AN ENVIRONMENTAL APPROACH TO LAND CLASSIFICATION FOR OUTDOOR RECREATION

by

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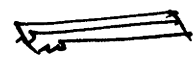
ORIGINALITY OF THESIS

This thesis is the author's own work except where specific acknowledgement is given.



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ABSTRACT

The importance of the Paddys River Catchment, A.C.T., for outdoor recreation has been discussed. The concept of recreation, the classification of recreational activities and conflict and compatibility arising between different recreational activities have been explained. Different approaches used to develop outdoor recreation capability classifications have been reviewed and a method for developing an outdoor recreation capability classification based on resource data has been suggested.

The different physical, biological and cultural resources of the catchment have been inventoried, described and mapped. Then on the basis of these findings, the catchment was divided into environmental units, where each unit has a degree of uniformity with respect to its resource data. The outdoor recreation capability of each unit was subjectively evaluated. By numerical weighting, with or without consideration given to conflicts or compatibilities existing between outdoor recreational activities, the environmental units were ranked to form some outdoor recreation capability classifications.

The methodology and application of the classification to the land use planning process have been discussed.

PART I

INTRODUCTION

CHAPTER I

RECREATION IN THE AUSTRALIAN CAPITAL TERRITORY

1.1 Growth of Demand

The expansion of Canberra (City district), from 20 Sq. ml. (52 Sq. Km) in 1909 to about 150 Sq. Ml. (388 Sq. Km) at present, is an indication of the rapid growth of Australia's National Capital. During the last decade this expansion has been hastened by the development of three new towns, Woden, Belconnen and Tuggeranong.

The current population of Canberra is approximately 188,000 (Australian Bureau of Statistics, 1975), and using a 7.6% annual growth rate, the National Capital Development Commission has projected the present population to about 400,000 in 1985 and 700,000 by the year 2000 (N.C.D.C. 1974, 1975).

The N.C.D.C. had planned to expand the border of the A.C.T. into New South Wales to meet this expected growth in the population. It would appear, however, that the boundaries will remain unaltered, so that Canberra's population will have to be absorbed within the A.C.T.'s existing border. Wright (1975) claims that if the N.C.D.C.'s plan, to expand Western Belconnen into N.S.W., is accepted at a later date, it will result in the A.C.T. being enlarged by some 50 per cent.

If the projected population has to live within the A.C.T.'s existing border, then it is conceivable that the trend will be towards medium and even high density accommodation on land within the present city boundary. If we take into consideration the predicted growth of the population and combine this with a greater degree of leisure time, then a much greater pressure is likely to be exerted in the future on the land available for outdoor recreation both in urban and rural areas of the A.C.T.

The increased leisure time available to the present population of Canberra, as a result of higher incomes, less work hours and more holidays, greater personal mobility and better education, has already contributed to the increasing demand for recreation facilities in the countryside over recent years.

This increase in demand for outdoor recreation (Boden 1971; For. Dept., A.N.U. 1973; Walker 1974), is reflected in such current activities as driving for pleasure, picnicking, sightseeing, fishing, bush walking, motor biking, cycling, horse riding, attending and watching, hunting and camping.

1.2 Availability of Recreation Outlets

The demand for the many forms of outdoor recreation will have to be met by a corresponding increase in the availability of recreation areas, as at present, the amount of land used exclusively for outdoor recreation in the A.C.T. is not great. Recreational land, excluding Lake Burley Griffin and foreshore, is 2.2% of the land area of the A.C.T. (Boden 1971).

Recreation outlets are, of course, available to the population of Canberra beyond the border of the A.C.T. and this diverts some of the pressure away from recreation areas within the A.C.T. Two major recreation areas used extensively by residents of the A.C.T. are the Kosciusko National Park, and the south coast of N.S.W.

Gurr (Forestry Department, A.N.U.) in an unpublished survey estimated that 13 to 20 per cent of the total visitors to the Kosciusko National Park (SW of the A.C.T., approximately 5 hours driving), are from the A.C.T. This National Park is one of Australia's largest and has an area of 612,166 hectares. This great mountain area of weathered snow-bound granite outcrops, alpine plateaus and steep forested ridges is best

known as a winter playground, having some of the finest and most extensive snow fields in Australia. The region is just as fascinating in summer when thousands of visitors tour the alpine roads, drive up almost to the highest peaks, fish for trout in the cold, clear streams and hike or ride on horseback across the high plains.

Another major outlet for the A.C.T. residents is Bateman's Bay, (south coast of N.S.W. and its environs about 3 hours by road from Canberra). Bateman's Bay is an area surrounded by wooded hills sloping to the water's edge. In some of its picturesque places, picnic facilities and boating services are available, together with extensive camping areas on the shores. Visitors can also enjoy swimming and fishing along the coast and adjacent rivers.

Several other recreation outlets also are available in surrounding N.S.W. for day trips for residents of the A.C.T., eg. Burrinjuck Dam, Wee Jasper Caves and Lake George.

1.3 The Importance of the Paddys River Catchment for Recreation[1]

The growth rate of Canberra's population, the large number of visitors to the A.C.T. (65% of total visitors to the A.C.T. come to recreate in rural A.C.T., N.C.D.C. 1972,) and the apparent demand for more outdoor recreation make it essential that sound management plans be developed for recreation in the A.C.T.

There are seven major catchments in the A.C.T. which could be expected to meet the increasing demands for outdoor recreation for many years to come. One of these is the Paddys River Catchment. This catch-

---

1. The literature indicates two differing ways of expressing Paddys River
   Paddy's River (Boden 1971)
   Paddys River (Strusz 1971)
   In this thesis Paddys River has been used.
   A similar variation in expressing Murrays Corner has been observed and it has been used in the same consistent manner.

ment, as Boden (1971) pointed out, is ranked with the Murrumbidgee River, Molonglo River and Ginninderra River Catchments, as unsuitable for use ~~as a~~ for domestic water catchment.

Several authors have suggested alternative uses for the catchment. King (1946) considered that there is no further possibility of expansion of farm land in this catchment, while reclamation of farm land towards soil conservation, afforestation and park land seems worthwhile objectives.

Ovington *et al.* (1970) and Boden (1971) claim that in the 1980's recreational pursuits, such as picnicking, sightseeing, fishing and driving for pleasure will be dominant and softwood timber production will be co-dominant in the catchment while agriculture, wild life conservation, research, and educational use of land will be sub-dominant. They also suggested that country settlement will remain at the existing level or perhaps even decline.

Ovington *et al.* (1970) suggested that"in the buffer zone around Tidbinbilla Tracking Station, an extensive park land could be ecologically and aesthetically pleasing."

According to Boden (1971), the mean and maximum daily flow of visitors to the catchment are highest after the Cotter Recreation Area. Visitors use the Paddys River Catchment primarily on weekends and holidays for outdoor recreation, but ~~continuous~~ weekday use has also been observed.

For Australians "life assumes meaning in the weekends and on holidays" (Horne, 1966), and the Paddys River Catchment with its diverse and picturesque landscapes, picnic areas, Nature Reserve, Tracking Station, circuit roads, and easy accessibility, is a focal point of attraction for many recreationists. The recreational demand for this area has increased rapidly over the last decade, e.g. the total number of

visitors to the Tidbinbilla Nature Reserve in 1966 was 9,700 (Boden 1971). In 1975 this figure had increased to 165,000 (Kerr, Personal Communication). If we accept the Tidbinbilla Nature Reserve as being representative of the trend in the demand for outdoor recreation, it would appear that the future of the catchment will centre largely on its recreational use.

1.4 The Necessity for a Management Plan

There has been no overall survey conducted of the natural resources or the recreational potential in the catchment. Except for the Tidbinbilla Nature Reserve, there is no management plan for the existing recreational facilities within the catchment. There are five picnic grounds in the catchment apart from those in the Tidbinbilla Nature Reserve. Their development and ~~continuous~~ maintenance is the responsibility of the Department of the Capital Territory (City Parks ~~and~~ Administration Branch). Routine maintenance is reliable but further developments only occur when a need becomes obvious. As there is no management plan for these picnic areas, all modifications to these sites are carried out on an *ad hoc* basis. There is little evidence of research, preparation of annual programs or reports on progress for recreation.

These picnic areas and the rest of the catchment (where public access is possible), are receiving considerable use by Canberra people and visitors to the A.C.T. As the number of visitors to the catchment is likely to increase in the future, the Paddys River Catchment, urgently needs a management plan for recreation.

In order that a land ~~use~~ *area* can be managed efficiently it is essential to obtain relevant information concerning the supply of the resources and the demand for it from which a suitable management plan can be prepared.

To determine the nature of supply two basic elements should be identified: (1) capability classification of land (qualitative measure), and (2) the land's carrying capacity (quantitative measure).

The capability of land does not fully indicate the overall situation of supply. It is only a preliminary indicator of supply which requires elaboration in terms of identification of the carrying capacity of land. This will then enable us to show the nature of supply.

A measure of recreation carrying capacity can be determined by measuring the level of degradation of the area. This would require a field observation over a long period of time combined with an adequate knowledge of resource data. A better solution may be to define "capacity standards" for each recreational activity and to quantitatively express the suitability of land for recreation. Unfortunately, this technique also requires measurement over an extended period.

In this study, an outdoor recreation capability classification of land has been developed. Because of the limitation of time available for the study and the lack of adequate resource data the author has been unable to consider the recreation carrying capacity of land. Further research into this important area is strongly recommended.

CHAPTER 2

TERMINOLOGY AND DEFINITION

2.1 Concept of Recreation

It is perhaps appropriate to define and explain some of the terminologies and concepts of recreation and land capability classification for recreation.

The term recreation is subject to a great variety of interpretations. Bulcock (in Brockman 1959) defined recreation as "the pleasurable and constructive use of leisure time". The Countryside Recreation Glossary (1970) defined it as "any pursuit engaged upon during leisure other than pursuits to which people are normally highly committed". Sanders (1973) stated that recreation is the activity to which children and adults spontaneously turn in their leisure time. Margules and Deverson (1974) defined recreation as "the pursuit of a self-motivated leisure activity in non-obligated time. It is the use of leisure for diversion, self expression and cultural enrichment, and the promotion of physical, mental and spiritual well being".

It seems there is general agreement that recreation is a pursuit undertaken during leisure time. Leisure itself is defined by the Countryside Recreation Glossary (1970) as "the time available to the individual, when the disciplines of work, sleep and other basic needs have been met".

As a result, recreation may be defined as an activity or planned inactivity undertaken by individuals during leisure time for refreshment of body and spirit.

2.2 Classification of Recreational Activities

Recreational activities can be categorized using either of two approaches, i.e. by activities or by resources required. The first was used by Margules and Deverson (1974) in deriving 3 broad classes of activities:

(1) Hobby, craft, creative and cultural, i.e. cultural and social activities such as attending the theatre, visiting parks and zoos or participating in painting, carving and acting.

(2) Sport, outdoor, and contact with nature, i.e. indoor and outdoor physical activities such as, camping, picnicking, sightseeing, nature study, window shopping, playing different sorts of sports, flying and ballooning.

(3) Handicapped, i.e. activities of handicapped people.

The second one was used by Boden (1971), who classified recreational activities according to the resources to be used, that is into indoor and outdoor recreation. Indoor recreation is an activity which takes place in covered areas, such as dancing, acting, attending art galleries, and indoor games. Outdoor recreation comprises activities occurring in an open space such as camping, bush walking or barbecuing in the suburban backyard.

The first approach is more useful in a cultural study of human behaviour in relation to recreation "demands" study. The second one is more suitable for studying the nature of the "supply" of resources for recreation.

The second approach, according to the degree of required development can be classified into intensive and extensive forms.

Intensive forms of outdoor recreation include those activities which require a relatively high degree of development of a specific area (Clawson and Knetch 1969; Kavanagh 1970). Extensive use requires little such development. Intensive recreation includes activities such as camping, picnicking, attending and watching (visiting historical, archeological or special features), many forms of informal sports, swimming and hobby farming. Extensive recreation includes such activities as bush walking, mountain climbing, horse riding, trail biking, driving for pleasure, sightseeing, animal watching, fishing and hunting (Douglass 1969; Piesse 1969; and Kavanagh 1970).

In this thesis only outdoor forms of recreation are considered.

2.3 Outdoor Recreation, Conflict and Compatibility

Conflicts between outdoor recreational activities and other land uses can arise when they compete for the same area at the same time.

A distinctive example is the conflict between forestry operations and a variety of recreational activities in a commercial forest (logging operations and bush walking, sightseeing and clearfelling). These conflicts however tend to be localised and relatively shortlived within any one area.

Another conflict of a more permanent nature exists with the damming of rivers and certain water based activities such as fishing and canoeing.

The solution to these problems in most cases is a compromise where efforts are made to establish other land uses with the minimum practical disturbance to the recreational use.

When the demand for other land uses seems to be high, a specific solution might be sought. There are several possible alternative solutions: (1) banning the area for other uses; (2) zoning, to provide for specific uses on specific parts of the area, and (3) modification of harvesting techniques to allow for recreation in a forest area.

Further, conflict can exist between different recreational activities. Conflicts arise when activities compete for the same area at the same time. The most common form of conflict occurs between mechanised and non-mechanised outdoor recreation, e.g. motor biking and bush walking, or between intensive and extensive forms of outdoor recreation, such as swimming and fishing.

The feasible solutions to overcoming conflicts appear to be banning, zoning or alternative use. Any specific policy decision made by the manager depends upon the nature of the resources and the predicted demand.

In contrast, there are many recreational activities which are compatible such as sightseeing and picnicking, bush walking and camping.

An understanding of those recreational activities which are in conflict and those that are compatible is essential if correct management policies are to be made.

The overall nature of compatibility or conflict existing between recreational activities is shown in Table 2.1. In this table, a degree of compatibility is given to each activity in the form of compatible, moderate compatibility, low compatibility and incompatible. In order to ratify the recreational activities in correspondence to their compatibility or conflict, a weighted value was given to each degree of compatibility. Incompatibility was given a weighting value of 10, low compatibility 5, moderate compatibility 2, and compatible nil. By summing up the weighting

Table 2.1 Degree of compatibility of recreational activities

ACTIVITIES	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	Total Weighting Value
1		●	■	■	●	●	●	■	■	●	▼	■	■	●	▼	50
2			●	★	★	★	■	■	■	■	■	■	▼	●	▼	41
3				■	★	★	■	■	■	■	■	■	▼	■	▼	29
4					●	★	★	■	■	●	★	▼	▼	■	★	40
5						★	■	■	■	★	■	▼	▼	★	▼	45
6							▼	■	■	▼	★	▼	▼	●	▼	71
7								■	■	●	■	★	▼	●	▼	49
8									■	●	■	■	▼	★	●	22
9										■	■	■	■	■	■	0
10											■	●	▼	▼	▼	67
11												★	▼	▼	▼	46
12													●	★	★	48
13														▼	▼	115
14															★	58
15																101

compatible ■moderate compatibility ★ low compatibility ● incompatible ▼

values, a total weighting value was ~~resulted~~ derived for each activity. Accordingly, the order of conflict for activities is as follows: 1- hunting, 2- trail biking, 3- hobby farming, 4- horse riding, 5- driving for pleasure, 6- informal sports,7- bush walking, 8- fishing, 9- animal watching, 10- attending and watching, 11- camping, 12- swimming, 13- picnicking, 14- mountain climbing, 15- sightseeing.

TABLE 2.1

1. Informal sports
2. Camping
3. Picnicking
4. Swimming
5. Attending and watching
6. Hobby farming
7. Bush walking
8. Mountain climbing
9. Sightseeing
10. Horse riding
11. Animal watching
12. Fishing
13. Hunting
14. Driving for pleasure
15. Trail biking

2.4 Land Capability Classification for Outdoor Recreation

The natural resources required for outdoor recreation are land, water, or other natural features actually used for recreation. It may be an area of land with or without tree cover, a body of water, a flowing stream, or it may be other natural features such as caves which extend far below the surface. The natural features may or may not have been modified or improved by man.

The use of specific areas of land for recreation in the past has more often been dictated by user demand with scant regard for the physical and biological consequences of over and/or unregulated use, or indeed wrong use. Ecological changes may occur which are often irreversible and arise as a consequence of site deterioration (Glikson, 1965).

Destruction of vegetation is one of the first indications of over use in a recreational area. Brockman (1959), Ovington (1969), Chappel *et al.* (1971), Lime and Stankey (1971), and Mercer (1972) all agreed that the damage to ground cover and trees occurs not only because of the vegetation being trampled and crushed, but also because of soil compaction.

According to Warren (1973), noise and air pollution are further resultant features of recreational over use or unregulated use on the land.

There is no doubt that the visual impact of the landscape of wild lands is being altered and degraded by the effect of recreational over use. Deterioration of the landscape causes generalized reduction in environmental quality, especially for sightseers (Litton, 1972).

In short, in many recreation areas the environment is being destroyed by the very people who set out to enjoy it.

This deterioration suggests that land resources have a given capability for a particular recreational use. If its inherent qualities are to be maintained, land needs to be used rationally and how it is used needs to be planned according to its capability. This practice would help to control environmental degradation, whilst providing a maximum and sustained yield of the resources for recreationists (Woolner 1959; Swartz 1974).

Consequently, outdoor recreation capability is basically a physical and biological (ecological) and cultural relationship between a given resource and its maximum and durable sustained yield for outdoor recreational pursuits.

2.5 Outdoor recreation capability classification: Procedure, problems, and review of the methods

Land capability determination is a qualitative evaluation. It is an assessment of the suitability of land for man's use for agriculture, forestry, engineering, hydrology, regional planning and recreation (Stewart 1968; Mabbutt 1968). Land capability classification involves categorising the results of land capability evaluation into units of determinate extent.

An area of land represents a number of characteristics which possess intrinsic values for particular land users. Robertson *et al.* (1968) and McHarg (1969) recognized that in order to evaluate a site's capability, identification of land characteristics and their values was necessary. They believed evaluation involved matching an inventory of land characteristics to a value system based on the certain land use.

Therefore, land evaluation involves the collection and interpretation of very large amounts of data. This practice requires a

considerable amount of man power and time. In the twentieth century, many systems have been introduced which in turn reduce the difficulties occurring in data collection, analysis and interpretation.

Aerial photographs are extensively used in land evaluation, and it is now recognized that the air photo is a very compact store of land data (Howard, 1970). Direct measurement of land characteristics on air photos and the use of air photo interpretation by relating air photo patterns to non-visible land parameters are both widely used.

Air photo interpretation remains somewhat subjective and dependent on the experience and breadth of knowledge of the interpreter. In recent years, much attention has been given to automated patterns of interpretation, in which a complex mathematical model is used to co-ordinate automated air photo interpretation. In this evaluation, mathematical complexity is such that a specialist in mathematics is needed to work in close association with land evaluation research workers (Stewart, 1968).

As a result of the rapid development of computer technology in the last decade, considerable attention is now being given to the application of computers to the storage and processing of land evaluation data. The most comprehensive computer based land evaluation system at present is the Canadian Geographic Information System for regional planning (Tomlinson, 1968). Its objective is to store and manipulate land data from the Canada Land Inventory.

With the potential for automated data processing, and development of computer technology, future evaluation will be a system based on matching the two techniques. Human will only be required to direct the data that machines collect, process and store.

The practice of land capability evaluation and its classification for agriculture and forestry has a longer history than evaluation and classification for outdoor recreational use.

In Australia a well known land use classification was prepared by Christian and Stewart and their colleagues, C.S.I.R.O. (1953-1973). They used "Land System" and "Land Form Types" as mapping units both based on a geomorphological separation. The Victorian Soil Conservation Authority follows the method of the C.S.I.R.O. for land survey and classification with some modification, i.e. in the separation of the more detailed pattern into land units any feature of the environment is used and it is frequently not geomorphological.

The implementation of the land capability classification for outdoor recreation is rather a new approach and was initiated within the last decade.

A recreation capability classification prepared by the Canada Land Inventory (1966) is the best known and most comprehensive land capability study (Swartz, 1974). In this system, land is ranked in 7 classes according to its capability for outdoor recreation under existing conditions, whether in natural or modified state. Classes of capability are differentiated on the basis of the intensity or quantity of outdoor recreational use, and the natural limitations such as harsh topography, poor soils or an adverse climate.

This system, is more applicable for large areas, i.e. state and country. Climatic pattern has a significant role in the formation of the capability classes, and therefore in a large area like a state, climatic differentiation might be expected to occur. There also appears to be a lack of proper determination in identifying the limitations, e.g. it does not indicate the level of adversity of the climate which might affect the classification.

In Australia, Hogg (1973) classified the Victorian Alps for winter sports. He firstly defined a number of blocks of land according to the physiography of the land. Even though the establishment of the boundaries of these blocks was a rather subjective process, some prior knowledge of the study area would be essential. These blocks were loosely defined as a continuous area in which the natural attributes, in as much as they affect recreation, were similar throughout. For each block he produced weighted judgement based on (1) value of natural and cultural features; (2) the conflict between recreational activities; (3) demand prediction, and (4) user suitability. Finally he was able to achieve a classification based on this weighted judgement.

This system goes beyond the land capability classification and considers also the user attitudes towards the land (demand prediction and conflict between activities). Because of this practice, its subjectivity is greater than the Canadian system. Demand prediction and the determination of the degrees of conflict are two subjective appraisals in which accuracy can hardly be ensured. Again by considering the demand variability for land classification another problem arises. That is, the system would be more efficient on a larger scale, e.g. shires, state.

Despite these problems and in the light of the growing importance of recreation as a land use in Australia, Hogg's system can be valuable as a means of identifying problems and approaching recreation planning using its fundamental principles.

In the U.S.A., Nordstrom (1972) used a procedure similar to that of Hogg (1973) but in a much more detailed and intensive way. In summary, his work established a general relationship between (1) an individual outdoor recreation activity; (2) natural resources requirements for that activity; (3) site inventory based on the activity, and (4) analysis and ratings of those data.

The main objections to his work are: (1) that the interaction between land units was not considered; (2) that the numerical weighting was based only on one natural resource. This has resulted in difficulties, e.g. at a particular level of classification a simple feature cannot necessarily be correlated with the potential use of the area, and (3) that the interactions of ecological factors were neglected.

PART II

A RECREATION CAPABILITY CLASSIFICATION

CHAPTER 3

METHODOLOGY

The author believes that by reducing the deficiencies and problems occurring in capability classifications, a more accurate method can be developed.

The methodology for developing a land capability classification for outdoor recreation may be approached by examining the intrinsic[1] values in the absence of external interactions.

The method may consist of four phases:

(1) Identification and collection of land characteristics in relation to outdoor recreation. Land characteristics have a direct bearing on the types of use that can be sustained. For a particular land use, a number of land characteristics may have a greater bearing on that use than other uses. For example, in forestry the amount of growing stock of a stand in a unit of land is more significant than the scenic attractiveness of that stand, whereas in recreational use the scenic attractiveness would be considered more important. This implies that different components of land characteristics have various effects on the use of land. Hence, in the case of recreational land use, relevant components of land characteristics should be identified and collected.

(2) Identification of detailed requirement of each outdoor recreational activity from the land. Each recreational activity requires specific components of land to be available. For example, a picnic area requires a range of slope between 0 and 15%.

(3) Evaluation of land capability for outdoor recreation. Evaluation is usually a subjective interpretation, based on matching the land

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1 It refers to study of resources of natural origin in contrast to resources of human origin, i.e. extrinsic resources.

characteristics to a series of resources required by recreational activities. Land characteristics relevant to recreation cannot be evaluated in isolation from each other, because the availability and suitability of one factor may be restricted by the lack of another. Therefore, for any recreational activity, a collection of factors must be taken into consideration.

The evaluation provides a series of possible options. The best option could be taken by regarding the user's satisfaction and the land's maximum and durable sustained yield.

(4) Classification of the evaluation. In any unit of terrain (a river basin, mountain ridge, catchment, district, county, state, country, continent) recreation capability is not similar throughout. In order to understand this variation in the range of land capabilities, it would be beneficial to categorize it into a series of classes. A classification may then be arranged by giving a numerical value to the variation.

In the following sections, land characteristics relevant to outdoor recreation, and the nature of land requirement for the various recreational activities are explained.

3.1 BASE DATA

As mentioned in the last section (Methodology), two sets of data from the land are required to produce an outdoor recreation capability classification. First, resource data of land characteristics in relation to outdoor recreation, and second, data of the requirement for outdoor recreation from the land.

3.1.1 Resource Data of Land Characteristics in Relation to Outdoor Recreation

Land is characterized by its physical properties, biological components and cultural features (Brockman 1959; Baker 1961; Downes 1969).

Physical properties of the land include climatic pattern, geological pattern, topographic configuration (land form), soils and hydrological pattern (water).

Biological components include both domestic, agricultural and wild animals and vegetation.

The history of land use is reflected in the present cultural features of the land.

These characteristics determine the scenic appeal of an area, together with interesting points in relation to outdoor recreation.

Some difficulties arise in obtaining and relating the resource data to outdoor recreational use. This is because there has been little research on the matter of resource data dependent upon recreation. Many workers in recreation research have studied the demand prediction for outdoor recreation, but less attention has been given to the matter of supply evaluation for outdoor recreation. Nevertheless, it is possible to extract relevant data from some of the literature on the subject.

In extracting such data, however, and constructing a relevant list, confusion may occur. The degree of confusion depends on the knowledge and ability of the interpreter. In order to avoid or reduce the confusion, it should be ensured that the data are useful and appropriate in different places. Subjectivity in the collection of resource data is another problem.

By implication, it is suggested that further research, in the evaluation of supply for different recreational activities in different places is necessary.

3.1.1.1 Physical Resources

a. Climate

Climate is defined as the average condition of the weather at any locality over a period of years (Meteorological Glossary, 1944). It affects the quality and type of recreation. Its influence may be indirect or direct. Directly, climate, as a major factor in the distribution of plants and animals, has a strong bearing upon the characteristics of various recreation areas.

Climate determines and regulates public recreational interests and it is responsible for different facilities being required for the same activity. For example, trail shelters for the comfort and convenience of bush walkers are necessary where adverse conditions are likely to occur.

Indirectly, climate may also materially affect recreational values by causing heavy seasonal concentrations of people, e.g. beach and ski resorts (Brockman, 1959).

Generally, for recreational land use studies, components of climate should be regarded, firstly, as factors reflecting the nature of the site, and secondly, as factors affecting recreationist's physical comfort.

Rainfall is relatively uniform over large areas and generally does not influence site selection. However, when combined with other site factors, precipitation becomes very important in influencing the quality of a recreation site, e.g. dampness and dreary weather, mud and

damage to the ground surface and problems that occur more readily in areas that are wet during heavy use periods, while dust, limited vegetation growth and recreation area damage are problems to be faced on dry sites.

For winter sports, obviously, a knowledge of the frequency of snowfall, its amount, depth, persistence and distribution would assist the site selection.

Temperature ranges are important in site selection for recreation. Mean seasonal temperature will influence the vegetation growth, and therefore have an indirect relationship with recreation, e.g. shade and deciduous trees and recovery of ground cover following heavy pedestrian traffic (Agnew, 1965).

Frost does not directly affect recreation (except skating in open areas), but it is responsible for damage to other site factors such as soils and vegetation.

Wind speed and direction need to be considered where outdoor recreation facilities are concerned, e.g. cabins and camping grounds. Wind speed can be modified by natural and artificial shelters, and windbreaks, but little can be done to modify wind direction. Wind direction is also an important consideration for such an activity as hunting.

The risk of fire in recreation areas, particularly in late summer would be greater if the daily temperature is high, the humidity is low, and the prevailing wind is dry, although the type and condition of the ground cover may modify this risk.

Physical comfort is affected by a number of meteorological factors, e.g. temperature, wind speed, temperature of surrounding objects, humidity and the number of wet days (Bureau of Meteorology, 1968). It is also affected by the personal characteristics of the recreationist's

health, degree of physical fitness, and type and amount of clothing worn. Thus it is difficult to compare the physical comfort of different sites.

Some investigations have suggested that the physical comfort can be expressed from measurements of wet bulb temperatures. For example, Lowry (1969) suggested physical discomfort occurs if the wet bulb temperature is greater than 21°C for lengthy periods of the day.

The Bureau of Meteorology (1968) has recommended vapour pressure ranges as an indication of physical comfort. The range of comfort has been given as between 6.8 mb and 16.9 mb. At 6.8 mb, when temperatures are low the average person is uncomfortable and above 16.9 mb conditions are enervating when the temperature is high.

The Bureau of Meteorology (1968) also considered a good general indication of the climate of a particular region in mid latitude is given by the number of hours of sunshine, particularly during the winter months. Lengthy periods of cloudiness are undesirable for some recreational pursuits,e.g. swimming.

In summary, the following climatic data should be considered when classifying land for outdoor recreation:

1. annual rainfall, its seasonal distribution and variability;
2. frequency of snow fall, amount, depth, persistence and distribution;
3. daily, seasonal and annual average temperatures and the frequency of frosts;
4. prevailing wind direction, and average wind speed;
5. relative humidity;
6. frequency and degree of hazard of fire, and
7. average monthly and annual occurrence of cloudy periods and

clear days and the annual mean of hours of sunshine per day.

b. Geology

The geology of an area will affect its recreational potential since it directly influences the physiography and soil type. Indirectly, it influences vegetation through the inherent physical and chemical properties of the soil. Soil stability, structure and fertility are perhaps the most important attributes.

Physiography is the outline of the earth's surface and is synonymous with relief (Young, 1969). Many investigations have shown that all land surfaces are constantly changing through weathering and erosion. The degree of change depends on many environmental factors of which geology is an important one, e.g. granite rocks are the most resistant to weathering and erosion. Therefore, the geological pattern, the age of the rocks and the climate of an area will affect the topographic configuration of the area. The nature of the topographic configuration (land form) can influence soil in many ways (Jenny 1941; Corbette 1969; and Fitzpatrick 1971). The depth of soil is often determined by the nature of the relief. Soils on steep mountain slopes are shallow, often stoney, and unstable. In addition, differences in elevation, aspect and slope (land form components) lead to the formation of different soils.

In summary, identification of rock types, their orientation and location, and the history of rock formation would be major attributes of the geology of an area which will be needed for an outdoor recreation capability classification.

c. Landform

Landform is a feature of the earth's surface caused by natural phenomena (Young, 1969). The relative configuration of land plays a major role in determining the recreational use of a site. Land relief exhibits itself in such forms as the steepness of slopes, aspect, altitude, and relative position.

The aspect of a slope can determine the desirability of any given recreational activity. In the northern hemisphere, east slopes may be best for camping grounds, west and south aspects for beaches, and north aspects for skiing (Fogg, 1975). Vistas and scenic lookouts should be placed where they are most effective, however a northerly aspect is considered best whenever a choice exists (Shafer *et al.*, 1969).

The exposure of an area to sunlight plays an important role in determining recreational use. Northern aspects in the southern hemisphere and southern aspects in the northern hemisphere generally have the greatest exposure to sun. Sites with high exposure times tend to become hot and are not desirable except as swimming areas or for use in late autumn, winter or early spring when the heating effects of long exposure time are welcomed (Douglass, 1969).

The placement of a recreation area on the terrain is important to user comfort. Hillsides should be divided into lower, middle and upper thirds of slope, and each third considered in relation to its effect on recreation. The middle slopes offer the best microclimate conditions for recreation area development (Hough *et al.*, 1973). Morning updrafts and evening downdrafts produce good ventilation and provide a moderating effect on temperature.

Site steepness is one of the most important features of land form which affect the capability for recreation, particularly intensive use (Table 3.1).

TABLE 3.1 Percentage of Slope Showing Degree of Limitation for Intensive Recreation (Adopted from Montgomery and Edminster, 1966)

Item	None to slight	Moderate	Severe
Camp areas	0 - 8%	8 - 15%	15%+
Playgrounds	0 - 2%	2 - 8%	8%+
Buildings in recreation areas	0 - 8%	8 - 15%	15%+
Paths or trails	0 - 15%	15 - 25%	25%+
Picnic areas	0 - 8%	8 - 15%	15%+

Steeper slopes require long trails, more steps, or steeper grades. Road and trail layout is restricted by steep slopes which also limit accessibility. Also the danger of erosion and slides is increased. Level land,however,is not without hazard. Level areas might be poorly drained and therefore unsuitable for fields, heavy traffic or certain structures. According to Eyre (1966) and McHarg (1969), flat land with good surface and soil drainage is intrinsically the most suitable land for intensive recreation, while areas of diverse topography represent a higher value for extensive recreation.

In land evaluation for most of the land uses such as agriculture, forestry and recreation, land formation is an appropriate tool in a resources survey of the land. Land form can be used for primary division into units for mapping and convenience in data collection, analysis and interpretation. This practice has been applied in many land use studies carried out by the C.S.I.R.O. Land Use Research Division throughout Australia since 1953. It has also been applied in the survey of the Cotter River Catchment in the A.C.T. (For. Dept., A.N.U., 1973), though land form units defined in this survey were not used thoroughly in the research, and will be used in the future for intensive research.

The land form components required to be identified for outdoor recreation capability classification are of two types:

1. those which are used in separation and mapping by determination of land form units, such as macro and micro relief, slope, drainage patterns, degree of connection between ridges and mountain crests, orientation and strength of orientation, and predominant primary and secondary aspects, and
2. those which affect the recreation capability of a site, such as steepness of slope, exposure, aspects and altitude.

d. Soil

"Soil is the result of climate, topography and organisms interacting upon the parent material over a period of time" (Gibbons and Downes, 1964). Therefore, parent rock provides much of the raw materials, the climate lubricates and determines the speed of manufacture, but the vegetation ultimately determines the nature of the products (Eyre, 1966).

Gibbons and Downes (1964) stated that the texture of the soil affects the capacity of the soil to absorb, store and yield water. Structure affects the permeability, storage capacity and rate of surface water loss. The depth affects the quantity of water near the surface horizon.

The relationship of soils to recreation capability of the site refers to soil suitability for construction of facilities, its permeability, trafficability, water storage capacity, and its general fertility for growing plants.

All soils can be used for recreational activities of some kind. Some have no soil limitations for specific kinds of recreational use, others have moderate to severe limitations for certain uses.

On beach sites, coarse soils such as sands are desirable. Loams of the medium textured soils are suitable for a variety of recreational activities where a grass cover is required,e.g. camping and picnicking. One advantage of very coarse soil material is the lack of dust. The heavier soils of silt and clay are more susceptible to puddling, surface run off and erosion. Sandy loam and loamy surface textured soils are the most desirable for intensive recreation (Montgomery and Edminster, 1966).

Physically, rock outcrops and shallow uniform soils have features which could be difficult or expensive to overcome when constructing roads, drains and foundations, though they are generally well drained.

Litton (1972) focused attention on the fact that the colour of the topsoil (which may be reflective), is an important structural component of the landscape and its scenic appeal.

Water capacity of a soil as well as its structure has a direct bearing on its susceptibility to wind erosion which is very important in beach sites (Darley, 1952). Soils subject to flooding have several limitations for use as sites for camps and recreation buildings. Soils that are wet all year, even though not flooded, have severe soil limitations for camp sites, recreational roads and trails, playgrounds and picnic areas. Dry soils also have limitations for many recreational uses, e.g., horse riding and driving for pleasure.

By implication, texture, depth, colour, structure and general fertility are the main characteristics of the soils which are useful criteria in surveying the soil for an outdoor recreation capability

classification. Consequently, a knowledge of the soil type,e.g. as defined by Smith (1960), Stephens (1962) (compiled by Corbett, 1969) and Northcote (1965) appropriately depicted on a map will simplify the understanding of soil characteristics in the area.

e. Water

Water is an essential component of most recreation areas (Smith, 1972). Directly, it is required for swimming, boating, and fishing. Indirectly, it can be a significant component of scenic vistas. It is also required for domestic use. According to Brockman (1959), a water resource is the determining factor in the development of camping grounds, hotels, and sanitary facilities. Water appears to be essential for the success of most recreation areas.

Generally, recreational use of water does not consume the resource, but goes hand in hand with other uses. Some activities will pollute the resource, e.g. domestic use, bathing and even power boating.

Water quality is influenced by the volume of water present. Bodies of standing water are more susceptible to contamination, e.g. The U.S. Public Health Service (1965) suggested the rate of water flow should be more than 2000 litres/day to prevent pollution by concentration of contaminated materials.

In an initial evaluation of water resources for outdoor recreation, the following information is required. The nature of the water body, its configuration, permanent volume in different seasons, its rate of flow,and quality.

3.1.1.2 Biological Resources

a. Wildlife[1]

Wildlife can enrich the landscape and adds to its recreation quality. Its value to recreation is often related to the uniqueness and numbers of animals. Wildlife may be composed entirely of indigenous species as on many game reserves in Africa, or more often contain varying proportions of introduced species. Such introductions may be accidental or deliberate, e.g. trout for fishing in southern Australia.

The persistence of wildlife and its recreational value is dependent on suitable habitats.

