cleared areas were Oryzomys longicaudatus and Akodon longipilis.

A study of a forested area and of an adjacent two-year old burned-over area 7 kilometers southwest of Contulmo indicated the early invaders of old fields in the region. Common as early invaders of old fields were cane (prominent as a shrub level species in mature southern forests), Muehlenbeckia sp., Plantago sp., Ribes sp., Senecio sp., Ugni molinae, and a species of Cruciferae. The copihue (Lapageria rosea) was found growing on the ground in the open field and as an arboreal vine in the woods.

Central Valley

The Central Valley, averaging 25 kilometers in width in Malleco, lies between the Cordillera de los Andes and the Cordillera de Nahuelbuta. The preponderance of cultivated fields (see Plate 2b), pastures, and plantations of non-native trees reflects the extensive utilization of the land by man.

Central Valley Agriculture.-- A large portion of the land in the Central Valley has been cleared and turned into large farm estates where wheat and other grains, such as oats and corn, are cultivated extensively, and fruit orchards are widely evident. Other important crops are beans, beets, potatoes, lentils, and chick peas. Livestock, mainly cattle and sheep, are raised throughout the Valley, some in managed pastures. There are plantations of Monterrey pine used for lumber locally or for the expanding pulp industry, and groves of eucalyptus (Eucalyptus globulus) used primarily for fuel. These two imported species exhibit especially rapid growth in this region which has a long growing season.

An obvious result of over-use of the land is extensive erosion of the hills (see Plate 3a). Clearing and cultivation have been carried out with little regard to good land use practices and hill-sides have been worked or grazed to the extent that little vegetation remains to prevent formation of gullies. An increase in use of land for pine plantations and eucalyptus groves is an encouraging sign.

Open, untended, and usually overgrazed grasslands support scattered shrubs, such as wild rose and pelú (Sophora sp.), besides various grasses and weeds. These areas (see Plate 3b) often are rocky with boulders scattered throughout.

Few large tracts of natural forests remain in the Central Valley. Roble (Nothofagus obliqua) the dominant tree in wooded areas, often is mixed with other species of Nothofagus (viz., rauli, N. alpina, and the evergreen coihue, N. dombeyi) or with broadleafed evergreens, many of which are species common to southern forests. In marshy areas species of Myrceugenia are prominent trees.

Trees found in the Nothofagus forest associations include: Aextoxicon punctatum, Aristotelia chilensis, Drimys winteri, Eucryphia cordifolia, Guevina avellana, Laurelia spp., Lithraea caustica, Lomatia dentata, L. hirsuta, Myrceugenia spp., Ovidia sp., Persea lingue, and Peumus boldus. The shrubs are: Azara spp., Berberis spp., Cestrum parqui, Colletia sp., Leptocarpha rivularis, Rosa sp., Rubus sp., and Sophora sp. Prominent woody vines are: Boquila trifoliata, Cissus striata, Hydrangea interrima, and Lapageria rosea.

Cordillera de los Andes

Due to differences in topography, elevation, and exposure, a variety of vegetational aspects characterizes the Andean region. In this portion of Chile forests of Nothofagus (alpina, obliqua, and dombeyi) characterize the Andean foothills (see Plate 4a). The front range is higher than 1,800 meters in elevation and has an atmosphere of moisture laden air from the Pacific Ocean creating conditions suitable for the Araucaria-Nothofagus forests (see Plates 1b and 4b). Black, sandy flats are characteristic of the high passes (see Plate 5a). More xeric conditions exist along the Río Bío Bío and its tributaries (see Plate 5b) due to the rainshadow effect of the front range. Ñirre (Nothofagus antarctica)-grasslands occur on the western slope of the continental divide above 1,060 meters elevation (see Plate 6a).

Andean Forests.-- The Andean foothills (about 300 to 900 meters elevation) east of the Central Valley, receive relatively heavy rainfall and support luxuriant forests of the deciduous roble (Nothofagus obliqua) and raulí (N. alpina) in northern areas (such as near Termas Pemehue, 20 kilometers east of Jauja, see Plate 4a), and raulí and the evergreen coihue (Nothofagus dombeyi) in southern areas (such as near Baños Río Blanco). These Nothofagus species are mixed with a variety of broadleafed evergreens characteristic of southern forests. There is generally a dense shrub layer including cane, a woody, grasslike bamboo (Chusquea sp.) and barberry (Berberis spp.).

Among the understory trees are these: Aristotelia chilensis, Cryptocaria alba, Drimys winteri, Guevina avellana, Lomatia dentata, Myrceugenella apiculata, Persea lingue, Pseudopanax sp., and Weinmannia trichosperma. Shrubs include: Azara lanceolata, Berberis spp. (heteriphylla, trigona, and buxifolia), Colletia sp., Pernettya sp., and Ribes sp. Woody vines are: Boquila trifoliata, Cissus striata, Elytropus chilensis, and Hydrangea intergerrima.

On the western exposures of the front range at 1,200 meters elevation a few Araucarian pines are evident, becoming more prominent at higher elevations and climaxing in vast forests in the altitudinal zone between 1,550 and 1,850 meters near the summit of the front range (see Plate 4b). Lenga (Nothofagus pumilio), absent from the Cordillera de Nahuelbuta, is a common forest associate of the Araucaria in the Andes. Chusquea sp., Berberis sp., Pernettya sp., and Ribes sp., are prominent shrubby species and Spanish moss clings to the tree branches. Various grasses, herbs, and ferns, along with ample litter, form a ground cover. Mammals trapped in pine forests were Dromiciops australis, Akodon longipilis, Notiomys macronyx, and Phyllotis micropus. Parrots are common and feed on the pine fruit in late summer, and the striking Magellanic woodpecker (Ipocrantor magellanicus) is found in some areas.

Stretches of dark volcanic sand separate forest stands on the passes in the front range (see Plates 4b and 5a). The vegetation on these sandy flats consists of sparse grasses and herbs. Ctenomys maulinus was trapped in sandy areas and denuded grassy slopes in a manner similar to that reported for C. opinus in Peru (Pearson, 1959).

Coihue grows at lower elevations on the western slopes of the front range than on the eastern slopes; roble and raulí (both slightly xerophilic) grow at higher elevations in the rain-shadow on the eastern slopes than on the western side.

The vegetation in the valleys of the Río Bío Bío (see Plate 5b) and its tributaries is similar to that of the western side of the front range at 500 to 600 meters elevation. Akodon olivaceus, generally a rodent characteristic of dry areas, was taken in both regions.

Nothofagus antarctica-grasslands.-- The roble forests in the Río Bío Bío valley and the Araucaria-Nothofagus (dombeyi and/or pumilio) forests gradually give way to the ñirre-grassland associations (see Plate 6a) at higher elevations (generally above 1,200 meters). These relatively open areas extend north to south along the broad slopes of the Andes to about 1,800 meters elevation (see Figure 4). Windy exposures near the passes into Argentina are covered mostly with grass. Local residents reported that the high areas are used as pasture for cattle in summer.

Chusquea sp. and other grasses, and various herbs are common in the ñirre-grasslands. Shrubs, besides ñirre, include: Baccharis magellanica, Berberis (buxifolia, heteriphylla, empetrifolia), Colletia sp., Escallonia vergata, Ribes sp., and Wendtia gracilis. Some ñirre-grassland stands at lower elevations appear to be the result of heavy lumbering rather than of natural conditions. Southeast of Lago Icalma at about 1,300 meters elevation near the Argentine border, pine forests are being cut by lumbering companies,

and the cleared areas are invaded by ñirre and grass. Individual or groves of Araucarian pine are scattered throughout the ñirre-grassland.

The Alpine zone is so rough, rocky, and steep that little life exists there above the upper limit of the trees. This zone in Malleco is discontinuous in that it is located only on the mountain tops. The mountain vizcacha (Lagidium viscacia) is an interesting inhabitant of the region.

Land use.-- (See also Conservation) During my travels into various forested regions in the Andes I was disturbed at the constant sight of smoke curling up from the landscape. I learned that fire, generally out of control, was consuming the rejects of lumbering operations. Uncut timber often is consumed before fires are under control. One such area (see Plate 6b) was visited approximately three years after it had been razed by fire. Cane (Chusquea sp.) was well-established in this area and Akodon longipilis was common.

Plate 1a. Roble (Nothofagus obliqua) forest in the Parque Nacional de Nahuelbuta. Barberry (Berberis spp.) is prominent in the shrub layer, and Spanish moss (Tillandsia sp.) is common in the branches of the trees. Dromiciops australis, Oryzomys longicaudatus, Akodon longipilis and Aconaemys fuscus are characteristic small mammals. 27 kilometers west-northwest of Angol, 1110 meters elevation.

Plate 1b. Logs of Araucaria pine (Araucaria araucana) in the Cordillera de los Andes. These are hauled by oxen to roads where diesel trucks transport the logs to lumber mills in Chile or Argentina. 21 kilometers south of Lonquimay, 1,280 meters elevation.

PLATE 1



Plate 2a. Cleared lands in the southern sector of the Cordillera de Nahuelbuta. Roble (Nothofagus obliqua) forests once covered this area and, reportedly, coihue (Nothofagus dombeyi), ulmo (Eucryphia cordifolia), and palo santo (Weinmannia trichosperma) still are being logged from higher areas nearby. Common rodents in the brush in cleared areas are Oryzomys longicaudatus and Akodon longipilis. Relún, 152 meters elevation.

Plate 2b. A small farm in the Central Valley. This farm belonging to Araucarian (Mapuchi) Indians living on the Río Rehue is characteristic of small landholdings in the Central Valley. Nothofagus obliqua may have dominated the original vegetation where willow, poplar, and eucalyptus now are common. 6 kilometers southwest of Angol, 75 meters elevation.

PLATE 2



Plate 3a. An agricultural area in the Central Valley. Roble (Nothofagus obliqua) forests formerly covered these now eroded hills in Malleco. Oryzomys longicaudatus is common in omnipresent blackberry hedgerows. Near Los Sauces, about 100 meters elevation.

Plate 3b. Pasture and pine plantations in the Central Valley. These areas often are cleared of rocks for cultivation, and rows of Monterrey pine act as windbreaks for the crops. The original vegetation on this land likely was dominated by Nothofagus obliqua. El Vergel, 5 kilometers south of Angol, 150 meters elevation.

PLATE 3



Plate 4a. Valley of the Río Renaico in the foothills of the Cordillera de los Andes. Blackberry and wild rose are visible as brush on the overgrazed terrain and much of the land has been cleared of the native forests. Pinus radiata and Populus niger are growing where Nothofagus obliqua and N. alpina in the past were abundant. Jauja, 485 meters elevation.

Plate 4b. Paso de las Raices in the front range of the Cordillera de los Andes. The Araucaria pines (Araucaria araucana) are taller and darker than the evergreen lenga (Nothofagus pumilio). This forest growing at the edge of an old lava flow does not support a high density of rodents. 11.3 kilometers west of Lonquimay, 1,650 meters elevation.

PLATE 4



Plate 5a. Paso de las Raices in the front range of the Cordillera de los Andes. Ctenomys maulinus inhabits the deep, black sands on flats, as well as adjacent slopes. Dromiciops australis, Akodon longipilis, Notiomys macronyx, and Phyllotis micropus live in the Araucaria (Araucaria araucana) forests. 11.3 kilometers west of Lonquimay, 1,650 meters elevation.

Plate 5b. Valley of the Río Bío Bío in the Cordillera de los Andes. Ctenomys maulinus lives in the deep alluvial soils; Akodon olivaceus, Akodon longipilis, and Oryzomys longicaudatus inhabit brushy habitats above ground. 20 kilometers southeast of Lonquimay, 980 meters elevation.

PLATE 5



Plate 6a. Ñirre (Nothofagus antarctica)- grasslands at Lago Icalma, headwaters of the Río Bío Bío. A few Araucarian pine (Araucaria araucana) are present, but the Antarctic beech, or Ñirre, a low shrub-like tree, is the prominent plant form. Oryzomys longicaudatus, Akodon longipilis, and Phyllotis micropus are found in the grass at the bases of the Ñirre, and Notiomys macronyx and Ctenomys maulinus inhabit burrows in open areas. Lago Icalma, 1,190 meters elevation.

Plate 6b. A skeleton forest of coihue (Nothofagus dombeyi) near Volcán Tolhuaca. A recent burn in this forest stand shows that cane (Chusquea sp.) is an early invader of such disturbed areas, along with the rodents Oryzomys longicaudatus, Akodon longipilis, and Akodon olivaceus. 9 kilometers north of Manzanar, 1,155 meters elevation.

PLATE 6



Plate 7a. Dromiciops australis. This marsupial becomes torpid and attains a flexed position when exposed to temperatures below 5°C. for periods to six hours.

Plate 7b. A stand of coihue (Nothofagus dombeyi) in the foothills of the Cordillera de los Andes. Chusquea sp., a cane, is abundant as forest underbrush where Dromiciops australis, Oryzomys longicaudatus, and Akodon longipilis and Irenomys tarsalis were trapped; Notiomys valdivianus and Aconaemys fuscus were taken in underground burrows in the open grassy areas. Trails made by Myocastor coypus crisscross the marshy area. 25 kilometers north of Curaçautín, 980 meters elevation.

PLATE 7



Plate 8a. Rocky pasture land in the Central Valley. Phyllotis darwini was trapped under these rocks. Fundo Itraque, 5 kilometers south of Angol, 152 meters elevation.

Plate 8b. Feces of Aconaemys fuscus. The winter accumulation of feces at the entrance of a burrow of this fossorial rodent exceeded 28 quarts. 27 kilometers west-northwest of Angol, 1,155 meters elevation.

PLATE 8



CHARACTERISTICS OF THE MAMMALIAN FAUNA

Composition and Derivation

Zoogeographically, Chile, Argentina, Uruguay, and parts of Bolivia, Peru, and Ecuador are located in the Patagonian Subregion (Chilean subregion of Wallace, 1876) of the Neotropical Region. For an overall view of the Patagonian mammalian assemblage, Simpson (1950) and Hershkovitz (1963) may be referred to for an historical approach---Hershkovitz (1958) for zoogeographic affinities, and Osgood (1943) for the distribution of Chilean mammals.

The living mammals of the Patagonian plateau and southern Andes (including Malleco Province) are descendents of early Tertiary marsupial, edentate, and caviomorph rodent fauna and progressive elements of Pliocene-Pleistocene carnivores, cricetine rodents and artiodactyls (Hershkovitz, 1963:42). The Andean highlands were, and remain, a principal route for the dispersal of mammals, at least in temperate South America. An important ecological factor in adaptive radiation, speciation, and extinction among recent Neotropical mammals is the establishment of new temperate zone habitats in the wake of melting glaciers (op.cit.). The transition between southern moist forests and more northern xerophilic savannah which exists at present slightly north of Malleco, probably existed considerably northward at the time of maximum glaciation. It may be that there was a more varied mammalian assemblage in Malleco before the advance of the Pleistocene ice sheets. For example, cavies, which occur commonly in the pampas of Argentina today,

may have crossed the low passes in the southern Andes into Chile (including Malleco) during a drier and warmer period, and may have dispersed at least as far north as Coquimbo where there is a relict of the southern forest (Forest of Fray Jorge), evidence of the extent of the cool, moist climate of the past.

Genera.-- The mammalian fauna of South America was derived from North America by way of the Isthmus of Panama over a long geologic interval (Simpson, op.cit.). Following these introductions, a great diversification in many of the immigrant groups resulted in the evolvement of endemic mammals, while some others diversified to a lesser extent and maintained closer genetic ties to their northern Holarctic relatives. Accordingly, the Recent mammals found in Malleco include many strictly endemic Neotropical genera and only a few which are also Nearctic. Twenty-four native genera (listed in Table 2) can be arranged (according to Hershkovitz, 1958) as follows: 4 genera (2 of which are bats) as cosmopolites (because they occur both in Neotropica and in Palearctica); 2 genera as Nearctic-Neotropical varicants (because they occur in both areas but their exact geographic derivations are unknown); 2 genera as excurrent Neotropical regionalites (because they are native to Neotropica but also have spread into Nearctica); and 16 genera as endemic Neotropical regionalites (because they have not spread into Nearctica). Sixteen (67 per cent) of the Mallecan genera are endemic in Neotropica while only 8 (33 per cent) occur elsewhere. Of these 16, 11 are endemic to the Patagonian Subregion. This high percentage is to be expected since this subregion has the largest number of endemics of any subregion in Neotropica (see Hershkovitz, op.cit.).

Table 2. Geographic classification of native mammalian genera in Malleco Province, Chile.

Genera (no. of species in parentheses)	Cosmopolites	Nearctic- Neotropical Varicants	Neotropical Regionalites (excurrent)	Neotropical Regionalites (endemic)
MARSUPIALIA				
<u>Dromiciops</u> (1)				x*
<u>Marmosa</u> (1)			x	
CHIROPTERA				
<u>Myotis</u> (1)	x			
<u>Histiotus</u> (1)				x
<u>Lasiurus</u> (2)		x		
<u>Tadarida</u> (1)	x			
RODENTIA				
<u>Oryzomys</u> (1)			x	
<u>Akodon</u> (2)				x
<u>Notiomys</u> (2)				x*
<u>Eligmodontia</u> (1)				x*
<u>Phyllotis</u> (2)				x*
<u>Irenomys</u> (1)				x*
<u>Euneomys</u> (1)				x*
<u>Lagidium</u> (1)				x*
<u>Myocastor</u> (1)				x*
<u>Octodon</u> (1)				x*
<u>Aconaemys</u> (1)				x*
<u>Ctenomys</u> (1)				x*
CARNIVORA				
<u>Dusicyon</u> (2)				x
<u>Galictis</u> (1)				x
<u>Conepatus</u> (2)		x		
<u>Lutra</u> (1)	x			
<u>Felis</u> (2)	x			
ARTIODACTYLA				
<u>Pudu</u> (1)				x
TOTALS	4	2	2	16

* endemic to the Patagonian Subregion

Species.-- There are 31 species of native mammals recorded in Malleco Province, Chile. These species may have entered Malleco from the north via the coastal lowlands and the Central Valley or via the Cordillera de los Andes; from the south via the Andes or the Cordillera de Nahuelbuta; or from the east via low passes in the Andes. Several species of mammals reach their southernmost limits, or their northernmost limits (at least in Chile) in Malleco Province. Seven species (23 per cent) of mammals that reach their northernmost limits in mountainous regions in Malleco are the following:

Dromiciops australis

Aconaemys fuscus

Notiomys valdivianus

Conepatus humboldti

Phyllotis micropus

Pudu pudu

Irenomys tarsalis

All are forest-dwelling species and are distributed in both the Andes and the Nahuelbuta, but are absent from the open areas in the Central Valley which separates these mountainous regions. However, the forested, hilly country in the Central Valley south of Malleco in Cautín and Valdivia provinces seems to be suitable habitat for the animals and possibly acts as a bridge between the two mountain ranges.

Four (13 per cent) mammals that reach their southernmost limits of distribution in Malleco are the following:

Marmosa elegans

Phyllotis darwini

Lasiurus borealis

Octodon bridgesi

Of these species, Marmosa elegans seemingly is restricted to matorral (shrub) type of vegetation (see Mann, 1955:159-160);

Phyllotis darwini shows geographic variation within the province in two widely diverse habitats; Octodon bridgesi appears rare, occurring in pockets in the Andes only; and Lasiurus borealis is volant. In addition, M. elegans and O. bridgesi reach their eastern limits in Malleco (i.e., seem barred from Argentina). Two species of Mallecan mammals which have an extensive range in Argentina and enter the eastern edges of Malleco via low passes are Eligmodontia typus and Euneomys chinchilloides. In all, 29 (94 per cent) of the 31 Mallecan species occur east of the Cordillera de los Andes in Argentina (Neuquen Province); thus it appears that the Andes in this region only slightly impedes the east-west movement of mammals.

Climatic factors may be of greater importance than physical factors in the dispersal of mammals in Malleco. Progressing southward through Malleco and across the 38th parallel, there is a transition from a warm, dry climate to a cool, moist one, while the Central Valley becomes progressively more hilly and forested with roble (Nothofagus obliqua) except where cleared by man. Mammals having their northermost limits in Malleco once may have had a wider distribution in the Central Valley before the clearing of the forested hills. At least Marmosa elegans may have extended its range southward into Malleco as the clearing of the original forest took place. Twenty (65 per cent) of the mammalian species which occur in Malleco occupy areas both to the north and south of this province, while 11 (35 per cent) which occur in Malleco are found either to the north or to the south. Based on

these figures, it would appear that climatic factors and, to a lesser extent, physiographic factors, operating principally on vegetation have influenced north-south distribution more than east-west distribution.

Geographic Variation

Of the 31 native mammalian species found in Malleco Province, 6 are monotypic and 25 polytypic. Three of the polytypic species demonstrate sufficient geographic variation to have more than one named subspecies in Malleco. Populations of 11 (44 per cent) of the Mallecan species belong to subspecies which occur in adjacent Chilean provinces both to the north and south (see Table 3). Eight (32 per cent) of the polytypic species belong to subspecies different from those in the provinces north of Malleco, and thus they are identified with more southern populations. Six (24 per cent) have different subspecies in provinces to the south, and thus are closely identified with more northern populations. Four of the latter 6 species are large, wide-ranging mammals while all of the former 8 species are small animals and more restricted in distribution.

Eight (32 per cent) species in the Andes of Malleco are sub-specifically distinguishable from more eastern populations of these species (in Neuquen, Argentina); on the other hand, 17 (68 per cent) are indistinguishable (Table 3). This relationship corresponds with previously mentioned species distribution in which there appears to be greater affinities between Malleco and

Table 3. Occurrence of subspecies of native Mallecan mammals in adjacent provinces.

