Status Survey and Conservation Action Plan

Grebes

Compiled by Colin O'Donnel and Jon Fjeldså

IUCN/SSC Grebe Specialist Group

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Foreword

Grebes have been around for 40 million years. When you look at a grebe you are looking at something whose genetic identity is ten, maybe twenty times longer established than your own. This is a good way to start thinking about grebes and their place on the planet we fondly imagine ours.

But when you look at a grebe in close-up, you get something else altogether: an electric shock of surprise! They almost look 40 millions years old! With their blood-red eyes and their crests and ear-tufts and taillessness, they look to have come from another world. Even the most familiar of them, bobbing up like unsinkable toys in drainage ditches and the reedy corners of our domestic reservoirs, just when we thought there was nothing interesting to be seen there – even these everyday creatures are somehow alien and remote, as fiercely resistant to our interest as to our help. To witness their courtship – those wonderful water-dances when two birds tread water face-to-face waving water-weed in their bills, or rush side-by-side across the water, bodies upright and calling wildly – is less to learn anything of *their* lives than to sense the crippling limitations of *ours.*

There are only 22 species in the family and we have managed to lose three of them in the past 30 years (if the Alaotra Grebe is not yet quite gone it is, in the true sense of that misused, haunting phrase, "committed to extinction", and I personally think we shall be able to do nothing for it now but mourn). No other widespread avian family can match this ratio. Worse, we are on the brink of losing a fourth; and there are three others listed in the IUCN Red List, queuing quietly up for oblivion.

We *can* save them. But the key message in this action plan is that we can *only* save them by ensuring that their wetland homes retain enough of their original character – their food chain structures – for the grebes, which are simply the final expressions of those structures, to continue in their ancient ways. So here we have a blueprint for some desperately needed ecosystem management which will benefit not just one or two target species but also whole suites of other animals and plants that participate in these ecosystems. In a real sense this is a *habitat* action plan, something that environmental managers who have never actually seen a grebe can still confidently use as one of their source-books. If they do, they stand to give the world of the future the chance to see what they have missed – and it's well worth the seeing!

N.J. Collar
BirdLife International

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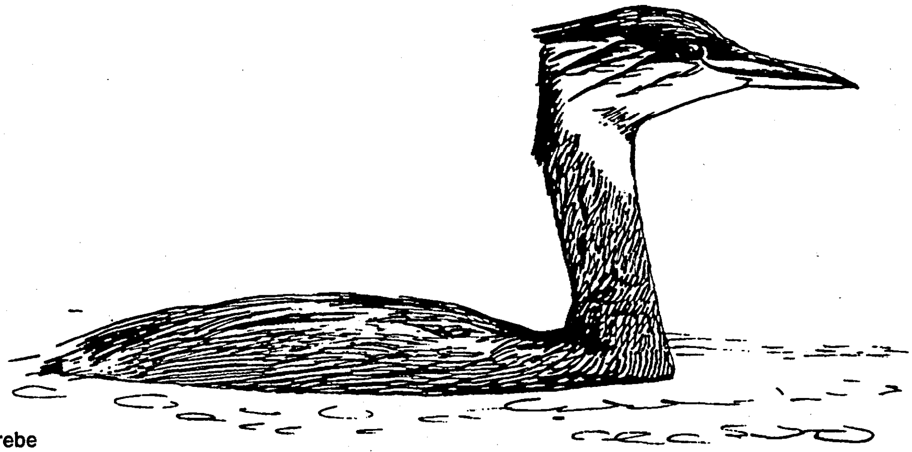


Titicaca flightless grebe

Executive Summary

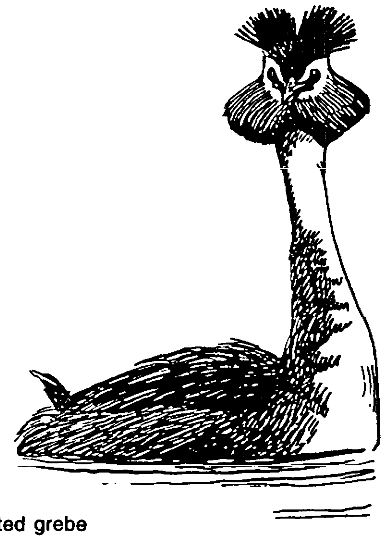
Grebes are specialised waterbirds which inhabit marshes and reed-fringed lakes. Virtually unable to move on land, they build floating nests and find all their food (arthropods and fish) in the water. Because of their total dependence on wetlands they are sensitive to changes in these ecosystems. Changes in numbers of grebes may reflect changes that take place under the water's surface, at the trophic web level, which easily escape our attention. Because of grebes' sensitivity to changes in the trophic webs of wetland ecosystems, grebes could be used as indicators of such changes, and as symbols of the struggle to restore these ecosystems. Of the 22 recognised species of grebes, two have gone extinct since ca. 1970 and two others are in a critical situation. All these cases reflect serious changes in aquatic ecosystems which also affect human livelihood.

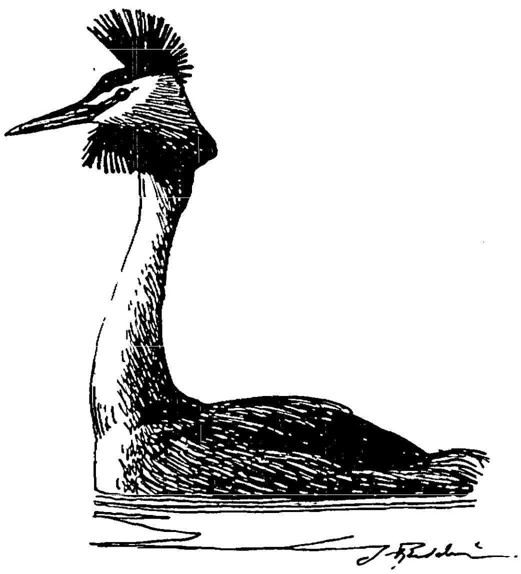
This Action Plan reviews the current distribution and status of grebes of the world, identifies threats to grebe populations, and formulates world conservation objectives and specific conservation actions, particularly for threatened species. Furthermore, by indicating how grebe populations are influenced by changes in the trophic webs of wetlands, it highlights the potential importance of demographic data on grebes in monitoring the health of these ecosystems. This document integrates both species and ecosystem approaches into a global action plan.

The prevailing threat to grebes this century has been loss of habitat, particularly because of the conversion of shallow lake habitats into agricultural land and the re-allocation of water for other uses. Additional threats include the deleterious effects of pesticides; altered functioning of wetlands because of eutrophication, pollution, siltation, introduction of fish and other predators and competitors; alterations to water levels; and the modern increases in water-based recreation. Certain populations are affected by oil pollution and gill netting. The impact of such factors on populations varies greatly because of different breeding strategies (some species being opportunistic and multiple-brooded, others showing a very slow breeding rate) and feeding habits.

The conservation status of 22 grebe species, and their currently recognised subspecies, is summarised in this Action Plan. Six species were classified in the four threatened or potentially threatened categories as well as twenty subspecies of the remaining species. The majority of threatened forms occur in Central and South America, followed by Southeast Asia/Australasia. Of these, two species were classed as Critically Endangered: Delacour's little grebe from Madagascar and the Junín flightless grebe from Peru. A subspecies of the white-tufted grebe (*R. rolland morrisoni*) from Lake Junín, Peru is classed as Endangered. The other threatened and potentially threatened subspecies are mainly island forms in the Australasian islands. Two species, the giant pied-billed grebe from Guatemala and the Colombian grebe are thought to be extinct.

As a result of this review of grebe status, the IUCN/SSC Grebe Specialist Group has created the Global Conservation Strategy to ensure the successful recovery of grebe populations and the management of wetlands. The Strategy includes eight priorities:





Great crested grebe

Priority 1
Immediate production and implementation of recovery plans for critically endangered grebe species: the Junín flightless grebe from Lake Junín in Peru (*Podiceps taczanowskii*) (ca. 200 birds); a subspecies of white-tufted grebe (*R. rolland morrisoni*) (ca. 500 birds) also from Lake Junín; and Delacour's little grebe from Madagascar (*Tachybaptus rufolavatus*) (possibly extinct). To be effective, these plans should include comprehensive lake restoration actions. The wetlands in question represent principal local hydrological and production resources.

Priority 2
Conservation of grebes through identification and sustainable management of wetlands of international and regional importance for grebes. Where appropriate use grebes to raise public awareness about the importance of wetlands.

Priority 3
Development of methods for using grebes as keystone indicator species for monitoring wetland health and biodiversity, changes in the ecological functioning of wetlands, and the success of management measures. Grebes may be particularly useful as bioindicators for the planning of wetland management in the western Palearctic, Manchuria, western North America, southern South America, and the Andes.

Priority 4
Development of management techniques for the maintenance and restoration of grebe populations.

Priority 5
Clarification of the conservation status of grebe species currently classed in the Data Deficient threat category. Establishment of a monitoring system for these species.

Priority 6
Monitoring of key grebe populations, particularly Vulnerable species which may become Endangered in the future.

Priority 7
Clarification of taxonomic status of potentially threatened taxa.

Priority 8
Promotion of public awareness of grebes and their wetland habitats.

This Action Plan is aimed to assist the Species Survival Commission/BirdLife International (formerly ICBP)/ Wetlands International Specialist Groups, specialists in wetland management and restoration, and other relevant government institutions and development agencies which may help implement it or use it as a reference for their own action plans. The Grebe Specialist Group co-ordinates the implementation of this plan. However, since SSC groups operate on a voluntary basis, it is often difficult to produce output for specific deadlines; thus, Regional Co-ordinators and implementing institutions need to be identified and some funding obtained (core funding as well as project money).

Chapter 1

Introduction

This Action Plan reviews the current distribution and status of grebes of the world, identifies threats, and formulates world conservation objectives and specific conservation actions, particularly for threatened species.

1.1 Background and vision

The order Podicipediformes consists of one family, the Podicipedidae or grebes, an ancient group of specialist diving birds. They inhabit all continents, but are most common in the temperate to subtropical climatic zones. The family contains six genera with altogether 22 species (Vlug and Fjeldså 1990) and they appear to have no close relatives among other birds (Sibley and Alquist 1990).

Grebes are specialised birds of freshwater lakes and marshes. Their peculiarly lobed toes propel and steer them underwater. Their large feet are set well back on the body, making them efficient swimmers, but clumsy on land; therefore, they avoid leaving the water. Thus, grebes even nest on the water, in floating nests which they build of reeds and water-weeds. Since grebes normally cover their eggs with nest material when leaving them, the nests look like rather random accumulations of floating plant debris. Some species form breeding colonies, often near other waterbirds, but other species breed as scattered pairs and conduct a rather secluded life as long as they are nesting. At other times of the year, when they inhabit open lake surfaces, they are conspicuous members of many wetland avifaunas.

Grebes typically inhabit marshes, ponds, brackish coastal lagoons, or shallow lakes with muddy or sandy bottoms that are often fringed with reeds. Being strongly specialised, grebes do not leave these habitats unless forced to. Grebes which inhabit northern lakes which freeze in the winter or arid zones where wetlands sometime dry up, normally migrate and spend unfavourable periods on larger lakes, estuaries, harbours, or coastal waters, often in large numbers. Grebes normally migrate and fly between lakes by night. However, grebes which inhabit non-seasonal climatic zones may not need to migrate. Such species fly only very rarely and a few of them have become flightless or virtually so.

Fish-eating grebes have long, pointed bills; whereas, insect-eaters have short, stubby bills. Food is obtained by diving, or, sometimes, picking it from the water's surface. Most grebes, especially the fish-eating species, swallow their own feathers which appears to help in the formation of digestive pellets. It may also help them to get rid of intestinal parasites.

The sexes are alike, but males are larger than females on average and have longer bills. Most grebes have handsome breeding plumage, often with distinctive markings on their face and neck or with crests and head plumes. The colours are mainly blackish, warm brown, buff, and white. Many grebes have complex, ritualised pair-bonding and courtship displays which often take place in full view on the open lake surface. Grebes exhibit both territorial and colonial nesting behaviour, depending on differences in feeding strategies. The young are covered with short down and are able to dive shortly after they hatch. However, the young depend on their parents for several weeks and use them to ride on their backs (often hidden under the parent's wings). A very high proportion of the world's grebe species have been the subject of detailed study (see the review in Vlug and Fjeldså 1990).

Grebes are found throughout the world, but centres of diversity occur in South America (the southern cone of the continent and the Andes), and the steppe/forest ecotones of the Holarctic (see Figure 3.1). Many species range through both tropical and temperate regions. Some species are represented by a large number of subspecies. For example, *Tachybaptus* shows a complex vicariance pattern throughout Southeast Asia and Australasia, the Australasian little grebe having seven subspecies and the Eurasiatic little grebe having seven subspecies in this region, and altogether 10 subspecies. Grebes are poorly represented in the tropical rainforest biomes and in eastern North America. These regional trends may, to some extent, be related (inversely) to the complexity of the fish fauna, because of the strong impact fish may have on the trophic structure of wetlands (Reichholf 1975).

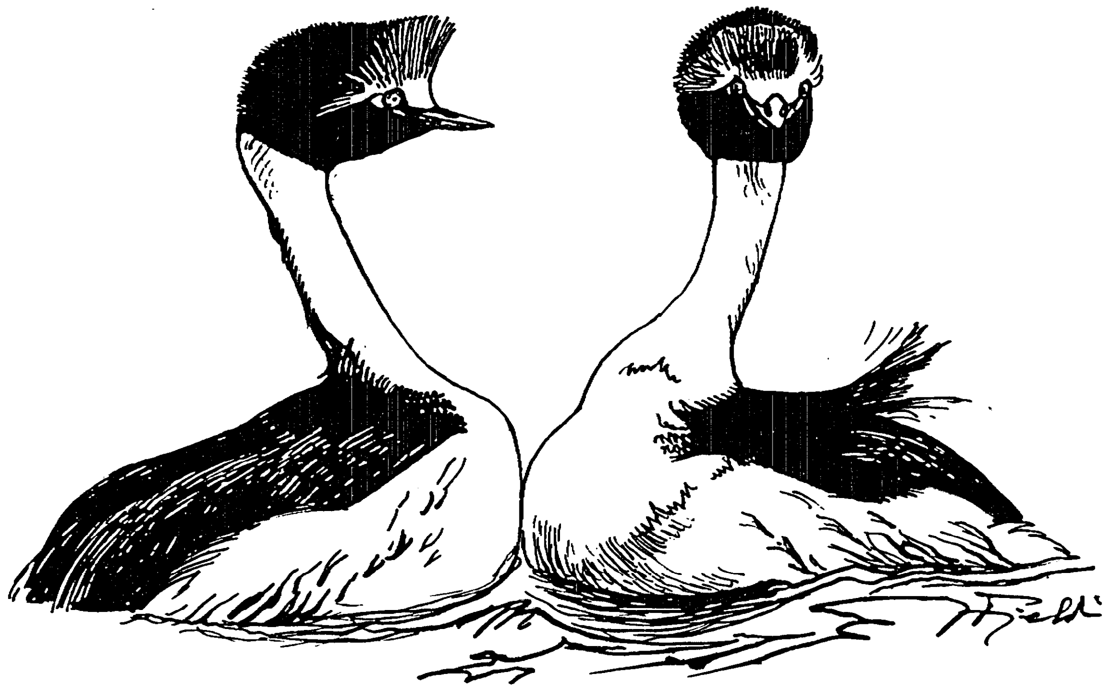
The establishment of an IUCN/SSC Grebe Specialist Group was first proposed at the International Waterfowl and Wetlands Research Bureau (IWRB) XXXI Annual Meeting in Paracas, Peru, on the 10–16 February, 1985. This need was recognised because one quarter of the world's grebe species were thought to be threatened by extinction or to have died out during the last few years. One species may have already been extinct at the time of the first call of alarm, and another died out recently, despite considerable efforts to rescue it.

Aims for the Specialist Group are: (1) to stimulate or initiate relevant research on grebes, with special regard to detecting threats to the populations; (2) to define proper conservation measures; (3) to secure the continuation of the management projects for populations at risk; (4) to detect and warn against new threats to grebe populations; (5) to use grebe studies more purposefully for developing priorities for wetland conservation in a broader sense. Grebes have proved to be a valuable group for the study of ecological interactions in wetland habitats and as such, have stimulated the development of a wider vision for wetland conservation. The conservation of grebes and other groups of wetland organisms would be greatly enhanced if SSC expert groups integrated their approaches to wetland conservation and focused on the management of ecosystem processes, as well as species management. The marine and freshwater aquatic habitats which grebes and other species inhabit exhibit complex and interrelated functions. Thus, management of one group will have flow-on effects on other groups and could influence ecosystem processes. The needs of one taxonomic group should be considered along with those of other groups under threat. Grebes are important examples of how conservation of wetlands *per se* would benefit a species group immensely. This document attempts to integrate both species and ecosystem approaches into a global Action Plan.

Threats toward grebes have changed over time. A century ago, species such as the great crested grebe and the western grebe were brought to the edge of extinction in parts of their ranges because of the use of "grebe-fur" in women's fashion. Grebes have also been persecuted on the suspicion of harming freshwater fisheries, but are presently hunted only in small parts of the world. The prevailing threat this century has been loss of habitat, particularly because of changes to shallow lake habitats and wetlands caused by human activity, such as wetland conversion to agricultural land. These changes to limnic communities have had a profound impact on grebe species, initiating the immediate need for wetland conservation action.

1.2 Assessing conservation status

The assessments of grebe conservation status in this Action Plan are based on both the 1994 IUCN Red List Categories (see Appendix 3) and the 1992 Mace *et al.* categories of threat which were an earlier version of the



Hooded grebes

final system adopted in 1994. All species and subspecies have been classed according to the 1994 IUCN Red List Categories.

Population estimates are from the IWRB database, from estimates from members of the Grebe Specialist Group (Appendix 1), and from Perennou *et al.* (1994) for Asia, Marchant and Higgens (1990) for Australasia, and Cramp *et al.* (1977) for the western Palearctic. Populations of many of the grebes were grouped in the current IWRB abundance categories: A: Less then 10,000; B: 10,000–25,000; C: 25,000–100,000; D: 100,000–1,000,000; E: Over 1,000,000. Quantitative data are lacking for many parts of the world and in some cases, the population estimate is only a qualified guess.

A major source-book for the review was the Working Bibliography of the Grebes of the World (Vlug and Fjeldså 1990). The references in this book are ordered by key words; therefore, it is easy to find complete l istings of sources of information on distribution, numerical status etc. For this reason, the present publication contains only a minimum of references, including most recent publications.

Adult white-crested grebe bringing fish to its young.

Chapter 2

Review of Threats and Causes of Decline

2.1 Habitat loss and degradation

2.1.1 Wetland modification

The most conspicuous habitat modification which has negatively affected grebe populations has been the manipulation of water levels, particularly as a result of the intensive reclamation of wetlands and the reallocation of water which first took place in the industrialised world (see next section). Worldwide cutting and burning of reeds often has a conspicuous and immediate impact on wetland habitats. Destruction and changes in vegetation on the margins of wetlands cause loss of breeding habitat, facilitate increased disturbance of breeding grebes by increasing access to lake shores, and often cause an increased amount of silt and pollutants in the inflowing water. The Colombian grebe and the Junín flightless grebe were strongly affected by water level alterations which caused changes in the vegetation of their lakes.

Although much attention has been given to the very "visible" effects of water level alterations and the destruction of reed-beds, grebes may be even more affected by changes in the trophic conditions of wetlands. Grebes may disappear from lakes with excellent marginal vegetation for nesting because of trophic changes, while in cases where there is plenty of food, grebes nest successfully in exposed coastal areas without normal grebe nest sites (e.g., Fjeldså 1973a, Ulfvens 1989ab). The trophic conditions of wetlands change because water regimes, water chemistry, and inflow sediments are being modified. This may be triggered by factors in the entire surrounding catchment, in terms of fertilisers used, irregular variations in run-off, and siltation. A widespread deterioration of lake conditions has been observed since the early 1960s in many industrialised northern hemisphere countries. The growth of municipal and industrial waste disposal, and the intensification of agriculture, has led to the rapidly increasing enrichment of waterways with nutrients. This nutrient enrichment has resulted in increased plant productivity which manifests as algal blooms, turbid waters, deoxygenization, and excessive macrophyte growth.

However, the effect of such changes on grebe populations are far from fully understood. In many regions, the introduction of modern agriculture had an overall positive impact on grebes. In the 19th century, grebes were generally rather scarce in western Europe, which had strongly degraded landscapes with large areas of fallow land and oligotrophic cultural heathlands. A marked increase in most grebe populations was once attributed to legal protection, but probably an even more important factor was the eutrophication caused by the use of fertilisers and incipient pollution. Marked numerical and geographical changes are described for all European grebes, but notably for the black-necked grebe (which "invaded" western Europe from the east), the horned grebe (which colonised Sweden and now expands into southern Norway, but declines elsewhere) and the great crested grebe (which expanded strongly from the mid-1800s and recently showed a numerical "explosion" in the northern parts of its range).

At first, grebes profited from higher water productivity caused by eutrophication. High densities of grebes (and other waterbirds) are sometimes found in sewage farms and in strongly polluted lakes near garbage dumps. Piscivorous grebes benefit from the "explosion" of cyprinid fishes in eutrophicated lakes. However, this advantage is reversed as the fish populations cause a higher turnover of nutrients (Andersson 1982) leading to simple food chains (phytoplankton, microzooplankton and plankton-eating fish) and finally, pH and NH_3 levels which are too high for fish reproduction. These changes have different effects on each grebe species. Crested grebes take advantage of the abundance of fish, even in truly hypereutrophic lakes (see section on Great crested grebe, p. 25). The gregarious hoary-headed, black-necked, Colombian, silvery, and hooded grebes are more sensitive. Because of their specialisation on small prey (macrozooplankton and arthropods and their larvae), their breeding success depends strongly on fairly clear water with underwater water-weed "meadows" harbouring high densities of invertebrates (Fjeldså, 1988, 1993). While benefiting from incipient eutrophication, these species are highly sensitive to stronger pollution, siltation, or build-up of dense (competing) fish populations.

Introduction of fish in many areas has changed the food sources available to grebes (e.g. Madagascar, Guatemala). Introduced predatory fish have decimated indigenous fish and have become new competitors for grebes (e.g. New Zealand). In Andean lakes, the introduction of trout caused a decline of the macrozooplankton community which is vital for silvery grebes (and flamingos) (Hurlburt and Chang 1983).

Changes in habitats have also meant that some adaptable species expand strongly and come into contact with previously isolated (local) species, which become "swamped away" because of hybridisation (e.g. Madagascar).

A particularly graphic example of long-term, incremental degradation of grebe habitat, resulting in extinction of a grebe species and marked declines of other wetland birds is provided by LaBastille (1993) for Lake Atitlán, Guatemala. In 1960 there was a stable population of ca. 200 giant pied-billed grebes on the lake. Since then, the number of kilometres of reeds and cattails (the main aquatic habitat) has been reduced from 25 to 7.3km, 35% of which is too narrow to use. The number of fish species on the lake has been reduced from 18–19 to six to eight, the water level has dropped markedly, the number of buildings near the lake shore has increased from 28 to over 550, amounts of raw sewage from surrounding settlements has increased, and a wide variety of recreational boats are being used on the lake. The giant pied-billed grebe became extinct by 1991 and many other wetland species have been severely reduced. Similar, interrelated modifications have severely affected Lake Tota in Colombia (see section on Colombian grebe, p. 28) and Lake Junín in Peru (see section on Junín flightless grebe, p. 29).

2.1.2 Water level modification

Grebes appear to be sensitive to extreme water level fluctuations which occur in hydro-electric and other water storage lakes. For example, productivity of the crested grebe has been badly affected by the creation of water storage lakes in New Zealand (O'Donnell 1983). Nesting birds have an inability to cope with widely fluctuating water levels. The size and shape of the nest makes it vulnerable to flooding. In New Zealand, highest grebe numbers occur on lakes with very stable water levels and greatest productivity occurs in years when water level fluctuations are least (O'Donnell 1983).

In Lake Junín, Peru, pollution, combined with declining water levels due to unsustainable management of the hydroelectric power plant, severely affect the Junín flightless grebe (see Section on Junín flightless grebe, p. 29). The white-tufted grebe (*R. rolland morrisoni*) feeds mainly on moderate-sized fish (*Orestias*), which used to be abundant in open channels and ponds inside the wide reed-marshes fringing Lake Junín. During dry seasons and draw-down periods, die-offs of *Orestias* occur and many birds are forced from their preferred feeding areas out into the open lake where shallow-water fish densities are low. Here, they compete more directly with the flightless grebe. In some years during the 1980s, all ponds and channels inside the reed-marshes dried out and a mass mortality of grebes was noted, particularly in the case of reed-swamp dependent *morrisoni*.

2.1.3 Changes of saline lakes

Because of their high productivity and low species diversity, hypersaline and alkaline lakes play a key role for some specialised grebes. Large populations of black-necked and silvery grebes depend on a few semi-stable saline lakes. Jehl (1994) reviewed the history of such lakes in North America over the last 150 years. Of eight lakes treated in detail, two (Owen's and Winnemucca Lakes) have been lost due to the increasing demands of human populations; the long-term adequacy of water supplies to the Carson Sink area is questionable; the Salton Sea in California is rapidly reaching a salinity threshold that will probably exclude grebes; and three other lakes have major engineering works, either planned or in effect. Of the lakes considered, only three (Mono, Pyramid, and perhaps Great Salt Lake) seem likely to remain largely unchanged in their ability to support current populations of black-necked grebes into the next century. While black-necked grebes concentrate on saline lakes for long periods (up to six to eight months), not all birds come to these staging areas. In certain years, the food supplies on these lakes are eaten up abnormally early and the grebes then move on. Thus, the significance of specific staging sites remains unknown.

We do not know to what extent the aridification of the Lake Aral area (Kazakhstan and Uzbekistan) has affected grebes.

2.2 Hazards

Hazards affecting grebes comprise bad weather, pollution, and contamination of waterways. The latter threat is increasing. Such hazards can have a pronounced and immediate effect on local populations of common species, particularly where large concentrations occur on wintering and staging grounds. For example, 150,000 black-necked grebes (8% of the North American population) died in 1992 at Salton Sea, California. The cause of the mortality was never found, despite extensive investigation by a team of 40 scientists (J. Jehl pers. comm.).

While it is known that the hazards can kill large numbers of grebes, the impacts of such mortality on the long-term viability of grebe populations is UNKNOWN. For instance, there is no evidence yet that the large die-off at Salton Sea had any effect on population. Other large die-offs have been known historically and cannot be blamed on "pollution" or other anthropogenic causes.

2.2.1 Marine pollution

A large number of marine pollution hazards exist today, including direct dumping of pollutants, oil pollution, radioactive discharges, and pipeline effluent discharges. Contaminated run-off from agricultural practices form a more indirect threat to the marine environment. Grebes benefit from eutrophication up to a certain level (see section on Wetland modification, p. 4), but may be severely affected by pollution by heavy metals, organic and inorganic chemicals, organochlorides, and organophosphates (see section on Agricultural chemicals, this page).

Marine pollution constitutes a significant threat to grebes which winter in large concentrations in open coastal waters, such as crested, red-necked, and western grebes (Storer and Nuechterlein 1993). The populations of red-necked grebes in Zealand (Denmark) and Scania (Sweden) were reduced by ca. 50% after a severe oil spill (which probably killed ca. 800 grebes) in February 1979 and needed at least five years to recover.

2.2.2 Agricultural chemicals

Agricultural activity in catchments surrounding grebe lakes forms an important threat to food sources, water quality, and breeding habitat. Inorganic fertilisers and pesticide residues enter waterways via run-off. These chemicals affect water quality directly. They can enter the food chain and markedly change the nature of aquatic plants and animals by over-enrichment. The impacts of this form of pollution on population viability are unknown, although (in the past) the use of DDT pesticides reduced some populations of western grebe drastically (Herman *et al.* 1969). The build-up of organochlorine levels has been recorded in western and crested grebes (Lindvall and Low 1980, Lukowski 1978, Prestt and Jefferies 1969, Schifferli 1978). These chemicals are thought to cause shell-thinning and a reduction in breeding success. Agricultural chemicals also have a direct impact on grebe habitat by accelerating eutrophication (see section on Wetland modification, p. 4).

