

TONGARIRO/TAUPO CONSERVANCY

Lake Taupo (24)

Location: 175°55'E, 38°47'S. In the centre of North Island.

Area: c.61,500 ha.

Altitude: 357 m.

Overview: Lake Taupo is a deep, windswept, volcanic lake, the largest in the southern hemisphere. Its waters support abundant life, particularly aquatic plants and fish, while the lake and its associated environs support a host of waterfowl. The lake is noted for the clarity of its waters, and provides scenic vistas and fishing opportunities for local people and visitors alike. It is at the centre of the region's economy, as it supports an internationally renowned recreational fishery, and its protection dictates land use throughout the catchment. A large wetland on the southern shore of the lake, South Taupo Wetland, is described separately as Site 25.

Physical features: The lake is a large volcanic caldera, the result of a depression formed with the uplifting and down faulting of the central North Island mountain ranges, which have undergone frequent and often violent volcanic activity. It is surrounded by pumice terraces. Today, water levels are manipulated for hydro-electric power generation. Control gates at the lake's outflow regulate discharge which ranges from nil to 330 cubic metres per second. The lake has a catchment area of some 328,930 ha, and is the source of New Zealand's longest river, the Waikato. The Waikato River is important for hydro-electric power generation as well as a variety of domestic, recreational, industrial and agricultural users along its entire length of 450 km. The river and its associated wetlands are of significant ecological importance and have high wildlife values (see Site 10). Retention of high water quality in Lake Taupo therefore has important implications for both on-site and downstream values.

Lake Taupo is an oligotrophic lake with a slightly eutrophic influence at its southern end where its major tributaries deposit alluvium washed from the mountains of Kaimanawa Forest Park and Tongariro National Park. It is 184 m deep at its deepest point, and averages 97 m in depth over its entire area. Of the 60 cubic km of water present in the lake at any one time, 90% is contributed by rivers and streams, 7% from direct rainfall and 3% from groundwater sources. Water captured from 130,000 ha of catchment area outside the Taupo Basin, to boost hydro-electric power generation capacity down the Waikato River, can add up to 33.4 cubic metres per second above natural inflow. Residence time for an average drop of water is 10.5 years.

Ecological features: The distribution of submerged aquatic plants in the lake is patchy, the major areas of colonisation being the extensive littoral shelves at the southern end. Much of the shoreline is unsuitable for growth of vascular aquatic plants because of vertical ignimbrite cliffs which extend deep into the water. There is a distinct vertical zonation of aquatic plants in the lake down to about 15 m in depth where the bottom profile allows. For reasons not yet understood, the vegetation in the lake does not grow beyond this depth, even though the native characean algal meadows should occur to depths of 30 m in such clear water.

Lake Taupo is frequently exposed to strong southwesterly winds, and as a result its surface waters are well mixed throughout the year. However, because of its great depth, mixing of the bottom waters takes many months and winter cooling is not complete until early spring. This mixing is important to the ecology of the lake in that it distributes life-supporting nutrients dissolved in the water.

Much of the lake's margin remains in original natural forest and wetland cover, although development on the eastern side of the lake has modified this shoreline to varying degrees.

Land tenure: The lake is currently Crown land, although this is likely to change in the near future. The catchment area has a mixture of land tenures including Crown-administered parks and reserves, private farmland and plantation forest and private land still in natural vegetation. Much of the catchment remains in private Maori ownership administered by trust boards. Some Crown land is vested in the local authority for reserve purposes, and the local authority also administers some Esplanade Reserve land.

Conservation measures taken: The lake and river bed (of major tributaries) are currently Crown land. An agreement was reached in 1926 between Ngati Tuwharetoa, the Maori tribe whose lands encompass Lake Taupo, and the government that the bed of Lake Taupo would be reserved for public use. The agreement was formalised in the 1926 Maori Land Amendment and Maori Land Claims Adjustment Act. Some other key features in, or deriving from, the 1926 Act were: a special licence was required to fish at Lake Taupo; the Crown was to pay the Tuwharetoa Maori Trust Board an annual sum approximately equivalent to half the revenue received from the sale of fishing licences; a public right-of-way, 20 m wide, was provided over all Maori land adjoining the lake; a 20 m wide right-of-way on foot for licensed anglers was provided over Maori land adjoining the sections of rivers where the beds were declared to be Crown land; compensation was paid to owners of riverbank Maori land which was subject to the right-of-way; the Crown was given the right to use and control the waters overlying these lake and river beds; and the Crown was empowered to make regulations governing fishing, boating and other use of the waters.

