



## Darwin Initiative Annual Report



### Darwin Project Information

Project Ref Number	15/007
Project Title	Focus for Fiji: Insect Inventories for Biodiversity Assessment
Country(ies)	Fiji
UK Contract Holder Institution	University of Sussex
Host country Partner Institution(s)	National Museums & Galleries of Wales
Other Partner Institution(s)	University of the South Pacific
Darwin Grant Value	£203,780
Start/End dates of Project	1 October 2006 – 31 March 2010 *
Reporting period (1 Apr 200x to 31 Mar 200y) and annual report number (1,2,3..)	1 April 2008 – 31 March 2009. Annual Report number 3
Project Leader Name	Dr Alan J A Stewart
Project website	<a href="http://www.usp.ac.fj/index.php?id=7040">http://www.usp.ac.fj/index.php?id=7040</a>
Author(s) and main contributors, date	Alan Stewart, Hilda Waqa; 30 April 2009

\* Extended from 30 September 2009.

### 1. Project Background

Due to their remote location and unique geological history, the Fiji Islands contain a high proportion of endemic species, especially amongst invertebrates. Knowledge of the insect fauna is extremely patchy, mainly due to an almost complete lack of within-country expertise in entomology, resulting in poor integration of insects into national conservation strategies. In conjunction with the University of the South Pacific, this project aims to build capacity for insect diversity survey work by establishing and training a team of senior curators, technicians and parataxonomists. The team is conducting multiple insect diversity surveys across the Fiji Islands, establishing a national insect collection and raising general awareness of environmental and biodiversity issues. Team members are receiving training from visiting UK experts running intensive courses in Fiji and through visits to key institutions in the UK. The team is housed within the Institute of Applied Sciences (IAS) based at the University of the South Pacific (USP) in Suva.

## **2. Project Partnerships**

### **Partnership between UK lead institution (University of Sussex (US)) and host country partner (University of the South Pacific (USP)):**

The collaboration between US and USP continues to work well. As the UK partner, Alan Stewart has concentrated on project management, developing links with taxonomic experts who will assist with specimen identification and maintaining links with previous Darwin project partners in Papua New Guinea. Although these Darwin projects (EIDP 09/10-030 and 14/054) have now finished (the latter one within the current reporting period), Alan Stewart retains good working relations with the partners in PNG (e.g. through co-supervision of new projects and continued publishing of material arising from the DI work). The Fiji project is using similar insect survey techniques and protocols to those in PNG so there is considerable synergy between the two projects. Overall management of the project at USP continues to be the responsibility of Professor Bill Aalbersberg at the Institute of Applied Sciences (IAS), with Hilda Waqa (Senior Curator) taking progressively more responsibility for day-to-day management of the project and the project team. The project remains housed within the South Pacific Regional Herbarium at IAS and continues to benefit from close collaboration with Mr Marika Tuiwawa, Curator of the Herbarium, especially in relation to knowledge of potential survey sites, background information on vegetation and contacts for gaining permission for fieldwork. Most communication is via e-mail.

### **Partnership with other UK partners:**

The project continues to benefit from collaboration with the National Museums & Galleries of Wales (NMGW), Cardiff, primarily through Dr Mike Wilson. Since his training visit to Fiji in 2007, Dr Wilson has continued to provide taxonomic and curatorial advice and an identification service for the Hemiptera-Auchenorrhyncha from the project surveys. Dr Chris Hodgson (also NMGW) will be running a training course at USP in June 2009.

### **Collaborations with other similar projects:**

Fiji (and Suva in particular) is the focus of considerable activity in biodiversity conservation. USP in particular provides a nexus for a great many projects and international collaborations focused on the south Pacific region. This Darwin project is fortunate in being able to tap into this extensive network of contacts, through our partners at USP, especially Professor Bill Aalbersberg. The previous Annual Report described these links in some detail. Good working relationships have been developed with the Fiji programme of WCS, BioNet, The Ministry of Agriculture's Koronivia Research Station, the Forestry Department at Colo-i-Suva and the Fiji Museum in Suva, all of which are based either on the USP campus or in/near Suva. Conservation International (CI) has major conservation projects recently funded by the Fiji Water Foundation to protect the Sovi Basin, one of the largest tracts of unlogged land in the island Pacific, and the Ra Province Nakauvadra watershed. Staff trained under this Darwin project have contributed to biodiversity assessments in these areas in 2008, resulting, amongst other developments, in two insect species not recorded for more than 100 years being "rediscovered".

## **3. Project progress**

### **3.1 Progress in carrying out project activities**

#### **(a) Development of the project team**

Ms Hilda Waqa continues as Senior Curator and project team leader at USP. She is responsible for organising and leading the field surveys, organising the processing of specimens and training the technicians and parataxonomists in essential entomological skills.

Ms. Waqa is also concurrently pursuing a PhD in entomology at USP. Regrettably, we have been unable to find a replacement for Mr. Sunil Prasad (the other senior curator) who left the project in September 2007.

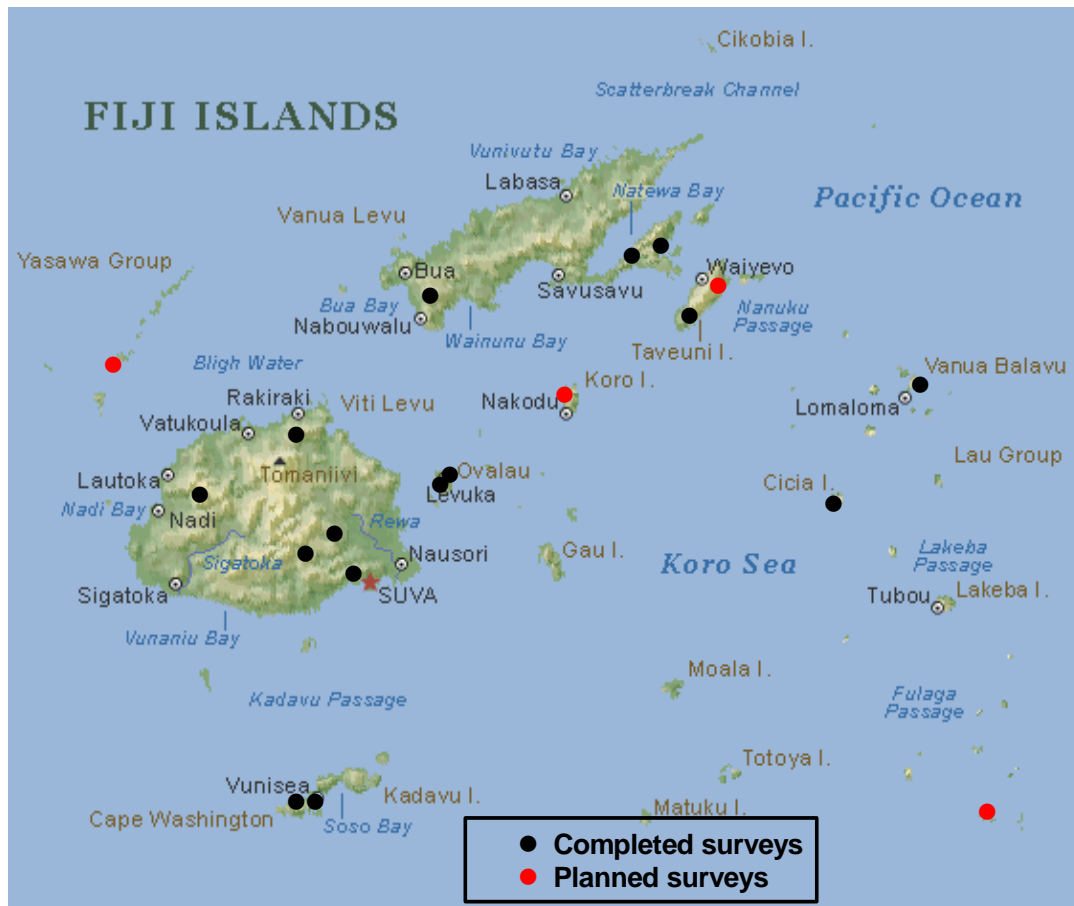
The team currently comprises Ms Waqa plus technicians, graduate assistants and parataxonomists, contributing varying amounts of time to the project (see Annex 3, Table 1).