Wildlife is important to certain types of recreation. Firstly, activities involving just observing wildlife for the joy of seeing it. It may be the sole purpose of a recreational pursuit, e.g. bird watching or just casual observation while bush walking. Secondly, those activities involving the taking of animals, e.g. hunting and fishing. By implication, the relationship between outdoor recreation capability and wildlife depends on the persistence of the wildlife, which in time is dependent upon the maintenance of populations and their habitats.

Basic wildlife information required for studying the recreational potential would include: (1) a check list of species likely to interest the observer, and those useful for hunting and fishing; (2) those species which could be introduced or removed to increase the recreational use and, (3) data on the habitat requirements of the species listed.

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1 Domestic agricultural animals are discussed in 5.5.3.1.

b. Vegetation

Vegetation is an important component of most landscapes. Landscape or scenery is a product of landform, land use, and vegetation (Boden, 1971). Aesthetic appeal of landscape often depends on the nature of the vegetation because of its forms, colours and shapes. In the case of scenic evaluation, vegetation's attractiveness is measured as a contribution to scenic appeal.

The quality of aesthetic appeal of vegetation is strongly related to the uniqueness and diversity of the vegetation. The uniqueness of giant sequoias in California attracts many tourists every year to that part of the world. Likewise the diversity of vegetation in Queensland's rainforest is one reason for the increasing numbers of visitors to its National Parks.

Simonds (1961), Beazley (1969), Douglass (1969), Cook (1972) have all suggested that in order to increase the attractiveness of a site for intensive recreation, it should either be well vegetated or adjacent to a well vegetated area.

Vegetation is an essential component of the habitat of most animals, and as a source of food for herbivores. The diversity and persistence of vegetation types usually ensure the variety of animals. Since some animals are an important recreational resource, the maintenance of their habitat is important.

Vegetation cover plays an important role in stabilizing and protecting soil, e.g. in coastal areas its value in stabilizing frontal dunes has long been recognized. (Hewitt 1954; Sless 1955; Condon and Barr 1968). Vegetation acts as a shelter and blanket over the soil. According to Bacon (1969) and Bengtsson (1970), it is a shelter against wind and sun, and partly against cold. In alpine regions it also

influences the snow pattern. Usually an increase in tree growth results in a decrease in wind velocity near the ground.

Vegetation cover influences pollutant levels in recreation areas, e.g. dense tree and shrub growth can reduce noise and dust levels.

The relationship between vegetation and outdoor recreation capability refers to the contribution vegetation makes to landscape and to aesthetic quality, habitat and food for animals, stabilizing soil and reducing erosion, providing shade trees and ground cover and as a pollution deterrent.

In this respect, attributes of vegetation required to produce an outdoor recreation capability classification can be grouped as follows:

1. the occurrence and distribution of plant communities;
2. percentage of cover (density);
3. plant ecological habitat, and
4. tree species and their associations.

3.1.1.3 Cultural Resources

a. Land Use

Any account of land use should involve an examination of man's impact and demands upon the physical and biological features of land. These properties as they occur in their natural state, form the recreational potential of uncommitted land. On committed land, the intrinsic potential of recreation is modified by the effect of past use.

Man's impact on land, may, over time, either increase or decrease the potential of this land for recreational purposes. This change is related to the amount of time spent on the land, the nature of past and present land use, the application of technology, the availability of

services and the kind of recreational activities envisaged.

These matters may be clarified by a detailed examination of significant land uses in the study area.

The use of land for timber production may enhance the land capability for recreation by providing access, or it may decrease the potential in the short term by clearfelling or permanently by replacing one forest type with another as can occur when plantations of exotic species are established. The intensity of management is the most important criterion affecting the lands potential for recreation.

In a forest being managed extensively, where production is minimal, access and disturbance associated with logging is likely to be limited, and with little disturbance to the natural forest, those types of recreation, which require a natural landscape, will be least affected, e.g. bush walking, sightseeing and animal watching. Extensive land management provides a greater potential for these activities than land being managed intensively.

In a forest being managed intensively, with maximal production, access and disturbance can be considerable, and the recreational potential is reduced for those activities requiring a natural landscape. Intensive management, however, requires facilities such as roads and trails, which provide more potential for those recreational activities which require intensive development, e.g. picnicking.

Generally, agricultural land is suitable for more intensive forms of recreation, such as informal sports, picnicking, camping and hobby farming. Agricultural land is generally on flat to undulating topography with more fertile soils, a continuous ground cover and reliable sources of water. The level of such existence depends on the

intensity of management.

Agricultural practice and the intensity of management will alter the landscape composition. This will have important consequences for some forms of recreation.

The use of land for mining may have a potential for attending and watching, but often, mining operations decrease the land potential for other forms of recreation by producing various pollutants, and creating adverse scenery. The level of deterioration in potential for recreation is related to the type of mining operation and the intensity of management.

A region being used for wildlife conservation has a great potential for bush walkers, animal watchers, sightseers, and back country campers who seek wildness and solitude. The degree of natural potential in this region for these recreational activities is dependent on the duration of land allocation for conservation purposes, the natural condition of the area at the time of allocation and the intensity of management applied. Recreational activities normally have no place in an area being used for scientific purposes, but with the preparation of informative displays the area can be utilized for attending and watching.

An area currently used for recreation would have certain facilities, these being dependent on the type of recreation and level of management. These facilities may affect lands potential for future recreation. The level of potential for recreation depends on the intensity of management and type of recreational activities envisaged.

Finally, services such as roads, car parks, and support facilities used for other past and present land uses in an area could perhaps be utilized for recreational use. The suitability of these facilities will also depend on their condition and this will also affect the level

of a land capability for outdoor recreation.

Consequently, past and present land uses would influence the recreation potential of land by the creation of facilities, landscape modification, introduction of pollutants and availability of services.

It is important to note that land tenure and future land use trends are two factors which influence the availability of land for recreation. In this study, however, only the intrinsic recreational potential of land is considered.

Therefore, the land use resource data required to produce an outdoor recreation capability classification include:

1. the type of land uses, the level and the nature of management practices;
2. the history of land uses, and
3. existing facilities and services.

3.1.1.4 Miscellaneous Resources

a. Landscape

The landscape comprises all features of the land of which vegetation, landform and land use are significant components. The importance of the landscape to recreation lies in its scenery.

Scenery is something the value of which is seldom realized until it has been destroyed (Gair, 1963). A simple definition is that "it is the outdoor visual environment, extensive or intimate, continually varying, ever adapting" (Calder, 1970).

Recreational value of natural scenery cannot be described in any quantitative way (Mosley, 1954). Recreation capability of a site is tied to the surrounding beauty and attractiveness of the site. For

example, a picnic ground adjacent to a panoramic view of a jungle or a lake is often preferred to one without it (Fogg, 1975).

In order to relate the landscape to outdoor recreation capability, its scenic values needs to be recognized as a contribution to the quality of the surroundings. It is therefore necessary to analyze its visual appeal and to appraise its scenic values.

b. Interesting Points

If the recreational use of land is the objective, then the determination of points of interest, concerning recreation, will be vital.

Interesting points, concerning recreation, are the result of integration and interaction of all land characteristics upon each other. Interesting points for recreation refer mainly to existing recreational facilities of land such as picnic spots, trails and animal enclosures, historical sites, and natural features such as scenic lookouts, waterfalls and sites with biological and geological interest. Generally these features will add to the recreation capability of a site. Hence, recording and tabulating such features are required for determining the outdoor recreation capability of land.

3.1.2 Recreation Data

Outdoor recreational activities, whether intensive or extensive, require a certain number of physical, biological and cultural components of the site to be considered, so as to best satisfy the users.

The level of site requirement for extensive and intensive uses differs, because of differences in the degree of their required development by man. The level of requirement also varies for various types of activities within each broad area of activity, e.g. camping requires

more water than picnicking, and driving for pleasure requires gentler slopes than bush walking. In turn, there are some activities for which the requirement is similar, e.g. bush walking and trail biking.

Some land characteristics are basically required for some activities, such as gentle slopes for sportsgrounds, whereas some land characteristics have only a marginal effect, e.g. existence of scenery for picnicking to supplement the site quality. Some land characteristics such as soils with impeded drainage have adverse affects on some kind of activities.

Requirements for each recreational activity, feasible in the survey area, are described in Table 3.2. Some data seem to be too obvious, e.g. fish for fishing, but they are mentioned as a checklist for planners.

In collecting these data, the same problems as those described for land characteristics (3.1.1) arise. The table is the result of amalgamation and modification of work done by Brockman (1959), Makhdoum (1967), Beazley (1969), Douglass (1969), Nordstrom (1972), Hough *et al.* (1973), Fogg (1975), and Roberts (1975).

Table 3.2 Land Characteristics Required for Recreational Use

Recreational Activities	LAND CHARACTERISTICS						
	Climate	Water	Geology & Soil	Land Form	Wildlife	Vegetation	Other Features
Bush walking, Trail biking, Driving for Pleasure	Vapour pressure should be between 6.8 and 16.9 mb for physical comfort. Areas where thunder and hail-storms, floods and frosts frequently occur, throughout the year, are not suitable. At least 7 clear days in a month are required.	Scarcity of water is not so important, because these recreationists usually carry water. But existence of water bodies can add to the recreationists pleasure.	Wet soil (very clayey) organic soil, loose soil (very sandy), are not suitable. A well drained loamy soil is most desirable for trails and roads.	Slope more than 15% is hazardous. 10% is desirable for trails. 5% is desirable for roads.	The existence of wildlife generally is not significant, unless the aim of the bush walker is animal watching or taking photographs.	Vegetation is required as an integral part of the landscape and its beauty. Tree density between 40% and 80% is desirable.	Accessibility is required. Existence of at least one feature of interesting points should be present for bush walking.
Horse Riding	" "	Existence of drinking water for horses.	" "	" "	" "	Tree density up to 50% is desirable. The height of the tree's branches should be at least 3.5m.	Accessibility is required.
Mountain Climbing	" "	Not important	Screes and loose rocks are not desirable.	Existence of hills and mountains.	Not important.	Not important.	" "
Sightseeing	" "	The setting of a body of water, geological features, landform configuration, wildlife, vegetation, scenic vistas are collectively or individually required.					
Fishing	" "	Water should be free of turbidity (dependent on the kind of fish). Water body is required to be deeper than 50 cm, and wider than 5 m.	Sand and gravel are more suitable for the stream bank than silt or clay which create turbidity.	High banks and gorges are hazardous to fishermen.	At least the existence of fish is required.	Good arrangement of trees, shrubs, and grasses improves stream side stability, reduces siltation and gives shade coverage.	Fishing should be admitted legally. The area should be accessible.
Hunting	" "	Existence of a body of water increases hunting opportunity.	Soil conditions and terrain should not be harsh, so hunters can move about.		Availability of game species is required.	Availability of dense vegetation to increase the chance of finding game, because vegetation usually creates the habitat and food for game. In contrast, it reduces visibility, although it assists hunters to camouflage.	Hunting should be admitted legally.

Table 3.2 (Contd.)

Animal Watching	" "	" "	They are not important.		Diversity and abundance of fauna required.	" "	Accessibility is required. Existence of man made animal enclosures ensures visitors will see some animals.
Informal sports	Vapour pressure should be between 6.8 and 16.9 mb in order to satisfy recreationist's physical comfort. Areas where thunder and hailstorms, floods and frosts frequently occur, throughout the year, are not suitable for this activity. At least 7-15 clear days are required in a month.	For those sports which need grass cover, 2000 litres of water, in summer, is required for irrigation of $10m^2$ of sports grounds. Sportsgrounds require 12 to 25 litres of water per day for domestic use per user.	Soil should be free of stone, well drained, of medium depth and fine to medium textured. Usually a loamy surface is most desirable. Fine sandy soil, because of its softness and dryness, is most suitable for children's playgrounds.	Slope between 0-8% is most desirable. Site with mild exposure is required. Midslope, because of morning updrafts and evening downdrafts, has a moderate temperature and is preferred. In southern hemisphere during summers, westerly aspects are required, because of the lower exposure times. Easterly aspects are required for winter use and late autumn and early spring, because east aspects have moderate exposure times.	Not important.	Light woodland is desirable for sports grounds. Tree glades should be big enough to provide light as well as shade and space. For those sportsgrounds which need grass coverage, native grasses, in Australia, would not usually satisfy this requirement and introduced species such as perennial rye grass, tall fescue and Kentucky blue grass are often used.	The site should be accessible and be located at least 45m from the waters edge to avoid hazards to site and users. Vistas are desirable.
Picnicking	" "	Drinking water is less essential to picnicking than it is to camping. A picnic area with flush toilets needs 25 litres/day/user. Without flush toilets 15 litres/day/user for other domestic uses. However, this amount will be almost twice for moslem countries as moslems use water instead of toilet paper.	" "	Slope between 0-15% is desirable. Other aspects are the same as above.	" "	Light woodland is desirable. Ground cover should be resistant to trampling and be able to recover during off-use period.	" "

Table 3.2 (contd.)

Camping	" "	1. With showers and flush toilets 100-120 litres/day/user (for moslem countries 150-170 litres/day/user). 2. With flush toilets 60-80 litres/day/user (for moslem countries 90-110 litres/day/user). 3. Without showers and flush toilets 25 litres/day/user (for moslem countries 50 litres/day/user).	" "	" "	" "	" "	" "
Swimming	The same as above. Temperature of water in the use period is required to be between 15-30°C.	$5m^2$ of water surface is required for each swimmer. Water should have less than 1000 coliform organisms per 100ml. Stream flow should be at least 3km/hour. The amount of domestic water is similar to that for picnicking and camping.	On a site without grass cover, fine gravel makes a desirable floor to walk on. Clay and silt may become muddy when walked on. At least 30cm of sand as a surface layer on the shore is required.	Shores should have a gentle, slope that extends to a depth of nearly 2m. Escarpment and under water rocks should be considered as submerged hazards. In southern hemisphere, for summer use, easterly aspects are desirable because of the moderate exposure time. For winter or late autumn, early spring, northerly aspects are desirable because of their greater exposure time.	Not important.	A grass cover strip with scattered shade trees would provide a place for relaxation and supplement the site capability.	Swimming should be admitted and the area be accessible.
Hobby farming	" "	The amount of water essential for user's domestic use is similar to that for picnicking & camping. For farming, dependent on the type of cultivation, 1000 to 2000 litres of water for $10m^2$ of land are required during growing season.	Soil should be suitable for kind of cultivation undertaken.	Slope between 0-8% is most desirable.	Not important.	Existence of trees as wind break around the farm is desirable. Trees can also be utilized as shelter for live stock.	Existence of farmhouse is much preferred. Accessibility is required.
Attending & watching	" "	The same as that for picnicking.	Not important.	Not important.	Existence of animal enclosures supplements the capability.	Not important.	Existence of historical or archeological or special features, such as animal enclosures or deep space tracking station.

PART III

RESOURCE DESCRIPTION

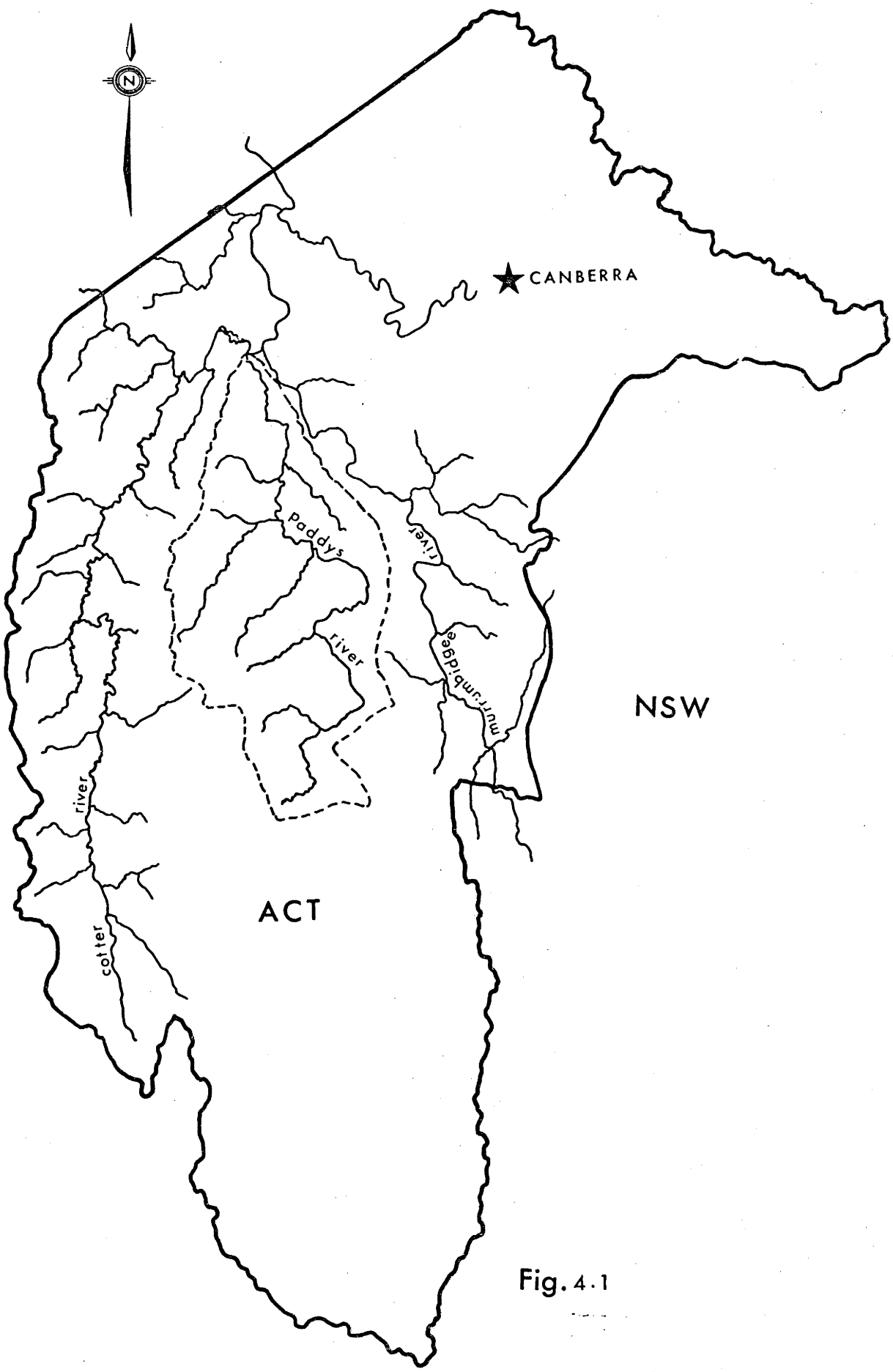
CANBERRA
Paddys river
river
Murrumbidgee
NSW
river
ACT
cotter

Fig. 4.1

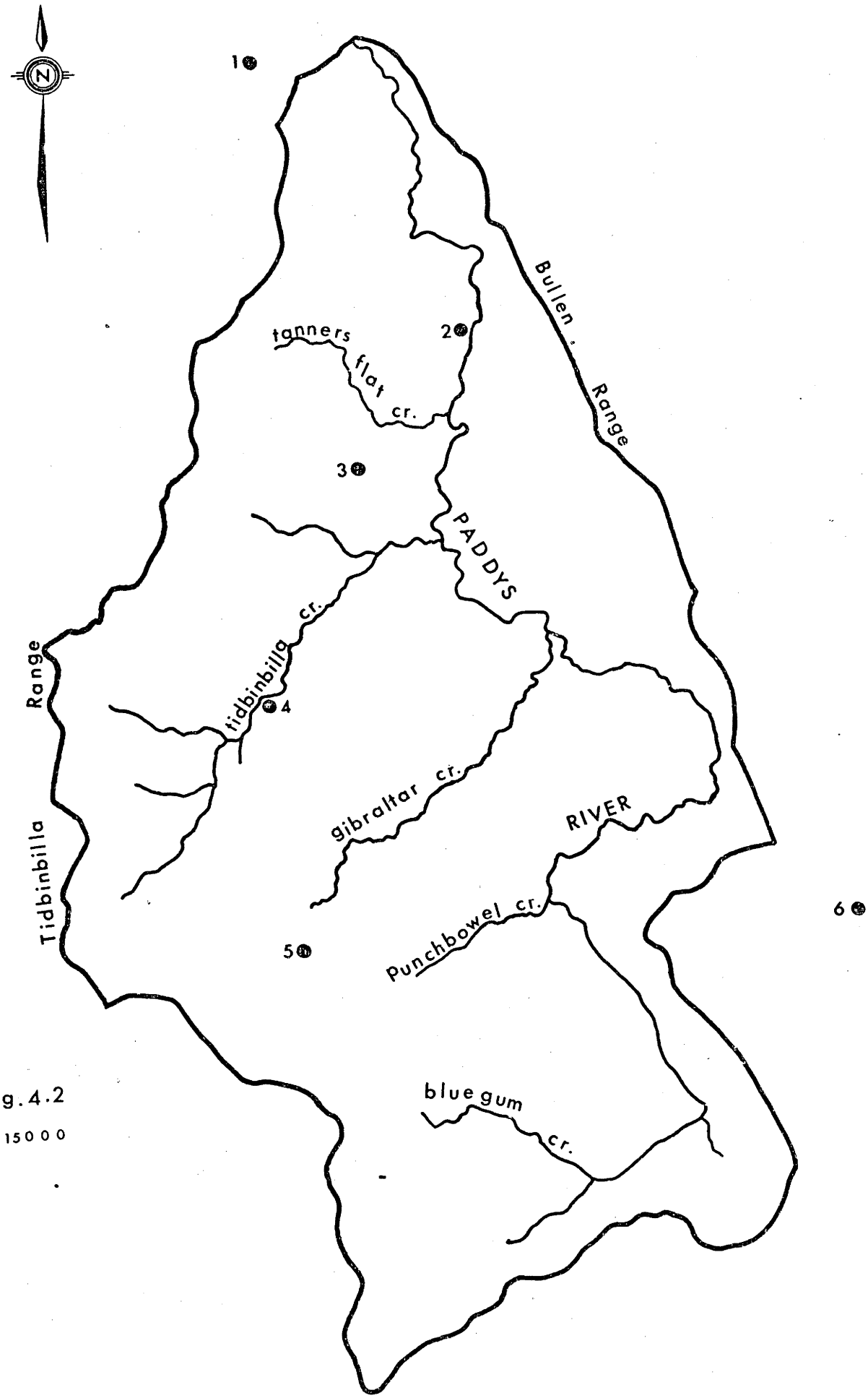

Fig. 4.2

1:115000

FIGURE 4.2 Meteorological Stations

1. Pierces Creek
2. Riverlea
3. Congawarra
4. Tidbinbilla
5. Back flats
6. Tharwa

CHAPTER 4

SURVEY AREA

4.1 Introduction

The Paddys River Catchment (Fig. 4.1), in the Australian Capital Territory, was chosen for an experimental study on the determination of the outdoor recreation capability of a particular area of land.

The study aimed to evaluate the area intrinsically, rather than extrinsically. Therefore, socioeconomic factors have not been considered.

In order that a better understanding of the area can be achieved the catchment is described initially in terms of its physiography, access and resource data.

4.2 Description of the Catchment

4.2.1 Physiography

The Paddys River Catchment is located entirely within the A.C.T. (Fig. 4.1), and lies between the Cotter and Murrumbidgee Rivers. It is part of the Cotter River Catchment, with the Paddys River joining the Cotter River about 1,200m above its junction with the Murrumbidgee River. It is bound on the east by the Bullen Range and on the west by the Tidbinbilla Range.

The Paddys River Catchment contains five main creeks, has a northerly drainage (Fig. 4.2), and has an area of about 27,000 hectares. It has essentially a broad open undulating terrain with relatively

steep rising hills and mountains to the west and south, and lower, more gently undulating hills to the east and north. The elevation of the valley floor is about 500m above sea level with surrounding hills and mountains ranging from 1000 to 1550m in height.

4.2.2 Access

(a) Access to the Catchment

The Paddys River Catchment area is linked to Canberra City in the north, by the Cotter Road, and in the south by the Tharwa Road and Monaro Highway (Fig. 4.3).

The distance from the northern end of the area, near the Cotter Kiosk, to Canberra City (Civic), via the Cotter Road is about 32km. The distance from the south-eastern end of the Catchment, near the junction of Paddys River and Paddys River Road, to Canberra City (Civic), via the Tharwa Road and the Monaro Highway is about 50km, and to the proposed Tuggeranong Town Centre, it will be about 10km.

All these roads, except part of the Tharwa Road, are graded and sealed. They are two-way and vary from 6m to 10m in width.

(b) Access within the Catchment

The Paddys River Road which passes through the Catchment is linked in two ways to the city area, creating a circular drive which, as Boden (1971) stated, is of high quality for the most part, and has attractive and diverse scenery.

There are three subordinate public roads which are two-way and sealed. These are the Tidbinbilla Nature Reserve Road (10km long), the Tidbinbilla Tracking Station Road (5km), and Corin Dam Road (16km up to the catchment's western boundary).

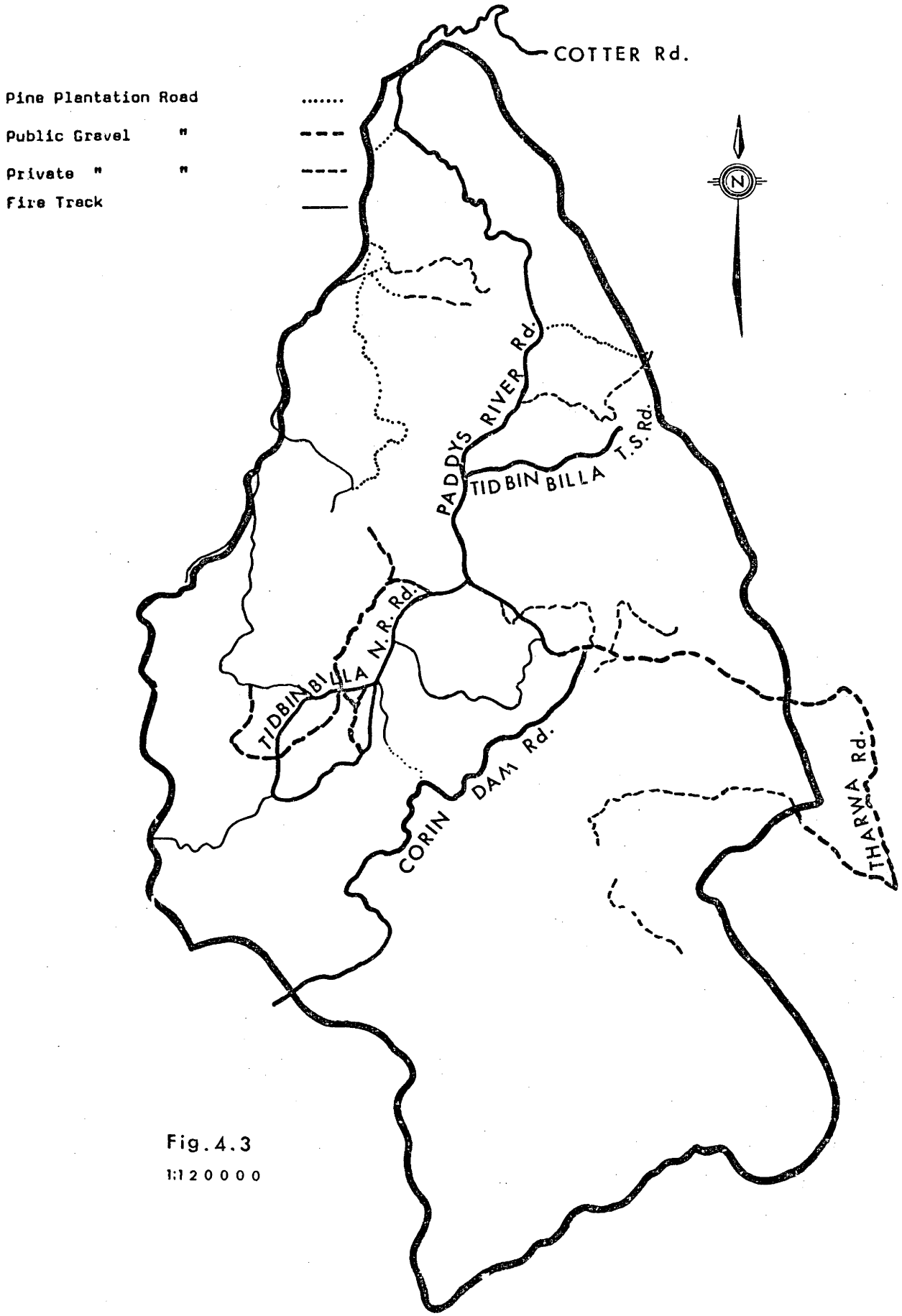

Fig. 4.3
1:120000

The width of these roads and of the Paddys River Road is similar to that of the Tharwa Road, Monaro Highway and the Cotter Road.

The Paddys River Road still has about 9.5km of gravel surface.

There are many private roads within the catchment which connect farmland to homesteads. They are mainly one-way gravel roads averaging about 3m in width.

In the pine plantation areas accessibility is very good to excellent, due to an abundant network of gravel roads. The average intensity of roading is 50m per hectare.

The road condition itself in the catchment is not very good. Erosion and the high cost of maintenance are the major problems resulting from a lack of a proper pre-design for road construction. If the area is going to be used increasingly for recreation, at least the Paddys River Road should be basically sub-graded, widened, and up-graded again with firm and hot tar.

CHAPTER 5

RESOURCE DATA

5.1 Introduction

For the catchment as a whole no previous detailed resources survey has been conducted, although some resource data for parts of the catchment were available. For example, wildlife , vegetation and rock types of the Tidbinbilla Nature Reserve have been surveyed by the Department of the Capital Territory (unpublished data). Likewise, the climatic data were available for Riverlea, Congawarra and Tidbinbilla (Fig. 4.2). Water discharges and run-off from the Paddys River at Riverlea were recorded by the Department of Housing and Construction for a short period (unpublished data). Soil types and geological patterns of the entire catchment were surveyed by Northcote (1965), and the Bureau of Mineral Resources (Strusz, 1971) respectively. From these surveys, soil and geology maps of the catchment were produced at the scale of 1:2,000,000 and 1:250,000. These small scale maps were inadequate for the purpose of the current work. Because of this and the complete absence of much of the relevant data, it was decided to survey, as far as possible, all the relevant resources of the catchment in the time available.

5.2 Resource Inventory

The resource inventory involved the gathering of basic data in either tabular form or on maps, for use in the next stage (Part IV). Before collecting the basic data, it was necessary to consider the type of data required, the possible source of this data, and the scale at which it would be collected.

The data required could be grouped into four categories: Physical, Biological, Cultural and Miscellaneous resources. The potential range of data in each category and their importance in developing an outdoor recreation capability classification have been described in part II. The actual data collected, in the resource inventory (Table 5.1), were less than ideal because of restraints on the availability of data and the limited time available for field work.

Ideal mapping scales for resources inventories range from 1:10,000 to 1:25,000 (Etter, 1972). By considering the total area of the catchment, the scale of available resource maps, the efficiency of field work, available time and accessibility of the catchment, it was decided to use a base map scale of 1:24,000. For convenience of publication, 1:75,000 scale was chosen for the final maps of the resources.

The method used for the resource inventory was an amalgamation and modification of the methods used by Christian and Stewart and their colleagues in C.S.I.R.O., Land Use Research Division (1953 - 1973), Gibbons and Downes (1964), Kuchler (1967), Makhdoum (1967), For. Dept., A.N.U. (1970, 1973), Etter (1972), and the Victorian Land Conservation Council (1972 - 1974). The resource inventory involved air photo interpretation and field investigation.

The 1968 1:24,000 series of aerial photographs taken vertically by Civil Aerial Survey Pty Ltd were used in conjunction with available maps for recording resource data. The 1:24,000 series cadastral maps of the A.C.T. were used, but the boundary of the catchment itself was

TABLE 5.1 Resource Inventory

Physical Resources

1. Climate: Precipitation, temperature, humidity, physical comfort and evaporation, sunshine, clouds, number of clear days.

2. Geology: Rock types and their occurrence.

3. Land Form: Altitude, aspect, slope, drainage pattern, macro and micro relief and orientation.

4. Soil: Soil types and their occurrence.

5. Water Resources: Annual and monthly discharge and run-off from the Paddys River.

Biological Resources

1. Agricultural animals and wildlife: Frequency and occurrence.

2. Vegetation: Forest types and tree density.

Cultural Resources

1. Land Use: History of land uses.

Miscellaneous Resources

1. Points of interest: Historic sites, special geological and botanical features, recreation facilities and scenic attractions.

2. Vistas and their scenic values.

amended on these maps with the help of the A.C.T. 1:50,000 topographic map printed by the Royal Australian Survey Corps (1961), the 1:50,000 Tidbinbilla Nature Reserve Map, the Pierces Creek 1:16,000 forest stock map (1971), and NASA Sheets (No. 4395). These maps together with the 1:250,000 geological map of the A.C.T. made by the Bureau of Mineral Resources (Strusz, 1971), and soils map series No. 3 made by Northcote (1965) at the scale of 1:2,000,000 were used to identify the resources.

To obtain the resource information as quickly as possible, it seemed appropriate to divide the catchment into smaller zones and units. The zoning was based on major land uses, these being readily delineated on the aerial photographs. The zones delineated were:

Zone 1: The Tidbinbilla Nature Reserve;

Zone 2: Native forest;

Zone 3: Pine plantation, and

Zone 4: Grazing lands.

The zones were then subdivided into 54 land form units on the aerial photographs. The basis of this subdivision was the land formation. For each land form unit the drainage patterns, primary and secondary aspects, altitude, degree of connection between ridges and mountain crest, orientation and strength of orientation, macro and micro relief and slope classes were delineated.

In order to define land form units, a terrain classification map was produced from the A.C.T. 1:50,000 topographic map. Five classes of slopes were recognized (Map No. 2).

The land form units constitute fundamental units for the collection, mapping and interpretation of resource data.

Within land form units, soil types, forest types and tree densities were defined on aerial photographs. The principal factors, causing differences in photographic patterns were changes in land form and vegetation. In vegetation distribution, changes in tone and texture of photographic pattern were caused mainly by variation in the light reflecting properties of species, the density and height of trees and shrubs, the colour, density and degree of smoothness of leaves, structure of tree canopies, proportion of ground cover exposed and shadow effects. Soils distribution was generally correlated closely with the lithology of underlying rocks and structural forms of land.

The resource data of soils, land form units, forest types, tree densities and land use were then transferred onto the 1:24,000 base maps.

After completion of the base maps, a field investigation was made by traversing all known roads and tracks in the catchment using two and four-wheel-drive vehicles, and travelling by foot in inaccessible areas. Except for the southern part of the catchment where access is poor,soil types and their boundaries, forest types and their boundaries, tree density, slope classes, and land formation, were checked, and where errors were found the base maps were corrected. During the field work, delineation of skylines and definition of their qualities at 11 observation points were accomplished in order to describe scenic values and vistas. Points of interest of the catchment in relation to recreational use were also recorded on the base map. Approximately 90 days were spent in the field for inventory, examination and control of resource data (Appendix 4, sample sheets of field investigation).

Ultimately, final maps of geology, terrain classification, soil types, forest types, tree density and points of interest were produced at a scale of 1:75,000 and a description of each of these resources is given. Skylines from each observation point have been drawn at a scale of 1:108,000 and the landscape compositional types of each skyline have been described. Vistas and their scenic values have been analysed, described and mapped in Appendix 3 as a basis for future planning, and further research in the area.

The history of land uses and the available and related climatic records of the catchment are discussed.

5.3 Physical Resources

5.3.1 Climate

The climate of the catchment is typical of that for the southern tablelands, with warm to occasionally hot summers and cool to cold winters. Annual rainfall varies from about 57 to 100cm. In winter, snowfalls are common on the highest parts of the Tidbinbilla Range and occasionally on the valley floor.

Climatic data for the catchment are derived from six meteorological stations. These are Back flats, Riverlea, Congawarra, Tidbinbilla (all in the catchment) and Tharwa and Pierces Creek stations which are just outside, but representative of, the catchment (Fig. 4.2). The data for Congawarra, Tidbinbilla and Tharwa have been combined. The availability of data for all stations is given in Table 5.2.

TABLE 5.2 Climatic Observation in the Catchment

Climate Station	Operating Authority(1)	Location of Stations in the area	Parameter measured/years of record				
			Rainfall	Temperature	Evaporation, Humidity	Wind	Sunshine, cloud, number of clear days
Backflats	DHC	SE	1968-73	*	*	*	*
Riverlea	DHC	Centre	1970-73	*	*	*	*
Congawarra(2)		Centre					
Tidbinbilla(2)	DHC	W	1956-70	*	*	*	*
Tharwa(2)		SE					
Pierces Creek(3)	FB	N	1930-72	*	*	*	*

(1) DHC = Department of Housing and Construction. FB = Forest Branch (now Division of Forest Research)

(2) Data for these stations have been combined.

(3) Station outside the catchment, but north part of the catchment is included

* Data unavailable

Long term climatic records are unavailable in the area (Table 5.2) and comparison with Fairbairn (Canberra Airport) and Canberra Forestry stations is necessary to obtain some idea of the general variability of the climate (Table 5.3).

