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Nassella tussock population monitoring system for Marlborough District Council

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CONTENTS

1. EXECUTIVE SUMMARY

- AgResearch has been contracted by MBIE to undertake a project for Marlborough District Council (MDC) entitled “Nassella tussock population monitoring system for MDC”. Specifically, the authors of this report have been contracted to:
    - Participate in a workshop with MDC biosecurity staff to develop the monitoring system
    - Write a report for MDC describing the protocol for the monitoring system.
- The authors of this report, Graeme Bourdôt and Dave Saville, participated in a workshop with MDC Biosecurity Officers Jonathan Underwood, Rob Simons and David Webb on 21 March, 2017. The report is based upon the information conveyed and decisions made during this meeting.
- At the workshop it was agreed that the Nassella tussock population monitoring system that the authors have developed in conjunction with Environment Canterbury biosecurity staff (Bourdôt & Saville 2016b) will be adapted for use in Marlborough by MDC officers.
- This report provides the details on the adapted protocol.
- An accompanying Excel workbook (with eleven worksheets), provides a resource for MDC to obtain and analyse data on the size of the nassella tussock population in Marlborough.

2. BACKGROUND

In the MDC region, nassella tussock (*Nassella trichotoma*), hereafter referred to as "nassella", is a pest governed by the "Sustained Control" Objective. This Objective means that the pest should be "kept as it is now" within the existing known infested area.

The program described herein applies only to the monitoring of the level of infestation of nassella plants within the area known to be infested on the date that the MDC monitoring program commences.

The aim of the monitoring program is to develop a trend graph showing the estimated density of visible (large enough to be seen) nassella plants over time. Given the high degree of variability which can be expected in the yearly estimates, it is anticipated that about ten years of monitoring may be required before any meaningful trend can be observed.

3. METHODS

3.1 Populations (strata) of study

On the MDC database, pink polygons show nassella-infested areas. As new information comes to hand, these pink polygons will change. That is, there is potentially the problem of trying to measure a moving target.

To get around this problem, it was decided at the 21 March meeting that just before the start of the first monitoring survey (planned for autumn 2018), the area infested with nassella would be downloaded from the database, and "fixed in time" for the next five years. And that every five years it would be downloaded afresh and fixed for the following five-year period. This is the methodology that has been followed in the Environment Canterbury nassella monitoring program, which is currently at the end of its fourth five-year period (Bourdôt & Saville 2016a).

The question also arose as to what is the appropriate statistical sampling unit. It was decided that the infested "property" is the appropriate sampling unit.

Again, each "property" is to be fixed in time for the purposes of each five-year monitoring period. Hence if a property is subdivided, the parts are to be treated in the monitoring as if no subdivision had occurred. Similarly, if two properties amalgamate, only the pre-amalgamation part is to be monitored. Every five years, the property lists are redrawn, again as in (Bourdôt & Saville 2016a).

When a property appears in the monitoring sample, the aim of the transect counts on that property is to derive an unbiased estimate of the total number of nassella on the property. Hence if a property is sampled twice during a five-year period, such as in years 2 and 5, and if the positions of the pink polygons within the property changes between years 2 and 5, this is perfectly OK. In year 2, the best information on the distribution of nassella within the property can be used for the within-property sampling that year, and similarly, in year 5, the best information on the distribution of nassella

within the property (as provided by revised polygons within the same boundary) can be used for the within-property sampling that year. In both years, an unbiased estimate of the total number of nassella on the property is obtained (the only difference being that the estimate may be more accurate in year 5 than in year 2, but this is not something we can take into account).

An excel file that gives exact details of the MDC monitoring protocol will serve as a document that accompanies this report in tandem. This file is called **"MDC Nassella Monitoring Project Details June 2017.xlsx"**. In the first sheet of this excel file, named **"Raw data (Jan 2017)"** is a list of infested properties as drawn up in Jan 2017. This list will presumably need revision before the monitoring commences.

It was decided by MDC to use the same six sub-populations (strata) as those used for the Hurunui District in our 2016 report (Bourdôt & Saville 2016a). As at Jan 2017, these give rise to the summary given in Table 1. Refer to sheets 2 and 3, named **"Sorted by strata (Jan 2017)"** and **"Summary of strata (Jan 2017)"** in the tandem excel file for details of the sorting, counting and summing that gave rise to the figures in Table 1.

