RESUMES OF CONFERENCE PAPERS

Resumes of papers read at the Ecological Society Conference, 1981. are presented (except those presented in full elsewhere in this volume). For the complete programme of papers given at this conference please refer to the Annual Report at the back of the Journal.

CONSTANT COUNT -A SOLUTION TO PROBLEMS OF QUADRAT SIZE

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In a wide ranging forest inventory, the use of one plot size in all situations can give rise to serious under- or over-sampling and considerable wasted effort. One solution to this problem has been to use distance methods such as the point centred quarter, nearest neighbour or random pairs (Mueller-Dombios and Ellenberg, 1974). This results in inadequate amount of data being collected at each sample point for characterising the vegetation, and as a result, data for several points must be combined in some arbitrary manner. In the constant count plot, the principle of sampling is similar to that of other distance methods but the problem of sample size is obviated by increasing the radius to include a fixed number of individuals. The distance from a randomly selected point to the furthest plant of a fixed sample count is then used to define the plot area. As a consequence, the area of each plot varies in proportion to the density of the individuals measured, and a wide range of plant densities can be sampled efficiently.

The optimal-sized count, as suggested by optimal sample size of fixed area plots, appears to be between 15 and 20. Firstly, the measurement of the distance to ing the furthest individual (Husch, Miller and Beers, 1972; Spurr, 1952). In multi-aged forest of several species, a number of strata need to be defined to efficiently sample all size classes in a similar manner to fixed area sampling. A minimum of three strata is suggested but more can be defined in complex forest for detailed studies (Borman, 1976).

Strata can be defined in several ways but if they are defined by the minimum diameter of each stratum with no upper size limit, a maximum search radius needs to be defined for only the uppermost stratum. Where this form of search limit is used, the maximum search distance becomes the same as that for the largest size class. Unless the forest is heavily depleted by browsing mammals, this rarely results in an empty stratum.

The densities for each species and size class are then obtained by proportioning the density for the appropriate. strata. There are several ways of calculating density depending on how the radii are averaged :

1. $$D = \frac{c \cdot m}{\pi} \cdot \frac{1}{\left(\frac{\Sigma r}{n}\right)^2}$$ (Thompson, 1956; Morista, 1954)

2. $$D = \frac{m}{\pi} \cdot \frac{1}{\frac{(\Sigma r^2)}{n}}$$ (Pielou, 1977; Morista, 1954)

3. $$D = \frac{(n-1) \cdot m}{n\pi} \cdot \frac{\left(\Sigma \frac{1}{r^2}\right)}{n}$$ (Eberhardt, 1967)

where m is the count size; n is sample size; r is distance to the furthest individual and $c = \frac{(2m)!\,m}{(2^m \cdot m!)^2}$

The second estimator is more usual and easier to manipulate, but while the first two are only valid for Poisson (random) populations, the third is also valid for binomial and negative binomial distributions (Ederhardt, 1967).

Natural populations are rarely randomly distributed but several considerations suggest that the method may be robust if the count size is between 15 and 20. Firstly, the measurment of the distance to the mth neighbour effectively averages all preceding neighbour distances. As a result, where population aggregation is present at an order less than the count size, the effects will be greatly reduced, and if aggregation is in units greater than the count size, it may well be a readily recognisable ecological unit. Secondly, Greig-Smith (1964) suggested that, in mixed populations, several scales of aggregation are likely to be present and that the distribution of the whole population is likely to tend to randomness. Some types of aggregation can be minimised at sampling. For instance, the common practice of recognising separate stems of a multi-stemmed plant as individuals results in severe aggregation. This can be circumvented by keeping a separate record of total stems and plants (= individuals) and recognising only individuals for the purposes of the count.

The basic principles of the method offer a new and simple sampling technique. However, the robustness of the method needs to be tested by sampling known (model) populations and determining the characteristics of the method under a wide range of dispersal patterns.

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THE INTERACTION OF FOUR SOCIAL CLASSES IN A MAGPIE (*GYMNORHINA* spp) POPULATION

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The ecologically important features of magpie behaviour were studied at Linton, Manawatu. This population of mostly white-backed birds (*Gymnorhina tibicen hypoleuca*) maintained twice the density of the only Australian population to have been described (Carrick, 1972), and produces twice as many free-flying young.

Both a non-territorial and a territorial phase occurred at Linton. All territories encompassed both trees and pastures and were defended by pairs or groups of birds. Group size may interact with time-activity distributions.

