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CYSTICERCUS OVIS SURVEY: SUMMARY OF THREE YEARS' RESULTS

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A SURVEY of the incidence of *Cysticercus ovis* in New Zealand was carried out in 14 selected meat works by officers of the Meat Division and Biometrics Section of the Department of Agriculture during the meat years commencing October 1, 1967, 1968, and 1969. It involved examination of some 778,000 lambs and 526,000 ewes. The detailed information from the 3 years of this survey has been summarized in the tables presented below.

These figures relate to the "incidence" of *Cysticercus ovis* as found under standard meat inspection procedures and hence represent superficial infections only. The actual incidence is much higher than this but the survey figures are indicators of differences in the true level, either over time or between districts.

SEASONAL PATTERN

As shown in Table 1, there is no meaningful pattern in the variation between months or years. The "incidence" (as shown by meat inspection) in ewes is best summarized in the single overall (weighted) mean of 5.9%.

To obtain the means quoted in Table 1 and following tables, each figure was weighted according to the total kill relevant to it. Thus, the 5.9% is not the simple mean of the numbers in the column above it but takes account of the differences over months of the number of animals killed.

TABLE 1: EWES (PERCENTAGE TOTAL INFECTION OVER ALL DISTRICTS)

	Year			
	1967-8	*1968-9*	*1969-70*	*Mean*
Nov.	7.32	5.96	6.40	6.5
Dec.	5.74	7.12	4.23	5.0
Jan.	5.85	5.20	4.96	5.3
Feb.	5.85	5.33	6.48	5.7
Mar.	6.98	6.36	6.84	6.7
Apr.	5.76	5.42	6.44	6.0
May	5.96	4.74	6.75	5.9
Jun.	7.00	5.61	5.92	6.4
Jul.	6.07	4.70	6.11	5.9
Mean	6.18	5.55	5.84	5.9

TABLE 2: LAMBS (PERCENTAGE TOTAL INFECTION OVER ALL DISTRICTS)

	Year			
	1967-8	*1968-9*	*1969-70*	*Mean*
Nov.	0.41	NA	NA	0.4*
Dec.	0.61	NA	NA	0.6*
Jan.	1.34	1.79	1.44	1.5
Feb.	3.41	2.01	3.14	2.6
Mar.	4.07	4.18	5.51	4.6
Apr.	4.17	5.32	5.00	4.9
May	4.85	5.80	6.19	5.7
Jun.	5.78	6.38	5.62	5.8
Jul.	5.88	5.03	5.21	5.4

*From 1967-8 only. NA—not available.

With lambs the pattern is different (Table 2). There is a steady build-up in successive months, similar in pattern in the 3 years. Hence the figures of interest are the monthly means (over the 3 years) and not the average over the whole set as with the ewes.

As suggested by previous experience, and confirmed in the first year's results, the incidence (as detected by standard meat inspection procedures) is low in the early months—partly because of the difficulty in detecting small lesions before calcification—but by autumn it has reached a level of between 5 and 6% at which it remains steady and similar to the overall ewe figure. This suggests that infection is occurring during the first few months of the lamb's life and that, after the animal has survived its first autumn, parasitic immunity may play a part in preventing further infection.

VARIATION BETWEEN DISTRICTS

Tables 1 and 2 give averages over all districts as the pattern through time is similar from district to district. However, the levels at any one time tend to differ between districts. To illustrate this, Tables 3 and 4 give the means for a single month (April, representing the autumn peak) set out by districts. In general, although not always, the

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survey contained a selection of two (from more than two) works within each district. Because of the practice of not necessarily sending animals to the nearest works, the boundaries of districts are not clear-cut (and in particular do not necessarily correspond exactly with the provincial boundaries). This should be borne in mind when examining these figures. However, figures from individual works suffer from the same defect and it is considered better to quote the results on a "per district" rather than a "per works" basis.

TABLE 3: EWES (PERCENTAGE TOTAL INSPECTION, MONTH OF APRIL)

	Year			
	1967-8	*1968-9*	*1969-70*	*Mean*
Auckland	6.66	3.89	6.58	5.6
East Coast N.I.	4.25	9.48	5.80	5.5
Taranaki	3.22	5.37	5.57	5.2
Wellington	5.22	7.11	6.70	6.4
Nelson/Marlborough	8.37	7.95	10.21	9.3
Canterbury	5.69	5.17	7.31	6.5
Otago/Southland	7.15	3.04	4.68	5.6
New Zealand	5.76	5.42	6.44	6.0

With ewes (Table 3), there is considerable variation within a district between years (and, in particular, the low figures for Auckland and Otago/Southland in 1968-9 are confirmed) but the 3-year means are reasonably similar between districts except that the Nelson/Marlborough district is consistently high. This area has the highest observed incidence in 2 of the years and is second in the remaining year.