Mallecan subspecies	Provinces only			Provinces to both		Province to the
	to the north	to the south	north and south	east	(Argentina)	
<u>Dromiciops australis australis</u>		x			x	
<u>Marmosa elegans soricina</u>	x					
<u>Myotis chiloensis chiloensis</u>		x				
<u>Histiotes montanus montanus</u>			x		x	
<u>Lasiurus borealis varius</u>			x		x	
<u>Lasiurus cinereus villosissimus</u>			x		x	
<u>Oryzomys longicaudatus philippi</u>		x				x
<u>Akodon longipilis apta</u>		x				
<u>Akodon olivaceus pincanus</u>		x				
<u>Notiomys macronyx vestitus</u>		x				
<u>Notiomys valdivianus valdivianus</u>			x			
<u>Eligmodontia typus typus</u>			x			x
<u>Phyllotis darwini darwini</u>	x					
<u>Irenomys tarsalis tarsalis</u>			x			x
<u>Euneomys chinchilloides petersoni</u>			x			x
<u>Lagidium viscacia sarae</u>		x				x
<u>Myocastor coypus coypus</u>	x					x
<u>Aconaemys fuscus fuscus</u>			x			x
<u>Ctenomys mauhinus brunneus</u>		x				x
<u>Dusicyon culpaeus culpaeus</u>	x					x
<u>Dusicyon griseus domeykoanus</u>	x					
<u>Galictis cuja cuja</u>			x			x
<u>Conepatus chinga mendosus</u>	x					x
<u>Felis concolor araucana</u>			x			x
<u>Felis guigna guigna</u>			x			x
TOTALS	6	8	11			17

Neuquen than between Malleco and provinces in Chile to the north and south.

There are but 3 species which show geographic variation within Malleco Province: (1) Phyllotis darwini darwini Waterhouse lives among rocks in the cleared lowlands in the Central Valley, whereas P. d. fulvescens Osgood occurs in the Araucaria forest of the Cordillera de Nahuelbuta; (2) Akodon longipilis apta Osgood is characteristic of the roble (Nothofagus obliqua) forests in the Nahuelbuta and is geographically separated by the open lands of the Central Valley from A. l. suffusus Thomas living in the semi-open ñirre (Nothofagus antarctica)-grassland of the Andes; (3) Conepatus chinga is separable into recognizable subspecies in Malleco, but I know little of the differences in habitat preferences of the Andean form, C. c. mendosus Thomas, and the Nahuelbuta form, C. c. chinga Molina.

A factor affecting subspeciation of these latter two species is the Central Valley which appears to bar gene flow between the populations of the species living in the Cordillera de Nahuelbuta and the Cordillera de los Andes. Also, the Central Valley, by virtue of its different climate and vegetation, has allowed for the development of a population of Phyllotis darwini distinct from that of the Nahuelbuta forests of Araucaria pine.

The fact that populations of 14 (56 per cent) of the species demonstrate geographic variation and are distinguishable either from those to the north or to the south of Malleco suggests that the area may be important in the speciation of mammals. This

distributional pattern seems to relate closely to the transitional characteristics of the vegetation, i.e., the northern xerophilic vegetation in the drier climate interdigitating with the southern mesic vegetation where greater rainfall occurs. In addition, the Río Bío Bío crosses Chile in Bío Bío and Concepción Provinces (averaging 50 kilometers north of Malleco) and may constitute a barrier to the movement of some fauna living in the coastal ranges and the Central Valley in South Central Chile, but not to movement of fauna living in the Andes.

Species Diversity

The Neotropical Region has nearly twice the number of mammalian species as has the Nearctic Subregion (see Hershkovitz, 1963). However, the Patagonian Subregion (of which the Chilean Province is a part) is the sector of Neotropica most impoverished in mammalian fauna. Malleco Province, as well as the entire western coast of the temperate part of Chile, has a much less diverse mammalian fauna than that of the Pacific Coast of North America which has a somewhat similar climate and topography. For example, the species density in Chile (including approximately 38° of latitude, from 18° S. to 55° S.) is 63 native, nonmarine mammals (Osgood, 1943:42-43) while in the western part (east to the crest of the Cascade Mountains) of the state of Washington (including 5° of latitude, from 45° N. to 49° N.), there are 64 native, non-marine mammals (Dalquest, 1948).

As a comparison, Malleco has 13 species of rodents and western Washington has 22. Differences in the distribution of these rodents

in the coastal ranges (Nahuelbuta in Malleco, Olympic Mountains in Washington), the "central valleys", and the "high ranges" (the Andes in Malleco; Cascade Mountains in Washington) are apparent in Table 4.

Factors which may have a bearing on the low species density of Chilean mammals are as follows:

(1) The temperate region of Neotropica (including Argentina and Chile) is not extensive and becomes progressively smaller southward due to the shape of the South American Continent.

(2) The entrance of many mammals into Chile was probably by way of low passes in the southern Andes since the higher northern Andes and the northern Atacaman Desert very likely formed effective barriers to many Recent silvan and pastoral species.

(3) Pleistocene glaciation on several occasions disrupted resident mammals, especially in southern Chile, and probably contributed to local extermination of many forms and prevented long-continued colonization of the area, especially from the south. The establishment of present day temperate habitats in southern Chile (including Malleco) is fairly recent, and thus probably there has not been enough time for extensive speciation.

(4) Chile, although not a true peninsula, is similar to one in being narrow because of the Andean barrier on one side and the Pacific Ocean on the other. In comparing the species density on each side of the Andean backbone of southern South America, the narrow space occupied by Chile on the west side supports only 63 species of native, nonmarine mammals while the broad space occupied

Table 4. Comparison of species densities of rodents in Malleco, Chile, and western Washington (east to the crest of the Cascade Mountains)

Location	Total number	Distribution of species		
		Coastal Mountains	Central Valleys	High Ranges
Malleco	13	8	3	13
Washington	22	16	14	17

by Argentina on the east side supports approximately 160 species (extracted from Cabrera, 1958-61). Perhaps the low density of mammalian species in Chile (and in Malleco Province) may be partly the result of the peninsula effect, as pointed out by Simpson (1964:73), who found species densities on North American peninsulas lower than those for non-peninsular areas of similar latitudes and reliefs.

Mammal-Habitat Relationships in the Andes

More species of mammals occur in the mountainous regions (Andes or Nahuelbuta) than in the Central Valley, and the Andean fauna is the richest, harboring at least five more kinds of mammals than live in the Central Valley or Nahuelbuta (see Table 5). My trapping records show that the most ubiquitous mammal in Malleco was Oryzomys longicaudatus and that the most restricted in distribution were Eligmodontia typus, Euneomys chinchilloides, and Octodon bridgesi.

Akodon olivaceus was common in grassy areas throughout Malleco. Akodon longipilis, the most abundant species in mountainous regions, preferred partially-cut Nothofagus forests or brush-grasslands to the virgin forests (see Population Studies).

Notiomys valdivianus, N. macronyx, Aconaemys fuscus, Octodon bridgesi, and Ctenomys maulinus were restricted to habitats with deep soils; of these only C. maulinus was found in the extensive open areas of the black sands of the high front range passes in the Andes (see Plate 5a).

Table 5. Summary of the occurrence* of small mammals in relation to habitat from trapping records

Species	Cordillera de los Andes				Cordillera de Nahuelbuta				Central Valley		
	Pine-lenga woods	Roble woods	Nirre-grassland	Volcanic sands	Pine-coihue woods	Roble woods	Southern forests	Roble woods	Pasture	Wasteland	Riparian growth
<u>Oryzomys longicaudatus</u>	x	x	x		x	x	x	x	x	x	x
<u>Akodon olivaceus</u>		x	x		x	x	x	x	x	x	x
<u>Phyllotis darwini</u>		x			x	x	x	x	x	x	x
<u>Akodon longipilis</u>	x	x	x		x	x	x				
<u>Dromiciops australis</u>	x	x	x		x	x	x				
<u>Phyllotis micropus</u>	x	x	x		x	x					
<u>Notiomys valdivianus</u>	x	x	x		x	x					
<u>Aconaemys fuscus</u>		x				x					
<u>Irenomys tarsalis</u>		x				x					
<u>Notiomys macronyx</u>	x	x	x								
<u>Ctenomys maulinus</u>			x	x							
<u>Octodon bridgesi</u>		x									
<u>Eligmodontia typus</u>			x								
<u>Euneomys chinchilloides</u>			x								

* I Abundant

x Present, but not abundant

To study the effect of altitude and vegetation on mammalian distribution, mammals were investigated along a transect bordering the road which winds from the Paso Pino Hachado on the Andean slopes west of the continental divide downward to the floor of the valley of the Río Bío Bío. The treeless grasslands and rocky soils at the 1,830 meter pass give way to ñirre (Nothofagus antarctica) or cane (Chusquea sp.) thickets and bunch grass at lower elevations. At approximately 1,650 meters, the soils become deep and sandy. Below this, deep ravines are lined with species of Berberis and Ribes and an occasional grove of Araucarian pine breaks up the rolling landscape.

The investigation was carried out for two nights, using 30 snap traps at each of 7 localities separated by altitudinal intervals of 90 meters (see Table 6). Eighty-three rodents (9 species) were trapped in 480 trap-nights. In general, the rodents were well-distributed, although somewhat less numerous at the highest and lowest stations. I have no explanation for the lack of catches at the 1,650 meter trapping-station. Ctenomys maulinus was taken in underground tunnel-sets of "Macabee" traps at all localities studied, but is not figured into the totals since its "trap-night" density relative to other mammals taken in snap traps, is not suitable for comparison.

Based on the snap-trapping records, Akodon longipilis was the most widely distributed and most abundant species, totaling 52 per cent of the catch. This animal was captured in grass or close to clumps of ñirre or cane. Most Phyllotis micropus and Oryzomys longicaudatus taken were trapped at the lower elevations.

Table 6. Distribution and numbers of small mammals trapped on Andean slopes west of Paso Pino Hachado, Malleco Province, Chile

Species	Kilometers west of Paso Pino Hachado								Per- cent of catch
	1.7	3.5	6.0	9.4	15.2	16.7	17.6	20.7	
	Elevation in meters								
	1830	1740	1650	1555	1460	1370	1280	1190	
<u>Akodon longipilis</u>	3	6	-	8	14	9	3	-	52.0
<u>Phyllotis micropus</u>	1	-	-	-	2	2	2	-	8.5
<u>Oryzomys longicaudatus</u>	1	-	-	-	-	2	2	-	6.0
<u>Notiomys valdivianus</u>	1	5	-	-	2	-	-	-	9.6
<u>Euneomys chinchilloides</u>	-	3	-	1	-	-	-	-	4.7
<u>Notiomys macronyx</u>	-	-	-	2	2	-	-	-	4.7
<u>Dromiciops australis</u>	-	-	-	-	1	-	-	-	1.2
<u>Eligmodontia typus</u>	-	-	-	-	-	-	3	2	6.0
<u>Akodon olivaceus</u>	-	-	-	-	-	-	3	3	7.3
TOTALS	6	14	0	11	21	13	13	5	
<u>Ctenomys maulinus*</u>	2	2	1	2	3	1	1	2	

* Taken in underground tunnel sets of Macabee traps

Notiomys valdivianus and N. macronyx, burrowers of similar habits, were caught in the same trapline at the 1,460 meter elevation. Euneomys chinchilloides seemingly preferred the higher elevations. Eligmodontia typus and Akodon olivaceus were found at lower elevations where soils generally were dry; Eligmodontia was taken in a sandy arroyo at 1,280 meters and on a dry, rocky hillock at 1,190 meters; Akodon olivaceus was taken on bare ground under the shrubbery of Colletia sp., in the broad flat lands of the river valley; and the Dromiciops australis was trapped in luxuriant vegetation near a spring.

Population Studies

In the course of field work, grids of traps were set in measured plots in various habitats in Malleco to determine (1) the species of mammals present, (2) the relative abundance of these mammals, and (3) the preferred habitats of the observed species. Either Museum Special snap traps or live traps made of wood were used; one trap was placed at each station with stations set 6.4 meters apart (a square 6.4 meters, or 20.9 feet, on each side equals .004 hectares or .01 acres). Densities of the sampled mammalian populations were calculated using the trap-removal method (Hayne, 1949) when snap traps only were employed, and by the Lincoln Index method (Lincoln, 1930) when live traps were used initially, followed by snap traps. By using live traps to catch mammals for marking, releasing, and recapturing, data on movements of individuals also were obtained (see Species Accounts). A summary of the findings for the 19 plots studied follows.

Cordillera de los Andes

Plot 1.-- An uncut coihue (Nothofagus dombeyi) forest, 4 kilometers west of Baños Río Blanco, 1050 meters elevation. In 5 days (28 February to 4 March) 5 Akodon longipilis were captured in a grid of 30 live trap stations in a 0.12 hectare quadrat. All 5 animals were caught two or more times in live traps (set for 3 days), and released and recaptured in the first 24 hours in snap traps set terminally for 48 hours. In similar studies in other Andean areas, all Akodon longipilis captured also were taken in the first two days of trapping. This suggests that all trappable individuals of this species in a given area may be accounted for within 48 hours. In plot 1, the trap-removal method of Hayne and the Lincoln Index method to determine rodent density are unsuitable; the former method may show too high an estimate, while the failure to take unmarked individuals in the snap-trapping period rules out the use of the latter method. The trapping results suggest that the entire population was caught. Therefore, the total catch of 5 animals is the basis for making the estimate that this area supported 41 animals per hectare.

Plot 2.-- A coihue forest area (about 600 meters from Plot 1) from which the largest trees had been removed permitting the growth of saplings and associated shrubs, such as Berberis sp. The catch in a 0.12 hectare quadrat containing a grid of 30 snap traps was 7 Akodon longipilis. All were taken in the first 2 days of a 3-day trapping period (28 February to 2 March). The estimated number of animals, based on the trap-removal method was 123

animals per hectare. However, if all resident mice had been trapped in the first 2 days (as suggested in Plot 1) then the estimate based on Hayne's method may be as much as twice the actual population number. If the population estimate is based on the total catch (as in Plot 1), the density is calculated at 58 animals per hectare. The true density per hectare may be between the two estimates of 58 and 123.

Plot 3.-- A wooded area having large Araucarian pine (Araucaria araucana), a shrub cover composed mostly of cane (Chusquea sp.), and a ground cover of litter and debris, 17 kilometers south of Lonquimay, 1340 meters elevation. In February (9-11), 7 Akodon longipilis and one Notiomys macronyx were snap-trapped. The estimated density of A. longipilis was 113 animals per hectare calculated using the trap-removal method of Hayne. However, as suggested for Akodon longipilis in the coihue forest in Plot 1, the 7 animals taken in 2 days may represent all of the animals living in the area of the grid. An estimate based on this total catch would be 50 animals per hectare. The actual number of animals per hectare is probably between 50 and 113. No estimate was made on the number of Notiomys macronyx present because of the low catch.

Plot 4.-- An open ñirre (Nothofagus antarctica)-grassland area 500 meters from the forested area of Plot 3. A catch of 9 Akodon longipilis in the first 2 days of a 3-day snap-trapping period in February (9-11) indicated the density estimate per hectare based on the total catch would be 64 animals.

Plot 5.-- An area of low (to 1 meter), widely-spaced ñirre shrubs on the grassy banks of the Río Bío Bío where it flows

from Lago Icalma, 1,190 meters elevation. A catch of 4 Akodon longipilis, 1 female A. olivaceus, and 1 male Mus musculus was made in February (12,13) in a 0.06 hectare plot (a grid of 16 traps). Since A. longipilis was not taken on the third day of trapping, its population can be estimated, based on the total catch, like those in Plots 1-4, and would be 62 animals per hectare. No estimate of density was made for the Mus or A. olivaceus.

Plot 6.-- An area of tall (to 4 meters) ñirre about 400 meters from the site of Plot 5 on the Río Bío Bío. A catch made during the same trapping period as for Plot 5 consisted of 1 male Akodon longipilis, 1 female A. olivaceus, and 1 female Notiomys macronyx. Due to the low numbers caught no estimate of density was made for these species.

Cordillera de Nahuelbuta

Plot 7.-- An Araucarian pine forest in the Parque Nacional containing a dense cover of shrubs of Pernettya sp., 27 kilometers west-northwest of Angol, 1,170 meters elevation. A 0.14 hectare plot with a grid of 35 snap traps produced in 2 days in February (18,19) a single Akodon longipilis.

Plot 8.-- A partly cut over roble (Nothofagus obliqua) woods in the Parque Nacional about 300 meters from Plot 7. No animals were taken in the 0.14 hectare plot, but in a similar habitat near the periphery of the study area, Dromiciops australis, Akodon longipilis, and A. olivaceus were trapped.

Plot 9.-- A meadow sparsely covered with Berberis spp., located near forested areas of coihue and roble in the Parque Nacional.

No animals were taken in February (18,19) in a grid of 50 traps in a 0.2 hectare plot, but Akodon olivaceus was trapped near the periphery of the grid.

Plot 10.-- A coihue woods adjacent to Plot 9 in the Parque Nacional, having Pernettya sp. as a shrub cover. No animals were taken in November (17,18) in a 0.2 hectare plot of 50 snap trap stations.

Plot 11. A roble woods of widely spaced, gnarled, old trees in the Parque Nacional about 1 kilometer from Plot 9. A southern house wren (Troglodytes musculus) was the only animal taken in November (17,18) in the 50 traps in the 0.2 hectare quadrat. Traps placed nearby and in similar habitat caught Aconaemys fuscus and Akodon longipilis.

Plot 12.-- "Parque Turismo", a forested area having a variety of southern tree species at 0.5 kilometers west of Purén, 460 meters elevation. A catch in January (22,23) of 1 Akodon longipilis and 1 ground bird (Scelochilus rubescens) was made in a 0.14 hectare quadrat of 36 snap traps. No density estimates were made. Animals taken nearby in similar habitats were Dromiciops australis and Akodon olivaceus.

Central Valley

Plot 13.-- A grassy area having widely spaced shrubs, such as Sophora sp., rose, and thickets of blackberry on the banks of the Río Malleco flowing through the Fundo El Vergel, 5 kilometers south of Angol, 76 meters elevation. A 4-day catch in January (29,30, and 31) and February (1) of 23 Oryzomys longicaudatus and 8

Akodon olivaceus was made on a 0.3 hectare plot with 75 snap traps.

During the first 3 days of trapping, 14 Oryzomys longicaudatus were taken: 6 on the first day, 6 on the second, and 2 on the third. On the fourth day of trapping, 9 were taken. The catch (14 individuals) for the first 3 days only was used to calculate the population density by the trap-removal method of Hayne (1949) which gave an estimate of 60 animals per hectare. The high catch on the fourth day suggests a rapid influx of rice rats into the area and the likelihood that there is keen competition, at least for space, among members of this group of rodents. Many catches on the fourth day were young animals.

The density of Akodon olivaceus was estimated from the total catch of 8 animals using the trap-removal method, at 30 per hectare. This estimated population density is about one-half that of O. longicaudatus. I found this same ratio between the two species in other trapping situations of mixed grass and blackberry cover throughout the Central Valley; O. longicaudatus favors the shrub cover and A. olivaceus the grass. Consequently, wherever there is ample cover, especially of blackberry, O. longicaudatus outnumbers A. olivaceus, the former occupying the shrubs and ecotone between the shrubs and grassy areas, and the latter staying in the grass away from the thickets.

Plot 14.-- Near Plot 13 in grass and blackberry thickets adjacent to the Río Malleco, on Fundo El Vergel. A 3-day catch in winter (June 23-25) in the 0.3 hectare plot produced 36 Oryzomys longicaudatus and 27 Akodon olivaceus. On the third day of trapping, 23 O. longicaudatus were caught, 10 more than the total taken

on the first and second days of trapping; probably many of these were immigrants. Also, many of the catches on the third day were young animals. The density of resident O. longicaudatus based on the catches in the first two days, is estimated by the trap-removal method as 69 animals per hectare. This density in winter is about the same as the density (60) in summer (see Plot 13). The density of resident A. olivaceus based on the Hayne trap-removal method is estimated to be 115 animals per hectare. As noted during the summer trapping in Plot 13, A. olivaceus in winter were also taken chiefly in grassy areas and O. longicaudatus were mostly in brush.

Plot 15.-- A 0.12 hectare marshy area, part of an oxbow lake formed by the Río Malleco at El Vergel, containing a dense growth of rush (Scirpus sp.) and surrounded by blackberry. A 9-day live-trapping period in April in which 5 Oryzomys longicaudatus, 19 Akodon olivaceus, and 5 Rattus rattus were caught, marked, and released was followed by a 3-day snap-trapping period (April 23-25). In the snap-trapping period, there was a catch of 14 O. longicaudatus (including 1 of the 5 previously marked animals), 14 A. olivaceus (including 2 of the previously-marked individuals).

The density of O. longicaudatus was determined by means of the Lincoln Index to be 173 animals per hectare. No estimate was made on its density by the trap-removal method of Hayne, since 7 animals were caught on each of the first 2 days of trapping and only 2 on the last day. The density of A. olivaceus was estimated by the Lincoln Index to be at 234 animals per hectare. The density of R. rattus was estimated by the Lincoln Index method as 41 individuals per hectare.

The trapping sites of the 3 species caught in this plot of mixed marsh vegetation and blackberry brush were separated into two sectors. The 5 R. rattus occupied about one-half the plot (mostly the wet area of rushes close to the cornfield) and the O. longicaudatus and A. olivaceus were taken together in overlapping ranges in the other half of the plot (drier area with mostly mixed grass and blackberry). For movement and range data for these 3 species, see ACCOUNTS OF SPECIES.

