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AN ANNOTATED BIBLIOGRAPHY OF LAKES MANAPOURI AND TE ANAU

by

R.A. Pickrill and E.J. Maciver

NEW ZEALAND OCEANOGRAPHIC INSTITUTE
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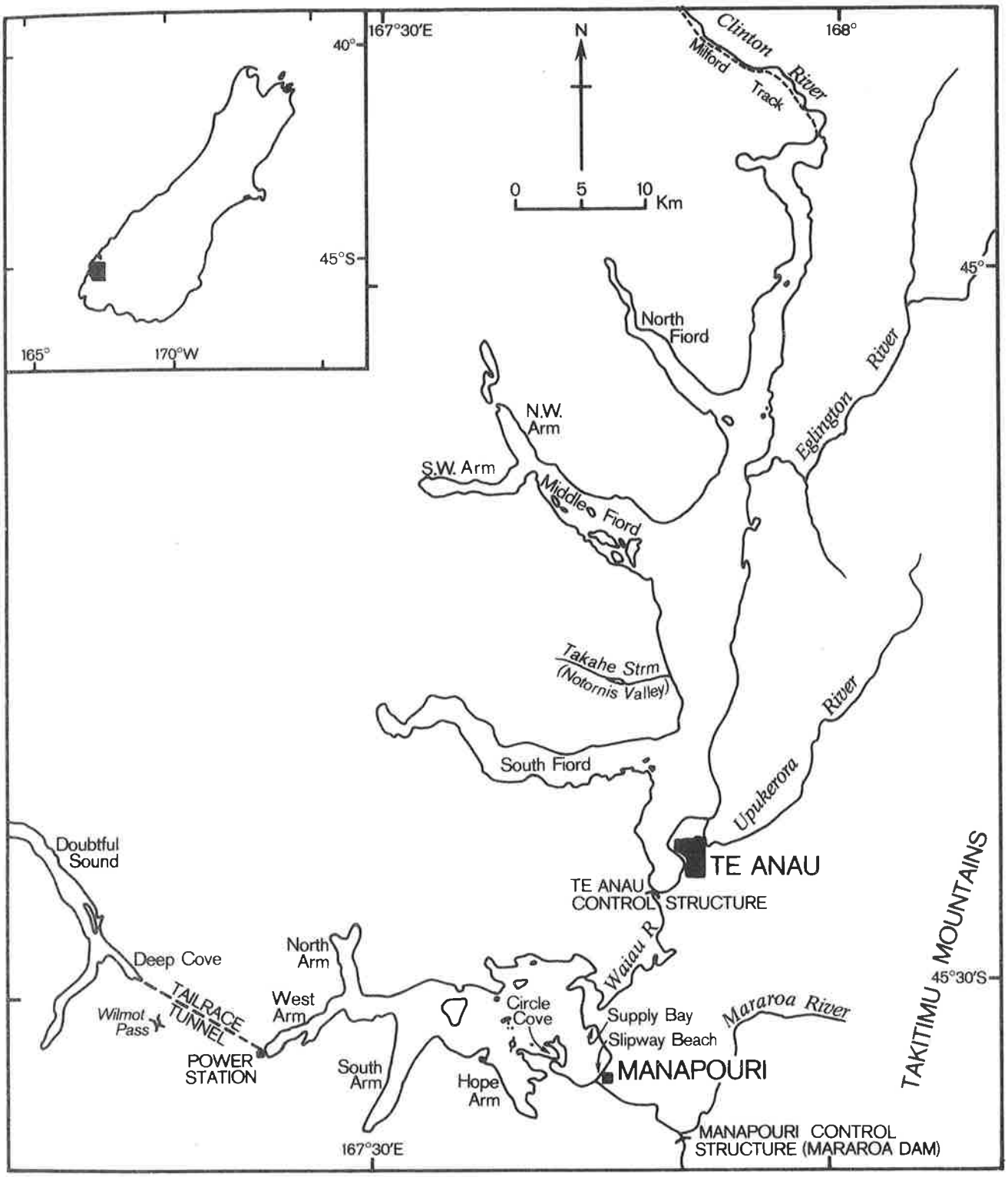
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River
Doubtful
Sound
TE ANAU
TE ANAU
CONTROL STRUCTURE
Deep Cove
North
Arm
Waiau R
TAILRACE
TUNNEL
Wilmot
Pass
West
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Circle
Cove
Supply Bay
Slipway Beach
Mararoa River
POWER
STATION
South
Arm
Hope
Arm
MANAPOURI
TAKITIMU MOUNTAINS
45°30'S
167°30'E
MANAPOURI CONTROL
STRUCTURE (MARAROA DAM)

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INTRODUCTION

Lakes Manapouri and Te Anau are two of the 11 large glacial lakes in the southern half of the South Island, New Zealand. Both lakes have been the centre of a controversy over the development of their hydro-electric power potential. Largely as a result of this controversy a considerable research effort has gone into the scientific study of the two lakes over the last 15 years, and this bibliography draws together this published and unpublished work.

Both lakes lie on the eastern side of the Fiordland mountains, with long, narrow, formerly glaciated arms and fiords extending westwards into the heart of the mountains. A small eastern part of the shoreline of both lakes is partly developed farmland, while the remainder lies within the Fiordland National Park and is covered by dense forest. Both lakes are noted for their scenic attractions. The extremely irregular outline and bush clad islands have earned Manapouri the description "the loveliest lake in New Zealand" (McLintock 1966 : 390), while the world famous Milford Track starts at the head of Lake Te Anau. Lake Manapouri is 29 km long and covers an area of 153 km^2, while Te Anau is 61 km long, 10 km wide at its widest part, and covers an area of 352 km^2. The bathymetry of the lakes reflects their glacial origins (Irwin 1969, 1971); both are deep with a maximum depth of 444 m in Manapouri and 417 m in Te Anau, the 15th and 19th deepest lakes in the world (Hutchinson 1957).*

The potential of Lake Manapouri as a source of hydro-electric power was recognised as early as 1904. In 1926 the New Zealand Sounds Hydro Electric Concessions Limited was granted a licence to draw water from Lake Manapouri to generate power for nitrate production to make fertilisers and explosives. The proposal was to drive a tunnel from West Arm on Lake Manapouri, 6 miles through the mountains to Deep Cove in Doubtful Sound where 12 generators were to produce 210,000 kW of electricity from the 680-ft head of water. The scheme never got off the ground but it was not forgotten, and in the 1950's the plans

* Hutchinson, G.E. 1957: "A Treatise on Limnology. Vol. 1". Wiley, New York.

to harness the large hydro-electric potential were revised culminating in the Manapouri-Te Anau Development Act 1960. The Act gave authority to raise the level of Lake Manapouri 27.4 m turning Manapouri and Te Anau into one large lake. The power scheme was essentially similar to that proposed in 1926. Water was to be diverted out of a new outlet from West Arm into Deep Cove but instead of generating electricity at the Deep Cove end, a powerhouse was to be hewn out of solid rock beneath the lake with a 6-mile tailrace tunnel to the sea at Deep Cove. Under the terms of the Act, Consolidated Zinc Proprietary Limited of Australia was to develop the scheme for the sole benefit of an aluminium smelting industry to be established at Bluff. By 1963 Comalco (formerly Consolidated Zinc) was having trouble financing the scheme, and a new agreement was signed whereby the Crown undertook to develop the project with the provision that some power would be available for the national grid.

In 1966 the agreement was amended again and the proposed mean level of Lake Manapouri reduced from 27.4 m to 8.4 m above its present mean, while debate ranged over proposed levels for Lake Te Anau which now became important storage for the scheme.

Rising construction costs and opposition to raising the lake turned the Manapouri controversy into a national issue. The "Save Manapouri" organisation was formed in opposition to raising the lake, and in 1969 a petition against raising the lake was presented to Parliament with 264,906 signatures to make it the largest petition ever presented to the House. In 1969, the Government ordered a Commission of Inquiry on the subject. A change of Government in 1972 meant that the proposals for substantial alterations to the natural range of levels were dropped and that an independent body was established (Guardians of Lakes Manapouri and Te Anau) in order to recommend suitable patterns for working levels of both lakes to the Minister for the Environment as well as to investigate other long-term effects of the power scheme.

Prior to 1969 and the commissioning of the power station the levels of both Lakes Manapouri and Te Anau remained uncontrolled. From 1969 onwards the level of Manapouri has remained in a semi-controlled situation through the operation of the

power station. The final stage of the project involved the building of control structures on the outlets of both lakes; the Te Anau structure was completed in 1974 and the Manapouri structure in 1976.

Many of the early papers published prior to the construction of the power scheme are of an exploratory nature. For many years the inhospitable terrain around both lakes proved an obstacle to both exploration and research. The construction of the power station and the proposals to flood the lakes quickly changed this. Information was required initially for engineers in the planning stages of the project; later, when the question of lake levels became a national issue, a wide range of research encompassing geology, biology, limnology and fisheries was carried out to enable a rational decision to be made on the lake level issue.

Following the decision to preserve the lakes, research centred on isolating the effects that small-scale alterations in the natural lake level regimes would have on the shoreline ecology and sediments of the littoral zone.

The bibliography is divided into published and unpublished material, and maps and charts, much of the unpublished material being reports on specific aspects of proposals to raise the levels of the lakes and emotion-charged conservationist's view points.

References are arranged alphabetically by author and where an author has more than one entry the arrangement is chronological. Papers of joint authorship are listed under the senior author after those for which the senior author was the sole author.

The references were located by a systematic search of the journals held in the New Zealand section of the N.Z. Oceanographic Institute library and are listed in Appendix A. A brief note on the contents is annotated to most of the references, those not seen by the authors remain unannotated and are marked with an asterisk.

The reference abbreviations used in this bibliography are according to the "World List of Scientific Periodicals, Fourth Edition" edited by Peter Brown and George Burder Stratton and published by Butterworths of London. For books, unpublished manuscripts and journals ceasing publication before 1900 or initiated after 1960, the guidelines set out in Hurley (1974)* were followed.