Salton Sea in California receives large amounts of agricultural and industrial run-off. Massive die-offs of fish, shorebirds, and waterfowl from avian cholera and botulism are not unusual. The 1992 deaths of 150,000 black-necked grebes could have been related to such factors, though this was never proven (J. Jehl pers. comm.). High mortality of black-necked grebes and other waterbirds at a reservoir near Léon, Mexico, in 1995, was probably caused by heavy metal poisoning from chemical plants and tanneries.

It has been suggested that an adaptive advantage of the continued feather growth in grebes is to remove heavy metals and other toxic compounds from the body (J. Jehl pers. comm.).

2.2.3 Industrial activity

Industrial activity in catchments surrounding grebe sites may influence grebe habitats in much the same way as agricultural and marine pollutants, via discharges and run-off. Open-cast mining is a particular threat because increased amounts of suspended sediment in water flowing from the mine to wetland habitats is altering aquatic vegetation communities and feeding habitats. Mining and sedimentation of metallic oxides appears to have had a major role in the decline of the threatened grebes of Lake Junín, Peru (see section on Junín flightless grebe, p. 29).

2.2.4 Weather

Weather can pose an important hazard to migration. Jehl and Bond (1983) and Jehl (1993) have published information on large-scale mortality of North American grebes during migration, probably as birds fly into snowstorms. In South America, the hooded grebe would also be potentially vulnerable to snow-storms, whether they migrate to the Atlantic coast or stay on ice-free upland lakes. In New Zealand, crested grebes have been trapped on lakes as they freeze overnight in the Southern Alps during winter (Geddes 1983).

2.2.5 Natural catastrophe

During the eruption of the Volcán Hudson in the Patagonian Cordillera of the Andes in November 1991, the important breeding area for hooded grebes on Meseta del Lago Buenos Aires, was covered by 40cm of volcanic cinders. This incident had an immediate effect on the lake habitat and may have a long-term impact on grebes and other wetland birds using the area, largely because of the mineralisation of waters and changes in the limnic and wetland community (A. Johnson, A. Serret, C. Bertonatti pers. comm.). In the volcanic Lake Mývatn, Iceland, changes in the mineral composition in the groundwater flow are known to cause large-scale, long-term changes in the composition of the trophic structure of the lake and, therefore, also of the avifauna. On the other hand, the high diversity of waterbird species is maintained by long-term temporal heterogeneity, in addition to short-term or spatial heterogeneity (Gardarsson 1979). It is not known to us whether any of the local insular subspecies of *Tachybaptus* are likely to become eliminated by volcanic eruptions.

2.3 Recreation pressures

The impacts of increasing levels of water-based recreation activities on grebes and other wetland birds are now being realised (e.g. Fuchs 1978a, 1978b, 1982, Ranftl 1980, Keller 1989, Titus and Van Duff 1979).

A study comparing the behaviour of incubating grebes on days with and without recreation showed that they left their nests more often, and for longer periods, on days with recreation (Ingold *et al.* 1983). Keller (1989) and others have found that nesting success of crested grebes was lower on lakes with recreation than on an undisturbed lake. On the lakes with recreation grebes left their nests without covering their eggs when approached by rowing boats, leaving the eggs exposed to predators. In New Zealand, crested grebes no longer occur on lakes where power boating is allowed, possibly because the waves created by power boats have reduced nesting success of the birds (O'Donnell 1980, and unpubl. data). On Lake Titicaca, grebes have disappeared from areas around Puno where there is now high boat usage. Small chicks of the western grebe often become separated from parents and die of exposure when disturbed by motor boats. If a grebe colony is approached suddenly by a recreational boat, fewer nests are covered before parents depart which may cause the over-heating of eggs (Storer and Nuechterlein 1993).

More research is required to assess the longer-term impacts of recreational disturbances on grebe populations, but as recreation continues to increase in many parts of the world, these impacts are likely to increase, and will require regulations.

2.4 Predators

In most grebe species, predation is probably insignificant. However, egg predation by the Dominican gull (*Larus dominicanus*) on hooded grebe (whose breeding colonies are completely open to view in floating *Myriophyllum* vegetation) may have a severe impact on certain lakes (C. Bertonatti, A. Johnson, G. Nuechterlein and A. Serret, pers. comm.). In New Zealand, where the breeding success of the southern crested grebe is very low, predation by introduced animals is probably important. Ferrets (*Mustela furo*) have been recorded taking eggs and introduced trout (*Salmo* spp.) probably take chicks. Predation by large gulls, coots, terns, and crows is often important in grebe breeding colonies disturbed by humans. Chicks of the western grebe are vulnerable to predation by bass (*Micropterus* spp.) and pike (*Esox* spp.) (Storer and Nuechterlein 1993). The smallest grebe species may be vulnerable to predatory fish even as adults.

Like other threats, the impacts of such mortality on the long-term viability of grebe populations is unknown.

2.5 Hunting and related activities

2.5.1 Direct threats (hunting)

There is archaeological evidence suggesting that hunting for "grebe fur" has occurred since ancient times. Such hunting was the main factor responsible for the rarity of grebes in Britain 100 years ago. Tens of thousands of western grebes were shot for their "fur" between the 1890s and 1906 in North America (Storer and Nuechterlein 1993). Grebe fur is still used in parts of Central Asia. Hunting possibly played a subsidiary role in the decline of the Colombian grebe at a time when only a few breeding colonies were left. These grebes were said to be very confiding and easy to shoot when nesting, since they swam out on open water when disturbed (unlike the pied-billed grebe which skulks into vegetation cover). Therefore, they were shot in large numbers. This took place between 1965 to 1968 until there were none left in these colonies (Fjeldså 1993).

Cultural use of wetland birds, including grebes, has caused conflict at Lake Junín. For certain periods, national park guards tried to reinforce a hunting ban. This caused great conflict because many locals are subsistence hunters. However, the effect of the hunting is probably insignificant compared to the other factors affecting the lake (pollution from mine-washing and changes of water levels; factors which were not acted upon).

2.5.2 Collection

Today, collection of specimens is probably insignificant; however, this may have been a factor influencing a few populations earlier this century.

2.5.3 Indirect threats (gill netting)

Death of grebes by indirect means occurs when grebes are caught in gill nets, although the overall impact on populations is poorly known. Netting is viewed as a major threat, particularly in Africa and Asia (G. Nuechterlein, D. Buitron, T. Mundkur pers. comm.). In retrospect, it seems probable that the intensive use of gill nets in prime grebe habitat may have contributed strongly to the disappearance of juvenile giant pied-billed grebes on Lake Atitlán, Guatemala. Large numbers of nets were placed outside the reed-beds to catch large-mouth bass. Gardarson (1961) considered that the number of horned grebes which drowned in gill nets in Mývatn, Iceland, could well be a limiting factor on the grebe population.

Over the period 1978 to 1985, an average of about 200 crested grebes drowned each nonbreeding season (August through March) in gill nets set for perch and pikeperch in Lake IJsselmeer, the Netherlands (T. Piersma pers. comm.). A few more birds may have died in fyke nets set for eel. First-winter juvenile birds were twice as likely as adults to drown. There is evidence that birds lucky enough to escape the nets upon an underwater encounter learn to avoid them; fishermen report that they had higher diving waterbird mortality during the 2nd World War when gill nets were secretly set and not marked above the water surface. With an overall average wintering population of about 5,000 to 6,000 crested grebes, the annual mortality inflicted by the gill net fishery was in the order of 4 to 5%, quite a high additional mortality for a long-lived species like a grebe. Drowning in fyke nets is a threat to crested grebes in New Zealand (O'Donnell 1985), and recent declines in Kenya may result from a rapid increase in the use of gill nets during the last 15 years (L. Bennun, D. Turner pers. comm.). Where populations are extremely small and vulnerable, as in New Zealand and perhaps Africa, netting could contribute to significant population declines. In the *salinas* of Thyna, Tunisia, large numbers (estimated at 400 in 1987) of black-necked grebes were entangled in fishing nets and were used for food (J. Gregersen, pers. comm.). G. Nuechterlein (pers. comm.) obtained nearly 100 western grebe carcasses in a single week from fishermen on Lake Winnipegosis, Canada, in the 1970s. Because of the widespread introduction of gill nets, particularly to provide protein in many developing countries, there has been a major increase in this threat to grebes and other diving birds.

2.5.4 Overfishing

As pressure on commercial fishing resources in both marine and freshwater environments increases, so do threats to the food sources of grebes. However, the potential impact of overfishing on grebe populations is unknown.

2.6 Vulnerability relating to life history tactics

Threats such as reduction of reed-beds, predation affecting breeding success, or hunting are often obvious. However, populations are not necessarily governed by those factors that kill individuals alone. The life history tactics of individual species will determine the effect of various kinds of stress on the long-term development of a population. Thus, various hazards may have fundamentally different impacts on species with high breeding potential than on long-lived species with low annual recruitment. A proper strategy for conservation cannot, therefore, be planned before the life history strategies of grebe species are well understood and the critical phases of the annual cycle identified.

The significance of life history studies for the development of conservation priorities has been well illustrated for the hooded grebe (Fjeldså 1986). For the first years after the discovery of this species, strong attention was paid to the extremely low breeding success (0.12 fledglings per grebe per year). Its affinity for the most barren and windy habitat in which a grebe could possibly breed, and repeated breeding failures, gave the appearance of a kind of "maladaptive behaviour." In the early 1980s, it was, therefore, considered necessary to take direct action to assist the species by continuous guarding of the known colonies, control of predators, and construction of artificial nest sites. Plans were developed to keep the eggs safely in incubators or to cross-foster eggs with silvery grebes breeding in sheltered lakes in the adjacent lowlands. However, biological studies have now shown that the species uses the windy highland lakes because of the high supplies of invertebrate foods, and that the entire life history strategy may be very well adapted to this habitat. The lakes may never support more grebes, even if the breeding success could be increased artificially. The population maintains itself because birds have a large number of alternative feeding lakes and evidently are very long-lived. Should some new factor change the existing habitats or limit survival in some way, the hooded grebe could move into the Endangered category.

Silvery and Junín flightless grebes are extremely slow reproducing species. Rather low reproductive powers also characterise hoary-headed, black-necked, western, and Clark's grebes (see under the species accounts for further information). Marked differences in breeding strategies may even be found between different populations of a species (Ferguson and Sealy 1983). It seems, in general, that species which have few good breeding lakes and large areas of potential non-breeding habitat, reproduce slowly (see Alerstam and Högstedt 1982). In this case, the attention should primarily be directed towards factors which influence the life expectancy of adults (more than towards breeding failures).

Chapter 3

Distribution and Conservation Status of the Grebes of the World

3.1 Conservation status of grebes of the world

The global variation in species richness of grebes is shown in Figure 3.1. This illustrates the predominance of species richness in the steppe/woodland biomes in western North America, the western Palearctic, southern South America, and the Andes. Areas with six species present are encircled.

The distribution, numerical status, and conservation status of 22 grebe species are summarised in Table 3.1. Of

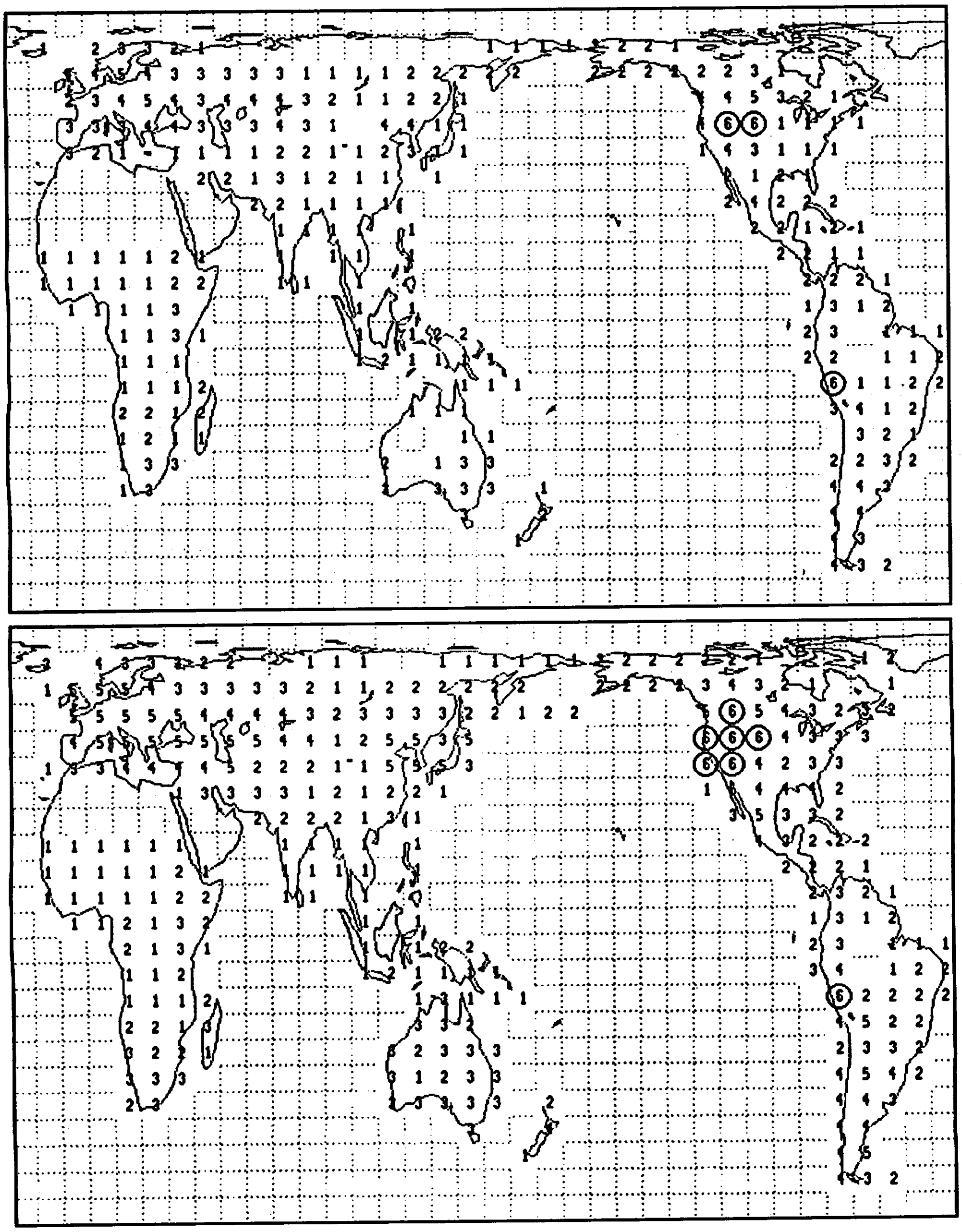


Figure 3.1 Global variation in species richness of grebes, on an equal-area grid size. Distributions were entered in the computer software WORLDMAP, which was developed by the British Museum for analysing geographical patterns of species richness and conservation priorities, based on complementarity principles (Williams 1994). The top map shows the number of species which breed regularly in each grid cell; the bottom map includes migrants and casual and past breeders (including the range of taxa which now are extinct).

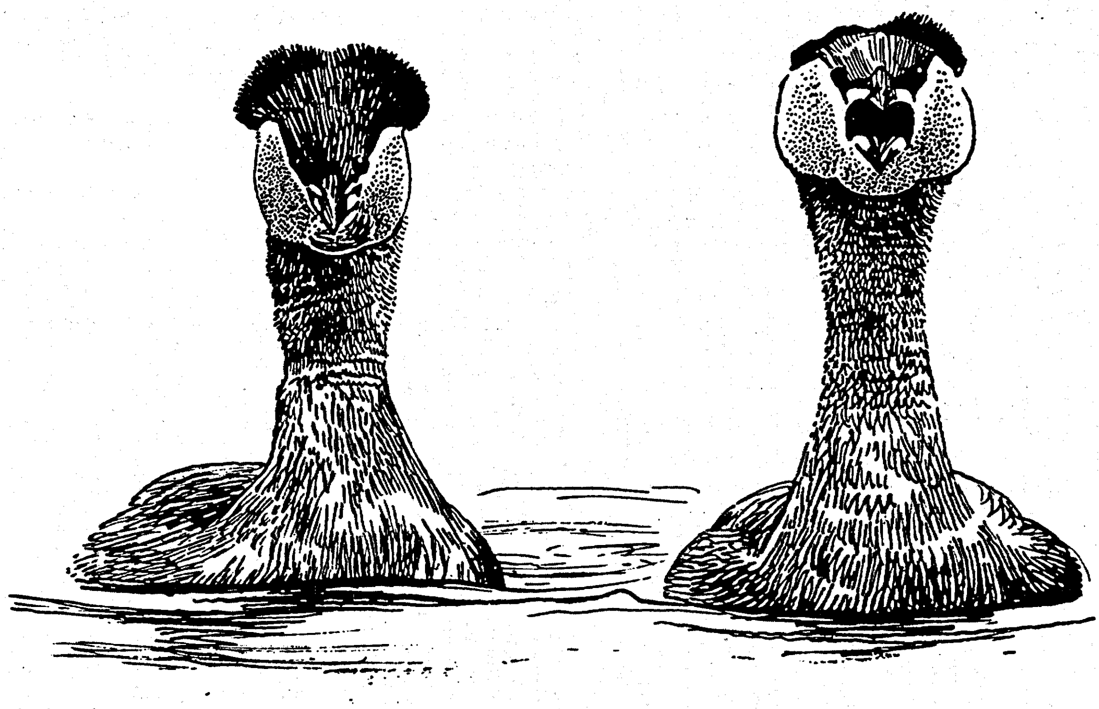
Table 3.1 Distribution, population size, and IUCN conservation status of grebe taxa of the world (Taxonomy follows Vlug & Fjeldså 1990)

Common name	Scientific name	Subspecies	Distribution	Population estimates	IUCN Status
White-tufted grebe	*Rollandia rolland*				Lower Risk (least concern)
		R. r. morrisoni	Lake Junín, Peru	declining to ca.500	Endangered (A1a, B1+2c)
		R. r. chilensis	South America	Unknown (>10 000)	Lower Risk (least concern)
		R. r. rolland	Islas Malvinas	Unknown (common?)	Data Deficient
Titicaca flightless grebe	*Rollandia microptera*		Peru and Bolivia	Unknown (>2000)	Vulnerable (C1)
Australasian little grebe	*Tachybaptus novaehollandiae*				Lower Risk (least concern)
		T. n. novaehollandiae	Australasia and New Guinea	ca. 500,000	Lower Risk (least concern)
		T. n. leucosternos	Vanuatu and adjacent islands	Unknown (very small?)	Vulnerable (B1+2b)
		T. n. renellianus	Rennell Island	Unknown (very small?)	Vulnerable (B1+2b)
		T. n. javanicus	Java	Unknown (very small?)	Vulnerable (B1+2b)
		T. n. timorensis	Supul and Timor, Indonesia	Unknown (very small?)	Vulnerable (B1+2b)
		T. n. fumosus	Sangihe and Taluad, Indonesia	Unknown (very small?)	Vulnerable (B1+2b)
		T. n. incola	Northern New Guinea	Unknown (very small?)	Vulnerable (B1+2b)
Eurasiatic little grebe	*Tachybaptus ruficollis*				Lower Risk (least concern)
		T. r. ruficollis	Western Palearctic	100,000–1,000,000	Lower Risk (least concern)
		T. r. iraquensis	Iraq and Iran	ca. 6,000	Vulnerable (A2c, C1)
		T. r. capensis	Africa and Madagascar	25,000–100,000	Lower Risk (least concern)
		Unnamed subspecies "yellow-eyed capensis"	Caucasus Mts through Sthn Asia to Burma	25,000–1,000,000	Lower Risk (least concern)
		T. r. poggei	SE Asia through Indochina to Japan	25,000–1,000,000	Lower Risk (least concern)
		T. r. philippensis	Phillipines	Unknown	Data Deficient
		T. r. cotabato	Mindanao, Phillipines	Unknown	Data Deficient
		T. r. tricolor	Indonesia to New Guinea	Unknown	Data Deficient
		T. r. vulcanorum	Southern Indonesia	Unknown	Data Deficient
		T. r. collaris	Solomon Islands and Papua New Guinea	Unknown (very small)	Vulnerable (B1+2b)
Delacour's little grebe	*Tachybaptus rufolavatus*		Madagascar	<10	Critically Endangered (D1)
Madagascar little grebe	*Tachybaptus pelzelnii*		Madagascar	5,000–10,000	Vulnerable (A1ace+2ce, C1+2b)
Least grebe	*Tachybaptus dominicus*			ca. 20,000 or more (all subspecies combined)	Lower Risk (least concern)
		T. d. dominicus	Bahama Islands	"	Lower Risk (least concern)
		T. d. brachypterus	Southern Texas to Panama	"	Lower Risk (least concern)
		T. d. bangsi	Baja California, Mexico	"	Lower Risk (least concern)
		T. d. speciosus	Eastern South America	"	Lower Risk (least concern)
		T. d. eisenmanni	Ecuador	"	Lower Risk (least concern)
Pied-billed grebe	*Podilymbus podiceps*				Lower Risk (least concern)
		P. p. antillarum	West Indes	Unknown but common	Lower Risk (least concern)
		P. p. podiceps	Canada to Panama	Unknown but common	Lower Risk (least concern)
		P. p. antarcticus	Panama through South America	Unknown but common	Lower Risk (least concern)
Giant pied-billed grebe	*Podilymbus gigas*		Guatemala	Nil	Extinct
Hoary-headed grebe	*Poliocephalus poliocephalus*		Australasia	ca. 500,000	Lower Risk (least concern)
New Zealand dabchick	*Poliocephalus rufopectus*		New Zealand	1200–1500	Lower Risk (near threatened)
Great grebe	*Podiceps major*			50,000 or more, (both subspecies included)	Lower Risk (least concern)
		*P. m. major**	South America	"	Lower Risk (least concern)*
		P. m. navasi	Chilean Fjords and Southern Andes	"	Lower Risk (least concern)
Horned grebe	*Podiceps auritus*				Lower Risk (least concern)
		P. a. auritus	Eurasia	50,000–100,000	Lower Risk (least concern)
		P. a. cornutus	North America	>100,000	Lower Risk (least concern)

Table 3.1 ... continued. Distribution, population size, and IUCN conservation status of grebe taxa of the world (Taxonomy follows Vlug & Fjeldså 1990)

Common name	Scientific name	Subspecies	Distribution	Population estimates	IUCN Status
Red-necked grebe	*Podiceps grisegena*				Lower Risk (least concern)
		P. g. grisegena	Western Palearctic to East Asia	50,000–100,000	Lower Risk (least concern)
		P. g. holboellii	North-east Asia and North America	>100,000	Lower Risk (least concern)
Great crested grebe	*Podiceps cristatus*				Lower Risk (least concern)
		P. c. cristatus	Eurasia	>300,000	Lower Risk (least concern)
		P. c. infuscatus	Africa	Unknown	Data Deficient
		P. c. australis	Australasia	Unknown (>3,000)	Vulnerable (A1cde, C1)
Black-necked grebe	*Podiceps nigricollis*				Lower Risk (least concern)
		P. n. nigricollus	Eurasia, East Africa	>150,000	Lower Risk (least concern)
		P. n. gurneyi	South Africa	10,000–100,000	Data Deficient
		P. n. californicus	North America	2,500,000	Lower Risk (least concern)
Colombian grebe	*Podiceps andinus*		Colombia	Nil	Extinct
Silvery grebe	*Podiceps occipitalis*				Lower Risk (least concern)
		P. o. occiptalis	Southern Andes	100,000	Lower Risk (least concern)
		P. o. juninensis	Northern Andes	Unknown	Lower Risk (near threatened)
Junín flightless grebe	*Podiceps taczanowskii*		Peru	ca. 200	Critically Endangered (A2ce)
Hooded grebe	*Podiceps gallardoi*		Santa Cruz, Argentina	3,000–5,000	Lower risk (near threatened)
Western grebe	*Aechmophorus occipitalis*				Lower Risk (least concern)
		A. o. occidentalis	Western North America	>120,000	Lower Risk (least concern)
		A. o. ephemeralis	Mexico	Unknown	Vulnerable (B1+2b)
Clarke's grebe	*Aechmophorus clarkii*				Lower Risk (least concern)
		A. c. clarkii	Mexican Plateau	Unknown	Vulnerable (D1)
		A. c. transitionalis	Western North America	Unknown but common	Lower Risk (least concern)

*The Peruvian population may be a distinct taxon; if so, it would probably be classed as Vulnerable.



Red-necked grebes

Table 3.2 IUCN Categories of Threat and distribution of threatened and potentially threatened grebe taxa (species and subspecies) by geographical region.

	Africa	Eurasia	North America	Central and South America	SE Asia and China	Australasia and Oceania	Total	% of Total Taxa
Total taxa	5	6	6	21	9	8	55	
Critically Endangered	1 (?)			1			2	3.6
Endangered				1			1	1.8
Vulnerable	1	1		4	3	5	14	25.4
Near Threatened	2			2	4	1	9	16.4
Extinct	1 (?)			2			3	5.5
Total Threatened	5	1	0	10	7	6	29	52.7
Total Currently Non-threatened	0	5	6	11	2	2	26	47.3

these, two species were classed as Critically Endangered, Delacour's little grebe from Madagascar and the Junín flightless grebe from Peru. Also, the white-tufted grebe subspecies *R. rolland morrisoni* from Lake Junín, Peru, is classed as Endangered. Three species were classed as Vulnerable. Two species, the giant pied-billed grebe from Guatemala and the Colombian grebe are thought to be Extinct. Of the 22 species, 13 species have been classified into two or more subspecies, of which altogether 20 fall into one of the four threatened or potentially threatened categories. These can also be seen in Table 3.1. The majority of threatened species are in Central and South America, while the majority of threatened subspecies inhabit islands in Southeast Asia and Australasia/Oceania.

There may be a large number of nationally threatened populations within taxa, but these have not been identified in this document.

3.2 Distribution, population, status, threats, and conservation actions for individual species

3.2.1 White-tufted grebe (*Rollandia rolland*)

Distribution and habitats: Widespread in the lowlands of the "Southern Cone" of South America and in Andean puna lakes, at 3,000 to 4,500m, and along the Pacific coast of Peru. It is common in marshes, ponds, and lake shallows. Although it inhabits a wide variety of wetlands, it clearly prefers mosaics of aquatic vegetation and open spaces, such as channels into reed-marshes, reed-fringed bays of open lakes, and lakes and ponds with no other vegetation than dense floating carpets of water-weeds. It is a generalised feeder which eats small fish and all kinds of nektonic arthropods. It sometimes occurs in large numbers, but is territorial when breeding. It is multiple-brooded and may breed at any time of the year in Peru.

Three subspecies are recognised. *R. rolland morrisoni* inhabits Lake Junín in Peru (Simmons 1962). (Storer [1979] refers all highland populations of Peru and Bolivia to this stocky and very heavy-billed form, but according to Fjeldså [1981a] the highland populations outside Lake Junín have the same characteristics as lowland populations). *R. rolland chilensis* inhabits coastal Peru and the highlands of Peru from Ancash to northwestern Argentina, as well as lowlands and lower Andean passes of Argentina and Chile, wintering along adjacent southern coasts or migrating north to Paraguay and southern Brazil. A slight morphological change is seen in Patagonia. *R. rolland rolland* inhabits the Islas Malvinas, where it is fairly common. This form is twice as big as mainland birds, and has, by some, been regarded as a separate species.