Some provisions of the Act differed from points of the agreement. In particular, the lake bed and designated portions of the inflowing river beds simply became land of the Crown, rather than public reserve vested in the Crown. Recent negotiations between the Crown and Tuwharetoa have focused on the mutual wish to restore the "mana" of ownership to the tribe, without impinging on existing public rights and privileges. The proposed outcome is to return the present Crown lake and river bed title to Tuwharetoa. This proposal requires ratification by the Tuwharetoa Trust Board's beneficiaries, before it becomes effective.

There are a number of Scenic and Recreation Reserves around the lake which act as a buffer between the lake shore and urban or agricultural development. The regional authority has had an active role since 1973, retiring areas around rivers and streams from grazing or development, and replanting these for erosion control purposes. Most headwater catchments remain in Crown land as national and forest parks managed for conservation/protection purposes. Wise land-use practises are promoted by local and regional authorities and by central government agencies such as the Department of Conservation. Legislation governs land-use practises over much of the catchment. Rights to use or discharge water are also strictly governed by legislation.

Conservation measures proposed: The Lake Taupo Lake Shore Reserves Scheme, a local authority scheme endorsed by central government, proposes a complete and continuous series of reserves surrounding the lake's perimeter. Although, acquisition of land for the scheme has slowed in recent years, a large proportion of the shoreline is already protected as Scenic Reserve. The Department of Conservation is promoting the need for an integrated plan of management, embodying all aspects of the lake and its catchments, involving the local Maori and the general public. The department has recently prepared a conservation strategy for the lake.

Land use: Recreation (including trout fishing and boating) is by far the most important use of Lake Taupo. A large tourist industry is based around the Taupo recreational trout fishery and the opportunities for other water sports. The lake is also a significant storage reservoir, feeding eight hydro-electric power generation systems downstream on the Waikato River.

The catchment has a resident population of some 25,000 people, but hosts over a million visitors each year. Land use in the catchment is varied, but has a strong orientation towards

protection of water quality. Plantation forestry and conservation areas cover much of the basin to the southwest and east, while extensive pastoral land occurs to the north.

Possible changes in land use: An increase in recreation and tourism is forecast. This will place more pressure on the lake and its fishery, and will undoubtedly mean an increase in boat use and possible further marina and foreshore development. Increasing human populations (including visitors) will also add pressure to urban waste disposal systems. Logging of the catchment's 200,000 ha of exotic forest plantations is due to begin over the next decade. Further development of energy resources (hydro-electric power) is likely.

Disturbances and threats: Two major threats exist, pollution and the establishment of exotic species. Run-off from surrounding pasture and forest and urban waste from the many settlements around the lake have the potential to add unnaturally high quantities of nutrients to the lake, especially as the population grows and visitor numbers increase. The threat of undesirable new species of plants and animals becoming established in the lake is high, and could have a major impact on water quality and/or the fishery. The alga Water Net *Hydrodictyon reticulatum* has recently become established, and the Brown Bullhead (catfish) *Ictalurus nebulosus* has also become established in the lake following a recent illegal liberation. The colonisation of the lake shore by Crack Willow *Salix* sp. over the past 20-30 years has had a major impact, choking tributaries and wetlands, reducing biological diversity and altering the visual appearance of the shoreline, especially along the eastern shores.

Hydrological and biophysical values: Lake Taupo plays a significant role in the storage and discharge of water to Waikato River, a major river in terms of wetland habitat and hydro-electric power generation. The associated wetland at the southern end of the lake (South Taupo Wetland) plays an important role in sediment trapping and maintaining water quality in the lake. The lake itself plays a general role in the maintenance of water quality, both within the lake and downstream, and is renowned for the clarity of its water. It is of great importance in supporting aquatic and terrestrial food chains, including the recreational trout fishery upon which the economy of the region is heavily reliant.