Plot 16.-- A cherry orchard at El Vergel. A catch in November (19-21) in a 0.19 hectare quadrat (a grid of 48 traps) of 6 Akodon olivaceus indicated a density of 36 animals per hectare by the trap-removal method.

Plot 17.-- An open, grassy hillside at El Vergel (Los Alpes section, 152 meters elevation), with Monterrey pine seedlings as high as 20 centimeters and spaced about $1\frac{1}{2}$ meters apart. A catch in May (19-24) of 4 Oryzomys longicaudatus, 11 Akodon olivaceus, and 1 male Phyllotis darwini was made in a 0.19 hectare quadrat. Using the trap-removal method, the density per hectare of O. longicaudatus was estimated to be 23 animals and of A. olivaceus to be 44 animals. The absence of brushy cover (as in Plot 13) may be the reason for the low number of O. longicaudatus present.

Plot 18.-- A steep, grassy slope of about 30° on the Fundo Itraque approximately 5 kilometers south of Angol, 137 meters elevation. Berberis sp., Sophora sp., Lithraea caustica, Peumus boldus, Hypericum perforatum, and Plantago sp. were prominent plants in the grassy parts; a rocky cliff formed a barrier on the rim on the hill. A catch in November (25-27) of 6 Akodon olivaceus was made in a 0.32 hectare plot.

Using the trap-removal method, the density was determined to be 22 animals per hectare.

Plot 19.-- A hillside dominated by olivillo (Aextoxicon punctatum), but also having roble (Nothofagus obliqua), lingue (Persea lingue), and maqui (Aristotelia chilensis), 10 kilometers west of Galvarino, 61 meters elevation. A catch in December (5,6) of 2 Akodon longipilis, 1 A. olivaceus, and 1 Oryzomys longicaudatus was made in a 0.12 hectare quadrat of 30 trapping stations. Density estimates were not made.

Summary of Plot Data

Rodents taken in 6 Andean plots were: Akodon longipilis, Akodon olivaceus, Notiomys macronyx, and Mus musculus. Population density estimates per hectare for A. longipilis were 41 individuals in an uncut coihue forest (Plot 1); 58 (estimated to be between 58 and 123) individuals in a partly-cut coihue forest (Plot 2); 50 (estimated between 50 and 113) individuals in an Araucarian pine forest with Chusquea undergrowth (Plot 3); and 64 (estimated between 64 and 176) individuals in open firre-grassland (Plot 4). Due to low numbers taken, no density estimates were made on the other rodents. It appears that Akodon longipilis is the principal trappable rodent in the Andean area. It was trapped in most habitats, but was most numerous in brushy, cutover areas.

Only A. longipilis was caught in the 6 plots (nos. 7-12) in the Cordillera de Nahuelbuta, although 3 other species were taken nearby. The small catch allowed for no population estimates.

The rodents trapped in plots in the Central Valley were: Oryzomys longicaudatus, Akodon olivaceus, Akodon longipilis, and Rattus rattus. Akodon longipilis was taken only in a southern forest situation (Plot 19) dissimilar to the open, agricultural land generally found in the Central Valley. Oryzomys longicaudatus and A. olivaceus were taken together where grasslands were surrounded by blackberry thickets (Plots 13, 14) while a marshy area (Plot 15) surrounded in part by blackberry bushes supported the greatest density of these two rodents (see Table 7). The specific trap sites in Plots 13 and 14 showed that O. longicaudatus has a preference for brushy areas and Akodon olivaceus for grassy situations. Akodon olivaceus appeared able to live in either brushy or grassy situations, whereas O. longicaudatus was absent from grassy situations (Plots 16 and 18) with no nearby brush.

Conservation

Soil, water, forests, grasses, and wildlife are renewable resources which, with wise management, may be both used and conserved. However, these resources are diminishing rapidly in Malleco. In the Central Valley, poor choice of land for agriculture, with subsequent clearing for plowing and ultimate failure of crops has produced erosion-marked hills which were once covered with robble (Nothofagus obliqua) forests (see Plate 3a). Along with the loss of trees and water-holding capacity of the soil is the loss of cover and food to sustain wildlife.

In the mountainous areas of Malleco, forests of the unique and beautiful Araucarian pine (Araucaria araucana) and the majestic

Table 7. Estimated densities per hectare of small mammals taken in the Central Valley based on quadrat studies

Plot no.	Habitat	Date	<u>Oryzomys</u> <u>longicaudatus</u>	<u>Akodon</u> <u>olivaceus</u>
13	grass & brush	Jan. 30	60	30
14	" "	June 24	69	115
15	marsh	April 24	173	234
16	orchard	Nov. 20	0	36
17	grass	May 22	23	44
18	grass, some brush	Nov. 26	0	22

coihue (Nothofagus dombeyi) are being removed by lumbering practices in which there is little attempt to cut selectively or to replant trees. Uncontrolled fire often burns the uncut trees and leaves areas unsuitable for many kinds of wildlife. As the forests disappear, the native forest animals, such as the Octodont rodents that live only under these great trees, also are disappearing. The preservation of these interesting rodents may be of less interest to the campesino attempting to eek a meager living from the land or to the lumberman than to the student of natural history, but at least the large lumbering firms exploiting the forests of Malleco should consider the future generations of Chileans and try to preserve a few wilderness tracts where one might glimpse a fleeting form of a pudu, or find the track of a puma, or hear the hollow clack of the Magellanic woodpecker resounding like a woodsman's ax in the forest.

The constant hunting pressure on the chilla and culpeo (Dusicyon spp.) probably has contributed to the increase of the European rabbit (Oryctolagus cuniculus) and European hare (Lepus europaeus), to the detriment of crops. The otter (Lutra provocax) has disappeared from all the riverways in its former range in Malleco, perhaps within the past five years. Also, the Chilean pigeon, "torcaza" (Columba araucana), a noted game bird, is all but extinct. The huemul (Hippocamelus bisulcus) is extirpated from its former range in the Malleco Andes and the guanaco (Lama guanicae) is gone from its probable former range throughout the Province.

There is some evidence that the trend is changing. In a recent article by Buchinger (1965:37), which reviewed the conservation

problem in Latin America, Chile appeared to be one of the most active countries in Latin America in developing a national park system. In Chile, at least 19 parks are proposed with the program orientation emphasizing scientific research and tourism. Malleco Province has three national parks: Parque Nacional de Nahuelbuta (approximately 1,200 meters elevation), Parque Nacional de Tolhuaca (25 kilometers north of Curacautín, 1,050 meters elevation), and Parque Turismo (15 kilometers east of Purén, 460 meters elevation). Each of the former two parks has a resident forest ranger or administrator. In addition, a proposed dam on the Río Malleco at Collipulli will create a lake for agricultural irrigation and recreation.

To make a preliminary inquiry about hunting and the use of wildlife by people living in Malleco, questionnaires with stamped return envelopes included, were mailed to 115 members of the Hunting Club of Angol on 30 November 1961. An additional 10 persons met during several field trips in mountain areas were interrogated, using the questionnaire as a guide. I wished to learn which animals were hunted most, of what commercial value was the kill, and what were the impressions of the hunters regarding the change in abundance of certain game animals. Only 19 questionnaires were returned by mail, an insufficient number to give a good cross section of attitudes and local philosophies with respect to wildlife, but some of the data obtained were interesting.

The participants classified themselves in the following groups: 1 student, 1 doctor, 1 service man, 1 city-dwelling farmer, 2 teachers, 4 merchants, 4 supervisors of laborers, 5 laborers, and 11 rural campesinos. The city people hunted an average of 5.2 hours

a day, 3.9 days a month, whereas the country people averaged 6.7 hours a day, and 4.8 days a month hunting. Twelve of the 19 urban people owned double-barreled shotguns, commonly .16 ga. (made during the years 1930, 1946, 1950, 1954, 1960), whereas of the rural folks, 1 had a rifle, and another had a muzzle-loading shotgun. (It was common in the country to see muzzle-loaders.) Snares were most commonly used by country people to secure game, and dogs and steel traps were also used. Of the city people, 4 supervisors of laborers spent the most money, a total of \$30.00 (U. S. equivalent) per month on ammunition, while the 10 farmers spent the next highest total of \$3.90 per month.

None of the rural campesinos hunted solely for sport, but sold or otherwise used their catch, whereas 14 of the city people hunted for sport only; none of the country people had hunting permits but 11 of the city-dwelling hunters had them. Nine of the townspeople had dogs which were used exclusively for hunting, whereas all the rural folks had dogs but none used them solely for hunting.

None of the city people sold the meat of animals hunted, but farmers sold meat of the rabbit for \$0.25 (U. S. equivalent) and the meat of the hare for \$0.50. Hides of nutria (Myocastor coypus) and culpeo (Dusicyon culpaeus) were sold on occasion by farmers. (Currently, there is no bounty on the culpeo.) Skins of hares were sold by farmers to merchants in towns for \$0.15 and \$0.25 each; rabbit skins sold for \$0.09 and \$0.10 each.

Some birds sought by hunters in Chile are not known in the United States as game animals. The following list includes the total catch in the 3 months prior to distribution of the questionnaire (disregarding hunting season) and is followed by the number (in parentheses)

of hunters who reported making kills: Chilean robins (Turdus falklandii), 404 (10); eared doves (Zenaidura auriculata), 336 (9); parrots (Enicognathus leptorhynchus), 160 (3); tinamous (Nothoprocta perdicaria), 205 (10); introduced California quail (Lophortyx californica), 15 (3); snipe (Capella paraquaiiae), 20 (1); and various ducks, 40 (5). The following mammals were taken: European hare, 75 (7); European rabbit 246 (5); culpeo, 5 (2).

Observations and impressions of hunters indicated the following changes in abundance of certain animals during the past 15 years. Everyone agreed that the Chilean pigeon was nearly extirpated; 2 people reported a decrease by 50 per cent in the dove and 5 reported an increase of from 1 to 2 times; for quail, between 50 per cent decrease and 2 times increase was reported; all agreed on a decrease of from 50 to 25 per cent in parrots; a decrease of from 50 to 25 per cent was reported for snipe; an increase of from 1 to 3 times was reported for the tinamou; the red-breasted meadowlark was reported to have increased 3 times; the European rabbit was reported to have increased from 2 to 5 times; for European hare a decrease of from 50 to 25 per cent was reported by 9 hunters, while 3 reported an increase of up to 2 times; and 7 reported an increase in the culpeo.

From the preceeding statements it appears that the game sought by Chilean hunters does not resemble the big game such as bear or moose of North American hunters. The largest wild animal in Malleco is the small puma weighing about 25 kilograms. The pudu, a potential game animal, is too rare to be sought actively. Rabbits and hares are the only game mammals in Malleco which can be taken in

large numbers. The tinamou is the game bird most actively sought, with robins, doves, quail, and parrots taken in lesser numbers. Lakes harboring duck in Malleco are relatively inaccessible to the game hunter.

The tinamou will probably continue to be the favorite game species. Agricultural practices create waste areas adjacent to croplands, providing cover near a food supply for rabbits and hares, thus helping maintain high populations of these game animals.

The problem of conservation of resources is a matter of education and law enforcement, the goal of which could be championed by the popular "Club de Caza" in many of the towns throughout Malleco.

CHECK-LIST OF THE RECENT MAMMALS

The following is a list of 39 kinds (species and subspecies) of wild mammals belonging to 36 species, 28 genera of 14 families of 6 orders living today in Malleco Province, Chile. These include 31 native species and 5 introduced species (each marked with an asterisk). Six other species that have not been reported from Malleco but may occur there are listed following the ACCOUNTS OF SPECIES.

Order MARSUPIALIA---marsupials

Family Didelphidae---opossums

<u>Dromiciops australis australis</u> (Philippi)	monito del monte
<u>Marmosa elegans soricina</u> (Philippi)	mouse opossum; llaca

Order CHIROPTERA---bats

Family Vespertilionidae---common bats

<u>Myotis chiloensis chiloensis</u> (Waterhouse)	Chiloé bat; murciélago oreja de ratón
<u>Histiotus montanus montanus</u> (Philippi and Landbeck)	murciélago orejudo
<u>Lasiurus borealis varius</u> (Poeppig)	red bat; murciélago colorado
<u>Lasiurus cinereus villosissimus</u> (Geoffroy)	hoary bat; murciélago gris

Family Molossidae---free-tailed bats

<u>Tadarida brasiliensis</u> (Geoffroy)	free-tailed bat; murciélago común
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Order LAGOMORPHA---hares, rabbits and pikas

Family Leporidae---hares and rabbits

<u>Lepus europaeus</u> Linnaeus*	European hare; liebre
<u>Oryctolagus cuniculus</u> Linnaeus*	European rabbit; conejo

Order RODENTIA---rodents

Family Cricetidae---native rats and mice

<u>Oryzomys longicaudatus philippi</u> (Landbeck)	lauchita de los espinos
<u>Akodon longipilis apta</u> Osgood	ratoncito lanoso
<u>Akodon longipilis suffusus</u> Thomas	ratoncito lanoso
<u>Akodon olivaceus pencanus</u> (Philippi)	ratoncito olivaceo
<u>Notiomys macronyx vestitus</u> (Thomas)	mole mouse; ratón topo, tunduco
<u>Notiomys valdivianus valdivianus</u> (Philippi)	mole mouse; ratón topo de la selva, tunduco
<u>Eligmodontia typus typus</u> Cuvier	laucha sedosa
<u>Phyllotis darwini darwini</u> Waterhouse	leaf-eared mouse; lauchón orejudo
<u>Phyllotis darwini fulvescens</u> Osgood	leaf-eared mouse; lauchón orejudo
<u>Phyllotis micropus</u> Waterhouse	lauchón de pie chico
<u>Irenomys tarsalis tarsalis</u> (Philippi)	laucha arborea
<u>Euneomys chinchilloides petersoni</u> J.A. Allen	rata sedosa

Family Muridae---introduced rats and mice

<u>Mus musculus</u> Linnaeus*	laucha doméstica
<u>Rattus rattus</u> (Linnaeus)*	black rat; rata de las casas, ratón
<u>Rattus norvegicus</u> (Berkenhout)*	Norway rat; ratón, rata de acequias

Family Chinchillidae---vizcacha and chinchilla

Lagidium viscacia sarae mountain vizcacha; vizcacha
Thomas and St. Leger

Family Capromyidae---nutrias

Myocastor coypus coypus (Molina) coipu, coypu, coipo

Family Octodontidae---degus

Octodon bridgesi Waterhouse Bridges' octodon; degú de
los matorrales

Aconaemys fuscus fuscus Waterhouse rock rat; tunduco

Family Ctenomyidae---tucu tucu

Ctenomys maulinus brunneus Osgood tunduco, tuco-tuco del Maule

Order CARNIVORA---carnivores

Family Canidae---wolves, coyotes and foxes

Dusicyon culpaeus culpaeus (Molina) Andean wolf; culpeo

Dusicyon griseus domeykoanus pampa fox; chilla
(Philippi)

Family Mustelidae---weasels, skunks and allies

Galictis cuja cuja (Molina) grison; quique, hurón

Conepatus chinga chinga (Molina) Chilean skunk; chingue común

Conepatus chinga mendosus (Molina) Chilean skunk; chingue común

Conepatus humboldti Thomas Patagonian skunk; chingue de
Magallanes

Lutra provocax Thomas otter; huillín

Family Felidae---cats

Felis concolor araucana Osgood Chilean forest puma; puma, león

Felis guigna guigna Molina guíña, gato montéz

Order ARTIODACTYLA---even-toed ungulates

Family Cervidae---deer

Pudu pudu (Molina) pudu, venado

ACCOUNTS OF SPECIES

Rata, Monito del monte

Dromiciops australis australis (F. Philippi)

Distribution.-- Forested areas in the Cordillera de la Nahuelbuta and Cordillera de los Andes, above 360 meters in elevation and below tree line.

Remarks.-- Osgood (1943:48) considered this subspecies restricted to the "Valdivian Forest District" from the higher parts of the Cordillera de la Nahuelbuta west to, and beyond, the Argentine-Chilean border in the Andes. Moist, forested areas, at least in Malleco Province, appear to be the preferred habitat of this small opossum, although it is not confined to this habitat. This marsupial was found in Araucaria-Nothofagus dombeyi forests, N. obliqua woods, N. obliqua-N. dombeyi forests, as well as in localized wooded areas having evergreens, such as Peumus boldus, Guevina avellana, Persea lingue, Myrceugenia spp., and Drimys winteri, which are characteristic of southern forest. Cane (Chusquea sp.) thickets in these forested areas are likely places to trap D. australis.

Adults caught in the Cordillera de Nahuelbuta average slightly larger in several measurements, especially in length of tail vertebrae and in condylobasal length, but somewhat smaller in length of head and body, than specimens of similar age taken in the Cordillera de los Andes (Table 8). There are no significant color differences between skins from these two mountainous areas.

Table 8. Average and extreme measurements of Dromiciops australis from Malleco Province, Chile

	Cordillera de Nahuelbuta (6 adults)	Cordillera de los Andes (17-20 adults)
Length of head and body	101.3 (96-109)	107.9 (83-113)
Length of tail vertebrae	107.7 (101-116)	99.7 (90-115)
Length of hind foot	19.7 (19-20)	19.3 (16-20)
Height of ear from notch	19.0 (18-20)	18.7 (17-20)
Condylbasal length	26.4 (25.5-27.9)	25.7 (23.6-27.5)
Zygomatic breadth	15.6 (14.6-16.1)	15.6 (14.4-16.4)
Mastoid breadth	12.1 (11.7-12.6)	12.6 (11.5-12.5)
Least interorbital breadth	4.8 (4.5-4.9)	4.9 (4.7-5.1)
Weight	24.1 (21.3-28.1)	22.3 (16.7-31.4)

Based on the study of 27 skulls, and following Tate (1933) with modification, 22 were judged to be adults (M_4 present, P_3 at least as high as P_2); 3 were young adults (M_4 unerupted, P_3 at least emerging); and 2 were juveniles (M_4 unerupted, M_3 just emerging, P_3 deciduous). Of the total trapped, one-third were females; one taken in summer (21 December 1960) had in its marsupium 2 young measuring 8.0 mm and 8.2 mm in length.

I found no nests in trees as reported by Mann (1958:209-213) in his study of the life history of D. australis, but I did find a nest in a thicket of cane (Chusquea sp.) which had been bent to the ground by a fallen tree. One animal was trapped in front of a burrow which opened onto a dry slope next to a stump of an old roble (Nothofagus obliqua). The burrow averaged 10 cm in diameter and extended for 76 cm sloping downward slightly before dividing into two separate smaller tunnels of undetermined length. No nests were found.

Mann (1955:159-160) hypothesized that when the southern forest receded post-glacially and was replaced by the bush-like "matorral" which was inhabited by Marmosa elegans, there must have been a consequent decrease in abundance of the previously established D. australis. My trapping results indicated that the latter marsupial may be more abundant in Malleco now than when Osgood and Sanborn traveled there in 1923-24 and in 1939, and, based on all reports which I received, there is more open land in the area today than previously. I trapped no Marmosa elegans in Malleco whereas 33 D. australis were obtained. Dromiciops were trapped in association with other small mammals, such as Oryzomys longicaudatus,

Akodon longipilis, A. olivaceus, Notiomys macronyx, N. valdivianus, Phyllotis micropus, Irenomys tarsalis, and Octodon bridgesi. Near Troyo, two marsupials were captured on the third day of trapping on a steep, rocky, moist slope among the roots of a cedar tree in traps which on the first two days caught only Oryzomys longicaudatus. A similar sequence was obtained at 15.2 kilometers west of Paso Pino Hachado and 19 kilometers south of Lonquimay where two A. longipilis were trapped before D. australis was finally snared. Perhaps D. australis was shy of foreign objects placed within its home range, or perhaps the other animals were more aggressive in their search for food.

Mann (op.cit.:163) found that these marsupials hibernate when cold temperatures prevail and food is scant. Animals which I captured and kept alive in cages and exposed to the nighttime cold temperatures in the same region in which they were trapped, would attain a flexed position (see Plate 7a). If early morning temperatures dropped to 4.5°C or lower, the animals' bodies became stiff, and quite cool to the touch. After being placed in my shirt pocket, they emerged from their torpor, finally crawling out of my pocket and becoming quite active.

I did not notice a disagreeable odor when the live animals were disturbed by handling as reported by Mann (op.cit.:166), nor did handling livetrapped animals provoke aggressive behavior. At night, or when left unmolested for a period of time, some individuals made soft buzzing noises.

Specimens trapped with Museum Special traps often showed a

great capacity for survival by not being killed instantly by the snap traps. Each of three animals with damaged backs lived for two days before being sacrificed. Another animal withstood at least 30 hours with its head and neck held in a trap. The same animal also survived an ocean trip back to Michigan.

Cabrera and Yepes (1940:46) reported interesting and fearful superstitions which natives have concerning this marsupial, but I found that in Malleco Province, it is generally unknown to local residents. Those who did know it were unafraid of it. "Rata" (cf: "laucha", mouse; and "ratón", rat) was the name used locally for the animal.

Three live animals were brought via ship to the United States in the confines of a small, covered basket. Food given these animals during the voyage consisted of oatmeal, potato, powdered milk mixed with canned peach syrup (the animals either lapped this mixture from a dish or were fed the concoction with an eye dropper), plum, pear, watermelon, applesauce, blackberry, and hamburger. In nature, these animals prefer larvae of Arthropods and eat whenever food is available (Mann, 1955:163). After arriving in Michigan in late July, one of the animals weighing 26.5 grams was given known quantities of ham and weighed each day for 5 days. It ate an average of 4.1 grams of ham daily and consumed an average of 6 cc of water. Its weight increased by 3 grams during the 5 days.