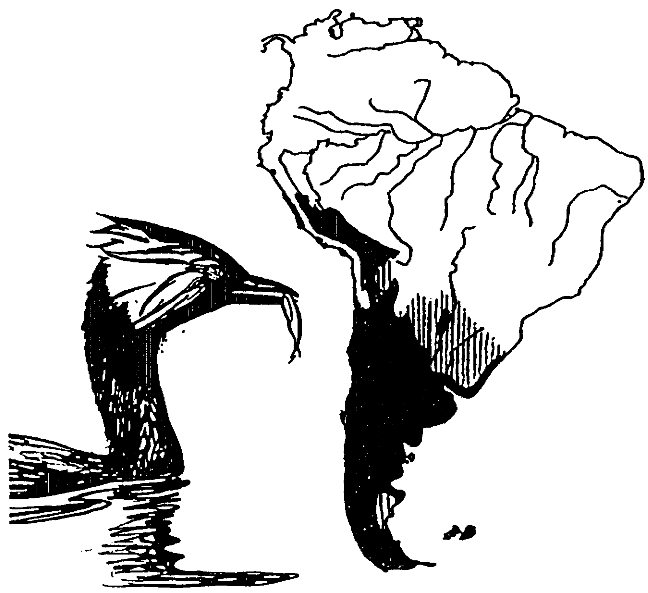


Table 3.2 IUCN Categories of Threat and distribution of threatened and potentially threatened grebe taxa (species and subspecies) by geographical region.

	Africa	Eurasia	North America	Central and South America	SE Asia and China	Australasia and Oceania	Total	% of Total Taxa
Total taxa	5	6	6	21	9	8	55	
Critically Endangered	1 (?)			1			2	3.6
Endangered				1			1	1.8
Vulnerable	1	1		4	3	5	14	25.4
Near Threatened	2			2	4	1	9	16.4
Extinct	1 (?)			2			3	5.5
Total Threatened	5	1	0	10	7	6	29	52.7
Total Currently Non-threatened	0	5	6	11	2	2	26	47.3

these, two species were classed as Critically Endangered, Delacour's little grebe from Madagascar and the Junín flightless grebe from Peru. Also, the white-tufted grebe subspecies *R. rolland morrisoni* from Lake Junín, Peru, is classed as Endangered. Three species were classed as Vulnerable. Two species, the giant pied-billed grebe from Guatemala and the Colombian grebe are thought to be Extinct. Of the 22 species, 13 species have been classified into two or more subspecies, of which altogether 20 fall into one of the four threatened or potentially threatened categories. These can also be seen in Table 3.1. The majority of threatened species are in Central and South America, while the majority of threatened subspecies inhabit islands in Southeast Asia and Australasia/Oceania.

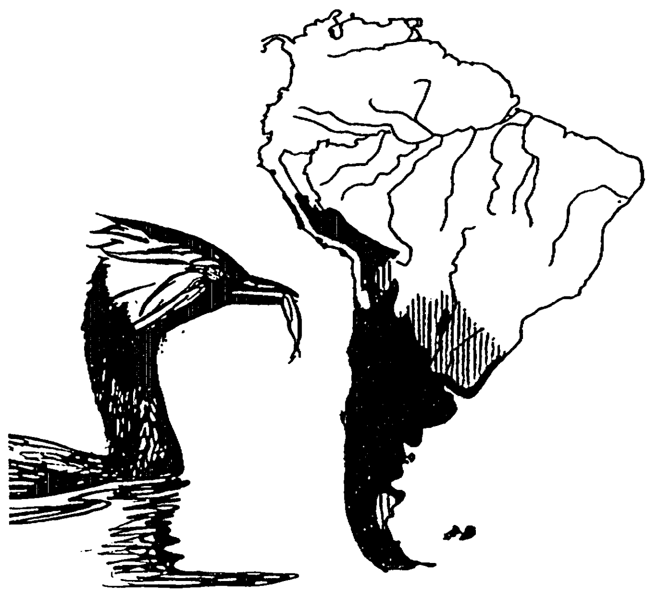
There may be a large number of nationally threatened populations **within** taxa, but these have not been identified in this document.

3.2 Distribution, population, status, threats, and conservation actions for individual species

3.2.1 White-tufted grebe (*Rollandia rolland*)

Distribution and habitats: Widespread in the lowlands of the "Southern Cone" of South America and in Andean puna lakes, at 3,000 to 4,500m, and along the Pacific coast of Peru. It is common in marshes, ponds, and lake shallows. Although it inhabits a wide variety of wetlands, it clearly prefers mosaics of aquatic vegetation and open spaces, such as channels into reed-marshes, reed-fringed bays of open lakes, and lakes and ponds with no other vegetation than dense floating carpets of water-weeds. It is a generalised feeder which eats small fish and all kinds of nektonic arthropods. It sometimes occurs in large numbers, but is territorial when breeding. It is multiple-brooded and may breed at any time of the year in Peru.

Three subspecies are recognised. *R. rolland morrisoni* inhabits Lake Junín in Peru (Simmons 1962). (Storer [1979] refers all highland populations of Peru and Bolivia to this stocky and very heavy-billed form, but according to Fjeldså [1981a] the highland populations outside Lake Junín have the same characteristics as lowland populations). *R. rolland chilensis* inhabits coastal Peru and the highlands of Peru from Ancash to northwestern Argentina, as well as lowlands and lower Andean passes of Argentina and Chile, wintering along adjacent southern coasts or migrating north to Paraguay and southern Brazil. A slight morphological change is seen in Patagonia. *R. rolland rolland* inhabits the Islas Malvinas, where it is fairly common. This form is twice as big as mainland birds, and has, by some, been regarded as a separate species.



Population: There is no good basis for a total estimate. *R. r. morrisoni* has declined seriously on Lake Junín, from ca. 4,000 in 1977 (Fjeldså 1981a) to 2,150 in 1981 to not many more than 500 during a survey in January 1993, with similarly low numbers in 1994 and 1995 (J. Tueros and T. Valqui pers. comm.). *R. r. chilensis* is common and probably numbers greater than 100,000 birds. Concentrations include up to 5,000 on Laguna La Margarita, up to 5,000 on lakes in southwestern Córdoba, and over 2,000 at four other sites in Argentina. In coastal Peru, important sites are the Mejia Lagoons (150 in 1990), the outlet of the Ica River, and the Valparaiso wetlands. In the dry season, up to 3,500 assemble on Lakes Pomacanchi, Asnacocha, and Pampa Marca in Cusco. Probably similar numbers gather in Laguna Langui Lai, Cusco, and certainly many thousand assemble on Lake Titicaca and lagoons of the adjacent plains, especially to the west. No estimates exist for *R. r. rolland*, although the population probably numbers less than 10,000.

Detailed ecological studies have been conducted in Peru (notably in the Junín and Puno Departments; Fjeldså 1981a). These studies demonstrate a considerable plasticity in habitat and diet, as well as high population densities in lakes with mosaic vegetation. In districts where small lakes and ponds tend to dry up seasonally, large numbers may assemble in open lakes.

The species is a territorial nester which normally lays a clutch of two eggs only. However, it is multiple-brooded and an opportunistic breeder, ready to nest at any season if conditions are good. It clearly has a high reproductive potential.

Status: The species as a whole is in the Lower Risk (lc) category (single-lake population in strong decline). However, *R. r. morrisoni* is Endangered (A1a, B1+2c) and *R. r. rolland* is in the Data Deficient category and could perhaps be Vulnerable because of the small area of occupancy and small population on Islas Malvinas.

Threats: *R. r. morrisoni* has declined because of pollution from mining activities and water level fluctuations accentuated by the regulation of Lake Junín for hydro-electric power (see Section on Junín flightless grebe, p. 29). This subspecies feeds mainly on fish (*Orestias*, up to 12cm long), which used to be abundant in open channels and ponds inside the wide reed-marshes fringing the lake. During dry seasons, many birds are forced from their preferred, diverse feeding areas out into the open lake where shallow-water fish densities are low. Draw-downs for hydro-electric purposes appear to have increased the frequency of low water level conditions. In this situation *morrisoni* attempts to take any prey available, including fish which are smaller than those that would normally be preyed upon causing more direct competition with the Junín flightless grebe (*Podiceps taczanowskii*). In some years during the 1980s, all ponds and channels inside the reed-marshes dried out and a mass mortality of grebes, particularly the reed-dependent *morrisoni*, was noted.

Recommended actions:

1. Immediately begin managing *R. r. morrisoni* to halt the population decline. Focus management on habitat restoration, in particular, sustainable management of the water resource of Lake Junín, including water level management and prevention of the inflow of water from Río San Juan, which is severely contaminated by mining activities. Management which is good for the grebes will also permit restoration of the previously very intensively cattle-grazed, surrounding meadows. Immediate implementation of a species recovery plan, in conjunction with that for *P. taczanowskii* (see section on Junín flightless grebe, p. 29), is required.
2. Survey *R. r. rolland* to ascertain the conservation status of this subspecies.
3. Identify key populations of *R. r. chilensis* and set a monitoring programme in place. Evaluate the potential of *R. r. chilensis* as a keystone indicator of wetland health and wetland bird population trends.

3.2.2 Titicaca flightless grebe (*Rollandia microptera*)

Distribution and habitats: This flightless grebe is endemic to the open, freshwater lakes of the Peruvian/Bolivian Altiplano. It often feeds far offshore, in rather deep water. It is a social species which is usually solitary when

feeding. It breeds in wide reed-marshes in places with easy access to open water, or in open view in floating water weeds.

The species occurs from Lakes Arapa and Umayo in southeastern Peru, through Lake Titicaca into adjacent Bolivia, and along the Desaguadero River to Lakes Uru-uru and Poopó. Temporary populations occur on smaller adjacent lakes in years when Lake Titicaca floods.

Population: Unknown, but certainly greater than 2,000 (2,000 to 10,000). It is common on Lake Umayo where it appears to be stable, despite considerable numbers currently being caught in fishing nets. It is also common in Lake Arapa, and in several sheltered bays near the northern corner of Lake Titicaca, but has disappeared from the area near Puno town and from other areas where the harvesting of reeds is intensive. In 1977–78 it was absent from most inundated parts of the marshy plains of the Río Ramis Delta, but in 1982 it was common and breeding, indicating that peak water levels sometimes permit colonisation of ephemeral habitats.

The clutch size is usually only two eggs. However, the species is multiple-brooded and an opportunistic breeder. Pairs with small young are often associated with nearly full-grown birds from an earlier clutch. The species is ready to nest in any season and, therefore, has a high reproductive potential.

Status: Vulnerable (C1). A relatively small population size which is declining at least in some areas and has disappeared from some parts of the area.

Threats: The species is vulnerable to disturbance of feeding and breeding habitats. On Lake Titicaca, *R. microptera* has disappeared locally from polluted areas, from places with high boat traffic near Puno, and from areas with heavy harvesting of reeds and water-weeds (for cattle fodder in the dry season). The total area of marsh vegetation is enormous, but over large areas, the density of emergent plants is now too low for grebe nesting.

Recommended actions:

1. Closely monitor population to determine whether it is stable or if local declines are symptomatic of more widespread problems.
2. Survey the current distribution and population size. Include Rio Desaguadero and Lake Poopó in the survey.
3. Create a contingency fund for the preparation and implementation of a recovery plan should the conservation status change.
4. Establish a plan for the sustainable use of lake-side reed-beds which includes consideration of the needs of grebes and other wetland birds.

3.2.3 Australasian little grebe (*Tachybaptus novaehollandiae*)

Distribution and habitats: Inhabits Australia, New Guinea, adjacent islands of Indonesia from Java to Timor and as far north as the Lesser Sunda Islands, and recently New Zealand. This grebe occurs in a wide range of water bodies, mainly freshwater and permanent or semi-permanent marshes, creeks, and ponds, but also on temporary floodwaters. It can be common on urban waterways and in farm ponds. It occurs throughout the year in areas of predictable rainfall, but is migratory or nomadic elsewhere. Large numbers may congregate in floodwater swamps, but when breeding, it typically disperses to small water bodies with rich marginal vegetation.

Seven subspecies are recognised. *T. n. novaehollandiae* is distributed throughout Australia and Tasmania, where it is generally common, and in the Snow Mountains and lowlands of southern New Guinea. Vagrants occur on Admiralty Islands and the Moluccas. It has recently colonised New Zealand, with a small population now breeding on the North and South Islands. *T. n. leucosternos* breeds on the islands of Vanuatu and the New Hebrides Basin, Santa María (Gaua), Dolphin, Espíritu Santo, and Oba Islands. *T. n. rennellianus* inhabits only Rennell Island. *T. n. javanicus* occurs on Java. It is rare everywhere except in Rakukak (altitude 1,300m) where it is common. *T. n. timorensis* inhabits Supul and Timor. *T. n. fumosus* occurs on Sangihe and Talaud Islands in northern

Indonesia. *T. n. incola* inhabits Sentani Lake, the Sepik River, and Bulolo in northern New Guinea.

Population: In Australia, *T. n. novaehollandiae* is common, except in some arid areas, and is apparently stable. The population is estimated at ca. 500,000 (IWRB). In Tasmania, less than 10 grebes have been recorded annually (1972–88). The newly-established New Zealand population numbers less than 50 birds. Two hundred and sixty-four were counted in a census in Papua New Guinea in January 1991 with most in the south and the largest concentrations in Kanosia Lagoon (131) and Lakes Iaraguma/Buna (64). All other subspecies are poorly known, but probably all have populations less than 10,000. *T. n. leucosternos* may be common in Vanuatu, but other island populations are probably very small and potentially at risk. *T. n. fumosus* may only survive as a small population on the crater lake of Great Awu, Sangihe. Status is uncertain in the Lesser Sundas.

Because of the Australasian little grebe's high breeding potential (multi-brooded) and somewhat opportunistic habits, a rapid population response can be shown following the creation of new habitats, such as water reservoirs and farm ponds. It can also recover rapidly after droughts.

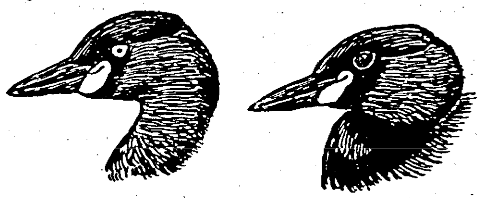
Status: The species as a whole is in the Lower Risk (lc) category. However, all subspecies except *T. n. novaehollandiae* are tentatively classed as Vulnerable (B1+2b) because of their very small population sizes and largely unknown threats. However, since the status of most is uncertain, some subspecies may even be Endangered. According to Perennou *et al.* (1994), the taxonomy of this group is unclear.

Threats: Largely unknown. In Australia the distribution of these grebes is locally influenced by variations in rainfall and drought. Some local declines or extinctions due to human modifications of wetlands (drainage, increased salinity resulting from land use changes, exploitation of underground water supplies) have been recorded. However, since the species prefers fairly deep creeks, ponds, and wetlands, they will only be marginally affected by droughts. The widespread creation of artificial wetlands has undoubtedly benefited this species.

Recommended actions:
1. Urgently reassess the taxonomic status of all subspecies.
2. Urgently assess the population trends, threats, and conservation status of all subspecies except *T. n. novaehollandiae*. Write and implement species recovery plans if necessary.
3. Identify and protect key sites for all subspecies.
4. Evaluate the potential of *T. n. novaehollandiae* as a keystone indicator of wetland health and wetland bird population trends.

3.2.4 Eurasiatic little grebe (*Tachybaptus ruficollis*)

Distribution and habitats: Widespread through Europe, Africa, and Southeast Asia to New Guinea. It is found in a wide range of wetlands, normally in small ponds, canals, and swamps, but also in sheltered parts of larger lakes and reservoirs. It is rarely seen far from vegetation cover. Some populations are migratory, moving to the nearest ice-free waters, mainly in larger rivers and estuaries. The breeding season is highly variable, and in some areas it may breed most of the year. High reproductive potential compensates for severe losses in cold winters or in dry years. Because of its opportunistic habits and weather-induced population changes, it may not be suitable as an indicator species of wetland health.



Nine described and possibly one undescribed subspecies (see Recommended Actions) are recognised. *T. r. ruficollis* is widespread from the western Palearctic, including the British Isles, southern Sweden, and Lithuania, south to the Mediterranean and North Africa, and east to southwestern Russia, Turkey, and Palestine. It straggles to northern Norway, and the Azores, Madeira and the Canaries. *T. r. iraquensis* is endemic to the marshes of the Al Furat (Euphrates) and Dijlah (Tigris) Rivers in Iraq and adjacent Iran. *T. r. capensis* is widespread and common in Africa, south of the Sahara to the Nile Valley. It is abundant in the Rift Valley and present in Madagascar (few records in the 19th century, but now common and widespread) and the Comoro Islands. No subspecies name applies to the yellow-eyed birds of southern Asia, previously referred to as *capensis*, which are distributed from the Caucasus Mountains, southern Aral Sea, and Balkhash, south through Iran (except the SW) and India to Sri Lanka. It stretches east to Burma where it intergrades with

T. r. poggei of Southeast Asia. The following areas in southwestern Asia are of international importance for the species: Gorgan Bay, Horeh Bamdej, Izeh and Shiekhon Lakes, and Maharloo Lake in Iran; Lake Dengizkul in Uzbekistan; and Wadi Jizan Dam in Saudi Arabia. *T. r. poggei* occurs from the Malay Peninsula through Indochina, central and east China, and Manchuria to west Ussurilysk. It occurs on Hainan, Taiwan, and the Ryukyu Islands, through Japan to the southern Kurils. *T. r. philippensis* inhabits the northern Philippine islands of Calayan and Luzon, while the islands from Mindoro to Negros and Bohol have intermediates with *T. r. cotabato*, which is regarded as endemic to the island of Mindanao. *T. r. tricolor* inhabits Sulawesi, Buru, Seram, Ambon, Flores, Lombok, and Timor. It occurs in scattered localities in northern New Guinea and is casual or rare on Borneo. *T. r. vulcanorum* inhabits Java, Bali, Lombok, Sumba, Flores, Timor, and Kai Kecil. *T. r. collaris* inhabits Bougainville Island in the Solomons, New Ireland, New Britain, and the Huon peninsula of Papua New Guinea, where intermediates with *tricolor* are found.

Population: The population of *T. r. ruficollis* is stable and estimated at 100,000 to 1,000,000 in the western Palearctic (IWRB), or 66,000–170,000 in Europe. In Britain and Ireland 9,000 to 18,000 were recorded in the mid-1970s and 1990–91. Some of the most important European wintering grounds are the Rhine Delta, the Netherlands, with ca. 4,300 to 5,400 birds (Meininger 1979); the Swiss Lakes, especially Lake Geneva with 4,800 to 6,000 birds (Bandorf 1970); Spain, where concentrations of 500 to 1,000 birds are common. A summary of recent population changes in Europe (Hildén and Sharrock 1985) shows increases in five countries, decline in one, and unchanged numbers in the rest. More recently, Tucker and Heath (1994) recorded moderate declines in 21% of the countries and a strong decline in one country. *T. r. iraquensis* is estimated at ca. 6,000. African *T. r. capensis* is estimated at less than 100,000 and *T. r. poggei* to somewhere between 25,000 and 1,000,000. Mid-winter counts in 1991 yielded 8,450 in Kenya, 23,676 in India, 1,359 in Pakistan, and 1,035 in Japan (these counts are certainly underestimates). No estimates exist for *T. r. philippensis, T. r. cotabato, T. r. tricolor*, or *T. r. vulcanorum*. Some island populations, especially of *T. r. collaris*, may be very small.

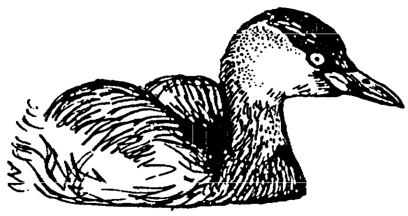
The Eurasiatic little grebe normally nests in isolated (territorial) pairs and has high breeding potential (clutch-size three to five, rarely two to 10 eggs; and normally multiple-brooded).

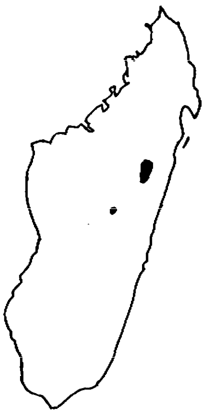
Status: The species as a whole is in the Lower Risk (lc) category. *T. r. iraquensis* is classed as Vulnerable because of its small population size and unknown threats. *T. r. philippensis, T. r. cotabato, T. r. tricolor, T. r. vulcanorum* are listed in the Data Deficient category. *T. r. collaris* is tentatively classed as Vulnerable (B1+2b) because the population may be very small.

Threats: Not known. However, local impacts could include pollution, habitat loss and degradation because of siltation, and increased disturbance.

Recommended actions:
1. Describe the taxonomic status of the yellow-eyed "*capensis*"/*poggei* and clarify the status of intermediate forms of *collaris*/*tricolor* and *philippensis*/*cotabato*. The systematic implications of the variation in eye colour need resolving. Populations in the Asiatic region have yellow eyes, like *T. novaehollandiae*, but are separated by red-eyed populations from this latter species. It is unknown whether integration zones exist or whether different para-species should be recognised.
2. Urgently assess the population trends, threats, and conservation status of all subspecies in the Vulnerable or Data Deficient categories. Write and implement species recovery plans if required.
3. Identify and protect key sites for all subspecies. The Bonn Convention and African-Eurasian Waterbird Agreement (which are formally adopted international agreements for protecting migratory species) are of relevance at least for the management of the European populations.

3.2.5 Delacour's little grebe (Rusty or Alaotra grebe) (*Tachybaptus rufolavatus*)





Distribution and habitats: Very rare if not extinct and mainly from Lake Alaotra, the largest lake in Madagascar. Outside Lake Alaotra, it has been recorded in the regions of Antananarivo and from Lake Itasy, as well as in the regions of Isalo and Antsalovo in the west of the country (Collar and Stuart 1985, Langrand 1988, Wilmé 1990). However, Delacour's grebe has not been seen since 1962, despite surveys from September 1989 to March 1990 (Wilmé 1994). Judging from its wing-loading, this species must have been highly sedentary, although not flightless.

Hybridisation with *Tachybaptus ruficollis* has taken place at least since the 1920s (in fact the type specimen has hybrid characters). No pure individuals, only intergrades with *Tachybaptus ruficollis*, were found during recent surveys (Wilmé 1990). We do not follow Sibley and Monroe (1990), who ranked *rufolavatus* as a subspecies of *ruficollis*, because such a practice would hide any hybridisation extinctions.

Lake Alaotra has 22,000ha of open water and an additional 35,000ha of marsh and seasonally flooded shores. It is not known whether the principal habitat of this grebe was the channels and water-lily-covered ponds in the wide papyrus swamps (*Cyperus madagascariensis*), or the outer reed border of *Phragmites australis*.

Population: During a seven-day study in December 1982 at Lake Alaotra, 12 individuals were seen (V. Bretagnolle, O. Langrand, L. Wilmé, pers. comm.). Two were seen in September 1985 near Andreba (together with several apparent hybrids; Thompson *et al.* 1987). However, during a three month study in 1990, no typical *T. rufolavatus* could be found; therefore, it must be considered on the brink of extinction. Altogether, the 43 grebes seen in October–November 1989, in a wide variety of habitats, were probably *T. ruficollis capensis*, although few could be identified with certainty because birds were in non-breeding plumage. Population is guessed to be no more than 20 pairs (Collar *et al.* 1994).

Status: Critically Endangered (D1) if not already extinct. Listed in Appendix III of CITES.

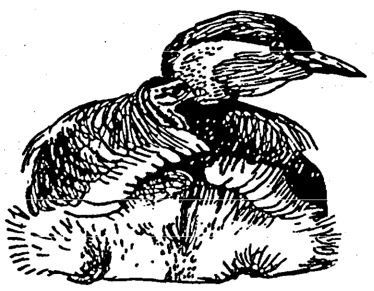
Threats: Lake Alaotra has changed drastically over the last century for several reasons, the most prominent being increased erosion and siltation following total deforestation of the surrounding hills, reclamation of land for irrigated rice cultivation, and steady encroachment of vegetation into the open water. The entire trophic web of the lake may have changed with alterations to the microhabitat and food availability. Introduced exotic fish (*Cyprinus carpio* and cichlids) are fast breeding and predominantly herbivorous. They have quickly altered the vegetation structure of the lake, particularly by destroying the beds of *Nymphus stellata*. Introduced predatory fish, such as *Micropterus salmoides*, may have eaten the food supply of native diving birds and perhaps their young. The introduction of exotic plants, such as *Eichhornia crassipes* and *Salvinia* sp., has resulted in eutrophication of the lacustrine habitat. The impact of the frequent burning of marsh vegetation on the grebe is unknown. Finally, trapping and the use of mono-filament gill nets may be a severe problem. The use of organochloride pesticides may also have had detrimental effects on wildlife (Young and Smith 1989, Wilmé 1994).

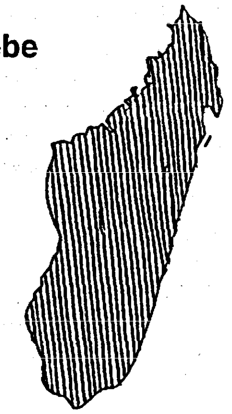
Declining numbers may have facilitated genetic swamping through hybridisation with the widespread Eurasiatic little grebe.

Recommended actions:

1. Immediately begin management actions to halt population decline, if indeed the species still exists. Survey the habitat to identify any remaining individuals and prepare and implement a species recovery plan. Many small lakes and ponds around Alaotra, some almost inaccessible, may not have been affected as badly by ecological changes as the main lake, and could still have small numbers of *T. rufolavatus* and the endangered duck *Aythya innotata*. Specific recommendations (Wilmé 1994) include:
   - i) Declaration of the grebe as a totally protected species by national legislation.
   - ii) Classification of key areas of least-modified habitat as national park, controlling access, fishing, and modification of habitat.
   - iii) Sustainable management of *Cyperus madagascariensis* reed-beds.
   - iv) Continuation of the campaign promoting awareness amongst local villagers of the values of wetlands and, specifically, of locally threatened wildlife.
2. Study the feasibility of possibilities for formulating a large scale wetland restoration project to be presented to a suitable donor institution.

3.2.6 Madagascar little grebe (*Tachybaptus pelzelnii*)





Distribution and habitats: This species is distributed throughout Madagascar, up to 2,000m, but has apparently been declining and is very scarce now (Collar and Stuart 1985, Langrang 1988, Wilmé 1990). It inhabits permanent or temporary water bodies, mainly freshwater, preferably with abundant aquatic vegetation, especially water-lilies. It is sometimes on rivers. It breeds mainly in the rainy season (February to March). It is recorded from six protected areas (Nicoll and Langrand 1989).

Population: Insufficiently known. A decline was first noted in the early 1960s. In the early 1970s, it was still considered common through most of Madagascar, though rare in the Antananarivo area, due to siltation and vegetation changes (see section on Delacour's little grebe, p. 16) It is more numerous now in the west and north and on the High Plateau. Groups of over 150 birds were recorded on Lake Ihotry in August 1983. The current population may be 5,000 to 10,000 birds (IWRB), although it could be less.

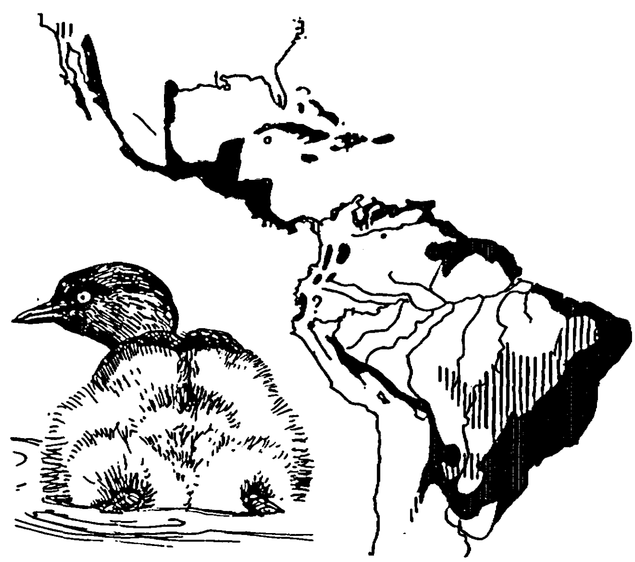
Status: Vulnerable (Al ace+2ce, C 1 +2b). Close monitoring is required as this species could move into the Endangered category in the near future.

