Springbrook Rescue Restoration Project

Progress Report

Australian Rainforest Conservation Society Inc.

September 2011

This Report was prepared by Aila Keto and Keith Scott

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Introduction

In 2008, a Restoration Agreement was signed between the Queensland Government and Australian Rainforest Conservation Society Inc (ARCS). Under the Agreement, ARCS has undertaken to carry out a restoration project on a number of properties on Springbrook Plateau purchased by Queensland Government for addition to the Protected Area estate and eventually to the Gondwana Rainforests of Australia World Heritage Area. This work is carried out by ARCS on a largely *pro bono* basis.

Two of the properties that were purchased by the Queensland Government supported accommodation businesses. At the time the government acquired the properties, ARCS purchased the businesses which included fittings and goodwill. The restoration work being undertaken by ARCS on properties purchased by the Government is calculated to be worth more than $300,000 per year. In recognition of that contribution, the Government leases the two properties to ARCS for a peppercorn rental. All profits from the two businesses are applied to the Springbrook Rescue project and ARCS receives no part of the income despite a significant input in relation to accounting, advertising and services.

In early 2010, ARCS provided the Department of Environment and Resource Management (DERM) with a progress report, *Springbrook Rescue Restoration Project — Performance Story Report 2008–2009*. The report was structured to be consistent with the Australian Government's Monitoring, Evaluation, Reporting and Improvement (MERI) framework, and with guidelines established by the International Society for Ecological Restoration (SER).

The Desired Outcomes defined in the *Performance Story Report 2008–2009* provide the framework for this present report.

Restoration activities have initially been confined mainly to four properties in order to establish the science-based adaptive management framework suitable for broader application to other sites. The four properties (51.6 ha) involved in model testing were:

Warblers (17 Bilborough Court) — 3 ha;
Ashmiha (16 Bilborough Court) — 15 ha;
Pallida (2824 Springbrook Road) — 32 ha; and
Ankuna (2666 Springbrook Road) — 1.6 ha.

Restoration work on some other acquired properties with redundant infrastructure was delayed pending removal of buildings that would otherwise have impacted on regeneration. Since demolitions/recycling were not completed until 2011 some advanced regeneration was inevitably lost but care was taken to identify threatened and near-threatened species to ensure their protection. A list of the remaining properties transferred either to National Park or National Park recovery, are listed in Appendix 1, with cleared or degraded areas requiring natural or assisted ecological restoration listed in order of cleared-area size.

The diverse environmental gradients encompassed by these additional properties will allow an effective testing of the adopted conceptual models for ecological restoration, making this project a globally significant Case Study area.

Progress report

1. Foundational activities

This reporting period marks the end of the foundational activities phase.

Desired outcome	Activity reporting
Program logic defined using Investment Framework for Environmental Resources (INFFER) and Society for Ecological Restoration (SER) guidelines	Program logic has been defined in *Springbrook Rescue Restoration Project — Performance Story Report 2008–2009*. The framework follows a "social ecological systems" approach and remains valid after the first three-year period of implementation, monitoring and review. The only change proposed to the Program Logic is to include "Peer Review and collaboration" at the level of Intermediate Activities and Outcomes (3–9 years). Whilst this was identified as a key action within the Report, it was an inadvertent omission in the summary Program Logic table.
Potential threats and barriers to ecological restoration described; risk factors identified; mitigation options evaluated	Potential threats and barriers to ecological restoration were defined in *Springbrook Rescue Restoration Project — Performance Story Report 2008–2009*. Most of the original assessment remains valid. In addition to minor editing changes to the original foundation document, the level of risk associated with assumptions needed amendment with respect to (1) identification of biotic threats; (2) adequacy of resources for implementation; and (3) improvements in cross-scale or off-site institutional policies and on-ground practices. The magnitude of cross-scalar governance inadequacies was underestimated. If anything, on-ground practices have deteriorated on service corridors (roads, powerlines, communication). Cross-jurisdictional coordination and consensus has not been achieved to date as predicted. Ultimately, government policies and priorities on population growth, commitment to honouring World Heritage obligations and to effective biosecurity processes, will determine whether restoration and protection of this core of the Gondwana Rainforests of Australia World Heritage Area are successful in the long-term. TABLE 1.6 in the original report required amendment of risk levels, particularly regarding the validity of assumptions. These changes carry the underlying assumption, that if not addressed, the project goals may not be achieved because the impacts of fragmentation, invasive weeds, feral animals and pathogens, particularly when exacerbated by climate change, will be irreversible.
Resource requirements identified and costed; feasibility determined.	Resourcing levels depend on the honouring of commitments defined in the Licence Agreement. Resources requirements were identified and costed in *Springbrook Rescue Restoration Project — Performance Story Report 2008–2009* and on that basis the project was deemed to be feasible. In this current reporting period, all activities have

Desired outcome	Activity reporting
	been framed within specific projects informed by the original ecological conceptual model. As a result of both formal monitoring and general observations, further projects were deemed necessary. This will mean a significant increase in the cost of the project which was originally estimated to be more than $3.1 million over 10 years. The additional costs relate to scientific monitoring and on-ground practice, particularly with regard to the eradication of *Aristea ecklonii*. The latter dominates restoration activities more than originally anticipated. The increased monitoring costs are considered acceptable as this project is breaking new ground on many fronts and management practices resulting from a science-based approach are often counter-intuitive and contrary to standard practice. As a result of the greater than expected resource requirements based on monitoring and review, it will be necessary to expand the business at Springbrook Lyrebird Retreat to include all five cabins at Springers (74 Repeater Station Road). This will require amendment of the Lease Agreement for Lyrebird Retreat to incorporate the Springers property. Preparatory and costly work repairing or replacing damaged pumps, electrical cables and missing equipment caused through theft is well under way. The additional cabins are expected to be operational by the beginning of the next season. Resourcing of long-term projects is generally recognised as notoriously difficult. The normal avenues of grants and philanthropy are unpredictable and mostly relatively short-term in nature. However, being able to operate ecologically sustainable tourism facilities with all profits dedicated to restoration, provides the potential long-term security that this project requires. To date, this method of resourcing has been essential and effective. The project-based approach will also enable targeted application for supplementary funding from philanthropic organisations and government grant programs. Failure to secure additional funding will not impact on the core activities but would represent a significant loss of (a) a unique opportunity associated with an ecologically significant, biogeographically contained, and environmentally diverse location; and (b) the opportunity to establish the project as an internationally significant and sought after Case Study.
Monitoring, evaluation and reporting processes defined	Monitoring covers both ecological and social aspects within the adopted social-ecological systems framework. Ecological monitoring protocols are in place for both drivers and response variables of ecosystem dynamics relevant to natural regeneration (assisted or not). Biodiversity monitoring (of species pools in 'undisturbed' and 'old-field' successional sites) is in place for indicator species within key functional groups (plants, fungi, invertebrates, and vertebrates). Indicator species were selected on the basis of phylogenetic and functional significance, with particular attention to their trophic roles and strength of feedback interactions responsible for system regime change or stability.

Desired outcome	Activity reporting
	We adopted both (a) standard techniques based on field monitoring by trained people and (b) newly emerging techniques involving wireless sensor networks for macro – and micro-meteorological changes, and multi-media sensors for monitoring richness, composition and presence/absence or abundance of a range of priority fauna. Central to the monitoring program, which better enables detection of patterns and trends in succession or development of alternative stable states at a range of scales, is a nested grid system conducive to raster-based GIS analysis and which comprises: • A continuous 150-metre grid, subdivided into 16.67-metre square cells, has been established on all major restoration sites. This has proved invaluable for precise site-based recording of all management activities and results thereof. Regular evaluation of regeneration progress and control of barriers to ecological restoration continues as planned. GIS mapping and a series of program-specific databases are used to record management actions and observed changes temporally and spatially. • Selected cells are further subdivided into 9 x 9 sub-cells for more intensive assessment where required, such as within growth plots (Project P2) and recruitment and community assembly monitoring (Project S1). Evaluation • Progress is being evaluated using standardised criteria and indicators recommended within guidelines developed by the Australian Government for Natural Resource Management programs and those indicated by INFFER and SER. The project also provides a basis for evaluating the appropriateness of the respective recommendations for NRM programs and ecological restoration. Reporting An initial report format is established, consistent with guidelines developed by the Australian Government for Natural Resource Management programs (MERI) and incorporating baselines and indicators recommended by the international Society for Ecological Restoration. At this stage, no variation in the reporting format is deemed necessary as a result of any emerging implementation deficiencies. There is no equivalent standardised reporting format for the social component of a social-ecological systems framework. It was recognised that the original outcome statements were limited and not supported by a conceptual model allowing in-depth evaluation of factors conducive to or limiting success. A framework and conceptual model for social learning and social well-being has been developed since the first reporting period. To develop the appropriate monitoring criteria for the "social" component of the social-ecological systems