ACKNOWLEDGMENTS

The authors would like to thank librarians from other institutions from where material was sought, Miss E. Bardsley for assistance in the preparation, and Mrs R.M. Thompson for typing the manuscript.

*HURLEY, D.E. 1974: Titles of selected scientific periodicals and expedition reports dealing with marine sciences, New Zealand and the Antarctic. *Misc. Publs N.Z. oceanogr. Inst. 58* : 45 pp.

PUBLISHED LITERATURE

1. ANDREWS, E.C. 1904: Some interesting facts concerning the glaciation of south-western New Zealand. *Rep. Australas. Ass. Advmt Sci. 10* : 189-205.

Considers Manapouri and Te Anau as remnants of a once very large lake with the Takitimu Mountains as its eastern shore.

2. ANON, 1950a: Operation Fiordland. A New Zealand Expedition. Part I. *Can. geogrl J. 41(4)* : 152-65.

Describes a multi-disciplinary study of the area between George and Caswell Sounds and Lake Te Anau.

3. ANON, 1950b: Operation Fiordland. New Zealand. Part II. *Can. geogrl J. 41(5)* : 210-25.

A continuation of Part I.

4. ANON, 1952*: Sandal found in Notornis Valley. *J. polynes. Soc. 61* : 93-112.

5. ANON, 1960a: Facts about the Manapouri - Te Anau agreement. *Forest Bird 135* : 5-6.

Outlines the rights of Comalco and conflict with the 1952 National Parks Act.

6. ANON, 1960b: Manapouri - Te Anau, two sides to every question. *Forest Bird 137* : 3-4.

A brief discussion of the arguments for and against the proposed submerging of Manapouri and Te Anau.

7. ANON, 1960c: The Manapouri petition. *Forest Bird 138* : 3.

Report on submissions to Parliament asking for Lakes Te Anau and Manapouri to be saved from despoilation and seeking amendment to National Parks Act in order that New Zealand's national parks be afforded greater security.

8. ANON, 1962: Lake "more beautiful" if raised. Southland A.A. *Press, Christchurch, 26 October* : 12.

Outlines contents of letter from Automobile Association (Southland) to Automobile Association (Canterbury). Claims that lake level used to be 100 feet higher than it is today, so that proposed scheme would merely take it back to nearer the original depth.

9. ANON, 1969a: Guidance on Manapouri (editorial). Press, *Christchurch, 20 November* : 16.

Welcomes Prime Minister's suggestion of an independent tribunal, in the light of continuing arguments about the future of Lake Manapouri.

10. ANON, 1969b: The tragedy of Manapouri and Te Anau. *Forest Bird 172* : 4-5.

A plea for keeping present lake levels.

11. ANON, 1971a: The Manapouri Report (editorial). *Press, Christchurch, 10 June* : 10.

Comments on the recommendations of the Parliamentary Select Committee on Lake Manapouri, which favour "those who oppose the raising of the lake to produce electric power".

12. ANON, 1971b: Manapouri compromise (editorial). *Press, Christchurch, 23 September* : 14.

Considers that "the only economically feasible outcome might be still to raise the lake".

13. ANON, 1971c: Manapouri : costs and benefits (editorial). *Press, Christchurch, 26 November* : 8.

Comments on report of N.Z. Institute of Economic Research on the Manapouri scheme.

14. ANON, 1972a: Te Anau lake levels : Manapouri lake levels. Mararoa Dam. *Nat. Conserv. Coun. Newsl. 1* : 9-10.

Reports on problems over lake level controls on Te Anau and Manapouri and particularly slumping of Manapouri shoreline during low levels. The Government decision to build a wide-based dam at Mararoa to control Lake Manapouri at natural levels is reported. This structure allows for the lake level to be raised 40 feet.

15. ANON, 1972b: Lake conditions not as serious as expected. *Soil Water 9(1 & 2)* : 8.

Considers shoreline changes at low lake levels must be accepted when weighed against the economic benefits to the nation.

16. ANON, 1972c*: Lake Te Anau. Government response to field report on shoreline of Lake Te Anau by ... Botany Department, University of Otago. *N.Z. Environ. 2(3)* : 14-15.

This report by the Botany Department is referenced under Baylis *et al* (1970).

17. ANON, 1973: Manapouri Power Scheme. *Nat. Conserv. Coun. Newsl. 4* : 3-4.

Reports the Government decision of February 1973 to build a narrow-based dam to control the level of Lake Manapouri within its natural range, and the decision not to dredge the lower Waiau River to increase storage capacity.

18. ANON, 1974: Energy - 20B - Electric Power. Pp 549 *in* Department of Statistics "New Zealand Official Year Book". Government Printer, Wellington. 1127 pp.

Describes the history of the development of the Manapouri power scheme, the present power output and operational controls on the levels of Lakes Manapouri and Te Anau.

19. ATKINS, R. [1971]: Manapouri power development seismic survey : Monowai bridge dam site. *Rep. Geophys. Div. D.S.I.R. 67* : 6 pp.

Reports the findings of a survey carried out to determine the thickness of the gravels along four 1200-ft long seismic lines.

20. BAYNE, M. 1951: Visit to Milford Sound and Lake Manapouri. *Notornis 4(4)* : 68.

Lists the species and numbers of birds seen between Gore and Te Anau and at Lake Manapouri.

21. BEATTIE, H. 1955a: "The Attractions of Te Anau". Otago Daily Times, Dunedin. 16 pp.

A travelogue which includes descriptions of the Maori and European history and the major tourist attractions.

22. BEATTIE, H. 1955b: "Majestic Manapouri". Otago Daily Times, Dunedin. 16 pp.

A travelogue which includes sections on Historic Connections and Maori Associations.

23. BENHAM, W.B. 1903: A note on the Oligochaeta of the New Zealand lakes. *Trans. Proc. N.Z. Inst. 26* : 192-98.

Describes 16 specimens recovered from six stations in Lake Manapouri.

24. BENSON, W.N. 1935: Some land forms in southern New Zealand. *Aust. Geogr. 2(7)* : 3-22.

"The area occupied by Te Anau, Manapouri and the Waiau Valley coincides with a broad and deep syncline of Tertiary sediments, probably once continuous with those in the infaulted strip of the upper Eglinton River". (p.16)

25. BISHOP, D.G. 1967: The geology of the powerhouse access tunnel, West Arm, Manapouri. *N.Z. Jl Geol. Geophys. 10(3)* : 831-38.

The extensive excavations for the power station provided an unique opportunity to describe in three dimensions the geology of the area. The country rock, structure, shearing and sulphide mineralisation are described.

26. BLAIR, W.N. 1887: The cold lakes of New Zealand. *Scott. geogrl. Mag. 3* : 577-88.

In a general discussion of New Zealand lakes, the morphology of Manapouri and Te Anau are described.

27. BROCKIE, R.E. 1975: Distribution and abundance of the hedgehog (*Erinaceus europaeus*) L. in New Zealand, 1869-1973. *N.Z. Jl Zool. 2* : 445-62.

Hedgehogs were first recorded at Manapouri in 1947 and in the township of Te Anau in the period 1970-73. In both areas its level of abundance is "Few" and its status "Increasing".

28. BROWN, T.J. 1970: Manapouri - a lake or a soup? *Dominion, Wellington, 20 February* : 9.

Discusses the problems of water pollution resulting from the proposed flooding of the shorelines. Decaying plant and animal matter and organic and mineral constituents create a particular problem on drowned shorelines.

29. BURROWS, C.J.; DOBSON, A.T. 1971a: Mires of the Manapouri - Te Anau lowlands. *Proc. N.Z. ecol. Soc. 19* : 75-99.

Discusses the vegetational history of the mires on the eastern shores of the lakes and describes the general nature and vegetation of some of the mires.

30. BURROWS, C.J.; DOBSON, A.T. 1971b: Botanical finds during recent fieldwork. *J. Canterbury bot. Soc. 4* : 18-20.

Includes flora found in Manapouri - Te Anau area.

31. BURROWS, L. 1974: "Te Anau Anchorage". McIndoe, Dunedin. 149 pp.

An account of the author's experiences as a launch operator on Lake Te Anau.

32. BURTON, A.H. 1889: "Wintering on Lake Te Anau and Manapouri. A Photographer's Diary". Otago Daily Times, Dunedin. 16 pp.

Descriptive narrative with a list of 120 photographic views.

33. CALDER, A.A. 1976: The New Zealand genus *Metablax* (Coleoptera : Elateridae) and its relationship to the Campsosterninae. *N.Z. Jl Zool. 3* : 313-25.

Records *Metablax acutipennis* from Lake Te Anau.

34. CAMPBELL, W.C. 1968: Manapouri and Te Anau must be saved from despoilation. *Forest Bird 169* : 6-8.

Describes subsidence of soil and trees which could take place many hundreds of feet above Lake Manapouri if lake levels are raised. The author has seen such a slip occurring near the head of the South Arm when Lake Te Anau was unusually high during the late 1940's.

35. CHAPMAN, A. *et al.* 1959: The Biological Society in Fiordland. Report on expeditions to the head of Lake Manapouri and to Secretary Island, February 12-24, 1959. *Sci. Rec., Dunedin 9* : 39-54.

Botanical and zoological findings are presented.

36. CLARKE, C.E. 1933: The Lepidoptera of the Te Anau - Manapouri Lakes districts. *Trans. Proc. N.Z. Inst. 63* : 112-32.

Lists species found on excursions to these districts over the years up to 1932.

37. COTTON, C.A. 1947: "Climatic Accidents in Landscape-making". Whitcombe & Tombs, Christchurch. 354 pp.

Suggests that while Lakes Manapouri and Te Anau have glacial origins they may be dependent on tectonic activity for their initial forms.

