

The ecology of river birds in Nepal

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Five weeks were spent in Nepal in November and December 1991 and a further three weeks in March and early April making a preliminary investigation of the ecology of river birds. Field work was carried out on selected stretches of rivers from c. 200 m to over 3,500 m.

Data were collected on the distribution, use of the river corridor, feeding behaviour and diet of Brown Dippers *Cinclus pallasii*, Grey Wagtails *Motacilla cinerea*, four species of forktail *Enicurus*, Plumbeous Water-Redstarts *Rhyacornis fuliginosus*, White-capped Water-Redstarts *Chaimarornis leucocephalus*, Blue Whistling-Thrushes *Myiophonus caeruleus* and several species of kingfisher. Data on biometrics of some of these species were also obtained, and any aggressive interactions between species noted.

Species diversity in the winter months was highest at altitudes between 600 m and 1,600 m, with few riverine species noted above c. 2,300 m. Plumbeous and White-capped Water-Redstarts were the most numerous species, the former occurring at densities of a bird per 50-60 m on rivers in the Middle Hills. Some evidence was obtained for differences in the use of river habitats by male and female Plumbeous Water-Redstarts. Brown Dippers were in pairs and nest-building during November in the Middle Hills. By March, Brown Dippers and other river birds had returned to breed on high altitude rivers; Brown Dippers were still nest-building at over 3,000 m but pairs were feeding young in the lower Langtang.

In the winter Brown Dippers, Little Forktails *Enicurus scouleri*, White-capped Water-Redstarts and Plumbeous Water-Redstarts occurred predominantly on rocks in the river. However, of these four species only Brown Dippers were frequently recorded wading, swimming and diving in the river. White-capped Water-Redstarts favoured rocks at the edges of rivers and also often occurred on riparian ground. Spotted *Enicurus maculatus*, Slaty-backed *E. schistaceus* and Black-backed Forktails *E. immaculatus* were recorded mainly on marginal rocks or shoals or wading at the river's edge, with Black-backed Forktails in particular often noted in riparian vegetation.

When foraging, Brown Dippers mainly caught prey from submerged rocks or the river bed, whereas Little Forktails picked prey from spray-drenched rocks at waterfalls or from the hypopetric area (the wetted zone) of rocks. Plumbeous Water-Redstarts predominantly used aerial flycatching as a foraging technique. Both White-capped Water-Redstarts and Grey Wagtails also flycatched, but also spent much time picking prey from shoals or mud or from riparian ground. Spotted and Slaty-backed Forktails picked much prey from along the edges of the river, both from the river bed and from the mud or vegetation at the river margins. Leaf- and stone-turning were frequent strategies. Most observations of foraging Black-backed Forktails were of them picking prey from rocks and from shoals, muddy river margins and riparian ground.

Measurements and weights of 20 Plumbeous Water-Redstarts and smaller numbers of ten other species of river bird are presented. These are discussed in relation to the birds' use of the river corridor and their foraging behaviour.

Few instances of intra- or inter-specific aggression were noted, but Plumbeous Water-Redstarts appeared to be particularly aggressive towards other river birds.

Possible implications of land use changes for river birds are discussed in the light of these observations. It is suggested that Brown Dippers may be adversely affected on rivers in the Middle Hills by deforestation, ploughing and resulting siltation and by the restricted flows due to the diversion of water for irrigation. Spotted, Slaty-backed and Black-backed Forktails which require bankside trees or dense riparian vegetation, are likely also to suffer from deforestation.

INTRODUCTION

There is much concern among conservationists throughout the world about the impact on communities of terrestrial birds and other wildlife of land use changes, notably the removal of natural forest cover by man to grow crops or graze stock. Inskipp (1989) has described the threats to birds from deforestation in Nepal, whilst Ormerod (1990) has drawn attention to the subsequent impacts on riverine ecosystems. He also made some preliminary observations on bird communities on rivers in the Middle Hills and terai.

The river bird community in the Himalaya and Middle Hills in Nepal is particularly diverse, including Brown Dippers *Cinclus pallasi*, Grey Wagtails *Motacilla cinerea*, four species of forktail *Enicurus*, Plumbeous Water-Redstarts *Rhyacornis fuliginosus* and White-capped Water-Redstarts *Chaimarornis leucocephalus*. Little is known, however, of the impact of land use changes on these species.

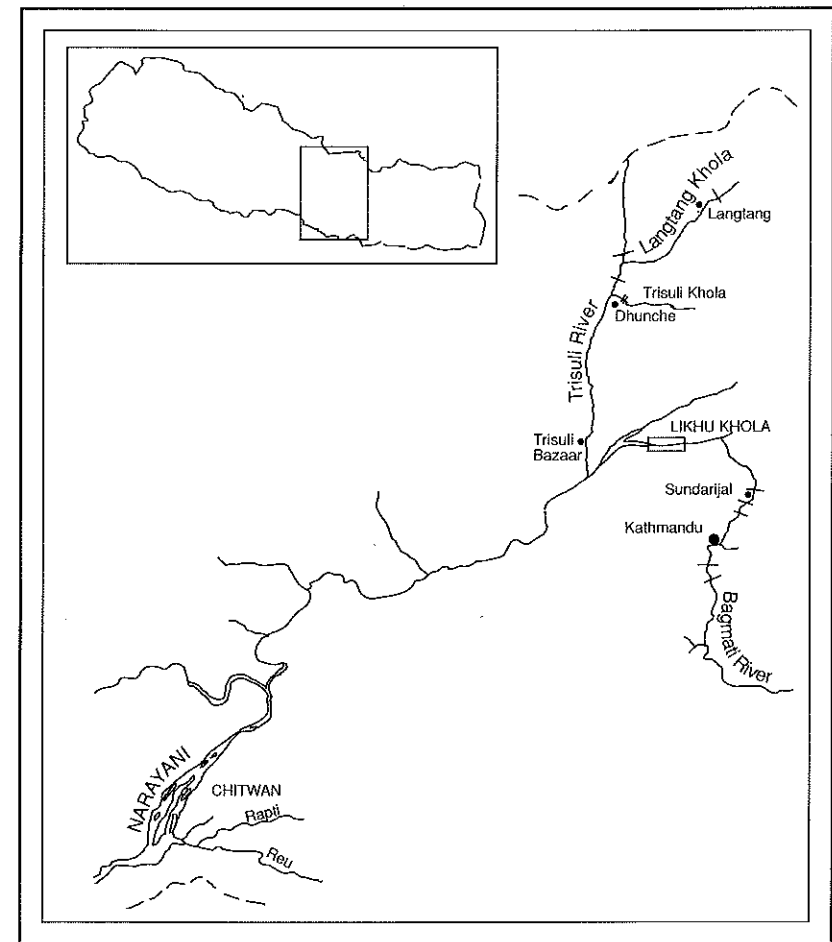
A large scale research project on water, erosion and land management, funded by the Overseas Development Administration (ODA), is currently being undertaken in catchments of the middle hills of Nepal by the Royal Geographical Society, the Institute of Hydrology and various universities. The aim is to investigate the physical, chemical and biological changes in rivers from catchment perturbations; it involves comparisons between sub-catchments of a major river system, the Likhu Khola, which are subject to different land uses. It was thought useful to carry out ornithological work on the same catchments being studied for the ODA project so that opportunistic use could be made of the available data on river quality and aquatic biota. The aim of the ornithological study was to investigate the ecological requirements of river bird species and, hence, better predict the wider effects of land use changes such as erosion, sedimentation and habitat modification.