Desired outcome	Activity reporting
	approach adopted, a literature review was conducted to determine how best to ensure obligations under the World Heritage Convention can be met including ensuring World Heritage has a function in the life of the community. The consensus in the scientific literature indicates that social aspects inevitably relate to changing human behaviour. Damage to biodiversity in general, and to World Heritage values in particular, largely arises from lack of generalised and institutional trust, which in turn limits the capacity to effectively implement institutional conservation policies and programs. International standard criteria and indicators that appear appropriate for this project will be incorporated as indicated below.
Conceptual and growth models of ecological restoration selected	Three ecological conceptual models informative for restoration — stochastic, gradual continuum and threshold — have been selected for evaluation. Conceptual models are an essential prerequisite for adaptive management. They represent current understanding of ecosystem processes and how these processes are affected by land-use change and management. The ecological models adopted have proved to be remarkably effective in helping direct management practices. No modifications appear necessary as a result of monitoring and review to date.
Added: Conceptual models for social systems relevant to a social-ecological systems approach to restoration selected	Analogous models for the social component of our systems approach (governance, community support) have been developed, with key drivers and response variables identified, to better plan and monitor the effectiveness of actions undertaken (e.g. policy change; introduction of social learning tools) to achieve these linked goals. The benefit of a conceptual model is that it can more effectively guide actions based on transparent assumptions and allows the development of indicators for quantitative evaluation. Funding will be sought to enable independent professional evaluation.
Assets defined and described; significant species selected and life history attributes completed [Whilst we adopted the terminology recommended by the Australian Government's Monitoring, Evaluation, Reporting and Improvement (MERI) framework, e.g.	"Assets" were defined in *Springbrook Rescue Restoration Project — Performance Story Report 2008–2009*. The minimum set of significant species originally selected as defined in the 2008–2009 report has been expanded to include an additional 12 species of mammals, birds, frogs and reptiles as denoted by asterisks in the following table. The original selection of significant species was based on a minimum set of phylogenetically and/or ecologically significant species contributing to World Heritage values and integrity as indicated in the Nomination document prepared by ARCS, and defined in the Operational Guidelines to the World Heritage Convention. The results of monitoring have necessitated inclusion of additional taxa. Criteria for selecting additional species relate to the role of indicator species in (a) feedback interactions controlling succession or threshold dynamics, (b) functional roles in trophic webs, or (c) niche construction or selection, e.g. bird guilds based on foraging modes

Desired outcome	Activity reporting
describing biodiversity in terms of "assets", we are uncomfortable with this approach because of a range of flaws (Beder 1988). It is a term associated with markets, economics, and "self-interest" versus "public interest" none of which should be the principal drivers for conserving biodiversity for all future generations.]	or food preferences. *Assa darlingtonii* (Pouched Frog) has been added as a significant species featured in the World Heritage nomination on the basis of its phylogenetic, biogeographic and functional group significance, being only one of two ground-dwelling frog species not dependent on water for completing its life cycle. *Lechriodus fletcheri* (Black-soled Frog) represents the sole surviving species within the genus, restricted to Australia and New Guinea, of an old lineage of frogs (the oldest frog fossils recorded anywhere in Australia, and dating to the Miocene when mesic climates were collapsing globally). It opportunistically capitalises on ephemeral pools associated with high rainfall events and tadpoles canabalise siblings when food resources are limiting. Range contractions would be expected as a result of global warming. *Egernia major* (Land Mullet)(renamed *Bellatorias major*) is the world's largest and long-lived skink restricted to rainforests, especially its ecotones. Fossil evidence and molecular clocks indicate a long evolutionary history in Australia prior to the Late Oligocene with more recent records also from Riversleigh. These are viviparous, diurnal heliotherms with specific habitat requirements and strong sociality and pair-bond formation (male-female, female-offspring) unheard of in any other reptile, representing a major evolutionary advance in the development and maintenance of social systems. *Pseudechis porphyriacus* (Red-bellied Black Snake), a key representative of Elapid snakes, is considered the basal taxon within the genus that most likely originated in Australia. Elapid snakes represent the majority of all snakes in Australia, possibly sister to all Old World elapids, and the sole clade of venomous snakes capable of inflicting human mortalities. It is also the only viviparous member of the genus. The species is dependent on water bodies for its primary food source of frogs. *Potorous tridactylus* (Long-nosed Potoroo) a medium-sized (660-1640 g) ground-dwelling, solitary, nocturnal mammal that is primarily mycophagous (fungus-feeding). Whilst broad-scale habitat associations are generally known, survival depends on an understanding of finer scale habitat specificity. The potoroid-macropodid split in marsupials is thought to have occurred in late Oligocene or early Miocene coinciding with major geological and ecological changes in Australia. The Long-nosed Potoroo is one of the earliest mammals recorded in Australia. The Vulnerable Spotted-tailed Quoll (*Dasyurus maculatus maculatus*) is one of only two extant species within the large-sized marsupial carnivore guild in Australia. These are top predators, of critical importance in ecosystem dynamics, which, because of body size, diet and habitat specialisation, are particularly vulnerable to extinction. Dasyurids appeared in the fossil record in the late Oligocene to early Miocene, increasing in diversity through the late Miocene to ultimately dominate most insectivore-carnivore niches. Thus this moderately arboreal species, together with thylacines is basal in the evolution of large marsupial carnivores during a period of dramatic climate

<table>
<tr><th>Desired outcome</th><th>Activity reporting</th></tr>
<tr><td></td><td>change during the Miocene.
The Long-nosed Bandicoot (Parameles nasuta) is a relict of marsupial evolution in Australia during the Mid Tertiary. The origin of bandicoots is presumed to date to at least 54 million years ago in the Eocene of East Gondwana, and typifies rainforest ancestry of large numbers of lineages and subsequent Miocene radiations coinciding with global climatic collapse precipitated by the final breakup of Gondwana.</td></tr>
<tr><td></td><td>The fact sheets incorporating life history attributes prepared for 62 bird species and 25 species of frogs in the last report have been supplemented by a further 55 species of birds and 3 species of frogs. The additions were deemed required based on results of baseline field monitoring and comprehensive literature reviews of critical functional groups. These fact sheets, including those for the extra species when completed, will be posted on the Springbrook Rescue website as part of our community support strategy. The information compiled is also essential for assessment of critical habitat requirement for the indicator species (Project BD8), and hence informs strategic monitoring of long-term trends in critical habitat suitability.</td></tr>
<tr><td></td><td>The following table represents the amended list of indicator species of relevance to recovery of World Heritage values and integrity. Asterisks mark species additions to the original list.

<table><tr><th>MAMMALS</th><th>BIRDS</th><th>FROGS & REPTILES</th></tr><tr><td>* Spotted-tailed Quoll
* Long-nosed Potoroo
* Long-nosed Bandicoot</td><td>Albert’s Lyrebird
Rufous Scrub-bird
Australian Logrunner
* Yellow-throated Scrubwren
Paradise Riflebird
Wompoo Fruit-dove
* Topknot Pigeon
* Glossy Black Cockatoo
* Yellow-tailed Black Cockatoo</td><td>* Assa darlingtonii (Pouched Frog)
Mixophyes fasciolatus (Great Barred Frog)
Mixophyes fleayi (Fleay’s Barred Frog)
Kyrranus loveridgei (Masked Mountain-Frog
* Lechriodus flecheri (Black-soled Frog)
* Litoria revelata (Whirring Tree Frog)
* Bellatorias major (Land Mullet)
* Pseudechis porphyriacus (Red-bellied Black Snake)</td></tr></table></td></tr>
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<tr><th>Desired outcome</th><th colspan="3">Activity reporting</th></tr>
<tr><td></td><th>INVERTEBRATES</th><th>PLANTS</th><th>FUNGI</th></tr>
<tr><td></td><td>Dung Beetles (Cephalodesmius species for which the Border Ranges are the centre of diversity).