Groups originated in two ways. At the end of their first year of life, young magpies either remained in their natal territories, or departed to the non-territorial flock. If they remained, a family group was formed. Small groups of flock birds recovered territorial status, and were termed cohort groups.

Thus, four lifestyles interacted in the Linton magpie population and behavioural strategies for maximising ecological priorities, such as food supply, were possible by lifestyle switching.

Ultimately an animal behaves so as to increase its inclusive fitness-the sum total of its genes which are passed into the next generation. An approximation of inclusive fitness, termed average individual fitness, was derived from the product of average territory production and r, the coefficient of relatedness to those offspring. It was found that the family lifestyle confers the greatest average individual fitness on a magpie.

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CASSOWARIES AS CURRENCY

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Following restrictions on tribal fighting with the arrival of the first Australian patrol in 1949, the Mendi people of the New Guinea Southern Highlands evolved a novel dispute-resolving procedure in which the antagonists acquired, and then killed, large numbers of valuable cassowaries (*Casuarius*). The tribe that killed more birds in the ceremonial ritual was the winner as it obviously had greater status and resources. The 'Cassowary-cult' died out between 1974-1978, but during its 20-25 years existence, resulted in the disappearance of cassowaries from traditional jungle hunting grounds used by 14 of 47 Mendi Villages.

Mendi hunting grounds could not meet the demands, and the high prices offered resulted in a flourishing cassowary trade and contributed to over-exploitation throughout large areas of the highlands. Of 378 villages surveyed in other highland districts, 192 reported cassowaries as being either 'extinct' or 'very-rare' in their hunting grounds by 1978. Details of the cult, and of the use of cassowaries throughout the four Highland provinces are presented in the two papers listed below,

REID. BRIAN, 1979. History of domestication of the cassowary in Mendi Valley, Southern Highlands, Papua New Guinea, *Ethnomedizin* 5 (3-4); 407-32,

REID, BRIAN, 1982. The cassowary and the highlanders, Present day contribution and value to village life of a traditionally important wildlife resource in Papua New Guinea. *Ethnomedizin* 7 (1-4): 149-240.

THE REMNANT FORESTS OF NORTHLAND: THEIR CLASSIFICATION AND CONSERVATION RANKING

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An inventory of the remnant forests of Northland has just been completed. It has to be assumed that the approximately 1500 sites visited were once part of an almost continuous forest cover. These forests would have formed a vegetation continuum over topographic and other features. As a result, the remaining stands of forest are only segments of the original vegetation sequences. It is also likely that these remnants are a biased representation of the original forests, since they are predominantly on the less productive land. When the data from such modified forests is examined, the effect is to produce an impression of a random selection of forest segments showing continuous variation in species composition. This places an important constraint on the interpretation of vegetation patterns, in that it is only possible to classify the vegetation as it exists today, rather than to produce a classification which accurately reflects the original forest types.

For classification purposes, each site was described by a list of the canopy species, note was made of any species that could be considered dominant, i.e. occupying more than approximately 30% of the canopy. Thus each species could be represented in one of three ways: present, dominant or absent. The data was then analysed using a classification procedure known as indicator species analysis (Hill, Bunce and Shaw, 1975). The end result of the analysis was a classification of the sites into 31 end-groups based on their botanical affinities. Further interpretation of these end-groups based solely on their botanical affinities proved very difficult, due to the complex nature of the data. To further facilitate interpretation, each end-group was then placed in a landform category following the system developed by Armstrong, Park and Molloy (1981). The landform elements used were as follows: altitude-upland (> 300 m) / lowland; inland/coastal; slope-steeplands (> 15°) / rolling country (5-15°) / flatlands (< 50). The three elements being combined, e.g. inland/upland/steeplands, give 12 possible broad landform categories.

Each end-group was then defined by the mean or median value *for* each landform element of the sites within the end-group and placed in a landform category. This had the advantage of allowing for the wide variation in site location for sites of similar species composition. These end-groups were then further defined by the major species of that group. A major species was arbitrarily defined as one present in at least 75% of the sites in the group. Each forest type was then defined by its landform category and major species composition e.g. inland/upland/steepland-miro, *(Podocarpus ferrugineus),* rimu *(Dacrydium cupressinum),* towai *(Weinmannia silvicola)* (Type la); inland/lowland/steeplands-taraire *(Beilschmedia tarairi),* kohekohe *(Dysoxylum spectabile),* rata *(Metrosideros robusta)* (Type 2c).

