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STUDIES OF WATERFOWL (ANATIDAE) IN NORTH QUEENSLAND. 4. MOVEMENTS

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SUMMARY

Movement patterns of the 15 species of waterfowl occurring in north Queensland during 1959-1963 were determined from population fluctuations observed by regular counting, particularly in the Bohle River and Ross River basins, from band recoveries, and from more general widespread observations.

Species of the coastal plains, mainly magpie goose (*Anseranas semipalmata* (Latham)), grass whistling-duck (*Dendrocygna eytoni* (Eyton)), water whistling-duck (*Dendrocygna arcuata australis* Reichenbach), black duck (*Anas superciliosa rogersi* Mathews) and Australian pygmy goose (*Nettapus coromandelianus albipennis* Gould), moved annually from shallow-water to deep-water habitat, often nearby. Species of the inland, as examples grey teal (*Anas gibberifrons gracilis* Buller), white-eyed duck (*Aythya australis* (Eyton)), maned wood duck (*Chenonetta jubata* (Latham)) and other black ducks, also moved, as evaporation proceeded, from shallow-waters to more permanent habitat mostly distributed on the distant coastal plains.

The seasonal and permanent habitat types used were characteristically distributed for each of these species. Under the regular seasonal climatic conditions in north Queensland, movements between the types also were regular. Proximate factors that initiated the movements are as yet undefined.

Vagrant birds (e.g. populations of black duck) invaded north Queensland from time to time; these flocks were readily distinguished by large size, irregular occurrence and use of mostly different habitat.

I. INTRODUCTION

There is little published information on the movements of tropical Australian waterfowl except magpie geese (*Anseranas semipalmata* (Latham)) in Northern Territory. The present work describes and compares the broad movement patterns of those species occurring in north Queensland, especially in the Townsville Study Region (see Lavery 1966*a*), during 1959-1963.

II. METHODS

From January 1959 to December 1963, fortnightly counts of the non-vagrant species—i.e. magpie goose, grass whistling-duck (*Dendrocygna eytoni* (Eyton)), water whistling-duck (*Dendrocygna arcuata australis* Reichenbach), radjah shelduck (*Tadorna radjah rufitergum* Hartert), black duck (*Anas superciliosa rogersi* Mathews), grey teal (*Anas gibberifrons gracilis* Buller), pink-eared duck (*Malacorhynchus membranaceus* (Latham)), white-eyed duck (*Aythya australis* (Eyton)), maned wood duck (*Chenonetta jubata* (Latham)), green pygmy goose (*Nettapus pulchellus* Gould) and Australian pygmy goose (*Nettapus*

coromandelianus albipennis Gould) and the common vagrant species, black swan (*Cygnus atratus* (Latham)), in north Queensland were made at waterfowl habitat in the Bohle River and Ross River basins (Figure 1) as follows:

1. Belgian Gardens Town Common; swamp of optimum area 150 acres dominated by sedges (*Eleocharis* species) in the shallow water and waterlilies (*Nymphaea* species) in the few deeper areas. (This area was drained and consequently abandoned by waterfowl from July 1961.)
2. Cape Pallarenda Town Common; swamp of approximately 500 acres, some two-thirds of which dominated by bulkuru sedge (*Eleocharis dulcis* (Burm. f.) Trin.).
3. Thornley Park, near Garbutt; swamp of 180 acres of mixed wetland vegetation with some adjacent grassland habitat.
4. Mt. St. John; impoundment of approximately 200 acres of permanent lagoon habitat with adjacent grassland.
5. West Mt. St. John; impoundment of 150 acres of mixed swampland vegetation.
6. Upper Ross River; some 100 acres of river habitat with adjoining creeks during and immediately following the wet season, i.e. from November to about June.
7. Gleeson's Weir, Ross River; impoundment of 30 acres of river habitat.
8. Applin's Weir, Ross River; impoundment of 65 acres of river habitat.
9. Oonoonba lagoons; three lagoons totalling 25 acres in area with adjacent meadow habitat during the wet season, i.e. November-April.
10. Lower Ross River; tidal flats of approximately 50 acres with adjoining bay, saltpan and other tidal flat habitat.

These were all the major waterfowl areas in the district; the relative extent of habitat types was approximately that for north Queensland as a whole. The seasonal rainfall pattern in the district was typical of all north Queensland and broadly was greater in annual amount than elsewhere (Table 1).

TABLE 1

MEAN ANNUAL RAINFALL IN THE 12 CLIMATIC DISTRICTS OF NORTH QUEENSLAND*

District	Approximate Mean Annual Rainfall (in.)
Peninsula North	57
Peninsula South	38
Carpentaria Lower	24
Carpentaria Upper	25
North Coast Barron	62
North Coast Herbert [1,2]	73
Central Coast East [2]	39
Central Coast West [2]	25
Central Highlands	24
Central Lowlands	19
Western Upper	14
Western Lower	10

* From *Annual Rainfall Australia* 1966, 1967 (Commonwealth Bureau of Meteorology, Melbourne).

[1] Including Bohle River–Ross River basins.

[2] Including Townsville Study Region.

Counts were made with binoculars during midday hours when birds were static and flights of even small flocks were uncommon. During the wet (breeding) season, when much habitat was inaccessible and birds were secretive, counts of all species except colonial magpie goose and black swan were unreliable and records of presence or absence were considered most important. Population sizes were compared with those from estimates made by counting during regular surveys throughout the Townsville Study Region; despite limited facilities, accuracy of these estimates increased with experience. Surveys of waterfowl numbers and habitat distribution were made from time to time in other districts of north Queensland.

