4.0 RESULTS

4.1 Dairy farmer interviews

Farms ranged in size from 70 to 312 hectares and most had always operated as dairy farms (Table 3). All farms had a large number of small paddocks with the range of average sizes between 1.2-3.6 hectares. More than half the farms had been "in the family" for at least two generations but there was a wide range in the period of time that the present owners/managers had managed properties (Table 3).

Table 3. Size and tenure attributes for dairy farms where interviews were conducted with landholders (n=28 farms).

Attributes	Response
Farm size	70-312 ha
Time under current manager	1.7-46 yrs
Percentage of farms passed down through the family	56%
Always operated as a dairy farm	88%
Total number of paddocks	24-66
Mean size of paddocks	1.2-3.6 ha

There was a wide range in the size of milking herds (110-581 cows), and the mean annual stocking rates ranged from 25 to 73 DSE per hectare (McLaren 1997) (Table 4) (see Appendix 7 for DSE conversion rates). Three-quarters of the managers employed 12-hour rotations of cows in grazing paddocks. All farmers interviewed removed cows from paddocks when they were very wet.

Table 4. Milking herd size and stock management practices on dairy farms where interviews were conducted with landholders (n=28 farms).

Management practices	Response
Milking herd size	110-581 cows
Annual stocking rate	25-73 DSE/ha
Percentage of total farm area allocated to milking herd	70-100%
Percentage of farms using 12 hour rotation	76%
Adoption of on/off grazing on wet paddocks	100%

Sixty percent of farmers interviewed had ponds to hold milking shed effluent and more than two-thirds of farmers used this effluent to irrigate pastures. Nearly a third of farmers interviewed either allowed effluent to move directly on to pastures from the dairy shed or had no effluent management system (Table 5). All farmers

interviewed used some form of fertiliser to increase production on paddocks adjacent to rivers/creeks (Table 5).

Table 5. Irrigation and effluent management practices on dairy farms where interviews were conducted with landholders (n=28 farms).

Management practice	Response
Percentage of farms using irrigation	80%
Percentage of farms using effluent for irrigation	68%
Most common method of irrigation	Spray irrigation
Dairy effluent systems in use:	
• Single pond	28%
• Two ponds	32%
• Direct to pasture	24%
• No system	8%
• Other	8%
Frequency of cleaning of effluent systems*	
• Daily	28%
• 2-3 times per year	16%
• Once yearly	16%
• Less than annually	24%
Percentage of farms that apply fertilisers to river/creek frontage paddocks	100%

* Some participants declined to answer this question and percentages are calculated based on those that did.

More than half of the farmers interviewed had more than one river/creek frontage on their property but less than 20% of those interviewed used these rivers/creeks as the main watering points for livestock (Table 6). However, on most farms the milking herd had access to a majority of the total farm area (Table 4) and in most cases cows readily accessed riparian habitats. Most farms were subject to flooding in most years and floodwaters inundated significant areas of these relatively small properties (Table 6). The majority of farmers had put in place some fencing initiatives to reduce stock access to river/creek frontages. This often included alternative watering points for livestock and fencing-off of riparian areas. The most common reason given for fencing was to prevent stock accessing neighbouring paddocks (Table 6). However, most fenced off riparian areas were replanted with native plants (Table 6), indicating a conservation perspective among farmers.

Table 6. Attributes of river/creek frontages and management practices related to riparian areas on dairy farms where interviews were conducted with landholders (n=28 farms).

Management practice	Response
Percentage of farms affected by flooding	60%
Distance floodwaters can reach laterally from creek bed	20-500m
Mean distance from river/creek frontage to other watering points	40-400m
Percentage of farms with more than one river/creek frontage	56%
Percentage of farms that use river/creek as main watering points	16%
Percentage of farms with some fenced river/creek frontage	84%
Percentage of fenced areas replanted with trees	76%
Most common reason for fencing river/creek frontage	Prevent stock accessing neighbouring paddocks
Most common method of weed management in fenced areas	Spot spraying
Percentage of farms where fencing river/creek frontage reduced time required for stock management	72%

Nearly three-quarters of farmers interviewed indicated that fencing of riparian areas resulted in a significant time saving in stock management, and fencing and other new resource management initiatives focused on the riparian zone were generally (84% of those interviewed) seen to be positive in terms of cost effectiveness (Table 7).

