Darwin Initiative Main Project Annual Report

Important note: *To be completed with reference to the Reporting Guidance Notes for Project Leaders: it is expected that this report will be no more than 10 pages in length, excluding annexes*

Submission Deadline: 30th April 2017

Darwin Project Information

Project reference	23-020
Project title	Sustaining biodiversity, livelihoods and culture in PNG's montane forests
Host country/ies	Papua New Guinea
Contract holder institution	Wildlife Conservation Society (WCS)
Partner institution(s)	Oxfam International, Individual Reform & Restoration Movement, and KGWan Eco-Habitat
Darwin grant value	£299,959
Start/end dates of project	Apr 2016 – Mar 2019
Reporting period (e.g., Apr 2016 – Mar 2017) and number (e.g., Annual Report 1, 2, 3)	Apr 2016 – Mar 2017
Project Leader name	Ambroise Brenier
Project website/blog/Twitter	www.wcspng.org, @WCSMelanesiaSci
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1. Project rationale

To significantly and demonstrably reduce deforestation in the Bismarck Mountains of PNG, strengthen local livelihoods, and conserve biological and cultural diversity, this project will improve agricultural practices, implement sustainable forestry and silviculture, reduce hunting pressure on threatened species, and retain and pass on traditional ecological knowledge to the next generation. [For map see Community mobilisation section in the attached Compendium Report Annex 4 for more detail]

2. Project partnerships

Memorandums of understanding (MoUs) have been signed with two community based organisations: IRRM (Womkama village) and KGWan Eco-habitat (Danbagl) in Gembogl District, and the Miruma (Namta) community in Daulo District. The established community based organisations (CBO) of IRRM and KGWan Eco-habitat have additionally been supported through the signing of sub-grants. Additional MoUs have been signed with Oxfam International (for agricultural support) and Man on Earth Ltd (to utilise a nearby nursery to trial native timber propagation methods). A sub-grant has also been signed with the National Agricultural Research Institute (NARI) to undertake agricultural training and drought resistant plant propagation with the participating communities. The sub-grant with NARI took 4-5 months to sign and as a consequence there has been a delay in NARI activities. WCS also engaged

Oxfam International to evaluate agricultural resilience in Gembogl in response to the 2015-2016 drought to inform our agricultural initiatives. A consultative approach has been undertaken in formulating the sub-grants and the activities in which each partner organisation will be involved. All partners (with the exception of Man on Earth ltd) were involved in the initial planning of the project proposal.

3. Project progress

3.1 Progress in carrying out project Activities

Output 1. The introduction and uptake of improved gardening practices in three communities and an increase in the duration and life of garden areas

Activity 1.1 Increase the number of new gardening techniques that are taken up by communities in the project area. WCS has identified current agricultural systems in use and crops currently cultivated from a survey of 59 people (33 male, 26 female). WCS has engaged NARI via a sub-grant to lead CBO training in new gardening techniques. In addition, WCS is propagating the multi-use tree species *Causarina oligodon* for use as a nitrifying legume for fallow areas (1,400+ seedlings are currently growing in the WCS nursery). [See Agriculture intitiatives, and Silviculture initiatives (regarding *Causarina oligodon)* sections in the attached Compendium Report Annex 4 for more detail]

Activity 1.2 Ensure activities are established in >300 households using new gardening techniques by March 2018.
Currently, there is only 1 major commercial crop growing at Womkama and Danbagl (bulb onions, identified through Activity 1.1 survey), and none at Miruma. WCS has engaged the NARI via a sub-grant to undertake training of village agricultural extension officers, who will then disburse the information to the wider community (undertaken respectively by IRRM in Womkama, KGWan Eco-habitat in Danbagl, and community facilitators in Miruma). As yet no activities have been undertaken.

Activity 1.3 Promote new techniques to ensure the duration of active garden areas is increased by 30% by March 2019 in comparison to baseline information from past practise.
WCS has engaged NARI via a sub-grant to undertake community training over the course of the next two years to increase the lifespan of active garden areas (as above). Baseline surveys of garden duration will be completed in the next 12 months by WCS.

Output 2. Introduction of new market crops for income generation, and introduction of pest and drought resistant varieties for subsistence use within all three communities

Activity 2.1 Work with Oxfam and local partners to promote a 50% increase in the number of marketable crops in gardens
WCS has thus far identified 4 crops with potential for scaling to commercial levels (garlic, potato, apples, and strawberries). Crops were screened on the basis of community familiarity, perishability, low competition and marketability. The prospects of these crops will be investigated in collaboration with NARI, Oxfam and local CBOs over the coming year. [See Agricultural initiatives section in the Compendium Report, Annex 4, for more detail]

Activity 2.2. With the support of NARI introduce least 2 new pest and/or drought tolerant crop varieties
WCS has engaged Oxfam International in a sub-grant to undertake an evaluation of drought preparedness in Gembogl District with respect to the effectiveness of current agricultural practices in response to the extreme 2015-16 El Niño. NARI will be the partner responsible for introducing drought resistant varieties (along with the aforementioned Activities 1.1 and 1.3).[see Agricultural initiatives section in the Compendium Report, Annex 4,for more detail]

Output 3. Nursery practices for native tree species tested and established in two communities and active planting of areas with native species by the project end

Activity 3.1 Develop propagation methods for at least four native tree species in nurseries
Six species are currently in propagation at the WCS (Man on Earth) nursery. As of 22 March 2017, over 3,100 seedlings had germinated from the following species: 1) *Causarina oligodon* (1,400 seedlings); 2) *Nothofagus pulleii*, (200 + seeds germinating); 3) *Fragrea* spp. (1,700 seedlings); 4) *Pandanus julianetti*, (~600 seeds germinating); 5) *Ficus copiosa* (1,000+ seeds germinating); and 6) *Castonopsis acuminatissima*, (only 10 seeds germinating).In the community nurseries IRRM is focusing on husbandry of seedlings obtained from the wild while KGWan Eco-habitat has recently begun germinating *Fagraea* spp (~300 seeds) and *Nothofagus pullei* (~300 seeds).[see Silviculture initiatives section in the Compendium Report, Annex 4,for more detail]

Activity 3.2 Introduce the planting of native tree species in place of exotics into land use plans and ensure over 100 ha of land planted with native trees.

Thus far some potential woodlot sites have been proposed by the communities of Womkama and Danbagl. These will be mapped over the course of the next year and WCS will help to facilitate community meetings to go over existing (or establish new) land use plans.

Output 4. Sustainable use of existing forest stands within remaining areas of native forests and planted areas of exotic trees

Activity 4.1 Work with local CBOs to reduce the number of native trees harvested compared to number of exotic trees harvested from already existing forest stands
As of yet this activity has not yet been targeted. In the upcoming year we will focus on enumerating the volume of timber available from exotic woodlots compared to that available from the forest.

Activity 4.2 Ensure more than 500 hectares under sustainable forestry practices as compared to baseline by March 2019
WCS has calculated the baseline rate of forest cover loss from changes in closed canopy cover within the project footprint via an analysis of deforestation and afforestation rates within the project area of interest using the Global Forest Change database. Total forest loss between 2001 and 2014 in the project area was 40.6 ha (where forest loss is defined as canopy cover over 5 meters in height and of at least 80% cover at a 30 x 30 m resolution). This has revealed that comparatively little closed canopy forest has been lost from Womkama and Danbagl but by comparison forest loss is increasing year-on-year at Miruma. Overall 32.6 ha has been lost at Miruma over the 13 year period. [See Silviculture initiatives section in the Compendium Report, Annex 4, for more detail]

Output 5. Capturing and passing on traditional ecological knowledge on forests and threatened species

Activity 5.1 Produce school curricula capturing local ecological knowledge in 3 primary schools in the project area by September 2017
WCS is in still in the process of collecting local ecological knowledge (LEK). Thirteen community facilitators have been trained at Miruma (10 men, 3 women) and have collected local ecological knowledge based on 64 interviews (38 male, 26 female) with regard to natural resource management, perceptions of the importance of forest and traditional ornamentation. The capture of LEK is currently underway at Womkama and Danbagl. We are currently on track for producing education materials for Sep 2017.[See Traditional ecological knowledge section in the Compendium Report, Annex 4,for more detail]

Activity 5.2 Measure an increase in the number of school children that learn about their local culture and traditional ecological knowledge by March 2019
Baseline rates of school children knowledge have not as yet been assessed but will assessed over the next 12 months.

Output 6. Minimizing impacts on hunted species by preserving local costumes and reviving traditional *tambu* (no hunting) areas.

Activity 6.1 Promote the uptake of improved preservation methods for fur and feathers in traditional costumes (termed bilas in tok pisin)

On 19 December 2016,110 bilas protection kits were given to the Gembogl based Mt Wilhelm cultural group, thereby exceeding the initial target of reaching 75 performers. Additionally, in 2016 WCS ran a stall at the 2016 Goroka cultural show under the theme: strengthen your culture, look after your ornamentation specifically to target Highland costume owners. Over August and September 2016, a total of 644 bilas protection kits were given out at the Goroka and Mt. Hagen cultural shows. [See Wildlife monitoring and natural resource management section in the Compendium Report, Annex 4, for more detail]

Activity 6.2 Work to increase the area or number of tambu sites created or re-established in the project area by March 2019, or other compatible traditional management methods

WCS is in the process of surveying communities with regard to traditional practices including tambu areas (64 surveys completed from Miruma, see Activity 5.1 & 5.2). Thus far surveying of the Miruma community has been completed but as yet there is no indication that tambu prohibitions are being used as an a resource management technique. There is some indication IRRM are interested in developing a protected area along their tourist path to Mt. Wilhelm at Womkama. The prospect of developing a formal protected area near Womkama, and examination of tambu use in Gembogl District will be investigated over the next 12 months.

6.3 Conduct baseline and end threshold surveys for key biodiversity indicator species, and establish monitoring procedures for birds of paradise

We carried out a survey on the use and importance of wild caught meat by interviewing a total of 59 community members (33 male, 26 female) across Womkama, Danbagl, and Miruma. We have recently completed our first wildlife monitoring transect at Womkama. For in situ monitoring we have settled on two monitoring methods: 5 minute bird counts incorporating a distance variable detection methodology, and camera trap monitoring for cursorial and arboreal species (both mammals and birds). Threshold surveys in which hunter caught animals are intercepted at households will commence as soon as community facilitator training has finished (currently underway at Womkama and Danbagl). [See Wildlife monitoring and natural resource management section in the Compendium Report, Annex 4, for more detail]

3.2 Progress towards project Outputs

Output 1. The introduction and uptake of improved gardening practices in three communities and an increase in the duration and life of garden areas

1.1 Number of new gardening techniques that are taken up by male and female community members in the project area by March 2018 and by March 2019

1.2 At least 300 households using new gardening techniques by March 2018

1.3 Duration of active garden areas increased by 30% by March 2019 in comparison to baseline information from past practise

The signing of a sub-grant agreement with NARI was protracted taking 4-5 months. As a result NARI as yet has not begun field activities. However, there is no indication that these initial delays will impact the ability of the project to deliver within the remaining two years. However, WCS is propagating the multi-use tree species *Causarina oligodon* for use as a nitrifying legume for fallow areas (1,400+ seedlings are currently growing in the WCS nursery) to be distributed to farmers. No change to indicators.

Output 2. Introduction of new market crops for income generation, and introduction of pest and drought resistant varieties for subsistence use within all three communities

2.1. A 50% increase in the number of marketable crops in gardens in project areas by March 2019.

Through surveys at Womkama, Danbagl and Miruma WCS has achieved a baseline measure of crop diversity and the number of marketable crops. Only bulb onions at Womkama and Danbagl are sold commercially. Some broccoli is sold locally. WCS has identified 4 crops with possible commercial potential. Liaison with project partners and downstream industry and sellers will further screen the crops. NARI will then introduce the appropriate varieties. No change to indicators.

2.2 At least 2 new pest and/or drought resistant crop varieties introduced by March 2018

This output, tied to Output 1 is dependenet on NARI and as a consequence is experiencing a delay while we wait for NARI to begin field activites. The sub-granting of Oxfam International to evaluate drought resilience in Gembogl district is designed to help inform the site appropriate crop selection. No change to indicators.

Output 3. Nursery practices for native tree species tested and established in two communities and active planting of areas with native species by the project end

3.1 Successful propagation of at least four native tree species in nurseries by March 2018

Propagation of six species is underway. Two species have thus far been reared successfully to seedling stage. Four other species are still germinating (at time of writing low quantities of two more species have germinated). This output is well on track and will likely exceed the initial target of 4 species. No change to indicators.

3.2 Planting of native tree species in place of exotic species incorporated into land use plans by March 2018 and over 100 ha of land planted with native trees by project end (March 2019)

Two nurseries are currently in operation at Womkama and Danbagl. Two new community nurseries are currently being established at Miruma and will be operational by late 2017. Planting of the current cohort of seedlings under propagation into community woodlots as weather hardened specimens is expected in 2018. Given that the production of weather hardened seedlings will have a lead in time of 12-18 months, and current time lag in updating of the Global Forest Cover database (~2 years in arrears) would suggest that change in measurement of tree cover loss over the project period is also unlikely to be obtained by project close using this method. Consequently we suggest that the indicator 3.2 be revised to: “community nursery output exceeding 3,000 weather hardened native seedlings per nursery per year by project end" rather than the current target of 100 ha.

Output 4. Sustainable use of existing forest stands within remaining areas of native forests and planted areas of exotic trees

4.1 Reduced area and number of native trees harvested compared to number of exotic trees harvested from already existing forest stands by March 2019 (Note: the aim is to shift stand diversity towards native trees by removing exotics.)

As yet this activities relating to this output have not yet been targeted. In the upcoming year we will focus on enumerating the volume of timber available from exotic wood lots compared to that available from the forest. No change to indicators.

4.2 More than 500 hectares under sustainable forestry practices as compared to baseline by March 2019

As yet this activities relating to this output have not yet been targeted. WCS will investigate the possibility of developing a protected forest area in Womkama to develop as part of the land use planning process. WCS will train the extension workers of IRRM and KGWan Eco-habitat, and Miruma community facilitators in continuous cover forestry in the coming 12 months as well as working with communities to establish or administer land use plans when such plans already exist (e.g. Danbagl). No change to indicators.

Output 5. Capturing and passing on traditional ecological knowledge on forests and threatened species

5.1 Quantitative survey on knowledge and attitudes of men, women and children in project and control areas at the project start and end

A baseline survey covering traditional ecological knowledge and perception of environmental values has been completed at Miruma (64 people, 38 male, 26 female). This survey is currently beginning replicated at Womkama and Danbagl. No change to indicators.

5.2 Produce school curricula capturing local ecological knowledge in 3 primary schools in the project area by September 2017

Activity associated with this output has not yet been targeted. Due to national restrictions on alteration to school curricula we will provide supplementary education materials. Consequently the indicator should be changed to: "supplementary education material capturing local ecological knowledge in 3 primary schools in the project area by September 2017"

5.3 Increase in number of school children that learn about their local culture and traditional ecological knowledge by March 2019

Activity associated with this output has not yet been targeted. Given that WCS will not feasibly be able to access school records of attendance, we suggest that indicator 5.3 be changed to " knowledge of tok pes names by school students under 12 years old at project end exceeds that baseline collected in 2017".

5.4 Documentation of tok ples names and traditional knowledge of culturally and ecologically important fauna and flora gathered from female and male community members by March 2018

WCS has documented 28 names documented so far. Baseline surveys completed at Miruma and currently being undertaken in Womkama and Danbagl. No change to indicators.