Movements of birds within one district, among habitat types throughout the Townsville Study Region, and between this Region and other parts of north Queensland and elsewhere, were confirmed by recoveries from 1,495 birds of 10 species that were trapped using wire traps, cannon nets and hand nets and

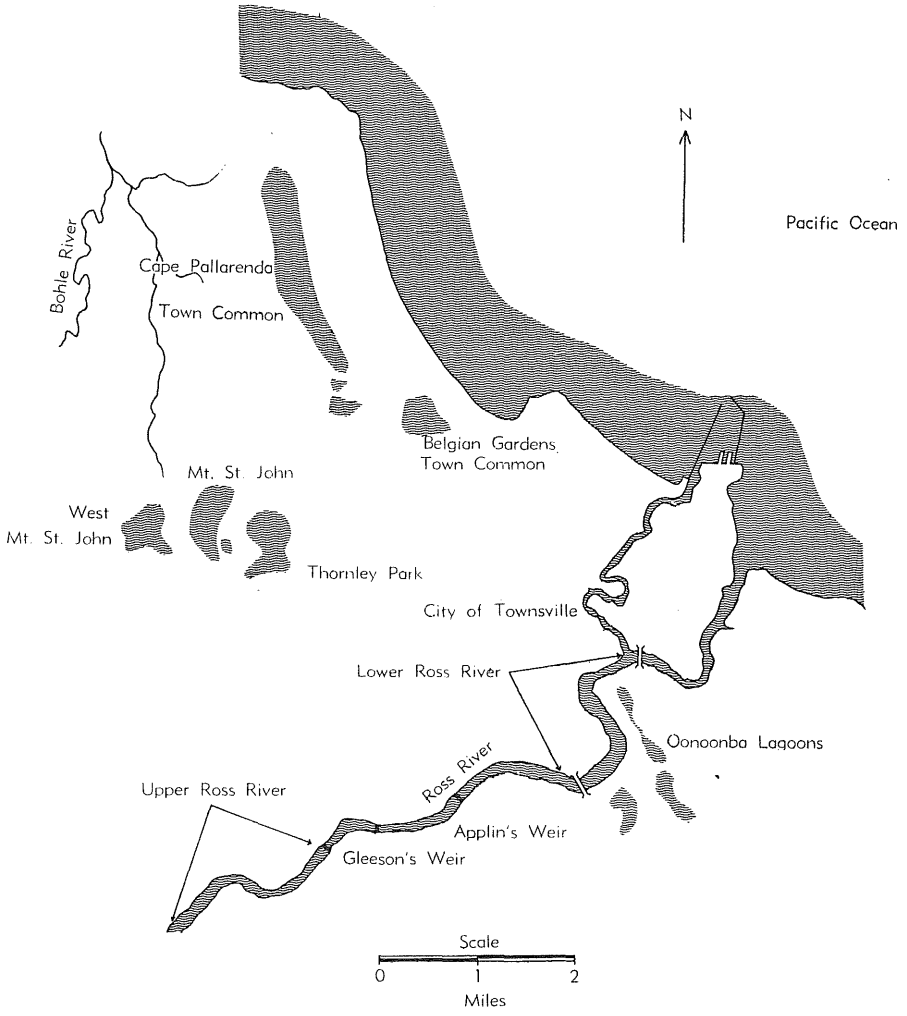

Fig. 1.—Bohle River and Ross River basins, Q., showing waterfowl habitat localities regularly visited.

banded with numbered aluminium leg bands and occasionally colour-strap neck bands. Banding results were of limited application because of localized distribution in time and place of the relatively little shooting that provided most recoveries (see Lavery 1969); in any event, banding of large numbers of birds of known history throughout north Queensland was impracticable. Banding/recovery data are presented as place of banding (banding date) to recovery locality (recovery date).

