CHAPTER THREE

A survey of properties running sheep to ascertain the significance of nematode parasites and diarrhoea and determine some important epidemiological factors.

3.1 INTRODUCTION

As defined in the literature review, the Wormkill strategic drench programme (Dash, *et al.* 1985) has been developed to achieve nematode control in sheep on the Northern Tablelands of New South Wales. Field observations (Hall *et al.* 1990) suggested that the program appears to commonly fail to achieve control of *Trichostrongylus spp.* in Merino weaners over the winter period, with the clinical expressions of illthrift and diarrhoea being identified as a major problems by sheep graziers.

A field survey was designed with the objectives of establishing the importance of nematode parasites, diarrhoea and the extent of the problem both on a district level and as it occurs within individual flocks. To also determine those epidemiological factors sheep owners associate with nematode parasites and/or diarrhoea, where either was identified as a problem.

The survey was planned and conducted along the principles outlined by Martin, Meek and Willeberg (1987).

3.2 MATERIALS AND METHODS

3.2.1 Coverage and Selection of Samples

The survey was limited to the Armidale Rural Lands Protection Board area, which encompasses an area of 1,376,384 HA on the New England Tablelands. There are 2,787 registered ratepayers (ie, owners of more than 10 HA of land) in this area, of which 1,646 filed a Land and Stock Return indicating they run sheep, however, it includes a considerable number of small holdings ("hobby farmers"). The survey was conducted on sheep owners selected from the Board list of ratepayers who, on 30 June, returned a number in excess of 1000 sheep.

300 ratepayers (plus 25 replacements) were selected in a systematic random manner using random numbers from the Board's computer list of assessment numbers. Checks were made to ensure there were at least 10 properties in 10 different defined geographical areas so that some analysis could be done on a stratified basis.

3.2.2 The Survey Design

The survey was non-specific in that questions covered a broad range of factors. The questions ranged from collecting basic data (property size, stock types and numbers) through to some non-specific open-ended questions, and generally allowed for comment on specific issues to allow for flexibility. However, most questions were one answer questions ie, respondents were required to mark one of a number of boxes, or a particular factor (eg, month).

A copy of the survey is given in Appendix A2.

Leading questions were avoided, for example, to determine the importance of internal parasites respondents were only asked to list the three most important sheep health problems. More specific questions were asked about diarrhoea.

3.2.3 Testing the Survey

As laid down in standard procedure (Kennedy and Roe 1987), a pilot survey of 20 sheep owners was conducted to ensure all important factors among the alternative answers had been covered, as well as to ensure that the questions were not ambiguous.

3.2.4 Conducting the Survey

Surveys were initially posted by mail. Surveys were noted on return and after specific periods of time, follow-up action was taken to encourage further returns. This follow-up was by mail 2 months after initial posting, and by telephone one to two months after that. It was decided that as it was a relatively lengthy survey, a long period would be taken to ensure as many replies as possible were collected. Final collections were by personal visits.

When a respondent was found not to be suitable (eg, died, sold property, sold all sheep), then a selected replacement was included.

3.3 RESPONSES

The response return rate was slow, however, following telephone and personal contact a response rate of 93% was finally achieved, ie, of the responses received 93% could be included in the final analysis.

3.4 ANALYSIS

Analysis was conducted using Genstat 5, Released 1.2 (Lawes Agricultural Trust, 1987). Initial analysis was conducted on 100 respondents selected at random. A second analysis was completed in which properties were selected from those that had at least 500 Merino ewes, and these were stratified into 10 areas from which 10 were selected at random.

Cross-tabulations were conducted to determine various relationships to try to determine which factors may be most significant.

3.5 RESULTS

3.5.1 Primary Analysis of Data Relating to General Features of the Properties Surveyed

Relevant results of the primary analysis of the survey are shown below. The column marked "1st analysis" represents the results of a random sample of 100 replies selected from all respondents. Column 2, marked "Merino analysis", represents the results from the total collected that initially were selected from respondents having 500 Merino ewes or more (ie, had a reasonable Merino breeding flock).

Q2. Sheep and cattle numbers on properties surveyed.

	Minimum	Maximum	Mean
Sheep	1000	24200	5882
Cattle	0	1894	299

Q33. Property size in hectares.

	1st Analysis	Merino Analysis
Under 250	2%	1%
215-500	8%	9%
501-750	21%	22%
751-1000	21%	20%
Over 1001	48%	48%

Q34. Average annual rainfall in mm.

	1st Analysis	Merino Analysis
Under 600 (24")	0%	0%
600-750 (24"-30")	23%	30%
750-900 (30"-36")	70%	64%
900-1050 (36"-42")	6%	6%
1050-1200 (42" - 48")	1%	0%
Over 1200 (48")	0%	0%

Q36. Percentage area of Improved pasture.

	1st Analysis	Merino Analysis
Nil	8%	7%
0-25%	13%	16%
25-50%	13%	15%
50-75%	22%	20%
75-100%	20%	21%
100%	24%	21%

Q43b. Annual average usage of fertiliser per year over the last 10 years.

	1st Analysis	Merino Analysis
None	1%	2%
Less than ½ cwt per acre	30%	25%
½ - 1 cwt per acre	42%	40%
1 cwt per acre	23%	28%
More than 1 cwt per acre	4%	5%

Q3a Number and type of sheep.

	None	< 500	500-1000	1000-3000	3000 +
	1st Analysis	1st Analysis	1st Analysis	1st Analysis	1st Analysis
Commercial Merino breeding ewes	13%	7%	31%	40%	42%
Commercial Crossbred ewes	27%	30%	27%	24%	11%
Merino wethers	8%	23%	35%	35%	47%
Stud ewes	52%	40%	7%	1%	0%

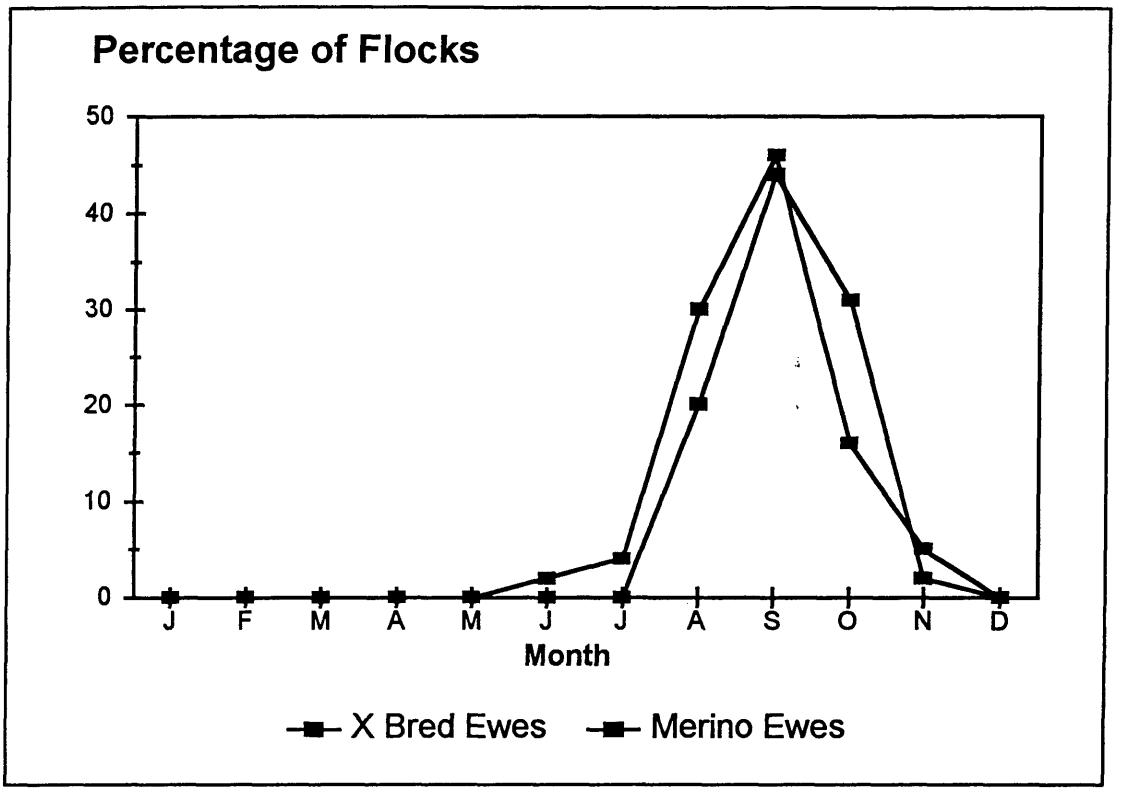
	None	<500	500-1000	1000-3000	3000+
	Merino	Merino	Merino	Merino	Merino
Commercial Merino breeding ewes	0%	13%	37%	45%	49%
Commercial Crossbred ewes	36%	28%	22%	18%	9%
Merino wethers	8%	22%	35%	34%	42%
Stud ewes	56%	37%	6%	3%	0%

Note: This is the percentage of properties that run the specified number of certain types of sheep - but it must be kept in mind 50% run at least two of the nominated groups.

Q3b. Wool Type.

	None	<500	500-1000	1000-3000	3000+
	1st Analysis	1st Analysis	1st Analysis	1st Analysis	1st Analysis
Commercial Merino breeding ewes	13%	30%	34%	34%	0%
Commercial Crossbred ewes	28%	26%	28%	14%	0%
Merino wethers	7%	30%	32%	45%	50%
Stud ewes	52%	14%	6%	7%	50%

	None	<500	500-1000	1000-3000	3000+
	Merino	Merino	Merino	Merino	Merino
Commercial Merino breeding ewes	0%	32%	39%	42%	0%
Commercial Crossbred ewes	36%	24%	21%	13%	0%
Merino wethers	7%	30%	33%	38%	0%
Stud ewes	57%	14%	7%	7%	100%



Q4. Months in which lambing occurs in Merino and XB ewes.

Figure 3.1 *Month of year in which lambing occurs as a percentage of respondents with lambing ewes.*

Q6. If sheep are purchased, give category.

	1st Analysis	Merino Analysis
Only buy rams	48%	57%
Buy sheep on a regular basis	30%	17%
Buy sheep occasionally	22%	26%

Q16. Percentage of diarrhoea affected sheep crutched more frequently than normal.

	1st Analysis	Merino Analysis
Crutched	54%	55%

Q17. Percentage of diarrhoea affected sheep jetted more frequently than normal.

	1st Analysis	Merino Analysis
Jetted	37%	40%

Q23. What treatments were applied?

	1st Analysis	Merino Analysis
No treatment	31%	34%
Re-drenched with same drench	15%	18%
Re-drenched with different drench	33%	31%
Changed paddock only	1%	1%
Drenched with sulphur drug	3%	2%
Combination of above	17%	14%

Q24. How successful were the measures adopted in eliminating the scouring problem?

		1st Analysis	Merino Analysis
Excellent	95-100%	21%	19%
Very successful	85-90%	25%	27%
Partially successful	50-85%	27%	27%
Some improvement	up to 50%	12%	10%
No change		8%	8%
No answer		7%	9%

3.5.2 Primary Analysis of Data Relating to Nematode Parasites, Other Parasites and Diarrhoea

Analysis results of questions relating to nematode parasites, parasites and diarrhoea are shown below:

Q7. List the three most important sheep health problems.

	Most Important		Second Most Important		Third Most Important	
	1st An	Merino	1st An	Merino	1st An	Merino
Worms	52%	53%	22%	23%	7%	4%
Flystrike	23%	20%	36%	34%	27%	28%
Diarrhoea	11%	10%	6%	6%	5%	8%
Barbers Pole	4%	5%	2%	10%	0%	11%
Liver fluke	4%	4%	10%	2%	14%	0%
External Parasites	2%	3%	10%	3%	6%	15%
Pizzle Rot	2%	2%	1%	2%	4%	3%
Pulpy Kidney	1%	1%	2%	6%	3%	10%
Others	1%	2%	11%	14%	34%	21%

Q8. Does diarrhoea occur, and if so, on regular or sporadic basis?

	1st Analysis	Merino Analysis
Number with diarrhoea sheep	92%	90%
Diarrhoea occurs:		
Regularly	23%	26%
Sporadically	54%	50%
Regularly and Sporadically	15%	14%

Q9. How important is diarrhoea relative to other problems?

	1st Analysis	Merino Analysis
Unimportant	28%	27%
Important	43%	45%
Very Important	29%	28%

Q10. List types of sheep in which diarrhoea is a problem.

	1st Analysis	Merino Analysis
Merino lambs (birth-weaning)	18%	20%
Merino weaners (weaning-12 months)	24%	25%
Merino hoggets (12-24 months)	23%	25%
Merino Adults (over 24 months)	10%	9%
Crossbred lambs (unweaned)	15%	13%
Crossbred weaners and hoggets	7%	6%
Crossbred Adults	3%	2%

Q11. How long does the outbreak of diarrhoea persist?

	1st Analysis	Merino Analysis
No diarrhoea	5%	5%
Less than 7 days	10%	9%
7-14 days	33%	24%
More than 14 days	52%	62%

Q13. What month/s of the year does diarrhoea occur?

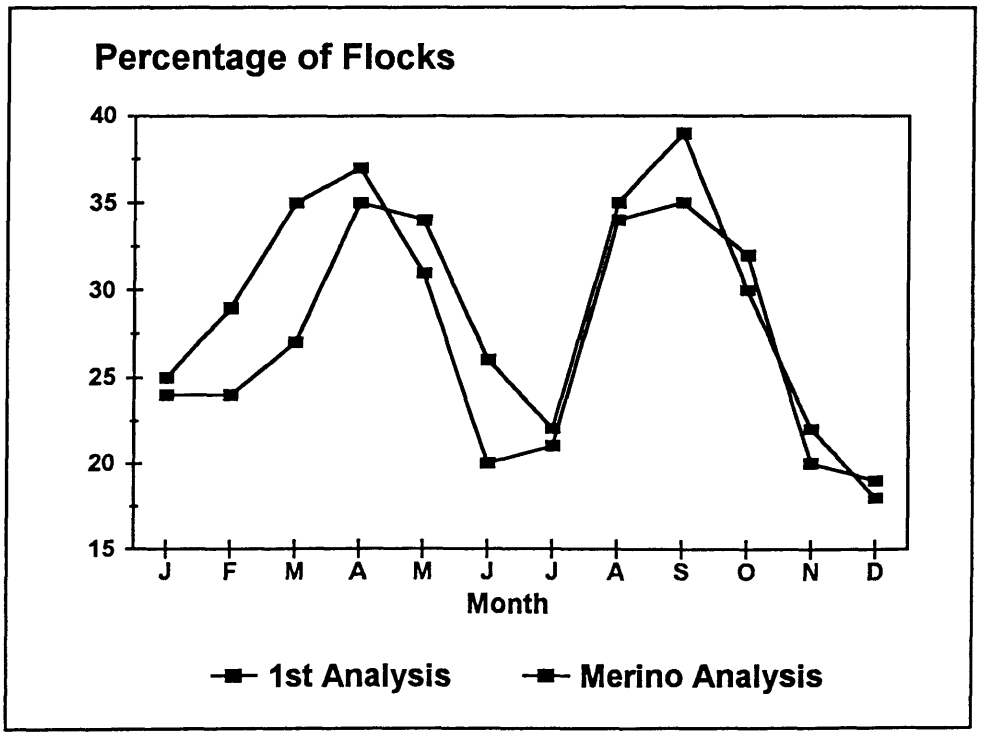


Figure 3.2 *Month of year in which diarrhoea occurs given as a percentage of respondents that reported diarrhoea in that month.*

3.5.3 Cross-Tabulation of Results

To determine those factors which might be correlated with parasites or diarrhoea, cross-tabulations were carried out.