Threats: Largely unknown. Being less exclusively piscivorous than the other Malegassian grebes, it may require undisturbed water with a rich supply of aquatic arthropods. It is apparently sensitive to siltation, water pollution, and ecological changes caused by introduced fish species. Factors thought to have contributed to the decline of Delacour's grebe (see section on Natural catastrophe, p. 6) may also have influenced this species.

Recommended actions:
1. Conduct a comprehensive survey of the population and closely monitor it to determine whether it is still declining and at what rate this decline is occurring.
2. Immediately research the factors responsible for decline.
3. Create a contingency fund for the preparation and implementation of a species recovery plan should its conservation status change.

3.2.7 Least grebe (*Tachybaptus dominicus*)

Distribution and habitats: Very local, mainly in subtropical parts of the Americas. Although the species does not show regular migrations (except maybe in Argentina), it is somewhat dispersive and able to colonise small temporary waters, which may have high densities of fairly large arthropods. It may favour small temporary waters which lack predatory fish. It also occurs in swamps, shallow lakes, or oxbows, often almost overgrown with floating vegetation.



Five subspecies are recognised. *T. d* dominicusinhabits the Bahama Islands from Eleutheraand Andros to Inagua, Greater Antilles, Virgin Islands and Cozumel Island. *T. d. brachypterus* lives from southern Texas and Sinaloa south to Panama. *T. d. bangsi* inhabits southern Baja California in Mexico, but scattered records from southern California, Arizona, and Sonora may also represent this form. *T. d. speciosus* inhabits South America east of the Andes. It occurs mainly near the Caribbean coast and in the scattered lakes of the premontane zone (to 2,500m) of the eastern Andes, south to northwestern Argentina, Paraguay, and southern Brazil. *T. d. eisenmanni* inhabits the lowlands of western Ecuador.

Population: Common locally. The population of all subspecies combined has been estimated at ca. 20,000 (but may be considerably larger) and is expected to be stable (IWRB). No breakdown by subspecies is available.

This species is multi-brooded, opportunistic breeder, ready to nest in any season if conditions are suitable. Clutch size is usually four to six eggs. Therefore, it has a high reproductive potential.

Status: The species and all its four subspecies have been placed in the Lower Risk (Ic) category in Table 3.1. However, information is rather inadequate for most subspecies.

Threats: Unknown. It is apparently quick to adapt to environmental changes, moving quickly between a limited number of suitable wetlands.

Recommended actions:
1. Conduct a survey and initiate amonitoring programme required to assess the populations and conservation status of individual subspecies of the least grebe.
2. Investigate the potential of the least grebe as a keystone indicator ofwetland health and wetland bird population trends because of its apparently more specialised habitat requirements.

3.2.8 Pied-billed grebe (*Podilymbus podiceps*)

Distribution and habitats: This grebe is distributed through large parts of the Americas. In South America the pied-billed grebe is restricted to the northwest and to the east and south of the continent. It inhabits lakes, marshes, and ponds, usually with abundant reeds, floaters, and submergents, and not necessarily very much open water.

numerous now in the west and north and on the High Plateau. Groups of over 150 birds were recorded on Lake Ihotry in August 1983. The current population may be 5,000 to 10,000 birds (IWRB), although it could be less.

Status: Vulnerable (Al ace+2ce, C 1 +2b). Close monitoring is required as this species could move into the Endangered category in the near future.

Threats: Largely unknown. Being less exclusively piscivorous than the other Malegassian grebes, it may require undisturbed water with a rich supply of aquatic arthropods. It is apparently sensitive to siltation, water pollution, and ecological changes caused by introduced fish species. Factors thought to have contributed to the decline of Delacour's grebe (see section on Natural catastrophe, p. 6) may also have influenced this species.

Recommended actions:

1. Conduct a comprehensive survey of the population and closely monitor it to determine whether it is still declining and at what rate this decline is occurring.
2. Immediately research the factors responsible for decline.
3. Create a contingency fund for the preparation and implementation of a species recovery plan should its conservation status change.

3.2.7 Least grebe (*Tachybaptus dominicus*)

Distribution and habitats: Very local, mainly in subtropical parts of the Americas. Although the species does not show regular migrations (except maybe in Argentina), it is somewhat dispersive and able to colonise small temporary waters, which may have high densities of fairly large arthropods. It may favour small temporary waters which lack predatory fish. It also occurs in swamps, shallow lakes, or oxbows, often almost overgrown with floating vegetation.

Five subspecies are recognised. ***T. d*** dominicusinhabits the Bahama Islands from Eleutheraand Andros to Inagua, Greater Antilles, Virgin Islands and Cozumel Island. ***T. d. brachypterus*** lives from southern Texas and Sinaloa south to Panama. ***T. d. bangsi*** inhabits southern Baja California in Mexico, but scattered records from southern California, Arizona, and Sonora may also represent this form. ***T. d. speciosus*** inhabits South America east of the Andes. It occurs mainly near the Caribbean coast and in the scattered lakes of the premontane zone (to 2,500m) of the eastern Andes, south to northwestern Argentina, Paraguay, and southern Brazil. *T.* d. ***eisenmanni*** inhabits the lowlands of western Ecuador.

Population: Common locally. The population of all subspecies combined has been estimated at ca. 20,000 (but may be considerably larger) and is expected to be stable (IWRB). No breakdown by subspecies is available.

This species is multi-brooded, opportunistic breeder, ready to nest in any season if conditions are suitable. Clutch size is usually four to six eggs. Therefore, it has a high reproductive potential.

Status: The species and all its four subspecies have been placed in the Lower Risk (Ic) category in Table 3.1. However, information is rather inadequate for most subspecies.

Threats: Unknown. It is apparently quick to adapt to environmental changes, moving quickly between a limited number of suitable wetlands.

Recommended actions:

1. Conduct a survey and initiate amonitoring programme required to assess the populations and conservation status of individual subspecies of the least grebe.
2. Investigate the potential of the least grebe as a keystone indicator ofwetland health and wetland bird population trends because of its apparently more specialised habitat requirements.

3.2.8 Pied-billed grebe (*Podilymbus podiceps)*

Distribution and habitats: This grebe is distributed through large parts of the Americas. In South America the pied-billed grebe is restricted to the northwest and to the east and south of the continent. It inhabits lakes, marshes, and ponds, usually with abundant reeds, floaters, and submergents, and not necessarily very much open water.

Three subspecies are recognised. *P. p. antillarum* is resident on suitable bodies of fresh water throughout the West Indies. However, it has been suggested that the resident populations of the Bahamas are referable to the nominate subspecies. *P. p. podiceps* is widespread and common in North America from Vancouver Island in British Columbia, northern Saskatchewan, and southwestern Quebec in the north, to Panama in the south. Wintering occurs in the southern part of the range and in the West Indies. It is casual to Hawaii, northern Alaska, southern Baffin Island, and Bermuda, and accidental on the Azores and in Great Britain. *P. p. antarcticus* is distributed from eastern Panama through South America to 43°S, except in the Amazon and Orinoco Basins. It also inhabits much of the Andean highlands, the southern Brazilian highlands, and Trinidad and Tobago (accidental in Grenada).

Population: No population estimates exist, but apparently the species is common over much of its range. Strong numerical decline in the eastern USA has not been analysed in detail, but it may reflect eutrophication of wetland habitats. In the Colombian Andes, *P. podiceps* has declined strongly in many areas following siltation of lakes (because of deforestation and soil erosion).

It breeds as isolated (territorial) pairs and is multiple-brooded, laying larger clutches (four to eight eggs, but two to three eggs in the tropics) than other grebes in the same areas. The high breeding potential is expected to permit it to respond rapidly to the formation of new wetland habitats.

Status: All subspecies are placed in the Lower Risk (lc) category.

Threats: Unknown. However, local impacts could include pollution, habitat loss and degradation, and increased disturbance.

Recommended actions:

1. Review all population information and potential threats on each subspecies of pied-billed grebe to confirm conservation status classification.
2. Identify and protect key sites for all subspecies of pied-billed grebe.
3. Evaluate the potential of the pied-billed grebe as a keystone indicator of wetland health and wetland bird population trends.

3.2.9 Giant pied-billed grebe (Atitlán grebe) (*Podilymbus gigas*)

Distribution and habitats: This flightless grebe was confined to Lake Atitlán, Guatemala, where it is now apparently extinct and has been replaced by *P. podiceps* (LaBastille 1969, 1974, 1984, Hunter 1988).

It has been suggested that *P. gigas* was only a local population of the common pied-billed grebe, adapted to the open high-altitude locality which, as the population

declined and adjacent populations colonised the lake, gradually hybridised into extinction. The alternative is that it was simply replaced by the common species.

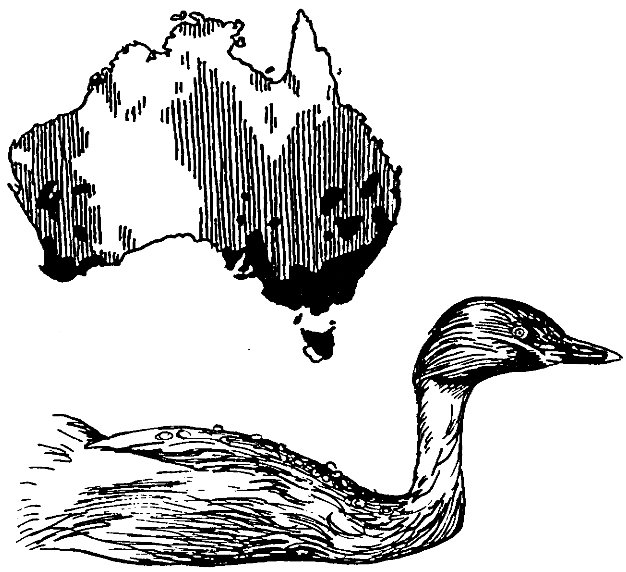
Population: None known. The population only numbered about 200 birds in 1960 and 1976. By 1980 only 55 to 65 remained. The species was extinct by 1991. The cause of extinction has been linked to the considerable degradation of the Lake Atitlán ecosystem over the last 30 years. These changes include loss of over 50% of fish species in the lake after the introduction of bass in 1960, reduction of shoreline reed-beds by 65%, a massive drop in lake level, eutrophication of the lake, and huge increases in human usage and pollution (LaBastille 1993). In retrospect it seems that the intensive use of gill nets in the lake may also have been a crucial factor (see section on Indirect threats, p. 7).

Status: Extinct. Appendix I of CITES.

Recommended actions:
1. No action specific to this grebe is required unless the species is rediscovered. However, LaBastille (1993) made recommendations for sustainable development and conservation of the Lake Atitlán catchment (see Chapter 4, section on Priorities of the Global Conservation Strategy, p. 36) which serve as an example for the types of actions necessary for the conservation of grebes in their natural habitat.

3.2.10 Hoary-headed grebe (*Poliocephalus poliocephalus*)

Distribution and habitats: This Australian grebe is widespread, preferring rather large, open, and unsheltered wetlands, permanent or semi-permanent. It also uses temporary wetlands, especially those appearing in the Australian interior after a heavy rainfall. Its strongholds are in the southwest and southeast, in the Murray-Darling watershed, and on the eastern tablelands. It is also present in Tasmania and has nested in recent years in New Zealand. Although the typical breeding habitat is semi-permanent swamps, including lignum swamps, it is well adapted to the rather unpredictable conditions of Australian wetlands. It shows nomadic movements which take advantage of large concentrations of invertebrates that sometimes abound in temporary waters. In drought years, they congregate in coastal lagoons and in estuaries. Unlike the nomadic waterfowl of Australia, hoary-headed grebes do not show rapid breeding responses to temporary food peaks, but depend on more permanent wetlands for breeding.



Population: No accurate estimate is available. However, the population is high and stable, perhaps numbering in the order of 500,000 birds (IWRB). Flocks of thousands can turn up in inland swamps shortly after a rise in water levels. Large non-breeding flocks have been recorded. For example, flocks of 2,000 to 3,000 at Fletchers Lake, New South Wales, and 4,900 at Bibra Lake, Western Australia were recorded (Marchant and Higgins 1990). In New Zealand, although a few birds remain from a small influx in the mid-1970s, breeding has not been recorded since 1978.

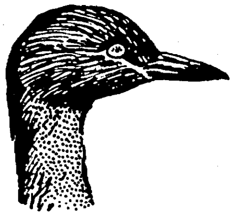
This is the world's most gregarious grebe species (Fjeldså 1983, 1988). It is very social, even while feeding. It feeds on a variety of small arthropods, usually ignoring small fish. Its feeding adaptations may be the reason why it maintains such high numbers, in spite of the unpredictable conditions for waterbirds in Australia. It breeds in colonies of up to 400 nests and appears to be single-brooded, normally laying three to five eggs.

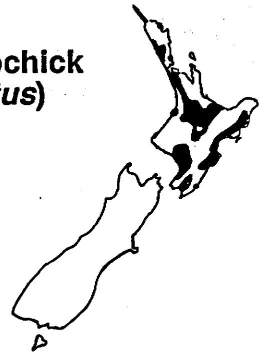
Status: Placed in the Lower Risk (lc) category.

Threats: Definite information is lacking, but alterations to inland river flood regions may have a negative influence.

Recommended actions:
1. Identify and protect key sites of the hoary-headed grebe.
2. Evaluate the potential of the hoary-headed grebe as a keystone indicator of wetland health and wetland bird population trends. Although it can tolerate a wide range of conditions, its optimal habitat for breeding is semi-permanent wetlands with extensive open shallows, linear-leaved submergent vegetation (*Vallisneria, Ruppia, Potamogeton* etc.) and a high density and diversity of arthropods.

3.2.11 New Zealand dabchick (*Poliocephalus rufopectus*)





Distribution and habitats: Confined to New Zealand, this species previously occurred throughout the country. It declined in the South Island during the mid-nineteenth century and remnant populations on the West Coast and in Fjordland had disappeared by 1960 (last confirmed breeding in the early 1940s). It is still widely distributed on the North Island, where it is most abundant on the Volcanic Plateau. Other key populations are in the east and south of North Island (Hawke's Bay, Wairarapa, Manawatu). It is generally found in low numbers, favouring sand-dune lakes, lagoons, farm dams, and inland lakes surrounded by dense marginal vegetation. Unlike its Australian sibling-species, it is assumed to be an unspecialised feeder.

Population: Total estimate is 1,200 to 1,500. It is probably now stable at: Northland, less than 200; Volcanic Plateau, maximum 500; Hawke's Bay, unknown, but winter flocks up to 55; Wairarapa, ca. 130; Manawatu 250 to 280.

Generally, it lays a two-egg clutch, but it has a long breeding season and more than one clutch in the northern part of the range. It has a high reproductive potential. However, the breeding success on larger water bodies is very low (less than 20%), although it can produce up to six replacement clutches in a season (see Threats, below).

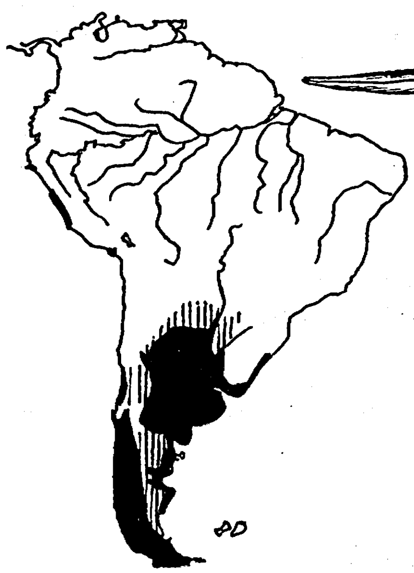
Status: Lower Risk (near threatened).

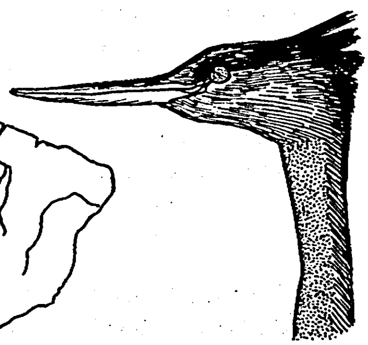
Threats: Classed as Endangered by The IUCN 1996 Red List of Threatened Animals because of its small and localised population which has declined significantly in the past. However, the population appears to be fairly stable under present day conditions, and we, therefore, prefer the Lower Risk (near threatened) category. Causes of decline were associated with changes in the wetland environment, particularly changes in sediment loads of inflowing waterways. Some key sites in Northland dune lakes have dried out, while in others the spread of *Typha orientalis* has encroached on open waterways. Destruction of emergent vegetation on lake margins has led to abandonment. It suffered from widespread draining of marshes in the past, but since the 1940s has benefited from the creation of rural farm ponds and sewage ponds. Apparently, it is hardly affected by waterfowl shooting, being small, hard to panic and ignored by shooters. The reasons for the extinction in the South Island are not known. Other suggested causes of decline (though no direct evidence is available) include predation by introduced rats and mustelids, water level fluctuations, wave action, and disturbance, all of which contribute to very low breeding success on larger lakes.

Recommended Actions:
1. Implement a monitoring programme for the New Zealand dabchick at key sites.
2. Write and implement a species recovery plan for the New Zealand dabchick in case circumstances change and its decline starts again.

3.2.12 Great grebe (*Podiceps major*)

Distribution: Widespread in the Southern Cone of South America, where it inhabits estuarine marshes and reed-fringed bays of larger lakes, especially in forested or wooded areas. It often winters or moults in marine kelp-zones, and occasionally roams far offshore.





Two subspecies are recognised. *P. m. major* inhabits South America from Paraguay and the most southern part of Brazil to the Atlantic zone of Patagonia and west to San Juan in central Argentina. It also inhabits the lowlands of central Chile and it is accidental to the Islas Malvinas. A small population occurs in the coastal zone of Peru with scattered records from estuarine marshes and bays. Breeding has now been confirmed in two lagoons in northern Lima (T. Luscumbe pers. comm.; J. Fjeldså pers. obs.). **This population may represent a distinct (small-sized) subspecies.** *P. m. navasi* inhabits the Chilean fjordlands and the Andean lake districts south of Llanquihue. It frequents marine habitats when not breeding; large numbers assembling in certain places, such as near Chiloë Island, Chile.

Population: Not known, but estimated at ca. 50,000 and stable (IWRB). The Peruvian populations may number only a few hundred (increasing), with a maximum of 68 birds recorded in Paracas Bay.

The great grebe has a high reproductive potential. Often nesting in colonies, it is multiple-brooded or shows fairly irregular, but opportunistic, breeding. In Peru, it only nests in some years.

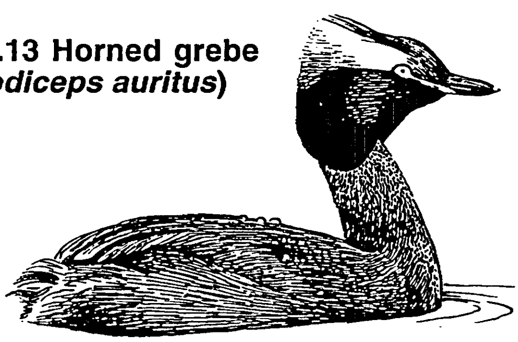
Status: Placed in the Lower Risk (lc) category. However, assessment of the Peruvian population is required to determine whether it requires a separate classification. Although this population is increasing at the moment, it should be regarded as Vulnerable because of the small number of wetlands that exist along the Peruvian coast.

Threats: Not known. However, the Peruvian population is vulnerable because of the very small area of coastal wetlands remaining.

Recommended actions:

1. Assess the taxonomic and conservation status of the Peruvian population of *P. m. major* to determine whether it warrants separate classification. Collect a few specimens or tissue samples if necessary. If a valid taxon, then implement a monitoring programme, and perhaps a recovery plan.
2. Identify and protect key sites of the great grebe.
3. Evaluate the potential of the great grebe as a keystone indicator of wetland health and wetland bird population trends. Its value as a keystone indicator may be similar to that of the great crested grebe (See section on Great crested grebe, p. 25).

3.2.13 Horned grebe (*Podiceps auritus*)



Distribution and habitats: This grebe is circumpolar in the Northern Hemisphere. It occurs mainly in the transition zones between the deciduous-forest parklands and the taiga, but also locally in the subarctic zone.

Two subspecies are recognised. *P. a. auritus* inhabits western Eurasia, locally in Iceland (occasionally Faeroes), northeastern Scotland, and northwestern Norway, and continuously from southeastern Norway and central Finland, east through Russia to Sachalin, generally between 50° and 65° north. It is a casual breeder south to Denmark and in recent years in northern Germany and Poland. It occurs south to 44° in the region of Balkhash. It winters as far west as Greenland and south to the Mediterranean, the Iranian Gulf, inland China, and Korea. It is casual in India, Pakistan, and on the Azores in winter. The eastern Asian population winters south to Korea, China, and Taiwan. The nominate subspecies intergrades in eastern Siberia towards *P. a. cornutus*, which breeds throughout North America from central Alaska to northern South Dakota and central Minnesota. Formerly, it bred sporadically south to northern Nevada, Utah, Nebraska, Iowa, and Indiana, and east to Maine. It winters along the coast, south to California and Texas. It is casual in Greenland and Bermuda, and accidental in Hawaii.

Population: Generally common. The population of *P. a. auritus* is estimated at 50,000 to 100,000 birds, with a minimum of 15,000 breeding pairs in Europe. Western European populations are well known, but few comprehensive counts have been taken elsewhere. Breeding population estimates include: Iceland, 500 to 750, but declining to 400 over the last few years; Scotland, ca. 50 pairs, increasing in recent years to ca. 70 pairs (1990 to 91; Andrew and Carter 1993); Finland, 1,500 pairs, decreasing from ca. 3,000 in the 1950s; Norway, very restricted in the north in the last century, ca. 500 pairs in the 1960s, increasing during recent years (mainly in the Trøndelag region) to 1,000 to 1,500 pairs; Sweden, immigrating in the beginning of the 20th century, increasing to 2,000 to 2,500 or even more (1972), but since then declining strongly in some areas. The mid-winter estimate for western Europe is ca. 5,000 The northern Norwegian population apparently winters in shallow straits and bays

in the archipelago, mainly at 63°30' to 64° and 65°30'N (Hitra, outside Trondheimsfjord, Vega). In the southern Baltic Sea the wintering population was estimated to be 1,830 birds, with a distinctive concentration of ca. 1700 off Swinoujscie in the Gulf of Pommern, at 10 to 20m water depth (Durinck *et al.* 1994). Populations probably lie between 10,000 and 100,000 in northeastern Europe, 10,000 and 25,000 in the Caspian Sea area, and 25,000 and 100,000 in eastern Asia.

P. a. cornutus may be the commonest grebe in North America and probably numbers greater than 100,000 birds. However, a considerable decline has been noted in recent years, paralleling the decline in many inland-nesting waterfowl, and possibly reflecting the drying-up of many of the pothole areas.

The population in western Europe expanded strongly in the 20th century, but the trend has been reversed in some areas (notably in Iceland). Hildén and Sharrock (1985) noted increases in two European countries, static numbers in five countries, and uncertain status in three. However, a more recent analysis by Tucker and Heath (1994) suggests a more widespread decline in Europe. In North America a decline has mainly been noted in the southwest.

It usually breeds as isolated (territorial) pairs, but sometimes forms small colonies. It is single-brooded, but shows considerable variation in strategy, inland populations having a high breeding potential, while the North Atlantic birds are much more prudent breeders (compare Fjeldså 1973b and Ferguson and Sealy 1983).

Status: Both subspecies are placed in the Lower Risk (lc) category. However, populations have fluctuated and, in some areas, declined markedly in the last 100 years. Some local populations may be threatened. It is not yet possible to define key sites for conservation.

Threats: The species is vulnerable to oil spills in the marine environment, particularly where the birds winter. Causes of decline in Iceland, Finland, and elsewhere are not known.

Recommended actions:

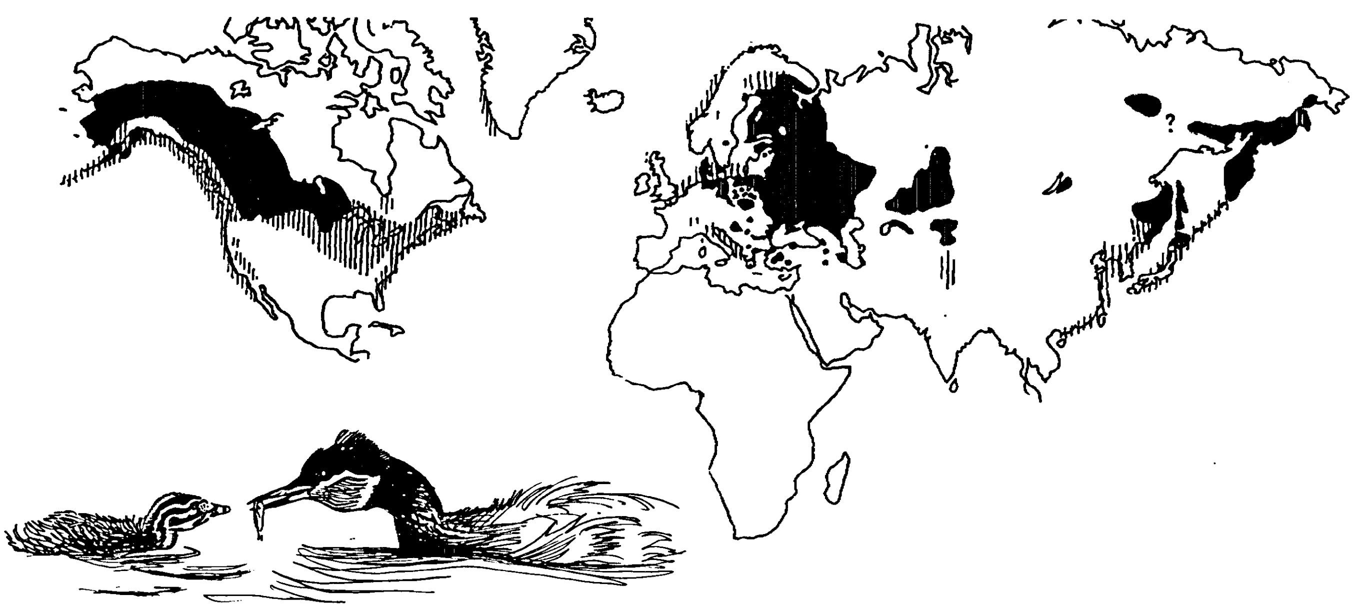
1. Identify sites of international importance for the horned grebe, as some regional populations may be threatened. The Bonn Convention provides a relevant mechanism for actions to protect key sites at least in western Europe (where implementation has been most active).
2. Closely monitor populations of horned grebes to determine whether numbers are stable or whether local declines are symptomatic of more widespread problems.
3. Conduct survey work to accurately ascertain the current population sizes of both subspecies of horned grebe. Monitor marginal populations in northwestern Europe which have shown strong historical fluctuations.
4. Create a contingency fund for the preparation and implementation of a regionally based species recovery plan for the horned grebe in case the conservation status changes.
5. Use the horned grebe as a focal species for wetland conservation locally in the boreal zone. In the oligotrophic/mixotrophic northern wetlands, this species is an excellent indicator of lakes with high mineral content (e.g., in limestone zones or lowlands covered with Pleistocene marine sediments) and high secondary production (Fjeldså 1975a, 1980). It may also be sensitive to many kinds of changes in the ecosystem.

3.2.14 Red-necked grebe (*Podiceps grisegena*)

Distribution and habitats: Generally common and widespread in the northern hemisphere, from the western Palearctic through to eastern Asia and North America. It breeds in reeds, overgrown pools, and quiet waters, and winters mainly along coasts, often in large concentrations over shallow banks, and in archipelagos of considerable distance off the coast.