In the following sections, several climatic features are discussed in relation to the Paddys River catchment.

(a) Precipitation

The annual distribution of rainfall within the catchment is illustrated in Figure 5.1. Rainfall is relatively uniform from month to month, but is generally greatest in autumn and spring with October showing the highest registration. Mean monthly rainfall within the catchment for both north (Pierces Creek Station) and south parts (combined stations) is similar.

Average monthly days of rain for the catchment and Canberra are given in Table 5.4. In order to obtain an overall idea of rainfall in the catchment, and to compare the number of wet days in the catchment to that of Canberra, the average monthly number of wet days, in three stations is depicted in Figure 5.2. The data reveal that the average number of wet days in the centre and southern sections (96) of the catchment is slightly less than in the northern part (102), and Canberra (110).

For Backflats and Riverlea stations, where recording started 5 and 4 years ago respectively, only an annual summary of rainfall is given (Table 5.5). Thunderstorms and hail are not the main feature of the region's climate, but they would be expected over the mountainous country, e.g. Tidbinbilla Range on the west side of the catchment (Bureau of Meteorology, 1968).

TABLE 5.3 Climatic Observation in the Region

Climate Station	Operating Authority(1)	Location of Stations	Parameter measured/years of record				
			Rainfall	Temperature	Humidity	Wind	Number of clear days
Fairbairn	FMO	Canberra	1940-74	1940-74		1940-74	1940-74
Bull's Head	FRI	W of ACT		1945-54			
Canberra Forestry Station	FRI	Canberra			1928-65	1940-74	

(1) FMO = Fairbairn Meteorological Office; FRI = Forest Research Institute (now Division of Forest Research).

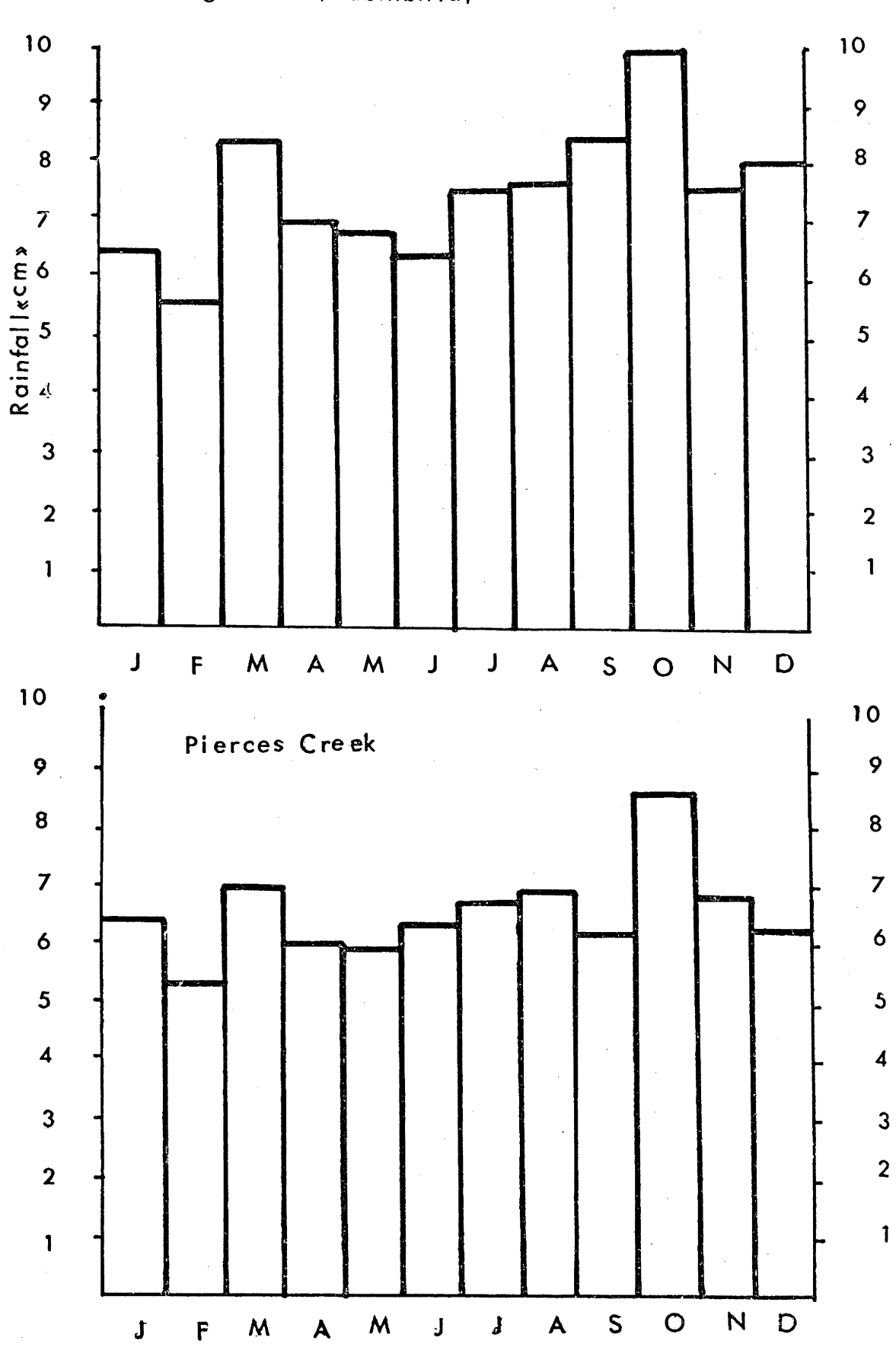
Congawarra, Tidbinbilla, Tharwa
Rainfall «cm»
10
9
8
7
6
5
4
3
2
1
J F M A M J J A S O N D
Pierces Creek

Fig. 5.1

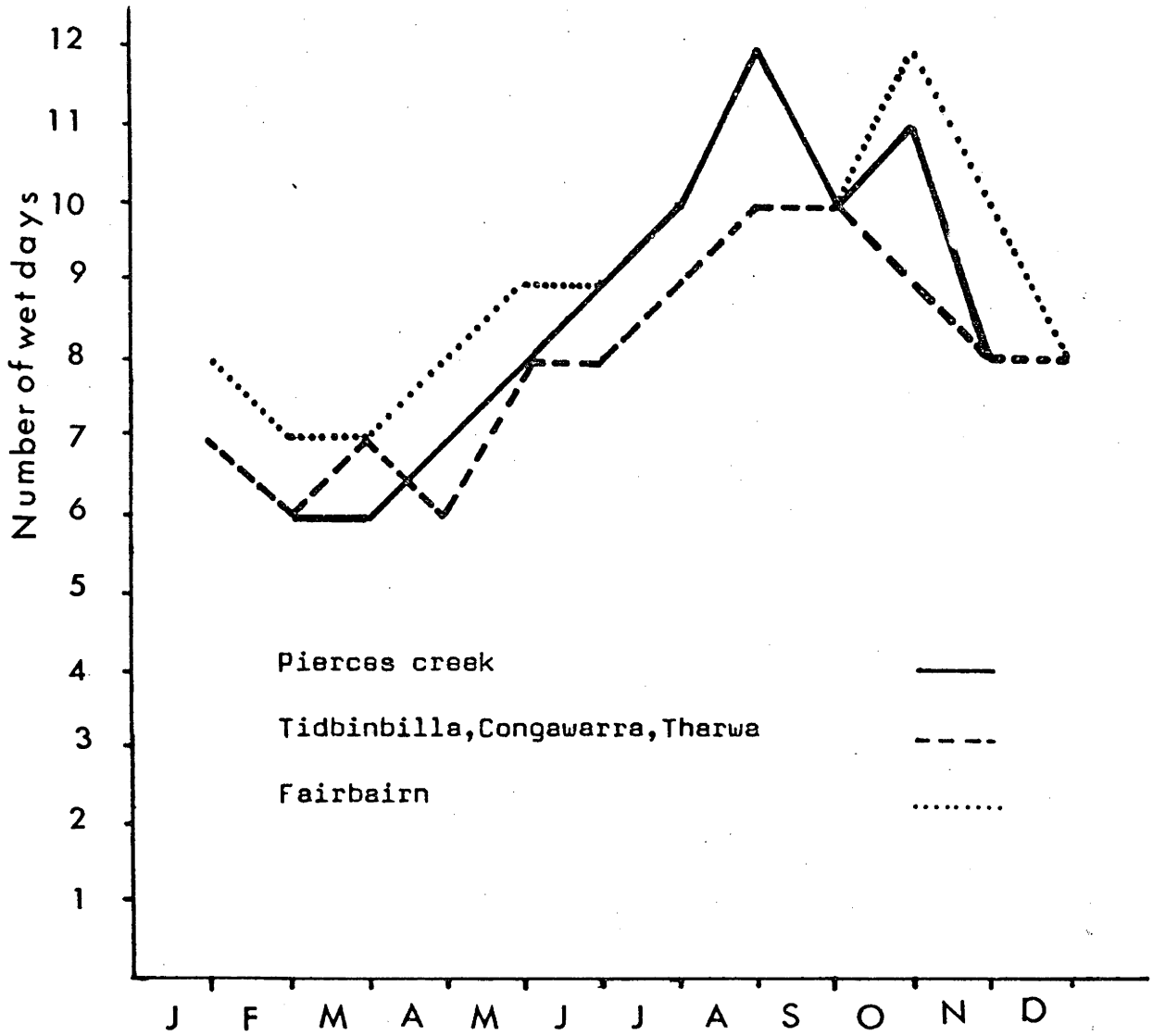
Number of wet days
12
11
10
9
8
7
6
5
4
3
2
1
J F M A M J J A S O N D
Pierces creek
Tidbinbilla,Congawarra,Tharwa
Fairbairn

Fig. 5.2

TABLE 5.4 Average Monthly Days of Rain (Days with Rain of 0.25mm or More)

Month	Stations (Years of Record in Brackets)		
	Congawarra, Tidbinbilla and Tharwa (combined stations) (1956-1970)	Pierces Creek (1929-1965)	Fairbairn (1940-1974)
January	7	7	8
February	6	6	7
March	7	6	7
April	6	7	8
May	8	8	9
June	8	9	9
July	9	10	10
August	10	12	12
September	10	10	10
October	9	11	12
November	8	8	10
December	8	8	8
Year	96	102	110

Source: Forestry Department, ANU, DHC, FMO

TABLE 5.5 Summary of Rainfall (mm) for Backflats (A) and Riverlea Stations (B)

Year	Total		Wet Days		Max.Monthly		Max.Daily	
	A	B	A	B	A	B	A	B
1968	1102		115		249		69	
1969	1475		145		233		144	
1970	1339	847	136	106	227	170	58	65
1971	1292	894	140	102	258	194	82	68
1972	855	407	103	64	150	87	59	30
1973	1467	810	150	101	263	153	60	51

Disastrous floods have occurred at irregular intervals since early settlement on the Murrumbidgee River and its tributaries.

Floods of short duration occur along the Paddys River, and they cause damage to picnic facilities in the low-lying country (Tanners Flat and Flint Crossing).

Snowfalls occur during winter on the Tidbinbilla Range and can remain for several weeks above 1,200m. There are no reliable records of the depth and extent of this snow cover.

Fogs occur fairly frequently in elevated areas as well as on the valley floor. In the absence of any data it is necessary to assume that their frequency would be similar to the days when fog is recorded at Fairbairn station. Fairbairn has an average of 46.5 days of fog which are recorded throughout the year with the maximum number of days in any month occurring in July.

Drought is a common feature of the climate of the region, and major droughts have been recorded in 1940 and 1965 (Bureau of Meteorology, 1968). It is assumed that the effects of these droughts would have been just as severe in the catchment as in surrounding areas of the region.

(b) Temperature

Mean monthly temperature variations in the region are related mainly to elevation and local topography (Boden, 1971). To obtain a better understanding of the temperature variations of the region, temperature data are quoted for both the mountainous country and the valley floor.

The only temperature records which are available for the mountain region to the west and south of the Canberra region are those at the Forestry station at Bulls Head. Average monthly and annual temperatures for the Bulls Head station are given as an indication of the temperature variation in the mountainous country of the catchment (Table 5.6).

For an estimation of the average monthly and annual temperatures experienced on the valley floor, the data recorded by Fairbairn Meteorological Office for Canberra have been used. The average monthly and annual temperatures for Canberra are shown in Table 5.6.

The average temperature is greatest for January and lowest for July. These values indicate, by world standards, a rather mild continental climate (Bureau of Meteorology, 1968).

TABLE 5.6 Average Monthly and Annual Temperatures for Bulls Head (A) (1945-1954) and Canberra (B) (1940-1974) Stations in ^{o}C

Month	Maximum		Minimum		Mean	
	A	B	A	B	A	B
January	20.7	27.5	9.2	12.9	14.8	20.2
February	20.0	26.6	9.2	12.6	14.5	19.6
March	19.0	24.4	8.7	10.5	13.8	17.5
April	13.6	19.6	4.6	6.5	9.2	13.1
May	9.3	14.8	2.1	2.8	3.8	8.8
June	6.5	12.0	-0.2	0.8	3.1	6.5
July	5.7	11.0	-1.1	-0.3	2.3	5.3
August	6.7	12.6	-1.3	0.8	2.7	6.7
September	10.3	15.8	1.7	2.7	6.0	9.3
October	12.7	19.0	3.2	5.7	8.0	12.3
November	16.1	22.0	5.6	8.1	10.9	15.1
December	20.4	25.9	8.6	11.0	14.4	18.5
Year	13.4	19.3	4.2	6.2	8.7	12.7

Frosts are common throughout the region with Canberra experiencing an average of 100 days each year (FMO). The distribution of frosts is variable depending on location.

Despite the absence of records for the catchment, severe frosts apparently occur frequently in winter even at lower elevations.

(c) Humidity, Physical Comfort and Evaporation

Average monthly and annual relative humidity readings for 9am and 3pm at Canberra, are given in Table 5.7. Humidity is low,

particularly during summer which is less enervating than in coastal areas with high temperature and high relative humidity (Boden, 1971).

Recent studies in Australia (Bureau of Meteorology, 1968) indicate that the climate and vapour pressure ranges of the Canberra region are comfortable for most people.

Evaporation for Canberra is recorded at 125cm per year with a maximum in January and a minimum in July. Annual evaporation in the Canberra region is comparatively low by Australian standards (Bureau of Meteorology, 1968).

TABLE 5.7 Average Monthly and Annual Relative Humidity (%) (1928-1965)

Month	Av. Monthly Relative Humidity 9am	Av. Monthly Relative Humidity 3pm
January	53	31
February	60	36
March	67	40
April	74	49
May	79	58
June	82	59
July	81	58
August	76	54
September	67	43
October	62	43
November	55	40
December	53	34
Year	67	44

Source: The Bureau of Meteorology (1968)

(d) Wind

The Bureau of Meteorology (1968) showed that the western part of the A.C.T., including the Paddys River catchment, is located in a region, where winds from the westerly quarter predominate. The prevailing north west direction over most of the year appears to be largely due to topographic channelling. This persistant prevailing wind affects the recreationist's physical comfort particularly in winter months. The north westerly winds in the region also appear to affect tree root systems (Pryor 1939). Wind records collected at the Canberra Forestry station and Fairbairn station are illustrated in Table 5.8.

TABLE 5.8 Wind Records for Canberra Forestry Station and Fairbairn Station 1940-1974

Month	Prevailing Wind		Average Wind Speed Km/h (a)
	9am	3pm	
January	NW	NW	6.6
February	NW	NW	6.1
March	SE	NW	5.3
April	NW	NW	5.0
May	NW	NW	4.4
June	NW	NW	4.8
July	NW	NW	5.0
August	NW	NW	5.9
September	NW	NW	6.0
October	NW	NW	6.5
November	NW	NW	6.9
December	NW	NW	6.9
Year	NW	NW	5.8

(a) Recorded at Canberra Forestry Station

(e) Sunshine, Clouds and Number of Clear Days

Canberra ~~records an annual~~ has a mean of 7.2 hours of sunshine per day.

A better appreciation of the amount of cloudiness and sunshine is perhaps obtained from the number of clear days and these are listed in Table 5.9.

A clear day is defined as a day when the mean of the amount of cloud observed at 9am and 3pm is less than two eights (Bureau of Meteorology 1968).

TABLE 5.9 Mean Monthly and Annual Number of Clear Days for Fairbairn Station (1940-1974)

Month	Mean Monthly Number of Clear Days
January	7.5
February	6.3
March	7.8
April	7.0
May	6.7
June	6.6
July	7.1
August	6.9
September	8.1
October	6.2
November	5.7
December	7.6
Year	7.0

(f) Bushfires

Bushfires are natural phenomena of the Australian landscape. In the catchment the risk of fire is greatest in the summers, particularly in the months of December and January.

5.3.2 Geology

Geology is indirectly important for an outdoor recreation capability classification, because of the relationship between soil types and underlying bedrocks.

In the current study, rock types and their occurrence in different parts of the catchment are the geological features chosen as a basis for the soil survey.

The following brief account of the geology of the catchment has been adopted and simplified from the Geological Report of the Tidbinbilla Nature Reserve (Department of Interior), 1:250,000 geological series of Canberra Sheet S1 55-16, (Strusz 1971), and (For. Dept., ANU,1973). A survey in the area to produce a geological map with a scale of 1:100,000 is conducted by the Bureau of Mineral Resources, but the results are not yet available.

The Paddys River Catchment is part of the Cotter hurst physiographic region. The oldest known rocks in the area are Ordovician sediments, the youngest are the Murrumbidgee batholith which belongs to the early Devonian period. All of the geological formation occurred in the Paleozoic era.

Most of the catchment consists of foliated, contaminated granodiorites, which are part of the Murrumbidgee batholith, and generally they bear fertile soils. Tidbinbilla quartzites occur in the western part of the catchment.

A magnetic deposit with reserves estimated at 1,000,000 tonnes, and assaying 64% Fe, lies above the west bank of the Paddys River (Jaquet 1901). A small deposit of lead, silver, copper and gold also exists in this part of the catchment.

Summary of Geological History:

Period	Rock Types	Map Symbol
Upper Ordovician	Ordovician sediments: Grey wacke; sandstone; slate; chalk; limestone, and quartzite	OS
Undifferentiated Silurian	Tidbinbilla quartzite: Sandstone; quartzite; thin limestone and slate, and sedimentary breccia	St
Middle Silurian	Paddys River volcanics: Dacite; acid tuff; lenses of limestone calcareous shale, and phyllite	Smp
Silurian to Devonian	Murrumbidgee batholith: Undifferentiated granite rocks; foliated contaminated granodiorite, and Tharwa adamellite	gm gmn amt

The 1:75,000 geological map was adopted and enlarged from Canberra sheet Sl 55-16, (Map No. 1).

5.3.3 Land Form

Taylor (1910) described the catchment as a broad belt of country separated by the old divide at Mt Tennent, drained by the Paddys River (to the north), which flows through broad valleys before dropping rapidly to the Cotter River.

The area, as mentioned before, is part of the Cotter hürst, much of which consists of a series of sub-parallel north-south uplifted blocks of hills or mountains with steep slopes particularly in the west and south-west.

Physiographically, the catchment resembles an asymmetrical bowl with the western and southern edges being higher and having an almost flattish, broad bottom in the middle. The highest point is on the Tidbinbilla range (1550m) and the lowest point is at the junction of the Paddys and Cotter Rivers (500m).

To produce a terrain map (Map No. 2), slope categories were demarcated on the A.C.T., 1:50,000 contour maps with 15.24m (50ft) contour intervals, by determining the number of contour lines for a given horizontal distance on the map. Horizontal distance for steep slope was assumed to be 5mm and for gentle slopes 15mm.

On the very steep slopes the number of contours per 5mm were counted. As slopes decreased in severity the horizontal distance over which the number of contours was counted increased and for slopes of 0-8% a 15mm horizontal interval was used. Some interpretive ability was required in achieving terrain classification and a high order of accuracy obviously cannot be guaranteed because of the scale of the map.

On the basis of this demarcation of slope, and relief, the area was classified into five major types of terrain:

(a) Mountainous. Local relief over 200m and average slope exceeding 25%. This country includes the highest lands in the area which rise to 1550m. Rock outcrops are extensive and shallow skeletal soils with gravel and stone predominate;

(b) Hills. Hilly terrain with local relief of 100-200m and slope mainly between 10-25%, with extensive outcrops, including tors and slabs on granite;

(c) Rolling Terrain. With local relief of 80-150m, and average slope of 6-15%, outcrops restricted to crests, spurs and steeper slopes;

(d) Undulating Terrain. Local relief ranges from 20-80m and slopes of 2-7% are most common, and

(e) Flat. This type of country has gentle slopes and local relief up to 20m with slopes ranging from 0-3%.

Undulating and flattish terrains have alluvial almost stone-free soils, and layered soils.

Five classes of terrain were illustrated on the terrain classification map at a scale of 1:75,000 (Map No. 2).

5.3.4 Soils

The soil type provides useful criteria for determining land capability for outdoor recreation (Part II).

In attempting to obtain such results, the nature of the scil in the catchment was studied. The study was based primarily on photo interpretation in connection with geology, landform and slopes of the catchment. Previous soil research within or in vicinity of the catchment, such as Northcote (1965), Gunn (1969), For. Dept., ANU (1970,1973), Stevens and Banks (1973), Makhdoum (unpublished), aided the survey.

It was assumed that by considering the relationship between soil formation, geology and landform, it would be possible to relate soil types of the catchment to those of Cotter River Catchment, Gungahlin, Tuggeranong, and the Queanbeyan-Shoalhaven areas.

Slope was classified into ~~steep~~ upper slope, mid slope and footslope in each land form unit and was marked on air photos.

Then, in each class of slope in any land form unit, according to the existing geology and land form, the appropriate soil type occurring with the same underlying geological formation and land form, in prescribed areas,was related and delineated on aerial photographs. For example, in the Cotter River Catchment deep sandy and gravelly yellow podzolic soils occur on footslopes, on granite and granodiorite rocks. In the current study, where rock types on footslopes, in any landform unit, were granite and granodiorite it was assumed the soil types would be yellow podzolics.

The information compiled on the base map was checked in the field, in accessible areas, to verify the presumed soil types and their boundaries. Augering was employed to determine texture, colour and, as

far as possible,the depth of soil horizons. Raupach's indication was used to determine the pH values.

Finally, a soil map (Map No. 3) at a scale of 1:75,000 was drawn and a description of each soil type follows.

Soil survey procedure followed for recreational use was not as complicated as that for uses such as forestry and agriculture (Part II), though time availability, and accessibility were two limiting factors in this survey.

The survey confirms the generally complex distribution of soils and the importance of geomorphology in soil formation. There is a strong relationship between geomorphology and soil types. Most of the soils have formed in a wide range of parent materials derived mostly from granites, granodiorite, ordovician sediments, and to a lesser extent from volcanics. Layered or buried soils are common, particularly in flattish country.

5.3.4.1 Soil Description

The soils of the area have been arranged in 5 major groups, differentiated mainly on the basis of texture following the uniform, gradational and duplex primary profile forms of Northcote (1965), and further differentiated according to variation in effective depth, structure, texture, and colour.

(a) Texture Contrast Soils

As the name implies, the soils of this group have profiles with abrupt textural differentiation between sandy or loamy surface

horizons and clayey subsoils. They are described as duplex soils by Northcote (1965). Most have a reaction that ranges from acid to neutral, some have strongly alkaline reactions. They occur extensively throughout the area and have developed in situations of both erosion and deposition from a wide range of parent materials derived mostly from granite and granodiorite. They have formed in a wide range of topographies from gently undulating terrain to mountainous country.

The group is subdivided into two sub-groups, according to colour of subsoils:

1. Duplex, red clayey subsoils.

Coarse and medium textured shallow red podzolic soils on granite and granodiorite, Tidbinbilla quartzite, and Ordovician sediments occur on steepest slopes, in patches with rock outcrops, and on midslopes. On sheltered aspects at high altitudes, topsoils have humus under heavy litter. Similar profiles occur on exposed aspects, but these have much less organic matter. They comprise the main acidic soils of the area.

2. Duplex, Yellow Clayey Subsoils.

Coarse and medium textured acid yellow podzolic soils with varying depths from moderate to deep. These occur on granite and granodiorite which mostly have formed on mid slopes.

Hard neutral and alkaline yellow mottled soils with some rock outcrops have formed on Ordovician sediments. They occur on undulating basins and low hilly to hilly terrain. In their association, buried and layered soil materials occur. In some parts such as the lower area of the Tidbinbilla valley, weak differentiation of the profile may be

observed. According to Northcote's (1965) classification associated soils of this group are: (um4); (um5); (uc4); (Gn2.14); (Gn2.15); (Gn2.25); (Gn 2.75); (Dd 1.43); (Dr 2.22), and (Dr 2.42).

(b) Massive Earths

The main characteristics of this group of soils are their gradational texture profile, in which the clay content gradually increases with depth, and containing massive subsoils with earthy porous fabric. They have formed on a wide range of rocks. They occur mostly on the steepest slopes with some to be found on midslopes.

The group is classified into two sub-groups, according to the depth of the soil:

1. Shallow coarse massive earths.

Red earths with acid to mildly alkaline reaction, occur mainly on steepest slopes, associated with rock outcrops, and few screes.

2. Deep, medium textured massive earths.

Porous red and yellow earths, which have a wide textural range, occur on midslopes. They are more loamy and well developed on sheltered aspects. Generally, they have an acid reaction.

(c) Uniform, Coarse Textured Soils

This group of soils, comprises soil textures ranging from uniform coarse sand to sandy loams, in association with red and yellow podzolic soils. They have formed on hilly to mountainous terrain. Parent materials of the soils are largely derived from granite.

(d) Uniform, Medium Textured Soils

The soils of this group have uniform loam to loamy clay textures. They have formed in materials derived from sedimentary rocks, Tidbinbilla quartzites, and granite. They occur in a range of country from hilly to undulating terrain.

This group is subdivided into two sub-groups, according to the structure of the soils:

1. Alpine humus soils, which are characterized by a marked accumulation of well humified organic matter that is intimately incorporated in the mineral soil. Changes with depth are gradual with changes in altitude and topography, but the soil is strongly acidic throughout (For. Dept., ANU, 1973).

2. Shallow to very shallow skeletal soils with a weak differentiation in profile occur in rolling to mountainous terrain.

(e) Alluvial Soils

The soils of this group occur throughout the area on recent alluvial deposits, adjacent to main streams, and they show little or no profile development and weak structure development except for flood plain areas. The group is subdivided into two sub-groups, according to texture differentiation:

1. Uniform coarse textured alluvial soils.

These are extensive near streams in the northern part of the catchment. Textures range from medium sandy to sandy loams. Colours at the surface are dark brown to dark greyish brown. Reaction is slightly acidic to mildly alkaline.

2. Uniform, Medium Textured Alluvial Soils.

These are commonly underlain by layered materials. They are the most extensive alluvial soils in the area and occur on lower terraces near major streams. Textures range from silty loam to clay loams. Colour of the soils is usually dark brown. Soil reaction is usually moderately acidic to neutral throughout.

In addition to those soils which have been described, it is worthy of note that:

(1) Some swampy areas occur in the flat terrain. Only that area upstream of Tanners Flat Creek was large enough to be mapped. The soils in these swamps are wet, humic gleyed with variable depth of peat-like topsoil over fairly compact saturated olive silt loam or clay loams. The soils of the swamp margins are similar to the soils of the swamps but they are less wet (For. Dept., ANU, 1970).

(2) The soils of foothills particularly in the centre, east and south east of the catchment consist of deep accumulations of colluvium. These are generally well drained and the profile contains large amounts of gravel and small stones.

MAP NO. 3 - Legend of Soils Map

a Medium textured red podzolic soils in association with uniform coarse textured soils.

b Coarse textured red podzolic soils in association with uniform coarse textured soils.

c Coarse textured yellow podzolic soils with moderate depth in association with uniform medium textured soils.

d Medium textured yellow podzolic soils with moderate depth in association with uniform medium textured soils.

e Medium textured yellow deep podzolic soils.

MAP NO. 3 - Legend of Soils Map (Cont'd)

f	Hard neutral yellow mottled soils.
g	Alkaline yellow mottled soils in association with massive earths.
h	Shallow coarse textured red earths.
k	Deep medium textured red earths.
w	Deep medium textured yellow earths.
t	Uniform coarse textured alluvial soils.
m	Uniform medium textured alluvial soils.
Ah	Alpine humus soils.
S	Swamp soils.

5.3.5 Water Resources

The availability and nature of the water resource is significant for water-based recreation and for domestic use in outdoor recreation areas (Dasmann, 1972). Therefore, data on the nature of the water body, its configuration, permanent volume in different seasons, its rate of flow and quality are the factors which are appropriate for an outdoor recreation capability classification.

There was no record of the quality of stream water, the depth, and the nature of ground water in the catchment. The only available data were the mean monthly and annual discharge and run-off from the Paddys River (Table 5.10 and 5.11). The occurrence of permanent streams was considered in the capability evaluation.

TABLE 5.10 Mean Monthly Discharge and Median in m^3 for Riverlea Station (Paddys River) (1957-1973)

Month	Mean ('000 m^3)	Median ('000 m^3)
January	1,500	900
February	2,700	1,000
March	1,700	9,000
April	1,900	1,100
May	1,600	1,200
June	1,800	1,300
July	4,300	1,800
August	4,000	3,700
September	5,100	3,800
October	4,600	3,200
November	3,700	2,300
December	3,000	2,200

Source: DHC

TABLE 5.11 Gauging and Run-off Information for Riverlea Station (Paddys River) Station No. 410713 (1957-1973)

Lat.	Long.	Annual Discharge ('000 m^3)		Monthly Discharge ('000 m^3)		Max. Daily Discharge ('000 m^3)	Max. Instant-aneous flow (m^3/sec)	Annual Run-off (cm)		Monthly Run-off (cm)		Daily Run-off (cm)
		Max.	Min.	Max.	Min.			Max.	Min.	Max.	Min.	
$35^{o}23'$	$148^{o}58'$	66,000	8,800	24,000	28	6,600	5,645	29	4	10.5	0	3

Source: DHC

5.4 Biological Resources

5.4.1. Wildlife[1]

The relationship between wildlife and recreation is in terms of animal watching, fishing or hunting. Australia, because of the uniqueness and diversity of its animal life, i.e. 100 species of reptiles, 700 species of birds, 227 species of mammals (including 119 marsupials, 108 placentals), and 25 species of introduced birds and 17 mammals (Fennessy 1970; Costin and Frith 1971), is one of the most distinctive and interesting countries in the world for animal observation (Troughton, 1967). There is not the same emphasis on wildlife for hunting as there is in some other parts of the world (Cowling, 1970), because Australia lacks the broad spectrum of game species found elsewhere.

Rowley (1967) (in Boden, 1971), listed 10 families of mammals comprising 44 species in the A.C.T., 10 of these species are exotic. Among these, feral cats and dogs have had a deleterious effect on recreation areas particularly in the Tidbinbilla Nature Reserve (Boden, 1971).

Wildlife in the catchment has not been systematically surveyed in this study but during the survey sightings of animals and traces of them were recorded. According to these observations, pine plantations in the north and native forests in the west and south of the catchment are the habitats of most mammals in the catchment. Birds were mostly recorded around Congawarra and Riverlea, almost in the centre of the catchment, particularly near water bodies. Black and brown snakes

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(1) Domestic agricultural animals are discussed in 5.5.3.1

were observed in thick and dense grass, in summer, mainly in flattish country. Trout occur in the Paddys River and Murray cod may be found in deep holes.

In the Tidbinbilla Nature Reserve, there are some animal enclosures where indigenous species of mammals and birds are readily observed by the public. A list of the animals known to occur in the Tidbinbilla Nature Reserve (prepared by the Nature Reserve Authority) is given as representative of fauna in the catchment as a whole (Appendix 1).

5.4.2 Vegetation

For the purpose of this study, vegetation is considered as a contributor to landscape composition and its aesthetic quality, as a habitat and food for animals, as an influence in stabilizing soil and reducing erosion, for the provision of shade, and as a pollution deterrent. In this case, an understanding of forest types, their distribution, and the density of tree cover is required.

In the Paddys River catchment, the forest types have been recognised following the method used by For. Dept., ANU, (1973) in a survey of the Cotter Catchment. The reasons for using this method are:

1. Similarity of the forest cover in the two catchments particularly in the western and southern sections of the Paddys River catchment;

2. The method provides a reasonably accurate estimate of existing forest types, and

3. The classification could be readily used for land evaluation in terms of a distinct determination of the tree's ecological habitat.

Determination of forest types, and their mapping were based primarily on photo interpretation. In this respect, aspect, altitudinal ranges, slope and typical habitat of tree species were considered. Then a field survey was conducted in order to examine forest types, their associations and their boundaries.

By these means a map showing the distribution of forest types was produced at a scale of 1:75,000 (Map No. 4).

The reports of Pryor (1939), Pryor and Moore (1954), Burbidge and Gray (1970), Hall *et al.* (1970), Stevens and Banks (1973), Ingwersen *et al.* (1974) and Ingwersen (unpublished) were also used to categorise the tree species distribution.

(a) Description of Forest Types

According to Pryor (1939), forests of the Paddys River catchment consist of wet and dry sclerophyll forest and savannah woodland. In the area, 11 forest types have been recognized to be associated with a specialized habitat. There are some 17 eucalypt species (Table 5.12), and 14 non-eucalypt tree species (Table 5.13) as well as many understorey species (shrubs, herbs and grasses) (Appendix 2).

Some eucalypt species are widespread over the catchment area while others have very limited distribution. Only two sub-genera of Eucalyptus are represented (Monocalyptus and Symphyomyrtus).

TABLE 5.12 Eucalypts of the Paddys River Catchment

Scientific Name	Common Name
E. blakelyi	Blakely's red gum
E. bridgesiana	Apple box
E. dalrympleana	Mountain gum
E. delegatensis	Alpine ash
E. dives	Broadleaved peppermint
E. fastigata	Brown barrel
E. macrorhyncha	Red stringybark
E. mannifera spp. maculosa	Brittle gum
E. melliodora	Yellow box
E. nortonii	Mealy bundy
E. pauciflora	Snow gum
E. polyanthemos	Red box
E. radiata	Narrowleaved peppermint
E. rossii	Scribbly gum
E. rubida	Candlebark
E. stellulata	Black sallee
E. viminalis	Manna gum

TABLE 5.13 Non-Eucalypt Tree Species

Indigenous		Introduced	
Scientific Name	Common Name	Scientific Name	Common Name
Acacia dealbata	Silver wattle	Pinus elliottii	-
Acacia falciformis	Broadleaved hickory	Pinus laricio	Corsican pine
Acacia melanoxylon	Blackwood	Pinus ponderosa	Ponderosa pine
Bedfordia salicina	Blanket bush	Pinus radiata	Radiata pine
Callitris endlicheri	Black cypress	Populus nigra var. Italica	Lombardy poplar
Casuarina cunninghamiana	River oak	Salix babylonica	Weeping willow
Exocarpus cupressiformis	Cherry ballart	Ulmus sp.	Elm

In three instances, two forest types are very clearly associated with each other, and demarcation of their boundaries is generally difficult. These are combined on the map. These complexes are:

1. b (manna gum, candle bark and brittle gum) + lP (lower peppermint);

2. sr (scribbly gum and red stringybark) + d (apple box, red gum and red stringybark), and

3. b + c (river oak and tea tree).

Descriptions of eleven forest types are summarized in Table 5.14. Column 1 indicates forest types and the symbols used to illustrate them on the Map (No. 4). In some instances, one forest type consists of two tree associations, e.g. Forest type lP, includes associated tree species of narrow leaved peppermint with manna gum and broad leaved peppermint with brittle gum. Tree composition of the forest types is given in Column 2. Slope, altitudinal range, exposure and aspect of the forest types are shown in Column 3 to 6 respectively. Lower and upper limits of the forest types are given in Column 7. Other features of the forest types are indicated in Column 8.

Four Pinus species were introduced to the catchment. Their distribution has been delineated on Map No.4.

(b) Tree Density

It is necessary to determine tree density for evaluation of shelter, defining the landscape compositional types and evaluation of

TABLE 5.14 Forest Types of the Catchment

Forest Type and Map Symbol	Tree Composition	Slope	Altitudinal Range (m)	Exposure	Aspect	Replacement or Lower or Upper Limits	Other Features
sr= Scribbly gum-red stringybark	Scribbly gum + brittle gum	Mod. to steep	500-1000	Drier, exposed	Mainly N, NW	Replaces lower peppermint	Very complex type, sometimes doesn't respond to environmental factors. Red stringybark in some areas (e.g., north of Tidbinbilla Nature Reserve) with northerly aspect occurs as pure stand. Red box, apple box and candle bark are superimposed in some cases on this type. In some instances, it was possible for the two tree associations s and r to be split up and to be shown as independent forest types.
Composed of two associations: s= Scribbly gum + Brittle gum, and r= red stringy bark + brittle gum + mealy bundy	Red stringy bark + brittle gum + mealy bundy	Mod.	500-1000	Moister, Sheltered	All, Dominates S-SE	Replaces upper peppermint	
c= River Oak	River oak	Gentle	500-700	Moister, Sheltered	W- S	Replaced by manna gum, candlebark, brittlegum	This forest type occurs near streams (mostly along northern part of the Paddys River) in association with Tea Tree.