Preliminary data on habitat use and foraging behaviour of some river birds in the Likhu Khola and in the Langtang area, the Kathmandu Valley and in the Royal Chitwan National Park are presented here. These data were collected during a 30 day period from 8 November to 11 December 1991 and during three weeks in late March and early April 1992. They indicate some of the likely impacts on birds of land use changes, but it is emphasised that further data are needed over a longer period of time and from other seasons of the year before there can be an adequate understanding of the impacts.

STUDY AREA AND METHODS

The main study area covered 3 km of the Likhu Khola (600-700 m), a river lying 25 km north of Kathmandu (27°50'N 85°20'E), and draining into the Trisuli River and thence the Narayani and the Ganges (Fig. 1). This area

Figure 1. Sketch of central Nepal showing the location of the Langtang Khola, Trisuli Khola, Likhu Kola, Bagmati River and the Narayani River.



included 1-2 km stretches of seven tributaries, the Mahadev and Dee Khola to the north, and the Bhondare and Jogi, the Bore Khola, Syalping and Ghyambe Khola to the south (Fig. 2). Land use in the Likhu Khola is predominantly arable farmland, with rice the main summer crop and cereals grown as a winter crop. Terraces adjoin the main river and tributaries for much of their length, with many irrigation ditches diverting water from the streams onto the small fields. The steepest banks along the river still support trees and scrub, with patches of degraded Sal *Shorea robusta* forest in a few

areas. Alder *Alnus nepalensis* fringes some streams, but felling for fuel and timber has reduced these in most places to a sparse scattering. The tributary streams have a steep gradient, and are rocky with frequent waterfalls. Descriptions of each are given in Appendix 1, but a common characteristic in both the winter and spring visits was an accumulation of gravel, sand and silt on the stream bed, and a much reduced flow due to diversion of water for irrigation.

Additional data were collected opportunistically during both visits in the Langtang Himal from a short stretch of the Trisuli Khola at c. 1,600 m, from the Trisuli River between Dhunche and Syabrubesi (c. 1,200-1,600 m) and from sections of the Langtang Khola from its junction with the Trisuli at Syabrubesi up through oak *Quercus/Rhododendron* forest to Kyangin Gumpa above Langtang (c. 3,700 m) (Fig. 1). Data were gathered also from three 1 km stretches of the Bagmati River in the Kathmandu Valley:

1. A rocky, Alder-lined, fast-flowing stretch (15-20 m wide) at Sundarijal, upstream of Kathmandu, at an altitude of c. 1,450 m;
2. A slower, open stretch (10-20 m wide) with shingle beds and vertical sand banks, downstream of Sundarijal;
3. A heavily organically polluted slower-flowing and braided section (up to 50 m) below the Chobar Gorge (c. 1,200 m) downstream of the city).

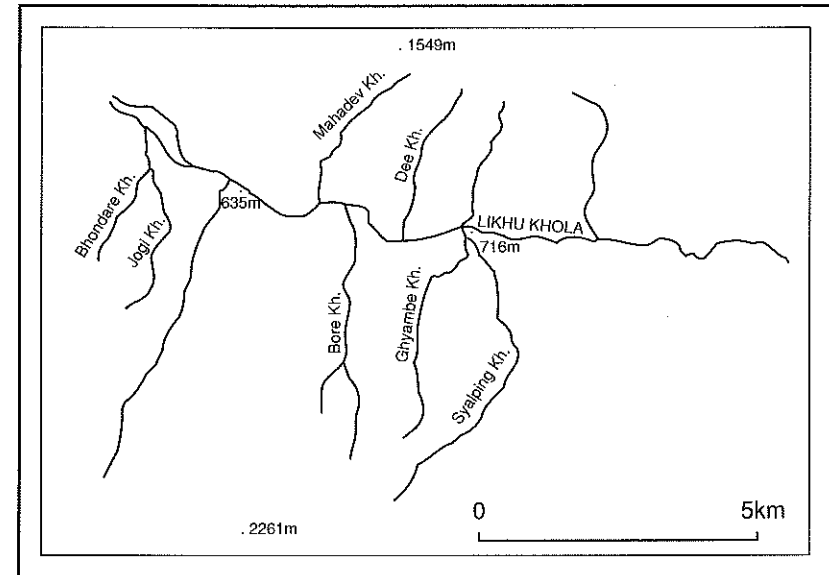
They were also gathered from various stretches of the Narayani (up to 400 m in width), the Reu and small forest streams in the Royal Chitwan National Park at 200-250 m (Fig. 1).

The distribution of river birds on all these watercourses was assessed both in the winter and in the spring study periods, by walking (or in the case of the Narayani drifting in a boat) along each section. Data were also collected on bankside habitats, river or stream width and the general nature of the watercourse (e.g. presence of rocks, shoals, riffles etc.).

The location of each bird in the river corridor was noted i.e. whether in the mid-river, marginal (within 1 m of the bank) or riparian zone, the last defined as that area of rock, grassland or woodland up to 10 m from the river bank, and whether in the water, on mid-river or marginal rocks, shoals or mud, in trees or other vegetation. During observations of individual birds, each time they moved, their new location was recorded.

The foraging behaviour of nine species of river bird was recorded in various categories: picking prey from rocks, shoals, mud, riparian ground or vegetation; flycatching; catching prey on or in water or the river bed when swimming, diving or wading. Faecal samples, where these could be definitely attributed to a particular species, were collected and stored in alcohol for later analysis of invertebrate or other prey; some opportunistic observations were also made of the prey taken by different river birds.

Figure 2. Likhu Kola catchment showing area covered in this study.



All interactions between birds, both intra- and inter-specific, were noted.

To obtain some data on biometrics, a sample of birds was caught in mist-nets erected across tributaries of the Likhu Khola and across the Trisuli Khola and Langtang Khola. Each bird was weighed (+ 0.1 g) by spring balance, and the length of wing to + 0.5 mm (maximum flattened chord), tarsus to 0.1 mm (using the method described by Schmid and Spitznagel (1985), bill (tip to feathering), bill to skull (tip of bill to hind skull) and depth of bill (above the nostrils) to + 0.5 mm were measured.

RESULTS

Distribution

1. The Likhu Khola

a) Winter period

Over twenty species of river bird were recorded in the Likhu Khola catchment. In addition to those species listed in Table 1, Indian Pond-Herons *Ardeola grayii*, Little Egrets *Egretta garzetta*, Cattle Egrets *Bubulcus ibis*, Black Storks *Ciconia nigra* and Woolly-necked Storks *C. episcopus*, Red-wattled Lapwings *Vanellus indicus*, Common Sandpipers *Tringa hypoleucos* and Green Sandpipers

T. ochropus and Plain Martins *Riparia pahudicola* were all frequent. The most numerous river passerines were Plumbeous Water-Redstarts and White-capped Water-Redstarts. Only two pairs of Brown Dippers and two single birds were seen here. They were on the main river and on the Syalping Khola, the largest of the tributaries surveyed (Fig. 3a). Grey Wagtails were widespread (Fig. 3a).