Terrestrial snails (good indicator species of forest health and integrity)</td><td>Argyrodendron trifoliolatum (Booyong)
Acmena ingens (Red Apple)
* Acronychia suberosa (Corky Acronychia)
Sloanea australis (Maiden's Blush)
Sloanea woolsii (Yellow Carabeen)
Duboisia myoporoides (Corkwood)
Acacia melanoxylon (Blackwood)</td><td>Indicator species reflect their role in enhancing nutrient availability (symbiotic species, e.g. ectomycorrhizal fungi), or in recycling through decomposition of dead and decaying organic matter (saprotrophic species).</td></tr>
<tr><td>Community support strategy defined</td><td colspan="3">Public education and outreach are considered fundamental to the long-term success of the Project. To change land-use activities that threaten the viability of wildlife habitats and linkages, needs community understanding and active engagement that fosters both sense of place and stewardship. This is consistent with the obligation placed on governments under the World Heritage Convention to ensure World Heritage has a role in the life of the community. What was missing in our original report was a conceptual model for the development of social capital to underpin the support strategy and to guide evaluation of the effectiveness of that strategy. The Project's public education strategy originally included the following five elements:

• Web site & blog

• On-site displays incorporating appropriate conceptual diagrams

• Field days

• Signage on two or more sites

• Brochures

It is now considered that a range of social media avenues need to be incorporated in the amended social-ecological systems model and introduced as soon as the web site is completed and on line. We recognise, however, that the primary responsibility for education and outreach on World Heritage is with the Australian and State Governments. DERM has established a web page specifically for the Springbrook project that will complement the ARCS site yet to be published.</td></tr>
<tr><td>Policy deficiencies that allow continuing</td><td colspan="3">Governance structures, policies and strategies at multiple scales have a critical bearing on the potential for</td></tr>
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Desired outcome	Activity reporting
threatening processes identified	protection and restoration success. Relevant Local, State and Federal government policies have been identified. Policy deficiencies that allow continuing threatening processes include the following: • Lack of a unified 'whole-of-government' policy on World Heritage protection and restoration, and lack of coordination across governments • Failure of Biosecurity Queensland to give priority to prevention over response strategies for alien species or pathogen control in World Heritage Areas • Weakening of existing planning controls: The revision to the SEQ Regional Plan relaxed requirements for tourism development in the Regional Landscape and Rural Production Area. The Regulatory Provisions allow material change of use for short-term accommodation for up to 300 persons and a gross floor area of up to 5000 m^2 without assessment by the referral agency. At Springbrook where such accommodation would be likely to be mainly for couples, this could mean that a material change of use for up to 50 cabins could be approved by Gold Coast City Council without referral to a State Government agency • Conflicting policy objectives: (a) Whereas the Queensland Government has purchased cleared land for restoration and conservation, the Gold Coast City Council's Local Area Plan for Springbrook includes the following objective: It is intended to preserve the character of the rural areas and, in particular, the predominantly cleared areas, as an important asset for residents of, and visitors to, the Springbrook Plateau. The existing landscape of the Plateau is to be protected, and future developments are to enhance the recognised landscape character." (b) The Queensland government policy of "Good Quality Agricultural Land" identified properties bought by the government for enhancement of national park and World Heritage integrity in this category. Moreover the GQAL policy requires Local Government to implement this policy in its planning controls, thus undermining a policy on restoration of World Heritage values and integrity. • Absence of a Local Government population policy leads to escalating development pressures and policy responses driven by demand. • Inadequate planning, e.g. lack of appropriate Codes of Practice for service corridors: Road verge

Desired outcome	Activity reporting
	management by the Department of Main Roads and Gold Coast City Council maintain canopy openings, encourage weed growth and spread weeds and pathogens such as Myrtle Rust; heavy pruning is apparently intended to prevent damage to large buses which are arguably inappropriate for the Springbrook setting. Also, the absence of a specific science-based linkage design for wildlife habitat corridors on the part of the local government results in incremental change-of-use decisions that cumulatively undermine the primary goal of such corridors. • Seriously detrimental on-ground management practices at both State and Local government levels: Road verges are often managed to replace native species cover with exotic species thereby establishing or maintaining grassy areas which attract pademelons and lead to regular road kills of World Heritage listed fauna with typically long lifespans and low reproductive rates; removal of low shrubs and vines at forest edges destroys natural seals which are essential for maintaining microclimates. • Inadequate resources applied to solving policy dilemmas: Energex contractors are required to clear vegetation around powerlines; the existence of powerlines and the associated clearing along roads such as Repeater Station Road maintain canopy openings with associated compounding impacts on rainforest and World Heritage values; a number of powerlines traverse properties that are the subject of restoration and this is a source of conflict that will be exacerbated as regeneration proceeds. This current and future problem is particularly acute on Warblers, Pallida, Kanimbla and the adjoining Springers properties. Institutional inertia and lack of policy commitment results in failure either to actively seek funding or capitalise on funding opportunities (such as the Australian Government's Economic Stimulus Package) for undergrounding powerlines. • Inadequate focus on and resourcing of the development of social capital (social learning and helping behaviour); governments have a key role in influencing social capital; failure to invest results in divided communities where distrust and environmentally damaging behaviour increases. Increasing institutional distrust is likely to impact significantly on community acceptance of government policies.

2. Initial activities and outcomes

Desired outcome	Activity reporting
Conceptual and growth models of ecological restoration evaluated	Three conceptual models of ecological restoration — stochastic, gradual continuum and threshold — were originally selected for evaluation. To test these models, and hence usefulness in guiding restoration strategies at all scales, thirty-five separate projects have been designed, costed and established to quantitatively measure both the drivers of system dynamics (species pool effects, resource availability, and disturbance regime changes) and response variables (species recruitment, plant productivity and ecosystem stability or resilience). The project-based approach provides a more coherent, transparent, measurable and repeatable approach. All projects relate to model testing, analysis, review and improvement of models and practice to achieve greater cost effectiveness and success in attainment of goals. Cross-links between projects and with SER goals are defined. A common framework defines project goals, scientific rationale, assumptions, hypotheses, methods, location of study areas, timelines, resource requirements, budgets, scientific references, progress to date and listing of any published reports. Progressive documentation and evaluation of results has been important in order to detect trends and opportunities for management interventions in a timely manner.
Conceptual models of social learning evaluated (a new part of the Program Logic)	An equivalent, testable "social systems" model has been developed, together with protocols for indicators and baselines, that links with the ecological conceptual models. We have not gone beyond defining the models and potential performance indicators. ARCS will fund independent, reputable experts to conduct evaluations.
Threats and barriers to ecological restoration under active control based on observation and monitoring	A comprehensive list of likely threats was provided in the foundation report. These relate to detrimental changes to the primary drivers of ecosystem dynamics that influence restoration: (1) changes to the resource base (a) directly through altered biogeochemical processes, or (b) indirectly through changes in macro- or micro-climates that affect the resource base itself and/or the dynamics of resource use; (2) changed disturbance regimes that affect biomass production directly or indirectly through changing resource availability; (3) changes in the species pool or its health through loss of species or introduction of competitively superior or

Desired outcome	Activity reporting
	dominant non-native species, or pathogens can affect vital plant functions and ecosystem processes. The results of both opportunistic observations and standardised monitoring associated with transects and quadrats indicate the following: — Biogeochemical processes are likely to have been sufficiently altered through clearing, grazing and associated erosion so that recovery of authentic analogues of original forests is unlikely for several hundred years if at all on many sites (especially within Pallida). Deep, nutrient-rich basaltic soils on steep slopes have been stripped down to sub-soil or bedrock in many areas, to now overlay naturally thin, nutrient-poor rhyolite derived soils at lower altitudes. However recovery of adequate habitat quality for World Heritage fauna to survive still seems possible, especially if adjacent to high quality habitat. — Microclimates necessary for regeneration of ancient lineages of plants have most likely been lost through extensive clearing and associated erosion, but facilitation processes can be mimicked through a range of species interactions involving modern plant lineages regardless of their geographic origins. — The most significant biological threats and barriers to natural regeneration observed to date include heavy and prolonged frosts, weeds (especially *Aristea ecklonii* and Kahili Ginger), introduced mat-forming grasses (Kikuyu, Setaria, Dactylis), herbivory by insects and mammals, predation of wildlife by foxes or wild dogs, physical damage by large dogs and apparently deliberate damage by humans. The project is based on facilitation of natural regeneration. Weeds and introduced grasses are under active management where they are inhibiting natural regeneration. The Restoration Plan incorporated in the Restoration Agreement between ARCS and the Queensland Government specifies the approach to weed control: > In general, weed infestations will not be addressed unless they are inhibiting natural regeneration without active intervention or there is a legal requirement to remove them (e.g. fireweed, groundsel bush, giant rat's tail grass). > Those weeds occurring on the Properties that will be eradicated naturally by shading from advancing regeneration will not be actively removed, unless it can be demonstrated that medium- to long-term benefits can be achieved regarding site capture, accelerated growth or reduced mortality of regenerating species. Biological barriers that are under the most active management include aristea and introduced grasses. However, exotic trees or shrubs capable of aggressive spread, including *Camelia japonica* (Camelia), *Cestrum elegans* (Red Cestrum), *Fatsia japonica* (Japenese Aralia), *Musa paradisiaca* (Banana), *Paulownia tomentosa*, *Ricinus communis* (Caster