## **(b) Field surveys**

**Collection techniques:** Field survey techniques were outlined in the 2008 Annual Report but have been modified slightly since then. Each site (an approximately 1 ha plot) is chosen from an area of relatively intact forest. The following traps were set at each sampling site: (i) one malaise trap, set for a period of two months; (ii) two light traps run for at least two nights with good weather; (iii) flight intercept traps (FIT) for six days; and (iv) window intercept traps (WIT) for six days. We reviewed whether or not to continue with the latter two techniques and reached a decision to focus on malaise traps, light traps, butterfly collections, leaf litter sieving (in some sites) and hand-searching. Butterfly collections tend to be mainly on roadsides, grassland areas and along forest edges. Canopy fogging was done at one site, producing approx. 1900 specimens. A vegetation study is also conducted at each site: four 10m x 10m sub-plots within the 1ha sampling plot are marked and plants >5cm DBH are identified.

**Focal insect taxa:** The following taxa are extracted from trap catches and are targeted for particular attention: Coleoptera (beetles), Hemiptera (bugs), Formicidae (ants), Lepidoptera (butterflies & moths), Odonata (dragonflies & damselflies) and Phasmida (stick insects). Butterflies are identified wherever possible in the field and small representative collections are made either for subsequent confirmation of identity or as voucher specimens.

**Surveys completed:** Sites were chosen to cover a range of island sizes and degrees of remoteness within the Fiji Islands archipelago. Field entomological surveys have now been completed at 24 sites on 15 islands (15 sites from 6 major islands plus 9 smaller islands within the Lau group) (see map overleaf and Annex 3 Table 2). The team has therefore already considerably exceeded the number of surveys originally planned (10, later revised to 14). The strategy has been to complete the field surveys as early as possible within the project, to allow the remainder of the time to process, curate and properly identify the material. This has also allowed the possibility of running further follow-up surveys to build upon the results of those already completed. Thus, a programme of three further field surveys and one repeat survey (previously abandoned due to bad weather) has been planned for the last 12 months of the project (see Annex 3 Table 3).



**Map of Fiji Islands showing surveys completed and planned within the project.**

**(c) Identification of specimens**

Insect samples from field surveys are ‘rough-sorted’ by the parataxonomists in Fiji to order or family level. Wherever possible (i.e. where appropriate taxonomic literature exists) specimens have been identified to generic or species level. In most cases however, material is sorted into ‘morphospecies’, with representative specimens of each one sent to taxonomic experts for verification as unique taxa and possible identification. In the case of Coleoptera (beetles) we have developed an arrangement with the Entomology Department at the Natural History Museum whereby the entire beetle collection is sent to London, where the coleopterist staff will identify and label the material, retain a small number of duplicate specimens for the NHM collection, and then return the rest to Fiji. Although it involves shipping more material, this approach has two advantages: (i) duplicate specimens of most beetle species are retained in the NHM as an insurance against loss or damage to the collection in Fiji, and (ii) the entire collection is examined by expert coleopterists who are more likely to notice subtle differences between similar species that might otherwise be missed in the rough sorting to morphospecies by parataxonomists.

11,107 of the 16,855 insect specimens collected have been ‘processed’ prior to species-level identification (i.e. identified to order or family level, mounted, labelled and databased) (see Annex 3, Table 2 for breakdown into insect orders). So far, specimens have been sent to the following experts for identification/verification:

- Mr Max Barclay (NHM): Coleoptera
- Dr Judith Marshall (NHM): Phasmida, Orthoptera
- Dr Mike Wilson (National Museum of Wales): Hemiptera-Auchenorrhyncha

- Dr Steve Lingafelter (Smithsonian Institution, Washington): Coleoptera-Cerambycidae
- Dr Neal Evenhuis (Bishop Museum, Hawaii): Diptera

**(d) Database of insects within collections**

All information relating to curated insect material is being properly stored electronically, including information on sampling site, habitat, date, weather, method, recorder, determiner, specimen location within the collection and provisional taxonomic determination. This information is currently being held in simple Excel spreadsheets, but nevertheless in a format that could be migrated to a fully relational database (such as Access or FileMaker) as the collection grows. UK collaborators have considerable experience of using databases that are currently available for storing information on collections and constructing bespoke databases for particular purposes and have been advising the Fiji team accordingly.

**(e) Rediscovery of rare endemic stick insect species**

The 2008 survey of the Nakauvadra Ranges in northern Viti Levu produced highly significant rediscoveries of two species that had not been reported for over 100 years, both from the order Phasmatodea (commonly known as stick insects, local names- “ucikau” or “mimimata”):

- A female of *Nisyrys* (= *Cotylosoma*) *spinulosus* (Annex 4, Figure 1), a species that was first described in 1877 from Viti Levu. Interestingly, nothing is known about *N. spinulosus* except that it is endemic to the Fiji Islands but its distribution within them is unknown.
- A female of *Phasmotaenia* (= *Hermarchus*) *inermis* (Annex 4, Figure 2), first described in 1908. This species is an island endemic to Viti Levu, having so far been recorded only from Korovou, Baulevu and Nadarivatu. Our survey produced the first record from the Nakauvadra ranges. Very little is known about this species.

A short description of these discoveries has been written by Hilda Waqa and published in the magazine *Melanesian Geo* (appended to this report).