Table 7. The introduction of new resource management practices on dairy farms where interviews were conducted with landholders (n=28 farms).

Management practice	Response
Newly adopted land management practices resulting in improved farm environment*	
• Fencing of remnant vegetation	32%
• Fencing waterways	40%
• Tree planting	36%
• Grazing techniques	56%
• Fertiliser plans/soil tests	64%
• Other**	44%
Most common effect of these new practices	Increased production
Cost effectiveness of new practices	
• Cost positive	80%
• Cost negative	4%
• Cost neutral	16%
Percentage of owners who were Landcare members	68%

* Multiple answers for this question

** Examples include pasture renovation, re-fencing and installation of water troughs.

Many of the farmers interviewed had introduced a range of new farm practices to both increase production and conserve resources. Sixty-four percent used soil testing to monitor nutrient levels in pastures and more than half had introduced new grazing rotations and installed new water troughs. A third of those interviewed had recently fenced-off remnants of native vegetation and streambanks to control livestock (Table 7).

4.2 Condition of riparian sites and relationships with dairy farm management

General patterns

With the exception of some sites in patches of remnant vegetation most riparian sites on dairy farms across south and west Gippsland were in very poor condition (Fig. 3). This was particularly true for grazed sites where livestock had direct access to streams and associated riparian habitats. Generally, most planted sites were in very poor condition. Most fenced remnants of well-developed riparian forest were in good to excellent condition (Fig 3).

When riparian sites on dairy farm sites were considered according to topographic categories (flat or hilly country) and the context of the four major management land management practices it was clear that topography had no significant effect on mean condition index scores (Fig. 4). However, there were significant differences between management practices and riparian sites. Remnants were in better condition than those in planted sites, which in turn were in better condition than those sites that were grazed. Grazed sites in both topographic categories had means scores below 15 out of a possible maximum score of 50 (Fig. 4; Table 8).

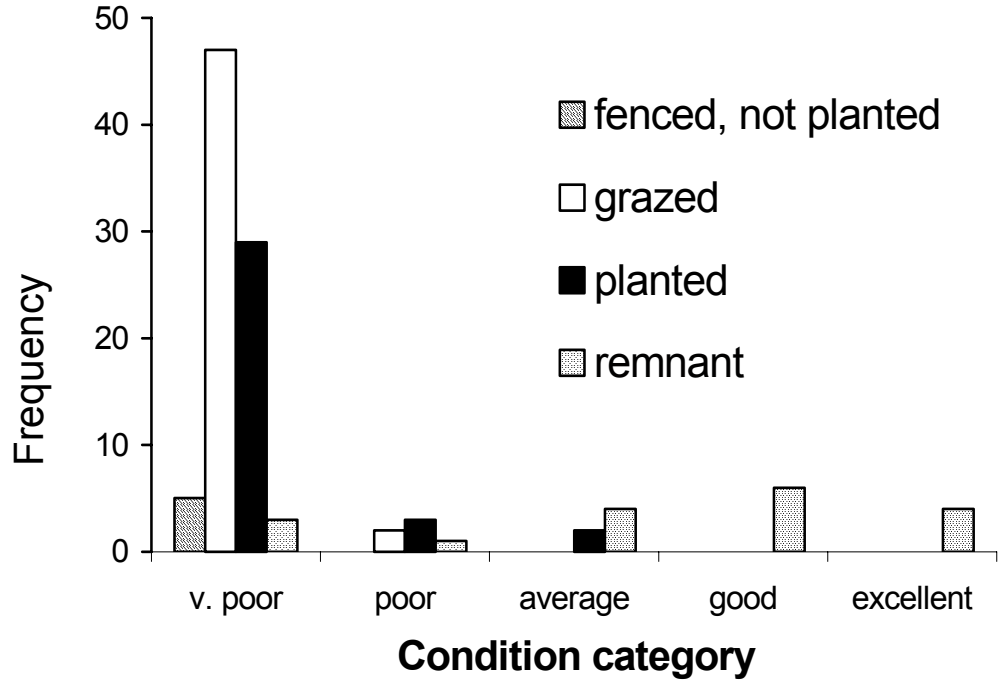

Figure 3. Frequency of condition index score categories for riparian sites subject to different management on dairy farms in south and west Gippsland. Data pooled over flat and hilly regions.