38. COTTON, C.A. 1948: Otago's physiography. Pp 1-17 *in* Garnier, B.J. (ed.) "The Face of Otago". Otago Centennial Historical Publication, Dunedin.

Discusses the formation of Lakes Manapouri and Te Anau in glacially overdeepened basins.

39. COTTON, C.A. 1952" "Geomorphology". Whitcombe & Tombs, 6th Edition, Christchurch. 505 pp.

Former glaciers of Lake Te Anau and an example of spur truncation at the entrance to South Fiord are described.

40. COUTTS, P. 1969: A field survey of some traditional Maori sites in the Te Anau region. *N.Z. archaeol. Ass. Newsl. 12(4)*: 224-28.

Outlines the results of a brief survey of traditional Maori sites located in the Te Anau - Manapouri region during October 1968.

41. COUTTS, P.J.F. 1970: Archaeological reconnaissance around Lake Manapouri. *N.Z. archaeol. Ass. Newsl. 13(4)* : 178-90.

The archaeological sites around the lake have not been subjected to detailed field reconnaissance. This survey was undertaken to establish archaeological sites of interest prior to the proposed flooding of the lake.

42. COWAN, J. 1906: Maori place-names; with special reference to the great lakes and mountains of the South Island. *Trans. Proc. N.Z. Inst. 38* : 113-20.

Discusses the Maori legends behind the naming of Lakes Manapouri and Te Anau.

43. CRANWELL, L.M.; VON POST, L. 1936: Post-Pleistocene pollen diagrams from the Southern Hemisphere. *Geogr. Annlr H3-4* : 308-47.

Includes diagrams of pollen from peat beds on the eastern shoreline of Lake Manapouri.

44. COX, S.H. 1878: Report on the geology of the Te Anau district. *N.Z. geol. Surv. Rep. geol. Explor. 11* : 110-18.

An early report on the geology of the area between the Te Anau and Manapouri Lakes and the Takitimu Mountains.

45. CUMBERLAND, K.R. 1953: Geographic regions of New Zealand. The Fiordland - Stewart Island region. *Post-Primary School Bull. 7(1)* : 32 pp.

A general review of history, landscape, vegetation and tourism in Fiordland. Brief mention is made of the two lakes.

46. DUFF, R.S. 1952*: Recent Maori occupation of Notornis valley, Te Anau. *J. polynes. Soc. 61* : 90-119.

47. EIBY, G.A. 1968: An annotated list of New Zealand earthquakes, 1460-1965. *N.Z. Jl Geol. Geophys. 11(3)* : 630-47.

Includes three earthquakes felt at Lake Manapouri and Lake Te Anau between 1948 and 1965 ranging in magnitude between force 5.5 and 6.2.

48. FEDERATED MOUNTAIN CLUBS OF NEW ZEALAND, 1970: Manapouri. *Fed. Mountain Clubs Bull. 34* : 4 pp.

A defence of the conservationist point of view based on the findings of the Nature Conservation Council.

49. FLEMING, C.A. 1971: "The proposal to raise the level of Lake Manapouri for the purpose of generating electricity. : A case-history in environmental resource management." *Rec. Proc. 12th Pacif. Sci. Congr. 1971, 1 Abstr. Pap.* : 344-45.

Outlines the history of the development of the power scheme.

50. FLINT, E.A. 1970: Phytoplankton in some New Zealand surface waters. *Proc. N.Z. Water Conf. 1970* : 7.1-7.13.

Classifies Lakes Te Anau and Manapouri as oligotrophic, based on their algae and the conductivity of their water.

51. FOWLER, J.M. 1921: On an ice-striated rock surface on the shore of Circle Cove, Lake Manapouri. *Trans. Proc. N.Z. Inst. 53* : 175.

Describes striations in conglomerate beds on the eastern shore of the lake and attributes these to glacial action.

52. GASKIN, D.E. 1975: Revision of the New Zealand Crambini (Lepidoptera : Pyraliae : Crambinae). *N.Z. Jl Zool. 2* : 265-363.

The distribution of *Orocranus haplotomus* is given as "Apparently confined to South Island subalpine areas around Lakes Te Anau and Wakatipu, extending to Milford Sound" (p.317). Several other species with less restricted subalpine ranges would also probably be found in the area.

53. GIBBS, H.P. 1930: "Report. Manapouri - Deep Cove Hydro Electric Power Project". L.T. Watkins, Wellington. 30 pp.

Outlines an early proposal to develop the hydro-electric power potential of Lake Manapouri for nitrate production to make fertilisers and explosives.

54. GIFFORD, A.C. 1900: Explorations in the Te Anau district. *Trans. Proc. N.Z. Inst. 32* : 425-26.

Reports the first European expedition to travel from North Fiord, Lake Te Anau through to Bligh Sound and back.

55. GLASBY, G.P. 1972: Limitations of carbonate determinations in marine and lacustrine sediments at low concentration levels. *NZOI Rec. 1(4)* : 143-48.

Carbonate concentrations in 31 marine and 11 lacustrine sediment samples, including one from Lake Manapouri are given. Comparisons are made between the results obtained using the acid titration technique with those obtained by the Leco gasometric technique.

56. GRAY, H.R. 1961: Sale of Lake Manapouri. *Landfall 15* : 386-91.

A detailed article written from the conservationist view point outlining the proposals to date and questioning the political morality and ultimate economic benefit to the country.

57. GRINDLEY, G.W. 1960: The geology of the Eglinton Valley, Southland. *N.Z. geol. Surv. Bull. n.s. 58* : 64 pp.

Discusses the structural geology of the Te Anau area, and the Tertiary and metamorphic rocks of the northeast side of Lake Te Anau.

58. GUARDIANS OF LAKES MANAPOURI AND TE ANAU, 1977: "Operating guidelines for the levels of Lakes Manapouri and Te Anau". Dunedin. 4 pp.

Three operating ranges are defined for the two lakes. A main range, and a high and low range in which restrictions on the period of duration are built in to preserve the shoreline in a natural state.

59. HALL, W.Y.H. 1899*: Report on the country west of Lake Te Anau. *Append. J. House Repres. N.Z., C-1* : 136-37, map.

60. HALL-JONES, G. (ed.) 1973: "Moir's Guide Book (Southern Section) 4th Edition". Whitcombe & Tombs, Christchurch. 153 pp.

A handbook to tramping tracks in the Fiordland National Park, including those around Lakes Manapouri and Te Anau.

61. HALL-JONES, G. 1965: "Fiordland National Park". Fiordland National Park Board, Invercargill & Te Anau. 74 pp.

A handbook for users of the Park, including sections on both lakes.

62. HALL-JONES, J. 1960: Rare Fiordland birds. *Notornis 8(7)* : 191-92.

Describes the findings of an expedition to the head of South Arm, Lake Te Anau.

63. HALL-JONES, J. 1971: "Mr Surveyor Thomson". A.H. & A.W. Reed, Wellington. 146 pp.

An historical account of the life and explorations of the first European surveyor to set eyes on Lakes Te Anau and Manapouri.

64. HALL-JONES, J. 1976: "Fiordland Explored". A.H. & A.W. Reed, Wellington. 148 pp.

An illustrated history of Fiordland which includes sections on the "Great Lakes of the Interior", the Towns at the Lakes; and Some Early Explorers", all of which outline the early history of the Te Anau - Manapouri area. An update of an earlier study (Hall-Jones, J. 1968 "Early Fiordland", A.H. & A.W. Reed).

65. HARPER, C.T.; McGILL, I. 1960: Lake Manapouri : Notes on the proposed power scheme. *Sci. Rec., Dunedin 10* : 45-48.

A report on the geology of the area near the proposed power station at West Arm and the tailrace outlet at Deep Cove.

66. HECTOR, J. 1864: On the geology of Otago, New Zealand. *Proc. geol. Soc., Lond. 1864* : 124-28.

Includes the Te Anau series in synopses of geological formations in Otago Province.

67. HENDERSON, F.M. 1960: Alternative proposed to Manapouri plan. *Press, Christchurch, 6 August* : 10.

Article by a senior lecturer in engineering at the University of Canterbury. Outlines alternative scheme requiring only seasonal storage and using existing lake levels. Claims this scheme would produce almost the same amount of power at a similar cost. Map given.

68. HENDERSON, F.M. 1961: Massive works will be needed for aluminium smelter hydro project. *N.Z. Manufacturer 13(4)* : 141-44.

Attacks the proposed 100-ft lake raising on Manapouri from both aesthetic and engineering view points.

69. HOWARD, G. 1969: "The Heart of Fiordland". Whitcombe & Tombs Ltd, Christchurch. 211 pp.

Howard describes his experiences in the Manapouri - Doubtful Sound area as a tourist-operator on the West Arm - Doubtful Sound track, and later as a worker on the construction of the power station.

70. HUNT, A.L. [1926]: "An Empire Enterprise". N.Z. Sounds Hydro-Electric Concessions Ltd, L.T. Watkins Ltd, Wellington. 32 pp.

Outlines the company's concession and licences to build a power station at Manapouri to generate electricity for nitrate production to make fertilisers and explosives.

71. HUTCHINSON, R.T. 1970: Fisheries and the Manapouri Sceme [sic]. *Wildlife - A Review 2* : 57-61.

Outlines the major proposals of the 1960 agreement between Comalco and the Government, and fisheries problems associated with the proposals to raise the level of Lake Manapouri.

72. HUTTON, F.W. 1872: Reports on the geology of Southland. *N.Z. geol. Surv. Rep. geol. Explor. 1871-72, 7* : 89-112.

Description extends to the eastern shore of Lake Manapouri and the lower Waiau River.

73. IRWIN, J. 1971: Exploratory limnological studies of Lake Manapouri, South Island, New Zealand. *N.Z. Jl mar. Freshwat. Res. 5(1)* : 164-77.

Results from bathymetric and thermometric surveys of the lake are described. Tritium determinations are used to estimate the amount of mixing in the lake. Surface sediments are described.

