SOME OBSERVATIONS ON THE WINTER DISTRIBUTION OF THE NEW ZEALAND KINGFISHER

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ABSTRACT

A census of kingfishers was taken between the Waikato district and the Canterbury Plains and linear density calculated by a new method. Kingfisher density declined progressively to the south, where birds were especially concentrated at lower elevations. They preferred open pasture habitat created by man. Contrary to established notions, the kingfisher may be at least partially migratory in New Zealand.

INTRODUCTION

The Sacred Kingfisher *(Halcyon sancta)* is widespread in the Australasian region. The various subspecies apparently differ in the patterns of seasonal distributions, some being migratory, others not. In this study we contribute to the knowledge of the species' habitat, winter movements, and range in New Zealand.

The Australian subspecies, *H. s. sancta* breeds throughout most of the wetter portions of the continent (Keast 1957). At least the southern populations migrate in the autumn to northern Australia, and as far north as Borneo, Sumatra, New Guinea, and the Solomon Islands (Stresemann 1914). A few individuals on the east coast winter as far south as Sydney (Hindwood & McGill 1958). Frith (1969) suggested that the entire Australian population may be migratory. Through colonization, the species has established additional subspecies to the east of Australia, one each on Norfolk Island, Lord Howe Island, New Caledonia, and the Loyalty Islands, as well as New Zealand and its offshore islands (Peters 1945). These subspecies are not thought to be migratory, although Guthrie-Smith (1910) and Oliver (1930) noted apparent altitudinal migration in the New Zealand subspecies *(H. s. vagans)*. Taylor (1966), in the Nelson region of the South Island, observed that at altitudes above 120 m birds were abundant only during the spring breeding season. Below 120 m, nearer the coast, he found birds in approximately equal numbers throughout the year. Stead (1932) even suggested that regular movements may take place between the North and South Islands, although he did not state the basis for this impression.

In New Zealand, the species has adapted with alacrity since the European discovery to man-made habitats such as pastures. As Taylor (1966) noted, it is easily censused because of its conspicuousness on exposed perches.

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In this study we attempt to document the winter distribution of the New Zealand race over a broad latitudinal range, comparing its behaviour with that of other subspecies.

METHODS

Between 21 June and 12 July 1975 we surveyed the abundance of kingfishers in eleven geographic regions from the Waikato district in the North Island to Christchurch in the South Island (Fig. 1). We defined these regions by what we considered to be important geographical features. For our entire journey through these regions,

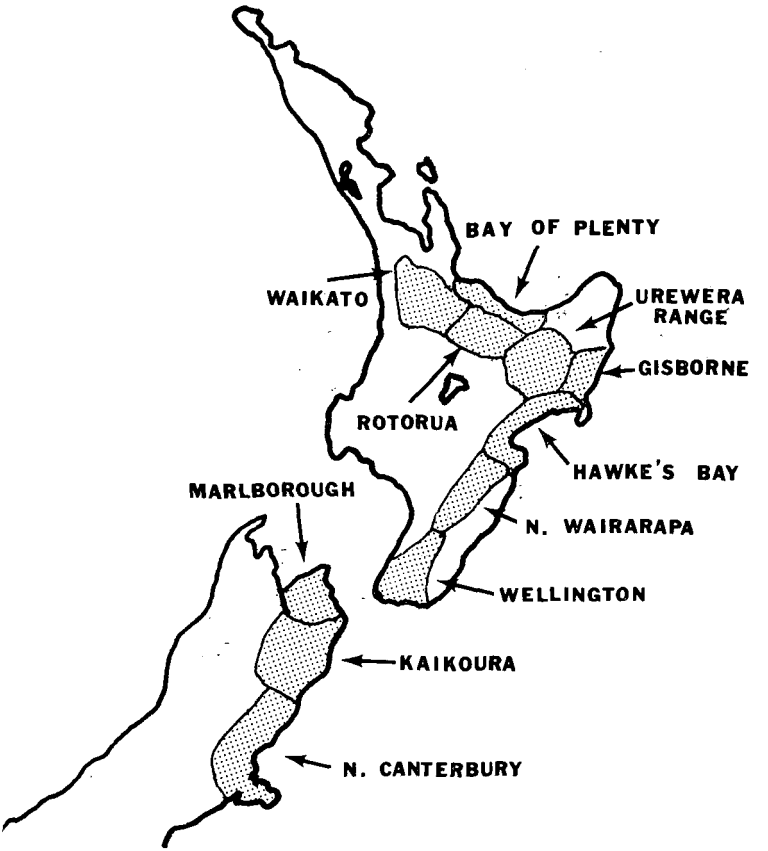

FIGURE 1 — Regions of census on North and South Islands.