The frequency of each forest type was then incorporated into a conservation index. The lower the frequency of occurrence, the rarer the forest type, and thus the higher the conservation ranking. Three other measures were also recorded to construct an overall conservation index for each site; the degree of modification, the degree of isolation, and the size. Each measure was ranked on a 0-100 scale. The mean of the four conservation measures for each site was then calculated to determine the overall conservation index of each site. The sites could then be ranked according to their conservation ranking.

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THE SALMON ENHANCEMENT PROGRAMME

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Three species of salmon have been introduced to New Zealand: the Atlantic *(Salmo salar),* sockeye *(Oncorphynchus nerka)* and chinook or quinnat *(O. tshawytscha)*. Only the last species currently provides an important fisheries. It is found mainly on the east coast of the South Island, from the (northern) Wairau to the Clutha and within this range concentrated between the Hurunui and Waitaki Rivers. Small numbers also exist in Westland. Most chinook populations in New Zealand are diadromous, but there are also lake stocks in which the lake environment replaces the sea.

Chinook salmon spend 1-4 years at sea then return to freshwater to breed. They come in from the sea over an extended period through summer and autumn, during which time they are exposed to river fishermen and form a popular sports fishery in those rivers where they are common. The juveniles spend 3-15 months in freshwater before migrating to sea.

The numbers of chinook salmon in some rivers have declined because of reduced river flows caused by abstraction for irrigation, or because of hydro-electric power dams preventing access to upriver spawning grounds. Most other east coast salmon rivers are threatened by the same detrimental practices. It is anticipated that the number of salmon fishermen will continue to increase and fishing pressure on a decreasing resource will rise. MAF has therefore begun a programme of salmon enhancement in the hope of at least maintaining the size of the present fishery and, better, of increasing the numbers of salmon. In addition, the Ministry is required to support the new commercial salmon farms by supplying stock until such times as farm hatcheries can generate enough of their own.

The brief strategies of the enhancement programme are hatchery rearing and release to sea, confinement of wild fry for onward rearing and release, environmental improvements to natural spawning and rearing areas, and support of commercialisation in the form of salmon ranching. In this programme MAF works together with the Acclimatisation Societies.

The first MAF hatchery was at Silverstream in the Waimakariri basin. A small run of salmon has successfully been induced at Silverstream. The resultant progeny are being used for releases at Silverstream and elsewhere in the Waimakariri. This hatchery is also used for eyeing ova before transport to other parts of the South Island. Hatchery facilities have also been built at Glenariffe on the Rakaia River and a major effort is being made here to increase the Rakaia salmon, both for the Rakaia fishery and to obtain stock for commercial purposes and for release on other rivers. Research is also being done with pilot facilities on other means of enhancement such as creation of spawning channels and rearing of wild fry in impoundments.

At both hatcheries, experiments are being made to discover the optimum time and size for release of young salmon to obtain maximum returns. Returning adults are identifiable by a coded internal tag. Best returns so far have been from juveniles released as yearlings, but this is likely to prove Uneconomic and efforts are needed to improve returns from releases made earlier in the year.

Extensions to natural spawning and rearing areas are being made in the Rakaia basin, with help from the Acclimatisation Societies who are also doing similar work on other rivers.

Because of the temporal extent of one generation (3-4 years) it will be some years before the enhancement programme shows its effects. In particular much work remains to be done on methods of ensuring survival of young salmon transported and released to rivers distant from the hatchery, a part of the programme which will rise in importance once large returns are occurring in the Rakaia.

FLOWERING PATTERNS IN THE GENUS *MELICYTUS* (VIOLACEAE)

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The flowering patterns of three species of *Melicytus* were studied in Canterbury during the 1979-80 flowering season. M. *lanceolatus* was studied at Peel Forest, South Canterbury, and M. *ramiflorus* and M. *micranthus* at Price's Valley, Banks Peninsula. The species are shrubs or small trees and are dioecious.

At Peel Forest, M. *lanceolatus* flowered in late August and early September. The flowers were produced in fascicles in the leaf axils, mostly on the previous season's growth. The plants flowered profusely and synchronously over about three weeks.

M. *ramiflorus* showed a remarkably different flowering pattern. At Price's Valley, flowering occurred over about four months, from November to March, in a series of four, more or less, distinct pulses. I quantified the pattern by choosing a sample of branches on trees of both sexes and visiting them at fortnightly intervals to count the number of flowers. The first two pulses overlapped slightly but the later ones were clearly separated by periods when no trees were in flower. A few plants flowered in early November before the first major pulse. All the plants sampled flowered in the first pulse, but decreasing numbers of plants flowered in subsequent pulses. The number of flowers produced on individual trees also decreased in successive pulses. The flowers were produced in fascicles in the leaf axils and a single branch and even a single node often flowered in successive pulses.