Plumbeous Water-Redstarts occurred at densities of one bird per 50-60 m along the open main river, males greatly outnumbering females (by 10:1). By contrast, on the well-wooded Bore Khola and on some other tributaries, females were predominant (Figs. 3b and c). White-capped Water Redstarts occurred commonly on the main river and more open south-facing tributaries (Fig. 4a). Little Forktails *Enicurus scouleri* were scarce, although three birds were recorded in 1 km of the Mahadev Khola, where there was a narrow gorge with numerous waterfalls and wet rock faces (Fig. 4b). One pair of Spotted Forktails *E. maculatus* was seen regularly on a shoal in the Likhu Khola, with a third bird on the Syalping (Fig. 4b). The scarcer Black-backed *E. immaculatus* and Slaty-backed Forktails *E. schistaceus* both occurred only on wooded sections of tributaries, even on very narrow (1 m wide) wooded side streams (Fig. 4c). Blue Whistling-Thrushes *Myiophonus caeruleus* were frequently seen by water but usually flew off when disturbed into trees or up the valley sides. Three Blue Rock-Thrushes *Monticola solitarius* were also seen by the main river and by the Dee Khola, where a Wallcreeper *Tichodroma muraria* was noted on streamside rocks. Both Common Kingfishers *Alcedo atthis* and Crested Kingfishers *Megaceryle lugubris* were seen on three or four occasions on the main river and the Syalping, with the former species also on the narrow Bhondare. White-throated Kingfishers *Halcyon smyrnensis* were seen twice by water but were often away from watercourses over fields.

b) Spring period

By late March there were very few Plumbeous Water-Redstarts in the Likhu Khola (Table 1). About 5 km downriver below the confluence with the Tadhu Khola, near Dhikuri, a pair was feeding three recently fledged young on 27 March, indicating a laying date in late February, earlier than noted by Inskipp and Inskipp (1991). The other main differences between the two visits were the small numbers of White-capped Water Redstarts and the paucity of forktails, with only Slaty-backed seen during the spring survey (Table 1).

2. Himal Langtang, Kathmandu Valley and Chitwan.

a) Winter period

On a short stretch (200 m) of the Trisuli Khola, Plumbeous Water-Redstarts were the most frequent species, although were scarce on the 100 m wide

Table 1. Numbers of 14 species of riverbird observed in the Likhu Khola study area in November 1991 and late March 1992. Figures in parentheses for Plumbeous Water-Redstart refer to the number of males.

	Likhu Khola (3km)		All Tributaries (12km)	
	Winter	Spring	Winter	Spring
Crested Kingfisher	3	3	1	0
White-throated Kingfisher	1	2	1	0
Common Kingfisher	3	0	2	2
Grey Wagtail	3	2	14	2
White Wagtail	16+	8	0	0
White-browed Wagtail	4	2	0	0
Brown Dipper	3	2	4	3
Little Forktail	1	0	6	0
Spotted Forktail	2	0	1	0
Slaty-backed Forktail	0	1	5	3
Black-backed Forktail	0	0	7	0
White-capped Water-Redstart	10	6	21	7
Plumbeous Water-Redstart	33 (30)	1 (1)	35 (12)	4 (3)
Blue Whistling-thrush	3	8	7	10
	82+	35	104	31

Trisuli River and on the Langtang Khola (Table 2). Brown Dippers were only seen on the Trisuli Khola; above 2,000 m there were only a few Plumbeous Water-Redstarts, two Spotted Forktails and a Blue Whistling-Thrush (Table 2).

By contrast, at the lower altitude of the Bagmati River near Sundarijal, there was a good diversity of species. Here Plumbeous Water-Redstarts were at the highest densities, with males predominating (Table 2, Fig. 5). Downriver of this stretch, where the gradient declined and the river meandered across a broad, open valley, Common Sandpipers, Little Ringed Plovers *Charadrius dubius*, White Wagtails *Motacilla alba* and Plain Martins replaced the species of the rocky, turbulent rivers (Table 2). On the Bagmati below Kathmandu, both Plumbeous and White-capped Water-Redstarts occurred in small numbers in the Chobar Gorge and on marginal rocks immediately downriver, but the bird community on this grossly polluted river was dominated by sandpipers and wagtails, as well as by Indian Pond-Herons and both Little and Cattle Egrets (Table 2). Thus on 10 and 20 November, there was a large flock of Green Sandpipers with smaller numbers of Wood *T. glareola* and Common Sandpipers, one Common Redshank *T. totanus*, three White-breasted Waterhens *Amawornis phoenicurus*, a flock of over 40 Grey-headed Lapwings *Vanellus cinereus* and a Northern Lapwing *V. vanellus*, numerous White Wagtails, 5 White-browed *M. maderaspatensis* and at least 2 Grey Wagtails.

Figure 3. Distribution of three species of river birds in November 1991 in the Likhu Kola.
 a) Brown Dippers and Grey Wagtails; b) male Plumbeous Water-Redstarts; c) female Plumbeous Water-Redstarts.