covering 70 km on foot and 1932 km by automobile, we recorded the time spent, the kilometres covered, and our velocity in the various habitats. These habitat types were defined as:

Forest. 70-100% cover by woody vegetation taller than 3 m.
Shrub. 70-100% cover by woody vegetation less than 3 m tall.
Open Forest; Open Shrub. 30-70% cover by either trees or shrubs, the remainder usually pasture, occasionally marsh.
Sparse Forest; Sparse Shrub. 5-30% cover by either trees or shrubs.
Without Woody Vegetation. Less than 5% cover by woody vegetation. This was mostly dry pasture, occasionally wet pasture or marsh.
Coastal. Areas in close association with salt water.
Suburbs. Residential areas with much vegetation as well as buildings. Heavily urbanized areas were excluded from the survey.

The data recorded for each of the more than 300 perching kingfishers seen included habitat, perch site, and our speed of travel. Perch sites were classified as over or in trees or shrubs, over pasture or over open water.

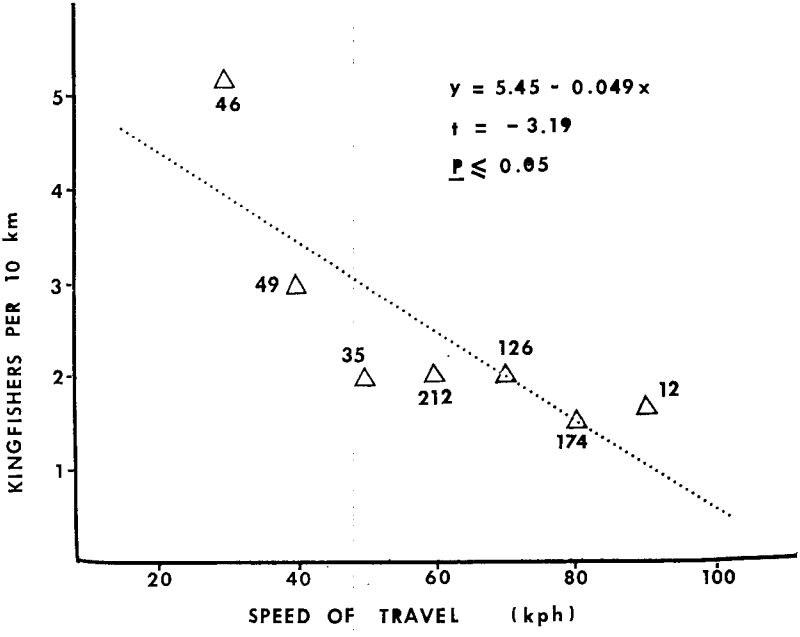

FIGURE 2 — Number of kingfishers observed per 10 km, Hawke's Bay and north. All observations are in areas containing some pasture. Number of km travelled at each speed is shown.

Since the number of kingfishers seen could depend on the speed of the observer, we devised a method to correct for observer speed. Using our data from the regions north of and including Hawke's Bay, we calculated a linear relationship between observer speed and number of kingfishers seen (Fig. 2). We limited this calculation to the northern regions to avoid confusion with geographic variations in abundance, and we excluded " Forest " and " Suburb " habitat types to avoid potential visibility problems in these habitats. Too few

Table 1 - Correction factor for number of kingfishers observed relative to the speed of travel

Speed (kph)	Correction factor
0	1.0000
2	1.0183
20	1.2193
30	1.3694
40	1.5617
50	1.8168
60	2.1715
70	2.6984
80	3.5628
90	5.2420