Table 1: Number of properties and total hectares on these properties in each of the monitoring strata for the first five-year period of the MDC monitoring study, as at Jan 2017. These numbers will change prior to the commencement of monitoring, planned for autumn 2018.

Monitoring STRATUM (=infestation estimate)	Number of properties	Total Area (ha)
1 (small: <10 ha)	165	723
2 (0 - 250 plants/property)	295	77,785
3 (251 - 1,000 plants/property)	106	35,080
4 (1,001 - 5,000 plants/property)	87	36,770
5 (5,001 - 15,000 plants/property)	29	28,239
6 (> 15,000 plants/property)	9	15,963
Total	**691**	**194,560**

3.2 Optimal design and sample sizes per stratum

Overall, the method of monitoring is to use standard statistical methods for a stratified random survey, as detailed in Cochran (1963). These methods involve random sampling from the six strata in a manner that gives the most accurate estimate of nassella density over the entire infested area, for the least effort.

The optimum allocation of effort to the six strata is calculated using equation (1) described below. The calculation involves the stratum size, i.e., the total number of properties in the stratum (N_i), the standard deviations of the number of nassella tussocks per property within each stratum (S_i), and the cost of sampling each property (C_i). Here, the strata sizes N_i are known (Table 1), the costs per property C_i are assumed to be 0.25 of a day for each transect sampled, and the standard deviations between properties within each stratum (S_i) are taken from the Environment Canterbury values for the same strata in Hurunui averaged over the monitoring sampling in the autumns of 2003 to 2016. In the second and subsequent MDC monitoring samplings, the standard deviations from previous MDC monitoring can be used. The formula for each of the 6 strata, from Cochran (1963), is:

$$n_i = \frac{64 \times N_i \times \frac{S_i}{\sqrt{C_i}}}{\sum_1^6 \left(N_i \times \frac{S_i}{\sqrt{C_i}} \right)} \qquad \text{(Equation 1)}$$

where n_i is the optimal sample size for the i-th stratum (where i runs from 1 to 6), and 64 is the initial estimate of the total number of properties to be sampled. Note that the optimality of this allocation of effort to the various strata will improve each year as better information on the relative sizes of the variability within strata is obtained.

Table 2 gives the results from this optimal allocation exercise, based upon the Jan 2017 lists (so this allocation may change when the lists are revised prior to the first monitoring sampling). In the third column of Table 2, the number of transects to sample is specified; this increases from 2 to 6 transects as you go from the more lightly infested strata to the most heavily infested strata; accordingly, the cost of sampling a property (C_i) increases from 0.5 to 1.5 days, respectively. Table 2 has been copied from the fourth sheet, named **"2018_19 design"**, in the tandem excel file, which will make it easy to adapt the table as required. Currently, the "rounded design" sample resulted in an estimated 62 days of work. If this is more or less than the MDC monitoring budget allows, the total sample size can be changed from 64 to another number in the excel file, and the formulae will automatically work out a new optimal allocation (which then needs to be manually adjusted to a "rounded sample size" as described in Table 2); for example, if the total sample size is changed to 48 (3/4 of 64), then all the sample sizes in the "optimal sample size" column are multiplied by 3/4.

Table 2: Optimal stratified survey design for 2018. In working out the cost of sampling each property, it was assumed that each transect took a quarter of a day. Optimal sample size (i.e., number of properties sampled) in each stratum was determined using equation (1). Optimal sample sizes of less than 3 were rounded up to a minimum of 3 for each stratum, and sample sizes in other strata reduced slightly to ensure the total number of days of work remained within the 62 planned days. See excel file for the formulae in each cell.

Monitoring design 18/19

Notes: Based upon 4 transects per day.
Plus a minimum of 3 farms per stratum.
For first year of monitoring, use ECAN SDs (as given below) - from then on, use your own SDs.

Stratum	*Stratum size (N)*	**Number of transects**	***Cost in days (c)***	**Standard Deviation within stratum (SD)**	*Stratum weight is N x SD /√(c)*	*Optimal sample size*	**Rounded sample size (minimum of 3)**	**No. of transects (using rounded sample sizes)**	**Total number of days of work**
1	**165**	**2**	**0.50**	123	28,745	0.3	**3**	6	1.50
2	**295**	**3**	**0.75**	1,790	609,702	7.0	**7**	21	5.25
3	**106**	**3**	**0.75**	9,773	1,196,252	13.7	**13**	39	9.75
4	**87**	**4**	**1.00**	29,186	2,539,199	29.2	**28**	112	28.00
5	**29**	**5**	**1.25**	32,029	830,782	9.5	**9**	45	11.25
6	**9**	**6**	**1.50**	50,000	367,423	4.2	**4**	24	6.00
TOTALS	**691**				5,572,103	**64**	**64**	**247**	**61.75**
	(from previous sheet)	(rounded values, based on ECAN monitoring)		(based on ECAN monitoring SDs - use your own in future)	(arithmetic to optimise the survey - ignore this column)	(you set the 64 - reduce if too many days of work)	(you adjust the previous column by hand - if <3, increase to 3, and reduce others to match total no. farms)		(if too many days of work, reduce the total optimal sample size till it works for you)