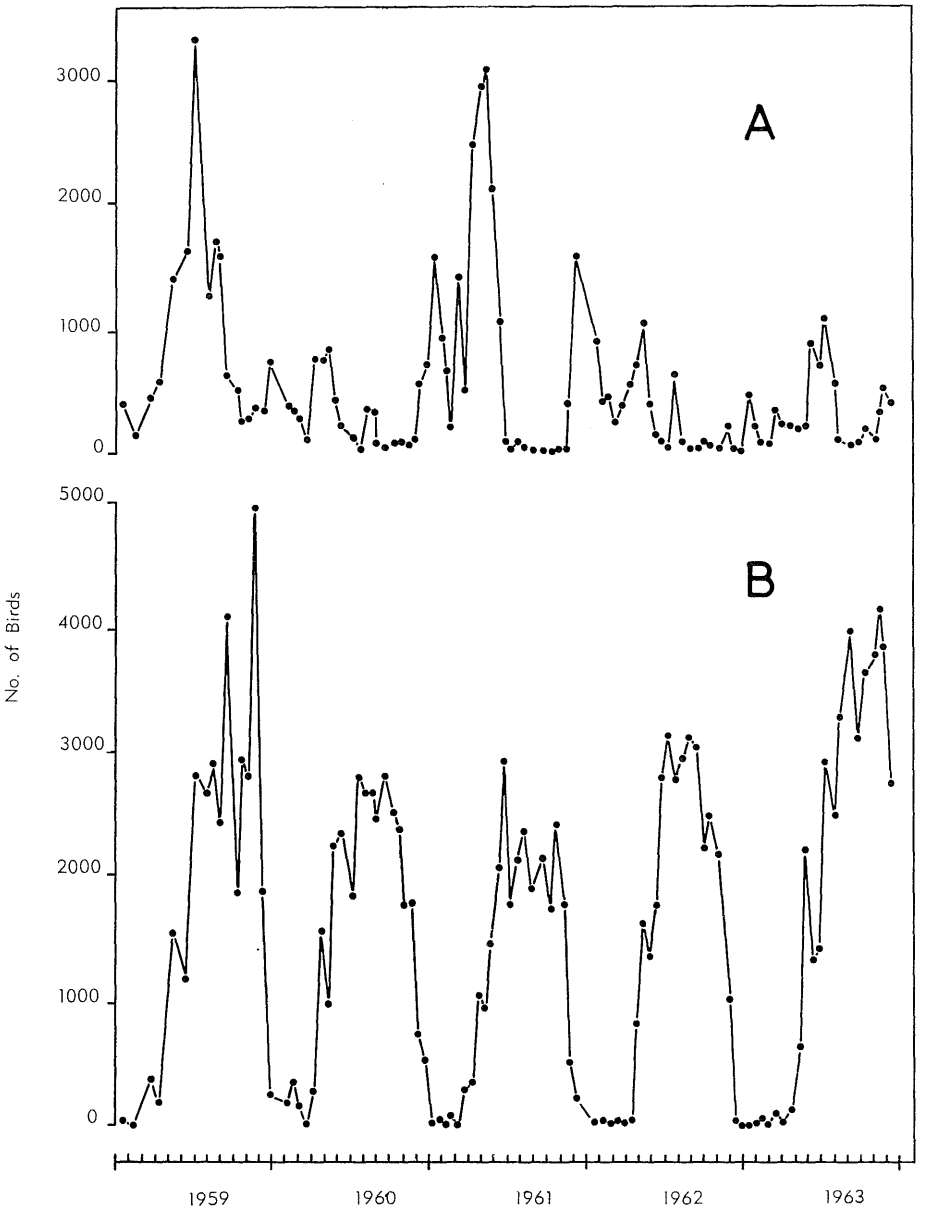

Fig. 2.—Numbers of magpie geese (A) and grass whistling-ducks (B) present each fortnight, January 1959 to December 1963, in the Bohle River-Ross River basins, Q.

III. RESULTS

Numbers of magpie geese, grass whistling-ducks, water whistling-ducks, black swans, black ducks, grey teal, pink-eared ducks, white-eyed ducks, maned wood ducks, green pygmy geese and Australian pygmy geese counted in the Bohle River-Ross River basins during 1959-1963 are given in Figures 2–4. Two radjah shelducks were observed at Mt. St. John in March 1963. Water whistling-ducks and black ducks were widespread in the district during each wet season.

Numbers of magpie geese, water whistling ducks, black ducks and grey teal counted at different habitat types within the two river basins during the same period are shown in Figures 5–7. Movements of banded birds amongst habitat types are illustrated by recoveries listed in Table 2.

TABLE 2

MOVEMENTS OF BANDED BIRDS AMONGST HABITAT TYPES IN NORTH QUEENSLAND WITHIN ONE YEAR, 1959–1963

Species	No. of Movements Between Habitat Types				
	Swamp→ River	Swamp→ Lagoon	Lagoon→ Lagoon	Lagoon→ Swamp	Lagoon→ Grassland
Magpie goose	..	..	1	..	..
Grass whistling-duck ..	..	..	1*	6*	1*
Water whistling-duck ..	..	..	1	..	..
Black swan	2	2	..	..	..
Black duck	1	16	4	1*	..
Grey teal	..	..	2	..	..

* Temporary foraging movement only.

The distribution of band recoveries during 1958-1967 following banding in north Queensland in 1958–1962 is given in Table 3. Figure 8 shows places of recovery of banded birds outside north Queensland.

TABLE 3

DISTRIBUTION OF RECOVERIES 1958–1967 FOLLOWING BANDING OF WATERFOWL IN NORTH QUEENSLAND 1958–1962

Species	No. of Birds Banded	No. of Birds Recovered in Year of Banding			No. of Birds Recovered Later		
		At Banding-Place*	Elsewhere in North Queensland	Elsewhere in Australia†	At Banding-Place*	Elsewhere in North Queensland	Elsewhere in Australia†
Banded inland							
Grey teal	191	Nil	Nil	1	Nil	Nil	6
White-eyed duck ..	4	Nil	Nil	1	Nil	Nil	Nil
Maned wood duck	26	Nil	Nil	Nil	Nil	Nil	1
Banded coastal plains							
Magpie goose ..	8	Nil	1	Nil	Nil	Nil	Nil
Grass whistling-duck	476	78	8	1	1	18	6
Water whistling-duck	9	Nil	1	Nil	Nil	Nil	Nil
Black swan ..	100	2	3	Nil	1	Nil	Nil
Black duck ..	530	35	22	Nil	6	60	5
Grey teal	144	Nil	2	Nil	1	7	3

* At least 14 days after banding or previous recovery. † See Figure 8.

