# The waterbirds of Lake Junin, central Peru

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Lake Junin is one of the largest high level lakes in South America and has long been known for its numbers of waterfowl and the flightless endemic grebe *Podiceps taczanowskii*. This paper reports on what is known of the numbers of waterbirds in view of the proposal to use the lake as a water storage reservoir with associated alteration of the water level.

**The area** (Figure 1)

Lake Junin is a large eutrophic natural lake at an altitude of 4078 m drawing its water from c. 1800 km$^2$ of the puna zone of Junin Province in central Peru. Although about 28 km long and 13 km wide at its broadest, it is only 3–4 m deep over most of its area and 11–12 m at its deepest. The surface area of the lake varies from 150 to 400 km$^2$ depending on the amount of water present. The water is fringed by belts of *Scirpus californicus* and *Juncus andecolus* up to 6 km wide which have a total area of 60 km$^2$. A small quantity of these plants is used by the local people for animal feed and artifact manufacture and areas are regularly burnt to drive out guinea-pigs *Cavia tschudii*—a local delicacy. The common aquatic plants include the submerged *Myriophyllum* and *Elodea* and the floating *Azolla*. The mean seasonal difference in water level is 1·5 m, with a maximum in recent years of 2·7 m (per Binnie and Partners). When the level is high, usually

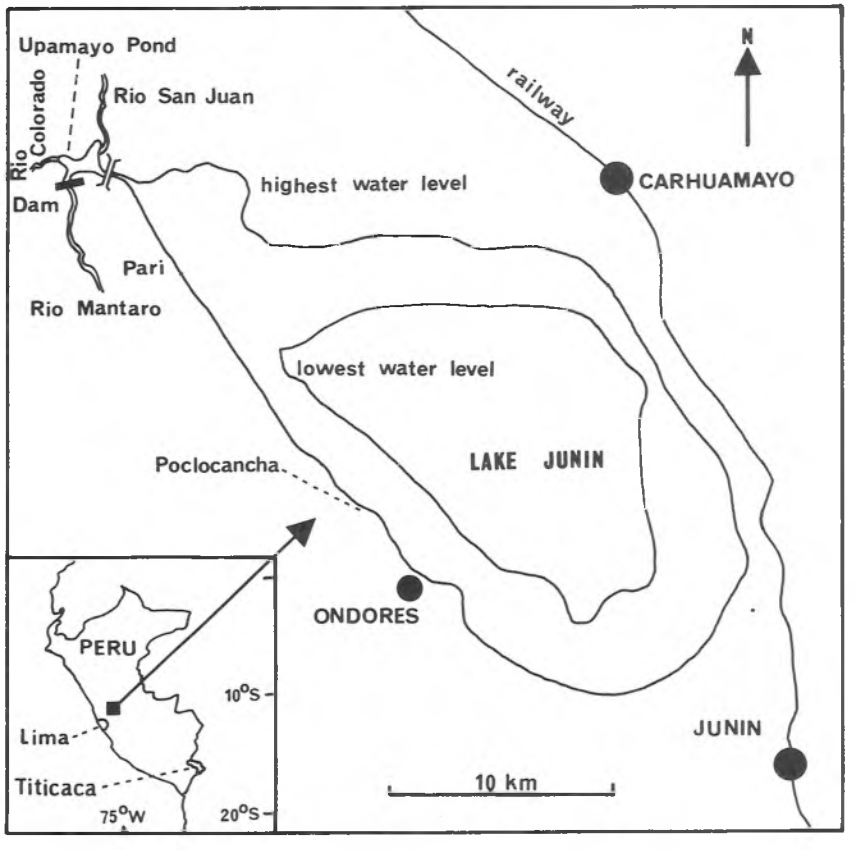


**Figure 1. The outline of Lake Junin and its position in Peru.**



Wildfowl 32 (1981): 137–45

between June and October, large areas of surrounding pasture are flooded. This pasture is extremely heavily grazed by herds of sheep, cattle and llamas. There are few trees at this altitude and turf is the usual fuel for the 6,000 people who live around the lake and for many of the 20,000 in the nearby towns including Junin (9,000) and Carhuamayo (6,000). Large areas of turf are dug up on a 1–10 year rotation. Fish in the lake are two or three small *Orestias* spp. and the catfish *Pygidium orayae*. These, and the totally aquatic giant edible frog *Batrachophrynus macrostomus*, are only common among the reeds. A detailed account of the area is given by Dourojeanni, Hofmann, Garcia, Malleaux and Tovar (1967).