**(f) Field experiment on host-specificity in wood-boring beetles**

A major experiment to examine host-specificity in wood-boring beetles has been set up in Savura Forest Reserve near Suva with the permission of the Department of Forestry. This involves hoisting timber baits (constructed from logs of standard number, width and length, tied together) into the canopy using ropes (Annex 4, Figure 3) and leaving them for one month to be colonised by dead-wood boring insects (principally beetles in the families Scolytidae, Platypodidae and Cerambycidae). The experiment is testing which insects colonise each of twelve tree species that are typical of lowland forest. After one month of exposure, the baits are removed from the canopy and held for at least six months in individual net cages to allow emergence of insects from the logs (Annex 4, Figure 4). This experiment has the dual purpose of (i) testing the host-specificity of dead-wood species and characterising the structure of the dead-wood insect community, and (ii) adding species to the general entomological surveys that would otherwise be difficult to sample. The experimental protocol follows that used by our collaborators working in Papua New Guinea (previously funded by Darwin projects 10/030 and 15/054, both lead by Alan Stewart). Hilda Waqa was able to view and discuss the experimental protocol when she was shown parallel experiments in the Czech Republic during her visit to Europe in 2007. These are being run by the scientists who have been our partners on the former DI projects in PNG. So far, a total of four sets of baits have been exposed and collected for rearing and monitoring of adult emergence from specific tree species. Two sets of data have been completed with the 3<sup>rd</sup> and 4<sup>th</sup> set still running and being monitored fortnightly. The last set of data is expected to be completed in November, 2009. Results so far indicate that the Coleopteran family Scolytidae are generalists whilst Curculionidae and Cermabycidae are specialists on the tree species *Garcinia myrtifolia* and *Serianthes melanesica*. A total of 4356

beetles have been reared so far from the 1<sup>st</sup> and 2<sup>nd</sup> sets of timber baits of which 65% belong to the dominant family Scolytidae.

**(g) MSc research project on the Fijian swallowtail butterfly**

MSc research student Visheshni Chandra has been working on the ecology and distribution of the rare endemic Fijian swallowtail butterfly *Papilio schmeltzii*. The main aims of the project have been to: (i) verify the natural habitat of *P. schmeltzii* and determine its specific larval host plants and (ii) determine its current distribution in Fiji. Fortnightly field observations were carried out in the Vatukarasa area, Sigatoka, from January to December 2008. Results suggest that the butterflies prefer isolated forested areas, in which they are found near forest edges, and show a preference for stream and river corridors. Female *P. schmeltzii* have been observed ovipositing on *Micromelum minutum* (a native evergreen tree in the Rutaceae), a species on which larvae have also been found feeding (see Annex 4, Figure 5). Adult butterflies mainly visit *Stachytarpheta urticifolia* (Blue rat's tail) occurring around forest clearings. The butterfly is currently known from four areas on the mainland and ten sites on the outer islands (see Annex 4, Figure 6). The project has added four new islands to the list on which the species is found: Beqa, Koro, Taveuni and Kadavu. Records of the butterfly on the outer islands of Fiji in the absence of *M. minutum* suggest that it may have a wider range of host plants. In the absence of *Micromelum minutum*, results have shown that *P. schmeltzii* prefers to oviposit on *Citrus reticulata* (Mandarin orange).

**(h) Development of the Fiji National Insect Collection at USP**

The Fiji National Insect Collection (FNIC) at the South Pacific Regional Herbarium, USP, now has a total of 6 insect cabinets each comprising 12 drawers. We have also received insect boxes from Landcare Research, New Zealand for proper storage of specimens. The team is currently placing mounted insects into respective orders and families and a proper labelling system has been put in place.

The number of specimens fully identified to species level and deposited in the Fiji National Insect Collection so far for the various target orders is as follows: Lepidoptera: 88; Coleoptera: 4080; Hemiptera: 393; Hymenoptera: 112; Diptera: 229; Orthoptera: 164; Odonata: 0; Isoptera: 7; Blattodea: 16; Phasmida: 9; Dermaptera: 3; Total: 5202. The majority of the remaining specimens collected are awaiting shipment to overseas experts for identification or verification. Full specimen data are held on Excel spreadsheets.

As outlined in the last Annual Report, other important collections of Fiji insects are held in other institutions within Fiji. Rather than combining these with a central collection, we have decided that a better strategy will be to train the curators of these collections to a high standard using the facilities at USP and encouraging them to attend training workshops led within this project by visiting taxonomic experts from the UK.

**(i) Darwin Initiative biodiversity gallery at Fiji Museum**

Following the successful launch of the butterfly guidebook *Butterflies of the Fiji Islands* by Sunil Prasad and Hilda Waqa in April 2007, published in conjunction with the Fiji Museum, it became apparent that there was an additional opportunity to work with the Museum to develop in-country awareness of biodiversity and conservation issues. The Fiji Museum has wanted to open a natural history gallery for some time, but they have been unable to do so due to lack of funding.

Following discussions with the Director of the museum, Sagale Buadromo, and the Head of the Collections, Sela Reyawa, the museum indicated strong support for the establishment of a collaborative project to develop a gallery space devoted to biodiversity. Additionally, and partly in response to previous reviews of our project that recommended greater links with other Darwin projects in Fiji, we have had discussions with the coordinators of two other Darwin projects (15/019 with Birdlife International and 14/020 with WWF) who also

support the project and would be able to provide assistance in developing the exhibits within the gallery. We also have support from a newly formed membership organisation, *Nature Fiji*, and hope to engage other conservation partners (especially the National Trust of Fiji who maintain a number of important sites within the islands).

The project will involve: (i) refurbishment of gallery space including provision of an air conditioning unit to maintain suitable conditions for specimens, (ii) construction of display cabinets to house specimens supplied by Darwin participants and the museum, and (iii) production of high quality display boards designed by professional graphic artists. The proposed gallery conversion will cost FJ\$30,150 (approximately £11,000) which the DI Secretariat has agreed can be sponsored by this project. We have selected a project manager to oversee the work and develop the gallery content: Nunia Thomas who is a research assistant employed by the Institute of Applied Sciences and who will be seconded onto the project for 2.5 days per week as added value to the project.

#### **(j) Education & Outreach activities**

- The guidebook '*Butterflies of the Fiji Islands*' by Sunil Prasad and Hilda Waqa continues to be sold by the Fiji Museum. This collaboration with the Museum led to developing plans for a 'Darwin Initiative Biodiversity Gallery' within the museum (see above).
- Lecture by Hilda Waqa (March, 2009) to USP Biology undergraduates on *Insect Biodiversity*, describing insects in general and their significance to ecosystem function and the work of the Darwin Initiative project.
- Poster presentation and insect displays at the USP Open Day 2008. This event attracts thousands of school children and their parents and is an excellent means of advertising the project to a wide and varied audience.
- Presentation on the biodiversity of insects in the Northern Lau group of islands (June, 2008) by Mr. Naikatini (Senior Technician, USP) to the Lau Provincial Council Representatives.
- Visheshni Chandra gave an oral presentation at the 11<sup>th</sup> Pacific Science Inter-Congress held in Tahiti, 2-6 March 2009. The title of her presentation was: "The Distribution and Food Preference of *Papilio schmeltzii* Herrich-Schaffer".