TABLE 5.14 (Cont'd)

Forest Type and Map Symbol	Tree Composition	Slope	Altitudinal Range (m)	Exposure	Aspect	Replacement or Lower or Upper Limits	Other Features
b= Manna gum + candle bark + brittle gum	Manna gum, candlebark, brittle gum	Mod. steep	550-1300	Moister	E-SE	Lower limit sr, upper limit lp	Is associated mostly with other forest types, occur near streams.
d= Apple box, red gum	Apple box, red gum, red stringybark	Very gentle	550-800	All	All, but mainly on N	Replaced by sr	Is mostly associated with other forest types. Yellow box in some areas is seen within this type.
lsg= Lower snow gum	Snow gum, black sallee + candle bark	Foothill slopes. Valley bottoms, flats	Above 910	Cold	S-W	Replaces upper peppermint	-
bb= brown barrel	brown barrel + manna gum	Mod. to steep	Narrow range	Moister, sheltered	SE	Upper limit aa, Lower limit up	Occurs in a narrow band below the Alpine ash.
aa= Alpine ash	Alpine ash + mountain gum	"	1070-1500	Sheltered	S-E	Replaces sm	Occurs as narrow band above brown barrel.
lp= Lower peppermint (composed of two associations)	narrowleaved peppermint + manna gum	Mod.	Variable	Moister, Sheltered	Variable	Replaced by sr at lower elevation, replaced by mountain gum at upper elevation	-
	Broadleaved peppermint + brittle gum	Mod. to steep	"	Drier, Exposed	"		It may contain apple box.

TABLE 5.14 (Cont'd)

Forest Type and Map Symbol	Tree Composition	Slope	Altitudinal Range (m)	Exposure	Aspect	Replacement or Lower or Upper Limits	Other Features
up= Upper Peppermint (composed of two associations)	Narrowleaved peppermint + mountain gum / Broadleaved peppermint + mountain gum	Mod. to steep	Variable	Moister, Sheltered / Drier, Exposed	E-SE / All	Mountain gum replaced by candlebark on upper slopes and by brittle gum on lower slopes	Variability in composition occurs due to aspect, temperature and slope.
sm= Snow gum + mountain gum	Snow gum + mountain gum	"	1280-1500	Mild	SE	Upper limit is sg, lower up	Snow gum increases at upper elevations, at lower levels mountain gum increases.
sg= Snow gum	Snow gum	Steep	over 1400	Cold	All	Replaces sm at upper elevations	Tree stands varying from woodland to open forest or even closed forest. Latter confined to southerly aspect.

its aesthetic value, and future planning. A rather new criterion based on the work of Avery (1968) was employed for categorizing the tree cover in the catchment. Air photographs of the catchment were used in conjunction with later field observation.

According to this criterion, the tree cover of the catchment was categorized into five classes of density. These categories are:

1. grassland, contains less than 2 trees per hectare;
2. sparse, 2 to 6 trees per hectare;
3. medium, 6 to 20 trees per hectare;
4 dense, 20 to 30 trees per hectare, and
5. very dense, tree coverage is continuous.

The overall tree cover is illustrated on a tree density map, at the scale of 1:75,000 (Map No. 5).

For the pine plantation area, where logging operations are carried out almost continually, the age of stands is given as an indication of density (Table 6.1).

5.5 Cultural Resources

5.5.1 Introduction

It has been the demands and impact of early man and recent man which has shaped the environment and created a variety of land uses. These demands and impacts evolved from the evolution of man's beliefs, attitudes, policies and practices. Collectively, they represent the cultural features of man. Therefore, cultural resources of the land are the result of past and present use of land by man.

In the following sections, the history of land uses, prior to and subsequent to European migration to the catchment is discussed.

5.5.2 Pre-European Settlement

Prior to its discovery and settlement by Europeans, early last century, the catchment was occupied by two aboriginal tribes, Walagalu and Dunawal. It is believed that these tribes had only a minimal impact on the ecology of the catchment. They are known to have hunted for food, periodically burnt the bush, and gathered chert, jasper and quartzite for implement making (Marchant).

5.5.3 Post-European Settlement

The dates of discovery and occupation of the catchment are uncertain. King (1954) mentioned 1820 as a date for farming along the Paddys River and adjoining creeks. Boden (1971) stated that settlers moved across the Murrumbidgee into the valleys of Paddys River and Tidbinbilla Creek between 1828 and 1836. Cox (1922) described settlements around the eastern parts of the Cotter River (which may have been in the Paddys River catchment) as early as 1832. Robinson (1927) suggested 1840 as a date for the first settlement in the Tidbinbilla Valley. Booroomba (south of the catchment) was first established in 1842 by James McKeahnie (Fitzharding, 1954).

Extensive clearing and over grazing has resulted since European settlement, particularly, in the valley floor and on the lower slopes. This is still readily observable today. However, the catchment is now used for a variety of uses including agriculture, forestry, wildlife conservation, mining and quarrying, recreation and scientific research (Fig. 5.3).

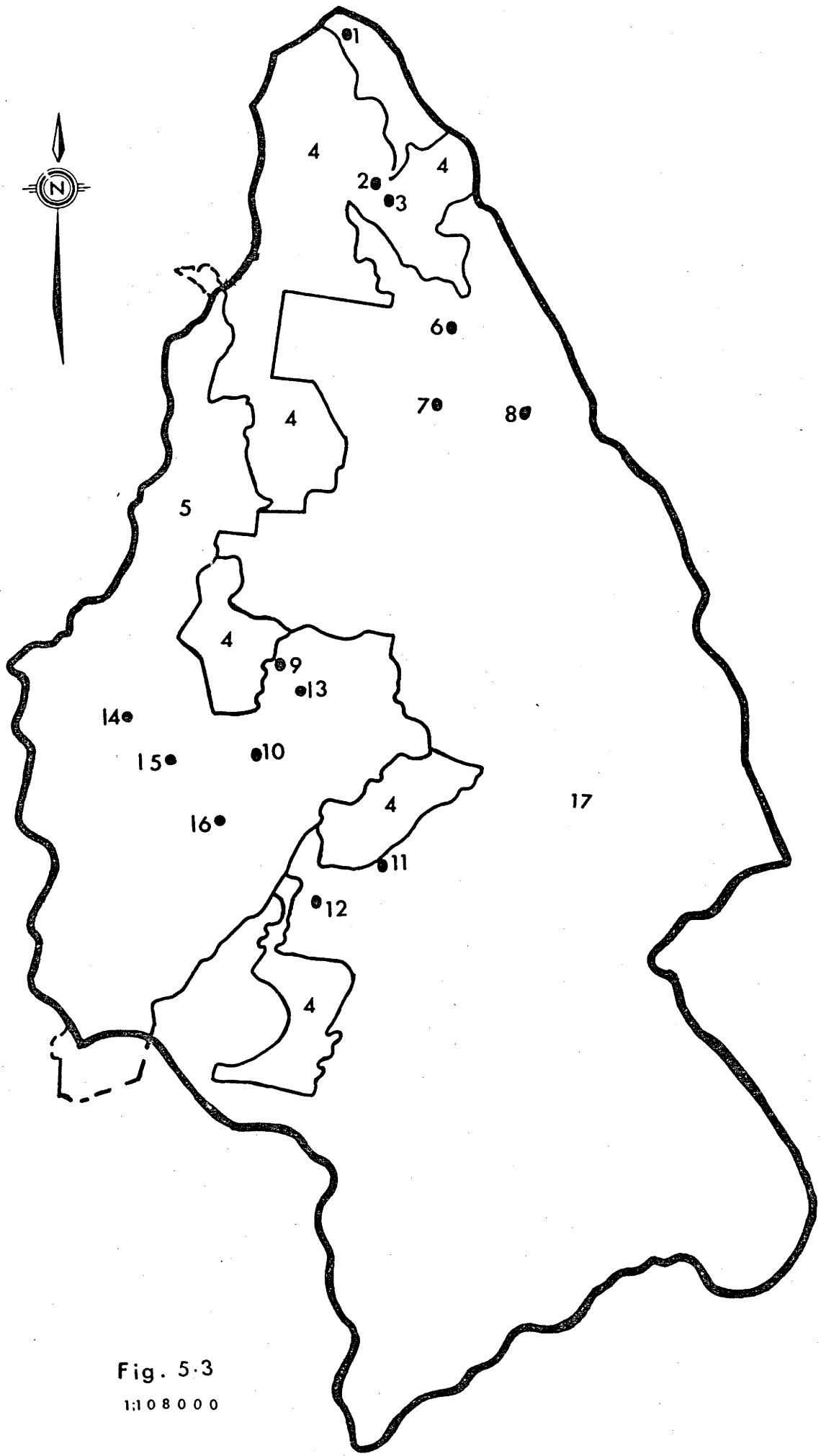

Fig. 5·3

1:108000

FIGURE 5.3

1. Abandoned mine
2. Murrays Corner gravel pit
3. Murrays Corner picnic area
4. Pine plantation
5. Tidbinbilla Nature Reserve
6. Flint Crossing picnic area
7. Tanners Flat picnic area (Riverlea)
8. Tidbinbilla Tracking Station
9. Picnic Area 1, 2 (Tidbinbilla)
10. Sheedys Creek, bird feeding areas picnic ground (Tidbinbilla)
11. Lower Gibraltar picnic area
12. Upper Gibraltar picnic area and look-out
13. Information centre (Tidbinbilla)
14. Animal enclosure "
15. Animal enclosure "
16. Look-out "
17. Grazing lands and Native forests

5.5.3.1 Agriculture

King (1954) stated that in the catchment, agricultural use, particularly grazing, along the Paddys River and adjoining creeks started in the 1820's.

Since that time, the area under agriculture as well as the number of farm holdings has decreased. Because of the introduction of new plant species and the use of fertilizers, native grasses such as Wallaby grass (Danthonia vickeryi, Danthonia pallida), and Kangaroo grass (Themeda australis) have decreased or in some areas have been replaced altogether.

The first record of the agricultural potential of the area dates back to King (1946) who stated that the Paddys River has only limited value for grazing. "The territory as a whole is an essentially upland area with pastoral emphasis and the physical environment does not lend itself to any major development work to improve production. Carrying capacity is one sheep to 1½ acre or one beast to 2 acres" (1½ acres is equivalent to 0.6 ha and 2 acres to 0.8 ha).

Even in good seasons domestic animal grazing was the only major land use. The importance of the area, however, for agriculture is not as great as east of the Murrumbidgee River.

According to King (1946) 16 land holders, each with an average area of 1,600 ha, occupied the catchment. At that time 164 hectares were under grain and hay crops, there were 225,000 sheep, and 1,000 beef cattle. The weight of annual wool shorn was 115 tonnes.

Sheep grazing was dominant in cleared areas but steeply sloping woodland on rocky uplands ~~were~~ was also used, in part, for light grazing activities.

At present, agriculture is still a dominant use of the land in the area, but since King's report, the number of holdings has decreased to 14, and the total area of holdings to about 21,000 hectares.

Generally there is now a trend toward cattle husbandry for meat production and away from wool and dairy products.

This situation might change in the future, but it is likely that the agricultural use of land will become co-dominant or even sub-dominant in the area (Boden, 1971).

The overall agricultural conditions of the area, are shown in Tables 5.15 and 5.16. This information was obtained and elaborated from the A.C.T. Statistical Summary* (1970-71-72-73-74).

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* These tables are solely for the Paddys River district and information of the northern part of the Tennent and Rendezvous Creek district is not included. All holdings are leasehold except one which is freehold.

TABLE 5.15 Rural Holdings and wool shorn production in the Paddys River District

Year	No. of Holdings	Total Area of Holding (Hectares)	Areas Used for (ha)				Total Wool Production (tonnes)
			Crops	Lying Fallow	Sown Grasses and Fallow	Other Grazing Land	
1968-69	18	25,000	100	200	6,700	18,000	134
1969-70	17	24,500	90	200	6,000	1,800	175
1970-71	17	24,500	160	5	6,600	17,500	145
1971-72	17	25,000	16	3	6,500	*	55
1972-73	14	21,000	170	60	7,000	*	82

* Data Unavailable

TABLE 5.16 Principal Livestock in the Paddys River District

Year	Sheep and Lambs	Cattle and Calves	Horses
1969	33,000	3,500	85
1970	30,500	3,000	90
1971	36,400	3,400	95
1972	33,600	4,100	*
1973	22,500	4,300	*

* Data Unavailable

5.5.3.2 Forestry

(a) History

At the time of early settlement, forest trees such as red stringybark (E. macrorhyncha), and yellow box (E. melliodora) were used for domestic purposes, e.g. fencing and buildings.

Before the Australian Capital Territory was ceded to the Commonwealth government, forestry activities within it were under the control of the chief forest officer of New South Wales. At this time, sawmilling of brown barrel (E. fastigata) and manna gum (E. viminalis) was carried out in the Tidbinbilla district, but sound forestry practice commenced with the appointment of the late T.C.C. Weston as First Superintendent of Parks and Gardens in Canberra who established the first pine plantation in 1915 in Mt Stromlo (Rodger, 1954, 1957).

The introduction of exotic tree species probably started with plantations of weeping willow (Salix babylonica) in 1845 (Schumack, 1967). Timber production of exotic tree species started with a plantation of (Pinus radiata) in the northern section of the catchment in 1932 (Pierces Creek forest, Fig. 5.3).

(b) Native Hardwood

Most of the native forests in the Paddys River Catchment occur in mountainous areas. Rodger (1957) considered that these mountainous areas could produce mill logs. Among the indigenous species, only (E. delegatensis) and (E. dalrympleana) are worthy of management for future hardwood production.

At present, there is no management plan for hardwood production from native forests in the catchment, and all forestry practices are confined to pine plantations.

(c) Introduced Softwood

Of all the coniferous species introduced into the A.C.T. in an attempt to increase the forests production of softwood, (Pinus radiata) proved the most successful. Consequently, a major programme aimed at wood production from this species was initiated.

The pine planting programme commenced in 1932 in the northern part of the catchment. The development of these plantations has been set out in the Pierces Creek forest management plan. As Jacobs (1963) stated, the main purpose of these plantations has been the establishment of an industrial forest unit,to improve the site and the landscape.

The last area to be planted in the catchment was in the Gibraltar Creek area. This brought the total area under plantation to 2,800 hectares in 1970.

Besides (Pinus radiata) other species of the genus(Pinus) have also been planted in the catchment, e.g.(Pinus ponderosa) 190ha, (Pinus laricio) 14ha, and (Pinus elliottii) 8ha.

The productivity of the plantation varies from around 10.5m^3/ha mean annual increment at age 40 years, to around 24.5m^3/ha. The more productive stands are on deeper, well drained, better structured soils, and on lower slopes (For. Dept., ANU, 1973). Ovington *et al.* (1970) stated that in the Paddys River Catchment, limited availability of land for exotic forests occurs, especially where soils are shallow or drainage impeded.

Nowadays, besides timber production, and site preservation, the plantation area is also used for recreation purposes. In the catchment, management practices associated with timber production affect recreational pursuits in two ways:

1. During logging operations, plantation roads are closed to the public ,

2. Due to clear cutting the beauty of vistas diminishes because after a compartment is clear cut the site remains bare for almost one year.

The problem of wind throw in the plantations is especially serious in areas having shallow soils. Wind throw is most likely to

occur on sites with fully wet soil profiles, in periods of high wind, following prolonged rains. The problem is greatest in stands recently thinned, and along plantation edges.

5.5.3.3. Wildlife Conservation

Wildlife conservation is justified for scientific and educational purposes, recreation, potential use to man, and for preservation.

In the A.C.T. broad land use planning policies have allowed rational allocation of land resources from urban areas through park-land to natural wilderness areas. Fifty two percent of the Australian Capital Territory has been set aside for conservation, reserves, or equivalent land uses, and these areas are managed by the Department of the Capital Territory.

The Tidbinbilla Nature Reserve is the only nature reserve in the catchment. This reserve lies in the western part of the Paddys River Catchment (Fig. 5.3).

The establishment of the reserve dates back to 1936 when 810 hectares at the head of the Tidbinbilla valley were set aside for a proposed National Park and Fauna Reserve. Due to World War II, development was delayed until 1964 when an adjacent area of 3240 hectares was added to the original area, and approval was given for the establishment of the Tidbinbilla Nature Reserve. The Reserve was recently extended to about 5515 hectares.

There are some historical and cultural features in the reserve. These include evidence of aboriginal occupation in the valley.

A management plan, for the period 1968-1984 was prepared by Margules *et al.* (1968). The principal objective of the management plan is to maintain the diversity and dynamic balance of the ecosystems, whilst providing for public use and recreation.

For management purposes the reserve is divided into six zones, (Margules *et al.*, 1968). These are:

Zone 1. 57 hectares, zoned for administrative building. To this zone there is no public access;

Zone 2. 101 hectares, zoned for playground and picnic area. Provided with water, tables, barbecues, shelters, access, parking and later a kiosk;

Zone 3. 1221 hectares, zoned for serious study. There is no public accesss;

Zone 4. 2800 hectares, zoned as wilderness. Access with permission;

Zone 5. 766 hectares, zoned for habitat interpretation. Access restricted to trails, and

Zone 6. 570 hectares, zoned as a recreation centre, animal house, and animal enclosures, with access.

Generally, zones 1, 2, 6 are essentially controlled by man and zones 3, 4, 5 are controlled by nature and man.

Eleven staff are required to run the reserve. Their responsibilities are: (1) ecology and animal husbandry; (2) administration; (3) extension services, and (4) public works.

The capital cost for current development up to 1984 is estimated at $2,182,000.

It is anticipated that the maximum visitor capacity would be 6200/day, and the average visitor capacity 3200/day (1,120,000/year).

5.5.3.4 Mining and Quarrying

The first mining operation in the catchment was carried out for iron ore on the west bank of the Paddys River, 3.2km above its junction with the Cotter River, in 1895 (Jaquet, 1901). In 1897 the mine was expanded, and it continued until it was abandoned in 1947.

Gravel pit exploitation started in 1930 at Murrays Corner (Fig. 5.3), which was then leased for 50 years. It was proposed that its boundary would extend to the edge of the pine plantation. Ovington *et al.* (1970) suggested that due to erosion and deterioration of the scenic value, as a result of quarrying, since the deteriorated site is adjacent to the main access road, eventual rehabilitation of the land surface is necessary.

Another gravel pit in Compartment 77b of the Pierces Creek pine plantation was established by the Commonwealth Department of Works in 1932, but due to unsuitability of materials for road construction, it has since been abandoned.

5.5.3.5 Recreation

In the days of early pioneers, there was little time for recreation for farmers and shepherds, who worked seven days a week. In the 1830's there were no books, no newspapers, no mail, no unions, and no communities. Attending church on Sundays was followed by a social picnic around the church (Robinson, 1927).

Ploughing competitions and horse riding (bush meetings) were the most common recreational activities in the 1850's. Hunting, as a sport, started in the 1870's and this resulted in a decline in the number of native animals such as wallabies, and the introduction of exotic animals, e.g. fox in 1895 (Boden, 1971).

Half holidays on Saturdays for the sake of cricket were available in the 1890's but Sunday sports were still forbidden by law.

Fishing, and angling, as a sport, and a source of food, were also popular. Increasing interest in this kind of recreation led to the introduction of English trout to the catchment by 1900.

At present, Canberra residents, as well as visitors to the A.C.T. use the Paddys River catchment area for a variety of recreational activities including picnicking, attending and watching, bush walking, sightseeing, horse riding, animal watching, fishing, hunting, driving for pleasure and trail biking.

(a) Picnicking

The major construction of picnic areas in the catchment began in 1965-66 leading to the establishment of 9 picnic grounds in the area (Table 5.17, Fig. 5.3).

TABLE 5.17 Organized Picnic Areas in the Catchment

Name	Size (ha)	Material used for Construct-ion of Facilities	Type & No. of Fire-Places	Type & No. of Tables	Type of Carpark	Flush Toilets	No. of Rubbish Bins	Grass Cover	Shade Trees	Other Features
Murrays Corner	-	Brick	4 gas	14 (8 in shelter)	Sealed	2	3	Sparse	Excel-lent	Area is heavily used due to easy access. Crossing of tracks through nearby river detracts from the quality of the site. The distance of area from river is less than satisfactory (40m)
Flint Crossing	5	Stone & Brick	2 wood	4 in shelter	Gravel-led	2	4	Good	Fair	Was part of grazing land. Species such as Acacia baileyana, E. bicostata, Populus nigra var. Italica, Salix babylonica have been planted. Due to scattered nature of shelters, the area is not used as heavily as Murrays Corner. Distance to river is less than satisfactory (40m). Flood washed out carpark in 1971 & 1974. Severe frost damaged water pipes (1971).

TABLE 5.17 (Cont'd)

Name	Size (ha)	Material used for Construction of Facilities	Type & No. of Fire-Places	Type & No. of Tables	Type of Carpark	Flush Toilets	No. of Rubbish Bins	Grass Cover	Shade Trees	Other Features
Tanners Flat	3.6	Stone & Brick	4 wood	8 in shelter	Gravel-led	2	4	Fair	Fair	Same as Flint Crossing
Tidbinbilla Reserve										
a. No. 1	-	Stone-metal	4 wood	4 wood stool + 4 seats	Gravel-led	2	4	Good	Good	Existence of signs
b. No. 2	-	"	"	5 seats	Gravel-led	-	4	Fair	Good	Signs exist. Area is close to area No. 1.
c. Bird feeding Area	-	"	3 wood	3 tables	Gravel-led	2	5	Good	Poor	Signs exist.
d. Sheedys Creek	-	"	2 wood	2 tables	Gravel-led	-	2	Good	Good	Signs exist. Weeping willows from previous occupation adds to shelter and beauty of the site.

TABLE 5.17 (Cont'd)

Name	Size (ha)	Material used for Construct-ion of Facilities	Type & No. of Fire-Places	Type & No. of Tables	Type of Carpark	Flush Toilets	No. of Rubbish Bins	Grass Cover	Shade Trees	Other Features
Gibraltar Creek Area										
a. Lower	-	Stone-brick	2 wood	4 (in shelter	Sealed	2	3	Good	Good	A supplementary plantation of indigenous spp. has been established. Signs exist.
b. Upper	-	"	3 wood	6 tables	"	2	3	Fair	Good	Area is near Gibraltar Falls which offers high recreation potential, demand is higher than lower area. Signs exist.

(b) Attending and watching

This term as mentioned in Part I, refers to attending historical or archeological sites or sites of scientific and natural interest. These include the visitors room at the Tidbinbilla Tracking Station with its display of small scale models. It has a lot of visitors, particularly on weekends and public holidays.

At the Tidbinbilla Nature Reserve, the animal enclosure and bird feeding area provide an opportunity for the public to see examples of Australian fauna, e.g. kangaroos and emus. These are the focus of attention of the visitors to the reserve and they provide a tangible opportunity for people to watch and feed animals.

The displays at the Information Centre of the reserve not only provides information but also provides a recreational function.

Granite and quartzite rock outcrops in the reserve also give an opportunity to those who are interested in natural phenomena.

(c) Bushwalking

Bushwalking by groups from clubs or by individuals is popular in the Crown Lands of the catchment.

The Tidbinbilla Nature Reserve provides a very good opportunity for both experienced and inexperienced bushwalkers, through its marked walking trails.

The Bullen Range (Fig. 4.2) offers an outlet for the bushwalkers who prefer lower hills. The pine plantation area in the north of the catchment is also a focus for this kind of activity. Rock Valley in

the south of the catchment is an area recommended by the A.C.T.'s Bushwalking Club for this purpose.

(d) Sightseeing

The catchment offers a diversity of landscapes for sightseers from the pine forests, to the wet and dry sclerophyll forest, the woodlands and grasslands, and from flat country to mountainous terrain. Most sightseeing is done from the roadside, although undoubtedly roadsides ~~have~~ give less tangible opportunity to observe a range of vistas when compared with bushwalking trails. The road system provides access to a variety of vistas which encompass one or several of the vegetation types. Vehicular access to two outstanding lookouts has been developed. One is on a low hill in the Tidbinbilla Nature Reserve and the other is at the top of Gibraltar Falls.

(e) Horse Riding

This recreational pursuit has been of increasing interest to the urban population in recent years. Because of the distance of the catchment from Canberra, organized horse riding groups do not frequent the area, and horse riding is confined to the families and friends of the land holders. They have access to all parts of the catchment, except the Tidbinbilla Nature Reserve, where horse riding is prohibited for the public.

(f) Animal Watching

This activity attracts many people and is often associated with other recreational pursuits. Tidbinbilla Nature Reserve is perhaps the best place to see native animals because they are kept in enclosures. They can also be seen at Riverlea, Congawarra (along Paddys

River Road) and along Corin Dam Road. Users interest varies from being members of amateur bird watching clubs to family groups, who may stop along the road to watch the animals.

(g) Fishing

Paddys River contains trout which are fished by the public. More fishing is done in the northern downstream end of the river where there are deep holes and the river is more accessible. It is common knowledge among fishermen that in recent years, the number and size of the catches have decreased. The reason for this is unknown.

(h) Hunting

With the increasing number of rabbits and foxes in the A.C.T., hunting of these vermin for sport and pleasure has also increased. In the catchment, hunting of these animals is often carried out by farmers, and occasionally some urban visitors also take part. Hunting of indigenous species was popular in the past, but it is now forbidden.

Generally hunting in the catchment is a minor recreational activity.

(i) Driving for Pleasure

The catchment, with its circuit drive and many subordinate roads and good scenery, is heavily used for this purpose. At the present time, demand is relatively high. With the expected sealing of part of Paddys River and Tharwa Roads the demand is likely to increase.

(j) Trail Biking

In the catchment, there is no area set aside for trail bikes similar to that provided at Stromlo Forest. Nevertheless, the accessible areas in the catchment are being used increasingly by trail bikes. This activity is associated with two major problems: (1) noise; its interference to other recreationists and wildlife, and (2) soil disturbance with the risk of accelerated erosion. The latter problem is greatest where trail bikes are ridden on fire trails and cross country, especially in steep terrain.

5.5.3.6. Scientific Use

Part of the Tidbinbilla Nature Reserve has been allocated for scientific research. Many scientists from different institutions, and with a variety of interests, frequent the Reserve for this purpose. Their interests are mainly plant ecology, wildlife biology, geology and recreational use studies.

Tidbinbilla deep space communication complex (Tidbinbilla Tracking Station) is another centre for scientific use (Fig. 5.3).

This complex was established in March 1965, following a cooperative agreement between the USA and Australian governments. Construction of the complex started in June 1963, and it first became operational in December 1964.

The complex is located in a natural geographic depression in the Tidbinbilla Valley, and occupies about 4 hectares in which landscaping has been effectively used to control soil erosion, to provide a fire-break, and a pleasing environment.

The main purpose of this complex is for deep space probes and manned space flights.

5.5.3.7 Roading

The various components of land use need a communication network which must operate to integrate all uses. Road systems, as a composite part of land use, are an important communication network, and must form part of overall planning. In this context, roads can be regarded as a dependent part of an overall plan before construction and as an independent land use after being built, from which other land uses will benefit.

Roads have a major role to play in allocation and planning of land for recreational pursuits. Moreover, in determining suitable land for intensive recreation, the suitability of surrounding areas for roading should also be assessed.

In the Paddys River catchment, existing roads play a significant part in determining recreational use, although this road network was designed primarily to service other land uses.

Paddys River Road probably originated from access tracks developed by the early settlers. These tracks would have undoubtedly originated from Tharwa and Cotter. From this beginning, the road network has been progressively developed and upgraded. The last major upgrading took place in 1968 (City Parks & Administration files, unpublished data).

Subordinate road construction was started in association with the establishment of pine plantations in 1932. Later,

Tidbinbilla Nature Reserve Road, Tidbinbilla Tracking Station Road and Corin Dam Road were built when development of these establishments commenced.

The present situation and location of roads was discussed in Chapter 4. Generally, due to more pressure on various land uses in the north of the catchment, the road network has been improved and provides excellent access. The roading for the western, centre and south-eastern sections of the catchment varies from good to very good. But the southern section of the catchment, where country is steep, and small pressure from land uses occur, has a poor access.

The total area of land devoted to roads is about 250ha, but in the light of expected growth of recreational use in the future, the quality and density of the present road systems must be improved.

5.5.4 Discussion

At the present time, agricultural use of land (grazing) is the dominant land use in the catchment. The emphasis is more on beef and cattle husbandry rather than sheep husbandry and dairying.

Softwood timber production, particularly from radiata pine, is a co-dominant land use. This situation will probably continue until the 1980's when it is likely to become sub-dominant to recreation.

Recreation, especially extensive activities, is a sub-dominant land use of the catchment at present. However, intensive uses such as picnicking and attending and watching are of high demand value and are therefore dominant activities. Wildlife conservation with reference to research, education and preservation is also a sub-dominant land use.

Mining and quarrying, country settlement and other land uses are the group of land uses which are suppressed.

5.6 Miscellaneous Resources

5.6.1 Scenic Vistas and their Values

A vista may be objectively assessed in both radial distance and azimuth angle of any view sector from a given point, while the scenic value is a subjective judgement of the aesthetic worth of the objects which are appraised from the point.

Recreational interest in land has usually been allied to the surrounding beauty of the land. An aesthetic vista is one of the most important factors in determining land capability for some recreational uses.

In the Paddys River Catchment, skylines of scenic vistas from eleven points were objectively determined, and then any sector of skylines was qualitatively assessed. Following reports were used in this achievement. Litton (1968, 1972, 1974), For. Dept., ANU (1970), Sargent (1971), Stevens and Banks (1973), Zube *et al.* (1974).

A plane table was used at the eleven observation points to observe eleven vistas and their appropriate skylines. These have been mapped at the scale of 1:108,000 (Appendix 3). The observation points were selected on the following basis:

1. having interest in future planning;
2. having some common features of catchment vistas;
3. representing the whole aspect of vistas in the catchment, and

4. regarded as points where all skylines could be seen (except point 7), ~~in~~ through 360° without any obstacle to the observation.

From each observation point, the skylines were observed and marked on the skyline maps with letters.

Assessment was carried out subjectively by qualifying the existing features of skylines from observation points.

In order to assess the scenic value of skylines a series of criteria were considered:

(a) observer position which may be "inferior", "normal" or "superior" to vistas;

(b) distance to vistas which may range from 0-400m (foreground), 400m-8km (middle ground), and 8km - ∞ (background);

(c) Edge of skyline, which might be sky with ranges; grassland; forest; bare rock or logged area;

(d) landscape compositional types which might be (1) panoramic, which in this view the observers position is superior, distance is fore or middle ground and skyline can occupy up to 360° angle of observation; (2) enclosed landscape, e.g. slope faced enclosure; cliff faced enclosure; vegetation faced enclosure (hardwood, or conifer), and (3) focal landscape, where there is convergence of parallel lines such as roads, rivers or a geological feature, and

(e) any type of landscape which may have unity (a dominant land-form with co-ordinated, sub-ordinated surrounded parts),

vividness (contrasting elements such as shape, line, colour), and variety (richness).

Descriptions of the observation points, and their appropriate skylines are given in Appendix 3 (Table 3.1), and their positions in the catchment are illustrated in Fig. 3.1, 3.2, 3.3, 3.4, 3.5, 3.6, 3.7, 3.8, 3.9, 3.10, 3.11 of the Appendix.

5.6.2 Points of Interest

Points of interest are places which influence the recreation capability classification, according to their natural and cultural features. These are:

1. historic sites;
2. areas of special geological interest;
3. areas of special botanical interest;
4. areas with recreation facilities;
5. areas of scenic attraction, and
6. areas with special scientific interest.

During the survey in the Paddys River catchment, such points were recorded. The recording of these places on the map (1:75,000) was based solely on field observation (Map No. 7).

PART IV

RESOURCE ANALYSIS

CHAPTER 6

INTEGRATION OF RESOURCE DATA

6.1 Introduction

The object of this study was an attempt to produce an outdoor recreation capability classification using intrinsic criteria for an actual area of land and using the available resource data.

In the description of the methodology, in Part II, evaluation of a land capability for outdoor recreation is based on matching the land characteristics to a series of resources required by recreational activities.

In actual practice, however a problem arises, that is, land characteristics relevant to outdoor recreational use (resource data) cannot be evaluated singly, because the availability and suitability of one factor may be restricted by the lack of another. For the assessment of any activity, therefore, a number of factors must be taken into consideratior. At the same time, each set of resource data contains a variety of types and components, e.g. in the catchment under study, the vegetation included eleven different forest types. Each type or component of the resources may also occur repeatedly at different sites in an area. This makes evaluation particularly complicated.

To overcome some of the problems, it is necessary to integrate all available resources of the area into a series of units, each of which contains a degree of uniformity with respect to these resources.

So far, there has not been an actual "Model" produced for the integration of resource data to be used for an outdoor recreational use

study. Therefore, in this study, an attempt was made to integrate land resources relevant to outdoor recreation into a number of units. These units form the basis for evaluation of the Paddys River catchment's capability for outdoor recreation.

6.2 Integration

The intrinsic capability of a particular area of land for outdoor recreation is related to all of its resources. The environmental characteristics influencing this intrinsic capability of land for outdoor recreation include climate, hydrology, geology, landform, soil types, wildlife , vegetation, land use and the interaction of these factors in the form of scenery and points of interest (Part II).

The object of integrating the resource data was to delineate areas of land which possessed basically distinctive patterns of all the resources.

In this study, some of the environmental factors mentioned above could not be inventoried in sufficient detail to be used in the integration process, due to deficiencies in some resource data, e.g. climate and water resources, lack of expertise, e.g. wildlife. and the limitations of time and accessibility, e.g. scenic values and vistas. Therefore, the resource data used to integrate and derive the units included; geology, land form, soil types, forest types and tree density,and land use.

The integration process involved the manual stereoscopic interpretation of aerial photographs. The resource data were transferred from the final resource maps onto aerial photographs. This subjective stereoscopic interpretation involved recognizing and delineating areas

possessing combined features of land resources according to their distinctive patterns of type and uniformity. These areas are called "Environmental units". The environmental units resulting from the integration of resource data are different from one another according to their prescribed resource properties (Plates 6.1, 6.2).

6.3 The Environmental Units

Using the criteria outlined above some 37 environmental units (Map No. 6) were identified as having distinctive ecological and cultural characteristics.

An environmental unit is a unit of land where there is an interacting pattern of geomorphology, soils and vegetation within a given land use. These units form the basis for the catchments' capability classification for outdoor recreation. Table 6.1 describes each environmental unit, in terms of its major environmental components. The environmental units are numbered (Column 1). The area of each unit and its percentage of the total area, are shown in Column 2. The geology of the unit is given in Column 3. A brief description of altitude, slope classes, aspect, and physiography is given in Columns 4, 5 and 6. Soils and vegetation are described in Columns 7 and 8 respectively. Present land use and the nature of accessibility in each unit are explained in Columns 9 and 10. The occurrence of natural and cultural features, in each unit, in relation to recreation are given in Columns 11 and 12.

Plate 6.1 The types of environmental units identified

Plate 6.2 The types of environmental units identified

TABLE 6.1 Environmental Units in the Paddys River Catchment

Unit	Area ha	Area % of total	Geology	Altitude	Slope Classes %	Aspect and Physiography	Soils
1	2002	7.38	Silurian to devonian. Murrumbidgee batholith: foliated contaminated granodiorite.	Max. 670 Min. 550	0- 3= - 2- 7= 92.5 6-15= 5 10-25= 2.5 > = -	Aspect, SE-NE-NW. Undulating terrain running N. Two sugar loaf escarps on the W boundary face E with a creek draining north easterly.	Mainly c on mid slopes, on western side of sugar loaf country, h, K. In gullies, e + w.
2	83	0.31	Paddys River middle silurian volcanics.	Max. 550 Min. 500	0- 3= - 2- 7= 1 6-15= 2.5 10-25= 57.5 > = 39	Primary aspect, E, secondary aspects SE, NE. An escarpment facing NE with the permanent stream in the bottom.	Mainly h. In gullies, w + e
3	959	3.53	On ridge, ordovician sediments. On slopes, silurian to devonian adamellite, foliated contaminated granodiorite of Murrumbidgee batholith, and Paddys River middle silurian Volcanics.	Max. 915 Min. 550	0- 3= 7 2- 7= 8 6-15= 33.5 10-20= 44 > = 7.5	Primary aspect, SW, secondary aspects, NW, NE. Mountainside with ridges, escarpment generally facing SW.	Mainly a + b on steep slopes. On midslopes, ordovician sediments, and undulating country soil is better developed with medium textured, c + d.
4	87	0.33	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max. 610 Min. 550	0- 3= - 2- 7= 100 6-15= -	Aspects variable. Undulating terrain with a creek draining eastward in the middle.	Mainly, c.