The bulk of the waterbirds occur in two main habitats—shallow pools on the landward side of the reedbeds, especially in the west, and flooded grasslands in the south and the north-east. The density of birds is low among the reeds and in the open water, although the latter is the main habitat of the endemic grebe and moulting ducks and coots. See Figures 2 and 3.

The lake and surrounding land totalling 530 km$^2$ was made a National Reserve in 1975.

**Existing data and methods**

Morrison (1939) collected specimens on the eastern shore of the lake from 18 January–11 May 1938 and guessed the abundance of the waterbirds. Between July 1966 and March 1968, Dourojeanni *et al.* (1968) surveyed the aquatic birds from the shore and produced population estimates by extrapolating from counts on small areas and a very detailed habitat survey. Petterson (1977), who lived at Ondores during 1975, did not attempt any population estimates but his account of the breeding seasons is by far the most complete. Fjeldså (1980) counted the numbers of waterbirds in large areas (1800 ha in January) of different habitats and extrapolated totals for the whole lake between 30 September and 28 October 1977, and 31 December and 17 January 1978.

I visited much of the lake margin 18–23 May and 5–10 October 1979. I had an inflatable boat so for the first time the centre of the lake was systematically covered. Counts were made in sample areas of various habitats and the populations estimated by extrapolation using total areas calculated from maps. In most places 5–10% of the area was counted. Endemic

**Figure 2. Shallow pools on the landward side of the reed-beds at the southern end of Lake Junin.** The lake itself is just visible in the distance. October 1979.

grebes were counted from a rubber boat navigated around the outer margins of the reed-beds and in transects across the lake. In May, the position of every grebe seen was plotted by compass bearings and the water depth measured.

## Species accounts

The available estimates of numbers are summarized in Table 1.

### Junin Grebe *Podiceps taczanowskii*

In May 1979, 145 grebes were counted including pairs with one young (13), two young (7), three young (1) and without young (18). There were 20 single adults. The 17 remaining birds were in groups and certainly included some pairs. There were probably about 45 pairs in the area covered. During the count the lake was glassy calm and grebes with their contrasting plumage were visible for about 1 km. Assuming this range of sighting, about half the open area of the lake was covered suggesting a population of 80–100 pairs or 250–300 birds including immatures. If anything, this will be an underestimate as the assumed sighting range may have been too optimistic. Nonetheless the population is certainly very small. Only three individuals were seen in water less than 5 m deep so very few would have been missed unless they were on lagoons within the reeds. Detailed work by J. Fjeldså (pers. com.) has shown that they do not regularly inhabit such places except when breeding but one was caught in a fish net set in 1 m of water off Ondores in 1979.

The situation had changed by October and 47 grebes were recorded in water 1 m or less deep on the outer edge of the reeds including 34 birds in the south corner of the lake—a place where J. Fjeldså (pers. com.) noted numbers in 1977–78. A further 28 grebes (including a pair with one half-grown young) were seen during the transect across the centre of the lake with the majority (23) north-east of Poclocancha in 5 m of water. It is not possible to estimate the population from these counts as water conditions, and therefore the range of sightings, varied greatly during the survey.