Table 2a - Number of kingfishers observed, Hawke's Bay and north of Hawke's Bay

Habitat types	Regions																				
	Waikato			Rotorua			Bay of Plenty			Urewera Range			Gisborne			Hawke's Bay			Total		
	No.[1]	km[2]	Cor.[3]	No.	km	Cor.	No.	km	Cor.	No.	km	Cor.	No.	km	Cor.	No.	km	Cor.	No.	km	Cor.
Forest				3	58	0.71				0	9	0.00	0	22	0.00	1	4	5.43	4	93	0.68
Shrub				3	11	3.98	4	34	2.55				1	2	17.81	1	1	0.00	8	48	3.46
Open forest	4	2	23.12	5	28	1.94				1	33	0.55	11	22	6.54	2	22	2.20	23	107	2.91
Open shrub	4	2	11.56	2	1	26.58				1	18	1.01	2	27	1.58	5	29	3.74	14	77	2.84
Sparse forest	3	25	1.30	2	18	1.35	3	2	15.27				65	109	11.81	29	99	6.63	102	253	8.03
Sparse shrub	1	1	18.17	8	6	17.14	16	56	6.70	9	33	5.95	12	32	8.45	0	4	0.00	46	132	7.30
No woody vegetation				3	2	21.50	14	13	22.59				12	15	21.59	5	10	10.85	34	40	19.23
Coastal							2	10	4.56							1	1	14.55	3	11	5.47
Suburbs	1	26	1.37				1	14	1.30				5	21	2.46	1	24	1.48	8	85	1.66
Total	13	56		26	124		40	129		11	93		108	250		44	194				
Corrected[4]			2.78			2.71			6.59			2.50			8.62			5.12			
Not corrected[4]			2.32			2.10			3.10			1.18			4.32			2.27			

1/ Number seen in each region/habitat type.

2/ Number of kilometres traveled in each region/habitat type.

3/ Number seen per 10 km, corrected for speed of travel (see text for details).

4/ #/10 km, not corrected for speed of travels.

Table 2b - Number of kingfishers observed, south of Hawke's Bay

Habitat types	Regions																	
	N. Wairarapa			Wellington			Marlborough			Kaikoura			N. Canterbury			Total		
	No.[1]	km [2]	Cor. [3]	No.	km	Cor.	No.	km	Cor.	No.	km	Cor.	No.	km	Cor.	No.	km	Cor.
Forest				0	24	0.00	1	14	0.81	0	7	0.00				1	45	0.25
Shrub				0	27	0.00	1	4	4.13	0	20	0.00				1	51	0.32
Open forest	1	30	0.89	0	19	0.00	2	34	1.58	4	74	1.39	0	42	0.00	7	199	0.92
Open shrub				0	37	0.00	2	82	0.76	3	61	1.29	0	6	0.00	5	186	0.76
Sparse forest	7	132	0.38	2	38	1.35	2	49	1.10	1	115	0.31	5	117	0.74	17	451	0.62
Sparse shrub				0	4	0.00	1	8	3.37				0	3	0.00	1	15	1.80
No woody vegetation				0	1	0.00	10	67	5.32				2	49	0.44	12	117	3.23
Coastal				19	23	12.50	1	2	5.09	5	6	8.49				25	31	11.25
Suburbs	0	15	0.00	1	16	0.98	0	12	0.00	0	7	0.00	0	16	0.00	1	66	0.24
Total	8	177		22	189		20	272		13	290		7	233				
Corrected[4]			0.43			1.88			2.17			0.92			0.46			
Not corrected[4]			0.45			1.16			0.74			0.45			0.30			

1/ Number seen in each region/habitat type.

2/ Number of kilometres traveled in each region/habitat type.

3/ Number seen per 10 km, corrected for speed of travel (see text for details).

4/ #/10 km, not corrected for speed of travels.

observations were made below 25 kph to include them in this calculation. The number of kingfishers seen at 0 kph, found by extrapolating this line, is an estimate of the average number per 10 km for these habitats in these regions. More important for our calculations, the ratio of the value of the line at a particular speed to this value at 0 kph (the y-intercept), tells what fraction of the estimated actual population an observer sees at that speed. By multiplying our observed kingfisher densities by the inverse of this fraction (Table 1), we arrived at the estimated actual population, corrected for speed.