Output 6. Minimizing impacts on hunted species by preserving local costumes and reviving traditional *tambu* (no hunting) areas.

6.1 Uptake of improved preservation methods for fur and feathers in traditional costumes (termed bilas in tok pisin) by 3 active cultural troupes (at least 75 dancers) by March 2019

On 19 December 2016 110 bilas protection kits were given to the Gemobogl based Mt Wilhelm cultural group thereby exceeding the initial target of reaching 75 performers. A total of 644 bilas protection kits were also given out at the Goroka and Mt Hagen cultural shows. Given that the target of 75 performers clearly under estimated local demand for bilas protection kits we suggest increasing indicator 6.1 to: "at least 200 local bilas owners by project end".

6.2 Increase in area or number of tambu sites created or re-established in the project area by March 2019

WCS is in the process of surveying communities with regard to traditional practices including tambu areas. Thus far surveying of the Miruma community has been completed but as yet there is no indication that tambu prohibitions are being used as an a resource management technique. However, there is some indication IRRM are interested in developing a protected area along their tourist path to Mt Wilhelm at Womkama. The prospect of developing a formal protected area near Womkama, and examination of tambu use in Gembogl District will be investigated over the next 12 months. No change to indicators.

6.3 Participatory threshold surveys for key biodiversity indicator species (tree kangaroos, forest wallabies, echidna and cassowaries) by September 2016 and end surveys by March 2019, and established monitoring procedures for birds of paradise by November 2016

Hunter inception surveys and bird monitoring techniques have been trialled at Womkama. Threshold surveys to be undertaken across all three sites upon completion of community facilitator training. Bird monitoring to be restricted to dry season period. No change to indicators.

3.3 Progress towards the project Outcome

Outcome 1: 50% decrease in rate of forest loss in the 45,000 ha project area by March 2019 in comparison to baseline information and improved status for key biodiversity indicators.

Progress: Baseline rates of annual forest loss have been established for all communities. **Adequacy of indicators and achievability:** Due tree growth rates the ability of timber production from nursery propagated trees to offset timber extraction from the wild is unlikely to be achieved within the time frame of this project. The current time lag in updating of the Global Forest Cover database (~2 years in arrears) would suggest that change in measurement of tree cover loss over the project period is also unlikely to be obtained by project close using this method. Consequently we propose that the indicator 0.1 is revised to: "Area under new woodlot production at project end equals or exceeds the area affected by 3 years of annual forest loss (averaged across 2001-2014) within the project footprint."

Outcome 2: Increased food security and climate resilience through doubling in variety of crops in gardens (in comparison to baseline) for 1000 households in the project area by March 2019. **Progress:** Baseline indices of crop diversity have been established for all communities. One of the deliverables in the sub-grant that NARI signed WCS with is to increase crop diversity over the next two years. **Adequacy of indicators and achievability:** currently considered measureable and achievable.

Outcome 3: Diversified livelihood opportunities for households in 3 communities, disaggregated by gender, by March 2019
Progress: One of the deliverables in NARI's sub-grant that NARI is to help develop new crop based livelihoods over the next two years. Adequacy of indicators and achievability: currently considered measureable and achievable.

Outcome 4: Increased awareness, including among youth, of importance of forests and local biodiversity to local people and cultures, measured through quantitative surveys at the project start and end in communities within the project
Progress: Awareness surveys and activities have begun at Miruma. Traditional ecological knowledge and wildlife monitoring has begun at Womkama (IRRM). **Adequacy of indicators and achievability:** currently considered measureable and achievable

3.4 Monitoring of assumptions

Assumption (Outcome): Large scale changes outside the control of the project (such as major droughts and forest fires or political and social unrest) do not impact the project area

Drought: Just prior to the inception of the Darwin grant, the highlands of Papua New Guinea were affected by a very strong El Niño-associated event over the period 2015-2016 resulting in a prolonged drought. WCS has determined that the ramifications of this event on agriculture need to be assessed in order to better tailor our agricultural inventions in the area. As a result WCS has engaged our Darwin Initiative partner organisation Oxfam International to evaluate the impact of the El Niño event on agricultural practices in Gemogl district. *Political unrest - upcoming 2017 Election*: The 5 yearly PNG elections have been scheduled to take place 24th June – 7th July. Historically, election activity in the highlands has been accompanied by gun related violence. Prior experience has shown that communities are typically distracted over the campaign period and political candidates will use project activity as a political device. To take necessary precautions, WCS will be refraining from community field work between 24th May – 7th August and will focus on initiating activities prior to the campaign period so that some level of work will continue through the election period.

Assumption (Output 1-2): Extreme weather events do not occur during the project period. While no drought occurred during last 12 months, communities have been in a recovery phase from the preceding drought (see above).

Assumption (Output 3): No major forest fires in the area during the project period (see graph)

During the 12 month project period no forest fires have been recorded from project site locations (based on data from http://fire.pngsdf.com/)

Assumption (Output 4): Market opportunities continue for using native tree species
Native timber, especially *Nothofagus* spp., remains sought after. Indeed in Miruma one clan opted out of signing an MOU (in 2016) with WCS in order to engage a logging company to log their forest.

Assumption (Output 5): Approval from provincial education divisions for use of developed curriculum materials and willingness from community members to participate in surveys
From our engagement with provincial education advisors we have received feedback that alteration to existing curricula is not possible as these are nationally mandated. As an alternative, we are preparing supplementary education materials (of an equivalent content) to support the teaching of the existing curriculum and developing multiuse educational posters focusing on forest and bio-cultural themes for schools.

Assumption (Output 6): Changing use of *bilas* products (e.g. development of markets for these materials) do not impact the project area. Community members are willing to participate in threshold surveys.To date there is no evidence to suggest an alteration in bilas practices and we infer there are no novel factors at play.

3.5 Impact: achievement of positive impact on biodiversity and poverty alleviation

Biodiversity conservation is being addressed through reforestation initiatives focusing through reducing forest degradation through the development of native timber woodlots, introduction of continuous cover forestry practices, reducing demand for wildlife through preservation initiatives for existing ornamentation, and revitalisation of traditional land management practices to better manage wildlife. Poverty alleviation is being directly addressed through the introduction of drought resistant crops, permaculture methods, and diversification of marketable crops.

4. Contribution to the Global Goals for Sustainable Development (SDGs)

Goal 2: End hunger, achieve food security and improved nutrition and promote sustainable agriculture
The project has worked towards achieving food security through the trial propagation of food bearing tree crops (*Castonopsis acuminatissima, Pandanus julianetti* and *Ficus copiosa*) which we have identified as important reserve food crops during times of drought.

Goal 12: Ensure sustainable consumption and production patterns
The project has begun the propagation of native timber species which will form the foundation of the development of sustainable forestry to meet the immediate timber needs of villagers, and ultimately lessen the impact of degradation on the surrounding primary forest.

Goal 13: Take urgent action to combat climate change and its impacts
The project has begun to pioneer the propagation and husbandry of native montane tropical timber species. By promoting the husbandry edible tree crops, which we have identified as one of the most important food reserve in times of drought, we will be strengthening the resilience and adaptive capacity of the community to climate-related hazards especially drought. The growth of the current crop of 3,100 seedlings into mature trees will sequester carbon thereby begin to offset the communities carbon footprint.

Goal 15: Sustainably manage forests, combat desertification, halt and reverse land degradation, halt biodiversity loss
The development of community nurseries and the timber species husbandry methods by WCS over the 12 months should form the foundation for reducing the rate of forest degradation, deforestation, and diminish the risk of catastrophic landslides at the partnering villages.

5. Project support to the Conventions, Treaties or Agreements

The objectives of the project are directly relevant to the Convention on Biological Diversity (CBD)'s 2011-2020 Strategic Plan, most notably Goal A (Address the underlying causes of biodiversity loss);Goal B (Reduce the direct pressure on biodiversity and promote sustainable use); and Goal C (To improve the status of biodiversity by safeguarding ecosystems, species and genetic diversity). The project also supports three of the CBD's seven thematic programmes of work for Agricultural Biodiversity; Forest Biodiversity and Mountain Biodiversity.

Within PNG the project supports many of the key goals identified within PNG's Medium Term Development Plan (2) and the National Strategy for Responsible Sustainable Development. This includes supporting the national government's aim to support the sustainable development of PNG's natural resources (strategic assets) and activities to promote the conservation and sustainable use of forests and biodiversity, protect the area's rich cultural authenticity and promote high organic agriculture practises. Priority areas of the Medium Term Development Plan (2) include: maintaining areas under forest cover through afforestation/reforestation; development of coping and mitigation strategies for pests and diseases including climate change; and promoting research on culture, biodiversity and medicinal plants.

WCS has made a presentation about our Darwin Initiative work program at which the Conservation and Environment Protection Authority (the host country focal point) attended (Endemic and Flagship Species workshop presentation: 3 Mar 2017 by Nathan Whitmore).

6. Project support to poverty alleviation

Poverty alleviation is being directly addressed through the introduction of drought resistant crops, permaculture methods, and diversification of marketable crops. We expect to alleviate poverty indirectly through: strengthening pre-existing community based organisations (IRRM & KGWan Eco-habitat), and helping developing the basis for a community based organisation in Miruma, promoting, advocating for, and delivering gender inclusive training and activities, increasing soil fertility especially through use of nitrogen fixing *Casaurina oligodon* trees as a fallow crop, and decreasing the high landslide risk on the characteristic steep slopes of the region by using woodlots to stabilise soil. The beneficiaries of the projects will be the communities of Womkama, Danbagl, and Miruma; and theird community based organisations (IRRM & KGWan Eco-Habitat).

7. Project support to gender equality issues

WCS is working to achieve gender parity within the communities with respect to all training and participatory activities. While WCS has stipulated to the communities parity representation is mandatory for community facilitators, attrition resulted in only 3 women completing training at Miruma compared to 10 men. WCS is investigating the causes behind this attrition and will over the next two years undertake specific training of new female community facilitators until parity is met. Even achieving such low numbers of women in a representative role is an achievement given that typically in Highland's culture there is no female representation at all. While this project does not have any gender specific activities, gender inclusiveness is a cross-cutting principle within our project. Each WCS activity is expected to integrate the perspectives of women and include female representation.

8. Monitoring and evaluation

Outcome indicators 0.1-0.4: Change to indicator 0.1: The current time lag in updating of the Global Forest Cover database (~2 years in arrears) would suggest that change in measurement of tree cover loss over the project period is unlikely to be obtained by project close using this method. Consequently we propose that **indicator 0.1** is revised to: "Area under new woodlot production at project end equals or exceeds the area affected by 3 years of annual forest loss (averaged across 2001-2014) within the project footprint."

Output indicators 1.1-1.3. Will be monitored through an assessment of gardening techniques in use and determining the average duration of garden areas at the start of the project. Number of men, women and households attending trainings in improved techniques will be captured and actual uptake of these methods will be recorded from annual surveys of gardens. **No change to indicators**

Output indicators 2.1-2.2. The number of market crops in gardens will be monitored by farmer surveys, data, collated from sale records (in collaboration with Oxfam) and compared to the baseline information. WCS staff will record changes in the number of subsistence crops in gardens from the over the lifespan of the project (including new crops from NARI). **No change to indicators**

Output indicators 3.1-3.2. Currently no native trees are being grown in the study area for forestry. WCS's Forestry Officer will lead in developing methods for propagation of local tree species. Numbers of native and introduced tree species planted and maps and photo-plots of planted areas will be produced to monitor the success of this activity. **Change to indicator 3.2:** given that the production of weather hardened seedlings will have a lead in time of 12-18 months we suggest that the indicator be revised to: "community nursery output exceeding 3,000 weather hardened native seedlings per nursery per year by project end."

Output indicators 4.1-4.2. Publically available forest change satellite imagery(Global forest change) has allowed us to ascertain baseline deforestation rates, sustainable forestry areas to be mapped by GPS, threshold surveys will record changes in household use of timber species. **No change to indicators.**

Output indicators 5.1-5.3. Community surveys will be undertaken at the start and end of the project to assess awareness of traditional ecological knowledge and changes in this measure over the course of the project. Numbers of children taught with the new education materials will also be captured. **Change to indicator 5.2:** Given that school curricula are set by law and cannot be modified, WCS can only provide supplementary education materials. Consequently we recommend the indicator 5.2 be changed to: "Copies of supplementary education materials capturing local ecological knowledge in 3 primary schools in the project area by September 2017".

Output indicators 6.1-6.3. Numbers of *bilas* protection kits distributed will be recorded, along with information on pre-existing, re-established and newly established *tambu* sites. WCS's science team will lead on participatory threshold surveys and forest bird surveys that, combined with forest loss measurements, will monitor the long-term effectiveness of this project for key biodiversity indicators. Local management interventions in response to participatory monitoring and data repatriation will also be recorded. **Change to indicator 6.1** Given that the target of 75 performers clearly under estimated local demand for bilas protection kits, we suggest increasing indicator 6.1 to: "at least 200 local bilas owners by project end".

9. Lessons learnt

Thus far the collection of native tree species seed has been comparatively straightforward despite no information on their phenology. *Causarina oligodon* and *Fragraea* sp. appear to be very easy to germinate. All indications are that propagating the native timber species will be more straightforward than we could have hoped for. In the future for similar projects, we will have to allow more time for community engagement and development of agreements with partner organisations. Community engagement and consent following free, prior and informed consent procedures culminating in the signing of a memorandum of understanding takes time, and is a necessary prerequisite before any other agreements or grants can be established with other implementing partner organisations. In the initial timeline for this project field activities were imagined within the first 3 months – this is not realistic if FPIC protocols are being adhered and follow up agreements need to be signed with implementing partners.

10. Actions taken in response to previous reviews (if applicable)

Not applicable

11. Other comments on progress not covered elsewhere

Currently, the major risk to the project is coming from the PNG national election. WCS, along with most non-government organisations, will be forced to suspend field activities in the Highlands over the election period. WCS will be attempting to continue field activities in situ via the CBOs and community facilitators but there is a risk that the level of distraction may derail the progress of some activities for a few months.

12. Sustainability and legacy

We have given profile to the project through the production and distribution of posters to government and partner organisations. We additionally profiled the project at our stall at the Port Moresby Nature Park on World Wildlife Day (4 March 2017) and gave an interview on Tribe FM. We also presented the project at the Endemic and Flagship Species workshop held in Port Moresby 2-3 March 2017, which was attended by conservation and governmental organisations. Our exit strategy remains to enshrine the current projects within the work of the CBOs and we will bolster our impact in the Bismarck Range with the addition of a new grant focused on the provision of alternative protein sources to wean forest communities off wild meat sources (funded by the Food and Agriculture Organisation) due to start later this year.

13. Darwin identity

The Darwin Initiative logo has been used on all documents related to this project. It is evident on our posters and presentations. The Darwin Initiative funding is recognised as the major funder of our Bismarck Forest Corridor programme, along with the co-funder The Christensen Fund. Our social media accounts (Twiitter: @WCSMelanesiaSci and Facebook:WCSPNG) are linked back to the Darwin Initiative, and are actively posting.