Desired outcome	Activity reporting
	Oil Plant), *Sambucus canadensis* (American Elder), *Thuja plicata* (Western Red Cedar), *Tibouchina urvilleana* (Glory Bush), *Toxicodendron succedaneum* (Rhus), on Pallida, Warblers and Springers have been progressively removed and mulched by teams of volunteers. A new and unpredicted threat is myrtle rust (*Uredo rangelii*) which now occurs at several locations on Springbrook. Infections have been observed on *Rhodamnia maideniana*, *Decaspermum humile* and *Syzygium oleosum*. Initial observations suggest infection of flowers on one *Rhodamnia maideniana* plant on Warblers may have prevented the development of fruit. Our studies indicate the fungus is dormant over winter but re-emerges with greater virulence with warmer weather in spring.
Extent of invasion by Aristea ecklonii and other priority weeds identified; control options assessed and measures underway	Project D6 specifically addresses identification and control measures for invasive species. The original list in our earlier report, in the form of an Excel spreadsheet, which includes declared status, ranked invasiveness, phenology and distribution by individual properties has been updated progressively as more information comes to hand. Fifty-two Weed Fact Sheets have been completed and include photographs and information on weed status, origin, distribution globally and on Springbrook, habit, habitat, morphology, phenology, ecology, propagation and dispersal, pest potential, control and prevention, and references. A further 160 are at various stages of completion. The information is based on a compilation from the literature as well as on Springbrook-specific observations. The data are also included in a comprehensive database. *Aristea ecklonii* overwhelmingly dominates work allocated to weed control on the four restoration properties: ▪ across virtually the whole of Warblers ▪ the northeast corner of Ashmiha and several other isolated patches ▪ about 15 per cent of Ankuna ▪ part of the road verge at Pallida Aristea has also been found on road reserves and private land on or adjoining Velvet Downs Road in the Purling Brook catchment, as well as in the Canyon Village precinct. These latter occurrences, which are beyond the capacity or responsibility of ARCS to control, have been notified to the Gold Coast City Council and Biosecurity Queensland but both organisations have been relatively unresponsive to date beyond BQ preparing an initial risk assessment (http://www.dpi.qld.gov.au/4790_13918.htm). Aristea is proving very difficult to eradicate. Control measures encompass both containment and eradication. The most effective control involves physically digging out whole plants in very labour-intensive operations. Follow up

Desired outcome	Activity reporting
	is essential. Based on quantitative time trials, at least two full-time staff equivalents over a five-year period are required for physical eradication of all clumps on just the three-hectare Warblers property. Methods used include clipping of flowers and fruits, mowing (after removal of fruits), herbicide and digging. The plant, a member of the iris family, Iridaceae, has rhizomes that allow survival during unfavourable periods. Trials (various combinations and concentrations of glyphosate and metsulfuron methyl indicate that the herbicide, glyphosate, does not necessarily kill the rhizomes and hence the plant can re-establish after treatment. Addition of metsulfuron methyl appears to be helpful, but it is persistent and water soluble and likely to have off-site impacts on native plants and wildlife. More trials are needed to establish the best time and method for herbicide application such that the rhizomes are killed but side-effects reduced to negligible levels. Patches where above ground plant parts have been killed remain devoid of regrowth of any kind for at least two years. It is possible that allelochemicals are released as aristea dies. Further, frequent unfavourable weather conditions are not conducive to use of chemical or mechanical methods of eradication. Use of heavy equipment such as ride-on-mowers will degrade water-logged soils. Teams of volunteers (of generally 12–18 people) have dug out aristea over half the grid cells on Warblers. Each grid cell is ~278 m^2. Volunteers are trained to try to ensure that no rhizomes or parts thereof are left behind. However the latter is difficult to achieve and follow-up removals will have to be repeated for several years. This work is extremely labour intensive. Productivity is of the order of 8–10 square metres/person hour; a single cell (out of 91) requires ~32 person hours of digging. Follow-up a year later can yield 13,000 plants per cell (~50 new plants/m^2). Culling of seed heads can yield 80 kg of seed heads/cell (over 8 million seeds). Clearly, employment of this strategy alone would result in losing control over infestations. Kahili Ginger is now widespread, the extent of which is difficult to establish given dispersal of propagules is by animals including birds, as well as by service corridor practices of local government, Department of Main Roads, Energex and Telstra. The delay by Biosecurity Queensland to formally list the species as a class of declared plant, and the absence of Codes of Practice by service providers, as occurs in the Wet Tropics World Heritage Area, is in large measure responsible for this highly damaging exotic plant getting out of control. Control options are limited given its occurrence now in rugged inaccessible areas or in sensitive wildlife habitats. Where repeated visits are feasible or routine for other reasons, ARCS has opted for physical control measures (mashing of all above-ground growth), with follow-up until occurrences die out. This method has met with some success at Mt Glorious in the D'Aguilar Ranges north of Brisbane. However, chemical control is still the more efficient method where regular follow-up is difficult. Likewise, *Plectranthus ciliatus* is now widespread primarily as a result of seriously negligent road and other corridor

Desired outcome	Activity reporting
	practices of Gold Coast City Council, Department of Main Roads, Energex and Telstra. Failure of these service providers to address the problem 'at source', makes control in other areas almost futile because of the inevitability of reinfestation. Occurrences of Moth Vine are increasing for the same reasons. We have consistently found that plant traits best able to suppress natural regeneration include: (1) tuft, mat or rosette forms of annual or perennial herbs that form overlapping canopies to reduce light levels below the affected plant's light compensation point. Examples of rosette plants are thistles (*Carduus*, *Cirsium*, *Silybum*), plantains (*Plantago* species), docks (*Rumex*) and dandelions or dandelion-like plants (2) grasses that form thick, necretosing, light-blocking masses (Kikuyu, Setaria, Yorkshire Fog, Dactylis) (3) shrubby plants with dense, light-limiting foliage such as rubus, inkweed (*Phytolacca octandra*), wild tobacco (*Solanum mauritianum*), (4) over-topping vines with dense crown (especially Blue Morning Glory, Japanese Honeysuckle, Moth Vine) that smother other plants, or those with wiry stems that strangle and block phloem movements (*Billadiera scandens*). The scale of the problem of mat-forming grasses impeding natural regeneration is recognised world-wide. Fireweed control is mainly mechanical, with teams of volunteers hand removing plants annually. Although infestations are decreasing dramatically in control areas, failure to control fireweed by neighbouring land-owners or managers, renders ultimate control impossible.
Sensor system installed for recording environmental parameters	The Wireless Sensor Network project involving CSIRO, DERM and ARCS has installed 175 nodes on Pallida (2824 Springbrook Road). The first 10 were installed in 2008, the next 50 in 2010 and the balance of the final 175 nodes in 2011. Only dendrometers and sap flow sensors remain unincorporated in the network due to manufacturing delays. These are expected to be installed by CSIRO/DERM late in 2011. ARCS was responsible for the deployment design (what, where, when, why), preparation of 5 km of access tracks (all of which were established on pre-existing but overgrown tracks), installation of a significant number of soil moisture and soil water potential sensors (particularly during the second phase), together with regular on-site attendance to assist with addressing a range of standard system malfunctions identified by either the DERM

Desired outcome	Activity reporting
	Project Manager or CSIRO staff. A local ARCS volunteer is an engineer who assists DERM and CSIRO. The network now has extensive coverage of the Boy-ull Creek catchment representing one of the largest terrestrial wireless sensor networks in Australia. In addition, ARCS has purchased and installed 9 supplementary monitoring stations (Decagon Devices Inc.). Six of these installations are full weather stations collecting data on rainfall, temperature, humidity, total and photosynthetically active radiation, leaf wetness and soil moisture. Soil water potential is measured on another 'node' . Data are downloaded monthly from dataloggers, and transferred by volunteers to a dedicated relational database using Filemaker Professional. Processing and analysis of data are well advanced with rainfall profiles up-to-date. Regular maintenance is required for unblocking tipping-bucket rain gauges, replacing cables damaged by antechinuses or rodents, cleaning surfaces of leaf wetness and solar radiation sensors, replacing batteries, and attending to any other incidental damage or malfunctions, including from deliberate interference by trespassers.
Long-term monitoring plots set up; growth rate, soil moisture and other measurements initiated; restoration trials started	Fifteen long-term monitoring plots for assessing successional dynamics and community assembly have been established across three properties, Warblers, Ashmiha and Pallida (Projects P2 and S1).