Results from question 9 determined those properties on which diarrhoea was considered unimportant, important or very important, and question 7 identified properties on which worms (nematode parasites) or diarrhoea were the most important problem.

Both these were cross-tabulated with the other questions, and the ones which gave results that may be significant were as follows.

1. Sheep numbers (Q3 v. Diarrhoea or Worms).

Both factors were related to sheep numbers, with disease importance increasing with sheep numbers.

	Diarrhoea	Worms
Unimportant	4729	4890
Important	6178	6924
Very Important	6555	6765

Average sheep numbers for each category.

2. Pattern of diarrhoea outbreak (Q8 v. Diarrhoea and Worms).

The majority of properties where diarrhoea was considered very important, the problem occurred on an annual basis; while when unimportant, then diarrhoea occurred mainly on a sporadic basis.

3. Types of sheep in which diarrhoea occurred (Q9 v. Q10).

The majority of properties on where diarrhoea was considered very important, the problem occurred mostly in weaners and hoggets.

	Diarrhoea			Worms		
Diarrhoea Category	Lambs	Weaners	Hoggets	Lambs	Weaners	Hoggets
Unimportant	9/28	10/28	10/28	4/14	5/14	6/14
Important	22/43	26/43	26/43	15/27	16/27	16/27
Very Important	15/29	26/29	25/29	10/16	16/16	16/16

Number of properties on which diarrhoea or nematode parasites were the major problem in weaners and hoggets.

4. Length of diarrhoea outbreak (Q11 v. Diarrhoea and Worms).

Both groups recorded problems as very important where diarrhoea persisted for more than 14 days.

	Diarrhoea	Worms
Unimportant	21%	29%
Very Important	79%	71%

Percentage of properties on which diarrhoea persisted for more than 14 days.

5. There was no difference in groups with respect to month of outbreak (Q13).

6. Extra crutching needed (Q16 v. Diarrhoea and Worms).

	Diarrhoea	Worms
Unimportant	8/28	4/14
Important	30/43	18/27
Very Important	16/29	7/16

Number of properties requiring extra crutching for each category.

7. Extra jetting required (Q17 v. Diarrhoea and Worms).

	Diarrhoea	Worms
Unimportant	6/28	3/14
Important	16/43	10/27
Very Important	15/29	8/16

Numbers of properties requiring extra jetting for each category.

8. Supplementary feeding (Q38).

Routine supplementary feeding was not carried out on a significant number of farms to ascertain any trends, although there were no obvious differences between the groups on the results given.

9. Stocking rate (Q2 & Q33 v. Diarrhoea).

By combining stock numbers and property size and assessing correlations with sheep that have diarrhoea, it was determined that there was a low correlation rate (0.124). This is also demonstrated in the scatter plot graph, Figure 3.3 in which properties on which diarrhoea or worms were an important problem, are shown in terms of dse.

Figure 3.3 *Scatter plot graph showing stocking rate (in dry sheep equivalents) versus responses indicating worms and/or diarrhoea were important health problems.*

3.6 DISCUSSION

Preliminary analysis of the survey demonstrated that sheep owners in the Armidale Rural Lands Protection Board thought "worms" (nematode parasites) and diarrhoea, a common clinical sign of nematode parasites, to be their major sheep health problem. Over 50% of sheep owners nominated nematode parasites as the most important problem, and 80% nominated nematode parasites as first, second or third.

These figures are consistent with recent estimates of disease costs to the industry, for example, Collins (1992) estimated nematode parasites to cost Australian sheep producers $337 million annually, and to be the most costly of all endemic diseases in sheep in Australia.

3.6.1 Age

The survey respondents nominated Merino weaners (6-12 months) and hoggets (12-24 months) as the most important groups affected, with Merino lambs next affected. There is always difficulty in using nomenclature of this type, as owners perceive "lambs" to be up to 12 months old, whilst others consider all weaned Merino sheep as "hoggets". This is made more difficult by the fact that most lambs, although still running with their mothers, are in fact long self-weaned prior to actual weaning.

This finding is consistent with the fact that Merino sheep under 5 months often fail to mount a sufficient immune response, and that sheep up to 18 months may respond poorly and more slowly than adults (Dobson *et al.* 1990a; Dobson *et al.* 1990b). Donnelly, McKinney and Morley (1972) found that growth in lambs is usually not affected by worm burdens prior to weaning, provided this takes place no later than when lambs are 12 weeks old. Waller, Axelsen, Donald and Morley (1978) found that parasites did affect lambs prior to weaning where high larvae uptake occurred. The concept of weaning 'early' at 12 weeks has become a standard sheep management recommendation (Lollback 1992), and illustrates the necessity of combining recommendations for parasite control programs with overall sheep management plans. This is further discussed in Chapter 7.

3.6.2 Stocking Rate

On further analysis, the cross-tabulations found that nematode parasites and diarrhoea were influenced by the total number of sheep, but not by stocking rate. This would indicate that management of larger farms may be different, although the actual differences were not investigated in this survey. In general, larger farms have less intense labour input, and rely on 'hired' labour who do not have the knowledge or the commitment to parasite control (R S Marchant, *pers comm.*).

Although increased stocking rates are generally thought to be a factor in causing parasite problems, the evidence does not support a consistent relationship between stocking rate and parasitological status (summarised in Morely and Donald 1980).

3.6.3 Season

Analysis indicates that the nematode parasites and diarrhoea identified are a problem in young sheep, specifically so on properties where the disease is considered very important. In these groups, the problem occurs all through the year, with a concentration of high problems in spring and autumn.

It is interesting to note that diarrhoea was not perceived to be a problem during the winter months. It is not likely this is due to low parasite burdens, as it has been shown that this continues to rise over this period and peak in late spring, as shown in Figure 2.8. It is probable the diarrhoea is due to the ingestion of larvae which peak in April (see Table 2.7), in combination with high moisture, low roughage pasture which is a feature in spring (as discussed in Section 2.6).

3.6.4 Other Factors Associated with Scouring

Other specific epidemiological factors did not appear as significant in this survey. This included stocking rate, soil types, rainfall, fertiliser application (the latter three all being important in determining stocking rate), nor did specific problems such as selenium application show up as important. Supplementary feeding did not appear to make any significant difference to the problem, even although 38% of respondents gave supplementation to weaners/hoggets in adverse seasons, with another 28% feeding in most or all seasons.

Further cross-tabulations did not reveal any further useful data. For example, there was no correlation between drenching strategies nominated against those with problems as identified in Q7 (most important sheep health problem), or Q8 (diarrhoea and type of diarrhoea).

3.6.5 Nutrition

There was no correlation between properties on which diarrhoea in weaners and hoggets was a problem including month of occurrence, fertiliser usage, country type, or feeding used.

There were a number of epidemiological factors specifically related to young Merino sheep, that were not canvassed in this survey, and which are now considered to be of major importance. These include age and weight at weaning, management after weaning (specifically the environment sheep are weaned into) and nutrition after weaning.

It was not possible to carry out any in depth epidemiological factors in relation to farm anthelmintic practices beyond establishing the type of drenching program used. A major cause of nematode parasite problems is reported to be anthelmintic resistance (Love *et al.* 1991; Rolfe 1997). This was not able to be determined by a survey of this type, nor was it possible to ascertain factors that lead to its occurrence.

This survey was conducted 6 years after the introduction of Wormkill (Dash *et al.* 1985). This program was at its peak in terms of achieving *Haemonchus contortus* control at this time, and as such the major nematode parasites were other intestinal worms, mostly *Trichostrongylus spp.* and less commonly *Ostertagia spp.* This was demonstrated in the monthly summary of Wormtests published monthly as "Wormwatch" (Holdsworth 1993).

The significance of this is that the survey respondents would be concerned and reporting the effects of trichrostrongylosis rather than the haemonchosis.

3.6.6 Survey Design

D Kennedy, *pers comm.*, suggested that with surveys, it is not until analysis is being conducted that the design faults become evident. In this case, two problems are evident.

Firstly, to avoid leading questions on importance of internal parasites, no specific questions relating to problems due to worms were canvassed. This effectively meant it was not possible to compare properties where no problem was perceived to occur, with properties that identified internal parasites as their major problem. This is probably unavoidable to some degree, because other than scouring, no specific signs identify internal parasites as a problem.

Secondly, to make it simple most factors were portioned into boxes giving ranges, which meant average figures for most factors could not be calculated.

Together, these two factors make analysis, ie, frequency tables, of determining probabilities or correlation impossible. This is not important in as much a survey of this type really can only determine trends in any event, however, it may serve to display such trends.

Finally, it must be noted that information on a number of epidemiological factors in terms of management procedures were not sought. In retrospect, given that problems were identified mostly in young sheep, then factors such as length of lambing, age at weaning and weaning practices are important.

Holdsworth (1993) measured these factors in a survey, however, although 43 percent identified Black Scour Worm as a problem, no attempt was made to correlate them with any of the management practices.

Although these were stratified into areas, there was no difference between these areas in importance of diseases or other epidemiological factors.

3.7 CONCLUSION

The conclusion that can be drawn from this survey is that over 50% of producers listed worms as their most important sheep health problem. Analysis of surveys reveals this to be a problem most prominent in Merino weaners and hoggets. The survey does not identify any particular epidemiological factors but suggests further work on farms will be necessary to determine significant epidemiological factors underlying the problem.

CHAPTER FOUR

On-property measurements of body weights in Merino weaners with field observations to study the relationship between growth rates, diarrhoea, nematode parasites and associated epidemiological factors.

4.1 INTRODUCTION

Overall management of internal parasites in ruminants requires the development of an integrated control program. In general terms, it is recognised this means developing particular programs to ensure adequate control of parasites in ewes during the pre-partinent phase, and young sheep after weaning, two times when sheep are most at risk due to developed resistance (Nicol and Everest 1997).

The Wormkill program, put into place in New England, has been successful in controlling Trichostrongylosis at these times, although for the post-weaning period this was only achieved by the inclusion of extra anthelmintic treatments (Holdsworth 1993).

The survey of sheep graziers reported in Chapter 3 revealed nematode parasites to be their major problem, with Merino weaners the most affected group. However, apart from age, no other epidemiological factors were identified in the survey as obvious causes or associated with nematode parasite problems.

With respect to age, it has been established that resistance to internal parasites takes up to 15 months to be fully operational (Dobson *et al.* 1990b). However, field trials (Hall 1990) have suggested inadequate nutrition may be a major factor in compromising the development of resistance.

To further evaluate this, a number of on-farm field trials were put into place, with the basic objective of determining the relationships of body weight and growth rates with nematode parasites and diarrhoea. The opportunity was taken to look at some other factors, such as selenium status.

4.2 MATERIALS AND METHODS

4.2.1 Properties

On-property observations were conducted on a number of properties over a 6 year period.

The main properties where trials were carried out over a 4-6 year period were:

A Fletcher, "Cairnie", Walcha
E Barnet, "Miramoona", Walcha
J McLaren, "Nerstane", Woolbrook
F J White & Co, "Saumarez", Armidale
D Gowing, "South Winscombe", Uralla

Observations were conducted on a number of other properties for one or two years.

4.2.2 On-Property Observations

On-property observations were commenced on each property at or around weaning time.

Observations were repeated at regular intervals of 8-12 weeks. These as a general outline were conducted as follows:

December	-	Weaning
February	-	2 month post weaning drench
April	-	4 month post weaning monitor
June	-	Mid winter (ie, lowest pasture growth period)
August	-	August drench
November	-	Monitor (November drench)
February	-	Prejoining.

These were varied for each property depending on weaning dates and other management factors.

On most properties culling of weaners from the flock being monitored (occurred in late spring or at shearing), and figures were corrected for the removal of these sheep.

4.2.3 Sheep Parameters Monitored

4.2.3.1 Sheep Weights

150 Merino ewe lambs were selected at random at weaning (or shortly afterwards) and double ear-tagged. These were weighed and diarrhoea scores recorded at times indicated above. Other unusual factors were also recorded. Sheep were weighed using Rudweigh electronic scales.

4.2.3.2 Faecal Egg Counts (FECs)

10 faecal samples were collected from the group for individual faecal egg counts a bulk differential was conducted on each group. The method is fully described in Appendix 5.1.1 and 5.1.2.

4.2.3.3 Dag Score (diarrhoea scores)

This is a visual subjective estimate of severity of diarrhoea.

Present and past diarrhoea were estimated using the presence of faecal material (fresh and wet) or dried (dry dags) on the breach using the following score system:

1. Wet diarrhoea
2. Dry diarrhoea

The severity was estimated using the following score system (adapted from Larsen *et al.* 1994).

1. nil
2. evidenced light scour or few dags
3. more moderate evidence of faecal material
4. severe, with the majority of the breech area covered
5. very severe diarrhoea, whole breech virtually covered in wet faecal material or dags including hind legs. Other clinical signs may be present.

Hence, for example, a score of 1.4 would represent a sheep presently scouring and the majority of the breech covered in fresh faecal material. A diagram indicating the measurements is given in Figure 4.1.

Dag Index (DI) is a flock average and is calculated by adding all the scores in the mob and dividing it by the number of sheep, and is therefore an average dag score for sheep in each mob.

Figure 4.1 *Assessment of dag score on the breech of scouring ewes - scores 0 and 1 (top row), 2 and 3 (middle) and 4 and 5 (bottom). Scores of 0 and 1 indicate nil or light dag, 2 and 3 moderate dag, and 4 and 5 severe dag, respectively.*

4.2.3.4 Blood Selenium Levels

Blood selenium levels were estimated by collecting blood into heparin vacuum tubes from 5 sheep and submitting it to EMAI Biochemical Laboratory, Menangle. Glutathione peroxidose levels (U/g Hb) were measured as an indication of selenium status. (Eamens 1992).

4.2.3.5 Other Factors

Other factors that may have directly affected body weight were also recorded (eg, lameness, flystrike, dermatitis (active), severe scabby mouth, local infections (including abscess), injury and miscellaneous.

4.2.4 Property Data Collected

Basic weather details - monthly rainfall measurements
- temperature variations, or severe wind if obviously unusual

4.2.5 Management Data

4.2.5.1 General Management Data

General management data was collected, with specific attention paid to events that may affect nutritional status or parasite burdens

Paddock measurements of monitored stock
Weaning date
Mulesing date
Crutching date(s)
Shearing date

4.2.5.2 Specific Treatment Data

Jetting date and treatment
Other fly prevention
Lice treatments
Nematode parasite control, specifically date, type of drench, dose rate

4.2.5.3 Property Map and Movement of Weaners

A property map was provided and movement of weaners was monitored, noting in particular previous stocking history of paddocks.

4.2.5.4 Supplementary Feeding

Type and amount of supplementary feeding.

4.2.5.5 Statistical Analysis

Measurable variables were analysed using Spearmans Rank Correlations using Statistix Analytical Software. This was carried out for the variables weight gain (or loss), FEC (arithmetic mean), Dag Index and Selenium levels (Glutathione peroxidase levels) on six farms, and all of the other farms with results bulked together.