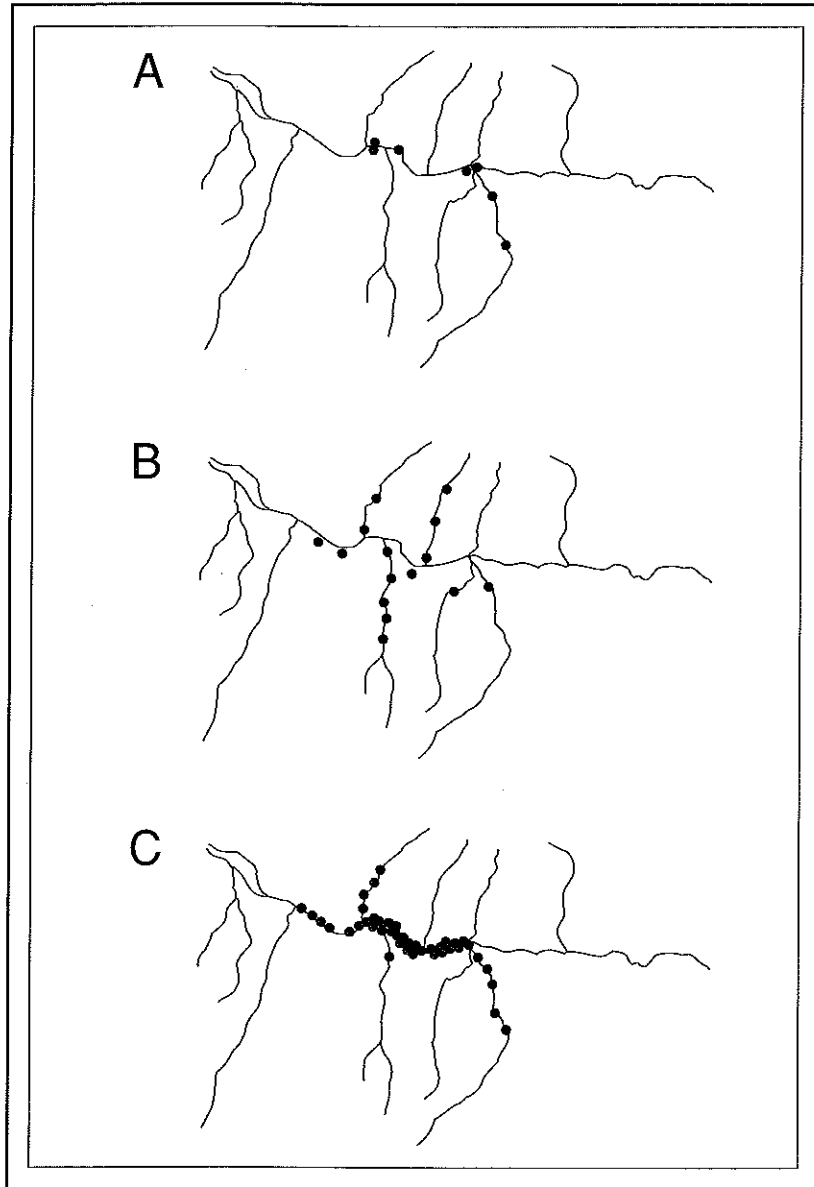
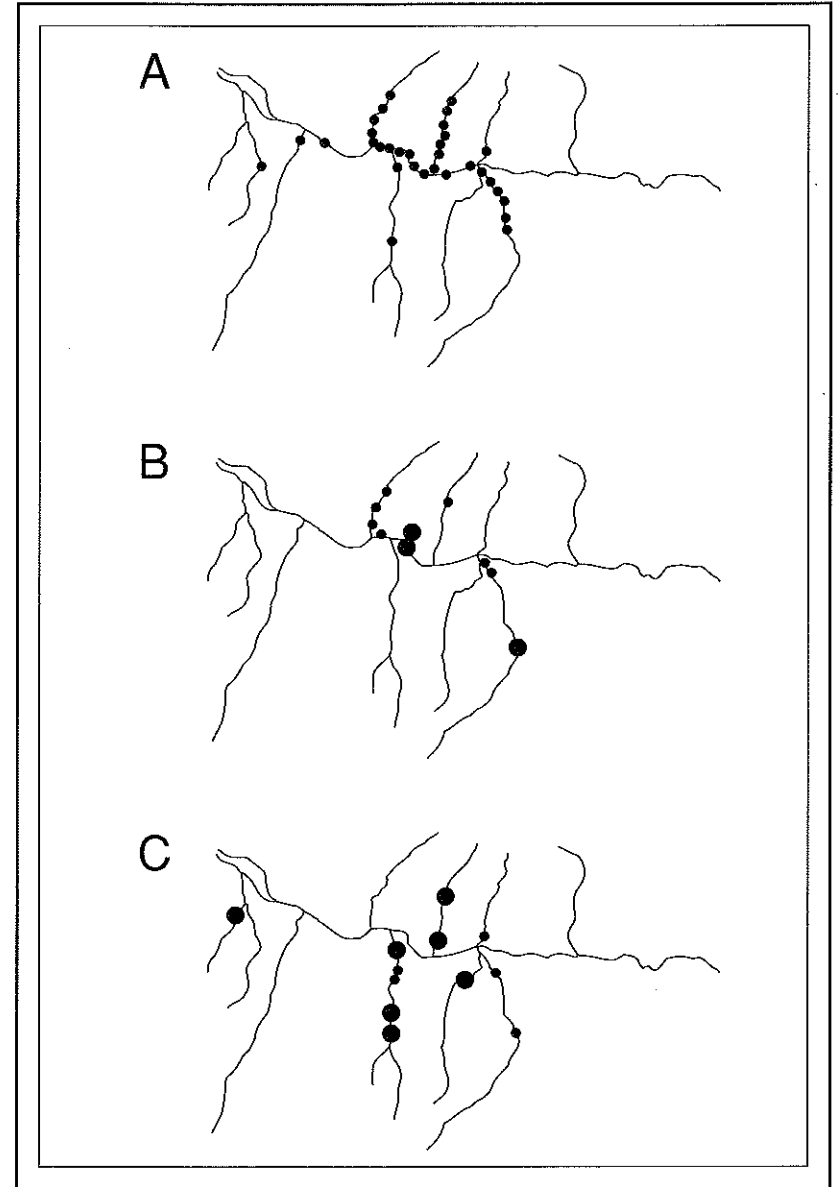


Figure 4. Distribution of five species of river birds in November 1991 in the Likhu Kola.
 a) White-capped Water-Redstarts; b) Spotted (large dots) and Little Forktails (small dots); c) Black-backed (large dots) and Slaty-backed Forktails (small dots).



Forktails at these high altitudes. Abundances of the redstarts were much greater at altitudes of 600-1,500 m compared with either 2,000 m or 200 m (Tables 1 and 2). Brown Dippers and Little Forktails were only noted between 600 and 1,600 m, whereas Grey Wagtails were widespread from 200 to over 1,500 m. Black-backed Forktails occurred alongside Slaty-backed and Spotted Forktails in the Likhu Khola up to 1,000 m, but unlike these species, were not seen above this altitude but did occur in the lowlands. Of the *Enicurus*, only Spotted Forktails were observed over 1,600 m.

In the spring Grey Wagtails, Brown Dippers and both Plumbeous and White-capped Water-Redstarts were widespread at higher altitudes, although only one White-capped Water-Redstart, one wagtail and three dippers were seen above 3,200 m. The forktails were more clearly segregated than in the winter with Little and Spotted from 1,600 to nearly 3,000 m, Slaty-backed in the Likhu Khola at 600 to 900 m and Black-backed in the Chitwan lowlands.

b) Habitat use

Both Plumbeous and White-capped Water-Redstarts commonly perched on top of large rocks or boulders in the river, with the latter species preferring marginal rocks and riparian ground, sometimes 100 m or more away from the river (Table 3). Little Forktails and Brown Dippers were also frequently seen on mid-river or marginal rocks, but these species generally occurred on small rocks, often drenched with spray or close to the water edge. Both these species commonly waded, although only dippers swam and dived (Table 3).

The other three species of forktail preferred marginal habitats, creeping amongst boulders, or wading at the water's edge on mud and shoals. The small number of observations preclude any realistic comparison of habitat

SPECIES	N	Mid-River Rocks	Marginal Rocks	River	Shoal/Marginal Ground	Riparian Ground incl. trees & rocks
Grey Wagtail	35	45.7	25.7	8.6	11.4	8.6
Brown Dipper	124	58.9	8	33.1	-	-
Blue Whistling-Thrush	59	6.8	33.9	6.8	6.8	45.7
White-capped Water-Redstart	305	22.6	59.8	-	2.9	15.4
Plumbeous Water-Redstart	752	56.8	34.2	0.13	3.2	5.7
Spotted Forktail	112	2.7	33.9	18.75	38.4	6.25
Little Forktail	169	55	29	16	-	-
Slaty-backed Forktail	139	6.5	56.1	20.9	9.3	7.2
Black-backed Forktail	36	5.5	38.9	5.5	27.8	22.2

Table 3. Use of the river corridor by nine species of bird as shown by the proportion of observations of each species in different locations.

use between these birds, although Black-backed Forktails were only seen in wooded sections of tributaries of the Likhu Khola and on forested streams in Chitwan National Park. This species spent more time in riparian habitats than Slaty-backed or Spotted Forktails. In the Likhu Khola catchment in the winter, the few Spotted Forktails observed were in more open habitat than the Slaty-backed Forktails but, at Sundarijal on the Bagmati, both occurred together on the alder-lined section (Fig. 5). On the Langtang Khola Spotted Forktails, if disturbed, flew into thick riparian vegetation, a habit shared with Slaty-backed Forktails.