After correcting the observations for speed of travel, we summed them and divided by the distance travelled, giving the mean linear density of kingfishers for each habitat within each region (Table 2). Similarly, average densities for a given habitat (rows in Table 2) or region (columns in Table 2) were calculated by summing the speed-corrected numbers and dividing by the total distance travelled in that habitat or region.

Statistical tests were taken from Sokal & Rohlf (1969). They included the significance of linear correlation by the least squares method (p. 420 ff.), and of differences between proportions, using an arcsine transformation (p. 607 ff.).

RESULTS

Kingfisher densities declined as the latitude increased (Fig. 3). The highest densities were recorded in the Bay of Plenty, Gisborne and Hawke's Bay regions, and fewest in the Kaikoura and Canterbury Plains regions. A linear correlation of these data was significant ($P < 0.025$), although scattered ($r = 0.470$). A calculation without the correction for observer speed was similar in distribution and scatter ($r = 0.533$), and also significant ($P < 0.025$).

These data show the effect of altitude and distance from the coast. Waikato, Rotorua, Urewera Range, and N. Wairarapa are inland regions, partly above 200 m, and they fall below the regression line in Figure 3. The greatest concentration of kingfishers we encountered was 15 km inland from Gisborne at about 50 m elevation where, in one six km section of road, we sighted 35 kingfishers.

To incorporate Taylor's (1966) censuses from the Nelson area, we calculated his totals for altitudes above and below 120 m altitude and corrected these for speed (Table 3). His winter populations are slightly lower than our figures (Fig. 3), possibly because Taylor apparently observed alone. Note also the marked increase of kingfishers in the spring at higher elevations to levels we found during the winter only in the coastal areas of the North Island.

In general, we found the kingfishers preferred the more open habitats. By comparing the distribution of habitats available with the distribution of kingfishers among those habitats, we found that as the ground cover of woody vegetation increased, the number of

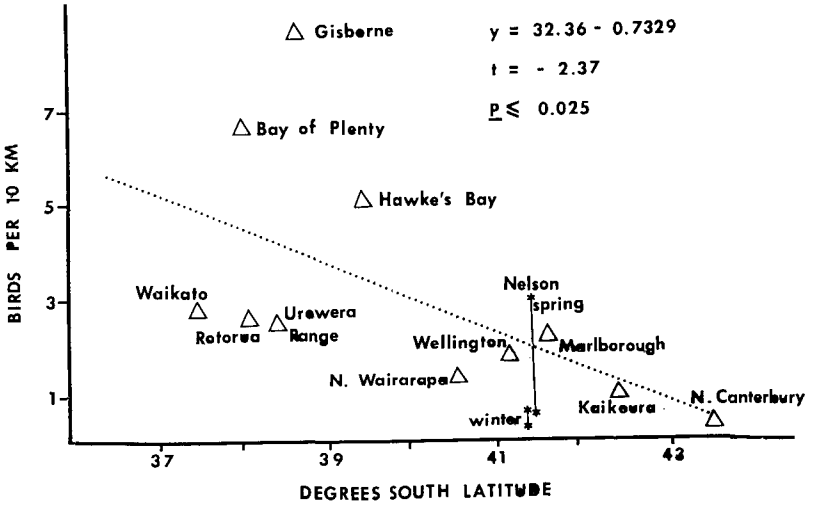

FIGURE 3 — Total number of kingfishers seen per 10 km in each geographical area plotted by latitude of centre of region. Taylor's (1966) data from Nelson are indicated by asterisks (*); the high elevation data from each season are above that of the low elevation observations.

kingfishers declined. The relative heights of the columns in Figure 4 show that this is most noticeable in the northern regions. This relation held for most habitat types whether the woody vegetation was trees or shrubs.