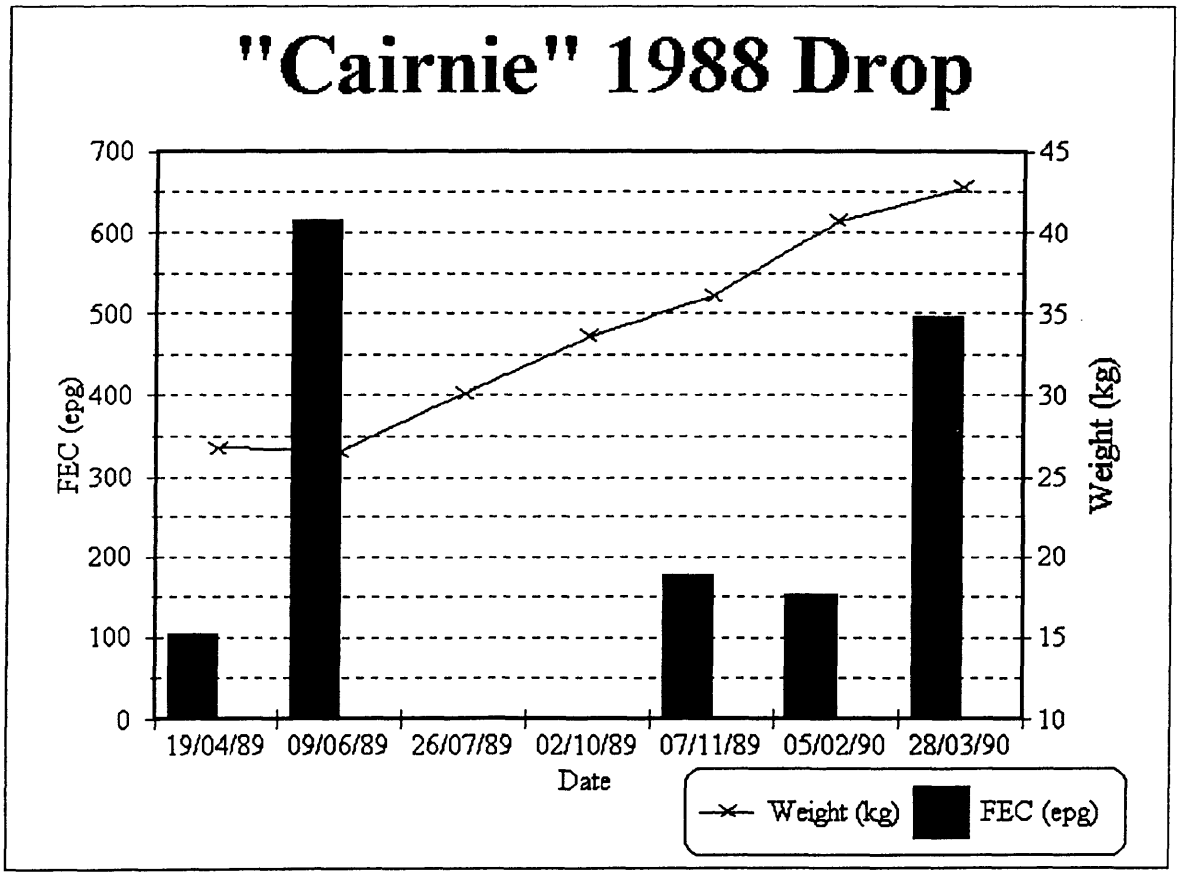
4.3 RESULTS

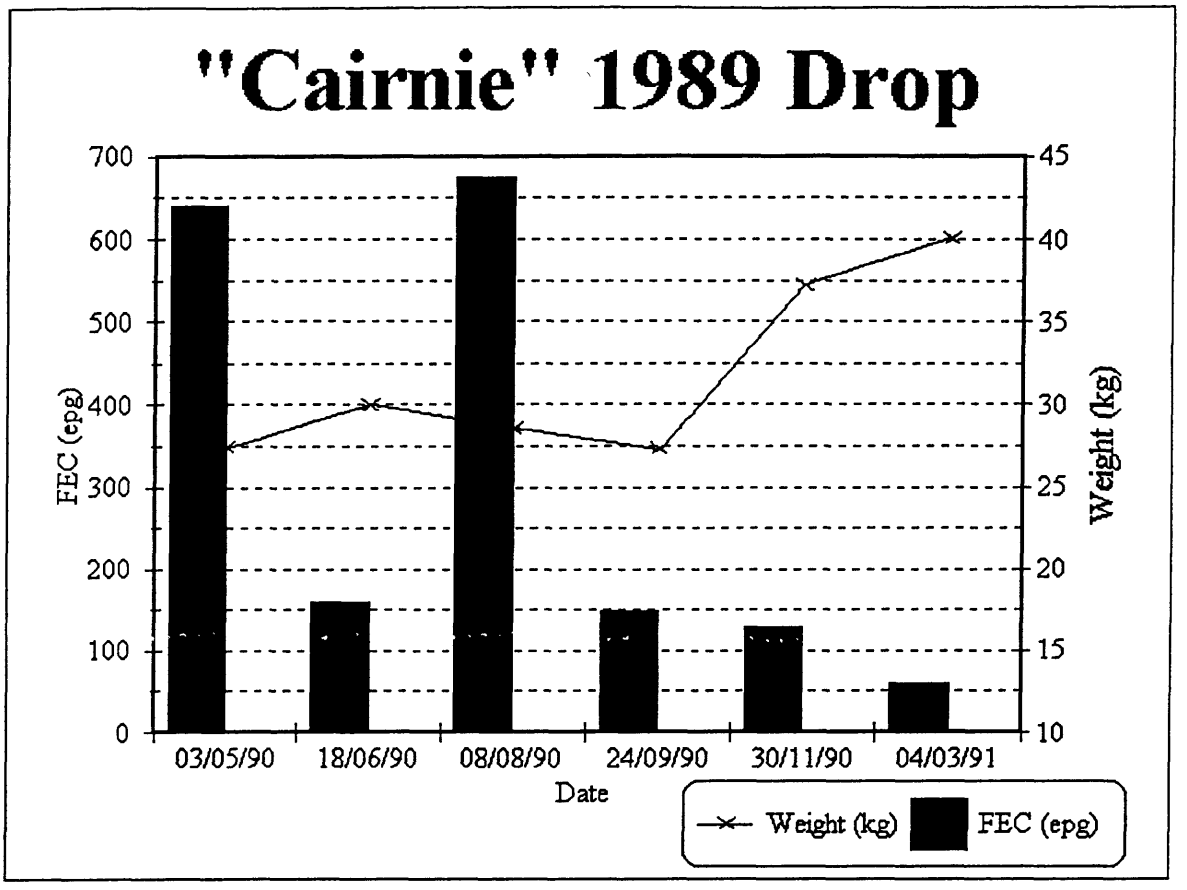
4.3.1 Field Observations

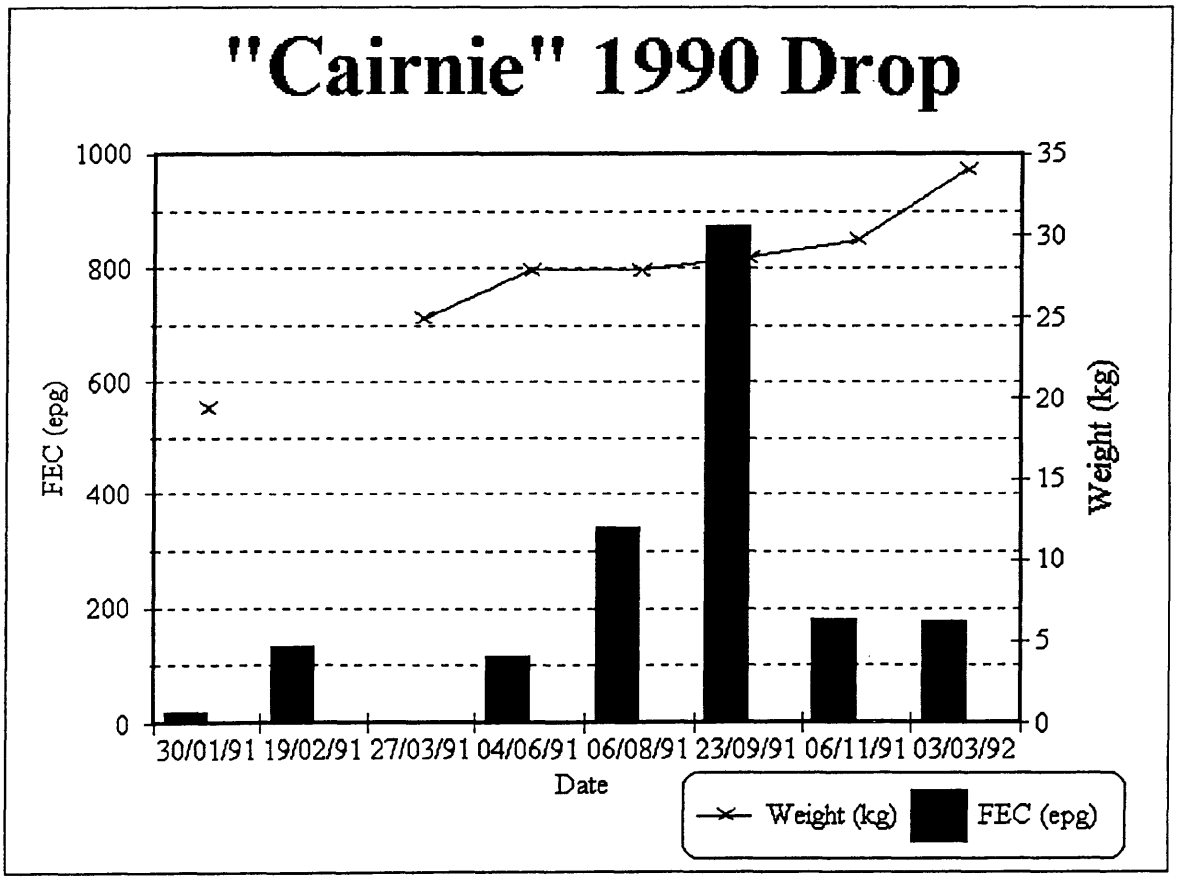
The results amount to a large amount of recorded data, which is given in Appendices A3.1 and A3.2. The data can be graphed on an individual year basis or all measurements for each farm over the period can be graphed. For the purpose of discussion, samples of both are given at the end of the chapter.

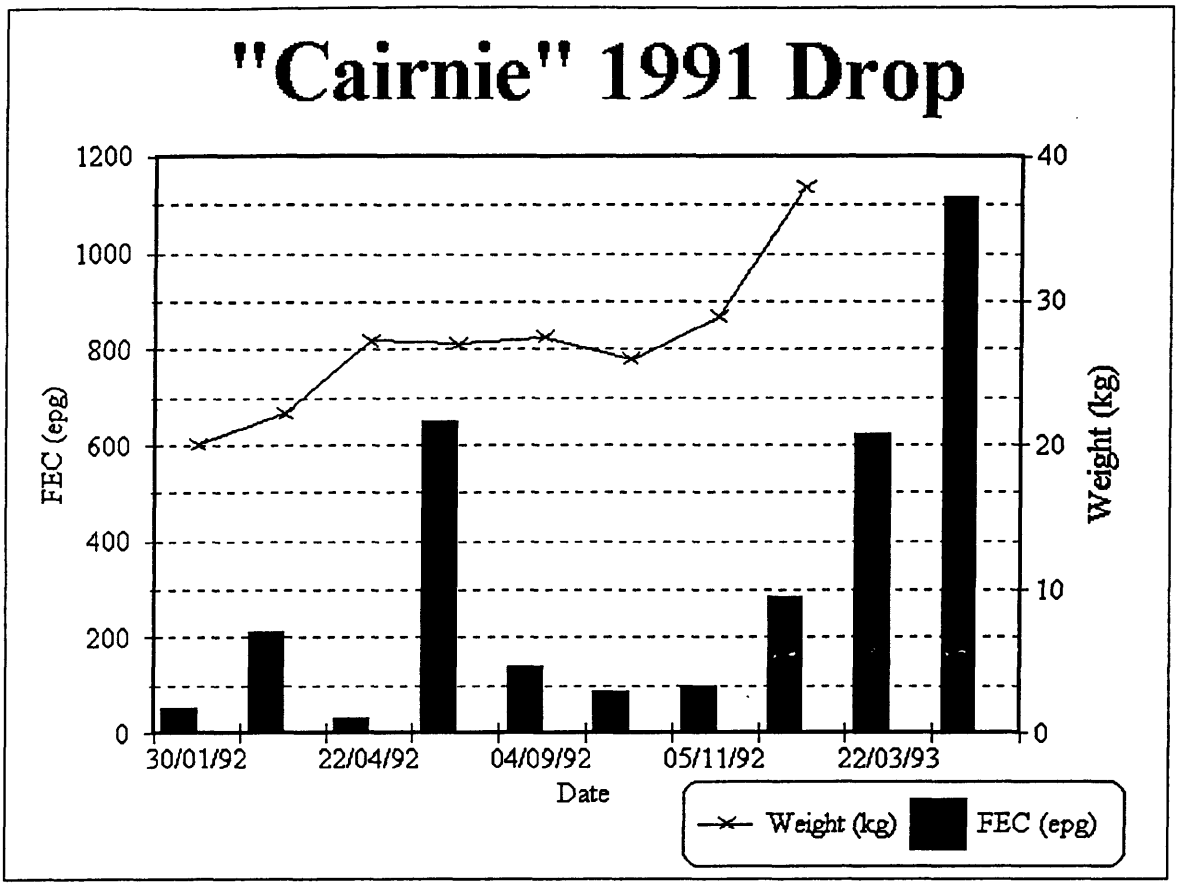
Figures 4.2 - 4.6. These figures show live weights and FECs over a number of years on single farms.

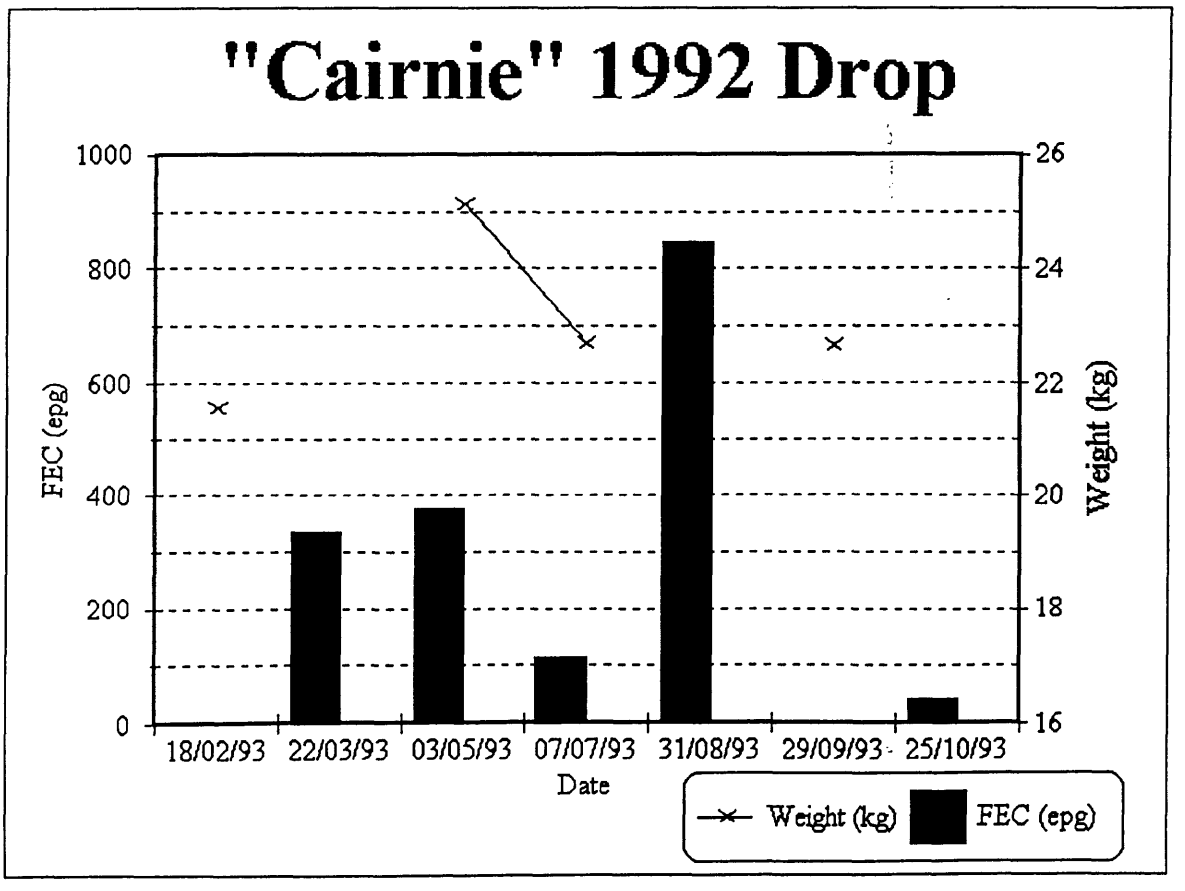
Figure 4.2 "Cairnie" live weights and FECs - 1988 to 1993 drop.




