THE SOCIAL STRUCTURE OF THE WEKA (*Gallirallus australis*) AT DOUBLE COVE, MARLBOROUGH SOUNDS

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ABSTRACT

The study group comprised territorial pairs and non-territorial adults and subadults. Pairs were maintained all the year and occupied minimum areas of between 2.6 and 15.8 ha. Most non-territorials were younger than 18 months. All wekas that obtained territorial positions in the study period were under 2 years old. Most pairs bred successfully at least once per year and one bred successfully three times in the same year, raising nine young. Recruitment exceeded losses in the territorial group. In the 1985 season, 37.5% of the territorial birds were lost through death or displacement.

INTRODUCTION

The territorial status of mainland wekas has been reported as temporary in some parts of Fiordland (Harper 1946) and permanent in other regions of New Zealand (Blackburn 1955).

Of the three recent weka studies (Coleman *et al.* 1983, Brothers & Skira 1984, Beauchamp 1987), only that of Coleman *et al.* was on the main islands of New Zealand and then as a sideline to possum research. Coleman *et al.* (1983) gave information on population dispersion and changes in numbers, but provided only limited information on the breeding performance and the social structure of their study birds.

The purpose of this study was to investigate the composition of a mainland weka population and the factors influencing changes to it.

The study area at Double Cove, 6 km north of Picton on the west side of Queen Charlotte Sound, comprised 66 ha of regenerating manuka *Leptospermum scoparium*), kanuka (*L. ericoides*) and early seral broadleaf forest. Much of the area is private land but some is the Rocks Scenic Reserve administered by the Marlborough Sounds Maritime Park Board (Walls 1984). In the study area are 30 holiday homes, none of which were permanently occupied.

The wekas there were derived from birds that arrived in the late 1960s, when the hillsides were covered with bracken (*Pteridium esculentum*) (D. Travers and D. & V. Burton, pers. comm.). Wekas could have come from both the north-east and south-west. Anecdotal accounts suggest that weka density was higher in the 1970s than during the study period (R. O'Neill and D. Travers, pers. comm.) and that weka density is highly variable.

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METHODS

I visited the study area in April, October, November 1984, February and April 1985, and January 1986 for 4, 5, 6, 6, 1 and 9 days respectively. All the area was searched for wekas throughout the daylight period.

Wekas were caught in cage traps and with hand-held snares. Adults were banded with numbered stainless steel colour bands. Subadults (wekas less than 12 months old) and dependent young were banded with numbered bands, and subadults were subsequently colour banded if they stayed in the study area for longer that 2 months after independence.

When a bird was first captured I analysed its plumage and state of moult. To aid in sexing I took two bill and four leg measurements, maximum tail length, compressed wing length, and weight (Beauchamp 1987). I aged each bird by its eye and leg colour and by the state of its wing spur and plumage as being in its first or second year, between its third and sixth year, or more than six years (Beauchamp 1987). When birds were recaptured I noted their state of moult, weight and breeding status.

During each visit I recaptured as many territorial wekas as possible and asked house owners about the breeding performance of the pairs they saw regularly.

All statistical test are Wilcoxon-t normality approximation tests.

RESULTS

Composition and distribution of the study group

The Double Cove wekas comprised both resident territorial pairs and non-territorial adults and subadults. Figure 1 gives the distribution of territorial pairs in November 1984 and January 1986. The territories did not overlap and some apparently lacked common boundaries. The actual size of many was hard to gauge because of the timid nature of the birds, the limited period of diurnal activity, and the dense vegetation. The mean known size was 4.8 ha (range 2.6-15.8 ha). The changes evident in some boundaries were associated with changes in pair composition or the death of both members of a pair.

The wekas maintained their territories by spacing calls and fighting. Territorial boom calls were generally associated with pair greeting and fighting. Birds gave few calls while foraging.

Table 1 gives the composition of the population throughout the study period. The numbers of territorial and non-territorial birds remained almost constant throughout the year, but the number of subadults was more variable. In April 1984, I saw only two non-territorials in four days. However, in a 24 hour visit in April 1985 I saw six in only a partial reconnaissance of the area. In 1984, I considered two territorial birds, one of each sex, to be 6-10 years old and three to be 2 years old or less. The rest were between 3 and 6 years. By January 1986 all 17 territorial birds were considered to be 6 years old or less, seven (41%) of them being under 2 years old.