Specimens examined.-- Total, 33, from: 27 Km. NW Angol, 1110 m., 2; 27 Km. NW Angol, 1170 m., 1; 9 Km. W Angol, 685 m., 3; 7 Km. W Angol, 534 m., 1; 13 Km. SE Contulmo, 427 m., 1; 14 Km. E Jauja,

610 m., 3; Laguna Malleco, 1050 m., 1; 17 Km. N Curacautín, 1035 m., 1; Río Ranquil, 1370 m., 1; 4 Km. NE Troyo, 1370 m., 1; Troyo, 980 m., 4; 20 Km. N Lonquimay, 915 m., 2; 10.3 Km. W Lonquimay, 1520 m., 1; 4 Km. W Baños Río Blanco, 980 m., 4; 19 Km. S Lonquimay, 1340 m., 2; 15.2 Km. W Paso Pino Hachado, 1460 m., 1; 10 Km. NW Selva Oscura, 305 m., 1. Other records: Curacautín, 2 (Wolffsohn and Porter, 1908, in Osgood, 1943:49); Río Colorado 915 m., 6; Sierra Nahuelbuta, 4; Victoria, 1 (Osgood, 1943:49-50).

Mouse opossum; Llaca

Marmosa elegans soricina (Philippi)

Distribution.-- Its range, as listed by Cabrera (1961:29-30), includes Malleco.

Remarks.-- Mann (1955:159-160) reported that the mouse opossum inhabits "mattoral" vegetation. I neither captured nor received reports of this mouse opossum in Malleco in 1960, 1961, or 1962. A specimen obtained by D. S. Bullock in Angol (or vicinity) on 29 June 1937 (winter) compares favorably with the descriptions of M. c. soricina in Osgood (1943:48).

Food preferences and behavior of M. elegans in captivity, as reported by Housse (1953:90-91) and Gay (1847:84 and 95), were similar to those of the Dromiciops australis which I retained in captivity for several months.

Specimens examined.-- One from Angol (collected by D. S. Bullock). Other record: Angol (Tate, 1933:217).

Chiloé bat; Murciélago de ratón

Myotis chiloensis chiloensis (Waterhouse)

Distribution.-- Throughout Malleco.

Remarks.-- These bats are uncommon but are widely distributed, especially where there are wooded areas. A Monterrey pine plantation adjacent to a large marsh on the Río Purén was used by these bats as a foraging site. The bats flew low while feeding in the plantation, but high while feeding in the open above the marshy land.

Myotis c. chiloensis, according to Osgood (1943:54-55), is more sooty in coloration and has less contrast between the tips and bases of the hairs of the underparts than M. c. arescens from northern Chile. He suggested that specimens be obtained from Curacautín may be intermediate since there is greater contrast in the hairs of the underparts than in other specimens of M. c. chiloensis. Two skins of specimens which I took from near Purén also seem to show considerable contrast and perhaps are intergrades as well. These two bats were taken, along with one Histiotis montanus, in a mist net stretched between the trunks of Monterrey pine trees near a marshy area.

Measurements of 2 adult Myotis chiloensis collected at 15 kilometers east of Purén are: total length, 84 and 86; length of tail vertebrae, 35, 35; length of hind foot, 11, 9; height of ear from notch, 16, 16; weight, 6.0, 8.2.

Specimens examined.-- Total, 4, from: Fdo. El Cisne, Mulchen,

Bío Bío Prov., 1; 15 Km. E Purén, 61 m., 2; Collipulli, 1. Other records: Curacautín, 2 (Osgood, loc.cit.).

Murciélago orejudo

Histiotus montanus montanus (Philippi and Landbeck)

Distribution.-- Throughout Malleco Province at elevations up to at least 1,220 meters.

Remarks.-- Forested lands where open areas are interspersed for foraging seemed to be the preferred habitat. Osgood (1943:60) remarked that the species probably is common, although it is known from only three localities in the province. A mist net stretched at ground level between tree trunks in a Monterrey pine plantation near Purén snared one of this species, along with a Myotis chiloensis, just at dark on 2 December (early summer). At the same locality on 4 December 1961, I found 17 more H. montanus in a hole in a tree (species of Myrtaceae), which was part of a grove growing in the midst of a large marsh (part of the Río Purén).

Of a total of 17 bats, 6 were immatures (3 males and 3 females) and 11 were adult females, 4 of which were lactating; none was pregnant.

Specimens examined.-- Total, 18, from: 15 Km. E Purén, 61 m. Other records: Curacautín, Malleco, 2; Lake Galletué, Cautín (Malleco), 1 (Osgood, 1943:60).

Red bat; Murciélago colorado

Lasiurus borealis varius (Poeppig)

Distribution.-- In the Central Valley and Cordillera de Nahuelbuta.

Remarks.-- Red bats were found roosting in a maqui (Aristotelia chilensis) tree in a tract of southern forest vegetation, in cherry trees in orchards, and in an apple tree in an orchard.

One was shot at dusk as it flew over a stream in a flat area at the Fundo Copihues (15 kilometers northwest of Angol, 473 m. elevation). Another specimen, along with L. cinereus, was obtained at Fundo Los Alpes (24 kilometers northwest of Angol at 473 m. elevation) in a mist net stretched across a fast-flowing stream.

Local residents in the Cordillera de Nahuelbuta did not know the red bat, but fruit pickers on the farms in the Central Valley were well-acquainted with the colorful species.

Females having 2 young attached were collected on December 4, 5, 7, and 18. In one case, the combined weight of both young (10.7 gms) was more than the weight of the mother (10.5 gms). This female was able to maneuver well while flying with the two young.

Specimens examined.-- Total, 22, from: 24 Km. NW Angol, 472 m., 1; 15 Km. NW Angol, 472 m., 1; Angol, 9; 5 Km. S Angol, 76 m., 7; 10 Km. W Galvarino, 61 m., 3. Other records: Angol, 6 (Osgood, 1943:53).

Hoary bat; Murciélago gris

Lasiurus cinereus villosissimus Geoffroy

Distribution.-- The Central Valley and Cordillera de Nahuelbuta.

Remarks.-- The hoary bat occurs mostly in forested regions and in orchards in the Central Valley. In February, a male, along with one L. borealis, was taken after dark in a mist net stretched across a fast-flowing stream 24 kilometers northwest of Angol at 472 meters elevation. A male was taken in September at 76 meters elevation. Females were obtained in March at 800 meters elevation and in April at 76 meters elevation. The sexes and the dates of capture of these bats correspond generally to those for hoary bats studied by Findley and Jones (1964). The elevations and dates do not appear to support a seasonal altitudinal migration hypothesis, as proposed by Sanborn and Crespo (in Findley and Jones, op. cit.).

A female with two large young was found clinging to a branch of an apple tree in an orchard near Santiago (Santiago Province) in January. The young, one male and one female, measured in total length, 108 and 115 mm, respectively, and the mother measured 119 mm.

Specimens examined.-- Total, 7, from: Isla de Maipo, Santiago Prov., 3 (2 young); 24 Km. NW Angol, 472 m., 1; Fdo. Chanleo, Angol, 800 m., 1; Angol, 2,. Other records: Nahuelbuta, (Osgood, 1943:54).

Free-tailed bat; Murciélago común

Tadarida brasiliensis (Geoffroy)

Distribution.-- In the Central Valley and foothills of the Cordillera de los Andes.

Remarks.-- The free-tailed bat is perhaps the most abundant bat in Chile (Osgood, 1943:62) and is found commonly in dwellings. Two were collected in September from storage barns at El Vergel. A night watchman reported that the bats were common in these barns. Dr. D. S. Bullock reported seeing many free-tailed bats in a barn at the Fundo El Cisne, southeast of Mulchén. At Fundo Jauja, residents reported that barns housed these bats. A vertical mine shaft, four feet in diameter, about one kilometer southeast of Huequén, reportedly contained bats in winter (June-August), but no bats were observed in December, nor were bats caught in a mist net stretched across the entrance on two consecutive nights.

The specimens examined were obtained in March, July, and October (females) and July, September, and November (males).

Specimens examined.-- Total, 7, from: El Cisne, Mulchén, Bío Bío Prov., 2; Angol, 3; 5 Km. S Angol, 76 m., 2.

European hare; Liebre

Lepus europaeus Linnaeus

Distribution.-- Throughout Malleco Province from the Central Valley to at least 1,830 meters elevation in the Cordillera de los Andes.

Remarks.-- Open areas, such as grasslands, agricultural areas, and pastures, surrounded by woodlands, are preferred habitats of the hare. Blackberry, gorse, and rose, as well as new growths of trees, such as Guevina avellana, Aristotelia chilensis, and Persea lingue, are used for cover in many areas.

The European hare, after its introduction into Malleco Province from Argentina sometime before 1928, has proliferated and become abundant and widespread and causes crop damage. Dr. D. S. Bullock related to me in 1961 that the hare first arrived in the Central Valley in Malleco Province in 1928, and in the same year there were unmistakable tracks as far west as Paicavai on the coast in Arauco Province. Dr. Bullock attributed this rapid expansion of the hare to the low fox population, low because of the high bounty on these animals. He added that in 1933, the hares were a "plague" on the Fundo El Vergel where 300 raulí (Nothofagus alpina) trees, planted in a hilly section of the farm, had been destroyed by the hares. To combat this "plague", a hare "round-up" using dogs was conducted. Ninety-three hares were killed with sticks wielded by the hunters. The carcasses were distributed for food among the people on the ranch. In 1934, 72 hares were taken in the same manner.

Hares appeared to me to be more abundant in the Cordillera de

Nahuelbuta than in the Central Valley or in the Cordillera de los Andes. Luis Schlindler, the forest ranger at the Laguna Malleco, 25 kilometers north of Curacautín, 980 meters elevation, reported that the hare was present, but that the rabbit, Oryctolagus cuniculus, was absent. He stated that the numbers of hares increased markedly during 1959 and 1960. Hunting in this forest reserve had been prohibited for several years. Housse (1953:147) stated that rabbits and hares in Chile do not occur in the same areas because the hares drive the rabbits away. At least at El Vergel the two occurred together. The Chilean government has recognized the problem of overabundance of the hare and attempts are being made to administer the best methods of control, according to Dr. Guillermo Mann F. (personal communication in 1961).

A female obtained at El Vergel, 152 meters elevation, on 20 August 1961, had 2 embryos; another female obtained at 24 kilometers northwest of Angol, 472 meters, 15 February 1961, was in lactation.

On March 1 at El Vergel I flushed a large hare. As it ran away, a Chilean spurwing lapwing (Belanopterus chilensis) immediately flew after the fast-moving animal, ultimately striking the hare on the head. The same behavior between these two animals also was reported to me by local residents.

Specimens examined.-- Total, 12 from: 27 Km. W Angol, 1155 m., 1; 20.4 Km. WNW Angol, 1; 24 Km. NW Angol, 472 m., 3; 5 Km. S Angol, 76 m., 2; 12 Km. SE Angol, 122 m., 1; Laguna Malleco, 25 Km. N Curacautín, 980 m., 1; 4 Km. E Lonquimay, 980 m., 1; 1 Km. W Paso Pino Hachado, 1770 m., 1; 3.5 Km. W Paso Pino Hachado, 1740 m., 1.

European rabbit; Conejo

Oryctolagus cuniculus Linnaeus

Distribution.-- Throughout Malleco Province, except at high elevations in the Cordillera de los Andes.

Remarks.-- Open grasslands where there is ample cover in the form of shrubby vegetation appeared to be the European rabbit's preferred habitat, although it was abundant locally where there were garden plots or cultivated fields. Their burrows and runways were seen in the blackberry bush and gorse (Ulex europaeus) which line trails, oxen paths, roads, and riverbeds.

Since its introduction into Chile in the mid-18th century, the European rabbit has spread throughout Chile, becoming abundant and a nuisance in many localities (Housse, 1953:150). As late as 1943, the animal was not recorded in central Chile (Osgood, 1943:236), but in 1960 it was present throughout Malleco Province, and was abundant in some localities. A ranger at the forest reserve at the Laguna Malleco, 25 kilometers north of Curacautín at 980 meters elevation, reported that the rabbit was absent in this location, but it was seen commonly on the road at Fundo Bella Vista, 17 kilometers north of Curacautín at 1,035 meters elevation, where there was a considerable amount of grassland in extensively deforested areas. The rabbit was reported to be established in the Cordillera de los Andes, at least as high as 1,500 meters (Housse; loc.cit.).

Campeños living in the Cordillera de Nahuelbuta west of Angol reported that rabbits dig up seeds and eat plants in vegetable gardens. Examination of the stomach contents of a rabbit killed at

El Vergel, revealed that carrots and greens were part of its diet. A rabbit shot at El Vergel had a diseased liver and a cysticercus in the body cavity near the spleen. The remains of a rabbit were found in the crop of a Harris' hawk (Parabuteo unicinctus) killed near Collipulli (Greer, 1965a). A rabbit skull was found on the ground below where a pair of barn owls was nesting, west of Los Sauces.

Man is increasing the habitat available to the rabbit by utilizing more land each year for agriculture and livestock. Overgrazed lands appear ideal for growth of the blackberry bush which provides excellent cover for the rabbit (see Plate 4a). Man's constant attempts to exterminate Felis guigna and the dog-like carnivores, Dusicyon culpaeus and D. griseus, have reduced the number of natural enemies of the rabbit in many areas. Man hunts the rabbit for both food and fur, but seemingly not to a great enough extent to reduce its populations (see Conservation).

Several underground burrows measured approximately 15 cm in diameter, whereas the tunnels in the grass at the base of blackberry thickets measured generally between 12 cm and 20 cm.

Adult females weighed 968.7 grams and 817.0 grams; adult males weighed 1716.0 grams and 1568.0 grams.

Specimens examined.-- Total, 7, from: Angol, 1; 5 Km. S Angol, 76 m., 2; 4 Km. W Los Sauces, 130 m., 1; 10 Km. W Collipulli, 443 m., 1; Jauja, 50 Km. ESE Collipulli, 487 m., 1; 17 Km. N Curacautín, 1035 m., 1.

Rice rat; Lauchita de los espinos

Oryzomys longicaudatus philippi Landbeck

Distribution.-- In grassy and brushy habitats throughout Malleco.

Remarks.-- The large series of this common Chilean rodent examined from different parts of Malleco, exhibits a wide variation in size and coloration. Color differences between individual animals depend on the time of year, the color of the substrate of the habitat, and the age of the animal. Older animals (with well-worn teeth) are larger and generally are paler, especially around the shoulder region, and are more mottled than younger animals (with the teeth erupted, but not well-worn). Generally, animals taken in winter (June-August) in the Central Valley were darker in color, especially on the head, than animals trapped in summer (December-February).

Oryzomys longicaudatus, along with Akodon olivaceus, was the most frequently trapped and the most widely distributed rodent in Malleco (Table 5). This rice rat was more numerous in brushy places where the land had been cleared of trees in the Central Valley and in shrubs surrounding grassy areas in mountainous regions in the Cordillera de Nahuelbuta. High populations existed in brushy cover, the animal's preferred habitat, in overgrazed pastures, and it also was found with regularity, but in smaller numbers, in forests located near water sources. Blackberry hedge rows in the Central Valley adjacent to agricultural areas (see Plate 3a), and bordering trails, oxcart paths, and roads leading into mountainous areas provide excellent cover, food and, probably, avenues for dispersal.

Oryzomys longicaudatus was absent from the high (1,520 meters elevation and above) Araucarian pine forests on the Paso de las Raices on the front range of the Andes (west of Lonquimay), but was taken at the 1,830-meter pass, Paso Pino Hachado, near the Malleco-Argentine border on a mossy stream bank and in grass at the bases of the shrubby ñirre (Nothofagus antarctica) where the terrain would be buried under several meters of snow in winter.

Of 339 animals trapped, 316 had their teeth fully erupted; of these 148 (47 per cent) were females; 53 (36 per cent of the females) were pregnant or lactating. The greatest percentages of pregnant or lactating females were captured in January, February, November, and December. By month, the reproductive records of trapped O. longicaudatus are as follows: in January, 15 of 18 females taken were pregnant or lactating; in February, 3 of 6; in March, 10 of 28; in April, 15 of 45; in May, none of 7; in June, none of 28; in July and August, no animals were taken; in September, none of 1; in October, no females were taken; in November, 3 of 6; and in December, 7 of 9. Forty-five females carried 3 to 9 embryos each, averaging 4.9. Young animals were trapped in the highest percentages in the months of January and February; 23 young animals (teeth not fully erupted) were trapped by month as follows: in January, 9 of a catch of 35; in February, 2 of 15; in March 3 of 81; in April, 7 of 108; in May, 1 of 13; in June, none of 15; in July and August, no animals were taken; in September, none of 4; in October, none of 1; in November, none of 11; and in December, 1 of 20.

Movement.-- A grid of 30 box traps was placed in a marshy area which was part of an oxbow lake formed by the Río Malleco, 5 kilometers south of Angol, 76 meters elevation. Five (3 males and 2 females) Oryzomys longicaudatus were trapped, marked, released, and recaptured 12 times (2 to 4 times each for the males and 2 times each for the females, and at 1 to 4 stations each for the males and 2 stations each for females) over a 9-day trapping period (April 14-22) in a 0.12 hectare plot. The average maximum movement of this mouse was determined to be 138 (30-240) meters and the average area occupied as 15.1 (0 to 32.2) square meters. These estimates may be somewhat low (see Negus, et al., 1961:99)

The 9-day catch (between April 14 and 22) included, besides O. longicaudatus, Akodon olivaceus and Rattus rattus. A. olivaceus co-existed in brush with O. longicaudatus, a relationship not usually found in my trapping experiences in Malleco. Rattus rattus was trapped in another part of the study plot and the ranges of R. rattus and the other two species overlapped slightly.

Snap-trapping for 3 days followed the 9-day movement study. Only one of the 14 Oryzomys caught in snap traps had been previously trapped, marked, and released (see Population Studies, Plot 15).

Specimens examined.-- Total, 334, from: 15 Km. NW Angol, 472 m., 2; 7 Km. ENE Angol, 122 m., 1; 9 Km. NE Angol, 122 m., 5; 18 Km. WNW Angol, 1007 m., 4; 10 Km. WNW Angol, 718 m., 4; 30 Km. W Angol, 1145 m., 1; 23 Km. W Angol, 830 m., 2; 24 Km. NW Angol, 472 m., 2; 5 Km. S Angol, 76 m., 138; 5 Km. S Angol, 152 m., 18; 6.6 Km. NE Trintre, 152 m., 4; 10 Km. NE Collipulli, 30.5 m., 2; 10 Km. W Collipulli, 442 m., 1; 5 Km. W Lumaco, 366 m., 9; 13 Km. SE Contulmo,

427 m., 1; 15 Km. E Purén, 61 m., 9; Jauja, 487 m., 16; 14 Km. E Jauja, 610 m., 4; 25 Km. N Curacautín, 980 m., 1; 26 Km. SW Capitán Pastene (Relún), 152 m., 25; 16.6 Km. E Victoria, 366 m., 13; Troyo, 980 m., 11; 20 Km. N Lonquimay, 980 m., 1; 4 Km. E Lonquimay, 980 m., 1; 8 Km. NE Selva Oscura, 550 m., 1; 10 Km. W Galvarino, 61 m., 6; 11 Km. E Curacautín, 734 m., 10; 17.6 Km. W Paso Pino Hachado, 1280 m., 2; 16.7 Km. W Paso Pino Hachado, 1372 m., 2; 1.7 Km. W Paso Pino Hachado, 183 m., 1. Other records: Angol, 2; Sierra Nahuelbuta, 20; Curacautín, 4 (Osgood, 1943:149-150).

Ratoncito lanoso

Akodon longipilis Thomas

Distribution.-- Forested areas or brushy grasslands in mountainous regions.

Remarks.-- On geographic grounds, and following Osgood (1943: 188-189), I assign all of the specimens I obtained in the Cordillera de Nahuelbuta, including those taken in forested areas near Galvarino, to Akodon longipilis apta Osgood. The fur on the backs of these western specimens is dark reddish-brown and contrasts with grayish sides. Akodon l. longipilis, which occurs in central Chile north of Malleco, is paler and more uniform in color.

Animals taken in the eastern part of Malleco Province, on the western slopes of the Continental Divide, as well as examples trapped in the valley of the Río Bío Bío and tributaries, are smaller, grayer and paler, than the specimens of A. l. apta from the Nahuelbuta. Based on the smaller size and paler coloration, I have assigned these Andean specimens to the subspecies A. l. suffusus

Thomas, after Osgood (op.cit.:189, 192, 193). Animals taken in the extreme eastern part of Malleco, although assignable to A. l. suffusus, show some relationships to A. l. hirta Thomas in Argentina in having broad crania, pale coloration, and prominently bicolored tails.

Animals assigned to A. l. suffusus from the foothills of the Andes are variable in color and size, some approaching the characteristics of the coastal race, A. l. apta.

These heavy-bodied, dark-furred rodents, characteristic of forested regions in South Central Chile, were not so abundant in the virgin tracts of Araucarian pine as in areas where the trees had been selectively removed allowing for the invasion of a dense ground cover. These animals were trapped commonly in or near rotted, hollow logs, and in the following places: grassy areas at the bases of shrubs, such as ñirre (Nothofagus antarctica), near Paso Pino Hachado and Lago Icalma (see Plate 6a); rocky areas, such as a rock slide north of Manzanar (see Plate 6b) and rocky outcroppings near Troyo; dense undergrowth of cane (Chusquea sp.) at moderate elevations above 487 meters on the western slope of the front range of the Andes (see Plate 7b).

Oryzomys longicaudatus and Akodon olivaceus were frequently caught with A. longipilis. For example, one trap set in a hollow log in a moist habitat at Relún caught, at different times, all three species. In forested areas, such as the Parque Turismo in the Nahuelbuta, or west of Lonquimay in the Andes, Dromiciops australis was trapped along with A. longipilis.