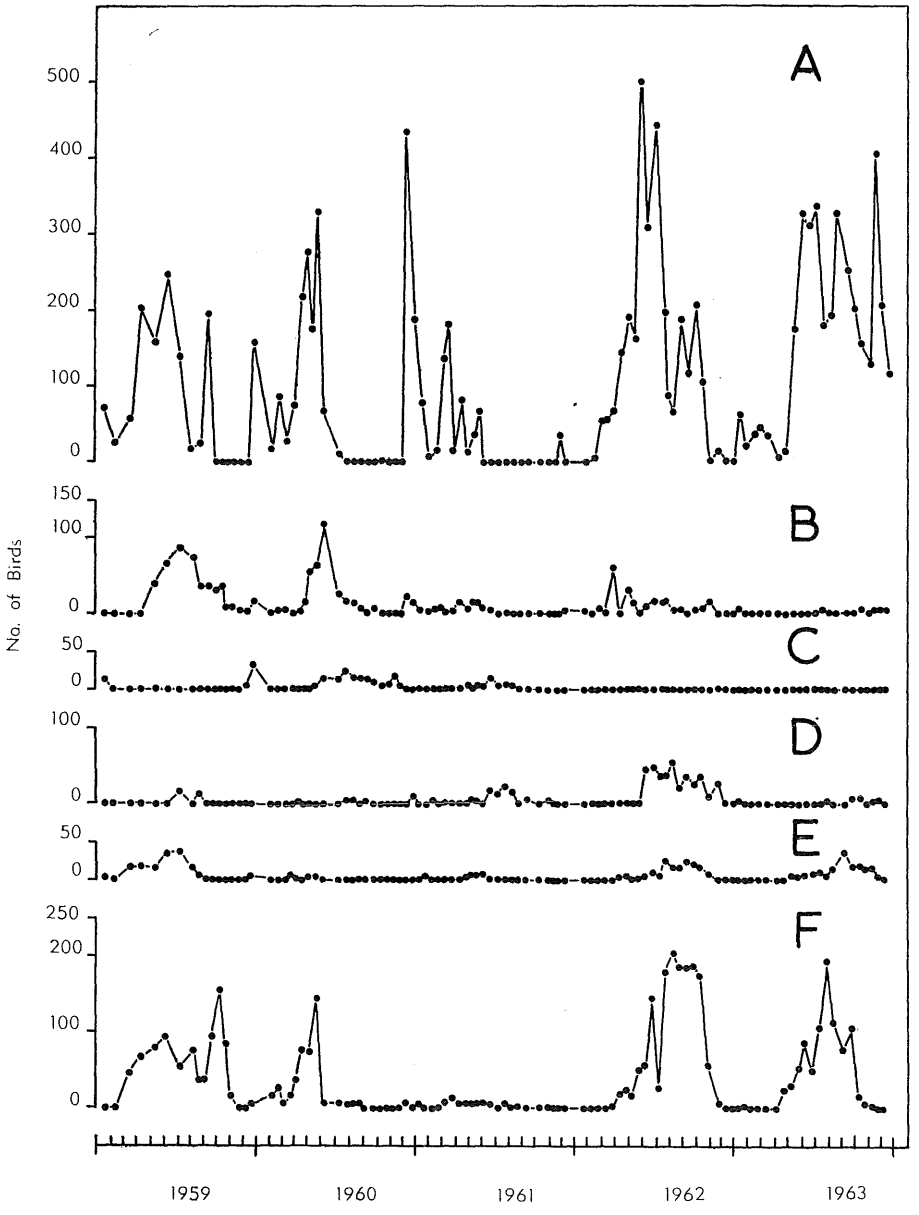

Fig. 3.—Numbers of water whistling-ducks (A), black swans (B), pink-eared ducks (C), maned wood ducks (D), green pygmy geese (E) and Australian pygmy geese (F) present each fortnight, January 1959 to December 1963, in the Bohle River-Ross River basins, Q.

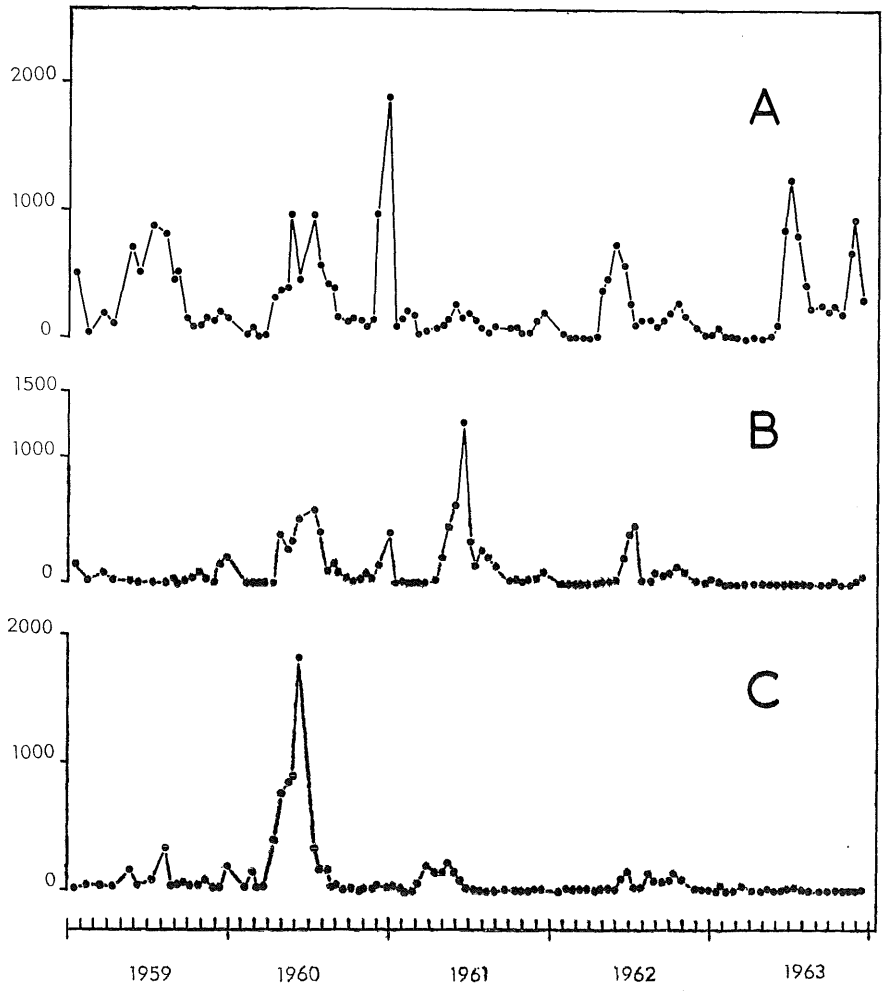

Fig. 4.—Numbers of black ducks (A), grey teal (B) and white-eyed ducks (C) present each fortnight, January 1959 to December 1963, in the Bohle River-Ross River basins, Q.

IV. DISCUSSION

Regular population counts at study areas in north Queensland were of primary importance in determining waterfowl movements because of the extremely limited value of band recoveries from individual birds taken disproportionately at a few localities in a few months of each year. Accordingly, the movement pattern of each species was as follows.