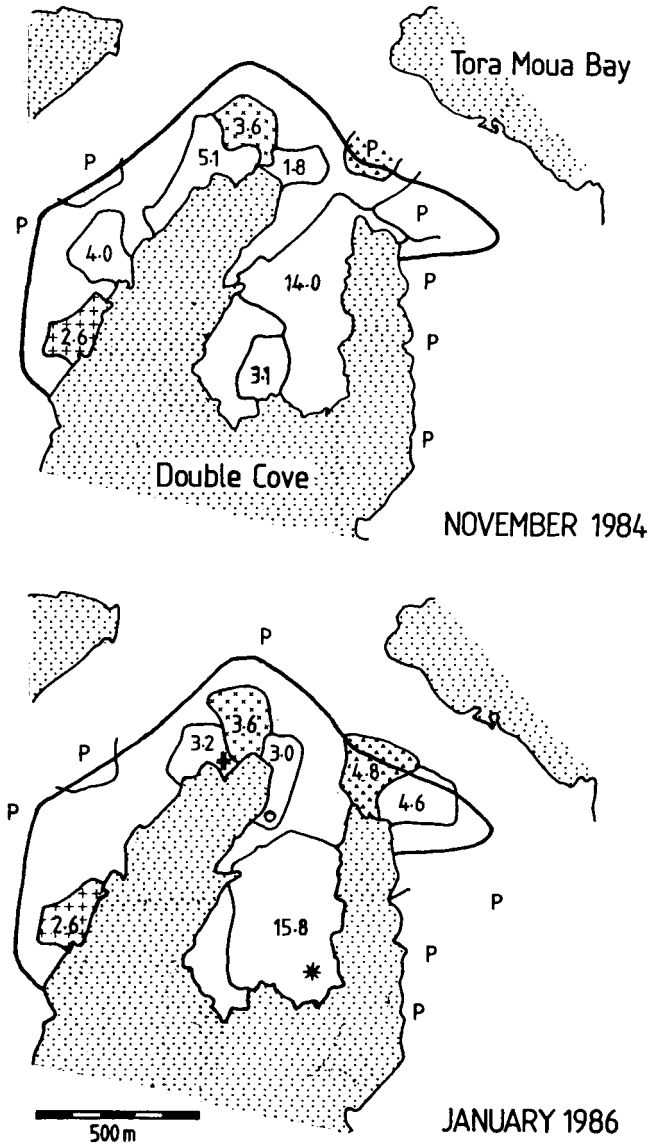

FIGURE 1 — Weka territories in Double Cove, Marlborough Sounds, in November 1984 and January 1986. Numbers indicate planar estimates of territory size in hectares. The solid line is the boundary of the 66 ha area that was carefully searched each visit. The same pair is shown by the same shading pattern in each diagram. o = a new pair, ★ = a new female, # = a new male, P = an unbanded pair, as indicated by calling. The dotted areas are salt water.

The longest-known periods of non-territorial residency were 18 and 14 months for two females and 14 months for a male. All non-territorial wekas ranged widely. One female was seen throughout the study area and others probably ranged over more than 70 ha.

TABLE 1 - Study group structure

	Apr 1985	Oct-Nov 1984	Feb 1985	Jan 1986
Territorial wekas	14*	18	20	17
Non-territorials	1	1	2	2
Subadults	1	11	3	8
Dependent young	3	15	2	4

* = Minimum estimate as not all birds were banded

Breeding performance and movement of young

Table 2 summarises the breeding performance of eight pairs. The main period of breeding was late August to October, although successful breeding occurred during most of the year, including the period of moult. One pair raised nine chicks to independence in a calendar year, but most pairs showed no signs of courtship outside the main breeding period.