#### **(k) Training**

- Senior Curator Hilda Waqa visited the Smithsonian Institute in Washington DC for training in the taxonomy of long-horn beetles (Cerambycidae) (the focus of her PhD studies) under the supervision of Dr Steve Lingafelter.
- Ongoing weekly training in entomological techniques and basic insect taxonomy has been provided by Hilda Waqa for technicians in the Department of Forestry & Agriculture. This training ran for a period of six months (February – July, 2008)
- Training by Hilda Waqa has been provided to Presly Dovo (Dept of Forestry, Vanuatu; trainee curator), Tokasaya Cakacaka (lab assistant) and Apaitia Liga (parataxonomist).
- Hilda Waqa continues her research for her PhD on the taxonomy, systematics and biogeography of longhorn beetles.
- Vishenshi Chandra (a graduate assistant under the DI Project) continues her MSc research on the habitat, biology and behaviour of *Papilio schmeltzii* (an endemic swallowtail butterfly)

Future plans for taxonomic training workshops in Fiji led by UK experts include:

- Workshop on scale insects (Hemiptera: Coccidae), led by Dr Chris Hodgson (Cardiff Museum), to run for 3 weeks in July 2009
- Training course on various Coleoptera families, led by Mr Max Barclay and Mr Howard Mendel (NHM), date to be decided.

### **(I) Checklist & analysis of Auchenorrhyncha (Hemiptera) records for Fiji**

Dr Mike Wilson (Cardiff Museum and UK collaborator on this project) has published a checklist of the Hemiptera-Auchenorrhyncha (leafhoppers, planthoppers, cicadas and spittlebugs) of Fiji, based on a collation of records from the published literature together with records from his own visit to Fiji in March 2007 (see table of publications). He reports a total of 299 species, mostly from Viti Levu, with most other islands (including Vanua Levu) being severely under-recorded. He suggests that many novel records are to be expected from further survey. Accordingly, he is identifying all the Auchenorrhyncha from the field surveys generated by this project.

The pattern of species richness and levels of endemism across the various Fiji Islands are remarkable. In ten out of the 16 families found in Fiji, more than 90% of species are endemic. Levels of endemism on the seven major islands or island groups all exceed 75%. In fact, most species are island endemics and few are known currently from more than one island group. It is clear that this taxonomic group would repay considerable further study to establish whether these apparent patterns remain after more detailed survey work.

### **3.2 Progress towards Project Outputs**

The field surveys have progressed faster than expected, resulting in more surveys already having been completed than originally planned. However, the project has continued to experience delays in the training schedule. This is substantially due to the difficulty in finding suitable trainers who are free to visit Fiji to run workshops. This resulted in a substantial underspend of £52,000 for 2008-09 which the Darwin Secretariat has agreed can be carried over into the next financial year. It has also been agreed to extend the finishing date of the project from 30 September 2009 to 31 March 2010. We are confident that these two adjustments to the project will allow us to meet all of the projected outputs within the project's lifetime.

Progress towards each output is summarised below. We have no concern that these will not be achieved by the end of the project. The output indicators are still appropriate and there have been no changes in the assumptions behind these.



### 3.3 Standard Measures

**Table 1 Project Standard Output Measures**

Code No.	Description	Year 1 Total	Year 2 Total	Year 3 Total	Year 4 Total	Total to date	Number planned for this reporting period	Total planned from application
<b>Established codes</b>								
5	Fijian nationals receive in-service training in entomology	2	6	6				11
6B	Fijian nationals receive 2 months training each in UK	0	1	0				6
8	UK experts provide 2-week intensive workshops in Fiji	2	1	0				6
9	Species Action Plans / recommendation for special protection ( <i>Xixuthrus</i> beetles)		1					1
9	Fiji insect conservation strategy plan							1
10	Guide book: Butterflies of the Fiji Islands		1					1
11A, 11B	Scientific papers published			2 (1 in press)				3
12A	Specimen and field survey databases established	1	1					2
13A	Fiji National Insect Collection established at USP	1						1
13B	Fiji National Insect Collection enhanced at USP		1	1				
14A	Closing project seminar							1
14B	Conferences attended with DI project presented		1	1				4
15A	Fiji national & local press release announcing start of Darwin project	1,1						4

**Table 1 continued**

Code No.	Description	Year 1 Total	Year 2 Total	Year 3 Total	Year 4 Total	Total to date	Number planned for this reporting period	Total planned from application
15C, 15D	UK national & local press release announcing start of Darwin project	1,1						2
18A	National TV programmes in Fiji		1					2
19A, 19C	Fiji national & local radio interviews	0	1					2
20	Equipment value: laptops, printers, microscopes, digital camera, insect storage facility	£7300						
<b>New project-specific measures</b>								
	Web-sites created / enhanced		1	1				
	Field experiments established			1				
	Permanent exhibits established / enhanced							1
	Single-species studies established / completed			1				

**Table 2 Publications**

Type (eg journals, manual, CDs)	Detail (title, author, year)	Publishers (name, city)	Available from (eg contact address, website)	Cost £
Journal	Wilson, M.R. (2009) A checklist of Fiji Auchenorrhyncha (Hemiptera). In: Evenhuis, N.L. & Bickel, D.J. <i>Fiji Arthropods XII</i> . Bishop Museum Occasional Papers 102: 33 -48.	Bishop Museum, Honolulu, Hawai'i	<a href="http://hbs.bishopmuseum.org/fiji/index.html">http://hbs.bishopmuseum.org/fiji/index.html</a>	Free
Journal	Waqqa-Sakiti, H. & Lingafelter, S. (2009, in press) New Fijian Callidiopini (Coleoptera: Cerambycidae). <i>Fiji Arthropods</i> . Bishop Museum Occasional Papers.	Bishop Museum, Honolulu, Hawai'i	<a href="http://hbs.bishopmuseum.org/fiji/index.html">http://hbs.bishopmuseum.org/fiji/index.html</a>	Free
Popular magazine	* Waqa-Sakiti, H. (2009) Two endemic and rare stick insects from the Nakauvadra Ranges, Fiji. <i>MelanesianGeo</i> , 7: 38.	Melanesian Geo Publications	<a href="http://www.melanesiangeo.org/">http://www.melanesiangeo.org/</a>	Free
Popular magazine	* Waqa-Sakiti, H. (2007) Entomolgy work in Fiji: how much do we really know? <i>MelanesianGeo</i> , 5: 24-25.	Melanesian Geo Publications	<a href="http://www.melanesiangeo.org/">http://www.melanesiangeo.org/</a>	Free
Popular magazine	* Prasad, S.R., Lal, S., Caginitoba, A & Olson, D. (2007) First steps: longhorned beetles of Fiji. <i>MelanesianGeo</i> , 5: 26-28.	Melanesian Geo Publications	<a href="http://www.melanesiangeo.org/">http://www.melanesiangeo.org/</a>	Free