To determine if this decline was due to reduced visibility where trees were more abundant, we compared the kingfishers' perch sites in habitats having less than 5% trees with those having more than 5% trees. We found that, despite greater numbers of trees, impairing visibility, the percentage of birds we saw perched in trees, as opposed to more exposed (and visible) perches, differed by less than 3% (Table 4), not a significant difference ($P < 0.10$).

When data were combined for all habitats, the vast majority (89.8%) of birds were perched on fence posts and overhead wires. These sites were usually (94.0%) over areas clear of woody plants. This reflects the bird's visual, sit-and-wait hunting methods. South of Hawke's Bay 27.9% of the birds seen were perched over water, while to the north, far fewer (4.5%) used this habitat. This difference was very significant ($P < 0.001$).

DISCUSSION

We found most wintering kingfishers in one of two habitats. One was pastures, where the birds perched on fences or power and

Table 3 - Seasonal distribution of kingfishers in the Nelson region (recalculated from Taylor 1966)

Altitude		May-July	Sept-Nov
0 - 120 m	km traveled	458	631
	Number observed	14	15
	Corrected #/10 km *	0.66	0.52
120 - 460 m	km traveled	946	1366
	Number observed	14	151
	Corrected #/10 km *	0.34	3.10

* Data were corrected for speed of observer using an average speed of 60 kph.

Table 4 - Type of perch site of kingfishers and percent ( ) of total

	On trees	Isolated perches	Total
Habitat with less than 5% trees	13 (8.8)	135 (91.2)	148 (100.0)
Habitat with greater than 5% trees	18 (11.6)	137 (88.4)	155 (100.0)
Total	31 (10.2)	272 (89.8)	303 (100.0)

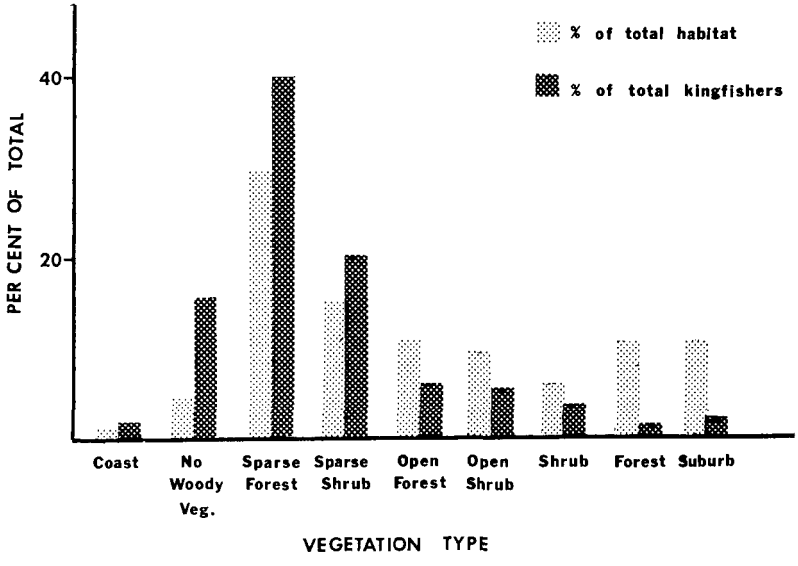

FIGURE 4 a — Comparison of percent available habitat and percent utilization by kingfishers, Hawke's Bay and north. Percent of total kingfishers data are corrected for speed.

