Appendix 3.5 Schematic diagram for construction of seedfall traps

Appendix 3.1 - Descriptions of maturity stages for selected species.

Developmental stage of flower (1) bud showing, (2) swelling and growing, (3) approximate mature size but still unopened, (4) open.
Developmental stage of fruit (1) recently fertilised, (2) swollen and growing, (3) approximate mature size but still unripe, (4) ripe.

The following descriptions are a guide to assigning the fruiting and flowering stage according to the scoring system above. In all described cases stage (2) covers a wide range of phenological stages. The reason for such a large category (2) score is that the main interest is in when fruit or flowers are available as food sources. The rates at which fruit and flowers mature are of interest but the stages through which they go during these processes are not.

Karaka flowers

Stage (1) The round pyramidal much divided inflorescence bud is protruding from the tip of the branch. Flowers only occur on branch tips surrounded by older leaves. If the leaves look light green, very new and shinny then there is unlikely to be an inflorescence there. Only score as a (1), don't try to count.
Stage (2) The inflorescence bud is expanding and filling out. The individual flower buds become more pronounced. Count the number of inflorescences per cubic metre; don't try to count the number of flowers per inflorescence.
Stage (3); The inflorescence is fully expanded and separated. Individual flower buds look full-sized (about 1 - 2 mm round). Count the number of inflorescences per cubic metre.
Stage (4) The yellow green flowers have opened. Don't count the number open, give a rough percentage of open flower, as a proportion of the cubic metre. Count the number of inflorescences per cubic metre.

Karaka fruit

Stage (1) Individual fruits visible, generally less than 2 mm long. Still hard to count at this stage.
Stage (2) The fruit is elongating and eventually thickens up and approaches full sized. Full sized fruit is anywhere between 3 and 5 cm long and 1 to 2.5 cm in diameter. Don't include full sized fruit under this category, but do count the number of fruits per cubic metre (and if desired the number of panicles within the cubic metre that carry the fruit. In that case the notation would be 48 frt/9 pan.)
Stage (3) The fruit is full sized but has not coloured up yet to a rich golden/apricot yellow. Count the number of fruit per cubic metre (and if desired the number of panicles within the cubic metre that carry fruits, notation as for stage 2)
Stage (4) The fruit is full sized and has coloured up to a rich golden/apricot yellow. Count the number of fruit per cubic metre (and if desired the number of panicles within the cubic metre that carry fruit, notation as for stage 2.)
Note; sometimes the fruit remains on the tree after it has over-ripened and shrivelled up. Don't count those fruits as they are not acceptable to birds any more.

Karaka general notes

- Fruit tends to ripen in bunches, either all or most of a bunch ripens, or the bunch/flower panicle does not develop at all. Fruit does not appear to abort at juvenile stages. James (1995) commented that, pigeons did not seem to favour karaka even when there were copious amounts on the tree.
Development of karaka fruit is very rapid, unlike taraire, which seems to have a quiescent phase.
It looks as if only old shoots produce flower buds, i.e. where new leaves were produced over the winter no flower buds appear. This means that for some Karaka, which were severely chewed by beetles, there was not much opportunity to flower because they were in the process of renewing leaves every year.

Puriri flowers

Stage (1) The immature inflorescences are visible in the leaf axils, but cannot distinguish the individual flower buds yet.
Stage (2) Can see, and perhaps even count, the individual flower buds within an inflorescence. Some buds might be starting to colour up towards pink, but the buds are still tightly packed.
Stage (3) The flower buds have achieved full colour and look ready to burst open at any time, or are partially open but not in such a way that birds or insects could access the nectar at the base of the calyx.
Stage (4) The flowers are fully open with stamen and pistil showing.
Note, there are a wide variety of puriri flower colours, ranging from whitish-yellow to scarlet-pink. The colour varies per tree and possibly also between seasons. To make sure that you are scoring the colour correctly, find open flowers in the tree, or on the ground, as a colour check.

Puriri fruit

Stage (1) The cupped flower-bases left on the tree, after the flower has fallen off. Can't distinguish between those flowers that were pollinated and those that were not, so don't even try.
Stage (2) The little knob in the base of the flower stalk is starting to fill the cup. Count fruit per cubic metre, up to and including nearly full-sized fruit. To determine what full sized-fruit is for that particular tree locate some ripe fruit in or below the tree.
Stage (3) The fruit looks full sized but is still green in colour, or just starting to colour up.
Stage (4) the fruit is full sized and red (or white depending on the tree) in colour.
Note; Don't bother to count the fruit once it has gone completely black and/or shrivelled. Fruit in that state is overripe, not acceptable to birds and unlikely to germinate.

Puriri general notes

Puriri can have all and any of the above stages on the tree at any one time. In fact sometimes you can find all of the above stages on one inflorescence (Petrie 1905)

Taraire flowers

Stage (1) The much divided inflorescence is bud protruding from the tip of the branch. Only score as a (1), don't try to count.
Stage (2) The inflorescence bud is expanding and filling out. The individual flower buds become more pronounced. Count the number of inflorescences per cubic metre, don't try to count the number of flowers per inflorescence.
Stage (3); The inflorescence is fully expanded and separated. Individual flower buds look full-sized (about 1 - 2 mm round). Count the number of inflorescences per cubic metre.
Stage (4) The red-sepia flowers have opened. Don't bother to count the number open, just give a rough percentage of open flowers as a proportion of the cubic metre. Count the number of inflorescences per cubic metre.

Taraire fruit

Stage (1) The individual fruits are visible, generally less than 2 mm long. Still hard to count at this stage.
Stage (2) The fruit is elongating and eventually thickens up and approaches full sized. Full sized fruit is anywhere between 3 and 5 cm long and 1 to 2.5 cm in diameter. Don't include full sized fruit under this category, but do count the number of fruit per cubic metre (and if desired the number of panicles within the cubic metre that carry the fruit. In that case the notation would be 48 frt/9 pan.)
Stage (3) The fruit is full sized but has not coloured up yet to a dark purpely black. Count the number of fruit per cubic metre (and if desired the number of panicles within the cubic metre that carry fruit, notation as for stage 2.)
Stage (4) The fruit is full sized and has coloured up to a dark purpely black and no longer has a glaucous sheen. Count the number of fruit per cubic metre (and if desired the number of panicles within the cubic metre that carry fruit, notation as for stage 2.)

Notes; sometimes the fruit remains on the tree after it has over-ripened and shrivelled up. Don't count those fruits as they are not acceptable to birds any more.

Kohekohe flowers

Stage (1) The much divided inflorescence bud is protruding from branches and the trunk of the tree. Only score as a (1), don't try to count.

Stage (2) The inflorescence bud is expanding and elongating. The individual flower buds become more pronounced. Count the number of inflorescence per cubic metre, don't try to count the number of flowers per inflorescence. However as the inflorescences approach full size it is useful to estimate the approximate length. A previous, as yet unpublished study, showed that there were on average one flower per cm length of inflorescence. Male trees will generally have longer more branched inflorescences than female trees.

Stage (3); The inflorescence is fully expanded and separated. Individual flower buds look full-sized (about 2 - 5 mm long). Count the length and number of inflorescence per cubic metre, note down as 125 cm/6pan.

Stage (4) the pale cream flowers are open or opening. Count either the number of flowers or length of panicle per cubic metre, these measures are approximately the same. Flowers on female trees open with the pollen sacks already shrivelled up, otherwise they look identical to male flowers. Male flowers are perfect also and have pollen bulging out of the pollen sacks. Refer to Braggins (1999) for more details.

Kohekohe fruit

Stage (1); This stage can initially be hard to judge. A lot of the flower bases remain attached to the panicles after the flower corolla has dropped off. However this stage lasts only a week or two. The fruit is very slow to develop in the early stages. Count number of fruit per cubic metre. Cannot count/measure length of panicles any more because the fruit is not always evenly spaced.

Stage (2); This stage lasts for nearly 11 months. Full sized fruit is a sphere from 2 to 5 cm in diameter. Count number of fruit per cubic metre.

Stage (3); The last couple of weeks before the fruit opens it does not grow in size any more - that is when it can be counted as full-sized fruit.

Stage (4); If fruit is scare you are unlikely to see the orange fruits inside the opened capsules because the birds will have found them before you could. So count both open empty seed capsules and opened/opening seed capsules per cubic metre. This count will drop quite rapidly, since the empty seed capsules drop of the tree very quickly.

Notes; In more northerly areas of New Zealand the fruit opens before the flowers, in more southerly areas (form at least Taranaki down) both are open at the same time. Kohekohe tends to have very pronounced good years bad year cycles. A good flowering year will be followed by a good fruiting year but a bad flowering year. This is probably due to energetics, since it takes a year for the fruit to ripen, thus when the tree has a lot of fruit it does not have the energy to produce many flowers that year.

Male trees seem to flower earlier and more profusely than female trees. Also in areas with high possum browse chances are that only the male trees flower. Male trees can produce the occasional fruits (up to about 4 fruit/cubic metre).

Tawa flowers

Stage (1-4); It is very hard to tell what flowering stage tawa is at. Inflorescences can be found on the tree most of the year and it is very hard to judge whether the flowers are open or not even with binoculars. If there are flowers at eyelevel you might be able to double check. Don't try counting the flowers, only score which stage the majority of inflorescences are at.

Tawa fruits

Stage (1); It is unlikely that stage 1 fruits are visible, they are very difficult to distinguish from flower buds.

Stage (2); Since the fruit is very cryptic and looks much like the leaves it is unlikely that many stage 2 fruits will be spotted. It might be possible to sight a few occasionally with binoculars, or if the fruits are at eye height.

Count fruits per cubic centimetre if possible. Full sized fruit is about 2 to 4 cm long and 1 to 2 cm wide.
Stage (3); These fruits can be distinguished from the leaves, since they tend to hang more and move more slowly than the leaves. Even in a gentle breeze the tawa leaves will rustle while the fruit will either hang or bob. Count fruit per cubic metre.
Stage (4); The fruit will become quite obvious when it is fully ripe and purplely black. Count number of fruits per cubic metre.

Kowhai flowers

Stage (1); Golden brown buds appear. The leaf buds have a more feathery look. Just note presence as a 1
Stage (2); The inflorescences become more obvious. Count inflorescences in the early stages, and if possible multiply the number of inflorescences by average number of flowers per panicle as the buds get bigger. Full sized buds are about 1 to 2 cm long.
Stage (3); Often the tips of the petals start protruding out the ends of the buds. Count inflorescences per cubic metre and multiply by the average number of flowers per panicle.
Stage (4); Flowers are fully expanded. Count inflorescences and multiply by the number of flowers per panicle

Kowhai fruit

Stage (1); The stamen of the flower rapidly elongates. Counter number of elongating stamens per cubic metre.
Stage (2); Seedpods fully lengthened and starting to thicken up. A fully-grown seedpod will have all the lumps and flanges of a mature seedpod, but still be green. Count number of developing seedpods per cubic metre.
Stage (3); Fully expanded, looks completely full sized and mature but are still green. Count number of developing seedpods per cubic metre.
Stage (4); Pods ripen to a dry brown husk. Count number of seedpods per cubic metre.
Notes; - From casual observation it seems as if a particular kowhai tree might alternate very good flowering seasons with poor one. Also, trees with leaves have fewer flowers than trees with few or no leaves. Anderson (pers. comm.) noted that bellbirds penetrate the side of the flower to obtain nectar, they do not use the corolla. Flower buds appear to have a more rounded tip than leaf buds, still, they are very hard to distinguish.

Rewarewa flowers

Stage (1); Little pyramidal lumps appear on the branches, a reddy-brown in colour. Just note presence as a 1 unless really keen to count lumps per cubic metre.
Stage (2); The pyramids lengthen and become more brush like. A fully expanded inflorescence is about 10 - 12 cm long and 5 to 7 cm in diameter. Count number of inflorescences per cubic metre.
Stage (3); Inflorescences are fully expanded but petal tips are not rolling back yet to reveal yellow stamen yet. The inflorescences still look like a coarse brush, not a fine "Australian type" bottlebrush. Count number of inflorescences per cubic metre.
Stage (4); Yellow pollen on the pistil, below the stigma, visible, petals are curled back to the main stem. The inflorescence looks more delicate at the outer edges but more solid toward the centre. Often bees and other insects humming around the flowers. Count number of inflorescences per cubic metre.

Rewarewa seedpods

Stage (1); All of the petals fall off leaving just the pistil. Where the flower has been successfully pollinated this will expand and thicken. Note number of inflorescences per cubic metre or just note as stage 1
Stage (2); Seed capsules continue to lengthen and thicken. As the seed capsules become more pronounced and distinct switch to counting actual seed capsules per cubic metre.
Stage (3); Seed capsules fully grown, 4 - 6 cm long and 1 cm thick, but not opened yet. Can at times be difficult to see if seed capsules open.
Stage (4); Seed capsules split open lengthwise - use binoculars to confirm.

Notes; In possum prone areas a lot of the flowers will have been damaged or knocked off. In some areas in the north of New Zealand where there are few possums the seed capsules can stay on the tree for at least 3 years. Old seed capsules can be distinguished from new ones because they are a darker, grey to almost black and have lost the tomentum. Don't count old capsules, just those from the most recent year.

***Metrosideros* flowers**

Stage (1); Flower buds very hard to tell from leaf shoots, you can distinguish them a bit after a few years of practice. Count number of inflorescences per cubic metre or just note presence of buds.

Stage (2); Leaf buds elongate very quickly, flower buds stay more rounded and club-shaped. A fully expanded inflorescence is usually as wide as it is long, or sometimes a bit wider. Count number of inflorescences per cubic metre.

Stage (3); Each branchlet in the inflorescence usually carries 3 buds (this does vary from 1 to 5, but 3 is the most common and probably the average though this hasn't been checked). When the tips of the buds start colouring up then flowering is imminent. Count the number of inflorescences per cubic metre, if a more accurate estimate is required then multiply this by an estimate of the number of flowers in an average panicle.

Stage (4); Usually pretty obvious when the flowers are fully open. Colour depends on the species. Counting as for stage 3.

***Metrosideros* seeds**

Stage (1); Is immediately after the flowering has finished.

Stage (2); This is probably the longest stage. The flower base expands and becomes rounder. Count number of inflorescences (and multiply by average number of capsules per inflorescence if desired)

Stage (3); The seed capsules are fully expanded but not turning brown or opening yet (check with binoculars). Count number of inflorescences and multiply by average number of seed capsules per inflorescence if desired.

Stage (4); Seed capsules are opening, seed can be seen flying from the tree (and gets in your eye) and seed capsules are turning brown. Score as for Stage (3).

Other species

Tawapou

Flowers hard to see at all stages. Fruit is the same size range as tawa to taraire. Ripens from green to yellow to red to black. Pigeons prefer it at the red stage, seem to ignore it at the black stage.

Kahikatea

Didn't do much counting of kahikatea. Never looked for or counted the flowers and didn't really try to count the fruit, just noted ripeness. Other small flowered and fruited species, such as rimu, and totara will also be problematical.

Miro & matai

Didn't try counting flower cones, but did note ripeness if that was possible. Rimu fruits are easy to see from about half-grown to fully red. Not sure how easy unripe matai is to spot, but ripe fruit are obvious black currant sized fruits.

Appendix 3.2 - Example of phenology data collection form

Whitford p.2

Collector: Site: Date:

	Flowers			Fruit			groundfall	
species	total #/m^3	#/m^3 open	Developmental stage of majority	total #/m^3	# or % ripe/m^3	Developmental stage of majority	Circle for flowers, underline for fruit	comments
Kr6			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
WRa6			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
TR8			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Pr3			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Pr4			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Pr5			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Kh3			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Kr9			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Kh8			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Kh9			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Pr6			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Kh4			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Kh10			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Rew1			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Rew2			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Rew3			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Rew4			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Rew5			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Tw4			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Kh5			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Kh6			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Tr5			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Tr6			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
Tw5			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
do *'s			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
WRa9			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	
			1 2 3 4			1 2 3 4	1-10 11-25 26-75 76+	

Developmental stage of flower (1) bud showing, (2) swelling and growing, (3) approximate mature size but still unopened, (4) open.
Developmental stage of fruit (1) recently fertilized, (2) swollen and growing, (3) approximate mature size but still unripe, (4) ripe.

Appendix 3.3 - Descriptions for seedfall trap contents

The contents of each seedfall trap was decanted into pre-labelled bags and allowed to dry so that samples were 'dry to the touch'. This took some experimenting, initially with oven-baking and blow-dryers, but by 27-6-95 the contents of sample bags were decanted into open weave cloth bags and allowed to dry naturally over a couple of nights. This also allowed insects to escape.

General descriptions

Flowers -includes all floral parts, including inflorescence stalks as a measure of floristic effort. To be included in results flowers must be of sufficient size to be weighable, or more than one of a small flower must be present to register a "yes". (From 11-3-95 two categories of "yes" are now indicated by 0.01 "a few present", and 0.05 "more than 2-5 but not easily separated/weighed".)

Leaves & twigs -includes leaf blades and stalks, and any other woody/stem material of the plant in question as a measure of vegetative effort. Any material not immediately recognised as belonging to one particular species is consigned to the "other" category.

Seed -includes all parts of the seed, including stalks, husks dried and/or fresh fruit as a measure of reproductive effort. See specific plants for more detailed descriptions.

Other -includes, all remaining material too small to separate, too mixed up to separate, too small to weigh, other materials such as lichens, mosses, insects, and all categories indicated by "yes" in the weight column. Where no "other" weight is given then the majority of the sample was composed of a recognisable plant part and assigned to that variable, common examples are flowers (e.g. rewarewa, taraire, karaka, tawa or pohutukawa), kowhai leaves, small seeds etc.

Species descriptions

Alseuosmia flowers -trumpet shaped flowers up to 2 cm long, variable number of petals. This plant by Wend tw6 has creamy white flowers with pinky-red flush on the interior. (*Alseuosmia macrophylla*)

Alseuosmia seed -a rich port red fruit is about 7-10mm long, fleshy.

Cabbage tree seed three lobed green (unripe) of white fruit up to 3/4 cm contains **Small black half spiral things.**

Coprosma fruit -two grass-like seeds enclosed in fleshy tissue. Looks like pale coffee bean.

Coprosma seed -the grass-like seed from above but without the fleshy tissue and generally separate.

Droppings, mouse -not striated, smaller than rat droppings.

Droppings, possum -single ovoid to deer/sheep like in form. Usually quite smelly.

Droppings, rat -not striated, quite large.

Droppings, weta -are striated, sometimes can only see one line, look rather like mouse or rat droppings in other respects, but blunt ended not pointy.

Hairy flowers -orange coloured flowers with so many stamen that it looks like fine hair- black wattle flowers.

Kahikatea seed -consumed look like little round black seeds, often with curvaceous stalks still attached. Not consumed means that the orange receptacle is still attacked.
-predated, the little black seeds have holes in them.
-Immature seed not completely developed and/or fleshy receptacle not completely developed/mature.

Kanuka flowers -presence is indicated by the little white floral leaflets in the sample.

Kanuka seed/pods -have to check this, but it looks like kanuka seedpods always have 5 “seed apertures" whereas rata (*Metrosideros perforata*) seedpods only have 3. (12-9-95)

Karaka flowers -look like taraire flowers but are pale or green in colour.

Karaka seed large yellow fruit up to 4 cm long
Predation by possums- can see the teeth marks on the fruit. It is interesting to note that the possums only eat the fruit flesh initially (and only the ripe yellow flesh, they avoid the green stuff) but later (about 3 months or more) come back for the kernel.
Except for a kernel found at Remiger's Bush on 22-1-97 which had the inside partially eaten.
Essentially the possum predation of karaka does not limit germination of the seed at a later stage, until the possums come back to the kernels after 6 months.

Karo flowers fall apart; the petals are still reddish brown in colour and curved over. Can also often find the flower-base in the trap

Kohekohe flower -panicles can be distinguished from titoki by larger flower buds that have a tripartite split (like the fruit). After discussion with Mick about the nectar content of kohekohe flowers (30-5-95) thought about counting kohekohe flowers as well as weighing them, but in the field I count flower panicles, not flowers. As a compromise could count the number of flowers on a panicle in relation to its size/length.

Kohekohe immature fruit just after flowering. count the swollen floral bases after flowering as immature fruit from 29-6-95 onwards. These look a bit like small spinning tops, quite different from immature flowers that are more ovoid in shape.

Kohekohe fruit -entire immature fruit capsules are counted and weighed. Individual fruits (one or more seed covered with fruit flesh, often 2 or 3 seeds) are counted and weighed, and any fruit husks are included in the total weight column only. -ripeness in fruit is indicated by fleshy capsule having split.

Kohekohe seed -individual seeds are counted and weighed, the total column includes the weights and numbers of seed from both “loose” seed and those still contained in a fruit (i.e., still enclosed by fruit flesh. It is quite easy to count the number of seed within a fruit).
-consumed seed all fruit flesh removed. These are difficult to determine sometimes, especially when samples have not been immediately processed and the fruit flesh has been allowed to dry out, in that case they are only included in the total columns

Kowhai flowers -immature flowers/buds are covered in a golden downy fur.
-predation is indicated by a hole chewed in the flower or bud.
-loose flower petals can also be found in the seedfall traps. A yellow brown with clear darker brown veins running longitudinally. Weighed in the totals but not counted (as I don’t know from how many flowers these come).
-it seems likely that we will only be able to count the number of immature flowers in the seedfall trap because mature flowers do not drop intact, instead they loose their leaves.
number of flowers is the number of flower bases, with the immature seedpod attached, found in the trap. Whole flowers are not included with flower parts.
- differential feeding by tui, Sept 1996 general observation that some fully flowering trees are more favoured by tui than others. There might be a correlation between the colour of the flowers on the tree and attraction/nutritional value. Darker trees seemed less favoured - perhaps the flowers were older?

Kowhai seed/pod -seedpods are counted and weighed, individual loose seeds are merely weighed. A seedpod (or part there off) containing only one seed is still counted as an entire seedpod.

Myrtaceous flower/pods -not sure if these are rata or kanuka seedpods. They most likely are rata seedpods.

Lacebark seed -are winged hay coloured seed. Predation shown by holes chewed in to the seed.

Nikau seed - predated, most of the fruit tissue removed (tissue rubs off very easily, but nikau seed force-fed to pigeons can still have partial flesh on them (pers. comm Rachael Bell)).
Classify as rodent predated when can't really distinguish what ate the fruit. If can find tooth marks then assign to appropriate category. I suspect that rats tend to chew into the seed whereas possums only remove the fruit flesh from the outside (possum predation of fruit flesh noted @ Val's bush on 8-1-97)
-chewed, seed husk in pieces (usually 4 pieces) indicative of rats.
Following discussion with Mick (31-5-95) have decided to tally the number of fruiting nikau along the phenological track at each site to get some indication of available ripe fruit or full sized green fruit.

Pohutukawa flowers -presence is indicated by red pistils & stamens or by furry silver flower bud scales.

Pohutukawa seed -Later in the season the flower/seed capsules fall in the traps, immature means that they haven't opened yet and disgorged the seed.

Pohutukawa leaves -look like tawa leaves except that veins are parallel, not branching, and underside can be (but not always in older leaves) distinctly tomentose. Both tawa and pohutukawa leaves have a tendency to under-curl leaf margins.

Puka seed small (up 5 mm long) green oval seeds, often found predated by insects. Sometimes multiples still attached to stalk of inflorescence. Also called small green oval fruit (epiphyte) or similar

Puriri flower -after baking, fresh flowers become a light brown, distinct from the older, nearly black flowers.
-flower stalks, are not counted individually, but weighed as part of flower weight. (this can sometimes skew the results as many more stalks can be in the sample than flowers, however the stalks should be included as a measure of reproductive effort)
-flower buds are counted as immature flowers, and weighed as such.
-predated by insects indicated by holes at the base of the calyx, shredded flowers are indication of possum predation. Incisions at the base of the flowers or flowers partially torn from the base up are indications of predation by birds, most likely rosella.

Puriri seed -stalks are not individually counted but weighed as part of seed, if only stalks in sample then only weight is noted. (this can sometimes skew the results as many more stalks can be in the sample than seed, however the stalks should also be included as a measure of reproductive effort)
Possum predated puriri seed have the fruit flesh removed in strips, the underlying woody capsule has the appearance of being planed smooth, occasionally tooth marks can be found on the flanges of the capsule or in the remnants of the fruit flesh (first found @ Val's bush on 8-1-97)

Rata flowers -seedfall presence indicated by flower bases, rather like kanuka capsules, but then shaped more like pohutukawa flower bases, a bit smaller than kanuka seed capsules on average too usually on a stalk, and often stigma still attached. Can't readily see whether seed has been disgorged or not, hence no seed category given. Additional confirmation is the presence of rata leaves in sample.
-clear polyurethane looking flower scales come from M. perforata.

Red matipo seed -immature fruit is small egg-shaped green with small red stripes.

Rewarewa flowers -presence is indicated by any part of the flower being present, the stamen, drumsticks ect. Not counted only weighed when sufficient in sample to warrant this.
-immature flowers are the entire inflorescence before it has grown much.
-one entire inflorescence had 50 floret positions on it (5-4-96)

Appendix 3.4 - Description of toxins

Talon® is produced by Crop Care Holdings Ltd, part of the ICI Group, and contains 0.02g/kg brodifacoum, which is a slow acting second generation anticoagulant poison, with death resulting commonly within one week of ingestion for rats and up to several weeks for possums. Talon was alternated with Pindone to reduce the chance of bait-shyness in possums.

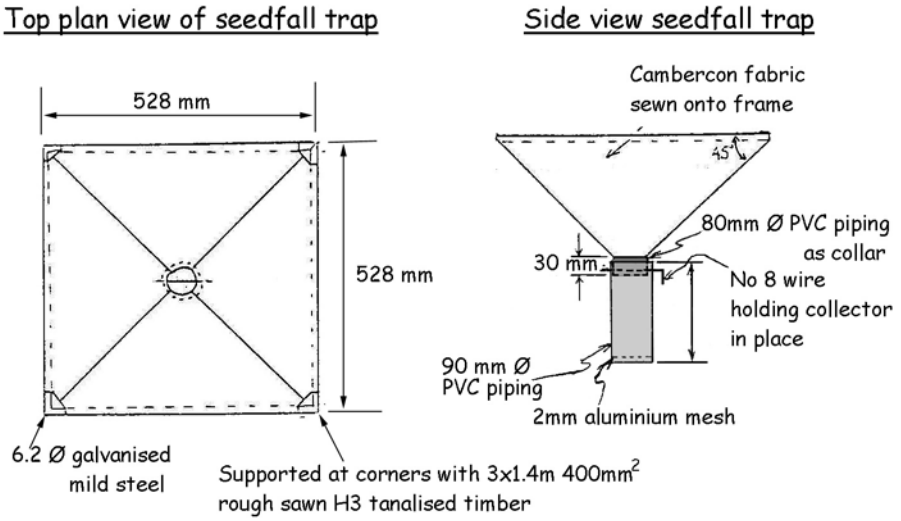
The Pindone cereal pellets contained 0.05% pindone which is a first generation anticoagulant that causes death by haemorrhage in 4 to 11 days after consumption. Pindone pellets were manufactured by Pest Management Services Litd, Waikanae.

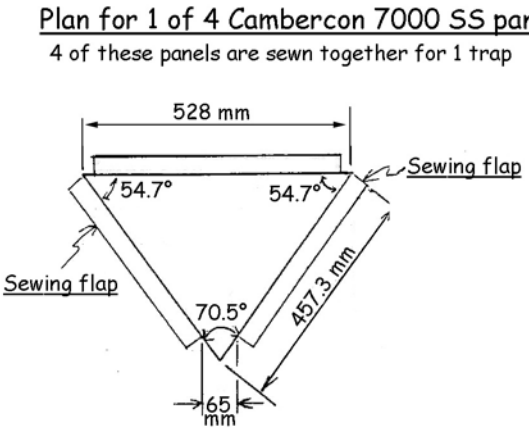
Talon 50WB®, produced by Crop Care Holdings Ltd, part of the ICI Group, is a cold formed wax pellet containing 0.05g/kg brodifacoum.

	October 1996 collected inflorescences from the ground and counted flowers on them. Most flowers come off the main stem in pairs these are called **double flowers**. There are some flowers that are not paired hence **single flowers**. **Undeveloped flowers** look like miniature immature antler buds. The category **flowers missing** is used when there is an obvious flower scar on the stem but no flower. Sequence of analysis: measure length of inflorescence, check whether end looks abscised or bitten off, check for chew marks, check for flowers missing & undeveloped flowers, then snip off all paired flowers while counting them and count the remaining flowers as singles. From 15-10-1996 started counting individual flowers (i.e. not inflorescences) in seedfall traps.
Rewarewa seed	-capsules are considered mature when these have split open. Predated when a visible hole can be seen in the juvenile seed capsules. Individual capsules are counted, but the winged seed is just weighed. 23-1-97, Whitford Bush, the possum damaged rewarewa seed capsules that are appearing in the traps look quite old, perhaps they predate the possum poisoning regime? possum predation of rewarewa seed capsules starts happening once the capsules reach about 3 cm long and 4mm in diameter.
Taraire flowers	-look like karaka flowers but are red in colour.
Taraire fruit	-immature fruit is usually blue and has a red tinged swollen receptacle. -ripe fruit exudes a lot of purple pigment when the skin is punctured (this colour comes from the skin) unlike tawa fruit that produces a clear juice. Taraire fruit also has a tendency to go sticky jelly like, whereas tawa decomposes more like a plum does. -dried kernels have a netted appearance, unlike tawa kernels that are more like olive kernels. -predation by possums or rodents begins as soon as the fruit is about 1 cm long!!!
Tawa flowers	-miniature versions of taraire flowers, often hard to separate from the sample because of smallness.
Tawa fruit	-ripe fruit produces a clear juice when the skin is punctured unlike taraire fruit that exudes a lot of purple pigment (this colour comes from the skin). Tawa decomposes more like a plum does (going soft and mushy, then drying out), whereas taraire fruit has a tendency to go sticky jelly like. -dried kernels look like olive kernels, unlike taraire kernels that have a netted appearance.
Titoki flowers	-look like little black specks with stalks on them. Also includes the inflorescence stalks which are tomentose greeny-yellow. Generally it actually is just the stalks of the inflorescences.
Titoki leaves	-description, greeny-yellow in colour, shiny upper surface, matt below, with bright yellow prominent veins on the under-surface.
Totara seed	-Small light green seed, a bit lumpy looking, curvaceous with rounded pointy ends. (from 5-9-95).
Totara flowers	-male cone is about 1 cm long; the one I id still had the sheath at the base from which it emerged.
Small black half spiral things	are some sort of monocotyledon (germinated some) occasionally find them encased in white fruit flesh. Came across one whole fruit, white and about 5 mm in diameter (cabbage tree or epiphyte?). I germinated some of the seed and it is looking more and more like cabbage tree seed. 1-2-97 - Just dissected a cabbage tree fruit and they do have these types of seed in them.
Wharangi leaves	-as distinct from karaka leaves, feel softer and often have pink tinge when dry.

Wharangi flowers	-light yellowy-green, with 4 petals, 8 stamen and the sepals make quite distinctive darker green triangles at the notches between the petals, the whole flower is just over 5mm in size.
Wharangi seed/pods	-seeds are shiny blue-black ovoid in shape, have thus far only found them in seedfall trays directly beneath wharangi trees (indicating no dispersal) -seedpods generally four capsules to a stalk, light brown in colour, shaped to tightly enclose seed, with a heavily pocked surface.
Whiteywood seed	-small round fruit on stalks when ripeness is purpley-black

Appendix 3.5 Schematic diagram for construction of seedfall traps





Appendix 4.1 Common and scientific names of plant species

Common Name	***Latin Name***
Coprosma	*Coprosma* spp.
Coral trees	*Erythrina* spp. - exotic spp.
Five-finger	*Pseudopanax arboreus*
Fuchsia	*Fuchsia excorticata*
Hall's totara	Podocarpus hallii
Hangehange	*Geniostoma rupestre*
Hawthorn	*Crataegus monogyna*, - exotic spp.
Hinau	*Elaeocarpus dentatus*
Kahikatea	*Darcycarpus dacrydioides*
Kaikomako	*Pennantia corymbosa*
Kamahi	*Weinmannia racemosa*
Kanuka	*Kunzea ericoides*
Karaka	*Corynocarpus laevigatus*
Kawaka	*Libocedrus plumosa*
Kohekohe	*Dysoxylum spectabile*
Kowhai	*Sophora microphylla*
Lancewood	*Pseudopanax crassifolius*
Mahoe	*Melicytus ramiflorus*
Maire	*Mida salicifolia*
Mamaku	*Cyathea medullaris*
Mangeao	*Litsea calicaris*.
Manuka	*Leptospermum scoparium*
Mapou	*Myrsine australis*
Matai	*Prumnopitys taxifolia*
Milk tree	*Strebulus* spp.
Miro	*Prumnopitys ferruginea*
Monocotyledon	mixture of *Cordyline australis* and Asteliaceae
Mountain beech	*Nothofagus solondri* var *cliffortioides*)
Nikau	*Rhopalostylis sapida*
Northern rata	*Metrosideros robusta*
Orange climbing rata	*Metrosideros fulgens*
Pahautea	*Libocedrus bidwillii*
Pigeonwood	*Hedycarya arborea*
Pohutukawa	*Metrosideros excelsa*
Puka	*Griselinia lucida*
Pukatea	*Laurelia novae-zelandiae*
Puriri	*Vitex lucens*
Putaputaweta	*Carpodetus serratus*
Rewarewa	*Knightia excelsa*
Rimu	*Dacrydium cupressinum*
Scarlet rata	*Metrosideros fulgens*
Silver beech	*Nothofagus menziesii*
Southern rata	*Metrosideros umbellata*
Supplejack	*Ripogonum scandens*
Taraire	*Beilschmiedia tarairi*
Tawa	*Beilschmiedia tawa*
Tawapou	*Pouteria costata*
Tawaroa	*Beilschmiedia tawaroa*

Common Name	***Latin Name***
Titoki	*Alectryon excelsus*
Toro	*Myrsine salicina*
Totara	*Podocarpus totara*
Tutu	*Coriaria arborea*
Wharangi	*Melicope ternata*
Whau	*Entelea arborescens*
White climbing rata	*Metrosideros perforata*
Whiteywood	*Melicytus ramiflorus*
Wineberry	*Aristotelia serrata*

Appendix 5.3 General Linear Models Procedure for aspects of synchrony analysis.

The SAS System

General Linear Models Procedure for Wenderholm data

Wenderholm PROP

General Linear Models Procedure

Class Level Information

Class	Levels	Values
SITE	1	wend
SPECIES	6	kara kohe puri tara tawa tawp

Number of observations in by group = 486

Dependent Variable: Wenderholm PROP (proportion of trees fruiting per visit)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	5.23883859	1.04776772	29.63	**0.0001**
Error	480	16.97566530	0.03536597		
Corrected Total	485	22.21450389			

R-Square	C.V.	Root MSE	PROP Mean
0.235830	131.9486	0.18805842	0.14252401

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SPECIES	5	5.23883859	1.04776772	29.63	**0.0001**

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SPECIES	5	5.23883859	1.04776772	29.63	**0.0001**

General Linear Models Procedure

Tukey's Studentized Range (HSD) Test for variable: PROP (proportion of trees fruiting per visit)

NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.

Alpha= 0.05 df= 480 MSE= 0.035366

Critical Value of Studentized Range= 4.046

Minimum Significant Difference= 0.0846

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SPECIES
A	0.36255	81	puri
B	0.15021	81	tara
C B	0.12593	81	tawp
C B	0.09835	81	kohe
C	0.06379	81	tawa
C	0.05432	81	kara

Wenderholm DURATN

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SITE	1	wend
SPECIES	6	kara kohe puri tara tawa tawp
YEAR	3	2 3 4

Number of observations in by group = 180
NOTE: Due to missing values, only 160 observations can be used in this analysis.

Dependent Variable: **Wenderholm DURATN (Duration of fruit phenology for all trees in the population, including those trees that did not have fruit in any particular year)**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	
Model	17	1324.8416667	77.9318627	6.62		**0.0001**
Error	142	1670.5333333	11.7643192			
Corrected Total	159	2995.3750000				

R-Square	C.V.	Root MSE	DURATN Mean
0.442296	99.77936	3.4299153	3.4375000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SPECIES	5	1142.7903846	228.5580769	19.43	0.0001
YEAR	2	3.9219275	1.9609637	0.17	0.8466
SPECIES*YEAR	10	178.1293546	17.8129355	1.51	0.1400

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SPECIES	5	1156.6121212	231.3224242	19.66	**0.0001**
YEAR	2	11.2333333	5.6166667	0.48	0.6214
SPECIES*YEAR	10	178.1293546	17.8129355	1.51	0.1400

General Linear Models Procedure

Tukey's Studentized Range (HSD) Test for variable: Wenderholm DURATN

NOTE: This test controls the type I experimentwise error rate.
Alpha= 0.05 Confidence= 0.95 df= 142 MSE= 11.76432
Critical Value of Studentized Range= 3.350
Comparisons significant at the 0.05 level are indicated by '***'.

YEAR Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit
2- 3	-1.3416	0.3167	1.9750
2- 4	-1.2750	0.3833	2.0416
3- 2	-1.9750	-0.3167	1.3416
3- 4	-1.4166	0.0667	1.5499
4- 2	-2.0416	-0.3833	1.2750
4- 3	-1.5499	-0.0667	1.4166

General Linear Models Procedure

Tukey's Studentized Range (HSD) Test for variable:Wenderholm DURATN

NOTE: This test controls the type I experimentwise error rate.