74. IRWIN, J. 1972: New Zealand lakes bathymetric surveys 1965-1970. *NZOI Rec. 1(6)* : 107-26.

Survey and charting techniques used on many New Zealand lakes (including Te Anau and Manapouri) are described. Features of the morphology of the lake types are outlined.

75. IRWIN, J. 1974a: Shoreline profiles of selected sites on Lakes Manapouri and Te Anau. *NZOI oceanogr. Fld Rep. 1* : 24 pp.

Beach and nearshore profiles from 50 sites are described. Lead line soundings and echo soundings were used to extend the profiles into 50 feet of water. An informative appendix by J.W. Brodie describes the general beach characteristics and assesses the stability of the beaches.

76. IRWIN, J. 1974b: Report on bathymetric survey of nearshore zone, the south end of Lake Te Anau. *NZOI oceanogr. Fld Rep. 3* : 7 pp.

85 profiles taken in a similar manner to those in Irwin (1974a) are described.

77. IRWIN, J. 1974c: Water clarity records from twenty-two New Zealand lakes. *N.Z. Jl mar. Freshwat. Res. 8(1)* : 223-27.

Secchi disc observations from Lake Te Anau are included in this comparative study.

78. IRWIN, J. 1975a: Shoreline profiles of selected sites on Lake Te Anau. *NZOI oceanogr. Fld Rep. 5* : 43 pp.

Echo sounding profiles from 67 sites are described. (Similar to Irwin 1974a, 1974b).

79. IRWIN, J. 1975b: Checklist of New Zealand lakes. *Mem. N.Z. oceanogr. Inst. 74* : 161 pp.

The location, area, dimensions, altitude, direction of major axis and lake type for all New Zealand lakes are listed. A selected bibliography of New Zealand lakes is included.

80. JOHNSON, P.N. 1972a: Applied ecological studies of shoreline vegetation at Lakes Manapouri and Te Anau, Fiordland. Part 1 : Vegetation of Lake Manapouri shoreline. *Proc. N.Z. ecol. Soc. 19* : 102-19.

Thirteen lake edge communities are described in terms of composition structure, site preference and relation to lake level. The effects of browsing mammals on the flora are outlined and the shoreline vegetation is compared with that recorded from other areas in Fiordland.

81. JOHNSON, P.N. 1972b: Applied ecological studies of shoreline vegetation at Lakes Manapouri and Te Anau, Fiordland. Part 2 : The lake edge flora - habitats and relations to lake levels. *Proc. N.Z. ecol. Soc. 19* : 120-42.

Floristic composition at different elevations is described and a hypothesis that species distribution is governed by extremes of submergence and emergence is put forward. The means by which species limits are determined by lake level fluctuation and the effect of the lake on reproductive biology are discussed.

82. JOLLY, V.H. 1956: Thermal stratification in some New Zealand lakes. *Proc. N.Z. ecol. Soc. 4* : 43-44.

Thermocline depths from various New Zealand lakes including Manapouri are tabulated.

83. JOLLY, V.H. 1958*: A preliminary study of some New Zealand lakes. *Verh. int. Verein. theor. angew. Limnol. 13* : 436-38.

Includes lakes Te Anau and Manapouri.

84. JOLLY, V.H. 1968: The comparative limnology of some New Zealand lakes. 1. Physical and chemical. *N.Z. Jl mar. Freshwat. Res. 2(2)* : 214-59.

The morphometry, environmental conditions, and some physical and chemical data are given for 24 New Zealand lakes, including Lakes Manapouri and Te Anau.

85. JOLLY, V.H.; BROWN, J.M.A. (eds) 1975: "New Zealand Lakes". Auckland University Press/Oxford University Press, Auckland. 388 pp.

A national review of New Zealand lakes including information on Lakes Manapouri and Te Anau.

86. KNIGHT, W.J. 1974: Revision of the New Zealand genus *Novothymbris* (Homoptera : Cicadellidae). *N.Z. Jl Zool. 1* : 453-73.

Novothymbris notialis n.sp. was collected from West Arm, forest half way up to Wolfe Flat, Grebe River and Hunter Mountains. *Novothymbris vagans* n.sp. was collected from Torret Range, Wolfe Flat and Hunter Mountains.

87. KNIGHT, W.J. 1975: Deltocephalinae of New Zealand (Homoptera : Cicadellidae). *N.Z. Jl Zool. 2* : 169-208.

Limoteltix awae n.comb. is recorded from Manapouri. *Arawa salubris* n.sp., *Arahura reticulata* n.sp.,and *Horouta inconstans* n.sp. are recorded from the Hunter Mountains, with *A. salubris* also being found at Wolfe Flat, Wilmot Pass and in the Spey River Valley.

88. LANDIS, C.A. 1974: Stratigraphy, lithology, structure and metamorphism of Permian, Triassic, and Tertiary rocks between the Mararoa River and Mount Snowdon, western Southland, New Zealand. *Jl R. Soc. N.Z. 4(3)* : 229-51.

Describes the geology of the area east of Lake Manapouri.

89. LINDROTH, C.H. 1976: Genus *Bembidion* Latreille (Coleoptera : Carabidae) in New Zealand : a revision. *N.Z. Jl Zool. 3* : 161-98.

Bembidion maorinum, B. anchonoderum, B. hokitikense and *B. wanakense* n.sp. are recorded in the Manapouri - Te Anau region.

90. LITTLEWOOD, G.E. 1972: Resource development by Comalco in New Zealand and Australia. *Proc. N.Z. ecol. Soc. 19* : 13-15.

The development of the Manapouri power project for the Australian bauxite resources at Weipa is placed in historical perspective. The need to flood Manapouri is seen as necessary as embodied in the original agreement.

91. LUCAS, K. 1904: A bathymetrical survey of the lakes of New Zealand. *Geogrl J. 23* : 744-60.

Describes the morphology of Lake Manapouri and includes the first bathymetric chart of the lake based on 200 spot soundings.

92. LUSH, A. 1960: The rape of Manapouri : need to amend Development Bill. *Press, Christchurch, 6 September* : 12.

Endorses the alternative proposal of Henderson (1960). Outlines concern for scenic preservation and considers possible earthquake risks of the proposed project.

93. LUSK, P. 1975: Comalco, Manapouri, and the Bluff smelter. *N.Z. Environ. 4(3)* : 18-24.

A comprehensive article outlining the history of the Manapouri Power Project and the smelter. Effects of low lake levels on shoreline stability are described.
Also in : *Canta, 1974(9)* : the magazine of the Canterbury University Students Association.

94. McCANN, E. 1970: The Manapouri - Comalco deal. *Econ. Bull. Canterbury Chamber Commerce 536* : 4 pp.

Carries out a cost benefit analysis on the economics of the power scheme and concludes the benefit to New Zealand would be maximised if the electricity were sold to national electrical consumers rather than at a cut rate to Comalco. Uses this as a basis to justify renegotiation of the contract with Comalco.

95. McDOWALL, R.M. 1970: Comments on a new taxonomy of *Retropinna* (Galaxioidei : Retropinnidae). *N.Z. Jl mar. Freshwat. Res. 4(3)* : 312-24.

Variations in the taxonomy of smelt in New Zealand lakes have previously been attributed to environmental conditions. This viewpoint is questioned.

96. McKELLAR, I.C. 1956: Geology of the Takahe Valley district, eastern Murchison Mountains. *N.Z. Jl Sci. Technol. Sect. B, 38(2)* : 120-28.

Rocks of the Fiordland Complex (granites and gneisses) in a small area between the South and Middle Fiords of Lake Te Anau are described.

97. McKELLAR, I.C. 1973: Geology of the Te Anau - Manapouri district. *Notes to accompany N.Z. geol. Surv. Misc. Ser. Map 4* : 20 pp.

98. McKENZIE, N.M. 1971: The Manapouri controversy, a personal comment. *Road Transport Contract. 19(2)* : 28-31.

Argues for the raising of the lake on economic grounds, the costs from alternative power sources being excessive and the scenic beauty not being diminished.

99. MACKENZIE, T. 1887: Opening of the south-western lakes and sounds. *Append. J. House Repres. N.Z., H-20* : 1-2.

Following an exploratory visit to Lakes Manapouri and Te Anau proposals are put forward to Government to develop the area for tourism.

100. MACKENZIE, T. 1894: South west of Lake Manapouri. *Append. J. House Repres. N.Z., C-1* : 79-80.

Describes exploratory excursions into the mountains.

101. McKERROW, J. 1863: Reconnaissance survey of the lake districts. *Otago Prov. Govt. Gaz. 6(270)* : 381-98.

Lakes Te Anau and Manapouri are included in a description of the physical geography, forests, pasture, and agricultural land. Also in : *Jl R. geogrl. Soc. 34* : 56-82.

102. McKERROW, J. 1871: On the physical geography of the lake districts of Otago. *Trans. Proc. N.Z. Inst. 3* : 254-63.

Discusses the glacial origins of the Otago lakes, including Lakes Manapouri and Te Anau.

103. MACLAURIN, J.S. 1910*: Radioactivity of the thermal waters of Rotorua, Taupo and Te Anau. *A. Rep. Dom. Lab. 44* : 63-70.

104. McLELLAN, I.D. 1977: New alpine and southern Plecoptera from New Zealand, and a new classification of the Gripopterygidae. *N.Z. Jl Zool. 4* : 119-47.

Apteryoperla ramsayi n.sp., *Zelandobius brevicauda* n.sp., *Vesicaperla dugdalei* n.sp. and *Spaniocerca longicauda* n.sp. were all collected in the vicinity of Lake Manapouri.

105. McLINTOCK, A.H. (ed.) 1959: "A Descriptive Atlas of New Zealand". Government Printer, Wellington. 109 pp.

Gives brief mention of Lakes Manapouri and Te Anau.

106. McLINTOCK, A.H. 1966: "Encyclopaedia of New Zealand". Government Printer, Wellington.

Includes a brief history of the exploration of the two lakes, their morphology and the power scheme.