14. Project expenditure

Table 1: Project expenditure <u>during the reporting period</u> (1 April 2016 – 31 March 2017)

Project spend (indicative) since last annual report	2016/17 Grant (£)	2016/17 Total Darwin Costs (£)	Variance %	Comments (please explain significant variances)
Staff costs (see below)			1.04%	
Consultancy costs			7.68%	
Overhead Costs			-0.41%	
Travel and subsistence			-4.28%	
Operating Costs			-8.28%	
Capital items (see below)	0	0	0	
Monitoring & Evaluation (M&E)			3.20%	
Others (see below)			-9.32%	
TOTAL			**0.00%**	

Annex 1: Report of progress and achievements against Logical Framework for Financial Year 2016-2017

Project summary	Measurable Indicators	Progress and Achievements April 2016 - March 2017	Actions required/planned for next period
Impact The restoration and sustainable management of montane forests within the Bismarck Mountains to strengthen livelihoods, protect biological and cultural diversity, and act as a model for forest conservation in PNG.		Darwin Initiative activities have begun at all project locations. All listed partner organisations are engaged via MOUs and/or sub-grants.	
Outcome Reduced rates of deforestation in the Bismarck Range through improved agricultural and forestry practices that diversify and strengthen livelihoods and conserve PNG's cultural and biological diversity.	0.1 50% decrease in rate of forest loss in the 45,000 ha project area by March 2019 in comparison to baseline information and improved status for key biodiversity indicators 0.2 Increased food security and climate resilience through doubling in variety of crops in gardens (in comparison to baseline) for 1000 households in the project area by March 2019 0.3. Diversified livelihood opportunities for households in 3 communities, disaggregated by gender, by March 2019 0.4 Increased awareness, including among youth, of importance of forests and local biodiversity to local people and cultures, measured through quantitative surveys at the project start and end in communities within the project	Baseline rates of forest loss have been carried out from 2001-2014. Baseline identification of crops currently grown in the 3 communities has been carried out. Livelihood diversification has thus far not been initiated Baseline surveys of environmental awareness have begun	Introduce drought tolerant crops and train community members in their husbandry. Train community members in techniques for increasing garden duration such as composting and mulching. Develop an additional 1-2 crops for household income generation. Quantify baseline rates of household use of timbers and wild game; as well as estimates of garden duration. Develop and deliver supplementary education materials to local schools.
Output 1. The introduction and uptake of improved gardening practices in three communities and	1.1 Number of new gardening techniques that are taken up by male and female community	Engagement with NARI resulting in the signing of a sub-grant agreement faced protracted delays of 4-5 months. As a result, while WCS has conducted baseline agricultural surveys (cropping systems & crop	

an increase in the duration and life of garden areas	members in the project area by March 2018 and by March 2019 1.2 At least 300 households using new gardening techniques by March 2018 1.3 Duration of active garden areas increased by 30% by March 2019 in comparison to baseline information from past practise)	diversity) NARI as yet has not begun field activities. WCS is propagating the multi-use tree species *Causarina oligodon* for use as a nitrifying legume for fallow areas (1,400+ seedlings are currently growing in the WCS nursery) to be distributed to farmers. However there is no indication that these initial delays will impact the ability of the project to deliver within the remaining two years. Indicators remain appropriate. *Evidence provided in section 3.2 of report and Annex4: [See Agriculture, and Silviculture initiatives (with regard to Causarina oligodon) sections in the attached Compendium Report Annex 4 for more detail]*
Activity 1.1 Increase the number of new gardening techniques that are taken up by communities in the project area		Through baseline data collection, WCS has identified current agricultural systems in use and crops currently cultivated from a survey of 59 people (33 male, 26 female) across the three project villages. WCS is propagating the multi-use tree species *Causarina oligodon* for use as a nitrifying legume for fallow areas (1,400+ seedlings are currently growing in the WCS nursery). WCS has engaged the NARI via a sub-grant to undertake community agricultural training to introduce new gardening techniques.
Activity 1.2 Ensure activities are established in >300 households using new gardening techniques by March 2018		WCS has engaged the NARI to undertake training which will then be disbursed to the wider community by village extension workers of IRRM in Womkama, village extension workers of KGWan Eco-habitat in Danbagl, and community facilitators in Miruma, each group will be targeting 100 households.
Activity 1.3 Promote new techniques to ensure the duration of active garden areas is increased by 30% by March 2019 in comparison to baseline information from past practise		WCS has engaged the NARI to undertake training on extending garden longevity over the course of the next two years (as above). Baseline survey of garden duration to be completed in the next 12 months by WCS.
Output 2. Introduction of new market crops for income generation, and introduction of pest and drought resistant varieties for subsistence use within all three communities	2.1. A 50% increase in the number of marketable crops in gardens in project areas by March 2019 2.2 At least 2 new pest and/or drought resistant crop varieties introduced by March 2018)	WCS signed a sub-grant with NARI for the introduction of new crop species (and related associated training) and a sub-grant with Oxfam International to undertake an evaluation of the resilience of Gembogl agricultural practices with regard to improving the effectiveness of Darwin initiative interventions based on the experiences of the 2015-2016 drought. Four potential marketable crops have been identified for further investigation. Indicators remain appropriate.

		Evidence provided in section 3.2 of report and Annex 4: Agricultural initiatives section in the Compendium Report.
Activity 2.1 Work with Oxfam and local partners to promote a 50% increase in the number of marketable crops in gardens		Currently, there is only 1 major commercial crop (bulb onions, identified through Activity 1.1 survey). WCS has thus far identified 4 crops with potential for scaling to commercial levels (garlic, potato, apples and strawberries). The srops were screened on the basis of community familiarity, perishability, low competition and marketability. The prospects of these crops will be investigated in collaboration with NARI, Oxfam and local CBOs over the coming year. NARI will be the partner responsible for introducing the appropriate seed stock and giving the necessary training.
Activity 2.2. With the support of NARI introduce least 2 new pest and/or drought tolerant crop varieties		WCS has engaged Oxfam International in a subgrant to undertake an evaluation of drought preparedness in Gembogl District (Womkama and Danbagl) with respect to the effectiveness of their past agricultural initiatives. Oxfam will be responsible for delivering: 1) a report evaluating the agricultural initiatives undertaken in response to the 2015 El Niño event in Gembogl district and 2) a recommendation list of priority climate change compatible sustainable agricultural activities to be undertaken in Gembogl district. NARI is the partner responsible for introducing drought resistant varieties and this is a deliverable in their sub-grant (please see the aforementioned Activities 1.1 and 1.3).
Output 3. Nursery practices for native tree species tested and established in two communities and active planting of areas with native species by the project end	3.1 Successful propagation of at least four native tree species in nurseries by March 2018 3.2 Planting of native tree species in place of exotic species incorporated into land use plans by March 2018 and over 100 ha of land planted with native trees by project end (March 2019)	Two community nurseries (KGWan Eco-habitat and IRRM) are active, producing seedlings and growing wildlings. Ground has been broken and equipment manufactured for two new community nurseries in Miruma. Six native species are currently being propagated. Currently, 1,400+ seedlings of *Causarina* spp. and 1,700+ of *Fragrea* spp. have germinated. A further 200+ *Nothofagus pulleii* seeds, ~600 *Pandanus julianetti* seeds, 1,000+ *Ficus copiosa* (kumu mosong) seeds, and 10 *Castonopsis acuminatissima* seeds are being germinated at the WCS nursery. Land use planning for woodlots will occur over the next 12 months. Planting out will not occur until 2019. Given that the production of weather hardened seedlings will have a lead in time of 12-18 months, we suggest that the indicator 3.2 be revised to: “community nursery output exceeding 3,000 weather hardened native seedlings per nursery per year by project end". *Evidence provided in section 3.2 of report and Annex4: Silviculture*

		initiatives section in the Compendium Report
3.1 Develop propagation methods for at least four native tree species in nurseries		Signed sub-grant agreements have been put in place with IRRM and KGWan to undertake the collection of native seeds for plant and tree species of high community value for propagation in both community nurseries and the WCS experimental nursery, propagate native species in community nurseries, and distribute and plant native seedlings into community or household woodlots. Six species are currently in propagation from seeds at the WCS (Man on Earth) nursery, as of 22 March 2017, over 3,100 seedlings had germinated: 1. *Causarina oligodon* (fuel wood, nitrogen fixer, to be used as nurse crop for hardwoods species in woodlots). 1,400 seedlings. 2. *Nothofagus pulleii* durable hardwood – considered highest value). 200 + seeds germinating 3. *Fragrea* spp. (durable hardwood). 1,700 seedlings. 4. *Pandanus julianetti* (reserve food crop for under story planting) ~600 seeds germinating 5. *Ficus copiosa* (reserve food crop for under story planting). 1,000+ seeds germinating 6. *Castonopsis acuminatissima* (general purpose timber, food source (seeds), has commensal edible fungi). Only 10 seeds germinating.
3.2 Introduce the planting of native tree species in place of exotics into land use plans and ensure over 100 ha of land planted with native trees		Thus far some potential woodlot sites have been proposed by the communities in Womkama and Danbagl. These will be mapped over the course of the next year, and community meetings will be organised to go over existing (or establish new) land use plans.
Output 4. Sustainable use of existing forest stands within remaining areas of native forests and planted areas of exotic trees	4.1 Reduced area and number of native trees harvested compared to number of exotic trees harvested from already existing forest stands by March 2019 (Note: the aim is to shift stand diversity towards native trees by removing exotics.)	Baseline total forest loss between 2001 and 2014 in the project area was 40.6 ha (where forest loss is defined as canopy cover over 5 meters in height and of at least 80% cover at a 30 x 30 m resolution). This has revealed that comparatively little closed canopy forest has been lost from Womkama and Danbagl but by comparison forest loss is increasing year-on-year at Miruma. Overall 32.6 ha has been lost at Miruma over the 13 year period.

	4.2 More than 500 hectares under sustainable forestry practices as compared to baseline by March 2019	*Evidence provided in section 3.2 of report and Annex4: Silviculture initiatives section in the Compendium Report*
4.1 Work with local CBOs to reduce the number of native trees harvested compared to number of exotic trees harvested from already existing forest stands		As of yet this activity has not yet been targeted. In the upcoming year we will focus on enumerating the volume of timber available from exotic wood lots compared to that available from the forest and train community representatives in the principles of continuous cover forestry.
4.2 Ensure more than 500 hectares under sustainable forestry practices as compared to baseline by March 2019		As yet this activities relating to this output have not yet been targeted. WCS will investigate the possibility of developing a protected forest area in Womkama to develop as part of the land use planning process. WCS will train the extension workers of IRRM and KGWan Eco-habitat, and Miruma community facilitators in continuous cover forestry in the coming 12 months as well as working with communities to establish or administer land use plans when such plans already exist (e.g. Danbagl). No change to indicators.
Output 5. Capturing and passing on traditional ecological knowledge on forests and threatened species	5.1 Quantitative survey on knowledge and attitudes of men, women and children in project and control areas at the project start and end 5.2 School curricula capturing local ecological knowledge in 3 primary schools in the project area by September 2017 5.3 Increase in number of school children that learn about their local culture and traditional ecological knowledge by March 2019 5.4 Documentation of *tok ples* names and traditional knowledge of culturally and ecologically important fauna and flora gathered from female and male community members by March 2019	Surveys of baseline traditional ecological knowledge have been undertaken for Miruma, and are underway for Womkama and Danbagl (currently being undertaken as of April 2017). Tok ples names for important species are gradually being collated with at least 28 verified from the Kuman and Miruma languages. Development of supplementary education materials is to take place by September 2017. Given that school curricula are set by law and cannot be modified, we can only provide supplementary education materials. Consequently we recommend the indicator 5.2 be changed to: "Copies of supplementary education materials capturing local ecological knowledge in 3 primary schools in the project area by September 2017". *Evidence provided in section 3.2 of report and Annex 4: Traditional ecological knowledge section in the Compendium Report*

5.1 Produce school curricula capturing local ecological knowledge in 3 primary schools in the project area by September 2017		Currently, WCS is in still in the process of collecting local ecological knowledge. Thirteen community facilitators have been trained at Miruma and have collected local ecological knowledge with regard to natural resource management, perceptions of the importance of forest and traditional ornamentation. At Womkama we have been recording the traditional ecological knowledge of the village elders in the local language. This knowledge together with the local names recorded through our wildlife monitoring and silviculture activities will form the basis of educational materials.
5.2 Measure an increase in the number of school children that learn about their local culture and traditional ecological knowledge by March 2019		Baseline rates of school children knowledge have not as yet been assessed but will assessed over the next 12 months.
Output 6. Minimizing impacts on hunted species by preserving local costumes and reviving traditional *tambu* (no hunting) areas.	6.1 Uptake of improved preservation methods for fur and feathers in traditional costumes (termed *bilas* in *tok pisin*) by 3 active cultural troupes (at least 75 dancers) by March 2019 6.2 Increase in area or number of *tambu* sites created or re-established in the project area by March 2019 6.3 Participatory threshold surveys for key biodiversity indicator species (tree kangaroos, forest wallabies, echidna and cassowaries) by September 2016 and end surveys by March 2019, and established monitoring procedures for birds of paradise by November 2016	Project targets have currently been exceeded with 110 bilas protection kits given out to performers in the based Mt. Wilhelm cultural group (Gembogl District) and a further 644 bilas protection kits given out at Highland cultural shows. Given that the target of 75 performers clearly under estimated local demand for bilas protection kits, we suggest increasing indicator 6.1 to: "at least 200 local bilas owners by project end". *Evidence provided in section 3.2 of report and Annex4: Wildlife monitoring and natural resource management section in the Compendium Report.*
6.1 Promote the uptake of improved preservation methods for fur and feathers in traditional costumes (termed *bilas* in *tok pisin*)		On 19 December 2016, 110 bilas protection kits were given to the Gemobogl based Mt. Wilhelm cultural group thereby exceeding the initial target of reaching 75 performers. Additionally, in 2016 WCS ran a stall at the 2016 Goroka cultural show under the theme " Strongim Kastom. Lukautim Bilas bilong Yu!" (Translation: strengthen your culture, look after your ornamentation) specifically to target Highland costume owners. A

	total of 644 bilas protection kits were given out between the Goroka cultural show and a similar event at Mt. Hagen cultural show combined.
6.2 Work to increase the area or number of *tambu* sites created or re-established in the project area by March 2019, or other compatible traditional management methods	WCS is in the process of surveying communities with regard to traditional practices including tambu areas. Thus far surveying of the Miruma community has been completed but as yet there is no indication that tambu prohibitions are being used as an a resource management technique. However, there is some indication IRRM are interested in developing a protected area along their tourist path to Mt Wilhelm at Womkama. The prospect of developing a formal protected area near Womkama, and examination of tambu use in Gembogl District will be investigated over the next 12 months.
6.3 Conduct baseline and end threshold surveys for key biodiversity indicator species, and establish monitoring procedures for birds of paradise	We carried out a survey on the use and importance of wild caught meat b yi interviewing a total of 59 community members (33 male, 26 female) across Womkama, Danbagl, and Miruma. In terms of wild harvested meat the top three most common sources were cuscus, birds, and tree kangaroo. We have recently completed our first wildlife monitoring transect at Womkama. For in situ monitoring we have settled on two monitoring methods: 5 minute bird counts incorporating a distance variable detection methodology, and camera trap monitoring for cursorial and arboreal species (both mammals and birds). Threshold surveys in which hunter caught animals are intercepted at households will commence as soon as community facilitator training has finished (such training has been completed at Miruma in March 2017 and is currently underway at Womkama and Danbagl). The community facilitators will be tasked with recording the hunter quarry for a sub-sample of households over a two week period. In advance of the threshold surveys, opportunistic hunter interceptions have been undertaken while camera trapping.