"Cairnie" 1989 Drop
700
600
500
400
300
200
100
0
FEC (epg)
45
40
35
30
25
20
15
10
Weight (kg)
03/05/90
18/06/90
08/08/90
24/09/90
30/11/90
04/03/91
Date
Weight (kg)
FEC (epg)


"Cairnie" 1990 Drop
1000
800
600
400
200
0
FEC (epg)
35
30
25
20
15
10
5
0
Weight (kg)
30/01/91
19/02/91
27/03/91
04/06/91
06/08/91
23/09/91
06/11/91
03/03/92
Date
Weight (kg)
FEC (epg)


"Cairnie" 1991 Drop
1200
1000
800
600
400
200
0
FEC (epg)
40
30
20
10
0
Weight (kg)
30/01/92
22/04/92
04/09/92
05/11/92
22/03/93
Date
Weight (kg)
FEC (epg)


"Cairnie" 1992 Drop
1000
800
600
400
200
0
FEC (epg)
26
24
22
20
18
16
Weight (kg)
18/02/93
22/03/93
03/05/93
07/07/93
31/08/93
29/09/93
25/10/93
Date
Weight (kg)
FEC (epg)

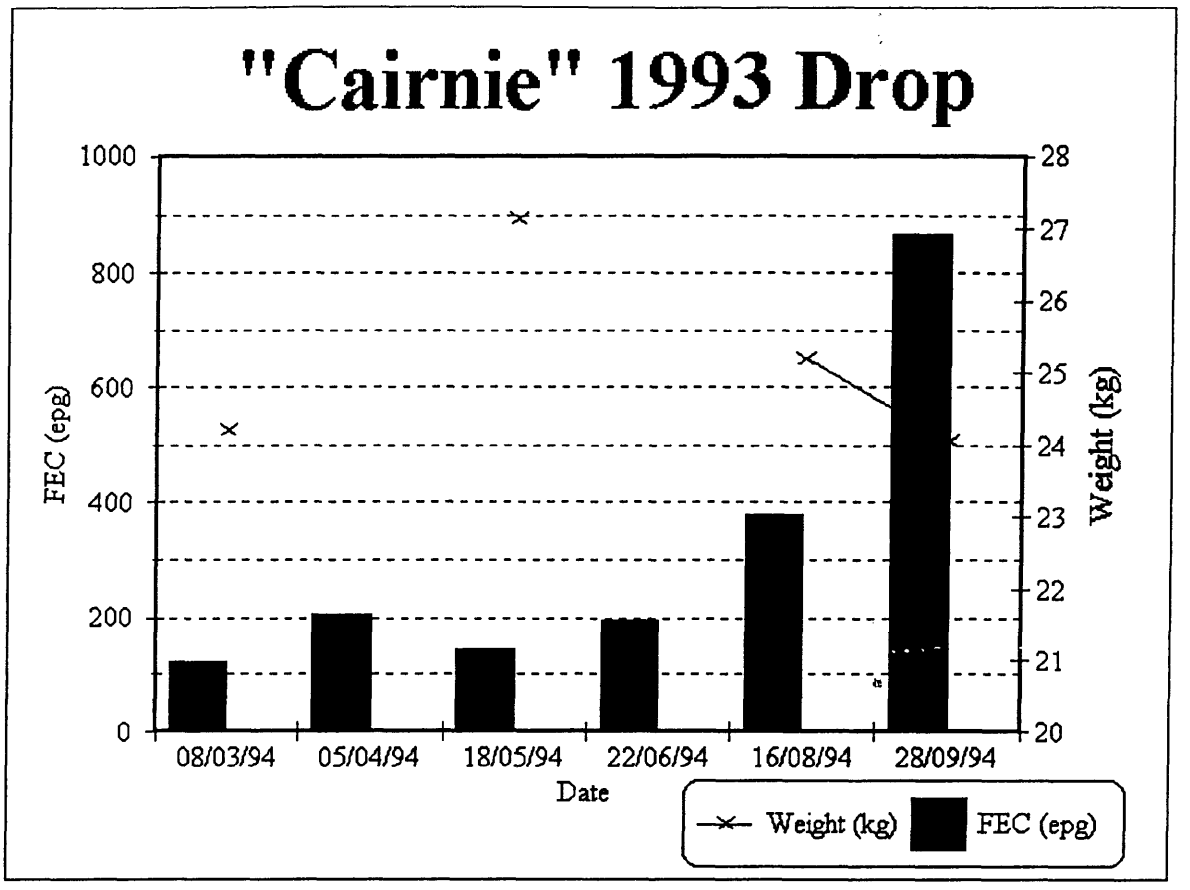
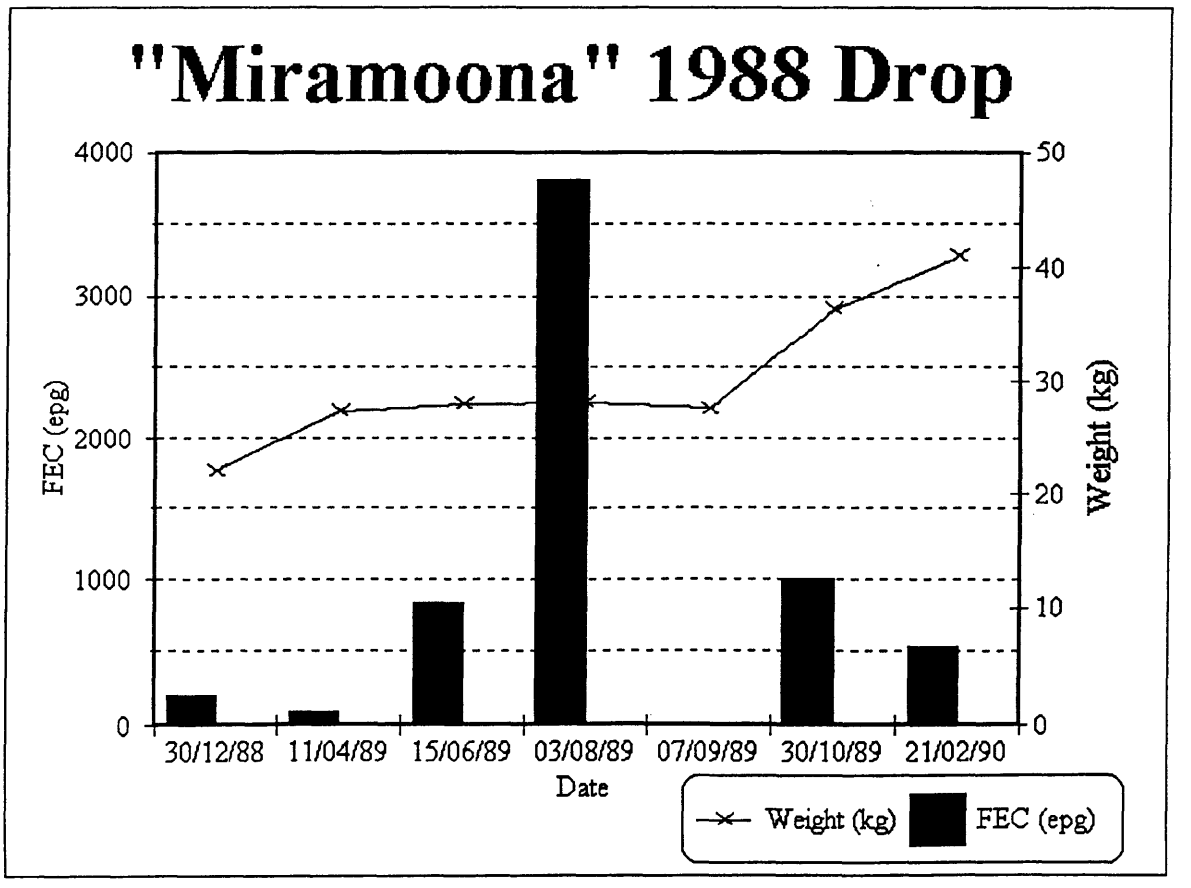
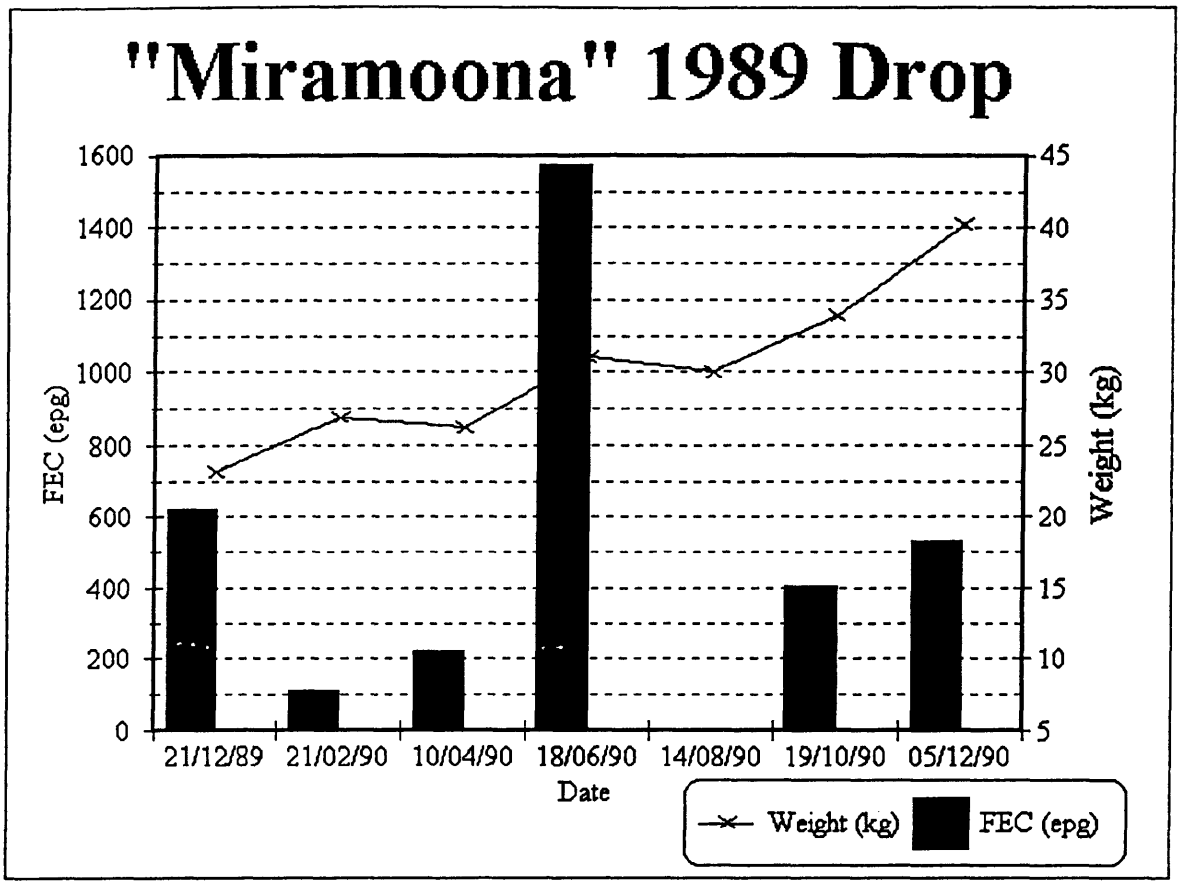
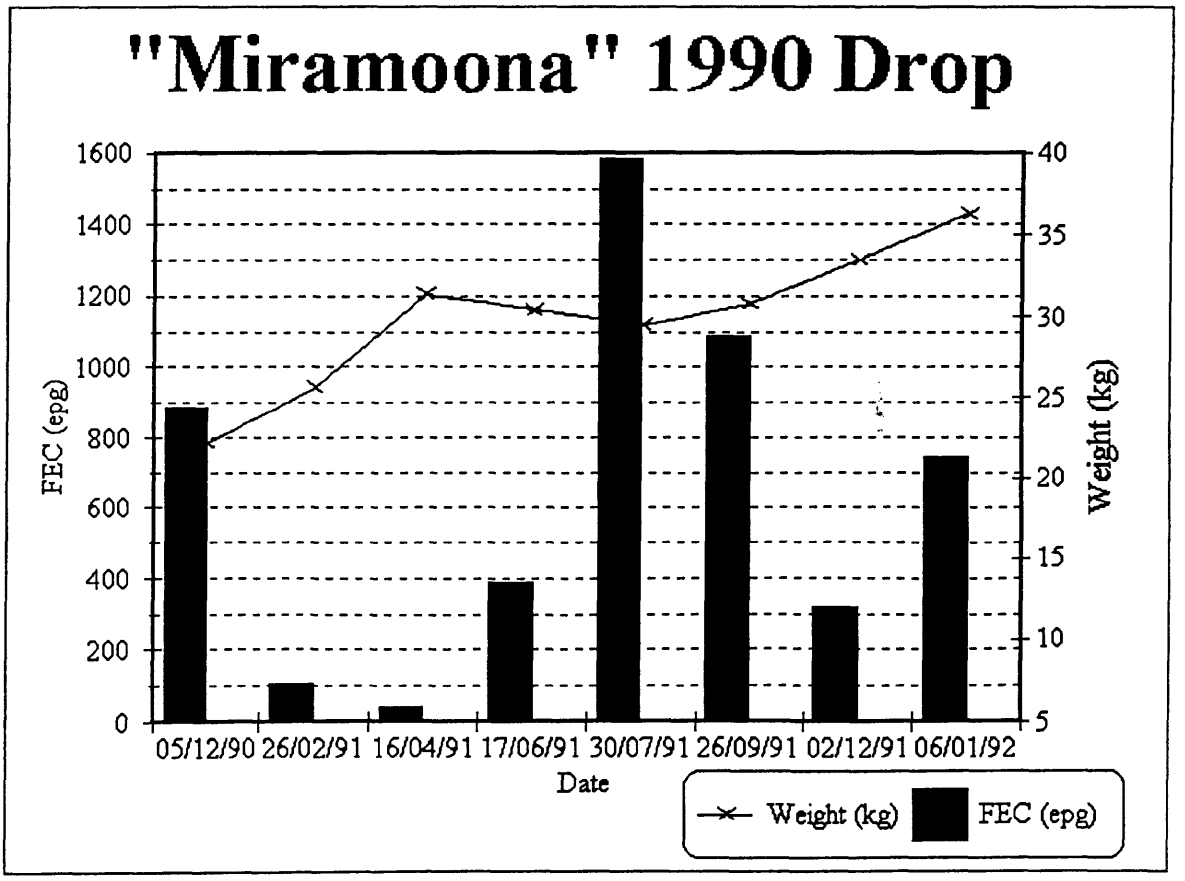
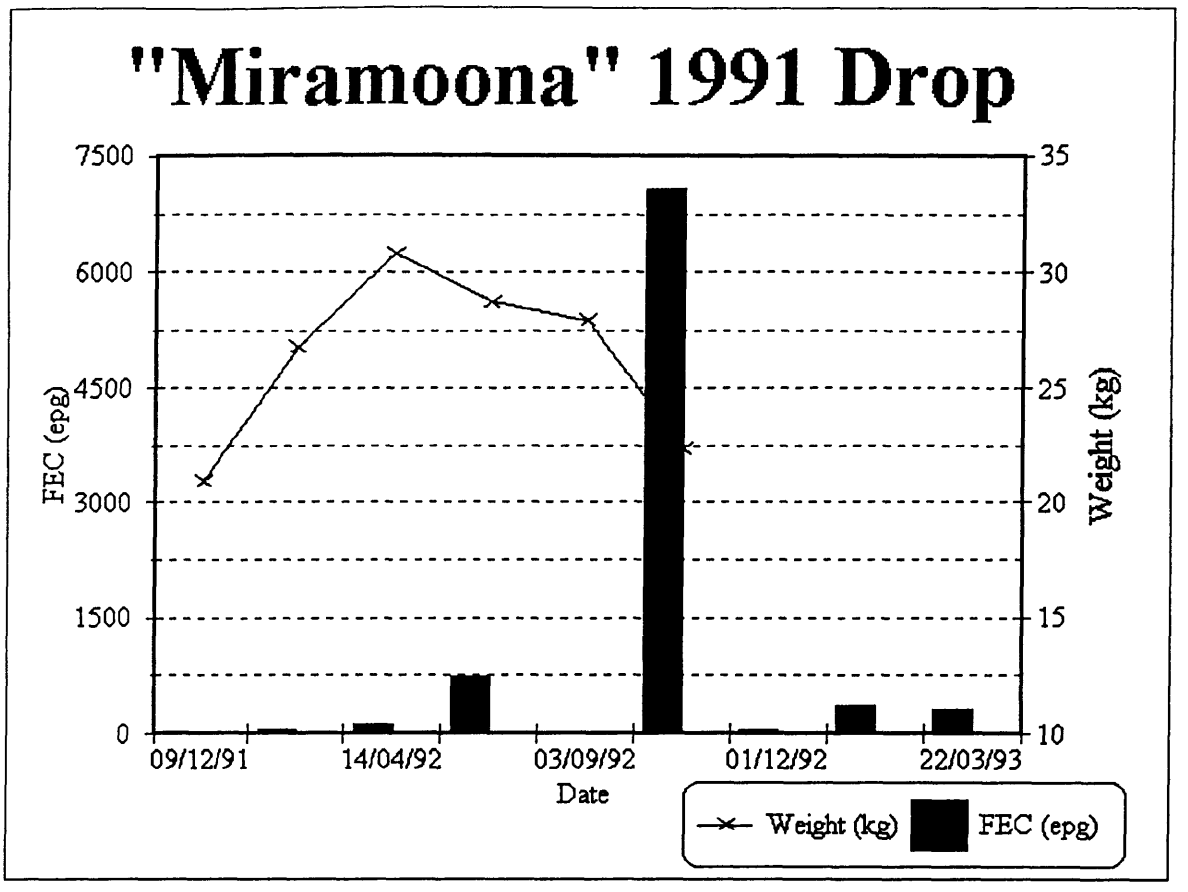