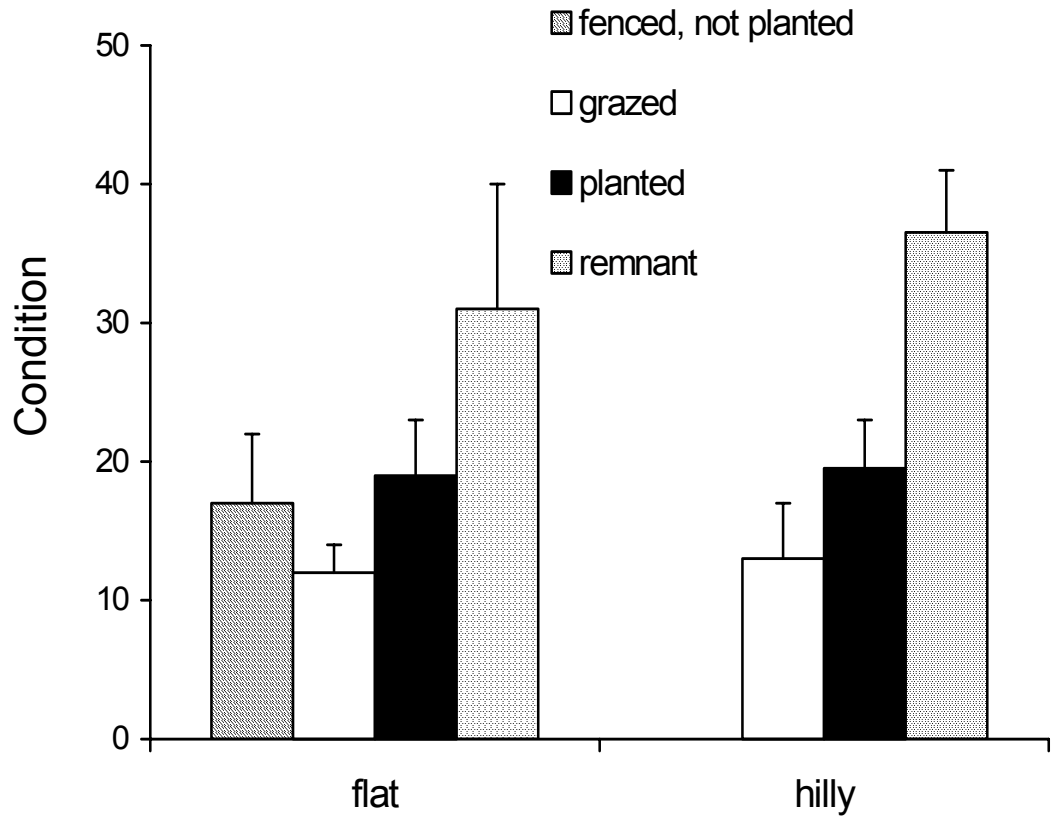

Figure 4. Mean (+ 95% CL) condition index scores for riparian sites subject to

different management on dairy farms in flat and hilly regions of west and south Gippsland.

Table 8. Analysis of variance for condition index scores for riparian areas subject to different management on dairy farms in flat and hilly regions of south and west Gippsland. ***, p < 0.001; g=grazed, p=planted, r=remnant. Note, fenced but not planted sites were not included in the analysis.

Source of variation	**SS**	**df**	**MS**	**F**	**Post-hoc comparisons**
Management regime	5724.4	3	1908.1	50.1***	r > p > g
Error	3880.7	102	38.0		
Total	46701.5	106			

Table 9. Summary of analyses of variance for mean scores of the five components of the condition index in riparian sites under management (r= remnant sites, p=planted sites, g=grazed) on dairy farms in different regions (flat, hilly) of south and west Gippsland. **, p < 0.01; ***, p < 0.001; ns = not significant. Results of post-hoc comparisons of means are also shown.