Alpha= 0.05 Confidence= 0.95 df= 142 MSE= 11.76432

Critical Value of Studentized Range= 4.086

Comparisons significant at the 0.05 level are indicated by '***'.

SPECIES Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
puri - tara	2.7518	5.5000	8.2482	***
puri - tawp	2.9834	5.6385	8.2935	***
puri - kohe	3.6364	6.3846	9.1329	***
puri - tawa	5.0979	7.8462	10.5944	***
puri - kara	5.4825	8.2308	10.9790	***
tara - puri	-8.2482	-5.5000	-2.7518	***
tara - tawp	-2.5166	0.1385	2.7935	
tara - kohe	-1.8636	0.8846	3.6329	
tara - tawa	-0.4021	2.3462	5.0944	
tara - kara	-0.0175	2.7308	5.4790	
tawp - puri	-8.2935	-5.6385	-2.9834	***
tawp - tara	-2.7935	-0.1385	2.5166	
tawp - kohe	-1.9089	0.7462	3.4012	
tawp - tawa	-0.4474	2.2077	4.8627	
tawp - kara	-0.0627	2.5923	5.2474	
kohe - puri	-9.1329	-6.3846	-3.6364	***
kohe - tara	-3.6329	-0.8846	1.8636	
kohe - tawp	-3.4012	-0.7462	1.9089	
kohe - tawa	-1.2867	1.4615	4.2098	
kohe - kara	-0.9021	1.8462	4.5944	
tawa - puri	-10.5944	-7.8462	-5.0979	***
tawa - tara	-5.0944	-2.3462	0.4021	
tawa - tawp	-4.8627	-2.2077	0.4474	
tawa - kohe	-4.2098	-1.4615	1.2867	
tawa - kara	-2.3636	0.3846	3.1329	
kara - puri	-10.9790	-8.2308	-5.4825	***
kara - tara	-5.4790	-2.7308	0.0175	
kara - tawp	-5.2474	-2.5923	0.0627	
kara - kohe	-4.5944	-1.8462	0.9021	
kara - tawa	-3.1329	-0.3846	2.3636	

Wenderholm DAYS

Class Level Information

Class	Levels	Values
YEAR	3	2 3 4
SPECIES	6	kara kohe puri tara tawa tawp

Number of observations in data set = 104

Dependent Variable: Wenderholm DAYS

(number of days that individual trees had fruit, equates to fortnights in table 5.3, and excludes trees that did not produce fruit in any one year)

Source	Sum of DF	Mean Squares	Square	F Value	Pr > F
Model	17	946.29884005	55.66463765	4.86	**0.0001**
Error	86	984.16269841	11.44375231		
Corrected Total	103	1930.46153846			

R-Square	C.V.	Root MSE	DAYS Mean
0.490193	64.20029	3.3828616	5.2692308

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	2	4.00003053	2.00001526	0.17	0.8399
SPECIES	5	769.11155839	153.82231168	13.44	0.0001
YEAR*SPECIES	10	173.18725114	17.31872511	1.51	0.1484

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	2	10.81104578	5.40552289	0.47	0.6251
SPECIES	5	837.20274573	167.44054915	14.63	**0.0001**
YEAR*SPECIES	10	173.18725114	17.31872511	1.51	0.1484

General Linear Models Procedure

Tukey's Studentized Range (HSD) Test for variable: Wenderholm DAYS

NOTE: This test controls the type I experimentwise error rate.

Alpha= 0.05 Confidence= 0.95df= 86 MSE= 11.44375

Critical Value of Studentized Range= 3.373

Comparisons significant at the 0.05 level are indicated by '***'.

YEAR Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit
4- 2	-1.7195	0.3135	2.3464
4- 3	-1.4007	0.4528	2.3063
2- 4	-2.3464	-0.3135	1.7195
2- 3	-1.8487	0.1393	2.1273
3- 4	-2.3063	-0.4528	1.4007
3- 2	-2.1273	-0.1393	1.8487

General Linear Models Procedure

Tukey's Studentized Range (HSD) Test for variable: Wenderholm DAYS

NOTE: This test controls the type I experimentwise error rate.

Alpha= 0.05 Confidence= 0.95df= 86 MSE= 11.44375

Critical Value of Studentized Range= 4.122

Comparisons significant at the 0.05 level are indicated by '***'.

SPECIES Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
puri - tara	1.1706	4.2966	7.4225	***
puri - tawp	1.3118	4.3399	7.3680	***
puri - kohe	3.6614	6.5720	9.4826	***
puri - tawa	3.2997	6.8902	10.4806	***
puri - kara	4.2088	7.7992	11.3897	***
tara - puri	-7.4225	-4.2966	-1.1706	***
tara - tawp	-3.2487	0.0433	3.3354	
tara - kohe	-0.9089	2.2754	5.4597	
tara - tawa	-1.2221	2.5936	6.4093	
tara - kara	-0.3130	3.5027	7.3184	
tawp - puri	-7.3680	-4.3399	-1.3118	***
tawp - tara	-3.3354	-0.0433	3.2487	
tawp - kohe	-0.8563	2.2321	5.3204	
tawp - tawa	-1.1858	2.5502	6.2862	
tawp - kara	-0.2767	3.4593	7.1953	
kohe - puri	-9.4826	-6.5720	-3.6614	***
kohe - tara	-5.4597	-2.2754	0.9089	
kohe - tawp	-5.3204	-2.2321	0.8563	
kohe - tawa	-3.3232	0.3182	3.9596	
kohe - kara	-2.4141	1.2273	4.8687	
tawa - puri	-10.4806	-6.8902	-3.2997	***
tawa - tara	-6.4093	-2.5936	1.2221	
tawa - tawp	-6.2862	-2.5502	1.1858	
tawa - kohe	-3.9596	-0.3182	3.3232	
tawa - kara	-3.2956	0.9091	5.1138	
kara - puri	-11.3897	-7.7992	-4.2088	***
kara - tara	-7.3184	-3.5027	0.3130	
kara - tawp	-7.1953	-3.4593	0.2767	
kara - kohe	-4.8687	-1.2273	2.4141	
kara - tawa	-5.1138	-0.9091	3.2956	

Wenderholm WITHINSP

General Linear Models Procedure
Class Level Information

Class	Levels	Values
YEAR	3	2 3 4
SPECIES	6	kara kohe puri tara tawa tawp

Number of observations in data set = 104

Dependent Variable: Wenderholm WITHINSP (within species synchrony)
Synchrony within species as per Table 5.3

Source	Sum of DF	Mean Squares	Square	F Value	Pr > F
Model	17	2.90388020	0.17081648	7.97	**0.0001**
Error	86	1.84289395	0.02142900		
Corrected Total	103	4.74677414			

R-Square	C.V.	Root MSE	WITHINSP Mean
0.611759	28.27072	0.14638647	0.51780250

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	2	0.19753062	0.09876531	4.61	**0.0125**
SPECIES	5	1.41187212	0.28237442	13.18	**0.0001**
YEAR*SPECIES	10	1.29447746	0.12944775	6.04	**0.0001**

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	2	0.34531404	0.17265702	8.06	**0.0006**
SPECIES	5	1.46750075	0.29350015	13.70	**0.0001**
YEAR*SPECIES	10	1.29447746	0.12944775	6.04	**0.0001**

Tukey's Studentized Range (HSD) Test for variable: Wenderholm WITHINSP (within species synchrony)

NOTE: This test controls the type I experimentwise error rate.
Alpha= 0.05 Confidence= 0.95df= 86 MSE= 0.009904
Critical Value of Studentized Range= 3.373
Comparisons significant at the 0.05 level are indicated by '***'.

YEAR Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
2- 3	0.00321	0.08923	0.17526	***
2- 4	0.01762	0.10560	0.19357	***
3- 2	-0.17526	-0.08923	-0.00321	***
3- 4	-0.06384	0.01636	0.09657	
4-2	-0.19357	-0.10560	-0.01762	***
4-3	-0.09657	-0.01636	0.06384	

Tukey's Studentized Range (HSD) Test for variable: Wenderholm WITHINSP (within species synchrony)

NOTE: This test controls the type I experimentwise error rate.
Alpha= 0.05 Confidence= 0.95df= 86 MSE= 0.009904
Critical Value of Studentized Range= 4.122
Comparisons significant at the 0.05 level are indicated by '***'.

SPECIES Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
kohe - kara	-0.09830	0.05927	0.21685	
kohe - tara	-0.07232	0.06548	0.20327	
kohe - puri	0.01788	0.14383	0.26978	***
kohe - tawp	0.12541	0.25905	0.39269	***
kohe - tawa	0.19614	0.35372	0.51129	***
kara - kohe	-0.21685	-0.05927	0.09830	
kara - tara	-0.15891	0.00620	0.17132	
kara - puri	-0.07081	0.08456	0.23993	
kara - tawp	0.03811	0.19978	0.36145	***
kara - tawa	0.11249	0.29444	0.47640	***
tara - kohe	-0.20327	-0.06548	0.07232	
tara - kara	-0.17132	-0.00620	0.15891	
tara - puri	-0.05691	0.07836	0.21363	
tara - tawp	0.05112	0.19358	0.33603	***
tara - tawa	0.12312	0.28824	0.45336	***
puri - kohe	-0.26978	-0.14383	-0.01788	***
puri - kara	-0.23993	-0.08456	0.07081	
puri - tara	-0.21363	-0.07836	0.05691	
puri - tawp	-0.01581	0.11522	0.24626	
puri - tawa	0.05451	0.20988	0.36525	***
tawp - kohe	-0.39269	-0.25905	-0.12541	***
tawp - kara	-0.36145	-0.19978	-0.03811	***
tawp - tara	-0.33603	-0.19358	-0.05112	***
tawp - puri	-0.24626	-0.11522	0.01581	
tawp - tawa	-0.06700	0.09466	0.25633	
tawa - kohe	-0.51129	-0.35372	-0.19614	***
tawa - kara	-0.47640	-0.29444	-0.11249	***
tawa - tara	-0.45336	-0.28824	-0.12312	***
tawa - puri	-0.36525	-0.20988	-0.05451	***
tawa - tawp	-0.25633	-0.09466	0.06700	

General Linear Models Procedure for Whitford data

Whitford PROP

Class Level Information

Class	Levels	Values
SITE	1	whit
SPECIES	5	kara kohe puri tara tawa

Number of observations in by group = 405

Dependent Variable: Whitford PROP (proportion of trees fruiting per visit)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	4	15.02711964	3.75677991	80.16	**0.0001**
Error	400	18.74658132	0.04686645		
Corrected Total	404	33.77370096			

R-Square	C.V.	Root MSE	PROP Mean
0.444936	108.2879	0.21648661	0.19991770

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SPECIES	4	15.02711964	3.75677991	80.16	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SPECIES	4	15.02711964	3.75677991	80.16	**0.0001**

General Linear Models Procedure

Tukey's Studentized Range (HSD) Test for variable: PROP

NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.

Alpha= 0.05 df= 400 MSE= 0.046866

Critical Value of Studentized Range= 3.875

Minimum Significant Difference= 0.0932

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SPECIES
A	0.56790	81	puri
B	0.21056	81	tara
C	0.11207	81	tawa
C	0.05514	81	kara
C	0.05391	81	kohe

Whitford DURATN

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SITE	1	whit
SPECIES	5	kara kohe puri tara tawa
YEAR	3	2 3 4

Number of observations in by group = 135
NOTE: Due to missing values, only 120 observations can be used in this analysis.

Dependent Variable: **Whitford DURATN (Duration of fruit phenology for all trees in the population, including those trees that did not have fruit in any particular year)**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	2728.9111111	194.9222222	30.08	**0.0001**
Error	105	680.3888889	6.4798942		
Corrected Total	119	3409.3000000			

R-Square	C.V.	Root MSE	DURATN Mean
0.800431	58.51870	2.5455636	4.3500000

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SPECIES	4	2484.3801282	621.0950321	95.85	0.0001
YEAR	2	104.7600060	52.3800030	8.08	0.0005
SPECIES*YEAR	8	139.7709769	17.4713721	2.70	0.0097

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SPECIES	4	2444.0387624	611.0096906	94.29	**0.0001**
YEAR	2	120.2419978	60.1209989	9.28	**0.0002**
SPECIES*YEAR	8	139.7709769	17.4713721	2.70	**0.0097**

General Linear Models Procedure

Tukey's Studentized Range (HSD) Test for variable: Whitford DURATN

NOTE: This test controls the type I experimentwise error rate.
Alpha= 0.05 Confidence= 0.95df= 105 MSE= 6.479894
Critical Value of Studentized Range= 3.362
Comparisons significant at the 0.05 level are indicated by '***'.

YEAR Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
2- 4	0.6180	2.0444	3.4709	***
2- 3	1.8180	3.2444	4.6709	***
4- 2	-3.4709	-2.0444	-0.6180	***
4- 3	-0.0759	1.2000	2.4759	
3- 2	-4.6709	-3.2444	-1.8180	***
3- 4	-2.4759	-1.2000	0.0759	

General Linear Models Procedure

Tukey's Studentized Range (HSD) Test for variable:Whitford DURATN

NOTE: This test controls the type I experimentwise error rate.
Alpha= 0.05 Confidence= 0.95df= 105 MSE= 6.479894
Critical Value of Studentized Range= 3.926
Comparisons significant at the 0.05 level are indicated by '***'.

SPECIES Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
puri - tara	6.7552	8.9583	11.1615	***
puri - tawa	9.9488	12.1154	14.2819	***
puri - kohe	10.8719	13.0385	15.2050	***
puri - kara	11.2565	13.4231	15.5896	***
tara - puri	-11.1615	-8.9583	-6.7552	***
tara - tawa	1.1569	3.1571	5.1572	***
tara - kohe	2.0800	4.0801	6.0803	***
tara - kara	2.4646	4.4647	6.4649	***
tawa - puri	-14.2819	-12.1154	-9.9488	***
tawa - tara	-5.1572	-3.1571	-1.1569	***
tawa - kohe	-1.0366	0.9231	2.8828	
tawa - kara	-0.6520	1.3077	3.2674	
kohe - puri	-15.2050	-13.0385	-10.8719	***
kohe - tara	-6.0803	-4.0801	-2.0800	***
kohe - tawa	-2.8828	-0.9231	1.0366	
kohe - kara	-1.5751	0.3846	2.3443	
kara - puri	-15.5896	-13.4231	-11.2565	***
kara - tara	-6.4649	-4.4647	-2.4646	***
kara - tawa	-3.2674	-1.3077	0.6520	
kara - kohe	-2.3443	-0.3846	1.5751	

Whitford DAYS

Class Level Information

Class	Levels	Values
YEAR	3	2 3 4
SPECIES	5	kara kohe puri tara tawa

Number of observations in data set = 1946

NOTE: Due to missing values, only 94 observations can be used in this analysis.

Dependent Variable: Whitford DAYS

(Table 5.11)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	2285.1844394	163.2274600	26.00	**0.0001**
Error	79	496.0496032	6.2791089		
Corrected Total	93	2781.2340426			

R-Square	C.V.	Root MSE	DAYS Mean
0.821644	45.12387	2.5058150	5.5531915

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	2	128.1712755	64.0856377	10.21	0.0001
SPECIES	4	2019.8864676	504.9716169	80.42	0.0001
YEAR*SPECIES	8	137.1266963	17.1408370	2.73	0.0104

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	2	82.6305734	41.3152867	6.58	**0.0023**
SPECIES	4	2052.6131970	513.1532992	81.72	**0.0001**
YEAR*SPECIES	8	137.1266963	17.1408370	2.73	**0.0104**

General Linear Models Procedure

Tukey's Studentized Range (HSD) Test for variable: Whitford DAYS

NOTE: This test controls the type I experimentwise error rate.

Alpha= 0.05 Confidence= 0.95df= 79 MSE= 6.279109

Critical Value of Studentized Range= 3.378

Comparisons significant at the 0.05 level are indicated by '***'.

YEAR Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
2- 4	0.4061	1.9466	3.4871	***
2- 3	1.3836	2.9639	4.5443	***
4- 2	-3.4871	-1.9466	-0.4061	***
4- 3	-0.4369	1.0174	2.4716	
3- 2	-4.5443	-2.9639	-1.3836	***
3- 4	-2.4716	-1.0174	0.4369	

General Linear Models Procedure

Tukey's Studentized Range (HSD) Test for variable: Whitford DAYS

NOTE: This test controls the type I experimentwise error rate.

Alpha= 0.05 Confidence= 0.95df= 79 MSE= 6.279109

Critical Value of Studentized Range= 3.948

Comparisons significant at the 0.05 level are indicated by '***'.

Simultaneous Lower SPECIES Comparison	Difference Confidence Limit	Simultaneous Upper Between Means	Confidence Limit	
puri - tara	5.9196	8.1667	10.4137	***
puri - kohe	9.0307	11.5769	14.1232	***
puri - tawa	9.4584	11.6818	13.9052	***
puri - kara	10.8271	13.1000	15.3729	***
tara - puri	-10.4137	-8.1667	-5.9196	***
tara - kohe	0.9414	3.4103	5.8791	***
tara - tawa	1.3809	3.5152	5.6494	***
tara - kara	2.7476	4.9333	7.1191	***
kohe - puri	-14.1232	-11.5769	-9.0307	***
kohe - tara	-5.8791	-3.4103	-0.9414	***
kohe - tawa	-2.3424	0.1049	2.5522	
kohe - kara	-0.9692	1.5231	4.0154	
tawa - puri	-13.9052	-11.6818	-9.4584	***
tawa - tara	-5.6494	-3.5152	-1.3809	***
tawa - kohe	-2.5522	-0.1049	2.3424	
tawa - kara	-0.7432	1.4182	3.5795	
kara - puri	-15.3729	-13.1000	-10.8271	***
kara - tara	-7.1191	-4.9333	-2.7476	***
kara - kohe	-4.0154	-1.5231	0.9692	
kara - tawa	-3.5795	-1.4182	0.7432	

Whitford WITHINSP

General Linear Models Procedure

Class Level Information

Class	Levels	Values

YEAR 3 2 3 4
SPECIES 5 kara kohe puri tara tawa
Number of observations in data set = 1946

NOTE: Due to missing values, only 94 observations can be used in this analysis.

Dependent Variable: Whitford WITHINSP (within species synchrony)

Table 5.11

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	14	4.01673714	0.28690980	15.99	**0.0001**
Error	79	1.41709564	0.01793792		
Corrected Total	93	5.43383278			

R-Square	C.V.	Root MSE	WITHINSP Mean
0.739209	25.10595	0.13393252	0.53346929

Source	DF	Type I SS	Mean Square	F Value	Pr > F
YEAR	2	0.08867427	0.04433714	2.47	0.0909
SPECIES	4	2.03399250	0.50849813	28.35	**0.0001**
YEAR*SPECIES	8	1.89407036	0.23675880	13.20	**0.0001**

Source	DF	Type III SS	Mean Square	F Value	Pr > F
YEAR	2	0.12601669	0.06300835	3.51	**0.0346**
SPECIES	4	1.77492698	0.44373175	24.74	**0.0001**
YEAR*SPECIES	8	1.89407036	0.23675880	13.20	**0.0001**

General Linear Models Procedure
Tukey's Studentized Range (HSD) Test for variable: Whitford WITHINSP (within species synchrony)
NOTE: This test controls the type I experimentwise error rate.
Alpha= 0.05 Confidence= 0.95df= 79 MSE= 0.010605
Critical Value of Studentized Range= 3.378
Comparisons significant at the 0.05 level are indicated by '***'.

YEAR Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit
2- 4	-0.02476	0.05758	0.13992
2- 3	-0.00826	0.07621	0.16068
4- 2	-0.13992	-0.05758	0.02476
4- 3	-0.05910	0.01863	0.09636
3- 2	-0.16068	-0.07621	0.00826
3- 4	-0.09636	-0.01863	0.05910

Tukey's Studentized Range (HSD) Test for variable: Whitford WITHINSP (within species synchrony)
NOTE: This test controls the type I experimentwise error rate.
Alpha= 0.05 Confidence= 0.95df= 79 MSE= 0.010605
Critical Value of Studentized Range= 3.948
Comparisons significant at the 0.05 level are indicated by '***'.

SPECIES Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
puri - kara	-0.10712	0.01436	0.13585	
puri - kohe	-0.11558	0.02052	0.15661	
puri - tara	0.01581	0.13591	0.25601	***
puri - tawa	0.25704	0.37588	0.49472	***
kara - puri	-0.13585	-0.01436	0.10712	
kara - kohe	-0.12706	0.00615	0.13936	
kara - tara	0.00472	0.12155	0.23837	***
kara - tawa	0.24599	0.36152	0.47704	***
kohe - puri	-0.15661	-0.02052	0.11558	
kohe - kara	-0.13936	-0.00615	0.12706	
kohe - tara	-0.01656	0.11539	0.24735	
kohe - tawa	0.22456	0.35536	0.48616	***
tara - puri	-0.25601	-0.13591	-0.01581	***
tara - kara	-0.23837	-0.12155	-0.00472	***
tara - kohe	-0.24735	-0.11539	0.01656	
tara - tawa	0.12590	0.23997	0.35404	***
tawa - puri	-0.49472	-0.37588	-0.25704	***
tawa - kara	-0.47704	-0.36152	-0.24599	***
tawa - kohe	-0.48616	-0.35536	-0.22456	***
tawa - tara	-0.35404	-0.23997	-0.12590	***

General Linear Models Procedure for Both sites

Both PROP

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SITE	2	wend whit
SPECIES	6	kara kohe puri tara tawa tawp

Number of observations in data set = 891

Dependent Variable: both PROP (proportion of trees fruiting per visit)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	10	20.99364066	2.09936407	51.72	**0.0001**
Error	880	35.72224661	0.04059346		
Corrected Total	890	56.71588727			

R-Square	C.V.	Root MSE	PROP Mean
0.370154	119.4922	0.20147819	0.16861205

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SITE	1	0.72768242	0.72768242	17.93	0.0001
SPECIES	5	18.82825301	3.76565060	92.76	0.0001
SITE*SPECIES	4	1.43770523	0.35942631	8.85	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SITE	1	0.59211111	0.59211111	14.59	**0.0001**
SPECIES	5	18.82825301	3.76565060	92.76	**0.0001**
SITE*SPECIES	4	1.43770523	0.35942631	8.85	**0.0001**

General Linear Models Procedure

Tukey's Studentized Range (HSD) Test for variable: PROP (proportion of trees fruiting per visit)

NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 880 MSE= 0.040593
Critical Value of Studentized Range= 2.776
Minimum Significant Difference= 0.0266
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 441.8182

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SITE
A	0.19992	405	whit
B	0.14252	486	wend

General Linear Models Procedure

Tukey's Studentized Range (HSD) Test for variable: PROP (proportion of trees fruiting per visit)

NOTE: This test controls the type I experimentwise error rate.
Alpha= 0.05 Confidence= 0.95df= 880 MSE= 0.040593
Critical Value of Studentized Range= 4.039
Comparisons significant at the 0.05 level are indicated by '***'.

SPECIES Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
puri - tara	0.22091	0.28484	0.34878	***
puri - tawp	0.26099	0.33930	0.41761	***
puri - tawa	0.31336	0.37730	0.44123	***
puri - kohe	0.32516	0.38909	0.45303	***
puri - kara	0.34656	0.41049	0.47443	***
tara - puri	-0.34878	-0.28484	-0.22091	***
tara - tawp	-0.02385	0.05446	0.13276	
tara - tawa	0.02852	0.09246	0.15639	***
tara - kohe	0.04032	0.10425	0.16819	***
tara - kara	0.06172	0.12565	0.18959	***
tawp - puri	-0.41761	-0.33930	-0.26099	***
tawp - tara	-0.13276	-0.05446	0.02385	
tawp - tawa	-0.04031	0.03800	0.11630	
tawp - kohe	-0.02851	0.04979	0.12810	
tawp - kara	-0.00711	0.07119	0.14950	
tawa - puri	-0.44123	-0.37730	-0.31336	***
tawa - tara	-0.15639	-0.09246	-0.02852	***
tawa - tawp	-0.11630	-0.03800	0.04031	
tawa - kohe	-0.05214	0.01180	0.07573	
tawa - kara	-0.03074	0.03320	0.09713	
kohe - puri	-0.45303	-0.38909	-0.32516	***
kohe - tara	-0.16819	-0.10425	-0.04032	***
kohe - tawp	-0.12810	-0.04979	0.02851	
kohe - tawa	-0.07573	-0.01180	0.05214	
kohe - kara	-0.04254	0.02140	0.08534	
kara - puri	-0.47443	-0.41049	-0.34656	***
kara - tara	-0.18959	-0.12565	-0.06172	***

SPECIES Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit
kara - tawp	-0.14950	-0.07119	0.00711
kara - tawa	-0.09713	-0.03320	0.03074
kara - kohe	-0.08534	-0.02140	0.04254

Both DURATN

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SITE	2	wend whit
SPECIES	6	kara kohe puri tara tawa tawp
YEAR	3	2 3 4

Number of observations in data set = 315

NOTE: Due to missing values, only 280 observations can be used in this analysis.

Dependent Variable: **Both DURATN (Duration of fruit phenology for all trees in the population, including those trees that did not have fruit in any particular year)**

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F	
Model	32	4110.8492063	128.4640377	13.50		**0.0001**
Error	247	2350.9222222	9.5179037			
Corrected Total	279	6461.7714286				

R-Square	C.V.	Root MSE	DURATN Mean
0.636180	80.58123	3.0851100	3.8285714

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SITE	1	57.0964286	57.0964286	6.00	0.0150
SPECIES	5	3342.6295047	668.5259009	70.24	0.0001
YEAR	2	70.7481789	35.3740894	3.72	0.0257
SITE*SPECIES	4	275.2923085	68.8230771	7.23	0.0001
SITE*YEAR	2	47.1824542	23.5912271	2.48	0.0859
SPECIES*YEAR	10	254.6472283	25.4647228	2.68	0.0040
SITE*SPECIES*YEAR	8	63.2531032	7.9066379	0.83	0.5762

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SITE	1	133.4977067	133.4977067	14.03	**0.0002**
SPECIES	5	3481.6744808	696.3348962	73.16	**0.0001**
YEAR	2	70.8971112	35.4485556	3.72	**0.0255**
SITE*SPECIES	4	256.4159972	64.1039993	6.74	**0.0001**
SITE*YEAR	2	16.0399641	8.0199821	0.84	0.4318
SPECIES*YEAR	10	255.8404934	25.5840493	2.69	**0.0038**
SITE*SPECIES*YEAR	8	63.2531032	7.9066379	0.83	0.5762

Tukey's Studentized Range (HSD) Test for variable:Both DURATN

NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 247 MSE= 9.517904
Critical Value of Studentized Range= 2.785
Minimum Significant Difference= 0.7338
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 137.1429
Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SITE
A	4.3500	120	whit
B	3.4375	160	wend

Tukey's Studentized Range (HSD) Test for variable:Both DURATN

NOTE: This test controls the type I experimentwise error rate.
Alpha= 0.05 Confidence= 0.95df= 247 MSE= 9.517904
Critical Value of Studentized Range= 3.335
Comparisons significant at the 0.05 level are indicated by '***'.

YEAR Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
2- 4	-0.0273	1.0952	2.2177	
2- 3	0.4489	1.5714	2.6939	***
4- 2	-2.2177	-1.0952	0.0273	
4- 3	-0.5278	0.4762	1.4802	
3- 2	-2.6939	-1.5714	-0.4489	***
3- 4	-1.4802	-0.4762	0.5278	

Tukey's Studentized Range (HSD) Test for variable: Both DURATN

NOTE: This test controls the type I experimentwise error rate.
Alpha= 0.05 Confidence= 0.95df= 247 MSE= 9.517904
Critical Value of Studentized Range= 4.062
Comparisons significant at the 0.05 level are indicated by '***'.

SPECIES Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
puri - tara	4.9411	6.7727	8.6044	***
puri - tawp	5.7747	7.8727	9.9708	***
puri - kohe	7.3999	9.2150	11.0301	***
puri - tawa	7.6692	9.4843	11.2994	***
puri - kara	8.5153	10.3304	12.1455	***
tara - puri	-8.6044	-6.7727	-4.9411	***
tara - tawp	-0.9464	1.1000	3.1464	
tara - kohe	0.6872	2.4423	4.1974	***
tara - tawa	0.9564	2.7115	4.4666	***
tara - kara	1.8026	3.5577	5.3128	***
tawp - puri	-9.9708	-7.8727	-5.7747	***
tawp - tara	-3.1464	-1.1000	0.9464	
tawp - kohe	-0.6893	1.3423	3.3739	
tawp - tawa	-0.4200	1.6115	3.6431	
tawp - kara	0.4261	2.4577	4.4893	***
kohe - puri	-11.0301	-9.2150	-7.3999	***
kohe - tara	-4.1974	-2.4423	-0.6872	***
kohe - tawp	-3.3739	-1.3423	0.6893	
kohe - tawa	-1.4686	0.2692	2.0070	
kohe - kara	-0.6224	1.1154	2.8532	
tawa - puri	-11.2994	-9.4843	-7.6692	***
tawa - tara	-4.4666	-2.7115	-0.9564	***
tawa - tawp	-3.6431	-1.6115	0.4200	
tawa - kohe	-2.0070	-0.2692	1.4686	
tawa - kara	-0.8917	0.8462	2.5840	
kara - puri	-12.1455	-10.3304	-8.5153	***
kara - tara	-5.3128	-3.5577	-1.8026	***
kara - tawp	-4.4893	-2.4577	-0.4261	***
kara - kohe	-2.8532	-1.1154	0.6224	
kara - tawa	-2.5840	-0.8462	0.8917	

Appendix 5.4 Synchrony of the fruiting population versus the whole population.

The term n_s, in equation 1a) in section 5.8.1 only included those trees that had one or more fruits during the sampling year. However, for most species not all trees fruited every year (Tables 5.3 and 5.6). For some species, in some years, up to 7 of the 10 trees did not fruit, thus the non-fruiting population can be a significant proportion of the population. This section illustrates that inclusion of non-fruiting individuals, which ultimately also contribute the amount or lack of fruit in any one year, has a significant negative effect on within species synchrony.

Population synchrony values ($Z_s^{(sp)}$)have been calculated in two ways;

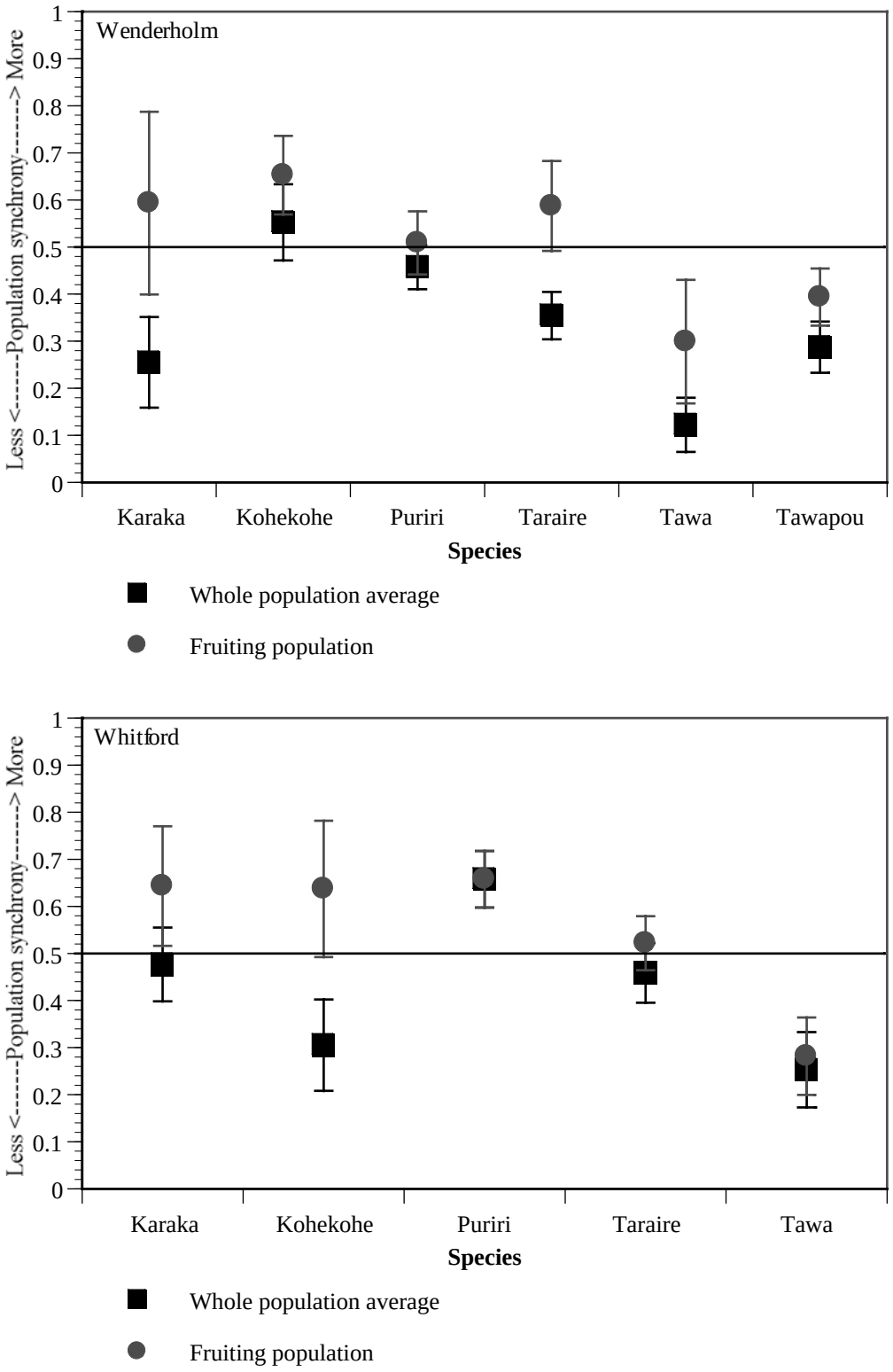
- The first includes only those trees that had fruit in any particular year, as illustrated and discussed in Section 5.8.
- The other includes all individuals of species s, regardless of whether they had fruit that year.

All species at both sites (with the exception of puriri at Whitford Bush because all trees fruited every year) show a marked, and often significantly large, reduction in population synchrony upon the inclusion of non-fruiting trees. When the analysis only includes those trees that fruited in any particular year then karaka, kohekohe, puriri and taraire at Wenderholm Regional Park, and karaka, kohekohe, puriri and taraire at Whitford Bush have greater synchrony values ($Z_s^{(sp)}$) than the critical value ($C_s^{(sp)} = 0.5$) although not always significantly so ($Z_s^{(sp)} \pm$ 95% confidence interval of the mean) (Figures 5.4.1, 5.4.2 and 5.4.3). Only kohekohe at Wenderholm and puriri at Whitford exceed, or come close to exceeding, the critical synchrony value when all trees are included in the calculations.

The synchrony values for tawa and tawapou also improve when only fruiting trees are considered but not sufficiently to exceed the critical value. The population synchrony values for those species with the greatest number of non-fruiting individuals (refer Tables 5.3 and 5.6) increased the most when non-fruiting trees were excluded.

The amount of fruit produced at a site, and hence the amount of fruit available for dispersal by kereru, in any one year depends not only on the numbers of fruits per tree but also on the number of trees with fruit. The large proportion of non-fruiting trees at a locality or per annum has implications for conservation management, especially with regards to tree density per site, patch size and patch isolation. If there are only a few trees of each species per site than this increases the chance that occasionally no fruit from that species are available at all, with subsequent impacts on native birds. Other studies have found that there are fewer birds in smaller forest patches (Ogle 1987; Willson *et al.* 1994), or that forest patch isolation affects bird species composition (Price *et al.* 1999). Perhaps inconsistent food availability was a contributing factor to the noted reduction of bird species. Further study for a range of species is required to determine what proportion of the trees fail to fruit per annum, whether this is a constant proportion or whether it can be predicted by climatic or environmental conditions.

Figure 5.4.1: Comparison of population synchrony values ($Z_s^{(sp)}$) for all monitored trees (whole population) and $Z_s^{(sp)}$ for fruiting trees only (fruiting population).
For the 'fruiting trees only population' n_s in equation 1a) only included those trees that fruited in that particular year (these were used to assess the synchrony for species in Table 5.3). The whole population included all trees, whether they had produced fruit that year or not. Error bars are ±95% confidence limits of the mean.



Figures 5.4.2 and 5.4.3 plot the number of trees (per year and per species) that failed to fruit against the synchrony value ($Z_s^{(sp)}$) for that species and year. Figure 5.4.2

compares the fruiting population only; the 95% confidence interval becomes larger as fewer trees within a species have fruit due to smaller sample sizes. Figure 5.4.3 illustrates the entire fruiting population synchrony value versus the number of non-fruiting trees. The regression equation in Figure 5.4.3 can account for about 66% of the observed variance in synchrony values, at Wenderholm Regional Park. Whitford Bush has slightly more unexplained variance, only about 40% can be explained by the linear relationship between the synchrony value and the number of trees not fruiting. It is also noteworthy that the regression lines for Wenderholm Regional Park and Whitford Bush are remarkably similar for the whole population graphs.