There is evidence that M. *ramiflorus* flowers in pulses elsewhere in New Zealand and that flowering may sometimes be synchronous over large areas. The occurrence of several flowering pulses per season is uncommon in angiosperms and has not been previously recorded in any woody plant of temperate regions.

The flowering pattern in M. *ramiflorus* is further complicated by the occurrence of ramiflory, the production of flowers on bare branches below the leaves on wood older that the present, or the previous season's growth. It is possible to distinguish wood of different ages along the branches by differences in the colour and texture of the bark, the pattern of lateral branches and the spacing of the nodes. Flower production varied with the age of the wood and between the flowering pulses. In the first pulse, all plants flowered on one-year-old wood. Male plants flowered on wood up to 19 years old and females flowered on wood up to 14 years old. The percentage of plants which flowered on wood of a particular age decreased as the age of wood increased. In later pulses, fewer plants flowered on wood of each age and there was a decrease in the maximum age of wood on which flowers were produced. However, flowers were produced on the new growth of some shoots. The number of flowering fascicles and the number of flowers per fascicle decreased with increasing age of wood and with successive pulses, except on the new growth where the reverse occurred. Overall, the one-year-old wood was the most productive, although the new growth became more productive as the season progressed.

M. *micranthus* has an extended flowering season. At Price's Valley it flowered from early November until April. There were plants in flower over the whole of the flowering season, although individual plants did not necessarily flower throughout the entire period. The plants produced a few flowers at a time over a long period. Some plants, especially males, appeared to have a peak of flowering, but different plants 'had peaks at different times and there was no regular, synchronous pattern as there was in M. *ramiflorus*.

Thus, the three species show a marked contrast in flowering patterns. There is a single brief flowering episode in M. *lanceolatus,* a series of four pulses of diminishing intensity in M. *ramiflorus* and extended flowering in M. *micranthus*.

EXPLOITATION OF WATERFOWL IN NEW ZEALAND

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With the aim of establishing a data base on hunter success and the harvest levels of each game species, a waterfowl hunting diary scheme was begun in 1968.

Waterfowl are exploited each year by about 50,000 licensed hunters. In addition, there are an unknown number of participants and their families who, by confining their hunting to their family land, are not required to hold a game hunting licence. In rural areas as many as 20 % of local hunters could be unlicensed and perhaps they could number 5,000 nationally. Because these hunters are difficult to contact, estimates of waterfowl harvest as presented below are likely to be conservative.

Over the initial years of the scheme, diaries were distributed with every fifth licence sold by most sports shops, and wildlife rangers gave them to every third person interviewed in the field.

The initial sample in 1968 was equivalent to 1.1 % of licence sales, in 1969 2.2 % were sampled, and since then a steady 3.3 % of licensed hunters have returned diaries.

Hunter interest and co-operation has been maintained by providing each with a summary of the past season's results (e.g. Caithness, 1981) and a fresh diary two weeks before the new season begins. The diary return rate averages 60% each year.

Between 1968 and 1980, 19,600 diaries have been returned on which 458,000 birds were recorded as retrieved, with an average season's bag of 23.4 per gun.

The most ubiquitous species hunted were mallards *(Anas p. platyrhynchos)* and grey duck *(A. s. superciliosa*). Collectively they comprised c. 85 % of the

TABLE 1. *Estimated number of waterfowl harvested and estimated waterfowl resource 1968-1980.*

Year	Estimated Harvest x 10^3	Estimated Resource x 10^3
1968	959	4,795
1969	857	4,285
1970	869	4,345
1971	895	4,475
1972	1,060	5,300
1973	966	4,830
1974	936	4,680
1975	1,200	6,000
1976	1,102	5,510
1977	1,276	6,380
1978	1,254	6,270
1979	1,214	6,070
1980	1,348	6,740