TABLE 6.1 (Cont'd)

Unit	Forest Type and Tree Density	Present Land Use	Access	Natural Features Suitable for Outdoor Recreation	Artificial Features and Amenities Suitable for Outdoor Recreation
1	Pinus radiata. Pinus laricio (corsicana pine), almost 40 years old.	Timber Production.	Excellent. 2 wheel drive, walking. Paddys River Road passing through the unit with many diverging gravel roads from plantations.	Shade trees (excellent). Existence of wildlife.	Roads & trails.
2	Open forest, which mainly consists of sr forest type. Density: S, M.	Native forestry, fishing for recreation.	Good. 2 & 4 wheel drive. Walking. Accessibility to north of the unit is by pine plantation gravel roads.	Fish for fishing. Shade trees (very good). Existence of wildlife.	Roads & trails.
3	Dry sclerophyll forest which mainly consists of sr forest type, and a small patch of lp forest type. Density: M, D.	Native forestry.	Moderate, 4 wheel drive, difficult walking.	Shade trees (very good), fish for fishing, scenic lookout and botanical features. Existence of wildlife.	Tracks and ruin of house.
4	Pinus ponderosa 35-40 years old.	Gravel pit, timber production.	Good. 2 wheel drive, walking. Pine plantation gravel roads.	Shade trees (excellent). Existence of wildlife.	Roads & trails.

TABLE 6.1 (Cont'd)

Unit	Area ha	Area % of total	Geology	Altitude	Slope Classes %	Aspect and Physiography	Soils
5	177	0.66	Silurian to devonian undifferentiated granite rocks, and foliated contaminated granodiorite both of Murrumbidgee batholith. A small patch of ordovician sediments occursin Western part of the unit.	Max. 790 Min. 650	0- 3= - 2- 7= 95 6-15= - 10-25= 5 > = -	Primary aspect, NE, secondary aspects, SE,NW. Undulating terrain, granite outcrops common.	On foot slopes, mainly e, and on midslopes, c.
6	320	1.18	Silurian to devonian foliated granodiorite of Murrumbidgee batholith, and Paddys River middle silurian volcanics in far South.	Max. 650 Min. 590	0- 3= - 2- 7= 68 6-15= 28 10-25= - > = 4	Aspect, NE. Undulating terrain with creeks draining eastward.	Mostly g, and a complex of K + w.
7	83	0.31	Paddys River middle silurian volcanics in the North, and silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max. 610 Min. 500	0- 3= - 2- 7= 46 6-15= 54 10-25= - > = -	Permanent river gorge running S to N with some steep slopes. Aspect, SE, NW, N, S.	Mostly t.
8	225	0.83	On ridge, ordovician sediments. On slopes, silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith, and Paddys River middle silurian volcanics.	Max. 730 Min. 550	0- 3= - 2- 7= 2 6-15= 70 10-25= 28 > = -	Primary aspect SW, secondary aspects, NE, NW. Mountainside with ridges, escarpment generally facing SW.	f on steep slopes, g on midslopes.

TABLE 6.1 (Cont'd)

Unit	Forest Type and Tree Density	Present Land Use	Access	Natural Features Suitable for Outdoor Recreation	Artificial Features and Amenities Suitable for Outdoor Recreation
5	Pinus radiata, Pinus ponderosa almost 40 years old.	Timber production.	Very good. 2 wheel drive, walking. Many pine plantation gravel roads.	Shade trees (excellent), existence of wildlife.	Roads & trails.
6	Pinus radiata, 35-40 years old. Compartments 69-73 have been clear cut, compartment 72 is 3 years old (replanted 1973), compartment 74 has been wind thrown.	Mainly timber production. Gravel pit.	Excellent. 2 wheel drive, walking. Paddys River Road passes through the unit with many divergent pine plantation gravel roads.	Shade trees (good), existence of wildlife. Scenic lookout.	Roads & trails.
7	Dominantly Casuarina cunninghamiana + tea tree, manna gum. Apple box,in some places,replaces river oak. Density: M.	Recreation (picnicking, fishing).	Excellent. 2 wheel drive, walking.	Fish for fishing. Fire wood, shade trees (excellent). Existence of domestic water and wildlife.	Roads & trails. Picnic facilities, gas & wood fireplaces, flush toilets parking area, rubbish bins & ornamental plantations.
8	Pinus radiata. Pinus ponderosa. 30-35 years old. Compartment 133 has been wind thrown.	Timber Production.	Moderate. 2 & 4 wheel drive. Walking. Pine plantation gravel roads. (Accessibility is arranged by passing directly through the Paddys River).	Shade trees (very good). Evidence of wildlife. Scenic lookout.	Roads & trails.

TABLE 6.1 (Cont'd)

Unit	Area ha	Area % of total	Geology	Altitude	Slope Classes %	Aspect and Physiography	Soils
9	237	0.87	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max. 850 Min. 520	0- 3= - 2- 7= 34 6-15= 37 10-25= 25 > = 4	Hilly to undulating terrain with N primary aspect. Dissected with a creek. Outcrops and stony rubbles common. Secondary aspects E, W.	On steep slopes d + c, on sugar loaf country an association of a + b.
10	178	0.66	Ordovician sediments.	Max. 850 Min. 670	0- 3= - 2- 7= 20 6-15= 13 10-25= 10 > = 57	Mountainside with ridges facing Northward. Very steep escarpment. Secondary aspects, NW, NE.	Mainly b.
11	504	1.85	On ridge, ordovician sediments, and silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith on slopes.	Max.1340 Min. 850	0- 3= - 2- 7= - 6-15= - 10-25= 30 > = 70	Primary aspect NE. Steep escarpments on mountainsides with ridges generally running S to N. Secondary aspects NW, SE.	Mainly b + d.
12	326	1.20	Ordovician sediments (NE), and silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max. 955 Min. 760	0- 3= - 2- 7= 60 6-15= 16 10-25= 18 > = 6	Hilly to undulating country with S primary aspect. Outcrops common. Secondary aspects E, NW.	On steep slopes a, on midslopes, c, and on footslopes, e.

TABLE 6.1 (Cont'd)

Unit	Forest Type and Tree Density	Present Land Use	Access	Natural Features Suitable for Outdoor Recreation	Artificial Features and Amenities Suitable for Outdoor Recreation
9	Pinus radiata 35-40 years old.	Timber Production.	Very good. 2 & 4 wheel drive, walking. Pine plantation gravel roads.	Shade trees (very good). Existence of wildlife.	Roads & trails.
10	Dry sclerophyll forest. Dominant forest type is sr. Density: V, D, M.	Native forestry.	Good. 2 & 4 wheel drive. Walking, difficult walking. Pine plantation gravel roads+ some fire tracks.	Shade trees (very good). Existence of wildlife. Scenic lookout.	Roads & trails.
11	Wet sclerophyll forest, consists of five forest types. r, lP, uP, Sm, Sg. Density: V, D, M.	Nature reserve.	Moderate to poor, 4 wheel drive, difficult walking. Fire tracks only.	Existence of wildlife. Shade trees (very good). Scenic lookout.	Fire tracks.
12	Pinus radiata 20 & 35 years old.	Timber production.	Very good. 2 & 4 wheel drive. Walking, pine plantation gravel roads.	Shade trees (good). Existence of wildlife. Scenic lookout.	Roads & trails.

TABLE 6.1 (Cont'd)

Unit	Area ha	Area % of total	Geology	Altitude	Slope Classes %	Aspect and Physiography	Soils
13	456	1.68	A complex unit, where three geological types converge. 1-Paddys River middle silurian volcanics (E). 2-silurian to devonian adamellite of Murrumbidgee batholith (S). 3-ordovician sediments.	Max. 670 Min. 610	0- 3= 17 2- 7= 61 6-15= 17 10-25= 5 > = -	Rolling to flattish country dissected by the Paddys River. Aspects variable, sheet and gully erosion common.	Near Paddys River, m, on top of the hill, h, on middle slopes, a complex of K + w, and c + g.
14	332	1.22	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max. 915 Min. 790	0- 3= - 2- 7= 44 6-15= 2 10-25= 43 > = 11	Primary aspect NE. Secondary aspects NW, E, SE. Hilly to undulating country with frequent rock outcrops.	On steep slopes a + h, on midslopes a complex of K + c.
15	693	2.55	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max. 790 Min. 610	0- 3= 16 2- 7= 69 6-15= 12 10-25= 3 > = -	Primary aspect SW, secondary aspects variable, hilly to flattish terrain facing generally southward. Sheet and gully erosion common.	On steep slopes, a, on midslopes, c, swampy area, s.
16	474	1.75	Ordovician sediments.	Max. 830 Min. 610	0- 3= 30 2- 7= 42 6-15= 4 10-25= 19 > = 5	Hilly to flattish terrain which hills discontinuously running SE to NW. Sheet and gully erosion common. Aspects variable.	Mainly d, and on top of the hills, f.

TABLE 6.1 (Cont'd)

Unit	Forest Type and Tree Density	Present Land Use	Access	Natural Features Suitable for Outdoor Recreation	Artificial Features and Amenities Suitable for Outdoor Recreation
13	Dry sclerophyll forest which comprises a complex of forest types: sr + d, b. Density: D, M, G, S.	Space Tracking Station, grazing, recreation (picnicking, fishing).	Very good. 2 wheel drive, walking. Paddys River and Tidbinbilla Tracking Station Roads.	Fish for fishing, shade trees (poor). Existence of domestic water. Scenic lookout, botanical and scientific features.	Roads & tracks, picnic facilities, fire places, constructed shelters, flush toilets, parking area and plantations.
14	Pinus radiata. almost 15 years old.	Timber production.	Very good. 2 & 4 wheel drive, walking. Plantation gravel roads.	Existence of wildlife. Shade trees (good).	Roads & trails.
15	Dry sclerophyll and open forest. Forest types are sr and d. Density: S, G.	Grazing.	Good. 2 & 4 wheel drive. Walking. Paddys River Road, and pine plantation gravel roads.	Shade trees (poor).	Roads & trails.
16	Dominantly grassland with some patches of sr forest type. Density: S, G.	Grazing	Moderate. 2 wheel drive, difficult walking. Tidbinbilla Tracking Station Road dissects the unit.	Shade trees (poor).	Roads & tracks.

TABLE 6.1 (Cont'd)

Unit	Area ha	Area % of total	Geology	Altitude	Slope Classes %	Aspect and Physiography	Soils
17	148	0.55	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max. 915 Min. 730	0- 3= - 2- 7= 24 6-15= 70 10-25= - > = 6	Primary aspect SE, secondary aspects NW, NE. Generally, rolling country, some rock outcrops.	On steep slopes, a, on lower and midslopes a complex of K + c.
18	3252	11.98	Silurian to devonian foliated contaminated granodiorite, small patches of undifferentiated granite (centre and S), and adamellite (W) of Murrumbidgee batholith.	Max. 790 Min. 610	0- 3= 64 2- 7= 16 6-15= 19 10-25= 1 > = -	Generally, undulating to flattish terrain, primary aspect SW, secondary aspects NW, SE, NE.	A very complicated distribution of soils, which on river bank is m, and on flattish area a complex of e+m, t, c, t+m+e, e+K.
19	2228	8.20	Ordovician sediments (N). Tidbinbilla quartzite (Centre and S). Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max.1550 Min. 730	0- 3= - 2- 7= 0.5 6-15= 16.5 10-25= 9 > = 74	Primary aspect, SE. Secondary aspects variable. Steep escarpment of mountainside with ridge running S to N. Slabs and tors on ridges. Outcrops, stone rubble common.	On Tidbinbilla Peak above 1500, Ah, and below 1500 m a complex of b + d.
20	314	1.16	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max. 850 Min. 730	0- 3= - 2- 7= 57 6-15= 28 10-25= 10 > = 5	Primary aspect SE. Secondary aspects NW, SE, NE, N, S. Hilly to undulating terrain dissected by permanent creek. Rock outcrops common.	On steep slopes, a, on midslopes, c.

TABLE 6.1 (Cont'd)

Unit	Forest Type and Tree Density	Present Land Use	Access	Natural Features Suitable for Outdoor Recreation	Artificial Features and Amenities Suitable for Outdoor Recreation
17	Pinus radiata 15 years old.	Timber production.	Very good. 2 & 4 wheel drive, walking. Pine plantation gravel roads.	Existence of wildlife. Shade trees (moderate to good).	Roads & trails.
18	Dominant cover is grassland. Density: G.	Grazing.	Very good. 2 & 4 wheel drive, walking. Paddys River, Tidbinbilla Tracking Station and Nature Reserve Roads.	Fish for fishing. Existence of domestic water. Botanical features, scenic look-outs.	Roads & trails, picnic facilities, flush toilets, constructed shelters, fire places, parking area, and ornamental plant-ations.
19	Wet sclerophyll forest, comprises six types. lp, up, bb, aa, sm, sg. Density: V, D, M.	Nature reserve.	Poor. 4 wheel drive, difficult walking. Fire trails, walking trails.	Existence of wildlife. Shade trees (excellent).	Fire tracks & trails.
20	Pinus radiata, Pinus elliottii. 10-12 years old.	Timber production.	Very good. 2 & 4 wheel drive, walking. Pine plantation gravel roads.	Existence of wildlife. Shade trees (moderate to poor).	Roads & trails.

TABLE 6.1 (Cont'd)

Unit	Area ha	Area % of total	Geology	Altitude	Slope Classes %	Aspect and Physiography	Soils
21	710	2.62	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max. 760 Min. 670	0- 3= 11 2- 7= 62.5 6-15= 21.5 10-25= 5	Primary aspect, SE, secondary aspects NE, NW, SW. Hilly to flattish country. Sheet, gully erosion and rock outcrops common.	On steep and higher slopes, c, on foot slopes a complex of e + m, layered material in gullies.
22	237	0.87	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max. 980 Min. 840	0- 3= - 2- 7= 12.5 6-15= 17.5 10-25= 22.5 > = 47.5	Primary aspect SE, secondary aspects NE, NW. Hilly to undulating country.	On midslopes a complex of K + c. On foot slopes this complex is associated with e.
23	190	0.70	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max. 840 Min. 700	0- 3= - 2- 7= 99 6-15= 1 10-25= - > = -	Primary aspect SE, secondary aspects NW, NE. Undulating terrain dissected by a creek.	On mid slopes c, on steep slopes, a, on foot slopes, e.
24	1280	4.71	Silurian to devonian foliated contaminated granodiorite and undifferentiated granite rocks (NW) of Murrumbidgee batholith.	Max.1220 Min. 700	0- 3= - 2- 7= 42.5 6-15= 4.5 10-25= 40 > = 13	Aspect variable, Moderate escarpment of mountainside facing NW, with an almost broad valley. Outcrops and stone rubble common.	1- On westerly aspect, on steep slopes, a, on midslopes, c, on foot slopes (N. aspects), e. 2- on Easterly aspect. a + b. on midslopes, c, which gradually becomes e further downslopes.

TABLE 6.1 (Cont'd)

Unit	Forest Type and Tree Density	Present Land Use	Access	Natural Features Suitable for Outdoor Recreation	Artificial Features and Amenities Suitable for Outdoor Recreation
21	The forest types consist of sr, r, lp + b, d. Density: M, S, G.	Grazing	Good. 2 & 4 wheel drive, walking. Paddys River Road and pine plantation gravel roads.	Shade trees (moderate to poor).	Roads & tracks.
22	Wet sclerophyll forest, which comprises forest types lp, sr, lp + b. Density: D, M.	Nature Reserve.	Poor. 4 wheel drive, hard walking. Fire trails.	Existence of wildlife. Shade trees (very good).	Fire trails.
23	Mainly Pinus radiata. 13 years old.	Timber production.	Very good. 2 & 4 wheel drive, walking, pine plantation gravel roads.	Shade trees moderate to poor. Existence of wildlife.	Roads & trails.
24	A transitional unit between dry and wet sclerophyll forest. Comprises forest types up, lp, sr, r, d, lp + b. Density: D, M, S, G.	Nature Reserve. Recreation (picnicking, animal watching, bush walking).	Excellent. 2 & 4 wheel drive, easy walking. Tidbinbilla Loop Road (sealed). Fire, walking trails.	Drinking water, fire wood. Existence of wildlife. Shade trees (good). Geological and botanical features. Scenic lookout.	Roads & fire trails & walking trails. Picnic facilities, fire places, flush toilets, parking area, information centre, signs. Scenic lookout, animal enclosures.

TABLE 6.1 (Cont'd)

Unit	Area ha	Area % of total	Geology	Altitude	Slope Classes %	Aspect and Physiography	Soils
25	367	1.35	Silurian to devonian foliated contaminated granodiorite and undifferentiated granite rocks (NW) of Murrumbidgee batholith.	Max. 760 Min. 670	0- 3= - 2- 7= 68 6-15= 29 10-25= 3 > = -	Hilly to undulating terrain with some sugar loaf hills. Aspects variable.	c, e, c + d.
26	925	3.41	Undifferentiated silurian Tidbinbilla quartzite (W), and silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max.1525 Min. 820	0- 3= - 2- 7= 11.5 6-15= 12.5 10-25= 24 > = 52	Primary aspect NW, Secondary aspects SW, SE. Moderate to steep escarpment on mountainside with ridges, rock outcrops common.	On steep slopes, a complex of a + h, on midslopes a complex of K + c.
27	1208	4.45	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max.1370 Min. 730	0- 3= - 2- 7= 12 6-15= 12 10-25= 60 > = 16	Primary aspect SE. Secondary aspects NE, SW. Moderate to steep escarpment on mountainside and ridges. Permanent stream and waterfall in the bottom of the unit, rock outcrops common.	On steep slopes, a, on midslopes, c, on foot slopes a complex of K + e.
28	403	1.48	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max.1310 Min. 730	0- 3= - 2- 7= 3 6-15= 22 10-25= 1 > = 74	Primary aspect NW. Secondary aspects NE, SW. Moderate escarpment of mountainside and ridges. Outcrops common.	On steep slopes, a, on midslopes, c, on foot slopes a complex of K + e.

TABLE 6.1 (Cont'd)

Unit	Forest Type and Tree Density	Present Land Use	Access	Natural Features Suitable for Outdoor Recreation	Artificial Features and Amenities Suitable for Outdoor Recreation
25	Dominant cover is grassland. Density: S, G.	Grazing	Very good. 2 & 4 wheel drive, walking. Paddys River, Corin Dam sealed roads, and some tracks.	Scenic lookout.	Roads & trails, signs.
26	Wet sclerophyll forest which comprises forest types aa, sg, up, lp, bb, Density: D, M, S.	Nature Reserve	Poor. 4 wheel drive, difficult walking, fire trail.	Existence of wildlife. Shade trees (excellent). Scenic lookout.	Fire trails.
27	Mainly Pinus radiata which is 5 to 11 years old. On the fringe of plantation, wet sclerophyll forest consists of 3 forest types; up, aa, sg. Density: V,D,M,G.	Timber production, native forestry, picnicking, bush walking.	Very good. 2 & 4 wheel drive, walking. Corin Dam Road. Pine plantations gravel roads.	Existence of wildlife, firewood. Shade trees (good), existence of domestic water, fish for fishing. Scenic lookout.	Roads & trails, picnic facilities, flush toilets, fireplaces, parking area, sign, plantations, constructed shelter.
28	Wet sclerophyll forest, consists of three forest types lp, up, sg. Density: D, S, M.	Native Forestry	Only through Unit 27.	Existence of wildlife, fish for fishing. Shade trees (very good). Geological and botanical features.	-

TABLE 6.1 (Cont'd)

Unit	Area ha	Area % of total	Geology	Altitude	Slope Classes %	Aspect and Physiography	Soils
29	592	2.18	Silurian to devonian foliated contaminated granodiorite, and undifferentiated granite (S) of Murrumbidgee batholith.	Max.1020 Min. 700	0- 3= 16 2- 7= 18.5 6-15= 5.5 10-25= 5 > = 55	Aspects variable. Mountain ridges with some slope running SW to NE. One granite tor.	On steep slopes, a, on midslopes, c, on foot slopes, e.
30	758	2.79	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max.1030 Min. 655	0- 3= 3 2- 7= 6.5 6-15= 87.5 10-25= - > = 3	Aspects variable. Mountainous to flattish country. Outcrops and gully erosion common.	On midslopes, c, on foot slopes, e, on stream banks, t.
31	1145	4.21	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max.1430 Min.1020	0- 3= 6 2- 7= 15 6-15= 54 10-25= 24 > = 1	Primary aspect, NE. Secondary aspects variable. Rolling terrain with some hills with flat valley bottoms. The unit is dissected by the Gibraltar creek. Some rock outcrops.	On steep slopes, a complex of a + h, on stream banks a complex of t + m.
32	296	1.09	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max.1320 Min. 820	0- 3= - 2- 7= 13 6-15= 38 10-25= 2 > = 47	Secondary aspect, SE. Mountainside with steep escarpment and ridges running SW to NE. Rock outcrops common.	On steep slopes, a, on mid slopes, c, on footslopes, e.
33	296	1.09	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max.1280 Min. 780	0- 3= 10 2- 7= 4 6-15= 38 10-25= - > = 48	Primary aspect, E, secondary aspects SE, NE. Steep escarpment on mountainside with ridges. Rock outcrops and stone rubble common.	On steep slopes, a, on midslopes, c, on footslopes, e.

TABLE 6.1 (Cont'd)

Unit	Forest Type and Tree Density	Present Land Use	Access	Natural Features Suitable for Outdoor Recreation	Artificial Features and Amenities Suitable for Outdoor Recreation
29	Wet sclerophyll forest consists of only one forest type, lp. Density: M, S, G.	Native forestry	Very poor, difficult walking.	Existence of wildlife, fish for fishing.	-
30	Dominantly grass-land.	Grazing, fishing for recreation.	Poor. 2 & 4 wheel drive, walking. Paddys River Road passes NE of the Unit.	Fish for fishing. Existence of wildlife. Botanical features.	Roads & trails.
31	A very complicated unit which in its eastern part mainly Pinus radiata plantation exists (8 to 11 yrs old), on western side wet sclerophyll forest occurs. The forest types are aa, lsg, sg, up. Density: V,D,M.	Native forestry, timber production.	Very good. 2 & 4 wheel drive, walking. Corin Dam Road, Pine plantation gravel road.	Shade trees (good). Existence of wild-life, botanical feature and scenic lookout.	Roads & trails.
32	Wet sclerophyll for-est. Forest types up, sg, and sm. Density: D,M,G.	Native forestry	Very poor.	Existence of wildlife. Shade trees (good).	-
33	Wet sclerophyll, for-est types up, sr, lp Density: V,D,M,S,G.	Native forestry, grazing. Country settlement.	Very poor. Difficult walk-ing 2 & 4 wheel drive.	Existence of wildlife. Shade trees (good).	Roads & tracks.

TABLE 6.1 (Cont'd)

Unit	Area ha	Area % of total	Geology	Altitude	Slope Classes %	Aspect and Physiography	Soils
34	1120	4.13	Mainly silurian to devonian undifferentiated granite, and foliated contaminated granodiorite (S) of Murrumbidgee batholith.	Max.1220 Min. 730	0- 3= 12 2- 7= 28 6-15= 19 10-25= 28 > = 13	Aspects variable. Escarpment which begins with moderate slope in the N of the unit, gradually increasing its slope up to mountainous terrain in the S, running mainly SE to NW.	On steep slopes, a, on mid slopes, c, on footslopes, e.
35	421	1.55	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max.1340 Min. 790	0- 3= - 2- 7= 29 6-15= 18.5 10-25= 7.5 > = 45	Primary aspect, NE, secondary aspects SE, NW. Mountainside with ridges, steep escarpment and a valley. Rock outcrops and stone rubble common.	On steep slopes, a, on footslopes, e.
36	652	2.40	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max.1430 Min.1280	0- 3= 1 2- 7= 29 6-15= 37 10-25= - > = 33	Primary aspect, SE, secondary aspects SW, NE, NW. Mountainous to undulating terrain facing generally SE. Rock outcrops common.	On midslopes, c, which on footslopes becomes deeper, e.
37	3470	12.77	Silurian to devonian foliated contaminated granodiorite of Murrumbidgee batholith.	Max.1460 Min. 820	0- 3= 1 2- 7= 19.5 6-15= 10.5 10-25= 44 > = 25	Dominantly mountainous with variable aspects. Outcrops common.	On steep slopes, a, b, on mid slopes, c, on footslopes, e.

TABLE 6.1 (Cont'd)

Unit	Forest Type and Tree Density	Present Land Use	Access	Natural Features Suitable for Outdoor Recreation	Artificial Features and Amenities Suitable for Outdoor Recreation
34	Open forest and dry sclerophyll forest, forest types are lp and up. Density: D,M,S,G.	Native forestry, grazing. Fishing for recreation.	Moderate. 2 & 4 wheel drive. Walking. Paddys River, Booroomba Roads.	Existence of wildlife, fish for fishing. Geological feature and scenic lookout.	Roads & trails.
35	Wet sclerophyll forest consists of two forest types sg and up. Density: M, S, G.	Native forestry	Good. Difficult walking.	Existence of wildlife. Shade trees (good).	-
36	Wet sclerophyll forest, which forest types are lSg, sm, sg, aa, up. Density: M, S.	Native forestry	Very poor. Difficult walking.	Existence of wildlife. Shade trees (moderate).	-
37	Dry and wet sclerophyll forest, which forest types are sg, sm, aa, up and lp. Density: V,D,M,S.	Native forestry	Very poor. Difficult walking.	Existence of wildlife. Shade trees (very good).	-

CHAPTER 7

OUTDOOR RECREATION CAPABILITY CLASSIFICATION

7.1 Evaluation of Land Capability

The object of evaluating the recreational capability of the catchment was to determine the potential recreational use of the catchment for a given number of feasible outdoor recreational activities. These activities included informal sports, camping, picnicking, swimming, attending and watching and hobby farming (intensive use), and bush walking, mountain climbing, sightseeing, horseriding, animal watching, fishing, hunting, driving for pleasure and trail biking (extensive use).

Evaluation of the catchment for outdoor recreation was achieved by considering the ecological and cultural requirements of each recreational activity (Part II) and matching these with the components of each environmental unit.

For this evaluation, it was assumed that:

1. all lands in the catchment are potentially available for recreation, that is, land tenure is not a constraint;
2. recreational land would, to a large degree, be used also for agriculture, forestry and nature conservation;
3. there are no economic or political constraints on recreational development, and
4. recreational land use is considered as an optimum use of land even though it may not be the best land use to be envisaged.

On the basis of these assumptions, a subjective evaluation has been carried out unit by unit, considering each of the prescribed recreational activities independently.

Examples

Example 1:

Environmental unit No.7 is regarded as suitable for picnicking. By comparing the resource data in the unit (Table 6.1) against recreation data for picnicking (Table 3.2), it is seen that geology and soils and aspects of the unit are not the most suitable for picnicking, but suitability of slope classes, tree density, shade trees, access, natural and artificial features makes the unit moderately suitable for picnicking.

Example 2:

For environmental unit No.3, slope, aspect, and water availability are not suitable for sportsgrounds, but soil, shade trees and nature of vegetation in the unit make it suitable for sportsgrounds. With slope modification, the unit may be suitable for informal sports.

Example 3:

In environmental unit No. 11, where wildlife conservation is the major land use, the diversity and abundance of animals, makes it suitable for animal watching.

Example 4:

Environmental unit No.4 because of the suitability of its slope, soils, shade trees and accessibility is suitable for bushwalking.

In a similar manner, for each environmental unit, the soils and geology, landform attributes, forest types and tree density, existing

land use, the frequency of occurrence of wildlife, the occurrence of permanent streams and of any points of interest were examined against the requirements for each recreational activity, using a subjective value judgement. This value judgement was represented by indicating:

1. high capability of an environmental unit for a specific recreational activity, e.g. environmental unit number 24, in which most of the land's required characteristics are suitable for picnicking.

2. moderate capability of environmental unit, i.e. the unit's characteristics can moderately accomplish the required attributes of a specific recreational activity, e.g. environmental unit number 23 and camping. Alternatively, in half of the unit only the land characteristics are desirable for a specific recreational activity, e.g. environmental unit number 34 where it is only the northern half of the unit in which land characteristics make it suitable for camping.

3. low capability of environmental unit, i.e. the desirable environmental characteristics required by a specific kind of recreation occur in less than half of the unit, e.g. environmental unit number 2 for mountain climbing. In this unit 39% of the unit consists of mountainous country. Alternatively, the total unit's characteristics are poorly capable of fulfilling the requirements for a specific type of recreation, e.g. environmental unit number 30 and driving for pleasure, in which accessibility is poor.

In some units in which one or two characteristics were not in harmony with others, modification seemed to be necessary, e.g. the environmental unit number 8 in which shade trees, aspect, soil, and accessibility are suitable for informal sports, but its slopes are a

restricting factor. Since modification of slope would be possible, the feasibility of modification has also been regarded in the assessment.

Consequently, all the environmental units have been evaluated according to their degree of capability for outdoor recreational activities (Table 7.1).

7.2 Classification

Classification of the total outdoor recreation capability of each environmental unit was obtained, by giving a numerical value to each value judgement for each recreational activity in each unit (Table 7.1), i.e. a value judgement of high capability was given a numerical capability value of 10, a moderate capability was given 5 and a low capability was given 2. Where modification was considered possible, an arbitrary value of 1.5 was subtracted from the numerical capability value of each activity.

Classification has been attempted in the following ways:

1. classification A, in which overall suitability for recreational activity was assessed disregarding conflicts or compatibilities;
2. classification B, similar to A, but in which compatibility or conflict was taken into consideration; and
3. identification of units in which specified combinations of compatible activities could be undertaken.

7.2.1 Classification A

This classification was achieved by summing the numerical capability values for each environmental unit, disregarding any conflict

Table 7.1 Value Judgement for Environmental Units

Not suitable = Blank High capability = 10 Moderate capability = 5 Low capability = 2 Where modification is feasible 1.5 value is subtracted from the actual gained value.

Environmental Units	Informal sports	Camping	Picnicking	Swimming	Attending & watching	Hobby farming	Bush walking	Mountain climbing	Sightseeing	Horseriding	Animal watching	Fishing	Hunting	Driving for pleasure	Trail biking
1	3.5	5	5				10	2	10	10	5		2	10	10
2	2	2	2		5		5	2	10	2	5	5	2	2	5
3	0.5	3.5	3.5		5		5	5	10	2	5	5	2	0.5	2
4	3.5	5	5				10	2	10	10	5		2	5	5
5	5	5	5				10	2	5	10	5		5	10	10
6	5	5	5				10	2	10	10	5		2	10	10
7	0.5	10	10	2			10	2	10	5	5	5	2	10	10
8	3.5	5	5				10	5	10	5	5		2	5	5
9	0.5	5	5				10	5	5	10	5		5	5	5
10							5	10	10	2	5		5	2	5
11							10	10	10	2	10			0.5	2
12	0.5	5	5				10	5	10	5	5		5	5	5
13	5	8.5	8.5	2	10	5	10	2	5	5	5	5	5	10	10
14	0.5	3.5	3.5				10	5	10	10	5		5	5	5
15	2	2	2			10	5	2	10	5	5		5	5	5
16	0.5	2	2			5	5	2	10	5	5		5	5	5
17	0.5	2	2				10	5	10	5	5		5	5	5
18	8.5	8.5	8.5	2		10	10	2	10	10	5	5	5	10	10
19			0.5				5	10	10	5	10			0.5	2
20	0.5	3.5	3.5				10	5	10	5	5		5	5	5
21	2	3.5	3.5			5	5	2	10	5	5		5	2	5
22		2	2				0.5	2	10	2	10			0.5	2
23	5	5	5				10		10	10	5		5	5	5
24	10	10	10		10		10	5	10	10	10			10	10
25	3.5	5	5			5	10	2	10	10	5		5	10	10
26							0.5	10	10	0.5	10			0.5	0.5
27	3.5	10	10				5	5	10	5	10	5	10	10	10
28		0.5	0.5				0.5	10	10	0.5	10	5	10	0.5	0.5
29	0.5	2	2				2	10	2	5	5	5	5	0.5	0.5
30	2	2	3.5			5	5	5	5	5	5	5	5	2	5
31	2	5	5				8.5	5	10	3.5	10		10	5	5
32							2	10	5		5		5		2
33	2	2	2			10	5	5	5	5	5		5	5	5
34	5	5	5			5	5	5	10	5	5	5	5	5	5
35	0.5	2	2			2	5	10	5	5	5		5	2	2
36	0.5	3.5	3.5			5	8.5	5	5	3.5	5		5	3.5	3.5
37	0.5	0.5	0.5				3.5	10	10	3.5	10		10	0.5	0.5

or compatibility existing between the activities. The object of this classification was to show the maximum suitability of environmental units for different types of activity.

Consequently, a 'total capability value' was derived for each unit (Table 7.3). The range of values for units was from 29 to 105. This range has been arbitrarily sub-divided into nine outdoor recreation capability classes. (Table 7.4). Outdoor recreation capability classes of the environmental units are shown in Table 7.5. Finally, an outdoor recreation capability classification map (A) was produced for the catchment at the scale of 1:75,000 (Map No.7).

7.2.2 Classification B

This classification was achieved by taking into account the conflicts and compatibilities that exist between the activities. The object of this classification was to show the maximum suitability of environmental units with respect to conflicts and compatibilities between activities, for the different types of activities envisaged.

By considering a total weighting value for outdoor recreational activities in relation to their existing compatibility (Table 2.1), and the order of outdoor recreational activities in respect to degrees of compatibility (Part I), a compatibility value was given to each activity, i.e. sightseeing 15 (highly compatible), mountain climbing 14, picnicking 13, swimming 12, camping 11, attending and watching 10, animal watching 9, fishing 8, bush walking 7, informal sports 6, driving for pleasure 5, horse riding 4, hobby farming 3, trail biking 2, and hunting 1 (the least compatible). By multiplying these compatibility values with the numerical capability value for each outdoor

recreational activity in each environmental unit (Table 7.1), and summing the derived values for each environmental unit, a 'total interactive capability value' was obtained for each environmental unit (Table 7.3).

ticv = compatibility value x capability value.

The range of values for units was from 283 to 890. This range has been arbitrarily sub-divided into seven outdoor recreation capability classes (Table 7.4). Outdoor recreation capability classes of the environmental units are shown in Table 7.5. Finally, an outdoor recreation capability classification map (B) was produced for the catchment at a scale of 1:75,000 (Map No. 8).

7.2.3 Classification of Compatible Groups (1,2,3)

Any attempt to group compatible outdoor recreational activities is not only subjective but also a practically complex task. To appreciate possible application of a classification based on compatible groups, three examples have been provided. In Table 7.2 different highly compatible outdoor recreational activities have been grouped together. Three different classifications were then derived from these three examples (Table 7.5).

The procedure for classification was similar to that of type A, i.e. in each environmental unit the numerical capability values of outdoor recreational activities occurring in each compatible group were summed (Table 7.3). The range of these values were then arbitrarily sub-divided into seven outdoor recreation classes (Table 7.4). Finally, three different outdoor recreation capability classification maps were produced for the catchment at the scale of 1:125,000 (Fig. 7.1 to 7.3).

TABLE 7.2 Three Examples of Groups of Compatible Outdoor Recreational Activities.

1	driving for pleasure - picnicking - swimming - sightseeing
2	camping - bush walking - mountain climbing - sight-seeing - fishing
3	horse riding - sight seeing - animal watching - picnicking.

TABLE 7.3 Total Capability Values (A, 1,2.3) and t.i.c.v. (B) of Environmental Units.

Environmental units	A	B	1	2	3	Environmental units	A	B	1	2	3	Environmental units	A	B	1	2	3
1	72.5	546	25	27	30	14	62.5	502	18.5	28.5	28.5	27	93.5	746	30	35	35
2	49	448	14	25	19	15	58	408	17	19	22	28	48	451	11	26	21
3	49	503.5	14.5	28.5	20.5	16	51.5	384	17	19	22	29	39.5	384.5	4.5	21	14
4	62.5	511	20	27	28.5	17	54.5	446	17	27	22	30	54.5	404	10.5	22	18.5
5	72	483	20	22	25	18	104.5	757	30.5	35.5	33.5	31	69	560	20	28.5	28.5
6	74	555	25	27	30	19	43	448	11	25	25.5	32	29	283	5	17	10
7	81.5	637	27	32	25	20	57.5	464	18.5	28.5	23.5	33	56	375	12	17	17
8	60.5	533	20	30	25	21	53	414	15.5	20.5	23.5	34	70	565	20	30	25
9	60.5	465	15	25	25	22	31	334	12.5	14.5	24	35	45.5	391	9	22	17
10	44	403	12	25	17	23	65	495	20	25	30	36	51.5	395	12	22	17
11	44.5	426.5	10.5	25	17	24	105	890	30	35	40	37	49.5	447	11	24	24
12	60.5	518	20	30	25	25	80.5	564	25	27	30						
13	96	726	25.5	30.5	23.5	26	32	388.5	10.5	20.5	20.5						

TABLE 7.4 Range of Outdoor Recreation Capability Classes (A,B,1,2,3)

Outdoor Recreation Capability Classes	A	B	1	2	3
1	100-110	850-950	28-32	32.5-35.5	37-41
2	90-100	750-850	24-28	29.5-32.5	33-37
3	80-90	650-750	20-24	26.5-29.5	29-33
4	70-80	550-650	16-20	23.5-26.5	25-29
5	60-70	450-550	12-16	20.5-23.5	21-25
6	50-60	350-450	8-12	17.5-20.5	17-21
7	40-50	250-350	4- 8	14.5-17.5	< 17
8	30-40				
9	20-30				

TABLE 7.5 Outdoor Recreation Capability Classes of Environmental Units (A,B,1,2,3).