3.3 Random selection

The monitoring occurs after all "compliance" work has been completed for the season, which normally means sampling in the autumn. The method of drawing a random sample for each of the strata, according to the rounded sample sizes yielded by Table 2, is described in the tandem excel file, in the fifth and sixth sheets named **"Choosing your random sample"** and **"Monitoring sample"**. The first of these two sheets tells you how to draw the random numbers, and the second tells you how to apply this to your list of infested properties.

3.4 Property maps

For designing the sampling within each randomly selected property, MDC Biosecurity Officers need to do the following (as also described on the seventh sheet, named **"Sampling within each property"** in the tandem excel file):

(1) Obtain a map of the property.

(2) Divide the property into "homogeneous" areas (each with a similar density of infestation), using the pink polygons on the MDC nassella database and using MDC Biosecurity staff knowledge of the property. For an example, go to Appendix A.

Define a "nil nassella" homogeneous area, and 1 - 4 other homogeneous areas of increasing nassella density. The distribution of nassella on the property determines the number of homogeneous areas. For example, if there is no nassella on part of the property and a light, scattered infestation on the rest, then this naturally leads to 2 homogeneous areas. As a second example, if there is no nassella on part of the property, a light, scattered infestation on other parts, and a medium density of nassella on other parts, then this naturally leads to 3 homogeneous areas. As a third example, if there is no nassella on part of the property, a light infestation on other parts, a medium density of nassella on other parts, and a high density on other parts, then this naturally leads to 4 homogeneous areas (and the addition of “very high” density would lead to 5 areas). Note that each homogeneous area can consist of several geographical areas, and need not be a single contiguous area. Also note that what you call (e.g.) “light” on one property does not need to match what you call “light” on another property, since the categories are only relative to one another, to aid in dividing the property into areas that are more similar in density within areas than between areas.

(3) Look on the "Design" Table 2 (third column) to see how many transects to do on the property.

Make sure you allocate at least one transect to each homogeneous area.

If there are transects left over, allocate more to the most heavily infested and/or bigger homogeneous areas. Only allocate two transects to the "nil nassella" homogeneous area if this area makes up (say) >90% of the property.

Example 1: Three homogeneous areas, with the “nil nassella” area being 10% of the property, medium density 50%, high density 40%.

Then if the design says 4 transects in total, allocate 1 transect to the “nil nassella” area, 1 to the medium density, and 2 to the high density area.

Example 2: Four homogeneous areas, with the “nil nassella” area being 20% of the property, low density 55%, medium density 15%, high density 10%.

Then if the design says 4 transects in total, allocate 1 transect to each of the four homogeneous areas.

Example 3: Three homogeneous areas, with the “nil nassella” area being 40% of the property, low density 20%, higher density 40%.

Then if the design says 5 transects in total, allocate 1 transect to the “nil nassella” area, 1 to the low density, and 3 to the higher density area.

Note that if the design specifies 2 transects, but you have 3 homogeneous areas, then allocate 3 transects (1 per area).

(4) Use a random placement method to randomly select the starting position for each transect. One method is to use a random number generator to randomly select numbers between 01 and 99 to serve as the (x, y) coordinates in conjunction with a 99 x 99 gridded overlay. Random spots that are outside the property boundary are rejected, as are random spots within a homogeneous area for which the required number of random spots has already been found.

If there are multiple transects in a homogeneous area, ensure they are not too close to one another (e.g., the rule could be no closer in distance than 20% of the maximum diameter of the largest sub-area that makes up the homogeneous area – except for a large, densely infested area with 4 transects, you may need to relax this to 15%).

(5) Use a random number generator to effectively toss a coin to determine whether to go east or west along the contour.

This completes the work to be done in the office, prior to going out into the field.

