

Waitakere Greenroof Summary update following March 2008 Assessment

The Waitakere greenroof has performed well over the unusually dry summer of 2007/08 with no supplemental irrigation. Plants died back in February as the roof dried out, turning the roof a dominant brown as leaves senesced (Photo 1). The low groundcovers Mercury Bay weed and Selliera retreated back to the shade provided by both live and dead woody plants (Coprosmas, NZ Daphne and Meuhlenbeckia) and the south side of clumps of NZ iris. NZ iris, tussocks, NZ daphne, sand dune coprosma and nertera have all suffered, with dieback at the tips, outside leaves, and on the sunniest (northern) sides of individual clumps. NZ iceplant continues to be most resistant to drought - planted seedlings continue to spread, and the new seedlings that germinated in autumn 2007 are now well-established in areas with thinnest substrate (harshes growing conditions) and least competition. Calystegia has also weathered the summer well, with its large, green leaves providing relief to the dominant brown vegetation colours. Some plants appear to have died over the summer - these are concentrated on the areas with thinnest substrate and highest exposure to afternoon sun, but mortality won't be able to be assessed until after autumn regrowth, as last summer many plants resprouted from underground roots and stolons, particularly NZ daphne, coprosma, mercury bay weed and selliera.

The autumn regrowth started in early March: Mercury bay weed, Selliera, Nertera and Coprosma are growing particularly strongly at this stage.

Plant growth this summer confirms the value of:

- substrates c. 100 to 120 mm deep in maintaining plants through dry conditions in the absence of watering,
- variation in substrate depth in creating 'refuges' for plants during dry conditions
- woody or upright plants in creating shady conditions that allow lower plants to survive
- any manipulation of a roof that provides some afternoon shade (e.g. shading by parapets or adjacent buildings) or increases water reaching the roof (e.g. controlled runoff from adjacent structures)

Weeds have died back along with native plants, particularly oxalis. The first weeds to germinate or resprout with early autumn rains have been The bird dispersed karamu (*Coprosma*) has survived the summer and will probably need to be removed this winter, with the self-sown kanuka (*Kunzea*) before they get too tall.

Insects - rounds



Photo 1. March 2008 showing summer vegetation colours and dieback



Photo 2. *Calystegia* provides 'green relief' (left) and Mercury Bay weed shelters in the shade of a *Coprosma* with severe dieback.



Photo 3. The roof in June 2007 showing peak vegetation cover and winter colours

April work planned

1. *Biodiversity*

Next week I am meeting our key invertebrate ecologist to pull together the story to date on insect colonisation and use of the roof. This will form the basis of a paper for which an abstract has been submitted (appended below) for the Third World Greenroof Congress that presents plant and animal biodiversity data from Waitakere and Auckland University Greenroofs. If accepted, the paper will be presented by Dr Elizabeth Fassman (University of Auckland) who leads the research programme in the School of Engineering and will be reporting the performance of the second generation of greenroof substrates. The first generation of substrates were developed with Waitakere City Council funding.

2. *Hydrological performance*

Sam will pull together a spreadsheet for me on 15 April that will allow us to report on key hydrological performance criteria over a 12 month period:

- detention of stormwater (m³ and as a % of rainfall – we estimated in excess of 50% reduction on an annual basis)
- retention of stormwater, i.e. delay in discharge compared to a standard roof
- what size of rainfall was completely mitigated by the greenroof (i.e. negligible runoff occurred – we estimated a 20 to 25 mm rainfall event)
- number of raindays vs number of days the roof discharged water

This will enable us to make a recommendation re use of the greenroof to pre-treat runoff from part or all of the copper dome

3. *Suggested April/May Maintenance - Waitakere City Council*

- planting 30 *Calystegia soldanella*, sand dune convolvulus as PB3/4 into areas of the roof where a 'greener' look would be particularly beneficial (areas with sparse cover or dominant cover of brown-toned plants (libertia, tussock, coprosma)
- Assess need for weeding in mid April. Regenerating plants are vulnerable to damage, so foot traffic should be minimised until May or June if possible, but this needs to be balanced against the benefits of preventing seeding of weed species.