107. MACPHERSON, D. 1918: Report on exploration, South Fiord (Lake Te Anau) to Gaer Arm, Doubtful Sound. *Append. J. House Repres. N.Z., C-1A* : 9-10.

A report of an exploration made from Lake Te Anau towards the west coast.

108. MALIPATIL, M.B. 1976: *Metagerra* White (Heteroptera : Lygaeidae) : a review. *N.Z. Jl Zool. 3* : 303-12.

Metagerra helmsi and *M. obscura* (long form) are recorded from Manapouri. *Metagerra angusta* is found in Takehe Valley and the Turret Range.

109. MANAPOURI COMMISSION OF INQUIRY, 1970: "Report on the proposal to raise the level of Lake Manapouri for the purpose of generating electricity". Government Printer, Wellington. 65 pp.

The report of the three commissioners based on 68 written submissions and 1800 closely typed pages of evidence. The terms of reference of the Commission are presented and a five point summary of the principal findings. The written submissions are held in the General Assembly Library.

110. MANAPOURI HIGHER OFFICIALS COMMITTEE, 1970*: Report to Cabinet Committee on Manapouri re matters relating to Lake Te Anau and the Upper Waiau River. Held at the General Assembly Library.

111. MANAPOURI - TE ANAU DEVELOPMENT ACT, 1960: *Statutes N.Z. 1* : 87-92.

The first Manapouri - Te Anau Act authorising the agreement between Comalco and the Government.

112. MANAPOURI - TE ANAU DEVELOPMENT ACT, 1963: *Statutes N.Z. 1* : 244-74.

The Act authorised the renegotiation of the Government's agreement with Comalco whereby the Government undertook to construct the scheme in return for an option on power produced.

113. MARK, A.F. 1972: Applied ecological studies of shoreline vegetation at Lakes Manapouri and Te Anau, Fiordland. General introduction. *Proc. N.Z. ecol. Soc. 19* : 100-1.

Outlines the history of the Manapouri power project and the scope of a series of studies carried out to determine an operating regime for the two lakes that would allow the maximum exploitation of the water resources while yet conserving the natural features of their forested shorelines.

114. MARK, A.F. 1975: Lakes Manapouri and Te Anau. *N.Z. Nature Heritage 7(103)* : 2877-84.

A brief description of the physical setting is followed by a discussion of the history of the hydro-electric development, the Manapouri controversy, and scientific studies initiated to assess the ecological consequences of the power scheme.

115. MARK, A.F.; CRUSH, J.R.; MEURK, C.D. 1972: Applied ecological studies of shoreline vegetation at Lakes Manapouri and Te Anau, Fiordland. Part 3 : Vegetation of the Lake Te Anau shoreline. *Proc. N.Z. ecol. Soc. 19* : 143-54.

Shoreline traverses suggest a delicate ecological balance between natural lake level variation, shoreline relief, and vegetation.

116. MARK, A.F.; JOHNSON, P.N. 1972: Applied ecological studies of shoreline vegetation at Lakes Manapouri and Te Anau, Fiordland. Part 4 : Recommendations. *Proc. N.Z. ecol. Soc. 19* : 155-57.

Recommendations for the control of the level of the two lakes are made based on the lake level records available since 1932 and the findings of Parts 1-3 of the applied ecological studies.

117. MARK, A.F.; JOHNSON, P.N.; CRUSH, J.R.; MEURK, C.D. 1972: Lake Te Anau. *N.Z. Environ. 2(3)* : 14-18.

Outlines the Government response to a field report prepared by the above authors assessing the ecological effects of proposed lake level alterations on Lake Te Anau.

118. MARK, A.F.; JOHNSON, P.N.; WILSON, J.R. 1977: Factors involved in the recent mortality of plants from forest and scrub along the Lake Te Anau shoreline. *Proc. N.Z. ecol. Soc. 24* : 34-42.

The effects of recent high flood lake levels on the shoreline vegetation are discussed.

119. MARSHALL, P. 1905: "The Geography of New Zealand". Whitcombe & Tombs Ltd, Christchurch. 401 pp.

Discusses the glacial origins of Lake Manapouri.

120. MARSHALL, P. 1908: Vicinity of Lake Te Anau and Milford Sound, New Zealand. *Geogrl J. 32* : 353-63.

Describes the geomorphology of the country between the head of Lake Te Anau and Milford Sound.

121. MARSHALL, P. 1912: "The Geology of New Zealand". Government Printer, Wellington. 218 pp.

Classifies New Zealand lakes by origins. Te Anau and Manapouri are described as glacially eroded basins.

122. MATHESON, D. 1960: Beautiful Manapouri. *Forest Bird 137* : 11-12.

Description of the scenic beauties of Lake Manapouri. Contains quotations from various writers and speakers. Makes a plea for the saving of the lake.

123. MENTIPLAY, C.R. 1971: Comment from the Capital : Manapouri problems seen : but no real answer given. *Press, Christchurch, 6 June* : 16.

The *Press's* parliamentary reporter comments on the Parliamentary Select Committee's report on six Manapouri petitions.

124. MEURK, C.K. 1973: Shoreline forests of Lake Te Anau, Fiordland. *Proc. N.Z. ecol. Soc. 20* : 95-102.

The structure of the forest on unconsolidated material close to high flood levels around the lake is described. Five forest associations are recognised and related to differences in soil moisture conditions.

125. MILLS, J.A. 1976: Status, mortality, and movements of grey teal (*Anas gibberifrons*) in New Zealand. *N.Z. Jl Zool. 3* : 261-67.

Figure 1 indicates that there were 100-500 grey teal on Lake Te Anau in April 1973, but none were seen in 1972. They were not seen on Lake Manapouri either year.

126. MINISTRY OF WORKS, 1965-68: Manapouri Power. *N.Z. Minist. Wks Inf. Ser. 6* : 4 pp.

An informative leaflet outlining the history of Lake Manapouri and facts and figures on the construction, power house, and generating capacity.

127. MINISTRY OF WORKS, 1965-68: Manapouri Progress. *N.Z. Minist. Wks Inf. Ser. 20* : 4 pp.

An illustrated leaflet dealing mostly with the power house construction.

128. MURPHY, R.C. 1951: The impact of man upon nature in New Zealand. *Proc. Am. phil. Soc. 59(6)* : 569-82.

Includes an aerial photograph of the western shore of Lake Te Anau showing forest of red beech (*Nothofagus fusca*) and silver beech (*N. menziesii*) leading up to grassy mountain valleys. States that "The contrast between the pristine forest west of Lake Te Anau and the long-exploited and partly devastated eastern shore is very striking". (p.581)

129. NATURE CONSERVATION COUNCIL, 1963-: *A. Rep. Append. J. House Repres. N.Z., H-30.*

Founded in 1962 the Council has been very active in the Manapouri controversy. Its findings and recommendations, summarised in the annual reports, contain many reasoned comments.

130. NATURE CONSERVATION COUNCIL, 1968a: Lake Manapouri Power Scheme. *Nat. Conserv. Coun. Inf. Leafl. 1* : 4 pp.

A brief history of the power project is given followed by a statement of the Council's attitude to the proposed manipulation of lake levels.

131. NATURE CONSERVATION COUNCIL, 1968b: Lake Manapouri Power Scheme. *Nat. Conserv. Coun. Inf. Leafl. 2* : 4 pp.

The Council's reasons for opposing the raising of the level of Lake Manapouri and building of a control structure on Lake Te Anau are put forward.

132. NATURE CONSERVATION COUNCIL, 1970: Manapouri - Te Anau Power Scheme. *Nat. Conserv. Coun. Inf. Leafl. 6* : 8 pp.

Sets out the Council's opinions on the Commission of Inquiry Report into the raising of the lake.

133. NELSON, R.C. 1963: Manapouri power project. *Forest Bird 156*: 8-9.

Describes the results of a discussion between the President of the Society and Ministry of Works officers on shoreline clearing, construction and plans for lake level manipulation.

134. NELSON, R.C. 1969: Manapouri is threatened with fate of Canadian lake used for power generation. *Forest Bird 156*: 9.

The level of Lake Buttle in Canada was raised in 1955. A comparison is drawn between the depressive effects on the shoreline and the possible effects of flooding Lake Manapouri.

135. NELSON, R.C. 1970a: Meeting is convinced that raising the levels of Manapouri and Te Anau is a dreadful mistake. *Forest Bird 175* : 15.

Brief report of meeting in Invercargill which had been called to hear reasons for the raising of Lakes Manapouri and Te Anau.

136. NELSON, R.C. 1970b: A ten year struggle to save Lake Manapouri. *Forest Bird 176* : 10-11.

An article expressing disappointment at the Government's stand on the issue and re-stating the Society's opposition to the raising of the lake.

137. NELSON, R.C. 1971: Government should decide now not to raise levels of Lake Manapouri. *Forest Bird 181* : 3-4.

Urges Government to make decision that the levels of Lake Manapouri will not be raised at any time.

138. NELSON, R.C. 1974: Raising level of Manapouri would not have helped power shortage today. *Forest Bird 192* : 7-10.

Traces the history of the proposed power scheme and the opposition to it. Claims that the raising of the lake levels would not have affected today's power shortage.

139. NELSON, R.C. 1975: The politics of Manapouri. *Forest Bird 198* : 11-12.

Looks back at events which led up to the "Save Manapouri Campaign" and the Royal Forest and Bird Protection Society's presentation of New Zealand's biggest petition to Parliament.

140. N.Z. CABINET, 1970: Report of the Cabinet Committee on Lake Manapouri. Government Printer, Wellington. 78 pp.

The emphasis of this report is on the estimated costs of shoreline clearing and the feasibility of alternative schemes.

141. N.Z. ELECTRICITY DEPARTMENT, 1967a: Manapouri - Te Anau hydro-electric development. Government Printer, Wellington. 67 pp.

The official White Paper presented to explain the purpose of the project and survey its planning and development.