TABLE 2 — Times when successful breeding and breeding attempts occurred and territorial wekas died or were displaced

	1984									1985									1986	
PAIR	M	A	M	J	J	A	S	O	N	D	J	F	M	A	M	J	J	A	S	O	N	D	J	F
1										2Y									PL					
2										3Y									2Y	ML			3Y	
3										2Y									1Y					
4	3Y									3Y			3Y						FL	COURT				
5										1Y			PL											
6										1Y									PL					
7													2Y										1Y	
8													COURT										COURT	

1Y = one young, 2Y = two young, 3Y = three young,
PL = pair lost, FL = female lost, ML = male lost,
COURT = courtship

Parental care (six pairs) lasted 60-80 days and young remained near their parental territory for up to 2 months. Most had dispersed from these areas by 4 months after independence, and in summer young birds were passing constantly through the study area.

During the 22 months, the study group raised 23 chicks, only two of which were still present more than a year after fledging. However, no locally raised bird obtained a territorial position within the study area. The only known bird raised in the study area that established a territory was a female

that moved to Portage, 5 km from the study area, within 4 months of moving from its parents' territory.

Age of territorial establishment and first breeding

During the study five wekas, all between 10 and 18 months old, obtained territorial positions within the study area. Two of the females paired with older males, and one of them bred successfully at the age of 18 months, 3 months after territorial establishment. A 12-month-old male established with an older female and bred within a month, and the other two wekas established as a new pair (see Figure 1).

Population losses

During the 12 months February 1985 to January 1986, 37.5% of the territorial wekas were lost through death or displacement. Each sex was equally represented, and two pairs disappeared (see Figure 1). Two birds lost from different pairs were 6 or more years old and all the others were older than 3 years. Only one dead weka was recovered and she had a leg injury similar to those associated with gin traps. Another female was apparently displaced by a newly established neighbouring pair of subadults after the loss of her partner, and one male was displaced by a non-territorial subadult. All the other territorial wekas that disappeared probably died.

During the study period one non-territorial banded weka was recovered after being shot, 4.5 km from the study area at Lochmara Bay. The deaths of other non-territorial subadult wekas were probably associated with poor condition, due to frequent attacks and disturbance by other wekas. Subadults in poor physical condition (low weight for size) were seen moving throughout the study area in January 1985 and February 1986.

Weights

Figure 2 shows the known weight cycle of the population. The observed pattern of peak weights in autumn and winter, and lower weights associated with breeding, are typical of wekas elsewhere (Carrol 1963, Coleman *et al.* 1983, Beauchamp 1987). Most losses were associated with winter, but there was no indication that deaths were associated with a food shortage.

Two territorial wekas disappeared at the end of the breeding season, when wekas would be more easily displaced by heavier non-territorial birds (Beauchamp 1987).

DISCUSSION

In this study I found a population structure similar to that on Kapiti Island (Beauchamp 1987) and a pattern that I interpret, from the individual longevity and range information presented by Coleman *et al.* (1983), to be similar to that at Lake Haupiri, Westland. There was no indication of pair bonds dissolving after the breeding season, as suggested by Harper (1946) for Fiordland.

Distribution: The results of this study, although based on less than 2 years' information, indicate a series of demographic differences between wekas on the mainland and those on some offshore islands. Some of these differences are habitat related but they also reflect the different influences working on the birds.

The Double Cove birds occupied an earlier successional stage of smaller-leafed forest, on a drier shallower soil, than the Kapiti Island birds.

In Double Cove not all territorial pairs had boundaries in common with other pairs, and birds were found up to 200 metres into a neighbouring territory. Territorial wekas seldom gave the territorial boom call while foraging, indicating a low level of direct territorial conflict or of interaction with non-territorial wekas.

In contrast, wekas on Kapiti Island held territories that were significantly smaller ($p<0.0001$), averaging 1.96 ha; territorial conflicts were higher, averaging one every 3 hours; and booming occurred on average once an hour (Beauchamp 1987). Population density averaged 0.8 weka per hectare as opposed to 0.3 weka per hectare in Double Cove, and non-territorials were a much higher proportion of the population throughout most of the 5 years of the Kapiti study. This led on Kapiti to territorial wekas intruding more often into neighbouring territories, though the average distance of incursion was only about 10 metres.