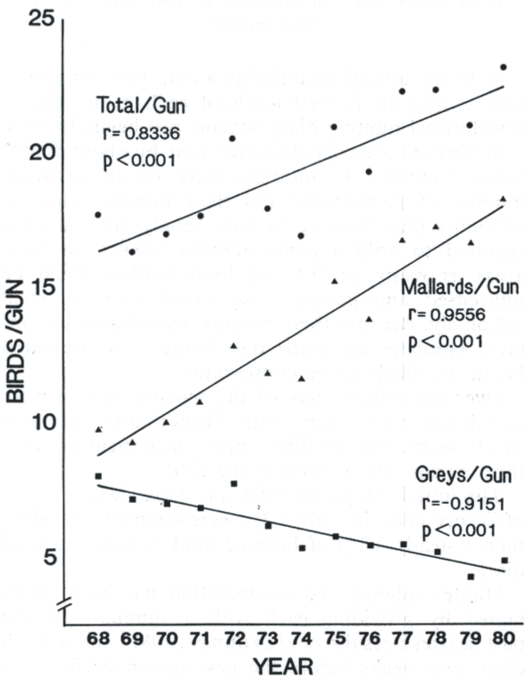

FIGURE 1. *Average bag per gun for grey duck, mallard and both species combined, 1968-1980.*

bag. Other game birds entered on the diaries were New Zealand shoveler *(A.rhynchotis variegata),* paradise shelduck *(Tadoma variegata),* black swan *(Cygnus atratus),* Canada goose *(Branta canadensis maxima),* and the gallinule pukeko *(Porphyria p. melanotus).*

From banding studies on each game species except pukeko, annual return rates and mortality rates have been calculated: grey and mallard duck (Balham and Miers, 1959; Caithness, unpub.), shoveler (Caithness, 1975), paradise shelduck (Williams, 1972, 1979a), black swan (Williams, 1973, 1979b) and Canada goose (Imber & Williams, 1968). While there are differences in return rates for each species, generally the collective return in the year of banding is in the order of 20%. Because there is no evidence of any differential vulnerability between marked and unmarked birds, this implies that about 20 % of all birds are shot. From these data, the average bag revealed by diaries, multiplied by licence sales, gives an annual harvest estimate. As this represents only 20% of the population, the total resource available to hunting is in the order of five times the estimated harvest. Approximations of the harvest rates and population resource available for hunting are given in Table 1.

Clearly, the waterfowl resource has been increasing steadily over the past decade, due almost entirely to a rapid expansion of the mallard population, and a slow decline in grey duck. In 1970, mallard and grey duck were 81 % of the total resource, the mallard-grey ratio was 57 : 43 and their populations 2.0 and 1.5 million respectively. By 1980, they were 85% of the total resource, the mallard-grey ratio now 80: 20 and their respective populations 4.5 and 1.2 million.

As a consequence of the burgeoning mallard population, the hunters have clearly enjoyed vastly better results over the past decade and there is no indication they have yet reached their zenith.

The average bag per gun of mallard (Fig. l) has significantly increased between 1968 and 1980, while, in turn, the bag for grey duck has significantly decreased. Overall, the mallard-grey duck bag has improved by one third.

The increasing dominance of mallards in the duck population has been more rapid in North Island than in South Island (Fig. 2). Nationally, they have now reached 80% of the waterfowl population. Apart from Wairarapa in North Island, where the two species seem to have reached a proportional stability, mallards are everywhere increasing. In South Island, and in the grain growing areas in particular, farmscapes already dominated by mallards in 1968, have seen a gradual change approaching saturation.

Mallards are clearly well adapted to cope with a man-infested or man-modified environment, and in

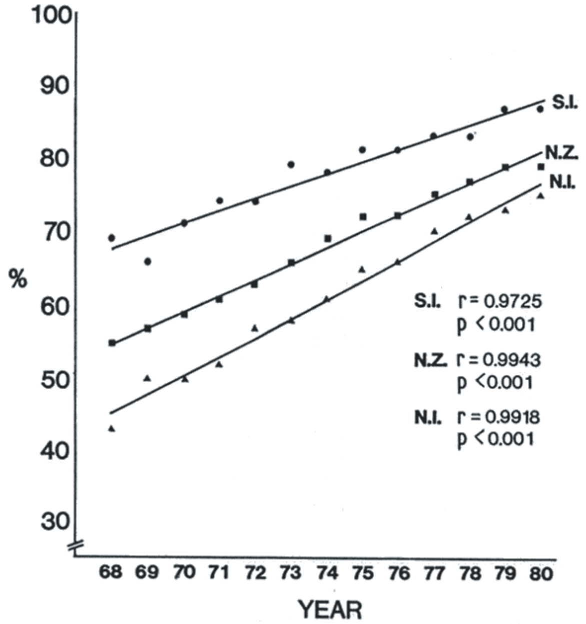

FIGURE 2. *Changes in the proportion of mallards in the combined grey duck-mallard bag in North Island, South Island and both islands combined, 1968-1980.*