3.5 Walking the transects

In the field (or beforehand even!), read the instructions on how to count nassella on each transect (see Appendix B). If your transect reaches the edge of the homogeneous area, you'll need to toss a coin to decide whether to go 40 paces left or right along the boundary to reposition yourself before continuing your transect in the opposite direction.

So, take a coin with you!!

If the area being sampled is in a vineyard, the transect should go between two rows, with the central 1m strip being assessed. At the end of the row, turning left or right needs to be determined by a coin toss, and repositioning is by walking 40 paces (unrecorded). Mode of transport should be on foot (not motor bike), for consistency with sampling on hill faces.

In the field, remember to turn on your GPS so that it records the distance walked in the 30 minutes of walking the transect. Do not include the distance walked during any repositioning(s).

Train yourself (beforehand) to count only the nassella tussocks in a 1m-wide "vertically projected" strip, 0.5 metre on either side. This training can be done by holding a 2.5cm – diameter pipe horizontally on a slope, with a thin chain dangling down from the two ends until each end of the chain is touching the ground (see Bourdôt and Saville (2016) for more details).

Don't continue the contour into precipitous terrain, like along a cliff face (reposition, and turn back)! There are no prizes for mis-placed bravado!

At the end of each transect, write the number of nassella counted on a recording sheet such as the one described in the next section. Also record the other information on the sheet.

3.6 Recording sheet

The recording sheet is given in Appendix C and in the eighth sheet, named **"Recording sheet"**, of the tandem excel file. A copy of this sheet is taken to each of the properties and completed by the Officer(s) conducting the sampling. Each row of the sheet applies to a transect on the particular property. For each transect, six pieces of information are recorded in the field: transect ID, aspect, slope, vegetation type, number of nassella plants, and ease of detection (easy, average, difficult). The transect walked is sketched on the property plan in the field (or recorded using a GPS unit); the transect length is then (or later, via GIS) recorded on the sheet. Back in the office, the land area occupied by each homogeneous area is measured using a Geographical Information System (GIS), and recorded on the sheet.

At the 21 March, 2017 meeting at MDC, the recording of "ease of detection" was discussed. If recorded as E, A and D (easy, average, difficult), these codes could easily be replaced in the "Raw database" by 1, 2 and 3 respectively, to enable easy calculation of an average ease of detection. Alternatively, they could be recorded as 1, 2 and 3 on the sheet, but this may make the field recording more error-prone. As another option, a 4-point scale could be used, with 1 = "nassella standing out", 2 = ?, 3 = ?, and 4 = "taggy, nassella hard to see", with points 2 and 3 yet to be defined, and with each point on the scale defined by reference to a photo. If desired, any of the alternative options could be easily implemented by editing the "Recording sheet" in the tandem excel file.

The data on each recording sheet are typed into excel, into the ninth sheet named **"Raw database"** and the estimated number of tussocks in each homogeneous area is then calculated and summed to derive an estimate of the total number of nassella on the property, as described on the right-hand side of this sheet.

In this arithmetic, account needs to be taken of multiple transects in a homogeneous area. To make this easy, an extra column, stating the (actual) number of transects sampled in the homogeneous area, needs to be added to each recording sheet (back in the office, before data entry). Then, the formulae given in the excel file does the work of averaging over multiple transects within each homogeneous area, then adds estimated numbers of nassella over the homogeneous areas.

3.7 The final steps

As an example, fictitious basic data are given on a per transect basis in Appendix D and on a per property basis in Appendix E. The underlying formulae are best seen by referring to the tandem excel file, in the **"Raw database"** sheet, from which (fictitious) property totals are copied into the **"Data processing, step 1"** sheet, in which means are calculated for final results tabulation in the **"Data processing (step 2) + Table"** sheet.

Table 3 gives the results of this processing of the fictitious data. Here the mean number of nassella per property in each stratum is scaled up to an estimated total number of nassella in the stratum by multiplying by the number of properties in the stratum. This estimated total number of nassella is then divided by the land area of the stratum to yield an estimated density of nassella in the stratum. Similarly, an overall estimated density for the Marlborough District is derived.

Table 3: (Fictitious) Estimates of the size of the nassella population in each MDC stratum, and overall, in autumn 2018 following the 2017–2018 grubbing and compliance checks.