The principal-use areas of non-territorials on Kapiti overlapped more territories than at Double Cove and, because of the higher density of birds, conflicts were more frequent.

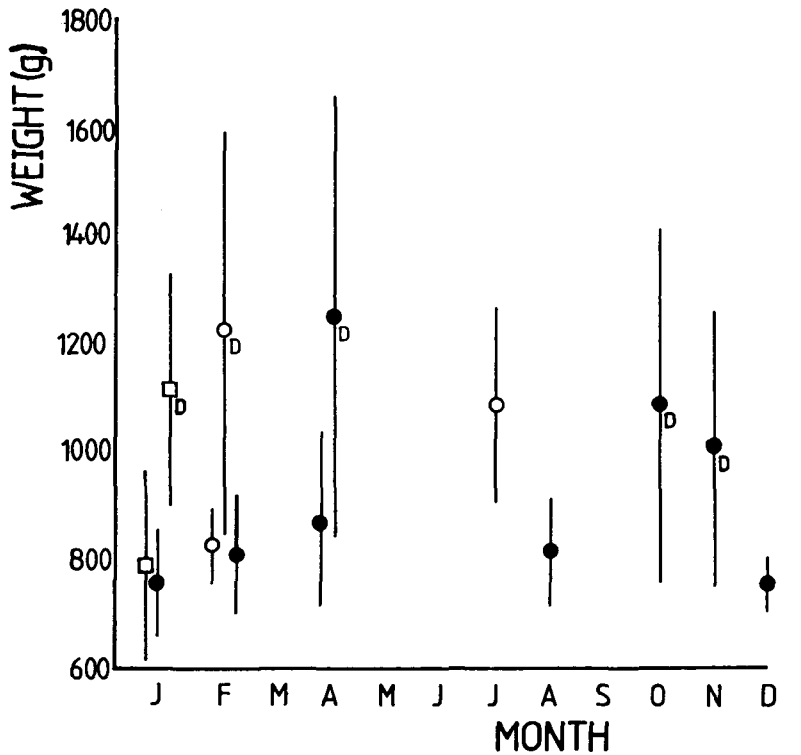

FIGURE 2 — Weights + 95% confidence limits of Double Cove (D) and Kapiti Island male wekas. o = weights in 1984, ● = weights in 1985, □ = weights in 1986.

Foods and breeding frequency: Major differences between the Kapiti Island and Double Cove populations were associated with food supply, the overall level of population condition (as expressed by weight for size), and the time taken by wekas to regain condition after breeding. These differences led to differences in the rate of breeding, the number of young raised per clutch and the timing of renesting attempts.

The Double Cove wekas had extensive and almost year-round supplies of fruit, especially fivefinger (*Pseudopanax arboreum*) and karamu (*Coprosma lucida*), which give a high energy yield per unit time of collection (Williams 1982), and so the birds could recover their weight quickly after breeding. Kapiti wekas relied more on invertebrates, which usually give less energy per unit time of collection and so their recovery time was longer (Beauchamp 1987).

Both groups of weka had similar duration of parental care. On Kapiti, however, the minimum time taken to recover breeding condition was 2 months. Food levels were inadequate for year-round breeding and weka pairs did not maintain courtship throughout the year (Beauchamp 1987). At Double Cove, recovery times were less than 1 month and food levels and year-round courtship permitted multiple breeding attempts. As a result, the number of young raised per pair at Double Cove (2.8, averaged over 2 years) was significantly higher ($p<0.001$) than on Kapiti (0.3, average over 6 years).

Survival and mortality: In both places productivity exceeded losses of territorial birds, and the life expectancy of non-territorial birds that did not obtain a territorial position was much lower than that of the territorial birds (Beauchamp 1987).

The higher breeding rate and survival of young at Double Cove were associated with a higher turnover in the population and a lower age of territorial establishment. The higher level of turnover in the Sounds was also indicated by the proportionately lower numbers and ages of the resident non-territorial birds. On Kapiti, the average annual adult turnover rate over 10 years was 14%. The highest annual adult death and displacement rate recorded was 27%, much lower than the 37.5% recorded at Double Cove in 1985.