Annex 2: Project's full current logframe as presented in the application form (unless changes have been agreed)

Project summary	Measurable Indicators	Means of verification	Important Assumptions
Impact: (Max 30 words) The restoration and sustainable management of montane forests within the Bismarck Mountains to strengthen livelihoods, protect biological and cultural diversity, and act as a model for forest conservation in PNG.			
Outcome: (Max 30 words) Reduced rates of deforestation in the Bismarck Range through improved agricultural and forestry practices that diversify and strengthen livelihoods and conserve PNG's cultural and biological diversity.	0.1 50% decrease in rate of forest loss in the 45,000 ha project area by March 2019 in comparison to baseline information and improved status for key biodiversity indicators 0.2 Increased food security and climate resilience through doubling in variety of crops in gardens (in comparison to baseline) for 1000 households in the project area by March 2019 0.3. Diversified livelihood opportunities for households in 3 communities, disaggregated by gender, by March 2019 0.4 Increased awareness including among youth, of importance of forests and local biodiversity to local people and cultures, measured through quantitative surveys at the project start and end in communities within the project area and control	0.1 Satellite imagery of forest areas and cleared land and on the ground mapping of forest extent, and monitoring reports for key biodiversity indicators 0.2 WCS and community reports on agriculture and forestry work, showing diversified crops, drought and pest tolerant crops, and native species in use in gardens 0.3 Socio-economic studies at the project start and end, including sales/income records, indicate increased use and importance of diversified crops and timber products for households 0.4 Records of number of school children who have been taught with the project's curricula (disaggregated by gender), and published report on results of quantitative survey	Large scale changes outside the control of the project (such as major droughts and forest fires or political and social unrest) do not impact the project area

	areas		
Outputs: 1. The introduction and uptake of improved gardening practices in three communities and an increase in the duration and life of garden areas	1.1 Number of new gardening techniques that are taken up by male and female community members in the project area by March 2018 and by March 2019 1.2 At least 300 households using new gardening techniques by March 2018 1.3 Duration of active garden areas increased by 30% by March 2019 in comparison to baseline information from past practise	1.1 WCS and community reports detailing successful introduction of new techniques 1.2 Community reports on garden numbers and gardeners, disaggregated by gender 1.3 Baseline report on current garden life and reports on duration following establishment of new techniques	Extreme weather events do not occur during the project period
2. Introduction of new market crops for income generation, and introduction of pest and drought resistant varieties for subsistence use within all three communities	2.1. A 50% increase in the number of marketable crops in gardens in project areas by March 2019 2.2 At least 2 new pest and/or drought resistant crop varieties introduced by March 2018	2.1 WCS and community reports detailing the number of new crops against baseline information 2.2 WCS and NARI reports on the planting and use of new pest/drought resistant varieties	Extreme weather events do not occur during the project period
3. Nursery practices for native tree species tested and established in	3.1 Successful propagation of at	3.1 Propagation records from	No major forest fires in the area

two communities and active planting of areas with native species by the project end	least four native tree species in nurseries by March 2018 3.2 Planting of native tree species in place of exotic species incorporated into land use plans by March 2018 and over 100 ha of land planted with native trees by project end (March 2019)	nursery programme 3.2 (a) Land use plans incorporate planting areas for native species 3.2 (b) Maps/photos of areas planted with native species	during the project period
4. Sustainable use of existing forest stands within remaining areas of native forests and planted areas of exotic trees	4.1 Reduced area and number of native trees harvested compared to number of exotic trees harvested from already existing forest stands by March 2019 (Note: the aim is to shift stand diversity towards native trees by removing exotics.) 4.2 More than 500 hectares under sustainable forestry practices as compared to baseline by March 2019	4.1 (a) Records of tree species felled 4.1 (b) Community land use plans and forestry plans 4.1 (c) Area of forest clearance from satellite imagery 4.2 Community land use plans and forestry plans; WCS and community reports on forestry work	Market opportunities continue for using native tree species
5. Capturing and passing on traditional ecological knowledge on forests and threatened species	5.1 Quantitative survey on knowledge and attitudes of men, women and children in project and control areas at the project start and end 5.2 School curricula capturing local ecological knowledge in 3 primary schools in the project area by	5.1 Published results of quantitative survey 5.2 Copies of school curricula	Approval from provincial education divisions for use of developed curriculum materials and willingness from community members to participate in surveys

	September 2017 5.3 Increase in number of school children that learn about their local culture and traditional ecological knowledge by March 2019 5.4 Documentation of *tok peles* names and traditional knowledge of culturally and ecologically important fauna and flora gathered from female and male community members by March 2018	5.3 Records of number of children taught (disaggregated by gender) at three primary schools in the project area 5.4 Reports detailing *tok peles* and scientific names for >100 species and reporting traditional uses for fauna and flora including gender specific uses	
6. Minimizing impacts on hunted species by preserving local costumes and reviving traditional *tambu* (no hunting) areas.	6.1 Uptake of improved preservation methods for fur and feathers in traditional costumes (termed *bilas* in *tok pisin*) by 3 active cultural troupes (at least 75 dancers) by March 2019 6.2 Increase in area or number of *tambu* sites created or re-established in the project area by March 2019 6.3 Participatory threshold surveys for key biodiversity indicator species (tree kangaroos, forest wallabies, echidna and cassowaries) by September 2016 and end surveys by March 2019, and established monitoring procedures for birds of	6.1 Reports on number of *bilas* protection kits distributed to male and female performers and in use by cultural groups 6.2 Copies of resource management plans and maps of *tambu* sites 6.3 Project reports on hunted species that are brought in by community members (“threshold surveys”) and reports and results from forest bird surveys	Changing use of *bilas* products (e.g. development of markets for these materials) do not impact the project area Community members are willing to participate in threshold surveys

	paradise by November 2016		

Activities

1.1 Increase the number of new gardening techniques that are taken up by communities in the project area

1.2 Ensure activities are established in >300 households using new gardening techniques by March 2018

1.3 Promote new techniques to ensure the duration of active garden areas is increased by 30% by March 2019 in comparison to baseline information from past practise

2.1 Work with Oxfam and local partners to promote a 50% increase in the number of marketable crops in gardens

2.2 With the support of NARI introduce least 2 new pest and/or drought tolerant crop varieties

3.1 Develop propagation methods for at least four native tree species in nurseries

3.2 Introduce the planting of native tree species in place of exotics into land use plans and ensure over 100 ha of land planted with native trees

4.1 Work with local CBOs to reduce the number of native trees harvested compared to number of exotic trees harvested from already existing forest stands

4.2 Ensure more than 500 hectares under sustainable forestry practices as compared to baseline by March 2019

5.1 Produce school curricula capturing local ecological knowledge in 3 primary schools in the project area by September 2017

5.2 Measure an increase in the number of school children that learn about their local culture and traditional ecological knowledge by March 2019

6.1 Promote the uptake of improved preservation methods for fur and feathers in traditional costumes (termed *bilas* in *tok pisin*)

6.2 Work to increase the area or number of *tambu* sites created or re-established in the project area by March 2019, or other compatible traditional management methods

6.3 Conduct baseline and end threshold surveys for key biodiversity indicator species, and establish monitoring procedures for birds of paradise

Annex 3: Standard Measures

Please expand and complete Table 1: new projects should complete the Y1 column and also indicate the number planned during the project lifetime. Continuing project should cut and past the information from previous years and add in data for the most recent reporting period. Quantify project standard measures over the last year using the coding and format from the Darwin Initiative Standard Measures (see website for details: http://darwin.defra.gov.uk/resources/) and give a brief description. Please list and report on relevant Code No's. only. The level of detail required is specified in the Standard Measures Guidance notes under 'definitions and reporting requirements' column. Please devise and add any measures that are not captured in the current list. Please note that these measures may not be a substitute for output level objectively verifiable indicators in the project logframe.

Table 1 Project Standard Output Measures

Code No.	Description	Gender of people (if relevant)	Nationality of people (if relevant)	Year 1 Total	Year 2 Total	Year 3 Total	Total to date	Total planned during the project
Established codes								
23	The Christensen Fund for activities on traditional ecological knowledge	NA	NA	75,000 USD				75,000 USD (initially 100,000 USD requested but only 75,000 forth coming)
23	Pacific Development Conservation Trust) for development of bilas protection kits	NA	NA	10,092 NZD				0 NZD

In Table 2, provide full details of all publications and material produced over the last year that can be publicly accessed, e.g. title, name of publisher, contact details, cost. Mark (*) all publications and other material that you have included with this report.

Table 2 Publications

Title	Type (e.g. journals, manual, CDs)	Detail (authors, year)	Gender of Lead Author	Nationality of Lead Author	Publishers (name, city)	Available from (e.g. weblink or publisher if not available online)
None to date						

Annex 4 Onwards – supplementary material (optional but encouraged as evidence of project achievement)

Report Compendium below…

Contributions by:

Nathan Whitmore (WCS)

Arison Arihafa (WCS)

Grace Nugi (WCS)

Toppy Sundu (IRRM)

StevenYandime (KGWan)

Background

Papua New Guinea (PNG), a mountainous land of vast forests, contains around 8% of global biodiversity and 12% of the world's languages in only 1% of global land area. The Bismarck Mountains, running east-west along the spine of PNG, contain the nation's highest peak, Mt Wilhelm, and some of the country's most spectacular landscapes, home to many famed endemic species, including cassowaries, birds of paradise and tree kangaroos, all integral to PNG's biological and cultural diversity. Unfortunately, these forests are under severe threat from a human population set to double in the next 25 years. Local communities, the traditional forest landowners, are almost totally dependent on natural resources for their subsistence and for livelihood opportunities, and are driving forest loss through small-scale but widespread clearance for vegetable gardens (for local subsistence and sale) and timber (for building materials and firewood). Further threats to the ecological integrity of forests are hunting and over-exploitation of birds and mammals for food and for cultural use (e.g. feathers and fur in traditional outfits) and the loss of traditional ecological knowledge about these species and about the uses of forest products for food, medicine and timber. An additional threat is the widespread planting of non-native pines and eucalypts for timber. These species can reduce pressure on native forest for timber, but are also considered invasive in many areas of the world and have the potential to irreparably alter forest composition in upland areas of PNG. Capacity needs assessments demonstrate that local communities recognize that forest clearance is a major threat, and that forest loss and the resultant biodiversity loss will limit their current and future livelihood opportunities, threaten their traditional cultures, and limit their ability to adapt to the predicted impacts of climate change that include unpredictable weather patterns, droughts and novel pests and diseases.

Purpose of project

To significantly and demonstrably reduce deforestation in a 45,000 ha montane region of PNG's Bismarck Range and to strengthen local livelihoods, activities will be aimed at improving agricultural practices, implementing sustainable forestry and silviculture, reducing hunting pressure on threatened species, and retaining and passing on traditional ecological knowledge to the next generation. Technical assistance for improved gardening practices will be provided, including ways to extend the life of gardens (thus reducing rates of forest loss) such as mulching and not burning cleared vegetation, rotation systems of fallow and active garden areas (to reduce further forest clearance) and market crop diversification (to increase livelihood opportunities by reducing the reliance on a single cash crop). Diversification of subsistence crops will include introducing drought and pest tolerant varieties to build resilience to climate change.

Technical assistance for sustainable forestry will include better management of remaining timber stocks and reforestation with native species, as well as silvicultural plots stocked with local species as future timber sources. This approach supports PNG's national efforts for climate change mitigation through protection and reforestation of forest areas, and replanting with fast growing, high value native species will utilize the existing biological diversity of PNG, and address the current problematic practice of planting invasive pines and eucalypts. Conservation of key species will be addressed by extending the life of feathers and fur that are used in traditional outfits (thereby reducing the high demand for species such as Goodfellow's Tree Kangaroo (Figure 1) whose scarcity is now affecting traditional cultural groups in the area) and in assisting local communities in the reestablishment of traditional management methods such as *tambu* (no take) reserves: an approach WCS has successfully used in other regions of PNG. Traditional ecological knowledge of animals and

botanical resources, currently only held by the elderly, will be captured and incorporated into school curricula with local consent to ensure it is passed on and to establish the cultural links and recognition of the wider value of forests and biodiversity. Our most important partnership will be with local communities in Chimbu and Eastern Highlands, whose support is a prerequisite as they are the landowners who control and manage their natural resources. These communities have identified the ongoing loss of forests as a key problem and they have a track record of silviculture and sale of crops that we will adapt to include propagation of native tree species and the introduction of new crops. Expertise within WCS will be used to develop school curricula that include local and traditional ecological knowledge. NARI will help with technical support for improved gardening techniques and crop varieties. Oxfam already work in the area and we will work collaboratively to ensure that there is access to markets for diversified crops and timber products, whose sale is vital for long-term development and poverty alleviation goals. Finally the project will be undertaken in close cooperation with the Eastern Highlands and Chimbu provincial authorities to ensure it supports their existing policies on environment, culture and rural development.

Figure 1: Daulo singsing group from Miruma wearing the pelt of the endangered Goodfellow's tree kangaroo (*Dendrolagus goodfellowi*).

Community mobilisation

Study sites

Darwin Initiative project activities are taking place at three locations (Figure 1, detail Figure 2):

1. Chimbu province, village = Womkama: implementing partner Individual Reform & Restoration Movement hereafter referred to as IRRM (community based organisation)
2. Chimbu province, village = Danbagl: implementing partner hereafter referred to as KGWan Eco-Habitat (community based organisation)
3. Eastern Highlands Province, village = Miruma (also known as Namta):no community based organisation present

Free Prior and Informed Consent (FPIC)

A series of open meetings were held with Womkama, Danbagl and Miruma communities culminating in the signing of memorandum of understanding with the community based organisations (CBOs) of IRRM and KGWan Eco-habitat. Due the absence of a community based organisation at Miruma a memorandum of understanding was signed with six of the seven clans making up the community. One clan opted out of the MOU as they were signing on with a company to commercially log their section of the forest. Sub-grants were signed with IRRM and KGWan Eco-habitat to act as the implementing partners in Chimbu province. In order to implement activities in Miruma WCS trained 13 community facilitators to assist WCS in project activities including: disseminating project information, undertaking surveys, and mobilising the community for activities (as Miruma has no CBO there is no mechanism for them to receive direct funding as part of this grant). As part of WCS's commitment to the FPIC all visits to the communities are begun with a community meeting outlining the nature of our visits and activities and providing an opportunity for people to ask questions in an open forum (Figure 3).