**Figure 3. Lake Junin at Poclocancha in October 1979.** In May the water reached right to the fore-ground.

**Table 1. Status of waterbirds on Lake Junin 1938–79**

| | Jan–May 1938 | June 1969 | 1975–6 | Oct 1977/ Jan 1978 | May 1979 | Oct 1979 |
|---|---|---|---|---|---|---|
| Junin Grebe | extremely abundant | not seen | common | 300 | 300 | |
| White-tufted Grebe | common | 4,000 | very common | 3,600/4,000 | 1,000 | common |
| Silvery Grebe | rather scarce | 200 | frequent | c. 50 | very few | |
| Black-crowned Night-heron | common | 250 | common | very common | fairly common | common |
| Puna Ibis | extraordinarily common | 8,000 | very common | in region of 8,000 | abundant | abundant |
| Chilean Flamingo | not seen | 595 | abundant | 300 | none | 829 |
| Andean Goose | occasional | 796 | common | present | 500 | 1,000 |
| Crested Duck | not common | 100+ | fairly rare | ? | few | few |
| Speckled Teal | fairly common | 33,000 | very common | 7–8,000 | 1,000 | 10,000 |
| Puna Teal | commonest duck | 400,000 | very common | 12,000 | 50,000 | 8,000 |
| Yellow-billed Pintail | a good many | 16,000 | very common | 6,000 | 1,000 | 1,000 |
| Peruvian Ruddy Duck | common | 5,000 | frequent | 2–3,000 | | 1,500–2,000 |
| Plumbeous Rail | common | few | frequent | thousands | frequent | not seen |
| Common Gallinule (= Moorhen) | common | 316,000 | frequent | 50–65,000 | | 10–15,000 |
| American Coot | extraordinarily common | 67,000 | common | 15–17,000 | 4,000 | 15,000 |
| Andean Gull | extraordinarily common | very abundant | very common | 3,000 | small numbers | hundreds of pairs |

Note: 1. Chilean Flamingo and Andean Gull are not resident on the lake.
2. Figures refer to birds.
3. Data from Morrison (1939), Dourojeanni *et al.* (1969), Petterson (1979), Fjeldså (1980) and my own records.

**Figure 4. A group of flightless Junin Grebes in glassy calm condition, May 1979.**

Fjeldså (1980) suggested a total population of 100 pairs or 300 birds including immatures in 1977. He estimated 70 and 75 grebes living along 9·5 and 12 km of reed edge off Ondores in October 1977 and January 1978. I saw 41 birds in 8 km of the same reed-edge in October. Although our close agreement of the total population may be circumstantial, the population is certainly small. See Figure 4.

White-tufted Grebe *Rollandia rolland*

This common and obvious species lives in shallow waters all around the lake and in pools among the reeds. It was less common outside the reeds and absent from the centre of the lake in May 1979 but small numbers were there in October. My estimate of 1,000 birds is possibly too low as the ponds within the dense reed-beds were inadequately sampled.

Silvery Grebe *Podiceps occipitalis*

This is the rarest of the resident grebes and the few I saw in May were among the outer fringes of the reeds except for two birds where the Rio Colorado entered Upamayo Pond. The latter had red underparts, presumably from iron in the water. Numbers may vary greatly and 200 and 50 birds were recorded in 1967 and 1977–78 but none in October 1979.

Neotropic Cormorant *Phalacrocorax olivaceus*

Morrison recorded a few in February 1938 and there were two in October 1979. A local hunter who was helping me had never seen the species before. Its rarity is probably due to the scarcity of medium-sized fish.

Black-crowned Night-heron *Nycticorax nycticorax*

Small numbers occur in most reed-beds and flooded areas.

Cattle Egret *Bubulcus ibis*

Small numbers occur with cattle and elsewhere but the species does not breed at this altitude.

Puna Ibis *Plegadis ridgwayi*

This, the most conspicuous bird of the lake edge, is common in all wet areas. Estimates of 8,000 in 1967 and 1977–78 seem reasonable for 1979.

Chilean Flamingo *Phoenicopterus chilensis*

Junin is by far the most northerly breeding area of this species which leaves the lake when the water level is high between February to May. Most counts are in the range 500–1,000 birds.

Andean Goose *Chloephaga melanoptera*

Counts vary from 500–1,000 birds. Birds nest in the nearby mountains and only rarely near the lake.

Crested Duck *Lophonetta specularioides*

The population is small and probably only a few pairs breed. It is much commoner at higher altitudes.

Speckled Teal *Anas flavirostris*

Although seen all around the lake, the species is commonest on flooded meadows. Numbers vary greatly, for instance there were only 1,000 birds in May but 10,000 in October 1979 when it was the commonest duck.

Puna Teal *Anas puna*

This is usually by far the commonest duck occurring in all habitats except the centre of the lake.