142. N.Z. ELECTRICITY DEPARTMENT, 1967b: Power from Manapouri. Government Printer, Wellington. 33 pp.

An illustrated booklet covering the development of the project since its inception, and incorporating scenic, geological and historical information.

143. N.Z. ELECTRICITY DEPARTMENT, 1973: Manapouri Power Station. Government Printer, Wellington. 7 pp.

An informative publication with headings : history, the project, the powerhouse, the lakes, and transmission.

144. N.Z. SCENERY PRESERVATION SOCIETY, 1962: Reply to A.A. on Lake Manapouri level. *Press, Christchurch, 27 October* : 13.

Outlines joint statement made by President (Dr P.S. Cook) and Professor H.R. Gray, a member of the committee. Protests strongly against A.A. (Southland)'s claims.

145. N.Z. SCENERY PRESERVATION SOCIETY, 1973: Annual Report 1973. *A. Rep. N.Z. Scenery Preserv. Soc. 13* : 21 pp.

Front cover illustrates Lake Manapouri in 1972 after the Electricity Department had lowered the lake level, causing slumping of the beaches. Further comments "Save Manapouri" and "Manapouri - Te Anau Report" appear on pp 12-13.

146. O'CONNOR, K.F. 1972: Planning for recreation among other uses of mountain land and water resources. *Rev. Tussock Grasslands Mountain Lands Inst. 24* : 26-41.

Includes a section on the Waiau catchment which includes Lakes Manapouri and Te Anau.

147. PARK, J. 1921: Geology and mineral resources of western Southland. *Bull. N.Z. geol. Surv. n.s. 23* : 88 pp.

Included in the discussion of the geology is a section on the flora and fauna of the eastern shores of Lakes Te Anau and Manapouri, and several photographs of historic interest.

148. PARROTT, A.W. 1932: Age and growth of the Te Anau salmon. *Salmon Trout Mag., March* : 86-94.

Gives some new data on Atlantic salmon growth in New Zealand based on material taken during December 1930 and January 1931 from localities in and around Lake Te Anau.

149. PASCOE, J. (ed.) 1974: "National Parks of New Zealand". Government Printer, Wellington. 179 pp.

A section on Fiordland National Park which includes Lakes Te Anau and Manapouri.

150. PICKRILL, R.A. 1978: Beach and nearshore morphology of Lakes Manapouri and Te Anau, New Zealand : Natural models of the continental shelf. *N.Z. Jl Geol. Geophys. 21(2).*

The shelf form of the beaches and shore normal sediment distribution is shown to be an equilibrium form developed in response to wave activity. Parallels are drawn with oceanic shelves.

151. PICKRILL, R.A. 1978: Water tables in Slipway Beach, Lake Manapouri : controls and effects on the beach system. *N.Z. Jl mar. Freshwat. Res. 12(1).*

Fluctuations in the beach water table are described. Rainfall, lake level fluctuations and wave activity are shown to control these movements. Effects on beach morphology are outlined.

152. POWELL, C.L.; MARK, A.F. 1972: Lake levels. *N.Z. Environ. 2(3)* : 28-29.

Two letters expressing concern at the proposed flooding of Lakes Manapouri and Te Anau. Photographic evidence from Lakes Monowai and Hawea is presented as evidence of probable effects on the shoreline vegetation.

153. RAE, D. 1977*: A benefit-cost analysis of further development of the Manapouri/Te Anau hydro-electric scheme. *Res. Pap. N.Z. Inst. econ. Res. 23* : 132 pp.

Outlines the conflict between further development of the power scheme and preservation or conservation of the environment. Contains bibliography.

154. RICHMOND, J.E. 1887: Opening of the south-western lakes and sounds. *Append. J. House Repres. N.Z., H-20* : 1-2.

Based on an exploratory visit to the area, puts forward a suggestion to the Government to open up Lakes Manapouri and Te Anau for tourism.

155. SALMON, J.T. 1973: Nature conservation. Pp 393-410 *in* Williams, G.R. (ed.) "The Natural History of New Zealand". A.H. & A.W. Reed, Wellington. 434 pp.

In a discussion of conservation organisations, the Lake Manapouri controversy is cited as an example.

156. SHAND, T.P. 1966: Level of Lake Manapouri. *Index Statements N.Z. Minist. Crown 15* : 8-10.

The official statement by the Minister of Electricity announcing that the maximum lake level would not exceed 37 feet, instead of the proposed 80 feet, and explaining the engineering and conservation reasons behind the decision.

157. SOUTHLAND SAVE MANAPOURI CAMPAIGN, 1970: "Save Manapouri". Invercargill. 5 pp.

An emotional publicity pamphlet accusing the Government of deliberately concealing the facts of the Manapouri project. A parallel is drawn with Lake Monowai.

158. STENHOUSE, L.J. 1964: The Manapouri Power Scheme. *N.Z. Geogr. 20(1)* : 91-92.

Outlines the proposed power scheme and early opposition to the proposal to raise Lake Te Anau by 20 feet. The recent Government decision not to flood Lake Te Anau is reported.

159. STOKELL, G. 1959: The structural characters of Te Anau salmon. *Trans. R. Soc. N.Z. 87(4)* : 255-63.

The structural features of the Te Anau freshwater salmon are described and compared with those in other freshwater and marine habitats. It is concluded from these features that the Te Anau salmon have been derived from sea-going salmon.

160. STOKELL, G. 1973: Pacific salmon in New Zealand. *Rep. Waitaki Valley Acclim. Soc. 6* : 41-46.

Included in this report for the year ended 31 August 1973, is a section on lake dwelling quinnat referring to the *Salmo salar* of Lake Te Anau.

161. STOUT, V.M. 1970: Lake Manapouri. *Newsl. N.Z. limnol. Soc. 5* : 1-2.

Outlines scientific studies carried out on the lake. The information was supplied by the Ministry of Science in answer to a request by the N.Z. Limnological Society.

162. STOUT, V.M. 1973: The freshwater environment. Pp 229-50 *in* Williams, G.R. (ed.) "The Natural History of New Zealand". A.H. & A.W. Reed, Wellington. 434 pp.

Lakes Manapouri and Te Anau are mentioned in various sections of this national review including : The history of limnological work; General survey of limnology of lakes; Large glacial lakes east of the main divide.

163. SUTER, H. 1905: Report on the Mollusca collected by Messrs Keith Lucas and G.L. Hodgkin in six lakes of New Zealand. *Trans. Proc. N.Z. Inst. 37* : 233-57.

Discusses three species of Mollusca dredged from Lake Manapouri.

164. TURNER, F.J. 1937a*: Pre-Tertiary rocks of Lake Manapouri, New Zealand. (Abstr.) *Rep. Aust. N.Z. Ass. Advmt Sci. 23* : 97.

165. TURNER, F.J. 1937b: The metamorphic and plutonic rocks of Lake Manapouri, Fiordland, New Zealand. Part I. *Trans. Proc. R. Soc. N.Z. 67* : 83-100.

166. TURNER, F.J. 1937c: The metamorphic and plutonic rocks of Lake Manapouri, Fiordland, New Zealand. Part II. *Trans. Proc. R. Soc. N.Z. 67* : 227-49.

167. TURNER, F.J. 1938a: The metamorphic and plutonic rocks of Lake Manapouri, Fiordland, New Zealand. Part III. *Trans. Proc. R. Soc. N.Z. 68* : 122-40.

A detailed description (in three parts) of the geology of the shoreline and a summary of the structural features of the area as a whole.

168. TURNER, F.J. 1938b: Progressive regional metamorphism in southern New Zealand. *Geol. Mag. 75* : 160-74.

Lakes Manapouri and Te Anau border the area discussed in this regional study.

169. TURNER, F.J. 1939*: Granitization of gneiss and epidiorite and contaminations of granites at Lake Manapouri, New Zealand. (Abstr.) *Rep. Aust. N.Z. Ass. Advmt Sci. 24* : 97-98.

170. WARDS, I. (ed.) 1976: "New Zealand Atlas". Government Printer, Wellington. 291 pp.

The Manapouri controversy is mentioned.

171. WHITE, T. 1894: A Maori pa at Lake Te Anau. *Trans. Proc. N.Z. Inst. 26*: 513-15.

Describes the remains of a Maori pa at the outlet of the Upukarora River visited in 1859.

172. WHITNEY, C.A. 1927: *Salmo salar* in Te Anau. *N.Z. Fish. Shoot. Gaz. 1(1)* : 12-13; *1(2)* : 12-14.

Compares the identical habits of the Atlantic salmon (*Salmo salar*) found in Lake Te Anau with Scottish salmon.

173. WILLIAMS, R.J. 1974*: The surveyor's role in construction - the Manapouri - Doubtful Sound hydro electric power development project. *N.Z. Surv. 27* : 629-35.

174. WILMOT, E.H. 1897*: Report on the region between Lake Manapouri and Dusky Sound. *A. Rep. Dep. Lands Surv. 1897*.

175. WOOD, B.L. 1962: Geological factors in Fiordland ecology. *Proc. N.Z. ecol. Soc. 9* : 15-17.

Broad relationships between geology and forest cover are established. Soil forming properties in the rocks and the influence of slope in controlling ground-water levels are isolated as ecological controls.

UNPUBLISHED LITERATURE

176. ANDREWS, P.B. 1973a: Lake Manapouri sand and gravel beaches : Effect of lowered lake level. Unpublished report, Sedimentation Laboratory, N.Z. Geological Survey, Christchurch. 6 pp.

Describes beach types and suggests the beach form is in equilibrium with wind and wave processes.

177. ANDREWS, P.B. 1973b: Lake Manapouri beaches - Report of visit of July 15, 1973. Unpublished report, Sedimentation Laboratory, N.Z. Geological Survey, Christchurch. 3 pp.

Natural repairs to beaches cliffed during periods of low lake levels are described.