Recruitment into territories: In both populations the path to recruitment into the territorial group varied. On Kapiti, most subadults became part of the non-territorial group, from which most territorial recruitment occurred (Beauchamp 1987). Non-territorial adults and subadults made up about 30% of the population. Few subadults (<5%) entered the territorial group directly. The ages of the birds recruited into the territorial group depended on the success of the subadults in entering the non-territorial group, the rate and level of loss from the non-territorial and territorial populations, and the age classes represented in each group of the population (Beauchamp 1987). Most birds were at least 2 years old before they obtained a territorial position, and males tended to establish younger than females.

At Double Cove, however, all wekas that established territorial positions were less than 18 months old. The non-territorial component varied between

6% and 12% of the permanent population and there were many spaces where wekas could establish. The rate of territorial recruitment depended more on the ability of subadults to enter the territorial group.

In both places, recruitment into the territorial group varied from year to year. On Kapiti, this variation was due to uneven breeding, uneven entry into the non-territorial group, and uneven survival; whereas in Double Cove, it depended more on uneven annual breeding success.

If the long-term longevity trend in the Sounds is similar to the trend observed in the two years studied, the mean longevity of a territorial bird could be as low as 4 years. This is much lower than the 6.5 years on Kapiti and a short life span for the size of the bird (Ricklefs 1973). It is also likely that the life span of the territorial wekas in the Marlborough Sounds is more variable than on Kapiti because the Sounds wekas depend much more on fruit, which can differ markedly in quantity between seasons.

It is conceivable that the oldest wekas at the start of the study were survivors of population crashes associated with unfavourable dry conditions which had greatly reduced fruit and invertebrate foods. Such high annual variability appears to be a feature of this population (D. Burton, pers. comm.) and the populations in the North Island (Guthrie-Smith 1926).

The long-term survival and density of the weka in the Double Cove region of the Marlborough Sounds is likely to depend on the habitats that result from forest succession. Terminal forests in the Marlborough Sounds have lower densities of wekas than the earlier-succession broadleaf forests. Pure beech forests lack wekas probably because they have few fruit-bearing plants and a poorer supply of litter invertebrates.

Current succession in Double Cove and the surrounding areas is moving towards a broadleaf and pine (*Pinus radiata*) forest. Beech is now restricted to the coastal margin and will only slowly spread back up the hillsides. It appears that pine forest is as unsuitable as beech forest for wekas, and ultimately the suitability of this area will be governed by the continuing availability of the fruits of fivefinger, karamu, mingimingi (*Cyathodes fasciculata*) and mahoe (*Melicytus ramiflorus*) and by the composition and density of invertebrates. Both the forest composition and the litter quality will depend on the density of the pine cover and how possums affect the native component of the forest (Fitzgerald 1978, Coleman *et al.* 1985). Any reduction in the broadleaf component is likely to lead to a permanent reduction in weka numbers.

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SHORT NOTE

A beach-wrecked White-naped Petrel

On 27 January 1986 at Karikari Bay, Northland, with Geoff Arnold and Julie Macefield, I found the remains of a large grey and white gadfly petrel which I subsequently identified as a White-naped Petrel (*Pterodroma cervicalis*). The bird was incomplete, with one wing largely missing and the other damaged. Some tail feathers and part of the forehead and facial plumage were also missing. The bird had begun to dry and there was probably some shrinkage of soft parts.

Description: Upper wing and crown predominantly dark grey to black. Mantle, back and scapular feathers white at the base, distally frosty-grey, with a few of the scapulars narrowly tipped with white. There was a partial collar of grey-tipped feathers. Remaining (outer) rectrices were white, some tipped and flecked with grey. Nape and underparts white. Primaries had black shafts, black outer webs and grey and off-white inner webs. The bill was dull black. The feet were largely white to pale flesh with the distal parts of the toes and webs grey-black.

Measurements (mm)

Body:	Length	c. 420	Foot:	Tarsus	40
	Wingspan	c. 990		Mid-toe and claw	53
	Wing	305	Bill:	Length	36
	Tail (incomplete)	123		Depth	16
				Width	17