Using fictional data				Nassella tussock		
Monitoring STRATUM	**Number of properties in stratum**	**Total land area (ha)**	**Sample size**	**Mean no. per property**	**Estimated no. per stratum**	**Estimated no. per hectare**
1 (small: <10 ha)	165	723	3	26	4,235	5.9
2 (0 - 250 plants/property)	295	77,785	6	142	41,960	0.5
3 (251 - 1,000 plants/property)	106	35,080	12	5,682	602,343	17.2
4 (1,001 - 5,000 plants/property)	87	36,770	26	29,881	2,599,631	70.7
5 (5,001 - 15,000 plants/property)	29	28,239	8	67,049	1,944,414	68.9
6 (> 15,000 plants/property)	9	15,963	4	50,785	457,067	28.6
Total	**691**	**194,560**	59		**5,649,651**	**29.0**

The ultimate aim, after perhaps ten years of monitoring, is to examine the trend in the annual monitoring estimates. After year 1, there is just one such estimate, as shown in Figure 1. Ultimately, there will be many such estimates; for example, Figure 2 shows the trend graph obtained by Environment Canterbury after 19 years of monitoring. (These graphs have been copied from the **"Trend graph"** sheet of the tandem excel file.)

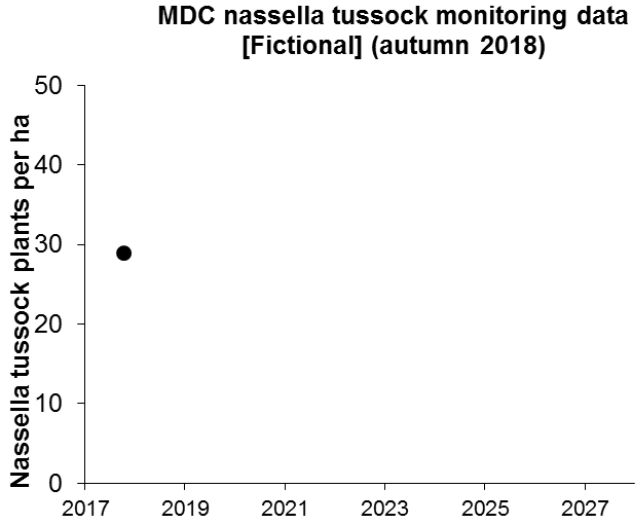


Figure 1: (Fictitious) Estimate of the population density of N. trichotoma in the Marlborough District for all plants visible in the autumn of 2018 (●___●).

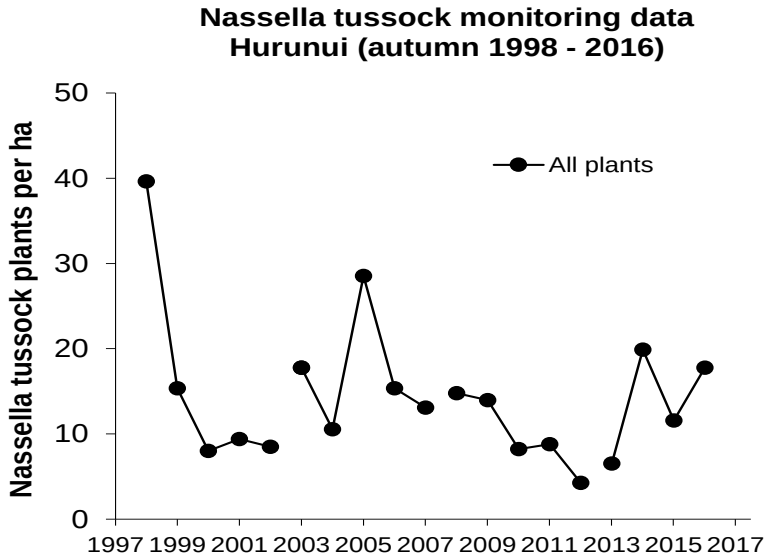


Figure 2: Trend in the population density of *N. trichotoma* in the Hurunui District, Canterbury, New Zealand from 1998 until 2016 for all plants visible in the autumn (●___●). Note: The trend lines are interrupted between each five-year period because the study population of farms changed slightly between periods, corresponding to the updating of the lists of infested properties every five years.

3.8 Improving the precision of the trend graph

As described in our recent report (Bourdôt & Saville 2016a), the accuracy of trend determination can be improved by correlating the annual estimates (y) with the average nassella visibility (x) during monitoring. It was decided that a suitable x variable would be the "ease of detection" variable on the recording sheet, averaged over all transects, after adjustment to a 1 – 3 or 1 - 4 scale.