	Components of Condition Index				
Factor	**HABITAT**	**COVER**	**NATIVES**	**SPECIES**	**DEBRIS**
Slope type (S)	** **hilly>flat**	ns	p=0.058 **hilly>flats**	ns	ns
Management (M)	*** **r>p>g**	*** see below	*** **r>p>g**	*** **r>p=g**	*** **r>p=g**
Interaction (S x M)	ns	** Condition at **g** and **p** sites in hilly regions less than in flat regions. Condition at **r** sites in hilly regions greater than in flat regions	ns	ns	ns

Subindices of the overall index of condition contributed in different ways to total index scores (see Appendix 8a-b). Thus, the mean scores of several of the components of the overall index exhibited different patterns with respect to terrain and management practices (Table 9). The mean condition scores for the HABITAT (=

habitat continuity and extent) and NATIVE (=dominance of natives versus exotics) components were significantly greater in hilly sites than in flat sites, while overall mean scores were greater for remnants than replanted sites and those for replanted sites were greater than for grazed sites. For COVER (=vegetation cover and complexity) mean scores at grazed and replanted sites in hilly regions were less than they were in flat regions, while remnant sites in hilly regions had greater mean scores than those in flat regions. Mean scores for SPECIES (=indicative species) and DEBRIS (=standing and fallen debris) components showed similar patterns to the overall condition index (Tables 8 and 9).

For fenced and planted sites we wished to explore how long was required for riparian condition to approach that of reference sites in the region (mean condition score for the seven reference sites = 37). Our data (Fig. 5) indicates that there exists a strong positive correlation between planting age and riparian condition scores, but that it takes more than 16 years for planted sites to approach excellent condition (i.e. an index score >40).

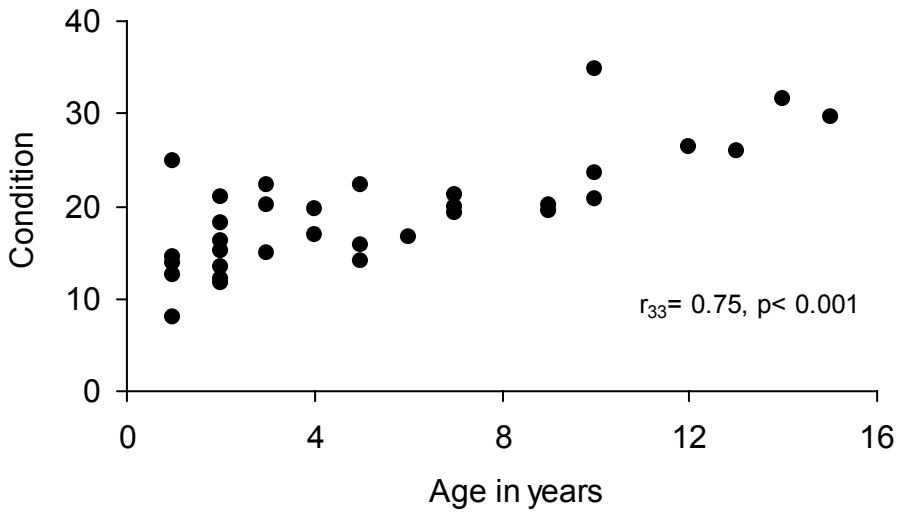

Figure 5. Condition index scores for fenced and replanted riparian sites of different age (since restoration) in flat and hilly regions of west and south Gippsland.

Relationships with other aspects of farms and their management

For those farms for which we had accurate information on annual stocking rates derived from interviews with farmers it was clear that there was no relationship between stocking rates and the condition index for riparian sites subject to grazing by livestock (Fig. 6).