Two very well marked subspecies are recognised. *P. g. grisegena* inhabits the western Palearctic from the Netherlands (irregular and recent breeding attempts in Great Britain) and Sweden east to western Siberia. Birds reach as far north as 67° in Russia and northern Finland. They reach as far south as Romania, eastern Kazakhstan, northwest India, and Pakistan. They winter mainly at sea, off northern Norway and Denmark, sporadically south to the Mediterranean and northern Iran, and accidentally to Greenland, Spitsbergen, and northern Africa. A form previously known as subspecies *balchashensis*, which breeds in the Balkhash area, has a small wintering population in Pakistan and an increasing one in northwestern India. *P. g. holboellii* (Holboell's grebe) inhabits eastern Asia from 115°E to the Anadyr basin and from 69°30'N in the Kolyma basin south to Ussuriland and Japan (Hokkaido). It occurs in North America from north-central Alaska to Washington, Montana, and Minnesota, and sporadically to Michigan and New Hampshire. In winter, these grebes occur in Korea, China, California, and Florida, and they are casual to Louisiana, Greenland, Iceland, and western Europe.

Population: Relatively stable, but a moderate decline in recent years in several countries has been recorded by Tucker and Heath (1994). The breeding population



estimate of *P. g. grisegena* in Europe (west of Ural) is 28,000 breeding pairs. The breakdown per country is listed in Table 3.3. About 18,000 birds are present in northwestern Europe in the non-breeding season. The population wintering in the Baltic Sea and Danish Belts has been estimated at 5,510 with concentrations in western Kattegat and Pomerian Bay. Along the northwestern coast of Norway, ca. 2,500 to 3,000 winter in fairly exposed banks and shallows in the archipelago between 63° and 65°N. Few counts are available from elsewhere and the IWRB estimate of 50,000 to 100,000 birds may be too high. Hildén and Sharrock's (1985) review suggests that numbers have increased in two European countries, declined in two, and remained stable in ten. Numbers are probably ca. 10,000 in the Black Sea/Mediterranean area and ca. 15,000 and increasing in the Caspian area. There are no population estimates for *P. g. holboellii* but this subspecies probably numbers greater than 100,000 birds. Diurnal migration through Lake Michigan in August and early September 1992 was 18,739 red-necked grebes in 727 hours of daytime observation (B. Stout cited by G. Nuechterlein, D. Buitron pers. comm.).

Table 3.3 Breeding population estimates of *P. g. grisegena* in Europe.

Country name	Breeding population estimate (in pairs)
Denmark	350–400
Estonia	120
Finland	2,500
Germany	700
Hungary	50–60
Poland	1,000
Sweden	600
former Soviet Union	20,000–25,000

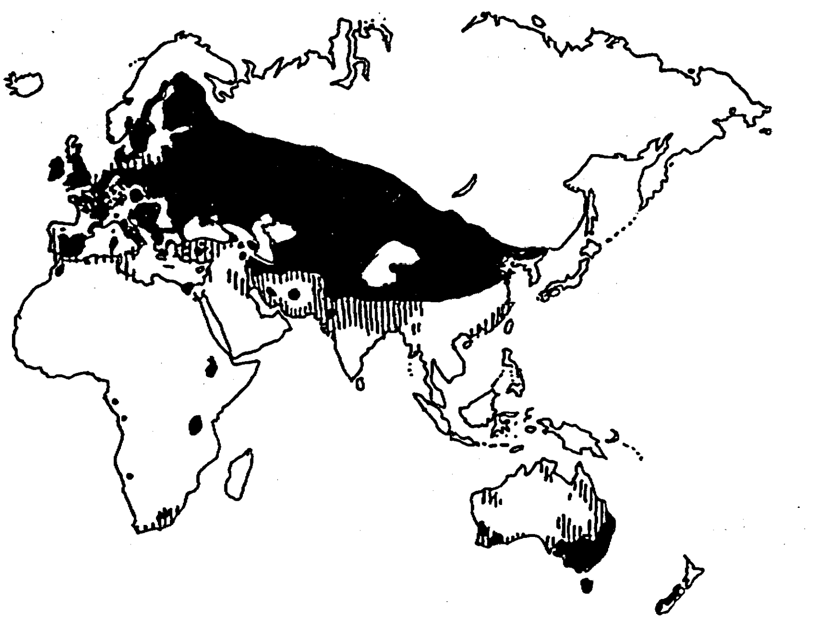
It usually breeds as isolated (territorial) pairs, which are single-brooded, normally laying three to five eggs.

Status: Both subspecies are in the Lower Risk (lc) category.

Threats: Largely unknown. Vulnerable to oil spills in its winter quarters. Such disasters in the Danish coastal waters had a marked impact on the breeding populations in Denmark and southern Sweden for several years. Local impacts could include pollution, habitat loss, degradation, and increased disturbance.

Recommended actions:

1. Identify and protect key sites of the red-necked grebe. Pay special attention to areas with large numbers of wintering grebes. The Bonn Convention provides a relevant mechanism for actions to protect key sites at least in western Europe (where implementation has been most active). Also, continue the process for the conservation of offshore areas of international importance that has started in areas such as Canada and the Baltic and North Sea (see Kelleher and Kenchington 1992).
2. Evaluate the potential of the red-necked grebe as a keystone indicator of wetland health, particularly in the marine environment. Here it prefers extensive areas of rather shallow water, often far offshore, which may be very important for other diving birds as well, notably scoters (*Melanitta*).
3. Conduct a taxonomic evaluation of the form of red-necked grebe previously known as subspecies *balchashensis*.

3.2.15 Great crested grebe (*Podiceps cristatus*)

Distribution and habitats: The crested grebe occurs widely in the Palearctic, Africa, and Australasia. The species is generally common, but the occurrence is local and unstable in many parts of the range. It prefers fairly open lakes with reed-fringed bays and occurs in vast numbers in some large and open marshes. In Europe it is opportunistic and has colonised many habitat types, (including artificial lakes) in recent decades. As waters become increasingly eutrophic and large populations of cyprinid fish develop, the grebe populations may increase enormously. However, once eutrophication reaches a certain stage and recruitment of small fish populations becomes irregular, complete breeding failures and drastic population shifts may be seen. However, the lakes may remain important as moulting areas for adult grebes (Meltofte 1996). Because of these relationships, counts of great crested grebes (number of adults and a record of their breeding success) are cheap and reliable indicators of changes in water quality in agricultural regions (Asbirk and Dybbro 1978).

Three subspecies are recognised. *P. c. cristatus* inhabits the Palearctic, from the British Isles to southern Ussuriland, and north to 66°N in Sweden. It occurs in northeastern Africa, Iran, the Himalayan region, and increasingly in northwestern India. Northern populations are migratory, reaching southern Iran, Bangladesh, southern China, Hong Kong, Japan, and Korea. It is casual to Taiwan and possibly Senegal. *P. c. infuscatus* occurs in Africa. It is patchily distributed in highland lakes from southern Ethiopia to near the Zambia-Tanzania border and in southern Africa, south from Transvaal. There is one breeding record from Gabon. *P. c. australis* inhabits Australia, especially the southeast and extreme southwest, but it is also present in Tasmania and New Zealand, where it is now confined to the South Island.

Population: *P. c. cristatus* is common in many parts of the Palearctic. There are ca. 150,000 estimated in northwestern Europe and a minimum of 340,000 pairs estimated in Europe west of Ural. Current breeding population estimates are listed in Table 3.4. Hildén and Sharrock (1985) suggest numbers have increased in 13 European countries in recent years; Tucker and Heath (1994) noted declines only in two countries. The most marked change has been in the north, notably in Finland. Some of the largest autumn and winter concentrations occur in IJsselmeer, in Holland, and the lakes of Switzerland; however, the migration pattern and the relative importance of different wintering areas has changed markedly with the total population increase (Adriaensen *et al.* 1993). The

Table 3.4 Breeding population estimates of *P. c. cristatus* in Europe.

Country name	Breeding population estimate (in pairs)	Breeding population trend
Denmark	2,350	
Finland	50,000	increased from 5,000 in the 1950s
France	80	
Germany	2,500	
Netherlands	3,650	
Norway	300–500	increased recently from 50
Spain	6–12	
Sweden	32,000	increase since the 1970s
Great Britain	6,000	

Mokkebank area in IJsselmeer has, during recent years, had an average of 10,000 moulting birds, with peak figures up to 40,000. The wintering population in the Baltic Sea is estimated at ca. 11,000 birds, with main concentrations in shallow (less than 10m) water in Pomerian Bay and Fehmarn-Hohwachter Bay (see Durinck *et al.* 1994).

Populations in southwestern Asia probably number ca. 10,000 with two areas of international importance: the Caspian Sea coast between Farahabad and Ashur, and the Gomishan Marsh, both in Iran. In southern Asia, over 10,000 occur and numbers are apparently increasing in some areas. Three sites may be of international importance: Nanakmata Reservoir, India, which has 1,500 birds, Sibsagar Tank, India, and Rara Lake, Nepal. Populations in eastern Asia are not well known, but may be in the order of 25,000 birds. There are no estimates for *P. c. infuscatus* in Africa or *P. c. australis* in Australasia. Drastic declines of crested grebes in Kenya have been reported recently (G. Nuechterlein, D. Buitron pers. comm., and various reports) and it has also become rare in Namibia (A. J. Williams pers. comm.). The largest concentrations in Australia have been in New South Wales, with up to 1,200 birds on breeding grounds, up to ca. 600 on wintering grounds in Victoria, and ca. 1,000 in Western Australia (Marchant and Higgins 1990). Bird populations in New Zealand have decreased significantly in the last 100 years and number 200 to 300 today (still declining).

The great crested grebe is an opportunistic breeder which shows strong variation in dispersal (territoriality versus colony-breeding), breeding phenology, clutch size (one to nine eggs), and number of annual clutches (see Simmons 1970). In many parts of its range it is multiple-brooded, ready to breed at any season if suitable conditions arise; therefore, it has considerable breeding potential.

Status: The species as a whole is in the Lower Risk (lc) category. However, *P. c. infuscatus* is in the Data Deficient category and is potentially Vulnerable. *P. c. australis* is currently classed as Vulnerable (A1cde, C1) because of its apparently small population size (probably ca. 3,000) and the uncertain taxonomic status of the New Zealand population.

Threats: Threats to *P. c. infuscatus* are unknown; however, the recent declines in Kenya may have resulted from a rapid increase in the use of gill nets for fishing during the last 15 years (L.Bennun, D.Turner pers. comm.). In New Zealand, *P. c. australis* declined significantly after the arrival of Europeans. It disappeared from the North Island and the north of the South Island first. Factors causing decline included: (i) predation of nests from introduced mustelids and possibly feral cats and rats; (ii) human-induced lake level fluctuations, particularly hydroelectric developments; (iii) loss of original nesting habitats on lake margins; (iv) competition with introduced trout for native fish foods; (v) probably increased disturbance from water-based recreation; and (vi) predation of chicks by introduced trout. In Europe, such threats are of importance only on a local scale.

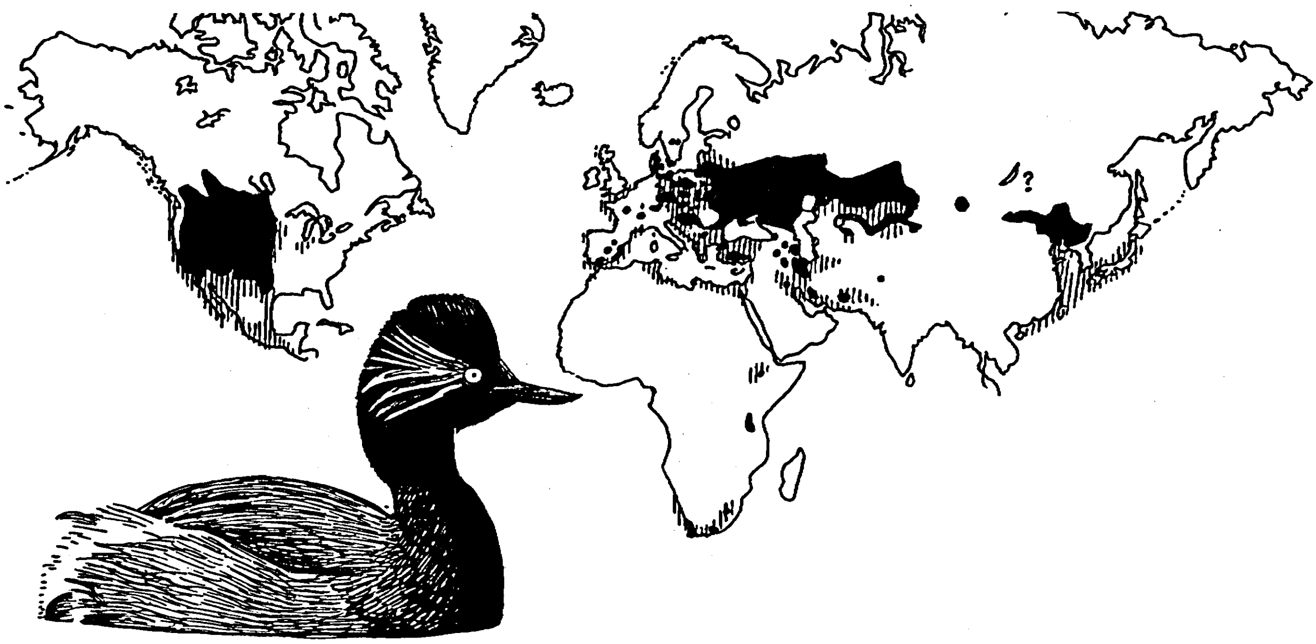
Recommended actions:

1. Immediately assess the current conservation status of *P. c. infuscatus*, including population trends and threats.
2. Assess the Vulnerable *P. c. australis* population and write and implement a recovery plan if necessary. Recommended actions include:
   i) protecting lake habitats
   ii) imposing limits on water-based recreation at key sites
   iii) reducing lake level fluctuations where possible
   iv) enhancing nesting habitat in predator-free environments
3. Reassess the taxonomic status of *P. c. australis* in New Zealand.
4. Identify and protect key international sites for all subspecies of crested grebe. The Bonn Convention provides a relevant mechanism for actions to protect key sites at least in western Europe (where implementation has been most active).
5. Evaluate the potential of *P. c. cristatus* as a keystone indicator of wetland health (see Distribution and habitats). Clearly, the large scale changes of the European population reflect, to a large extent, trophic changes in wetland ecosystems driven by changes in agriculture, but the process is not understood in detail.

3.2.16 Black-necked (eared) grebe (*Podiceps nigricollis*)

Distribution and habitats: This gregarious species occurs widely from the western Palearctic to North America. Its main concentration is in the ecotones between steppe/prairie zones and woodland zones. It inhabits freshwater marshes and lakes, often with extensive shallows with dispersed submergent vegetation and scattered patches of reeds. It nests colonially in reed-beds or, sometimes, open to view in places with water-weeds on the surface. In most geographical areas, a strong breeding association exists with terns and small gulls. Outside the breeding season the species is strongly dependent on stable salt-lakes with high densities of brine shrimp or other macrozooplankton.

Three subspecies are recognised. *Podiceps n. nigricollis* breeds from Britain and southern Sweden to the Ob valley in western Siberia, south to Morocco, Iraq, and Afghanistan. It also breeds in Manchuria, southern



Ussuriland, eastern Africa in the Rift Valley zone from Ethiopia to northern Tanzania, and southwestern and southern Asia, east to India and Pakistan. In winter, it exists south to the Nile Valley, southwest Asia, northern India, and the Ryukyu and Bonin Islands. An east Asian population winters in southern China, Korea, Japan, and Taiwan. It is casual in the Kola Peninsula, and on the Azores, Madeira, and the Canaries. *Podiceps n. gurneyi* inhabits South Africa from Transvaal to Cape Province, and is occasional in Angola and Mozambique. *Podiceps n. californicus* breeds in western North America from central British Columbia (isolated in Yukon), Alberta, and Saskatchewan, south to northern Baja California and New Mexico. It is isolated in southern Texas and Jalisco and Puebla in Mexico. In winter it is casual on the Atlantic and Gulf coasts, and accidental on Hawaii.

Population: Generally common, occurring in large numbers in certain areas, but the population is patchy and unstable in parts of its range. Tucker and Heath (1994) estimate a minimum of 39,000 breeding pairs in Europe. IWRB estimates ca. 100,000 birds in western Europe and ca. 25,000 in the Caspian area. The IWRB breeding estimates for European countries are listed in Table 3.5. Hildén and Sharrock (1985) suggest that the rapid spread in Europe from ca. 1860 has now reversed to a decline in seven countries, while numbers have remained stable in ten countries and increased in two; Tucker and Heath (1994) indicate declines in nine countries.

Winter concentrations in Eurasia include: 1,500 to 6,400 birds in the hypersaline lagoon of Formentera, Mallorca (Mayol 1984); ca. 1,500 in the salines of Thyna near Sfax in Tunisia (J. Gregersen, pers. comm.); ca. 1,100 on Fateh Sagar Lake in Rajasthan, India (Perennou *et al.* 1994); up to 10,800 on Lake Quarun in the Fayum depression, and over 1,000 at El Malaha near Bur Fuad, both in Egypt (Meininger and Mullié 1981). Considerable numbers are found at the Black Sea coast, but are poorly documented. There are no estimates for Africa, but black-necked grebes are generally uncommon and local (Williams and Arlott 1980). Several hundred were seen in large flocks on Lake Bogoria, Kenya, in 1992 (G. Nuechterlein, D. Buitron pers. comm.), and over 1,000 have been seen on Lake Nakuru. No estimates are available for eastern Asia, but the population is somewhere between 10,000 and 100,000 birds (IWRB). Ssp. *gurneyi* could well count 100,000 judging from large concentrations seen from a ship a long way off the Namibian coast (T. Williams pers. comm.).

The North American population is much larger, estimated at ca. 2,500,000 birds (IWRB). However, it is difficult to determine because of shifts between lakes, and

Table 3.5 IWRB breeding population estimates of the black-necked grebe in Europe.

Country name	IWRB breeding population estimates (in pairs)
Czech Republic	2,500–5,000
Denmark	124–350
France	800–1,250
Germany	1,200–2,000
Great Britain	15–40
Netherlands	80–250
Poland	3,000–5,000
Romania	2,000–4,000
Slovakia	300–1,500
Turkey	2,000–10,000
Ukraine	15,000–19,000

there could be no more than 1,500,000 birds (J. Jehl pers. comm.). The largest moult concentration is in Mono Lake, California (Jehl 1988), and the winter concentration on the Salton Sea, California comprises greater than 450,000 birds (J. Jehl pers. comm.). Surprisingly, no staging and wintering concentrations comparable to those found in North America have yet been found in Eurasia.

There are some indications that breeding populations may show considerable fluctuations which do not correlate with local environmental changes and, therefore, may reflect conditions in the winter quarters. They are normally single-brooded.

Status: The species as a whole is in the Lower Risk (lc) category, but *Podiceps n. gurneyi* is in the Data Deficient category.

Threats: The species may be vulnerable because of its feeding adaptations and strong dependence on a few stable saline lakes outside the breeding season. *Podiceps n. nigricollis* colonised western Europe from the east from ca. 1860. This range expansion has now stabilised and numbers fluctuate strongly, possibly because of hazards in the winter quarters and, maybe, ecological changes in the breeding lakes which are secondary effects of highly intensive agriculture. The species has declined suddenly in the wintering sites in Egypt. Simultaneously (1982), there was a sharp decline in Holland and Denmark, but a marked increase was seen here in 1985. Massive mortality has been recorded in North America during winter migration. For example, 10,000 casualties were recorded in 1991 during migration across major mountain ranges (Jehl 1993). No long-term impact of this mortality was detected.

Recommended actions:
1. Assess the current conservation status of *Podiceps n. gurneyi*, including population trends and threats.
2. Closely monitor key sites for black-necked grebes because of the large fluctuations that have been recorded. Determine whether numbers are stable or whether local declines are symptomatic of more widespread problems.
3. Identify and protect key international sites for all subspecies of black-necked grebe, especially key staging sites, some of which are threatened. The Bonn Convention provides a relevant mechanism for actions to protect key sites at least in western Europe (where implementation has been most active).
4. Evaluate the potential of black-necked grebes as keystone indicators of wetland health and wetland bird population trends in Eurasia and North America. Good breeding success seems to reflect weakly alkaline conditions and very high production of aquatic arthropods, while large non-breeding concentrations reflect stable salt lakes.

3.2.17 Colombian grebe (*Podiceps andinus*)

Distribution and habitats: The Colombian grebe was once found on several lakes, with tall marginal reeds and extensive shallows full of submergent water-weeds, on the Bogotá and Ubaté savannahs and in Lake Tota in the eastern Andes of Colombia. The species was first described based on two male specimens collected in 1945 from Lake Tota. Only a few other specimens were collected between 1939 and 1964. Searches were made for the Colombian grebe in 1981 (Fjeldså 1984, 1985a, 1993) and in 1982 (Varty *et al.* 1985) in the wetlands of the eastern Andes, Colombia. The studies also included surveys of other waterbirds and the general conditions of these wetlands, once the stronghold for waterbirds in the northern Andes. The Colombian grebe populations apparently collapsed in the 1950s, but a very low number survived until the 1970s when the last two or three were seen (in 1977) on Lake Tota. The species is currently extinct in its historically known range and the chance that it still exists elsewhere, outside the northern Andes, appears extremely slight.

Population: None known.

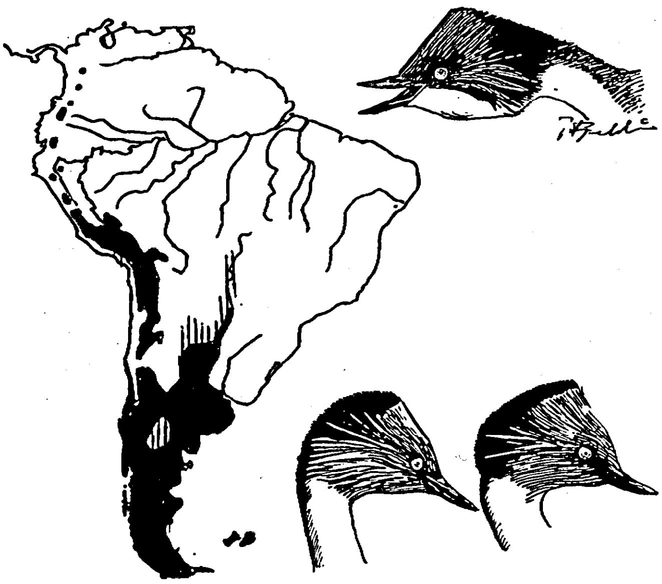
Status: Extinct.

Threats: The main reason for the decline was drainage of wetlands, siltation, and eutrophication in Lake Tota which destroyed the open, submergent *Potamogeton* vegetation and led to the formation of a dense monoculture of *Elodea* (Varty *et al.* 1985, Fjeldså 1993). Introduction of exotic fish may have played a role in affecting the supply and accessibility of macro-invertebrates, and hunting in the breeding colonies probably played a role during the last critical years (Fjeldså 1993).

Recommended actions:
1. Assess the possibility that populations of Colombian grebe may still exist outside its former breeding range.
2. Initiate a large-scale investment in the Bogotá area for better management of wetland ecosystems in order to secure populations of other rare waterbirds (several endemic reed-swamp species, as well as endemic subspecies of ruddy duck *Oxyura jamaicensis andina*, cinnamon teal *Anas cyanoptera borreroi*, and American coot *Fulica americana*). This effort will also secure stable water supplies for the greenhouse industries of the area and areas which can function as sinks for pollutants. Water levels and large-scale reforestation must be managed better to reduce siltation (see Fjeldså 1993).

3.2.18 Silvery grebe (*Podiceps occipitalis*)

Distribution and habitats: The silvery grebe is widespread in the Southern Cone of South America and in the high Andes. It inhabits open lake habitats with or without reed-beds, but always with high densities of macrozooplankton or extensive areas of submergent vegetation with high densities of arthropods. It prefers shallow, weakly alkaline lakes and, sometimes, congregates on salt lakes. It breeds in colonies, in reed-beds, or in areas where water-weeds form floating carpets.



Two subspecies are recognised. *Podiceps o. juninensis* inhabits high Andean lakes from the central Andes of Colombia to Antofagasta in northern Chile and Catamarca in northwestern Argentina and, occasionally, to the Pacific coast of Peru. *Podiceps o. occipitalis* occurs from central Chile and Córdoba and Santa Fe, Argentina, to Tierra del Fuego and the Islas Malvinas. It is mainly a migrant in the northern parts.

Population: Generally common and numbering ca. 100,000 birds (IWRB). *Podiceps o. occipitalis* appears to be stable, but *P. o. juninensis* has become very local north of Lake Titicaca and may be vanishing in the paramos in the northern Andes.

The life history strategy is poorly known. The species appears to be adapted to stable ecosystems of larger, weakly alkaline lakes with extensive shallows with high densities of arthropods. It sometimes aggregates in thousands on saline lakes with brine shrimp and other macrozooplankton. It is single-brooded and has a two egg clutch.

Status: The species as a whole is in the Lower Risk (lc) category, but *Podiceps o. juninensis* is classed as Lower Risk (near threatened), considering the recent declines in the north part of its range.

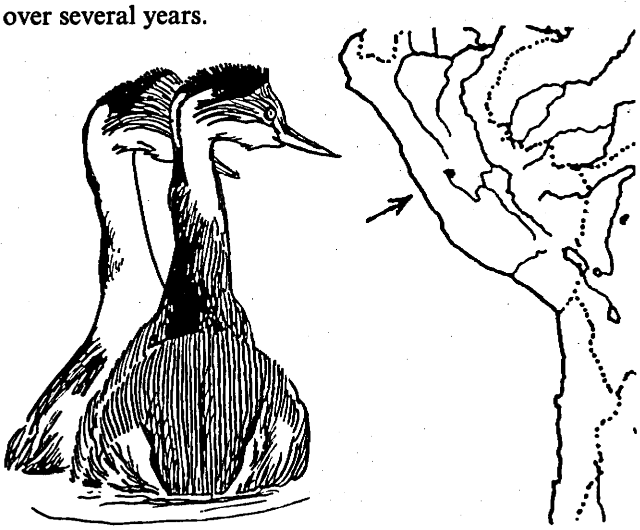
Threats: Draining of wetlands, eutrophication, and siltation, which destroy submerged weed beds, may all threaten this species. Reductions of the macrozooplankton following the introduction of exotic fish (Hurlbertand and Chang 1983) is also a critical factor.

Recommended actions:

1. Identify and protect key international sites for the silvery grebe.
2. Implement a monitoring programme for the silvery grebe at key sites.
3. Write and implement a species recovery plan for *P. o. juninensis* if circumstances change and recent declines in the northern part of the range continue.
4. Evaluate the potential of silvery grebes as keystone indicators of trophic structures of wetlands and of general changes in its key habitats.

3.2.19 Junín flightless grebe (*Podiceps taczanowskii*)

Distribution and habitats: This grebe is confined to Lake Junín at 4,080m asl in central Peru (Fjeldså 1981b). It is a bird of open lake habitat which stays far offshore, mainly in the lake centre, for part of the year, but in the breeding season, visits "islands" of tall *Scirpus (californicus) tatora* or bays and channels in the outer edge of the 2–5km wide reed-marshes surrounding the lake. It nests colonially in reed-beds. Its principal requirement in the breeding season is a high density of fish (*Orestias*) in the shallow waters along the outer edge of the reed-marshes. Pollution and management of the water level are critical factors in the grebe environment, as they lead to desiccation of the main recruitment habitats for fish in the marsh zone over several years.



