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Sampling southern **weed** pests

Maths has enabled Environment Southland to obtain a statistically valid assessment of the amount of land in the region covered by introduced weeds. Jenny Rankine reports.

Environmental Science student Meghan Williams is developing simulations using geographic information systems (GIS) and the statistics software R for her PhD. The simulations will assess the effectiveness of spatially-balanced sample designs for mapping the spread of six different types of weeds, such as wilding pine and old man's beard, in different habitats over time.

She is using GRTS (generalized random tessellation stratified) sampling with Environment Southland's weed surveillance programme. "Historically, in environmental resource sampling, designs have been grid-based or spatially random," she says. "It's important to get a probability-based sample so that inferences are valid, but grids are inflexible and random can be clumpy. GRTS is a valuable alternative."

Meghan Williams with a new infestation of Old Man's Beard strangling some native Southland vegetation. Background: The GRTS algorithm converts area to line.

Statisticians Don Stevens at Oregon State University and Tony Olsen of the USA Environmental Protection Agency developed the GRTS design and an application using the New Zealand statistics software R in 2004, which is available free on the EPA website.

GRTS was initially designed for monitoring aquatic resources; the Southland project is its first use in New Zealand and its first for terrestrial weeds. Biosecurity Officer Randall Milne says Environment Southland had done random surveys in known weed habitats, and door-knocking surveys in urban areas, but "we needed some reliability about weed data".

They met Williams and her supervisor Dr Jennifer Brown at the University of Canterbury and agreed to field test the GRTS sampling design. They asked for 200 sampling points each year for five years, focussed along roads and rivers, and other accessible areas of Southland.

"While the GRTS input and output is GIS data, R does the processing," says Williams. "Using R requires familiarity with the programming language, and the GRTS library (spsurvey) has a relatively steep learning curve. So I made a user-friendly tool in ArcGIS. It generates a GIS shapefile to use with global positioning system (GPS) units, Google Earth, or other GIS software."

The shapefile included XY co-ordinates of the 200 points and tables for field workers to fill in. Williams also delivered a map of all 1,000 points and one of the first 200, and some oversample sites in case some points could not be sampled.

Says Milne: "We had a list of 94 weed pests from our regional pest management strategy and the Department of Conservation's weed surveillance list for Southland." Points were found using a GPS unit and weeds recorded on paper. "We look for weeds within a 100 metre-square area around the random point, noting the presence of any one within each one square metre sub-plot. We use a tape measure and a frame. We don't usually find more than half a dozen weeds in a subplot, but it can take from 40 minutes to two hours per site."

Using that information, Williams was able to supply an estimate of land area covered by each of the 94 weeds. "It was really exciting to plug in the season's site results and come up with statistically valid estimates of kilometres of roadside, riverside and regional weed occurrence. These results help managers identify the severity of weed infestation, changes in species and new occurrences. These numbers can document control efforts and help the case for funding. These sites can also be used to tailor sampling strategies to find specific species.

"It's been very useful," says Milne. "It's statistically valid evidence we haven't had before. The results to date back up what we largely know already - the most common weeds are the long-established species often found in the agricultural landscape. However, stonecrop was turning up a lot more than we expected. Over five years we also hope to get good data that can be used in predictive models of weed spread. This will help us focus on which weeds to keep a watch out for in the region."

Says Williams: "The field realities of sampling are much messier than on the computer. Fortunately, we can refine our methods as we learn and the stats are pretty straightforward with GRTS." Milne is hoping to change the model for the 2009/10 sample to exclude some of the highly-managed agricultural land. Williams says the flexibility of GRTS means "you don't bust the whole five-year plan by adapting the sampling design".

See also

The free GRTS software - http://epa.gov/nheerl/arm/analysispages/software.htm