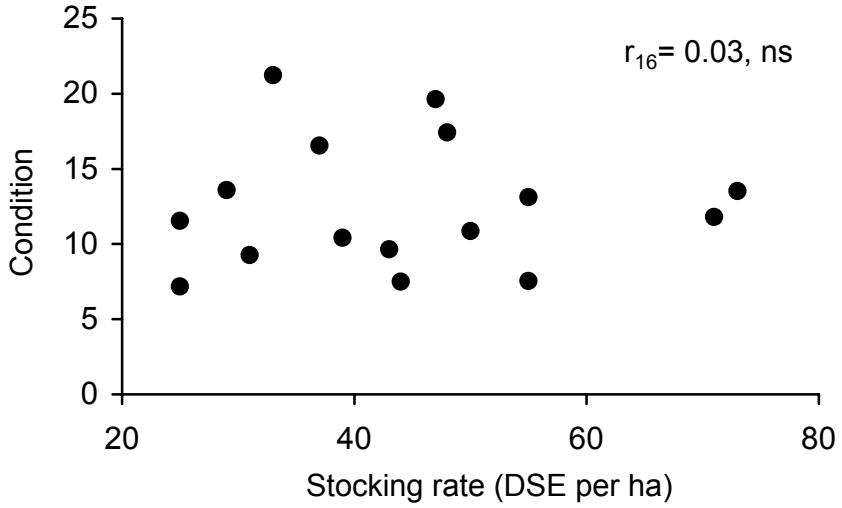

Figure 6. Condition of riparian sites plotted against the mean annual stocking rate (Dry Sheep Equivalents per hectare) for the dairy farms on which interviews and surveys were conducted. Data for grazed sites only.

Because average stocking rates are not necessarily a good predictor of cattle activity near water, we also investigated the relationship between the density of cowpats and condition at a number of riparian sites that were grazed (Fig. 7). There was only a very weak relationship between the two variables. Interestingly, there was a stronger negative relationship between cowpat densities and the index of riparian condition for sites that had been fenced and replanted (Fig. 8), although the level of significance of the relationship was obviously influenced by the large number of sites with zero cowpats. Clearly cows had accessed many replanted sites prior to the surveys and many sites were fenced at the top of the bank so cowpats were still counted outside the fence and condition was poorest at sites with greater densities of cowpats.

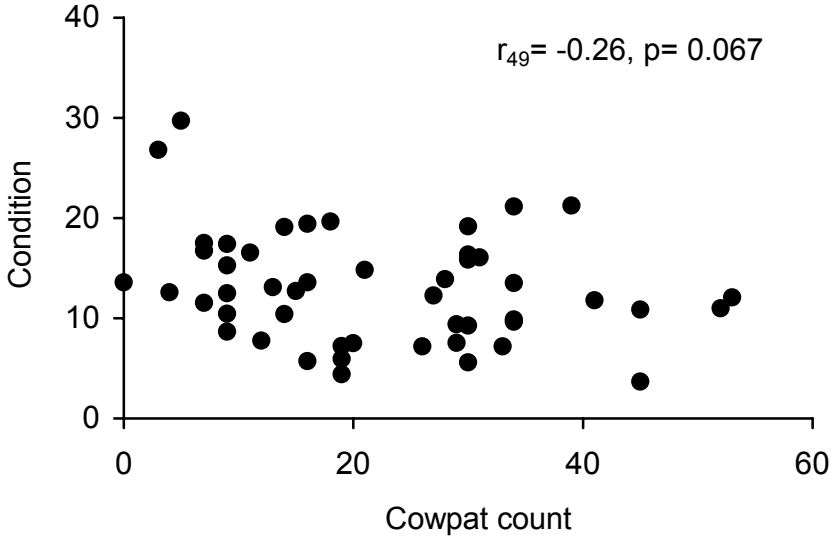

Figure 7. For grazed riparian sites, condition plotted against the number of cowpats (used as an indicator of cattle activity).