4. GENERAL DISCUSSION

In this report we summarise the results of discussions with MDC biosecurity staff on 21 March, 2017, and summarise the steps required to implement a statistically robust monitoring scheme for MDC.

Such a monitoring scheme will enable assessment of long term trends in nassella density within the MDC area.

5. REFERENCES

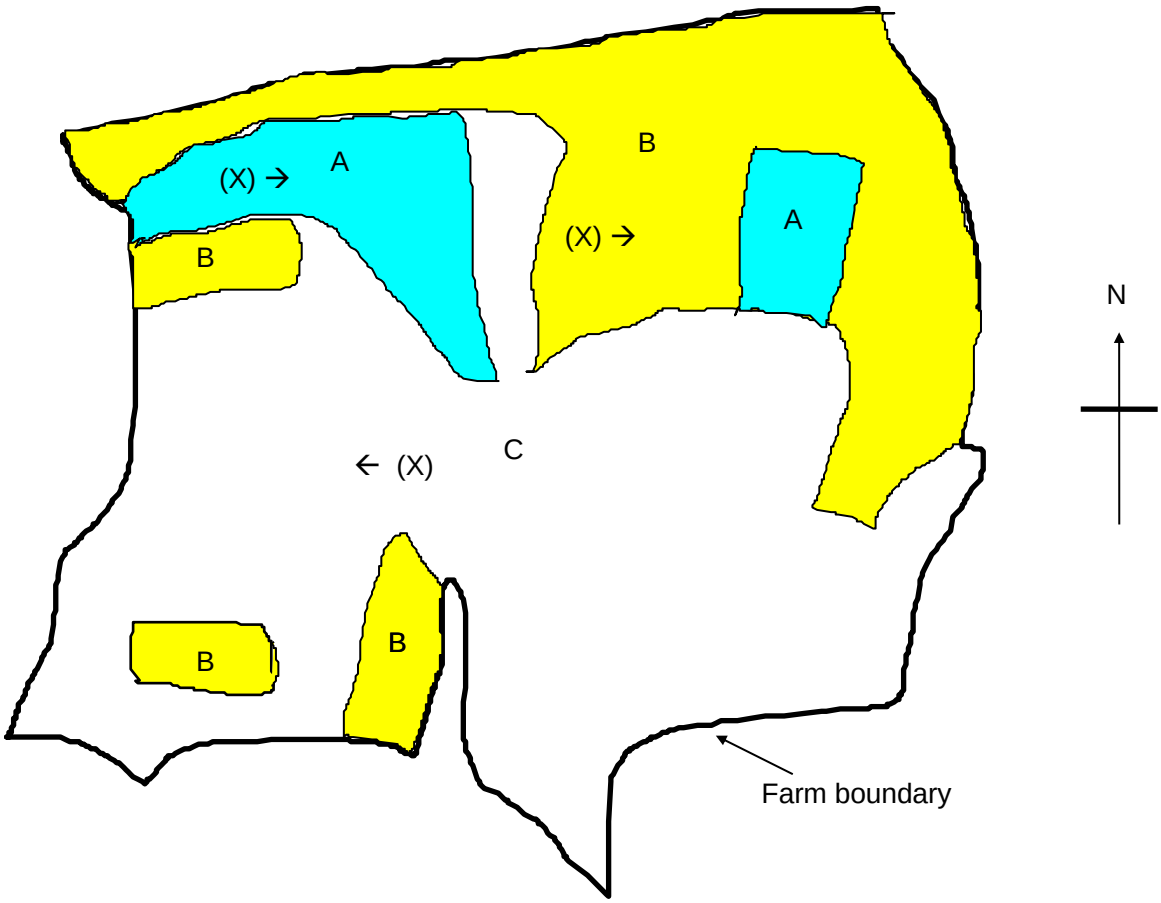
Bourdôt G, Saville D 2016a. Monitoring nassella tussock (Nassella trichotoma) under Environment Canterbury's Regional Pest Management Strategy, Years 13 to 17 (2009 - 2010 to 2013 - 2014) - report to ECan. In ed. Lincoln, AgResearch. Pp. 70.

Bourdôt GW, Saville DJ 2016b. Nassella trichotoma in modified tussock grasslands in Canterbury, New Zealand; a case study in landscape-scale plant population monitoring. Weed Research 10.1111/wre.12221.

Cochran WG 1963. Sampling Techniques: A Wiley publication in applied statistics. John Wiley & Sons Inc., New York. 413 pp.