Magpie geese occurred in the Bohle River-Ross River basins during all seasons of the year, in the course of which several habitat types were used (Figures 2A and 5A). Moreover, within one habitat type several localities were used in different years—e.g. relatively large flocks of magpie geese sought drought-refuge at Mt. St. John lagoon in 1959, and birds nested commonly at Thornley Park swamp in 1962. A more or less constant number nevertheless

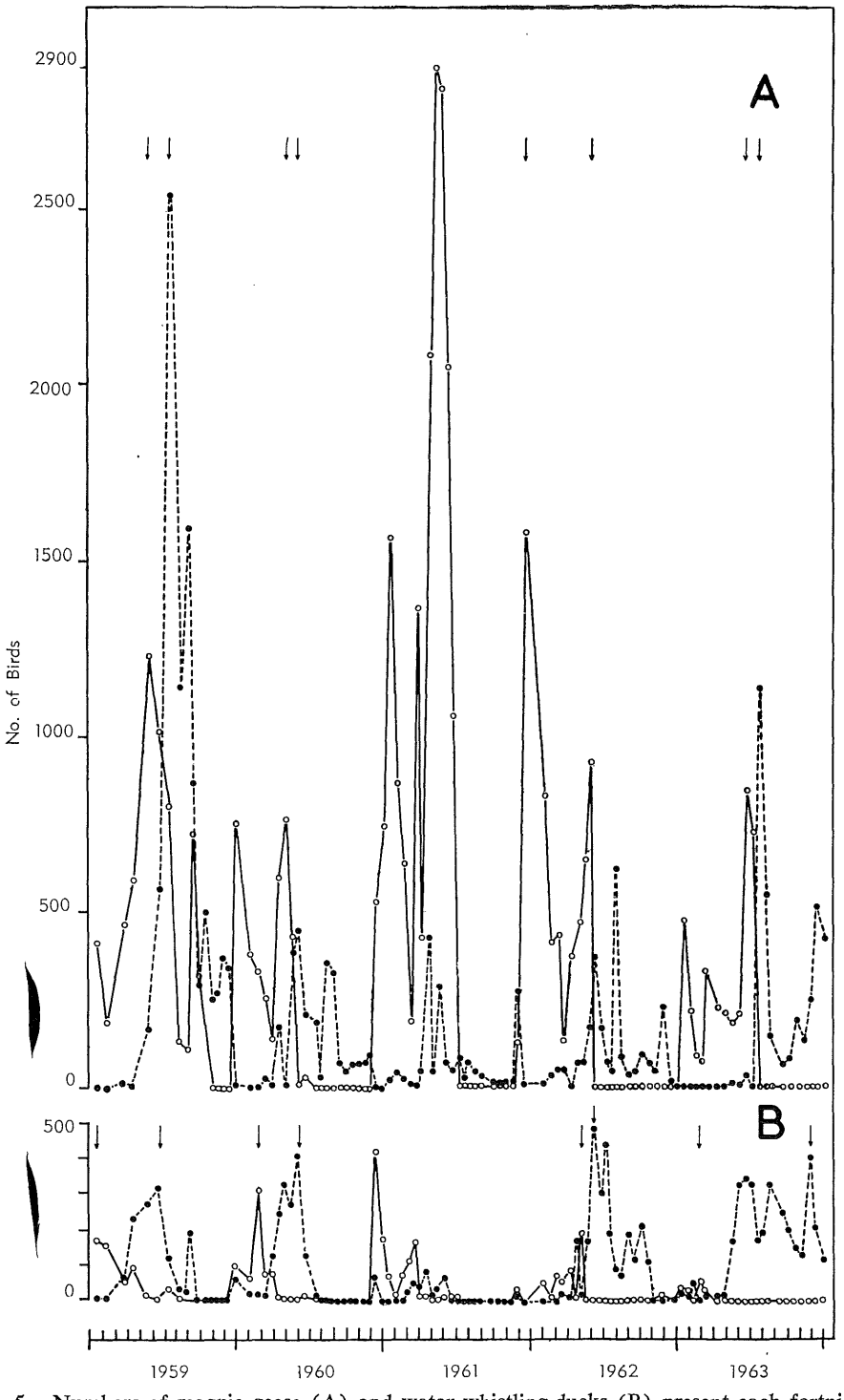

Fig. 5.—Numbers of magpie geese (A) and water whistling-ducks (B) present each fortnight, January 1959 to December 1963, at swamp (————) and lagoon (— — — —) habitat types in the Bohle River-Ross River basins, Q. Arrows illustrate annual sequence of utilization of the localities by birds except during the 1961 drought.