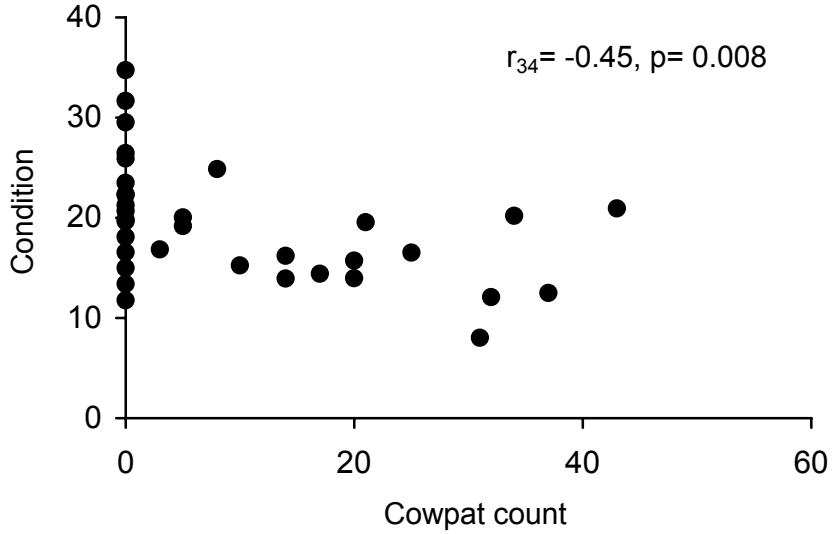

Figure 8. For planted riparian sites, condition plotted against the number of cowpats counted at the site (used as an indicator of cattle activity). Although fenced-off, half of the planted sites (17 of 34) had been accessed by cattle or were very narrow plantings.

There was a significant, positive relationship between the value of the riparian condition index and the distance of the riparian survey site from the dairy shed (Fig. 9). However, there was no relationship between the value of the condition index and the distance to the nearest artificial water sources (such as troughs or dams) (Fig. 10).

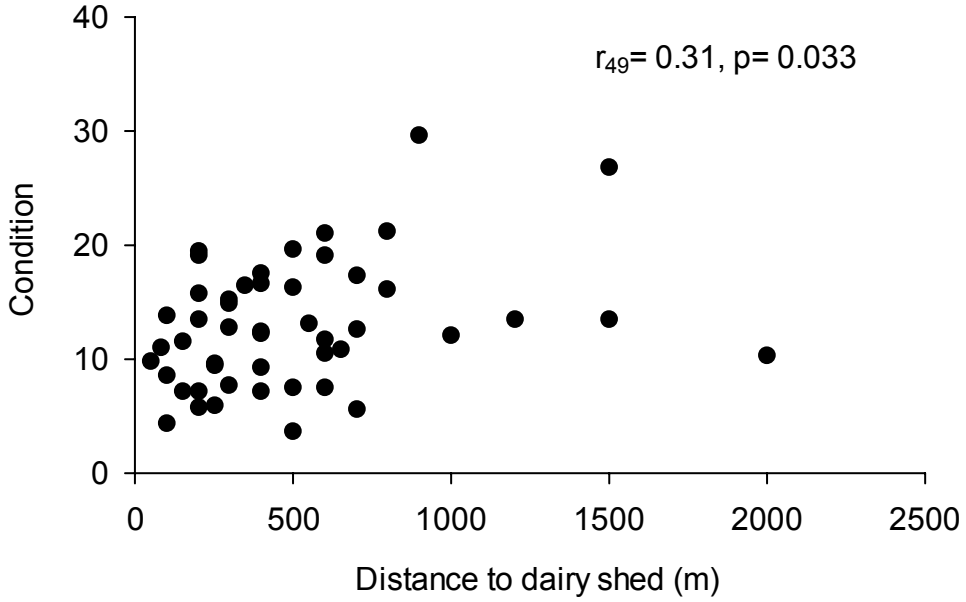

Figure 9. The condition of riparian sites plotted against the distance from the riparian site to the dairy shed used for milking. Analysis restricted to sites subject to grazing by the dairy herd.