The most important species of fish in the lake is the Rainbow Trout *Oncorhynchus mykiss*, first introduced in 1898 from stock originally obtained from northwestern America. Other species of significance are the Brown Trout *Salmo trutta*, introduced from Tasmanian stock (originally from Britain) and Common Smelt *Retropinna retropinna*, introduced from the lower Waikato River as a food source for the trout after the fishery crashed in the 1920s. The collapse was due to the depletion of native fish stocks of Koaro *Galaxias brevipinnis* which were once widespread and abundant in the lake. Koaro occur in much reduced numbers today. Koaro and the native crayfish or Koura *Paranephrops planifrons* were important food sources of the early Maori.

Social and cultural values: The Lake Taupo area has a long history of Maori colonisation. The lake provided food, protection and transport to early Maori. Numerous "pa" (fortified settlements) and other archaeological sites are scattered throughout the catchment. The lake is still culturally and spiritually significant to the Maori people. Lake Taupo is considered a "playground" for New Zealanders and overseas visitors alike, and is an important part of modern New Zealand culture.

Noteworthy fauna: The lake and its environs support a wide variety of waterfowl, including significant populations of New Zealand Dabchick *Poliocephalus rufopectus*, three species of shag *Phalacrocorax* spp., Australasian Bittern *Botaurus poiciloptilus* and North Island Fernbird *Bowdleria punctata vealeae*. The shallow southern bays are utilised by a variety of herons (Ardeidae), Black Swan *Cygnus atratus* (up to 3,000), Canada Goose *Branta canadensis*, Paradise Shelduck *Tadorna variegata*, Grey Teal *Anas gracilis*, New Zealand Scaup *Aythya novaeseelandiae*, Marsh Crake *Porzana pusilla affinis*, Banded Rail *Rallus*

philippensis assimilis, Common Coot *Fulica atra*, a variety of gulls *Larus* spp. (including Black-billed Gull *L. bulleri*) and Caspian Tern *Sterna caspia*.

Eight species of fish inhabit the lake. Rainbow Trout *Oncorhynchus mykiss* lead a primarily pelagic existence in pursuit of Common Smelt *Retropinna retropinna*, their main food source, while native bullies *Gobiomorphus* sp., Brown Trout *Salmo trutta*, the recently established Brown Bullhead (Catfish) *Ictalurus nebulosus*, Goldfish *Carassius auratus* and Sail-fin Molly *Poecilia latipinna* prefer the shallow margins. The native Koaro *Galaxias brevipinnis*, once widespread in the lake, has suffered as a result of trout introductions, but still exists in small numbers. The native crayfish or Koura *Paranephrops planifrons* is abundant throughout the lake.

The lake also has extensive benthic and planktonic faunas.

Noteworthy flora: The deepest and shallowest communities in the lake comprise native species. At depths of one to two metres, species of *Myriophyllum*, *Ruppia*, *Potamogeton* and *Ranunculus* can be found, while below ten metres, characean meadows of the algae *Chara* and *Nitella* occur. Between two and nine metres, native vegetation has been replaced by *Lagarosiphon major* and *Elodea canadensis*, which produce a greater biomass of plant matter and grow to the surface during the summer, often breaking free with wave action and creating problems for recreational uses. The shallow margins of the lake often support turf communities of species such as *Lilaeopsis* sp., *Hydrocotyle hydrophila*, *Crassula sinclairii*, *Epilobium nerterioides*, *Pratia* sp. and the small sedges *Eleocharis pusilla* and *Schoenus maschalinus*.

Scientific research and facilities: Research into many aspects of Lake Taupo's history, geology, ecology, human use, physical characteristics and flora and fauna is being conducted as a means of understanding and hence better managing the lake and its catchment to ensure its long-term protection. This research is being undertaken by a variety of central and regional government agencies.

Conservation education: A number of interpretive facilities exist, explaining the Taupo fishery, the lake's origins, its value as a hydro-electric power reservoir and the importance of wisely managing the lake and its catchments. These facilities are located in the region's information centres and at specific facilities used in the management of various aspects of the resource, such as trout hatcheries, power stations and research centres.

Recreation and tourism: A major tourist industry is based around Lake Taupo, its recreational fishery and its other opportunities for water sports. Charter boats, marinas, accommodation facilities and service industries support tourism throughout the region.