Participatory and partner organisations (and signing dates)

Partner organisation providing in-kind support:

1. Man on Earth ltd, role: nursery for native tree propagation trials (MOU 13 Jun 2016)

Partner organisations supported by sub-grant and/or memorandum of understanding (MOU):

1. Oxfam International, role: evaluation of drought preparedness in Gembogl district (MOU: 28 Oct 2017, Sub-grant 24 March 2017)
2. National Agricultural Research Institute, role: technical support for agricultural initiatives at all sites (Sub-grant 24 March 2017)
3. IRRM: field and community implementation (MOU 1 Oct 2016, Sub-grant 1 Oct 2016)
4. KGWan Eco-habitat: field and community implementation (MOU 1 Oct 2016, Sub-grant 1 Oct 2016)
5. Miruma community (MOU 6 Dec 2016)

Additional inception meetings were conducted with:

1. Chimbu provincial government representatives induction (27 June 2016)
2. Eastern Highlands provincial government representatives (1 July 2016)

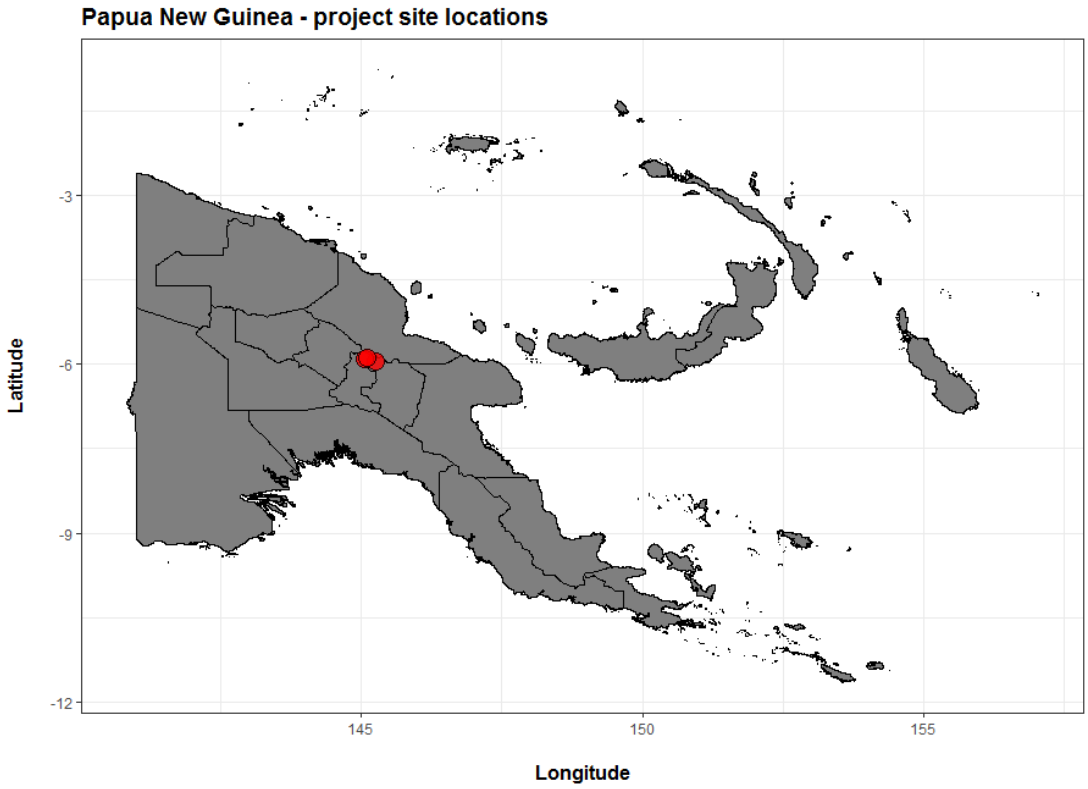

Figure 1: Project site locations (shown in red) within Papua New Guinea.

Figure 2: Project activity sites including active wildlife monitoring transects (blue), and provisional transects (purple). Provincial borders demarked by white lines.

Figure 3: WCS community engagement staffer John Kuange addressing a community meeting to outline upcoming activities at Danbagl

Project flagship

Goodfellow's tree kangaroo (*Dendrolagus goodfellowi*) is being used by WCS as the flagship species for the project (Figure 3 and 4). This endangered species is endemic to the montane forest of the Bismarck range and is heavily hunted for both meat and its rich burgundy pelt. The species is also of cultural significance and distinctively patterned (see Background section: Figure 1).

Figure 4: WCS induction poster designed for organisation partners and government awareness if project implementation. Note: Darwin Initiative and cofunder The Christensen Fund logos at top left.

Figure 4: WCS poster on display at Miruma community resource centre.

Agricultural initiatives (Activities 1 & 2)

Objective 1: The introduction and uptake of improved gardening practices in three communities and an increase in the duration and life of garden areas

Activity 1.1 Increase the number of new gardening techniques that are taken up by communities in the project area

Progress: WCS has undertaken three sub-activities with regard to this activity:

1. Identified current agricultural systems in use and species under cultivation
2. Propagated the multi-use species of *Causarina oligodon* for use as a nitrifying legume for fallow areas
3. Engaged the National Agricultural Research institute via sub-grant (signed 24 March 2017) to undertake the following deliverables:
    a. Agricultural assessments of current gardening practices are conducted at each community by 1 July 2017
    b. A prioritised plan of agricultural interventions based on the community needs expressed during the planning process is made for each community by 1 September 2017
    c. Appropriate drought tolerant varieties of crops are introduced to project sites for multiplication by 1 November 2017
    d. Field demonstrations and trainings for extension officers and community representatives are conducted on:
        1) rapid propagation methods and management practices for drought resistant crops by 1 November 2017
        2) appropriate food processing and low-cost storage techniques on how to store seed and planting materials by 1 March 2018
        3) use of plant derived pesticides pests e.g. neem and deris to control insects by 1 July 2018
        4) mulching and composting techniques by 1 September 2018
        5) integrated and resilient agriculture faming systems e.g. crop rotation and alley cropping techniques by 1 December 2018

Sub-activity 1: Agricultural systems in use and species under cultivation

In advance of NARI undertaking agricultural training at the project sites WCS has undertaken literature and site visits review to identify agricultural techniques in use , and undertaken baseline surveys at Womkama, Danbagl, and Miruma to determine what species were under cultivation or utilised by the community. A total of 59 community members were interviewed (33 male, 26 female).

The montane regions of eastern Highlands and Chimbu provinces can be broadly classified as being under a medium level of agricultural intensity. Despite the area being very steep and prone to landslide there is no active benching or terracing occurring but rather a passive system of soil retention through use of tree and shrubs (Figure 1). This is system of agriculture is typified by the use of short to medium fallow periods (1-15 years), small mound techniques (to prevent water logging), mixed crop gardens, drainage, and some limited use of tree fallows.
Some critical characteristics of agriculture in the area include: limited use of fire for fallow clearance, little evidence of shifting agriculture directly affecting remaining forest cover, fallow areas typified

by long grass and some encouragement of stands of the tree legume *Causarina oligodon* as a nitrifying species (especially at Womkama).

Figure 1: The pattern of planted shrub and tree species (currently parallel to slope contours) suggests that there is an element of passive soil retention being practiced although there is no evidence of benching occurring (hillside at Danbagl)

Figure 2: Typical multispecies garden at Danbagl. Note drainage lines, and use of small mounds for sweet potato on left-hand side.

In order of importance: sweet potato (kaukau), banana, cassava, sugar cane, and bulb onion were the main crops under cultivation (Figure 3). The communities identified the major agricultural threats as weevils, taro beetles, leaf eating caterpillars and sugar cane borer. To a lesser extent potato late blight was mentioned (although comparatively little potato cultivation is now undertaken). Some community members registered their disinterest in cultivating a high yielding sweet potato (which was recently introduced) due to its lack of flavour. The survey suggests that there were few marketable crops under cultivation at Miruma (Figure 3).

The most common domestic animals reared (in order) were pigs, goats, chickens, and ducks. Site visits suggest that shifting cultivation is no longer impacting existing forest although at Danbagl the edge of the forest is recovering from a bush fire of agricultural origin.

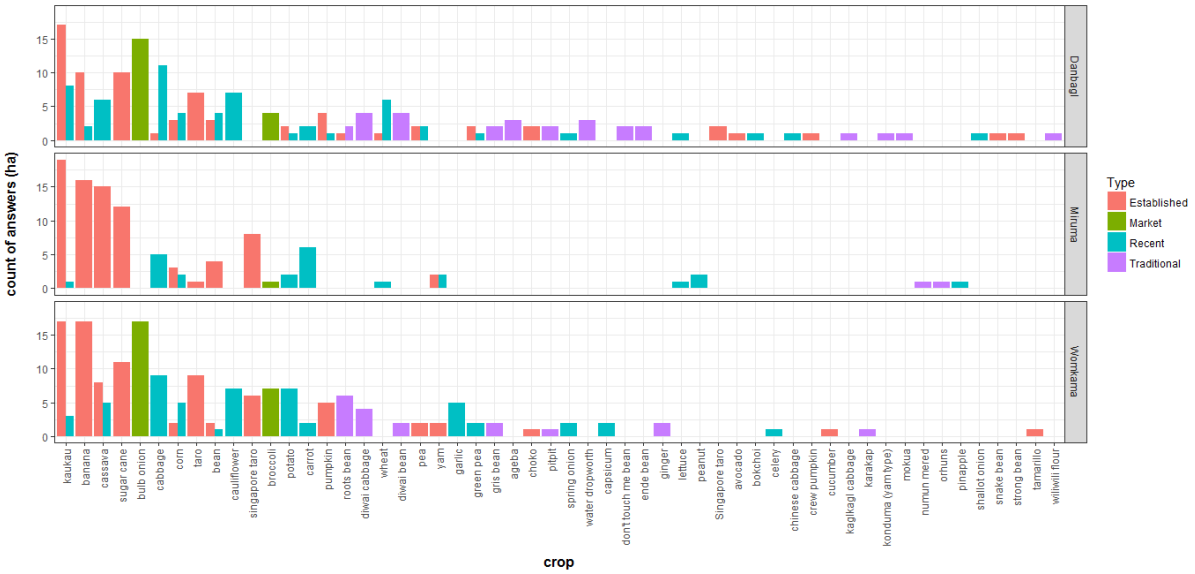

Figure 3: Crop diversification at the three communities. Commercially marketed crops (green) are largely restricted to Womkama and Danbagl. Miruma also appears to have comparatively lower crop diversity.

Sub-activity 2: Propagation of *Causarina oligodon* as a multi-use species
WCS has identified the tree legume *Causarina oligodon* as the single most important multi-use species. This species has important uses as a fuel wood, nitrifying species for fallow areas, and as a nurse crop for hardwood woodlots. To this extent WCS currently has 1,400+ seedlings under propagation, and the species is has in early stages of being propagated at IRRM and KGWan Eco-habitat nurseries.

Sub-activity 3: Currently waiting on NARI to begin activities:

Activity 1.2 Ensure activities are established in >300 households using new gardening techniques by March 2018

Activity 1.3 Promote new techniques to ensure the duration of active garden areas is increased by 30% by March

Progress: WCS has signed sub-grant agreements with the community-based organizations Individual IRRM, and KGWan Eco-habitat, Both organizations will implement the following:

1) Provide CBO based village extension officers to undergo WCS/ NARI training in techniques to increase yield, diversity and duration of household garden areas. These village extension officers in turn train households across the wider community.
2) Develop multiplication plots with guidance from WCS and NARI agricultural officers to help propagate new plant varieties.

Furthermore, Oxfam have arranged with IRRM and KGWan Eco-habitat for village agricultural extension officers, operating under an pre-existing Oxfam grant, to assist in the agricultural component of the current project at no additional cost.

Objective 2. Introduction of new market crops for income generation, and introduction of pest and drought resistant varieties for subsistence use within all three communities

Figure 4: **Bulb onion plot at Danbagl.**

Activity 2.1 Increase the number of marketable crops in gardens in project areas by 50%

Progress: Currently ,the only crop which is exported out of the Gembogl district at a commercial scale is bulb onion (Figure 3 & 4). This has been a result of a joint initiative between IRRM, KGWan Eco-habitat and Oxfam International. Brassicas (broccoli and some cabbages) are grown for the local market but are in low volumes, however brassicas may be unlikely to scale as there is substantial competition from other districts. WCS has thus far identified 4 crops with potential for scaling to commercial levels. Crops were screened on the basis of community familiarity, perishability, low competition and marketability. The prospects of these crops will be investigated in collaboration with NARI, Oxfam and local CBOs:

1. Garlic – currently grown for local market. The main advantage of garlic is that villagers in IRRM and KGWan Eco-habitat can piggy back on existing bulb onion infrastructure (including community drying houses currently being constructed by Oxfam). Garlic also has faster maturity than bulb onion (leading to more crops per year) and a higher price per weight than bulb onions. However, demand is likely lower than for bulb onions.
2. Potatoes – prior to 2003 potatoes were the staple vegetable grown in Gembogl district with substantial export out of the district. However, in 2003 the late potato blight decimated the crop and the pre-existing market subsequently collapsed. The current cultivars of potatoes in the district require multiple applications of fungicide to survive, and as a consequence their cultivation is outside the budget of most farmers. A recent meeting with NARI has established that they have had success with a blight resistant variety. This will likely be a focus of their forthcoming work in Gembogl.
3. Apples –are by reputation, notoriously hard to grow in Papua New Guinea. However, numerous scattered apple trees are now growing in Gembogl distict and are fruiting. Apples

are considered a luxury product and sale is only seen in regional centre supermarkets where the product commands a very high price as a result of being imported from Australia and New Zealand (typically costing around PGK 2.50 per apple). WCS intends trialling propagating cultivars using the recently established or upgraded nurseries. It is, however, unlikely that fruiting will be achieved before close of the current Darwin Initiative project.

4. Strawberries – although highly perishable the climatic conditions in the area are good for their cultivation. Currently, moderate quantities are grown and sold in road-side markets. While the fruit is highly perishable there are indications a regional producer of fortified wines and jams (Goroka based New Guinea Fruits) might be a potential client but they only undertake purchases at the factory. Consequently transport might be a major constraint.

Activity 2.2 With the support of the National Agriculture Research Institute (NARI), introduce least 2 new pest and/or drought tolerant crop varieties

Just prior to the inception of the Darwin grant the highlands of Papua New Guinea were affected by a very strong El Niño event over the period 2015-2016 resulting in a prolonged drought. WCS has determined that the ramifications of this event on agriculture need to be assessed in order to better tailor our agricultural inventions in the area based on recent experiences.

Progress: NARI will be the partner responsible for introducing drought resistant varieties (please see the aforementioned Activity 1.1). Due to slow negotiations leading up to signing NARI activites are currently delayed by 4-5 months. WCS has engaged Oxfam International to undertake an evaluation of drought resilence in Gembogl district (Womkama and Danbagl) with the following activities:

1. A report evaluating the agricultural initiatives undertaken in response to the 2015 El Niño event in Gembogl district.
2. A recommendation list of priority climate change compatible sustainable agricultural activities to be undertaken in Gembogl district

Silviculture initiatives (Activities 3 & 4)

The forest in the Bismarck Range has been impacted by traditional agriculture with the notable loss of *Castanopsis* forest (which is often used as an indicator of arable land), however, a large amount of *Nothofagus* (a sought after timber forest) remains (Figures 1 & 2).

Objective 3. Nursery practices for native tree species tested and established in two communities and active planting of areas with native species by the project end

Activity 3.1 Develop propagation methods for at least four native tree species in nurseries

Progress:
Signed sub-grant agreements have been put in place with IRRM and KGWan Eco-habitat to implement the following, with WCS assistance to:

- Undertake the collection of native seed for plant and tree species of high community value for propagation in both community nurseries and the WCS experimental nursery
- Propagate native species in community nurseries; and
- Distribute and plant native seedlings into community or household woodlots.

WCS has signed an MOU with Man on Earth Ltd for use of their nursery for WCS to trial native species propagation techniques under controlled conditions. An internal WCS report was written with regard to possible species to investigate prior to the initial field surveys being undertaken.

- *Arihafa A (2016) Notes on native timber species and their potential for silviculture in community forestry initiatives in the Bismarck Range, Papua New Guinea. WCS internal report* (see Annex 2).

Six species are currently in propagation from seeds at the WCS (Man on Earth) nursery (Figure 3 & 4; see Annex 3 for sowing and germination dates):

- *Causarina oligodon* (fuel wood, nitrogen fixer, to be used as nurse crop for hardwoods species in woodlots)
- *Nothofagus pulleii* (durable hardwood – considered highest value)
- *Fragrea* spp. (durable hardwood)
- *Castonopsis acuminatissima* (general purpose timber, food source (seeds), has commensal edible fungi)
- *Pandanus julianetti* (reserve food crop for under story planting)
- *Ficus copiosa* (reserve food crop for under story planting)

As 22 March 2017 1,400+ seedlings had germinated of *Causarina* spp. and 1,700+ of *Fragrea*. *Causarina oligodon* are thus far exhibiting high growth rates but susceptibility to over watering. *Fragrea* seedlings are proving to be robust and easy to propagate. Seed collection has been dependent on inception of fruiting seeds during field site visits. Currently, 200+ *Nothofagus pullei* seeds, ~600 *Pandanus* seeds, 1,000+ *Ficus copiosa* (kumu mosong) seeds, and 10 *Castonopsis acuminatissima* seeds are being germinated at the WCS nurseriy. Further seed collection will prioritise *Castanopsis acuminatissima* and native Podocarps, although fruiting phenology for these species / groups is not yet known.