### 3.4 Progress towards the project purpose and outcomes

#### Output 1: Training staff

Fiji staff continue to receive in-service training by the Senior Curator (Hilda Waqa) in the essentials of entomology, insect identification and collection curation techniques. Hilda visited the Smithsonian Institute in Washington DC for two weeks of training in the taxonomy of long-horn beetles (Cerambycidae) (the focus of her PhD studies) under the supervision of Dr Steve Lingafelter.

#### Output 2: Insect surveys

Surveys covering 15 separate sites on 6 major islands and 9 sites on smaller islands in the Lau group have now taken place, producing 16, 855 specimens, of which 11,107 have been sorted at least to Order or Family level, mounted and stored. Further identification is being achieved by sending material to international experts in particular taxonomic groups.

### **Output 3: Insect collection**

The Fiji National Insect Collection (FNIC) has been significantly enhanced. It currently comprises 72 cabinet drawers, although the total will rise further by the end of the project. Specimens are arranged by order then family with a museum-standard labelling system in operation.

### **Output 4: Database of survey information**

All specimen data are being entered into Excel spreadsheets for eventual transfer into a fully relational collections database for maximal flexibility in information retrieval. This will store the metadata associated with the specimens, but also supplementary material such as images and relevant literature.

### **Output 5: Outreach activities**

The Darwin team has been working on a pamphlet for dissemination to school children on the diversity of insects in Fiji and their significance. Relevant experts in the different insect groups have kindly sent good quality images and information on endemism, their distribution in Fiji and any other significance which will be incorporated into the text. Viliame Cegumalua (USP) has been working on the design and layout of the pamphlet.

Field surveys provide the opportunity for environmental education and conservation awareness activities in local village communities as part of the process of gaining permission to work and collect specimens on their land. The process of getting permission from the village elders ("Sevusevu" ceremonies) is normally done on the first day of the survey, followed up with reporting back on the final day. Considerable time needs to be set aside for such ceremonies, so that villagers can ask questions about the work being done and its significance. There is usually a lot of discussion because most local people are not aware of the diversity and the high endemism of insects in Fiji, the significance of insects to ecosystem functioning and their use as indicators of ecosystem health. The above pamphlet will be especially valuable in this context for distribution to grassroots village landowners.

A website linked to the Institute of Applied Sciences, USP, has been created by Hilda Waqa, Ron Vave and Viliame Cegumalua. This highlights the aims and objectives of the project, describes the methodology and provides some initial results. See: <http://www.usp.ac.fj/index.php?id=7040>.

## **3.5 Progress towards impact on biodiversity, sustainable use or equitable sharing of biodiversity benefits**

As reported in last year's Annual Report, a measurable impact on biodiversity was achieved early in the project through the addition of the longhorn beetle genus *Xixuthrus* to Schedule 2 of the Fiji Endangered and Protected Species (EPS) list, affording it some degree of protection. This was the first step in getting the genus accepted for IUCN Red Data Book status. We are hopeful that current ecological work on the endangered Fijian swallowtail butterfly, *Papilio schmeltzii*, will enable us to construct an action plan for its conservation within the Fiji Islands.

#### **4. Monitoring, evaluation and lessons**

We will use successful completion of the activities listed above to monitor progress on the project. The number of field surveys (already exceeding the original target), specimens identified and curated, and databases created/enhanced can all be quantified. Training is a more difficult output to evaluate since it cannot be measured simply in terms of the number of people receiving training for specified periods. Accordingly, we will monitor learning progress by including tests at the end of each training workshop, to assess the success of the workshop, provide feedback to trainees on their progress and to inform the planning of future workshops.

Ultimately, success will be judged against meeting the specified outcomes, but the wider objective (project purpose) will be judged against our success in building local capacity in insect identification, survey and monitoring.

#### **5. Actions taken in response to previous reviews (if applicable)**

The three actions recommended by the reviewer of last year's Annual Report were all dealt with in a note attached to the last half-year report: (i) provide copy of the guide *Butterflies of the Fiji Islands*; (ii) propose a response to the challenge of identifying potential senior Fijian staff for UK-based training; (iii) consider options for raising the profile of current DI projects via the USP website. A copy of the butterfly guide was provided and we have created a website specifically for the project.

We have had extensive discussions about bringing senior Fiji staff to the UK for training. We concluded that there were not enough suitably qualified and experienced personnel available in Fiji to take full advantage of the opportunity of coming to the UK for in-depth training. Whilst such visits do still remain a possibility for the remaining 12 months of the project, we have concluded that, in the circumstances, UK experts visiting Fiji is probably a better way to have an impact on a greater number of trainees.

#### **6. Other comments on progress not covered elsewhere**

We have had some difficulty in finding suitably qualified taxonomic experts to run training workshops in Fiji. One problem is that those who work in British museums are not necessarily in a position to spend extended periods abroad on such an exercise as part of their employment unless it also generates useful material for their institution's collection. Where possible, we have sought to use this to the mutual benefit of trainer and trainee as well as both the Fiji and UK collections. We are pleased to report that a workshop on scale insects (a very important but greatly understudied group in Fiji) will now take place in June 2009, and we are in advanced stages of planning a further workshop on beetles, focusing on families not covered in detail by the previous workshop.

We have experienced some logistic problems during the surveys, particularly loss of traps that have been left in the field for extended periods (up to two months in the case of Malaise traps). A trap on Taveuni was removed whilst another on the isolated island of Nayau could not be retrieved because of communication difficulties with the guides who were looking after it. In the former case, the trap will be replaced but we will do this in collaboration with the National Trust who is managing the Forest Reserve at Bouma so as to ensure that traps left in the field are not damaged or removed.

## 7. Sustainability

The profile of the project has been raised by the presence of the new website. This has generated considerable interest from amongst members of USP and the wider conservation NGO network within Fiji. One manifestation of this has been interest in the planned workshops, especially amongst the applied entomology sector. The articles in *Melanesian Geo* have attracted considerable interest and more are planned for the future. Participation in USP's annual Open Day exposes the project to the many visiting school children who may become interested in biodiversity conservation issues as a result.