Management authority: The Department of Conservation (Tongariro/Taupo Conservancy) is responsible for the management of parks and reserves, fisheries management, conservation advocacy, allocation of lake bed space and wildlife management. Waikato Regional Council is responsible for catchment planning, control of water use, granting of water rights and pollution monitoring, while Taupo District Council is responsible for local body reserves and lake bed planning. The Department of Internal Affairs has responsibility for navigation and boating facilities. The Department of Scientific and Industrial Research conducts hydrological research, nutrient monitoring, and research on algae, small animals and lake weeds. The Eastern Regional Fish and Game Council manages game-bird (waterfowl) hunting.

Jurisdiction: Territorial: Waikato Regional Council and Taupo District Council. Functional: Department of Conservation (Tongariro/Taupo Conservancy) and Eastern Regional Fish and Game Council.

References: Department of Conservation (1990a); Howard-Williams & Forsyth (1983).

Reasons for inclusion:

- 1a Lake Taupo is a particularly good representative example of a large, deep, volcanic lake; one of the best examples in the South Pacific.

- 2a Lake Taupo supports populations of two globally threatened species of birds, *Poliiocephalus rufopectus* and *Botaurus poiciloptilus*.
- 2d Lake Taupo is of special value for its endemic plant and animal species, including several endemic species of waterbirds (*Poliiocephalus rufopectus*, *Tadorna variegata*, *Aythya novaeseelandiae*, *Larus bulleri* and *Bowdleria punctata*).
- 3c The lake and its associated wetlands support more than 1% of the world population of *Poliiocephalus rufopectus* and New Zealand population of *Cygnus atratus*.

Source: Cam Speedy and Cathy Jones.

South Taupo Wetland (25)

Location: 38°58'S, 175°50'E. At the southern end of Lake Taupo in the centre of North Island. The wetland lies between the historic Maori village of Waihi and Motuoapa Village, encompassing the Tongariro River Delta, some 36 km southwest of the township of Taupo.

Area: c.1,540 ha.

Altitude: 357 m.

Overview: As a large continuous area of relatively unmodified wetland containing a wide range of representative vegetation types and providing breeding habitat for populations of common and vulnerable wetland birds, the wetlands between Waihi and Motuoapa on the southern shores of Lake Taupo are unmatched in the central North Island of New Zealand. The wetland is a complex mosaic of vegetation types influenced mostly by drainage and to some extent by past disturbance. Much of the area is composed of pumice and greywacke alluvium deposited by the three major catchments draining into the southern end of the lake from the Tongariro and Kaimanawa mountains. Drainage has been impeded by an accumulation of iron on the upper layers of this alluvium and by the establishment of beach ridges resulting in water ponding and the eventual establishment of wetland vegetation. The diverse range of habitats which has resulted is utilised by 48 species of birds including 36 native species, 16 of which are endemic to New Zealand. There are 206 plant species, of which 143 are native and 63 are adventive. (Lake Taupo itself is described separately as Site 24).

Physical features: The wetland occurs on the edge of a large volcanic caldera (Lake Taupo), but has also been influenced by the volcanoes and mountains of more ancient sedimentary origins to the south. Some 1,600 ha of the lake have been infilled at the southern end with pumice and greywacke alluvium. The region receives 1,200-3,000 mm of rainfall annually depending on altitude, and flood events are a regular occurrence. The lake level, which influences the hydrology of the wetland, is controlled for hydro-electric power generation purposes, and drawdown, combined with natural water loss, affects water levels within the wetland during periods of low rainfall. Water quality is generally high as a result of all the headwater catchments feeding into or through the wetland remaining in natural vegetation (beech forest, *Nothofagus* spp.) or having been planted in exotic plantation forest (*Pinus radiata*). Sediment loading can, however, be high following heavy rain. Fertility varies within the wetland from highly fertile river levees to semi-acid peat bogs of lower fertility where ponding has occurred away from rivers.