Activity 3.2 Plant native tree species in place of exotic species in over 100 ha of land by project end and incorporate planting method into land use plans

Progress: Thus far some potential woodlot sites have been proposed by the communities in Womkama and Danbagl these will be mapped over the course of the next year, and community meetings organised to go over existing (or establish new) land use plans. Two community nurseries in operation at Womkama and Danbagl (Figures 5-8) and two more being established at Miruma (Figure9).

Figure 1: The forest margin is delineated with a hard edge as a result of village agricultural activities. The remaining forest is mostly *Nothofagus* forest. *Castonopsis* forest, which is usually indicative of good agricultural land has been largely lost from the region. Picture taken at Danbagl.

Figure 2: The leading edge of the remaining forest is largely devoid of large trees and is dominated by secondary forest species before transitioning into intact *Nothofagus* forest. Picture taken at Danbagl.

Figure 3: Active germination trays at WCS (Man on Earth) nursery.

Figure 4: Poly tubes with sterilised soil ready for seedling transplanting at WCS (Man on Earth) nursery

Figure 5: Preproduction of nursery materials for Miruma nurseries (foreground: stand-up trays; Background: soil sterlisation drums and soil sifter.

Figure 5: KGWan Eco-habitat nursery (Danbagl) while functional was in a poor state of repair prior to WCS involvement

Figure 5: KGWan Eco-habitat extension workers build new stand up beds and begin wildling (native species) husbandry in advance of seed propagation (KGWan Eco-habitat nursery, Danbagl)

Figure 6: Purpose built soil sterilisation drum (right) built by WCS in use at KGWan Eco-habitat nursery, Danbagl.

Figure 7: Shelf repair for installation of germination trays (KGWan Eco-habitat nursery - Danbagl)

Figure 8: Wildling (seedlings sourced from the wild) rearing (IRRM nursery - Womkama)

Figure 9: Breaking ground for one of the two new nurseries at Miruma, Eastern Highlands

Objective 4. Sustainable use of existing forest stands within remaining areas of native forests and planted areas of exotic trees

Activity 4.1 Reduced number of native trees harvested compared to number of exotic trees harvested from already existing forest stands

As yet this activity has not yet been targeted. In the upcoming year we will focus on enumerating the volume of timber used by households from exotic wood lots compared to that available from the forest, as well as training community representatives in the principles of continuous cover forestry.

Activity 4.2 Secure more than 500 hectares under sustainable forestry practices as compared to baseline by March 2019

Over the past 12 months we have calculated the rate of forest cover loss from the closed canopy cover within the project footprint. This was accomplish by writing R code to allow analysis of deforestation and afforestation rates within the project area of interest via the Global Forest Change database. As a result we have established baseline rates for annual losses and gains between 2001 and 2014. Total forest loss between 2001 and 2014 in the project area was 40.6 ha, where forest loss is defined as canopy cover over 5 meters in height and of at least 80 percent cover at a 30 x 30 m resolution. This has revealed that comparatively little closed canopy forest has been lost from Womkma and Danbagl but by comparison forest loss is increasing year-on-year at Miruma (Figure 10). Overall 32.6 ha has been lost at Miruma over the 13 year period (Figure 11). As a consequence Miruma will be prioritised in terms of greatest need for intervention.

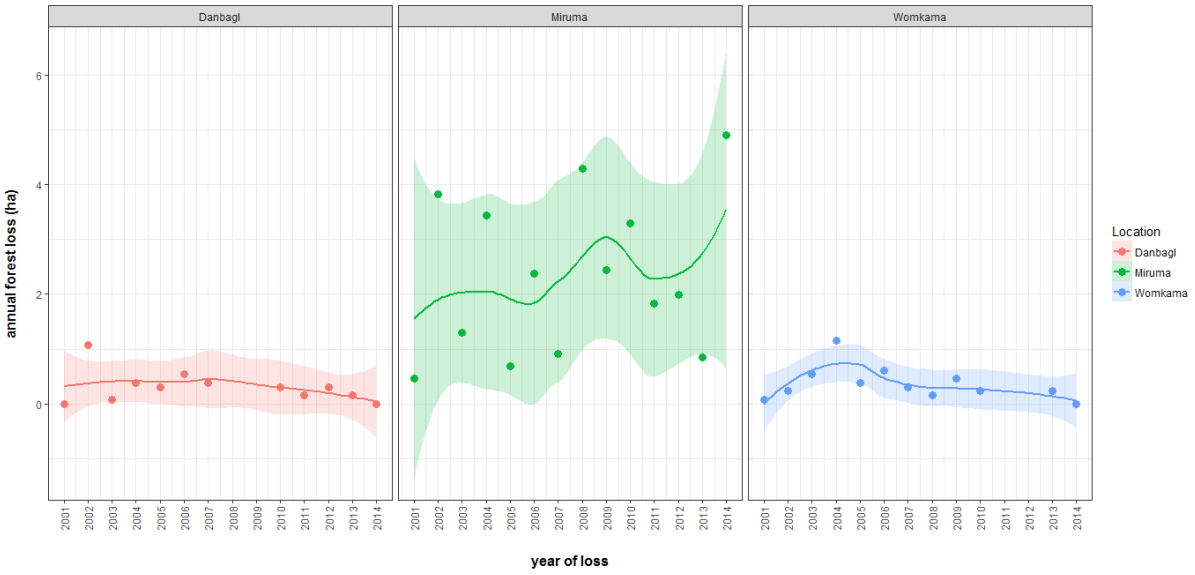

Figure 10: Comparative deforestation rates 2001-2014

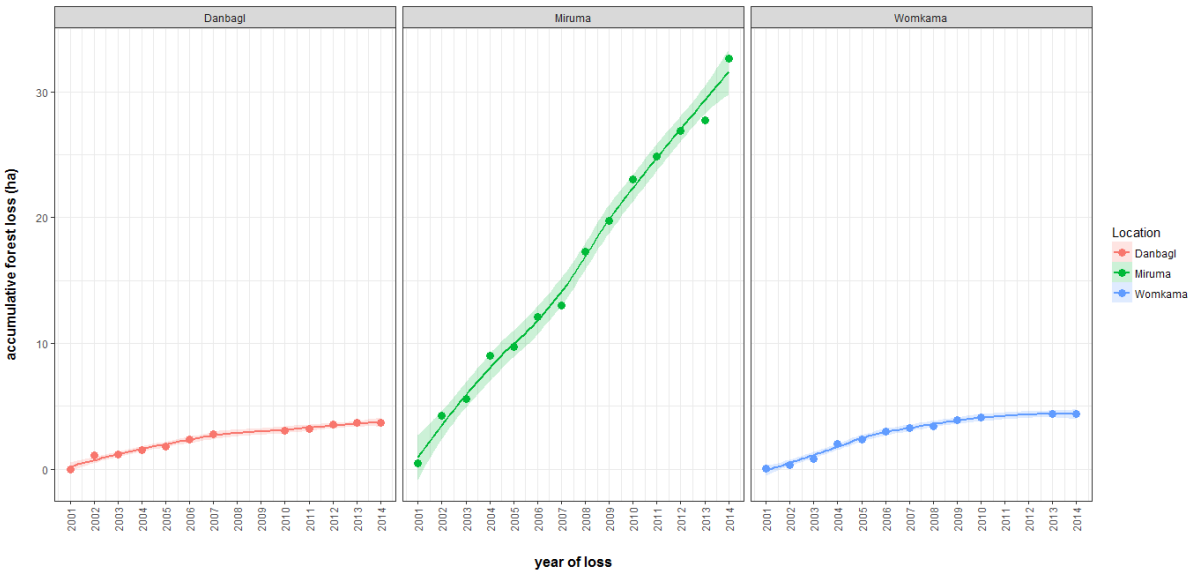

Figure 11: Accumulative deforestation rates 2001-2014

Traditional ecological knowledge (Activity 5)

Output 5. Capturing and passing on traditional ecological knowledge on forests and threatened species

Activity 5.1 Produce school curricula capturing local ecological knowledge in 3 primary schools in the project area by September 2017

Currently, WCS is in still in the process of collecting local ecological knowledge. Thirteen community facilitators have been trained at Miruma to collect local ecological knowledge with regard to natural resource management, perceptions of the importance of forest and traditional ornamentation (Figure 1). Simultaneously we have been recording the traditional ecological knowledge of the village elders in the local language (Table 1). Thus far this recording activity has only occurred at Miruma but will be repeated at Danbagl and Womkama. This knowledge together with the local names recorded through our wildlife monitoring and silviculture activities will form the basis of educational materials.

Recent engagement with the provinical education advisors has revealed that as the Papua New Guinean curriculum is nationally mandated local alterations to curricula are forbidden. In order to accomplish this activity WCS is now developing supplementary education materials based around the existing curricula to achieve an equivalent outcome. In particular WCS will run a series of educational posters designed for school children around “No gut y ulus tingting lo save blo place” (translation: Don’t lose local knowledge), and “Noken lus tingting lo gutpela diwai blo ples” (translation: don’t forget about useful local trees). Included amongst the information will profiles of edible tree crops which have been highlighted as an important reserve crop in times of drought and disaster.

Figure 1: A recently trained community facilitator at Miruma surveying a local woman about her knowledge and perceptions regarding wildlife, forest values, importance of cultural dress, and natural resource management.

. **Table 2:** Tok ples (local language) names gathered to date

Common name	**Group**	**Species Name**	**Gemogl (Kuman) name**	**Miruma name**
Stellas Lorikeet	Bird	*Charmosyna stellae*	Kagl	
Bicoloured Mouse Warbler	Bird	*Crateroscelis nigrorufa*	Bormana	
Mountain Mouse Warbler	Bird	*Crateroscelis robusta*	Teremba	
White-shoudered Fairywren	Bird	*Malurus alboscapulatus*	Tendewaka	
Belfords Melidectes	Bird	*Melidectes belfordi*	Augua	
Common Smokey Honeyeater	Bird	*Melipotes fumigatus*	Uka	
Red-Collar Myzomela	Bird	*Myzomela rosenbergii*	Dindongo	
Regent Whistler	Bird	*Pachycephala schlegelii*	Oungum	
Pitohui	Bird	*Pitohui*	Pitohui	
Yellow-streaked honeyeater	Bird	*Ptiloprora meekiana*	Wena	
Dimorphic Fantail	Bird	*Rhippidura brachyrhyncha*	Gilegaigle	
Rainbow Lorikeet	Bird	*Trichoglossus haematodus*	Pe-er	
Rungia	Edible plant	*Rungia klossi*		Ambo
Highlands Pitpit	Edible plant	*Setaria palmofolia*		Godoni
Aramanths	Edible plant	*Aramanthus* spp.		Parepare
Blackberried nightshade (Karakap)	Edible plant	*Solonum nigrum*		Makisi
Small Dorcopsis	Mammal	*Dorcopsulus vanheurni*	Kombon	
Subalpine Woolly-rat	Mammal	*Mallomys istapantap*	Bongre	
Mountain cuscus	Mammal	*Phalanger carmelitae*	Kawage	
Plush-coated ringtail	Mammal	*Pseudochirops corinnnae*	Andambo	
Coppery ringtail	Mammal	*Pseudochirops cupreus*	Andambo	
Painted ringtail	Mammal	*Pseudochirulus forbesi*	Andambo	
Good fellow's Tree Kangaroo	Mammal	*Dendrolagus goodfellowi*		Lasehe
Central Ranges Tree Kangaroo	Mammal	*Dendrolagus notatus*		Gombene
Bronze Quoll	Mammal	*Dasyurus spartacus*		Ekiene
Papuacedrus	Tree	*Libocedrus papuanus*		Guhi
High Mountain Podocarp	Tree	*Phyllocladus hypophyllus*		Leverisi
She oak	Tree	*Casuarina papuana*		Averehe

Activity 5.2 Measure an increase in the number of school children that learn about their local culture and traditional ecological knowledge by March 2019

This activity is planned for the forthcoming period.

[**Output 5.1: Quantitative survey on knowledge and atitudes of men, women and children in project an control areas at project start and end**]

Baseline rates of traditional ecological knowledge have been assessed at Miruma from a survey of 81 Miruma people (resulting in useable 64 interviews) addressing natural resource management, perceptions of forest value, bilas (traditional ornamentation) ownership, and a test of local knowledge. The reliability of this knowledge was tested by asking participants to give local names of 16 animals or plants including two species which were not found in the area. The sample was separated into 3 age classes (10-25, 26-40, 41-80 years). The younger age class was shown to have much less reliable knowledge of local names (Figure 2). The survey is currently being repeated in Womkama and Danbagl (Figure 2).

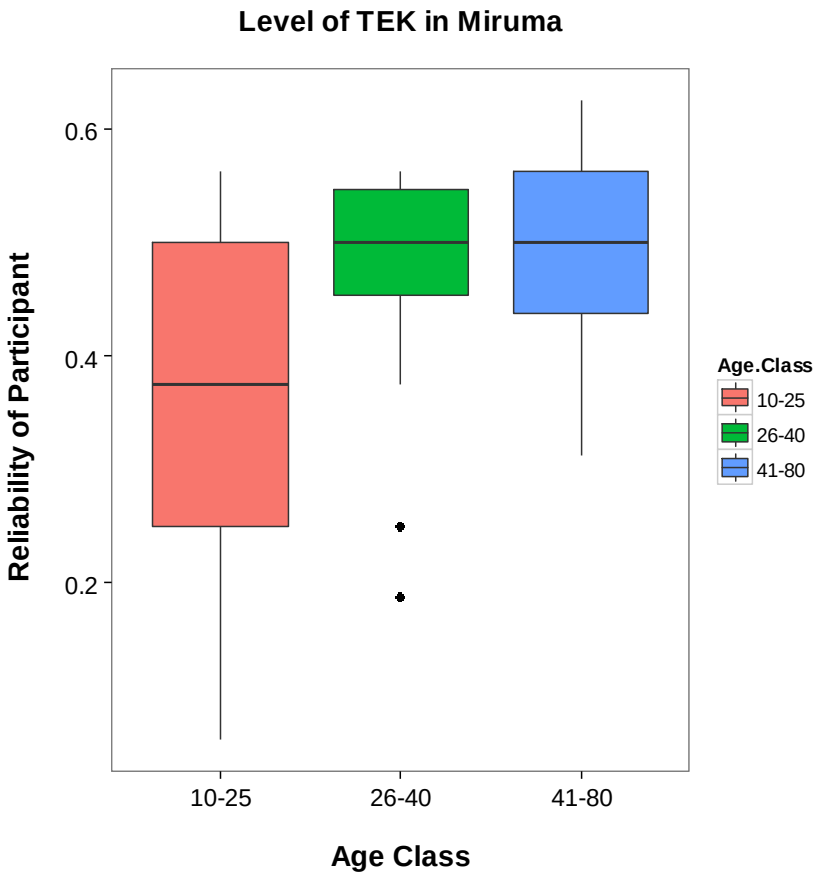

Figure 2: Output indicator 5.1: Reliability of traditional ecological knowledge as judged by ability to name 14 local species and 2 non-existent species.