6. APPENDICES

Appendix A - *The farm property maps*



A map of a typical property, showing three homogeneous areas (A, B, C) and a randomly chosen spot (X) in each, marking the starting point of the transect contour lines for counting nassella plants. The direction (east or west) to be walked initially from the starting point is shown by the arrow.

Appendix B - *Transect Instructions (nassella tussock)*

Transect Instructions (nassella tussock)

(1) Start at a random point as marked on the map (X). **If this point is inaccessible (e.g., a cliff face), start at the nearest accessible point.** There will be no prizes for misplaced heroism!

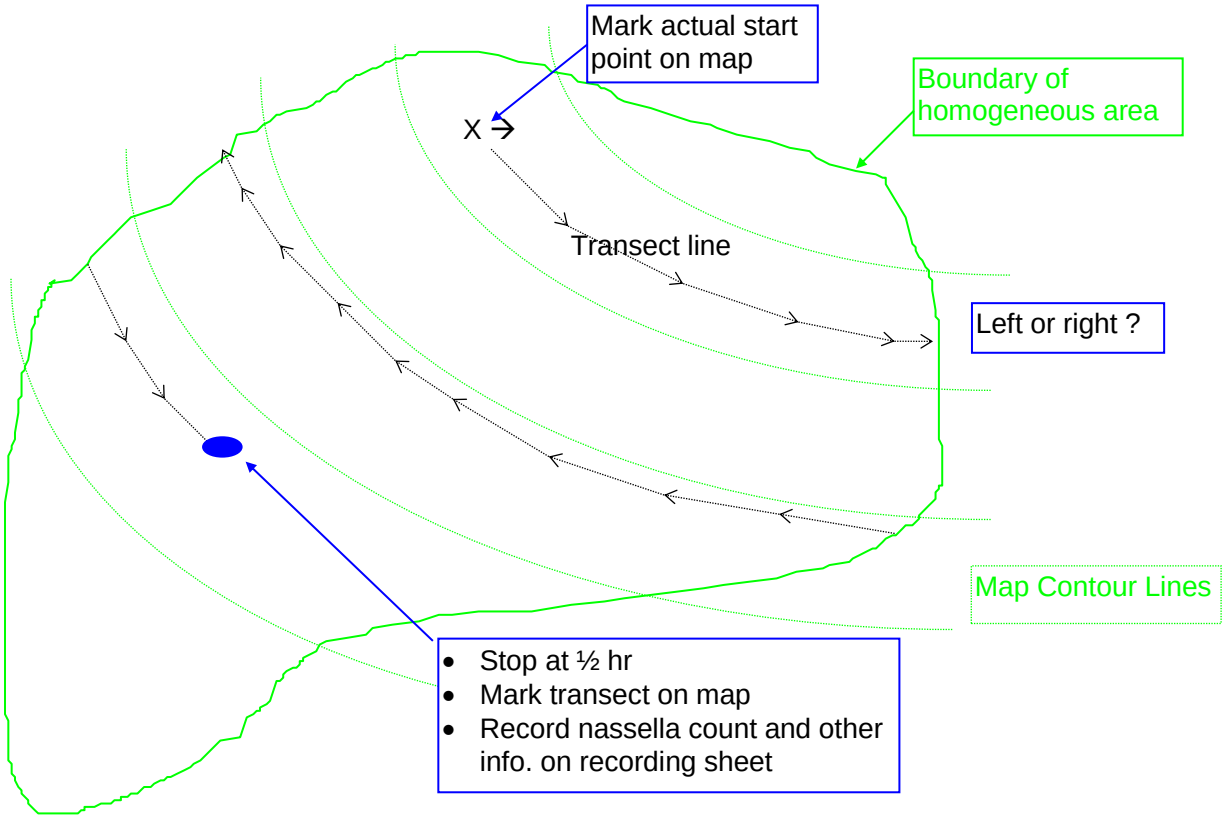
(2) Walk on a contour. Head East or West as marked on the map by an arrow (→). Before starting, fix on a landmark as a point to aim for.

(3) Walk for 30 minutes along the contour. If you hit a boundary of the homogeneous area, go left or right (toss a coin to decide which), walk 40 paces, then return along the contour parallel to the first one. If you again hit the boundary, continue on another parallel contour a further 40 paces away (in a snake-like fashion).

(4) Count the nassella tussocks within a 1-metre-wide "vertically-projected" strip. Don't count during any 40-pace re-positionings.