The error bars for some species in some years in Figure 5.4.2 are considerable greater than for Figure 5.4.3 due to the small number of trees fruiting for that species during that year. This in part contributed to the lack of significant synchrony for some species as discussed in section5.8.

Figure 5.4.2: Linear regression of number of trees failing to fruit plotted against synchrony values for fruiting population only.
For each site, each species is represented by three points on the graph, one for each year surveyed, plotted against the associated synchrony value (refer to Tables 5.3 and 5.6). Error bars are 95% confidence intervals for the mean.

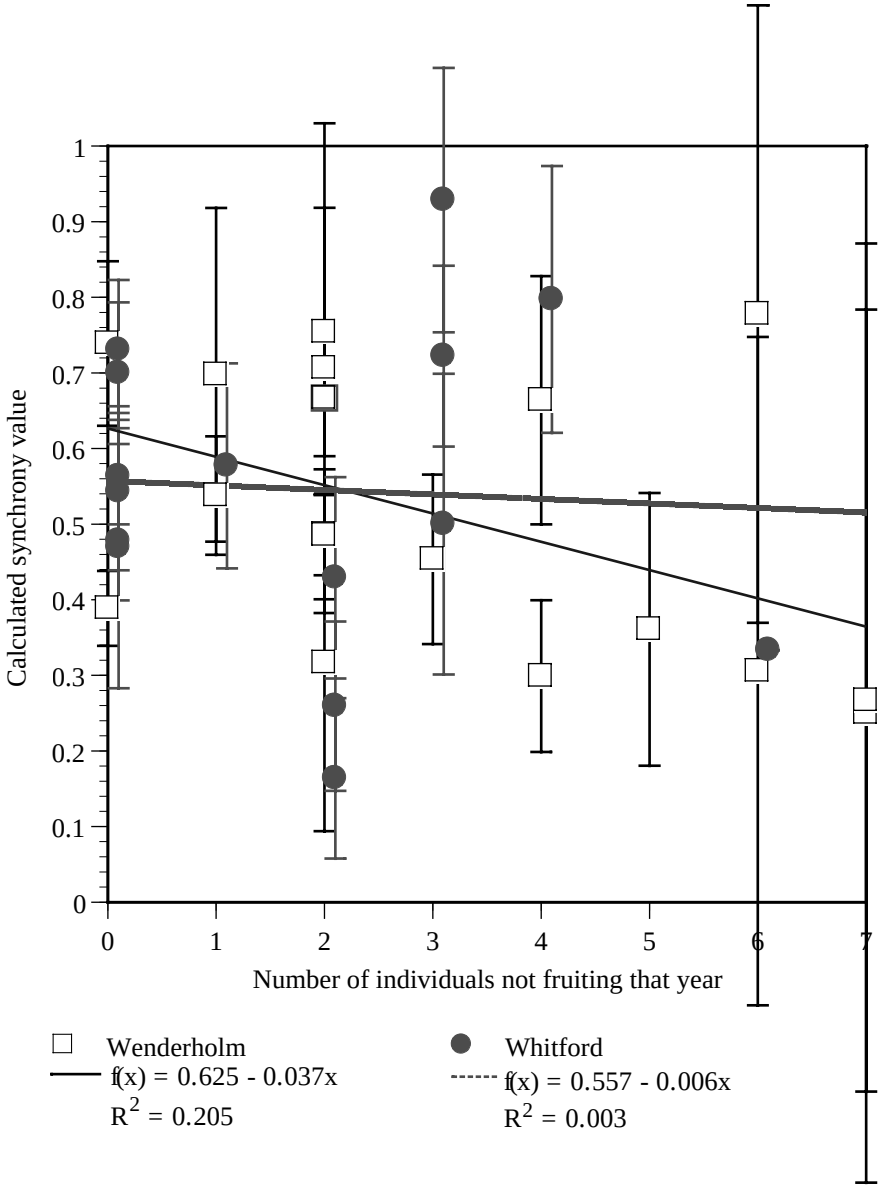
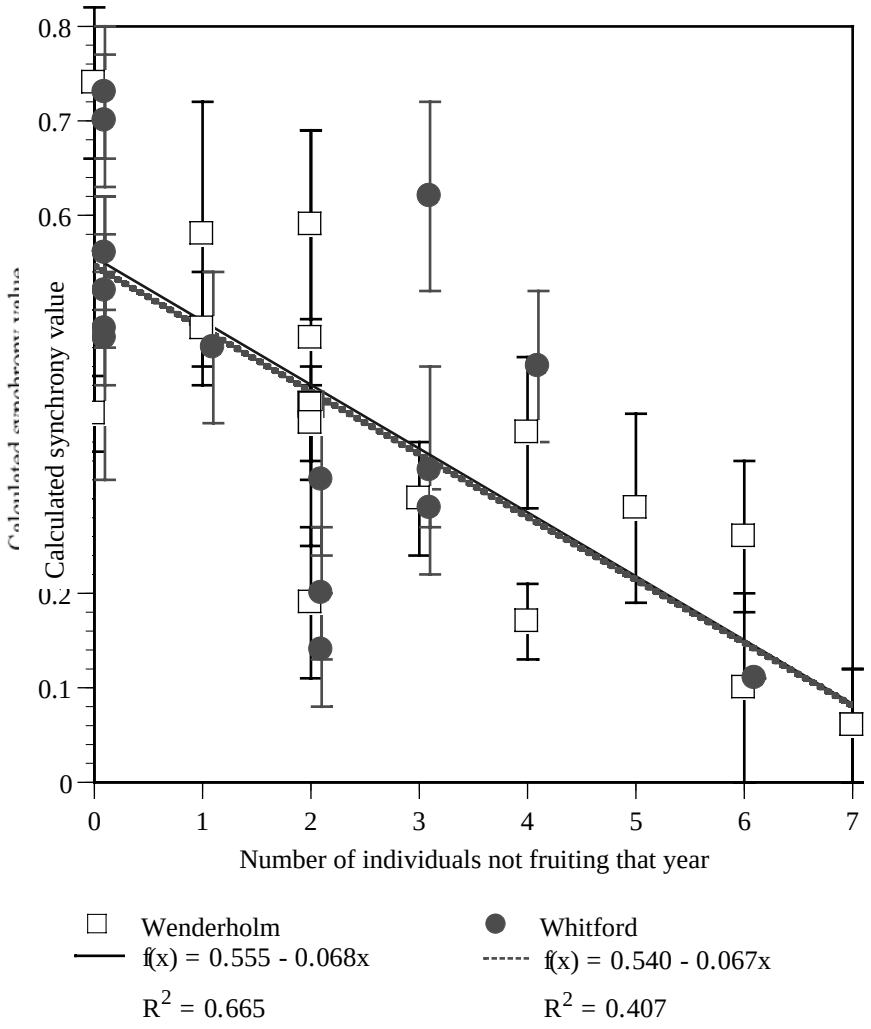

Calculated synchrony value
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
1
2
3
4
5
6
7
Number of individuals not fruiting that year
Wenderholm
f(x) = 0.625 - 0.037x
R2 = 0.205
Whitford
f(x) = 0.557 - 0.006x
R2 = 0.003

Figure 5.4.3: Linear regression of number of trees failing to fruit plotted against synchrony values for entire population.
For each site, each species is represented by three points on the graph, one for each year surveyed, plotted against the associated synchrony value (refer to Tables 5.3 and 5.6). Error bars are 95% confidence intervals for the mean.



Appendix 7.1 Weights and sex of possums caught during final two weeks of study..

Site	weight	sex	maturity
Robertson's	1400	f	juvenile
Robertson's	1100	f	juvenile
Robertson's	2250	f	mature
Robertson's	2600	f	mature+joey
Robertson's	2750	f	mature+joey
Robertson's	1500	m	juvenile
Robertson's	1500	m	juvenile
Robertson's	2250	m	mature
Robertson's	2100	m	mature
Robertson's	2850	m	mature
Remiger’s	2000	f	juvenile
Remiger’s	1950	f	juvenile
Remiger’s	2700	f	mature+joey
Remiger’s	1850	m	juvenile
Remiger’s	1600	m	juvenile
Remiger’s	2300	m	mature
Remiger’s	2250	m	mature
Val's	2000	f	juvenile
Val's	2200	f	juvenile
Val's	1850	f	juvenile
Val's	1800	f	juvenile
Val's	2250	f	mature
Val's	1500	f	mature
Val's	2400	f	mature
Val's	2000	f	mature
Val's	2500	f	mature
Val's	2200	f	mature
Val's	1900	f	mature
Val's	1300	f	mature
Val's	2350	f	mature
Val's	2550	f	mature
Val's	2150	f	mature
Val's	2250	m	juvenile
Val's	1950	m	juvenile
Val's	2700	m	mature
Val's	2700	m	mature
Val's	2700	m	mature
Val's	2500	m	mature
Val's	2700	m	mature
Val's	2600	m	mature
Val's	2050	m	mature
Val's	2005	m	mature

Site	weight	sex	maturity
Loch Amber	1350	f	juvenile
Loch Amber	2100	f	juvenile
Loch Amber	1570	f	juvenile
Loch Amber	1220	f	juvenile
Loch Amber	2050	f	mature
Loch Amber	2350	f	mature
Loch Amber	2000	f	mature
Loch Amber	2300	f	mature
Loch Amber	2050	f	mature
Loch Amber	2400	f	mature
Loch Amber	2600	f	mature
Loch Amber	2600	f	mature
Loch Amber	2350	f	mature
Loch Amber	2200	f	mature
Loch Amber	2300	f	mature
Loch Amber	2500	f	mature
Loch Amber	1300	m	juvenile
Loch Amber	1250	m	juvenile
Loch Amber	1700	m	juvenile
Loch Amber	1000	m	juvenile
Loch Amber	1000	m	juvenile
Loch Amber	1950	m	juvenile
Loch Amber	1450	m	juvenile
Loch Amber	1300	m	juvenile
Loch Amber	1400	m	juvenile
Loch Amber	2600	m	mature
Loch Amber	3100	m	mature
Loch Amber	2700	m	mature
Loch Amber	2600	m	mature

Appendix 7.2 Syntax used to analyse various aspects of mammalian predator presence.

A. Number of droppings

```
proc sort data = work.droptime;
 by species site;
 run;
```

Site nested within pest suppression

```
 proc glm data = work.droptime;
 class suppress site species ;
 model dropp = suppress site(suppress) /E1;
 random suppress / test;
 by species;
 means suppress / tukey;
 run;
```

Differences between sites

```
 proc glm data = work.droptime;
 class suppress site species weekno ;
 model dropp = site weekno site*weekno;
 by species;
 means site / tukey;
 run;
end;
```

Where

Dropp the number of traps containing droppings

Species the type of dropping (e.g. possum, rodent, insect, weta, kereru)

Suppress 1when the site had pest suppression and 2 when it didn't

Weekno the number of the sampling period

Site the name of the site

E1 Since the independent variable 'suppress' was defined as random (see below) it was necessary to specify whether the test should be more conservative with regards to Type I or Type II statistical error. E1 specifies that the model produces the Type I sum of squares (SAS Institute Inc. 1990b) and thus the null hypothesis is more likely to be retained unless there are indeed significant differences between the tested variables. (Type I error *rejects* the null hypothesis when it is true, while a Type II error *accepts* the null hypothesis when it is false (Rowntree 1991)).

Suppress(ion) was set as a random variable since it is theoretically possible to choose different sites with the same, or similar, levels of pest suppression. The level of suppression was not necessarily determined by the site, applied in a predetermined way or fixed to a specific value.

Site, where used, was nested in suppress(ion) since the site was chosen within different levels of pest suppression.

B. Predation, consumption and production of fruit

Analysis by paired sites (e.g. Wenderholm versus Loch Amber) for each category (type of predation, consumption, or total numbers of fruit or total numbers predated).

```
proc sort data =work.predall;
by pair pest;
run;

proc glm data = work.predall;
 class suppress site species pest pair;
 model result = suppress species species*suppress;
 by pair pest;
 means suppress species / tukey;
 run;
```

Suppress	Site has possum suppression = 1, without possum suppression = 2.
Site	Abbreviation of site name
Species	Abbreviation of plant species name
Pest	Category of predation (possum, rodent, insect, unknown), consumption, total immature, total fruit, total predated fruit.

Appendix 7.3 SAS output for pest species droppings.

SAS syntax as per Appendix 7.2

```
--------------------------------- SPECIES=possum ----------------------------------
```

Possum droppings analysis - Site nested within suppression

```
Class Level Information
Class          Levels  Values
SUPPRESS       2       1 2
SITE           6       loch remi robi vals wend whit
SPECIES        1       possum
       Number of observations in by group = 198

Type I Estimable Functions for: SUPPRESS
Effect                      Coefficients
INTERCEPT       0
SUPPRESS        1           L2
                2           -L2
SITE(SUPPRESS)  remi 1      0.3333*L2
                wend 1      0.3333*L2
                whit 1      0.3333*L2
                loch 2      -0.3333*L2
                robi 2      -0.3333*L2
                vals 2      -0.3333*L2

Type I Estimable Functions for: SITE(SUPPRESS)
Effect                      Coefficients
INTERCEPT       0
SUPPRESS        1           0
                2           0
SITE(SUPPRESS)  remi 1      L4
                wend 1      L5
                whit 1      -L4-L5
                loch 2      L7
                robi 2      L8
                vals 2      -L7-L8

Dependent Variable: DROPPINGS POSSUM
Source            DF        Sum of          Mean Square   F Value     Pr > F
                            Squares
Model             5         1377.47979798   275.49595960  50.09       0.0001
Error             192       1056.06060606   5.50031566
Corrected Total   197       2433.54040404
                  R-Square  C.V.            Root MSE      DROPP Mean
                  0.566039  57.39981        2.34527518    4.08585859

Source            DF        Type I SS       Mean Square   F Value     Pr > F
SUPPRESS          1         488.48989899    488.4898989   88.81       0.0001
                                            9
SITE(SUPPRESS)    4         888.98989899    222.2474747   40.41       0.0001
                                            5

Source            Type I Expected Mean Square
SUPPRESS          Var(Error) + 99 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)    Var(Error) + Q(SITE(SUPPRESS))

Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: DROPPINGS POSSUM
Source: SUPPRESS
Error: MS(Error)
               Denominator  Denominator
               DF           Type I MS      DF   MS             F Value   Pr > F
               1            488.48989899   19   5.5003156566   88.8112   0.0001
                                           2

Source: SITE(SUPPRESS)
Error: MS(Error)
               Denominator  Denominator
               DF           Type I MS      DF   MS             F Value   Pr > F
               4            222.24747475   19   5.5003156566   40.4063   0.0001
                                           2
```

```
       Tukey's Studentized Range (HSD) Test for variable: DROPPINGS POSSUM
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 192 MSE= 5.500316
       Critical Value of Studentized Range= 2.789
       Minimum Significant Difference= 0.6575
       Means with the same letter are not significantly different.

Tukey Grouping     Mean              N                 SUPPRESS
A                  5.6566            99                2
B                  2.5152            99                1
```

Possum droppings analysis - Differences between sites

```
       General Linear Models Procedure
       Class Level Information
Class          Levels  Values
SUPPRESS       2       1 2
SITE           6       loch remi robi vals wend whit
SPECIES        1       possum
WEEKNO         26      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
       Number of observations in by group = 198

       General Linear Models Procedure
Dependent Variable: DROPPINGS POSSUM
Source         DF          Sum of          Mean Square     F Value      Pr > F
                           Squares
Model          155         2131.04040404   13.74864777     1.91         0.0080
Error          42          302.50000000    7.20238095
Corrected      197         2433.54040404
Total
               R-Square    C.V.            Root MSE        DROPP Mean
               0.875696    65.68326        2.68372520      4.08585859

Source         DF          Type I SS       Mean Square     F Value      Pr > F
SITE           5           1377.47979798   275.49595960    38.25        0.0001
WEEKNO         25          196.79040404    7.87161616      1.09         0.3905
SITE*WEEKNO    125         556.77020202    4.45416162      0.62         0.9779

Source         DF          Type III SS     Mean Square     F Value      Pr > F
SITE           5           1320.30555556   264.06111111    36.66        0.0001
WEEKNO         25          196.79040404    7.87161616      1.09         0.3905
SITE*WEEKNO    125         556.77020202    4.45416162      0.62         0.9779

       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: DROPP
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 42  MSE= 7.202381
       Critical Value of Studentized Range= 4.222
       Minimum Significant Difference= 1.9723

       Means with the same letter are not significantly different.
Tukey Grouping     Mean         N         SITE
A                  7.5455       33        vals
A                  6.0303       33        remi
A                  5.8485       33        loch
B                  3.5758       33        robi
C                  1.2424       33        whit
C                  0.2727       33        wend
```

---------- SPECIES=rat ----------

Rat droppings analysis - Site nested within suppression

```
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       loch remi robi vals wend whit
       SPECIES        1       rat
       Number of observations in by group = 198
       Type I Estimable Functions for: SUPPRESS
Effect                      Coefficients
INTERCEPT       0
SUPPRESS        1           L2
                2           -L2
SITE(SUPPRESS)  remi 1      0.3333*L2
                wend 1      0.3333*L2
                whit 1      0.3333*L2
                loch 2      -0.3333*L2
                robi 2      -0.3333*L2
                vals 2      -0.3333*L2

       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                      Coefficients
INTERCEPT       0
SUPPRESS        1           0
                2           0
SITE(SUPPRESS)  remi 1      L4
                wend 1      L5
                whit 1      -L4-L5
                loch 2      L7
                robi 2      L8
                vals 2      -L7-L8

Dependent Variable: DROPPINGS RAT
Source            DF        Sum of          Mean Square    F Value     Pr > F
                            Squares
Model             5         121.31313131    24.26262626    31.46       0.0001
Error             192       148.06060606    0.77114899
Corrected Total   197       269.37373737
                  R-Square  C.V.            Root MSE       DROPP Mean
                  0.450352  184.9722        0.87815089     0.47474747

Source            DF        Type I SS       Mean Square    F Value     Pr > F
SUPPRESS          1         32.32323232     32.32323232    41.92       0.0001
SITE(SUPPRESS)    4         88.98989899     22.24747475    28.85       0.0001

Source            Type I Expected Mean Square
SUPPRESS          Var(Error) + 99 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)    Var(Error) + Q(SITE(SUPPRESS))

       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: DROPPINGS RAT

Source: SUPPRESS
Error: MS(Error)
                Denominator  Denominator
                DF           Type I MS     DF    MS            F Value  Pr > F
                1            32.323232323  192   0.7711489899  41.9157  0.0001

Source: SITE(SUPPRESS)
Error: MS(Error)
                Denominator  Denominator
                DF           Type I MS     DF    MS            F Value  Pr > F
                4            22.247474747  192   0.7711489899  28.8498  0.0001

       Tukey's Studentized Range (HSD) Test for variable: DROPP
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 192 MSE= 0.771149
       Critical Value of Studentized Range= 2.789
       Minimum Significant Difference= 0.2462
       Means with the same letter are not significantly different.

Tukey Grouping     Mean       N      SUPPRESS
A                  0.8788     99     1
B                  0.0707     99     2
```

Rat droppings analysis - Differences between sites

```
        General Linear Models Procedure
        Class Level Information
Class          Levels  Values
SUPPRESS       2       1 2
SITE           6       loch remi robi vals wend whit
SPECIES        1       rat
WEEKNO         26      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
        Number of observations in by group = 198

        General Linear Models Procedure
Dependent Variable: DROPP
Source          DF          Sum of          Mean Square     F Value      Pr > F
                            Squares
Model           155         248.87373737    1.60563702      3.29         0.0001
Error           42          20.50000000     0.48809524
Corrected       197         269.37373737
Total
                R-Square    C.V.            Root MSE        DROPP Mean
                0.923898    147.1599        0.69863813      0.47474747

Source          DF          Type I SS       Mean Square     F Value      Pr > F
SITE            5           121.31313131    24.26262626     49.71        0.0001
WEEKNO          25          26.95707071     1.07828283      2.21         0.0113
SITE*WEEKNO     125         100.60353535    0.80482828      1.65         0.0322

Source          DF          Type III SS     Mean Square     F Value      Pr > F
SITE            5           136.95000000    27.39000000     56.12        0.0001
WEEKNO          25          26.95707071     1.07828283      2.21         0.0113
SITE*WEEKNO     125         100.60353535    0.80482828      1.65         0.0322

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: DROPP
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 42  MSE= 0.488095
        Critical Value of Studentized Range= 4.222
        Minimum Significant Difference= 0.5134

        Means with the same letter are not significantly different.
Tukey Grouping     Mean         N       SITE
A                  2.2121       33      remi
B                  0.3333       33      wend
B                  0.0909       33      robi
B                  0.0909       33      whit
B                  0.0606       33      loch
B                  0.0606       33      vals

--------------------------------- SPECIES=rodent ----------------------------------
```

Rodent droppings analysis - Site nested within suppression

```
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           6       loch remi robi vals wend whit
        SPECIES        1       rodent
        Number of observations in by group = 198

        Type I Estimable Functions for: SUPPRESS
Effect                      Coefficients
INTERCEPT       0
SUPPRESS        1           L2
                2           -L2
SITE(SUPPRESS)  remi 1      0.3333*L2
                wend 1      0.3333*L2
                whit 1      0.3333*L2
                loch 2      -0.3333*L2
                robi 2      -0.3333*L2
                vals 2      -0.3333*L2
```

```
       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                     Coefficients
INTERCEPT       0
SUPPRESS        1          0
                2          0
SITE(SUPPRESS)  remi 1     L4
                wend 1     L5
                whit 1     -L4-L5
                loch 2     L7
                robi 2     L8
                vals 2     -L7-L8

Dependent Variable: DROPPINGS RODENTS
Source          DF         Sum of          Mean Square   F Value      Pr > F
                           Squares
Model           5          294.58585859    58.91717172   23.50        0.0001
Error           192        481.45454545    2.50757576
Corrected       197        776.04040404
Total
                R-Square   C.V.            Root MSE      DROPP Mean
                0.379601   85.20094        1.58353268    1.85858586

Source           DF         Type I SS       Mean Square   F Value      Pr > F
SUPPRESS         1          0.32323232      0.32323232    0.13         0.7200
SITE(SUPPRESS)   4          294.26262626    73.56565657   29.34        0.0001

Source           Type I Expected Mean Square
SUPPRESS         Var(Error) + 99 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)   Var(Error) + Q(SITE(SUPPRESS))

       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: DROPPINGS RODENTS

Source: SUPPRESS
Error: MS(Error)
               Denominator  Denominator
               DF           Type I MS     DF    MS            F Value   Pr > F
               1            0.3232323232  192   2.5075757576  0.1289    0.7200

Source: SITE(SUPPRESS)
Error: MS(Error)
               Denominator  Denominator
               DF           Type I MS     DF    MS            F Value   Pr > F
               4            73.565656566  192   2.5075757576  29.3374   0.0001

       Tukey's Studentized Range (HSD) Test for variable: DROPP
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 192 MSE= 2.507576
       Critical Value of Studentized Range= 2.789
       Minimum Significant Difference= 0.4439
       Means with the same letter are not significantly different.

Tukey Grouping    Mean       N       SUPPRESS
A                 1.8990     99      1
A
A                 1.8182     99      2
```

Rodent droppings analysis - Differences between sites

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SUPPRESS	2	1 2
SITE	6	loch remi robi vals wend whit
SPECIES	1	rodent
WEEKNO	26	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26

Number of observations in by group = 198

General Linear Models Procedure
Dependent Variable: DROPPINGS RODENTS

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	155	661.04040404	4.26477680	1.56	0.0473
Error	42	115.00000000	2.73809524		
Corrected Total	197	776.04040404			

R-Square	C.V.	Root MSE	DROPP Mean
0.851812	89.03108	1.65471908	1.85858586

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SITE	5	294.58585859	58.91717172	21.52	0.0001
WEEKNO	25	82.20707071	3.28828283	1.20	0.2937
SITE*WEEKNO	125	284.24747475	2.27397980	0.83	0.7843

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SITE	5	310.30370370	62.06074074	22.67	0.0001
WEEKNO	25	82.20707071	3.28828283	1.20	0.2937
SITE*WEEKNO	125	284.24747475	2.27397980	0.83	0.7843

General Linear Models Procedure
Tukey's Studentized Range (HSD) Test for variable: DROPP
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 42 MSE= 2.738095
Critical Value of Studentized Range= 4.222
Minimum Significant Difference= 1.2161

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SITE
A	4.1818	33	remi
B	2.4545	33	robi
C B	1.7576	33	loch
C B D	1.2424	33	vals
C D	1.1818	33	wend
D	0.3333	33	whit

Appendix 7.4 SAS output; predation and consumption of fruits between site pairs.

SAS syntax as per Appendix 7.2

Suppress	Site has possum suppression = 1, without possum suppression = 2.
Site	Abbreviation of site name
Species	Abbreviation of plant species name
Pest	Category of predation (possum, rodent, insect, unknown), consumption, total immature, total fruit, total predated fruit.
Pair	Values assigned to each experimental pair of sites, 1 = Wenderholm & Loch Amber, 2 = Whitford & Robertson's, and 3 = Remiger's & Val's.

```
------------------------------- PAIR=1 PEST=mattot --------------------------------
```

Wenderholm and Loch Amber –number of mature fruits

(including predated and consumed fruits)

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           2       loch wend
        SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
        PEST           1       mattot
        PAIR           1       1
        Number of observations in by group = 1060

        General Linear Models Procedure
Dependent Variable: RESULT = total number of mature fruits (including predated and consumed
fruits)
Source             DF         Sum of Squares     Mean Square      F Value       Pr > F
Model              19         160026.27452830    8422.43550149    6.11          0.0001
Error              1040       1434148.67924528   1378.98911466
Corrected Total    1059       1594174.95377359
                   R-Square   C.V.               Root MSE         RESULT Mean
                   0.100382   502.2691           37.13474269      7.39339623

Source             DF         Type I SS          Mean Square      F Value       Pr > F
SUPPRESS           1          16114.80094340     16114.80094340   11.69         0.0007
SPECIES            9          79820.96320755     8868.99591195    6.43          0.0001
SUPPRESS*SPECIES   9          64090.51037736     7121.16781971    5.16          0.0001

Source             DF         Type III SS        Mean Square      F Value       Pr > F
SUPPRESS           1          16114.80094340     16114.80094340   11.69         0.0007
SPECIES            9          79820.96320755     8868.99591195    6.43          0.0001
SUPPRESS*SPECIES   9          64090.51037736     7121.16781971    5.16          0.0001

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 1040       MSE= 1378.989
        Critical Value of Studentized Range= 2.775
        Minimum Significant Difference= 4.4762

        Means with the same letter are not significantly different.
Tukey Grouping     Mean       N          SUPPRESS
A                  11.292     530        1
B                  3.494      530        2

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 1040       MSE= 1378.989
        Critical Value of Studentized Range= 4.484
        Minimum Significant Difference= 16.173
```

```
       Means with the same letter are not significantly different.
Tukey Grouping    Mean           N              SPECIES
           A      28.491         106            kahi
B          A      14.821         106            puri
B          A      14.123         106            nika
B                 5.321          106            kara
B                 5.057          106            kohe
B                 2.755          106            rewa
B                 2.660          106            tara
B                 0.509          106            tawa
B                 0.170          106            supl
B                 0.028          106            pige

-------------------------------- PAIR=1 PEST=immtot --------------------------------
```

Wenderholm and Loch Amber –number of immature fruits

(including predated immature fruits)

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           2       loch wend
       SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
       PEST           1       immtot
       PAIR           1       1
       Number of observations in by group = 1060

       General Linear Models Procedure
Dependent Variable: RESULT =total number of immature fruits (including predated immature
fruits)
Source             DF        Sum of Squares   Mean Square    F Value       Pr > F
Model              19        19454.69433962   1023.93128103  10.22         0.0001
Error              1040      104205.16981132  100.19727866
Corrected Total    1059      123659.86415094
                   R-Square  C.V.             Root MSE       RESULT Mean
                   0.157324  332.4076         10.00985907    3.01132075

Source             DF        Type I SS        Mean Square    F Value       Pr > F
SUPPRESS           1         346.44905660     346.44905660   3.46          0.0632
SPECIES            9         13217.48679245   1468.60964361  14.66         0.0001
SUPPRESS*SPECIES   9         5890.75849057    654.52872117   6.53          0.0001

Source             DF        Type III SS      Mean Square    F Value       Pr > F
SUPPRESS           1         346.44905660     346.44905660   3.46          0.0632
SPECIES            9         13217.48679245   1468.60964361  14.66         0.0001
SUPPRESS*SPECIES   9         5890.75849057    654.52872117   6.53          0.0001

       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 1040       MSE= 100.1973
       Critical Value of Studentized Range= 2.775
       Minimum Significant Difference= 1.2066

       Means with the same letter are not significantly different.
Tukey Grouping    Mean       N         SUPPRESS
A                 3.5830     530       2
A                 2.4396     530       1
```

```
        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 1040       MSE= 100.1973
        Critical Value of Studentized Range= 4.484
        Minimum Significant Difference= 4.3595

        Means with the same letter are not significantly different.
Tukey Grouping    Mean      N       SPECIES
A                 12.340    106     tara
         B        4.745     106     rewa
C        B        3.934     106     kahi
C        B        3.783     106     nika
C        B        2.623     106     kara
C        B        1.887     106     puri
C        B        0.547     106     kohe
C                 0.255     106     tawa
C                 0.000     106     pige
C                 0.000     106     supl

-------------------------------- PAIR=1 PEST=predno ---------------------------------
```

Wenderholm and Loch Amber –number of predated fruits

(mature, immature and any type of predation)

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           2       loch wend
        SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
        PEST           1       predno
        PAIR           1       1
        Number of observations in by group = 1060

        General Linear Models Procedure
Dependent Variable: RESULT = total number of predated fruits (mature, immature and any type of
predation)
Source             DF         Sum of Squares  Mean Square    F Value        Pr > F
Model              19         7863.04150943   413.84428997   7.16           0.0001
Error              1040       60077.20754717  57.76654572
Corrected Total    1059       67940.24905660
                   R-Square   C.V.            Root MSE       RESULT Mean
                   0.115735   524.5089        7.60043063     1.44905660

Source             DF         Type I SS       Mean Square    F Value        Pr > F
SUPPRESS           1          891.30566038    891.30566038   15.43          0.0001
SPECIES            9          3656.34339623   406.26037736   7.03           0.0001
SUPPRESS*SPECIES   9          3315.39245283   368.37693920   6.38           0.0001

Source             DF         Type III SS     Mean Square    F Value        Pr > F
SUPPRESS           1          891.30566038    891.30566038   15.43          0.0001
SPECIES            9          3656.34339623   406.26037736   7.03           0.0001
SUPPRESS*SPECIES   9          3315.39245283   368.37693920   6.38           0.0001

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 1040       MSE= 57.76655
        Critical Value of Studentized Range= 2.775
        Minimum Significant Difference= 0.9162

        Means with the same letter are not significantly different.
Tukey Grouping     Mean         N           SUPPRESS
A                  2.3660       530         2
B                  0.5321       530         1
```

General Linear Models Procedure
Tukey's Studentized Range (HSD) Test for variable: RESULT
NOTE: This test controls the type I experimentwise error rate, but
generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 1040 MSE= 57.76655
Critical Value of Studentized Range= 4.484
Minimum Significant Difference= 3.3101

Means with the same letter are not significantly different.

Tukey Grouping		Mean	N	SPECIES
A		6.028	106	rewa
B	A	2.925	106	tara
B		2.283	106	nika
B		2.179	106	kara
B		0.755	106	puri
B		0.255	106	tawa
B		0.047	106	kohe
B		0.009	106	kahi
B		0.009	106	supl
B		0.000	106	pige

---------- PAIR=1 PEST=unpred ----------

Wenderholm and Loch Amber –number of unpredated fruits

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SUPPRESS	2	1 2
SITE	2	loch wend
SPECIES	10	kahi kara kohe nika pige puri rewa supl tara tawa
PEST	1	unpred
PAIR	1	1

Number of observations in by group = 1060

General Linear Models Procedure
Dependent Variable: RESULT = number of unpredated fruits

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	19	207031.90188679	10896.41588878	6.96	0.0001
Error	1040	1628247.28301887	1565.62238752		
Corrected Total	1059	1835279.18490566			

R-Square	C.V.	Root MSE	RESULT Mean
0.112807	380.3230	39.56794647	10.40377358

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SUPPRESS	1	11742.24905660	11742.24905660	7.50	0.0063
SPECIES	9	100178.48679245	11130.94297694	7.11	0.0001
SUPPRESS*SPECIES	9	95111.16603774	10567.90733753	6.75	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SUPPRESS	1	11742.24905660	11742.24905660	7.50	0.0063
SPECIES	9	100178.48679245	11130.94297694	7.11	0.0001
SUPPRESS*SPECIES	9	95111.16603774	10567.90733753	6.75	0.0001

General Linear Models Procedure
Tukey's Studentized Range (HSD) Test for variable: RESULT
NOTE: This test controls the type I experimentwise error rate, but
generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 1040 MSE= 1565.622
Critical Value of Studentized Range= 2.775
Minimum Significant Difference= 4.7695

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SUPPRESS
A	13.732	530	1
B	7.075	530	2

```
       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 1040       MSE= 1565.622
       Critical Value of Studentized Range= 4.484
       Minimum Significant Difference= 17.232
       Means with the same letter are not significantly different.
Tukey Grouping    Mean         N            SPECIES
      A          32.425       106          kahi
B     A          17.906       106          nika
B     A     C    16.708       106          puri
B           C    15.000       106          tara
B           C    7.943        106          kara
B           C    7.500        106          rewa
B           C    5.604        106          kohe
B           C    0.764        106          tawa
            C    0.160        106          supl
            C    0.028        106          pige

-------------------------------- PAIR=1 PEST=consno --------------------------------
```

Wenderholm and Loch Amber –number of consumed fruits

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           2       loch wend
       SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
       PEST           1       consno
       PAIR           1       1
       Number of observations in by group = 1060

Dependent Variable: RESULT =Number of fruits consumed
Source            DF        Sum of Squares    Mean Square     F Value        Pr > F
Model             19        123855.67547170   6518.71976167   6.43           0.0001
Error             1040      1054889.58490566  1014.31690856
Corrected Total   1059      1178745.26037736
                  R-Square  C.V.              Root MSE        RESULT Mean
                  0.105074  633.6194          31.84834232     5.02641509

Source            DF        Type I SS         Mean Square     F Value        Pr > F
SUPPRESS          1         15291.20377358    15291.20377358  15.08          0.0001
SPECIES           9         61511.37358491    6834.59706499   6.74           0.0001
SUPPRESS*SPECIES  9         47053.09811321    5228.12201258   5.15           0.0001

Source            DF        Type III SS       Mean Square     F Value        Pr > F
SUPPRESS          1         15291.20377358    15291.20377358  15.08          0.0001
SPECIES           9         61511.37358491    6834.59706499   6.74           0.0001
SUPPRESS*SPECIES  9         47053.09811321    5228.12201258   5.15           0.0001

       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 1040       MSE= 1014.317
       Critical Value of Studentized Range= 2.775
       Minimum Significant Difference= 3.839

       Means with the same letter are not significantly different.
Tukey Grouping    Mean     N        SUPPRESS
A                 8.825    530      1
B                 1.228    530      2
```

```
        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 1040       MSE= 1014.317
        Critical Value of Studentized Range= 4.484
        Minimum Significant Difference= 13.87

        Means with the same letter are not significantly different.
Tukey         Mean           N              SPECIES
Grouping
          A   24.868         106            kahi
B         A   12.274         106            nika
B             6.604          106            puri
B             4.226          106            kohe
B             1.453          106            tara
B             0.500          106            kara
B             0.217          106            tawa
B             0.094          106            supl
B             0.028          106            pige
B             0.000          106            rewa

-------------------------------- PAIR=1 PEST=inspre --------------------------------
```

Wenderholm and Loch Amber –number of insect predated fruits

(fruits could be mature or immature)

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           2       loch wend
        SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
        PEST           1       inspre
        PAIR           1       1
        Number of observations in by group = 1060

        General Linear Models Procedure
Dependent Variable: RESULT =number of insect predated fruits (fruits could be mature or
immature)
Source             DF         Sum of          Mean Square    F Value        Pr > F
                              Squares
Model              19         631.96603774    33.26137041    6.37           0.0001
Error              1040       5433.69811321   5.22470972
Corrected Total    1059       6065.66415094
                   R-Square   C.V.            Root MSE       RESULT Mean
                   0.104187   791.8000        2.28576239     0.28867925

Source             DF         Type I SS       Mean Square    F Value        Pr > F
SUPPRESS           1          29.22264151     29.22264151    5.59           0.0182
SPECIES            9          330.15471698    36.68385744    7.02           0.0001
SUPPRESS*SPECIES   9          272.58867925    30.28763103    5.80           0.0001

Source             DF         Type III SS     Mean Square    F Value        Pr > F
SUPPRESS           1          29.22264151     29.22264151    5.59           0.0182
SPECIES            9          330.15471698    36.68385744    7.02           0.0001
SUPPRESS*SPECIES   9          272.58867925    30.28763103    5.80           0.0001

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 1040       MSE= 5.22471
        Critical Value of Studentized Range= 2.775
        Minimum Significant Difference= 0.2755

        Means with the same letter are not significantly different.
Tukey Grouping     Mean         N         SUPPRESS
A                  0.4547       530       2
B                  0.1226       530       1
```