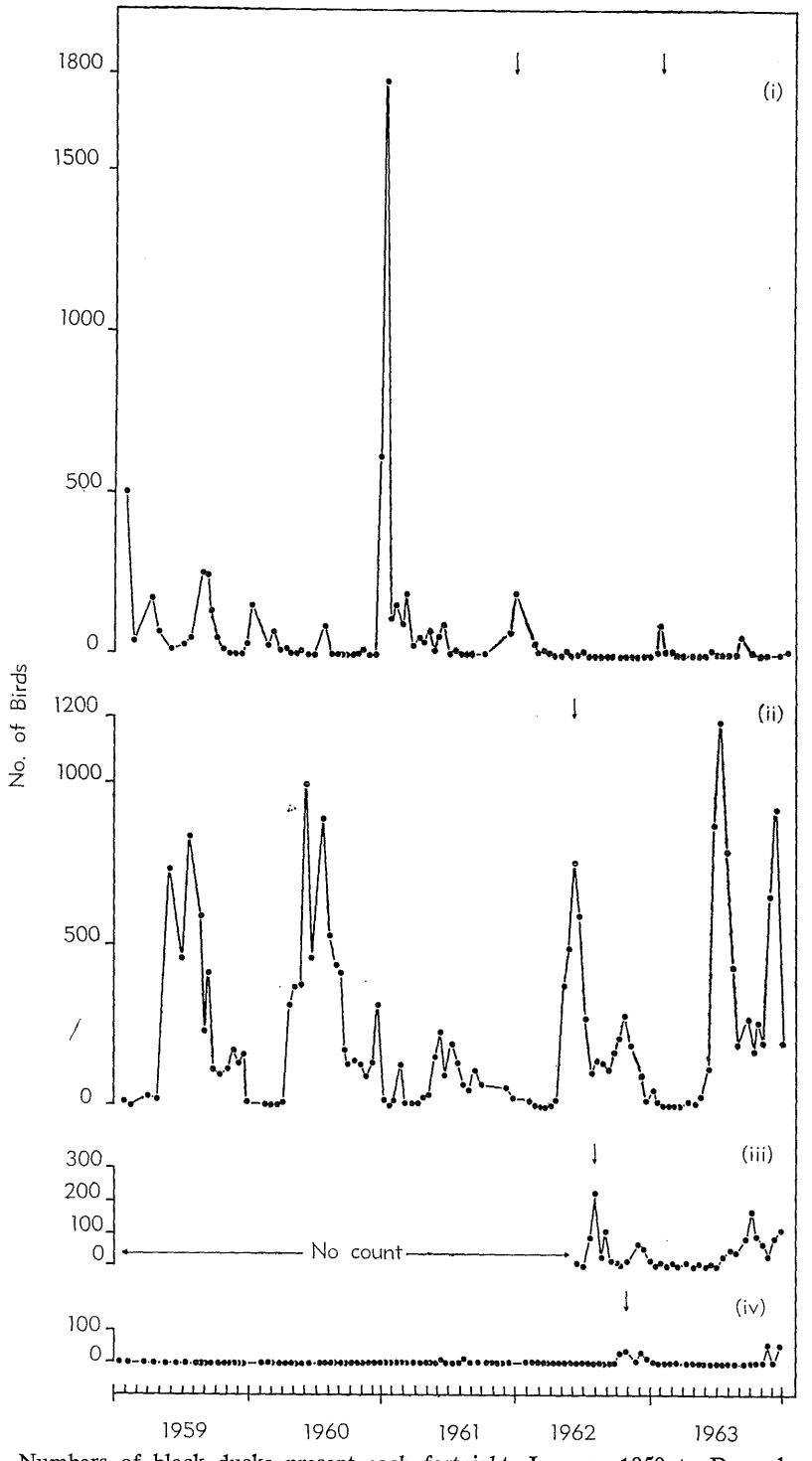

Fig. 6.—Numbers of black ducks present each fortnight, January 1959 to December 1963, at swamp (i), lagoon (ii), river (iii) and tidal flat (iv) habitat types in the Bohle River-Ross River basins, Q. Arrows illustrate sequence of utilization of the localities by birds in a year (1962).

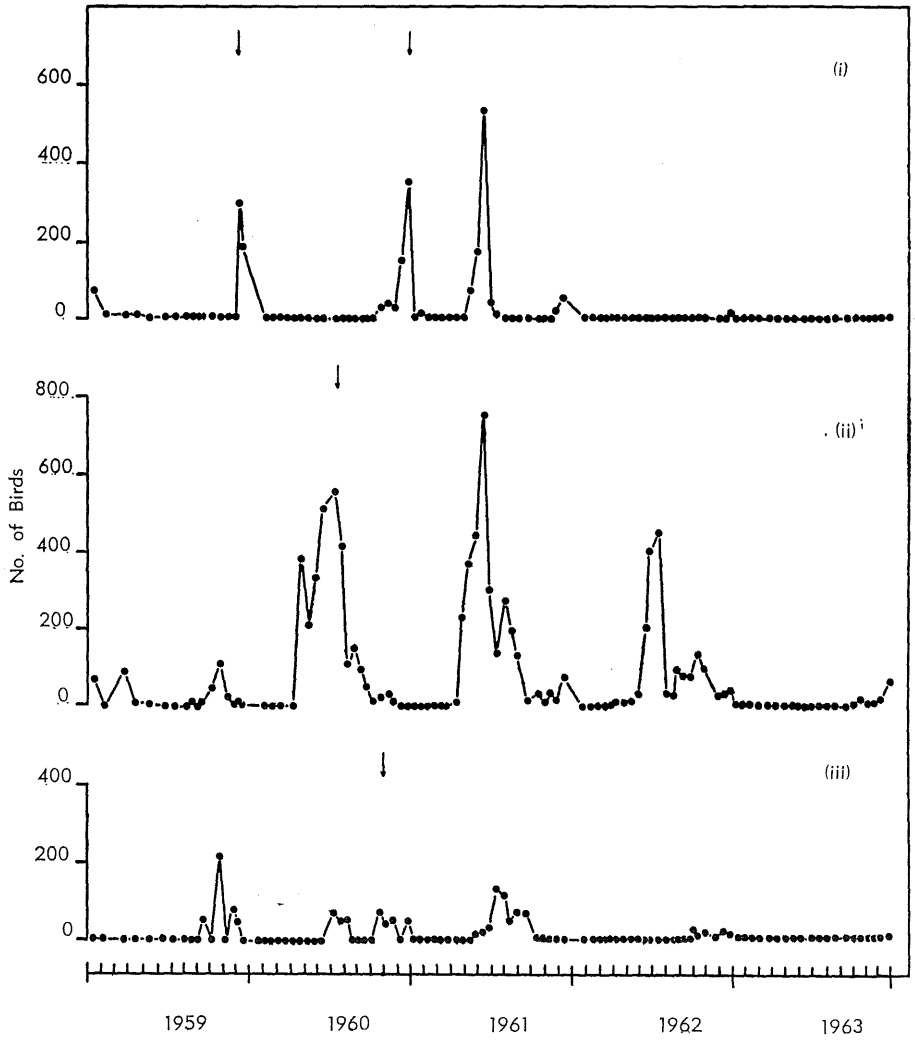

Fig. 7.—Numbers of grey teal present each fortnight, January 1959 to December 1963, at swamp (i), lagoon (ii) and tidal flat (iii) habitat types in the Bohle River-Ross River basins, Q. Arrows illustrate sequence of utilization of the localities by birds in a year (1960).