Yellow-billed Pintail *Anas georgica*

The 1979 estimate of 1,000 birds may be too low, but there were certainly far fewer than the 6,000–16,000 recorded in 1967 and 1977–78. In May several hundred birds in the lake centre were moulting their primaries.

Blue-winged Teal *Anas discors*

Although usually a rare visitor in the northern winters, Petterson (1977) reported hundreds.

Peruvian Ruddy Duck *Oxyura jamaicensis ferruginea*

This is common on all parts of the lake including the centre. Some birds occur on the red-tinged Upamayo Pond.

Plumbeous Rail *Rallus sanguinolentus*

Fjeldså (1980), the only observer to have spent nights in the reed-beds, suggested a population of thousands, maybe tens of thousands, of birds. I found it common in May but saw none in October.

Common Gallinule *Gallinula chloropus*

This moorhen is abundant all around the lake even in the contaminated water in the northern part of the lake.

American/Slate-coloured Coot *Fulica americana/ardesiaca*

Both these two forms of a single species (Gill 1964) are abundant between the reedbeds and the lake edge, and common among the reeds and in the lake centre.

Giant Coot *Fulica gigantea*

This is an occasional visitor. It is common in deep, open lakes slightly higher up the mountains.

Wilson's Phalarope *Steganopus tricolor*

Tens of thousands occur during the northern winter.

Andean Gull *Larus serranus*

Hundreds or possibly thousands of pairs breed in small colonies scattered through the reeds. It is less common at other times of year.

Several other species have been recorded (see Fjeldså 1980) including Piedbilled Grebe *Podilymbus podiceps*, Common Egret *Casmerodius albus*, Snowy Egret *Egretta thula*, Striated Heron *Butorides striatus*, Fulvous Tree-Duck *Dendrocygna bicolor*, Cinnamon Teal *Anas cyanoptera*, Blackish Rail *Pardirallus nigrans*, Black Crake *Laterallus jamaicensis*, Sora Rail *Porzana carolina*, Franklin's Gull *Larus pipixcan* and the surrounding area of fields and shore supports large numbers of waders including the resident Andean Lapwing *Ptiloscelys resplendens* and migrating Yellowlegs *Tringa* spp. and Baird's Sandpiper *Calidris bairdii*.

**Breeding seasons**

The information available is fragmentary and only Petterson (1977) spent long enough in the area to obtain meaningful series of records. Most other data come from sightings of small young or statements made by local hunters.

Many of these waterbirds have very prolonged breeding seasons with Peruvian Ruddy Ducks, Coots and Gallinules breeding in all or virtually all months of the year (Table 2). Some of this spread is probably due to yearly differences in laying dates linked to the rather variable time when the lake level changes. However, most species lay between September and March and

**Table 2. Breeding seasons of waterbirds of Lake Junin, central Peru**

| | J | F | M | A | M | J | J | A | S | O | N | D |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Junin Grebe | x | x | x | | | | | x | | | | x |
| Silvery Grebe | x | x | x | | | | | | | | | x |
| White-tufted Grebe | x | x | x | x | x | | | | x | x | x | x |
| Black-crowned Night-heron | x | x | | | | | | x | x | x | | |
| Puna Ibis | x | x | | | | | | X | X | | x | x |
| Chilean Flamingo | | | | | | | | | | x | x | x |
| Crested Duck | x | x | x | | (x) | | | | | x | x | x |
| Speckled Teal | x | x | x | | | | | | | | X | X |
| Puna Teal | x | | | | | | | x | x | x | x | |
| Yellow-billed Pintail | x | | | | | | | x | x | x | x | x |
| Peruvian Ruddy Duck | x | X | X | X | x | x | x | x | x | x | x | x |
| Plumbeous Rail | | | | | | | | x | x | x | x | x |
| Common Gallinule | x | x | x | x | | | X | X | X | X | X | x |
| American Coot | x | x | x | x | x | | X | X | X | X | X | x |
| Andean Gull | | | | | | | | | x | x | x | x |
| No. of species nesting | 12 | 10 | 8 | 4 | 3 | 1 | 3 | 9 | 10 | 11 | 12 | 13 |
| No. of years water level | | | | | | | | | | | | |
| increased | 22 | 28 | 28 | 20 | 8 | 1 | 1 | 1 | 0 | 6 | 6 | 13 |
| no change | 1 | 0 | 0 | 4 | 2 | 3 | 0 | 0 | 0 | 2 | 1 | 0 |
| decreased | 6 | 1 | 1 | 5 | 19 | 25 | 28 | 28 | 29 | 21 | 22 | 16 |