Figure 4.3 "Miramoona" live weights and FECs - 1988 to 1992 drop.




"Miramoona" 1989 Drop
1600
1400
1200
1000
800
600
400
200
0
FEC (epg)
45
40
35
30
25
20
15
10
5
Weight (kg)
21/12/89
21/02/90
10/04/90
18/06/90
14/08/90
19/10/90
05/12/90
Date
Weight (kg)
FEC (epg)


"Miramoona" 1990 Drop
1600
1400
1200
1000
800
600
400
200
0
FEC (epg)
40
35
30
25
20
15
10
5
Weight (kg)
05/12/90
26/02/91
16/04/91
17/06/91
30/07/91
26/09/91
02/12/91
06/01/92
Date
Weight (kg)
FEC (epg)


"Miramoona" 1991 Drop
7500
6000
4500
3000
1500
0
FEC (epg)
35
30
25
20
15
10
Weight (kg)
09/12/91
14/04/92
03/09/92
01/12/92
22/03/93
Date
Weight (kg)
FEC (epg)

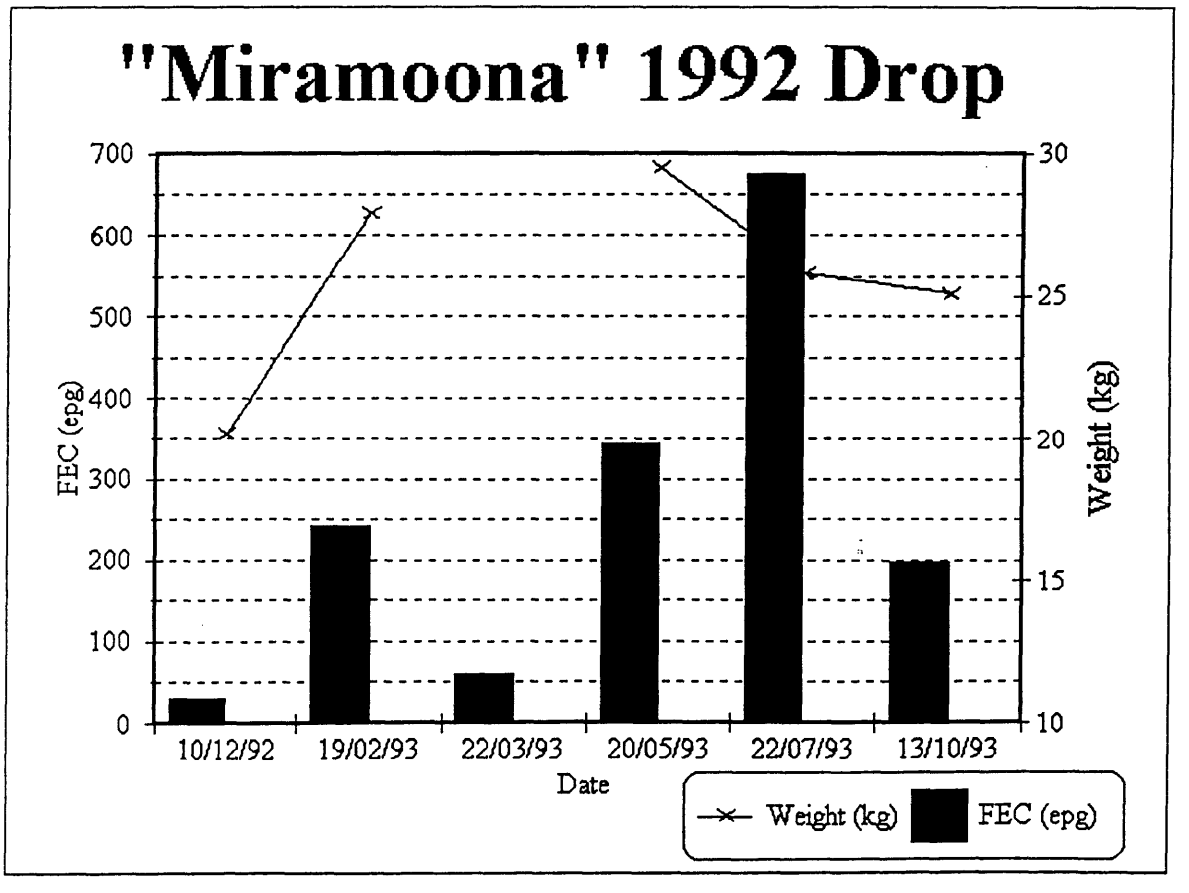
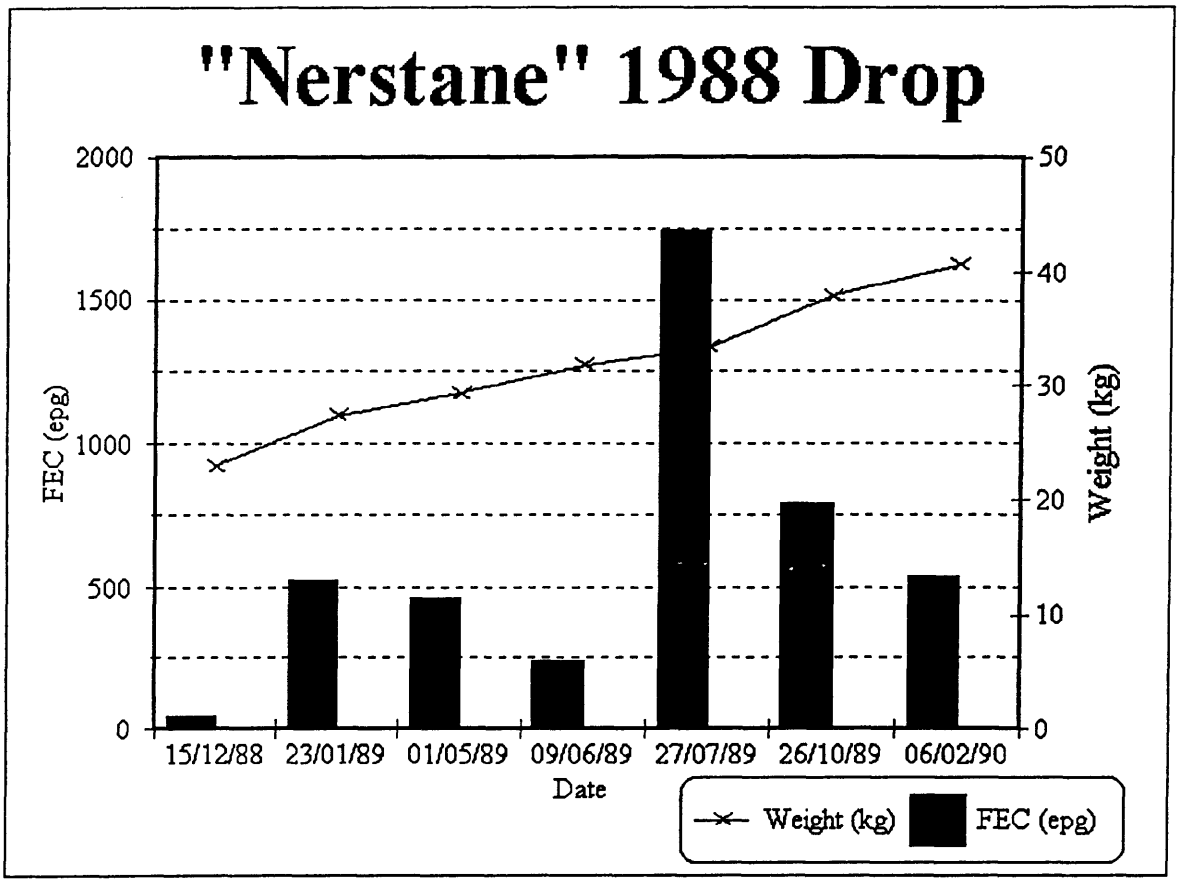
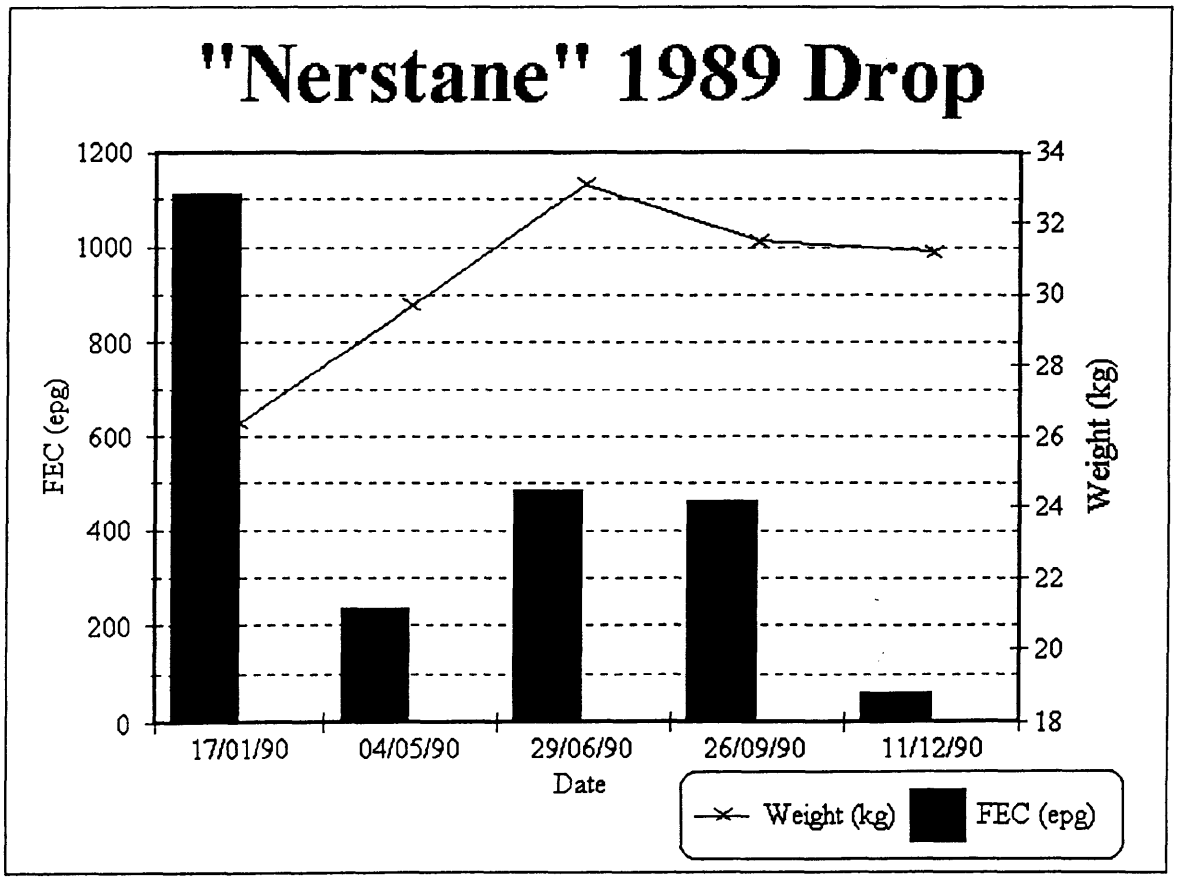
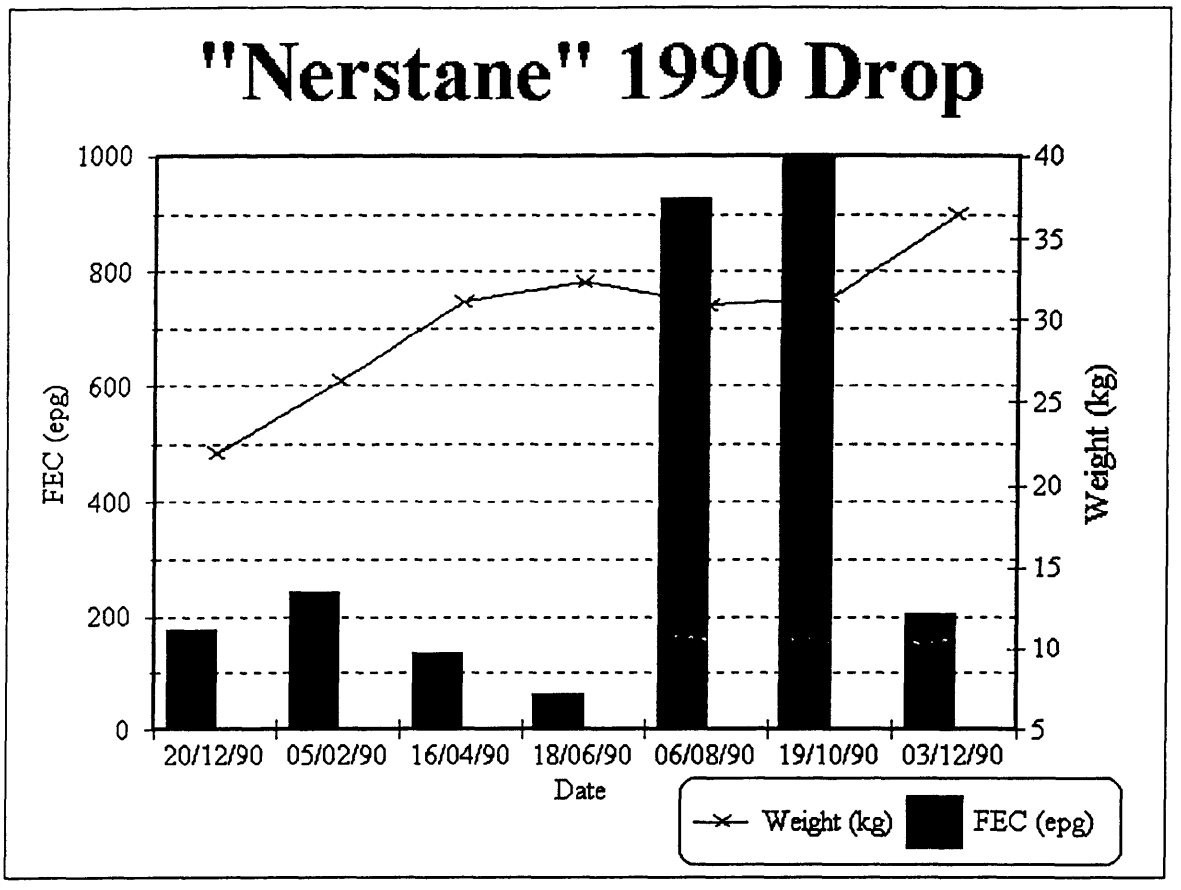
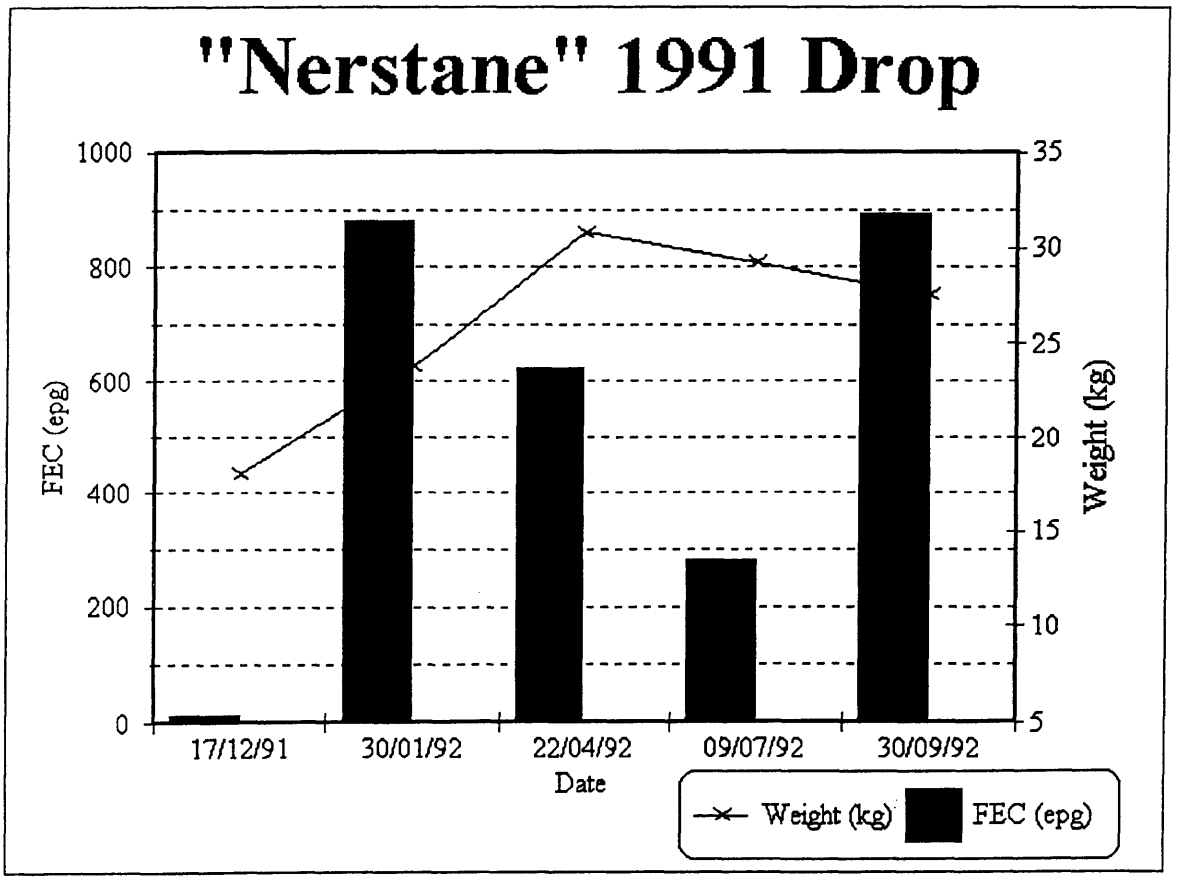