remained within a district (e.g. from Bohle River to Burdekin River), and band recoveries—e.g. from Mt. St. John (July 13, 1962) to Cromarty (August 11, 1962) and from Mt. St. John (August 31, 1962) to Brandon (September 4, 1963)—support the contention that this was the flock range of a localized population. Movements of magpie geese in the Region thus were broadly as described for Northern Territory by Frith and Davies (1961), i.e. multidirectional from shallow-water breeding grounds in the wet season to permanent freshwaters in the dry season. Distances travelled in north-eastern Queensland were shorter

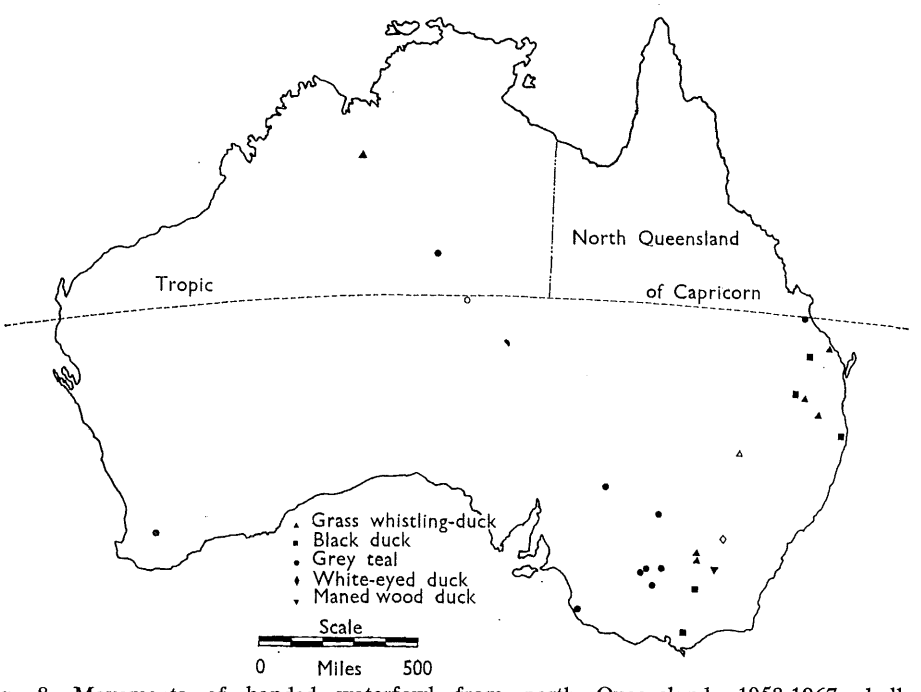

Fig. 8—Movements of banded waterfowl from north Queensland, 1958-1967; hollow symbol = recovery in year of banding; solid symbol = recovery later.

than elsewhere because of the limited, mountain-bordered habitat, and occurrence at any one locality was erratic perhaps because of the species' marginal distribution there.

Grass whistling-ducks were found as large flocks at the same localities in the Bohle River-Ross River basins during each dry season (Figure 2B). Breeding, by isolated pairs of these birds, was widespread along the adjacent coastal plains and hinterland; banded birds moved from "Labatt Lagoon", near Brandon (June 9, 1959) to 60 miles south-west of Charters Towers (September 1, 1960), from Mt. St. John (June 9, 1959) to "Havilak", 30 miles south of Scotville near Collinsville (June 26, 1960), and from Mt. St. John (December 20, 1960) to Barrhinga, near Woodstock (Q.) (December 31, 1960). Drought-refuges were located some 60 miles apart along the coastal plains of north-eastern Queensland, e.g. at Guthalungra, Brandon, Townsville and Ingham. Individuals stayed at these localities over many years—e.g. bird banded at Mt. St. John (October 22, 1958) and recovered there on December 6, 1958, December 17, 1960, and August 9, 1961—although some movements amongst localities also occurred, e.g. from Mt. St. John (August 6, 1958) to "Labatt Lagoon" (June 9, 1959) (see also Tables 2 and 3). Mostly birds remained resident at drought-refuges except for nocturnal foraging flights, often to distant feeding grounds. Occasionally grass whistling-ducks moved considerable distances along a path formed by the habitat, e.g. from Mt. St. John (August 23, 1963) to "Eight-mile Swamp", Vanrook, western Cape York Peninsula (May 20, 1967). These movements were relatively unimportant in view of the general stability of the habitat and of the large populations present at any one locality even during an extreme change in climate such as in 1961 (Figure 2B).

Water whistling-ducks occurred throughout the Bohle River-Ross River basins at all times of the year. Most breeding localities were inhabited in most years; at the Oonoonba lagoons in the wet seasons of 1959 and 1960 populations numbered 96 and 106 birds respectively. Drought-refuge areas were used less regularly, e.g. birds within the flock range Ingham-Ayr were concentrated near Brandon in 1959, Ingham in 1960 and Woodstock-Townsville in 1962 and 1963 (see Figure 3A). A large flock was present at "Caley Valley", near Bowen, in all years 1959–1963. Movements on the coastal plains in north Queensland thus followed the pattern of temporary/seasonal wetlands in the wet season to deep freshwaters, mostly lagoons, with young thereafter (Figure 5B); to effect such a change broods were sometimes led miles overland by parents. As with a number of other coastal species, movements to the adjacent hinterland were effected as increasing numbers of water conservation impoundments became available inland, e.g. banded bird from Townsville (August 31, 1962) to Charters Towers (June 3, 1964).