Grey Wagtails occurred in all locations, including habitats away from rivers e.g. on roads and tracks, and on rice stubble on terraces. By rivers they generally occurred along the margins or on damp riparian grassland.

c) Feeding behaviour

A diversity of feeding strategies was shown by the nine species of river bird for which data were collected during the winter period. Although some strategies were common to all or most species, there were some clear differences between species (Table 4). Thus flycatching was the predominant foraging strategy (75% of observations) used by Plumbeous Water-Redstarts. These small birds often perched high on a boulder and flew up almost vertically to catch an insect. Aerial sallies up to 5 m or more above the water were not uncommon, although most aerial flights (74%) were lower than 2 m. Birds usually caught insects over water but sometimes flew over riparian vegetation (c. 8% of aerial flights), even hovering briefly to pick an insect off a leaf. Most prey appeared to be small insects such as chironomid midges, but larger prey were also taken (see Diet section below). Other species, notably Grey Wagtails, White-capped Water-Redstarts and Slaty-backed and Black-backed Forktails, also used flycatching as a foraging method, but to a lesser extent than the redstarts. White-capped Water-Redstarts foraged commonly by picking prey from the ground or from vegetation in the riparian zone (40% of observations) as well as by picking prey from rocks (40%) (Table 4).

Only Brown Dippers foraged by swimming and diving as well as wading (95% of observations) but Grey Wagtails and all four species of forktail, particularly Slaty-backed and Spotted, picked items from shallow water whilst wading. Little Forktail spent most time picking prey from wet rocks and waterfalls, often drenched by spray. Pecking rates of Little Forktails were high, 80-124 pecks per minute, with a bird sometimes feeding on one small rock for five minutes or more and picking more than 400 items from the wet rock surface. Observations revealed many dipterans, small caddis larvae (Trichoptera) and mayfly nymphs (Ephemeroptera) in these areas. Whilst the three larger forktails all mainly fed in the marginal zone, picking items from the water, from rocks, shingle or mud, or turning over leaves to find

Table 3. Foraging techniques of nine species of river bird in Nepal shown by percentage of total observations: N Number of observations; 1 Catching prey in or on water or on river bed; 2 Picking prey from rocks; 3 Picking prey from shoals or mud; 4 Picking prey from riparian ground or vegetation; 5 Aerial flycatching.

SPECIES	N	1	2	3	4	5
Grey Wagtail	32	3.1	62.5	19	3.1	12.5
Brown Dipper	241	95.9	4.1	-	-	-
Blue Whistling-Thrush	12	66.7	8.3	25	-	-
White-capped Water-Redstart	178	-	39.3	1.7	39.9	19.1
Plumbeous Water-Redstart	600	0.5	9.7	13.3	1.2	75.4
Spotted Forktail	467	28	8.3	60.3	3.3	-
Little Forktail	879	2.3	97.7	-	-	-
Slaty-backed Forktail	115	50	3.5	36.5	3.5	3.5
Black-backed Forktail	33	9.1	30	39.4	18.2	3.0

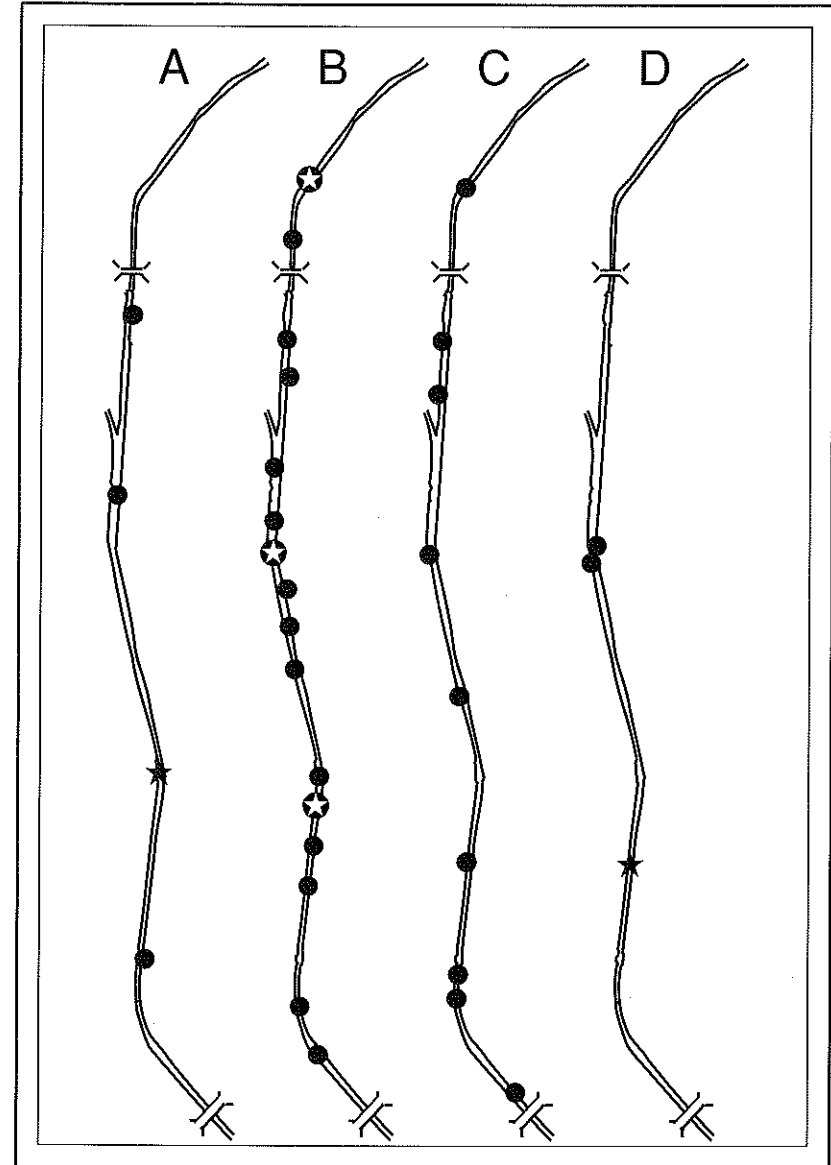
prey, only the Spotted was seen to frequently turn over stones and to foot-paddle to disturb and find prey. This species often picked up large items such as cased caddis larvae, and then had to pause to beat the prey repeatedly to kill it or extract it from its case. In fewer instances Little and Slaty-backed Forktails also dealt with caddis larvae, molluscs or large worms (*Oligochaeta*) in this way.

Few data were collected on the foraging behaviour of Blue Whistling-Thrushes which, when disturbed, tended to fly off into trees or away from the river. This species was less confined to the river corridor than the other river birds studied in this project although, as mentioned above, White-capped Water-Redstarts and Grey Wagtails also foraged away from watercourses. Even Plumbeous Water-Redstarts sometimes foraged in riparian vegetation. Because flycatching in the river corridor is a much more conspicuous foraging method, the true extent of vegetation gleaning may have been overlooked. Notably, Plumbeous Water-Redstarts when disturbed, frequently took cover in trees and scrub away from the river.

d) Diet

Faecal pellets collected from the Likhu Khola are still to be analysed, but observations suggested that all nine species of bird took invertebrate prey. Differences between species in their choice of prey were evident with, for example, Plumbeous Water-Redstarts taking more adult winged insects and Brown Dippers and Little Forktails feeding almost exclusively on aquatic larval or nymphal stages of insects e.g. mayfly nymphs, caddis larvae and blackfly larvae *Simulium* (Diptera). Size differences in prey taken by different

Figure 3. Distribution of some river birds at Sundarijal in November 1991 (not to scale). a) Slaty-backed Forktail (closed circle) and Spotted Forktail (star); b) male Plumbeous Water-Redstart (closed circle) and female Plumbeous Water-Redstart (white star in closed circle); c) White-capped Water-Redstart (closed circle); d) Grey Wagtail (star).



species were also evident. Thus Plumbeous Water-Redstarts preyed on a wide range of insects and from a diversity of orders e.g. large dragonflies (Odonata), butterflies (Lepidoptera), bees (Hymenoptera), but mainly small flies and midges (Diptera: Chironomidae, Simuliidae). Little Forktails took numerous tiny items of prey, sometimes spending 5-10 minutes picking prey from an algal web on the upstream side of a wet rock. Invertebrates in these situations included dipteran larvae and small caddis larvae and mayfly nymphs. Brown Dippers and the three larger species of forktail frequently took much larger items, which then involved considerable handling time (beating).