Environmental units	A	B	1	2	3	Environmental units	A	B	1	2	3
1	4	5	2	3	3	30	6	6	6	5	6
2	7	6	5	4	6	31	5	4	3	3	4
3	7	5	5	3	6	32	9	7	7	7	7
4	5	5	3	3	4	33	6	6	5	7	6
5	4	5	3	5	4	34	4	4	3	2	4
6	4	4	2	3	3	35	7	6	6	5	6
7	3	4	2	2	4	36	6	6	5	5	6
8	5	5	3	2	4	37	7	6	6	4	5
9	5	5	5	4	4						
10	7	6	5	4	6						
11	7	6	6	4	6						
12	5	5	3	2	4						
13	2	3	2	2	5						
14	5	5	4	3	4						
15	6	6	4	6	5						
16	6	6	4	6	5						
17	6	6	4	3	5						
18	1	2	1	1	2						
19	7	5	6	4	4						
20	6	5	4	3	5						
21	6	6	5	5	5						
22	8	7	5	7	5						
23	5	5	3	4	3						
24	1	1	1	1	1						
25	3	4	2	3	3						
26	8	6	6	5	6						
27	2	3	1	1	2						
28	7	5	6	4	5						
29	8	6	7	5	7						

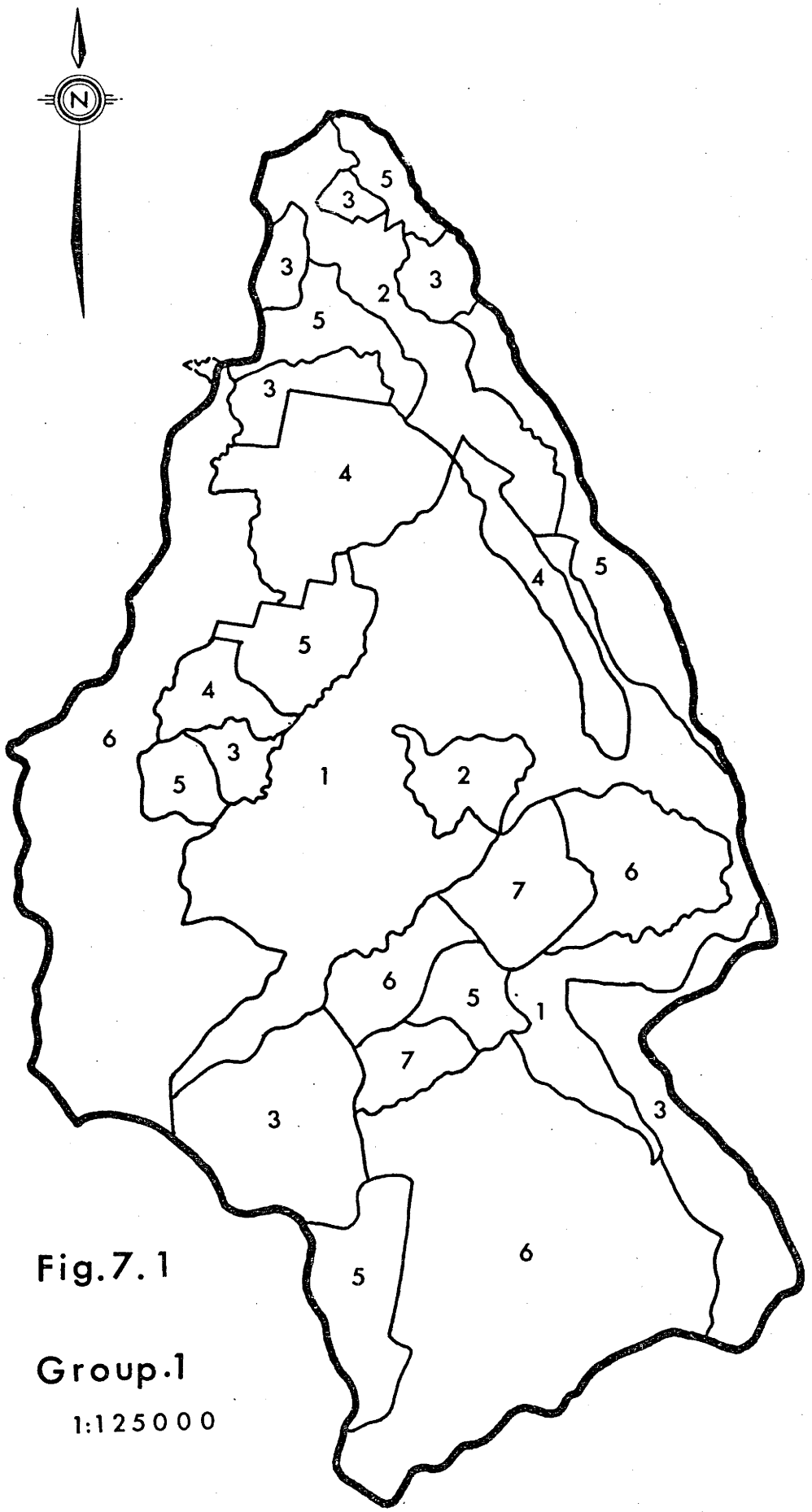

Fig.7.1

Group.1

1:125000

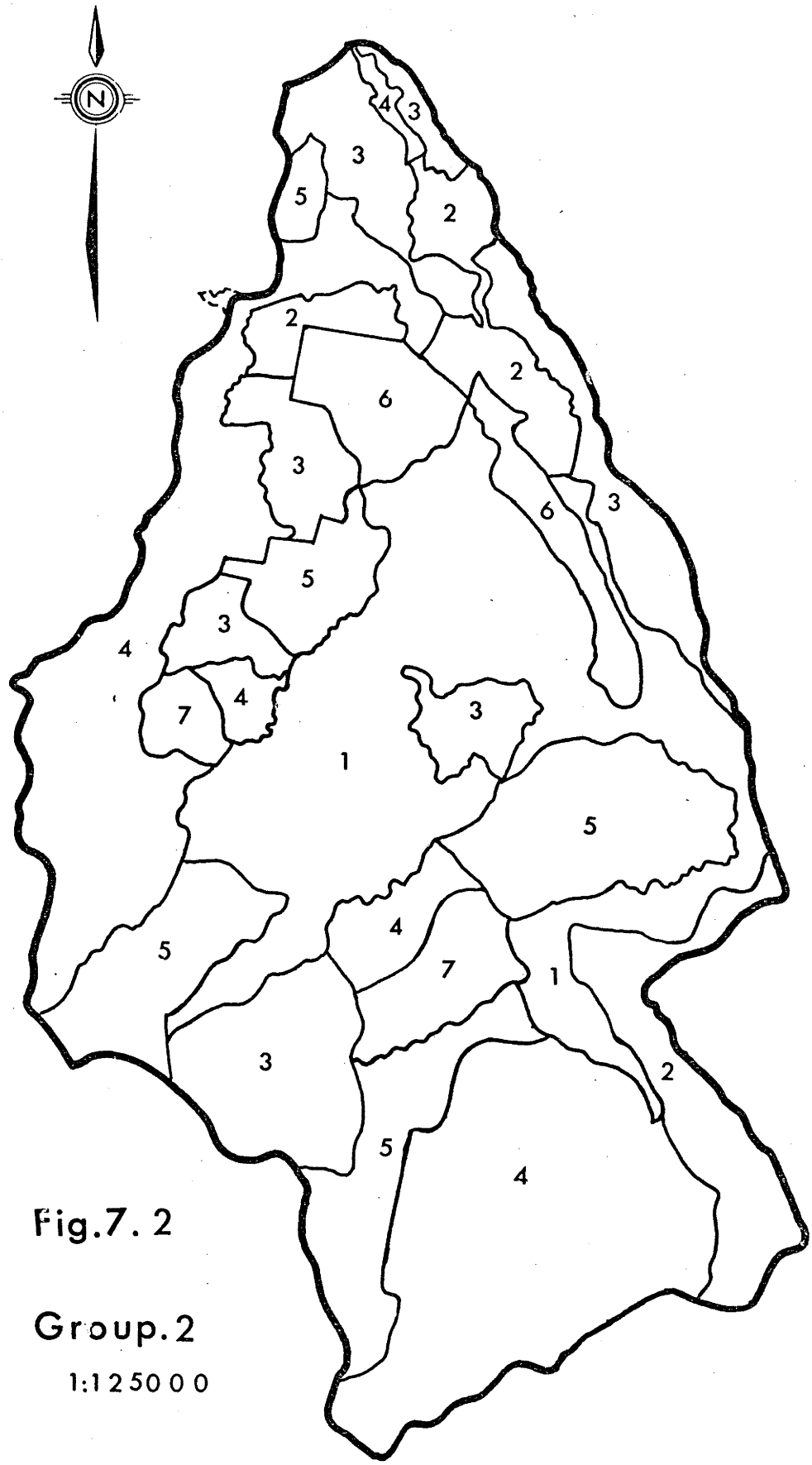

Fig.7. 2

Group.2

1:125000

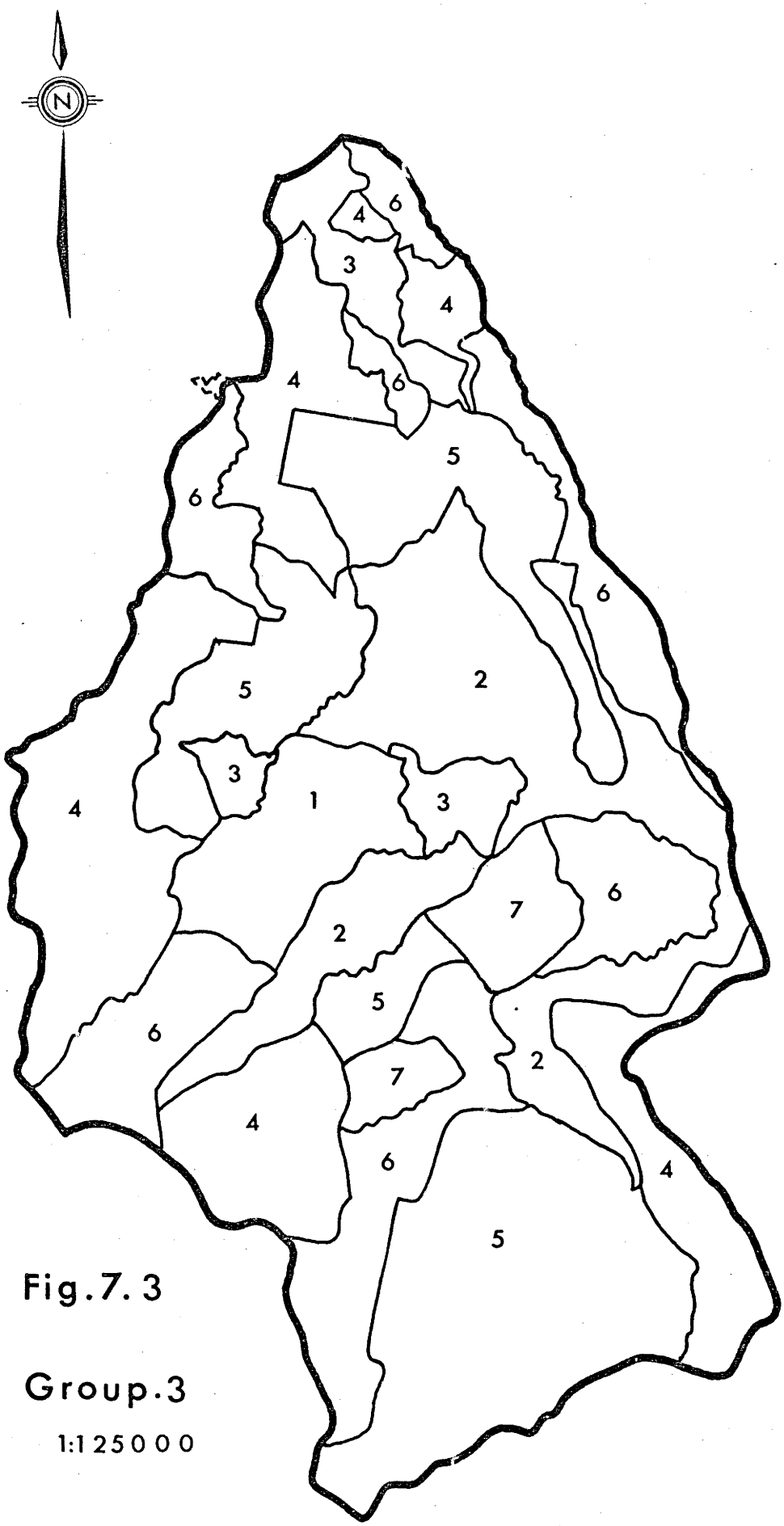

Fig.7.3

Group.3

1:125000

7.3 Discussion

The evaluation of all environmental units for outdoor recreaction reveals that the catchment is more suitable for extensive rather than intensive forms of outdoor recreation. The order of capability for of the catchment for different activities is:

1. sightseeing;
2. bush walking;
3. animal watching;
4. horse riding;
5. trail biking;
6. mountain climbing;
7. driving for pleasure;
8. hunting;
9. picnicking;
10. camping;
11. informal sports;
12. hobby farming;
13. fishing;
14. atterding and watching, and
15. swimming.

The environmental units located in the centre of the catchment and just north of the centre are more suitable for activities such as informal sports, camping, and picnicking. Although the modification of slope, in some units, is required so that these activities could be undertaken.

The only areas, in the catchment, suitable for swimming are in environmental units No. 7, 18 and 13 which have a low capability for this activity.

Some units have, on average, a moderate capability for such activities as attending and watching, hobby farming and fishing. Most of the units are not generally suitable for these activities,due to lack of natural and artificial supports.

Sightseeing, bush walking, mountain climbing, horse riding, animal watching, hunting, driving for pleasure and trail biking can be carried out in almost every environmental unit, although modification of slope in some units is necessary for bush walking, horse riding, driving for pleasure and trail biking. The catchment has, on average, a high capability for sightseeing and bush walking. For mountain climbing, horse riding, animal watching, hunting, driving for pleasure and trail biking the catchment has, on average, a moderate capability.

The capability classification, A, indicates 1/3 of the catchment consists of low capability classes, 1/3 indicates comparatively moderate capability and 1/3 of the catchment has relatively high capability. The central part of the catchment has a high capability, the north has a moderate capability and the remainder has a low capability for outdoor recreation (Map No.7).

Two environmental units (18, 24) have the highest capability and one unit (32) the lowest.

A similar conclusion can be drawn for the capability classification, B, except that here one environmental unit (24) has the highest capability and two have the lowest capability (22, 32).

Under capability classification 1, the centre and northern parts of the catchment show a high capability (Fig. 7.1). Three environmental units have the highest capability (18, 24, 27), and two units

have the lowest (29, 32).

Under capability classification 2, the central parts of the catchment have the highest capability, the north has moderate capability and the rest has the lowest capability (Fig. 7.2). Three environmental units have the highest capability (18, 24, 27), and three units have the lowest (22, 32, 33).

Under capability classification 3, the central parts of the catchment have the highest capability and the remainder has relatively low capability (Fig. 7.3). One environmental unit has the highest capability (24), and two units have the lowest (29, 32).

It is possible to conclude that the central parts and to some extent the north of the catchment are relatively more suitable for outdoor recreation.

PART V

CONCLUSION

CHAPTER 8

CONCLUSION

The object of this study was to attempt to produce an outdoor recreation capability classification for an actual area of land within the A.C.T. The concept of recreation was defined and its classification and the conflicts and compatibilities arising between recreational activities were discussed. It was emphasized that the outdoor forms of recreation would be considered. By then considering the concept and problems of an outdoor recreation capability classification and reviewing the different methods used in different countries, a methodology was introduced.

The methodology included four phases: identification and collection of land characteristics in relation to outdoor recreation, identification of the detailed requirement of each recreational activity from the land, evaluation of land capability for outdoor recreation, and classification of the results of the evaluation.

The Paddys River catchment, which formed the study area, was described in terms of its physiography and access.

Various physical, biological, cultural and aesthetic characteristics of the Paddys River catchment were determined in each land form unit. The features of these resources were then integrated to form a series of environmental units which became the basis for evaluation of the catchment's capability for outdoor recreation. Environmental units differed from one another according to the properties of their resources, such as geomorphology, soil, vegetation and land use.

An outdoor recreation capability evaluation for the catchment was achieved by considering the land resources requirements for specific outdoor recreational activities (recreation data, Part II), and matching these to the components of each environmental unit and other general features of the catchment, i.e. water resources, wild life and points of interest. Each recreational activity was evaluated independently of other recreational activities and other environmental units. Further, the range of the capability evaluation was classified into different classes of capability. With or without consideration of the conflicts existing between outdoor recreational activities, various forms of classification were delineated to represent the range of capability of the catchment for outdoor recreation.

Throughout the study recreational use was considered in the absence of any other land use restraints. The resultant classification, therefore, provides for optimum recreational use, but it was accepted that this may not necessarily be the best land use given other restraints, e.g. current demands for non-recreational use and the economics of those demands.

The shortcoming of this approach and the constraints which made it impossible to evaluate fully the resource data against recreation data are recognized. This is due to deficiencies in some resource data (climate, water resources), lack of expertise (wild life), and limitation of time and accessibility (scenic values and vistas).

Also, it is recognized that the conclusions with respect to recommended recreational uses in each environmental unit are value judgements. These value judgements in spite of being judged on a basis of existing land characteristics are a subjective measure. To avoid

this subjectivity, it is suggested that the integration of resource data, and evaluation of land capability be conducted with the assistance of computer techniques. It is not recommended, however, that computers should fully take over the human role. Any study of this type must involve an input from both sources, e.g., the outdoor recreation planning done in Michigan by a systems analysis approach (Chubb, 1967).

It is recognized that the methodology used in the current study could be improved in the following ways:

1. By taking account of climatic or even microclimatic patterns in the evaluation;
2. By building up more inter-related facts of outdoor recreation requirements and land characteristics. This would require considerably more experimentation in the field of recreation supply for a considerable length of time;
3. By taking account of ground cover in the evaluation, and construction of a factual list of vegetation characteristics in relation to ~~its~~ their resistance to trampling and crushing. This measure would be useful for evaluation of those outdoor recreational activities which require recreationists to frequent an area of land intensively, e.g. picnicking, and
4. By considering extrinsic factors (land ownership, price of land, tax, and future trends in land use) in any evaluation.

In spite of the obvious limitations of this study, it is believed that such an approach can make an important contribution to the evaluation of land for recreational uses, especially, in situations where available data and expertise are limited. In such situations the method

used in this study could be the most suitable, and could be of particular importance to developing countries. Even to follow through this approach with a minimal amount of data can be valuable as a means of identifying problems and would be more satisfactory than trying to prepare an overall evaluation based purely on broad judgement.

Generally, the study is believed to have been a successful approach towards:-

1. Understanding the existing problems in the Paddys River catchment;
2. Giving a measure of the lands limitation and suitability, and
3. Identifying some of the resource data for the catchment which were not previously available, and which could be used for other land use research.

Generally, it is believed that a land evaluation should be repeated when significant changes take place in any of the known resources, i.e. technology, finance, and labour, or ecology of the site.

It is predicted that recreational use will be the dominant use in the Paddys River catchment in the 1980's. In order to be prepared for this, it is recommended that further research in recreational use should be initiated. Specifically, quantitative evaluation of the catchment's ecological carrying capacity is required so that the required facilities for expected demands for outdoor recreation can be planned.

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APPENDICES

APPENDIX 1 List of Wildlife in the Tidbinbilla Nature Reserve

MAMMALS

Egg-Laying Mammals

- Platypus
- Echidna*

Marsupial Mammals

Carnivorous Marsupials

- Brown Marsupial Mouse
- Dusky Marsupial Mouse
- Tiger Cat

Possums and Gliders

- Brush-tailed Possum
- Ring-tailed Possum
- Greater Glider
- Sugar Glider
- Pigmy Glider
- Pigmy Possum

Wombats

- Common Wombat*

Kangaroo-like Mammals

- Red-necked Wallaby
- Swamp Wallaby*
- Grey Kangaroo*
- Wallaroo

Placental Mammals

Rodents

- Eastern Water Rat
- Bush Rat

Bats

- Several species not identified

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* Seen in Eucalyptus regeneration.

APPENDIX 1 (Cont'd)

Introduced Mammals

European Hare
European Rabbit
European Fox
Feral Goat
Feral Cat
House Mouse

Birds

The list of birds (Table 1.1), is based on birds actually seen and identified by rangers and other staff on the Tidbinbilla Nature Reserve. The list records status, whether resident (R), migratory (M), Exotic (E) or introduced to the enclosures or as a re-introduction of a once indigenous species (IN).

The frequency of occurrence is recorded as Common (C), Uncommon (U) or Rare (R).

The habitat in which the birds occur is recorded as grassland (Gr), Savannah woodland (Sav), Dry sclerophyll forest (DScl), Wet sclerophyll forest (WScl), Wetlands including streams; swamps, and pondages (Wtld).

TABLE 1.1 Birds of the Tidbinbilla Nature Reserve

Group	Common Name	Status	Frequency	Habitat
Grebes	Little Grebe	R	C	Wtld
Cormorants	Little Pied	M	U	"
	Black	M	U	"
Heron-like Birds	Straw-necked Ibis	M	R	"
	White faced Heron	R	C	"
	Brown Bittern	M	R	"
	Nankeen Night Heron	M	R	"
	Pacific Heron	M	R	"
Ducks, Geese & Swans	Wood Duck	R	C	"
	Black Duck	R	C	"
	Mountain Duck	M	U	"
	Black Swan	R(IN)	C	"
	Chestnut Teal	R(IN)	C	"
	Grey Teal	IN	C	"
	Blue Winged Shoveller	IN	U	"
	Pink Eared Duck	IN	U	"
	Hardhead or Whiteye	IN	U	"
	Freckled Duck	IN	R	"
	Musk Duck	IN	U	"
	Cape Barren Goose	IN	C	"
Fowl-like Birds	Stubble Quail	M	U	Sav.Gr
Rails	Eastern Water Hen	IN	U	Wtld
	Dusky Moorhen	IN	U	"
	Coot	IN	C	"
	Black-fronted Dotterel	M	U	"
	Japanese Snipe	M	U	Gr.Wtld
	Silver Gull	M	R	Wtld
Diurnal Predators	Wedge Tailed Eagle	R	C	Gr.DScl
	Brown Goshawk	R	C	Gr.DScl.Wtld
	Little Eagle	M	U	Sav.Gr.DScl
	Little Falcon	R	U	Sav.Gr.DScl
	Peregrine Falcon	R	U	DScl Gr.WScl
	Nankeen Kestrel	R	C	Sav.Gr.DScl
	Brown Hawk	R	C	All
	Whistling Eagle	R	U	Gr.DScl
Nocturnal Predators	Powerful Owl	R	C	WScl
	Masked Owl	M	R	Gr.Sav.DScl
	Boobook Owl	R	U	All
	Barn Owl	M	U	Gr.Sav.DScl
Cuckoos	Pallid Cuckoo	R	U	Gr.Sav
	Fantail Cuckoo	M	C	DScl.WScl
	Brush Cuckoo	M	R	Sav.Gr
	Channel Billed cuckoo	R	R	Gr.DScl
Pigeons	Wonga	R	C	WScl
	Forest Bronzewing	R	U	WScl.DScl
	Brush Bronzewing	R	U	WScl.DScl

TABLE 1.1 (Cont'd)

Group	Common Name	Status	Frequency	Habitat
Parrots & Cockatoos	Yellow Tailed Black Cockatoo	M	U	WScl.Sav.DScl
	Sulphur Crested Cockatoo	R	C	All
	Galah	M	U	Gr
	Eastern Rosella	R	C	Gr
	Crimson Rosella	R	C	All
	Gang-Gang Cockatoo	R	U	WScl.DScl
	King Parrot	M	U	WScl.DScl
Frogmouths	Tawny Frogmouth	R	C	DScl.Sav.WScl
Swifts	Spine Tailed Swift	M	U	All
Kingfishers	Kookaburra	R	C	DScl.Gr
	Sacred Kingfisher	M	U	Gr.Wtld
	~~Spine-tailed Swift~~	M	U	All
Bee Eaters	Rainbow Bird	M	U	Gr.Sav
Lyre Birds	Superb Lyrebird	R	C	DScl
Rollers	Dollar Bird	M	R	DScl.WScl
Swallows	Fairy Martin	R	C	Sav.Wtld
Pipits	Australian Pipit	R	U	Gr
Cuckoo Shrikes	Black Faced Cuckoo Shrike	M	R	DScl.Sav
	White-winged Triller	M	U	Sav.DScl
Thrushes	Grey Thrush	R	C	Sav.DScl
Quail Thrushes	Spotted Quail Thrush	R	U	DScl.WScl
Australian Warblers	Eastern Whiteface	R	C	Gr.Sav
	Yellow Tailed Thornbill	R	C	Sav.DScl
	Superb Blue Wren	R	C	DScl
	Emu Wren	M	R	Gr.Wtld
	Brown Thornbill	R	C	DScl
	Pilot Bird	R	C	WScl
	White-browed Scrub Wren	R	C	DScl.WScl.Sav
	Speckled Warbler	M	U	DScl
	Weebill	R	C	Sav
Australian Chats	White Fronted Chat	M	R	Wtld
Old World Flycatchers	Flame Robin	M	C	All
	Hooded Robin	R	C	Sav.DScl
	Southern Yellow Robin	R	C	DScl.WScl
	Scarlet Robin	R	U	All
Fantails	Willy Wagtail	R	C	DScl.Gr.Sav
	Grey Fantail	R	U	DScl.Gr.Sav
	Rufous Fantail	M	U	WScl.DScl
Monarch Flycatchers	Restless Flycatcher	M	U	DScl
	Satin Flycatcher	M	C	DScl.WScl
	Leaden Flycatcher	M	U	DScl
Whistlers	Golden Whistler	M	C	DScl.WScl
	Olive Whistler	M	C	DScl.WScl
	Rufous Whistler	M	C	DScl.WScl

TABLE 1.1 (Cont'd)

Group	Common Name	Status	Frequency	Habitat
Shrike Tits	Eastern Shrike Tit	R	C	DScl.WScl
Australian Tree-creepers	Brown Treecreeper	R	C	DScl.Sav.Gr
	White Throated T'per	R	C	All
	Red Browed T'per	R	C	WScl
Flowerpeckers	Spotted Pardalote	M	C	All
	Eastern Striated Pardalote	M	C	All
	Mistletoe Bird	M	U	All
Silvereyes	Eastern or Greybreasted Silvereye	M	U	WScl.DScl
Honeyeaters	White Naped	M	U	DScl.WScl
	White ~~eated~~ eared	M	U	DScl.WScl
	Eastern Spinebill	R	C	Wtld.WScl.Sav
	Lewin Honeyeater	M	U	WScl
	Yellow Faced	M	C	All
	Noisy Friar Bird	M	U	DScl.Sav
	White Cheeked	M	R	Sav.Gr
	New Holland	M	C	All
Grass Finches	Beautiful Firetail	M	U	WScl
	Red Browed Finch	R	C	All
	Diamond Firetail	M	U	Sav
Mud Nest Builders	Mudlark (Pee Wee)	R	C	Sav.Wtld.Gr
	White-winged Chough	R	C	Sav.DScl
Wood Swallows	Dusky	M	U	Sav
	Masked	M	U	Sav
Australian Magpies	Black Backed	R	C	Sav.DScl.Gr
	White Backed	R	C	Sav.DScl.Gr
	Pied Currawong	R	C	WScl.DScl.Sav
	Grey Currawong	R	U	WScl.DScl.Sav
	Grey Butcher Bird	R	U	WScl.DScl.Sav
Bower Birds	Satin Bower Bird	R	C	WScl
Crows & Ravens	Australian Raven	R	C	All
	Little Raven	M	U	Sav.Gr
Emus	Emu	IN	C	Gr.Sav
Introduced (Exotic) Birds	Goldfinch	E	U	Sav.Gr
	Starling	E	C	Gr
	House Sparrow	E	U	Sav
	Blackbird	E	U	Sav

APPENDIX 2 Understorey Species of the Catchment

Table 2.1 Understorey Species of the Catchment modified and adopted from Ingwersen (unpublished).

Ferns

Cheilanthes tenuifolia

Polystichum proliferum

Herbs and Grasses

Acaena anserinifolia

Agropyron scabrum

Asperula scoparia

Centaurium erythraea

Cirsium vulgare

Danthonia pallida

Dianella revoluta

Dichondra repens

Epilobium sp.

Geranium sp.

Helichrysum scorpioides

Hypericum gramineum

Lepidosperma sp.

Parahebe derwentiana

Poa sp.

Senecio linearifolius

Senecio quadridentatus

Stellaria pungens

Themeda australis

Trifolium repens

Viola betonicifolia

Viola hederacea

APPENDIX 2 (Cont'd)

Shrubs and Creepers

Acacia rubida
Bossiaea foliosa
Bursaria spinosa
Cassinia sp.
Clematis aristata
Coprosma hirtella
Daviesia mimosoides
Daviesia ulicifolia
Exocarpos strictus
Glycine clandestina
Grevillea sp.
Hardenbergia violacea
Hibbertia obtrusifolia
Hovea heterophylla
Indigofera australis
Leptospermum juniperinum
Lomatia myricoides
Melichrus urceolatus
Monotoca scoparia
Olearia argophylla
Olearia erubescens
Olearia megalophylla
Oxylobium alpestre
Oxylobium ellipticum
Persoonia chamaepeuce
Pimelea linifolia
Pomaderris aspera
Rosa rubiginosa
Rubus triphyllus
Tetratheca ericifolia
Tieghemopanax sambucifolius
Urtica incisa
Xanthorrhoea australis

APPENDIX 3 Observation Points, Vistas, Skylines and Scenic Values

(Table 3.1)

Skylines	Observer Position	Distance	Edge	Landscape Compositional Type	Aesthetic Features of Landscape Type
POINT 1 Location: (North of Riverlea) Altitude: 670 m					
A	Inferior	Middle ground	Sky with range (forest)	Vegetation faced enclosure (hardwood)	Variety
B	"	Background	" " " (")	" " "	Vividness
C	"	"	Sky with forest	Veg. faced enclosure (conifer, hardwood)	Variety
D	Normal	Foreground	Sky with grassland, forest	" " " (hardwood)	"
E	Inferior	Middle ground	Sky with forest	" " "	Unity
F	Normal	Foreground	Sky with grassland	" " "	"
POINT 2 Location: (South of Congawarra) Altitude: 710 m					
A	Inferior	Middle ground	Sky with range (forest)	Veg. faced enclosure (conifer)	Vividness
B	"	Background	Sky with range (forest, grassland)	" " " (conifer, hardwood)	Variety

APPENDIX 3 (Table 3.1) (Cont'd)

Skylines	Observer Position	Distance	Edge	Landscape Compositional Type	Aesthetic Features of Landscape Type
C	Inferior	Middle ground	Sky with grassland	Veg. faced enclosure	Unity
D	"	Background	Sky with forest	" " " (hardwood)	"
E & F	"	Middle ground	Sky with range (grassland, bare rock)	Veg. faced enclosure + Focal (geology)	Variety
G	"	Background	Sky with range (grassland)	Veg. faced enclosure	"
H	"	"	Sky with range (forest, grassland)	" " " (hardwood)	"
I	"	"	Sky with range (forest)	" " "	Unity
J & K	"	"	Sky with range (forest, bare rock)	Veg. faced enclosure (hardwood)	Vividness
POINT 3 Location: (Tidbinbilla Tracking Station) Altitude: 700 m					
A,B,I,I' J,L.	Superior	Background	Sky with range (forest)	Veg. faced enclosure (conifer)	Unity
C	Inferior	Middle ground	Sky with range (grassland)	Veg. faced enclosure	"
D	"	"	Sky with range (forest)	Veg. faced enclosure (hardwood)	"
E	Normal	Foreground	Sky with grassland	Veg. faced enclosure	"

APPENDIX 3 (Table 3.1) (Cont'd)

Skylines	Observer Position	Distance	Edge	Landscape Compositional Type	Aesthetic Features of Landscape Type
F & K	Inferior	Background	Sky with range (forest)	Veg. faced enclosure (hardwood)	Vividness
G	Superior	"	Sky with grassland	" " "	Variety
H	"	Middle ground	" "	" " "	"
M	Inferior	Foreground	" "	" " "	"
N	"	Background	Sky with range (forest)	Veg. faced enclosure (hardwood, conifer)	"
POINT 4 Location: (Tidbinbilla Nature Reserve, Information Centre) Altitude: 750 m					
A,B	Inferior	Background	Sky with range (forest, grassland)	Veg. faced enclosure (conifer, hardwood)	Variety
C	Superior	Background	Sky with range (bare rock, forest, grassland)	Veg. faced enclosure (hardwood)	"
POINT 5 Location: (Tidbinbilla Nature Reserve, Scenic Lookout) Altitude: 850 m					
A	Inferior	Background	Sky with range (forest)	Veg. faced enclosure (conifer, hardwood)	Variety
B	Superior	"	Sky with range (forest, grassland)	" " "	"
C,D	"	"	Sky with range (forest)	" " " (hardwood)	Unity

APPENDIX 3 (Table 3.1) (Cont'd)

Skylines	Observer Position	Distance	Edge	Landscape Compositional Type	Aesthetic Features of Landscape Type
POINT 6 Location: (Near Paddys River Gravel Road) Altitude: 740 m					
A,E	Inferior	Background	Sky with range (forest)	Veg. faced enclosure (hardwood)	Unity
B	"	"	" " "	Veg. faced enclosure (conifer, hardwood)	Variety
C	Normal	Foreground	Sky with range (grassland)	Veg. faced enclosure	"
D	"	"	Sky with range (forest, grassland, bare rock)	" " " (hardwood)	"
POINT 7 Location: (Murrays Corner) Altitude 560 m					
A	Inferior	Middle ground	Sky with range (forest)	Veg. faced enclosure (hardwood)	Unity
B	"	" "	Sky with forest	" " " (conifer)	"
POINT 8 Location: (Beginning of Corin Dam road) Altitude: 700 m					
A,G	Normal	Foreground	Sky with range (grassland)	Veg. faced enclosure	Unity
B,E	Inferior	Background	Sky with range (forest)	" " " (hardwood)	"

APPENDIX 3 (Table 3.1) (Cont'd)

Skylines	Observer Position	Distance	Edge	Landscape Compositional Type	Aesthetic Features of Landscape Type
C,F	Inferior	Middle ground	Sky with range (grassland, bare rock)	Veg. faced enclosure	Variety
D	"	"	Sky with range (forest, grassland)	" " " (hardwood)	"
POINT 9 Location: (Gibraltar Area, lower picnic area) Altitude: 880 m					
A_1	Inferior	Middle ground	Sky with range (forest, grassland)	Veg. faced enclosure (hardwood, conifer)	Variety
A_2	"	"	Sky with range (forest)	" " " (hardwood)	Unity
POINT 10 Location: (Eastern Side of Gibraltar Falls) Altitude: 1000 m					
A,B	Normal	Middle ground	Sky with range (grassland, forest, hardwood)	Veg. faced enclosure (conifer, hardwood)	Variety
C	Superior	Background	Sky with range (grassland, forest)	Panoramic	"
D,E	Inferior	Middle ground	Sky with range (forest)	Veg. faced enclosure (hardwood)	"
F	"	Foreground	" " "	" " "	Unity

APPENDIX 3 (Table 3.1) (Cont'd)

Skylines	Observer Position	Distance	Edge	Landscape Compositional Type	Aesthetic Features of Landscape Type
POINT 11 Location: (Booroomba)		Altitude: 780 m			
A,D,E,F	Inferior	Middle ground	Sky with range (forest)	Veg. faced enclosure (hardwood)	Unity
B	"	"	Sky with range (forest, grassland, bare rock)	" " " (hardwood)	Variety
C	"	Background	" " "	" " " + Focal (Geology)	Unity