Of 232 Akodon longipilis trapped in Malleco, 221 (95.2 per cent)

had their teeth fully erupted. Of these, 114 (49 per cent) were females, of which 12 (10.5 per cent of the females) were pregnant or lactating. By month, the reproductive records of trapped A. longipilis are as follows: in January, none of 4 females was pregnant or lactating; in February, 6 of 43; in March, 4 of 49; in April, none of 7; no females were trapped May through September; in October, none of 2; in November, 1 of 3; and in December, 1 of 6. Nine females carried 2 to 5 embryos each, with an average of 3.7. Young animals (teeth not fully erupted) were trapped in the highest percentages in February, March and December. Twelve young animals were trapped by month as follows: In January, none of a catch of 5; in February, 7 of 89; in March, 1 of 11; in April, none of 11; in May and June no animals were trapped; in July, none of 3; in August and September no animals were trapped; in October, none of 3; in November, none of 5; and in December, 4 of 12.

Movement.-- Two areas in the Andes provided information on the movement of Akodon longipilis:

Plot 1 (see Population Studies). Thirty box traps were placed in a 0.12 hectare grid under the cover of a virgin coihue (Nothofagus dombeyi) forest, 4 kilometers west of Baños Río Blanco, 980 meters elevation. Five animals (4 males and 1 female) were trapped, marked, released, and retrapped 24 times (21 times for males, or 3 to 7 times each, and 3 times for the female; at 3 to 6 stations each for males and 3 stations for the female). The average maximum movement was determined to be 16.7 meters (17.8 for males and 12.5 for the female). The average range was determined to be 175 (120 to 241) square meters, 173 (150 to 241) for males and 120 for the female.

Plot 4 (see Population Studies). Twenty-eight box traps were placed in a 0.11 hectare grid among ñirre (Nothofagus antarctica) and cane (Chusquea sp.) in a ñirre-grassland habitat, 19 kilometers south of Lonquimay, 1,340 meters elevation. Three males were trapped a total of 10 times (2 to 4 times each at 1 to 2 stations each). Three additional males were trapped only one time each. The movements of the 3 animals trapped at least twice, were 7 meters, 0 meters, and 15.6 meters; the average ranges were 118, 40, and 162 square meters.

Specimens examined.-- Akodon longipilis apta Osgood, total, 35, from: 27 Km. WNW Angol, 1170 meters, 1; 27 Km. WNW Angol, 1110 m., 3; 10 Km. WNW Angol, 718 m., 1; 13 Km. W Purén, 382 m., 2; 7 Km. SW Contulmo, 487 m., 3; 13 Km. SE Contulmo, 427 m., 1; 15 Km. SE Contulmo, 1; 10 Km. W Collipulli, 443 m., 1; Relún, 152 m., 10; 10 Km. W Galvarino, 61 m., 5. Other records: Sierra Nahuelbuta, 36 (Osgood, 1943:189).

Akodon longipilis suffusus Thomas, total, 197, from: Jauja, 487 m., 2; 17 Km. N Curacautín, 1035 m., 2; 25 Km. N Curacautín, 980 m., 3; 11 Km. E Curacautín, 734 m., 1; 9 Km. N Manzanar, 1155 m., 1; 16.6 Km. E Victoria, 366 m., 1; 40 Km. NNE Lonquimay, 1220 m., 3; 4 Km. NE Troyo, 1372 m., 7; Troyo, 980 m., 11; 20 Km. N Lonquimay, 915 m., 5; 10 Km. WNW Lonquimay, 1555 m., 2; 7.7 Km. W Lonquimay, 1007 m., 3; Lonquimay, 980 m., 1; 19 Km. S Lonquimay 1340 m., 43; 24 Km. S Lonquimay, 1280 m., 3; 4 Km. W Baños Río Blanco, 980 m., 50; 17.6 Km. W Paso Pino Hachado, 1280 m., 2; 16.7 Km. W Paso Pino Hachado, 1372 m., 10; 15.2 Km. W Paso Pino Hachado,

1465 m., 14; 9.4 Km. W Paso Pino Hachado, 1555 m., 8; 3.5 Km. W Paso Pino Hachado, 1740 m., 6; 1.7 Km. W Paso Pino Hachado, 1830 m., 3; Lago Icalma, 1190 m., 8; $\frac{1}{2}$ Km. E Lago Icalma, 1190 m., 6. Other records: Curacautín, 5; Lonquimai, 12; west of Lonquimay, 3; Río Colorado, 16; Río Lolén, Lonquimai Valley, 1; Tolhuaca, 16; Lake Galletué, 9; Pino Hachado (in Neuquen, Argentina), 3 (Osgood, loc.cit.).

Ratoncito olivaceo

Akodon olivaceus pencanus Philippi

Distribution.-- Throughout Malleco.

Remarks.-- The hair color of this common rodent is variable and seems to be influenced by both time of year and color of the substrate. In addition, there often is a considerable range of color in any large series from one locality at any one time, and overlapping of coloration occurs between series from different localities. For example, the animals from El Vergel generally are pale colored, but some blackish specimens match dark individuals from the volcanic lava flow (see Plate 6b) north of Manzanar. Animals taken at El Vergel tend to be darker in April, June, and September than animals taken in the same location in January and February (summer months). Animals trapped in blackish soils of the Parque Turismo in October generally are darker than animals taken in December in the lighter colored, marshy area in the same river system (Río Purén) 30 kilometers to the east.

This ubiquitous cricetine is common in grassy and brushy areas in the Central Valley and also in mountainous regions where forests

have been cleared for cropland and pasture. Where Oryzomys longicaudatus occurs with A. olivaceus in grassy areas surrounded by brush, the latter is consistently taken in grass, and is absent from the brush. The remains of one of this species were found in the stomach of a great horned owl (Bubo virginianus) shot near Collipulli (Greer, 1965a).

Of 345 animals trapped, 320 (92.7 per cent) had their teeth fully erupted; of these, 162 (46.9 per cent) were females, of which 27 (16.6 per cent of the females) were pregnant or lactating. The greatest percentages of pregnant or lactating females were captured in the months of November, December, and February. By month, the reproductive records of trapped A. olivaceus are as follows: in January, none of 11 females taken was pregnant or lactating; in February, 6 of 14; in March, 2 of 13; in April, 6 of 52; in May, none of 21; in June, none of 19; in July, none of 1; in August, there were no catches; in September, 1 of 4; in October, none of 4; in November, 4 of 9; and in December, 5 of 14. Eighteen females carried from 3 to 8 embryos each, averaging 5.5. Young animals were most conspicuous in the catches made in the months of January, April, and September. Twenty-five young animals (teeth not fully erupted) were trapped by month as follows: in January, 4 of a catch of 28; in February, 2 of 23; in March, 1 of 30; in April, 11 of 108; in May, 1 of 42; in June, none of 39; in July, none of 3; no animals were trapped in August; in September, 3 of 11; in October, none of 9; in November, 1 of 17; and in December, 2 of 25.

Movement.-- Twenty (11 male and 9 female) Akodon olivaceus were trapped, marked, and released between April 14 and 22 to study

their movement in a marshy area (0.12 hectares) of rush (Scirpus sp.) and blackberry brush in an oxbow lake formed by the Río Malleco, 5 kilometers south of Angol, 76 meters elevation (see also Plot 15, Population Studies). Thirteen (8 males and 5 females) were caught 42 times (2 to 8 times each for males and 2 to 3 times each for females). Seven (3 males and 4 females) others were captured only once. The average maximum movement of those trapped at least twice was determined to be 14.1 meters; 16.0 meters for males and 11.2 for females. The average range was determined to be 12.5 square meters, 13.5 for males and 10.8 for females. The 3-day kill-trapping period (April 22-25) following the live study produced 14 animals (8 males and 6 females) of which 10 (5 males and 5 females) had been marked during the live-trapping period.

Akodon olivaceus and Oryzomys longicaudatus were taken together in the brushy area, but their range was separate from the range of Rattus rattus which inhabited about half the area of the study plot.

Specimens examined.-- Total, 345, from: 27 Km. WNW Angol, 1110 m., 7; 24 Km. NW Angol, 472 m., 6; 18 Km. WNW Angol, 1007 m., 2; 15 Km. NW Angol, 472 m., 1; 10 Km. WNW Angol, 718 m., 11; 7 Km. ENE Angol, 122 m., 2; 9 Km. W Angol, 685 m., 1; Angol, 70-600 m., 12; 5 Km. S Angol, 76-152 m., 216; 10 Km. W Purén, 61 m., 9; Jauja, 487 m., 13; 14 Km. E Jauja, 610 m., 3; 5 Km. W Lumaco, 366 m., 6; 5 Km. WSW Capitán Pastene, 656 m., 2; Relún, 152 m., 9; 25 Km. N Curacautín, 980 m., 6; 17 Km. N Curacautín, 1155 m., 1; Troyo, 980 m., 2; 20 Km. N Lonquimay, 915 m., 2; 9 Km. N Manzanar, 1155 m., 1; 4.5 Km. N Manzanar, 1035 m., 2; 10 Km. NE Selva Oscura, 610 m., 1;

9 Km. NNE Selva Oscura, 460 m., 2; 10 Km. W Galvarino, 61 m., 9; 12 Km. NW Liacura, 1060 m., 3; 20.7 Km. W Paso Pino Hachado, 1170 m., 2; 17.6 Km. W Paso Pino Hachado, 1280 m., 3; Icalma, 1190 m., 1; 20.7 Km. W Paso Pino Hachado, 1170 m., 1; 1 Km. N Liacura, 1100 m., 1. Other records: Sierra Nahuelbuta, 32; Angol, 4; Curacautín, Cautín (Malleco) 4; Villa Portales, Cautín (=Malleco), 3 (Osgood, 1943:171).

Mole mouse; Ratón topo, Tunduco

Notiomys macronyx vestitus Thomas

Distribution.-- In the Cordillera de los Andes.

Remarks.-- Notiomys macronyx prefers deep soils in elevated lowlands in which it builds networks of tunnels. A specimen was trapped near Lago Icalma (see Plate 6a) on a mound of dirt pushed out of a burrow which had its entrance at the base of a medium-sized ñirre (Nothofagus antarctica) with a trunk 15 centimeters in diameter. The excavated burrow was 9 meters in length and resembled that of Ctenomys maulinus. Other shrubs (Ribes sp. and Berberis spp.) and cane (Chusquea sp.), besides ñirre, were plants with roots close to the burrow system.

One specimen was trapped beside a fallen Araucarian pine near a stream west of Paso Pino Hachado; another was taken in leaf litter at the base of a rock pile in a grove of roble (Nothofagus obliqua) northeast of Troyo. No burrows were evident at the latter area, so perhaps the animal lived among the rocks. Akodon longipilis and Dromiciops australis were taken near rocks in the same trapline in these woods.

One N. macronyx was trapped during the daytime indicating diurnal activities; eight other specimens were caught at night. One female trapped in February was lactating; others taken in February and in March showed no signs of sexual activity.

Specimens examined.-- Total 9, from: Pinares, Lonquimay, 1600 m., 2; 19 Km. S Lonquimay, 1340 m., 2; east end of Lago Icalma, 1190 m., 1; 15.2 Km. W Paso Pino Hachado, 1465 m., 2; 9.4 Km. W Paso Pino Hachado, 1555 m., 2. Other records: Lonquimay, 16; Río Colorado, 2; Lake Galletué, 2; Villa Portales, 1 (Osgood, 1943: 165). Osgood erroneously ascribes the latter two localities to Cautín Province.

Mole mouse; Ratón topo de la selva, Tunduco

Notiomys valdivianus valdivianus Philippi

Distribution.-- Open or forested areas in mountainous regions.

Remarks.-- I obtained specimens only from the Andes between 915 meters and 1,830 meters elevation, but Osgood (1943:150) reported the species also from the Cordillera de Nahuelbuta.

Notiomys valdivianus and N. macronyx were taken in the same trapline at 15.2 kilometers west of Paso Pino Hachado at 1,465 meters elevation. Both were caught in a row of shrubbery on the edge of a narrow, wet arroyo. Ñirre (Nothofagus antarctica), cane (Chusquea sp.) and bunch grass (Stipa sp.) comprised the prominent vegetation in the vicinity of the trapping locations in most areas where N. valdivianus was taken. One was trapped in cane among large rocks at the edge of a coihue (Nothofagus dombeyi) woods and

another was caught in a burrow system in a bunch grass meadow adjacent to a marshy area at the Laguna Malleco (see Plate 7b).

Burrow systems were found in grassy areas where gnarled, old roble (Nothofagus obliqua) grew as remnants of the past forests and where numerous roble saplings were scattered in the meadow at 17 kilometers north of Curacautín. The burrows found here were long and sinuous and were about 5 centimeters in diameter, often having dirt packed in the burrow about 20 to 25 centimeters from the surface entrances. Dirt was piled outside the burrow entrances in low mounds of about 15 to 25 centimeters in diameter and about 10 centimeters high. Also, there was evidence of burrow systems under barberry (Berberis sp.). There was much dead barberry, the stems of which had been cut about one inch below the ground level. Notiomys valdivianus was trapped also in a coihue woods near rotted logs in the heavy undergrowth of cane at this location.

In the Araucarian pine forests on the west side of the Paso de las Raíces at 1,555 meters elevation Notiomys valdivianus was caught from beneath a fallen log, amid a quantity of dugout soil in an abandoned lumber camp where most of the undergrowth had been cut away. Osgood (1925:117) also found this rodent in the Araucaria forest habitat. Usually mounds of soil evident outside the burrows of N. valdivianus were similar in appearance to, although not so massive as, those made by Ctenomys maulinus (see also Budin in Osgood, 1943:152).

Notiomys valdivianus also was trapped in a small cane thicket on a broad slope with shallow soil near the Río Bío Bío, 20 kilometers north of Lonquimay, 980 meters elevation. Digging was not

evident within 10 meters of where the trap was placed suggesting that these animals leave their burrows to rove above ground.

Females trapped in February, March, and December were not pregnant. The sex ratio from trapping records was 10 males to 11 females.

Most animals were trapped at night, but 3 were trapped between 0800 and 1700, suggesting some diurnal activities.

Specimens examined.-- Total, 22, from: 25 Km. N Curacautín, 980 m., 6; 17 Km. N Curacautín at 1035 m., 2; 4 Km. NE Troyo, 1372 m., 3; 20 Km. N Lonquimay, 915 m., 1; 10 Km. WNW Lonquimay, 1555 m., 1; 14.4 Km. W Lonquimay, 1555 m., 1; 15.2 Km. W Paso Pino Hachado, 1465 m., 2; 3.5 Km. W Paso Pino Hachado, 1740 m., 5; 1.7 Km. W Paso Pino Hachado, 1830 m., 1. Other records: Curacautín, 1; Río Colorado, 4; Tolhuaca, 4; Sierra Nahuelbuta, 2 (Osgood, 1943:154).

Laucha sedosa

Eligmodontia typus typus Cuvier

Distribution.-- Grassy western slopes of the Andes at elevations above 1,060 meters.

Remarks.-- Based on descriptions and measurements given in the literature, I judge these Malleco animals to be E. t. typus, although measurements of the Malleco specimens are somewhat smaller than those from specimens in Argentina (see Table 9).

Five specimens from near Paso Pino Hachado constitute the second locality record of Eligmodontia typus typus in Chile, Hershkovitz (1962:176) having recorded this race from Lake Sarmiento,

Table 9. Measurements of *Eligmodontia typus* from Chile and Argentina

Measurements	Malleco Province, Chile						Neuquen Province, Argentina	
	20.7 Km. W Paso Pino Hachado			17.6 Km. W Paso Pino Hachado			Chos Malal and Las Lajas (Herskovitz, 1962:192)	
	male no.7399	female no.7403	female no.7400	female no.7401	female no.7401	Average		
Length of head and body	90	92	92	87	87	90.3	90 (88-92)	3
Length of tail vertebrae	85	80	85	73	73	80.8	103 (96-110)	4
Length of hind foot	22	22	23	24	24	22.8	24.3 (22-26)	4
Height of ear from notch	19	16	19	-	-	18.0	17.3 (17-18)	4
Greatest length of skull	25.2	-	24.6	-	-	24.9	25.6 (25.3-25.9)	4
Zygomatic breadth	12.7	-	12.3	-	-	12.5	13.2 (12.9-13.6)	2
Condylbasal length	22.1	-	21.1	-	-	21.6	-	-
Breadth of braincase	11.8	-	11.1	-	-	11.5	-	-
Least interorbital breadth	3.8	-	3.7	3.9	3.9	3.8	-	-
Breadth of rostrum	4.0	-	3.8	4.0	4.0	3.9	-	-
Alveolar length of maxillary tooth row	3.8	-	3.5	3.7	3.7	3.7	4.2 (4.0-4.2)	4
Weight	26.1	27.2	26.1	-	-	-	-	-

Magellanes Province, approximately 1,400 kilometers to the south. However, this animal is known in Neuquen Province, Argentina (Hershkovitz, loc.cit.), approximately 60 kilometers east of the collecting site in Malleco. Apparently, it is characteristic of the eastern slopes of the Andes, but extends its range westward to the Andean slopes in Chile by using low passes.

Mice were trapped in rocky areas, moist arroyos with grass, and flat areas where ñirre (Nothofagus antarctica) and cane (Chusquea sp.) were abundant. One was captured in an arroyo which had on its banks an abundant growth of barberry (Berberis sp.). A rocky hilllock, relatively dry, overgrazed, and with bare ground (approximately 40-50 per cent cover) was the trapping site of another specimen.

Two females taken in March were pregnant, one had 6 embryos, the other 8. Another female taken in March was not pregnant.

Specimens examined.-- Total, 5, from: 20.7 Km. W Paso Pino Hachado, 1170 m., 2; 17.6 Km. W Paso Pino Hachado, 1280 m., 3.

Darwin's leaf-eared mouse; Lauchón orejudo

Phyllotis darwini Waterhouse

Distribution.-- Throughout the province.

Remarks.-- I follow Osgood (1943) and Hershkovitz (1962) in Distinguishing two subspecies of Phyllotis darwini in Malleco. Phyllotis d. fulvescens Osgood from the Cordillera de Nahuelbuta is grayish all over and lightly washed with fulvous and there is a semblance of a pale orange lateral line and pectoral spot. The

tail is sharply bicolored. Phyllotis d. darwini Waterhouse from parts of the Central Valley and the Andean foothills is richly colored and lightly washed with buff on its sides, shoulders, face, and around the base of the tail. A pale orange mid-ventral stripe is noticeable in some specimens.

Phyllotis d. darwini was trapped in the Central Valley on well-drained soils, often among large rocks in open, grassy areas or pastures (see Plate 8a). Between Angol and Collipulli these mice were trapped in rock piles made by man in preparing fields for plowing. One such rock pile about 8 meters in diameter produced 5 mice in one night of trapping in May. Eight months later in January, 3 days of intensive trapping in the same rock pile produced no mice. The omnipresent chimingo carrion hawks (Milvago chimingo) stole mice from traps placed in these rock piles. In the foothills of the Andes, this mouse was trapped in shrubby cane (Chusquea sp.), maqui (Aristotelia chilensis), and in forested areas of Chilean beech (Nothofagus spp.) which line the rim of the canyon of the Río Cautín.

Phyllotis d. fulvescens has heretofore been reported only in the Araucarian (Araucaria araucana) pine forest in the Nahuelbuta (Osgood, 1943:204). However, I took specimens in a semi-open area in the mountains, at the edge of a marsh where vegetation such as rushes (Juncus spp.) was common, and trees such as canelo (Drimys winteri) and pitra (Myrceugenia spp.) formed the bulk of the overstory. Another was trapped in a thicket of cane in a partially cleared woods of roble (Nothofagus obliqua) and coihue (Nothofagus dombeyi).

Juveniles of P. darwini darwini were taken in March, May, and November; an adult female was pregnant and another was lactating in March.

Specimens examined.-- Phyllotis darwini darwini Waterhouse, total, 39, from: Angol, 3; 5 Km. S Angol, 122 m., 1; 5 Km. S Angol, 152 m., 14; 5 Km. S Angol, 168 m., 13; 14 Km. S Collipulli, 168 m., 5; 7 Km. NW Collipulli, 198 m., 1; Jauja, 487 m., 1; 11 Km. E Curacautín, 724 m., 1.

Phyllotis darwini fulvescens Osgood, total, 3, from: 18 Km. WNW Angol, 1007 m., 1; 10 Km. WNW Angol, 718 m., 1; Relún, 152 m., 1. Other records for P. d. fulvescens: Sierra Nahuelbuta, 1; Araucaria Forest, Nahuelbuta, 1 (HersHKovitz; 1962:325).

Lauchón de pie chico

Phyllotis micropus Waterhouse

Distribution.-- Mountainous areas; absent from the Central Valley.

Remarks.-- The Phyllotis micropus trapped in the Cordillera de Nahuelbuta is washed slightly with buff on the undersides and is somewhat grayer than those taken in the Andes. These rodents were obtained in a variety of habitats, but were not found to be abundant anywhere. I found, as did HersHKovitz (1962:199), that this animal is essentially "a forest glade dweller", but may also inhabit grassy or bushy places in deforested areas.

Phyllotis micropus was taken in the Andes where Araucarian pine (Araucaria araucana), roble (Nothofagus obliqua), lenga (N. pumilio), and coihue (N. dombeyi) were prominent trees and cane (Chusquea sp.)

was common as a shrubby growth. It was taken also near water sources. Areas with firre (Nothofagus antarctica) six to ten feet high, were also trapping sites of this animal at Lago Icalma (see Plate 6a) and Paso Pino Hachado; and it was trapped by a rotted log in an area of dense cane in a coihue forest in the same trapline with Octodon degus and Irenomys tarsalis at Baños Río Blanco. A specimen was trapped in an Araucarian pine forest and another in a relatively open, bunch grass meadow adjacent to the forest in the Cordillera de Nahuelbuta.