```
General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 1040       MSE= 5.22471
        Critical Value of Studentized Range= 4.484
        Minimum Significant Difference= 0.9955

        Means with the same letter are not significantly different.
Tukey Grouping     Mean              N                 SPECIES
A                  1.9057            106               rewa
B                  0.5000            106               nika
B                  0.1604            106               kara
B                  0.1415            106               kahi
B                  0.1415            106               tara
B                  0.0189            106               puri
B                  0.0189            106               tawa
B                  0.0000            106               kohe
B                  0.0000            106               pige
B                  0.0000            106               supl

-------------------------------- PAIR=1 PEST=posspr --------------------------------
```

Wenderholm and Loch Amber –number of possum predated fruits

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           2       loch wend
        SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
        PEST           1       posspr
        PAIR           1       1
        Number of observations in by group = 1060

        General Linear Models Procedure
Dependent Variable: RESULT = number of fruits predated by possums
Source             DF         Sum of Squares  Mean Square    F Value        Pr > F
Model              19         3087.87169811   162.51956306   6.18           0.0001
Error              1040       27359.47169811  26.30718433
Corrected Total    1059       30447.34339623
                   R-Square   C.V.            Root MSE       RESULT Mean
                   0.101417   711.6225        5.12905297     0.72075472

Source             DF         Type I SS       Mean Square    F Value        Pr > F
SUPPRESS           1          386.41509434    386.41509434   14.69          0.0001
SPECIES            9          1350.49433962   150.05492662   5.70           0.0001
SUPPRESS*SPECIES   9          1350.96226415   150.10691824   5.71           0.0001

Source             DF         Type III SS     Mean Square    F Value        Pr > F
SUPPRESS           1          386.41509434    386.41509434   14.69          0.0001
SPECIES            9          1350.49433962   150.05492662   5.70           0.0001
SUPPRESS*SPECIES   9          1350.96226415   150.10691824   5.71           0.0001

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 1040       MSE= 26.30718
        Critical Value of Studentized Range= 2.775
        Minimum Significant Difference= 0.6183

        Means with the same letter are not significantly different.
Tukey Grouping     Mean         N           SUPPRESS
A                  1.3245       530         2
B                  0.1170       530         1
```

```
        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 1040       MSE= 26.30718
        Critical Value of Studentized Range= 4.484
        Minimum Significant Difference= 2.2338

        Means with the same letter are not significantly different.
Tukey Grouping    Mean           N              SPECIES
           A      3.5566         106            rewa
B          A      2.0000         106            tara
B                 1.0849         106            kara
B                 0.2736         106            puri
B                 0.1604         106            tawa
B                 0.0849         106            kohe
B                 0.0283         106            kahi
B                 0.0189         106            nika
B                 0.0000         106            pige
B                 0.0000         106            supl


------------------------------- PAIR=1 PEST=rodtpr --------------------------------
```

Wenderholm and Loch Amber –number of fruits predated by rodents

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           2       loch wend
        SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
        PEST           1       rodtpr
        PAIR           1       1
        Number of observations in by group = 1060
        General Linear Models Procedure

Dependent Variable: RESULT = number of fruits predated by rodents
Source             DF         Sum of          Mean Square    F Value        Pr > F
                              Squares
Model              19         301.09056604    15.84687190    8.89           0.0001
Error              1040       1854.86792453   1.78352685
Corrected Total    1059       2155.95849057
                   R-Square   C.V.            Root MSE       RESULT Mean
                   0.139655   468.7473        1.33548750     0.28490566

Source             DF         Type I SS       Mean Square    F Value        Pr > F
SUPPRESS           1          9.43396226      9.43396226     5.29           0.0217
SPECIES            9          162.75094340    18.08343816    10.14          0.0001
SUPPRESS*SPECIES   9          128.90566038    14.32285115    8.03           0.0001

Source             DF         Type III SS     Mean Square    F Value        Pr > F
SUPPRESS           1          9.43396226      9.43396226     5.29           0.0217
SPECIES            9          162.75094340    18.08343816    10.14          0.0001
SUPPRESS*SPECIES   9          128.90566038    14.32285115    8.03           0.0001

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 1040       MSE= 1.783527
        Critical Value of Studentized Range= 2.775
        Minimum Significant Difference= 0.161

        Means with the same letter are not significantly different.
Tukey Grouping    Mean        N         SUPPRESS
A                 0.37925     530       2
B                 0.19057     530       1
```

```
       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 1040       MSE= 1.783527
       Critical Value of Studentized Range= 4.484
       Minimum Significant Difference= 0.5816

       Means with the same letter are not significantly different.
Tukey Grouping    Mean      N         SPECIES
A                 1.3585    106       nika
B                 0.4717    106       kara
B                 0.3962    106       rewa
B                 0.2547    106       tara
B                 0.2264    106       kahi
B                 0.0472    106       tawa
B                 0.0472    106       kohe
B                 0.0377    106       puri
B                 0.0094    106       supl
B                 0.0000    106       pige

-------------------------------- PAIR=1 PEST=unknpr --------------------------------
```

Wenderholm and Loch Amber –number of fruits predated by unknown agents

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           2       loch wend
       SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
       PEST           1       unknpr
       PAIR           1       1
       Number of observations in by group = 1060

       General Linear Models Procedure
Dependent Variable: RESULT =number of fruits predated by unknown agents
Source             DF         Sum of         Mean Square    F Value        Pr > F
                              Squares
Model              19         22.79622642    1.19980139     2.11           0.0036
Error              1040       590.86792453   0.56814224
Corrected Total    1059       613.66415094
                   R-Square   C.V.           Root MSE       RESULT Mean
                   0.037148   849.9758       0.75375210     0.08867925

Source             DF         Type I SS      Mean Square    F Value        Pr > F
SUPPRESS           1          0.37735849     0.37735849     0.66           0.4153
SPECIES            9          16.32452830    1.81383648     3.19           0.0008
SUPPRESS*SPECIES   9          6.09433962     0.67714885     1.19           0.2963

Source             DF         Type III SS    Mean Square    F Value        Pr > F
SUPPRESS           1          0.37735849     0.37735849     0.66           0.4153
SPECIES            9          16.32452830    1.81383648     3.19           0.0008
SUPPRESS*SPECIES   9          6.09433962     0.67714885     1.19           0.2963

       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 1040       MSE= 0.568142
       Critical Value of Studentized Range= 2.775
       Minimum Significant Difference= 0.0909

       Means with the same letter are not significantly different.
Tukey Grouping    Mean       N          SUPPRESS
A                 0.10755    530        1
A                 0.06981    530        2
```

```
        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 1040       MSE= 0.568142
        Critical Value of Studentized Range= 4.484
        Minimum Significant Difference= 0.3283

        Means with the same letter are not significantly different.
Tukey Grouping    Mean      N         SPECIES
           A      0.3962    106       kara
B          A      0.2358    106       tara
B          A      0.1132    106       nika
B          A      0.0755    106       rewa
B                 0.0283    106       tawa
B                 0.0189    106       kahi
B                 0.0189    106       puri
B                 0.0000    106       kohe
B                 0.0000    106       pige
B                 0.0000    106       supl

-------------------------------- PAIR=2 PEST=mattot --------------------------------
```

Whitford and Robertson's –number of mature fruits

(including predated and consumed fruits)

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           2       robi whit
        SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
        PEST           1       mattot
        PAIR           1       2
        Number of observations in by group = 1060
NOTE: Due to missing values, only 920 observations can be used in this analysis.

        General Linear Models Procedure
Dependent Variable: RESULT =total number of fruits (including predated and consumed fruits)
Source             DF         Sum of Squares    Mean Square     F Value         Pr > F
Model              19         26294.13919196    1383.90206273   4.30            0.0001
Error              900        289539.20754717   321.71023061
Corrected Total    919        315833.34673913
                   R-Square   C.V.              Root MSE        RESULT Mean
                   0.083253   528.7209          17.93628252     3.39239130

Source             DF         Type I SS         Mean Square     F Value         Pr > F
SUPPRESS           1          945.77484750      945.77484750    2.94            0.0868
SPECIES            9          16402.77065217    1822.53007246   5.67            0.0001
SUPPRESS*SPECIES   9          8945.59369229     993.95485470    3.09            0.0012

Source             DF         Type III SS       Mean Square     F Value         Pr > F
SUPPRESS           1          945.77484750      945.77484750    2.94            0.0868
SPECIES            9          19543.99369229    2171.55485470   6.75            0.0001
SUPPRESS*SPECIES   9          8945.59369229     993.95485470    3.09            0.0012

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 900 MSE= 321.7102
        Critical Value of Studentized Range= 2.776
        Minimum Significant Difference= 2.3485
        WARNING: Cell sizes are not equal.
        Harmonic Mean of cell sizes= 449.3478

        Means with the same letter are not significantly different.
Tukey Grouping     Mean        N          SUPPRESS
A                  4.574       390        2
A                  2.523       530        1
```

```
       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 900 MSE= 321.7102
       Critical Value of Studentized Range= 4.485
       Minimum Significant Difference= 8.3877

       Means with the same letter are not significantly different.
Tukey Grouping    Mean            N               SPECIES
          A       13.902          92              kahi
B         A       8.402           92              puri
B                 3.783           92              nika
B                 3.152           92              kohe
B                 1.446           92              tara
B                 1.315           92              kara
B                 1.054           92              rewa
B                 0.446           92              tawa
B                 0.359           92              pige
B                 0.065           92              supl

------------------------------- PAIR=2 PEST=immtot --------------------------------
```

Withford and Robertson's –number of immature fruits

(including predated immature fruits)

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           2       robi whit
       SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
       PEST           1       immtot
       PAIR           1       2
       Number of observations in by group = 1060
NOTE: Due to missing values, only 920 observations can be used in this analysis.

       General Linear Models Procedure
Dependent Variable: RESULT = number of immature fruits (included predated and consumeded
fruits)
Source             DF         Sum of Squares   Mean Square    F Value        Pr > F
Model              19         81786.26019909   4304.54001048  6.11           0.0001
Error              900        634421.71262700  704.91301403
Corrected Total    919        716207.97282609
                   R-Square   C.V.             Root MSE       RESULT Mean
                   0.114193   590.7178         26.55019800    4.49456522

Source             DF         Type I SS        Mean Square    F Value        Pr > F
SUPPRESS           1          687.01806073     687.01806073   0.97           0.3238
SPECIES            9          68555.20108696   7617.24456522  10.81          0.0001
SUPPRESS*SPECIES   9          12544.04105141   1393.78233905  1.98           0.0389

Source             DF         Type III SS      Mean Square    F Value        Pr > F
SUPPRESS           1          687.01806073     687.01806073   0.97           0.3238
SPECIES            9          59269.25844271   6585.47316030  9.34           0.0001
SUPPRESS*SPECIES   9          12544.04105141   1393.78233905  1.98           0.0389

       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 900 MSE= 704.913
       Critical Value of Studentized Range= 2.776
       Minimum Significant Difference= 3.4764
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 449.3478

       Means with the same letter are not significantly different.
Tukey Grouping     Mean       N         SUPPRESS
A                  5.236      530       1
A                  3.487      390       2
```

```
       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 900 MSE= 704.913
       Critical Value of Studentized Range= 4.485
       Minimum Significant Difference= 12.416

       Means with the same letter are not significantly different.
Tukey Grouping     Mean       N        SPECIES
A                  30.076     92       tara
B                  4.261      92       nika
B                  3.576      92       kahi
B                  1.804      92       rewa
B                  1.772      92       puri
B                  1.707      92       kohe
B                  1.522      92       kara
B                  0.196      92       tawa
B                  0.033      92       pige
B                  0.000      92       supl

------------------------------- PAIR=2 PEST=predno --------------------------------
```

Whitford and Robertson's –number of predated fruits

(mature, immature and any type of predation)

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           2       robi whit
       SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
       PEST           1       predno
       PAIR           1       2
       Number of observations in by group = 1060
NOTE: Due to missing values, only 920 observations can be used in this analysis.

       General Linear Models Procedure
Dependent Variable: RESULT =number of predated fruits (mature, immature and any type of
predation)
Source             DF             Sum of Squares  Mean Square     F Value         Pr > F
Model              19             1205.01426821   63.42180359     4.81            0.0001
Error              900            11860.07160135  13.17785733
Corrected Total    919            13065.08586957
                   R-Square       C.V.            Root MSE        RESULT Mean
                   0.092232       417.9876        3.63013186      0.86847826

Source             DF             Type I SS       Mean Square     F Value         Pr > F
SUPPRESS           1              97.87943512     97.87943512     7.43            0.0065
SPECIES            9              871.53152174    96.83683575     7.35            0.0001
SUPPRESS*SPECIES   9              235.60331135    26.17814571     1.99            0.0379

Source             DF             Type III SS     Mean Square     F Value         Pr > F
SUPPRESS           1              97.87943512     97.87943512     7.43            0.0065
SPECIES            9              900.80331135    100.08925682    7.60            0.0001
SUPPRESS*SPECIES   9              235.60331135    26.17814571     1.99            0.0379

       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 900 MSE= 13.17786
       Critical Value of Studentized Range= 2.776
       Minimum Significant Difference= 0.4753
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 449.3478

       Means with the same letter are not significantly different.
Tukey Grouping     Mean          N          SUPPRESS
A                  1.2487        390        2
B                  0.5887        530        1
```

```
        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 900 MSE= 13.17786
        Critical Value of Studentized Range= 4.485
        Minimum Significant Difference= 1.6976

        Means with the same letter are not significantly different.
Tukey                 Mean       N       SPECIES
Grouping
          A           3.0326     92      nika
B         A           1.8478     92      rewa
B         A     C     1.5109     92      kahi
B         A     C     1.3696     92      tara
B               C     0.3587     92      puri
B               C     0.3043     92      kara
                C     0.1196     92      kohe
                C     0.0978     92      tawa
                C     0.0217     92      pige
                C     0.0217     92      supl

-------------------------------- PAIR=2 PEST=unpred --------------------------------
```

Whitford and Robertson's –number of unpredated fruits

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           2       robi whit
        SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
        PEST           1       unpred
        PAIR           1       2
        Number of observations in by group = 1060
NOTE: Due to missing values, only 920 observations can be used in this analysis.

        General Linear Models Procedure
Dependent Variable: RESULT =number of unpredated fruits
Source             DF         Sum of Squares    Mean Square     F Value         Pr > F
Model              19         112256.76597463   5908.25084077   5.58            0.0001
Error              900        953717.47750363   1059.68608612
Corrected Total    919        1065974.24347826
                   R-Square   C.V.              Root MSE        RESULT Mean
                   0.105309   412.7425          32.55281994     7.88695652

Source             DF         Type I SS         Mean Square     F Value         Pr > F
SUPPRESS           1          20.63360888       20.63360888     0.02            0.8891
SPECIES            9          81481.72173913    9053.52463768   8.54            0.0001
SUPPRESS*SPECIES   9          30754.41062662    3417.15673629   3.22            0.0007

Source             DF         Type III SS       Mean Square     F Value         Pr > F
SUPPRESS           1          20.63360888       20.63360888     0.02            0.8891
SPECIES            9          77237.94106140    8581.99345127   8.10            0.0001
SUPPRESS*SPECIES   9          30754.41062662    3417.15673629   3.22            0.0007

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 900 MSE= 1059.686
        Critical Value of Studentized Range= 2.776
        Minimum Significant Difference= 4.2623
        WARNING: Cell sizes are not equal.
        Harmonic Mean of cell sizes= 449.3478

        Means with the same letter are not significantly different.
Tukey Grouping     Mean       N       SUPPRESS
A                  8.062      390     2
A                  7.758      530     1
```

```
        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 900 MSE= 1059.686
        Critical Value of Studentized Range= 4.485
        Minimum Significant Difference= 15.223

        Means with the same letter are not significantly different.
Tukey Grouping    Mean       N        SPECIES
           A      31.522     92       tara
           A
B          A      17.478     92       kahi
B
B          C      10.174     92       puri
B          C
B          C      8.043      92       nika
B          C
B          C      4.859      92       kohe
B          C
B          C      2.859      92       rewa
B          C
B          C      2.837      92       kara
           C
           C      0.641      92       tawa
           C
           C      0.391      92       pige
           C
           C      0.065      92       supl

------------------------------- PAIR=2 PEST=consno ---------------------------------
```

Whitford and Robertson's –number of consumed fruits

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           2       robi whit
        SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
        PEST           1       consno
        PAIR           1       2
        Number of observations in by group = 1060
NOTE: Due to missing values, only 920 observations can be used in this analysis.

        General Linear Models Procedure
Dependent Variable: RESULT =number of consumed fruits
Source             DF         Sum of Squares    Mean Square     F Value        Pr > F
Model              19         10093.62335391    531.24333442    3.75           0.0001
Error              900        127378.06892598   141.53118770
Corrected Total    919        137471.69227989
                   R-Square   C.V.              Root MSE        RESULT Mean
                   0.073423   752.7219          11.89668810     1.58048913

Source             DF         Type I SS         Mean Square     F Value        Pr > F
SUPPRESS           1          106.39426937      106.39426937    0.75           0.3862
SPECIES            9          7390.25611141     821.13956793    5.80           0.0001
SUPPRESS*SPECIES   9          2596.97297313     288.55255257    2.04           0.0325

Source             DF         Type III SS       Mean Square     F Value        Pr > F
SUPPRESS           1          106.39426937      106.39426937    0.75           0.3862
SPECIES            9          8372.15971226     930.23996803    6.57           0.0001
SUPPRESS*SPECIES   9          2596.97297313     288.55255257    2.04           0.0325
```

```
       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 900 MSE= 141.5312
       Critical Value of Studentized Range= 2.776
       Minimum Significant Difference= 1.5577
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 449.3478

       Means with the same letter are not significantly different.
Tukey Grouping     Mean       N          SUPPRESS
A                  1.9769     390        2
A                  1.2888     530        1

       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 900 MSE= 141.5312
       Critical Value of Studentized Range= 4.485
       Minimum Significant Difference= 5.5634

       Means with the same letter are not significantly different.
Tukey Grouping     Mean       N          SPECIES
A                  9.751      92         kahi
B                  2.337      92         kohe
B                  1.663      92         nika
B                  1.370      92         puri
B                  0.239      92         tara
B                  0.239      92         tawa
B                  0.109      92         pige
B                  0.076      92         kara
B                  0.022      92         supl
B                  0.000      92         rewa

-------------------------------- PAIR=2 PEST=inspre ---------------------------------
```

Whitford and Robertson's –number of insect predated fruits

(fruits could be mature or immature)

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           2       robi whit
       SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
       PEST           1       inspre
       PAIR           1       2
       Number of observations in by group = 1060
NOTE: Due to missing values, only 920 observations can be used in this analysis.

       General Linear Models Procedure
Dependent Variable: RESULT =number of insect predated fruits (mature or immature)
Source             DF         Sum of          Mean Square    F Value        Pr > F
                              Squares
Model              19         161.00508614    8.47395190     4.68           0.0001
Error              900        1630.49056604   1.81165618
Corrected Total    919        1791.49565217
                   R-Square   C.V.            Root MSE       RESULT Mean
                   0.089872   543.1138        1.34597778     0.24782609

Source             DF         Type I SS       Mean Square    F Value        Pr > F
SUPPRESS           1          1.54848236      1.54848236     0.85           0.3555
SPECIES            9          133.40869565    14.82318841    8.18           0.0001
SUPPRESS*SPECIES   9          26.04790812     2.89421201     1.60           0.1114

Source             DF         Type III SS     Mean Square    F Value        Pr > F
SUPPRESS           1          1.54848236      1.54848236     0.85           0.3555
SPECIES            9          124.48269073    13.83141008    7.63           0.0001
SUPPRESS*SPECIES   9          26.04790812     2.89421201     1.60           0.1114
```

```
        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 900 MSE= 1.811656
        Critical Value of Studentized Range= 2.776
        Minimum Significant Difference= 0.1762
        WARNING: Cell sizes are not equal.
        Harmonic Mean of cell sizes= 449.3478

        Means with the same letter are not significantly different.
Tukey Grouping    Mean         N          SUPPRESS
A                 0.28302      530        1
A                 0.20000      390        2

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 900 MSE= 1.811656
        Critical Value of Studentized Range= 4.485
        Minimum Significant Difference= 0.6294
        Means with the same letter are not significantly different.
Tukey Grouping    Mean      N       SPECIES
           A      1.1739    92      rewa
           A
B          A      0.7609    92      nika
B
B          C      0.2500    92      tara
B          C
B          C      0.2065    92      kahi
           C
           C      0.0326    92      kara
           C
           C      0.0217    92      tawa
           C
           C      0.0217    92      kohe
           C
           C      0.0109    92      puri
           C
           C      0.0000    92      pige
           C
           C      0.0000    92      supl

-------------------------------- PAIR=2 PEST=posspr ---------------------------------
```

Whitford and Robertson's –number of possum predated fruits

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           2       robi whit
        SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
        PEST           1       posspr
        PAIR           1       2
        Number of observations in by group = 1060
NOTE: Due to missing values, only 920 observations can be used in this analysis.

        General Linear Models Procedure
Dependent Variable: RESULT =number of possum predated fruits
```

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	19	77.38855304	4.07308174	4.77	0.0001
Error	900	767.89840348	0.85322045		
Corrected Total	919	845.28695652			
	R-Square	C.V.	Root MSE	RESULT Mean	
	0.091553	685.3253	0.92369933	0.13478261	
Source	DF	Type I SS	Mean Square	F Value	Pr > F
SUPPRESS	1	9.18806925	9.18806925	10.77	0.0011
SPECIES	9	38.85217391	4.31690821	5.06	0.0001
SUPPRESS*SPECIES	9	29.34830988	3.26092332	3.82	0.0001
Source	DF	Type III SS	Mean Square	F Value	Pr > F
SUPPRESS	1	9.18806925	9.18806925	10.77	0.0011
SPECIES	9	48.18309249	5.35367694	6.27	0.0001
SUPPRESS*SPECIES	9	29.34830988	3.26092332	3.82	0.0001

```
        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 900 MSE= 0.85322
        Critical Value of Studentized Range= 2.776
        Minimum Significant Difference= 0.1209
        WARNING: Cell sizes are not equal.
        Harmonic Mean of cell sizes= 449.3478

        Means with the same letter are not significantly different.
Tukey Grouping     Mean        N         SUPPRESS
A                  0.25128     390       2
B                  0.04906     530       1

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 900 MSE= 0.85322
        Critical Value of Studentized Range= 4.485
        Minimum Significant Difference= 0.432

        Means with the same letter are not significantly different.
Tukey Grouping    Mean        N       SPECIES
            A     0.6739      92      tara
B           A     0.2935      92      rewa
B                 0.2283      92      puri
B                 0.0761      92      kara
B                 0.0761      92      kohe
B                 0.0000      92      nika
B                 0.0000      92      pige
B                 0.0000      92      supl
B                 0.0000      92      kahi
B                 0.0000      92      tawa

-------------------------------- PAIR=2 PEST=rodtpr ---------------------------------
```

Whitford and Robertson's -number of fruits predated by rodents

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           2       robi whit
        SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
        PEST           1       rodtpr
        PAIR           1       2
        Number of observations in by group = 1060
NOTE: Due to missing values, only 920 observations can be used in this analysis.

        General Linear Models Procedure
Dependent Variable: RESULT =number of fruits predated by rodents
Source             DF         Sum of          Mean Square     F Value         Pr > F
                              Squares
Model              19         281.34664395    14.80771810     21.22           0.0001
Error              900        628.14900822    0.69794334
Corrected Total    919        909.49565217
                   R-Square   C.V.            Root MSE        RESULT Mean
                   0.309344   337.1033        0.83543003      0.24782609

Source             DF         Type I SS       Mean Square     F Value         Pr > F
SUPPRESS           1          23.94538609     23.94538609     34.31           0.0001
SPECIES            9          170.01739130    18.89082126     27.07           0.0001
SUPPRESS*SPECIES   9          87.38386656     9.70931851      13.91           0.0001

Source             DF         Type III SS     Mean Square     F Value         Pr > F
SUPPRESS           1          23.94538609     23.94538609     34.31           0.0001
SPECIES            9          203.68821438    22.63202382     32.43           0.0001
SUPPRESS*SPECIES   9          87.38386656     9.70931851      13.91           0.0001
```

```
       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 900 MSE= 0.697943
       Critical Value of Studentized Range= 2.776
       Minimum Significant Difference= 0.1094
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 449.3478

       Means with the same letter are not significantly different.
Tukey Grouping     Mean        N          SUPPRESS
A                  0.43590     390        2
B                  0.10943     530        1

       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 900 MSE= 0.697943
       Critical Value of Studentized Range= 4.485
       Minimum Significant Difference= 0.3907
       Means with the same letter are not significantly different.
Tukey       Mean       N        SPECIES
Grouping
A           1.5000     92       nika
B           0.3370     92       kahi
B           0.2174     92       tara
B           0.1848     92       rewa
B           0.1087     92       kara
B           0.0652     92       tawa
B           0.0217     92       kohe
B           0.0217     92       puri
B           0.0109     92       pige
B           0.0109     92       supl

-------------------------------- PAIR=2 PEST=unknpr --------------------------------
```

Whitford and Robertson's –number of fruits predated by unknown agents

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           2       robi whit
       SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
       PEST           1       unknpr
       PAIR           1       2
       Number of observations in by group = 1060
NOTE: Due to missing values, only 920 observations can be used in this analysis.

       General Linear Models Procedure
Dependent Variable: RESULT = number of fruits predated by unknown agents
Source             DF         Sum of          Mean Square     F Value        Pr > F
                             res
Model              19         202.54480343    10.66025281     1.15           0.2903
Error              900        8309.08563135   9.23231737
Corrected Total    919        8511.63043478
                   R-Square   C.V.            Root MSE        RESULT Mean
                   0.023796   2150.304        3.03847287      0.14130435

Source             DF         Type I SS       Mean Square     F Value        Pr > F
SUPPRESS           1          15.96521949     15.96521949     1.73           0.1888
SPECIES            9          76.86956522     8.54106280      0.93           0.5022
SUPPRESS*SPECIES   9          109.71001872    12.19000208     1.32           0.2218

Source             DF         Type III SS     Mean Square     F Value        Pr > F
SUPPRESS           1          15.96521949     15.96521949     1.73           0.1888
SPECIES            9          104.94914916    11.66101657     1.26           0.2531
SUPPRESS*SPECIES   9          109.71001872    12.19000208     1.32           0.2218
```

```
       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 900 MSE= 9.232317
       Critical Value of Studentized Range= 2.776
       Minimum Significant Difference= 0.3978
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 449.3478

       Means with the same letter are not significantly different.
Tukey Grouping     Mean        N          SUPPRESS
A                  0.2949      390        2
A                  0.0283      530        1

       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 900 MSE= 9.232317
       Critical Value of Studentized Range= 4.485
       Minimum Significant Difference= 1.4209

       Means with the same letter are not significantly different.
Tukey Grouping     Mean      N        SPECIES
A                  1.0000    92       kahi
A                  0.1522    92       tara
A                  0.0652    92       kara
A                  0.0543    92       nika
A                  0.0543    92       puri
A                  0.0326    92       rewa
A                  0.0217    92       kohe
A                  0.0109    92       supl
A                  0.0109    92       pige
A                  0.0109    92       tawa

-------------------------------- PAIR=3 PEST=mattot --------------------------------
```

Remiger's and Val's –number of mature fruits

(including predated and consumed fruits)

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           2       remi vals
       SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
       PEST           1       mattot
       PAIR           1       3
       Number of observations in by group = 1060
NOTE: Due to missing values, only 700 observations can be used in this analysis.

       General Linear Models Procedure
Dependent Variable: RESULT =number of mature fruits (including predated and consumed fruits)
Source             DF         Sum of Squares   Mean Square     F Value       Pr > F
Model              19         71515.72853048   3763.98571213   7.62          0.0001
Error              680        335938.95004095  494.02786771
Corrected Total    699        407454.67857143
                   R-Square   C.V.             Root MSE        RESULT Mean
                   0.175518   357.2610         22.22673768     6.22142857

Source             DF         Type I SS        Mean Square     F Value       Pr > F
SUPPRESS           1          5439.56268281    5439.56268281   11.01         0.0010
SPECIES            9          49234.43571429   5470.49285714   11.07         0.0001
SUPPRESS*SPECIES   9          16841.73013338   1871.30334815   3.79          0.0001

Source             DF         Type III SS      Mean Square     F Value       Pr > F
SUPPRESS           1          5439.56268281    5439.56268281   11.01         0.0010
SPECIES            9          46286.33584767   5142.92620530   10.41         0.0001
SUPPRESS*SPECIES   9          16841.73013338   1871.30334815   3.79          0.0001
```

```
        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 680 MSE= 494.0279
        Critical Value of Studentized Range= 2.777
        Minimum Significant Difference= 3.3044
        WARNING: Cell sizes are not equal.
        Harmonic Mean of cell sizes= 348.8571
        Means with the same letter are not significantly different.
Tukey Grouping     Mean      N         SUPPRESS
A                  8.854     370       1
B                  3.270     330       2

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 680 MSE= 494.0279
        Critical Value of Studentized Range= 4.489
        Minimum Significant Difference= 11.926
        Means with the same letter are not significantly different.
Tukey Grouping    Mean      N         SPECIES
           A      25.314    70        nika
           A      15.686    70        kahi
B          A      13.843    70        puri
B          C      2.300     70        tara
B          C      2.029     70        kara
           C      1.100     70        kohe
           C      0.857     70        pige
           C      0.671     70        supl
           C      0.357     70        rewa
           C      0.057     70        tawa

-------------------------------- PAIR=3 PEST=immtot --------------------------------
```

Remiger's and Val's –number of immature fruits

(including predated immature fruits)

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           2       remi vals
        SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
        PEST           1       immtot
        PAIR           1       3
        Number of observations in by group = 1060
NOTE: Due to missing values, only 700 observations can be used in this analysis.

        General Linear Models Procedure
Dependent Variable: RESULT =immature fruits (including predated fruits)
Source             DF         Sum of Squares    Mean Square     F Value       Pr > F
Model              19         72416.50166725    3811.39482459   16.61         0.0001
Error              680        156006.17690418   229.42084839
Corrected Total    699        228422.67857143
                   R-Square   C.V.              Root MSE        RESULT Mean
                   0.317029   295.7504          15.14664479     5.12142857

Source             DF         Type I SS         Mean Square     F Value       Pr > F
SUPPRESS           1          2698.49142974     2698.49142974   11.76         0.0006
SPECIES            9          57399.55000000    6377.72777778   27.80         0.0001
SUPPRESS*SPECIES   9          12318.46023751    1368.71780417   5.97          0.0001

Source             DF         Type III SS       Mean Square     F Value       Pr > F
SUPPRESS           1          2698.49142974     2698.49142974   11.76         0.0006
SPECIES            9          54423.63738037    6047.07082004   26.36         0.0001
SUPPRESS*SPECIES   9          12318.46023751    1368.71780417   5.97          0.0001
```

```
        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 680 MSE= 229.4208
        Critical Value of Studentized Range= 2.777
        Minimum Significant Difference= 2.2518
        WARNING: Cell sizes are not equal.
        Harmonic Mean of cell sizes= 348.8571
        Means with the same letter are not significantly different.
Tukey Grouping     Mean      N         SUPPRESS
A                  6.976     370       1
B                  3.042     330       2

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 680 MSE= 229.4208
        Critical Value of Studentized Range= 4.489
        Minimum Significant Difference= 8.1269
        Means with the same letter are not significantly different.
Tukey Grouping    Mean      N         SPECIES
A                 28.686    70        tara
B                 15.757    70        nika
C                 2.271     70        kahi
C                 1.614     70        kara
C                 1.329     70        puri
C                 1.243     70        rewa
C                 0.214     70        pige
C                 0.057     70        tawa
C                 0.043     70        kohe
C                 0.000     70        supl

-------------------------------- PAIR=3 PEST=predno ---------------------------------
```

Remiger's and Val's –number of predated fruits

(mature, immature and any type of predation)

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           2       remi vals
        SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
        PEST           1       predno
        PAIR           1       3
        Number of observations in by group = 1060
NOTE: Due to missing values, only 716 observations can be used in this analysis.

        General Linear Models Procedure
Dependent Variable: RESULT
Source             DF         Sum of Squares  Mean Square     F Value        Pr > F
Model              19         8525.02716315   448.68564017    20.71          0.0001
Error              696        15081.56920557  21.66892127
Corrected Total    715        23606.59636872
                   R-Square   C.V.            Root MSE        RESULT Mean
                   0.361129   230.0188        4.65498886      2.02374302

Source             DF         Type I SS       Mean Square     F Value        Pr > F
SUPPRESS           1          133.02191433    133.02191433    6.14           0.0135
SPECIES            9          6324.04497259   702.67166362    32.43          0.0001
SUPPRESS*SPECIES   9          2067.96027622   229.77336402    10.60          0.0001

Source             DF         Type III SS     Mean Square     F Value        Pr > F
SUPPRESS           1          166.30097284    166.30097284    7.67           0.0057
SPECIES            9          5939.09854046   659.89983783    30.45          0.0001
SUPPRESS*SPECIES   9          2067.96027622   229.77336402    10.60          0.0001
```

General Linear Models Procedure
Tukey's Studentized Range (HSD) Test for variable: RESULT
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 696 MSE= 21.66892
Critical Value of Studentized Range= 2.777
Minimum Significant Difference= 0.6852
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 355.8101

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SUPPRESS
A	2.4223	386	1
B	1.5576	330	2

General Linear Models Procedure
Tukey's Studentized Range (HSD) Test for variable: RESULT
NOTE: This test controls the type I experimentwise error rate.
Alpha= 0.05 Confidence= 0.95 df= 696 MSE= 21.66892
Critical Value of Studentized Range= 4.489
Comparisons significant at the 0.05 level are indicated by '***'.

SPECIES Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
nika - tara	1.7740	4.2714	6.7689	***
nika - puri	4.6026	7.1000	9.5974	***
nika - kara	5.6168	8.1143	10.6117	***
nika - rewa	6.1026	8.6000	11.0974	***
nika - kahi	6.9168	9.4143	11.9117	***
nika - kohe	6.9168	9.4143	11.9117	***
nika - pige	7.0883	9.5857	12.0832	***
nika - tawa	7.1168	9.6143	12.1117	***
nika - supl	7.2412	9.6196	11.9980	***
tara - nika	-6.7689	-4.2714	-1.7740	***
tara - puri	0.3311	2.8286	5.3260	***
tara - kara	1.3454	3.8429	6.3403	***
tara - rewa	1.8311	4.3286	6.8260	***
tara - kahi	2.6454	5.1429	7.6403	***
tara - kohe	2.6454	5.1429	7.6403	***
tara - pige	2.8168	5.3143	7.8117	***
tara - tawa	2.8454	5.3429	7.8403	***
tara - supl	2.9697	5.3482	7.7266	***
puri - nika	-9.5974	-7.1000	-4.6026	***
puri - tara	-5.3260	-2.8286	-0.3311	***
puri - kara	-1.4832	1.0143	3.5117	
puri - rewa	-0.9974	1.5000	3.9974	
puri - kahi	-0.1832	2.3143	4.8117	
puri - kohe	-0.1832	2.3143	4.8117	
puri - pige	-0.0117	2.4857	4.9832	
puri - tawa	0.0168	2.5143	5.0117	***
puri - supl	0.1412	2.5196	4.8980	***
kara - nika	-10.6117	-8.1143	-5.6168	***
kara - tara	-6.3403	-3.8429	-1.3454	***
kara - puri	-3.5117	-1.0143	1.4832	
kara - rewa	-2.0117	0.4857	2.9832	
kara - kahi	-1.1974	1.3000	3.7974	
kara - kohe	-1.1974	1.3000	3.7974	
kara - pige	-1.0260	1.4714	3.9689	
kara - tawa	-0.9974	1.5000	3.9974	
kara - supl	-0.8731	1.5053	3.8838	
rewa - nika	-11.0974	-8.6000	-6.1026	***
rewa - tara	-6.8260	-4.3286	-1.8311	***
rewa - puri	-3.9974	-1.5000	0.9974	
rewa - kara	-2.9832	-0.4857	2.0117	
rewa - kahi	-1.6832	0.8143	3.3117	
rewa - kohe	-1.6832	0.8143	3.3117	
rewa - pige	-1.5117	0.9857	3.4832	
rewa - tawa	-1.4832	1.0143	3.5117	
rewa - supl	-1.3588	1.0196	3.3980	
kahi - nika	-11.9117	-9.4143	-6.9168	***
kahi - tara	-7.6403	-5.1429	-2.6454	***
kahi - puri	-4.8117	-2.3143	0.1832	
kahi - kara	-3.7974	-1.3000	1.1974	
kahi - rewa	-3.3117	-0.8143	1.6832	
kahi - kohe	-2.4974	0.0000	2.4974	
kahi - pige	-2.3260	0.1714	2.6689	
kahi - tawa	-2.2974	0.2000	2.6974	
kahi - supl	-2.1731	0.2053	2.5838	
kohe - nika	-11.9117	-9.4143	-6.9168	***

SPECIES Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit	
kohe - tara	-7.6403	-5.1429	-2.6454	***
kohe - puri	-4.8117	-2.3143	0.1832	
kohe - kara	-3.7974	-1.3000	1.1974	
kohe - rewa	-3.3117	-0.8143	1.6832	
kohe - kahi	-2.4974	0.0000	2.4974	
kohe - pige	-2.3260	0.1714	2.6689	
kohe - tawa	-2.2974	0.2000	2.6974	
kohe - supl	-2.1731	0.2053	2.5838	
pige - nika	-12.0832	-9.5857	-7.0883	***
pige - tara	-7.8117	-5.3143	-2.8168	***
pige - puri	-4.9832	-2.4857	0.0117	
pige - kara	-3.9689	-1.4714	1.0260	
pige - rewa	-3.4832	-0.9857	1.5117	
pige - kahi	-2.6689	-0.1714	2.3260	
pige - kohe	-2.6689	-0.1714	2.3260	
pige - tawa	-2.4689	0.0286	2.5260	
pige - supl	-2.3446	0.0339	2.4123	
tawa - nika	-12.1117	-9.6143	-7.1168	***
tawa - tara	-7.8403	-5.3429	-2.8454	***
tawa - puri	-5.0117	-2.5143	-0.0168	***
tawa - kara	-3.9974	-1.5000	0.9974	
tawa - rewa	-3.5117	-1.0143	1.4832	
tawa - kahi	-2.6974	-0.2000	2.2974	
tawa - kohe	-2.6974	-0.2000	2.2974	
tawa - pige	-2.5260	-0.0286	2.4689	
tawa - supl	-2.3731	0.0053	2.3838	
supl - nika	-11.9980	-9.6196	-7.2412	***
supl - tara	-7.7266	-5.3482	-2.9697	***
supl - puri	-4.8980	-2.5196	-0.1412	***
supl - kara	-3.8838	-1.5053	0.8731	
supl - rewa	-3.3980	-1.0196	1.3588	
supl - kahi	-2.5838	-0.2053	2.1731	
supl - kohe	-2.5838	-0.2053	2.1731	
supl - pige	-2.4123	-0.0339	2.3446	
supl - tawa	-2.3838	-0.0053	2.3731	

---------- PAIR=3 PEST=unpred ----------

Remiger's and Val's –number of unpredated fruits

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SUPPRESS	2	1 2
SITE	2	remi vals
SPECIES	10	kahi kara kohe nika pige puri rewa supl tara tawa
PEST	1	unpred
PAIR	1	3

Number of observations in by group = 1060

NOTE: Due to missing values, only 700 observations can be used in this analysis.