Ecological features: With European colonization of the Taupo Basin in the 1850s came the establishment of farming, and by 1941 large areas of manuka and kanuka scrub/forest backing the wetland had been cleared. Attempts were made to drain localised areas of wetland, but the raising of the lake level by almost a metre by the establishment of control gates in the lake's

outflow in 1941 meant that many of these low-lying areas became poorly drained. As a result, wetland vegetation and manuka scrub became re-established. The current vegetation of the wetland is influenced by drainage and this past disturbance and manipulation of water levels. The free-draining, coarser alluvium deposited on the levees of rivers is covered in vegetation composed predominantly of willow, adventive weeds and some early successional species such as Kanuka *Kunzea ericoides* var. *ericoides*, Manuka *Leptospermum scoparium*, Kowhai *Sophora tetraptera*, Kohuhu *Pittosporum tenuifolium* and Lancewood *Pseudopanax crassifolius*. Beach ridges, including the ridge backing the present lake shore, are also well drained and support similar vegetation. Further from rivers, the area is less well drained and supports a less fertile mosaic of swamp vegetation composed primarily of Flax *Phormium tenax*, Toetoe *Cortaderia toetoe*, Raupo *Typha orientalis*, Oioi *Leptocarpus similis*, *Carex* spp. and *Baumea* spp. Spatial variation in the abundance of these species reflects the influence of topography, drainage and fertility. Areas of semi-permanent surface water forming inlets and lagoons close to the lake support raupo reed-land.

Land tenure: Land ownership within the wetland is a mixture of Crown land with reserve status (Scenic and Recreation Reserves), private Maori land, Crown land vested in the local authority, land leased from the Crown, and special purpose Crown land (for hydro-electricity generation, managed by the Electricity Corporation).

The areas surrounding the wetland are a combination of private farmland and private exotic forest managed under a lease agreement by the Crown. The headwaters of the three major rivers feeding the wetland are Crown land (national and forest parks) interspersed with several blocks of private Maori land.

Conservation measures taken: Approximately 300 ha of Crown land (approximately 20% of the total wetland area) were formally gazetted as small, discrete Crown administered Scenic and Recreation Reserves between 1976 and 1987. Willow control has been undertaken in some of these areas. Control of straying stock (cattle and goats) is also undertaken as the need arises. Negotiations to protect a further 500 ha of the wetland are under way, and are likely to proceed as an exchange of land. Advocacy for protection of wetland values with owners of private areas of the wetland is ongoing.

Conservation measures proposed: Further willow control and continued stock control is required. Formal protection of a further 500 ha is being considered.

Land use: Conservation of plants and wildlife, recreation and scenic use occur in the reserve areas. Grazing takes place in some privately-owned areas of the wetland. Agriculture, forestry, recreation, hydro-electric power generation and tourism are the principal forms of land use in surrounding areas. The resident local population is around 4,700 people, rising to 10,000 in peak holiday periods.

Possible changes in land use: Further agricultural development and in-filling of parts of the wetland in private ownership to create a motor camp are likely. Local authorities and both regional and central government recognize the importance of protecting water quality in the Taupo Basin, and this is reflected in current land-use practices. Any further development in the catchment area of the wetland is therefore likely to remain compatible with protecting water quality.

Disturbances and threats: There are two major types of threat to the wetland, the spread of adventive weeds and development of private land. Pussy willow is invading the less fertile and wetter sites within the wetland, while crack willow is well established along river levees and beach ridges. Himalayan honeysuckle, blackberry and gorse are also a localised problem. Potential development of privately-owned areas of the wetland threaten to fragment the wetland. Stock wandering through the area seasonally have a major impact. Introduced feral cats and mustelids are major threats to wildlife.

Hydrological and biophysical values: The wetland plays an important role in trapping sediment washed off the Kaimanawa and Tongariro mountains during heavy rainfall, and thereby ensures high water quality in the shallow bays of Lake Taupo bordering the wetland. These shallow bays have extensive beds of weeds which are enhanced by nutrient-flushing from the wetland and play an important role in the ecology of the lake.

Social and cultural values: The area is used extensively for recreation, primarily waterfowl hunting and fishing. It is also culturally significant to the local Maori people as a source of food. In pre-European times, a large "pa" (fortified settlement) was located in the westernmost extremity of Stump Bay on the narrow strip of land which divides the main mouth of the Tongariro River Delta from the lake.