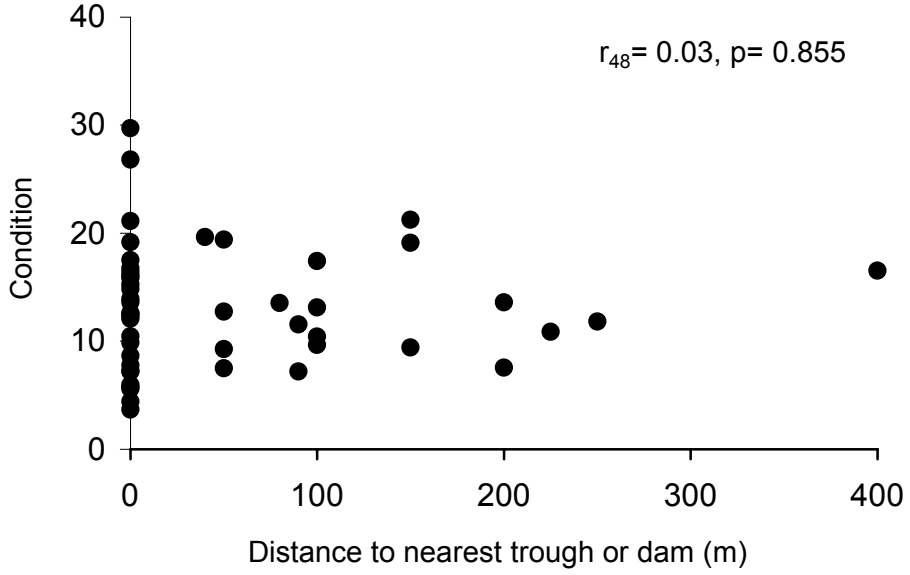

Figure 10. The condition of riparian sites plotted against the distance from the riparian site to the nearest artificial watering point (trough or dam). Analysis was restricted to sites subject to grazing by the dairy herd.

There were no significant relationships between farm size (Fig. 11) or the area of the farm used by the milking herd (Fig. 12) and the index of condition of riparian sites.

This was maintained for sites that were grazed and sites that were fenced and replanted.

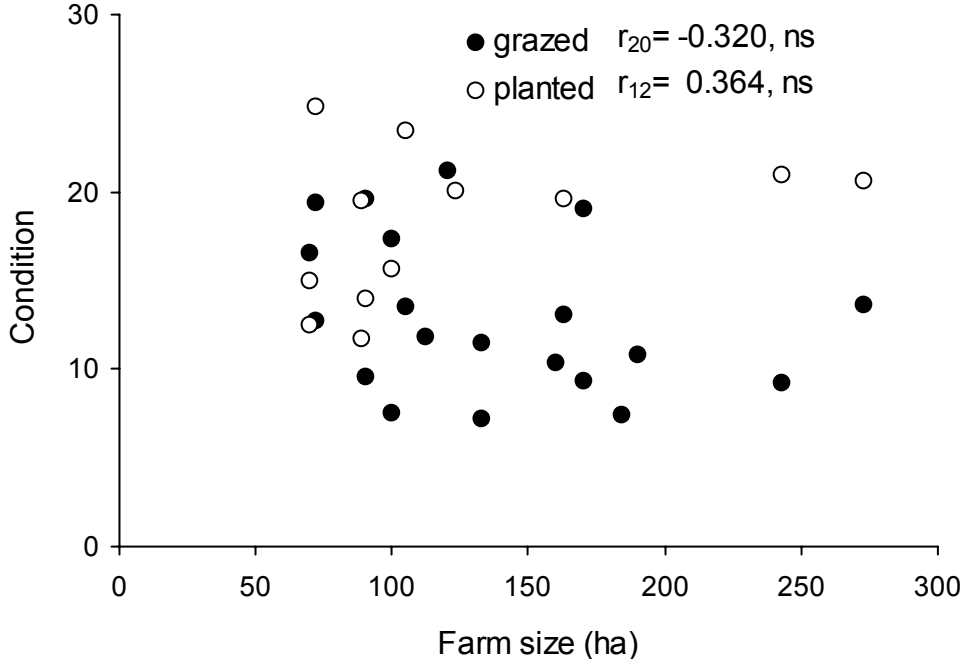

Figure 11. Condition of grazed and planted (fenced) riparian sites on dairy farms plotted against total farm size (ns = not significant).