General Linear Models Procedure

Dependent Variable: RESULT =number of unpredated fruits

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	19	183803.97472797	9673.89340674	14.08	0.0001
Error	680	467347.73955774	687.27608758		
Corrected Total	699	651151.71428571			

R-Square	C.V.	Root MSE	RESULT Mean
0.282275	231.1230	26.21595101	11.34285714

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SUPPRESS	1	15800.58979759	15800.58979759	22.99	0.0001
SPECIES	9	135222.65714286	15024.73968254	21.86	0.0001
SUPPRESS*SPECIES	9	32780.72778753	3642.30308750	5.30	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SUPPRESS	1	15800.58979759	15800.58979759	22.99	0.0001
SPECIES	9	128217.40778753	14246.37864306	20.73	0.0001
SUPPRESS*SPECIES	9	32780.72778753	3642.30308750	5.30	0.0001

```
       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 680 MSE= 687.2761
       Critical Value of Studentized Range= 2.777
       Minimum Significant Difference= 3.8974
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 348.8571

       Means with the same letter are not significantly different.
Tukey Grouping     Mean      N        SUPPRESS
A                  15.830    370      1
B                  6.312     330      2

       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 680 MSE= 687.2761
       Critical Value of Studentized Range= 4.489
       Minimum Significant Difference= 14.066

       Means with the same letter are not significantly different.
Tukey Grouping        Mean      N        SPECIES
               A      41.071    70       nika
B              A      30.986    70       tara
B              C      17.957    70       kahi
D              C      15.171    70       puri
D              E      3.643     70       kara
D              E      1.600     70       rewa
D              E      1.143     70       kohe
               E      1.071     70       pige
               E      0.671     70       supl
               E      0.114     70       tawa

-------------------------------- PAIR=3 PEST=consno ---------------------------------
```

Remiger's and Val's –number of consumed fruits

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           2       remi vals
       SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
       PEST           1       consno
       PAIR           1       3
       Number of observations in by group = 1060
NOTE: Due to missing values, only 700 observations can be used in this analysis.

       General Linear Models Procedure
Dependent Variable: RESULT = number of consumed fruits
Source             DF         Sum of Squares    Mean Square     F Value         Pr > F
Model              19         31591.81158184    1662.72692536   4.60            0.0001
Error              680        245805.01556102   361.47796406
Corrected Total    699        277396.82714286
                   R-Square   C.V.              Root MSE        RESULT Mean
                   0.113887   545.6663          19.01257384     3.48428571

Source             DF         Type I SS         Mean Square     F Value         Pr > F
SUPPRESS           1          2533.86260559     2533.86260559   7.01            0.0083
SPECIES            9          21301.81285714    2366.86809524   6.55            0.0001
SUPPRESS*SPECIES   9          7756.13611911     861.79290212    2.38            0.0117

Source             DF         Type III SS       Mean Square     F Value         Pr > F
SUPPRESS           1          2533.86260559     2533.86260559   7.01            0.0083
SPECIES            9          19942.02183339    2215.78020371   6.13            0.0001
SUPPRESS*SPECIES   9          7756.13611911     861.79290212    2.38            0.0117
```

```
        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 680 MSE= 361.478
        Critical Value of Studentized Range= 2.777
        Minimum Significant Difference= 2.8265
        WARNING: Cell sizes are not equal.
        Harmonic Mean of cell sizes= 348.8571
        Means with the same letter are not significantly different.
Tukey Grouping     Mean      N        SUPPRESS
A                  5.281     370      1
B                  1.470     330      2

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 680 MSE= 361.478
        Critical Value of Studentized Range= 4.489
        Minimum Significant Difference= 10.201
        Means with the same letter are not significantly different.
Tukey Grouping          Mean      N       SPECIES
                A       15.771    70      nika
B               A       12.600    70      kahi
B               C       4.114     70      puri
                C       0.671     70      kohe
                C       0.629     70      tara
                C       0.586     70      pige
                C       0.243     70      kara
                C       0.200     70      supl
                C       0.029     70      tawa
                C       0.000     70      rewa

-------------------------------- PAIR=3 PEST=inspre ---------------------------------
```

Remiger's and Val's –number of insect predated fruits

(fruits could be mature or immature)

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           2       remi vals
        SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
        PEST           1       inspre
        PAIR           1       3
        Number of observations in by group = 1060
NOTE: Due to missing values, only 700 observations can be used in this analysis.

        General Linear Models Procedure
Dependent Variable: RESULT =number of insect predated fruits (including mature and immature
fruits)
Source             DF         Sum of          Mean Square     F Value        Pr > F
                              Squares
Model              19         55.59751492     2.92618500      4.14           0.0001
Error              680        480.51105651    0.70663391
Corrected Total    699        536.10857143
                   R-Square   C.V.            Root MSE        RESULT Mean
                   0.103706   498.6700        0.84061520      0.16857143

Source             DF         Type I SS       Mean Square     F Value        Pr > F
SUPPRESS           1          2.68187200      2.68187200      3.80           0.0518
SPECIES            9          42.76571429     4.75174603      6.72           0.0001
SUPPRESS*SPECIES   9          10.14992863     1.12776985      1.60           0.1125

Source             DF         Type III SS     Mean Square     F Value        Pr > F
SUPPRESS           1          2.68187200      2.68187200      3.80           0.0518
SPECIES            9          41.08707149     4.56523017      6.46           0.0001
SUPPRESS*SPECIES   9          10.14992863     1.12776985      1.60           0.1125
```

```
        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 680 MSE= 0.706634
        Critical Value of Studentized Range= 2.777
        Minimum Significant Difference= 0.125
        WARNING: Cell sizes are not equal.
        Harmonic Mean of cell sizes= 348.8571
        Means with the same letter are not significantly different.
Tukey Grouping     Mean        N        SUPPRESS
A                  0.22703     370      1
A                  0.10303     330      2

        General Linear Models Procedure
        Tukey's Studentized Range (HSD) Test for variable: RESULT
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 680 MSE= 0.706634
        Critical Value of Studentized Range= 4.489
        Minimum Significant Difference= 0.451
        Means with the same letter are not significantly different.
Tukey Grouping    Mean      N        SPECIES
           A      0.7429    70       nika
B          A      0.5286    70       rewa
B          C      0.2286    70       tara
B          C      0.0857    70       kahi
           C      0.0571    70       kara
           C      0.0286    70       pige
           C      0.0143    70       kohe
           C      0.0000    70       puri
           C      0.0000    70       supl
           C      0.0000    70       tawa

-------------------------------- PAIR=3 PEST=posspr --------------------------------
```

Remiger's and Val's –number of possum predated fruits

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           2       remi vals
        SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
        PEST           1       posspr
        PAIR           1       3
        Number of observations in by group = 1060
NOTE: Due to missing values, only 700 observations can be used in this analysis.

        General Linear Models Procedure
Dependent Variable: RESULT =number of possum predated fruits
Source             DF         Sum of          Mean Square     F Value        Pr > F
                              Squares
Model              19         1546.30803674   81.38463351     9.12           0.0001
Error              680        6064.97624898   8.91908272
Corrected Total    699        7611.28428571
                   R-Square   C.V.            Root MSE        RESULT Mean
                   0.203160   418.9456        2.98648334      0.71285714

Source             DF         Type I SS       Mean Square     F Value        Pr > F
SUPPRESS           1          0.79247572      0.79247572      0.09           0.7657
SPECIES            9          1078.18428571   119.79825397    13.43          0.0001
SUPPRESS*SPECIES   9          467.33127530    51.92569726     5.82           0.0001

Source             DF         Type III SS     Mean Square     F Value        Pr > F
SUPPRESS           1          0.79247572      0.79247572      0.09           0.7657
SPECIES            9          1060.16556102   117.79617345    13.21          0.0001
SUPPRESS*SPECIES   9          467.33127530    51.92569726     5.82           0.0001
```

```
       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 680 MSE= 8.919083
       Critical Value of Studentized Range= 2.777
       Minimum Significant Difference= 0.444
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 348.8571
       Means with the same letter are not significantly different.
Tukey Grouping     Mean      N         SUPPRESS
A                  0.7485    330       2
A                  0.6811    370       1

       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 680 MSE= 8.919083
       Critical Value of Studentized Range= 4.489
       Minimum Significant Difference= 1.6024
       Means with the same letter are not significantly different.
Tukey Grouping     Mean      N         SPECIES
A                  3.8000    70        tara
A                  2.4000    70        puri
B                  0.4429    70        kara
B                  0.2286    70        rewa
B                  0.1857    70        nika
B                  0.0286    70        kohe
B                  0.0143    70        kahi
B                  0.0143    70        supl
B                  0.0143    70        tawa
B                  0.0000    70        pige

-------------------------------- PAIR=3 PEST=rodtpr ---------------------------------
```

Remiger's and Val's –number of fruits predated by rodents

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           2       remi vals
       SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
       PEST           1       rodtpr
       PAIR           1       3
       Number of observations in by group = 1060
NOTE: Due to missing values, only 700 observations can be used in this analysis.

       General Linear Models Procedure
Dependent Variable: RESULT –number of fruits predated by rodents
Source             DF         Sum of          Mean Square     F Value        Pr > F
                              Squares
Model              19         5272.62073710   277.50635458    68.30          0.0001
Error              680        2762.89926290   4.06308715
Corrected Total    699        8035.52000000
                   R-Square   C.V.            Root MSE        RESULT Mean
                   0.656164   219.0989        2.01571009      0.92000000

Source             DF         Type I SS       Mean Square     F Value        Pr > F
SUPPRESS           1          161.03875512    161.03875512    39.63          0.0001
SPECIES            9          3837.92000000   426.43555556    104.95         0.0001
SUPPRESS*SPECIES   9          1273.66198198   141.51799800    34.83          0.0001

Source             DF         Type III SS     Mean Square     F Value        Pr > F
SUPPRESS           1          161.03875512    161.03875512    39.63          0.0001
SPECIES            9          3578.07341055   397.56371228    97.85          0.0001
SUPPRESS*SPECIES   9          1273.66198198   141.51799800    34.83          0.0001
```

```
       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 680 MSE= 4.063087
       Critical Value of Studentized Range= 2.777
       Minimum Significant Difference= 0.2997
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 348.8571
       Means with the same letter are not significantly different.
Tukey Grouping     Mean        N        SUPPRESS
A                  1.3730      370      1
B                  0.4121      330      2

       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: RESULT
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 680 MSE= 4.063087
       Critical Value of Studentized Range= 4.489
       Minimum Significant Difference= 1.0815
       Means with the same letter are not significantly different.
Tukey Grouping     Mean        N        SPECIES
A                  7.9286      70       nika
B                  0.5714      70       tara
B                  0.2000      70       kara
B                  0.1857      70       kohe
B                  0.1286      70       kahi
B                  0.0857      70       puri
B                  0.0571      70       rewa
B                  0.0286      70       pige
B                  0.0143      70       supl
B                  0.0000      70       tawa

-------------------------------- PAIR=3 PEST=unknpr ---------------------------------
```

Remiger's and Val's –number of fruits predated by unknown agents

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           2       remi vals
       SPECIES        10      kahi kara kohe nika pige puri rewa supl tara tawa
       PEST           1       unknpr
       PAIR           1       3
       Number of observations in by group = 1060
NOTE: Due to missing values, only 700 observations can be used in this analysis.

       General Linear Models Procedure
Dependent Variable: RESULT =number of fruits predated by unknown agents
Source             DF         Sum of          Mean Square     F Value        Pr > F
                              Squares
Model              19         90.44328887     4.76017310      1.08           0.3644
Error              680        2990.55528256   4.39787542
Corrected Total    699        3080.99857143
                   R-Square   C.V.            Root MSE        RESULT Mean
                   0.029355   1482.806        2.09711121      0.14142857

Source             DF         Type I SS       Mean Square     F Value        Pr > F
SUPPRESS           1          3.39324792      3.39324792      0.77           0.3800
SPECIES            9          42.18428571     4.68714286      1.07           0.3861
SUPPRESS*SPECIES   9          44.86575524     4.98508392      1.13           0.3363

Source             DF         Type III SS     Mean Square     F Value        Pr > F
SUPPRESS           1          3.39324792      3.39324792      0.77           0.3800
SPECIES            9          46.59146952     5.17682995      1.18           0.3066
SUPPRESS*SPECIES   9          44.86575524     4.98508392      1.13           0.3363
```

General Linear Models Procedure
Tukey's Studentized Range (HSD) Test for variable: RESULT
NOTE: This test controls the type I experimentwise error rate, but
generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 680 MSE= 4.397875
Critical Value of Studentized Range= 2.777
Minimum Significant Difference= 0.3118
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 348.8571
Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SUPPRESS
A	0.2152	330	2
A	0.0757	370	1

General Linear Models Procedure
Tukey's Studentized Range (HSD) Test for variable: RESULT
NOTE: This test controls the type I experimentwise error rate, but
generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 680 MSE= 4.397875
Critical Value of Studentized Range= 4.489
Minimum Significant Difference= 1.1252
Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SPECIES
A	0.8286	70	kara
A	0.2714	70	tara
A	0.1857	70	nika
A	0.0857	70	kohe
A	0.0143	70	kahi
A	0.0143	70	puri
A	0.0143	70	tawa
A	0.0000	70	rewa
A	0.0000	70	pige
A	0.0000	70	supl

Appendix 7.5 SAS output for non-pest species droppings.

SAS syntax as per Appendix 7.2

```
---------------------------------- SPECIES=insect ----------------------------------
```

Insect (excluding weta) droppings analysis - Site nested within suppression

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       loch remi robi vals wend whit
       SPECIES        1       insect
       Number of observations in by group = 198


       General Linear Models Procedure
       Type I Estimable Functions for: SUPPRESS
Effect                         Coefficients
INTERCEPT       0
SUPPRESS        1              L2
                2              -L2
SITE(SUPPRESS)  remi 1         0.3333*L2
                wend 1         0.3333*L2
                whit 1         0.3333*L2
                loch 2         -0.3333*L2
                robi 2         -0.3333*L2
                vals 2         -0.3333*L2

       General Linear Models Procedure
       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                         Coefficients
INTERCEPT       0
SUPPRESS        1              0
                2              0
SITE(SUPPRESS)  remi 1         L4
                wend 1         L5
                whit 1         -L4-L5
                loch 2         L7
                robi 2         L8
                vals 2         -L7-L8


Dependent Variable: DROPPINGS INSECT (excluding weta droppings)
Source            DF         Sum of          Mean Square     F Value        Pr > F
                             Squares
Model             5          719.58081061    143.91616212    3.29           0.0071
Error             192        8398.46433939   43.74200177
Corrected Total   197        9118.04515000
                  R-Square   C.V.            Root MSE        DROPP Mean
                  0.078918   39.30142        6.61377364      16.82833333

Source            DF         Type I SS       Mean Square     F Value        Pr > F
SUPPRESS          1          107.67131364    107.67131364    2.46           0.1183
SITE(SUPPRESS)    4          611.90949697    152.97737424    3.50           0.0088

       General Linear Models Procedure
Source            Type I Expected Mean Square
SUPPRESS          Var(Error) + 99 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)    Var(Error) + Q(SITE(SUPPRESS))

Dependent Variable: DROPPINGS INSECT (excluding weta droppings)
Source: SUPPRESS
Error: MS(Error)
                Denominator    Denominator
                DF             Type I MS     DF     MS             F Value    Pr > F
                1              107.67131364  192    43.742001768   2.4615     0.1183
```

```
Source: SITE(SUPPRESS)
Error: MS(Error)
               Denominator    Denominator
               DF             Type I MS     DF    MS            F Value   Pr > F
               4              152.97737424  192   43.742001768  3.4973    0.0088


       Tukey's Studentized Range (HSD) Test for variable: DROPP
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 192 MSE= 43.742
       Critical Value of Studentized Range= 2.789
       Minimum Significant Difference= 1.8541

       Means with the same letter are not significantly different.
Tukey Grouping     Mean         N        SUPPRESS
A                  17.5658      99       1
A                  16.0909      99       2
```

Insect (excluding weta) droppings analysis - Differences between sites

```
       General Linear Models Procedure
       Class Level Information
Class          Levels  Values
SUPPRESS       2       1 2
SITE           6       loch remi robi vals wend whit
SPECIES        1       insect
WEEKNO         26      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25
26
       Number of observations in by group = 198

       General Linear Models Procedure
Dependent Variable: DROPPINGS INSECT (excluding weta droppings)
Source          DF        Sum of          Mean Square     F Value       Pr > F
                          Squares
Model           155       8348.54515000   53.86158161     2.94          0.0001
Error           42        769.50000000    18.32142857
Corrected       197       9118.04515000
Total
                R-Square  C.V.            Root MSE        DROPP Mean
                0.915607  25.43540        4.28035379      16.82833333

Source          DF        Type I SS       Mean Square     F Value       Pr > F
SITE            5         719.58081061    143.91616212    7.86          0.0001
WEEKNO          25        5605.99506667   224.23980267    12.24         0.0001
SITE*WEEKNO     125       2022.96927273   16.18375418     0.88          0.7044

Source          DF        Type III SS     Mean Square     F Value       Pr > F
SITE            5         644.42044815    128.88408963    7.03          0.0001
WEEKNO          25        5605.99506667   224.23980267    12.24         0.0001
SITE*WEEKNO     125       2022.96927273   16.18375418     0.88          0.7044


       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: DROPP
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 42  MSE= 18.32143
       Critical Value of Studentized Range= 4.222
       Minimum Significant Difference= 3.1457

       Means with the same letter are not significantly different.
Tukey Grouping        Mean         N       SITE
          A           20.091       33      wend
B         A           18.091       33      whit
B         A     C     17.394       33      vals
B               C     15.576       33      robi
B               C     15.303       33      loch
```

```
C     14.515       33      remi
```

```
---------------------------------- SPECIES=pigeon -----------------------------------
```

Pigeon droppings analysis - Site nested within suppression

```
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       loch remi robi vals wend whit
       SPECIES        1       pigeon
       Number of observations in by group = 198

       Type I Estimable Functions for: SUPPRESS
Effect                        Coefficients
INTERCEPT       0
SUPPRESS        1             L2
                2             -L2
SITE(SUPPRESS)  remi 1        0.3333*L2
                wend 1        0.3333*L2
                whit 1        0.3333*L2
                loch 2        -0.3333*L2
                robi 2        -0.3333*L2
                vals 2        -0.3333*L2

       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                        Coefficients
INTERCEPT       0
SUPPRESS        1             0
                2             0
SITE(SUPPRESS)  remi 1        L4
                wend 1        L5
                whit 1        -L4-L5
                loch 2        L7
                robi 2        L8
                vals 2        -L7-L8

Dependent Variable: DROPPINGS PIGEON
Source          DF        Sum of          Mean Square     F Value      Pr > F
                          Squares
Model           5         457.57575758    91.51515152     38.64        0.0001
Error           192       454.78787879    2.36868687
Corrected       197       912.36363636
Total
                R-Square  C.V.            Root MSE        DROPP Mean
                0.501528  80.61711        1.53905389      1.90909091

Source           DF        Type I SS       Mean Square     F Value      Pr > F
SUPPRESS         1         98.98989899     98.98989899     41.79        0.0001
SITE(SUPPRESS)   4         358.58585859    89.64646465     37.85        0.0001

Source  Type I Expected Mean Square
SUPPRESS        Var(Error) + 99 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)  Var(Error) + Q(SITE(SUPPRESS))

       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: DROPPINGS PIGEON
Source: SUPPRESS
Error: MS(Error)
               Denominator  Denominator
               DF           Type I MS     DF   MS             F Value   Pr > F
               1            98.98989899   192  2.3686868687   41.7910   0.0001

Source: SITE(SUPPRESS)
Error: MS(Error)
               Denominator  Denominator
               DF           Type I MS     DF   MS             F Value   Pr > F
               4            89.646464646  192  2.3686868687   37.8465   0.0001

       Tukey's Studentized Range (HSD) Test for variable: DROPP
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
```

```
        Alpha= 0.05    df= 192 MSE= 2.368687
        Critical Value of Studentized Range= 2.789
        Minimum Significant Difference= 0.4315

        Means with the same letter are not significantly different.
Tukey Grouping     Mean       N        SUPPRESS
A                  2.6162     99       1
B                  1.2020     99       2
```

Pigeon droppings analysis - Differences between sites

```
       General Linear Models Procedure
       Class Level Information
Class          Levels  Values
SUPPRESS       2       1 2
SITE           6       loch remi robi vals wend whit
SPECIES        1       pigeon
WEEKNO  26     1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
       Number of observations in by group = 198

       General Linear Models Procedure
Dependent Variable: DROPPINGS PIGEON
Source         DF           Sum of          Mean Square     F Value      Pr > F
                            Squares
Model          155          759.86363636    4.90234604      1.35         0.1284
Error          42           152.50000000    3.63095238
Corrected      197          912.36363636
Total
               R-Square     C.V.            Root MSE        DROPP Mean
               0.832852     99.81221        1.90550581      1.90909091

Source         DF           Type I SS       Mean Square     F Value      Pr > F
SITE           5            457.57575758    91.51515152     25.20        0.0001
WEEKNO         25           51.44696970     2.05787879      0.57         0.9334
SITE*WEEKNO    125          250.84090909    2.00672727      0.55         0.9936

Source         DF           Type III SS     Mean Square     F Value      Pr > F
SITE           5            419.96481481    83.99296296     23.13        0.0001
WEEKNO         25           51.44696970     2.05787879      0.57         0.9334
SITE*WEEKNO    125          250.84090909    2.00672727      0.55         0.9936

       General Linear Models Procedure
       Tukey's Studentized Range (HSD) Test for variable: DROPP
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 42  MSE= 3.630952
       Critical Value of Studentized Range= 4.222
       Minimum Significant Difference= 1.4004
       Means with the same letter are not significantly different.
Tukey                          Mean           N              SITE
Grouping
A                              5.0909         33             wend
                B              1.9697         33             remi
C               B              1.9394         33             loch
C               B              1.1212         33             vals
C               B              0.7879         33             whit
C                              0.5455         33             robi

---------------------------------- SPECIES=weta ----------------------------------
```

Weta droppings analysis - Site nested within suppress

```
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       loch remi robi vals wend whit
       SPECIES        1       weta
       Number of observations in by group = 198

       Type I Estimable Functions for: SUPPRESS
Effect                        Coefficients
INTERCEPT       0
SUPPRESS        1             L2
                2             -L2
SITE(SUPPRESS)  remi 1        0.3333*L2
                wend 1        0.3333*L2
                whit 1        0.3333*L2
```

```
loch 2      -0.3333*L2
robi 2      -0.3333*L2
vals 2      -0.3333*L2
```

```
       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                      Coefficients
INTERCEPT       0
SUPPRESS        1           0
                2           0
SITE(SUPPRESS)  remi 1      L4
                wend 1      L5
                whit 1      -L4-L5
                loch 2      L7
                robi 2      L8
                vals 2      -L7-L8

Dependent Variable: DROPPINGS WETA
Source          DF        Sum of          Mean Square    F Value     Pr > F
                          Squares
Model           5         1375.01515152   275.00303030   18.91       0.0001
Error           192       2791.57575758   14.53945707
Corrected       197       4166.59090909
Total
                R-Square  C.V.            Root MSE       DROPP Mean
                0.330010  54.82837        3.81306400     6.95454545

Source          DF        Type I SS       Mean Square    F Value     Pr > F
SUPPRESS        1         501.13636364    501.13636364   34.47       0.0001
SITE(SUPPRESS)  4         873.87878788    218.46969697   15.03       0.0001

Source  Type I Expected Mean Square
SUPPRESS        Var(Error) + 99 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)  Var(Error) + Q(SITE(SUPPRESS))

       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: DROPPINGS WETA
Source: SUPPRESS
Error: MS(Error)
               Denominator  Denominator
               DF           Type I MS     DF     MS            F Value   Pr > F
               1            501.13636364  192    14.539457071  34.4673   0.0001

Source: SITE(SUPPRESS)
Error: MS(Error)
               Denominator  Denominator
               DF           Type I MS     DF     MS            F Value   Pr > F
               4            218.46969697  192    14.539457071  15.0260   0.0001


       Tukey's Studentized Range (HSD) Test for variable: DROPP
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 192 MSE= 14.53946
       Critical Value of Studentized Range= 2.789
       Minimum Significant Difference= 1.069

       Means with the same letter are not significantly different.
Tukey Grouping    Mean       N        SUPPRESS
A                 8.5455     99       1
B                 5.3636     99       2
```

Weta droppings analysis - Differences between sites

```
       General Linear Models Procedure
       Class Level Information
Class          Levels  Values
SUPPRESS       2       1 2
SITE           6       loch remi robi vals wend whit
SPECIES        1       weta
WEEKNO  26     1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26
       Number of observations in by group = 198

       General Linear Models Procedure
```

Dependent Variable: DROPPINGS WETA

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	155	3786.59090909	24.42961877	2.70	0.0002
Error	42	380.00000000	9.04761905		
Corrected Total	197	4166.59090909			

R-Square	C.V.	Root MSE	DROPP Mean
0.908798	43.25122	3.00792604	6.95454545

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SITE	5	1375.01515152	275.00303030	30.40	0.0001
WEEKNO	25	1362.42424242	54.49696970	6.02	0.0001
SITE*WEEKNO	125	1049.15151515	8.39321212	0.93	0.6332

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SITE	5	1206.39259259	241.27851852	26.67	0.0001
WEEKNO	25	1362.42424242	54.49696970	6.02	0.0001
SITE*WEEKNO	125	1049.15151515	8.39321212	0.93	0.6332

General Linear Models Procedure
Tukey's Studentized Range (HSD) Test for variable: DROPP
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 42 MSE= 9.047619
Critical Value of Studentized Range= 4.222
Minimum Significant Difference= 2.2106
Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SITE
A	11.3333	33	wend
A	9.5152	33	whit
B	6.7576	33	vals
C B	5.2727	33	robi
C B	4.7879	33	remi
C	4.0606	33	loch

Appendix 7.6 SAS output for total number of birds noted per species and per visit to each site.

```
proc sort data = work.multbird;
 by species site;
 run;

 proc glm data = work.multbird;
 class control site species ;
 model TOTBIRD = suppress site(suppress) /E1;
 random suppress / test;
 by species;
 means suppress / tukey;
 run;
```

Where

TOTBIRD	the total number of birds, for a particular species, noted during a visit to a site
Species	the species of bird noted
Suppress	1when the site had pest suppression and 2 when it didn't
Site	the name of the site
E1	Since the independent variable 'suppress' was defined as random (see below) it was necessary to specify whether the test should be more conservative with regards to Type I or Type II statistical error. E1 specifies that the model produces the Type I sum of squares (SAS Institute Inc. 1990b) and thus the null hypothesis is more likely to be retained unless there are indeed significant differences between the tested variables. (Type I error *rejects* the null hypothesis when it is true, while a Type II error *accepts* the null hypothesis when it is false (Rowntree 1991)).

Suppress(ion) was set as a random variable since it is theoretically possible to choose different sites with the same, or similar, levels of pest suppression. The level of suppression was not necessarily determined by the site, applied in a predetermined way or fixed to a specific value.

Site, where used, was nested in suppress(ion) since the site was chosen within different levels of pest suppression.

```
--------------------------------- SPECIES=kereru ----------------------------------
```

Number of kereru seen per visit- Site nested within suppression

```
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       Loch remi robi vals wend whit
       SPECIES        1       kereru
       Number of observations in by group = 183

       Type I Estimable Functions for: SUPPRESS
Effect                     Coefficients
INTERCEPT       0
```

SUPPRESS	1	L2
	2	-L2
SITE(SUPPRESS)	remi 1	0.3438*L2
	wend 1	0.3646*L2
	whit 1	0.2917*L2
	Loch 2	-0.3678*L2
	robi 2	-0.3333*L2
	vals 2	-0.2989*L2

Type I Estimable Functions for: SITE(SUPPRESS)

Effect		Coefficients
INTERCEPT	0	
SUPPRESS	1	0
	2	0
SITE(SUPPRESS)	remi 1	L4
	wend 1	L5
	whit 1	-L4-L5
	Loch 2	L7
	robi 2	L8
	vals 2	-L7-L8

Dependent Variable: TOTBIRD (kereru)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	1890.38338150	378.07667630	19.95	0.0001
Error	177	3354.84066221	18.95390205		
Corrected Total	182	5245.22404372			

R-Square	C.V.	Root MSE	TOTBIRD Mean
0.360401	68.21149	4.35360793	6.38251366

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SUPPRESS	1	887.67950349	887.67950349	46.83	0.0001
SITE(SUPPRESS)	4	1002.70387802	250.67596950	13.23	0.0001

Source	Type I Expected Mean Square
SUPPRESS	Var(Error) + 91.279 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)	Var(Error) + Q(SITE(SUPPRESS))

Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD (kereru)
Source: SUPPRESS
Error: MS(Error)

DF	Type I MS	Denominator DF	Denominator MS	F Value	Pr > F
1	887.67950349	177	18.953902046	46.8336	0.0001

Source: SITE(SUPPRESS)
Error: MS(Error)

DF	Type I MS	Denominator DF	Denominator MS	F Value	Pr > F
4	250.6759695	177	18.953902046	13.2256	0.0001

Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 177 MSE= 18.9539
Critical Value of Studentized Range= 2.791
Minimum Significant Difference= 1.2718
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 91.27869

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SUPPRESS
A	8.4792	96	1
B	4.0690	87	2

---------- SPECIES=tui ----------

Number of tui seen per visit- Site nested within suppression

```
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       Loch remi robi vals wend whit
       SPECIES        1       tui
       Number of observations in by group = 176

       Type I Estimable Functions for: SUPPRESS
Effect                    Coefficients
INTERCEPT       0
SUPPRESS        1         L2
                2         -L2
SITE(SUPPRESS)  remi 1    0.3548*L2
                wend 1    0.3763*L2
                whit 1    0.2688*L2
                Loch 2    -0.3976*L2
                robi 2    -0.2651*L2
                vals 2    -0.3373*L2

       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                    Coefficients
INTERCEPT       0
SUPPRESS        1         0
                2         0
SITE(SUPPRESS)  remi 1    L4
                wend 1    L5
                whit 1    -L4-L5
                Loch 2    L7
                robi 2    L8
                vals 2    -L7-L8

Dependent Variable: TOTBIRD (tui)
Source          DF          Sum of Squares  Mean Square     F Value         Pr > F
Model           5           16430.23245671  3286.04649134   18.01           0.0001
Error           170         31015.08004329  182.44164731
Corrected       175         47445.31250000
Total
                R-Square    C.V.            Root MSE        TOTBIRD Mean
                0.346298    100.5179        13.50709618     13.43750000

Source          DF          Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1           5000.61163201   5000.61163201   27.41           0.0001
SITE(SUPPRESS)  4           11429.62082470  2857.40520617   15.66           0.0001

Source          Type I Expected Mean Square
SUPPRESS        Var(Error) + 87.716 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)  Var(Error) + Q(SITE(SUPPRESS))

       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD
Source: SUPPRESS
Error: MS(Error)
                            Denominator  Denominator
            DF    Type I MS     DF           MS             F Value      Pr > F
            1     5000.611632   170          182.44164731   27.4094      0.0001

Source: SITE(SUPPRESS)
Error: MS(Error)
                             Denominator  Denominator
            DF    Type I MS     DF           MS             F Value      Pr > F
            4     2857.4052062  170          182.44164731   15.6620      0.0001

       Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 170 MSE= 182.4416
```

Critical Value of Studentized Range= 2.792
Minimum Significant Difference= 4.0261
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 87.71591
Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SUPPRESS
A	18.473	93	1
B	7.795	83	2

---------- SPECIES=rosella ----------

Number of rosella seen per visit- Site nested within suppression

```
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       Loch remi robi vals wend whit
       SPECIES        1       rosella
       Number of observations in by group = 142

       Type I Estimable Functions for: SUPPRESS
Effect                    Coefficients
INTERCEPT       0
SUPPRESS        1         L2
                2         -L2
SITE(SUPPRESS)  remi 1    0.2078*L2
                wend 1    0.4026*L2
                whit 1    0.3896*L2
                Loch 2    -0.3538*L2
                robi 2    -0.4615*L2
                vals 2    -0.1846*L2

       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                    Coefficients
INTERCEPT       0
SUPPRESS        1         0
                2         0
SITE(SUPPRESS)  remi 1    L4
                wend 1    L5
                whit 1    -L4-L5
                Loch 2    L7
                robi 2    L8
                vals 2    -L7-L8

Dependent Variable: TOTBIRD (Rosella)
Source          DF          Sum of          Mean Square     F Value         Pr > F
                            Squares
Model           5           376.75886463    75.35177293     5.13            0.0002
Error           136         1995.83268467   14.67524033
Corrected       141         2372.59154930
Total
                R-Square    C.V.            Root MSE        TOTBIRD Mean
                0.158796    74.31387        3.83082763      5.15492958

Source          DF          Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1           177.38315769    177.38315769    12.09           0.0007
SITE(SUPPRESS)  4           199.37570694    49.84392674     3.40            0.0111

Source          Type I Expected Mean Square
SUPPRESS        Var(Error) + 70.493 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)  Var(Error) + Q(SITE(SUPPRESS))

       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD (Rosella)
Source: SUPPRESS
Error: MS(Error)
                              Denominator  Denominator
           DF    Type I MS     DF           MS             F Value      Pr > F
           1     177.38315769  136          14.675240328   12.0872      0.0007

Source: SITE(SUPPRESS)
Error: MS(Error)
                              Denominator  Denominator
           DF    Type I MS     DF           MS             F Value      Pr > F
           4     49.843926736  136          14.675240328   3.3965       0.0111

       Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 136 MSE= 14.67524
```

```
        Critical Value of Studentized Range= 2.797
        Minimum Significant Difference= 1.276
        WARNING: Cell sizes are not equal.
        Harmonic Mean of cell sizes= 70.49296

        Means with the same letter are not significantly different.
Tukey Grouping    Mean     N       SUPPRESS
A                 6.1818   77      1
B                 3.9385   65      2
--------------------------------- SPECIES=silvereye ---------------------------------
```