Planned, upcoming research activities

- Quarterly assessment of plants and invertebrates under wooden refuges (late May/early June)
- Substrate chemistry sampling to determine requirement for spring fertilization (May/June for August fertilisation)
- Annual detailed plant cover assessment in the third quarter
- Annual detailed invertebrate assessment November and December

TITLE:	<i>Invertebrate and plant diversity of two extensive New Zealand greenroofs</i>
AUTHORS:	<i>Robyn Simcock¹; Richard Toft¹; Elizabeth Fassmar²; Darren Ward¹; Renee Davies³; Mark Smale¹ 1-Landcare Research; 2-University of Auckland; 3-Waitakere City Council simcockr@landcareresearch.co.nz</i>
KEYWORDS:	<i>Biodiversity, invertebrates, pests, weeds, New Zealand</i>
BACKGROUND:	<i>Two extensive (substrates 50 to 125 mm deep) greenroofs were established on commercial offices in 2006 using indigenous plants and exotic sedums.</i>
OBJECTIVES:	<i>There is no New Zealand data on the potential biodiversity value, or biosecurity threats of greenroofs, and no information on the anticipated level of weeding required for extensive greenroofs in this warm, humid climate where more than 20,000 exotic plant species are in cultivation and we estimate 3 new plant species naturalise each year.</i>
METHODOLOGY:	<i>Invertebrate diversity was assessed (1) quarterly using refugia (wooden discs), and (2) weekly over one month in summer using a combination of emergence traps, baited pitfall traps (for ants) and unbaited pitfall traps. Growth of planted species and the number of self-establishing exotic and planted species was recorded quarterly.</i>
RESULTS:	<i>Most adventive invertebrate and plant species are wind-dispersed, with many plant species the same as those recorded in a United Kingdom study (Dunnet 2007), reflecting New Zealand's use of European pasture species (with their weeds). Some species established as hitch-hikers on nursery-grown plants (e.g., Oxalis and two species of slugs), while a few native plants have established from bird-dispersed fruits (e.g. Coprosma and Cordyline). Plant species naturally establishing on the roofs peak in early autumn (March-April) and again in early spring when the greenroof substrate is consistently moist and warm. Occupants of refugia also vary with seasonal moisture: slugs and earthworms are prevalent in winter; spiders in summer.</i>
IMPACT:	<i>Some of the sedum species used, particularly Sedum album are likely biosecurity threats if used on roofs near the native coastal or rocky outcrop environments. Even simple wooden discs (refugia) provide valuable places for beetle and moth larvae (especially those preferring rotting wood) to grow and pupate. These young greenroofs support a surprisingly diverse fauna which appears to be overwhelmingly exotic and/or cosmopolitan, however, an adventive Senecio supports a native moth with restricted hosts. Invertebrate results continue to be analysed.</i>

ABSTRACT INTENDED FOR ORAL OR POSTER PRESENTATION

TITLE:	<i>Development and Implementation of Locally-Sourced Extensive Green Roof Substrate in New Zealand</i>
AUTHOR(S):	<i>Elizabeth Fassman¹; Robyn Simcock²; Emily Voyde¹; Patrick Oldendorf¹ 1-University of Auckland; 2-Landcare Research e.fassman@auckland.ac.nz</i>
KEYWORDS:	<i>substrate design, FLL standards, implementation, New Zealand, stormwater management</i>
BACKGROUND:	<i>The project develops extensive green roof design suitable for new and retrofit construction under Auckland, New Zealand climate conditions, and quantifies stormwater retention. NZ's geographic isolation and absence of an existing green roof "market" creates challenges in obtaining materials suitable for green roof construction and implementation.</i>
OBJECTIVES:	<i>1. Develop extensive green roof substrate material that yields a saturated system weight of ≤ 100 kg/m², completely retains a 10-25 mm storm event, and supports a range of plants. 2. Compare FLL criteria with field performance.</i>
METHODOLOGY:	<i>Locally sourced volcanic aggregate, imported manufactured aggregate, and organic materials were tested primarily according to FLL methodology. Three substrate blends were subsequently installed on a 200 m² University of Auckland high-rise at depths of 50 and 70 mm. Hydrologic monitoring includes rainfall, runoff, and climatic conditions.</i>
RESULTS:	<i>Constraints imposed by retrofit potential (namely saturated system weight) are the most limiting design factor. While sedum species survive, the range of successful native species is limited. Results to date suggest that stormwater control objectives are achievable, and retention is greater in local materials compared to imported. FLL recommendations for permeability do not correlate well to actual events, hence result in overdesign. An FLL-acceptable PSD does not yield acceptable weight. Poor quality assurance in source material generation compromises design objectives.</i>
IMPACT:	<i>Implementation quality assurance procedures in the substrate supply, blending, and installation processes are specified. FLL parameters are modified to achieve an acceptable substrate, and consideration for broader application presented.</i>
	<i>ABSTRACT INTENDED FOR ORAL PRESENTATION</i>