Noteworthy fauna: The area has a high diversity of birdlife. Forty-eight species of birds have been recorded in the vicinity of the wetland, 36 of which are native and 12 of which are introduced. More than half are waterfowl, with forest birds making up a large percentage of the remaining species. Sixteen of the native species are endemic to New Zealand. This area has a greater diversity of birds than anywhere else on the lake because of three factors: (a) the lake is shallow in this area with extensive beds of macrophytes which support an abundant food supply of macro-invertebrates and small fish; (b) the area is sheltered from the prevailing southwest wind; and (c) the wetlands provide large and diverse areas of breeding habitat. Large numbers of Black Shag *Phalacrocorax carbo*, Little Shag *P. melanoleucos*, Little Black Shag *P. sulcirostris*, Black Swan *Cygnus atratus* (approximately 3,000 or 4% of the New Zealand population), Mallard *Anas platyrhynchos*, Grey Duck *A. superciliosa*, New Zealand Shoveler *A. rhynchotis variegata* and New Zealand Scaup *Aythya novaeseelandiae*, among others, reside in the area. Notable species include New Zealand Dabchick *Poliiocephalus rufopectus*, Australasian Bittern *Botaurus poiciloptilus*, Banded Rail *Rallus philippensis assimilis*, Spotless Crake *Porzana tabuensis plumbea*, Marsh Crake *P. pusilla affinis*, Long-tailed Cuckoo *Eudynamis taitensis* and North Island Fernbird *Bowdleria punctata vealeae*, while occasional visitors include Royal Spoonbill *Platalea regia* and Cattle Egret *Bubulcus ibis*.

Noteworthy flora: The wetland is noteworthy floristically because of its high diversity of plant species. Two hundred and six vascular plant taxa have been recorded of which 143 are native and 63 adventive. None is listed as rare or endangered; the majority are common in similar habitats throughout the district but nowhere do all occur together in one wetland. The bladderwort *Utricularia australis*, a plant of limited distribution, is at its southern limit in the North Island at this point, and Oioi *Leptocarpus similis*, a common coastal plant, although present elsewhere around the shores of Lake Taupo, is at its great abundance in these wetlands.

Scientific research and facilities: Some monitoring of weed growth and nutrient levels by the Department of Scientific and Industrial Research is being undertaken within the shallower bays of the lake bordering the wetland. The large and diverse avifauna, together with easy accessibility, offer excellent prospects for a range of ecological studies.

Conservation education: No programmes are presently in progress, but some limited opportunity for a wetland interpretation trail exists.

Recreation and tourism: Trout fishing and waterfowl hunting are the major recreational uses of the area. Trout fishing is linked to the large tourist industry within the district. Otherwise, the area has only limited opportunities for recreation.

Management authority: The Department of Conservation (Tongariro/Taupo Conservancy) is responsible for the management of parks and reserves, fisheries management, conservation advocacy and wildlife management. Waikato Regional Council is responsible for catchment planning, control of water use, granting of water rights and pollution monitoring, while Taupo

District Council is responsible for local body reserves and lake bed planning. The Eastern Regional Fish and Game Council manages game-bird (waterfowl) hunting.

Jurisdiction: Territorial: Waikato Regional Council and Taupo District Council. Functional: Department of Conservation (Tongariro/Taupo Conservancy) and Eastern Regional Fish and Game Council.

References: Bell (1986a); Bull (1983); Drake (1983); Gardner (1984); Given *et al.* (1984); Howard-Williams (1986); Rijkse (1986); Soons & Selby (1982).

Reasons for inclusion:

- 1d South Taupo Wetland is an example of a wetland type unusual in New Zealand. It is notable because of its large extent, the variety of wetland habitats occurring within a single wetland area, and its location (a large wetland on a lake edge).
- 2a The wetland supports populations of two globally threatened species of birds, *Poliiocephalus rufopectus* and *Botaurus poiciloptilus*.
- 2b The wetland supports an exceptionally high diversity of plant and bird species, and is thus of special value for maintaining the genetic and ecological diversity of the region.
- 2c The wetland is an important breeding area for various waterfowl including *Phalacrocorax carbo*, *P. melanoleucos*, *P. sulcirostris*, *Cygnus atratus*, *Anas superciliosa*, *A. platyrhynchos*, *A. rhynchotis* and *Aythya novaeseelandiae*.
- 2d The wetland is of special value for its endemic species and communities. Sixteen endemic species of birds have been recorded in the area.
- 3c The wetland regularly supports approximately 4% of the New Zealand population on *Cygnus atratus*.

Source: Cam Speedy and Cathy Jones.