A female taken at Baños Río Blanco, 980 meters elevation, on 2 March carried 5 embryos, the largest measuring 12 millimeters in crown-rump length. Another female taken near Paso Pino Hachado, 1,372 meters elevation, on 9 March had 4 embryos, the largest measuring 14 millimeters in crown-rump length. Two other adult females taken in February and March were lactating. Fifteen of the 26 Phyllotis micropus caught were females.

Specimens examined.-- Total, 26, from: 27 Km. WNW Angol, 1110 m., 2; 40 Km. NNE Lonquimay, 1372 m., 1; 4 Km. NE Troyo, 1372 m., 3; Troyo, 980 m., 2; 20 Km. N Lonquimay, 915 m., 2; Pinares, Lonquimay, 1600 m., 2; 10 Km. WNW Lonquimay, 1555 m., 1; 17.6 Km. W Paso Pino Hachado, 1520 m., 1; Lago Icalma, 1190 m., 2; 4 Km. W Baños Río Blanco, 980 m., 3. Other records: Araucaria forest, Nahuelbuta, 3; Sierra de Nahuelbuta, 3; Pinares, Lonquimay, 1; Araucaria forest west of Lonquimay, 1; Río Lolén, 1 (Hershkovitz, 1962:401).

Laucha arborea

Irenomys tarsalis tarsalis Philippi

Distribution.-- Malleco Province from widely scattered localities in the Cordillera de Nahuelbuta and Cordillera de los Andes.

Remarks.-- These medium-sized, long-tailed mice were found only in forested regions, where cane (Chusquea sp.) was abundant.

Irenomys tarsalis was trapped in three localities with strikingly similar vegetation and substrate. Each place was on a hillside on which thick patches of cane grew in soft, moist soil under roble (Nothofagus obliqua), raulí (N. alpina) or coihue (N. dombeyi). The ground beneath this vegetation often was covered with litter composed mostly of decaying cane leaves with a few herbs.

Dromiciops australis was taken in the same traplines as I. tarsalis in the three localities in similar habitats and both are reported to be arboreal (Osgood, 1943:49 and 219). Octodon bridgesi was taken in similar habitat of heavy cane growing on slopes near Baños Río Blanco. The animals living in cane may be influenced by the occasional "bloom" when seed is produced which seems to support a much greater abundance of rodents (Osgood, 1943:218). Local residents in Malleco told me about an occasional increase in abundance of rodents coincident with the flowering of the cane.

Evidence that I. tarsalis is either uncommon or trap-shy is revealed by trapping results: near Jauja, 3 were taken in 160 trap night; west of Baños Río Blanco, one was caught in 125 trap nights; north of Curacautín, one was caught in 219 trap nights.

Females (taken in December and March) showed no evidence of pregnancy.

Average and extreme measurements of 2 adult females and 3 adult males having teeth equally worn: total length, 249.2 (224-290); length of tail vertebrae, 148 (134-172); length of hind foot, 28.8 (27-31); height of ear from notch, 22.6 (22-23); greatest length of skull, 28.8 (27.3-30.0); condylobasal length, 24.7 (23.8-27.1); breadth of brain case, 12.7 (12.4-13.1); zygomatic breadth, 14.2 (13.8-15.3); least interorbital breadth, 3.5 (3.2-3.8); breadth of rostrum, 4.3 (4.1-5.0); breadth of palate, 2.3 (2.1-2.7); length of diastema, 6.7 (6.1-7.7); alveolar length of maxillary tooth row, 5.3 (5.1-5.4). The average weight was 32.4 (26.3-41.7).

Specimens examined.-- Total, 5, from: 14 Km. E Jauja, 610 m., 3; 25 Km. N Curacautín, 980 m., 1; 4 Km. W Baños Río Blanco, 980 m., 1. Other records: Sierra Nahuelbuta, 1 (Osgood, 1943:219).

Rata sedosa

Euneomys chinchilloides petersoni J. A. Allen

Distribution.-- In the Andes at high elevation.

Remarks.-- Hershkovitz (1962:492, fig. 121) mapped the widely separated type localities of nominal species and subspecies of Euneomys. Apparently, the taxonomy of this rare rodent is still somewhat clouded. Hershkovitz has suggested that Euneomys noei Mann (from Valle de la Junta, Canyon of the Río Volcán, Santiago, about 550 kilometers north of Malleco) may not be separable from E. mordax Thomas (from San Rafael, Mendoza, Argentina), and furthermore, that the latter may prove to be a subspecies of E. chinchilloides. I follow the diagnosis of the species by Hershkovitz (op.cit.) and assign the new records from Malleco to Euneomys chinchilloides petersoni J. A. Allen; albeit I recognize that the measurements of these new records are similar also to those of E. noei and E. mordax. I trapped this species in the ñirre (Nothofagus antarctica)-grassland habitat which occurs at high elevations throughout the western slopes of the Andes in Malleco (see Figure 4). Specimens were taken on slightly sloping ground under clumps (to 20 meters in diameter, and averaging about 3 meters in height) of ñirre where the soil is deep and sandy. Cane (Chusquea sp.) is interspersed throughout the ñirre and bunch grass and occasional other shrubs (Ribes sp. and Berberis spp.) are common. Other small mammals taken in the same trapline with E. chinchilloides were Akodon longipilis and Notiomys spp. (see Table 6).

Measurements of 3 males (MSU #7459, 7460, 7462) and 1 female (MSU #7461) are: total length, 199, 236, 230, 258; length of tail vertebrae, 74, 95, 87, 103; length of hind foot, 30, 33, 32, 33; height of ear from notch, 27, 25, 24, 27; weight, 57.4, 87.5, 83.6, 122.5; greatest length of skull, ---, 32.3, 31.4, ---; condylobasal length, ---, 30.9, 30.0, ---; breadth of braincase, ---, 14.7, 14.3, ---; zygomatic breadth, 18.0, 19.5, 19.5, 20.6; least interorbital breadth, 3.6, 4.5, 4.6, 4.4; breadth of rostrum, 5.5, 6.8, 6.5, 7.0; alveolar length of maxillary tooth row, 5.8, 6.4, 6.6, 6.8; length of diastema, 7.3, 8.3, 8.0, 9.6; breadth of palate, 2.2, 2.0, 2.3, 3.1.

Specimens examined.-- Total, 4, from: 9.4 Km. W Paso Pino Hachado, 1555 m., 1; 3.5 Km. W Paso Pino Hachado, 1740 m., 3.

House mouse; *Laucha doméstica*

Mus musculus Linnaeus

Distribution.-- Throughout the province.

Remarks.-- The house mouse is common, residing in or near habitations of man, or feral and in competition with native rodents. It was taken at Lago Icalma in bunch grass at the bases of the shrub-like ñirre (Nothofagus antarctica) along with Oryzomys longicaudatus, Akodon olivaceus, and A. longipilis. One was trapped with O. longicaudatus on floating mats of fallen cattail stems in a marshy area at the base of a watershed dam east of Trintre. It was found with A. olivaceus in a grid of traps set

in an apple orchard at El Vergel and in a grove of Myrceugenia sp. surrounded by a vast marshy area, 15 kilometers east of Purén. Local residents confuse house mice with young O. longicaudatus because of a superficial resemblance.

Specimens examined.-- Total, 9, from: Angol, 2; 5 Km. S Angol, 76 m., 4; 6.6 Km. NE Trintre, 152 m., 1; 15 Km. E Purén, 61 m., 1; Lago Icalma, 1190 m., 1.

Black rat; Ratón, Rata de las casas

Rattus rattus Linnaeus

Distribution.-- Throughout the province.

Remarks.-- Black rats, although common pests in human habitations, also are abundant in fields and woods, seemingly competing with the native rodents, and, according to my trapping records, more successful at this competition than the Norway rat.

Generally, black rats were trapped in brush near moist areas, such as marshes, streams, or irrigation canals. Native rodents, for example, Oryzomys longicaudatus, often were trapped in the same brushy areas near water as R. rattus. However, trapline records indicated that R. rattus and O. longicaudatus seem to maintain separate living places within the same general area. Black rats were taken in association with O. longicaudatus in a grove of trees surrounded by a marsh east of Purén, and six rats were taken in one night of trapping in a half acre wooded area of arrayán (tree species of Myrtaceae) in the middle of a wheat field northwest of

Collipulli. Black rats were the only rodents caught in cane (Chusquea sp.) undergrowth of a cleared roble (Nothofagus obliqua) woods along the edge of the Río Lumaco, near Lumaco.

The remains of a rat were found in the stomach of a Harris' hawk (Parabuteo unicinctus) shot near Collipulli (Greer, 1965a).

Movement.-- Thirty box traps were placed in a grid in a marshy area, part of an oxbow lake formed by the Río Malleco at El Vergel (see Population Studies, Plot 15). Five Rattus rattus (3 males and 2 females) were trapped, marked, released, and recaptured a total of 26 times (5 to 9 times each for males and 2 to 3 times each for females, and from 2 to 8 stations each for males and 2 to 3 stations each for females) during a 9-day live-trapping period (April 14-22) in a 0.12 hectare plot.

The average maximum movement of R. rattus was determined to be 22.2 meters; 23.7, 24.8, and 29.8 meters for males, and 12.5 and 20.1 meters for females. The average area occupied by R. rattus was determined to be 222 square meters: 240, 240, and 300 for males, and 120 and 210 for females. The females consistently occupied smaller areas than the males.

The 9-day live-trapping catch also included 20 Akodon olivaceus and 5 Oryzomys longicaudatus. Rattus rattus was caught in approximately one-half of the area of the 0.12 hectare plot, its range overlapping slightly with that of O. longicaudatus and A. olivaceus, which utilized the other half of the area.

Specimens examined.-- Total, 38, from: Angol, 9; 5 Km. S Angol, 76 m., 14; 8 Km. NW Collipulli, 198 m., 7; 1 Km. W Lumaco, 106 m., 3; Relún, 152 m., 1; Lago Icalma, 1190 m., 1.

Norway rat; Ratón, Rata de las acequias

Rattus norvegicus (Berkenhout)

Distribution.-- Throughout the province.

Remarks.-- Osgood's remarks (1943:235) about the overabundance of the pestiferous rodent in 1943 still prevail. Norway rats mostly inhabit human habitations, farm buildings, and environs, although on occasion they were trapped in the field, seemingly in competition with native cricetines. One was trapped along with Oryzomys longicaudatus and Akodon olivaceus in blackberry bushes at Jauja. The rats show little fear of people walking along the irrigation canals which harbor these pests. They were seen frequently running across country farm roads in front of oncoming vehicles and pedestrians.

A rat kept in captivity was maintained on a diet of rose haws, a source of food available naturally in many areas where the land has been cleared for agriculture or pasture.

Specimens examined.-- Total, 12, from: Angol, 4; 5 Km. S Angol, 76 m., 6; Jauja, 487 m., 1.

Mountain vizcacha; vizcacha

Lagidium viscacia sarae Thomas and St Leger

Distribution.-- High elevations in the Andes.

Remarks.-- The vizcacha lives near rocky cliffs and on boulder-strewn slopes and is well-known to people living in the Andes. A policeman at Lago Icalma reported that this animal is seldom hunted, although its flesh reportedly is palatable. Another inhabitant at

Lago Icalma said that in recent years he had trapped several of these animals alive, and that they were easy to find. However, when I contracted with him to obtain some specimens, he reported seeing only one after two days of searching in areas where previously he had seen many. My guide, in an area near the Andean village of Troyo, pointed out a pile of large, exposed boulders high on the side of the mountain overlooking the valley of the Río Bío Bío as a habitat of the vizcacha.

The only specimen I examined was brought to D. S. Bullock from the Río Ranguil, about 60 kilometers north-northwest of Paso Pino Hachado (Neuquen Province, Argentina) where the type specimen was collected by E. Budin (Thomas and St. Leger, 1926:640) and belongs to the northern race of the five southern Argentinian forms of Crespo (1963:63). The occurrence in Chile of this animal is not remarkable since the vizcacha habitat exists all along the Continental Divide, the political division between Malleco and Argentina.

Measurements of an unsexed skeleton (MSU #7564) taken in July of 1962 are the following: (the external skin measurements and weight were recorded by D. S. Bullock) weight, without viscera, 2 kilograms; total length, 840; length of tail vertebrae, 376; length of hind foot, 104; height of ear from notch, 66; the skull measured: greatest length, 92.6; condylobasal length, 87.4; zygomatic breadth, 49.0; breadth of braincase, 34.6; least inter-orbital breadth, 18.5; breadth of rostrum, 13.8; alveolar length of maxillary tooth row, 22.8; length of diastema, 27.2.

Specimens examined.-- 1, from Río Ranguil. Other records:
Paso Pino Hachado, Neuquen Province, Argentina (Thomas and St.
Leger, 1926, 640).

Nutria; Coipu (coypu, coipo)

Myocastor coypus coypus Molina

Distribution.-- Throughout Malleco Province.

Remarks.-- The coipu is well-known in Malleco, and occurs in waterways, rivers, lakes, and marshes, especially where there is succulent vegetation along the banks or emergent from the water. Gay in 1847 (p. 126) remarked that coipus were distributed between Coquimbo Province and Chiloé Island, and were somewhat more rare in Chile than in Argentina. Coipus are chiefly Central Valley low-land dwellers, but range as high as 1,190 meters in the Andes where the snow attains the depth of one meter in winter. Perhaps the animal is able to live there because many lakes and river do not freeze in spite of sub-freezing temperatures (see discussion in Miller, 1962).

At El Vergel, coipus were trapped in a marshy area (part of an oxbow lake of the Río Malleco) in which emergent vegetation such as "totora" (Scirpus sp.) grew. Coipus had chewed off the Scirpus about 15 centimeters above the water line in some places in this marsh. It was reported by a resident at El Vergel that coipus also feed on shell fish and leave piles of clam shells on sandbars of the nearby Río Huequén.

The forest ranger at Laguna Malleco estimated that between 20 and 25 coipus per hectare occurred in that lake. In areas of

rushes containing mostly "junquillo" (Juncus spp.), coipus ate stems of the plants above the water line. Here, one could watch the coipus forming trails by swimming, then crawling over the matted, floating vegetation, and finally breaking through the vegetation and again swimming. The crisscrossing trails were between 20 and 50 centimeters wide, some showing more use than others. Trails also were noted in a marshy area (see Plate 7b) near Laguna Malleco.

The ranger at the Laguna Malleco reported that coipus did little damage; however, this forest reserve was not used for crops. In other areas crops serve as food for the coipus living near the cultivated fields. Coipus are hunted in areas of the Central Valley where they are especially plentiful in an attempt to control the crop damage they cause. At 15 kilometers west of Purén, dogs were used to track and kill coipus in marshy areas which were being drained for cropland.

At the time Gay wrote of the coipu (1847), the fur was used as felt for hats (on Chiloé Islands, especially) and for tobacco pouches, and today the animals are still hunted for their skins. Although the meat is palatable, many local residents would not eat them since they believed they were "like large rats".

Gay remarked on the ease of taming coipus in captivity. An adult male which I kept for ten days, showed no sign of friendliness. While it was confined in a room, it made a peculiar noise, a soft, screechy call lasting one to three seconds and sounding not unlike a door slowly swinging on a rusty hinge. At other times it made a low guttural, growling noise both when

alone and while being handled.

This coipu (MSU #6399) was brought into the laboratory on 17 September 1961. Its weight at time of capture was 5,030 grams, and in ten days in captivity it had lost 200 grams. Food consumption averaged 1,520 grams of forage beets daily, or about 30 per cent of its body weight. There was nearly as much food consumed during the daylight hours (707 grams on the average) as there was during nighttime (813 grams on the average). Daily weight changes varied between a 170 gram loss and a 220 gram increase.

The ranger at the Laguna Malleco reported that young coipus are seen in spring, summer, and autumn, but rarely in winter (June, July, August). Of 8 specimens collected, one was a non-pregnant female taken in December; the others were males.

External measurements of 3 adult males from El Vergel are the following: total length, 865, 910, 942; length of tail vertebrae, 345, 403, 379; length of hind foot, 135, 143, 190; height of ear from notch, 30, 29, 35. Weight of one male was 4,280 grams. Average and extreme measurements of 6 skulls from Malleco Province are as follows (number of skulls measured follows the corresponding measurements): greatest length of skull, 111.4 (104.5-116.0), 4; condylobasal length, 107.3 (102.5-113.0), 5; zygomatic breadth, 67.7 (61.2-72.4), 6; breadth of braincase, 33.7 (32.0-34.4), 4; least interorbital breadth, 25.4 (23.0-27.3), 6; breadth of rostrum, 21.6 (20.5-22.7), 6; length of diastema, 31.5 (28.4-34.1), 6; alveolar length of maxillary tooth row, 28.4 (27.2-30.3), 6.

Specimens examined.-- Total, 8, from: Fundo Maitenrehue (north-west of Angol in the Cordillera de Nahuelbuta), 61 m., 1; Angol, 2; 5 Km. S Angol, 76 m., 3; 15 Km. E Purén, 61 m., 2. Other records: Lake Malleco (erroneously placed in Cautín Province by Osgood), 5 (Osgood, 1932:143).

Bridges' Octodon; Degú de los matorrales

Octodon bridgesi Waterhouse

Distribution.-- Western slopes of the Andes at moderate elevations.

Remarks.-- Preserved specimens of this species are poorly represented in museums; it appears difficult to trap. Yepes (in Osgood, 1943:110) recorded examples from Colchagua Province, and Osgood took a specimen in O'Higgins Province; these localities are about 400 kilometers north of Baños Río Blanco where I took one specimen (MSU #6345). This specimen was trapped in a streamside thicket of cane (Chusquea sp.) by a rotten log on the western slopes of the Sierra Nevada. Irenomys tarsalis, Dromiciops australis, and Phyllotis micropus were caught in the same trapline. The ground cover around where the trap was placed on the sloping bank consisted of leaf litter from the cane and a few herbs. The trees in the vicinity were mostly coihue (Nothofagus dombeyi). There was little evidence of burrows other than the diggings made by the ground bird, "chucac" (Scelorchilus rubescula).

Measurements of the young male taken at the Baños Río Blanco, 980 meters elevation, are as follows: total length, 250; length of tail vertebrae, 102; length of hind foot, 34; height of ear

from notch, 23; greatest length of skull, 37.4; condylobasal length, 33.7; width of brain case, 15.9; interorbital constriction, 8.2; breadth of rostrum, 8.6; alveolar length of maxillary tooth row, 9.1; length of diastema, 8.1; M1 width, 2.3; zygomatic width, 21.0; weight, 92.5.

Specimens examined.-- One male from 4 Km. W Baños Río Blanco, 980 m.

Rock rat; Tunduco

Aconaemys fuscus fuscus Waterhouse

Distribution.-- Mountainous areas.

Remarks.-- Tunducos were trapped in Nothofagus forests in burrows under shrubs, especially barberry (e.g., Berberis buxifolia). These octodonts seemingly prefer granular, well-drained soils which are found in elevated flats in the Cordillera de los Andes and the Cordillera de Nahuelbuta. Osgood (1943:112) mistakenly believed that these rodents were restricted to forests of Araucarian pine and that they may have been abundant, or at least common, in the Nahuelbuta. He further stated that in the Andes they were reduced to small colonies and were disappearing "like the great trees under which they make burrows". In 1960-62, I found this animal in open, cleared areas, as well as in forested areas. Perhaps these animals are able to adapt to the changing vegetation picture.

The A. fuscus burrow system is a network of interconnecting tunnels close to the surface of the ground. Entrances to this system from the surface may occur at intervals of up to one meter.

Often, the burrow is merely a much used runway worn deep and covered over, except in occasional clear areas, with a quantity of vegetation, reminiscent of Microtis runways in grassy places in Michigan. Debris which appeared to have been pushed outside a burrow by its inhabitant included: pieces of Berberis buxifolia stems (these stems were up to 30 millimeters in diameter, showed teeth marks, and were severed about 15 millimeters below the surface of the ground), leaves of B. buxifolia, lichens, leaves and roots of bunch grass, roble (Nothofagus obliqua) leaves; two sizes of feces composed of wood cuttings and appearing to be from large and small animals of the same species; and another pellet of feces having, besides wood cuttings, the legs and mouth parts of two unidentified beetles.

From the way in which the animals were caught, it is suspected that this rodent accidentally walked into traps placed in the runways, rather than being attracted to the traps by the bait.

Gay (1847:105) suggested that these animals may hibernate in winter, but this is refuted by Osgood (1943:112), as well as by my evidence. In late spring I found a large quantity of feces scattered on the ground in front of a burrow (see Plate 8b). All of this material was in approximately the same state of decomposition. This suggested that the animals were active during winter and deposited feces from time to time outside their burrows, perhaps under the snow.

Osgood reported the capture of young animals in November, as well as a female with two large fetuses. A female which I trapped

in November had 5 embryos, the longest being 50 millimeters in head-crown length; another female trapped in February was not pregnant or lactating.

Measurements of an adult male (MSU #6347) and 2 adult females, (MSU #6346, #6348) from 27 kilometers west-northwest of Angol, are as follows: total length, 224, 250, 223; length of tail vertebrae, 69, 78, 70; length of hind foot, 30, 33, 30; height of ear from notch, 21, 18, 20; greatest length of skull, 40, ---, 39; condylobasal length, 37.3, 38.8, 36.5; zygomatic breadth, 22.4, 22.9, 22.7; breadth of braincase, 15.7, 14.9, 15.8; breadth of rostrum, 8.3, 8.3, 8.3; length of diastema, 9.2, 9.9, 9.2; alveolar length of maxillary tooth row, 9.8, 9.9, 9.7; weight in grams, 118.9, 135.3, 152.2 (pregnant).