Desired outcome	Activity reporting
	 Productivity measurements encompassing recruitment, growth, mortality and reproduction on standardised plots have now been carried out over 4.5 years (Project P2). These have involved almost 27,000 individual measurements carried out seasonally for all native species detected regardless of size, using a minimum of eight separate parameters reflecting growth, health, mortality, leaf area index (also reflecting shading potential), and susceptibility to herbivory (insect/mammal) and plant pathogens. Other parameters reflect interspecies competition versus facilitation, soil depth and exposure, and a range of other associated properties. Specimen-based records of insect herbivores are collected, identified and archived according to prescribed entomological standards (Project D4). A university honours student is assisting with identification, preservation and mounting of specimens as part of an insect reference collection. All materials are sourced from Entomological Supplies. Infestation by potential plant fungal pathogens is noted with accompanying photographs or voucher specimens for identification. At the beginning of each season, regeneration is assessed on each plot (Project P1). Assessment includes growth, mortality, recruitment, health, leaf index and herbivory for each individual plant regenerating within 81 sub-plots nested within each main 16.66 m x 16.66 m plot. The work involves the same three scientists with specialised expertise (to minimise inter-observer variability) assisted by three community volunteers (citizen scientists). Data entry is up-to-date. Preliminary analyses to detect early trends have resulted in significant changes to traditional

Desired outcome	Activity reporting
	management practices. The results are indicating the vital importance of facilitation processes to successful recruitment, including the key role of even weed species in the early stages of native species establishment. This aspect has largely been under-reported in the scientific literature. As part of Project RC3 soil moisture measurements have been made across the whole of Warblers (92 sample points) and over 63 grid cells on Pallida. Future analyses will be commissioned for other biophysical parameters. In addition, the Wireless Sensor network and ARCS monitoring stations are continually recording soil moisture levels and soil water potential. Restoration trials were designed in 2009 and sites selected on the eastern boundary of Pallida adjoining riparian rainforest. However, in the light of observations of regeneration and ongoing management experience, these trials have been put on hold and are likely to be redesigned to take account of data from Project P2 and other projects.
Natural regeneration identified, evaluated & mapped	For baseline pre-Agreement data and planning (onward from 2005), all cleared areas within 16 properties (MAN, PAL, BAR, PUM, TIE, YOU, DON, GRE, KAN, SPR, GIL, WOO, ASH, WAR, KOO, LYR[1]) have been digitised and mapped on the basis of 2005 high-resolution imagery (donated by the Gold Coast City Council) using ArcGIS with each separate polygon identified and the area calculated for management purposes. For determining the age of regeneration where land-cover has already developed, historical air-photo records (1930, 1961, 1975, 1989, 1993, 1998) were purchased, scanned and rectified. Digital records for 2005 were obtained *pro-bono* from the Gold Coast City Council as part of a data-sharing arrangement under their program of support for not-for-profit organisations. Contemporary monitoring of land cover post-2005 is based on either Google Earth or NearMap imagery. The latter is regularly updated allowing early detection of trends. Photopoint monitoring is conducted from a number of permanent vantage points. These have been established by ARCS for Warblers and Pallida in particular. Additional ground-based historical photos have been accessed from web resources or helpful long-term local residents (post-1990 images).

[1] Codes for individual properties

Desired outcome	Activity reporting
	  Upper Pallida below Mt Springbrook 4/8/2006 Same site 18/8/2009 Photos: A. Keto In addition, for fine scale assessment of micro-topographic and micrometeorological influences, and the testing of ecological models, all regeneration on selected properties (or parts thereof) has been marked with pink plant markers. Regular inspections are made to identify, mark and record new regeneration. A range of both wind- and animal-dispersed species is occurring among the regeneration. Five of these are rare or endangered. More than 50 species from 42 genera and 25 families have been recorded from growth plots to date. These plots represent areas that were recently cleared. A wider range of species have been recorded from regenerating areas outside growth plots and reflects proximity to the species pool in adjoining forests Wind-dispersed species recorded in regeneration sites include: *Acacia melanoxylon* (Fabaceae) *Acacia obtusifolia* (Fabaceae) *Acacia orites* (Fabaceae) *Austrobuxus swainii* (Picodendraceae) *Callicoma serratifolia* (Cunoniaceae) *Cassinia subtropica* (Asteraceae) *Eucalyptus campanulata* (Myrtaceae) *Eucalyptus oreades* (Myrtaceae)

Desired outcome	Activity reporting
	Kunzea ericoides (Myrtaceae) *Leptospermum polygalifolium* var. *montanum* (Myrtaceae) *Lomatia arborescens* (Proteaceae) *Melaleuca pallida* (Myrtaceae) *Orites excelsa* (Proteaceae) Animal-dispersed species include: *Duboisia myoporoides* (Solanaceae) *Elaeocarpus grandis* (Elaeocarpaceae) *Elaeocarpus reticulatus* (Elaeocarpaceae) *Lenwebbia prominens* (Myrtaceae) *Persoonia media* (Proteaceae) *Pittosporum undulatum* (Pittosporaceae *Polyscias sambucifolia* (Araliaceae) *Rapanea howittiana* (Myrsinaceae) *Synoum glandulosum* (Meliaceae)
Flora, fauna and fungi surveys carried out in adjoining rainforest (species pool)	Flora (Project BD1), fungi (Project BD2), and fauna (Projects BD3–7) surveys of species pools in forests adjoining restoration sites or regional pools were carried out either during the land acquisition phase or more recently as part of the restoration project. Plant surveys include collection of voucher specimens to be lodged with the Queensland Herbarium. In the interim, to maximise benefits from having an accessible local reference collection during the project, a voucher-based herbarium was established and is maintained under conditions of low relative humidity to control insect damage. Twenty-five property surveys were conducted with detailed reports produced for the majority. The Queensland Mycological Society is collaborating with ARCS to carry out regular fungi surveys on restoration properties at Springbrook (Project BD2). Monthly surveys at selected sites are planned in the future.
Reference sites selected and attributes documented (chronosequence)	Reference sites (Project RSP4) representing various stages of recovery from past clearing across the broad range of environmental gradients are in the process of being identified based on aerial photographs dating back to 1930, geological substrate, altitude, aspect, slope angle, solar insolation, and topographic position.