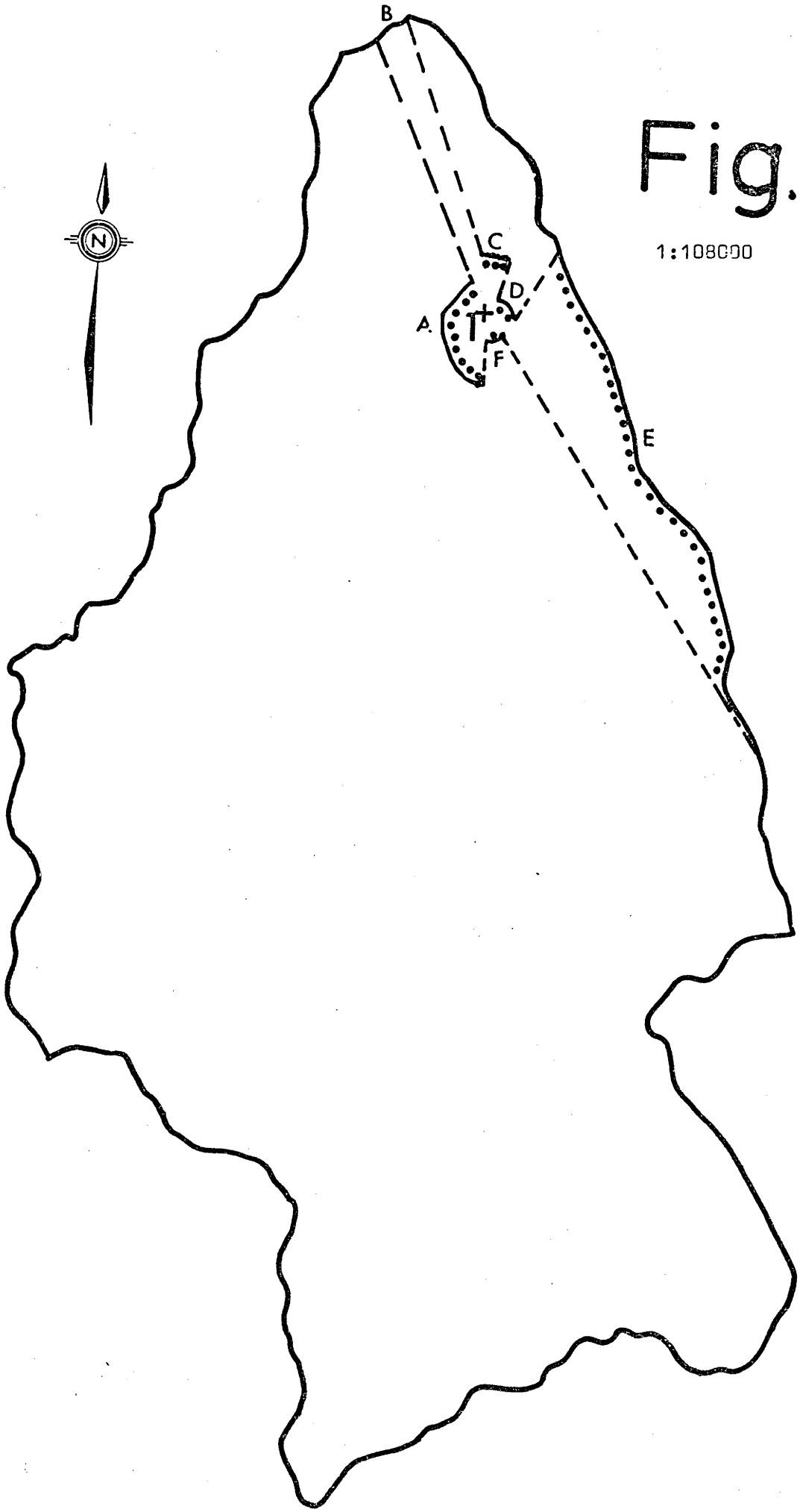

Fig. 3.1

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Fig. 3.2

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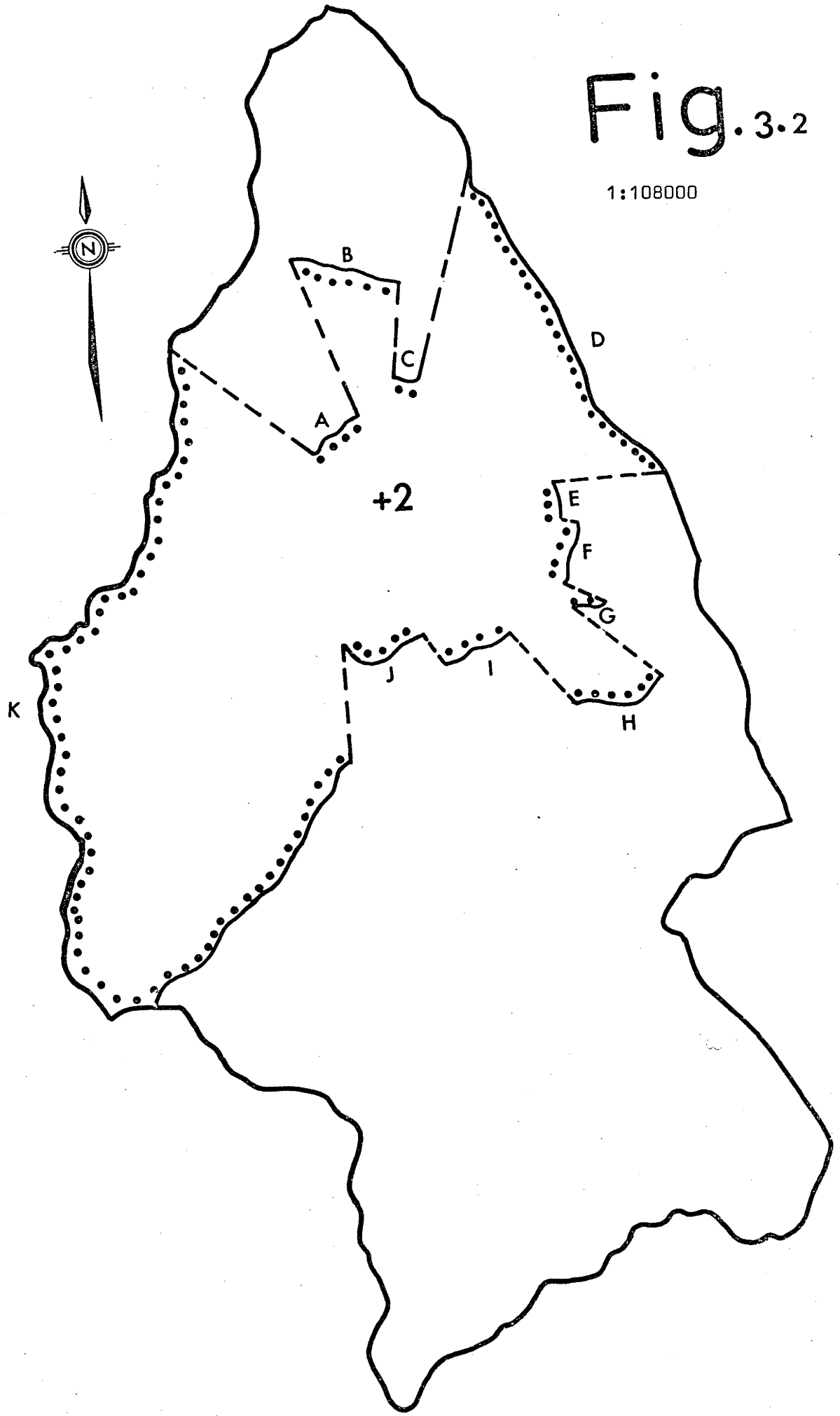

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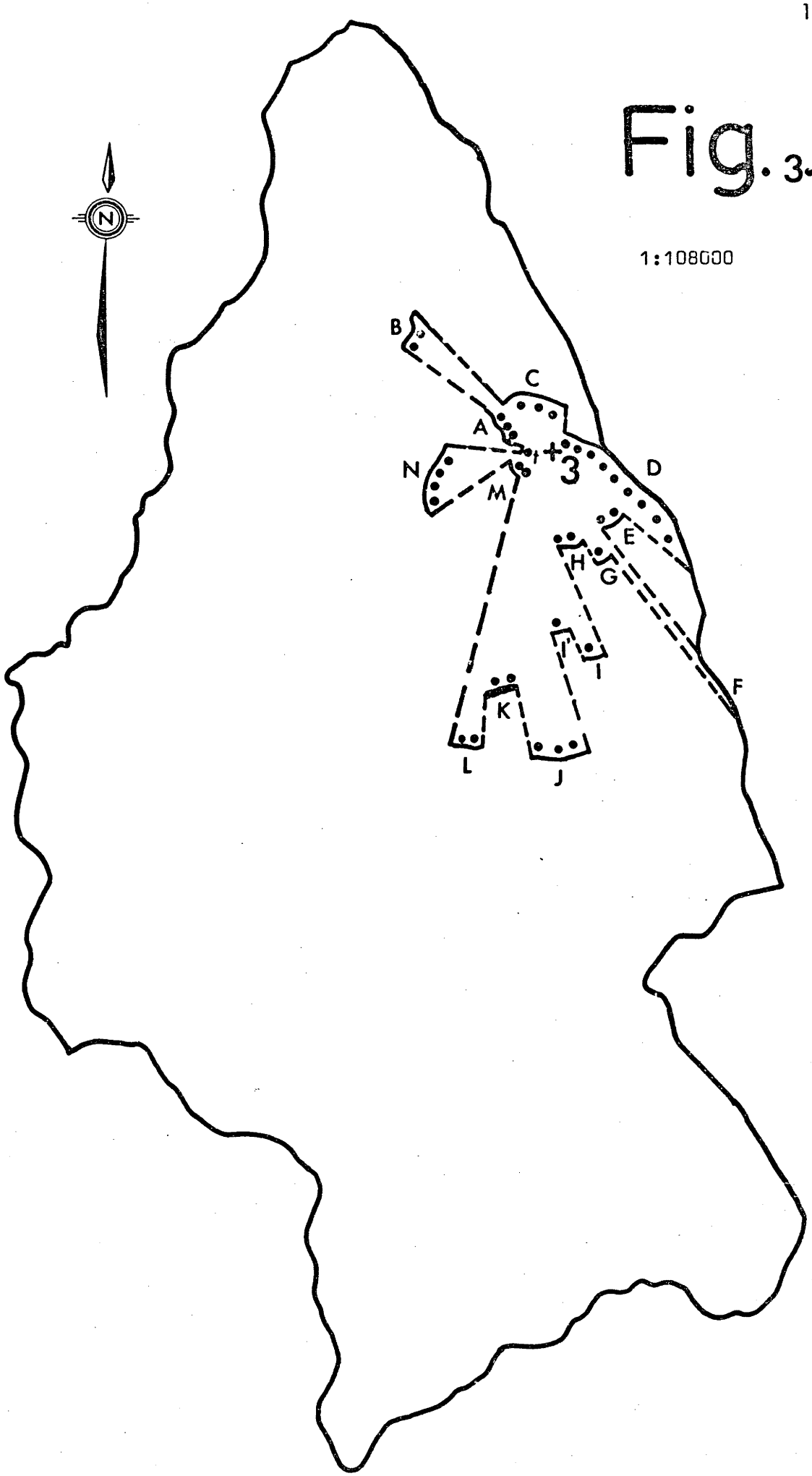

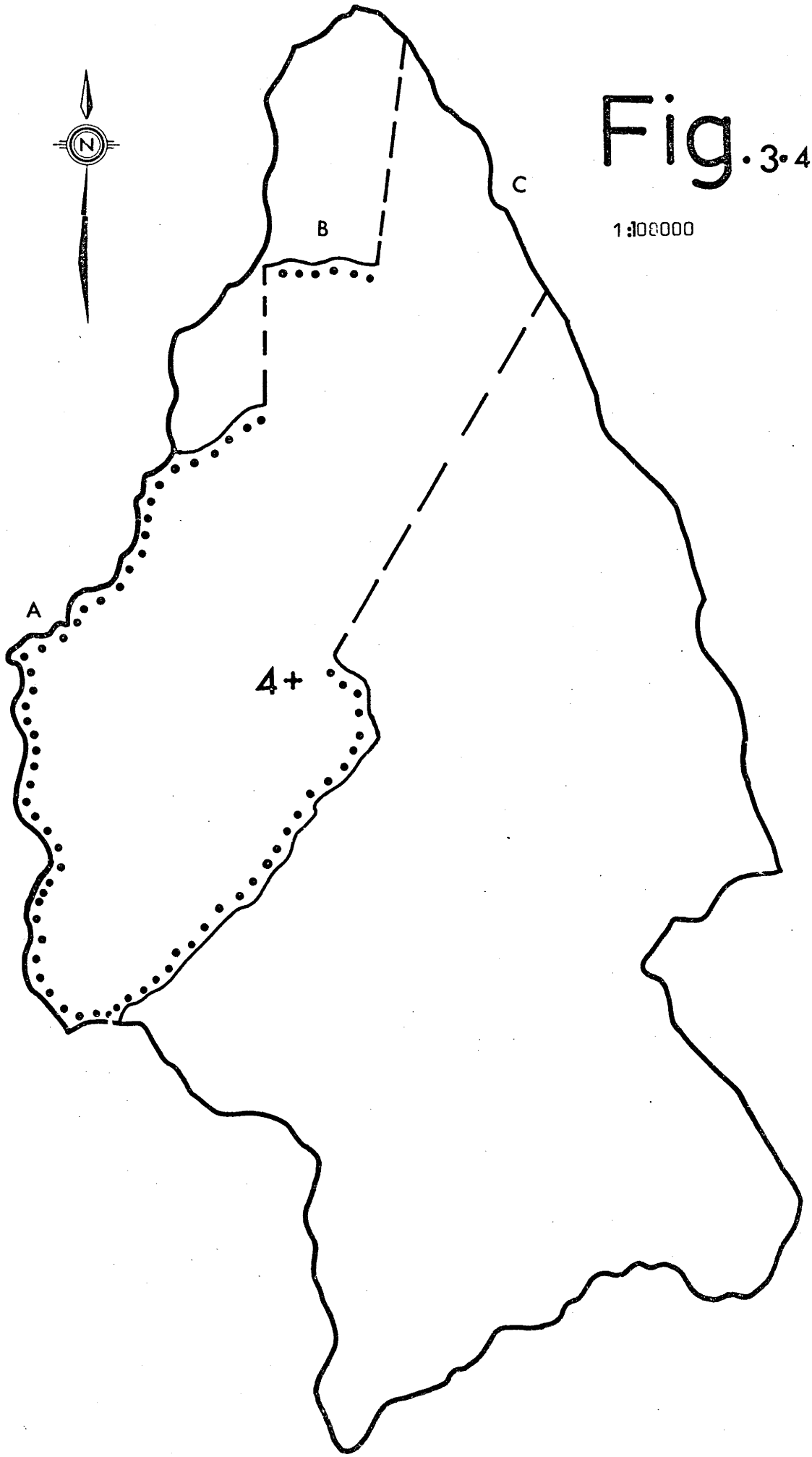

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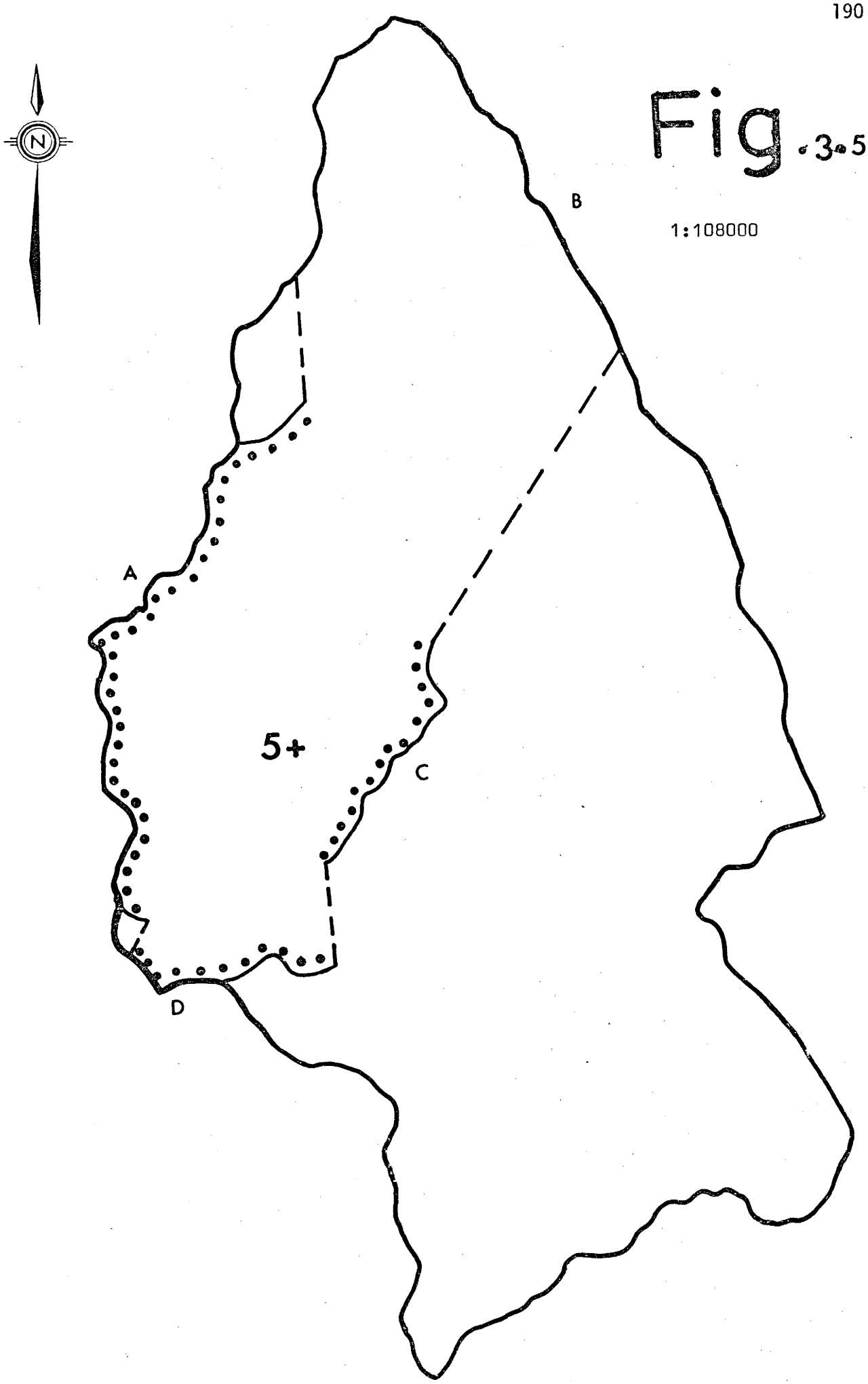

Fig. 3.5

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Fig. 3.6

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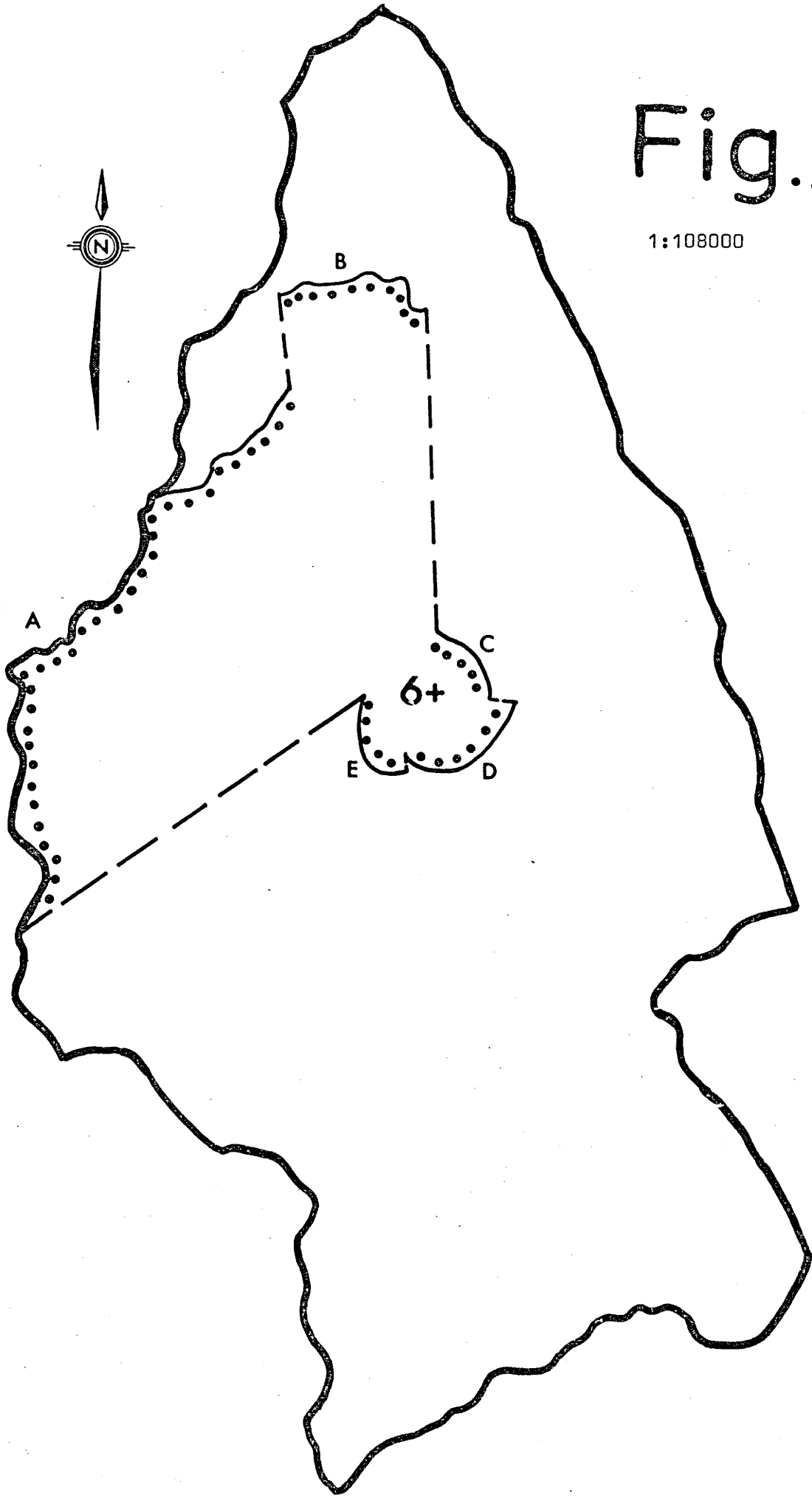

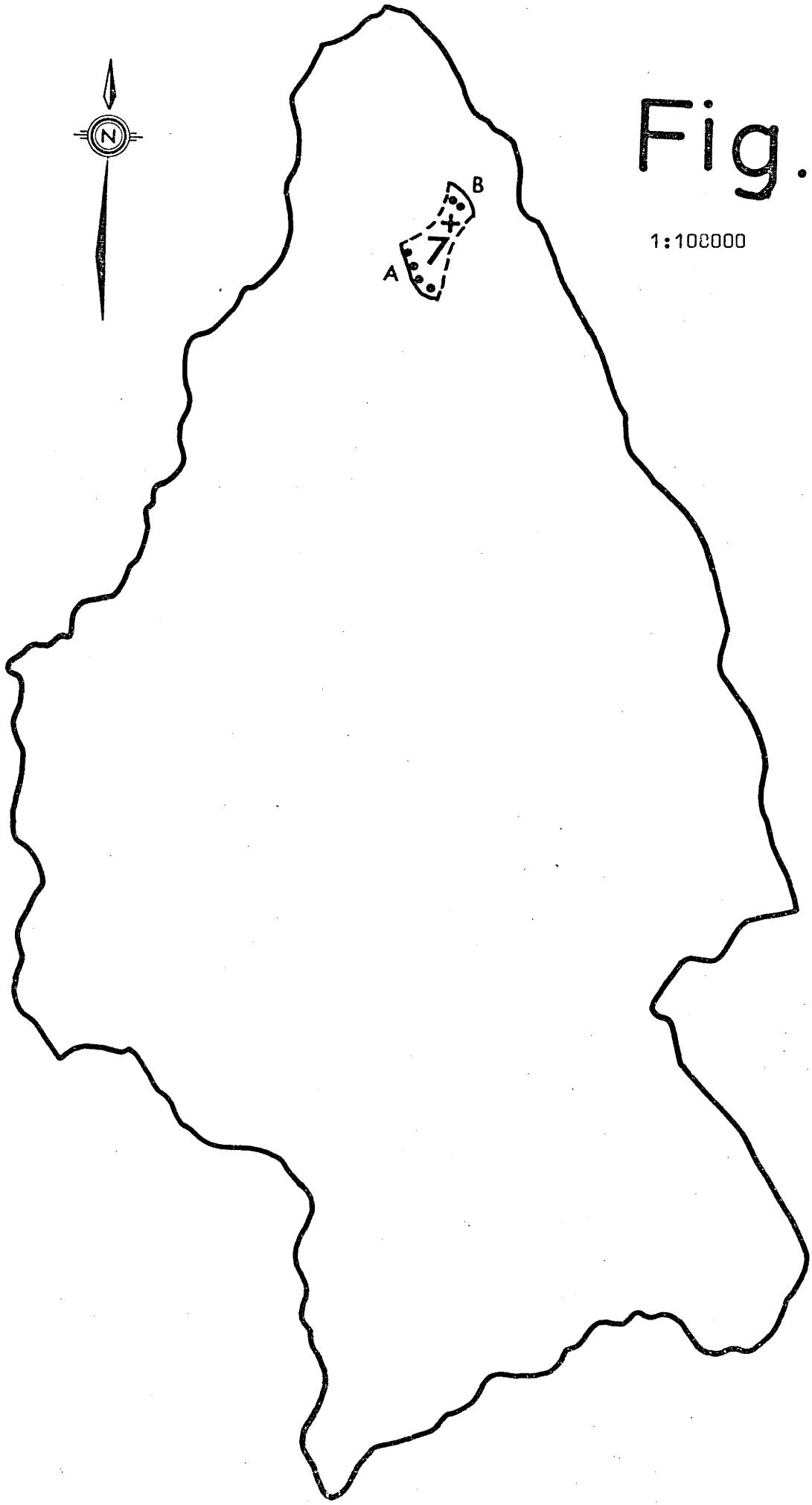

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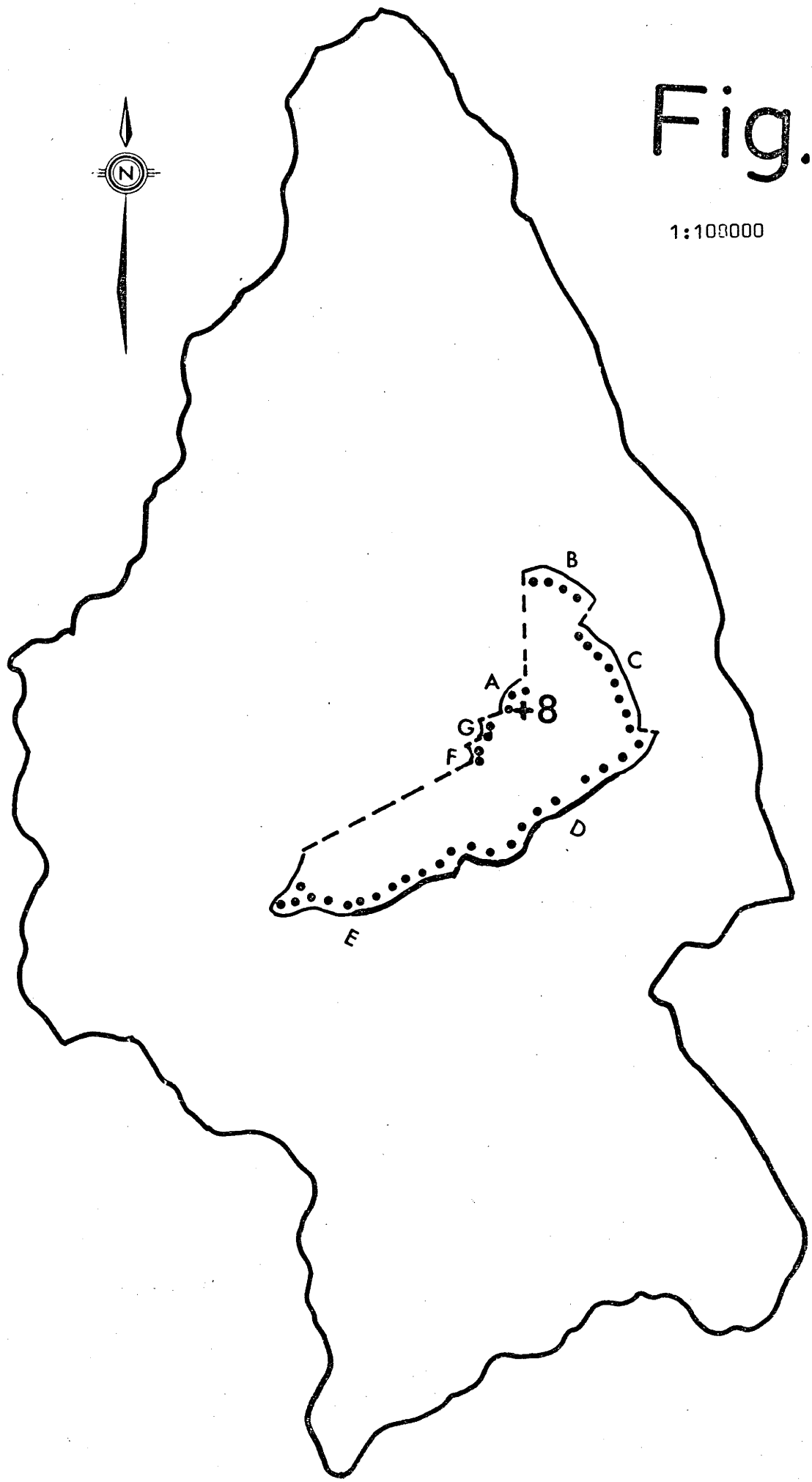

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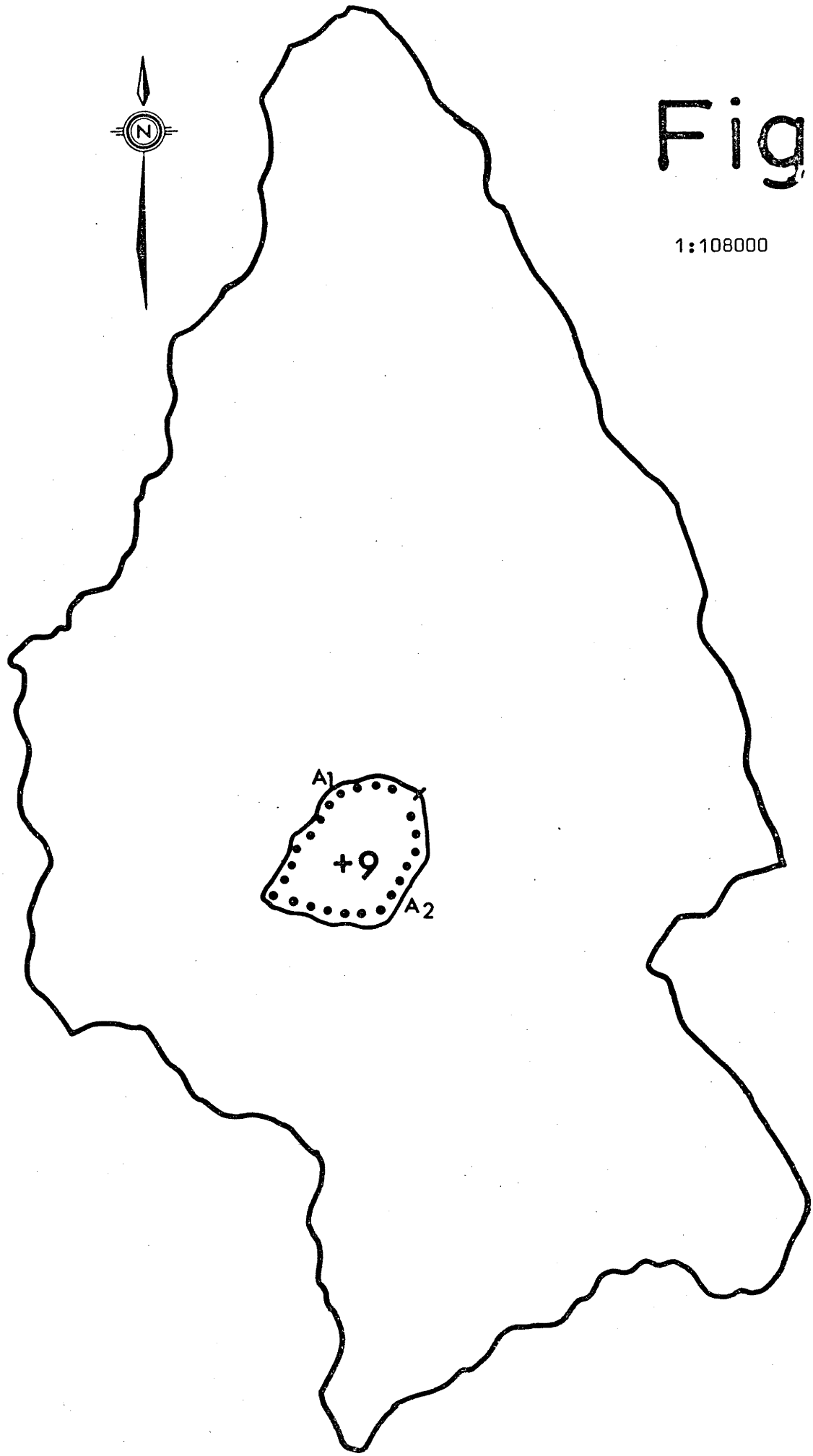

Fig. 3.9

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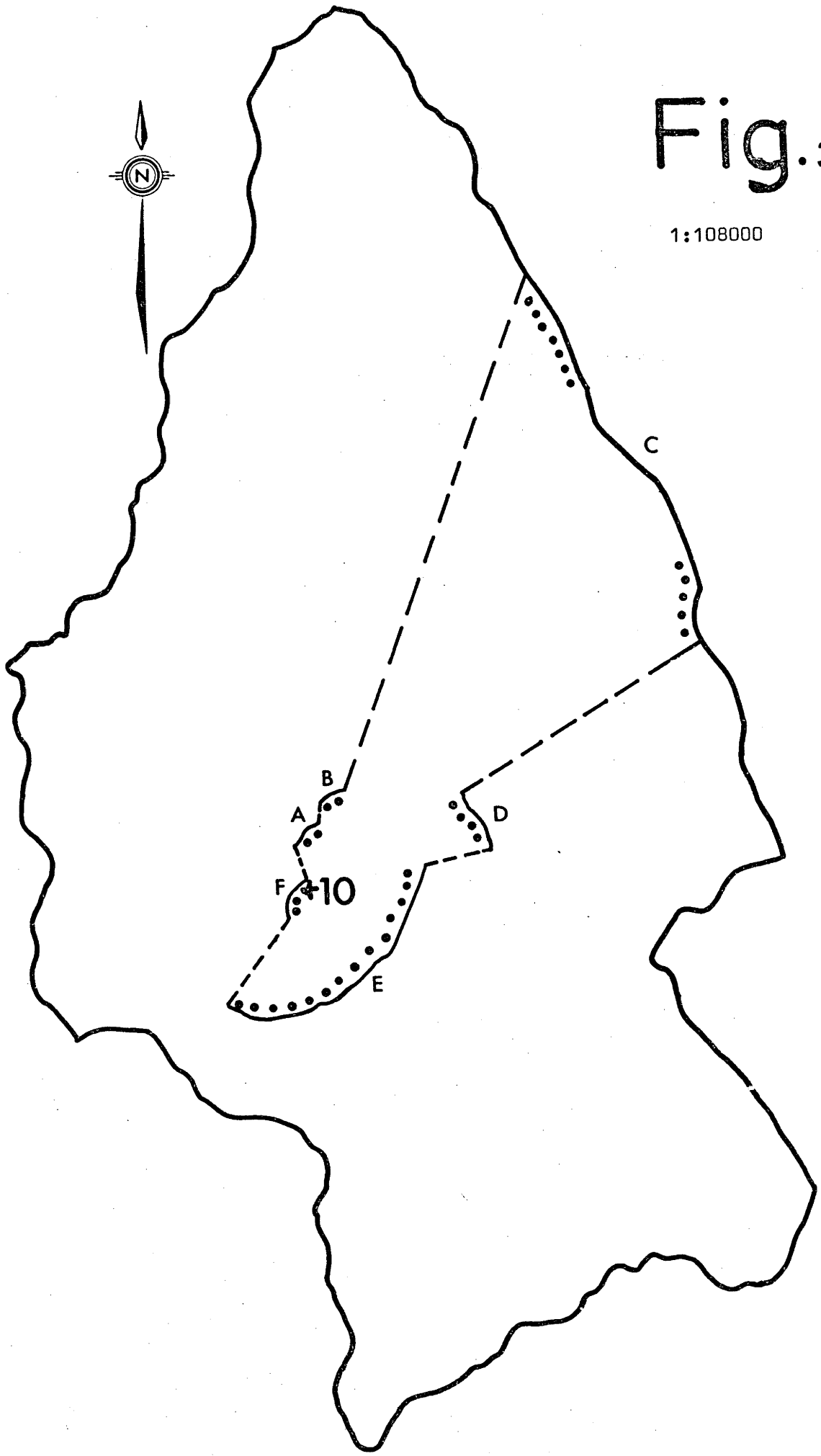

Fig. 3.10

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Fig. 3.11

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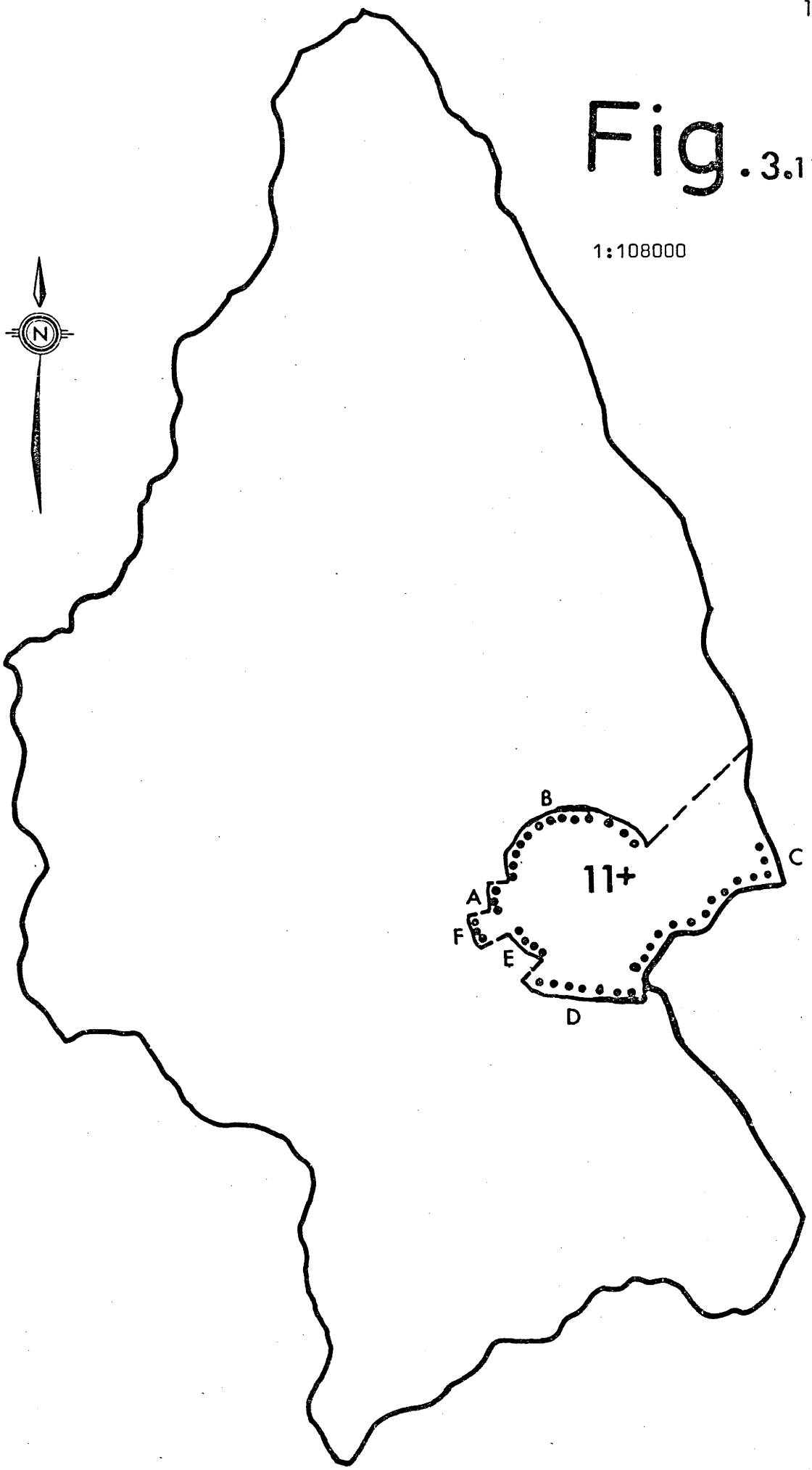


APPENDIX 4 Sample sheets

A: Resources inventory (field work examination).