Berries were eaten from riparian vegetation by Plumbeous Water-Redstarts and, from the nature of their faeces, probably also by White-capped Water-Redstarts and Blue Whistling-Thrushes.

e) Biometrics

Weights and measurements of the small sample of river birds caught in mist nets indicated considerable overlap between species in size and weight (Table 5). Excluding the two species of *Alcedo* kingfishers, Plumbeous Water-Redstarts and Little Forktails were the smallest species of river bird in all measurements; moreover, the weights and measurements of these two species were very similar. Grey Wagtails differed only in their longer bills and tails.

Brown Dippers and White-capped Water-Redstarts were also rather similar in wing and tarsus length but the dippers had longer, stouter bills, shorter tails and were twice the weight of the chats. Slaty-backed and Black-backed Forktails differed little from each other, and also resembled White-capped Water-Redstarts apart from their much longer tails (x 2 those of the chats), longer bills and shorter tarsi.

The single first year Brown Dipper had a wing of 92 mm, shorter than that of any of the adults caught (95-99 mm). Young White-throated Dippers *Cinclus cinclus* in Wales also have shorter wings than adults (Ormerod and Tyler 1986). Likewise, wing length of the first year Plumbeous Water-Redstarts (mean 73 mm, n=17) and White-capped Water-Redstarts (88.2 mm, n=3) were significantly smaller than older birds (79.2 mm, n=3; 95.4 mm, n=11).

f) Interactions between species

The high density of birds along some rivers inevitably resulted in birds sometimes being in close contact. With the exception of the Brown Dippers some of which were in pairs and nest-building in November, and Spotted Forktails, also mainly in pairs at this time, other river birds appeared to be holding individual territories during the winter study. A few instances of intra-specific aggression, especially between Plumbeous Water-Redstarts

Table 2. Biometrics of 11 species of river bird caught in Nepal in November/December 1991. Ranges of weights and measurements for each species are shown in parentheses.

SPECIES	N	Wing (mm) Mean	Tarsus (mm) Mean	Bill-feathering (mm) Mean	Bill-hindskull (mm) Mean	Bill depth (mm) Mean	Tail (mm) Mean	Weight (g) Mean
Common Kingfisher	1	72	13	36	65	8	30	24.6
Blue-eared Kingfisher	2	68 (68)	10 (9-11)	38 (37-39)	67 (66-68)	8.2 (7.8-8.5)	26	21.7 (21.3-22.0)
Crested Kingfisher	1	186	22	59	119	17	112	-
Grey Wagtail	7	82.6 (79.5-85)	22.8 (21.5-26)	11.6 (10-15)	32.8 (32-34)	3.2 (2.8-4)	85.3 (78-91)	16.0 (14.8-17.2)
Brown Dipper	6	96.6 (92-99)	36.2 (34.5-37)	17.1 (16-18)	50.8 (49-53)	5.1 (4-5.6)	48 (42-54)	73.2 (67.5-76.8)
Plumbeous Water-Redstart	20	73.8 (69-81)	25.8 (22-29.5)	7.5 (6-9.5)	31.5 (30-34.5)	2.9 (2.5-3.5)	45.5 (39-55)	17.4 (15.1-20)
White-capped Water-Redstart	14	93.8 (88-101.5)	34.2 (31.5-36.5)	10.5 (9-12)	37.9 (37-40)	3.7 (3-4)	69.2 (61-83)	30.5 (25.1-34.6)
Blue Whistling-Thrush	1	186	63	24	71	11	130	-
Little Forktail	7	75.4 (72-81)	27.1 (26-29)	7.7 (6.5-10.5)	31.2 (30-32.5)	2.7 (2.7-3.0)	44.3 (41-52)	16.2 (15.0-17.2)
Black-backed Forktail	3	97 (92-100)	32.5 (31-34.5)	15.3 (14-17)	41.8 (41.5-42)	3.9 (3.8-4.0)	126.7 (121-130)	27.4 (26.2-29)
Slaty-backed Forktail	4	95.4 (94.5-99)	31.1 (30.5-32)	14.5 (14-15)	39.75 (39-40)	3.7 (3-4.5)	117 (114-124)	26.0 (25.3-27.3)

and between White-capped Water-Redstarts, were observed (Table 6). When two birds of the same species approached within 1-2 m of each other, then chases ensued. Where male and female Plumbeous Water-Redstarts occurred on the same stream, the aggressor was often the male, and the subordinate bird a young female. Male redstarts also sang against each other. One Little Forktail chased another of the species which was driven by the observer into the former's territory, whilst one of the pair of dippers on several occasions chased off a third dipper. In general intra-specific aggression appeared to be largely avoided through the spacing of birds along the watercourses.

Despite occasional aggression between species, the territories of two or more different species frequently coincided or overlapped. Most instances of inter-specific aggression related to a bird of a larger species chasing one of a smaller species (Table 6). Individuals of Plumbeous Water-Redstarts and of White-capped Water-Redstarts frequently perched within a few metres of each other, but closer encounters often resulted in a short aerial pursuit, with the latter flying after the former species. The large, dominant, White-capped

Table 6. Intra- and inter-specific interactions among six species of river bird in Nepal.

		SUBORDINATE						
		White-capped Water-Redstart	Plumbeous Water-Redstart	Grey Wagtail	Little Forktail	Slaty-backed Forktail	Black-backed Forktail	TOTAL
D O M I N A T E	White-capped Water-Redstart	7	11	-	1	1	1	21
	Plumbeous Water-Redstart	-	9	6	4	1	-	20
	Grey Wagtail	-	1(f)	-	-	-	-	1
	Little Forktail	-	-	-	2	-	-	2
	Slaty-backed Forktail	-	2(f)	-	-	-	-	2
	Black-backed Forktail	-	-	-	-	-	-	0

Water-Redstarts also chased Slaty-backed, Black-backed and Little Forktails. Despite the Plumbeous Water-Redstart's small size, it was a particularly aggressive species, sometimes chasing Slaty-backed Forktails, Little Forktails and Grey Wagtails when these birds were feeding 4-5 m away. On one occasion a Plumbeous Water-Redstart pursued a Little Forktail repeatedly until the forktail left the former's presumed territory. One Plumbeous Water-Redstart also chased off a Hodgson's Redstart *Phoenicurus hodgsoni* which was foraging close to the river bank, whilst a Blue Rock-Thrush behaved very aggressively towards a White-capped Water-Redstart, the latter bird then chasing away a Plumbeous Water-Redstart. No aggression was noted towards or by Spotted Forktails even though other species fed in close proximity.