Specimens examined.-- Total, 4 from: Parque Nacional de Nahuelbuta, 27 Km. WNW Angol, 1110 m., 1 and at 1155 m., 2; Laguna Malleco, 25 Km. N Curacautín, 9.5 m., 1. Other records: Sierra Nahuelbuta, 14; Pinares, Lonquimay (erroneously placed in Cautín Province by Osgood), 1 (Osgood, 1943:113).

Tunduco, Tucotuco del Maule

Ctenomys maulinus brunneus Osgood

Distribution.-- Throughout the Andes.

Remarks.-- Following Osgood (1943:127), I assign all of the specimens of Ctenomys maulinus examined from Malleco to the subspecies C. m. brunneus. Most of my collections were made from somewhat higher elevations than the vicinity of the Río Colorado from where the type specimen for the subspecies was obtained,

although in similarly forested areas.

Tunducos which I trapped in black, granular volcanic sands at the Paso de las Raices (see Plate 5a) average darker than those taken in the pale colored alluvial soils in the valleys of the Río Bío Bío (see Plate 5b) and the Río Lonquimay, and areas near the Paso Pino Hachado. Specimens trapped near the Paso Pino Hachado (leading into Argentina) have reddish upperparts, while those from lower elevations have brownish upperparts.

The range of the Chilean Ctenomys, except for a species living in the northern desert, is restricted to mountainous areas of the Andes. In Malleco, C. maulinus lives in deep soils along the Río Bío Bío from near Lago Icalma downstream to the mouth of the Río Ranquil. Between the mouth of the Río Ranquil and the Central Valley, the Río Bío Bío flows through steep canyons where the soil is shallow and rocky. The absence of suitable soils for burrows in these canyons appears to bar the movement of C. maulinus into the Central Valley via the Río Bío Bío valley. The western slopes of the front range of the Andes in Malleco are rocky and mostly of volcanic origin with evidence of recent lava flows. Some areas at lower elevations in the Andean foothills seem suitable for these animals, but although abundant at higher elevations, they are either unable to traverse the rocky slopes to these isolated areas, or cannot adapt to the different environment. Except for the volcanic sands in the Paso de las Raices, the ñirre (Nothofagus antarctica)-grassland habitat seems to be preferred by these burrowers.

Burrow systems were excavated at the Paso de las Raices and at

Lago Icalma. Their total lengths were 49 meters and 14 meters respectively; their galleries averaged 20 centimeters (15-30) and 30 centimeters (15-45) below the ground surface. There was an average of one entrance for each 1.8 meters of tunnel in the burrow system at the Paso de las Raices, and cut vegetation was not found anywhere in this burrow. In contrast, in the burrow system at Lago Icalma there were 3 entrances in 14 meters of tunnel and there were cuttings of grass and herbs. Shrubs which commonly have their root systems near burrows of C. maulinus are Ribes sp., Berberis spp., Chusquea sp., and species of Rhamnaceae. The severed tops of the following herbs were in one burrow: Senecio spp., Mulinum sp., Vicia sp., and Baccharis sp. Other herbs found in close association with the burrow locations were Rumex sp., Fragaria sp., Euphorbia sp., Acaena sp., and Trifolium sp.

Residents in the Andes did not know the animal by the name, "tucu-tucu", used widely in scientific literature, but as "tunduco". The people know the animal by its burrows, rather than by the animal itself.

A specimen was caught alive near its burrow after a chase across a road in the early morning west of Paso Pino Hachado. This suggests that the animals may move about on the surface, at least during daylight. Pearson (1959:28,29) remarked on the prolonged diurnal activities of C. opinus and C. peruanus. The specimen which I caught alive ate potato while in captivity. I found the flesh of the animals to be tasty, but local people did not use them for food.

At Lago Icalma on 10 April a male and female were taken in the

same trap a few hours apart. Of 43 animals trapped, 25 were females, and none was pregnant in February, March, April, July or December.

Specimens examined.-- Total, 44, from: 40 Km. NNE Lonquimay, 1220 m. (approx.), 14 (skins only); 10 Km. WNW Lonquimay, 1555 m., 2; 11.3 Km. W Lonquimay, 1585 m., 5; 13.3 Km. W Lonquimay, 1650 m., 3; 2 Km. E Lonquimay, 1007 m., 1; 20 Km. W Paso Pino Hachado, 1170 m., 2; 17.6 Km. W Paso Pino Hachado, 1280 m., 1; 16.7 Km. W Paso Pino Hachado, 1372 m., 1; 15.2 Km. W Paso Pino Hachado, 1465 m., 3; 9.4 Km. W Paso Pino Hachado, 1555 m., 2; 6.0 Km. W Paso Pino Hachado, 1650 m., 1; 3.5 Km. W Paso Pino Hachado, 1740 m., 1; 1.7 Km. W Paso Pino Hachado, 1830 m., 2; Lago Icalma, 1190 m., 6. Other records: "west of Lonquimay", 2; Río Colorado, 915 m., 2 (Osgood, 1943:125-127).

Culpeo

Dusicyon culpaeus culpaeus (Molina)

Distribution.-- Throughout the province.

Remarks.-- The culpeo is the most widespread and largest canid in Malleco, and lives in open or cultivated lands and wooded areas in the Central Valley, and rocky slopes in mountainous regions. A comprehensive study by Crespo and DeCarlo (1963) of 257 culpeos captured in Neuquen Province, Argentina (adjacent to the eastern border of Malleco) has added much to our knowledge of this animal's biology; many of Crespo's findings are applicable to culpeos in Malleco.

Culpeos were sighted several times during field excursions. One was observed at night on a steep, heavily grazed slope of the

Cordón Litrancura east of Lonquimay, an area also frequented by European hares; two of these canids were seen at dusk running in the road about 20 kilometers east of Collipulli in the Central Valley, and another was seen at midday among rocks by a mountain road near Contulmo.

Local people reported that the culpeo does little harm, except for eating chickens occasionally. Generally, residents considered that culpeos benefit the farmer by preying on the European hare which causes widespread damage to their crops. The smaller chilla (Dusicyon griseus) and the culpeo were reported by local people as occurring in the same areas, the culpeo being the more abundant.

Average and extreme measurements are the following (the last numeral indicates the number of specimens measured): total length, 1172.5 (1110-124), 6; length of tail vertebrae, 439.5 (422-465), 6; length of hind foot, 176.3 (165-190) 6; height of ear from notch, 98.9 (95-103), 6; weight, 8600, 1. Greatest length of skull, 152.2 (143.6-163.5), 8; zygomatic breadth, 84.8 (79.1-90.7), 6; breadth of braincase, 49.5 (47.8-52.7), 8; alveolar length of maxillary tooth row, 58.3 (54.2-64.5), 8; least interorbital breadth, 25.8 (20.8-29.2), 8; breadth of rostrum, 26.9 (25.2-29.5), 8; condylo-basal length, 161.7 (154.0-173.1), 7.

Specimens examined.-- Total, 11, from: Nacimiento (Bío Bío Province), 4; Fundo Los Copihues, 15 Km. NW Angol, 472 m., 2; 10 Km. SE Angol, 1; 15 Km. E. Purén, 61 m., 1; Troyo, 980 m., 2 (skins only); east of Curacautín, 734 m., 1.

Chilla

Dusicyon griseus griseus (Philippi)

Distribution.-- Throughout the province; absent from high elevations in the Andes.

Remarks.-- Osgood (1943:68) reported that before the time of his study the chilla was abundant throughout its range, especially in Argentina, but that by 1943 their numbers were greatly reduced. He remarked that the chilla's range was limited to open, grassy lands and that this species rarely occurred in the Andes, even in the foothills. Although none of my specimens was taken at above 470 meters elevation in the Andes, I did receive reports from local residents that the chilla occurs at least as high as 1,220 meters. The chilla is less abundant than the culpeo (Dusicyon culpaeus) according to reports by residents of Malleco.

Two specimens brought to the Museo Dillman S. Bullock were taken in bushy, hilly country; one was shot on a farm in the foothills of the Cordillera de Nahuelbuta, and the other at the base of the foothills of the Andes. The foreman at the Fundo Huitanlebu (in the Central Valley near the Nahuelbuta) reported that the chilla generally remains in the hills (Nahuelbuta) because of the greater abundance of small birds and other animals there, and, unlike the culpeo, seldom causes damage on the farm.

External measurements of an adult male (MSU #6294) are as follows: total length, 1030; length of tail vertebrae, 370; length of hind foot, 160; height of ear from notch, 85; weight, 5450. Cranial measurements of two adult males (MSU #6290, #6294) are as follows:

total length, 1030; length of tail vertebrae, 370; length of hind foot, 160; height of ear from notch, 85; weight, 5450. Cranial measurements of two adult males (MSU #6290, #6294) are as follows: greatest length of skull, 117.4, 129.9; condylobasal length, 128.0, 141.3; zygomatic breadth, 67.7, 73.2; breadth of braincase, 44.1, 46.0; alveolar length of maxillary tooth row, 45.1, 51.2; least interorbital breadth, 22.5, 20.5; breadth of rostrum, 19.2, 22.9; crown length of carnassial tooth, 12.9, 13.4; length of baculum (MSU #6294), 59.2, and width, 4.2.

Specimens examined.-- Total, 5, from: 22 Km. SE Mulchén, 472 m., (Bío Bío Province to the north of Malleco), 1; Nahuelbuta, Angol, 1 (skull); Angol, 2 (skulls); Fundo Santa Abela, Los Sauces, 1. Other records: Curacautín, Malleco, 1 (Osgood, 1943:71).

Grison; Quique, Huron

Galictis cuja cuja Molina

Distribution.-- Mountainous areas throughout Malleco.

Remarks.-- The grison, or quique as it is known by Chileans (it is also called hurón by Indians near the Argentine-Chilean border), occurs in brushy areas below timberline in the Cordillera de los Andes and in the Cordillera de Nahuelbuta. No reports were obtained of its occurrence in the Central Valley.

A resident at Jauja in the foothills of the Andes reported killing three of these animals as they hid together in a hollow tree. A policeman gave me the skin of a quique which had been killed by his dogs in the rocks near Lago Icalma. The animal also

was reported to live among rocks along the Río Bío Bío north of Lonquimay. At Troyo, it was seen near human habitation more commonly in winter (June, July, August) than in summer. Residents in mountainous areas reported that the quique does no appreciable damage to poultry or other stock.

I obtained a live quique in August from a cowboy who captured it on the Fundo Los Copihues, 15 kilometers northwest of Angol, 762 meters elevation. Reportedly, a dog tracked this animal and it was captured with a snare from a burrow among rocks and roots of an avellano (Guevina avellana) on an incline (about 30° slope) in a roble (Nothofagus obliqua) woods. Three other quiques were reported killed at the same time and another was left alive in the burrow. An inspection at a later date of the burrow system from which the animal was taken revealed three adjacent entrances, one of which measured 36 centimeters wide and 20 centimeters high. One burrow was approximately 15 centimeters in diameter, one meter from its entrance. The entrances to the burrow system were partially obscured by leaves of a large bromelid (Greiga sp.). Trees in the vicinity were peumo (Cryptocarya alba), lingue (Persea lingue), and avellano.

Behavior in captivity.-- Between 25 August and 12 December 1961, the captured male animal was kept in a specially designed cage (Greer, 1965b) which permitted weighing, measuring food consumption, and collecting urine and feces. Some results of the investigation follow. Weight at time of capture was 1,225 grams; weight while on unlimited food rations 3 days after capture was 1,488 grams, showing a gain of 263 (21.5 per cent); the greatest amount

of meat eaten in one day was 444 grams (31.8 per cent of its body weight). Its weight reached 1,700 grams on an unlimited supply of meat; after 9 days of eating exactly 250 grams of meat per day, it gained 90 grams. Its food consisted of heart, tongue, ox lung and spleen, fox meat, spurwing lapwing and barn owl, a common snake (Dromicus chamionis), and fish heads; during a forced fasting period, an apple was offered but not taken. The quantity of excreted urine varied between 74 and 177 cc daily when on a meat diet, and between 5 and 10 cc daily during a forced fasting period; the weight of feces varied between 8 and 31 grams daily when on a meat diet. Weight loss after 6 days of forced fasting was 341 grams (20.6 per cent of its body weight at the beginning of the fasting period). Some normal values (in mEq X Lt) for cations in the urine were determined by Dr. Guillermo Mann of Santiago, Chile, to be for Na: 80.7, 89.0, 97.5; and for K: 27.0, 29.8, 16.0.

Dalquest and Roberts (1951:359-366) remarked on the docile behavior of a tamed grison (Galictis canaster) which was taken into captivity as a young animal. Osgood (1943:93) noted that natives used tamed grisons to drive chinchillas from their burrows in the Andes. Walker (1964:1199) reported that young grisons tame readily and make affectionate pets. My captive animal, unlike the above, was pugnacious. During 70 days in which I observed the behavior of this adult male, it constantly emitted sharp, guttural barking noises while I was in the room where the cage was kept. This noise intensified when the animal was weighed or fed.

During the final days of the animal's life, it was put on public display in the Museo Dillman S. Bullock at El Vergel in a cage

which had a glass top and front. The animal was in a constant frenzy and charged all observers. After eight days on display it became sick and died.

Measurements of two adults from the Nahuelbuta, the first a male from 15 Km. NW Angol, the second an unsexed skull, are as follows: greatest length of skull, 71.2, 63.0; condylobasal length, 77.5, 65.3; zygomatic breadth, 43.2, 40.0; least interorbital breadth, 17.3, 15.6; breadth of brain case, 36.2, 33.5; length of palate, 34.7, 30.8; alveolar length of maxillary tooth row, 15.2, 14.8; width of M^3 , 6.6, 4.9. The external measurements of the male were the following: total length, 601; length of tail vertebrae, 175; length of hind foot, 67; height of ear from notch, 30; length of the baculum, 41.3.

Specimens examined.-- Total, 8, from: 15 Km. NW Angol, 610 m., 1 (skull); Angol, 2 (skins); Nahuelbuta, 1 (skull); 40 Km. NNE Lonquimay, 1220 m., 2 (skins); Río Lonquimay, 980 m., 1 (skin); Lago Icalma, 1190 m., 1.

Skunk; Chingue común

Conepatus chinga Molina

Distribution.-- In the Cordillera de Nahuelbuta and Cordillera de los Andes.

Remarks.-- Specimens examined from the Cordillera de Nahuelbuta are assigned to the race Conepatus chinga chinga Molina on the basis of the terminal half of the tail being wholly white to the roots of the hairs. A skin from the Nahuelbuta on display in the

Museo Dillman S. Bullock has the two white stripes joining across the back of the head, and extending down the sides to the rump, and the terminal half of the tail is white. A skunk found dead in the road at 30 kilometers west of Curacautín, 590 meters elevation, seems best referred to C. c. mendosus Thomas on the basis of the lateral stripes being interrupted on the back and appearing again on the rump as two white patches.

Measurements for Conepatus chinga chinga Molina of 2 skulls (MSU nos. 6303, 6304) from 27 kilometers west-northwest of Angol and a skull (MSU no. 6305) from "Angol", are as follows: greatest length, 64.0, ---, 65.2; condylobasal length, 68.3, ---, 70.8; breadth of brain case, 33.0, 31.2, 32.0; least interorbital breadth, 19.7, ---, 18.5; length of palate, ---, ---, 30.1; alveolar length of maxillary tooth row, 15.2, ---, 15.7; width of crown of M^3 , 7.1, ---, 7.1.

Measurements for Conepatus chinga mendosus Thomas of a skin and broken skull (MSU no. 6307) from 30 Km. west of Curacautín, are the following: length of hind foot (dry), 70; alveolar length of maxillary tooth row, 16.1; width of M^3 , 7.4.

Specimens examined.-- Conepatus chinga mendosus Thomas, 1, from 30 kilometers west of Curacautín, 595 m.

Conepatus chinga chinga (Molina), total, 4, from: 27 Km. W Angol, 1110 m., 2; Angol, 2 (1 skin, immature); Nahuelbuta Angol, 1 (Museo Dillman S. Bullock).

Skunk; Chingue, Zorina

Conepatus humboldti Gray

Distribution.-- The Cordillera de los Andes.

Remarks.-- A skin of this skunk, stuffed with sawdust, was given to me in Lonquimay by a butcher, who said it came from the valley of the Río Lonquimay. The skin, although slightly soiled, agrees with the description by Osgood (1943:95) for this species in that the base color is blackish-brown, and two white stripes are united on the head and well-separated on the back. The presence of this skunk in the valley of the Río Lonquimay, a tributary of the Río Bío Bío suggests a connection across the Andes with the forms in Argentina. A specimen taken at Temuco in 1907 by D. S. Bullock is similar to the above specimen, except that the blackish-brown color is faded. Probably, there are connections between the Andean form, and those in the Central Valley.

Specimens examined.-- Total, 2, from: Valley of Río Lonquimay, 980 m., 1; Temuco (Cautín Province), 1.

River otter; Huillín

Lutra provocax Thomas

Distribution.-- Waterways in the Central Valley; however, the animal may be entirely extirpated.

Remarks.-- None of these animals was seen alive or was collected by me in Malleco Province. However, the otter may still exist along some streams in the Cordillera de los Andes, Central Valley, and Cordillera de Nahuelbuta which flow southward into the Río Imperial

in Cautín Province.

Residents of various localities along some of the rivers in Malleco were questioned about the presence of the animal. Near Jauja, a resident reported seeing an otter in the Río Renaico in 1960, and told me that one was hooked on fishing tackle. A former student at the El Vergel agricultural school reported seeing an otter in the Río Malleco near El Vergel "many years ago". Mr. Santiago Bachman, an agriculturist and lumberman from near Galvarino, reported otters in the Río Quillén in times past. The otter was unknown to residents questioned at Lago Icalma at the headwaters of the Río Bío Bío in the Andes, but 12 kilometers downstream, local residents reported having seen the animal in "past years". A storekeeper at Troyo saw an otter at the junction of the Río Ranquil and Río Bío Bío in 1961. A resident living 20 kilometers north of Lonquimay at 1,190 meters reported a breeding pair in the Río Bío Bío.

Some local observers may have confused the otter with the nutria (Myocastor coypus) which also occurs in many of these same rivers, but the reports I received suggested that in past times the Río Bío Bío and its larger tributaries, and the Río Imperial drainage in Malleco harbored otter, at least until heavy hunting pressure all but exterminated them.

Specimens examined.-- One, from Temuco (Cautín Province) taken by D. S. Bullock, April 17, 1908 (MSU no. 9654, a mounted skin without a skull).

Chilean forest puma; León, Puma

Felis concolor araucana Osgood

Distribution.-- Throughout Malleco except in flatlands in the Central Valley.

Remarks.-- Forested areas in all parts of Malleco Province are likely home sites of this largest of Chilean carnivores. Near Tijeral, pine plantations are used for cover by marauding lions in search of farm animals. Local residents throughout the province report the presence of the puma in areas that have been extensively cleared of timber, as well as in forests of Araucarian pine (Araucaria araucana), coihue (Nothofagus dombeyi), and raulí (N. alpina) and the highland areas of the Cordillera de los Andes where the low shrub-like ñirre (Nothofagus antarctica) is the prominent plant form.

Pumas of Malleco are small with an average weight of about 25 kilograms as adults. Measurements of 4 adults from the Cordillera de Nahuelbuta are listed in Table 10. They were collected by D. S. Bullock, and as untanned skins probably exhibit more natural color than tanned specimens. Following the classification of Sanborn (1954:126-128), I note that 3 skins (MSU nos. 6321, 6324, 2325) are in the red phase and one (MSU no. 6322) is in the gray phase. Measurements of animals from the same region are listed by Sanborn (op.cit.:127).

The puma was reputed to prey on domestic animals in every locality where local residents reported its presence. Sheep, especially stragglers, are the preferred food, according to reports, with

Table 10. Measurements of female Chilean Felis concolor from the Cordillera de Nahuelbuta, collected by D. S. Bullock

	no.6321	no.6322	no.6324	no.6325
Total length	1580	1570	1440	1610
Length of tail vertebrae	575	595	540	577
Length of hind foot	220	225	255	225
Height of ear from notch	82	83	90	83
Greatest length of skull	161.2	164.3	155.8	167.2
Condylbasal length	148.8	150.0	145.3	154.4
Zygomatic breadth	114.0	113.0	-	113.0
Least interorbital breadth	35.7	33.4	30.1	33.7
Post orbital breadth	48.9	43.3	47.7	41.7
Length of nasals	36.3	38.3	-	37.2
Mastoid breadth	70.0	68.4	63.8	69.1
Length of palate	55.6	66.5	65.3	69.5
Length of carnassial crown	19.4	20.4	21.1	20.6
Alveolar length of maxillary tooth row	39.7	40.9	39.6	41.3

calves, colts, and goats also alleged victims of puma attacks. Sheep remains were found in the stomach of a female puma killed at the Fundo La Boyanco, 10 kilometers south of Angol. Seemingly, there is a large number of pumas in the Cordillera de Nahuelbuta. For example, it was reported that 15 pumas were killed on the Fundo Copihues, 15 kilometers northwest of Angol, 610 meters elevation, in 1961. Reportedly, dogs used to hunt pumas often kill them.

A young male puma was kept in captivity at El Vergel between 5 September 1961 and 31 October 1961 and then caged at a neighboring farm until its death in May in 1962. It was found as a young kitten, with a broken leg, wandering in a road in the Andean foothills. Its age at time of capture was estimated to be 5 weeks.