B: Assessment of scenery (field work examination).

A: Sample Sheets for resource inventory (field work examination)

Land form unit	Land form attributes	Rock types	Soil types	Forest types	Tree density	Land use	Other features
5	Aspect: NE (P) Altitude: 600-660 Drainage pattern: dendritic (not well dissd) Slope class: undulating General Physiography: a creek draining eastward.	OS, St, (smp), gm, (gmn), amt	a,b,c, d,e,f, (g),h,(k),+ (w),t,m Ah,	Sr, c, b, d, bb, aa, lp, up, sm, lsg, sg (p:)	g, s, d, m V. 35-40 years old.	Timber production + grave pit	- excellent accessibility - shade trees good. - existence of wildlife.

A: Sample Sheets for resource inventory (field work examination)

Land form unit	Land form attributes	Rock types	Soil types	Forest types	Tree density	Land use	Other features
10	Aspect: NE, NW Altitude: 550-850 Drainage pattern: Slope class: Parallel undu- to Hilly General Physiography: dissected by a creek. Rock outcrops common.	OS, St, smp, gm, (gmn), amt	(a),(b),(c), (d),e,f, g,h,k, w,t,m Ah,	Sr, c, b, d, bb, aa, lp, up, sm, lsg, sg (p:)	g, s, d, m V. 35-40 years old.	Timber production	-2.4 wheel drive - accessibility good. - Pine plantation roads. - Stand trees very good. - features of wildlife

A: Sample Sheets for resource inventory (field work examination)

Land form unit	Land form attributes	Rock types	Soil types	Forest types	Tree density	Land use	Other features
25	Aspect: Variable Altitude: 600 - 670 Drainage pattern: Radial Slope class: Rolling General Physiography: dissected by the Paddys river. sheet and gully erosion Common.	(OS), St, smp, gm, gmn, (amt)	a,b,c, d,e,f, g,(h),(k), + (w),t,(m) Ah, near the river mostly on.	(Sr), c, b, (d), bb, aa, lp, up, sm, lsg, sg p:	(g), s, (d), (m) V.	Grazing - recreati	- Fish for fishing. - Shade tree food - domestic use - roads-tracks picnic - facilities - fertilizers supplementary planting - accessibility Very good

A: Sample Sheets for resource inventory (field work examination)

Land form unit	Land form attributes	Rock types	Soil types	Forest types	Tree density	Land use	Other features
43	Aspect: Variable Altitude: 650-1000 Drainage pattern: braided. Slope class: mount to flat. General Physiography: Outcrops Common	OS, St, smp, (gm), (gmn), amt	a,b,(c), d,(e),f, g,h,k, w,(t),m Ah, on stream banks	Sr, c, b, d, bb, aa, (lp), up, sm, lsg, sg p: dominantly grassland	(g),(s), d, (m) V.	Native forestry (light grazing)	- accessibility very poor. - first for hunting. - features of wildlife - Paddys wood farms N E of the area

A: Sample Sheets for resource inventory (field work examination)

Land form unit	Land form attributes	Rock types	Soil types	Forest types	Tree density	Land use	Other features
51	Aspect: SE Altitude: 800-1300 Drainage pattern: Parallel Slope class: mountain General Physiography: - mountain side with steep escarpment. - ridges running SW to NE. rock outcrops common	OS, St, smp, gm, (gmn), amt	(a),b,(c), d,(e),f, g,h,k, w,t,m Ah,	Sr, c, b, d, bb, aa, lp, (up), sm, lsg, (sg) p:	(g), s, (d), (m) V.	Natural forestry	- Shade trees good. - features of wildlife - accessibility very poor.

B: Point: 11 - Skyline A

Observer Position	Distance	Landscape Compositional type	Aesthetic criteria	Other characters and problems
Inferior ~~Normal~~ ~~Superior~~	~~Foreground 0-400 m~~ Middleground 400-8 Km ~~Background 8 Km~~	- ~~Panoramic~~ - Enclosed (slope faced - ~~cliff faced~~ - vegetation faced enclosure) - ~~Feature L/Scape~~ - ~~Focal~~ - Forest ~~or canopied~~	Unity ~~Vividness~~ ~~Variety~~	Edge (sky, range, ~~grassland~~, forest- ~~conifer~~, hardwood - ~~bare rock or logged~~ ~~Isolated~~ Dominant

B: Point 11 - Skyline B

Observer Position	Distance	Landscape Compositional type	Aesthetic criteria	Other characters and problems
Inferior ~~Normal~~ ~~Superior~~	~~Foreground 0-400 m~~ Middleground 400-8 Km ~~Background 8 Km~~ ∞	- ~~Panoramic~~ - Enclosed (slope faced - ~~cliff faced~~ - vegetation faced enclosure) - ~~Feature L/Scape~~ - ~~Focal~~ - Forest ~~or canopied~~	~~Unity~~ ~~Vividness~~ Variety	Edge (sky, range, grassland, forest-~~conifer~~, hardwood - bare rock ~~or logged~~ Isolated ~~Dominant~~

B; Point 11 - Skyline C

Observer Position	Distance	Landscape Compositional type	Aesthetic criteria	Other characters and problems
Inferior ~~Normal~~ ~~Superior~~	~~Foreground 0-400 m~~ ~~Middleground 400-8 Km~~ Background ∠ Km- ∞	~~- Panoramic~~ - ~~Enclosed~~ (slope faced ~~- cliff faced~~ - vegetation faced enclosure) - ~~Feature L/~~Scape - Focal - Forest or canopied	Unity ~~Vividness~~ Variety	Edge (sky, range, grassland, forest- ~~conifer,~~ hardwood - bare rock ~~or logged~~) ~~Isolated~~ Dominant

B: Point 11 - Skyline D

Observer Position	Distance	Landscape Compositional type	Aesthetic criteria	Other characters and problems
Inferior ~~Normal~~ ~~Superior~~	~~Foreground 0-400 m~~ Middleground 400-8 Km ~~Background 8 Km ∞~~	- ~~Panoramic~~ - Enclosed (slope faced ~~- cliff faced~~ - vegetation faced enclosure) - ~~Feature L/Scape~~ - ~~Focal~~ - Forest ~~or canopied~~	Unity ~~Vividness~~ ~~Variety~~	Edge (sky, range, ~~grassland,~~ forest- ~~conifer,~~ hardwood - ~~bare rock or logged~~ ~~Isolated~~ Dominant

B: Point 11 - Skyline E

Observer Position	Distance	Landscape Compositional type	Aesthetic criteria	Other characters and problems
Inferior ~~Normal~~ ~~Superior~~	~~Foreground 0-400 m~~ Middleground 400-8 Km ~~Background 8 Km~~	- ~~Panoramic~~ - Enclosed (slope faced ~~- cliff faced~~ - vegetation faced enclosure) - ~~Feature L/Scape~~ - ~~Focal~~ - Forest ~~or canopied~~	Unity ~~Vividness~~ ~~Variety~~	Edge (sky, range, ~~grassland,~~ forest- ~~conifer,~~ hardwood - ~~bare rock or logged~~) ~~Isolated~~ Dominant

B: Point 11 - Skyline F

Observer Position	Distance	Landscape Compositional type	Aesthetic criteria	Other characters and problems
Inferior Normal Superior	~~Foreground 0-400 m~~ Middleground 400-8 Km ~~Background 8 Km~~ ∞	~~- Panoramic~~ - Enclosed (slope faced ~~- cliff faced~~ - vegetation faced enclosure) - ~~Feature L/Scape~~ - ~~Focal~~ - Forest ~~or canopied~~	Unity ~~Vividness~~ ~~Variety~~	Edge (sky, range, ~~grassland~~, forest- ~~conifer,~~ hardwood - ~~bare rock or logged~~) ~~Isolated~~ Dominant

PADDYS RIVER

CATCHMENT AREA

GEOLOGY

1:75000

LEGEND

g m — GRANITE

s m p — PADDYS RIVER VOLCANIC

a m t — ADAMELLITE

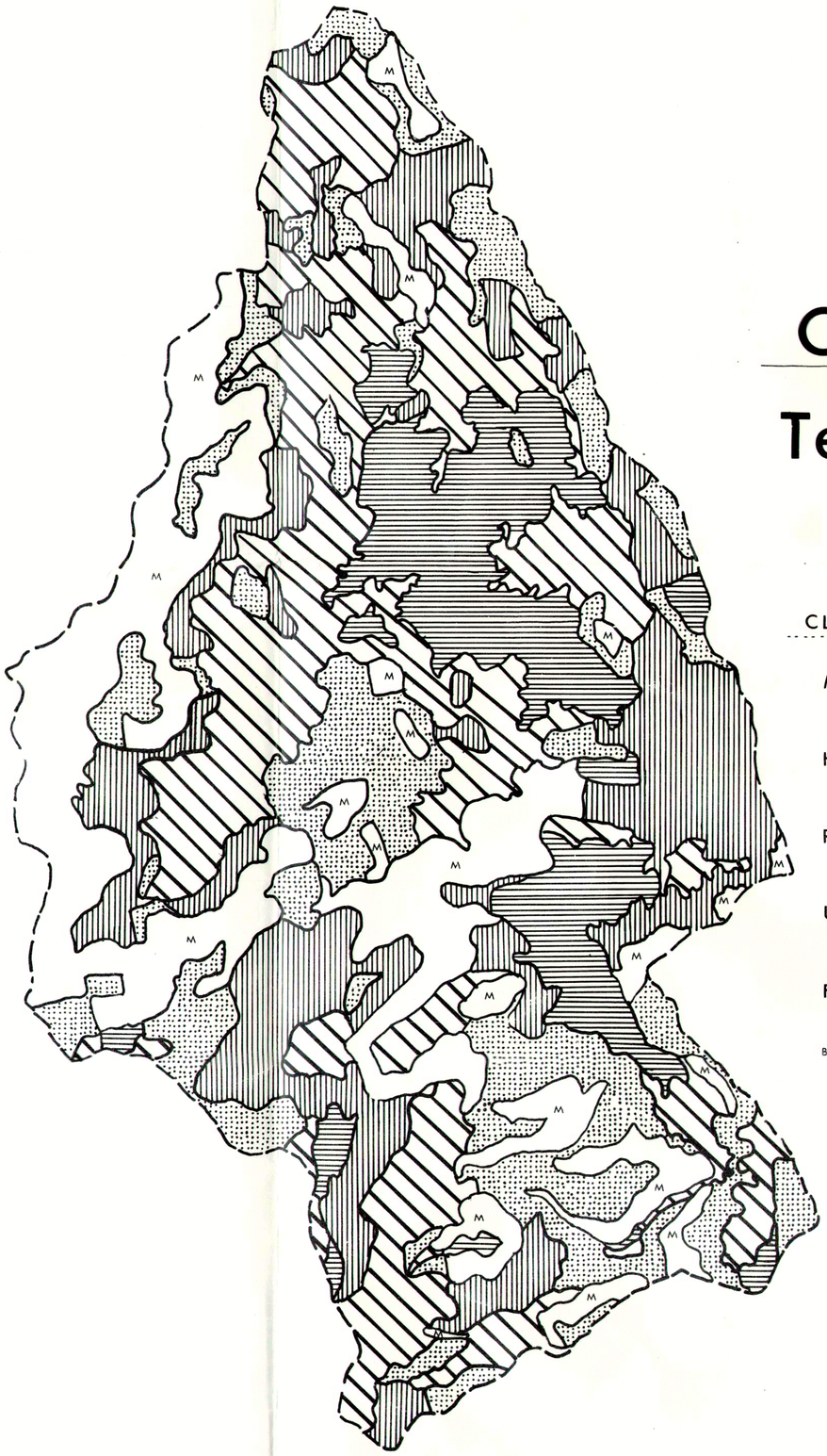
s t — TIDBINBILLA QUARTZITE

o s — ORDOVICIAN SEDIMENT

g m n — GRANODIORITE

L s — UNEXPLOITED MINERAL DEPOSIT

map.1



N

Paddys River Catchment Area

Terrain Classes

1:75000

LEGEND

CLASSIFICATION	SLOPE (%)	LOCAL RELIEF (m)	SYMBOL
Mountainous	>25	>200	M
Hilly	10-25	100-200	
Rolling	6-15	80-150	
Undulating	2-7	20-80	
Flat	0-3	< 20	
BOUNDARY			

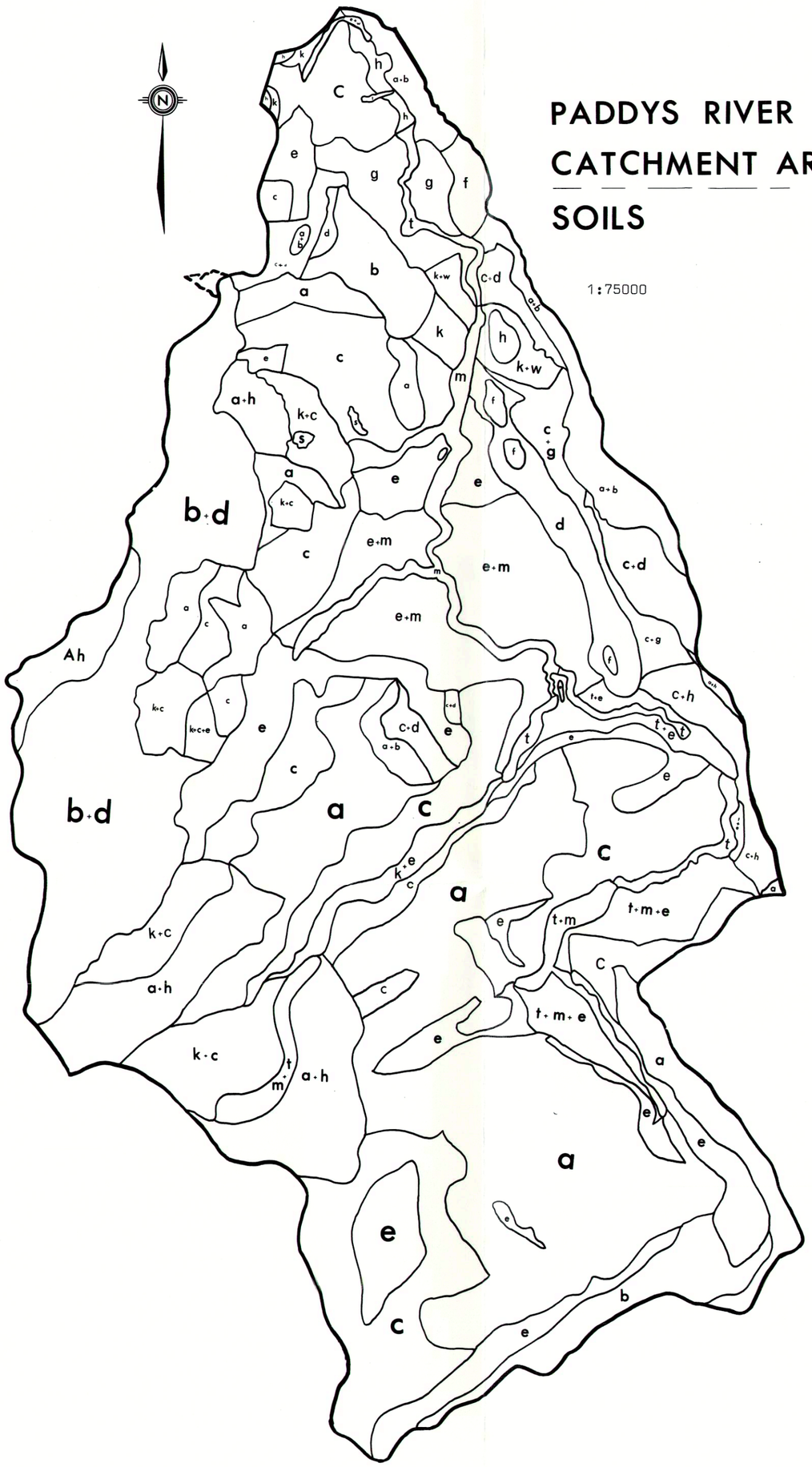
M. McKhoum

MAP. 2

PADDYS RIVER CATCHMENT AREA

SOILS

1:75000



M. Makhdoum

LEGEND

- a_1 MEDIUM-TEXTURED RED PODZOLIC SOILS IN ASSOCIATION WITH UNIFORM COARSE-TEXTURED SOILS
- b_1 COARSE " " " " " " " " " "
- c_1 " " YELLOW " " " " MEDIUM " "
- d_1 MEDIUM " " " " " " " " "
- e_1 " " " DEEP " "
- f_1 HARD NEUTRAL " MOTTLED "
- g_1 ALKALIN " " " " MASSIVE EARTHS
- h_1 SHALLOW COARSE-TEXTURED RED EARTHS
- k_1 DEEP MEDIUM TEXTURED RED EARTHS
- w_1 " " " YELLOW "
- t_1 UNIFORM COARSE-TEXTURED ALLUVIAL SOILS
- m_1 " MEDIUM " " "
- Ah: ALPINE HUMUS SOILS
- s_1 SWAMP SOILS

MAP.3

PADDYS RIVER CATCHMENT AREA

FOREST TYPES

1:75000

LEGEND

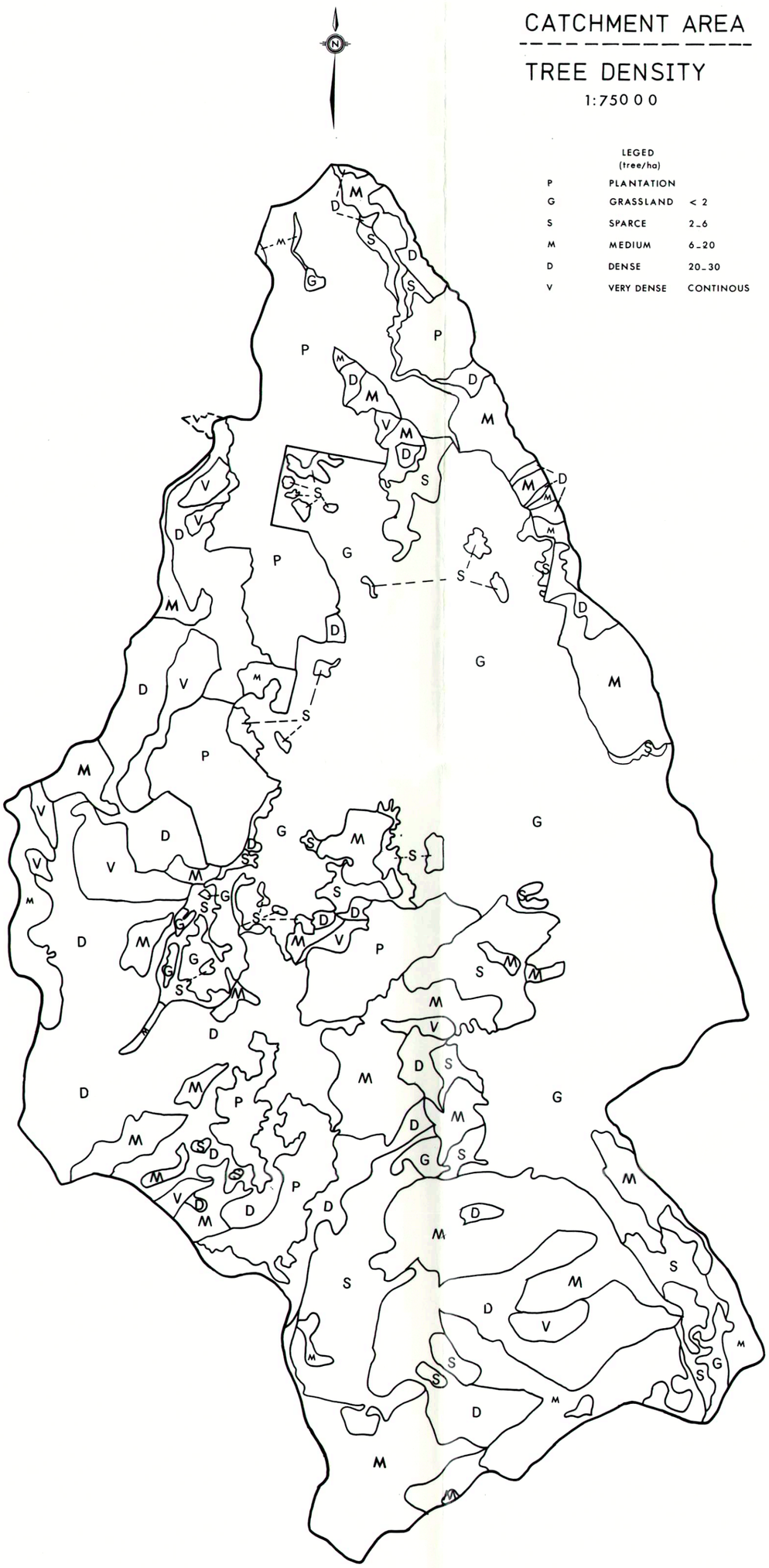
sr	scribbly gum_red stringy bark
c	river oak
b	manna gum_candle bark_brittle gum
d	apple box_red gum_red stringy bark
lsg	lower snow gum
bb	brown barrel
aa	alpine ash
lP	lower peppermint
up	upper „
sm	snow gum_mountain gum
sg	snow gum
pe	pinus elliottii
Pl	„ laricio
PP	„ ponderosa
pr	„ radiata
	grassland

MAP.4

PADDYS RIVER CATCHMENT AREA

TREE DENSITY

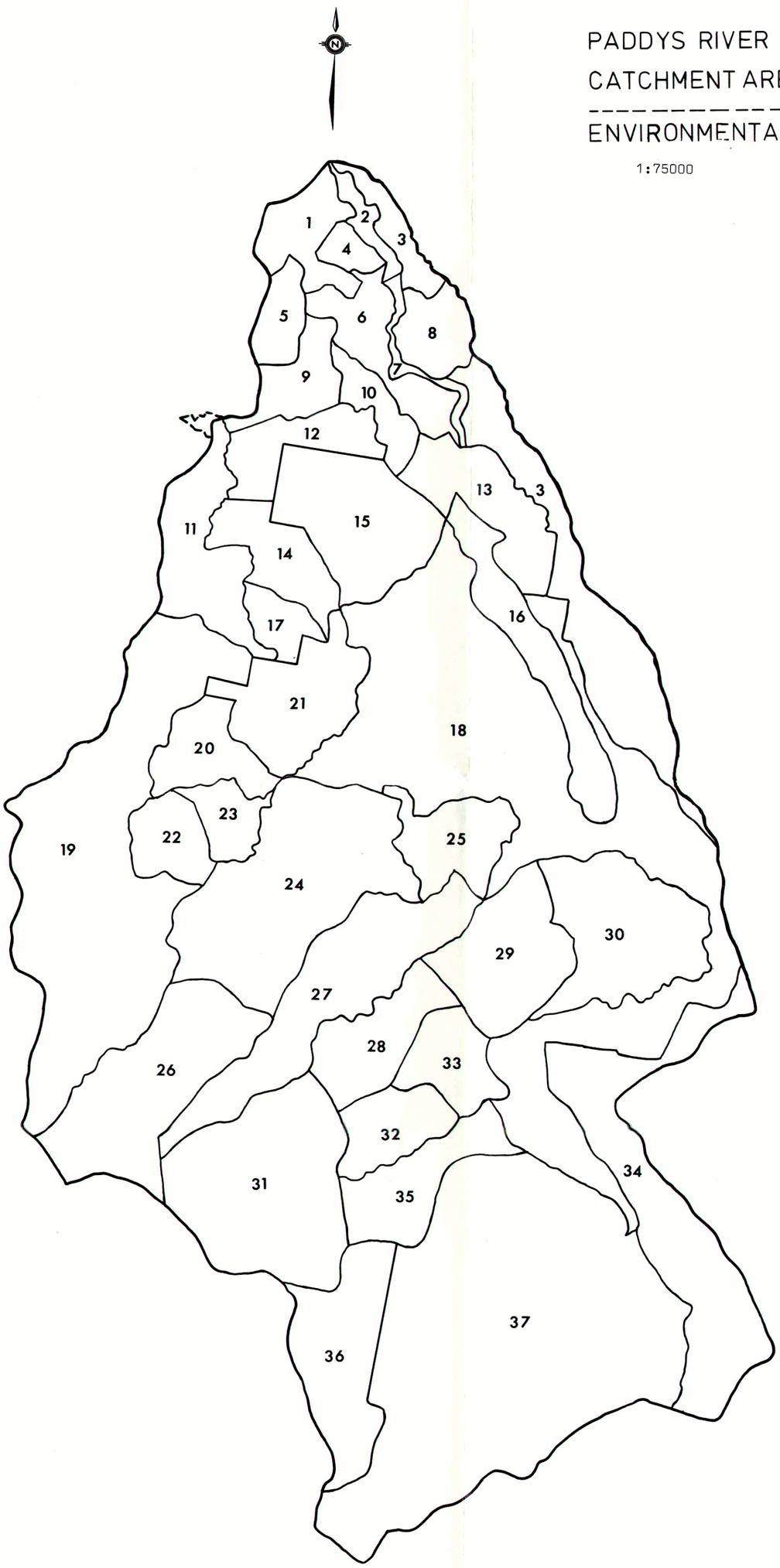
1:75000



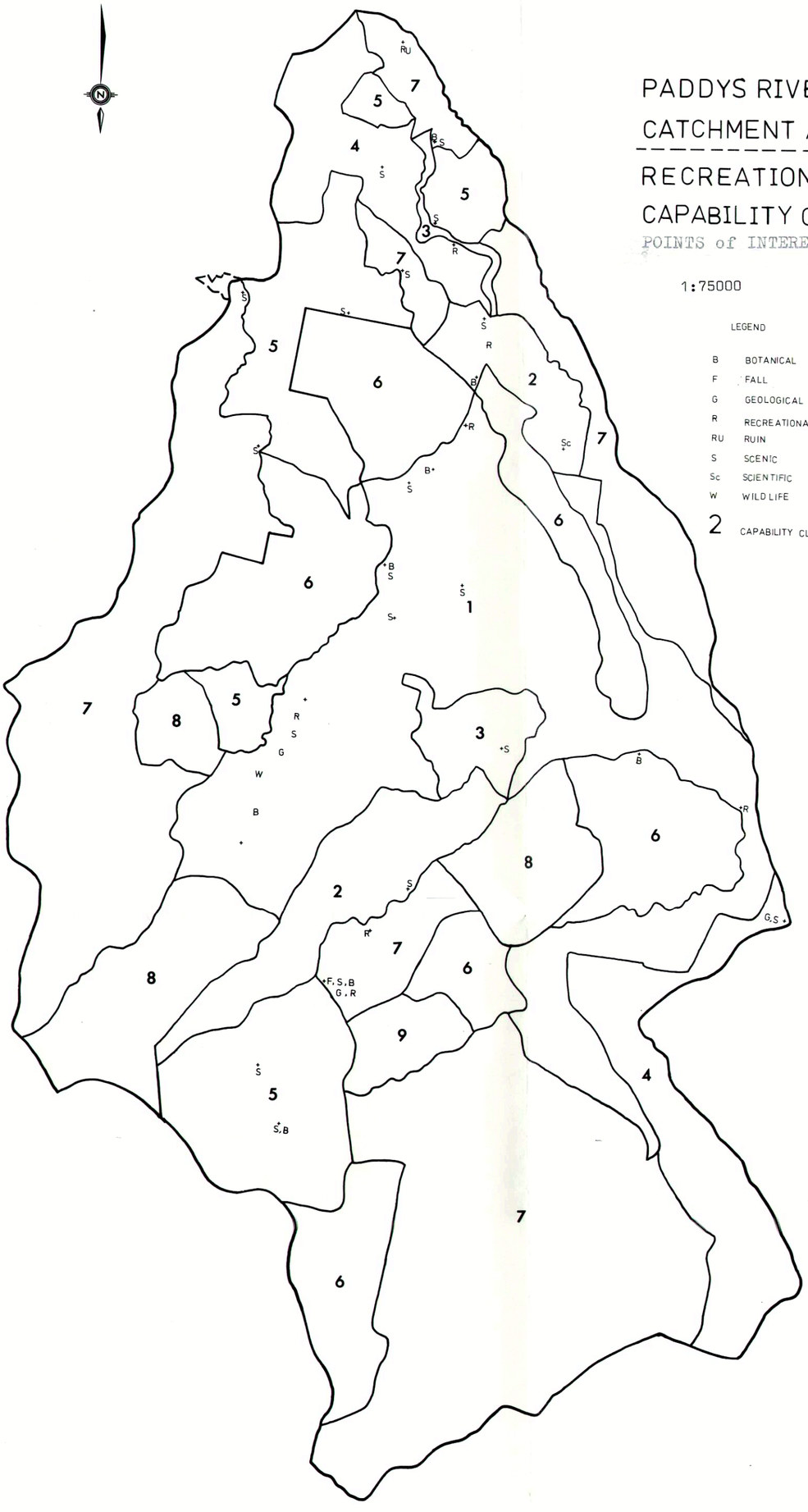
MAP.5

PADDYS RIVER
CATCHMENT AREA
ENVIRONMENTAL UNITS

1:75000



MAP. 6



PADDYS RIVER CATCHMENT AREA

RECREATION CAPABILITY CLASSES (A), POINTS of INTEREST

1:75000

LEGEND

B	BOTANICAL
F	FALL
G	GEOLOGICAL
R	RECREATIONAL
RU	RUIN
S	SCENIC
Sc	SCIENTIFIC
W	WILD LIFE
2	CAPABILITY CLASSES

MAP.7

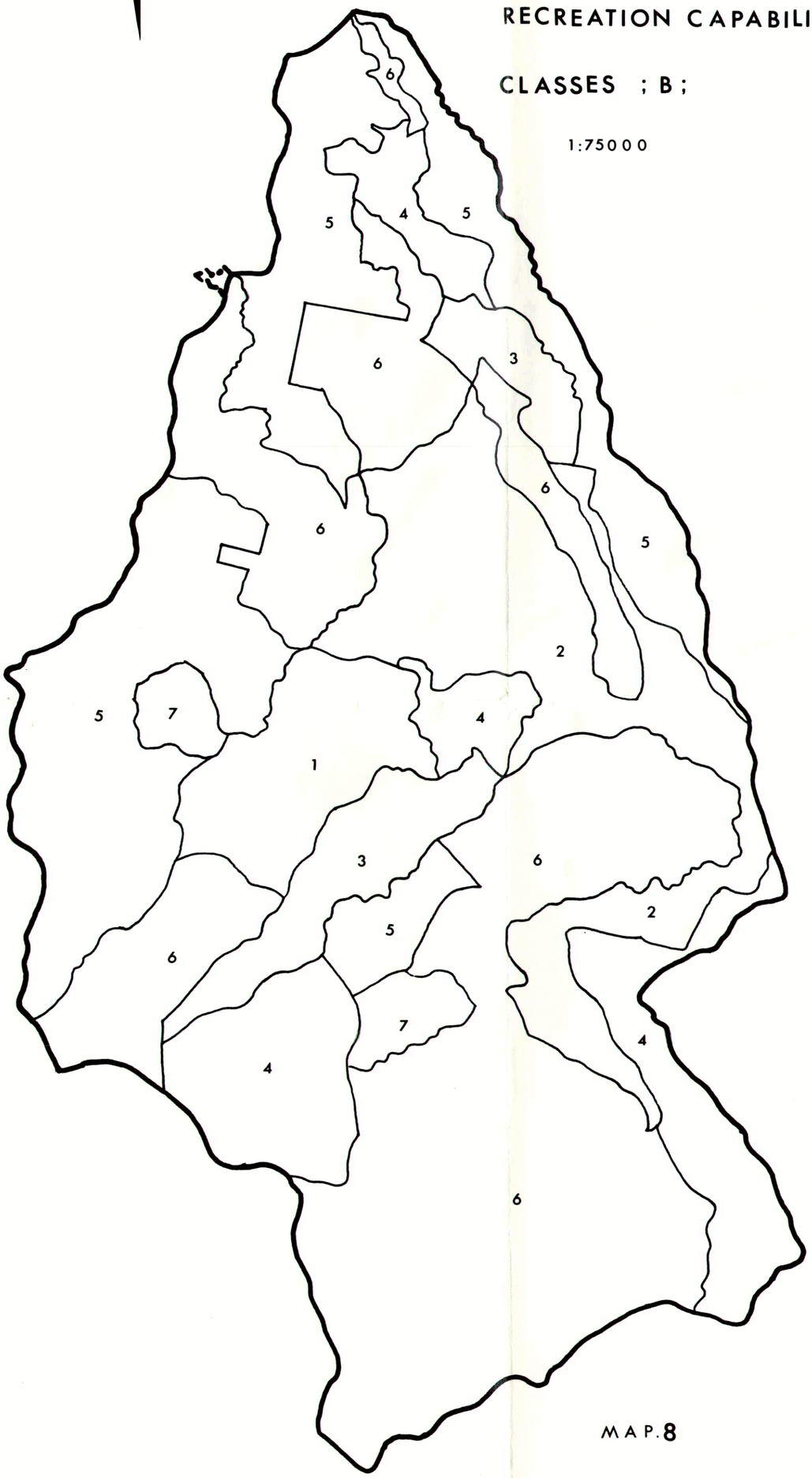
PADDYS RIVER

CATCHMENT AREA

RECREATION CAPABILITY

CLASSES ; B ;

1:75000



MAP. 8