Number of silvereyes seen per visit- Site nested within suppression

```
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           6       Loch remi robi vals wend whit
        SPECIES        1       silvereye
        Number of observations in by group = 165

        Type I Estimable Functions for: SUPPRESS
Effect                    Coefficients
INTERCEPT       0
SUPPRESS        1         L2
                2         -L2
SITE(SUPPRESS)  remi 1    0.2651*L2
                wend 1    0.4217*L2
                whit 1    0.3133*L2
                Loch 2    -0.3293*L2
                robi 2    -0.3415*L2
                vals 2    -0.3293*L2

        Type I Estimable Functions for: SITE(SUPPRESS)
Effect                    Coefficients
INTERCEPT       0
SUPPRESS        1         0
                2         0
SITE(SUPPRESS)  remi 1    L4
                wend 1    L5
                whit 1    -L4-L5
                Loch 2    L7
                robi 2    L8
                vals 2    -L7-L8

Dependent Variable: TOTBIRD (sileveyes)
Source          DF         Sum of Squares  Mean Square    F Value        Pr > F
Model           5          3387.91224146   677.58244829   15.05          0.0001
Error           159        7156.89987975   45.01194893
Corrected       164        10544.81212121
Total
                R-Square   C.V.            Root MSE       TOTBIRD Mean
                0.321287   64.21117        6.70909449     10.44848485

Source          DF         Type I SS       Mean Square    F Value        Pr > F
SUPPRESS        1          698.78464546    698.78464546   15.52          0.0001
SITE(SUPPRESS)  4          2689.12759601   672.28189900   14.94          0.0001

Source          Type I Expected Mean Square
SUPPRESS        Var(Error) + 82.497 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)  Var(Error) + Q(SITE(SUPPRESS))

        Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD (silvereyes)
Source: SUPPRESS
Error: MS(Error)
                          Denominator  Denominator
            DF    Type I MS     DF           MS             F Value      Pr > F
            1     698.78464546  159          45.011948929   15.5244      0.0001

Source: SITE(SUPPRESS)
```

```
Error: MS(Error)
                          Denominator  Denominator
             DF   Type I MS    DF           MS            F Value      Pr > F
             4    672.281899   159          45.011948929  14.9356      0.0001

       Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 159 MSE= 45.01195
       Critical Value of Studentized Range= 2.793
       Minimum Significant Difference= 2.0631
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 82.49697

       Means with the same letter are not significantly different.
Tukey Grouping     Mean     N       SUPPRESS
A                  12.494   83      1
B                  8.378    82      2
--------------------------------- SPECIES=blackbird ---------------------------------
```

Number of blackbirds seen per visit- Site nested within suppression

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS               2      1 2
       SITE           6       Loch remi robi vals wend whit
       SPECIES        1       blackbird
       Number of observations in by group = 111

       Type I Estimable Functions for: SUPPRESS
Effect                         Coefficients
INTERCEPT         0
SUPPRESS          1            L2
                  2            -L2
SITE(SUPPRESS)    remi 1       0.2361*L2
                  wend 1       0.4583*L2
                  whit 1       0.3056*L2
                  Loch 2       -0.2564*L2
                  robi 2       -0.4615*L2
                  vals 2       -0.2821*L2

       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                         Coefficients
INTERCEPT         0
SUPPRESS          1            0
                  2            0
SITE(SUPPRESS)    remi 1       L4
                  wend 1       L5
                  whit 1       -L4-L5
                  Loch 2       L7
                  robi 2       L8
                  vals 2       -L7-L8

Dependent Variable: TOTBIRD (blackbirds)
Source           DF             Sum of          Mean Square    F Value        Pr > F
                                Squares
Model            5              284.30233014    56.86046603    12.62          0.0001
Error            105            473.12109329    4.50591517
Corrected        110            757.42342342
Total
                 R-Square       C.V.            Root MSE       TOTBIRD Mean
                 0.375355       65.08875        2.12271411     3.26126126

Source           DF             Type I SS       Mean Square    F Value        Pr > F
SUPPRESS         1              70.36038924     70.36038924    15.62          0.0001
SITE(SUPPRESS)   4              213.94194090    53.48548523    11.87          0.0001

Source             Type I Expected Mean Square
SUPPRESS           Var(Error) + 50.595 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)     Var(Error) + Q(SITE(SUPPRESS))
```

```
       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD (blackbirds)
Source: SUPPRESS
Error: MS(Error)
                                Denominator  Denominator
               DF    Type I MS     DF           MS            F Value     Pr > F
               1     70.360389235  105          4.5059151742  15.6151     0.0001

Source: SITE(SUPPRESS)
Error: MS(Error)
                                Denominator  Denominator
               DF    Type I MS     DF           MS            F Value     Pr > F
               4     53.485485226  105          4.5059151742  11.8701     0.0001

       Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 105 MSE= 4.505915
       Critical Value of Studentized Range= 2.804
       Minimum Significant Difference= 0.8368
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 50.59459
       Means with the same letter are not significantly different.
Tukey Grouping    Mean              N                SUPPRESS
A                 3.8472            72               1
B                 2.1795            39               2
---------------------------------- SPECIES=thrush ----------------------------------
```

Number of thrushes seen per visit- Site nested within suppression

```
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           4       remi robi wend whit
       SPECIES        1       thrush
       Number of observations in by group = 28

       Type I Estimable Functions for: SUPPRESS
Effect                      Coefficients
INTERCEPT       0
SUPPRESS        1           L2
                2           -L2
SITE(SUPPRESS)  remi 1      0.1111*L2
                wend 1      0.6667*L2
                whit 1      0.2222*L2
                robi 2      -L2

       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                      Coefficients
INTERCEPT       0
SUPPRESS        1           0
                2           0
SITE(SUPPRESS)  remi 1      L4
                wend 1      L5
                whit 1      -L4-L5
                robi 2      0

Dependent Variable: TOTBIRD (thrushes)
Source          DF          Sum of          Mean Square     F Value         Pr > F
                            Squares
Model           3           4.40079365      1.46693122      0.73            0.5446
Error           24          48.27777778     2.01157407
Corrected       27          52.67857143
Total
                R-Square    C.V.            Root MSE        TOTBIRD Mean
                0.083540    67.30914        1.41829971      2.10714286

Source          DF          Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1           0.01190476      0.01190476      0.01            0.9393
```

SITE(SUPPRESS)	2	4.38888889	2.19444444	1.09	0.3520

Source	Type I Expected Mean Square
SUPPRESS	Var(Error) + 1.9286 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)	Var(Error) + Q(SITE(SUPPRESS))

Tests of Hypotheses for Mixed Model Analysis of Variance

Dependent Variable: TOTBIRD (thrushes)

Source: SUPPRESS

Error: MS(Error)

DF	Type I MS	Denominator DF	Denominator MS	F Value	Pr > F
1	0.0119047619	24	2.0115740741	0.005918	0.9393

Source: SITE(SUPPRESS)

Error: MS(Error)

DF	Type I MS	Denominator DF	Denominator MS	F Value	Pr > F
2	2.1944444444	24	2.0115740741	1.0909	0.3520

Tukey's Studentized Range (HSD) Test for variable: TOTBIRD

NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.

Alpha= 0.05 df= 24 MSE= 2.011574

Critical Value of Studentized Range= 2.919

Minimum Significant Difference= 2.9809

WARNING: Cell sizes are not equal.

Harmonic Mean of cell sizes= 1.928571

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SUPPRESS
A	2.111	27	1
A	2.000	1	2

---------- SPECIES=myna ----------

Number of myna seen per visit- Site nested within suppression

Class Level Information

Class	Levels	Values
SUPPRESS	2	1 2
SITE	6	Loch remi robi vals wend whit
SPECIES	1	myna

Number of observations in by group = 131

Type I Estimable Functions for: SUPPRESS

Effect		Coefficients
INTERCEPT	0	
SUPPRESS	1	L2
	2	-L2
SITE(SUPPRESS)	remi 1	0.35*L2
	wend 1	0.2875*L2
	whit 1	0.3625*L2
	Loch 2	-0.1765*L2
	robi 2	-0.549*L2
	vals 2	-0.2745*L2

Type I Estimable Functions for: SITE(SUPPRESS)

Effect		Coefficients
INTERCEPT	0	
SUPPRESS	1	0
	2	0
SITE(SUPPRESS)	remi 1	L4
	wend 1	L5
	whit 1	-L4-L5
	Loch 2	L7
	robi 2	L8
	vals 2	-L7-L8

Dependent Variable: TOTBIRD (myna)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	5	1110.92395605	222.18479121	3.86	0.0027
Error	125	7187.82413555	57.50259308		
Corrected Total	130	8298.74809160			

R-Square	C.V.	Root MSE	TOTBIRD Mean
0.133866	137.9693	7.58304643	5.49618321

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SUPPRESS	1	383.61353278	383.61353278	6.67	0.0109
SITE(SUPPRESS)	4	727.31042327	181.82760582	3.16	0.0163

Source	Type I Expected Mean Square
SUPPRESS	Var(Error) + 62.29 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)	Var(Error) + Q(SITE(SUPPRESS))

Tests of Hypotheses for Mixed Model Analysis of Variance

Dependent Variable: TOTBIRD (myna)

Source: SUPPRESS

Error: MS(Error)

DF	Type I MS	Denominator DF	Denominator MS	F Value	Pr > F
1	383.61353278	125	57.502593084	6.6712	0.0109

Source: SITE(SUPPRESS)

Error: MS(Error)

DF	Type I MS	Denominator DF	Denominator MS	F Value	Pr > F
4	181.82760582	125	57.502593084	3.1621	0.0163

Tukey's Studentized Range (HSD) Test for variable: TOTBIRD

NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.

```
        Alpha= 0.05    df= 125 MSE= 57.50259
        Critical Value of Studentized Range= 2.799
        Minimum Significant Difference= 2.6892
        WARNING: Cell sizes are not equal.
        Harmonic Mean of cell sizes= 62.29008
        Means with the same letter are not significantly different.
Tukey Grouping    Mean     N       SUPPRESS
A                 6.863    80      1
B                 3.353    51      2
---------------------------------- SPECIES=fantail ----------------------------------
```

Number of fantails seen per visit- Site nested within suppression

```
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           6       Loch remi robi vals wend whit
        SPECIES        1       fantail
        Number of observations in by group = 196

        Type I Estimable Functions for: SUPPRESS
Effect                          Coefficients
INTERCEPT         0
SUPPRESS          1             L2
                  2             -L2
SITE(SUPPRESS)    remi 1        0.32*L2
                  wend 1        0.35*L2
                  whit 1        0.33*L2
                  Loch 2        -0.3437*L2
                  robi 2        -0.3437*L2
                  vals 2        -0.3125*L2

        Type I Estimable Functions for: SITE(SUPPRESS)
Effect                           Coefficients
INTERCEPT         0
SUPPRESS          1              0
                  2              0
SITE(SUPPRESS)    remi 1         L4
                  wend 1         L5
                  whit 1         -L4-L5
                  Loch 2         L7
                  robi 2         L8
                  vals 2         -L7-L8

Dependent Variable: TOTBIRD (fantails)
Source           DF             Sum of          Mean Square     F Value         Pr > F
                                Squares
Model            5              2599.64446506   519.92889301    40.47           0.0001
Error            190            2440.74329004   12.84601732
Corrected        195            5040.38775510
Total
                 R-Square       C.V.            Root MSE        TOTBIRD Mean
                 0.515763       56.74396        3.58413411      6.31632653

Source           DF             Type I SS       Mean Square     F Value         Pr > F
SUPPRESS         1              222.38942177    222.38942177    17.31           0.0001
SITE(SUPPRESS)   4              2377.25504329   594.31376082    46.26           0.0001

Source           Type I Expected Mean Square
SUPPRESS         Var(Error) + 97.959 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)   Var(Error) + Q(SITE(SUPPRESS))

        Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD (fantails)
Source: SUPPRESS
Error: MS(Error)
                              Denominator  Denominator
             DF   Type I MS   DF           MS             F Value      Pr > F
             1    222.38942177 190          12.846017316   17.3119      0.0001

Source: SITE(SUPPRESS)
```

Error: MS(Error)

DF	Type I MS	Denominator DF	Denominator MS	F Value	Pr > F
4	594.31376082	190	12.846017316	46.2644	0.0001

Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 190 MSE= 12.84602
Critical Value of Studentized Range= 2.790
Minimum Significant Difference= 1.0102
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 97.95918
Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SUPPRESS
A	7.3600	100	1
B	5.2292	96	2

---------- SPECIES=harrier ----------

Number of harriers seen per visit- Site nested within suppression

```
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       Loch remi robi vals wend whit
       SPECIES        1       harrier
       Number of observations in by group = 85

       Type I Estimable Functions for: SUPPRESS
Effect                        Coefficients
INTERCEPT       0
SUPPRESS        1             L2
                2             -L2
SITE(SUPPRESS)  remi 1        0.359*L2
                wend 1        0.1795*L2
                whit 1        0.4615*L2
                Loch 2        -0.4565*L2
                robi 2        -0.1957*L2
                vals 2        -0.3478*L2

       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                        Coefficients
INTERCEPT       0
SUPPRESS        1             0
                2             0
SITE(SUPPRESS)  remi 1        L4
                wend 1        L5
                whit 1        -L4-L5
                Loch 2        L7
                robi 2        L8
                vals 2        -L7-L8

Dependent Variable: TOTBIRD (Harriers)
Source          DF          Sum of          Mean Square     F Value         Pr > F
                            Squares
Model           5           15.17801120     3.03560224      1.95            0.0951
Error           79          122.86904762    1.55530440
Corrected       84          138.04705882
Total
                R-Square    C.V.            Root MSE        TOTBIRD Mean
                0.109948    65.84166        1.24711844      1.89411765

Source          DF          Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1           4.61617811      4.61617811      2.97            0.0888
SITE(SUPPRESS)  4           10.56183309     2.64045827      1.70            0.1588

Source          Type I Expected Mean Square
SUPPRESS        Var(Error) + 42.212 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)  Var(Error) + Q(SITE(SUPPRESS))

       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD (Harriers)
Source: SUPPRESS
Error: MS(Error)
                            Denominator  Denominator
            DF   Type I MS  DF           MS             F Value      Pr > F
            1    4.61617811 79           1.5553044002   2.9680       0.0888

Source: SITE(SUPPRESS)
Error: MS(Error)
                             Denominator  Denominator
            DF   Type I MS   DF           MS             F Value      Pr > F
            4    2.6404582736 79           1.5553044002   1.6977       0.1588

       Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
```

```
        Alpha= 0.05    df= 79  MSE= 1.555304
        Critical Value of Studentized Range= 2.815
        Minimum Significant Difference= 0.5403
        WARNING: Cell sizes are not equal.
        Harmonic Mean of cell sizes= 42.21176
        Means with the same letter are not significantly different.
Tukey Grouping    Mean     N       SUPPRESS
A                 2.1087   46      2
A                 1.6410   39      1
---------------------------------- SPECIES=pukeko ----------------------------------
```

Number of pukeko seen per visit- Site nested within suppression

```
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           5       Loch robi vals wend whit
        SPECIES        1       pukeko
        Number of observations in by group = 20

        Type I Estimable Functions for: SUPPRESS
Effect                     Coefficients
INTERCEPT       0
SUPPRESS        1          L2
                2          -L2
SITE(SUPPRESS)  wend 1     0.6667*L2
                whit 1     0.3333*L2
                Loch 2     -0.25*L2
                robi 2     -0.625*L2
                vals 2     -0.125*L2

        Type I Estimable Functions for: SITE(SUPPRESS)
Effect                     Coefficients
INTERCEPT       0
SUPPRESS        1          0
                2          0
SITE(SUPPRESS)  wend 1     L4
                whit 1     -L4
                Loch 2     L6
                robi 2     L7
                vals 2     -L6-L7

Dependent Variable: TOTBIRD (pukeko)
Source           DF         Sum of          Mean Square     F Value         Pr > F
                            Squares
Model            4          2.92500000      0.73125000      0.74            0.5808
Error            15         14.87500000     0.99166667
Corrected        19         17.80000000
Total
                 R-Square   C.V.            Root MSE        TOTBIRD Mean
                 0.164326   52.41182        0.99582462      1.90000000

Source           DF         Type I SS       Mean Square     F Value         Pr > F
SUPPRESS         1          1.00833333      1.00833333      1.02            0.3293
SITE(SUPPRESS)   3          1.91666667      0.63888889      0.64            0.5985

Source           Type I Expected Mean Square
SUPPRESS         Var(Error) + 9.6 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)   Var(Error) + Q(SITE(SUPPRESS))

        Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD (pukeko)
Source: SUPPRESS
Error: MS(Error)
                              Denominator  Denominator
            DF    Type I MS   DF           MS             F Value      Pr > F
            1     1.0083333333  15         0.9916666667   1.0168       0.3293

Source: SITE(SUPPRESS)
Error: MS(Error)
```

```
                              Denominator  Denominator
          DF    Type I MS     DF           MS            F Value      Pr > F
          3     0.6388888889  15           0.9916666667  0.6443       0.5985

       Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 15  MSE= 0.991667
       Critical Value of Studentized Range= 3.014
       Minimum Significant Difference= 0.9688
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 9.6

       Means with the same letter are not significantly different.
Tukey Grouping     Mean     N       SUPPRESS
A                  2.0833   12      1
A                  1.6250   8       2

--------------------------------- SPECIES=kingfish ---------------------------------
```

Number of kingfishers seen per visit- Site nested within suppression

```
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       Loch remi robi vals wend whit
       SPECIES        1       kingfish
       Number of observations in by group = 117

       Type I Estimable Functions for: SUPPRESS
Effect                        Coefficients
INTERCEPT       0
SUPPRESS        1             L2
                2             -L2
SITE(SUPPRESS)  remi 1        0.2381*L2
                wend 1        0.4127*L2
                whit 1        0.3492*L2
                Loch 2        -0.3704*L2
                robi 2        -0.3704*L2
                vals 2        -0.2593*L2

       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                        Coefficients
INTERCEPT       0
SUPPRESS        1             0
                2             0
SITE(SUPPRESS)  remi 1        L4
                wend 1        L5
                whit 1        -L4-L5
                Loch 2        L7
                robi 2        L8
                vals 2        -L7-L8

Dependent Variable: TOTBIRD (kingfishers)
Source          DF          Sum of          Mean Square     F Value         Pr > F
                            Squares
Model           5           39.71182151     7.94236430      1.43            0.2195
Error           111         617.05740926    5.55907576
Corrected       116         656.76923077
Total
                R-Square    C.V.            Root MSE        TOTBIRD Mean
                0.060465    75.99421        2.35776923      3.10256410

Source          DF          Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1           4.57875458      4.57875458      0.82            0.3661
SITE(SUPPRESS)  4           35.13306693     8.78326673      1.58            0.1846

Source          Type I Expected Mean Square
SUPPRESS        Var(Error) + 58.154 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)  Var(Error) + Q(SITE(SUPPRESS))
```

```
       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD (kingfishers)
Source: SUPPRESS
Error: MS(Error)
                              Denominator  Denominator
           DF    Type I MS     DF           MS            F Value      Pr > F
           1     4.5787545788  111          5.5590757591  0.8237       0.3661

Source: SITE(SUPPRESS)
Error: MS(Error)
                              Denominator  Denominator
           DF    Type I MS     DF           MS            F Value      Pr > F
           4     8.7832667333  111          5.5590757591  1.5800       0.1846

       Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 111 MSE= 5.559076
       Critical Value of Studentized Range= 2.802
       Minimum Significant Difference= 0.8664
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 58.15385
       Means with the same letter are not significantly different.
Tukey Grouping    Mean       N        SUPPRESS
A                 3.2857     63       1
A                 2.8889     54       2
---------------------------------- SPECIES=warbler ----------------------------------
```

Number of warblers seen per visit- Site nested within suppression

```
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       Loch remi robi vals wend whit
       SPECIES        1       warbler
       Number of observations in by group = 185

       Type I Estimable Functions for: SUPPRESS
Effect                    Coefficients
INTERCEPT       0
SUPPRESS        1         L2
                2         -L2
SITE(SUPPRESS)  remi 1    0.3368*L2
                wend 1    0.3579*L2
                whit 1    0.3053*L2
                Loch 2    -0.3667*L2
                robi 2    -0.3*L2
                vals 2    -0.3333*L2

       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                    Coefficients
INTERCEPT       0
SUPPRESS        1         0
                2         0
SITE(SUPPRESS)  remi 1    L4
                wend 1    L5
                whit 1    -L4-L5
                Loch 2    L7
                robi 2    L8
                vals 2    -L7-L8

Dependent Variable: TOTBIRD (warblers)
Source          DF          Sum of          Mean Square     F Value         Pr > F
                            Squares
Model           5           447.51273031    89.50254606     10.21           0.0001
Error           179         1568.50889131   8.76261950
Corrected       184         2016.02162162
Total
                R-Square    C.V.            Root MSE        TOTBIRD Mean
```

```
               0.221978   62.51505       2.96017221     4.73513514

Source          DF         Type I SS      Mean Square    F Value        Pr > F
SUPPRESS        1          10.31869765    10.31869765    1.18           0.2793
SITE(SUPPRESS)  4          437.19403266   109.29850817   12.47          0.0001

Source          Type I Expected Mean Square
SUPPRESS        Var(Error) + 92.432 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)  Var(Error) + Q(SITE(SUPPRESS))

       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD (warblers)
Source: SUPPRESS
Error: MS(Error)
                            Denominator  Denominator
            DF    Type I MS     DF           MS            F Value      Pr > F
            1     10.318697645  179          8.7626195045  1.1776       0.2793

Source: SITE(SUPPRESS)
Error: MS(Error)
                            Denominator  Denominator
            DF    Type I MS     DF           MS            F Value      Pr > F
            4     109.29850817  179          8.7626195045  12.4733      0.0001

       Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 179 MSE= 8.76262
       Critical Value of Studentized Range= 2.791
       Minimum Significant Difference= 0.8592
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 92.43243
       Means with the same letter are not significantly different.
Tukey Grouping     Mean     N       SUPPRESS
A                  4.9778   90      2
A                  4.5053   95      1
---------------------------------- SPECIES=finches ----------------------------------
```

Number of finches seen per visit- Site nested within suppression

```
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       Loch remi robi vals wend whit
       SPECIES        1       finches
       Number of observations in by group = 96

       Type I Estimable Functions for: SUPPRESS
Effect                         Coefficients
INTERCEPT         0
SUPPRESS          1            L2
                  2            -L2
SITE(SUPPRESS)    remi 1       0.2931*L2
                  wend 1       0.4483*L2
                  whit 1       0.2586*L2
                  Loch 2       -0.3947*L2
                  robi 2       -0.3158*L2
                  vals 2       -0.2895*L2

       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                         Coefficients
INTERCEPT         0
SUPPRESS          1            0
                  2            0
SITE(SUPPRESS)    remi 1       L4
                  wend 1       L5
                  whit 1       -L4-L5
                  Loch 2       L7
                  robi 2       L8
                  vals 2       -L7-L8
```

```
Dependent Variable: TOTBIRD (finches)
Source          DF         Sum of          Mean Square    F Value        Pr > F
                           Squares
Model           5          76.17367681     15.23473536    1.70           0.1418
Error           90         804.78465652    8.94205174
Corrected       95         880.95833333
Total
                R-Square   C.V.            Root MSE       TOTBIRD Mean
                0.086467   92.60366        2.99032636     3.22916667

Source          DF         Type I SS       Mean Square    F Value        Pr > F
SUPPRESS        1          33.44109195     33.44109195    3.74           0.0563
SITE(SUPPRESS)  4          42.73258486     10.68314621    1.19           0.3186

Source          Type I Expected Mean Square
SUPPRESS        Var(Error) + 45.917 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)  Var(Error) + Q(SITE(SUPPRESS))

       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD (finches)
Source: SUPPRESS
Error: MS(Error)
                              Denominator  Denominator
            DF   Type I MS    DF           MS            F Value     Pr > F
            1    33.441091954 90           8.9420517391  3.7398      0.0563

Source: SITE(SUPPRESS)
Error: MS(Error)
                              Denominator  Denominator
            DF   Type I MS    DF           MS            F Value     Pr > F
            4    10.683146215 90           8.9420517391  1.1947      0.3186

       Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 90  MSE= 8.942052
       Critical Value of Studentized Range= 2.810
       Minimum Significant Difference= 1.2399
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 45.91667
       Means with the same letter are not significantly different.
Tukey Grouping    Mean     N      SUPPRESS
A                 3.7069   58     1
A                 2.5000   38     2
---------------------------------- SPECIES=magpie ----------------------------------
```

Number of magpies seen per visit- Site nested within suppression

```
       Class Level Information
       Class   Levels  Values
       SUPPRESS       2      1 2
       SITE           6      Loch remi robi vals wend whit
       SPECIES        1      magpie
       Number of observations in by group = 76

       Type I Estimable Functions for: SUPPRESS
Effect                    Coefficients
INTERCEPT       0
SUPPRESS        1         L2
                2         -L2
SITE(SUPPRESS)  remi 1    0.6897*L2
                wend 1    0.2759*L2
                whit 1    0.0345*L2
                Loch 2    -0.2553*L2
                robi 2    -0.234*L2
                vals 2    -0.5106*L2

       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                    Coefficients
```

```
INTERCEPT       0
SUPPRESS        1        0
                2        0
SITE(SUPPRESS)  remi 1   L4
                wend 1   L5
                whit 1   -L4-L5
                Loch 2   L7
                robi 2   L8
                vals 2   -L7-L8

Dependent Variable: TOTBIRD (magpies)
Source          DF         Sum of          Mean Square    F Value        Pr > F
                           Squares
Model           5          377.84226475    75.56845295    7.75           0.0001
Error           70         682.82878788    9.75469697
Corrected       75         1060.67105263
Total
                R-Square   C.V.            Root MSE       TOTBIRD Mean
                0.356229   87.58933        3.12325103     3.56578947

Source          DF         Type I SS       Mean Square    F Value        Pr > F
SUPPRESS        1          66.01367919     66.01367919    6.77           0.0113
SITE(SUPPRESS)  4          311.82858556    77.95714639    7.99           0.0001

Source  Type I Expected Mean Square
SUPPRESS        Var(Error) + 35.868 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)  Var(Error) + Q(SITE(SUPPRESS))

       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD (magpies)
Source: SUPPRESS
Error: MS(Error)
                              Denominator  Denominator
            DF    Type I MS   DF           MS             F Value      Pr > F
            1     66.013679191 70          9.7546969697   6.7674       0.0113

Source: SITE(SUPPRESS)
Error: MS(Error)
                              Denominator  Denominator
            DF    Type I MS   DF           MS             F Value      Pr > F
            4     77.957146391 70          9.7546969697   7.9918       0.0001

       Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 70  MSE= 9.754697
       Critical Value of Studentized Range= 2.821
       Minimum Significant Difference= 1.471
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 35.86842
       Means with the same letter are not significantly different.
Tukey Grouping    Mean       N      SUPPRESS
A                 4.2979     47     2
B                 2.3793     29     1
--------------------------------- SPECIES=pheasant ---------------------------------
```

Number of pheasants seen per visit- Site nested within suppression

```
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       Loch remi robi vals wend whit
       SPECIES        1       pheasant
       Number of observations in by group = 54

       Type I Estimable Functions for: SUPPRESS
Effect                    Coefficients
INTERCEPT       0
SUPPRESS        1         L2
                2         -L2
```

```
SITE(SUPPRESS)  remi 1   0.1111*L2
                wend 1   0.7037*L2
                whit 1   0.1852*L2
                Loch 2   -0.4815*L2
                robi 2   -0.3333*L2
                vals 2   -0.1852*L2

       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                  Coefficients
INTERCEPT       0
SUPPRESS        1       0
                2       0
SITE(SUPPRESS)  remi 1   L4
                wend 1   L5
                whit 1   -L4-L5
                Loch 2   L7
                robi 2   L8
                vals 2   -L7-L8

Dependent Variable: TOTBIRD (pheasants)
Source          DF         Sum of          Mean Square    F Value        Pr > F
                           Squares
Model           5          5.44471435      1.08894287     1.38           0.2487
Error           48         37.88861898     0.78934623
Corrected       53         43.33333333
Total
                R-Square   C.V.            Root MSE       TOTBIRD Mean
                0.125647   57.11475        0.88845159     1.55555556

Source          DF         Type I SS       Mean Square    F Value        Pr > F
SUPPRESS        1          0.29629630      0.29629630     0.38           0.5430
SITE(SUPPRESS)  4          5.14841805      1.28710451     1.63           0.1819

Source          Type I Expected Mean Square
SUPPRESS        Var(Error) + 27 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)  Var(Error) + Q(SITE(SUPPRESS))

       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD (pheasants)
Source: SUPPRESS
Error: MS(Error)
                              Denominator  Denominator
            DF    Type I MS   DF           MS             F Value      Pr > F
            1     0.2962962963  48         0.7893462288   0.3754       0.5430

Source: SITE(SUPPRESS)
Error: MS(Error)
                              Denominator  Denominator
             DF    Type I MS   DF           MS             F Value      Pr > F
             4     1.2871045134  48         0.7893462288   1.6306       0.1819

       Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 48  MSE= 0.789346
       Critical Value of Studentized Range= 2.844
       Minimum Significant Difference= 0.4862

       Means with the same letter are not significantly different.
Tukey Grouping     Mean       N       SUPPRESS
A                  1.6296     27      1
A                  1.4815     27      2

---------------------------------- SPECIES=skylark ----------------------------------
```

Number of skylarks seen per visit- Site nested within suppression

```
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
```

```
       SITE           5      Loch remi robi wend whit
       SPECIES        1      skylark
       Number of observations in by group = 14

       Type I Estimable Functions for: SUPPRESS

Effect                   Coefficients
INTERCEPT       0
SUPPRESS        1        L2
                2        -L2
SITE(SUPPRESS)  remi 1   0.5714*L2
                wend 1   0.2857*L2
                whit 1   0.1429*L2
                Loch 2   -0.7143*L2
                robi 2   -0.2857*L2

       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                   Coefficients
INTERCEPT       0
SUPPRESS        1        0
                2        0
SITE(SUPPRESS)  remi 1   L4
                wend 1   L5
                whit 1   -L4-L5
                Loch 2   L7
                robi 2   -L7

Dependent Variable: TOTBIRD (skylarks)
Source          DF         Sum of         Mean Square    F Value        Pr > F
                           Squares
Model           4          2.62857143     0.65714286     0.87           0.5180
Error           9          6.80000000     0.75555556
Corrected       13         9.42857143
Total
                R-Square   C.V.           Root MSE       TOTBIRD Mean
                0.278788   60.84589       0.86922699     1.42857143

Source          DF         Type I SS      Mean Square    F Value        Pr > F
SUPPRESS        1          1.14285714     1.14285714     1.51           0.2499
SITE(SUPPRESS)  3          1.48571429     0.49523810     0.66           0.5995

Source          Type I Expected Mean Square
SUPPRESS        Var(Error) + 7 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)  Var(Error) + Q(SITE(SUPPRESS))

       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD (skylarks)
Source: SUPPRESS
Error: MS(Error)
                              Denominator  Denominator
            DF    Type I MS   DF           MS             F Value      Pr > F
            1     1.1428571429 9           0.7555555556   1.5126       0.2499

Source: SITE(SUPPRESS)
Error: MS(Error)
                              Denominator  Denominator
            DF    Type I MS   DF           MS             F Value      Pr > F
            3     0.4952380952 9           0.7555555556   0.6555       0.5995

       Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 9   MSE= 0.755556
       Critical Value of Studentized Range= 3.199
       Minimum Significant Difference= 1.051

       Means with the same letter are not significantly different.
Tukey Grouping    Mean       N      SUPPRESS
A                 1.7143     7      1
A                 1.1429     7      2
```

---------- SPECIES=swallow ----------

Number of swallows seen per visit- Site nested within suppression

```
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       Loch remi robi vals wend whit
       SPECIES        1       swallow
       Number of observations in by group = 37
       Type I Estimable Functions for: SUPPRESS
Effect                    Coefficients
INTERCEPT       0
SUPPRESS        1         L2
                2         -L2
SITE(SUPPRESS)  remi 1    0.1034*L2
                wend 1    0.7241*L2
                whit 1    0.1724*L2
                Loch 2    -0.5*L2
                robi 2    -0.125*L2
                vals 2    -0.375*L2

       Type I Estimable Functions for: SITE(SUPPRESS)
Effect                    Coefficients
INTERCEPT       0
SUPPRESS        1         0
                2         0
SITE(SUPPRESS)  remi 1    L4
                wend 1    L5
                whit 1    -L4-L5
                Loch 2    L7
                robi 2    L8
                vals 2    -L7-L8

Dependent Variable: TOTBIRD (swallows)
Source          DF          Sum of          Mean Square     F Value         Pr > F
                            Squares
Model           5           54.98893179     10.99778636     0.92            0.4834
Error           31          372.03809524    12.00122888
Corrected       36          427.02702703
Total
                R-Square    C.V.            Root MSE        TOTBIRD Mean
                0.128772    90.26642        3.46427898      3.83783784

Source          DF          Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1           18.26840634     18.26840634     1.52            0.2266
SITE(SUPPRESS)  4           36.72052545     9.18013136      0.76            0.5562

Source          Type I Expected Mean Square
SUPPRESS        Var(Error) + 12.541 Var(SUPPRESS) + Q(SITE(SUPPRESS))
SITE(SUPPRESS)  Var(Error) + Q(SITE(SUPPRESS))

       Tests of Hypotheses for Mixed Model Analysis of Variance
Dependent Variable: TOTBIRD (swallows)
Source: SUPPRESS
Error: MS(Error)
                              Denominator  Denominator
           DF    Type I MS     DF           MS            F Value      Pr > F
           1     18.268406337  31           12.001228879  1.5222       0.2266

Source: SITE(SUPPRESS)
Error: MS(Error)
                              Denominator  Denominator
           DF    Type I MS     DF           MS            F Value      Pr > F
           4     9.1801313629  31           12.001228879  0.7649       0.5562

       Tukey's Studentized Range (HSD) Test for variable: TOTBIRD
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 31  MSE= 12.00123
       Critical Value of Studentized Range= 2.884
```

Minimum Significant Difference= 2.8216
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 12.54054
Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SUPPRESS
A	4.207	29	1
A	2.500	8	2

Appendix 7.7 SAS output for flock size per species and per site.