We are confident that the project outputs, especially in terms of training the next generation of entomologists and the development of the Fiji National Insect Collection will provide a lasting legacy of the project. Being housed within USP will help to ensure long-term security and protection of the collection.

## 8. Dissemination

Dissemination activities are listed in section 3.1 (j) above.

## 9. Project Expenditure

**Table 3 Project expenditure during the reporting period  
(Defra Financial Year: 1 April 2008 to 31 March 2009)**

Item	Budget	Expenditure	Balance
Rent, rates, heating, overheads etc			
Office costs (eg postage, telephone, stationery)			
Travel and subsistence			
Printing			
Conferences, seminars, etc			
Capital items/equipment			
Others –Training Materials			
Others – Specimen Shipments			
Other – Entomological Equipment			
Other – Lab + Field Consumables			
Other- Museum Gallery			
Salaries Alan Stewart			
Salaries Dave Pritcher			
Salaries Hilda Waqa			
Salaries C Tokasaya			
Salaries Maria Naula			
TOTAL			

Budget based on agreed carry-forward of £52,000 to 2009/2010 (see email from Eilidh Young, 20<sup>th</sup> Mar 2009). £11,784 reallocated to creation of Darwin Initiative gallery in Fiji Museum (see email from Eilidh Young, 16<sup>th</sup> January 2009).

**10. OPTIONAL: Outstanding achievements of your project during the reporting period (300-400 words maximum). This section may be used for publicity purposes**

The rediscovery of two species of stick insect (Phasmidae) after more than 100 years is remarkable given the size of these impressive insects. It demonstrates that there are probably many more rediscoveries of rare previously-described species, as well as discoveries of new species, to be made in Fiji, even within orders of large and obvious insects such as phasmids.

Further information and photographs (e.g. in Annex 3) can be obtained from Ms Hilda Waqa (waqa\_h@yahoo.com).

## Annex 1 Report of progress and achievements against Logical Framework for Financial Year: 2008/09

Project summary	Measurable Indicators	Progress and Achievements April 2008 - March 2009	Actions required/planned for next period
<p><b>Goal:</b> <i>To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but constrained in resources to achieve</i></p> <p><i>The conservation of biological diversity,</i></p> <p><i>The sustainable use of its components, and</i></p> <p><i>The fair and equitable sharing of the benefits arising out of the utilisation of genetic resources</i></p>			
<p>Purpose</p> <p>Within-country expertise in entomology to be developed, to enhance biodiversity conservation activity and allow stakeholders to meet their responsibilities under the Fiji Biodiversity Strategy and Action Plan.</p>	<p>Skills tests at start and end of project, plus at intervals during project to assess training needs.</p> <p>Extent &amp; quality of data; incorporation of data into local conservation plans.</p> <p>Establishment of in-country insect collection; number of specimens fully processed.</p> <p>Awareness of insect conservation in schools and wider community; level of media coverage (radio, newspapers).</p>	<p>16,855 specimens collected with associated data.</p> <p>Insect collection expanded at USP; 5,202 specimens identified.</p>	<p>Regular assessments of skills development in team</p> <p>4 insect surveys on 3 island groups planned for next year</p> <p>Further expansion of insect collection, based on specimens from surveys</p> <p>Outreach and environmental education activities in villages; dissemination of project outputs through local &amp; national media</p>
<p>Output 1. 11 trained staff (3 senior curators, 3 support technicians; 5 parataxonomists).</p>	<p>Assessment reports on trained personnel from project partners.</p>	<p>Full project team is in place, each contributing varying percentages of time to the project, although some have left to return to previous positions or take up new posts after having been trained. 1 senior curator receiving on-going training; attempts to find other staff at this level unsuccessful so far.</p>	
<p>Activity 1.1 UK training of 3 Fijian nationals as senior curators.</p>		<p>None taken place during this reporting period due to no suitably senior staff available; discussions have suggested that alternative solution would be for training to concentrate on UK experts running workshops in Fiji, thus reaching a wider Fijian trainee audience.</p>	



Activity 1.2 In-country training by 2 UK experts for 11 Fijians.		None taken place during this reporting period; at least 2 in-country workshops planned for next/final year.
Output 2. Insect survey information for 14 locations in Fiji.	Surveys completed; specimens deposited in collections; database on insect distributions	
Activity 2.1. Insect surveys of 14 Fiji Islands sites, conducted by Fijian staff.		15 sites surveyed on 6 major islands (or island groups) and 9 sites on smaller islands in the Lau group. A further 4 sites across 3 island groups targeted for survey in next year.
Activity 2.2. Sorting, curation and cataloguing of specimens. Assistance given by UK experts on in-country basis.		Over 65% of all collected material has been sorted to order or family level, mounted, labelled and catalogued. UK experts providing direct assistance with checking identifications and access to personal worldwide networks of taxonomist contacts, both remotely and when in Fiji.
Output 3. In-country insect collection.	Extent and quality of collection.	16,855 specimens collected, of which 5,202 already deposited in newly established Fiji National Insect Collection (FNIC). Voucher material of all species sent for verification to appropriate taxonomic experts with knowledge of Fijian fauna. Coleoptera: all specimens to be sent to NHM for expert identification/verification in exchange for voucher set of any duplicates retained by NHM.
Output 4. Database of insects within collection.	Proportion of insect collection identified to specified taxonomic levels.	Information on specimens currently held in Excel spreadsheets, ultimately to be incorporated into fully relational database for maximal flexibility in reporting. Full metadata recorded for all surveys. Database software options being evaluated (training will be required in system adopted). Image database (specimens, sites) under discussion.
Output 5. Outreach activities to schools, communities etc.	Number of schools, communities etc visited; demand for extra information.	Environmental awareness raising activities in villages hosting surveys. Pamphlet planned on insect diversity and endemism in Fiji for distribution to schools, villages etc. Considerable interest raised in training in entomology, ecology and conservation through: <i>Butterflies of the Fiji Islands</i> guide; USP annual Open Day; USP courses such as Diploma in Protected Area Management and the Pacific Islands Community-based Conservation Course.