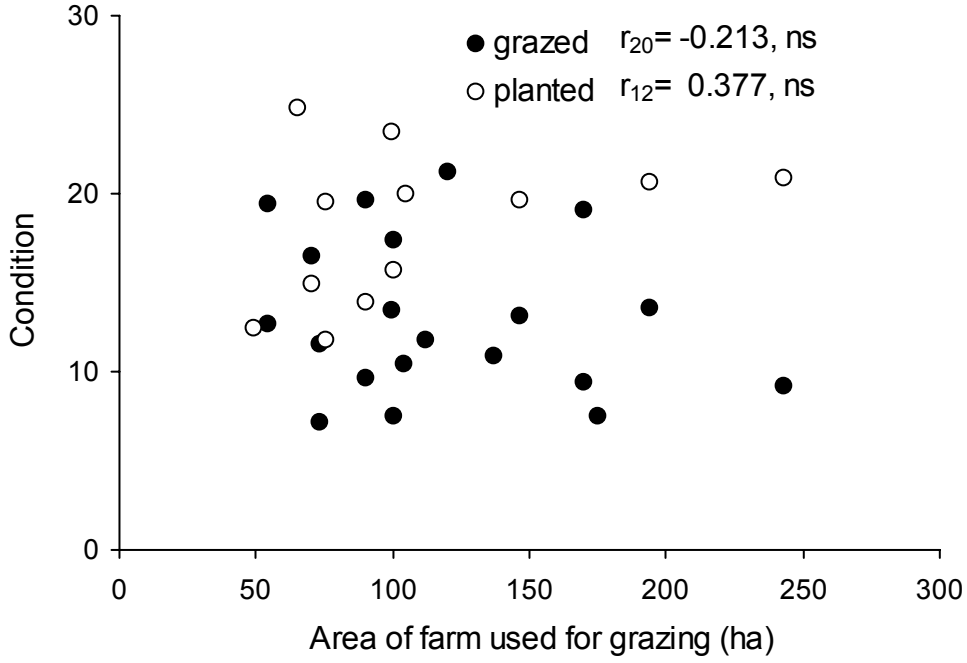

Figure 12. Condition of grazed and planted (fenced) riparian sites on dairy farms plotted against the area of the farm used for grazing (ns = not significant).

We plotted the condition index scores for remnant patches of riparian vegetation against the width of the riparian remnants in order to determine if there was a relationship that might suggest optimal design for rehabilitation sites on dairy farms in the study region. As we measured the total width of remnants we plotted half of the width (i.e. one side of a creek/river). Although there is a significant linear correlation between the two variables (r_{18}= 0.65, p=0.0036) the results reveal a relationship where condition index values appear to reach an asymptote between 30 and 40 metres (Fig. 13). However, caution is required when interpreting this relationship, as the maximum condition index score we recorded in these remnants was 33.25 out of a possible 40.

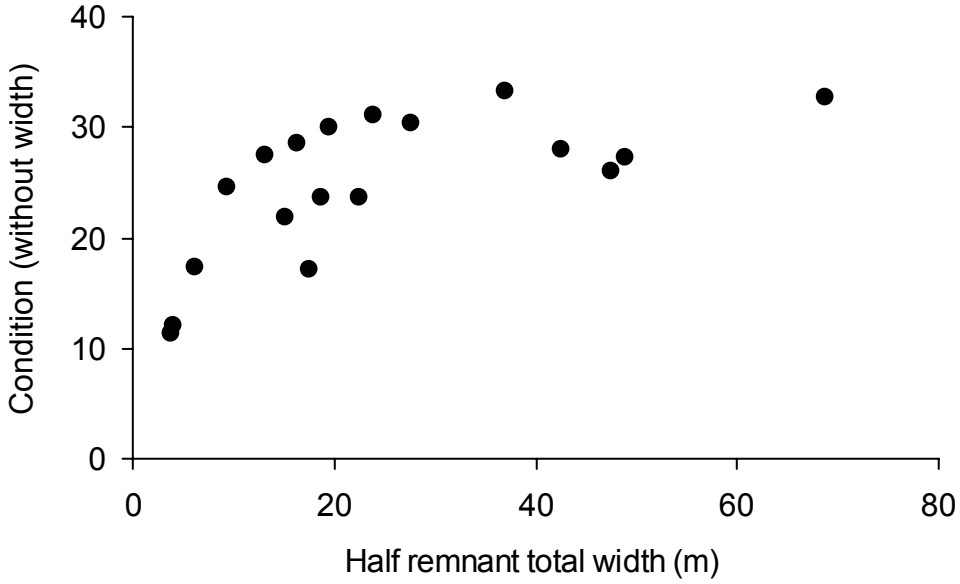

Figure 13. Relationship between the width of remnant patches of riparian vegetation and the condition index scores for the sites. Sites were "pooled" over flat and hilly terrain. Note that the metric associated with the width of riparian vegetation was excluded from the calculation of the condition index scores, and consequently the maximum score for the condition index is 40.