TABLE 4: LAMBS (PERCENTAGE TOTAL INFECTION, MONTH OF APRIL)

	Year			
	1967-8	*1968-9*	*1969-70*	*Mean*
Auckland	2.76	3.34	1.18	2.6
East Coast N.I.	1.76	5.48	4.94	4.2
Taranaki	4.17	7.57	4.54	5.6
Wellington	5.26	6.75	4.73	5.7
Nelson/Marlborough	7.23	6.69	5.35	6.3
Canterbury	5.62	4.64	6.60	5.7
Otago/Southland	4.38	1.90	5.38	4.9
New Zealand	4.17	5.32	5.00	4.9

With lambs (Table 4) the figures are again fairly similar except that the Auckland district is consistently low and, as for the ewes, the Nelson/Marlborough district has the highest 3-year mean.

LOCATION OF INFECTION WITHIN AN ANIMAL

Incidence in the heart was only slightly lower than in the remainder of the carcass, as is shown by Table 5.

TABLE 5: COMPARISON OF INCIDENCE IN HEART AND CARCASS (EXCLUDING HEAD MEATS AND DIAPHRAGM)

	Year			
	1967-8	*1968-9*	*1969-70*	*Mean*
*Ewes:				
Heart	3.34	2.80	2.99	3.06
Carcass	3.41	3.22	3.34	3.32
*Lambs:				
Heart	1.67	1.75	2.25	1.90
Carcass	1.79	2.04	2.42	2.09

*Ewes averaged over November to July, lambs over January to July.

The figures in this table relate to the presence of infection in a particular site and so cannot be added together to give the total infection as this would count those infected in both areas twice. As would be expected, the incidence of multiple infection is much higher than would be the case if infections in the two sites were completely independent processes.

A more detailed examination of ewes in October 1968 showed that incidence in the diaphragm was much higher than in the head (Table 6).

TABLE 6: COMPARISON OF INCIDENCE IN HEAD AND DIAPHRAGM

Site	*Infection (%)*
Diaphragm	6.00
Masseters	2.10
Tongue	0.76

RELATION WITH DAILY SLAUGHTERING RETURNS

An estimate of the total infection for lambs is available from the daily slaughtering returns from all works and abattoirs for days on which a survey was carried out. (A similar estimate is not available for ewes as the daily slaughtering returns give only combined figures for *Cysticercus ovis* infection in all sheep other than lambs). The two estimates for January to July 1969 are compared in Table 7. A similar effect was observed in the other years.

TABLE 7: COMPARISON OF SURVEY RESULTS AND DAILY RETURNS—LAMBS

Month	*Survey*	*Daily Returns*
Jan.	1.79	1.06
Feb.	2.01	1.12
Mar.	4.18	2.88
Apr.	5.32	3.51
May	5.80	3.52
Jun.	6.38	3.19
Jul.	5.03	2.75

Individual works tend to fall into one or other of three almost equal classes as regards correlation of the two estimates:

Daily return agrees with survey total infection

Daily return agrees with survey carcass infections only, or

Daily return much less than survey estimate.

RESULTS FROM DETAILED EXAMINATION OF CARCASS

During the second year of the survey (1968-9) a further secondary survey was carried out. From November to May, in some works each month, detailed post-mortem examinations of a small number of carcasses, condemned for reasons other than *C. ovis*, were conducted to see whether they contained *C. ovis* cysts. Because of the intensive examination required to detect small numbers of deep-seated cysts, no more than one carcass could be examined per day and in some months only one works participated. Results are given in Table 8.

TABLE 8: INFECTION RATE IN CARCASSES SHOWING NO SUPERFICIAL LESIONS

Month	*No. Carcasses Examined*	*No. Found to Contain Cysts*	*% Infection*
Nov.	23	6	26
Dec.	12*	5	42
Jan.	28	9	32
Feb.	81	16	20
Mar.	15*	3	20
Apr.	16*	8	50
May	15*	3	20
Total	190	50	26

*One works only.

There is no observable time trend in these data. The results are extraordinarily high in comparison with the general figures found in the survey (which in turn tended to be about 50% greater than that recorded on the routine daily inspection sheets).

It is clear that the survey figures are indicators only and that the true incidence of *C. ovis* is much greater than that suggested by statistics from standard meat inspection procedures.

Because of their nature, only a small proportion of infections, those that have produced obvious superficial lesions, are detected under routine meat inspection procedures.

SUMMARY

Cysticercus ovis infection in sheep, as detected by standard meat inspection procedures, has been shown to rise steadily until the lamb's first autumn when it reaches a level of 5 to 6% but remains fairly stationary from then on. This suggests that animals not infected by this stage may have developed an immunity to the infection.

Infections in the heart are only slightly less than in the remainder of the carcass, excluding the head and diaphragm. Incidence of infection in the head (masseters or tongue) is lower than the 6% incidence found in the diaphragm.

Comparison of the survey results with the corresponding daily returns, and results of detailed post-mortem examination on carcasses with no obvious *C. ovis* infection, shows that the survey results are indicators only. They very seriously underestimate the true incidence of *C. ovis* infection — although, in turn, are some 50% higher than the incidence of observed infections under standard meat inspection procedures.

It is clear that the true incidence of *C. ovis* is alarmingly high—perhaps five to ten times that suggested by statistics based simply on routine inspection.

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