## Annex 2 Project's full current logframe

Project summary	Measurable Indicators	Means of verification	Important Assumptions
<p>Goal: To draw on expertise relevant to biodiversity from within the United Kingdom to work with local partners in countries rich in biodiversity but poor in resources to achieve the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of benefits arising out of the utilisation of genetic resources</p>			
<p>Purpose</p> <p>Within-country expertise in entomology to be developed, to enhance biodiversity conservation activity and allow stakeholders to meet their responsibilities under the Fiji Biodiversity Strategy and Action Plan.</p> <p>N.B. Change to single purpose as requested in response letter to Stage 1 application.</p>	<p>Skills tests at start and end of project, plus at intervals during project to assess training needs.</p>	<p>Fijian nationals trained as senior curators (3), support technicians (3) and parataxonomists (5).</p>	<p>Suitably motivated people available; UK experts available to run intensive training courses.</p>
	<p>Extent &amp; quality of data; incorporation of data into local conservation plans.</p>	<p>Survey reports; site assessments; statements on species of conservation concern.</p>	<p>Access permitted to sites; adequate spatial and temporal coverage of surveys.</p>
	<p>Establishment of in-country insect collection; number of specimens fully processed.</p>	<p>Database of specimens held at USP; metadata made available through web page.</p>	<p>UK support for identification is available.</p>
	<p>Awareness of insect conservation in schools and wider community; level of media coverage (radio, newspapers).</p>	<p>Environmental lectures and workshops for schools, communities; educational leaflets; media coverage.</p>	<p>Knowledgeable staff can be trained for outreach work; schools, communities etc are receptive to environmental issues.</p>
<p>Outputs</p> <p>1. 11 trained staff (3 senior curators, 3 support technicians; 5 parataxonomists).</p>	<p>Assessment reports on trained personnel from project partners.</p>	<p>11 Fiji nationals trained as entomologists.</p>	<p>Dedicated people exist in Fiji to fill such posts; UK experts available to do training.</p>
<p>2. Insect survey information for 14 locations in Fiji.</p>	<p>Surveys completed; specimens deposited in collections; database on insect distributions</p>	<p>Survey reports; publications in appropriate journals</p>	<p>Intensity of sampling program sufficient; access to islands gained</p>
<p>3. In-country insect collection.</p>	<p>Extent and quality of collection.</p>	<p>Substantial insect collection held in a safe location.</p>	<p>Time available to collect, sort and curate collection.</p>
<p>4. Database of insects within collection.</p>	<p>Proportion of insect collection identified to specified taxonomic levels.</p>	<p>Database of collection; identifications confirmed by experts.</p>	<p>Time available to conduct identification to appropriate taxonomic level.</p>
<p>5. Outreach activities to</p>	<p>Number of schools,</p>	<p>Reports provided by</p>	<p>Schools, communities</p>

schools, communities etc.	communities etc visited; demand for extra information.	schools and participants.	etc willing to participate.
<b>Activities</b> 1. Training	<b>Activity milestones</b> Yr1: UK training of 3 Fijian nationals as senior curators. In-country training by 2 UK experts for 11 Fijians. Yr2: UK training of 3 Fijians as technicians. In-country training by 2 UK experts for 11 Fijians. Yr 3: In-country training by 2 UK experts for 11 Fijians.		<b>Assumptions</b>
2. Sampling/survey	Yrs 1, 2, 3: Insect surveys of 10 Fiji Islands, conducted by Fijian staff.		
3. Sorting and Identification	Yrs 1, 2, 3: Sorting, curation and cataloguing of specimens. Assistance given by UK experts on in-country basis.		
4. Outreach	Yrs 2 & 3: School, community visits to engender interest in entomology.		

## Annex 3 Tables

**Annex Table 1: Members of the Darwin project team during the reporting period.**

Name	Position & Roles	Starting Date	% time on project
1. Hilda Waqa	Project Co-ordinator	September, 2006-ongoing	100%
2. Tokasaya Cakacaka	Lab assistant- Fieldwork and curation	March 2008-ongoing	100%
3. Apaitia Liga	Lab assistant- Curation of specimens and databasing	Feb 2008-ongoing	100%
4. Presly Dovo	Technician- Fieldwork and curation	Jan- Dec, 2008	100%
5. Visheshni Chandra	Graduate assistant	Dec 2008-ongoing	80%
6. Alivereti Naikatini	Technician- Fieldwork and Plant identification	Jan 2008-ongoing	40%
7. Anare Caucau	Technician- Curation of specimens	Feb- Jun 2008	20%
8. Francis Wise	Technician- Curation of specimens	Feb- Jun 2008	20%
9. Vido	Parataxonomist- Fieldwork and Plant identification	Jun 2008-ongoing	20%

**Annex Table 2: Numbers of insect specimens sampled:**

Insect orders: Col: Coleoptera; Lep: Lepidoptera; Hem: Hemiptera; Hym: Hymenoptera; Dip: Diptera; Orth: Orthoptera; Other: Other orders

Island	Location	Date surveyed	Number of specimens in insect orders							Total
			Col	Lep	Hem	Hym	Dip	Orth	Other	
Viti Levu	Savura	05.iv.08	353	0	16	57	63	27	2	518
Viti Levu	Serea	08.v.08	193	0	5	73	0	577	0	848
Viti Levu	Nakavu	05.v.08	127	0	26	34	244	53	3	487
Viti Levu	Vaturu	10.vii.08	238	0	143	147	69	122	10	729
Viti Levu	Nakauvadra	20.ix.08	115	24	5	68	0	0	5	217
Viti Levu	Monasavu Dam	02.xi.06	1918	3	31	79	0	0	0	2031
Viti Levu	Naitasiri	23.vii.07	605	0	0	0	0	0	0	605
Viti Levu	Namosi	22.x.07	759	0	0	0	0	0	0	759
Viti Levu	Ba	23.ii.07	0	3	0	0	0	0	0	3
Vanua Levu	Driti	01.iv.08	338	0	28	71	0	259	5	701
Vanua Levu	Loa	05.iv.08	40	1	12	14	0	28	1	96
Vanua Levu	Natewa	05.iv.08	445	0	17	29	0	66	0	557
Vanua Levu	Buca Bay	05.iv.08	0	0	0	0	0	0	0	0
Taveuni	Ravilevu	12.xii.07	301	2	140	121	277	32	14	887
Kadavu	Solodamu	22.iii.08	783	4	152	52	48	162	9	1210
Vanuabalavu	Daliconi	21.xii.07	0	10	4	0	75	2	0	91
Vanuabalavu	Boitaci	29.xii.07	0	2	7	2	0	0	0	11
Vanuabalavu	Namalata	22.xii.07	8	5	64	67	0	10	12	166
Ovalau	Viro	19.ii.08	373	0	152	99	113	141	7	885
Central Lau	Komo/Driki	15.viii.08	0	0	0	0	0	0	0	0
Central Lau	Cicia	13.viii.08	131	0	59	86	0	0	0	276
Lau Group	Sovu	19.ix.07	0	3	0	0	0	0	0	3
Lau Group	Cikobia	18.ix.07	0	2	0	0	0	0	0	2
Lau Group	Lakeba	09.ix.08	0	17	0	0	0	0	0	17
Lau Group	Nayau	17.ix.08	0	5	0	0	0	0	0	5
Lau Group	Kanacea	19.ix.07	0	1	0	0	0	0	0	1
Lau Group	Tuvuca	24.ix.07	0	1	0	0	0	0	0	1
Lau Group	Kibobo	16.ix.07	0	1	0	0	0	0	0	1
<b>TOTAL</b>			<b>6727</b>	<b>84</b>	<b>861</b>	<b>999</b>	<b>889</b>	<b>1479</b>	<b>68</b>	<b>11107</b>

**Annex Table 3      Surveys planned for reporting year 2009/2010:**

All surveys will include: Malaise traps; flight interception traps; butterfly collection; leaf litter sampling; active searching.