178. ANDREWS, P.B. 1973c: Lake Manapouri : Lowered lake levels and possible loss of beach sand and gravel. Unpublished report, Engineering Geology Section, N.Z. Geological Survey, Lower Hutt. 4 pp.

Outlines a recommended programme of investigation following earlier reports describing slumping and beach degradation at low lake levels.

179. ANDREWS, P.B.; McKELLAR, I.C. 1973: Lake Manapouri - Shoreline stability and the effects of lowered lake levels. Unpublished report, N.Z. Geological Survey. 12 pp.

Summarises the findings from earlier reports on shoreline stability. Describes shoreline sediments and beach types. The effects of wind and wave action and fluctuations in lake level on shoreline stability are documented.

180. ANON, 1963a*: Reports on Lakes Te Anau and Manapouri and the Waiau River Project. Unpublished report by Chairman, Freshwater Fisheries Advisory Council, Fisheries Research Division, Wellington.

181. ANON, 1963b*: Comalco investigation. Unpublished report by Chairman, Freshwater Fisheries Advisory Council, Fisheries Research Division, Wellington.

182. ANON, 1969*: M.O.W. Manapouri Power Project. Final development Mararoa Dam - Lakeshore treatment report. Unpublished report, Chemistry Division, D.S.I.R. File 120/4/14.

183. ANON, 1963-70*: Water analyses, South Island lakes. Unpublished data sheets, Chemistry Division, D.S.I.R. Christchurch.

Includes Lakes Manapouri and Te Anau.

184. ANON, 1970a*: Survey map Lake Te Anau. Unpublished. Wildlife Division, Internal Affairs, Wellington. File 6/2/5.

185. ANON, 1970b*: Weed map Lake Manapouri. Unpublished. Wildlife Division, Internal Affairs, Wellington. File 6/2/5.

186. ANON, 1970c*: Effect of raising Lake Manapouri on scientific values. Unpublished report, Chemistry Division, D.S.I.R., Wellington. File 120/4/14.

187. ANON, 1970d*: Water analyses, South Island. Unpublished data sheets, N.Z. Electricity Department.

Includes hydro lakes and Lakes Te Anau and Manapouri.

188. ATKINSON, I.A.E.; McKELLAR, I.C. 1970: Relief and vegetation in the Lake Manapouri shoreline. Unpublished report, N.Z. Geological Survey. 17 pp.

A shoreline survey of areas flooded by a proposed lake level of 610 feet. The implications of the Lake Monowai shoreline to the Manapouri problem are discussed.

189. ATKINSON, I.A.E.; McKELLAR, I.C.; COLLINS, N.W.; McKENZIE, G.R. 1972: Report of party to investigate Manapouri shoreline. Unpublished report, presented to the Guardians of Lakes Manapouri and Te Anau. 8 pp.

A preliminary report describing slumping, beach degradation and stream channel downcutting as a result of low lake levels.

190. AXBEY, H.W. 1966*: Weed beds Lake Manapouri. Unpublished report, Internal Affairs, Wellington. File 6/2/8.

191. BAYLIS, G.T.S.; JOHNSON, P.N.; MARK, A.F. 1970: The vegetation and flora of the islands and shoreline of Lake Manapouri. Unpublished report, Botany Department, University of Otago. 63 pp.

The effect of a raised water table on the survival of beech forests are discussed. The conclusion is reached that present lake levels should be preserved.

192. BEGG, U.E. 1965*: A history of central Fiordland : with special reference to the exploitation of its national resources. Unpublished M.A. thesis, University of Otago, Dunedin.

193. BOTANY DIVISION, D.S.I.R., 1972: Comments on Reports of the shoreline vegetation of Lakes Manapouri and Te Anau, prepared by staff and students of the Botany Department, Otago University. Unpublished report.

Assesses the accountability of the research carried out by the Botany Department and suggests further avenues of research.

194. BRAGG, J.L. 1971: Manapouri - a crisis in conservation. Unpublished bibliography, N.Z. Library School, Wellington.

A bibliography concentrating on conservation aspects containing 55 entries and an index, all of which have been encompassed in the present work.

195. BURROWS, C.J.; HART, A. 1970: Report on field work carried out at Lake Manapouri. Unpublished report, Internal Affairs, Wellington. Manapouri file. 2 pp.

196. CHEMISTRY DIVISION, D.S.I.R., 1968-69*: Oxygen content of Lake Manapouri water and the effect of dumping timber in the lake. Unpublished report, Chemistry Division, D.S.I.R. Wellington. File 120/4/14.

197. GIBB, J.G. 1973: Preliminary report Lake Manapouri and Lake Te Anau. Unpublished report, Water & Soil Division, Ministry of Works and Development, Wellington.

Beach degradation and rotational slumping at low lake levels are described. Recommendations for beach protection and a future programme for investigative study are outlined.

198. GIBSON, G.M. [undated]*: Structure geochemistry and petrogenesis in the Wilmot Pass district of Fiordland. Unpublished Ph.D. thesis, University of Otago, Dunedin.

199. GUARDIANS OF LAKES MANAPOURI AND TE ANAU: Annual reports to the Minister for the Environment. Unpublished reports, Guardians of Lakes Manapouri and Te Anau, Dunedin.

The four annual reports (1974, 75, 76, 77) trace the endeavours of the Guardians to instigate scientific studies as a basis on which to recommend operational controls for the two lakes.

200. HILL, C.F. 1970*: Report on visit to South Island lakes. Unpublished report, N.Z. Electricity Department, Wellington.

Includes Lakes Te Anau and Manapouri.

201. HOLGATE, G.L. 1974: A study of plant succession at Lake Manapouri. Unpublished M.Agr.Sc. thesis, Lincoln College, Canterbury.

202. HUTCHINSON, R.T. 1969a*: Manapouri hydro-development, Lake Te Anau control. Unpublished report, Internal Affairs, Wellington. File 6/2/8.

203. HUTCHINSON, R.T. 1969b*: Investigation report Manapouri - Angling and survey data summary. Unpublished report, Internal Affairs, Wellington. File 24/2/4.

204. INGHAM, C.F. 1960*: Manapouri seismic report. Unpublished report, Geophysics Division, D.S.I.R,, Wellington.

205. JOHNSON, P.N. 1974: Report on field work carried out at Lakes Manapouri and Te Anau. December 1973 to May 1974. Unpublished report, Botany Division, D.S.I.R, Dunedin. 5 pp.

Lists permanent shoreline transects established by Botany Division, DSIR, to study changes in shoreline vegetation; an example of vegetation changes at Supply Bay, Manapouri is given. Future research is outlined.

206. JOLLY, V.H. 1959: A limnological study of some New Zealand lakes. Unpublished Ph.D. thesis, University of New Zealand. 95 pp.

Manapouri and Te Anau are included in the 24 lakes studied. Temperatures, water transparency, and zooplankton were studied at 3-monthly intervals.

207. JOLLY, V.H. 1970*: A report on the zooplankton and some physical features of fifteen South Island lakes visited at invitation of N.Z.E.D. in April 1970. Unpublished report, Freshwater Section, Ecology Division, D.S.I.R.

Includes Lakes Te Anau and Manapouri.

208. KELLY, G.C. 1968: Notes on the botany of Lake Manapouri with particular reference to the smaller islands. Unpublished report, Botany Division, D.S.I.R., Christchurch.

Describes the vegetation of the islands and mainland. The interest in the vegetation of the islands is not in its rarity, but in its absence of interference from deer.

209. LITTLE, R.W.; WILLIAMS, G.R. 1970*: Te Anau - Manapouri power scheme. Report on the fish and fisheries of the Upper Waiau River and Lake Te Anau. Unpublished report, Wildlife Division, Internal Affairs, Wellington. File 6/2/8.

210. LUSH, A. [undated]*: Case against Manapouri power for Comalco. Unpublished report, Internal Affairs Library, Wellington.

211. LUSH, A. [undated]*: Manapouri fallacies. 1. Plea for preservation of park lands. 2. Case for cancellation of Comalco offer. Unpublished. Held at Internal Affairs Library, Wellington.

212. McKELLAR, I.C. 1963: Manapouri - Te Anau Development Scheme. Formation new beaches high lake level. Unpublished report, N.Z. Geological Survey, Christchurch.

213. McKELLAR, I.C. 1969*: Beach formation at around 610 feet Lake Manapouri. Manapouri shoreline - post glacial high lake levels and associated lake shore deposits. Unpublished report, Chemistry Division, D.S.I.R., Wellington. File 120/4/14.

214. McKELLAR, I.C. 1970*: Effects of controlling Te Anau lake level. (Schematic cross-section). Unpublished report, Chemistry Division, D.S.I.R. File 120/4/14.

215. McKELLAR, I.C. 1972a: Lakes Manapouri and Te Anau : Effects of lake control. Geological aspects. Results of inspections 25 and 29 August. Unpublished report, N.Z. Geological Survey, Dunedin. 5 pp.

Discusses slumping of silty shore sediments, low cliffing of beach sands and stream downcutting induced by low lake levels.

216. McKELLAR, I.C. 1972b: Lithological control of degree of erosion and sliding around Lake Manapouri shoreline during low lake level. Unpublished report, N.Z. Geological Survey, Dunedin. 5 pp.

Discusses findings from shoreline inspection reported in McKellar (1972a). Beach erosion, slumping, and stream downcutting in response to low lake levels are described.

217. McKELLAR, I.C. [1972]c: Interim Report. Lake Te Anau shoreline. Effects of lake control - geological aspects. Unpublished report, N.Z. Geological Survey, Dunedin. 7 pp.

Assesses shoreline sediments in Middle and North Fiords to determine permeabilities and predict the effects of fluctuating lake levels on the beach water table.

218. McKELLAR, I.C. 1973: The susceptibility of Lake Manapouri shoreline to slumping at low lake levels. Unpublished report 156, N.Z. Geological Survey, Engineering Geology Section. 8 pp.

Describes the materials in which slope failures have occurred and maps their distribution.