Notes: 1. x = breeding recorded, X = main laying period if known, (x) = possible record.
2. Data from Morrison (1939), Dourojeanni *et al.* (1968), Petterson (1977), Fjeldså (1980) and present study. Water levels supplied by Binnie & Partners.

many of the records between March and July probably refer to repeat layings following the failure of the first attempt. The Peruvian Ruddy Duck may be an exception as Petterson (1977) gives the main laying season as February to April. This and the grebes are the only species which have their peak of breeding when the water level in the lake is rising.

**Hunting**

There is much hunting both of wildfowl and for the giant edible frog, and the collection of bird eggs is common. The local people have no fire-arms and birds and frogs are mainly speared by fishermen standing in narrow, flat-bottomed metal boats which are poled through the reeds. The birds most commonly killed are Peruvian Ruddy Duck, Common Gallinule, Coot and White-tufted Grebes—that is species living among the reeds. The endemic grebe is not bothered as its atrophied breast muscles make it hardly worth eating (J. Fjeldså, pers. com.). Small numbers of ibises and other wading birds are caught using small bolas. Hunting was officially banned when the lake was made a National Reserve but still continues. In 1979 up to 700 people were thought to hunt birds or collect eggs. Hunting pressure is probably too low to influence the numbers of birds but the protein obtained contributes much to the well-being of the extremely poor people. There seems no reason to stop these traditional activities.

**Numbers of waterbirds**

The large extent of the lake and especially of the reedbeds make any accurate assessment of the numbers of waterbirds extremely difficult. The available counts or estimates of numbers (Table 1) were all obtained in different ways. The accuracies of the estimates are unknown, but can fairly be assumed to be low.

Dourojeanni *et al.* (1968) suggested that the lake may have supported about a million waterbirds. Fjeldså (1980) estimated about 100,000 birds in 1977–78 and was sceptical of the earlier estimate, wondering whether it was too high due to uncritical extrapolation from sample counts. The 1979 total was slightly less at about 75,000 birds. The main differences are in the estimates of the common species, especially Puna Teal (400,000, 12,000 and 8,000–50,000 birds in 1967, 1977–78 and 1979 respectively) and Common Gallinule (316,000 in 1967 but only 10,000–15,000 birds in 1979).

The estimates were made at different times of year and it is known that ducks and maybe other waterfowl concentrate on the lake during the dry season when many of the numerous smaller lakes and pools in the area dry up (Fjeldså 1980). The high 1967 counts were made in June, when water levels are generally low. Even allowing for the undoubted inaccuracies in all the results, there appears to have been a decline in the numbers of waterbirds between the mid-1960s and the late 1970s.

The lake is superficially similar to Lake Titicaca, the only other large lake in the Peruvian Andes, but this has a mean depth of 90 m and its ecology has been drastically altered by the introduction of predatory trout *Salmo gairdneri* and intensive agriculture around the margins. Other Andean lakes are either very small or deep and lack the extensive reed-beds. It is unlikely that these birds would have moved elsewhere, or that the other lakes will be able to support any birds driven out by future changes in the lake.

**Conservation**

Even if the populations have declined, the lake still supports one of the largest concentrations of waterfowl in the Andes. Unfortunately even such inaccurate estimates as these are not available for other lakes so it is impossible to place Junin's waterbirds in a wider perspective. The future of the lake and its birds are threatened by pollution and development.