"Miramoona" 1992 Drop
700
600
500
400
300
200
100
0
FEC (epg)
30
25
20
15
10
Weight (kg)
10/12/92
19/02/93
22/03/93
20/05/93
22/07/93
13/10/93
Date
Weight (kg)
FEC (epg)

Figure 4.4 "Nerstane" live weights and FECs - 1989 to 1992 drop.






"Nerstane" 1990 Drop
1000
800
600
400
200
0
FEC (epg)
40
35
30
25
20
15
10
5
Weight (kg)
20/12/90
05/02/90
16/04/90
18/06/90
06/08/90
19/10/90
03/12/90
Date
Weight (kg)
FEC (epg)


"Nerstane" 1991 Drop
1000
800
600
400
200
0
FEC (epg)
35
30
25
20
15
10
5
Weight (kg)
17/12/91
30/01/92
22/04/92
09/07/92
30/09/92
Date
Weight (kg)
FEC (epg)

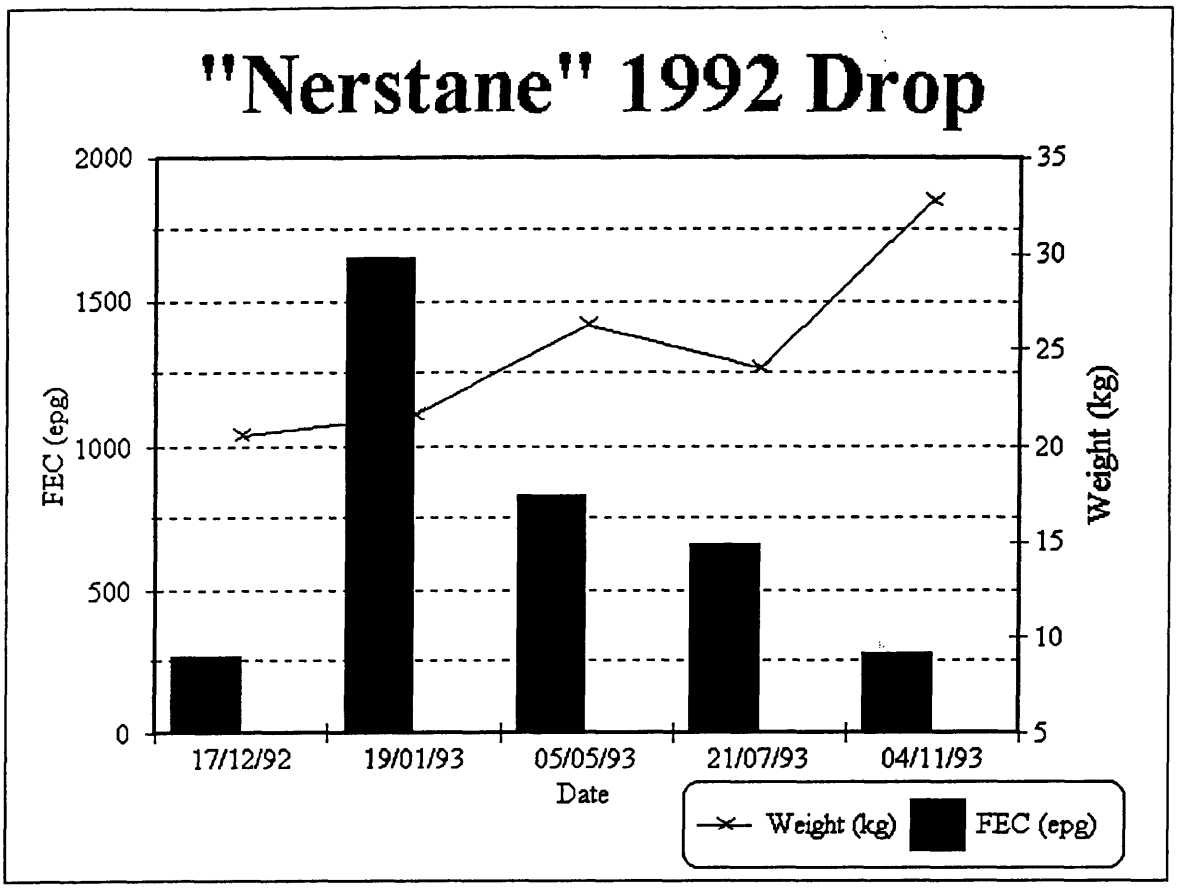
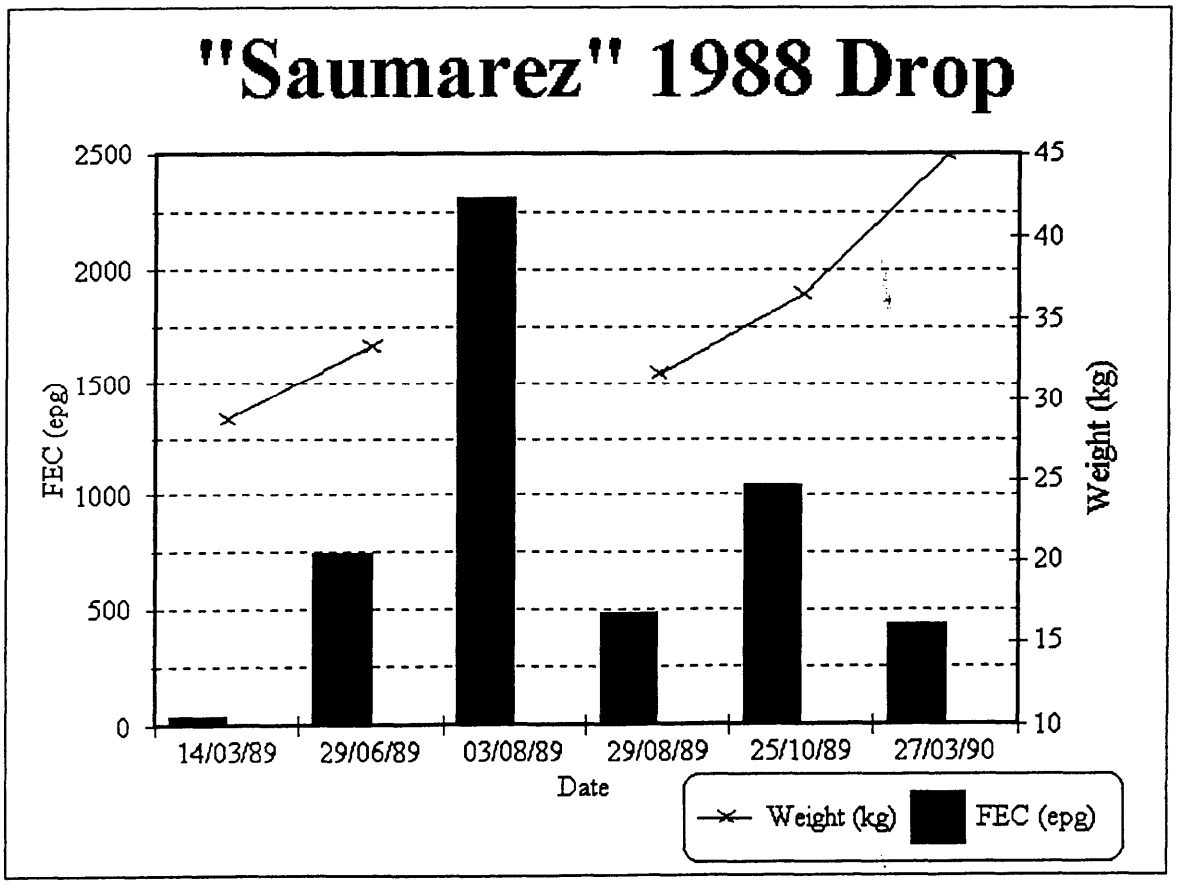
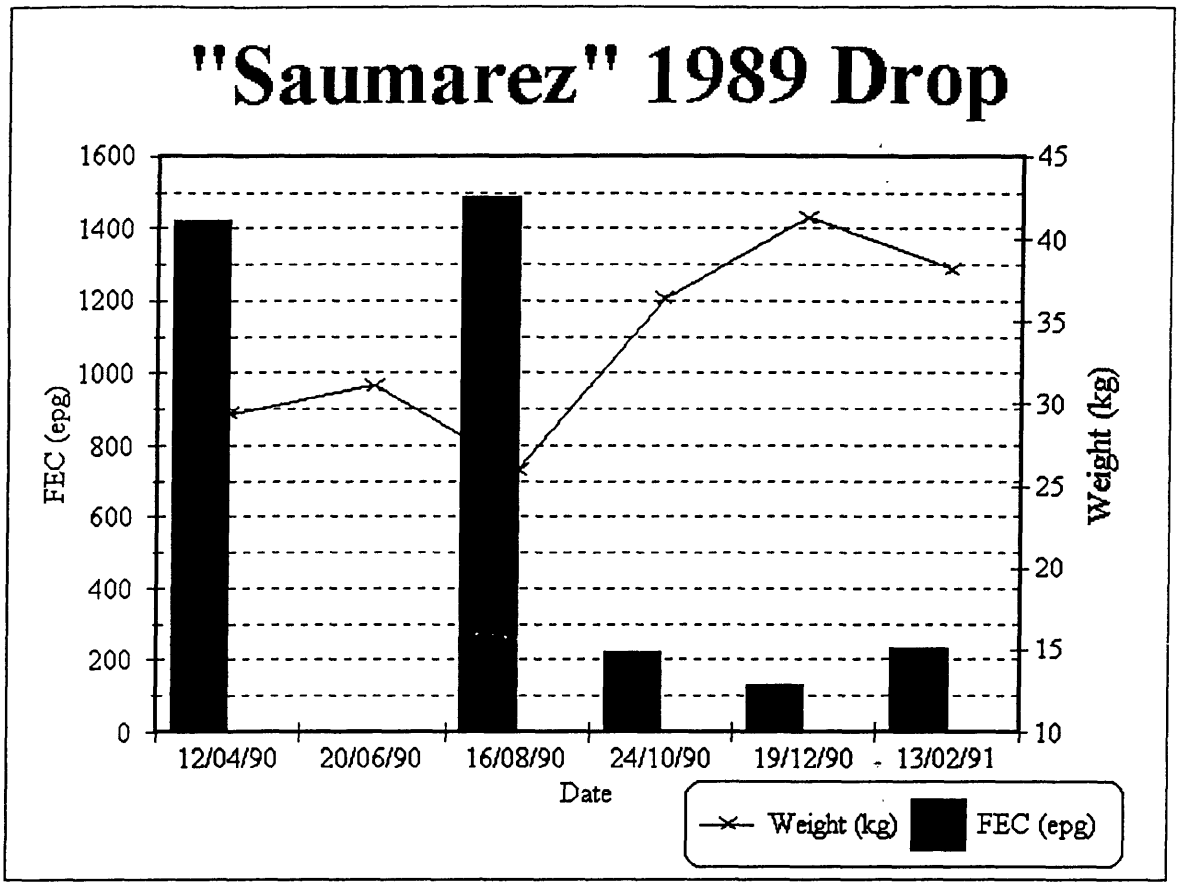
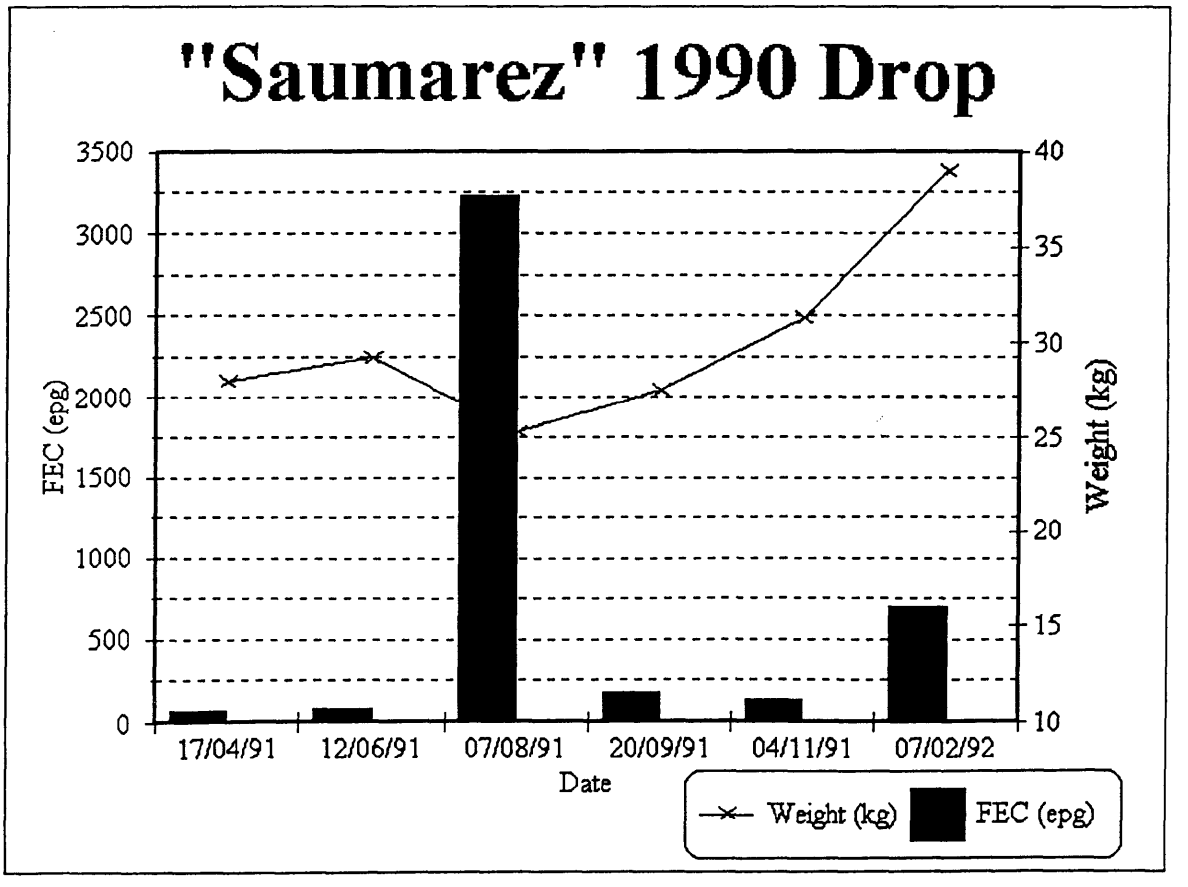
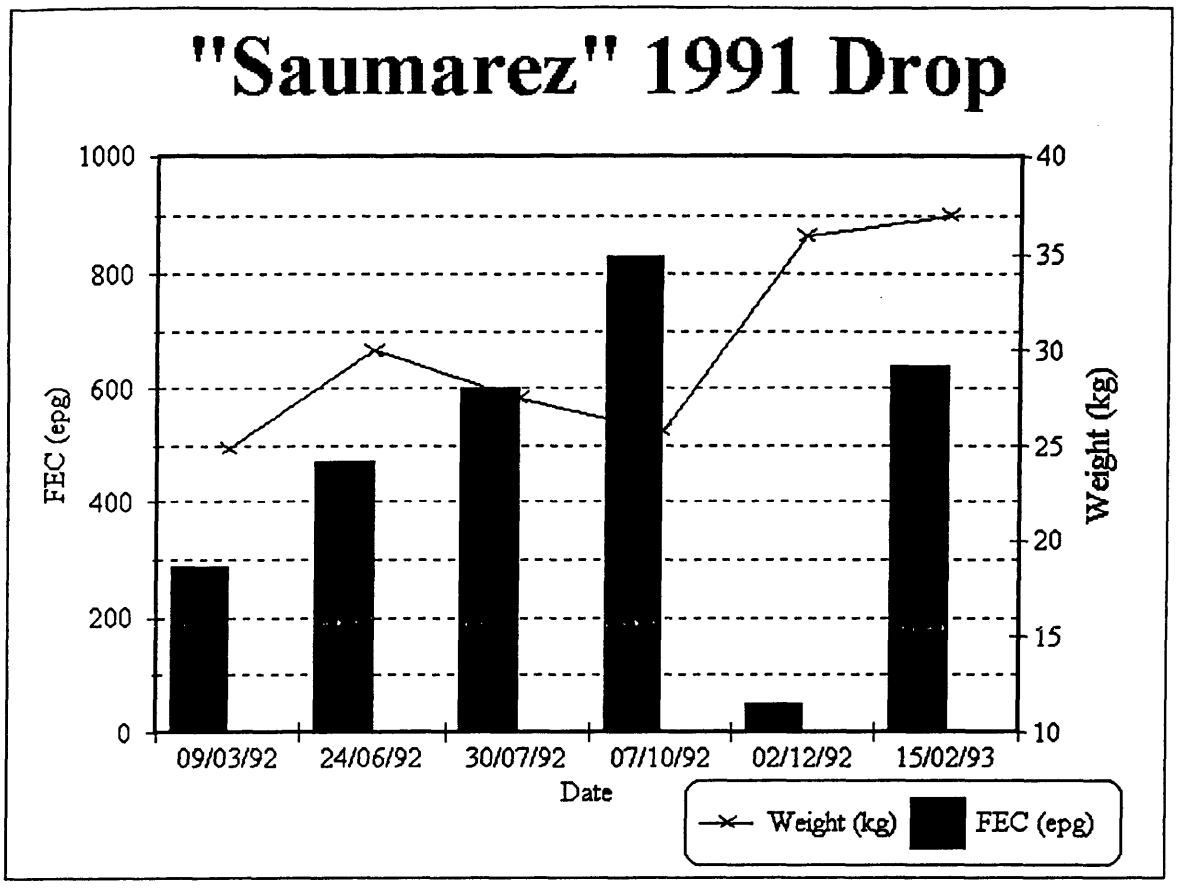