```
proc sort data=work.occbird;
  by species site;
run;
quit;

proc glm data=WORK.OCCBIRD;
  class SUPPRESS SITE NUMBER;
  model OCCASION = SUPPRESS SITE NUMBER ;
  by SPECIES;
  means control site number /tukey;
run;
quit;
```

Where

Occasion	number of occasions that flock sizes of a particular size were noted at each site
Species	the species of bird noted
Suppress	1when the site had pest suppression and 2 when it didn't
Site	the name of the site
Number	the number of birds in the flock

```
--------------------------------- SPECIES=kereru ----------------------------------
```

Flock size of kereru per site

```
        General Linear Models Procedure
        Class Level Information
        Class          Levels  Values
        SUPPRESS       2       1 2
        SITE           6       loch remi robi vals wend whit
        NUMBER         21      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25
        Number of observations in by group = 126

Dependent Variable: OCCASION
Source          DF         Sum of Squares  Mean Square     F Value         Pr > F
Model           25         35622.65079365  1424.90603175   28.07           0.0001
Error           100        5076.55555556   50.76555556
Corrected       125        40699.20634921
Total
                R-Square   C.V.            Root MSE        OCCASION
                                                           Mean
                0.875266   126.4436        7.12499513      5.63492063

Source          DF         Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1          280.50793651    280.50793651    5.53            0.0207
SITE            4          518.60317460    129.65079365    2.55            0.0435
NUMBER          20         34823.53968254  1741.17698413   34.30           0.0001

Source          DF         Type III SS     Mean Square     F Value         Pr > F
SUPPRESS        0          0.00000000      .               .               .
SITE            4          518.60317460    129.65079365    2.55            0.0435
NUMBER          20         34823.53968254  1741.17698413   34.30           0.0001

        Tukey's Studentized Range (HSD) Test for variable: OCCASION
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 100 MSE= 50.76556
        Critical Value of Studentized Range= 2.806
        Minimum Significant Difference= 2.5186
        Means with the same letter are not significantly different.
Tukey Grouping     Mean     N       SUPPRESS
A                  7.127    63      1
B                  4.143    63      2
```

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 100 MSE= 50.76556
Critical Value of Studentized Range= 4.109
Minimum Significant Difference= 6.3892

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SITE
A	10.143	21	wend
B A	7.143	21	remi
B A	6.000	21	loch
B A	4.095	21	whit
B A	4.000	21	vals
B	2.429	21	robi

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 100 MSE= 50.76556
Critical Value of Studentized Range= 5.187
Minimum Significant Difference= 15.088

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	NUMBER
A	75.500	6	1
B	25.667	6	2
C	9.667	6	3
C	3.667	6	4
C	1.500	6	5
C	1.500	6	6
C	0.500	6	8
C	0.167	6	10
C	0.167	6	12
C	0.000	6	7
C	0.000	6	9
C	0.000	6	11
C	0.000	6	13
C	0.000	6	14
C	0.000	6	15
C	0.000	6	16
C	0.000	6	17
C	0.000	6	18
C	0.000	6	19
C	0.000	6	20
C	0.000	6	25

---------- SPECIES=tui ----------

Flock size of tui per site

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SUPPRESS	2	1 2
SITE	6	loch remi robi vals wend whit
NUMBER	21	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25

Number of observations in by group = 126

Dependent Variable: OCCASION

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	25	51307.03174603	2052.28126984	16.33	0.0001
Error	100	12563.79365079	125.63793651		
Corrected Total	125	63870.82539683			

R-Square	C.V.	Root MSE	OCCASION Mean
0.803294	135.5387	11.20883297	8.26984127

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SUPPRESS	1	384.12698413	384.12698413	3.06	0.0834
SITE	4	2619.74603175	654.93650794	5.21	0.0007
NUMBER	20	48303.15873016	2415.15793651	19.22	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SUPPRESS	0	0.00000000	.	.	.
SITE	4	2619.74603175	654.93650794	5.21	0.0007
NUMBER	20	48303.15873016	2415.15793651	19.22	0.0001

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 100 MSE= 125.6379
Critical Value of Studentized Range= 2.806
Minimum Significant Difference= 3.9622

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SUPPRESS
A	10.016	63	1
A	6.524	63	2

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 100 MSE= 125.6379
Critical Value of Studentized Range= 4.109
Minimum Significant Difference= 10.051

Means with the same letter are not significantly different.

Tukey Grouping		Mean	N	SITE
	A	16.667	21	wend
B	A	10.381	21	remi
B	A	10.095	21	loch
B	A	7.190	21	vals
B		3.000	21	whit
B		2.286	21	robi

```
       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 125.6379
       Critical Value of Studentized Range= 5.187
       Minimum Significant Difference= 23.737

       Means with the same letter are not significantly different.
Tukey Grouping    Mean      N       NUMBER
A                 84.333    6       1
          B       42.500    6       2
C         B       19.000    6       3
C                 12.333    6       4
C                 6.500     6       5
C                 2.833     6       6
C                 1.333     6       7
C                 1.333     6       8
C                 0.667     6       10
C                 0.500     6       9
C                 0.500     6       11
C                 0.333     6       14
C                 0.333     6       13
C                 0.333     6       25
C                 0.167     6       12
C                 0.167     6       16
C                 0.167     6       19
C                 0.167     6       18
C                 0.167     6       20
C                 0.000     6       15
C                 0.000     6       17

---------------------------------- SPECIES=rosella ----------------------------------
```

Flock size of rosella per site

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       loch remi robi vals wend whit
       NUMBER         21      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25
       Number of observations in by group = 126

Dependent Variable: OCCASION
Source          DF         Sum of          Mean Square     F Value         Pr > F
                           Squares
Model           25         5400.53174603   216.02126984    19.42           0.0001
Error           100        1112.26984127   11.12269841
Corrected       125        6512.80158730
Total
                R-Square   C.V.            Root MSE        OCCASION Mean
                0.829218   118.3715        3.33507098      2.81746032

Source          DF         Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1          33.53174603     33.53174603     3.01            0.0856
SITE            4          176.69841270    44.17460317     3.97            0.0049
NUMBER          20         5190.30158730   259.51507937    23.33           0.0001

Source          DF         Type III SS     Mean Square     F Value         Pr > F
SUPPRESS        0          0.00000000      .               .               .
SITE            4          176.69841270    44.17460317     3.97            0.0049
NUMBER          20         5190.30158730   259.51507937    23.33           0.0001

       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 11.1227
       Critical Value of Studentized Range= 2.806
       Minimum Significant Difference= 1.1789

       Means with the same letter are not significantly different.
Tukey Grouping    Mean      N       SUPPRESS
A                 3.3333    63      1
A                 2.3016    63      2
```

```
       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 11.1227
       Critical Value of Studentized Range= 4.109
       Minimum Significant Difference= 2.9906

       Means with the same letter are not significantly different.
Tukey Grouping    Mean    N        SITE
           A      4.429   21       wend
B          A      4.095   21       whit
B          A      3.714   21       robi
B          A      1.905   21       loch
B          A      1.476   21       remi
B                 1.286   21       vals

       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 11.1227
       Critical Value of Studentized Range= 5.187
       Minimum Significant Difference= 7.0626

       Means with the same letter are not significantly different.
Tukey Grouping    Mean    N        NUMBER
A                 22.000  6        1
A                 20.500  6        2
           B      10.333  6        3
C          B      4.000   6        4
C                 2.167   6        5
C                 0.167   6        8
C                 0.000   6        7
C                 0.000   6        6
C                 0.000   6        9
C                 0.000   6        10
C                 0.000   6        11
C                 0.000   6        12
C                 0.000   6        13
C                 0.000   6        14
C                 0.000   6        15
C                 0.000   6        16
C                 0.000   6        17
C                 0.000   6        18
C                 0.000   6        19
C                 0.000   6        20
C                 0.000   6        25
--------------------------------- SPECIES=silvereye ---------------------------------
```

Flock size of silvereyes per site

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       loch remi robi vals wend whit
       NUMBER         21      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25
       Number of observations in by group = 126

Dependent Variable: OCCASION
Source          DF         Sum of          Mean Square     F Value         Pr > F
                           Squares
Model           25         6703.46031746   268.13841270    15.86           0.0001
Error           100        1690.69841270   16.90698413
Corrected       125        8394.15873016
Total
                R-Square   C.V.            Root MSE        OCCASION Mean
                0.798586   98.49584        4.11181032      4.17460317

Source          DF         Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1          53.36507937     53.36507937     3.16            0.0787
SITE            4          539.93650794    134.98412698    7.98            0.0001
NUMBER          20         6110.15873016   305.50793651    18.07           0.0001

Source          DF         Type III SS     Mean Square     F Value         Pr > F
SUPPRESS        0          0.00000000      .               .               .
SITE            4          539.93650794    134.98412698    7.98            0.0001
NUMBER          20         6110.15873016   305.50793651    18.07           0.0001
```

```
        Tukey's Studentized Range (HSD) Test for variable: OCCASION
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 100 MSE= 16.90698
        Critical Value of Studentized Range= 2.806
        Minimum Significant Difference= 1.4535

        Means with the same letter are not significantly different.
Tukey Grouping     Mean     N       SUPPRESS
A                  4.8254   63      1
A                  3.5238   63      2

        Tukey's Studentized Range (HSD) Test for variable: OCCASION
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 100 MSE= 16.90698
        Critical Value of Studentized Range= 4.109
        Minimum Significant Difference= 3.6872

        Means with the same letter are not significantly different.
Tukey Grouping     Mean     N       SITE
 A                 8.857    21      wend
 B                 3.905    21      vals
 B                 3.667    21      loch
 B                 3.476    21      whit
 B                 3.000    21      robi
 B                 2.143    21      remi

        Tukey's Studentized Range (HSD) Test for variable: OCCASION
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 100 MSE= 16.90698
        Critical Value of Studentized Range= 5.187
        Minimum Significant Difference= 8.7074

        Means with the same letter are not significantly different.
Tukey Grouping    Mean             NUMBER
           A      23.833           3
B          A      17.667           1
B          A   C  15.167           2
B              C  13.667           4
D              C  7.833            5
D                 3.500            6
D                 3.500            8
D                 0.833            9
D                 0.667            7
D                 0.500            10
D                 0.333            18
D                 0.167            11
D                 0.000            13
D                 0.000            12
D                 0.000            15
D                 0.000            16
D                 0.000            17
D                 0.000            14
D                 0.000            19
D                 0.000            20
D                 0.000            25
```

---------- SPECIES=blackbird ----------

Flock size of blackbirds per site

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SUPPRESS	2	1 2
SITE	6	loch remi robi vals wend whit
NUMBER	21	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25

General Linear Models Procedure
Dependent Variable: OCCASION (blackbirds)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	25	4323.22222222	172.92888889	8.02	0.0001
Error	100	2155.60317460	21.55603175		
Corrected Total	125	6478.82539683			

R-Square	C.V.	Root MSE	OCCASION Mean
0.667285	252.1546	4.64284737	1.84126984

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SUPPRESS	1	99.55555556	99.55555556	4.62	0.0340
SITE	4	191.17460317	47.79365079	2.22	0.0725
NUMBER	20	4032.49206349	201.62460317	9.35	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SUPPRESS	0	0.00000000	.	.	.
SITE	4	191.17460317	47.79365079	2.22	0.0725
NUMBER	20	4032.49206349	201.62460317	9.35	0.0001

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 100 MSE= 21.55603
Critical Value of Studentized Range= 2.806
Minimum Significant Difference= 1.6412

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SUPPRESS
A	2.7302	63	1
B	0.9524	63	2

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 100 MSE= 21.55603
Critical Value of Studentized Range= 4.109
Minimum Significant Difference= 4.1634

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SITE
A	5.095	21	wend
B A	2.000	21	whit
B A	1.381	21	robi
B A	1.095	21	remi
B	0.857	21	vals
B	0.619	21	loch

```
       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 21.55603
       Critical Value of Studentized Range= 5.187
       Minimum Significant Difference= 9.832

       Means with the same letter are not significantly different.
Tukey Grouping     Mean     N       NUMBER
A                  26.000   6       1
B                  7.333    6       2
B                  3.500    6       3
B                  1.000    6       4
B                  0.333    6       5
B                  0.333    6       6
B                  0.167    6       9
B                  0.000    6       8
B                  0.000    6       7
B                  0.000    6       10
B                  0.000    6       11
B                  0.000    6       12
B                  0.000    6       13
B                  0.000    6       14
B                  0.000    6       15
B                  0.000    6       16
B                  0.000    6       17
B                  0.000    6       18
B                  0.000    6       19
B                  0.000    6       20
B                  0.000    6       25


---------------------------------- SPECIES=thrush ----------------------------------
```

Flock size of thrushes per site

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           5       loch remi robi wend whit
       NUMBER         21      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25
       Number of observations in by group = 126

Dependent Variable: OCCASION
Source          DF         Sum of          Mean Square     F Value         Pr > F
                           Squares
Model           24         198.26984127    8.26124339      2.05            0.0070
Error           101        406.05555556    4.02035204
Corrected       125        604.32539683
Total
                R-Square   C.V.            Root MSE        OCCASION Mean
                0.328085   587.5355        2.00508155      0.34126984

Source          DF         Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1          10.86507937     10.86507937     2.70            0.1033
SITE            3          22.57936508     7.52645503      1.87            0.1391
NUMBER          20         164.82539683    8.24126984      2.05            0.0107

Source          DF         Type III SS     Mean Square     F Value         Pr > F
SUPPRESS        0          0.00000000      .               .               .
SITE            3          22.57936508     7.52645503      1.87            0.1391
NUMBER          20         164.82539683    8.24126984      2.05            0.0107

       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 101 MSE= 4.020352
       Critical Value of Studentized Range= 2.805
       Minimum Significant Difference= 0.7087

       Means with the same letter are not significantly different.
Tukey Grouping     Mean       N         SUPPRESS
A                  0.6349     63        1
A                  0.0476     63        2
```

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate.
Alpha= 0.05 Confidence= 0.95 df= 101 MSE= 4.020352
Critical Value of Studentized Range= 3.928

Comparisons significant at the 0.05 level are indicated by '***'.

SITE Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit
wend - whit	-0.5283	1.1905	2.9092
wend - remi	-0.3854	1.3333	3.0521
wend - robi	-0.0837	1.4048	2.8933
wend - loch	-0.2426	1.4762	3.1950
whit - wend	-2.9092	-1.1905	0.5283
whit - remi	-1.5759	0.1429	1.8616
whit - robi	-1.2742	0.2143	1.7028
whit - loch	-1.4331	0.2857	2.0045
remi - wend	-3.0521	-1.3333	0.3854
remi - whit	-1.8616	-0.1429	1.5759
remi - robi	-1.4171	0.0714	1.5599
remi - loch	-1.5759	0.1429	1.8616
robi - wend	-2.8933	-1.4048	0.0837
robi - whit	-1.7028	-0.2143	1.2742
robi - remi	-1.5599	-0.0714	1.4171
robi - loch	-1.4171	0.0714	1.5599
loch - wend	-3.1950	-1.4762	0.2426
loch - whit	-2.0045	-0.2857	1.4331
loch - remi	-1.8616	-0.1429	1.5759
loch - robi	-1.5599	-0.0714	1.4171

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 101 MSE= 4.020352
Critical Value of Studentized Range= 5.186
Minimum Significant Difference= 4.245

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	NUMBER
A	5.333	6	1
B	1.000	6	2
B	0.667	6	3
B	0.167	6	4
B	0.000	6	5
B	0.000	6	6
B	0.000	6	7
B	0.000	6	8
B	0.000	6	9
B	0.000	6	10
B	0.000	6	11
B	0.000	6	12
B	0.000	6	13
B	0.000	6	14
B	0.000	6	15
B	0.000	6	16
B	0.000	6	17
B	0.000	6	18
B	0.000	6	19
B	0.000	6	20
B	0.000	6	25

---------- SPECIES=myna ----------

Flock size of myna per site

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SUPPRESS	2	1 2
SITE	6	loch remi robi vals wend whit
NUMBER	21	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25

Number of observations in by group = 126

Dependent Variable: OCCASION

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	25	6012.00793651	240.48031746	18.70	0.0001
Error	100	1285.65079365	12.85650794		
Corrected Total	125	7297.65873016			

R-Square	C.V.	Root MSE	OCCASION Mean
0.823827	134.0609	3.58559729	2.67460317

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SUPPRESS	1	108.64285714	108.64285714	8.45	0.0045
SITE	4	133.87301587	33.46825397	2.60	0.0404
NUMBER	20	5769.49206349	288.47460317	22.44	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SUPPRESS	0	0.00000000	.	.	.
SITE	4	133.87301587	33.46825397	2.60	0.0404
NUMBER	20	5769.49206349	288.47460317	22.44	0.0001

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 100 MSE= 12.85651
Critical Value of Studentized Range= 2.806
Minimum Significant Difference= 1.2675

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SUPPRESS
A	3.6032	63	1
B	1.7460	63	2

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 100 MSE= 12.85651
Critical Value of Studentized Range= 4.109
Minimum Significant Difference= 3.2153

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SITE
A	4.333	21	whit
A	4.286	21	remi
B A	3.238	21	robi
B A	2.190	21	wend
B A	1.143	21	vals
B	0.857	21	loch

```
       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 12.85651
       Critical Value of Studentized Range= 5.187
       Minimum Significant Difference= 7.5931

       Means with the same letter are not significantly different.
Tukey Grouping     Mean     N         NUMBER
A                  29.333   6         1
B                  14.333   6         2
C                  5.833    6         3
C                  2.333    6         4
C                  2.333    6         5
C                  0.833    6         8
C                  0.333    6         6
C                  0.333    6         20
C                  0.167    6         15
C                  0.167    6         9
C                  0.167    6         25
C                  0.000    6         10
C                  0.000    6         11
C                  0.000    6         14
C                  0.000    6         7
C                  0.000    6         16
C                  0.000    6         17
C                  0.000    6         18
C                  0.000    6         19
C                  0.000    6         12
C                  0.000    6         13

---------------------------------- SPECIES=harrier ----------------------------------
```

Flock size of harriers per site

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       loch remi robi vals wend whit
       NUMBER         21      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25
       Number of observations in by group = 126

       Dependent Variable: OCCASION
Source          DF         Sum of          Mean Square     F Value         Pr > F
                           Squares
Model           25         1538.38888889   61.53555556     17.86           0.0001
Error           100        344.60317460    3.44603175
Corrected       125        1882.99206349
Total
                R-Square   C.V.            Root MSE        OCCASION Mean
                0.816992   184.1732        1.85634904      1.00793651

Source          DF         Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1          3.50000000      3.50000000      1.02            0.3160
SITE            4          28.73015873     7.18253968      2.08            0.0884
NUMBER          20         1506.15873016   75.30793651     21.85           0.0001

Source          DF         Type III SS     Mean Square     F Value         Pr > F
SUPPRESS        0          0.00000000      .               .               .
SITE            4          28.73015873     7.18253968      2.08            0.0884
NUMBER          20         1506.15873016   75.30793651     21.85           0.0001

       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 3.446032
       Critical Value of Studentized Range= 2.806
       Minimum Significant Difference= 0.6562
       Means with the same letter are not significantly different.

Tukey Grouping     Mean       N       SUPPRESS
A                  1.1746     63      2
A                  0.8413     63      1
```

```
       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 3.446032
       Critical Value of Studentized Range= 4.109
       Minimum Significant Difference= 1.6646

       Means with the same letter are not significantly different.
Tukey Grouping     Mean       N       SITE
 A                 1.9048     21      loch
 A                 1.1905     21      whit
 A                 1.1429     21      vals
 A                 0.9524     21      remi
 A                 0.4762     21      robi
 A                 0.3810     21      wend

       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 3.446032
       Critical Value of Studentized Range= 5.187
       Minimum Significant Difference= 3.9311
       Means with the same letter are not significantly different.
Tukey Grouping     Mean       N       NUMBER
A                  15.500     6       1
B                  5.667      6       2
C                  0.000      6       3
C                  0.000      6       4
C                  0.000      6       5
C                  0.000      6       6
C                  0.000      6       7
C                  0.000      6       8
C                  0.000      6       9
C                  0.000      6       10
C                  0.000      6       11
C                  0.000      6       12
C                  0.000      6       13
C                  0.000      6       14
C                  0.000      6       15
C                  0.000      6       16
C                  0.000      6       17
C                  0.000      6       18
C                  0.000      6       19
C                  0.000      6       20
C                  0.000      6       25

---------------------------------- SPECIES=pukeko -----------------------------------
```

Flock size of pukeko per site

```
       General Linear Models Procedure
       Class Level Information
       Class   Levels  Values
       SUPPRESS        2       1 2
       SITE    6       loch remi robi vals wend whit
       NUMBER  21      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25
       Number of observations in by group = 126

Dependent Variable: OCCASION
Source          DF          Sum of          Mean Square     F Value         Pr > F
                            Squares
Model           25          29.69841270     1.18793651      5.29            0.0001
Error           100         22.46031746     0.22460317
Corrected       125         52.15873016
Total
                R-Square    C.V.            Root MSE        OCCASION Mean
                0.569385    271.4287        0.47392317      0.17460317

Source          DF          Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1           0.03174603      0.03174603      0.14            0.7077
SITE            4           2.50793651      0.62698413      2.79            0.0303
NUMBER          20          27.15873016     1.35793651      6.05            0.0001

Source          DF          Type III SS     Mean Square     F Value         Pr > F
SUPPRESS        0           0.00000000      .               .               .
SITE            4           2.50793651      0.62698413      2.79            0.0303
NUMBER          20          27.15873016     1.35793651      6.05            0.0001
```

```
        Tukey's Studentized Range (HSD) Test for variable: OCCASION
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 100 MSE= 0.224603
        Critical Value of Studentized Range= 2.806
        Minimum Significant Difference= 0.1675

        Means with the same letter are not significantly different.
Tukey Grouping     Mean       N       SUPPRESS
A                  0.19048    63      1
A                  0.15873    63      2

        Tukey's Studentized Range (HSD) Test for variable: OCCASION
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 100 MSE= 0.224603
        Critical Value of Studentized Range= 4.109
        Minimum Significant Difference= 0.425

        Means with the same letter are not significantly different.
Tukey Grouping     Mean       N       SITE
 A                 0.3810     21      wend
 A                 0.3333     21      robi
 A                 0.1905     21      whit
 A                 0.0952     21      loch
 A                 0.0476     21      vals
 A                 0.0000     21      remi

        Tukey's Studentized Range (HSD) Test for variable: OCCASION
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 100 MSE= 0.224603
        Critical Value of Studentized Range= 5.187
        Minimum Significant Difference= 1.0036

        Means with the same letter are not significantly different.
Tukey Grouping     Mean       N       NUMBER
A                  2.0000     6       1
B                  0.8333     6       2
B                  0.6667     6       3
B                  0.1667     6       4
B                  0.0000     6       5
B                  0.0000     6       6
B                  0.0000     6       7
B                  0.0000     6       8
B                  0.0000     6       9
B                  0.0000     6       10
B                  0.0000     6       11
B                  0.0000     6       12
B                  0.0000     6       13
B                  0.0000     6       14
B                  0.0000     6       15
B                  0.0000     6       16
B                  0.0000     6       17
B                  0.0000     6       18
B                  0.0000     6       19
B                  0.0000     6       20
B                  0.0000     6       25
```

---------- SPECIES=kingfish ----------

Flock size of kingfishers per site

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SUPPRESS	2	1 2
SITE	6	loch remi robi vals wend whit
NUMBER	21	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25

Number of observations in by group = 126

Dependent Variable: OCCASION

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	25	6220.50793651	248.82031746	95.17	0.0001
Error	100	261.46031746	2.61460317		
Corrected Total	125	6481.96825397			

R-Square	C.V.	Root MSE	OCCASION Mean
0.959663	76.02189	1.61697346	2.12698413

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SUPPRESS	1	4.57142857	4.57142857	1.75	0.1891
SITE	4	31.96825397	7.99206349	3.06	0.0202
NUMBER	20	6183.96825397	309.19841270	118.26	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SUPPRESS	0	0.00000000	.	.	.
SITE	4	31.96825397	7.99206349	3.06	0.0202
NUMBER	20	6183.96825397	309.19841270	118.26	0.0001

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 100 MSE= 2.614603
Critical Value of Studentized Range= 2.806
Minimum Significant Difference= 0.5716

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SUPPRESS
A	2.3175	63	1
A	1.9365	63	2

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 100 MSE= 2.614603
Critical Value of Studentized Range= 4.109
Minimum Significant Difference= 1.45

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SITE
A	3.1429	21	wend
B A	2.3810	21	loch
B A	2.1905	21	whit
B A	1.8571	21	robi
B	1.6190	21	remi
B	1.5714	21	vals

```
       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 2.614603
       Critical Value of Studentized Range= 5.187
       Minimum Significant Difference= 3.4242

       Means with the same letter are not significantly different.
Tukey Grouping     Mean      N      NUMBER
A                  32.0000   6      1
B                  9.8333    6      2
C                  2.1667    6      3
C                  0.5000    6      4
C                  0.1667    6      5
C                  0.0000    6      6
C                  0.0000    6      7
C                  0.0000    6      8
C                  0.0000    6      9
C                  0.0000    6      10
C                  0.0000    6      11
C                  0.0000    6      12
C                  0.0000    6      13
C                  0.0000    6      14
C                  0.0000    6      15
C                  0.0000    6      16
C                  0.0000    6      17
C                  0.0000    6      18
C                  0.0000    6      19
C                  0.0000    6      20
C                  0.0000    6      25

---------------------------------- SPECIES=warbler ----------------------------------
```

Flock size of warblers per site

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       loch remi robi vals wend whit
       NUMBER         21      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25
       Number of observations in by group = 126

Dependent Variable: OCCASION
Source          DF        Sum of Squares  Mean Square     F Value         Pr > F
Model           25        45278.53174603  1811.14126984   36.73           0.0001
Error           100       4930.46031746   49.30460317
Corrected       125       50208.99206349
Total
                R-Square  C.V.            Root MSE        OCCASION
                                                          Mean
                0.901801  129.1587        7.02172366      5.43650794

Source          DF        Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1         0.38888889      0.38888889      0.01            0.9294
SITE            4         459.65079365    114.91269841    2.33            0.0611
NUMBER          20        44818.49206349  2240.92460317   45.45           0.0001

Source          DF        Type III SS     Mean Square     F Value         Pr > F
SUPPRESS        0         0.00000000      .               .               .
SITE            4         459.65079365    114.91269841    2.33            0.0611
NUMBER          20        44818.49206349  2240.92460317   45.45           0.0001
```

```
        Tukey's Studentized Range (HSD) Test for variable: OCCASION
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 100 MSE= 49.3046
        Critical Value of Studentized Range= 2.806
        Minimum Significant Difference= 2.4821

        Means with the same letter are not significantly different.
Tukey Grouping     Mean     N        SUPPRESS
A                  5.492    63       2
A                  5.381    63       1

        Tukey's Studentized Range (HSD) Test for variable: OCCASION
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 100 MSE= 49.3046
        Critical Value of Studentized Range= 4.109
        Minimum Significant Difference= 6.2966

        Means with the same letter are not significantly different.
Tukey Grouping     Mean     N        SITE
 A                 8.000    21       wend
 A                 6.857    21       vals
 A                 6.667    21       loch
 A                 5.048    21       remi
 A                 3.095    21       whit
 A                 2.952    21       robi

        Tukey's Studentized Range (HSD) Test for variable: OCCASION
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 100 MSE= 49.3046
        Critical Value of Studentized Range= 5.187
        Minimum Significant Difference= 14.87

        Means with the same letter are not significantly different.
Tukey Grouping     Mean     N        NUMBER
A                  87.000   6        1
B                  22.500   6        2
C                  3.833    6        3
C                  0.667    6        4
C                  0.167    6        5
C                  0.000    6        6
C                  0.000    6        7
C                  0.000    6        8
C                  0.000    6        9
C                  0.000    6        10
C                  0.000    6        11
C                  0.000    6        12
C                  0.000    6        13
C                  0.000    6        14
C                  0.000    6        15
C                  0.000    6        16
C                  0.000    6        17
C                  0.000    6        18
C                  0.000    6        19
C                  0.000    6        20
C                  0.000    6        25
```

---------- SPECIES=fantail ----------

Flock size of fantails per site

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SUPPRESS	2	1 2
SITE	6	loch remi robi vals wend whit
NUMBER	21	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25

Number of observations in by group = 126

Dependent Variable: OCCASION (fantails)

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	25	45985.64285714	1839.42571429	35.07	0.0001
Error	100	5245.28571429	52.45285714		
Corrected Total	125	51230.92857143			

R-Square	C.V.	Root MSE	OCCASION Mean
0.897615	114.7858	7.24243448	6.30952381

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SUPPRESS	1	68.64285714	68.64285714	1.31	0.2554
SITE	4	889.90476190	222.47619048	4.24	0.0033
NUMBER	20	45027.09523810	2251.35476190	42.92	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SUPPRESS	0	0.00000000	.	.	.
SITE	4	889.90476190	222.47619048	4.24	0.0033
NUMBER	20	45027.09523810	2251.35476190	42.92	0.0001

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 100 MSE= 52.45286
Critical Value of Studentized Range= 2.806
Minimum Significant Difference= 2.5601

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SUPPRESS
A	7.048	63	1
A	5.571	63	2

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 100 MSE= 52.45286
Critical Value of Studentized Range= 4.109
Minimum Significant Difference= 6.4945

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SITE
A	12.095	21	wend
B A	6.857	21	loch
B A	5.762	21	vals
B	4.905	21	remi
B	4.143	21	whit
B	4.095	21	robi

```
       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 52.45286
       Critical Value of Studentized Range= 5.187
       Minimum Significant Difference= 15.337

       Means with the same letter are not significantly different.
Tukey Grouping     Mean     N       NUMBER
A                  84.667   6       1
B                  32.667   6       2
C                  9.667    6       3
C                  3.167    6       4
C                  1.000    6       5
C                  0.500    6       6
C                  0.333    6       9
C                  0.333    6       8
C                  0.167    6       7
C                  0.000    6       10
C                  0.000    6       11
C                  0.000    6       12
C                  0.000    6       13
C                  0.000    6       14
C                  0.000    6       15
C                  0.000    6       16
C                  0.000    6       17
C                  0.000    6       18
C                  0.000    6       19
C                  0.000    6       20
C                  0.000    6       25

--------------------------------- SPECIES=finches ---------------------------------
```

Flock size of finches per site

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       loch remi robi vals wend whit
       NUMBER         21      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25
       Number of observations in by group = 126

Dependent Variable: OCCASION
Source          DF         Sum of          Mean Square     F Value         Pr > F
                           Squares
Model           25         1855.52380952   74.22095238     35.65           0.0001
Error           100        208.19047619    2.08190476
Corrected       125        2063.71428571
Total
                R-Square   C.V.            Root MSE        OCCASION Mean
                0.899119   104.4845        1.44288072      1.38095238

Source          DF         Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1          15.36507937     15.36507937     7.38            0.0078
SITE            4          19.11111111     4.77777778      2.29            0.0645
NUMBER          20         1821.04761905   91.05238095     43.74           0.0001

Source          DF         Type III SS     Mean Square     F Value         Pr > F
SUPPRESS        0          0.00000000      .               .               .
SITE            4          19.11111111     4.77777778      2.29            0.0645
NUMBER          20         1821.04761905   91.05238095     43.74           0.0001

       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 2.081905
       Critical Value of Studentized Range= 2.806
       Minimum Significant Difference= 0.51

       Means with the same letter are not significantly different.
Tukey Grouping     Mean     N         SUPPRESS
A                  1.7302   63        1
B                  1.0317   63        2
```

```
       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 2.081905
       Critical Value of Studentized Range= 4.109
       Minimum Significant Difference= 1.2939

       Means with the same letter are not significantly different.
Tukey Grouping             Mean     N        SITE
               A           2.4762   21       wend
B              A           1.4762   21       remi
B              A           1.2381   21       whit
B                          1.1429   21       robi
B                          1.0952   21       loch
B                          0.8571   21       vals

       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 2.081905
       Critical Value of Studentized Range= 5.187
       Minimum Significant Difference= 3.0555
       Means with the same letter are not significantly different.
Tukey          Mean         N        NUMBER
Grouping
A              17.0000      6        1
B              5.5000       6        3
B              4.8333       6        2
C              0.8333       6        4
C              0.3333       6        5
C              0.3333       6        6
C              0.1667       6        9
C              0.0000       6        8
C              0.0000       6        7
C              0.0000       6        10
C              0.0000       6        11
C              0.0000       6        12
C              0.0000       6        13
C              0.0000       6        14
C              0.0000       6        15
C              0.0000       6        16
C              0.0000       6        17
C              0.0000       6        18
C              0.0000       6        19
C              0.0000       6        20
C              0.0000       6        25
---------------------------------- SPECIES=magpie ----------------------------------
```

Flock size of magpies per site

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       loch remi robi vals wend whit
       NUMBER         21      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25
       Number of observations in by group = 147

Dependent Variable: OCCASION
Source          DF         Sum of          Mean Square     F Value         Pr > F
                           Squares
Model           25         1519.71428571   60.78857143     4.27            0.0001
Error           121        1722.95238095   14.23927588
Corrected       146        3242.66666667
Total
                R-Square   C.V.            Root MSE        OCCASION Mean
                0.468662   344.5366        3.77349651      1.09523810

Source          DF         Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1          61.36111111     61.36111111     4.31            0.0400
SITE            4          204.25793651    51.06448413     3.59            0.0084
NUMBER          20         1254.09523810   62.70476190     4.40            0.0001

Source          DF         Type III SS     Mean Square     F Value         Pr > F
SUPPRESS        0          0.00000000      .               .               .
SITE            4          204.25793651    51.06448413     3.59            0.0084
NUMBER          20         1254.09523810   62.70476190     4.40            0.0001
```

```
        Tukey's Studentized Range (HSD) Test for variable: OCCASION
        NOTE: This test controls the type I experimentwise error rate, but
        generally has a higher type II error rate than REGWQ.
        Alpha= 0.05    df= 121 MSE= 14.23928
        Critical Value of Studentized Range= 2.800
        Minimum Significant Difference= 1.2451
        WARNING: Cell sizes are not equal.
        Harmonic Mean of cell sizes= 72

        Means with the same letter are not significantly different.
Tukey Grouping     Mean     N        SUPPRESS
A                  1.8413   63       2
B                  0.5357   84       1

        Tukey's Studentized Range (HSD) Test for variable: OCCASION
        NOTE: This test controls the type I experimentwise error rate.
        Alpha= 0.05    Confidence= 0.95       df= 121 MSE= 14.23928
        Critical Value of Studentized Range= 4.095
        Comparisons significant at the 0.05 level are indicated by '***'.
               Simultaneous                 Simultaneous
               Lower          Difference    Upper
SITE           Confidence     Between       Confidence
Comparison     Limit          Means         Limit
vals - remi    -0.8962        2.4762        5.8486
vals - loch    0.0562         3.4286        6.8009        ***
vals - robi    0.1038         3.4762        6.8486        ***
vals - wend    0.3895         3.7619        7.1343        ***
vals - whit    1.1747         4.0952        7.0158        ***

remi - vals    -5.8486        -2.4762       0.8962
remi - loch    -2.4200        0.9524        4.3247
remi - robi    -2.3724        1.0000        4.3724
remi - wend    -2.0867        1.2857        4.6581
remi - whit    -1.3015        1.6190        4.5396

loch - vals    -6.8009        -3.4286       -0.0562       ***
loch - remi    -4.3247        -0.9524       2.4200
loch - robi    -3.3247        0.0476        3.4200
loch - wend    -3.0390        0.3333        3.7057
loch - whit    -2.2539        0.6667        3.5872

robi - vals    -6.8486        -3.4762       -0.1038       ***
robi - remi    -4.3724        -1.0000       2.3724
robi - loch    -3.4200        -0.0476       3.3247
robi - wend    -3.0867        0.2857        3.6581
robi - whit    -2.3015        0.6190        3.5396

wend - vals    -7.1343        -3.7619       -0.3895       ***
wend - remi    -4.6581        -1.2857       2.0867
wend - loch    -3.7057        -0.3333       3.0390
wend - robi    -3.6581        -0.2857       3.0867
wend - whit    -2.5872        0.3333        3.2539

whit - vals    -7.0158        -4.0952       -1.1747       ***
whit - remi    -4.5396        -1.6190       1.3015
whit - loch    -3.5872        -0.6667       2.2539
whit - robi    -3.5396        -0.6190       2.3015
whit - wend    -3.2539        -0.3333       2.5872
```

```
       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 121 MSE= 14.23928
       Critical Value of Studentized Range= 5.163
       Minimum Significant Difference= 7.3635

       Means with the same letter are not significantly different.
Tukey Grouping    Mean      N       NUMBER
           A      11.856    6       1
B          A      7.429     6       2
B          C      2.856     6       3
B          C      0.571     6       4
B          C      0.286     6       5
           C      0.000     6       6
           C      0.000     6       7
           C      0.000     6       8
           C      0.000     6       9
           C      0.000     6       10
           C      0.000     6       11
           C      0.000     6       12
           C      0.000     6       13
           C      0.000     6       14
           C      0.000     6       15
           C      0.000     6       16
           C      0.000     6       17
           C      0.000     6       18
           C      0.000     6       19
           C      0.000     6       20
           C      0.000     6       25
---------------------------------- SPECIES=pheasant ----------------------------------
```

Flock size of pheasants per site

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       loch remi robi vals wend whit
       NUMBER         21      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25
       Number of observations in by group = 147

Dependent Variable: OCCASION
Source          DF        Sum of          Mean Square     F Value         Pr > F
                          Squares
Model           25        726.23469388    29.04938776     11.05           0.0001
Error           121       318.22789116    2.62998257
Corrected       146       1044.46258503
Total
                R-Square  C.V.            Root MSE        OCCASION Mean
                0.695319  297.9914        1.62172210      0.54421769

Source          DF        Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1         0.20464853      0.20464853      0.08            0.7808
SITE            4         23.28174603     5.82043651      2.21            0.0715
NUMBER          20        702.74829932    35.13741497     13.36           0.0001

Source          DF        Type III SS     Mean Square     F Value         Pr > F
SUPPRESS        0         0.00000000      .               .               .
SITE            4         23.28174603     5.82043651      2.21            0.0715
NUMBER          20        702.74829932    35.13741497     13.36           0.0001


       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 121 MSE= 2.629983
       Critical Value of Studentized Range= 2.800
       Minimum Significant Difference= 0.5351
       WARNING: Cell sizes are not equal.
       Harmonic Mean of cell sizes= 72
       Means with the same letter are not significantly different.