Up to 1933, the only water entering the lake came from direct catchment. Then a dam and weir were built at the northern outflow at Upamayo. This raised the level of Upamayo Pond and allowed water from the Rio San Juan and Rio Colorado to be diverted into the lake. The latter river is well named as its water is red with iron. Since 1933, Upamayo Pond, once many metres deep, has become filled up by silt brought down by waters from the numerous large mines upriver at Cerro de Pasco and elsewhere. This has resulted in much river water overflowing into Lake Junin at times of flood. About 1958 these mines adopted a cementation process where scrap iron is sacrificed and other desirable metals precipitated. This iron itself is later precipitated when the acid mine water

meets the alkaline lake water. The resulting flocculant iron stains the shores of the lake from Upamayo to well south of Pari, and has been suggested as a cause for the reduction in edible frogs in the lake between 1962 and 1966 (Dourojeanni *et al.* 1968). See Figure 5.

The flocculant deposits now cover the bottom of the lake up to at least 14 km from the inflow of the Rio San Juan and are noticeable even in the lake centre (A. J. E. Smith, pers. com.). Fish are absent from the polluted shore-line and most bottom-dwelling animals and plants are smothered over perhaps a third of the lake area. If the pollution continues, it seems inevitable that there will be little animal life in the lake in a decade or two. There is no evidence that soluble metal pollution is having an adverse effect on the birds but it probably explains why trout are absent.

Lake Junin may be used as a water storage reservoir as part of a scheme—the Mantaro Water Transfer Project—to divert water across the Andes to serve the growing needs of the city of Lima. This would necessitate the removal of more water, either by increasing the capacity of the lake by raising the level by up to 1·0 m or by extracting more water during the dry period of the year. The first alternative would result in the flooding of reed beds and pastures, the second in a great reduction in the area of the lake and minimum depth during years of drought. However, if water is to be used for domestic purposes much of the pollution would have to be stopped and the water quality improved. This would have a marked beneficial effect.

The endemic grebe utilizes both the deep water in the centre and the outer reed-edges during the breeding season. These habitats are quite separate. In May 1979, the bulk of the population was in water more than 5 m deep. Presumably deep water is the preferred habitat, although birds must visit shallow water to breed, but the species may be forced to go there because of competition with the very numerous White-tufted Grebe. Whatever the reason, the endemic grebe's habitat in May was the deep area of the lake where there is 4–7 m of water even in the driest year. Although the grebe was once thought to occur on other nearby lakes, these re-

**Figure 5. Upamayo Pond in October 1979.** Before the building of a dam and weir in 1933 this lake was many m deep. Now it is filled up with silt from mines upstream and stained red with flocculant iron precipitates.

cords refer to mis-identified Silvery Grebes (R. W. Storer, pers. com.). The survival of this flightless species would be seriously threatened if the water level was lowered much below the recorded minimum or if the pollution extended much further into the lake. It could probably cope much better with an increase in water level.

The effects of changes in water level on the other waterbirds is harder to assess. Ducks, gallinules, coots, geese and White-tufted Grebes would probably still find sufficient food, although when the water was at its highest level they would be forced closer to roads and houses with increased risk of disturbance. This might be important to geese but the other species would easily adjust if hunting was restricted to traditional methods.

Although the use of Lake Junin as a reservoir would inevitably cause great changes, it appears to be the only hope of preventing the lake becoming more polluted and its ecology destroyed. The cost of dredging out the silted Upamayo Pond which would prevent much of the polluted water entering the lake is estimated at several million pounds sterling, obviously well beyond the limits of any conservation agency. This is one area where large scale development, suitably managed, might help preserve a unique collection of waterfowl.

**Acknowledgments**

My thanks are due to A. J. E. Smith, M. A. Plenge, Prof. K. Mellanby and staff of Binnie and Partners for help in Peru. Dr D. Jenkins improved the manuscript with criticisms. The study was undertaken by the Institute of Terrestrial Ecology under a contract with Binnie & Partners, Consulting Engineers, as a part of a feasibility study of the Mantaro Transfer Scheme commissioned by the Ministerio de Vivienda y Construccion of the Government of Peru.

**Summary**

The past and present status of 21 species of waterbirds are described. Many species have prolonged breeding seasons with some breeding in all months of the year. The population of the endemic flightless grebe *Podiceps taczanowskii* is 80–100 pairs. This, and other species, is threatened by pollution and plans to alter the water level of the lake.

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