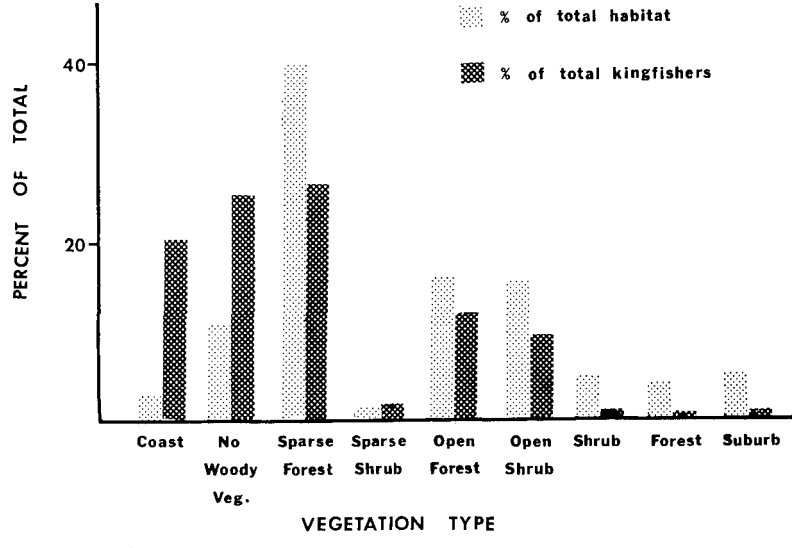

FIGURE 4 b — Comparison of percent available habitat and percent utilization by kingfishers, south of Hawke's Bay. Percent of total kingfishers data are corrected for speed.

telephone lines. Undoubtedly, kingfisher populations have benefited greatly from man's clearing the forests and erecting these structures. The second important habitat, especially in the south, was the coastal area. Hindwood & McGill (1958) noted the kingfisher's dependency on open water in Australia, where the few birds remaining near Sydney in winter were ". . . generally in mangroves . . . though at times they are also to be seen about the borders of tree-lined lagoons." Coastal regions may be preferred because of the more reliable food supply associated with open, shallow water, the more moderate climate, or both.

Sacred Kingfishers rarely winter as far south in Australia as they do in New Zealand. Confirming this, we encountered none in over 1000 km traversed between Sydney and Melbourne, 12-18 July 1975, including extensive field observations near Yarrawonga on the Murray River. The generally maritime climate of New Zealand may be enough milder than the Australian winter at similar latitudes to allow kingfishers to winter much farther south. On the other hand, the persistence of even reduced numbers of wintering kingfishers at higher altitudes in New Zealand, such as Taylor (1966) found above Nelson, suggests the New Zealand race may be hardier.

Hardy or not, the kingfisher can perform major movements between wintering and breeding grounds. In Australia this is a clear north-south migration. In New Zealand Taylor (1966) documented an altitudinal shift in population distribution. Although he did not mention it, his data also suggest a north-south movement of birds. While his low altitude population remains at 14-15 birds per 10 km through both seasons, the high altitude population increases tenfold in the summer. It is unlikely that all these incoming birds came from the nearby lowlands. They may have come from more northern centres of winter populations, such as we found in northern North Island.

It is interesting to speculate if Lesson (1826) had this in mind when he described the kingfisher in New Zealand as the Wandering Kingfisher (Fr: martin-pecheur errant) and gave it the specific name *vagans.*

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LITERATURE CITED

FRITH, H. J. 1969. Birds in the Australian High Country. Sydney: A. H. & A. W. Reed.
GUTHRIE-SMITH, H. 1910. Birds of the Water, Wood and Waste. Wellington: Whitcombe & Tombs.
HINDWOOD, K. A.; McGILL, A. R. 1958. The Birds of Sydney. Sydney: Royal Zool. Soc. of NSW.
KEAST, A. 1957. Variation in the Australian Kingfishers (Aves: Alcedinidae) Rec. Aust. Mus. 24: 61-72.
LESSON, R. P. 1826 (1830). Voyage autour du monde, sur la corvette, **La Coquille.** Vol. 5, Zoologie, 1: 694-696. Paris: Arthus Bertrand.
OLIVER, W. R. B. 1930. New Zealand Birds. Wellington: Fine Arts (N.Z.) Ltd.
PETERS, J. L. 1945. Check-list of Birds of the World. Vol. V. Cambridge: Harvard Univ. Press.
SOKAL, R. R.; ROHLF, F. J. 1969. Biometry. San Francisco: W. H. Freeman and Co.
STEAD, E. F. 1932. The Life Histories of New Zealand Birds. London: Search Publishing Co.
STRESEMANN, E. 1914. Die Vogel von Seram (Ceram). Nov. Zool. 21: 25-153.
TAYLOR, R. H. 1966. Seasonal and Altitudinal Distribution of Kingfishers in the Nelson District. Notornis 13: 200-203.

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