(5) After the 30 minutes along the contour is up, record the count on the recording sheet. Also record an estimate of how easy it had been to detect the tussocks. Record the transect ID from the map, and the other information requested, on the recording sheet.

(6) Mark the walked transect on the map (or use a GPS to measure the distance walked, not including any re-positioning(s)). If recording manually, you will need a good xerox of the topo map to make this easy to do (since someone in the office will need to estimate the length of the transect from your drawing, so the clearer the better).



Appendix C *- Recording Sheet*

NASSELLA TUSSOCK RECORDING SHEET 2018

Sample ID No.	Assessment Officer
MDC Site No.	Date of assessment
Owner	Weather conditions
Location	

						For office use	
Transect ID	Transect aspect (**N,S,E,W** or **F**lat)	Transect slope (**F**lat, **M**oderate or **S**teep)	Transect vegetation (**P,T,S,F,V**) [1]	**No. of nassella in transect**	Ease of detection (**E**asy, **A**verage, **D**ifficult)	*Transect length (m)*	*Size of homogeneous area (ha)*

[1] Vegetation type

Pasture (improved)
Tussock grassland
Scrub (area >40% scrub covered)
Forest / Reserve / Ungrazed
Vineyard

Appendix D - *Data for individual transects (Autumn 2018) – Fictitious!*

Entry of data on recording sheets into Excel											**Calculation of estimate of total number of nassella on each property**		
Date entry person - leave a blank line between properties please - and when done, please check data entry.											*Columns blank for data analyst to use later (using formulae below)*		
Sample ID no	**Transect ID**	**Transect aspect**	**Transect slope**	**Transect vegetation**	**Number of nassella counted**	**Ease of detection**	**Transect length (m)**	**Size of homogen area (ha)**	**No of transects in homogen area (n)**		***(Estimate of no of nassella in homogeneous area) / n***		***Estimate of total number of nassella on property***
Added back in the office	***These columns are entered directly from the field recording sheets.***								Added back in the office		Scaled up to 1 ha, then to ha in homogeneous area, then divided by number of transects (to set up for summing over property).		Here we sum, which is essentially averaging if >1 transect in the homog area, then summing over the homogeneous areas.
Example of data (falsified)													
13	1	N	S	S	1	D	1013	4.7	1		*46*		*89*
13	2	W	S	S	3	D	1678	2.4	1		*43*		
17	1	F	F	T	2	E	1502	17.1	2		*114*		*350*
17	2	F	F	T	4	E	1451	17.1	2		*236*		
44	1	F	F	P	0	E	2000	47	1		*0*		*36549*
44	2	N	S	T	27	E	1130	272	5		*12998*		
44	3	N	S	T	16	E	1250	272	5		*6963*		
44	4	E	MS	T	11	A	1000	272	5		*5984*		
44	5	N	M	TS	10	E	860	272	5		*6326*		
44	6	NE	M	TS	6	E	763	272	5		*4278*		

Appendix E - *Estimated nassella tussock plants on properties (Autumn 2018) – Fictitious*

Fictional data as example

Monitoring Stratum	Sample ID no	Estimate of total nassella on property		Stratum mean	Stratum SD
This information is added		These numbers come from last column of previous sheet			For use in design for next year
1	1	46		**26**	23
1	2	0			
1	3	31			
2	4	0		**142**	348
2	5	0			
2	6	0			
2	8	853			
2	9	0			
2	10	0			
3	11	27676		**5682**	8944
3	12	20532			
3	13	2191			
3	15	89			
3	16	6446			
3	17	3042			
3	18	2493			
3	19	350			
3	20	900			
3	21	334			
3	22	4137			
3	23	0			
4	24	10419		**29881**	38207
4	25	132208			
4	26	6376			
4	27	2906			
4	28	12686			
4	29	114618			
4	31	6106			
4	32	22468			
4	33	9414			
4	34	0			
4	35	2210			
4	36	10185			
4	37	0			
4	38	76777			
4	39	4302			
4	41	13977			
4	42	2850			
4	43	65874			
4	44	92132			
4	45	11182			
4	46	16773			
4	47	52699			
4	48	73706			
4	49	10632			
4	50	15775			
4	51	10627			
5	52	36549		**67049**	62374
5	53	88447			
5	54	12620			
5	56	18929			
5	57	29239			
5	58	52699			
5	59	201468			
5	60	96439			
6	61	26540		**50785**	32348
6	62	75537			
6	63	19399			
6	64	81665			