Black ducks also occurred in the Bohle River-Ross River basins at all times of the year, again using different habitat types (Figures 4A and 6). The number found dispersed during the wet season at all habitat in the two river basins was approximately the same as that found concentrated at the end of the dry season, some 200 birds (Figure 4A), and apparently involved the same individuals. Birds banded at Mt. St. John on December 5, 7, 11 and 21, 1958, and on September 1, 1960, were recovered there on December 13, 1960, November 5, 1960, September 1, 1960, December 14, 1960, and October 11, 1961 respectively (see also Table 3). Birds have been recovered in north Queensland up to 6 years after banding. During the early dry season, numbers in the two river basins increased for several months (Figure 4A) to include birds with young from more widespread breeding grounds. Additionally, invasions from the major southern Australian breeding habitat were apparent; thus in late 1960 large flocks were observed at habitat not otherwise being used in the Bohle River basin (Figure 6) and elsewhere, e.g. Rockhampton district.

Frith (*in litt.* 25.iii.64) noted that "following the drought of 1957-1958 in southern Australia, black ducks and white-eyed ducks concentrated in large numbers on the permanent wetlands particularly of the Riverina and lower Murray River until late 1959 when these birds dispersed undertaking unusual movements to atypical habitat". The invasions in north Queensland would have resulted accordingly. There was a similar pattern of events in white-eyed ducks, which were not common resident birds in most of north Queensland; the occurrence of black ducks in large flocks several months later than white-eyed ducks (Figure 4 (A and C)) followed the sequence in which these species left southern inland Australia. Banded black duck recoveries included from "Barrenbox Swamp", near Griffith, New South Wales (September 30, 1957) to Duneside, 36 miles north-east of Rockhampton (September 24, 1960), and from Lake Wyangan, N.S.W. (July 16, 1969) to Ayr (September 24, 1960). Movements of black ducks in southern Queensland tended northwards during this period (Lavery and Roff 1964) and there was a disproportionate number of north Queensland-banded birds recovered in the southern inland (Figure 8). These populations moved constantly (Figure 4) along paths of remaining habitat (see Lavery 1966*b*). There was no evidence of the return of comparable numbers of birds, particularly along these paths. After heavy rain the courses

may have been inland and the population dispersed, but southward movements by banded waterfowl were found more frequently under dry conditions, e.g. white-eyed ducks from Rifle Creek, near Mt. Isa (January 26, 1958) to 28 miles south-west of Forbes, N.S.W. (July 22, 1958).

In the Bohle River-Ross River basins, movements of grey teal were closely associated with local climatic conditions. The use of drought-refuge was one habit readily connected in this manner; thus reasonably constant numbers appeared at saltwater habitat types, especially along the coast, during each dry season. In the 1961 drought, birds first appeared at saline habitat as early as April 17, compared with July 5 as the earliest date in the wetter years 1959-1960 and 1962-1963. Birds returned from the inland breeding grounds to the same drought-refuge districts, e.g. Mt. St. John (July 30, 1958) to Bohle River (September 5, 1959), Mt. St. John (August 8, 1959) to the Oonoonba lagoons (September 30, 1961) and Mt. St. John (September 17, 1962) to the banding-place (September 3, 1965). There were occasional influxes of populations that were much larger than usual and at freshwaters rather than saltwaters; these populations remained in a district for less than 1 month (see Figures 4B and 7) and proceeded northwards (Lavery 1966*b*). The largest populations of grey teal throughout the Townsville Study Region were observed at "Caley Valley" in 1958-1959. These were in accordance with the occurrence and timing of southern irruptions and banded birds were recovered (see Downes 1954; Frith 1959). Nomadic flocks banded at Mt. Isa and recovered thereafter were predominantly to the south (Figure 8) in accordance with findings on the nomadic southward movements after drought also at this time in Northern Territory (Frith 1962). In north Queensland grey teal were mostly resident populations, moving relatively short distances from shallow-water breeding grounds, increasing in number with the construction of numerous water conservation impoundments, to saltwater drought-refuges according to prevailing seasonal conditions.

Australian pygmy geese likewise commonly used water impoundments in the hinterland of the coastal plains; movements to coastal deep freshwaters were related to local rainfall (Figure 3F) and were sufficiently constant in number and localized in distribution to suggest comparatively sedentary populations.

Thus according to population sizes waterfowl species in north-eastern Queensland may be grouped as those found (a) at all times of the year, i.e. the coastal species; (b) annually during the dry season utilizing localities regularly except during the years of climatic extremes, i.e. the inland species; and (c) occasionally for a short period at any time of year, except the main part of the wet season, either in unusually large or unusually small numbers at habitat not otherwise being widely used at that time, i.e. vagrants.

The effect of the 1961 drought on numbers and movements of these waterfowl in north Queensland is noteworthy. Birds of group (a) were in smaller numbers throughout the year, those of group (b) appeared on the coastal plains earlier in the year, and those of group (c) were present for longer periods if at all. Movements amongst habitat types were effected earlier, and some species disappeared at an earlier time, than usual.

The regular movement patterns of northern waterfowl populations, apparent also in other northern water-birds, e.g. brolga (*Grus rubicundus* (Perry)) (Lavery 1964), differ from the more erratic movements reported for southern Australia, e.g. by Frith (1959). Carrick (1962) concluded that despite highly nomadic habits throughout most of the southern inland range of white ibis

(*Threskiornis molucca* (Cuvier)) some birds were resident where a dependable rise in water level occurred, as happens to wetlands in north Queensland. In north Queensland no irruption of a waterfowl population is recorded and there is no evidence of invasions to the south such as occur regularly from there. All waterfowl species in the north nevertheless contributed some nomadic individuals progressively greater in numbers from groups (a) to (c). Many of these individuals moved northwards to New Guinea; subsequent movements are not known.

Proximate factors initiated movements between shallow-water and deep-water habitat types before water disappeared from the former; discounting daily foraging movements, some resident birds in north Queensland moved among permanent habitat types (Table 2); return movements to breeding grounds commenced as permanent wetlands became deeper. The nature of these factors is as yet undescribed.

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