219. McKELLAR, I.C. 1974: Te Anau lake shore beach sediments. Unpublished report, N.Z. Geological Survey, Engineering Geology Section, EG 188. 7 pp.

An extension of the work described in McKellar (1972c) into South Fiord.

220. McKELLAR, I.C.; ATKINSON, I.A.E. 1970: Report on the Lake Te Anau shoreline. Unpublished report, N.Z. Geological Survey, D.S.I.R. 4 pp.

Describes the width of the zone needed to be cleared of vegetation if the level of Lake Te Anau was controlled to the proposed maximum of 670 feet.

221. MINISTRY OF WORKS, 1949*: Seasonal variation of runoff. Unpublished report, Power Design Office Investigations Section, Wellington.

Includes Lakes Te Anau and Manapouri.

222. MINISTRY OF WORKS, 1965a*: Waiau River - Manapouri power development. Hydrology of the Mararoa River. Unpublished report, Power Design Investigations Section, Wellington.

223. MINISTRY OF WORKS, 1965b*: The hydrology of Lakes Manapouri and Te Anau. Unpublished report, Power Design Investigations Section, Wellington.

224. MINISTRY OF WORKS, 1966*: Progress report. Manapouri Power Project - Bechtel Pacific Corporation Ltd. Unpublished report, Ministry of Works. File 621/312134.

225. MINISTRY OF WORKS, 1970*: Te Anau Lake control - Upper Waiau Channel gradients. Unpublished report, Internal Affairs, Wellington. File 6/2/8, part 4.

226. MOIR, R. and ASSOCIATES, [1973]: Lake Te Anau Shoreline Survey. Unpublished Report. Ralph Moir & Associates, Invercargill. 15 pp.

A survey of the shoreline terrain with 12 accompanying maps.

227. N.Z. SCENERY PRESERVATION SOCIETY, 1969*: Is it for sale? Statement of the costs of preservation and related matters. Unpublished report, Internal Affairs Library, Wellington. 7 pp.

Includes a statement on conflicting statements and costs of construction and clearing given over the years.

228. N.Z. SCENERY PRESERVATION SOCIETY, 1970a: Commentary of the report of the Cabinet Committee on Lake Manapouri. Unpublished report, Internal Affairs Library, Wellington. 7 pp.

Critises the findings of this Committee as it relies solely on information supplied by Government departments.

229. N.Z. SCENERY PRESERVATION SOCIETY, 1970b*: Save Manapouri Campaign - Facts and fallacies about the proposal to raise the level of Lake Manapouri for power purposes. Unpublished report, Internal Affairs Library, Wellington.

A factual appraisal of the situation to date suggesting the Comalco agreement should be re-negotiated.

230. PICKRILL, R.A. 1976: Lacustrine geomorphology of Lakes Manapouri and Te Anau. Unpublished Ph.D. thesis, University of Canterbury. 402 pp.

A comprehensive study of the two lakes including chapters on - Shoreline characteristics; Lake shore processes; Beach morphology; Sediment transport; and Management implications and recommendations.

231. PICKRILL, R.A. 1977a: Summary of major findings concerning the stability of the shorelines of Lakes Manapouri and Te Anau. Unpublished report, N.Z. Oceanographic Institute, D.S.I.R., Wellington. 3 pp.

A 9-point summary, abstracted from Pickrill (1976). The Guardians' Guidelines for the two lakes are endorsed.

232. PICKRILL, R.A. 1977b: Geological implications of the proposed alterations to the operating Guidelines for the levels of Lakes Manapouri and Te Anau. Unpublished report, N.Z. Oceanographic Institute, D.S.I.R., Wellington. 2 pp.

The possible effects on the beaches of raising the long-term mean level on Manapouri, and lowering it on Te Anau are described.

233. SKINNER, B.E. 1966*: Lake survey Lake Te Anau. Unpublished report, N.Z. Geological Survey, Lower Hutt.

234. SLEE, J.F. 1974*: Labour policy on Manapouri 1959-1974. Unpublished M.A. thesis, University of Canterbury, Christchurch.

235. STOUT, V.H. 1973*: Preliminary report on a study of the lakes in the Waitaki River system, and Lakes Manapouri and Te Anau, mainly undertaken over the summer of 1970-71. Unpublished report, Freshwater Section, Ecology Division, D.S.I.R.

236. TAYLOR, R.H.; WHITAKER, A.H. 1968: A reconnaissance of areas to be flooded by the Manapouri Power Project. Unpublished report, Ecology/Chemistry Divisions, D.S.I.R. Wellington. File 120/4/14.

A survey of the birds and mammals in the areas likely to be flooded by proposed high lake levels.

MAPS AND CHARTS

237. IRWIN, J. 1969: Lake Manapouri. Provisional Bathymetry 1:31,680. *N.Z. oceanogr. Inst. Chart, Lake Ser.*

238. IRWIN, J. 1971: Lake Te Anau. Provisional Bathymetry 1:63,360. *N.Z. oceanogr. Inst. Chart, Lake Ser.*

239. LANDS AND SURVEY DEPARTMENT

Topographical Series N.Z.M.S. 1 1:63,360
Sheet 130 Stewart (1974) - Middle and North Fiords, Lake Te Anau
Sheet 131 Eglington (1973) - northern portion of Lake Te Anau
Sheet 140 Te Anau (1973)
Sheet 149 Manapouri (1974)

Topographical Series N.Z.M.S. 18 1:250,000
Sheet 22 - Lake Te Anau
Sheet 24 - Lake Manapouri

Topographical Series N.Z.M.S. 19 1:500,000
Sheet 6 Dunedin - Lakes Manapouri and Te Anau

Territorial Series N.Z.M.S. 10 1:253,440
Sheet 30 - Lakes Manapouri and Te Anau

239. Cont'd
National Park Maps N.Z.M.S. 122 1:300,000
Fiordland National Park *L & S 53*. (accompanies Hall-Jones, G. 1965)

Tourist Maps N.Z.M.S. 155 1:200,000
Lake Te Anau

Cadastral Map Series N.Z.M.S. 177 1:63,360
Sheet 130 Stewart - Middle and North Fiords, Lake Te Anau
Sheet 131 Eglinton - northern portion of Lake Te Anau
Sheet 140 Te Anau
Sheet 149 Manapouri

240. McKELLAR, I.C. 1973: Te Anau - Manapouri district 1:50,000. *N.Z. geol. Surv. Misc. Ser. Map 4.*

The map shows principally the Quaternary glacial deposits that cover most of the downland country east of Lakes Manapuri and Te Anau. A 19-page description of the geology accompanies the map.

241. WOOD, B.L. 1960: Sheet 27 - Fiord. 1:250,000. *N.Z. geol. Surv. Map.*

242. WOOD, B.L. 1962: Sheet 22 - Wakatipu (1st edition) 1:250,000. *N.Z. geol. Surv. Map.*

Shows the northern part of Lake Te Anau.

243. WOOD, B.L. 1966: Sheet 24 - Invercargill (1st edition) 1:250,000. *N.Z. geol. Surv. Map.*

Shows Lake Manapouri.

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APPENDIX A

List of publications searched

Bulletin. Geological Survey, New Zealand 1-89 (1906-1972)

Bulletin. Soil Bureau, New Zealand 1-36 (1949-1974)

Forest and Bird 102-204 (1951-1977)

General Assembly Library Newspaper Index

Hocken, T.M. 1909 "A bibliography of the literature relating to New Zealand". Government Printer, Wellington. 619 pp.

Index to New Zealand Periodicals 1945-1975

Johnstone, A.H. (comp.) 1927 "Supplement to Hocken's bibliography of New Zealand literature". Whitcombe & Tombs, Auckland. 73 pp.

Journal of the Canterbury Botanical Society 1-9 (1968-1976)

Journal of the Royal Society of New Zealand 1-7(3) (1971-1977)

New Zealand Geographer 1-33 (1945-1977)

New Zealand Journal of Botany 1-15(1) (1963-1977)

New Zealand Journal of Geology and Geophysics 1-20(1) (1958-1977)

New Zealand Journal of Marine and Freshwater Research 1-10 (1967-1977)

New Zealand Journal of Science 1-20(1) (1958-1977)

New Zealand Journal of Science and Technology 1-19 (1918-1938)

Section A 20-38 (1938-1957)
Section B 20-37 (1938-1956)

New Zealand Journal of Zoology 1-4 (1974-1977)

New Zealand National Bibliography 1966-1977

New Zealand Science Review 1-34(4) (1942-1977)

New Zealand's Nature Heritage 1-7 (1974-1975)

Newsletter, New Zealand Limnological Society 1-11 (1965-1975)

Notornis 1-24(4) (1943-1975) (Vols 1-3 as New Zealand Bird Notes)

Proceedings of the Ecological Society of New Zealand 1-23 (1952-1976)

Publications List. D.S.I.R., New Zealand (to 1975)

Publications to April 1976. N.Z. Oceanographic Institute.

Records of the Canterbury Museum 1-9(1) (1907-1971)

Report. Mines Department New Zealand

Reports of Geological Exploration, Geological Survey, New Zealand 1-22 (1866-1892/3)

Soil and Water 1-15 (1964-1977)

Transactions and Proceedings of the Royal Society of New Zealand 1-89 (1868-1961)

(Formerly Transactions and Proceedings of the New Zealand Institute and
Transactions of the New Zealand Institute)

Series : Botany 1-3 (1961-1969)
General 1-2 (1962-70)
Geology 1-6 (1961-1969)
Earth Sciences 7-8 (1969-1970)
Zoology 1-10 (1961-1968)
Biological Sciences 11-12 (1968-1970)

Tuatara 1-22 (1947-1977)

Union List of Higher Degree Theses in New Zealand Libraries (1910-1975)

Wildlife - A Review 1-7 (1969-1976)

E. C. KEATING, GOVERNMENT PRINTER, WELLINGTON, NEW ZEALAND—1978