Desired outcome	Activity reporting
	These variables are ecologically significant relating to resource availability and potential productivity as defined in our ecological conceptual model. A comprehensive listing of plant species has been completed at two of the selected sites. Micrometeorological parameters are also being monitored at two of the Reference sites to date. Birds Queensland is collaborating with ARCS to carry out long-term bird surveys (Project BD6) four times a year (each season) at Springbrook including areas adjoining restoration properties. A standardised survey method utilising "results-based" stopping rules (Watson 2003) has been adopted. This has the advantage over "effort-based" stopping rules (fixed times and/or areas or quadrats) of enabling valid comparisons between different sites of varying size and complexity together with providing a reasonable measure of species richness and abundance or habitat fidelity. Four teams of at least three participants, including an expert team leader, each survey one of four sites for at least 2 hours, post-dawn and pre-dusk. Fungi surveys (Project BD2) have been trialled by the Queensland Mycological Society and ARCS members over the same areas sampled for diversity of bird species as part of developing a robust long-term monitoring strategy covering species and functional group diversity allied to ecosystem function. Corresponding plant surveys (Project BD1) have been completed for all transects sampled for birds and fungi.
Restoration equipment purchased	Restoration equipment purchased to date includes 3 ride-on mowers, 4 brushcutters, 2 chain saws, a chipper, a splatter gun for lantana control, back-pack spraying equipment for applying herbicide, a comprehensive range of hand tools, plant markers and protective clothing and first-aid equipment for volunteers. A second-hand tractor and slasher was purchased as part of acquiring the Koonjewarre business. All equipment items are related to weed control (physical, chemical, mechanical) and fall into the category of management-based "controlled disturbance" to manipulate biomass production (productivity), species feedback interactions (ecosystem processes including competition, facilitation) or trophic structure based on the adopted conceptual models of ecosystem function.
Volunteers recruited; training, safety, insurance, accommodation in place	More than 120 volunteers have been recruited since the program began. Approximately 50 volunteers have committed to regular ongoing visits through partnerships established with Birds Queensland (BQ), Brisbane Bushwalkers (BBW), Community of Christ (CofC), Springbrook Wildlife Appreciation Group (SWAG), the Gold

Desired outcome	Activity reporting
	Coast and Hinterland Environment Council (GECKO) and the Queensland Mycological Society (QMS). Volunteers have been trained as required, e.g. in wildlife survey protocols, use of scientific equipment and in effective aristea eradication measures (especially recognising and removing all rhizomes when digging out aristea). All volunteers have been trained in safety procedures and hygiene protocols relating to myrtle rust (also effective on chytrid fungus affecting amphibians). ARCS provides protective clothing such as disposable overalls and work gloves where required due to known infestations of myrtle rust. Birds Queensland has committed to four weekends each year in the long-term and Brisbane Bushwalkers and the Community of Christ have committed to at least three weekends annually. These groups each currently provide 12 to 20 volunteers per participating visit. These groups are self-organising, attract committed members, and contribute significantly to building and yard maintenance. In addition to these groups, over 20 Springbrook residents are on call for activities including scientific monitoring, weed control, track maintenance and brushcutting at relevant times of the year. A total of eight ARCS members and volunteers have been trained to assist with the monitoring of regeneration on growth plots carried out at the beginning of each season. A number of volunteers also assist with data entry for the range of projects where this is relevant. Computer and software availability limit the numbers that can assist in this task. Currently, three volunteers assist with this task. Public liability insurance covering volunteers is in place. In addition, all volunteers sign forms indemnifying both the Queensland Government and ARCS. Wording is based on advice from lawyers for the Queensland Government and ARCS. Accommodation for the majority of volunteers is currently provided at "The Lodge" (317 Repeater Station Road). The facility has a maximum capacity for 20–23 people (more comfortably 15). Two self-contained cabins provide overflow accommodation for an additional four people. A minimum current charge of $20/person/night does not cover all overheads. Electrical repairs are significant in an old building. Control of mould is also a significant contributor to high electricity costs, given the upper-montane location where rainfall and cloud-immersion are frequent and sustained. When the web site is completed and on line, volunteer recruitment should reach levels to adequately complete planned restoration activities. The number of volunteers required overall has been calculated on a project basis where timelines, actions and resource requirements (equipment, volunteers, funding) have been specifically

Desired outcome	Activity reporting
	estimated.
Funding sources secured, identified or indicated	Funding sources comprise philanthropic donations (both directly and indirectly), government grants and in kind support. ARCS also solicits donations for the Springbrook Project from its members. This amounts to ~$6,000–$7,000 annually, but one-off donations have been substantial. Tax-deductible donations are processed through an independently audited fund established for the purpose (Springbrook Rescue Fund 1). ARCS also purchased two accommodation businesses at Springbrook to provide funding for the project. To date ARCS has not sought reimbursement of this capital contribution in order to meet early project establishment needs. All net income from the businesses is applied to the restoration project through an independently audited fund (Springbrook Rescue Fund 2). Auditing protocols meet obligations under the *Incorporated Associations Act 1981*, and as a Deductible Gift Recipient on the Register of Environmental Organisations. Legal advice for the establishment of both funds was provided by Allens Arthur Robinson, a prominent international legal firm. As ARCS involvement in the accommodation businesses (accounting, all advertising, general oversight, and key decision making) is not included in overheads, net profits incorporate a very significant donation to the restoration project by ARCS volunteers. Inclusion of these costs would compromise the viability of the Project. Essentially, these businesses allow the conversion of *pro bono* contributions into working capital to sustain the Springbrook Rescue Project in the long-term.
Monitoring equipment purchased	Monitoring is primarily directed at the key drivers of ecosystem dynamics such as abiotic resources (light, moisture, nutrients), ambient conditions (soil condition, microclimates), disturbance regimes (frosts, fire, water deficits etc), and response variables (biodiversity indicator species; species interactions, productivity measures including recruitment, growth and mortality). Monitoring is organised within 35 separate but interrelated projects of varying scope, cost and duration. Targets and indicators facilitate assessment of attainment of project goals as defined by the international Society for Ecological Restoration (SER). Resources purchased for the plant growth and health assessment (Project P2) include six telescopic, weatherproof measuring poles allowing height measurements to 6 metres, diameter measuring tapes and a laser hypsometer (Opti-Logic) for heights >6 metres, water-proof paper and pens, water-proof clipboards, hand lenses (10x magnification), UV-resistant paint pens for labelling permanent grids and recruitment markers, and star pickets or recycled plastic stakes for grid and sub-cell marking. Replacement costs are high as a result of

Desired outcome	Activity reporting
	frequently working under very wet conditions (heavy rain or immersion in cloud). Resources purchased for habitat monitoring (Project RC1) include sensors (temperature, humidity, soil moisture, soil water potential, leaf wetness, photosynthetically active solar radiation and tipping bucket rainfall sensors), data loggers, mounting poles, cross arms, cable ties and assorted nuts and bolts. Nodes with a range of sensors have been installed at 9 sites (extra to those associated with the wireless sensor network in the Boy-ull Creek catchment involving the CSIRO, DERM and ARCS and funded by the State Government — Project RC2). Infra-red video cameras, digital video recorders and digital audio recorders have been purchased to monitor wildlife, initially in the vicinity of Logrunners as part of critical habitat monitoring (Project S2). The Logrunners site is 35-year old regenerating rainforest whose overstory is dominated by *Callicoma serratifolia*. It is uncertain whether this represents an alternative stable state unable to sustain viable populations of indicator taxa, or simply a transient stage in normal succession towards typical mature rainforest. The long-term objective is to monitor the status of wildlife populations in a chronosequence of regenerating forest following original clearing as well as potential impacts of climate change on indicator species. This project will inform the design of habitat monitoring in restoration areas. In the short term, the project is providing insights into the life history attributes and habitat requirements of a number of restricted understorey birds and frogs contributing to World Heritage values. In the long-term, wildlife monitoring generally is expected to routinely use autonomous sensor networks. A Song Meter audio recording device (Wildlife Acoustics Inc.) was initially purchased and installed at Logrunners for trialling its suitability in an extremely wet environment. Software for analysing the recorded data (Songscope, also from Wildlife Acoustics Inc.) has also been purchased. The system allows monitoring birds, mammals and frogs in regenerating rainforest habitat within reference sites. A total of six Song Meters have now been acquired to extend the program (Project S2). An instrument for measuring photosynthesis has also been purchased. This allows determination of thresholds (light compensation points) that indicate a plant's response to different levels of shading, as well as comparative estimates of light- and water-use efficiencies that influence competitive species interactions (Project P2).
GIS mapping resources established; grid-based monitoring and reporting adopted and cells (16.67 m square) permanently marked	GIS mapping resources have been established. Around 100 grid cells have been permanently marked on Warblers, 60 on Pallida and 10 on Ashmiha. All monitoring and recording is based on the grid cells. This includes recruitment of new plants, weed control and removal, as well as management intervention activities such as mowing and brushcutting (controlled