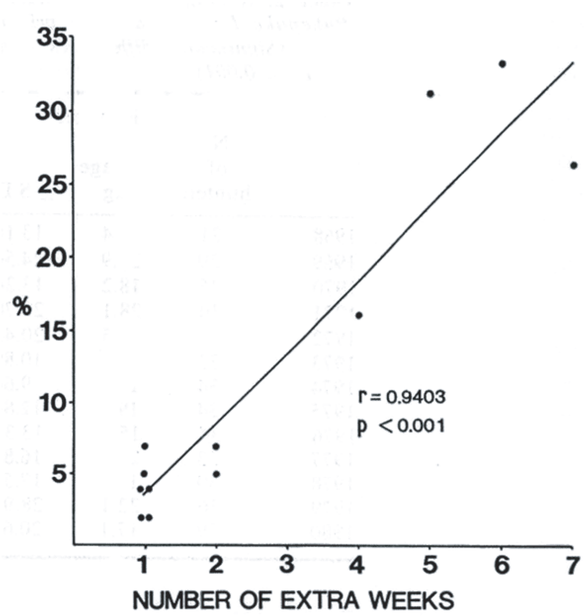

FIGURE 3. *Percent increase in season's bag obtained by extending the season beyond the traditional five weeks.*

some cases, in recent years, they have run foul of cropping farmers. The dilemma for game managers is how to more intensively exploit the population. Relaxing restrictive bag limits from 15 birds per day to 25 has made a small contribution, but increasing the length of season so that gun pressure can be sustained seems the most promising method.

Traditionally the game season has begun on the first Saturday in May and extended for five weeks to take in Queen's Birthday, the first Monday in June. In recent years, in some districts, the seasons have been extended by as much as seven weeks. This has resulted in a proportional increase in each season's bag relative to the length of extension (Fig. 3).

Diary analysis has revealed an unsuspected sociological problem which further compounds obtaining an adequate harvest of the dominant mallards. There are two distinct groups of hunters- (a) those hunting on private waters; and (b) those hunting on public waters. With the former group, their hunting behaviour is controlled in that inconsiderate action like shooting out of range, or too soon, is unheard of. They usually share their bag equally and enjoy good fellowship. They will desist from hunting for extended periods throughout the season so that the birds return and they invariably manage the area on a co-operative basis.

The latter group are almost the complete antithesis, consequently their bags are depressed (Table 2). Only in 1971 did the Pukepuke Lagoon (public) hunters obtain a better bag than elsewhere in Manawatu (private). In that year, waterfowl breeding at Pukepuke was outstanding, with a mean production of nine young per female, and local hunters clearly benefited.

The diaries also demonstrated that public water hunters (c. 50% of the sample) adopt a "boom and bust" approach in that they largely hunt only on opening weekend. The private hunters, although resting their areas, tend to put in more effort for better results.

The game manager cannot order hunters to hunt or to co-operate, and is now faced with a burgeoning mallard duck population while dealing with a consumer group with largely only passing interest. It is clear that successful qualitative and quantitative management aimed at exploiting mallards more intensively requires knowing a great deal more about hunter psychology and behaviour than is now known.

TABLE 2. *Average waterfowl harvest per hunter obtained on public water (Pukepuke Lagoon) and on private waters elsewhere in Manawatu, 1968-1980. (Significant differences indicated as* * P < *0.05.* ** P < *0.01.* *** P < *0.001)*

	Public water			Private water			
	No. of hunters	Average bag	± S.D.	No. of hunters	Average bag	± S.D.	
1968	21	22.4	13.16	16	25.4	12.80	
1969	29	25.9	24.54	27	27.3	18.10	
1970	25	18.2	13.24	31	20.8	11.53	
1971	30	28.1	28.70	49	21.9	16.07	
1972	36	22.5	20.45	53	27.2	23.04	
1973	33	14.7	10.89	42	24.4	17.00	**
1974	34	10.9	9.64	64	16.7	10.49	**
1975	34	19.0	12.84	49	21.8	14.50	
1976	34	15.1	13.31	42	23.6	20.93	*
1977	33	22.4	16.81	58	27.8	17.93	
1978	39	16.2	17.51	49	27.3	17.79	**
1979	36	22.1	28.93	31	26.1	19.18	
1980	39	17.1	20.68	84	32.9	17.43	***

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