Bilas ownership appears to increase with age but currently this pattern is not statistically supported (Figure 3). The inclusion of forth coming data from Womkama and Danbagl should help clarify if such a pattern holds. Currently, it is unclear what is driving bilas ownership. Possible factors include: cultural pride or distain, wildlife availability, or issues of inheritance.

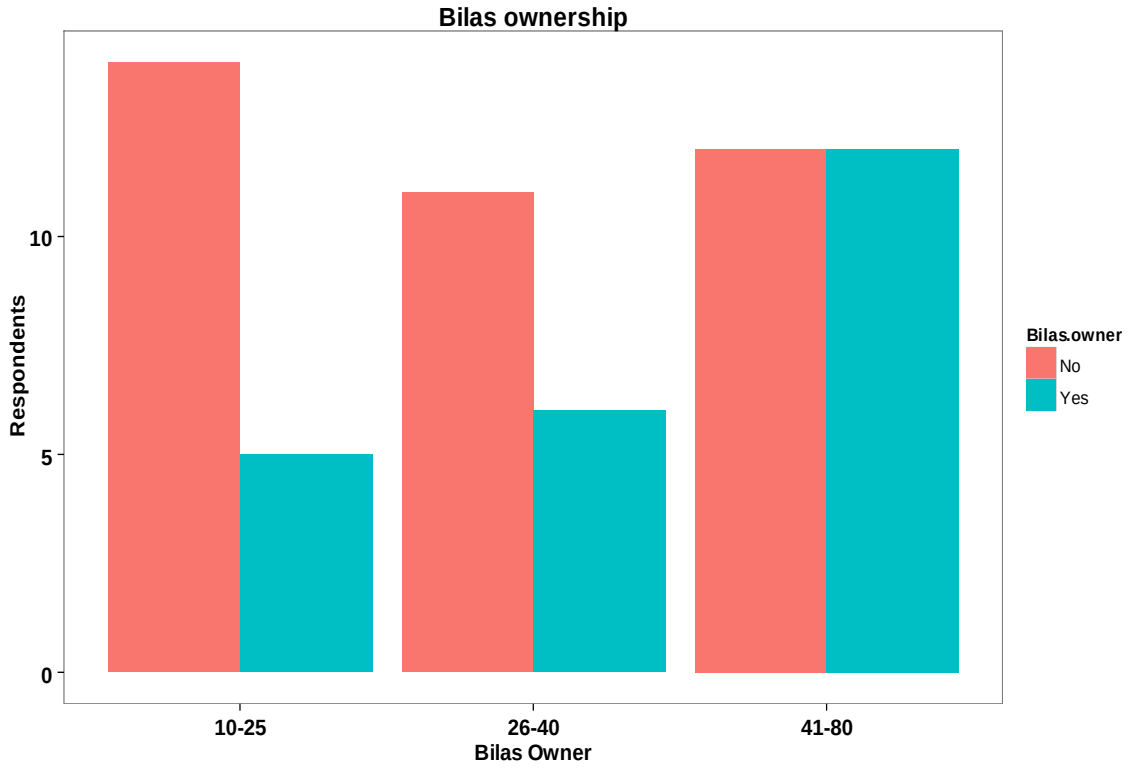

Figure 3: Bilas (traditional ornamentation) ownership by age group.

Wildlife monitoring and natural resource management (Activity 6)

Output 6. Minimizing impacts on hunted species by preserving local costumes and reviving traditional tambu (no hunting) areas.

Activity 6.1 Promote the uptake of improved preservation methods for fur and feathers in traditional costumes (termed bilas in tok pisin)

Progress: On 19 December 2016 110 bilas protection kits (65 performers physically present, see Annex 4 for names, and 45 kits for absentees) were given to the Gemobogl based Mt Wilhelm cultural group thereby exceeding the initial target of reaching 75 performers (Figure 1). Each bilas protection kit included instructions in Tok Pisin (Annex 1).

Figure 1: WCS staff member Grace Nugi (centre holding plastic) explains the use of bilas protection kits to representatives of the Mt Wilhelm cultural group.

Additionally, WCS in 2016 ran stall at the 2016 Goroka cultural show under the theme " Strongim Kastom. Lukautim Bilas bilong Yu!" (Translation: strengthen your culture, look after your ornamentation) specifically to target Highland costume owners. A total of 644 bilas protection kits were given out between the Goroka cultural show and a similar event at Mt Hagen cultural show (Figure 2 & 3).

We are aware there are many other performers and bilas owners in the Gembogl and Daulo regions and we will continue to disburse more bilas protection kits throughout the lifetime of this project.

Figure 2: WCS staff member Azalea Anota explains the use of bilas protection kits at the 2016 Goroka Cultural Show to some visiting tribesmen.

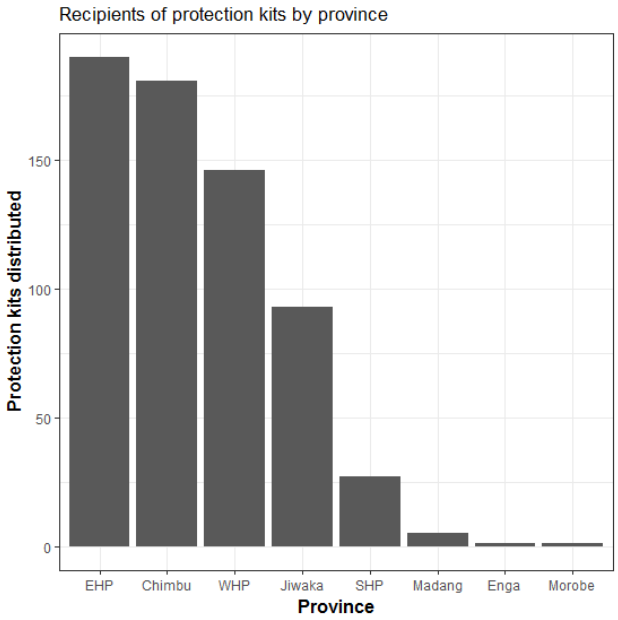

Figure 3: Recipients of bilas protection kits from WCS cultural show distributions by province, note that theparticipants of the shows often came from other provinces. Abbreviations: EHP = Eastern Highlands Province, WHP= Western Highlands Province, SHP = Southern Highlands Province

Activity 6.2 Work to increase the area or number of tambu sites created or re-established in the project area by March 2019, or other compatible traditional management methods

Progress: Currently we are in the process of surveying communities with regard to traditional practices including tambu areas. Thus far surveying of the Miruma community has been completed

but as yet there is no indication that tambu prohibitions are being used as an a resource management technique. However, there is some indication IRRM are interested in developing a protected area along their tourist path to Mt Wilhelm at Womkama. The prospect of developing a formal protected area near Womkama, and examination of tambu use in Gembogl district will be investigated over the next 12 months.

Activity 6.3 Conduct baseline and end threshold surveys for key biodiversity indicator species, and establish monitoring procedures for birds of paradise.

Progress: As part of the survey for Activity 1.1 we included a survey section on the use and importance of wild caught meat. A total of 59 community members were interviewed across Womkama, Danbagl, and Miruma (33 male, 26 female). In terms of wild harvested meat the top three most common sources were cuscus (inclusive of giant rats – as the name "kapul" (cuscus) in Tok Pisin is a catch-all word for any small-to medium sized native cursorial or climbing mammal), birds, and surprisingly tree kangaroo.

We have recently completed our first wildlife monitoring transect at Womkama (see Community mobilisation: Figure 1). For in situ monitoring we have settled on two monitoring methods: 5 minute dawn bird counts incorporating a distance variable detection methodology (enumerating all calling or sighted birds), and camera trap monitoring for cursorial and arboreal species (both mammals and birds: Figure 8) using 10 cameras set along a 5km transect line (Table 1). Tracking cards were trialled in a pilot study and found to be ineffective with animals appearing to avoid the baited cards (this was evidenced by using tracking cards in unison with camera traps). Thus far 5 minute bird counts have not been very effective as torrential rain associated with the rainy season (November – May) has thus far limited the effectiveness of the method. We now plan to undertake 5 minute bird counts only during the dry season (June- October).

Threshold surveys in which hunter caught animals are intercepted at households will commence as soon as community facilitator training has finished (such training has been completed at Miruma in March 2017 and is currently underway at Womkama and Danbagl). The community facilitators will be tasked with recording the hunter quarry for a sub-sample of households over a two week period. In advance of the threshold surveys being undertaken opportunistic hunter interceptions have been undertaken while camera trapping.

One Womkama hunter reported killing seven tree kangaroo from January-March 2017. Together with preliminary information coming by way of hunter interceptions (Figure 4 ,5 & 6) it would appear that bush meat remains an important component of the local diet and is very likely to be impacting forest species with low reproductive rates such as tree kangaroo. Hunting appears to be largely opportunistic with small game including passerine birds (*Paramythia montium* Figure7), and feral domestic cats being hunted and eaten.

Table 1: Species captured by camera trap, and their local and local (Kuman language names)

Species Name	Kuman name	Common name
Anisomys imitator		Uneven-toothed Rat
Astrapia stephaniae		Stephanies Astrapia
Charmosyna stellae	Kagl	Stellas Lorikeet
Crateroscelis nigrorufa	Bormana	Bicoloured Mouse Warbler
Crateroscelis robusta	Teremba	Mountain Mouse Warbler
Dorcopsulus vanheurni	Kombon	Small Dorcopsis
Mallomys istapantap	Bongre	Subalpine Woolly-rat
Malurus alboscapulatus	Tendewaka	White-shoudered Fairywren
Melidectes belfordi	Augua	Belfords Melidectes
Melipotes fumigatus	Uka	Common Smokey Honeyeater
Melomys rubex		Mountain Melomys
Microperoryctes longicauda		Striped Bandicoot
Myzomela rosenbergii	Dindongo	Red-Collar Myzomela
Pachycephala schlegelii	Oungum	Regent Whistler
Paramythia montium		Eastern Crested Berrypecker
Phalanger carmelitae	Kawage	Mountain cuscus
Pitohui	Pitohui	Pitohui
Pseudochirops corinnnae	Andambo	Plush-coated ringtail
Pseudochirops cupreus	Andambo	Coppery Ringtail
Pseudochirulus forbesi	Andambo	Painted ringtail
Ptiloprora meekiana	Wena	Yellow-streaked honeyeater
Rhippidura brachyrhyncha	Gilegaigle	Dimorphic Fantail
Stenomys niobe		Moss-forest rat
Trichoglossus haematodus	Pe-er	Rainbow Lorikeet
Zosterops novaeguineae		Black-fronted white-eye

Figure 4: High altitude hunter interception at IRRM. From left: Dorcopus wallaby, Coppery ringtail, and Subalpine woolly rat.

Figure 5: Woolly rat being held by adult male

Figure 6: Female Astrapia killed for food (70 g), only the males are used for ornamentation

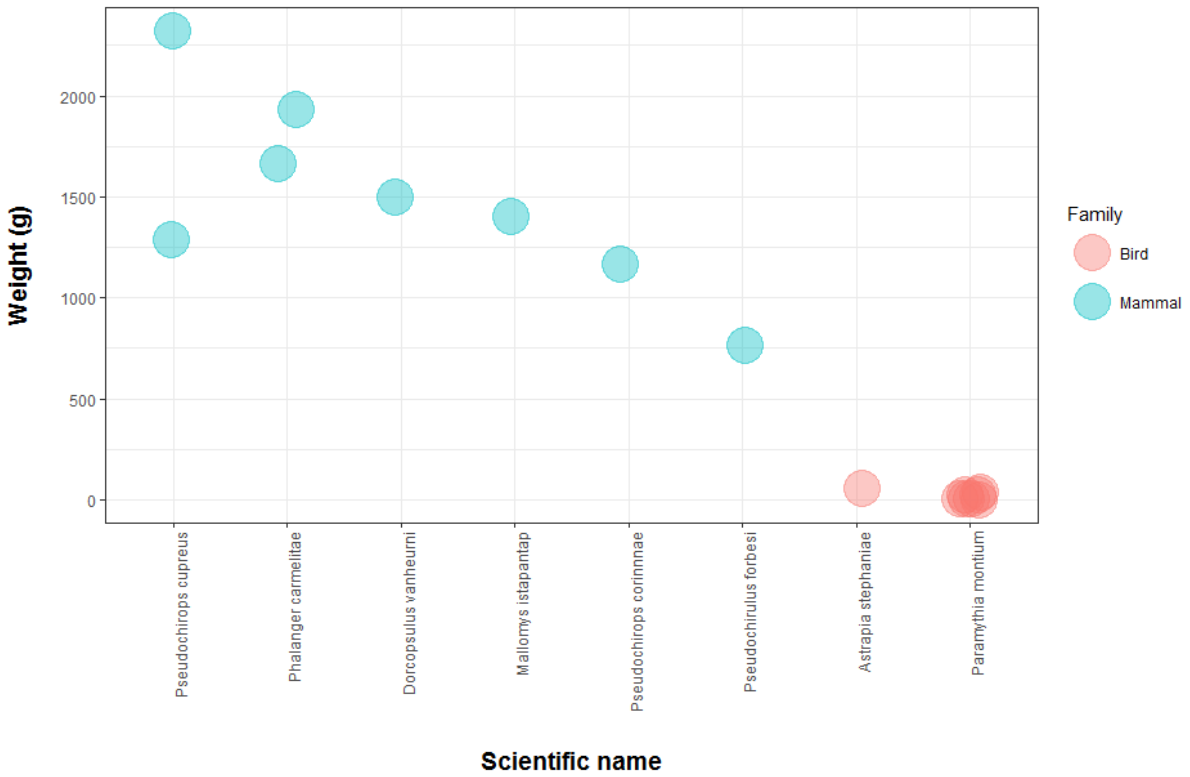

Figure 7: Weight of hunter quarry intercepted from Womkama transect

Figure 8: Woolly rat live image from camera trap.

Annex 1: Bilas protection instructions

Luksave long wok bilong bilas

WCS i mekim wok painim aut long bungim save bilong ples, na lukautim bilong bihain taim ol kainkain wel abus, diwai, na plawa. Na wankain taim WCS i luklukim long pasin bilong bilas na wei bilong kisim bilas long bus bilong yumi.

WCS i bin mekim wanpela wok painim aut long ol wei yumi long PNG i save yusim ol enimol long bilas long taim bilong singsing na wokim wok kastom. Dispela wok painim aut tu i laik save long wanem kain ol enimol ibungim hevi na klostu bai inogat moa long bus bilong yumi.

Long luksave bilong dispela wok painim aut, WCS i ken halivim ol man long ples long wei bilong lukautim ol bus bilong yumi bai ol enimol i stap nau na bihain taim tu.

Dispela wok painim aut i ken halivim ol manmeri long ples, na tu gavaman long mekim gutpela disisen long lukautim ol enimol na bus-graun bilong yumi insait long kantri, Papua New Guinea.

WCS

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WCS

PAPUA NEW GUINEA PROGRAM

VISION:

Gutpela bus, gutpela solwara, gutpela sindaun (empowered people with healthy forests, healthy seas).

Wei bilong lukautim bilas

DARWIN INITIATIVE

THE CHRISTENSEN FUND

Pisin gras na sikin bilong ol enimol long bilas i hat tru long painim na prais bilong ol tu i dia tumas. Sapos yu bihainim ol dispela wei tamblo, bai bilas bilong yu i ken stap gut planti krismas ikam.

1. Pisin gras/sikin mas stap klin oltaim

Sapos garas bilong pisin/sikin bilong enimol i wet, draim gut bipo yu putim long keis bilong em (olsem pipe). Noken draim pisin garas na sikin bilong enimol long simok bilong paia o long bikpela san. Dispela bai bagarapim pisin gras/sikin.