Desired outcome	Activity reporting
	disturbances that selectively reduce biomass thereby influencing competitive interactions favouring regenerating native species). This year (2011) has been remarkable for summer recruitment of *Lomatia arborescens,* with, for example, 390 new recruits identified, marked and measured on Plot A428 at Warblers. This is equivalent to a density of 14,000 plants per hectare (Projects P2 and S1).
Springbrook Rescue web site designed and online; brochures designed and printed; display designed and installed; 3 field days held; Scenario-Based Learning (SBL) Tool started	Springbrook Rescue web site has been designed and the content is about 90 per cent complete. It should be online in early 2012. A draft has been provided to DERM staff. Web visitation statistics (AW Stats and Google Analytics) will provide a progressive indicator of visitor interest. A general brochure describing the Springbrook Rescue project has been produced and is distributed to volunteers accommodated at The Lodge (317 Repeater Station Road) and associated with the Project. Other brochures associated with individual projects will be produced when conclusive results of monitoring are available. A brochure describing the values of Ankida has also been produced. ARCS contributed to the production of an information sheet (brochure) on the Springbrook wireless sensor network produced by the Queensland Government, and distributed to all Springbrook residents. A 'project room' has been set up at The Lodge with eight display boards and a large whiteboard mounted on the walls. Volunteer groups use The Lodge for accommodation. A number of maps illustrating the project are displayed. More will be produced and displayed, using conceptual diagrams, as the project progresses. A designer has been chosen to develop the conceptual diagrams. These poster displays will be amenable to presentation at international conferences, and to large groups of visitors at Koonjewarre. Two portable display units are housed at Warblers (Spyder: PanelKog Lite Fabric modular display units) for volunteer, day-visitors. Five field inspections have been conducted for local, national and international visitors including representatives of ACIUCN, the Co-Chairs of ECO (the leading New Zealand environment council and IUCN member), senior collaborating scientists from ICT International (Dr Michael Forster), Professor Stuart Gage (Michigan State University) who is a world leader in complex biological systems analysis and use of soundscapes to measure ecosystem health, and scientists from QUT Institute of Sustainable Resources specialising in acoustic monitoring. These field inspections have resulted in significant commitments to scientific collaboration with eminent international experts and the likelihood of the Project being accepted as an international Case Study on ecological

Desired outcome	Activity reporting
	restoration and linkage design for wildlife corridors. "Open" field days have not been held at this stage until adequate Myrtle Rust hygiene protocols have been determined or developed for large numbers of visitors. This presents a significant logistical challenge and potential cost to ARCS. The SBL eLearning tool, Scenario Based Learning Interactive (SBLi) developed by QBIT at the University of Queensland, will not be started until sufficient monitoring allows valid generalisations to be made. It was not realistic to expect results from the wide range of monitoring programs associated with forest regeneration to allow robust conclusions about correlations or causation within three years. In the interim, the website will provide a significant contribution to a systematic, science-based and cost-efficient approach to restoration at ecologically meaningful scales
Policy deficiencies that allow continuing threatening processes notified to authorities	Policy deficiencies have been notified to DERM and the Department of the Premier and Cabinet, and discussed at the project Steering Committee. The most significant deficiencies are listed below. ▪ A common objective and coordination among government agencies is absent. Whereas the Government set a vision in the SEQ Regional Plan 2009–2031, there is no indication that the vision has been recognised and adopted across government agencies and it has certainly not filtered down to on-the-ground staff or contractors. ▪ The SEQ Regional Plan 2009–2031 includes the statement that "The Queensland Government will minimise development and redevelopment on the Springbrook Plateau, and prevent further habitat fragmentation, forest edge impacts, clearing and loss of connectivity among habitat areas." However, there is no procedure or regulations in place to achieve this objective. Fragmentation of habitat, forest edge impacts and clearing continue. These have been reported to the Government. ▪ No serious attention has been given to presentation of World Heritage values, a major requirement under the World Heritage Convention in order to protect and transmit this area of outstanding universal significance unharmed to future generations. ▪ ARCS submitted draft hygiene protocols for consideration by DERM in 2008, which included preventative measures for the spread of plant and animal pathogens and highly invasive weed species. No response was received. Whilst progress on protocols was made following entry of Myrtle Rust into Queensland from New South Wales, inadequate consideration has yet been given to limiting the spread of

Desired outcome	Activity reporting
	Chytrid Fungus (*Batrachochytrium dendrobatidis*) and other emerging fungal or other pathogens.
Road verges and powerline easements managed to restore microclimate, protect habitat and reduce spread of weeds	ARCS has worked with DERM to address management of road verges. A modified version of the *Road Maintenance Code of Practice for the Wet Tropics World Heritage Area* has been developed between Department of Transport and Main Roads and DERM with input from ARCS. However, the draft code is not operational and there is at this time no indication that the contractors are applying the code. Quite the contrary. Grassy road verges continue to be maintained and even expanded, leading to increased fragmentation and edge effects as well as continued road kills of a wide range of fauna including reptiles, frogs, birds and mammals. These road kills for long-lived, low-fecundity taxa (many of which are listed as either endangered, vulnerable or near-threatened under the Commonwealth EPBC Act or the Queensland Nature Conservation Act 1992, can have significant impacts on species whose populations have already been depleted by past clearing and fragmentation. Individual species include lyrebirds, logrunners, bowerbirds, land mullets, Giant Panda snails, Lamington blue crayfish, koalas, greater gliders, pademelons and many others. There has been no change to management of powerline easements. Fifteen-metre corridors continue to be cleared to exposed soil. Significant machine clearing for replacement of cross-arms occurs instead of manual replacement. Contractors are ignorant of the required hygiene protocols for identification, cross-contamination and containment of pathogenic fungi such as Myrtle Rust. In fact swathes were cut through infected plants (*Lenwebbia prominens*, *Rhodamnia maideniana* in particular) on Repeater Station Road in 2011. More urgent efforts are required to establish appropriate policy guidelines and on-ground practices.

3. Unanticipated results

Unanticipated result	Explanation
Synergy of "year effects" and "facilitation" processes critical for sensitive species during seedling establishment phase	Whilst "year" effects are known and result from either sporadic inter-annual flowering and fruiting phenologies most likely associated with optimal weather conditions such as La Nina events, what was not expected was the close or very strong and quantifiable synergy between "year effects" and "facilitation" processes during seed germination and seedling establishment phases. The year 2011 was outstanding for regeneration, in particular, of

Unanticipated result	Explanation
	Lomatia arborescens in late Summer. This was especially the case in areas adjoining growth plots on the northern part of Warblers and the western boundary of Pallida where reproductively mature Lomatia adults exist in sufficiently close proximity. Young unprotected seedlings are frost prone, possibly where insufficient soil water is available to counter dehydration from intra- and inter-cellular ice crystal formation. What alerted us to facilitation effects was the dominant and close association of Lomatia seedlings with Aristea plants. It is concluded that any plant providing appropriate microclimate conditions (increased moisture availability) at this critically sensitive stage of development (even *Aristea ecklonii* or *Setaria sphacelata*) will enhance the survival of young seedlings. This has major implications for restoration practice: nurse plants (even if weeds) need to be retained through the frost season, but culled by the first sustained spring rains, to prevent mortality from carbon starvation through shading out by the competitively superior weed species, and to maximise root development prior to the next frost season. Results observed from trial plots will be published in a peer-reviewed scientific journal.
Virulence or explosive spread of plant and animal pathogens	The introduction and rate of spread of Myrtle Rust (*Uredo rangelii*) over a matter of a few months in 2011 was not anticipated. This can be attributed to the unusually wet spring-summer-autumn period and the failure of Biosecurity Queensland to anticipate the epidemic and institute widespread prevention or containment protocols. The extinction of locally threatened myrtaceous plants is likely as a result. The formal 'least concern' classification (under the Nature Conservation Act) of *Rhodamnia maideniana* is being revised to 'endangered' as a consequence. The failure to institute integrated, timely education and training programs for utility service provides and non-conservation stakeholders such transport, water, energy, land-use planning agencies and real-estate developers meant infections expanded explosively. The result is that ARCS has had to invest more time and resources than anticipated on instituting hygiene protocols on lands for which it shares responsibility, and on facilitating the adoption of similar protocols by other organisations and agencies. *Favolaschia calocera*, an exotic basidiomycete fungus, is also now widespread on Springbrook and of concern. The ecological consequences have not been determined, but natural wood decomposition and nutrient cycling processes are predicted to be affected with possible flow-on long-term effects to the composition of plant communities. Chytrid fungus affecting frog species and responsible for catastrophic population declines worldwide is also reported now to be widespread throughout Springbrook.