DISCUSSION

Distribution

Most river birds that spend the spring and summer in the Himalaya are altitudinal migrants, moving down to the foothills or the terai in the autumn (Ali and Ripley 1983, Fleming *et al.* 1984, Inskipp and Inskipp 1991). During November and December those birds observed in the study areas were therefore already on their lower wintering grounds, with very few birds observed above 2,000 m (Table 2). The paucity of Brown Dippers wintering at high altitudes in the Langtang valley is perhaps strange, given frequent observations of this species above 2,500 m in Nepal in November and December (e.g. Mycock and Calladine *in litt.*, D. Pritchard *in litt.*). The Blue Whistling-Thrush at Kyangin Gompa at 3,750 m was of particular note. With the exception of Brown Dippers, which are known to breed during the

winter when at low altitudes (Fleming *et al.* 1984), and Spotted Forktails, river birds were not in obvious pairs during the winter study period.

Few White-capped or Plumbeous Water-Redstarts winter below 500 m (Inskipp and Inskipp 1991) and so the records of a single of the former and five of the latter species in Royal Chitwan National Park at c. 200-250 m are of interest.

Plumbeous Water-Redstarts were the most numerous species in the Likhu Khola catchment (Table 1, Figs. 3b and c) and the most widespread species generally on fast-flowing, rocky rivers (Table 2, Fig. 5). A difference in distribution of males and females was noted by Ali and Ripley (1983), who found that the females and young birds wintered at lower levels than adult males. This study provides little evidence of this, although at 600 - 1,450 m in the Likhu Khola (Figs. 3b and c), and on the Bagmati river at Sundarijal (Fig. 5), males outnumbered females, whilst four of the five redstarts seen in the Chitwan lowlands were females. The most marked difference between the distribution of sexes in this study was in their use of different habitats, with males abundant on the wider rivers, and females more numerous on the narrow, more wooded tributaries (Figs. 3b and c). By March most redstarts had left the Likhu Khola. In May both Plumbeous and White-capped Water-Redstarts are absent from the valley (R. Wyatt pers. comm.). If some Plumbeous Water-Redstarts breed early in the spring as did the pair at Dhikuri, is it possible that they breed again in their higher summering areas?

Of the forktails, only Black-backed occurred at very low altitudes, as recorded previously. At 800-1,000 m Black-backed and Slaty-backed were found in close proximity during the winter, as noted by Ali and Ripley (1983), sometimes also alongside Spotted or Little Forktails. Only these two latter species were seen at over 1,000 m. Whilst Inskipp and Inskipp (1991) noted that Grey Wagtails wintered mainly below 365 m, this study showed them to be widespread and not uncommon wintering birds at altitudes up to 1,500 m.

The limited data on the altitudinal distribution of kingfishers accord with those of other observers, with Stork-billed, Pied and Blue-eared Kingfishers being notably lowland species, and the others occurring over a wider range of altitudes. The two Blue-eared Kingfishers were caught in an area at Chitwan where this locally scarce species has previously been recorded (Gurung 1983).

It was not the intention of this study to investigate birds on rivers with low gradients. Data collected opportunistically did, however, show that species diversity tended to be higher on such rivers, particularly at low altitudes (Table 2).

Possible competition between species using the same general habitat has been discussed by various authors (e.g. Diamond 1978, Schoener 1982).

Generally it appears that competition is avoided between closely related species through differences in their use of the habitat, foraging behaviour and diet, which may be reflected in differences in bill size, tail length or other biometric features. Alternatively, an abundance of food may prevent competition (Schoener 1982). Interference or exploitation competition may occur amongst other less closely related species using the same habitat (Eadie and Keast 1980, Hurlbert *et al.* 1986).

On those upland rocky fast-flowing rivers in Nepal between 800-1,000 m, there is, in the winter months, a concentration of migrant and resident species of birds, all of which feed mainly on invertebrates. This study, albeit using data collected over a very short period, demonstrates some differences in the use of the river corridor by different species, in foraging methods, diet and biometrics (Tables 3-5), suggesting how competition between species may be avoided.

a) Segregation by body size and weight

Differences in the size of species, or in the size of their bills, suggest that they exploit a different range of food resources and hence avoid competition. Our biometric data for 11 species of river bird (Table 5) accord with those obtained by other authors (Biswas 1961, Diesselhorst 1968, Rand and Fleming 1957, Ripley 1950), and do show marked differences between most species. A few species closely resembled each other in size and weight e.g. Plumbeous Water-Redstart and Little Forktail; Brown Dipper and White-capped Water-Redstart (Table 5), but these species pairs did show differences in bill size and in their foraging methods. Thus the redstarts flycatched or picked prey from riparian habitats or dry rocks, whilst the dippers and forktails foraged in the water, from wetted rocks or the marginal zone. The long, stout bill of the Brown Dipper enables it to probe amongst rocks and stones on the river bed, whilst the long bills of the larger forktails may also enable them to probe in mud and turn over leaves and stones.

b) Segregation by habitat, foraging behaviour and diet

Brown Dippers and Little Forktails appeared to be largely dependent on large and small aquatic invertebrates respectively, from the river bed or on midriver rocks, with the former species obtaining prey by diving, swimming, wading or picking from rocks below the water surface, and the latter mainly by picking from the hygropetric area on wetted rocks. White-capped and Plumbeous Redstarts took numerous aerial stages of insects, of both aquatic and terrestrial origin, by flycatching. The White-capped Water Redstarts also spent much time feeding from marginal rocks and the riparian zone, whilst the three larger forktails foraged extensively in the marginal zone, often where there was thick streamside cover.

Fleming *et al.* (1984) noted that White-capped Water Redstarts often associate with Plumbeous Water-Redstarts. Whilst the two species commonly occurred together in this study, even perching on the same or adjacent rocks, they differed in the extent to which they used different parts of the river corridor. Ali and Ripley (1983) found that White-capped Water-Redstarts favoured wider rivers, avoiding the small rivulets favoured by Plumbeous Water-Redstarts. Whether this was during the breeding season or on the wintering areas is not clear. In this study the White-capped Water-Redstarts avoided those narrow, wooded tributaries where female Plumbeous Water-Redstarts predominated. There was no evidence, though, that the latter, particularly the males, actually favoured small rivulets, as they occurred at the highest densities on the 20-40 m wide Likhu Khola. Various authors have noted the territoriality of wintering Plumbeous Water-Redstarts and their aggression towards others of the same species, but Ali and Ripley (1983) regarded them as being tolerant of White-capped Water-Redstarts and forktails. Certainly in this study they were not aggressive towards the larger redstart, rather the reverse, but did chase Little Forktails and other species within their territory (Table 6).

Whilst few data were collected on forktails during this study, it was evident that Little Forktails occurred on fast-flowing, turbulent stretches of river with spray-drenched rocks or waterfalls. Stream width appeared unimportant, with birds recorded on watercourses from only 6 m in width to 40 m, although Ali and Ripley (1983) noted that, in the winter, wider rivers were used by this species than in the summer. Ali and Ripley and Fleming *et al.* (1984) also recorded the three larger species, particularly Spotted, as essentially birds of small forest streams. Observations from this study confirmed this, although it is of note that a pair of Spotted Forktails were observed on five days foraging for long periods on a large shoal on a 40 m wide, almost treeless section of the Likhu Khola. All three species were generally found in the marginal zone where there was overhanging vegetation or thick riparian cover into which they could fly when disturbed.