Tukey Grouping    Mean      N       SUPPRESS
A                 0.5873    63      2
A                 0.5119    84      1
```

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate.
Alpha= 0.05 Confidence= 0.95 df= 121 MSE= 2.629983
Critical Value of Studentized Range= 4.095

Comparisons significant at the 0.05 level are indicated by '***'.

SITE Comparison	Simultaneous Lower Confidence Limit	Difference Between Means	Simultaneous Upper Confidence Limit
wend - loch	-0.8779	0.5714	2.0208
wend - robi	-0.6398	0.8095	2.2589
wend - vals	-0.4493	1.0000	2.4493
wend - whit	-0.1361	1.1190	2.3742
wend - remi	-0.2112	1.2381	2.6874
loch - wend	-2.0208	-0.5714	0.8779
loch - robi	-1.2112	0.2381	1.6874
loch - vals	-1.0208	0.4286	1.8779
loch - whit	-0.7075	0.5476	1.8028
loch - remi	-0.7827	0.6667	2.1160
robi - wend	-2.2589	-0.8095	0.6398
robi - loch	-1.6874	-0.2381	1.2112
robi - vals	-1.2589	0.1905	1.6398
robi - whit	-0.9456	0.3095	1.5647
robi - remi	-1.0208	0.4286	1.8779
vals - wend	-2.4493	-1.0000	0.4493
vals - loch	-1.8779	-0.4286	1.0208
vals - robi	-1.6398	-0.1905	1.2589
vals - whit	-1.1361	0.1190	1.3742
vals - remi	-1.2112	0.2381	1.6874
whit - wend	-2.3742	-1.1190	0.1361
whit - loch	-1.8028	-0.5476	0.7075
whit - robi	-1.5647	-0.3095	0.9456
whit - vals	-1.3742	-0.1190	1.1361
whit - remi	-1.1361	0.1190	1.3742
remi - wend	-2.6874	-1.2381	0.2112
remi - loch	-2.1160	-0.6667	0.7827
remi - robi	-1.8779	-0.4286	1.0208
remi - vals	-1.6874	-0.2381	1.2112
remi - whit	-1.3742	-0.1190	1.1361

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 121 MSE= 2.629983
Critical Value of Studentized Range= 5.163
Minimum Significant Difference= 3.1646

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	NUMBER
A	10.2857	7	1
B	0.8571	7	2
B	0.2857	7	3
B	0.0000	7	4
B	0.0000	7	5
B	0.0000	7	6
B	0.0000	7	7
B	0.0000	7	8
B	0.0000	7	9
B	0.0000	7	10
B	0.0000	7	11
B	0.0000	7	12
B	0.0000	7	13
B	0.0000	7	14
B	0.0000	7	15
B	0.0000	7	16
B	0.0000	7	17
B	0.0000	7	18
B	0.0000	7	19
B	0.0000	7	20
B	0.0000	7	25

---------- SPECIES=skylark ----------

Flock size of skylarks per site

General Linear Models Procedure
Class Level Information

Class	Levels	Values
SUPPRESS	2	1 2
SITE	5	loch remi robi wend whit
NUMBER	21	1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25

Number of observations in by group = 105

Dependent Variable: OCCASION

Source	DF	Sum of Squares	Mean Square	F Value	Pr > F
Model	24	33.77142857	1.40714286	5.01	0.0001
Error	80	22.47619048	0.28095238		
Corrected Total	104	56.24761905			

R-Square	C.V.	Root MSE	OCCASION Mean
0.600406	327.3835	0.53004941	0.16190476

Source	DF	Type I SS	Mean Square	F Value	Pr > F
SUPPRESS	1	0.05714286	0.05714286	0.20	0.6532
SITE	3	0.66666667	0.22222222	0.79	0.5025
NUMBER	20	33.04761905	1.65238095	5.88	0.0001

Source	DF	Type III SS	Mean Square	F Value	Pr > F
SUPPRESS	0	0.00000000	.	.	.
SITE	3	0.66666667	0.22222222	0.79	0.5025
NUMBER	20	33.04761905	1.65238095	5.88	0.0001

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 80 MSE= 0.280952
Critical Value of Studentized Range= 2.814
Minimum Significant Difference= 0.2101
WARNING: Cell sizes are not equal.
Harmonic Mean of cell sizes= 50.4

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SUPPRESS
A	0.1905	42	2
A	0.1429	63	1

Tukey's Studentized Range (HSD) Test for variable: OCCASION
NOTE: This test controls the type I experimentwise error rate, but generally has a higher type II error rate than REGWQ.
Alpha= 0.05 df= 80 MSE= 0.280952
Critical Value of Studentized Range= 3.947
Minimum Significant Difference= 0.4565

Means with the same letter are not significantly different.

Tukey Grouping	Mean	N	SITE
A	0.2857	21	loch
A	0.2381	21	remi
A	0.0952	21	robi
A	0.0952	21	wend
A	0.0952	21	whit

```
       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 80  MSE= 0.280952
       Critical Value of Studentized Range= 5.222
       Minimum Significant Difference= 1.2379

       Means with the same letter are not significantly different.
Tukey Grouping     Mean     N         NUMBER
A                  2.6000   5         1
B                  0.6000   5         2
B                  0.2000   5         3
B                  0.0000   5         4
B                  0.0000   5         5
B                  0.0000   5         6
B                  0.0000   5         7
B                  0.0000   5         8
B                  0.0000   5         9
B                  0.0000   5         10
B                  0.0000   5         11
B                  0.0000   5         12
B                  0.0000   5         13
B                  0.0000   5         14
B                  0.0000   5         15
B                  0.0000   5         16
B                  0.0000   5         17
B                  0.0000   5         18
B                  0.0000   5         19
B                  0.0000   5         20
B                  0.0000   5         25

--------------------------------- SPECIES=swallow ---------------------------------
```

Flock size of swallows per site

```
       General Linear Models Procedure
       Class Level Information
       Class          Levels  Values
       SUPPRESS       2       1 2
       SITE           6       loch remi robi vals wend whit
       NUMBER         21      1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 25
       Number of observations in by group = 126

Dependent Variable: OCCASION
Source          DF         Sum of          Mean Square     F Value         Pr > F
                           Squares
Model           25         179.65079365    7.18603175      3.05            0.0001
Error           100        235.65079365    2.35650794
Corrected       125        415.30158730
Total
                R-Square   C.V.            Root MSE        OCCASION Mean
                0.432579   333.4855        1.53509216      0.46031746

Source          DF         Type I SS       Mean Square     F Value         Pr > F
SUPPRESS        1          11.46031746     11.46031746     4.86            0.0297
SITE            4          38.22222222     9.55555556      4.05            0.0043
NUMBER          20         129.96825397    6.49841270      2.76            0.0005

Source          DF         Type III SS     Mean Square     F Value         Pr > F
SUPPRESS        0          0.00000000      .               .               .
SITE            4          38.22222222     9.55555556      4.05            0.0043
NUMBER          20         129.96825397    6.49841270      2.76            0.0005

       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 2.356508
       Critical Value of Studentized Range= 2.806
       Minimum Significant Difference= 0.5426

       Means with the same letter are not significantly different.
Tukey Grouping     Mean     N       SUPPRESS
A                  0.7619   63      1
B                  0.1587   63      2
```

```
       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 2.356508
       Critical Value of Studentized Range= 4.109
       Minimum Significant Difference= 1.3766

       Means with the same letter are not significantly different.
Tukey Grouping     Mean     N       SITE
 A                 1.8571   21      wend
 B                 0.2381   21      whit
 B                 0.2381   21      loch
 B                 0.1905   21      vals
 B                 0.1905   21      remi
 B                 0.0476   21      robi

       Tukey's Studentized Range (HSD) Test for variable: OCCASION
       NOTE: This test controls the type I experimentwise error rate, but
       generally has a higher type II error rate than REGWQ.
       Alpha= 0.05    df= 100 MSE= 2.356508
       Critical Value of Studentized Range= 5.187
       Minimum Significant Difference= 3.2508

       Means with the same letter are not significantly different.
Tukey Grouping    Mean    N        NUMBER
           A      3.8333  6        2
B          A      2.8333  6        1
B          A      1.5000  6        3
B          A      1.0000  6        4
B                 0.3333  6        8
B                 0.1667  6        12
B                 0.0000  6        5
B                 0.0000  6        7
B                 0.0000  6        9
B                 0.0000  6        6
B                 0.0000  6        11
B                 0.0000  6        10
B                 0.0000  6        13
B                 0.0000  6        14
B                 0.0000  6        15
B                 0.0000  6        16
B                 0.0000  6        17
B                 0.0000  6        18
B                 0.0000  6        19
B                 0.0000  6        20
B                 0.0000  6        25
```

Appendix 8.1: Some key references used in the construction of the food web

Allen, R. B., Lee, W. G. and Rance, B. D. (1994). "Regeneration in indigenous forest after eradication of Norway rats, Breaksea Island, New-Zealand." New Zealand Journal of Botany 32(4): 429-439.

Atkinson, R. (1993). "Killing the kereru." Forest and Bird 267: 18-23.

Berry, C. (1999). Potential interactions of hedgehogs with North Island kiwi at Boundary Stream Mainland Island. Wellington, Department of Conservation: 1-22.

Brockie, R. (1992). A living New Zealand forest. Auckland, David Bateman.

Campbell, D. J. (1990). "Changes in the structure and compostition of a New Zealand lowland forest induced by brushtail possums." Pacific Science 44: 277-296.

Clout, M. N. (1988). "Kereru hunting." Forest and Bird 19(3): 9.

Craddock, P. (1997). The effect of rodent control on invertebrate communities in coastal forest near Auckland. Zoology Department. Auckland, University of Auckland: 132 + appendices.

Efford, M. (2000). Possum density, population structure, and dynamics. The brushtail possum Biology, impact and management of an introduced marsupial. Montague, T. L. Lincoln, Manaaki Whenua Press: 47-61.

Fitzgerald, A. E. (1984). Diet overlap between kokako and the common brushtail possum in central North Island, New Zealand. Possums and Gliders. Smith, A. P. and Hume, I. D. Chipping Norton, N.S.W., Surrey Beatty & Sons and Australian Mammal Society: 569-573.

Halkett, J. C. (1985). "Present status of the Kokako and implications for forest management." New Zealand Journal of Forestry 30(2): 199 -208.

Hendra, R. (1999). Seasonal abundance patterns and dietary preferences of hedgehogs at Trounson Kauri Park. Wellington, Department of Conservation: 1-12.

Hutcheson, J., Walsh, P. and Given, D. (1999). Potential value of indicator species for conservation and management of New Zealand terrestrial communities. Wellington, Department of Conservation.

Innes, J., Calder, B. and Williams, D. (1991a). "Native meets exotic - kokako and pine forest." What's New in Forest Research(209).

Innes, J. G., Williams, D. S. and Shorten, R. M. (1991b). North Island kokako - struggling to breed, Forest Research Institute.

Leathwick, J. R., Hay, J. R. and Fitzgerald, A. E. (1983). "The influence of browsing by introduced mammals on the decline of North Island kokako." NZ journal of ecology 6: 55-70.

Nugent, G., Sweetapple, P., Coleman, J. and Suisted, P. (2000). Possum feeding patterns: dietary tactics of a reluctant folivore. The brushtail possum Biology, impact and management of an introduced marsupial. Montague, T. L. Lincoln, Manaaki Whenua Press: 10-19.

Park, G. N. (2000). New Zealand as ecosystems: the ecosystem concept as a tool for environmental management and conservation. Wellington, New Zealand, Department of Conservation.

Payton, I. J., Pekelharing, C. J. and Frampton, C. M. (1997). Foliar Browse Index: A method fof monitoring possum damage to forest and rare or endangered plant species, Landcare Research.

Payton, I. J., Pekelharing, C. J. and Frampton, C. M. (1999). Foliar Browse Index: A method for monitoring possum (*Trichosurus vulpecula*) damage to plant species and forest communities. Lincoln, Manaaki Whenua - Landcare Research: 62.

Powlesland, R. G. (1987). "The foods, foraging behaviour and habitat use of North Island Kokako in Puketi State Forest, Northland." New Zealand Journal of Ecology 10: 117-128.

Rogers, G. M. and Leathwick, J. R. (1997). "Factors predisposing forests to canopy collapse in the Southern Ruahine Range, New Zealand." Biological Conservation 80: 325-338.

Thomas, M. D., Hickling, G. J., Coleman, J. D. and Pracy, L. T. (1993). "Long-term trends in possum numbers at Pararaki: evidence of an irruptive fluctuation." New Zealand Journal of Ecology 17(1): 29-34.

Towns, D. R., Simberloff, D. and Atkinson, I. A. E. (1997). "Restoration of New Zealand islands: redressing the effects of introduced species." Pacific Conservation Biology 3: 99-124.

Appendix 7.1 Exercise in assessing community importance values and assigning keystone status.

This section describes an attempt to generate community-importance values in a more qualitative manner by assigning arbitrary constant values to links between functional groups. These community values were then used to in combination with biomass estimates to gauge whether a species or functional group was a keystone species or not.

Calculating Community Importance values.
It was assumed that the impact of removing a species or functional group on directly connected groups (i.e. linked directly by an arrow) could either be large or indirect/partial. For instance, kereru was the only species capable of dispersing large seeds intact and therefore the removal of kereru would have a large effect on this process. Several other birds can disperse smaller fruits thus the removal of kereru would only partially affect small seed dispersal. The decision to assign a large or indirect/partial effect was based on the literature, the structure of the food-web, and common sense.

A second assumption was that any subsequent linkages would not, initially, be affected to the same degree as those first functional groups. Lack of seed deposition would greatly, and almost immediately, affect seedling recruitment, but the effects on sapling recruitment would not be seen for a while since there still was a cohort of previous seedling to grow into saplings. A similar logic was applied to all other links presented in the food-web. It was arbitrarily decided that subsequent linkages had only half the value of the initial, or prior, linkage.

The importance values were generated as follows. A value of 1 was assigned to each processes, or functional group, that would be directly or greatly affected by the removal of a species (or functional group) and a value of ½ when processes or functional groups are indirectly or partially affected. Subsequent links are assigned half the value of the previous link, unless some other shorter route has already assigned a greater value to that functional group. If the change results in a decrease in biodiversity or biomass the assigned value is negative. If the removal of a species (or functional group) results, or could potentially result, in an increase in biomass or biodiversity the assigned value is positive. The removal of a functional group can result in positive values in one part of the food-web, and negative values in another part. The values assigned to each link are summed to give the community importance value for that species or functional group.

For instance, the removal of kereru would significantly disrupt the dispersal of large-fruits (-1), partially disrupt the dispersal of small-fruited species (-½), both of which would affect seed deposition(-½), seedling recruitment (-¼), sapling recruitment (-1/8), and recruitment of trees and shrubs (-1/16) in to the canopy. Soil and leaf litter processes would be affected by the loss of seed deposition (-½) and functional groups relying on soil processes (invertebrates) would subsequently be affected (-¼). Functional groups relying on seedlings (possum, rodents, goats/deer/pigs) would be affect by reduction in seedling recruitment (-1/8 each) and those that include invertebrates as a major component of their diets (cats/mustelieds, hedghogs, reptiles) would notice the loss of that resource (-1/8 each). The eventual reduction in seed producing species could affect fruit consuming-birds (-1/32 each) which in turn are preyed on by predatory birds (-1/64). Thus the community-importance score for kereru becomes minus 3.77, because overall the removal of kereru would impact negatively on forest ecosystem processes.

The same process was used for all other functional groups. The logic for each functional group are presented in below and in (excel spreadsheet ???) and Figure 7.4.

The removal of possums would directly improve the condition of trees and shrubs (+1), the amount of large and small fruits available (+2), the number of seedlings, saplings, invertebrates, and birds (+6). Possums also indirectly affect rodent populations (+½) and through the vegetation process would subsequently affect all species reliant on the maintenance of the forest ecosystem (9 x ¼). Total score +11.75.

Removal of rodents would directly increase the amount of small fruits available (+1), the number of seedlings, invertebrates, reptiles and birds (+6). Rodents also partially affect the number of viable large seed and leaflitter processes (2 x +½) and through the vegetation process would subsequently affect invertebrates, hedgehogs, goats (etc), trees and shrubs (forest composition) and the bird functional groups (7 x ¼). Total score +9.75.

Removal of cats and mustelids would directly increase the number of invertebrates, rodents, reptiles and birds (+6), no indirect effects, but subsequent lack of seed deposition by birds and reptiles could change forest composition (5 x ¼). Total score 7.25.

Removal of invertebrates would reduce the soil processes (-1) which would subsequently affect seedling, sapling and forest canopy processes (3 x -¼). Removal of invertebrates would reduce the amount of food available to reptiles, hedgehogs, and

rodents (-3), and partially affect birds cats and possums (4 x –½). Removal of invertebrates could see an improvement in browse of trees and shrubs and less predation of large and small fruits (3 x ¼). Total score –6.00

Removal of hedgehogs would improve soil processes and number of invertebrates (+2) and might partially affect ground nesting birds and low stature vegetation (2 x +½). Subsequent effects would be more invertebrates available for reptiles, birds, rodents, cats and possums (6 x +¼). Total score 4.5.

Goat deer and pigs, directly impact on seedlings, saplings, shrubs and trees (+3), this has subsequent effects all other species that rely directly on a forest canopy (8 x ¼). Total score 5.

Removal of bird seed predators would partially result in greater numbers of unpredated large fruit (+½) and could have effects on invertebrate numbers and large seed deposition (2 x +¼) However there could also be a loss in small seed deposition and an increase in destructive invertebrates but probably not significantly so. Total score 1

Removal of small seed eaters would result in a partial loss of small seed deposition (-½) and could affect invertebrate numbers (+¼), Total score –0.25.

Reptiles – would affect the number of invertebrates (+1) partially affect small fruit deposition (-½), and through the invertebrates the soil processes, but not sure whether positive or negative. Total score +0.25

Not sure that the removal of predatory birds would affect any of the processes greatly – total score =0

The removal of any of the forest vegetation processes (other than large and small fruits) would have

The removal of seed deposition would have a direct effect on seedling recruitment (-1) which would in turn affect goats (etc) hedgehogs, invertebrates, rodents, possum (5 x –½), and affect recruitment of saplings, trees and shrubs and soil processes (3 x –½) and all species that rely on the forest ecosystem (11 x –¼). Total score –7.75.

The removal of seedlings would have a direct effect on sapling recruitment and affect goats (etc) hedgehogs, invertebrates, rodents, possum (-6). Lack of seedling would subsequently affect recruitment of trees and shrubs (1 x –½) and all species that rely on the forest ecosystem (11 x –¼). Total score –9.25.

The removal of saplings would have a direct effect on goats, invertebrates and possums and the recruitment of trees and shrubs (-4) which would in turn affect all species that rely on the forest ecosystem (12 x –½) and all other vegetation processes (5 x –¼). Total score –11.25

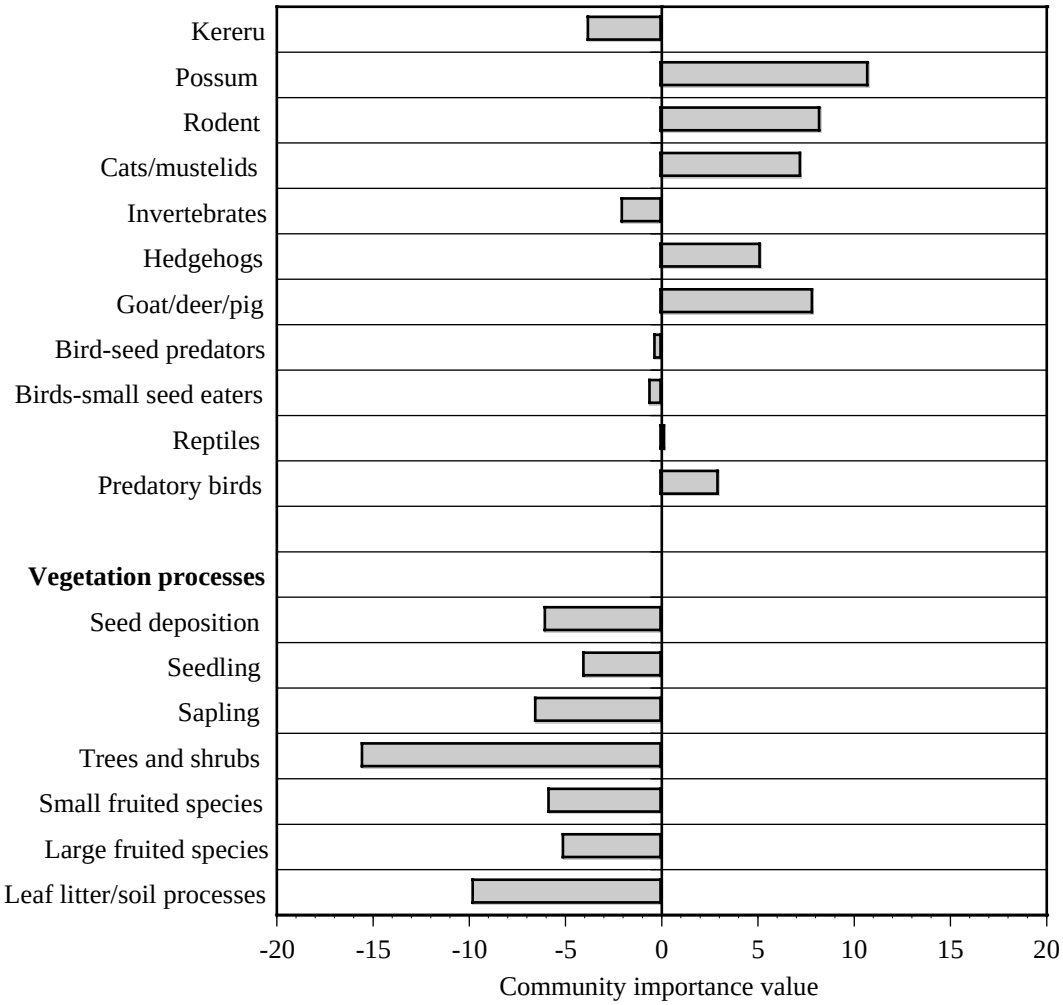
The removal of trees and shrubs would affect all species and processes directly –17

The removal of small fruits would directly impact birds, reptiles, rodents and seed deposition (-5) and partially affect possums, kereru, invertebrates, leaflitter processes and seedling recruitment (5 x –½). Lack of regeneration of small-fruited species would eventually cause loss of saplings and cause drastic changes in tree and shrub abundance (2 x –¼). Total score –8.5 (small fruited species are mostly subcanopy but there are a few significant canopy trees, especially the podocarp species)

The removal of large fruits would directly impact kereru, possums, seed deposition (-3) and partially affect rodents, bird seed predators, invertebrates, leaflitter processes and seedling recruitment (5 x –½). Lack of regeneration of large-fruited species would eventually cause loss of saplings and cause drastic changes in tree and shrub abundance (2 x –¼)

Figure A7.1: Hypothetical community-importance value calculated by considering the effect of removing a particular functional group from the food-web (Figure 7.1)

Positive values indicate that the biodiversity and/or biomass in the ecosystem improves when that functional group is removed, negative values indicate deterioration in the ecosystem processes.



The greatest hypothetical importance value occurred when trees and shrubs were removed, since nearly all other species would be directly and greatly impacted by the loss of all vegetative cover. Leaf litter and soil processes were the next most important functional group in the food-web. There is little difference in the community-importance values for the remaining vegetative processes.

Two native functional groups contribute in a largely positive way to maintaining the biodiversity and/or biomass of this hypothetical forest ecosystem since their removal resulted in negative community-importance values. Kereru makes the greatest positive contribution to the forest ecosystem food-web since it contributes positively to maintaining the forest canopy by seed dispersal, but does not significantly reduce the resources available to other species.

The invertebrate functional group makes the next most important contribution and it could be that the importance of this group has been under-emphasised in the analysis, since this group is composed of many different species fulfilling many different roles. However, these varied roles can contribute both in negative and positive ways to ecosystem functioning. For instance, insects can be significant agents of defoliation with subsequent reduced fruit and seedling output (A. Dijkgraaf pers. obs. of karaka) and yet the action of worms is vital to maintaining and enhancing soil processes. Thus on balance the relative contribution of invertebrates to the system is positive, but tempered by the negative contribution of some of its species.

Introduced mammalian species tend to make a negative contribution to this system, and the forest ecosystem processes would benefit from their removal. The relative importance values of these species tends to be greater than most vegetative processes, perhaps indicating or reflecting that forest processes are undermined in the presence of these groups. The forest benefits the most from the removal of possums, followed by rodents, the goat functional group and cats/mustelids. Towns

et al. [, 1997 #2456] also indicated that all of these introduced mammals are keystone species, as indicated by the results of their introduction or removal from a system.

Figure A7.1 illustrates the relative importance of each functional group in the hypothetical food web, but this analysis did not achieve the highly skewed distribution, with only a few species having large values, as postulated by Mills *et al.* [, 1993 #2432]. This probably reflects the effect of the introduced mammalian species on the functioning of the forest ecosystem and possibly indicates that many of these systems have not yet reach an equilibrium (potentially at a considerably lower level of biodiversity) with the introduced mammals.

It seems likely that the inclusion of introduced mammals in the analysis obscures the importance of some of the native species. However, omitting the introduced mammals from the analysis of present day forest ecosystems is non-sensical. It seems probable that the importance of the mammals will be lessened as the vulnerable components in the system are eliminated or reduced. If this analysis had been restricted to, for instance, the forests of the southern Ruahine Range which have undergone a remarkable degree of canopy collapse through a combination of possum and deer browse [Rogers, 1997 #661], then the importance and impact of possums and deer would be greatly reduced, compared to this more general analysis, since most vulnerable species are reduced or absent altogether. Similarly, if this analysis was restricted to forests of the lower South Island, where miro (Prumnopytis ferruginea) is the only large fruited species, the importance of kereru would be lessened.

If the direction of the overall contribution is considered then kereru and invertebrates would be keystone groups contributing positively to the forest ecosystem, but selecting amongst the detractors for forest processes remains problematical.

Perhaps another way of gauging which species, or functional groups, are keystone species is to determine which of them affected or changed more than half the community. The maximum community-importance value was 15.5 for the removal of trees and shrubs. Perhaps any species achieving an importance value greater than 50% of the maximum value could be considered to be a keystone species. In that case possums (69%), leaf litter and soil process (63%), rodents (53%) and goat/ deer/ pig (51%) are keystone species.

Biomass of species or functional groups.
It is possible to estimate the ‘typical’ abundance (as biomass per hectare) for most species and functional groups in a ‘typical’ New Zealand forest from the literature. The values presented in Table A7.1 are estimates compiled from different sources and include a whole range of different forest types, thus they should be treated with caution. It is hoped that the values are accurate to within an order of magnitude of the real values, should these be available for a northern New Zealand lowland hardwood-podocarp forest.

Table A7.1: Biomass estimates for species and functional groups featured in Figure 7.1.

Species/ functional group	Averagen umber/ha	Average Weight (kg)	Biomass (kg)/ ha of forest	Source(s)
Kereru	2	0.65	1.3	(Clout, 1990)
Possum	7	2.54	27.94	[This study \Cowan, 1998 #2275]
Rodent			0.671	
Norway rats	0.75	0.215	0.162	[This study \Moors, 1998 #2277;Bettesworth, 1972 #2284]
Ship rats	3.26	0.140	0.456	[This study \Innes, 1998 #2278].
Mice	2.5	0.021	0.053	[references in \Murphy, 1998 #2279], pers comm. C. Gillies & N. Marsh
Cats/ mustelids (total)			0.059	
Cats	0.0175	3.11	0.054	[Gillies, 1998 #2450; Fitzgerald, 1990 #2469]
Stoats	0.0175	0.270	0.005	Assume comparable homerange = comparable density from data in [Gillies, 1998 #2450]
Invertebrates			478	[Brockie, 1992 #2370]
Hedgehogs	4	0.684	2.736	[Brockie, 1990 #2468; Berry, 1999 #2435]
Goat/ deer/ pig (total)			11.066	
Goat	0.11	35.5	3.905	[Stronge, 2000 #2467]
Red deer	0.06	58.3	3.498	[Challies, 1990 #2471; Nugent, Unpublished manuscript #2444]
Pig	0.037	99	3.663	[McIlroy, 1990 #2470] density estimate for northern forest 1/10 of McIlroy density
Bird-seed predators (total)			0.238	
Kaka	0.04	0.450	0.018	Abundance this study, body weight (refs Mick to insert)
Rosella	2	0.110	0.220	Abundance this study, body weight (refs Mick to insert)
Birds-small seed eaters (total)			0.8062	
Tui	2	0.100	0.2	Abundance this study, body weight (refs Mick to insert)
Blackbird	1.5	0.090	0.135	Abundance this study [Brockie, 1992 #2370], body weight (refs Mick to insert)
Thrush	1	0.070	0.14	Abundance this study [Brockie, 1992 #2370], body weight (refs Mick to insert))
Myhna	2	0.125	0.25	Abundance this study, body weight (refs Mick to insert)
Silvereye	3	0.013g	0.039	Abundance this study [Brockie, 1992 #2370], body weight (refs Mick to insert)
Finch (green & chaffinch)	2	0.025	0.010	Abundance this study [Brockie, 1992 #2370], body weight (refs Mick to insert)
Fantail	2	0.008	0.016	Abundance this study [Brockie, 1992 #2370], body weight (refs Mick to insert)
Warbler	2.5	0.0065	0.0162	Abundance this study [Brockie, 1992 #2370], body weight (refs Mick to insert)
Predatory birds			0.2	
Morepork	11	0.170	0.170	Abundance this study [Brockie, 1992 #2370], body weight (refs Mick to insert)
Harrier	0.04	0.750	0.03	Abundance this study [Brockie, 1992 #2370], body weight (refs Mick to insert)
Reptiles			0.6	[Brockie, 1992 #2370]
Seedling			158.4	[Estimated from \Nugent, Unpublished manuscript #2444]
Sapling			129.6	[Estimated from \Nugent, Unpublished manuscript #2444]
Trees and shrubs			5000	[Nugent, Unpublished manuscript #2444]
Small fruited species			0.649	This study
Large fruited species			0.028	This study
Leaf litter/ soil process			500	Assumed to be at least as abundant as invertebrates

Abundance data for birds was generated from observations for forest patches around Auckland (mainly Whitford Bush, Wenderholm Regional Park and Remiger's Bush) and was checked for realism by comparison with the data obtained in the Orongorongo Valley and elsewhere [Brockie, 1992 #2370]. Brockie [, 1992 #2370] indicates that bird numbers tended to be higher (nearly double) in northern tawa forests, compared to the Orongorongo study. The Auckland forests are rich in

tawa and a number of other fruiting species not found in the Orongorongo Valley, thus generally double the Orongorongo Valley value was used for the relevant bird species. This, and the fact that the three forest patches used around Auckland all had possum control, has probably caused the abundance of some bird species to be overestimated somewhat. However, the number of birds per hectare are likely to be correct to within less than an order of magnitude.

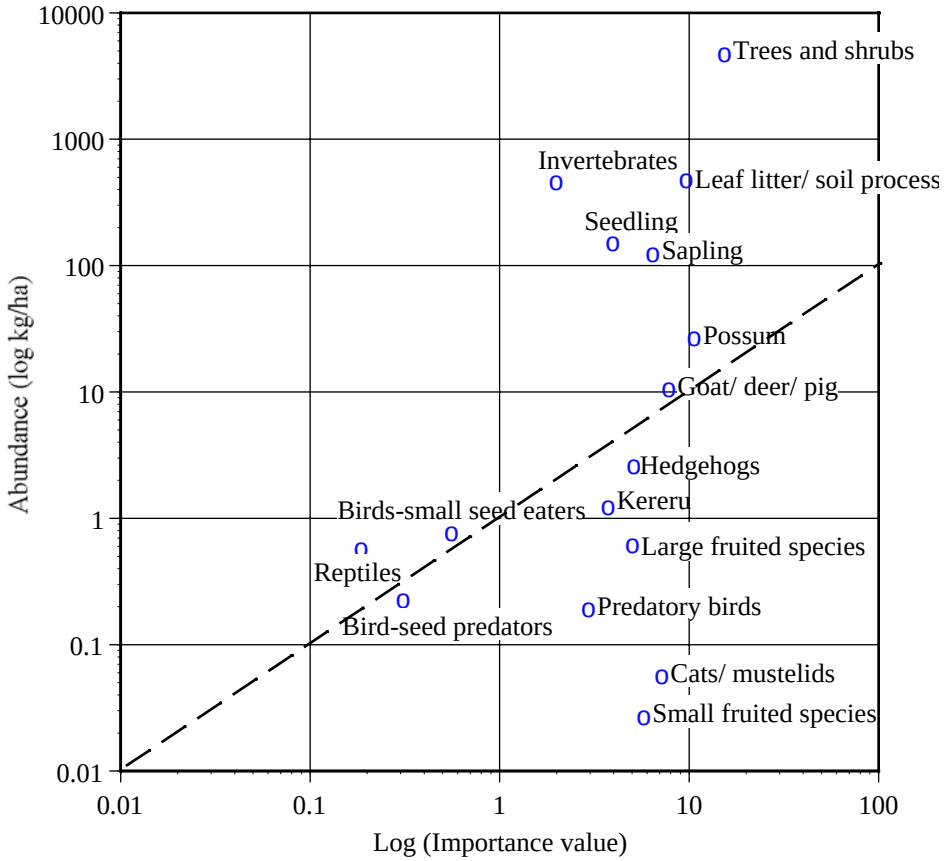
Amount of large and small fruits produced per hectare are based on seedfall collection data from Wenderholm, that spanned 85 weeks and utilised thirty 0.528m^2 traps. The data were averaged over all 85 sampling period and multiplied up to generate seedfall per hectare. The seedfall traps contained fresh, old and bird processed fruits, and are probably a reasonable, but possibly a slight underestimation, of the amount of fruit produced per hectare at a site with possum control.

Calculating Keystone values

This section uses the importance values and biomass estimates calculated above to generate a keystone species plot. There are theoretical and practical problems with the keystone species concept (refer to Chapter 7) yet it can still be of interest to compare the relative importance of a species against the total biomass.

The importance values presented above (Figure A7.1) were either negative or positive depending on whether removal of the organism/functional group resulted in loss or gain of biodiversity respectively. However, it is not possible to calculate the log of negative values, thus for this exercise the absolute importance values were used.

Figure A7.2: Biomass of species/functional groups plotted against relative community importance
Community importance was estimated by predicting the effects of removing an organism or functional group from the food-web depicted in Figure 7.1. Biomass (kg/ha) was estimated from published literature and other observations. Both are presented on a log scale.
The dashed diagonal line equates to Log(Importance value) = Abundance(log k/ha)



The distribution of New Zealand species/functional groups on the abundance versus importance graph (Figure A7.2) does not resemble the distribution proposed by Hurlbert [, 1997 #2481] Figure 7.4. There are a number of aspects that could have contributed to this;

1. The data include both functional groups and individual species. Such mixed data probably changes the emphasises for some species. Ideally the community importance values and biomass for all species, rather than functional groups, should be used. However, community importance data for all species within an ecosystem are not yet available.
2. Furthermore, many species share the same community value (e.g. smaller birds) because they belong to one functional group (e.g. birds-small seed eaters) thus they tend to cluster in the same area of the graph. Adding the biomass of individual species up within a functional group did not seem logical.
3. The community importance values did not have the predicted skewed distribution, therefore any subsequent distributions will not have the predicted distribution.
4. The community values are based on arbitrary constants and do not measure the *actual* general functional importance of the species and functional groups.
5. The predicted distributions generated by Mills *et al.* [, 1993 #2432] and Hurlbert [, 1997 #2481] are themselves plausible *hypothetical* distributions.
6. Hurlbert [, 1997 #2481] and Wooton [, 1997 #2482, cited in Hurlbert] illustrated that the scale and arithmetic transformation of the data affected the skewness of the data and hence keystoneness of species. Hurlbert recommended using a log transformation on both axis, but perhaps the data presented above require a different transformation.

It was also not possible to set the two arbitrary limits (the diagonal upper boundary and the vertical threshold boundary refer to Figure 7.4) that would encompass those species that are keystone species. There are no quantitative data available to set these limits and an arbitrary line could include many species or none at all. Not one species, not even stoats, immediately present themselves as definite keystone species candidates.

Appendix 8.2: - Other research questions

a) Tawa could be a genetically diverse species, possibly even to the point of tawaroa indeed being a separate species, or perhaps sub-species. The nutritional analysis between fruits from nominally tawa and nominally tawaroa trees revealed no difference in nutritional characteristics, though the sampling was probably not rigorous enough because of difficulties in distinguishing tawaroa from tawa trees. The apparent preference for 'tawa' fruit during the second fruiting peak, late summer, could be explained if tawaroa has a nutritionally superior composition and a characteristic later fruiting than tawa

b) Karaka fruits often appear too large to be swallowed by kereru and this probably reduces their attractiveness to and utilisation by kereru. The question then remains why are the fruits so large. The fruits are among the smallest in the family so size could be an evolutionary remnant and the size of the fruit is constrained by the evolutionary predetermined aspects such as the size of the embryo.

   Some have suggested that karaka was in fact introduced to New Zealand by the early Maori settlers some 1000 years ago. Karaka pollen is difficult to locate in paleological records because the tree does not produce copious quantities, but the potentially earliest record was from a strata less than 700 years old. If karaka was recently introduced then it can not have co-evolved with kereru and there is no reason to assume that the fruit characteristics or timing of fruiting has adapted to any significant extend to current conditions or to attract kereru as a disperser.

   However, other researchers dispute that karara was introduced by Maori. None of the other Cornynocarpus species can be mistaken for karaka, and no other Pacific location for karaka is currently known. This puts karaka firmly back on the New Zealand archipelago as an early inhabitant. It seems unlikely that these fruits were specifically targeting another native frugivore in New Zealand. None of the other known frugivores discussed in chapter 1 would have been capable of swallowing the fruit whole and disseminating it unharmed. Karaka seeds have a seedcoat of similar texture and hardness as peanut shells, and would not have withstood the grinding of moa gizzards or predation of parrot beaks. It is possible that a hitherto unknown, and now extinct, frugivore was the main vector for karaka dispersal, but this remains speculation only.

   It has been suggested that the legend of Maori bringing karaka to New Zealand actually translates into the early settlers moving the seed around within New Zealand. Thus perhaps the fruit size is a consequence of the selection and cultivation of the larger fruited specimen by Maori.

   Or perhaps the size of the karaka fruit is a question of resource allocation or pollination efficiency. It was noted in chapter 5 that a dry early summer resulted in large crops of smaller than usual fruits. Pollination is often adversely affected by wet weather, espcially for insect pollinated species. A dry spring could have increased the pollen loading per tree and resulted in greater fruit set. Since more fruits set less resources were available per fruit resulting in smaller fruits.

c) Does bird behaviour change when predators such as possums and rodents are removed?

d) What climatic or environmental conditions favour or predict heavy flower or fruit crops for large fruited species. What causes tawa, kahikatea, kohekohe, taraire to mast, what causes karaka to have large crops of small fruits

e) What part of the fruit production cycle of small fruited podocarps (e.g kahikatea) is affected by possum or rodent foraging? Why does possum rodent and suppression result in kahikatea fruit crops several orders of magnitude larger that at sites without possum suppression.

f) What is the nutritional value of rewarewa seeds?

g) Do rat numbers increase if only possums are suppressed? In what way are possums competing or preying on rats?

h) Do synchrony and overlap values for tawa improve during masting years?

i) Is there a predictable relationship between the number of trees fruiting and the quantity of fruit produced within a forest?

j) How much fruit, or nutrition, is required by kereru to complete a successful breeding cycle? Aspects to investigate include the condition of the bird prior to breeding and what fruiting species maintained that condition. Do kereru really source calcium and nitrogen rich fruit at the beginning of the breeding cycle, even when sufficient other foods are available?

k) Is fruit available year round at more southerly latitudes and how does this affect kereru breeding success?

l) As the number of fruiting species are reduced, the further south one goes, do the remaining fruiting species have longer fruit phenologies to ‘close the gaps’ left by the other species?

m) Can rodent (mainly rat) population fluctuations in forest be correlated to fluctuations in fruit availability? Are fluctuations in invertebrate population a more accurate predictor of rodent populations? Are fruit availability and fluctuations in invertebrate numbers correlated or linked? These linkages do seem to occur in beech forests, but does it hold true for hardwood podocarp forest?