Unanticipated result	Explanation
Severity of insect herbivory	The extensive, often fatal impact of insect herbivory, particularly on eucalyptus, acacia and leptospermum species, should have been, but was not anticipated. Early regeneration on cleared land effectively constitutes near "monocultures" with all attendant side effects frequently reported in the scientific literature. Botany Bay Weevils (*Chrysolopus spectabilis*, Curculionidae) cause significant mortality of advanced acacia species, especially at Pallida. An as yet unidentified leaf miner causes near total mortality of *Acaca orites* regeneration in many areas. Spittle Bug or Frog Hopper (*Philagra parva*; Asphrophoridae) infestation especially of *Leptospermum polygalifolium* var. *montanum*, results in suppressed growth, deformed plants, even mortality to an extent likely to detrimentally affect timescales of recovery. Whereas spittle bugs are native species, enhanced concentrations of their food resource result in major outbreaks. Because the nymphs cannot tolerate dessication, physical removal with dry absorbent cotton cloths, as opposed to chemical sprays has proved an effective control measure during the period of greatest vulnerability in key regeneration nodes. We have had to invest more resources than anticipated in insect collection and identification so as to recognise potential negative impacts on regeneration.
Vandalism, theft and trespass	Springbrook residents and ARCS in particular have been subjected to a wave of unlawful activities. Equipment losses and physical damage to buildings and wildlife have been significant. Damage to regeneration, particularly advanced regeneration of eucalypts, lomatias, callicomas and persoonias has been significant. Chain-saws or simply physical force have been used to destroy or push over plants. Plant markers identifying regeneration have been extensively removed or redistributed, as in the case of growth plots. Trespass is common and results in trampling of regeneration, compaction of soils in sensitive areas, and spread of plant pathogens and weeds. These hostile activities have negative impacts on regeneration success and on overall budgets. The impact on volunteer morale is significant. Signage and security surveillance have proved to be more necessary than originally anticipated. Ongoing implementation of the community support part of the program should help develop a broader commitment to the overall objective of increasing viability of the National Park and World Heritage areas.
Lack of commitment to World Heritage	It was our assumption that Australia as a nation is proud of and committed to protecting World Heritage values. As signatory to the World Heritage Convention in 1974, the Australian government, on behalf of the community, committed to honouring the obligations in both the Articles and Operational Guidelines of the Convention. The

Unanticipated result	Explanation
	Queensland Government, as a result of delegated responsibilities under the Intergovernmental Agreement signed between the Commonwealth, states and territories in 2010, shares the "duty, to the utmost of its ability" of protecting, conserving, restoring, presenting and transmitting to future generations, areas of outstanding universal value. The World Heritage Convention arose as a result of widespread concerns for ongoing losses of the world's natural and cultural "wonders"; as a result, nations committed to unprecedented cooperation to reverse this decline. However, this vision and these obligations do not appear to have widespread support or recognition amongst communities or institutions most directly affecting land use or land-use change. Ultimately it is a failure of governance that is responsible for the "tragedy of the commons" in its various forms. Ecological and demographic tipping points may be crossed sooner than anticipated without addressing this social issue. While development decisions and management continue to be conducted in ignorance of World Heritage values and integrity requirements and according to standard practice for suburban zones, highways and high-voltage power easements, endangerment of the Gondwana World Heritage Area escalates. A deeper understanding of the social aspect of social-ecological systems, particularly the primary drivers of change, is warranted as a result. The additional social-systems model adopted provides a means for identifying and addressing these drivers that is transparent, science-based and repeatable.
Positive benefits of institutional volunteers	The decision to develop partnerships with community organisations, in particular with Birds Queensland, Brisbane Bushwalkers, and Community of Christ, has been strongly vindicated. These organisations are committed, self-organising, and contribute additionally to accommodation maintenance. The resulting positive spirit and sense of achievement, development of trust, respect and sharing of experiences and knowledge provides a sustainable basis for community engagement.
Data storage needs underestimated	Data storage and backup needs were initially underestimated, particularly with camera- and audio-based monitoring. However, since prices of multi-terabyte internal and external drives have reduced considerably over a relatively short period, cost is no longer an issue.

4. Review and improvement

Outcome	Evaluation question	Answer (as at September 2011)
Improvement in the state of the asset	Are threats and barriers to ecological restoration under active control and based on best science and practice?	Yes
	Is the extent of *Aristea ecklnii* infestation identified; control options assessed, and control measures under way?	The extent of infestation is identified. Control options are physical, chemical and mechanical means of containment and eradication, however a regime (dosage rate and timing) for successful chemical destruction of rhizomes is still elusive. The more labour-intensive physical removal with follow-up remains the only effective method in sensitive areas containing threatened wildlife. The exceptional La Nina conditions in 2010–2011 resulted in 6-week fruiting cycles under weather conditions mitigating against normal controls. Increased volunteer recruitment will be necessary to keep the weed in check while labour-intensive ultimate solutions slowly progress, or effective herbicide regimes are found.
	Are appropriate control measures for all priority weeds under way?	Lists of priority weeds for each restoration area, their phenologies and life-history attributes and control measures are documented and management is underway. However, control measures for a range of weed species require the facilitative effects as 'nurse' plants to be taken into account especially during critical seedling recruitment stages.
	Are landscape-wide measures being applied to control weeds and restore habitat (e.g. along road verges and powerline easements)?	A failure of governance by both Queensland and local governments means that the fragmentation impacts of service corridors are increasing. More effort will be required to address these deficiencies.
Improvement in organisational capacity to	Were the threats and barriers to ecological restoration identified	Yes. A project-based framework was instituted as a considerable improvement which allows specific interventions

Outcome	Evaluation question	Answer (as at September 2011)
implement the program	and described for each asset?	and goal oriented monitoring to be more precisely defined and costed.
	Were sufficient funding sources secured?	Income is from donations and profits from the operation of Springbrook Lyrebird Retreat and Koonjewarre which are potentially sustainable in the long term. Income required is estimated on the basis of individual projects that collectively contribute to achieving clearly defined goals. A critical need for further strategic acquisition of properties for protection of habitat and connectivity requires further funding.
	Was all equipment necessary for restoration and monitoring acquired?	Core requirements are generally satisfied, but a replacement tractor/slasher and utility vehicle will be required and more monitoring equipment will be acquired as funds become available. Replacement of worn out or damaged equipment is an ongoing need.
	Were identified data acquisition, storage, analysis and reporting requirements set in place?	Yes, but storage capacity was originally underestimated. The extra capacity is within our means to acquire.
	Was a volunteer program successfully established	Volunteer recruitment has risen from 40 in the last reporting phase to over 150 to date. All four groups indicating an intention to be involved in the long term have committed and are actively involved in regular activities. A further number of groups is being considered.

Appendix 1

List of properties with cleared or degraded areas requiring natural or assisted natural regeneration in order of size of cleared or degraded areas

Code	Address	Total Area (ha)	Cleared (ha)	% of total	Catchment
ANK	2198 Springbrook Road	204.8	42.86	20.9	Waterfall Creek
WOO	636 Pine Creek Road	24.4	12.20	50.0	Waterfall Creek
BAR	2844 Springbrook Road	28.1	7.88	28.1	Ee-jung Creek
KOO	2806 Springbrook Road	5.4	4.29	79.4	Boy-ull Creek
GRE	252 Lyrebird Ridge Road	24.0	4.26	17.8	Pigeon Creek
DON	Lyrebird Ridge Road	20.4	4.05	19.9	Pigeon Creek
GIL	2511 Springbrook Road	24.3	2.41	9.9	Little Nerang Creek (East Br)
PUM	2884 Springbrook Road	8.2	2.24	27.2	Ee-jung Creek
LYR	418 Lyrebird Ridge Road	14.4	2.01	14.9	Cave Creek (North)
SPR	74 Repeater Station Road	5.9	1.40	23.8	Purling Brook
COU	300 Repeater Station Road	4.0	0.91	22.6	Boy-ull Creek
DWY	201 Repeater Station Road	5.1	0.50	9.7	Rush Creek
KYR	333–375 Repeater Station Road	1.1	0.44	38.9	Boy-ull Creek
OST	41 Bilborough Court	3.0	0.30	10.0	Mundora Creek
QUO	352 Repeater Station Road	58.2	0.18	0.3	Cave Creek (South)
LOD	317 Repeater Station Road	4.0	0.10	2.6	Boy-ull Creek
LOG	329 Repeater Station Road	4.1	0.02	0.4	Boy-ull Creek
Total		439.4	86.05	19.6	