Implications for river birds of land use changes

Removal of bankside cover is likely to be detrimental to a number of species of river bird, notably the three larger species of forktail, Plumbeous Water-Redstarts and Blue Whistling-Thrushes. All these species use riparian trees and shrubs for shelter and for food. The three larger forktails in particular, and Plumbeous Water-Redstarts frequently take refuge from potential predators in trees, shrubs and undergrowth; leaf litter in the riparian zone is also a favoured feeding area for all the long-tailed forktails, whilst the contribution of leaves and insects falling from bankside vegetation into the water is important for many invertebrates and hence fish. The contribution

of insects and berries from vegetation in the diet of Plumbeous Water-Redstarts (and probably White-capped Water-Redstarts and Blue Whistling-Thrushes) may be important at some times of the year and should be further evaluated. Ali and Ripley (1983) mention berries in the diet of both White-capped and Plumbeous Redstarts, although refer to them as only occasionally taken by the last species. In the Likhu Khola, female Plumbeous Water-Redstarts were seen taking berries on at least ten occasions.

Brown Dippers were few in the Likhu Khola, being found only on the main river and on the Syaiping Khola, where there was a good flow of water. Impacts on the tributaries through removal of bankside and hillside cover, cultivation of hillsides and diversion of the water from the streams for irrigation has made them unsuitable for birds which depend on large aquatic benthic invertebrates. The results of invertebrate sampling in the tributaries by the Catchment Group of the University of Wales College of Cardiff will be reported elsewhere, but preliminary results show that streams in areas of agriculture have much more sand on their beds than streams in forest, and differences in the aquatic insect community are also pronounced, caddis larvae and mayfly nymphs being scarce in streams with thick sandy sediment (Rundle, Jenkins and Ormerod in prep.). During the survey period, work by local farmers on the irrigation channels frequently resulted in very high sediment loads in the water in the tributaries. The turbidity in the water must also affect the ability of dippers to see and catch prey.

Pollution was not a major ecological problem on the rivers studied, other than on the lower Bagmati, which had a high input of sewage, as well as of other pollutants from domestic and industrial sources in Kathmandu. Here large aquatic invertebrates were absent but there were very high densities of small invertebrates (midge larvae). Species of birds, notably dippers, dependent on invertebrate groups such as caddis were absent from the lower Bagmati, but birds such as wagtails and sandpipers which could take advantage of the dense food supply in the mud, occurred at higher densities here than at any other observed stretch of river with similar gradient e.g. the stretch below Sundarjal. There was also a good diversity of, mainly migrant, species on the lower Bagmati, as recorded previously by Inskipp (1988) and others. Such high diversity and density of birds has been noted on other organically polluted rivers, as in Addis Ababa in Ethiopia (Tyler in press). The degree of pollution of rivers in the Middle Hills from human faeces, pesticides and fertiliser inputs is unknown, but is almost certainly considerable.

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APPENDIX 1
DESCRIPTION OF THE LIKHU KHOLA AND TRIBUTARIES

Dee Khola - open, very few alders, little riparian vegetation - either grazed, cut or cultivated to edge; some steep rocky dry hillsides with stunted scrub/tree growth; side tributaries with narrow strip of alder carr. Many irrigation channels diverting water from stream and much sandy sediment on stream bed. Large boulders in stream, but only two or three small (1 m high) waterfalls. South-facing.

Mahadev Khola - similar to Dee but riparian vegetation in patches by wooded sections and narrow gorge with cliffs and waterfalls up to 4 m high, for 300-400 m. Lower section with many rocks and stones. Wetted area reduced to trickle through irrigation diversions; much sediment and very turbid water. Hillside erosion in upper reaches. Channel width in lower section c. 10-15 m but stream reduced to 5-8 m. Gorge only 6-8 m wide. South-facing.

Bore Khola - narrow stream mainly with steep banks with shrubs and trees overhanging much of stream; and adjacent Sal forest in patches. Elsewhere rice fields. Rocks and boulders abundant but no true waterfalls. Many irrigation channels and much sediment on stream bed. Highest section more open. North-facing.

Syalping - broadest (20 m) of tributaries surveyed with good flow. Steep banks, many with fringe of trees and shrubs; some waterfalls; numerous rocks and boulders. North-facing.

Ghyambe Khola - a tributary of the Syalping - through woodland for much of survey stretch; meandering and rocky, narrow 4-6 m. More open in upper stretch.

Bhondare and Jogi - two narrow subtributaries, 2-8 m in width; the lower part of the Jogi through cultivation; little bankside cover; series of high rocky waterfalls at upper end of stretch surveyed; the Bhondare through cultivation too but in a narrow rocky channel with thick vegetation on streambanks; cliffs and waterfalls; a small trickle only in upper section

Likhu Khola - Upper 2 km surveyed rocky, open fast-flowing, 20-40 m wide; mainly 1 m depth; many shoals, riffles, some deep pools with riverside cliffs. Little riparian vegetation except odd patches and degraded forest along one bank for 500 m below the Syalping confluence. Alluvial terraces cultivated up to river edge. Much disturbance by local people and stock. Two bridges across the river and easily fordable elsewhere. Lower section in broad open valley, extensive shoals and river much braided, channel up to 500 m across. Gradient reduced cf. upper section.

Winter records of the Manchurian Reed-Warbler *Acrocephalus (agricola)* *tangorum* from Thailand

PHILIP D. ROUND

Non-breeding season records of the Manchurian Reed-Warbler *Acrocephalus (agricola) tangorum* are reported from Thailand. These are the only observations of this taxon away from north-east China and Amurland, Russia where it both breeds and has been recorded on passage. *A. tangorum* shows some distinct differences from nominate *A. a. agricola* and its taxonomic and conservation status should be examined anew, particularly as it may be severely threatened by habitat destruction in its Thai winter quarters.

INTRODUCTION

The Manchurian Reed-Warbler *Acrocephalus (agricola) tangorum* is a little known taxon which breeds in in both Heilongjiang province and the Nei Mongkol Autonomous Region in north-east China (Cheng 1987, Alström *et al.* 1991) and in Russian Amurland (Shibnev and Gluschenko 1977, Stepanjan 1978, Gluschenko 1989). It has also been recorded on passage, in the western part of Chaoyang, Liaoning Province (Cheng 1987) and at Qinhuangdao, Hebei Province from which it was first described (La Touche 1912). Kennerley and Leader (1992), Williams *et al.* (1992) and Williams and Hsu (1992) have recently detailed a number of sightings of migrant *tangorum* at the nearby sites of Beidaihe and Daihe in both spring and autumn.

This paper documents the first records of *tangorum* away from north-east Asia, in its presumed winter quarters in Thailand.

THE FIND

The author, together with Dr Boonsong Lekagul, was netting migrant passerines in a freshwater marsh at Khao Sam Roi Yot, Prachuap Khiri Khan Province, south-western Thailand (12°10'N 99°54'E) on 6 May 1981, when he noticed an unusually rufous warbler with only a slight blackish brow among a number of Black-browed Reed-Warblers *A. bistrigiceps* trapped. This was immediately recognised as being similar to a skin labelled *A. agricola* which the author had previously examined at the Centre for Thai Reference Collections, Thailand Institute of Scientific and Technological Research, Bangkok. That specimen (number 53-2875), a first autumn female, had