Figure 4.5 "Saumarez" live weights and FECs - 1988 to 1992 drop.




"Saumarez" 1989 Drop
1600
1400
1200
1000
800
600
400
200
0
FEC (epg)
45
40
35
30
25
20
15
10
Weight (kg)
12/04/90
20/06/90
16/08/90
24/10/90
19/12/90
13/02/91
Date
Weight (kg)
FEC (epg)


"Saumarez" 1990 Drop
3500
3000
2500
2000
1500
1000
500
0
FEC (epg)
40
35
30
25
20
15
10
Weight (kg)
17/04/91
12/06/91
07/08/91
20/09/91
04/11/91
07/02/92
Date
Weight (kg)
FEC (epg)


"Saumarez" 1991 Drop
1000
800
600
400
200
0
FEC (epg)
40
35
30
25
20
15
10
Weight (kg)
09/03/92
24/06/92
30/07/92
07/10/92
02/12/92
15/02/93
Date
Weight (kg)
FEC (epg)

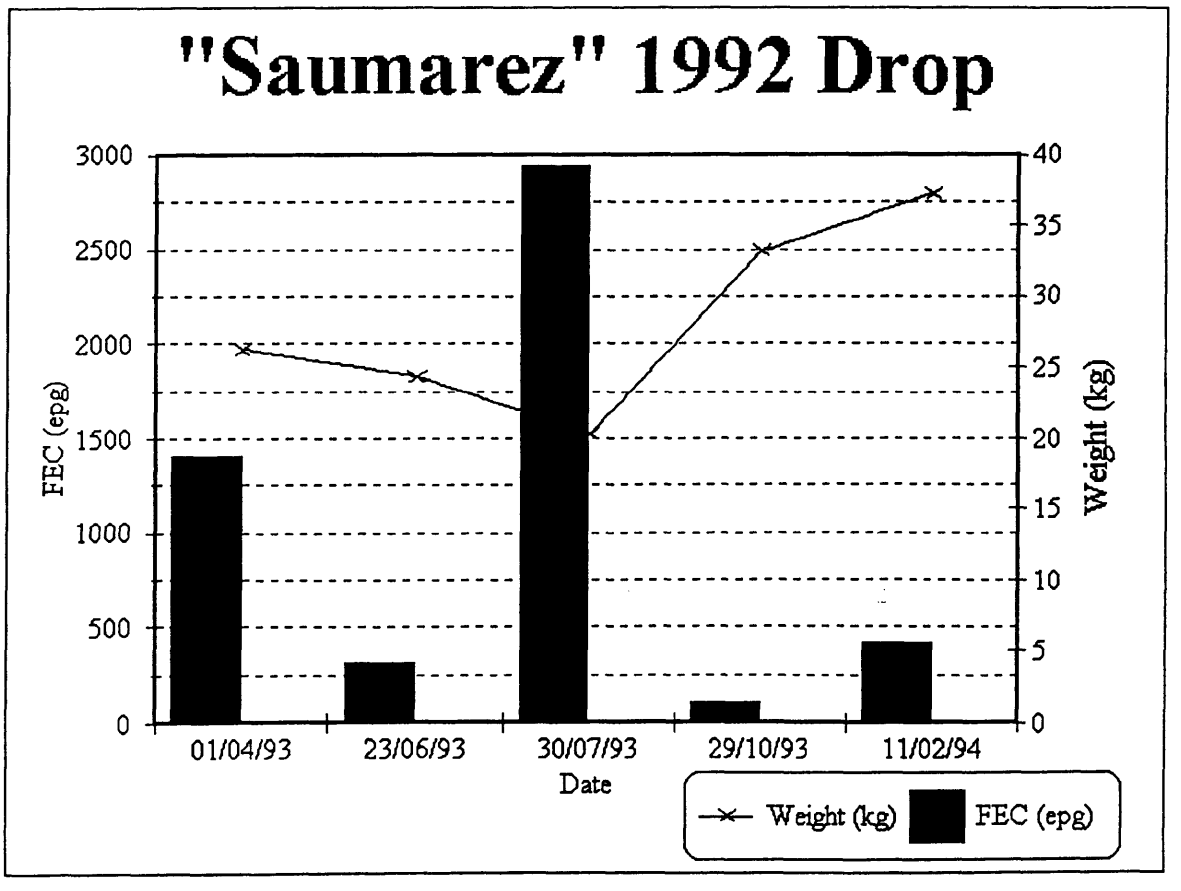
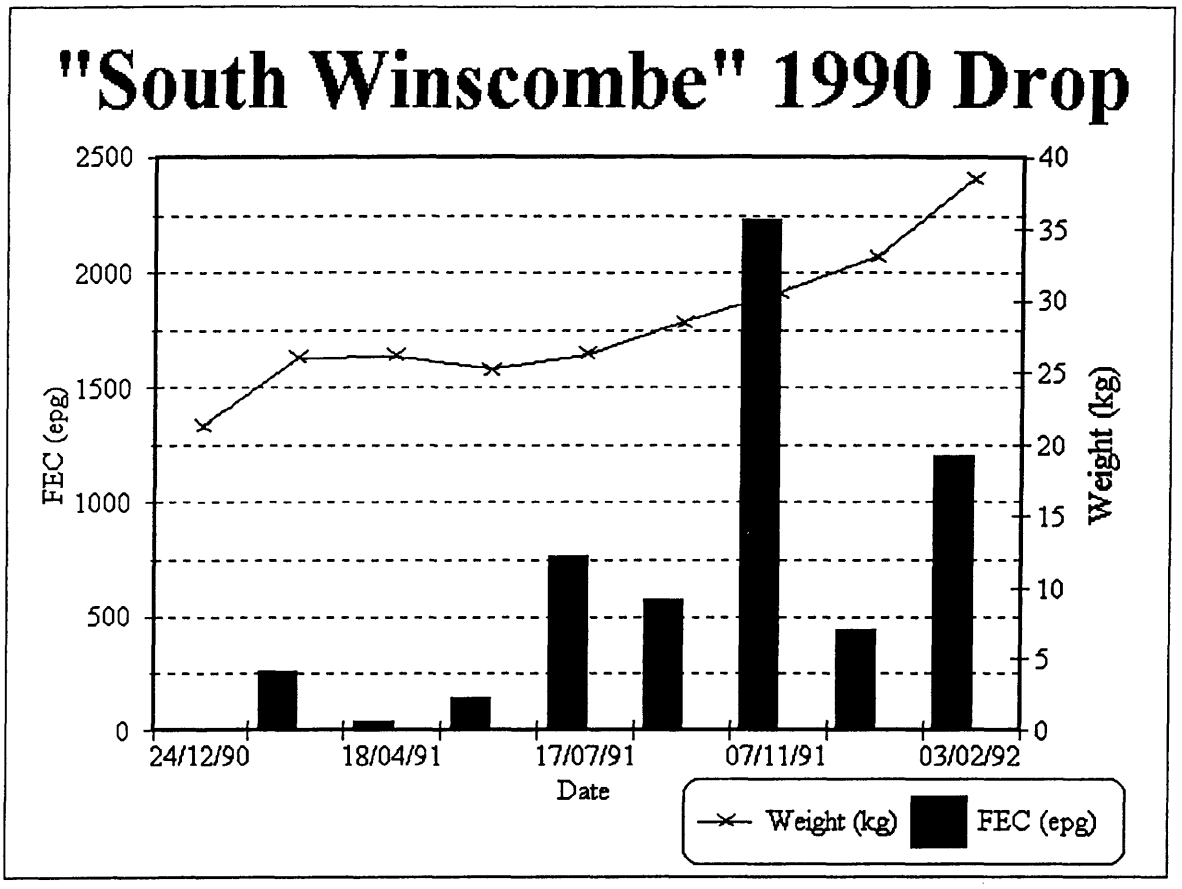
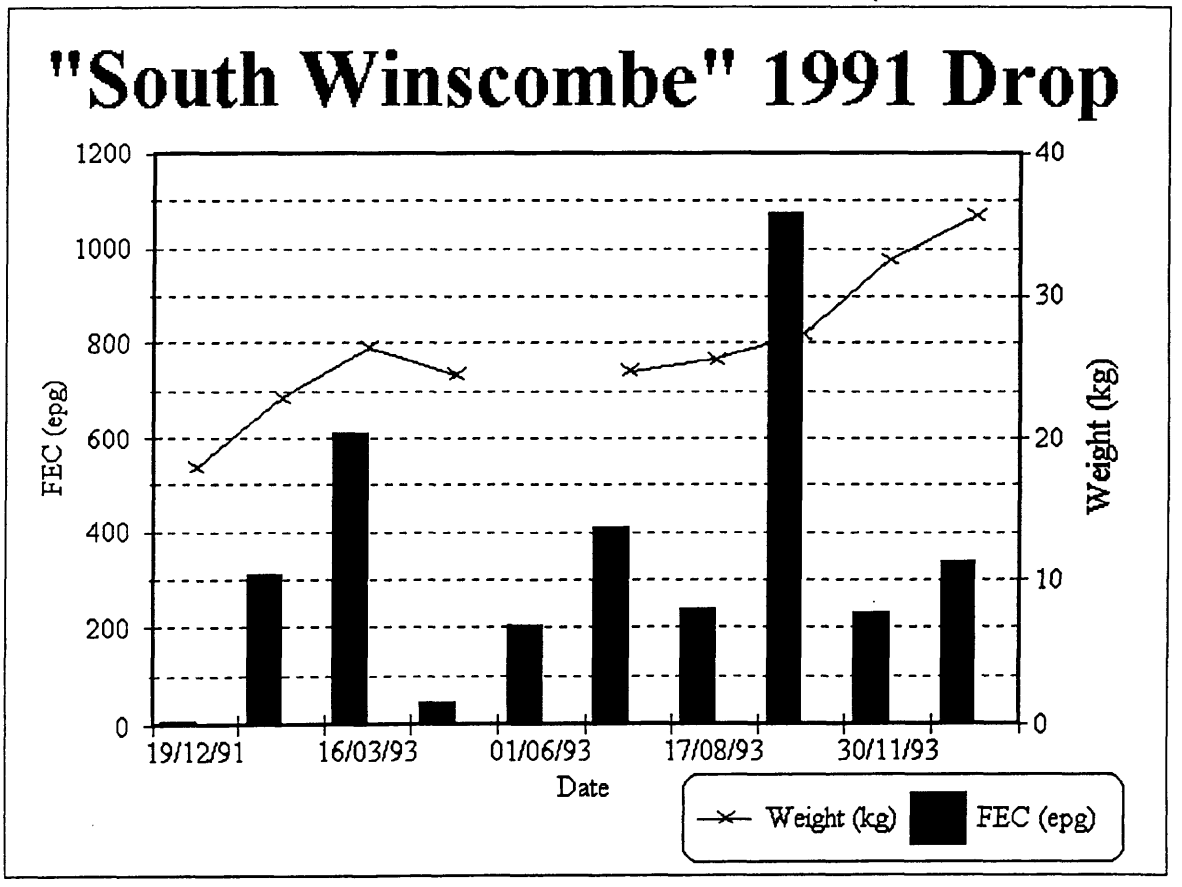
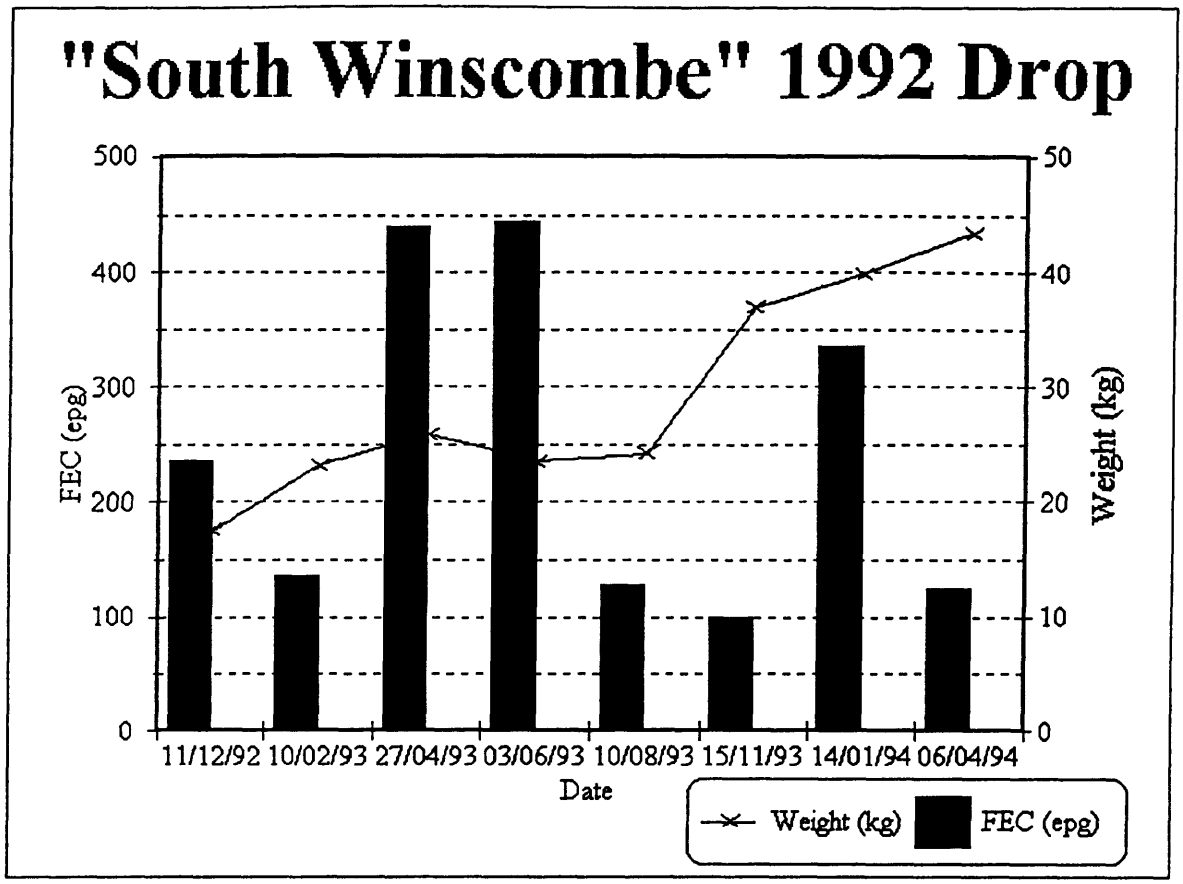
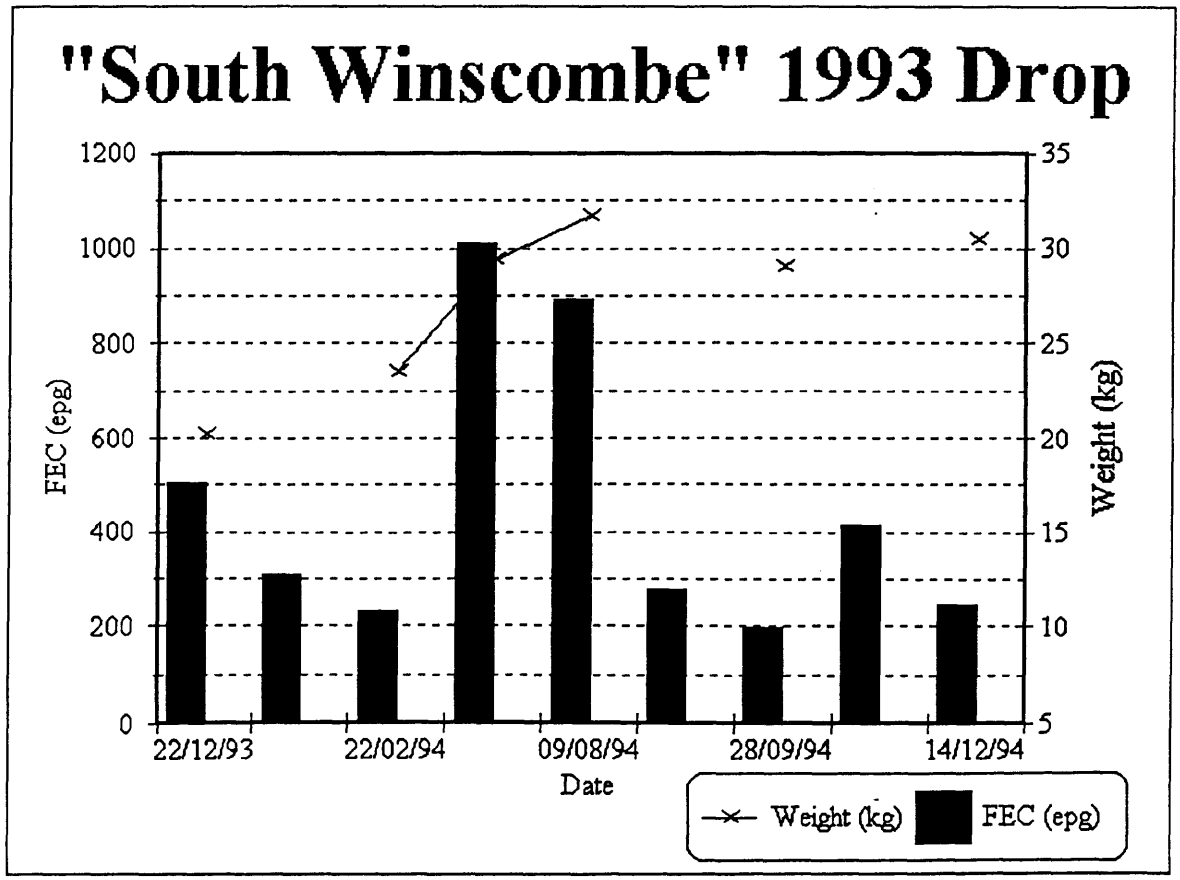

"Saumarez" 1992 Drop
3000
2500
2000
1500
1000
500
0
FEC (epg)
40
35
30
25
20
15
10
5
0
Weight (kg)
01/04/93
23/06/93
30/07/93
29/10/93
11/02/94
Date
Weight (kg)
FEC (epg)

Figure 4.6 "South Winscombe" live weights and FECs - 1990 to 1993 drop.






"South Winscombe" 1992 Drop
500
400
300
200
100
0
FEC (epg)
50
40
30
20
10
0
Weight (kg)
11/12/92 10/02/93 27/04/93 03/06/93 10/08/93 15/11/93 14/01/94 06/04/94
Date
Weight (kg)
FEC (epg)


"South Winscombe" 1993 Drop
1200
1000
800
600
400
200
0
FEC (epg)
35
30
25
20
15
10
5
Weight (kg)
22/12/93 22/02/94 09/08/94 28/09/94 14/12/94
Date
Weight (kg)
FEC (epg)

4.3.2 Statistical Analysis

The statistical analysis are presented in Table 4.1 and what is immediately apparent is that there are no significant correlations.

Saumarez				
VARIABLE 1	VARIABLE 2	SRC	NUMBER	P
Dag Index	FEC	-0.1035	26	n.s
FEC	Weight gain	-0.5539	22	n.s
Dag Index	Weight gain	0.6747	22	n.s
Selenium	Dag Index	0.4286	6	n.s
Selenium	FEC	0.1786	7	n.s
Selenium	Weight gain	-.50	3	n.s
Glenowen				
Dag Index	FEC	0.0125	24	n.s
FEC	Weight gain	-0.015	20	n.s
Dag Index	Weight gain	0.3465	20	n.s
Selenium	Dag Index	-0.828	6	n.s
Selenium	FEC	0.4131	7	n.s
Selenium	Weight gain	0.7207	7	n.s
Nerstane				
Dag Index	FEC	0.6424	23	n.s
FEC	Weight gain	-0.0526	20	n.s
Dag Index	Weight gain	-0.2535	20	n.s
Selenium	Dag Index	0.0252	14	n.s
Selenium	FEC	0.559	12	n.s
Selenium	Weight gain	0.1964	15	n.s
Miramoona				
Dag Index	FEC	0.25.31	30	n.s
FEC	Weight gain	0.3185	25	n.s
Dag Index	Weight gain	0.1643	25	n.s
Selenium	Dag Index	0.1965	14	n.s
Selenium	FEC	0.6	10	n.s
Selenium	Weight gain	0.2308	14	n.s

South Winscombe				
Dag Index	FEC	-0.011	24	n.s
FEC	Weight gain	0.2377	22	n.s
Dag Index	Weight gain	0.1403	22	n.s
Selenium	Dag Index	0.3612	17	n.s
Selenium	FEC	0.1857	15	n.s
Selenium	Weight gain	-0.2735	16	n.s
Mixed				
Dag Index	FEC	0.3146	25	n.s
FEC	Weight gain	0.1249	18	n.s
Dag Index	Weight gain	0.1930	18	n.s

SRC = Spearmans Rank Correlation
ns = Not significant

Table 4.1 *Spearmans Rank Correlation calculated for variables on five individual farms over a four year period, and 4 farms grouped together for one year.*

4.4 DISCUSSION

4.4.1 Liveweights

Figures 4.2 - 4.6 give weight growth curves of weaners over a number of years, and what is apparent is that weaners increase in body weight from weaning until late summer and declined until late winter. There is then an increase over the spring into the following summer. This is consistent with previous studies, a summary of which is given in Figure 2.4. Although no pasture estimates were carried out in this experiment, it is what is to be expected given seasonal pasture growth curves for the district (summarised in Figure 2.3, from Hilder 1956 and Vickery 1972).