While at El Vergel, the puma was raised as a pet in my apartment where it was uncaged. However for two hours daily it was kept on public display in a glass cage in the Museo Dillman S. Bullock and occasionally it was taken outdoors for exercise.

A splint was applied to the broken leg, but would not stay in place because of the puma's lively activities. The splint was removed after the second week and at no time did the fracture appear to cause discomfort. Seemingly, it healed after a month had passed. Between 24 September and 12 October the cat became ill and occasionally vomited mucus and nematodes; nematodes also were in its feces. Piperazine was administered in the puma's food and the animal's condition improved.

At first, the puma was hesitant to eat, but would take milk from an eye dropper. It soon learned to eat from a saucer and its diet included such foods as milk, oatmeal or farina, sugar, and, on

occasion, small amounts of meat. The meat content of its diet was gradually increased until by the end of October, it was eating from between 500 and 800 grams of meat daily. During 40 days in captivity the cat gained 1,900 grams and grew in external dimensions (see Figure 5).

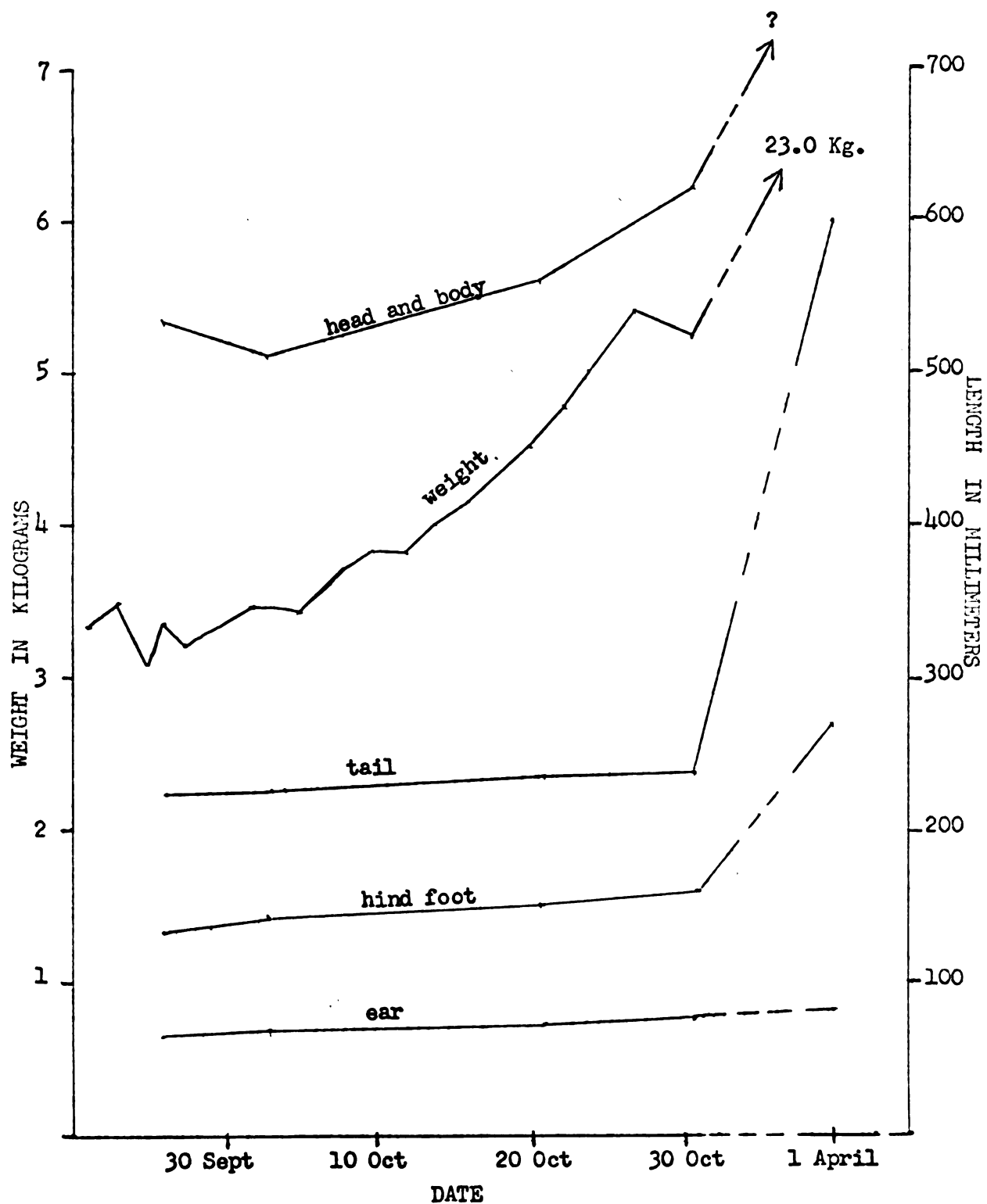
The puma learned rapidly what freedoms it was permitted as a pet in the confines of the apartment, and was disciplined by being slapped with a newspaper or a thin wooden slat. It evidenced no "remorse" when being punished and usually reacted by laying back its ears, hissing, and trying to avoid the blows. It learned generally what was expected during its enforced domestication. Usually, the only time it tended to be ferocious was when bothered while eating.

Generally, the puma greatly disliked being restrained, but thrived on rough play. It liked to be thrown on its back where it could play at biting and at using its hind paws. Another game was for it to stalk me as I would ascend the steps to my living quarters. The puma would sit waiting by the doorway of the apartment and pounce on my legs when I entered the room.

Occasionally it was released outdoors, but seemed afraid in the new surroundings. It would pace uncertainly about, pawing at the door of the museum, seemingly anxious to be back indoors. Vocalizing consisted of a high squeaking noise (see also, Rabb, 1959: 116-117), very similar to the noise made by a Chilean spurwing lapwing chick also kept in a cage in the apartment.

After sending the puma to a neighboring farm, the animal recognized me on sight even though I visited it infrequently in its new

Figure 5. Rate of weight gain and external growth in a Chilean Forest Puma from Malleco Province, Chile.



home. It also recognized me by smell from a short distance, and as I approached its cage, it would begin squeaking before it saw me and then bound toward me in greeting. It would first grab my legs with its front paws and nuzzle me with its head for about 30 seconds before beginning rough play in the old manner. The new owners reported that the animal normally was "fierce" and did not behave in a very tame manner toward anyone.

On April 2, the puma escaped from his cage and in the process of being captured rebroke its leg. As before, there was apparently no discomfort in the affected area as the puma remained quiet while a plaster cast was applied to the leg. The puma eventually chewed off the case and due to a subsequent infection in the leg had to be destroyed.

Specimens examined.-- Total, 5, from: Angol, 1; Nahuelbuta, Angol, 1; La Boyanco, 10 Km. S Angol, 3.

Other records: "Fdo. Maitenrehue", Sierra Nahuelbuta, west of Angol, 5 (Osgood, 1943:78); Angol, 2; Angol, Nahuelbuta, 2; Angol, Vegas Blancas, 2; Angol, Chanleo, 2 (Phillip HersHKovitz, letter to Rollin Baker, 25 Jan. 1965).

Guiña, Gato montéz

Felis guigna guigna Molina

Distribution.-- Throughout Malleco Province.

Remarks.-- The guiña is about the size of a housecat and occurs in wooded and semi-open areas in the Central Valley, as well as in forested regions in the Nahuelbuta and the Andes. It is locally abundant and commonly found near human habitations.

Guiñas frequently are melanistic. Two of 9 specimens which I examined from Malleco Province were dark. Philippi reported that of 4 specimens in the museum at Valdivia, 2 were entirely black (in Allen, 1919:362). The forest ranger at Laguna Malleco reported two cats, a guiña and a "gato montéz". It seemed from his descriptions that both were guiñas, and that one of these was melanistic.

In some places guiñas attack livestock, especially the young of goats, hence it is hunted when its presence is suspected. At 60 kilometers east of Los Angeles (Bío Bío Province north of Malleco), a guiña was treed by dogs, knocked from the tree by boys using sticks, and killed by the dogs. A female in lactation taken similarly at El Vergel had the remains of two rodents (Rattus sp.) in its stomach; the stomach of another guiña contained a rat (Rattus sp.) and unidentified feathers. Tapeworms were found in the small intestines of both animals.

Measurements of 3 adults (1 male, 2 females) from El Vergel are the following: total length, 706, 695, 690; length of tail vertebrae, 226, 235, 220; length of hind foot, 104, 106, 101; height of ear from notch, 45, 49, 48; weight, 2500, 2121, 2083. Average and

extreme measurements of the skulls of 5 adults are the following (final numeral indicates number of specimens measured): greatest length, 85.9 (82.6-89.6) 4; condylobasal length, 80.8 (77.4-84.5) 4; zygomatic breadth, 55.2 (53.5-57.7) 5; mastoidal breadth, 35.1 (33.4-36.5) 4; least interorbital breadth, 16.0 (15.0-16.6) 5; postorbital constriction, 23.5 (22.1-24.9) 5; length of palate, 30.8 (28.8-32.1) 5; length of nasals, 13.2 (11.2-14.6) 5; alveolar length of maxillary tooth row, 16.0 (15.3-16.7) 5; length of upper carnassial tooth (crown), 9.7 (9.6-10.0) 5.

Specimens examined.-- Total, 9, from: Nahuelbuta, 1; 5 Km. S Angol, 76 m., 3; Angol, 4; Ercilla, 1.

Pudu, Venado

Pudu pudu Molina

Distribution.-- In the Cordillera de Nahuelbuta and in the Cordillera de los Andes at moderate elevations.

Remarks.-- The pudu occurs in forested areas where the terrain is rough and undergrowth is thick. Local residents report that this deer is present in most parts of the Andean foothills east of the Central Valley, Osgood (1943:229) reported the pudu as "common at lower levels" in the Cordillera de Nahuelbuta. It is now rare in all parts of this mountainous area.

A local resident pointed out an area in the Nahuelbuta where he had seen a pudu in January, 1961. This area was rocky and steep with a dense growth of young roble (Nothofagus obliqua) and cane (Chusquea sp.). The campesino reported that the pudus do not change

places of habitation and are in the area in equal numbers in all seasons. Pudu, although reportedly shy, are seen by the forest ranger at the Laguna Malleco near his house in winter. This area is heavily forested with coihue (Nothofagus dombeyi), raulí (N. alpina), and roble, along with dense patches of cane. A resident from near Galvarino reported that the pudu forages on the fruit of avellano (Guevina avellana) and a shrub of the Myrtaceae family having succulent berries.

I saw two captive adults living in a garden of a residence in Angol. They had been caught while young in the Cordillera de Nahuelbuta. They seemed to be gentle and had been trained to wear collars and be led by a leash. Gay (1847:158) remarked that pudu are easily domesticated and often are found in houses. The captive animals ate apples principally. Measurements of five Mallecan specimens are in Table 11.

Specimens examined.-- Total, 7, from: Angol, 1; Nahuelbuta, Angol, 5; 10 Km. W Galvarino, 61 m., 1. Other record, 1, from Vega Blanca, Sierra Nahuelbuta (Osgood, 1943:231).

Table 11. Measurements of skulls of Pudu pudu Molina from Malleco Province, Chile.

Measurements	no.7538 male	no.7540 male	no.7542 male	no.7539 female	no.7541 female
Greatest length	-	126.2	125.0	88.7	69.9
Zygomatic breadth	-	64.7	-	51.6	39.5
Least interorbital breadth	29.7	30.4	29.1	24.3	19.5
Breadth of braincase	47.6	49.4	-	44.9	39.1
Alveolar length of maxillary tooth row	43.8	46.0	42.6	29.9	23.2
Antler length from frontal bone (right)	60.0	51.3	70.8	-	-
Antler length from frontal bone (left)	70.5	73.3	64.2	-	-

No.7542 is from 10 Km. W Galvarino; others from "Nahuelbuta, Angol".

ADDITIONAL RECORDS OF MAMMALS IN MALLECO

Additional records of mammals in Malleco will accumulate as more field workers venture into the newly accessible parts of the Andes. The following species may in the future be found by investigators:

Desmodus rotundus

Histiotus macrotus

Zaedyus pichiy

Spalacopus cyanus

Notiomys megalonyx

Felis pajeros

SUMMARY

Field study of mammals in Malleco Province, Chile, sponsored by The Museum, Michigan State University, and the Museo Dillman S. Bullock, El Vergel, Angol, Chile, was carried out from November, 1960, to May, 1962. Various aspects of the distribution and ecology of mammals of this little-studied part of south central Chile were investigated for the purpose of contributing to the knowledge of the natural history of this region.

Thirty-nine kinds (species and subspecies) of wild mammals belonging to 31 native species and 5 introduced species were collected or reported in Malleco. The 24 genera of native mammals may be arranged as follows: cosmopolites, 4; Nearctic-Neotropical varicants, 2; excurrent Neotropical regionalites, 2; and endemic Neotropical regionalites, 16; of the latter, 11 are endemic to the Patagonian Subregion.

The relationship of the mammalian fauna to that of provinces north and south of Malleco seems to be correlated with the transitional characteristics of the vegetation, i.e., the northern xerophilic vegetation and drier climate interdigitating with the southern lush vegetation and greater rainfall. Twenty (65 per cent) of the 31 species in Malleco occupy areas in the provinces to both the north and south, whereas 11 (35 per cent) are identified with the mammalian fauna only to the north (4) or only to the south (7) of Malleco. Of the 25 polytypic species in Malleco, 11

are indistinguishable from subspecies in the provinces both to the north and south of Malleco, whereas more than half (14) are distinguishable from the subspecies either to the north or south of Malleco.

Twenty-nine (94 per cent) of the 31 Mallecan species of mammals occur east of the continental divide in Neuquen, Argentina; thus it appears that the Cordillera de los Andes in this region only slightly impedes the east-west movement of animals. Based on this information, it would appear that climatic and, to a lesser extent, physiographic factors, operating principally on vegetation have influenced north-south distribution more than east-west distribution.

Of the Mallecan mammals, Oryzomys longicaudatus, Akodon longipilis, and Akodon olivaceus are the most common and widespread rodents. Oryzomys longicaudatus is the most ubiquitous rodent, and prefers a shrubby habitat, especially blackberry thickets, which are early invaders of cleared lands throughout Malleco. Akodon olivaceus is the most commonly trapped rodent in the Central Valley grasslands; Akodon longipilis, common in mountainous areas and absent from the Central Valley, is most numerous in partially cleared forests which have denser ground cover than the virgin forests.

Population densities per hectare of Akodon longipilis taken in 4 Andean areas were: 41 individuals in an uncut coihue (Nothofagus dombeyi) forest and 58 (estimated to be between 58 and 123) individuals in a partly cut coihue forest, and 50 (estimated between 50 and 113) individuals in an Araucarian pine forest with cane (Chusquea) undergrowth, and 64 (estimated between 64 and 176) individuals in open firre-grassland. Due to low numbers taken, no density estimates were made on the other rodents.

Population density per hectare for Oryzomys longicaudatus trapped in the Central Valley was between 23 and 173, and for Akodon olivaceus, between 20 and 234. Specific trapsites where these two species were sympatric showed that Oryzomys longicaudatus preferred brushy areas and Akodon olivaceus grassy situations.

Hunting questionnaires answered by members of the Hunting Club of Angol showed that robins, doves, parrots, tinamous, and quail (in that order) were the most frequently killed birds and that the European rabbit and European hare were the most frequently hunted mammals. The wild pigeon is no longer abundant, and the otter seems to be extirpated from its former range in Malleco.

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Appendix 1. Analysis of samples of soil from different localities in Malleco Province

Sample #	Locality, Elevation, Brief Description.	Level of Sample (inches)	Pounds per Acre Available					Exchange Capacity	% Saturation			% Base Saturation
			pH	P	K	Ca	Mg		K	Ca	Mg	
S1	27 Km.W Angol,3650' flat meadow	3	4.9	.014	48	80	3	7.2	0.8	2.7	2.7	-
S2	27 Km.W Angol,3650' flat meadow	6	5.1	.01	280	436	27	13.4	2.6	7.4	0.7	-
S3	27 Km.W Angol,3650' flat meadow	24	4.9	.008	152	56	3	10.2	1.8	0.9	-	1.9
S4	27 Km.W Angol,3650' "coihue" woods	1	4.9	.018	244	472	46	18.5	1.6	5.9	0.5	8.1
S5	27 Km.W Angol,3650' "coihue-roble"woods	6	4.7	.014	128	64	3	16.2	0.9	0.6	1.2	-
S6	27 Km.W Angol,3650' "coihue-roble"woods	12	4.9	.009	96	40	3	13.2	0.9	0.7	1.5	-
S7	27 Km.W Angol,3650' "coihue-roble"woods	24	5.0	.008	80	48	11	12.2	0.8	0.8	1.6	-
S8	15 Km.NW Angol,1550' "roble"woods on slope	2	5.5	.031	176	1200	61	12.4	1.7	24.1	1.6	27.4
S9	15 Km.NW Angol,1550' grassy area in flat	2	5.4	.028	240	728	61	11.3	2.6	15.9	1.7	20.3
S10	2 Km. E Tirua,50' river valley	2	4.9	.023	88	224	27	14.7	0.7	3.4	0.6	4.7
S11	2 Km. E Tirua, 0' by river	2	4.8	.030	120	384	96	15.4	0.9	5.6	2.5	9.0
S12	7 Km.ESE Tirua,1350' "southern forest"	2	5.0	.011	248	448	138	19.9	1.5	5.5	2.5	9.5
S13	50 Km.ESE Collipulli, 1600',"roble"slope	2	5.7	.014	196	440	32	10.4	2.4	10.5	0.9	13.4
S14	50 Km.ESE Collipulli, 1600',flat area	2	5.6	.013	424	528	40	11.9	4.5	10.9	0.8	15.9
S15	4 Km.W Banos Rio Blanco, 3200',"southern forest" *	2	5.4	.011	160	1248	46	14.4	1.3	21.5	0.6	23.6
S16	11.5 Km.W Lonquimay, 5200',grassy area	2	5.8	-	88	624	46	6.7	1.6	22.3	1.4	25.3
S17	11.5 Km.W Lonquimay, 5200',Araucaria woods	2	5.4	-	64	280	27	7.8	1.0	8.9	1.2	10.2
S18	11.5 Km.W Lonquimay, 5200',volcanic sands	2	5.4	-	35	64	3	2.1	1.9	4.7	-	4.7
S19	19 Km.S Lonquimay,4400' "longa" woods	2	6.0	.016	100	4656	274	24.8	0.4	46.7	4.4	51.6
S20	19 Km.S Lonquimay,4400' Araucaria woods	2	5.3	.030	96	1920	93	21.2	0.5	22.6	1.4	24.5
S21	Laguna de Icalma,3900' grassy flat	2	5.7	.019	48	348	3	7.8	0.7	10.2	-	10.2
S22	Laguna de Icalma,3900' grassy slope	2	5.8	.027	88	660	40	8.9	1.2	19.1	1.1	21.3

* Soil high in organic matter.

Appendix 2. Hunting Questionnaire.

Museo Dillman S. Bullock
El Vergel, Angol

Sr. Cazador:

Podría ayudarnos a aprender algo más sobre los animales silvestres, contentando lo más que pueda acerca de las preguntas siguientes? No se necesita su nombre y las respuestas coincidieran con las de muchas otras. Haga el favor de dar a cada respuesta la mayor precisión que sea posible o aunque sea cálculo aproximado. Sírvese contestar el mayor número posible.

Cuál es su ocupación?

Tiene Ud. una escopeta? Qué tipo? De qué año?

Cuánto dinero gastó por MUNICIÓN durante los últimos 30 días?

Durante los últimos 3 meses?

Usa Ud. otros medios de cazar? Trampas? Guachis? Otros?

Si Ud. usa trampas, en qué ESTACIÓN del año las usa?

Cuántas usa a la vez? Cuántos animales caen durante un período de 3 días?

Si Ud. usa los guachis, cuántos usa a la vez? Cuántos animales caen durante un período de 3 días?

Cuántos DÍAS sale a cazar cada vez?

Cuando caza, cuántas HORAS al DÍA lo hace?

Tiene Ud. un perro para cazar? Es este usado SOLO para cazar?

Cuántos de los animales siguientes ha cazado Ud. durante los 3 meses pasados? Liebre? Conejo? Coypu? Zorro? Otro? (de qué tipo y número).

Vende Ud. por lo general LA CARNE de los animales que caza?

Conejo? Precio por cada una? Coypu? Precio? Liebre?

Precio? Zorro? Precio? Otro? Precio?

Si usa Ud. la piel, en qué forma la ocupa?

Cuántos de los pájaros siguientes ha cazado Ud. durante los 3 meses

pasados? Zorzal? Tórtola? Perdíz? Cordoníz? Choroy?

Patos? Otros?

Vende Ud. por lo general los pájaros que caza? Qué pájaro?

Qué precio cada pájaro? Zorzal? Tortola? Perdíz?

Cordorníz? Choroy? Otro?

Tiene Ud. un permiso de cazar?

Ha notado Ud. una DISMINUCIÓN en la cantidad de algunos animales o

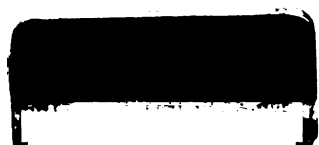
pájaros durante los últimos 15 años? Qué animal y en qué proporción? ($\frac{1}{2}$, $\frac{1}{4}$, etc.)

Ha notado Ud. un AUMENTO en cantidad de algunos animales o pájaros

durante los últimos 15 AÑOS? Qué animal y en que proporción?

(2 veces, 3 veces, etc.)

Caza Ud. para aprovechar o para deporte?



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