Abrusim das na simok. Wasim han bilong yu na draim pastaim long yu holim pisin gras o sikin bilong enimol. Putim Pisin gras o sikin insait long klinpela box o kontena.

2. Rausim binatang long pisin gras/sikin.

Ol liklik binatang save kaikai pisin gras/sikin olsem na yu mas putim ol insait long kontena i pas gut long stopim Binatang long go insait.

WCS i givim ol klinpela plastic na pepa wantaim ol motbol long yu ikan putim pisin gras/sikin igo insait wankain olsem yu save usim ol niuspepa na plastic. Slipim wanwan Pisin gras/sikin igo namel namel long ol pepa. Yu mas putim wanwan motbol antap long ol Pisin gras na bihain karamapim wantaim plastic

ITAMBU: Dispela marasin motbol i poisen.

PUTIM LONGWE LONG OL PIKININI BAI OL INO KEN KAIKAI!

3. Sekim pisin gras/wail laip sikin long ol bagarap

Sekim pastaim sapos binatang i stap o das i karamapim ol. Mortein sprei i ken kilim binatang. Spreim kontena wan raun tasol, putim pisin gras o sikin i go insait na pasim strong. Sampela binatang i save dai taim yu putim pisin gras o sikin i go insait long hokis na lusim wan o tupelo dei. Stron bilong paia i save kilim tu sampela binatang tasol noken putim pisin gras o sikin antap long paia. Paia i ken kukim

4. Lukautim gut spesel pisin gras/wail laip sikin long usim long ol bikpela bung.

Sapos yu holim ol dispela bilas natin natin, bai yu bagarapim or mekim ol i lusim gutpela kala bilong ol hariap tru. Ol dispela bilas i hat tru long painim na sapos yu lukautim gut ol i ken stap longpela taim.

Sapos yu lukautim bilas gut tru, bai bilas istap yet longpela taim na stap niupla yet bai ol pikinini bilong yu na ol tumbuna bilong yu bai amamas long usim bilas bihain taim tu.

Annex2: Notes on seed propagation protocol for key tree species selected for community forestry in montane valleys of Bismarck Range, Papua New Guinea

Arison Arihafa

Introduction

Three main ecological groups of species differing primarily in gap light requirements for growth at the seedling stage known as primary (shade tolerant), pioneer (shade intolerants) and the late secondary species (long-lived pioneers) occur in tropical rainforests (Runkle 1982, Brokaw 1985, Whitmore 1990). Most PNG indigenous knowledge could be used to identify species, and together with scientific knowledge they could help in choosing appropriate species for replanting in various light gaps. Human intervention through replanting is vital for replenishment. Most late secondary tree species are good commercial hardwood species; they are long-lived and are able to provide valuable timber and help reduce pressure on intact forests.
This paper proposes important commercial tree species and the techniques required for collecting seeds, sowing and germination of seedlings for replanting in highlands valleys.

Species selection

Most commercial tree species seedlings require placement in light gaps at some stage in order to grow vigorously to fill gaps (Brokaw 1985, Whitmore 1990). The late secondary species (often called the long-lived pioneers) would be most appropriate group of species to be selected for the highlands valley for reforestation. They have low to medium requirement for shade in the initial stages of seedling establishment after raising them in shade house (nursery)–this is an opportunity (for us) to hope for greater chances of success with seedling establishment in exposed light. For example, Mack et al. (1999) found out that the seedling of the commercial tree species *Aglaia mackiana* is a late secondary tree species that regenerates only in high shade and then grows vigorously when exposed to light gaps in PNG forest. Other useful commercial tree species include *Elaeocarpus spp.* while many others include both highly demanded commercial hardwood and softwood (conifers) trees are listed in Table 1. Once established, species with low shade requirement are characterised by their ability to grow fast, and the requirement for shade decreases with seedling growth. An important characteristic of most broadleaf tropical forest species are competition against one another for light, which contributes to achieving straight boles for good timber production; that is why spacing must be considered when planting.

Those tree species that are locally abundant and could be given low preference include: the mycorrhizae root family Fagaceae (*Castanopsis acuminatissima, Lithocarus spp., Nothofagus spp.)* – they require high shade for initial establishment, they are mono-dominant and outcompete other trees for soil nutrients. Other mycorrhizae root trees include the Araucariaceae (*Araucaria cunninghamii* and *Araucaria hunsteinii*) – though they require very

low shade during establishment, they should be planted on marginal lands as they will make their own nutrients from the soil.

Nurse plants

If required, the following secondary tree species can be used as nurse plants to grow hardwood (primary forest species) species under their shades: Euphorbiaceae (*Glochidion apodogynum, Homalanthus novoguineensis, Macaranga pleioneura* and *Phyllanthus flaviflorus*), Urticaceae (*Poikilospermum sp.* and *Pipturus argenteus*), Rhamnaceae (*Alphitonia sp*.), Malvaceae (*Commersonia sp*.). They are short-lived (10-15 years) and will die once the long-lived trees have established. The option of nurse plant is good for long term projects like (e.g. >20 years).

Table 1. List of native montane commercial tree species that could be selected for reforesting highlands valleys. Preference for selection is based on shade requirements for seedling after planting out. Trees with two preference numbers (1 and 3) are species that could be utilised if selection is based on its low shade requirement (1) or could be least preferred if other species are prioritised for selection (3).

Family	**Species**	**Common name**	**Shade requirement**	**Preference (1=very high)**	**Timber class**
Apocynaceae	*Alstonia brassii*	Alstonia	Medium	1	Minor hardwood
Araucariaceae	*Agathis alba*	Kauri Pine	Medium	1	Softwood
Araucariaceae	*Araucaria cunninghamii*	Hoop Pine	Low	1, 3	Softwood
Araucariaceae	*Araucaria hunsteinii*	Klinki Pine	Low	1, 3	Softwood
Casuarinaceae	*Casuarina oligodon*	Oak	Low	1, 3	Minor hardwood
Clusiaceae	*Calophyllum spp.*	Calophyllum	High	3	Major exportable hardwood
Combretaceae	*Terminalia spp.*	Terminalia	Medium	3	Major exportable hardwood
Cunoniaceae	*Caldcluvia nymanii.*		Medium-High	3	Commercial hardwood
Cunoniaceae	*Schizomeria brassii*	Pink Birch	High	3	Commercial hardwood
Cunoniaceae	*Weinmannia spp.*		Medium	3	Commercial hardwood
Cupressaceae	*Libocedrus papuana (Papuacedrus papuana)*		Medium	3	Softwood
Dilleniaceae	*Dillenia montana*	Dillenia	High	3	Commercial hardwood
Elaeocarpaceae	*Elaeocarpus spp.*	PNG Quandong	Medium	1	Commercial hardwood
Elaeocarpaceae	*Sloanea spp.*	Sloanea	Medium-High	3	Occasional timber
Euphorbiaceae	*Endospermum medullosum*	PNG Basswood	Medium	1	Major exportable hardwood
Fagaceae	*Lithocarpus spp.*	PNG Oak	Primary	1, 3	Major exportable hardwood
Fagaceae	*Castanopsis acuminatissima*	PNG Oak	High	1, 3	Major exportable hardwood
Fagaceae	*Nothofagus spp.*	PNG Beech	High	1, 3	Major exportable hardwood
Lauraceae	*Litsea spp.*	Litsea	Medium	3	Commercial hardwood
Lauraceae	*Cinnamomum sp.*		Medium-High	3	Occasional timber
Meliaceae	*Aglaia spp.*	Aglaia	Medium-High	2	Occasional timber
Meliaceae	*Toona sureni*	Red Cedar	Medium	3	Commercial hardwood
Myrtaceae	*Syzygium saundersii*	Water Gum	High	3	Commercial hardwood

Myrtaceae	*Decaspermum forbessii*		High	3	Commercial hardwood
Podocarpaceae	*Podocarpus neriifolius*	Podocarp	Medium	1	Softwood
Podocarpaceae	*Dacrycarpus compactus*	High Mountain Podocarp	Medium	1	Softwood
Podocarpaceae	*Dacrydium novoguineense*	Dacrydium	Medium	1	Softwood, occasional timber
Podocarpaceae	*Phyllocladus hypophyllus*		Medium	1	Softwood
Polygalaceae	*Xanthophyllum papuanum*	PNG Boxwood	High	3	Minor hardwood
Proteaceae	*Finschia chloroxantha*		Medium-High	4	Occasional timber
Sapotaceae	*Planchonella spp.*	Planchonella	Medium-High	1	Occasional timber

Seed collection and sowing

There are two kinds of seeds: the recalcitrant and the orthodox seeds with the former being able to lose viability quickly (as it cannot be stored for too long) while the later can be stored over long period (e.g. under drying or freezing conditions) (Whitmore 1990). Collecting seeds will not be easy because of irregular phenology in many flowering trees (Wright et al. 1997) and some species can take a long time from flowering to fruiting. For example, *Agathis spp.* would be the most suitable commercial tree for replanting, but the downside is that it can take up to 18 months from fruiting to fruit maturity (Bowen and Whitmore 1980); it makes seed collection tough if it is the flowering season. Seeds can be collected through setting up nets in the forest floor or through local people collecting them; but this has advantages and disadvantages, few of which are listed in Table 2.
Germination of seeds is even tough for many species because they are characterised by hard nut/seed coat impermeability making it difficult for germination and establishment (Khan et al. 2003). Proper care must be given when collecting, handling and raising plants from seeds. For many tree species, ripe fruits must be collected and treated to encourage germination. Generally only ripe fruits hanging on trees should be obtained for sowing; recently fallen fruits/seeds (less than a month old) can be utilised but they get infected with parasites easily. Seeds with short viability should be sown immediately upon collection, but seeds with longer viability can be stored in the fridge or on damp ground until they germinate. Research on the germination requirements of all the species selected above should be carried out before sourcing seeds; this can be done through literature search from past studies. It would be good to buy preferred seedling species from established nurseries but that would not be possible in PNG. Otherwise the only resort would be to collect wildings and raise them up in nursery beds before transplanting.

Table 2. Two approaches and its challenges for obtaining seeds.

Seed source	**Advantage**	**Disadvantage**
Putting up nets in forest floor to collect seeds that arrive by seed rain (from nearby standing tree or through frugivore vectors)	-Able to collect quality seeds over certain period	-It will be costly to collect from large sample area -Need large samples to collect more
Establishing a seed collecting centre where local people can collect from their forest and bring it in to be bought by WCS	-Cost of logistics cut down	-May wait too long for locals to brings seeds -There might not be enough seed suppliers -High chance of obtaining low quality seeds

Cleaning and treating seed

There are different types of seeds , so the cleaning and treating seed techniques vary from one another. Generally all seeds should be free of seed coat, capsules and fleshy fruits before they can be sown. Then instead of being too technical, we can simply organise to throw all the seeds collected onto seed bed on the ground with some cover and shade, but they must be exposed to some light, temperature and moisture to trigger them to germinate. Once they start germinating, they can be transferred into tubes and polybags to be raised in shade cloth house.

Conclusion

Before starting it is important to (1) research target species, (2) ensuring the team has the right skills, (3) set up appropriate facilities with necessary equipment, (4) obtain source of viable seeds and (5) develop seed sowing calendar. This paper did not cover point three and five as the equipment can be purchased from stores, and point five can be developed as seeds are collected and propagated. No specific technical skills are required for germination and growth, but the team must be organised and keep good records.

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Annex 3: Sowing and germination dates (WCS nursery)

Common name	Species	Seeds sowed	Sowing Date	Germination Date
Banda	*Fagraea sp.*	~2000	4/02/2017	23/02/2017
Yapbane (yar)	*Casuarina oligodon*	~1500	12/03/2017	24/03/2017
Nenge pii (Oak)	*Castanopsis acuminatissima*	10	12/03/2017	3/04/2017
Koga (Kumu mosong)	*Ficus copiosa*	~1000	25/03/2017	3/04/2017
Karuka (Pandanus)	*Pandanus julianettii*	~600	25/03/2017	yet to germinate
Yomba (Beech wood)	*Nothofagus pulleii*	~200	2/04/2017	yet to germinate

Annex 4: List of Mt Wilhelm cultural group recipients of bilas kits

Count	NAME	SEX	District
1	JOSEPH KOIMA	M	Gembogl
2	PIUS MUNO	M	Gembogl
3	CHRISTINA KOMANIDE	F	Gembogl
4	LUSA BARE	F	Gembogl
5	IERIKINA PETER	F	Gembogl
6	AGNES KOIMA	F	Gembogl
7	YASEPA KIMAM	F	Gembogl
8	DAKA EWA	F	Gembogl
9	BEN KIHANUGLA	M	Gembogl
10	MONIKA WAMUNA	F	Gembogl
11	ARNOLD KOMBA	M	Gembogl
12	SALUME WIMAGLE	F	Gembogl
13	OTTO DOCTA	M	Gembogl
14	JULLIE ARNOLD	F	Gembogl
15	PALUS KIANUGLA	M	Gembogl
16	TRESA KUBAINA	F	Gembogl
17	MORO ANTON	M	Gembogl
18	JAMES MAKAMO	M	Gembogl
19	CECELLIA BOGLKUN	F	Gembogl
20	PAUL TAKAI	M	Gembogl
21	CATHY PAPUA	F	Gembogl
22	MICHAEL NIMAYAGL	M	Gembogl
23	MARTHIN DUKUBUGL	M	Gembogl
24	ANTON KENWAND	M	Gembogl
25	MARTILA PIUS	F	Gembogl
26	PAULA SIBINA	F	Gembogl
27	PAPILA GARKI	F	Gembogl
28	UMBA DARWA	M	Gembogl
29	ANTON GUAMBO	M	Gembogl
30	PALUS BUNDO	M	Gembogl
31	JOHN GOR	M	Gembogl
32	MARIA KEWAND	F	Gembogl
33	ALUVIS GANDIN	M	Gembogl
34	KOLUMBA MAGRE	F	Gembogl
35	PAPUA GAMBA	M	Gembogl
36	JOHN MAGRE	M	Gembogl
37	TOBIAS KUA	M	Gembogl
38	MARIA BOMAI	F	Gembogl
39	MORO GANDIN	F	Gembogl
40	MARIA ALUVIS	F	Gembogl
41	MARIA KIANUGLE	F	Gembogl
42	HOIKEN KUA	M	Gembogl
43	ULKA GOVERNOR	M	Gembogl
44	SALUME ULKA	F	Gembogl
45	HOFFMAN KOIMA	M	Gembogl

46	PETER KOIMA	M	Gembogl
47	ANNA KIMAGL	F	Gembogl
48	JOHN JOKA	M	Gembogl
49	JOSEPH BIREKINDE	M	Gembogl
50	SALLY BIKI	M	Gembogl
51	TOBIAS KAMBE	M	Gembogl
52	SAINA KOMBA	F	Gembogl
53	MARIA WARI	M	Gembogl
54	SALUME RUSTER	F	Gembogl
55	MARKARTA K BEN	F	Gembogl
56	MARTHIAS GEREGL	M	Gembogl
57	DINI DAKA	F	Gembogl
58	KATHRINA KOMBA	F	Gembogl
59	THOMAS ULGO	M	Gembogl
60	APLOGOLA	M	Gembogl
61	ANDREW UMBA	M	Gembogl
62	MAGIRET KIMAGL	F	Gembogl
63	JOSEPHA KIMAM	F	Gembogl
64	PETER NARU	M	Gembogl
65	NOROBETH SIMBINA	F	Gembogl

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