These average seasonal pasture growth rates curves are compromised in any one particular situation due to variation in rainfall. The Saumarez trials demonstrate this. In 1989, a good rainfall year, body weights averaged 5 kg higher than in 1992, a declared drought year (Figure 4.5).

4.4.2 Faecal Egg Counts (FECs)

FECs are measured as an indication of nematode infestation at the time. In these trials, FECs were investigated to determine if there was any correlation with some parameters associated with nematode parasitism.

The results give no significant correlations using Spearmans Rank Correlation. This is not surprising as the level of internal parasitism in sheep in any one situation is influenced by a number of factors, and revolves around the host/environment interactions, as discussed in Chapter 2.

Merino weaners are at an age when immunity to parasites is developing (Dobson *et al.* 1990b), however, how the plane of nutrition affects this remains unresolved. Hall (1990), citing on-farm experiences in the New England area, suggested inadequate nutrition played an important role in compromising the development of immunity to *T. colubriformis* in Merino weaners.

High FECs would be expected at weaning time as most weaners have not been drenched until this time. In general, the other period when high FECs are recorded is in the mid-winter period. This is more pronounced on some farms than others. Saumarez (Figure 4.5) demonstrates it is apparent that FECs are high as body weights are falling. As body weights rise into the spring, FECs start to fall. This is also apparent at Miramoona, Walcha (Figure 4.3). The trend is less apparent on other farms. This is due to the other factors overriding this trend.

South Winscombe (Figure 4.6) always has a high nematode count in late summer. This relates to the fact that the pasture becomes long and rank in that area at that time, and to provide suitable feed, weaners are run in paddocks previously eaten down by other sheep at high stocking rates for a period. Very probably, pasture contamination would be peaking at this time (Donald 1968; Waller *et al.* 1993).

4.4.3 Dag Scores

Dag score does not appear to be related to FEC and this confirms previous observations (Larsen *et al.* 1994), that suggested the diarrhoea was due to parasite larvae, which in association with suitable diet high in moisture, low in roughage causes the diarrhoea syndrome.

4.4.4 Selenium Levels

In these trials, selenium levels were not significantly correlated with body weight gain, FEC or DAG Index. It has been speculated that selenium deficiency has been associated with diarrhoea ("selenium responsive" diarrhoea) and weaner illthrift (Plant 1985, Hart 1985).

4.5 CONCLUSION

The overall trend is that sheep lose weight in winter, reflecting pastoral conditions and feed availability. On some occasions, these weights fall to 25 kg level, a level designated as the actual weight weaners require to survive the New England winter (O'Halloran 1990). This low body weight is exacerbated by high parasite burdens (as reflected in high FECs) that occur as a part of the weaner "illthrift" syndrome. It has been suggested (Hall *et al.* 1990) that supplementary feeding would help alleviate this problem. Feed trials on Merino weaners run in the New England Tablelands confirm that feeding with protein supplements reduces production losses and reverses weight losses attributed to *T. colubriformis* infections (van Houtert, Barger and Steel 1995).

Trichostrongylus spp. egg counts are arithmetic means of a group of 10 selected at random from the flock, based on the percentage of *Trichostrongylus spp.* found in bulk cultures.

The year given is the year of birth.