Population: There were probably well over 1,000 Junín flightless grebes in 1961 (F. Gill, R. W. Storer pers. comm.). It was not found by Dourojeanni *et al.* (1968) who suggested it was extinct; however, these authors hardly surveyed habitats outside the reed-borders. In the 1977 to 1978 breeding season, Fjeldså (1983, Collar *et al.* 1992) counted ca. 75 along 12km of reed-borders in the southern part of the lake and estimated ca. 300 (100 breeding pairs) based on extrapolation and information from local fishermen about areas not examined. Harris (1981) estimated 250 to 300 adults and immatures in May 1979 in the non-breeding habitat near the lake's centre. At this time, the species had generally become absent from the northwestern part of the lake, where the lake bottom had become sterile because of sedimentation by iron oxides. In 1985, a count similar to that of 1977 to 1978 indicated a 30% decline (see PERU/PDG MEMO No. 6 at ICBP). However, in 1987, Balharry *et al.* (1989) recorded 147 adults and juveniles along two transects across the lake centre. Extrapolation implies that the population may have numbered 260 to 375 birds. Thus there is some uncertainty about the magnitude of decline. In 1989 and in subsequent years extreme drought and mass mortality of fish (*Orestias*) caused the die-off of many birds (J. and F. Tueros pers. comm.). Very small numbers of grebes were seen during surveys outside the reed-borders in 1992 to 1994 (J. Barrio, T. Valqui pers. comm.) and it was feared that the population had dropped to ca. 50 birds. However, when new extrapolations were made in February 1995 based on maps integrating data from different surveys by different people in November 1994, 205 birds (including juveniles) were estimated. This estimate assumes that there were no double counts and that the effective survey strip during calm weather was 2km wide.

The usual clutch size is two eggs and there are no indications of more than one clutch per year (apart from replacement clutches). No young are raised in years with low water levels. This species is probably long lived and invests little in recruitment per season. Any factor which threatens adult survival will have a severe impact on population viability, and in view of the pollution problems and water level instability (see below) a critical situation may develop very suddenly.

Status: Critically Endangered (A2ce).

Threats: Lake Junín was once probably the best waterbird locality in the Andes, as it was the home to nearly the whole assortment of puna zone waterbirds, with populations of tens of thousands of certain species. The decline of the flightless grebe has been attributed to pollution and regulation of the lake for hydro-electricity (since 1955) which causes nests and foraging areas to dry up. The grebe is particularly vulnerable because of its specialist foraging behaviour and slow reproductive rate. Fjeldså (1981 a,b) has detailed how the grebe is affected by a combination of water level changes and interactions in the ecosystem. Because few reed-beds are now permanently inundated, tall reeds (*Scirpus [californicus] tatora*) have virtually disappeared and the submergent vegetation of *Chara* (the principal feeding substrate of the Junín flightless grebe) has also become very scattered. Almost all other wildlife in the area is affected and the catfish (*Pygidium oroyae*) may no longer exist in the lake.

The waste-waters from the CENTROMIN mines in the area have caused water pollution and the build-up of iron oxides in lake sediments. Pollution from mining areas in the Cerro de Pasco area entered the lake from Río San Juan. This problem is related to the construction of a dam at Upamayo, on the common inlet/outlet of the lake. Lake Junín is used to store water (from Río San Juan) in the dry season as a hydroelectric resource for the mines. This water resource is not used sustainably, since water levels become very low in some years. When rains come (for example, in 1993 to 1994), the large amount of polluted water which is diverted into the lake floods the shore meadows, leaving a toxic and acid grey sediment all over the area. This has resulted in large-scale mortality of cattle (maybe ca. 2,000 in 1994) and birds. Symptoms described indicate lead poisoning, but this has not been verified. Dourojeanni *et al.* (1968) estimated the number of cattle and sheep on the shore meadows to be ca. 200,000 in the 1960s. Now, most farmers have transported their surviving cattle to other areas, leaving enormous grazing potential unexploited. Thus, the pollution and bad management of the water resource currently has enormous human and socio-economic costs.

Recommended actions:

1. Begin urgent management of the Junín flightless grebe to halt the population decline. Immediately prepare and implement a species recovery plan.
2. Continue surveys with methodological refinements (using Global Positioning System and additional floating buoys for exact determination of positions in the offshore parts of the lake).
3. Study Lake Yanacocha (west of Mantaro River) to assess its suitability for establishing a "reserve" population of the Junín flightless grebe.
4. Take a broad, sustainable approach towards the management of Lake Junín and its catchment, including:
   - i) Sustainable management of the foreshore for both local peoples and wildlife.
   - ii) Management of water levels in accordance with the needs of the grebe and local peoples. This includes applying massive pressure on CENTROMIN, the company responsible for the management of the water resource and for polluting the lake.

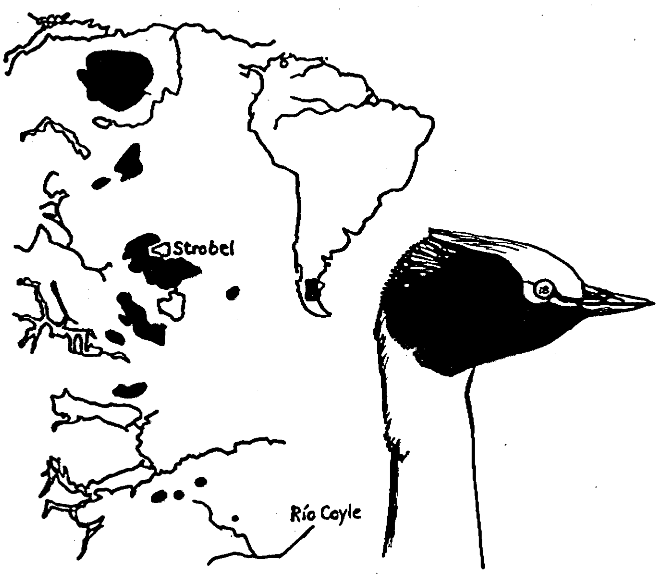
iii) Technical changes to the Upamayo dam to prevent pollutants from Río San Juan from entering Lake Junín, in addition to an effort to de-toxify sediments. Degradation of the local economy needs to be balanced against income from mining.

Since not only the grebe, but indeed the whole human population living on the Altiplano of Junín will benefit from this approach, a good case exists for applying for funds for a large scale ecosystem restoration project.

5. Gain a full understanding of the ecology and requirements of the Junín flightless grebe in order to make informed management decisions.

3.2.20 Hooded grebe (*Podiceps gallardoi*)

Distribution and habitats: The hooded grebe was discovered in 1974 on Laguna de Las Escarchados on a wind-blown upland steppe plateau, Meseta de Las Vizcachas, near Calafate in Santa Cruz, southern Argentina. In the 1970s, it was considered to be Argentina's rarest bird. However, large populations have been discovered since then, mainly on sub-Andean plateaus at 47° to 50°S in Argentina. A small breeding colony was also found near Torres del Paine in southern Chile.



Detailed studies show that the key habitat of the bird is extremely windblown volcanic plateaus. It is fairly common locally, but vulnerable, owing to its specialised habits, very slow reproduction, and inhospitable habitat (Fjeldså 1986, Beltrán *et al.* 1992). The typical habitat is a clear lake, sheltered by crater walls and with dense floating carpets of water millfoils (*Myriophyllum elatinoides*) forming on the water surface. However, a number of other upland lake types, including saline and bitter-salt lakes, are used by non-breeding flocks. Fish are absent; therefore, the lakes have high standing crops of macrozooplankton, amphipods, and snails. The breeding area of the hooded grebe has enormous numbers (probably several millions) of other waterbirds, notably Chiloë wigeons (*Anas sibilatrix*) and red shovelers (*Anas platalea*).

Population: The population is estimated to be 3,000 to 5,000 birds. One half inhabits the plateau between the Caldera Lakes Strobel and Cardiel (Meseta de Strobel). Other areas of great importance are Meseta del Lago Buenos Aires, Pampa del Asador Norte, Meseta del Lago San Martín, and Meseta del Tobiano, while Meseta de Las Vizcachas (where it was first found) is a marginal area which may not have permanent breeding colonies. The winter quarters were first assumed to be in Chilean fjords or on some large, permanently ice-free lakes on the volcanic plateaus of Santa Cruz, namely Lakes Strobel, Quiroga, Islote, and Cardiel. Although the latter possibility has not been examined, a wintering flock of over 400 birds has now (1994) been seen on the Atlantic coast (Río Coyle estuary; Johnson and Serret 1994).

The breeding strategy of the hooded grebe is extreme (Fjeldså 1986). Breeding colonies are very conspicuous, since the shiny white grebe's nests are completely open to view in floating *Myriophyllum* vegetation. Only two eggs are laid. A pair never tries to raise more than one young, and is likely to abandon this young after a few days if it proves difficult to find enough food. It has been demonstrated that hooded grebes may deplete the accessible supply of large-sized prey (snails and amphipods) needed to raise young and, therefore, often need to move between different lakes with suitable nest site vegetation. On average, only 0.2 juveniles are raised per two birds a year. While the potential resources for breeding are apparently limited, the resources for adult survival appear to be plentiful and adult mortality may be extremely low.

Threats: Many researchers have stressed the importance of inhospitable climate, egg predation by gulls and coots on some lakes, and exceedingly low breeding potential as major threats, while Fjeldså (1986) argues that the life history strategy of the species is well adapted to the special conditions of this area. The population may be limited by the carrying capacity of rather few lakes with good nest site vegetation. Volcanic eruptions in the breeding area (see section on Natural catastrophe, p. 6) may have a negative short-term effect because of heavy ash fall, but a long-term positive effect on the productivity of the wetlands.

Status: The hooded grebe is classed as Lower Risk (near threatened). There is no direct evidence that this species was ever more widespread than today or that declines have occurred. However, the world population is very small and, because it is a strongly specialised species with limited distribution, it is vulnerable to any major habitat changes which could occur in the future.

Recommended actions:

1. Continue monitoring hooded grebes at key sites at intervals of a few years. Survey upland and coastal sites to identify wintering sites.
2. Write and implement a species recovery plan for the hooded grebe if circumstances change and populations begin to decline. Studies in 1982 and 1983 by G. Nuechterlein show that the species readily accepts artificial, sheltered breeding colonies, and that various kinds of manipulation are possible if needed.

3.2.21 Western grebe (*Aechmophorus occidentalis*)

Distribution and habitats: The western grebe lives in western North America, south to Mexico. It is a colonial breeder, sometimes with large and dense breeding colonies. Two subspecies are recognised. *A. o. occidentalis* breeds from central British Columbia, Alberta, and Manitoba south to California and southwestern Minnesota. It winters along the Pacific coast, as far south as Baja California, and is casual to the Atlantic and Gulf coasts. *A. o. ephemeralis* has been recorded in Nayarít, western Jalisco, Puebla, and Guererro in Mexico, and generally in much larger numbers than *A. clarkii* with which it associates.

Population: The breeding population in the USA and Canada has been estimated at 70 to 100,000 birds (B. Eichhorst pers. comm.). The largest winter count of *Aechmophorus* on the Audubon Christmas Bird Count over 12 years was nearly 118,000 birds, including only 755 Clark's grebes, but ca. 38,500 birds were not identified to species (Storer and Nuechterlein 1993).

The population of *A. o. ephemeralis* is unknown, but likely to be very small. A partial count on the Mexican Plateau in 1982 only yielded 740 to 840 birds (Williams 1982).

The species lays rather small clutches (three to four eggs) and is apparently single-brooded (although with frequent re-nesting). It does not seem to show the adaptations for opportunistic breeding reported for *P. cristatus*.

Status: The species as a whole is in the Lower Risk (lc) category, but the status of *A. o. ephemeralis*, which has a much more limited range, is uncertain and, therefore, tentatively classed as Vulnerable (B1+2b). Storer and Nuechterlein (1993) suggested that this population may be declining.

Threats: *A. o. ephemeralis* is threatened by habitat loss in Mexico, especially from the cutting of tules which makes large sections of shoreline unsuitable for nesting and feeding habitat (Williams 1982). It may be vulnerable to oil spills and other hazards in its coastal wintering areas. Adverse weather is a major cause of nest and egg loss and large numbers of migrants have been frozen during rapid lake freezes in winter. Gull predation largely results from disturbance by humans (Storer and Nuechterlein 1993).

Recommended actions:

1. Immediately assess the current conservation status of *A. o. ephemeralis*, including population trends and threats.
2. Identify and protect key international sites for the western grebe.
3. Evaluate the potential of western grebes as keystone indicators of wetland health and wetland bird population trends in North America.

3.2.22 Clark's grebe (*Aechmophorus clarkii*)

Distribution and habitats: This newly recognised species inhabits western North America south to Mexico, where it is broadly sympatric with the Western grebe. It has a preference for more open and deep lake habitat, but otherwise the two have very similar habits.

Two subspecies are recognised. *A. c. clarkii* inhabits lakes of the Mexican Plateau from northern Chihuahua to

northern Guererro and near sea level in Nayarit. There may be a population breeding on Caballo Lake in New Mexico (Dickerman 1963). *A. c. transitionalis* inhabits western North America from the Mexican border north to Canada. Clark's grebe is more numerous than the sympatric *A. o. occidentalis* from California up to Oregon, but it is much rarer in Utah. The wintering range has not yet been clearly defined due to difficulties in separating western and Clark's grebes in non-breeding plumages.

Population: No estimates are available but it is not as common as the western grebe. On the Audubon Christmas Bird Count over 12 years, only 755 were identified as Clark's grebes, although ca. 38,500 birds were not identified to species (Storer and Nuechterlein 1993). In winter, only 11.6% of 2,098 *Aechmophorus* grebes in California and Nevada were Clark's, and in summer, 49.2% of 1,584 *Aechmophorus* grebes were Clark's in California, Oregon, and Utah (Ratti 1981). The population of *A. c. clarkii* is unknown, but likely to be very small.

Status: The species as a whole is in the Lower Risk (lc) category. However, because of the limited range and uncertain status of *A. c. clarkii*, this form is tentatively classed as Vulnerable (D1).

Threats: May be vulnerable to oil spills and other hazards in its coastal wintering areas. Hybridisation with western grebes occurs and is probably more widespread than previously thought (Eichhorst and Parkin 1991).

Recommended actions:
1. Immediately assess the current conservation status of *A. c. clarkii*, including population trends and threats.
2. Identify and protect key international sites for the Clark's grebe, notably in Mexico, and important wintering sites along the west coast of North America.

Chapter 4

World Conservation Objectives

4.1 Long-term objective

LONG-TERM GOAL

To maintain and enhance grebe populations throughout their present range and beyond, by halting and reversing the degradation of their wetland habitats.

The Grebe Action Plan is important because it addresses problems facing wetland birds throughout the world. Grebes are key indicator species of on-going processes and threats facing wetlands. Successful recovery of grebe populations and development of management techniques will have positive implications for all wetland birds.

4.2 Setting priorities

When setting priorities, our initial judgement was supplemented with a geographic analysis of the complementarity of species ranges, using the WORLDMAP computer software (see chapter 3, section on Conservation status of grebes of the world, p. 9). As illustrated in Figure 3.1, the highest species richness of grebes (six species) is found in western North America and in central Peru (six breeding species), closely followed by parts of Europe (five species), Manchuria, Mexico, the Peruvian/Bolivian Altiplano, and southern South America (four species). However, because of the wide distribution of many species and complementary ranges, twelve of the world's species can be protected in just two grid cells of Figure 3.1, and all grebes of the world could be covered in eight grid cells (or seven cells if only the breeding ranges of living species were considered). The first priority for conservation would be northwestern USA or central Peru (with Lake Junín) (the exact choice varying according to the analytic algorithm used). The subsequent priorities would be southern Patagonia, the middle grid in New Zealand, and northern central Madagascar (with Lake Alaotra). However, this weighting does not consider vulnerability (and conservation needs), but simply how as much biodiversity as possible can be conserved on a minimum area. If vulnerability could be considered, central Peru would clearly be the top priority. Northwestern USA becomes unimportant in the sense that all the species found there are widespread and under Lower Risk. However, this area could be a top priority for studies on how grebes can be used as bioindicators for better wetland management.

Comparing the biogeographic patterns of grebes and other waterbirds, we find a particularly poor correlation with wading birds, but a good correlation with freshwater diving ducks (Aythyini, Oxyurini). In general, the richest grebe areas have a high diversity of waterfowl, but mainly of common/widespread species. One exception is eastern Asia, where the presence of five grebe species could provide a monitoring mechanism in an area with several endangered or vulnerable species of waterfowl (*Anser cygnoides*, *Tadorna cristata*, *Aythya baeri*, *Mergus squamatus*, *Aix galericulata*; see Hunter and Green 1995). In South America, the historical range of the Colombian grebe corresponds to the key area for threatened waterfowl and reed-swamp birds in the northern Andes. Lake Junín has an endemic rail (*Laterallus tuerosi*) and was (until the 1960s) a key site for Andean waterfowl. Conservation attention in Lake Alaotra, Madagascar, is relevant for grebes as well as the critically endangered Madagascar pochard (*Aythya innotata*).

4.3 Recovery potential

Most grebes have a good potential for population recovery if the factors that have caused their decline can be eliminated or reduced significantly. Most lay moderate sized clutches and are capable of raising more than one brood per year, some species even being true breeding opportunists. Populations of northern hemisphere grebes that are reduced by 50% normally recover to their earlier levels in four to five years. Other species, however, have very poor reproductive potentials (see section on Vulnerability relating to life history tactics, p. 8).

4.4 Recovery mechanisms

A wide range of mechanisms exist for the protection of grebe habitats, for the active management of grebe habitats, and for the manipulation of aspects of grebe life history to increase productivity.

Mechanisms include:

1. **Protection and management of habitats:** This includes legislative protection of grebes and their habitats, less formal mechanisms such as covenants and

agreements, designation of sites to enhance their status (e.g. as Ramsar sites, biosphere reserves), and strategies for management of wetlands through wise use (see Dugan 1990). Most countries have defined a number of categories of protected nature areas (see the IUCN publication series Protected Areas of the World) and are, following recommendations in the Biodiversity Convention of 1992, formulating national integrated strategies for conserving biodiversity. In the European Union, however, national policies are being replaced by a common European strategy, including common environmental legislation and financial instruments (Structural and Cohesion Funds, LIFE Programme, support to environmental protection in eastern Europe). Great attention is being given to Important Bird Areas (Bird Directive, EU Bird Conservation Areas) (Grimmet and Jones 1989). International co-ordination is of special importance when it comes to establishment of marine protected areas, especially the recent development of large, multiple-use protected zones with an integrated management system (see Kelleher and Kenchington 1992 for guidelines). Of particular relevance to grebe conservation is the 1992 revision of the Helsinki Convention on the Baltic Sea, where a monitoring programme was started to provide the baseline knowledge for a Protected Areas Network in the Baltic Sea. This protected areas system for marine environments is expected to include mechanisms for the regulation of traffic, fisheries, oil-drilling, etc., in a way which considers the needs of the large numbers of wintering waterbirds.

2. **Wetland restoration:** A large amount of literature exists on how to restore wetlands which have lost their various ecological functions and attributes. In general, this topic is covered by the Wetland Restoration Specialist Group and Wetlands, River Basins and Water Resources Management Specialist Groups of Wetlands International. However, the appropriateness of traditional wetland management techniques, e.g. vegetation and water level management, need to be investigated in the context of grebe management.

3) **Population manipulations:** A number of management techniques may be of use for conserving endangered grebe taxa, such as translocations, cross-fostering of eggs, and captive breeding. However, these techniques need considerable development (see Priority 4, p. 41 of this chapter). Captive breeding could be very difficult, since grebes are hard to keep in captivity (e.g., Callegari 1956, Ratti 1977). Except when they are kept in semi-natural conditions, they usually die after a few months in captivity, even if they seem to adapt well initially. There does not seem to be any positive indication that captive breeding with grebes will succeed. It would be extremely risky to take birds from the critically endangered populations into captivity before the techniques have been well developed on common species. It, therefore, seems that grebe conservation must primarily rest on habitat management and control of the threats mentioned in the sections on Hazards relating to agricultural chemicals, industrial activity, weather and natural catastrophe, pp. 5–6.

Artificial nests can be made from various kinds of floating material and water-weeds, attached to poles, and protected by wave-brakes (see Figure 4.1). It is important: (1) to attach the nests loosely in a way which allows movements in response to water level changes, and (2) that the nests should not be bigger than is just needed to support a grebe (since bigger nests will be taken over by ducks and coots and used as loafing sites).

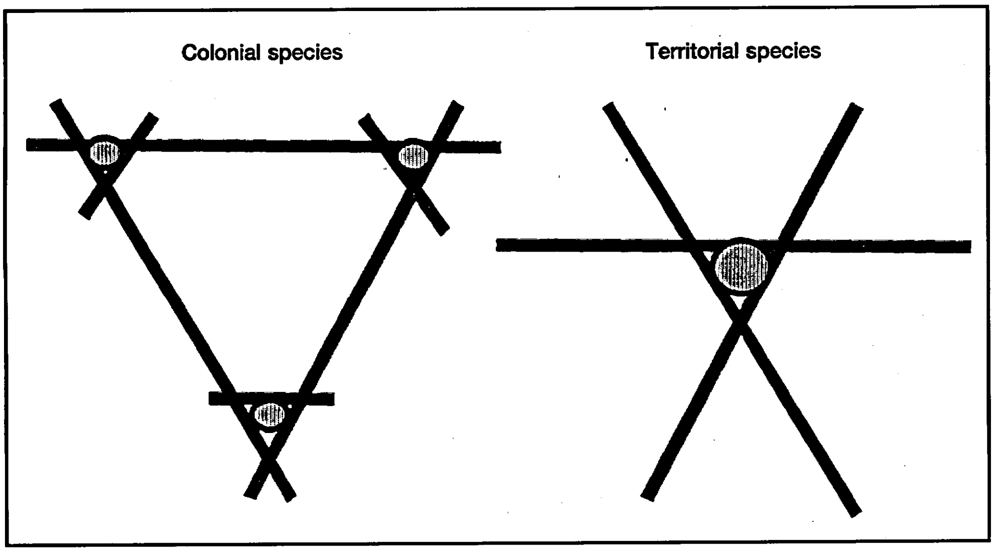


Figure 4.1. Suggested construction of floating rafts used to support artificial grebe nests. The extended arms and triangular design provide stability. The artificial nests (shaded circles) should be made of natural fibrous plant materials from the local vicinity (G. Nuechterlein and D. Buitron, in litt.).

4. **Research:** The conservation needs of grebes will be greatly enhanced by a better understanding of their ecology. While grebes as a group are well studied (Vlug and Fjeldså 1990), surprisingly few studies exist over the comparative ecology of North American grebes. More research is needed for understanding relationships between grebe demography and trophic structures of wetlands, as well as threat processes (as is highlighted in the "Threats" in chapter 2). Vlug and Fjeldså (1990) list general research needs for grebes. Specific needs relevant to priority conservation actions are listed in the following section.
5. **Study techniques:** A few techniques which are rather specific for grebes will be mentioned here.

   Capturing grebes is most easily done using gill nets in shallow straits between reed-beds. The net should be extended between two poles which slope outwards so that only the top line (which is above water) is stretched, allowing birds entering the net underwater to surface (see Ferguson 1980 for details).

   Censusing of grebes is discussed by Asbirk and Dybbro (1978), Haga (1982), Hughes *et al.* (1979), Leys and Wilde (1971), Møller (1983), Regnell (1981) and Woollhead (1978).

   Close range observations can be done from a floating hide ("musk-rat hut") made from the inner-tube of a truck wheel with a small hide mounted on it (Figure 4.2); the observer (wearing waders and flippers) sits on a seat suspended below the inner-tube, the head 0.5m above water (see Nuechterlein 1982).

4.5 Priorities of the Global Conservation Strategy

Priority 1 of the Global Conservation Strategy

Immediate production and implementation of species recovery plans for critically endangered grebe species: the Junín flightless grebe from Lake Junín in Peru (*Podiceps taczanowskii*); a subspecies of white-tufted grebe (*R. rolland morrisoni*), also from Lake Junín in Peru; and Delacour's little grebe (*Tachybaptus rufolavatus*) from Lake Alaotra, Madagascar.

Explanation

Endangered species require urgent management actions to halt population decline. Carefully written planning documents with achievable goals, which address all threats and are tailored to the needs of local management agencies, are required which facilitate the recovery of endangered species. Immediate preparation and implementation of species recovery plans is recommended. It is a great advantage that the habitat restoration schemes needed in Lakes Junín and Alaotra will also be beneficial for people living near these wetlands. These schemes can therefore be proposed and implemented as sustainable development projects. Background information about the taxa involved can be found in chapter 3 in the sections on White-tufted grebe (p. 12), Delacour's little grebe (p. 16) and Junín flightless grebe (p. 29).

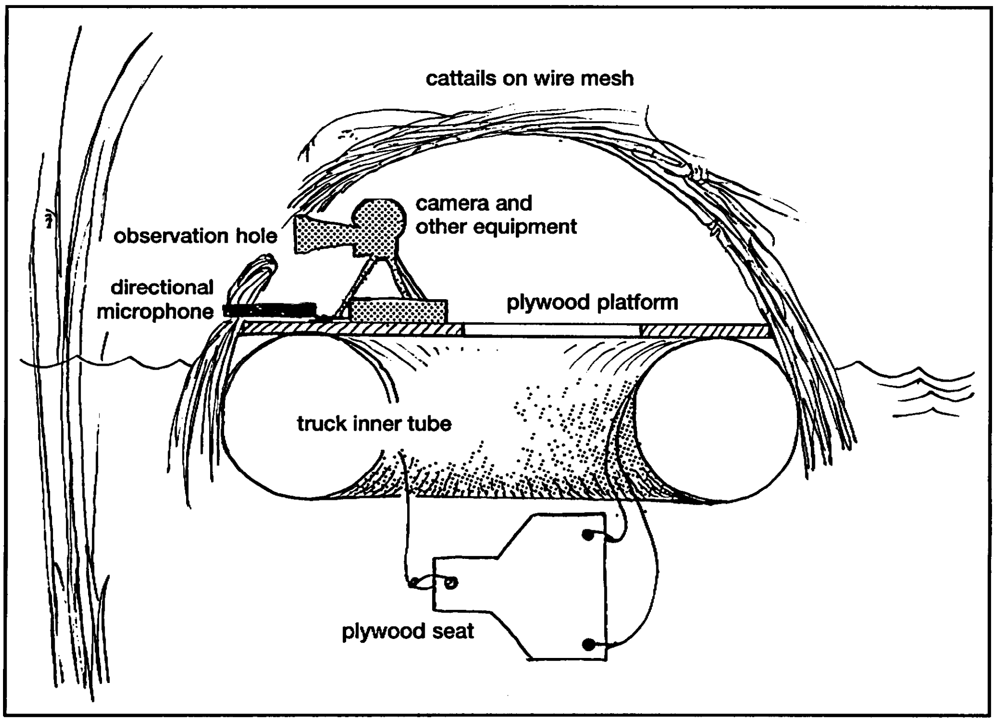


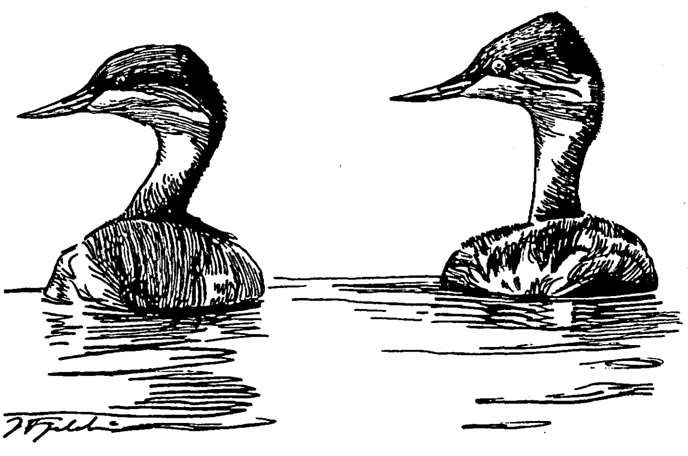
Figure 4.2 Portable floating "musk-rat hut" blind for observing grebe behaviour.
For extended use, the observer should wear chest-waders or a wet suit (redrawn from G. Nuechterlein and D. Buitron, in litt.).

Lake Junín project

Although Lake Junín is officially protected as a national reserve, the managing authorities did virtually nothing (until 1995) to stop the degradation of the wetland ecosystem that is primarily caused by pollution from mining activities (CENTROMIN) and an unsustainable management of the water levels by Electro-Peru. The survival of grebes of Lake Junín ultimately depends on the management of the whole ecosystem. The state of this wetland ecosystem also determines the grazing potential on the shore meadows (ca. 200,000 cattle and sheep in the 1960s) and thus the livelihood for people in this densely populated highland area. Therefore, an excellent case exists for saving the grebe through a large-scale scheme for sustainable human development.

The planning of such a project was started by a conference in Lima, hosted by INRENA (Instituto de Recursos Naturales), in February 1995, after an initiative had been taken by BirdLife International. The conference demonstrated a broad consensus about an integrated wetland restoration and sustainable development approach. However, the conference was attended almost exclusively from the environmental sector and, therefore, did not provide much opportunity for discussion with the mining and agriculture sectors. Nevertheless, there is some basis for optimism. Considering the degradation of the pastures and the declining livelihood for the people living in the area, considerable support could be expected from those involved in agriculture and from the political system. Furthermore, the privatisation policy under Mr. Fujimori's presidency has created a new situation for the mining sector: it seems quite clear that no other nation or foreign company is willing to buy the mining industries in central Peru and take over the responsibility for the environmental problems caused, unless the Peruvian government first finds a solution to the most severe problems. Some World Bank funding has already been given to reduce the inflow of acid substances into Río San Juan.

Junín flightless grebe



Constraints

During the 1980s, the Junín Department became a centre of terrorism in Peru. Luckily, there was little violence in the villages around Lake Junín itself, but long conflicts over customary land rights (publicised worldwide through the novels of M. Scorza) have caused latent opposition to public control. Today, the political situation has calmed down, permitting a conservation/management programme to take off. Any such programme will require the endorsement of managing authorities and engineering activities around the Upamayo Dam, but because of the distrust that exists, we suggest that activities in the villages around the lake be run by non-governmental organisations and persons trusted by the locals.

Actions

In the course of 1995, *Programa Nacional de Conservación y Desarrollo Sostenido de Humedades, Perú,* drafted a project proposal. The general objective was to halt the deterioration of the ecosystems of Lake Junín and prevent the extinction of the Junín flightless grebe through restoring the ecological integrity of the area and promoting sustainable development. During 1996 there was considerable attention in the media, as well as actions by schoolchildren and environmental groups, locally and in the capital Lima.

Specific objectives are to:

i) Restore the grebe populations and secure the conservation of Lake Junín.
ii) Reduce the level of pollution in Lake Junín.
iii) Initiate sustainable development in Reserva Nacional de Junín and throughout the surrounding impact zone, for the benefit of the local and regional communities.
iv) Create public awareness (on all levels) of the importance of conserving the Junín wetlands and the surrounding impact zone.
v) Achieve sustainable use of the natural resources of the area.
vi) Initiate a process of intersectorial co-ordination and broad participation.

These objectives should be reached in several ways:

a) Initially, biologists from Museo de Historia Natural in Lima, together with INRENA, make a three-month study of the current status of Lake Junín, using Dourojeanni *et al.* (1968) for comparative background data.
b) Universidad Nacional Agraria La Molina continues its study of the present land use and its multisectoral team continues diagnosing the harmful environmental impacts of the present land use, as well as considers possible control mechanisms.

c) Evaluate the potential for future sustainable development (commercial breeding of giant toads – a highly priced food, grazing, agriculture, recreation) in the area.
d) Implement a monitoring programme for the Junín flightless grebe and a feasibility study for establishment of a "reserve population" in Yanacocha.
e) Formulate an emergency plan and form a management committee.
f) Create a technical plan and obtain funds for changing the outlet of the lake to prevent polluted water from Río San Juan from entering the lake (collaborate with CENTROMIN and Electro Perú). Formulate a plan for the management of water levels.
g) Non-governmental bodies take the lead in creating awareness about the importance of Lake Junín, using the grebe as a "flagship species", and in running a species conservation programme. Establish databases, formulate a master plan for Reserva Nacional de Junín, and approach international donors for funds for a long-term development scheme for the Junín area.

The Lake Alaotra Project

According to the most recent reports, there seems to be little scope in narrow species-oriented actions. Therefore, it would be more relevant to local needs and interests to take an ecosystem approach. Because the limnological conditions may no longer permit any grebe species to maintain a population on Lake Alaotra, and because of hybridisation and the probable steady influx of *Tachybaptus ruficollis capensis* from source habitats elsewhere, it is improbable that the endemic grebe will survive (except as genes incorporated in the population of the last-mentioned taxon). However, searches for the endemic grebe (and possible hybrids) must be continued. Feeder lakes around Alaotra, some almost inaccessible, may not have been affected as badly by ecological changes as the main lake. Less disturbed lakes or marshes may be discovered.

Irrespective of whether *Tachybaptus rufolavatus* still exists or not, lake management should be initiated because of concerns for other wildlife (the critically endangered *Aythya innotata, Anas melleri, Anas bernieri, Nettapus auritus, Hapalemur griseus*) and in order to address sustainable development alternatives for the local human population (which depends on the lake for fish and wildlife meat). Young and Smith (1989) suggest the formation of a protected area to allow nesting birds to regain former numbers and encourage the return of absent species. Protection of a *Phragmites* wall of substantial length is needed to maintain *H. griseus*. Even more important is reforestation to prevent silting, loss of fish, and rice fields. All this will require the initiation of a lakeside education campaign with actions at village levels for some years.

Priority 2 of the Global Conservation Strategy

Conservation of grebes through identification and sustainable management of wetlands of international and regional importance for grebes. Where appropriate use grebes as flagship species for raising awareness about the need to conserve these wetlands.

Explanation

Protection of habitats is the first step towards protection of grebe populations. First of all, key localities for grebes need to be identified and then, protected through all mechanisms available (for example, formal or informal reservation, or rural development projects where wetland management is an integral part). Networks of reserves will be required that protect the full range of grebe populations, from representative core areas through to small populations at the edge of the species range, including key sites at different parts of the annual or life cycle (for example, migration routes). Three mechanisms should be pursued: protection (or "wise use") of habitats; significant reduction of threats and hazards; and legal protection of grebe species themselves.

While wetlands of international importance are well known in some parts of the world, too little is known to identify such sites in most parts. For example, the first steps have been taken for some species in Asia (Perennou *et al.* 1994), but initial assessments are based on winter counts. Thus, their list is only partial because other wetlands will undoubtedly become important in other seasons. Of primary concern is identifying sites which have greater than 1% of the populations of each grebe species. This criteria is often the first used to identify wetlands of international importance. However, attention should also be given to centres of grebe species diversity (see Figure 3.1). Formal protection of all sites may not be necessary. For example, the main populations of hooded grebes are outside national parks, but are well protected insofar as the areas are extremely inhospitable and uninhabited by humans.

The second primary step towards conserving grebe populations is legal protection by statute. Law enforcement is necessary but often difficult. Legal regulation, balanced against valid cultural needs of indigenous peoples, may be required for activities such as gill netting.

Grebes are important in a much wider sense because they are powerful indicator species for on-going processes and threats facing wetlands (see Priorities 3 and 8). Successful recovery of grebe populations and development of management techniques have implications for wetland birds in general. Conserving grebes also addresses problems facing other wetland birds, generally throughout the world. It is now well documented that the productivity of wetlands, their effects on hydraulic and climatic regulation, and their role as sinks for nutrients and contaminants, often represent far greater economic benefits than those obtained by converting them into agricultural or industrial areas, although in more indirect and long-term ways (e.g. Maltby 1986, Dugan 1990).

The past extinctions of the Colombian and giant pied-billed grebes have served as powerful lessons which should not be ignored. These examples have led to the formulation of an action plan for integrated protection near Bogotá.

LaBastille (1993) proposed a number of actions which needed the support of the public and administrative authorities, such as: (1) building community washing areas with appropriate disposal systems; (2) education of women to use biodegradable soaps; (3) visits to owners of foreshore chalets to educate them regarding the value of wetland habitats; (4) replanting of reeds and development of sustainable management systems; (5) presentations to the government to pursue legal protection of the habitat; (6) prohibition of dumping of wastes and pollutants in the lake; (7) development of small forest reserves in the catchment to provide firewood; (8) prohibition of fertilisers, pesticides, and herbicides close to the lake; (9) development of soil conservation procedures for the catchment; (10) housing restrictions close to the lake; (11) sewage treatment facilities.

In the Bogotá area, the conversion of wetlands for agriculture, and extreme pollution, have led to water resources being severely compromised. Varty *et al.* (1985) concluded that Lake Tota and the Bogotá and Ubaté wetlands had lost their value to open-lake birds, and that conservation work should now focus on the endemic reed-marsh avifauna (e.g. *Ixobrychus, Rallus, Gallinula, Cistothorus, Agelaius* spp.). However, there is still some incentive for protecting open water species (e.g. the threatened *Oxyura ferruginea andina, Fulica americana columbiana, Anas cyanoptera borreroi, Netta erythrophthalma*) and, of course, a strong reason to retain other ecosystem functions, such as stable supplies of water for drinking and irrigation (Fjeldså 1993). Measures such as reforestation, discontinuing reclamations, and drainage are urgently needed to ensure a drinking water supply, increase fish production, and reduce siltation caused by soil erosion. In 1995, the World Bank approved a project for wetland conservation which focused on Laguna Juan Amarillo and other remaining wetlands within the city of Bogotá (The Colombia Santa Fé I Water Supply and Sewerage Rehabilitation Project). These remaining urban wetlands are important to the overall project because: (i) they naturally reduce flood damage by storing excess water; (ii) they reduce pollution of the Bogotá River through physical and biological mechanisms which provide natural sewage treatment. These wetlands also harbour some of the threatened bird species of the area. This project is certainly a good start towards the much larger investments that are needed in the Bogotá area.

Actions

1. Appoint regional co-ordinators responsible for identifying localities of importance for all the Endangered and Vulnerable species and for identifying threats and relevant management mechanisms. For specific actions for Lake Atitlán and the Bogotá wetlands, we suggest that Wetlands of the Americas take action.
2. Identify key sites which fulfil the status of wetlands of international importance for all species of grebes, sites of regional or national importance, and centres of grebe biodiversity. Pursue designation of wetlands of international importance. This would be an integral part of the ongoing effort of Wetlands International to produce and update Directories for Wetlands of International Importance. Grebes may be particularly relevant for identifying such areas in northwestern Europe, Manchuria, northwestern USA/southwestern Canada, southern South America, and the Andes of Bolivia and Peru.
3. Identify key wintering sites where hazards (e.g. pollution) could have a major impact on grebe population viability and pursue the implementation of appropriate environmental safeguards.
4. Undertake research on key issues:
   i) The role and potential threat of hazards to population viability. A predictive population modelling approach would be valuable.
   ii) The importance of hunting (e.g. gill netting) and overfishing on grebe populations.
   iii) The importance of increasing recreational activities on the viability of grebe populations.
   iv) The effects of the increasing chemical pollutants on water quality and grebe feeding habitats, as well as mechanisms to reduce impacts.
5. Pursue appropriate mechanisms for the protection of grebe habitats and key populations (statutory protection, reservations, safeguards against hazards).

Priority 3 of the Global Conservation Strategy

Development of methods and guidelines for using grebes as keystone indicator species for monitoring wetland health and biodiversity, changes in the ecological functioning of wetlands, and the success of management measures.

Explanation

Wetlands, once seen as wastelands, are now known to be extremely valuable ecosystems. They are often highly productive and have important functions for maintaining stable hydrological regimes and as sinks of pollutants and carbon dioxide. It is now well documented that the draining of wetlands, from a holistic point of view, is an unwise use of this land. Yet, the destruction of wetlands continues in many areas at a scale that can only be reduced by pooling large financial resources and information about the wise use of these ecosystems. Here, bird counts have often proven useful as short-cuts for identifying top-priority areas. Grebe data have been much neglected in this respect, although we believe that grebes would be particularly suitable for identifying valuable wetlands.

An enormous amount of data exists on local and year-to-year variation in numbers of grebes and their breeding success (especially for various areas in northwestern Europe). Such data have often been collected on the assumption that grebe data are useful. However, rather few students have examined the indicator value in detail and the information value of the data collected has, therefore, not been fully exploited. The selection of wetlands for conservation was more often based on waterfowl in general, which may serve as a less specific bioindicator than

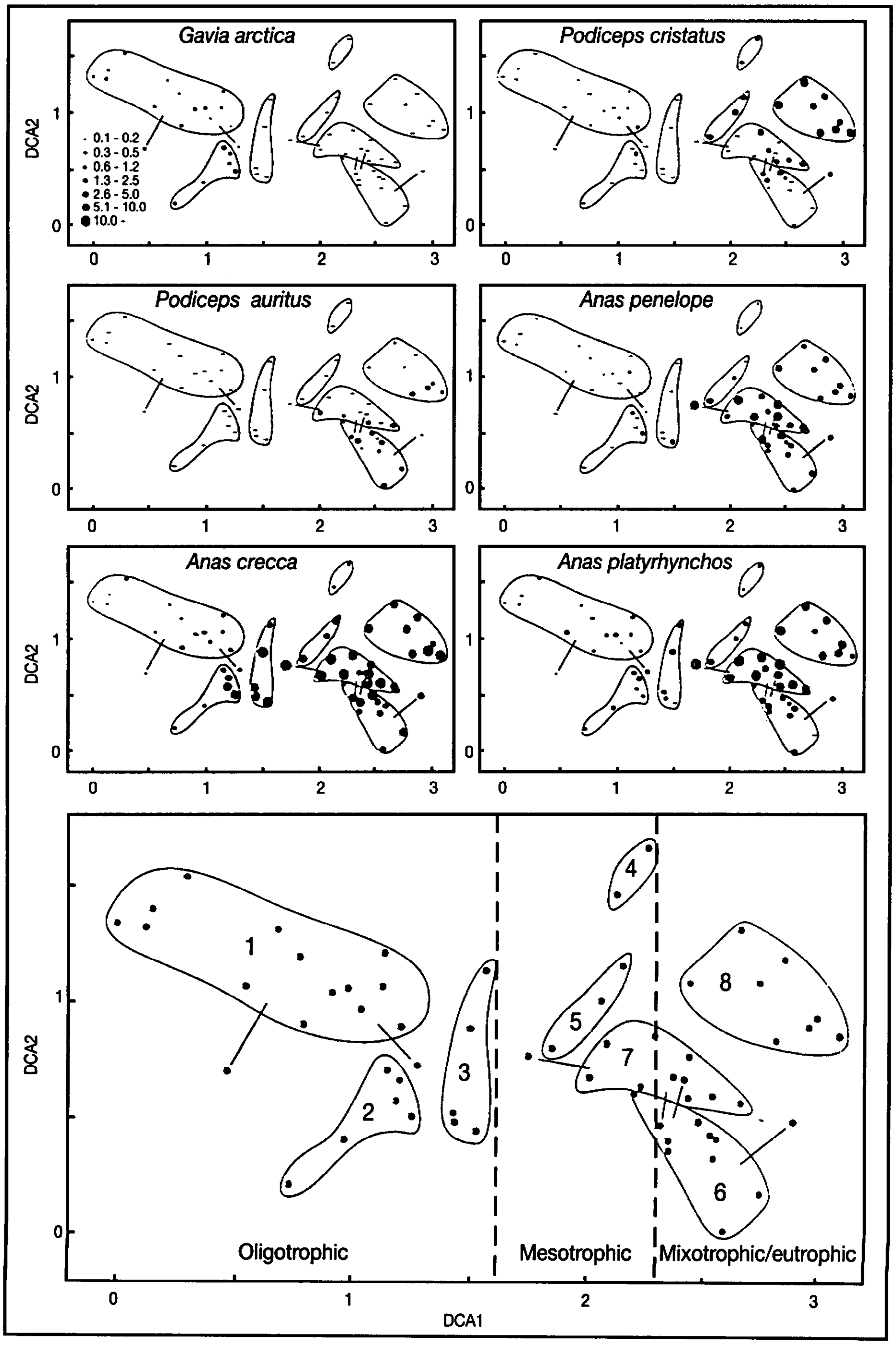


Figure 4.3 Comparison of lake type specificity of two grebes (*Podiceps cristatus, Podiceps auritus*) and other waterbirds. The six top diagrams show lake-specific densities (pairs/km²) in eight ornithological lake types in northern Savo, Finland. The ornithological typification of lakes (bottom diagram) was done by DCA ordination techniques with two independent DCA axes based on relative abundances of species; the lakes being named and described on the basis of environmental factors:
1 = Large dys-oligotrophic lakes,
2 = Small dys-oligotrophic lakes,
3 = Small dystrophic bog ponds,
4 = Large mesotrophic (eutrophicated) lakes,
5 = Small mesotrophic lakes,
6 = Large mixotrophic lakes,
7 = Small mixotrophic lakes,
8 = Eutrophic lakes.
From Kauppinen (1993).

grebes. Thus, more detailed analysis of grebe data could permit more specific interpretations to be made about wetland quality.

Several studies suggest considerable specialisations in grebes in terms of feeding strategies and size classes of prey taken (see e.g. Fjeldså 1981a, 1983, 1988, 1993), making them sensitive to changes in vegetation and the trophic structure of the lake ecosystems (see Chapter 2, section on Wetland modification p. 4). It has long been known that grebes are associated with quite specific limnological lake types (Palmgren 1936, Soveri 1940, Ekman 1944, Fjeldså 1973a, 1981ac, 1985b). This relationship has, in some cases, been explained in considerable detail, particularly in regard to feeding strategies (Asbirk and Dybbro 1978, Fjeldså 1973ab, 1985a, 1986, Jehl 1988, Piersma 1988, Piersma *et al.* 1988, Utschick 1980, Winkler and Cooper 1986, Woollhead 1986). For example, the crested grebe profits greatly from eutrophication caused by modern agriculture up to quite a specific limit (see sections on Wetland modification p. 3 and Great crested grebe p. 25) and is able to exclude other grebes from using these opportunities (Spletzer *et al.* 1974; see Fjeldså 1981a for other examples). Piscivorous grebes are also good indicators of environmental pollutants because of their status as top predators (Herman *et al.* 1969, Hunt and Bischoff 1960, Schifferli 1978, Ulfvens 1986).

The potential value of grebes for characterising waterbird communities can be illustrated by cluster analyses. Thus, studies of waterbird communities by Fjeldså (1973a, 1981c, 1985ab) in many parts of the world illustrated that most grebe species strongly cluster together with certain waterbird species and have negative associations with others. Kauppinen (1993) convincingly demonstrated this kind of clustering using ordination techniques (see Figure 4.3). He found the crested grebes to be strongly associated with garganey (*Anas querquedula*), shoveler (*Anas clypeata*), pochard (*Aythya ferina*), and coot (*Fulica atra*) in eutrophic and mesotrophic lakes surrounded by cultivation. Horned grebes were associated with pintail (*Anas acuta*), wigeon (*Anas penelope*), and tufted ducks (*Aythya fuligula*), but were also somewhat disassociated with other waterfowl because of a very strong association with mixotrophic (rich but humus-influenced), very shallow lakes with low *Carex/Equisteum* vegetation.

Such studies are needed for additional areas and need to be supplemented with detailed comparisons with structural and limnological parameters.

Actions

1. Develop a research project designed to evaluate the potential of grebes as keystone indicators of wetland health, wetland biodiversity, and wetland bird population trends.
2. Identify geographical areas where grebe population parameters could become useful for monitoring spatiotemporal variations in wetland quality. *A priori* we would expect the potential to be best in those geographical areas where at least three grebe species (representing different requirements) are present.
3. Compile an international database of grebe census data as the first step towards developing the research programme.
4. Once research and guidelines have been developed, set monitoring programmes in place at key sites.

Note A: Potential indicator species include *R. rolland* (high vegetational and trophic diversity), *P. dominicus* (high arthropod diversity; possibly favoured by low competition from fish), *P. podiceps* (thick vegetation cover; rich supply of fish and crustaceans), *P. major* (high densities of fish; expectedly affected by eutrophication in much the same way as *P. cristatus*), *P. grisegena* (rich vegetation cover; large arthropods and fish; often excluded by *P. cristatus*), *P. cristatus* (high densities of fish; benefits from eutrophication; may be extremely abundant in hypereutrophic lakes until a certain point), *P. nigricollis* (extensive areas with very high arthropod densities, including salt/alkaline lakes), *P. auritus* (in unproductive boreal areas strongly associated with the richer lake types), *P. occipitalis* (extensive areas with very high arthropod densities, including salt/alkaline lakes), *P. gallardoi* (lakes with high arthropod densities, including salt/alkaline lakes; successful breeding depends on *Myriophyllum* zones with high densities of amphipods and gastropods), *A. occidentalis* and *A. clarkii* (high densities of fish, but not well known).

Priority 4 of the Global Conservation Strategy

Development of management techniques for the maintenance and restoration of grebe populations.

Explanation

Developing management techniques will improve our ability to manage populations of Endangered grebes in the wild. Both *In-situ* and *Ex-situ* techniques should be considered.

In-situ management: This should remain the primary focus of grebe management. Key areas include improving and developing:

i) Methods for enhancing breeding success (e.g. artificial nest sites, protection from predators, imposing limits on the degree of water-based recreation on breeding areas, reducing lake level fluctuations, protection from wave action).

ii) Methods for increasing adult survival (e.g. enhancing feeding habitat, reducing hazards).
iii) Methods for enhancing habitats (e.g. replanting of nesting habitat, improving water quality, fencing foreshore vegetation off from browsers and human disturbance, managing water levels in drought-prone marshes).

Ex-situ management: The potential of close order management techniques should also be assessed. Close order management includes developing captive holding, test breeding and release capabilities, and undertaking trial translocations to safe sites. Captive breeding has been suggested for the giant pied-billed grebe and Delacour's grebe. However, this could be problematic (see section on Recovery mechanisms p. 34) and we suggest that suitable techniques be developed with more common species first.

Captive breeding trials should not distract attention from the key problem of habitat degradation and management in the wild.

Actions

1. Undertake research on key issues:
   i) The impact of predators (most importantly, **nest predators**) on grebe populations and methods for effective predator control.
   ii) The importance of the impact of the increasing **recreational activities** on the viability of grebe populations and methods for minimising impacts.
   iii) Study the impact of **gill nets** on grebes by identifying sites where this should be a major cause for concern and studying methods for minimising impacts.
2. Develop a manual of management techniques applicable to grebe conservation.
3. Develop guidelines for the captive management of grebe species.

Priority 5 of the Global Conservation Strategy

Clarification of the conservation status of grebe species currently classed in the Data Deficient threat category.

Explanation

Seven taxa are currently classed as having a Data Deficient conservation status. These taxa may fall into more serious threat categories, but lack of information on population sizes and potential threats precludes proper evaluation.

Actions

1. Assess the population trends, threats, and conservation status of all taxa of Unknown status: *Rollandia r. rolland*, *Tachybaptus ruficollis philippensis*, *T. r. cotabato*, *T. r. tricolor* and *T. r. vulcanorum*, *Podiceps cristatus infuscatus* and *Podiceps nigricollis gurneyi*.
2. Write and implement recovery plans if required.

Priority 6 of the Global Conservation Strategy

Monitoring of key grebe populations, particularly of Vulnerable species which may become Endangered in the future.

Explanation

Vulnerable taxa require close monitoring to determine whether the population is stable or whether local declines exist and indicate more widespread problems. For some species, survey work is still required to ascertain accurately current population sizes. All have small world populations and limited distributions which, coupled with specialised life history requirements, make them vulnerable to ecological changes in their habitats. Population declines could occur very quickly if factors changed.

Key grebe populations, regardless of their threat category, should be monitored on a regular basis so that checks can be kept on the health of populations, population change, and the rate of population change, as well as to identify where regional priorities are. Even the status of common species could change rapidly if new factors come into play (see Adriaensen *et al.* 1993 for the European crested grebe populations). Some numerous species could be vulnerable because they rely on only a few wetlands for wintering and staging. Identification of key grebe populations for protection can be difficult because populations can be recognised on several levels. For some monotypic species, it is possible to identify the range of the entire population. However, some subspecies may be broadly intergrading, and may not constitute discrete entities. Migratory populations of a species or subspecies often mix with other populations of the same species or subspecies.

Because of vulnerability to oil spills, it is desirable to have more precise data about main wintering areas for red-necked grebes, horned grebes, western grebes, and Clark's grebes.

Because of the dependence of non-breeding black-necked grebes on stable, saline lakes (Jehl 1988, Jehl *et al.* 1987 for North America), more precise information about the key sites for staging and wintering in the western Palearctic is needed. There are probably only a few really suitable staging lakes for this species.

Actions

1. Appoint regional monitoring co-ordinators.
2. Identify key taxa and populations for monitoring.
3. Extract the grebe data from the waterbird count data collected over the years by Wetlands International.
4. Identify and implement priority research projects, particularly those aimed at identifying threats.
5. Seek funding/institutional support for analysis of existing data and strategical research projects resulting from 3 and 4.
6. Create a contingency fund for the preparation and implementation of species recovery plans should the conservation status of any taxa change.

Note A: Vulnerable species needing close monitoring are: *Rollandia microptera, Tachybaptus novaehollandiae leucosternos, T. n. renellianus, T. n. javanicus, T. n. timorensis, T. n. fumosus, T. n. incola, T. ruficollis iraquensis, T. r. collaris, Tachybaptus pelzelnii, Poliocephalus rufopectus, Podiceps cristatus australis, Podiceps occipitalis juninensis, Aechmophorus occidentalis ephemeralis, Aechmophorus c. clarkii. Podiceps gallardoi* is classified as Lower Risk (nt); however, it is important to determine the long-term effects of the recent vulcanism within its range: ash fall may have serious effects on the lakes' productivity. It is also important to continue the efforts to find key staging/wintering sites, which may become focal sites for a long-term monitoring programme.

Note B: Species still requiring survey and census work to determine population sizes are: *Rollandia microptera, R. r. rolland, Tachybaptus novaehollandiae leucosternos, T. n. renellianus, T. n. javanicus, T. n. timorensis, T. n. fumosus, T. n. incola, T. ruficollis philippensis, T. r. cotabato, T. r. tricolor, T. r. vulcanorum, T. r. collaris,* all subspecies of *Tachybaptus dominicus* and *Podilymbus podiceps, Podiceps cristatus infuscatus, Podiceps auritus, Podiceps nigricollis gurneyi, Podiceps occipitalis juninensis,* subspecies of *Aechmophorus occidentalis* and *clarkii.*

Priority 7 of the Global Conservation Strategy

Clarification of taxonomic status of potentially threatened taxa.

Explanation

The taxonomy of threatened species requires clarification so that their conservation status can be properly assessed. Several taxa may need species recovery plans written.

Actions

1. Urgent reassessment of the taxonomic status of all subspecies of the Australasian little grebe, *T. novaehollandiae.*
2. Describe the taxonomic status of the yellow-eyed "*capensis*" and *poggei* forms of *Tachybaptus ruficollis* and clarify the status of intermediate forms of *T. r. collaris/tricolor* and *T. r. philippensis/cotabato.*
3. Assess the taxonomic and conservation status of the (isolated, small, but increasing) Peruvian population of the great grebe *P. m. major* to determine if it warrants separate classification.
4. Taxonomic evaluation of the form of red-necked grebe previously known as subspecies *balchashensis.*
5. Reassess the taxonomic status of the great crested grebe *P. c. australis* in New Zealand.

Priority 8 of the Global Conservation Strategy

Promotion of public awareness of grebes and their wetland habitats

Explanation

Grebes are readily accessible to the public in many parts of the world. In many cases, they have a high public appeal, particularly because of their interesting plumage and startling displays.

LaBastille (1993) gives an example of how involving the public in conservation could provide benefits for the grebe habitat on Lake Atitlán in Guatemala. While the actions proposed are too late for the extinct large pied-billed grebe, LaBastille's model is a valuable indication on how the public needs to be involved in grebe conservation (see Priority 2). LaBastille proposed a number of actions which needed the support of the public and administrative authorities. For such initiatives to succeed, a co-operative team consisting of government and non-government agencies, a scientist, and local representatives would be needed. Education packages would need to be prepared and incentives would have to be offered for people to change their habits.

In Lake Junín, Peru, the endemic flightless grebe will be used as a flagship species in an endeavour to promote sustainable management of the lake's ecosystem (see Priority 1).

Actions

1. Individuals and agencies responsible for grebe populations should promote public awareness through all forms of media (e.g. pamphlets,

education packages, publications, posters, talks, media releases).

4.6 Responsibilities for implementation of the Grebe Action Plan

Implementation shall be done through international networks of Wetlands International, BirdLife International, and the Species Survival Commission, as well as through relevant government institutions and development agencies. Overall responsibility for co-ordination of studies will lie with the Chairperson of the Specialist Group, but the implementation of larger projects will require the establishment of other institutional structures. This is because the Grebe Specialist Group, like other SSC Specialist Groups, is operating on a voluntary basis with no funds to work with. This makes it difficult to produce outputs on very specific time scales. We recommend the appointment of a number of Recovery Groups and Regional Co-ordinators. They will take responsibility for formulating plans and co-ordinating fundraising for individual species. They will report back to the Chairperson of the Specialist Group. Furthermore, collaborating institutions and organisations, and potential funding sources for larger projects must be identified. Several of the research tasks suggested may be suitable as post-graduate research projects in universities.

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Appendix I

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Appendix II

Glossary

avifauna bird fauna of an area or period.

dystrophic rich in organic matter, but low in nutrient content and unproductive.

eutrophic rich in mineral nutrients for green plants and having a high primary productivity.

eutrophication the natural process of nutrient enrichment of a water body which is enhanced by phosphate and nitrate waste from human activity. It can cause excessive organic growth and depletion of oxygen concentrations, resulting in the death of aquatic animals and higher plants.

intergrade the adoption of intermediate characters or traits of adjacent subspecies.

lacustrine pertaining to the lake.

limnic the biological, physical, and chemical aspects of lakes, ponds, and streams.

macrophytes large aquatic plants.

mesotrophic having intermediate levels of primary production.

mixotrophic rich, but humus-influenced.

nektonic freely swimming in the pelagic zone, regardless of water motion or wind.

oligotrophic poor in plant nutrients and unproductive in terms of flora and fauna.

para-species closely related species inhabiting adjacent, but non-overlapping areas.

piscivorous feeding on fish.

trophic structure the organisation of the system of nutrient (energy) transfer.

vicariance pattern the evolution of new species by geographical barriers which interrupt a once continuous distribution range.

Appendix

IUCN Red List Categories

Prepared by the IUCN Species Survival Commission
As approved by the 40th Meeting of the IUCN Council, Gland, Switzerland
30 November 1994

I) Introduction

1. The threatened species categories now used in Red Data Books and Red Lists have been in place, with some modification, for almost 30 years. Since their introduction these categories have become widely recognised internationally, and they are now used in a whole range of publications and listings, produced by IUCN as well as by numerous governmental and non-governmental organisations. The Red Data Book categories provide an easily and widely understood method for highlighting those species under higher extinction risk, so as to focus attention on conservation measures designed to protect them.

2. The need to revise the categories has been recognised for some time. In 1984, the SSC held a symposium, 'The Road to Extinction' (Fitter and Fitter 1987), which examined the issues in some detail, and at which a number of options were considered for the revised system. However, no single proposal resulted. The current phase of development began in 1989 with a request from the SSC Steering Committee to develop a new approach that would provide the conservation community with useful information for action planning.

In this document, proposals for new definitions for Red List categories are presented. The general aim of the new system is to provide an explicit, objective framework for the classification of species according to their extinction risk.

The revision has several specific aims:

- to provide a system that can be applied consistently by different people;
- to improve the objectivity by providing those using the criteria with clear guidance on how to evaluate different factors which affect risk of extinction;
- to provide a system which will facilitate comparisons across widely different taxa;
- to give people using threatened species lists a better understanding of how individual species were classified.

3. The proposals presented in this document result from a continuing process of drafting, consultation and validation. It was clear that the production of a large number of draft proposals led to some confusion, especially as each draft has been used for classifying some set of species for conservation purposes. To clarify matters, and to open the way for modifications as and when they became necessary, a system for version numbering was applied as follows:

Version 1.0: Mace & Lande (1991)
The first paper discussing a new basis for the categories, and presenting numerical criteria especially relevant for large vertebrates.

Version 2.0: Mace *et al.* (1992)
A major revision of Version 1.0, including numerical criteria appropriate to all organisms and introducing the non-threatened categories.

Version 2.1: IUCN (1993)
Following an extensive consultation process within SSC, a number of changes were made to the details of the criteria, and fuller explanation of basic principles was included. A more explicit structure clarified the significance of the non-threatened categories.

Version 2.2: Mace & Stuart (1994)
Following further comments received and additional validation exercises, some minor changes to the criteria were made. In addition, the Susceptible category present in Versions 2.0 and 2.1 was subsumed into the Vulnerable category. A precautionary application of the system was emphasised.

Final Version
This final document, which incorporates changes as a result of comments from IUCN members, was adopted by the IUCN Council in December 1994.

All future taxon lists including categorisations should be based on this version, and not the previous ones.

4. In the rest of this document the proposed system is outlined in several sections. The Preamble presents some basic information about the context and structure of the proposal, and the procedures that are to be followed in applying the definitions to species. This is followed by a section giving definitions of terms used. Finally the definitions are presented, followed by the quantitative criteria used for classification within the threatened categories. It is important for the effective functioning of the new system that all sections are read and understood, and the guidelines followed.

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II) Preamble

The following points present important information on the use and interpretation of the categories (= Critically Endangered, Endangered, etc.), criteria (= A to E), and sub-criteria (= a,b etc., i,ii etc.):

1. Taxonomic level and scope of the categorisation process

The criteria can be applied to any taxonomic unit at or below the species level. The term 'taxon' in the following notes, definitions and criteria is used for convenience, and may represent species or lower taxonomic levels, including forms that are not yet formally described. There is a sufficient range among the different criteria to enable the appropriate listing of taxa from the complete taxonomic spectrum, with the exception of micro-organisms. The criteria may also be applied within any specified geographical or political area although in such cases special notice should be taken of point 11 below. In presenting the results of applying the criteria, the taxonomic unit and area under consideration should be made explicit. The categorisation process should only be applied to wild populations inside their natural range, and to populations resulting from benign introductions (defined in the draft IUCN Guidelines for Re-introductions as "... an attempt to establish a species, for the purpose of conservation, outside its recorded distribution, but within an appropriate habitat and eco-geographical area").

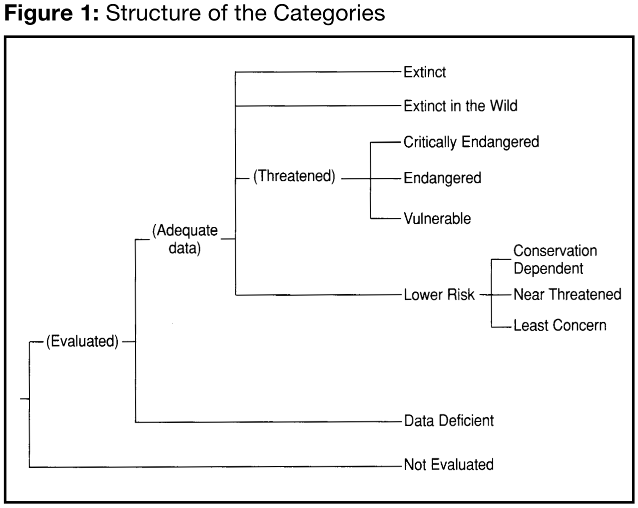
2. Nature of the categories

All taxa listed as Critically Endangered qualify for Vulnerable and Endangered, and all listed as Endangered qualify for Vulnerable. Together these categories are described as 'threatened'. The threatened species categories form a part of the overall scheme. It will be possible to place all taxa into one of the categories (see Figure 1).

3. Role of the different criteria

For listing as Critically Endangered, Endangered or Vulnerable there is a range of quantitative criteria; meeting any one of these criteria qualifies a taxon for listing at that level of threat. Each species should be evaluated against all the criteria. The different criteria (A–E) are derived from a wide review aimed at detecting risk factors across the broad range of organisms and the diverse life histories they exhibit. Even though some criteria will be inappropriate for certain taxa (some taxa will never qualify under these however close to extinction they come), there should be criteria appropriate for assessing threat levels for any taxon (other than micro-organisms). The relevant factor is whether any one criterion is met, not whether all are appropriate or all are met. Because it will never be clear which criteria are appropriate for a particular species in advance, each species should be evaluated against all the criteria, and any criterion met should be listed.

Figure 1: Structure of the Categories



4. Derivation of quantitative criteria

The quantitative values presented in the various criteria associated with threatened categories were developed through wide consultation and they are set at what are generally judged to be appropriate levels, even if no formal justification for these values exists. The levels for different criteria within categories were set independently but against a common standard. Some broad consistency between them was sought. However, a given taxon should not be expected to meet all criteria (A–E) in a category; meeting any one criterion is sufficient for listing.

5. Implications of listing

Listing in the categories of Not Evaluated and Data Deficient indicates that no assessment of extinction risk has been made, though for different reasons. Until such time as an assessment is made, species listed in these categories should not be treated as if they were non-threatened, and it may be appropriate (especially for Data Deficient forms) to give them the same degree of protection as threatened taxa, at least until their status can be evaluated.

Extinction is assumed here to be a chance process. Thus, a listing in a higher extinction risk category implies a higher expectation of extinction, and over the time-frames specified more taxa listed in a higher category are expected to go extinct than in a lower one (without effective conservation action). However, the persistence of some taxa in high risk categories does not necessarily mean their initial assessment was inaccurate.

6. Data quality and the importance of inference and projection

The criteria are clearly quantitative in nature. However, the absence of high quality data should not deter attempts at applying the criteria, as methods involving estimation, inference and projection are emphasised to be acceptable throughout. Inference and projection may be based on extrapolation of current or potential threats into the future (including their rate of change), or of factors related to population abundance or distribution (including dependence on other taxa), so long as these can reasonably be supported. Suspected or inferred patterns in either the recent past, present or near future can be based on any of a series of related factors, and these factors should be specified.

Taxa at risk from threats posed by future events of low probability but with severe consequences (catastrophes) should be identified by the criteria (e.g. small distributions, few locations). Some threats need to be identified particularly early, and appropriate actions taken, because their effects are irreversible, or nearly so (pathogens, invasive organisms, hybridization).

7. Uncertainty

The criteria should be applied on the basis of the available evidence on taxon numbers, trend and distribution, making due allowance for statistical and other uncertainties. Given that data are rarely available for the whole range or population of a taxon, it may often be appropriate to use the information that is available to make intelligent inferences about the overall status of the taxon in question. In cases where a wide variation in estimates is found, it is legitimate to apply the precautionary principle and use the estimate (providing it is credible) that leads to listing in the category of highest risk.

Where data are insufficient to assign a category (including Lower Risk), the category of 'Data Deficient' may be assigned. However, it is important to recognise that this category indicates that data are inadequate to determine the degree of threat faced by a taxon, not necessarily that the taxon is poorly known. In cases where there are evident threats to a taxon through, for example, deterioration of its only known habitat, it is important to attempt threatened listing, even though there may be little direct information on the biological status of the taxon itself. The category 'Data Deficient' is not a threatened category, although it indicates a need to obtain more information on a taxon to determine the appropriate listing.

8. Conservation actions in the listing process

The criteria for the threatened categories are to be applied to a taxon whatever the level of conservation action affecting it. In cases where it is only conservation action that prevents the taxon from meeting the threatened criteria, the designation of 'Conservation Dependent' is appropriate. It is important to emphasise here that a taxon require conservation action even if it is not listed as threatened.

9. Documentation

All taxon lists including categorisation resulting from these criteria should state the criteria and sub-criteria that were met. No listing can be accepted as valid unless at least one criterion is given. If more than one criterion or sub-criterion was met, then each should be listed. However, failure to mention a criterion should not necessarily imply that it was not met. Therefore, if a re-evaluation indicates that the documented criterion is no longer met, this should not result in automatic down-listing. Instead, the taxon should be re-evaluated with respect to all criteria to indicate its status. The factors responsible for triggering the criteria, especially where inference and projection are used, should at least be logged by the evaluator, even if they cannot be included in published lists.

10. Threats and priorities

The category of threat is not necessarily sufficient to determine priorities for conservation action. The category of threat simply provides an assessment of the likelihood of extinction under current circumstances, whereas a system for assessing priorities for action will include numerous other factors concerning conservation action such as costs, logistics, chances of success, and even perhaps the taxonomic distinctiveness of the subject.

11. Use at regional level

The criteria are most appropriately applied to whole taxa at a global scale, rather than to those units defined by regional or national boundaries. Regionally or nationally based threat categories, which are aimed at including taxa that are threatened at regional or national levels (but not necessarily throughout their global ranges), are best used with two key pieces of information: the global status category for the taxon, and the proportion of the global population or range that occurs within the region or nation. However, if applied at regional or national level it must be recognised that a global category of threat may not be the same as a regional or national category for a particular taxon. For example, taxa classified as Vulnerable on the basis of their global declines in numbers or range might be Lower Risk within a particular region where their populations are stable. Conversely, taxa classified as Lower Risk globally might be Critically Endangered within a particular region where numbers are very small or declining, perhaps only because they are at the margins of their global range. IUCN is still in the process of developing guidelines for the use of national red list categories.

12. Re-evaluation

Evaluation of taxa against the criteria should be carried out at appropriate intervals. This is especially important for taxa listed under Near Threatened, or Conservation Dependent, and for threatened species whose status is known or suspected to be deteriorating.

13. Transfer between categories

There are rules to govern the movement of taxa between categories. These are as follows: (A) A taxon may be moved from a category of higher threat to a category of lower threat if none of the criteria of the higher category has been met for five years or more. (B) If the original classification is found to have been erroneous, the taxon may be transferred to the appropriate category or removed from the threatened categories altogether, without delay (but see Section 9). (C) Transfer from categories of lower to higher risk should be made without delay.

14. Problems of scale

Classification based on the sizes of geographic ranges or the patterns of habitat occupancy is complicated by problems of spatial scale. The finer the scale at which the distributions or habitats of taxa are mapped, the smaller the area will be that they are found to occupy. Mapping at finer scales reveals more areas in which the taxon is unrecorded. It is impossible to provide any strict but general rules for mapping taxa or habitats; the most appropriate scale will depend on the taxa in question, and the origin and comprehensiveness of the distributional data. However, the thresholds for some criteria (e.g. Critically Endangered) necessitate mapping at a fine scale.

III) Definitions

1. Population

Population is defined as the total number of individuals of the taxon. For functional reasons, primarily owing to differences between life-forms, population numbers are expressed as numbers of mature individuals only. In the case of taxa obligately dependent on other taxa for all or part of their life cycles, biologically appropriate values for the host taxon should be used.

2. Subpopulations

Subpopulations are defined as geographically or otherwise distinct groups in the population between which there is little exchange (typically one successful migrant individual or gamete per year or less).

3. Mature individuals

The number of mature individuals is defined as the number of individuals known, estimated or inferred to be capable of reproduction. When estimating this quantity the following points should be borne in mind:

- Where the population is characterised by natural fluctuations the minimum number should be used.

- This measure is intended to count individuals capable of reproduction and should therefore exclude individuals that are environmentally, behaviourally or otherwise reproductively suppressed in the wild.

- In the case of populations with biased adult or breeding sex ratios it is appropriate to use lower estimates for the number of mature individuals which take this into account (e.g. the estimated effective population size).

- Reproducing units within a clone should be counted as individuals, except where such units are unable to survive alone (e.g. corals).

- In the case of taxa that naturally lose all or a subset of mature individuals at some point in their life cycle, the estimate should be made at the appropriate time, when mature individuals are available for breeding.

4. Generation
Generation may be measured as the average age of parents in the population. This is greater than the age at first breeding, except in taxa where individuals breed only once.

5. Continuing decline
A continuing decline is a recent, current or projected future decline whose causes are not known or not adequately controlled and so is liable to continue unless remedial measures are taken. Natural fluctuations will not normally count as a continuing decline, but an observed decline should not be considered to be part of a natural fluctuation unless there is evidence for this.

6. Reduction
A reduction (criterion A) is a decline in the number of mature individuals of at least the amount (%) stated over the time period (years) specified, although the decline need not still be continuing. A reduction should not be interpreted as part of a natural fluctuation unless there is good evidence for this. Downward trends that are part of natural fluctuations will not normally count as a reduction.

7. Extreme fluctuations
Extreme fluctuations occur in a number of taxa where population size or distribution area varies widely, rapidly and frequently, typically with a variation greater than one order of magnitude (i.e. a tenfold increase or decrease).

8. Severely fragmented
Severely fragmented refers to the situation where increased extinction risks to the taxon result from the fact that most individuals within a taxon are found in small and relatively isolated subpopulations. These small subpopulations may go extinct, with a reduced probability of recolonisation.

9. Extent of occurrence
Extent of occurrence is defined as the area contained within the shortest continuous imaginary boundary which can be drawn to encompass all the known, inferred or projected sites of present occurrence of a taxon, excluding cases of vagrancy. This measure may exclude discontinuities or disjunctions within the overall distributions of taxa (e.g. large areas of obviously unsuitable habitat) (but see 'area of occupancy'). Extent of occurrence can often be measured by a minimum convex polygon (the smallest polygon in which no internal angle exceeds 180 degrees and which contains all the sites of occurrence).

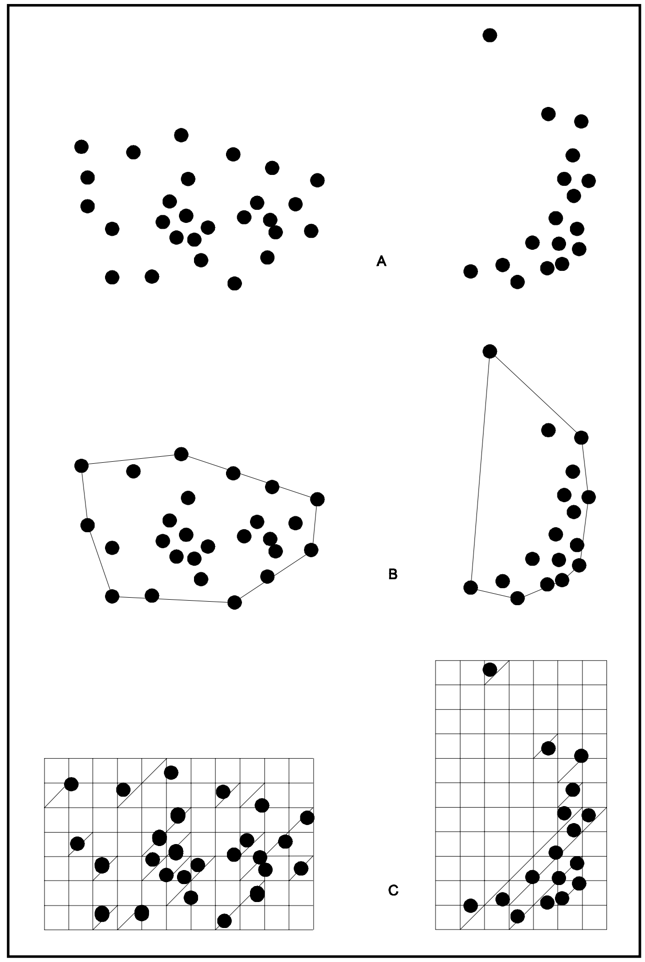


Figure 2: Two examples of the distinction between extent of occurrence and area of occupancy. (a) is the spatial distribution of known, inferred or projected sites of occurrence. (b) shows one possible boundary to the extent of occurrence, which is the measured area within this boundary. (c) shows one measure of area of occupancy which can be measured by the sum of the occupied grid squares.

10. Area of occupancy
Area of occupancy is defined as the area within its 'extent of occurrence' (see definition) which is occupied by a taxon, excluding cases of vagrancy. The measure reflects the fact that a taxon will not usually occur throughout the area of its extent of occurrence, which may, for example, contain unsuitable habitats. The area of occupancy is the smallest area essential at any stage to the survival of existing populations of a taxon (e.g. colonial nesting sites, feeding sites for migratory taxa). The size of the area of occupancy will be a function of the scale at which it is measured, and should be at a scale appropriate to relevant biological aspects of the taxon. The criteria include values in km^2, and thus to avoid errors in classification, the area of occupancy should be measured on grid squares (or equivalents) which are sufficiently small (see Figure 2).

11. Location
Location defines a geographically or ecologically distinct area in which a single event (e.g. pollution) will soon affect all individuals of the taxon present. A location usually, but not always, contains all or part of a subpopulation of the taxon, and is typically a small proportion of the taxon's total distribution.

12. Quantitative analysis
A quantitative analysis is defined here as the technique of population viability analysis (PVA), or any other quantitative form of analysis, which estimates the extinction probability of a taxon or population based on the known life history and specified management or non-management options. In presenting the results of quantitative analyses the structural equations and the data should be explicit.

IV) The Categories [1]

EXTINCT (EX)
A taxon is Extinct when there is no reasonable doubt that the last individual has died.

EXTINCT IN THE WILD (EW)
A taxon is Extinct in the wild when it is known only to survive in cultivation, in captivity or as a naturalised population (or populations) well outside the past range. A taxon is presumed extinct in the wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form.

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the criteria (A to E) on pages 104–105.

ENDANGERED (EN)
A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the criteria (A to E) on page 105.

VULNERABLE (VU)
A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the criteria (A to D) on pages 105 and 106.

LOWER RISK (LR)
A taxon is Lower Risk when it has been evaluated, does not satisfy the criteria for any of the categories Critically Endangered, Endangered or Vulnerable. Taxa included in the Lower Risk category can be separated into three subcategories:

1. **Conservation Dependent (cd)**. Taxa which are the focus of a continuing taxon-specific or habitat-specific conservation programme targeted towards the taxon in question, the cessation of which would result in the taxon qualifying for one of the threatened categories above within a period of five years.

2. **Near Threatened (nt)**. Taxa which do not qualify for Conservation Dependent, but which are close to qualifying for Vulnerable.

3. **Least Concern (lc)**. Taxa which do not qualify for Conservation Dependent or Near Threatened.

DATA DEFICIENT (DD)
A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution is lacking. Data Deficient is therefore not a category of threat or Lower Risk. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and threatened status. If the range of a taxon is suspected to be relatively circumscribed, if a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified.

NOT EVALUATED (NE)
A taxon is Not Evaluated when it is has not yet been assessed against the criteria.

V) The Criteria for Critically Endangered, Endangered and Vulnerable

CRITICALLY ENDANGERED (CR)
A taxon is Critically Endangered when it is facing an extremely high risk of extinction in the wild in the immediate future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

1) An observed, estimated, inferred or suspected reduction of at least 80% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:
   a) direct observation
   b) an index of abundance appropriate for the taxon
   c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
   d) actual or potential levels of exploitation
   e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

2) A reduction of at least 80%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than $100km^2$ or area of occupancy estimated to be less than $10km^2$, and estimates indicating any two of the following:
1) Severely fragmented or known to exist at only a single location.

2) Continuing decline, observed, inferred or projected, in any of the following:
   a) extent of occurrence
   b) area of occupancy
   c) area, extent and/or quality of habitat
   d) number of locations or subpopulations
   e) number of mature individuals.

3) Extreme fluctuations in any of the following:
   a) extent of occurrence
   b) area of occupancy
   c) number of locations or subpopulations
   d) number of mature individuals.

C) Population estimated to number less than 250 mature individuals and either:

   1) An estimated continuing decline of at least 25% within three years or one generation, whichever is longer or

   2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
      a) severely fragmented (i.e. no subpopulation estimated to contain more than 50 mature individuals)
      b) all individuals are in a single subpopulation.

D) Population estimated to number less than 50 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 50% within 10 years or three generations, whichever is the longer.

ENDANGERED (EN)
A taxon is Endangered when it is not Critically Endangered but is facing a very high risk of extinction in the wild in the near future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

   1) An observed, estimated, inferred or suspected reduction of at least 50% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:
      a) direct observation
      b) an index of abundance appropriate for the taxon
      c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
      d) actual or potential levels of exploitation
      e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

   2) A reduction of at least 50%, projected or suspected to be met within the next 10 years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d), or (e) above.

B) Extent of occurrence estimated to be less than 5000km^2 or area of occupancy estimated to be less than 500km^2, and estimates indicating any two of the following:

   1) Severely fragmented or known to exist at no more than five locations.

   2) Continuing decline, inferred, observed or projected, in any of the following:
      a) extent of occurrence
      b) area of occupancy
      c) area, extent and/or quality of habitat
      d) number of locations or subpopulations
      e) number of mature individuals.

   3) Extreme fluctuations in any of the following:
      a) extent of occurrence
      b) area of occupancy
      c) number of locations or subpopulations
      d) number of mature individuals.

C) Population estimated to number less than 2500 mature individuals and either:

   1) An estimated continuing decline of at least 20% within five years or two generations, whichever is longer, or

   2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
      a) severely fragmented (i.e. no subpopulation estimated to contain more than 250 mature individuals)
      b) all individuals are in a single subpopulation.

D) Population estimated to number less than 250 mature individuals.

E) Quantitative analysis showing the probability of extinction in the wild is at least 20% within 20 years or five generations, whichever is the longer.

VULNERABLE (VU)
A taxon is Vulnerable when it is not Critically Endangered or Endangered but is facing a high risk of extinction in the wild in the medium-term future, as defined by any of the following criteria (A to E):

A) Population reduction in the form of either of the following:

   1) An observed, estimated, inferred or suspected reduction of at least 20% over the last 10 years or three generations, whichever is the longer, based on (and specifying) any of the following:
      a) direct observation
      b) an index of abundance appropriate for the taxon
      c) a decline in area of occupancy, extent of occurrence and/or quality of habitat
      d) actual or potential levels of exploitation
      e) the effects of introduced taxa, hybridisation, pathogens, pollutants, competitors or parasites.

   2) A reduction of at least 20%, projected or suspected to be met within the next ten years or three generations, whichever is the longer, based on (and specifying) any of (b), (c), (d) or (e) above.

B) Extent of occurrence estimated to be less than 20,000km^2 or area of occupancy estimated to be less than 2000km^2, and estimates indicating any two of the following:

   1) Severely fragmented or known to exist at no more than ten locations.

   2) Continuing decline, inferred, observed or projected, in any of the following:
      a) extent of occurrence
      b) area of occupancy
      c) area, extent and/or quality of habitat
      d) number of locations or subpopulations
      e) number of mature individuals

   3) Extreme fluctuations in any of the following:
      a) extent of occurrence
      b) area of occupancy
      c) number of locations or subpopulations
      d) number of mature individuals

C) Population estimated to number less than 10,000 mature individuals and either:

   1) An estimated continuing decline of at least 10% within 10 years or three generations, whichever is longer, or

   2) A continuing decline, observed, projected, or inferred, in numbers of mature individuals and population structure in the form of either:
      a) severely fragmented (i.e. no subpopulation estimated to contain more than 1000 mature individuals)
      b) all individuals are in a single subpopulation

D) Population very small or restricted in the form of either of the following:

   1) Population estimated to number less than 1000 mature individuals.

   2) Population is characterised by an acute restriction in its area of occupancy (typically less than $100km^2$) or in the number of locations (typically less than five). Such a taxon would thus be prone to the effects of human activities (or stochastic events whose impact is increased by human activities) within a very short period of time in an unforeseeable future, and is thus capable of becoming Critically Endangered or even Extinct in a very short period.

E) Quantitative analysis showing the probability of extinction in the wild is at least 10% within 100 years.

Note: copies of the IUCN Red List Categories booklet, are available on request from IUCN (address on back cover of this Action Plan)

[1] Note: As in previous IUCN categories, the abbreviation of each category (in parenthesis) follows the English denominations when translated into other languages.