Island	Locations/sites	Dates to be surveyed	Notes
Koro	Nacamaki & Mudu	June, 09	
S.Lau	Vatoa/Ono-i-Lau	July, 09	
Yasawa	Nacula	Aug, 09	
Taveuni	Mt. Devo	Sept, 09	Repeat of 2008 survey, which was abandoned due to bad weather

## Annex 4 Photo gallery



**Figure 1:** *Nisyrys spinulosus* (Phasmida) found in survey of Nakauvadra Ranges, the first record since 1877.



**Figure 2:** *Phasmotaenia inermis* found in survey of Nakauvadra Ranges, the first record since 1908.



**Figure 3:** Exposed timber baits suspended in the forest canopy for colonisation by wood-boring beetles.



**Figure 4:** Insect-rearing 'sleeve cages' used for rearing wood-boring beetles out of pre-exposed timber baits.



**Figure 6:** *P. schmeltzii* larva on *Citrus reticulata* plant.

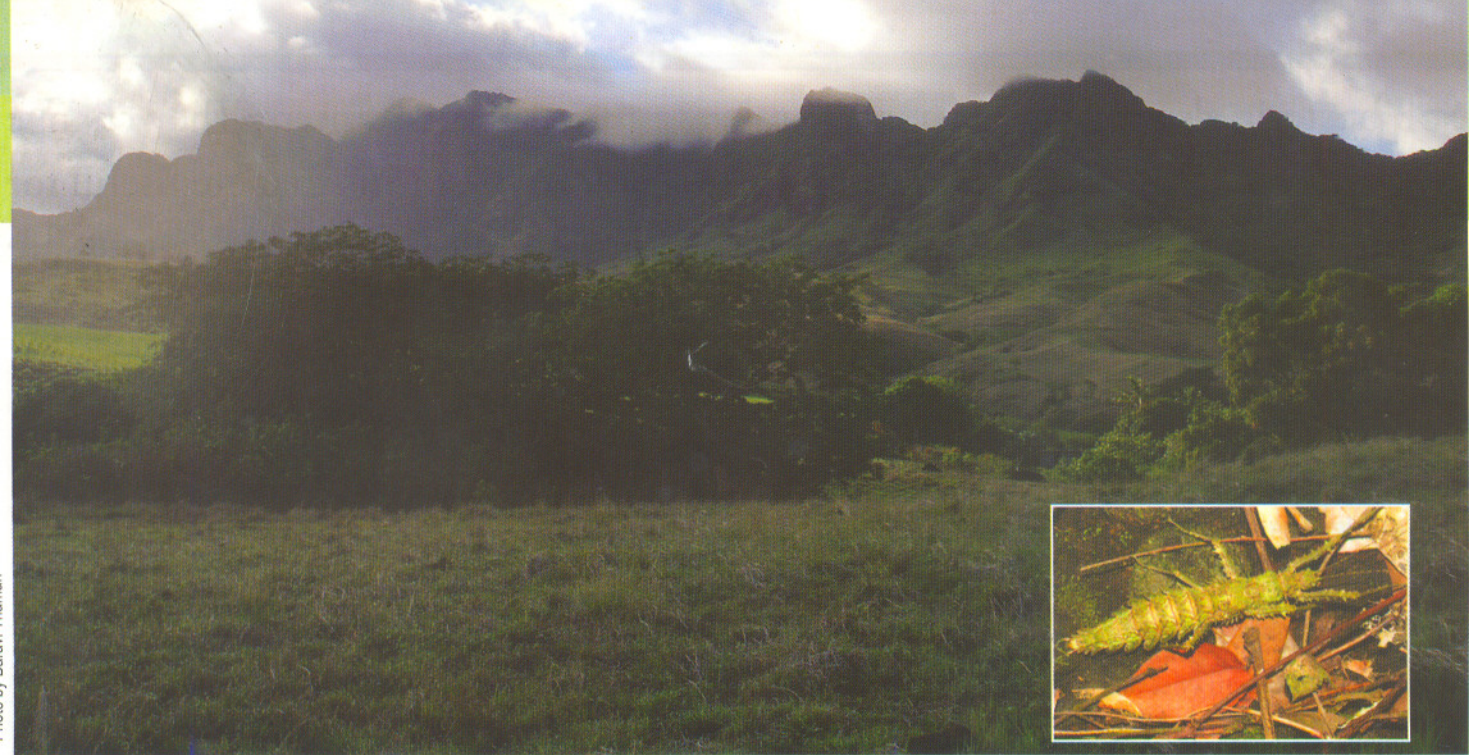


**Figure 5:** Known distribution of *P. schmeltzii* across the Fiji Islands. 'Known records' refer to those by Dr Gaden Robinson (1975). 'New records' refer to current project.

## **Annex 4: Articles from *Melanesian Geo* magazine**

1. Waqa-Sakiti, H. (2009) Two endemic and rare stick insects from the Nakauvadra Ranges, Fiji. *Melanesian Geo* 7: 38.
2. Waqa-Sakiti, H. (2007) Entomolgy work in Fiji: how much do we really know? *Melanesian Geo*, 5: 24-25.
3. Prasad, S.R., Lal, S., Caginitoba, A & Olson, D. (2007) First steps: longhorned beetles of Fiji. *Melanesian Geo*, 5: 26-28.





## Two Endemic, Rare and Possibly Endangered Stick Insects from the Nakauvadra Ranges, Viti Levu, Fiji Islands.

by Hilda Waqa-Sokiti

The Nakauvadra mountains are located on the northern side of Viti Levu and south of Rakiraki, Fiji. The Nakauvadra ranges run parallel to the coast about 7km inland with the highest elevation reaching 866m a.s.l. The range comprises of andesitic rocks and formed from the eroded rim of the large Rakiraki volcano.

A 10 day biodiversity survey within the Nakauvadra ranges was conducted. In fact, no entomological survey has been previously conducted or recorded from this area. This survey presented a significant discovery of two stick insects known to be very rare and endemic to the Fiji islands: *Nisyryus spinulosus* (syn. *Cotylosoma*) and *Phasmotaenia inermis* (syn. *Hermarchus*) with virtually nothing else known about them. The isolation of the forest system, hence the insect fauna, due to the high mountain ranges separating it from neighboring forest systems and grasslands, explains much of the uniqueness and great diversity of insects from Nakauvadra.

Unique entomological finds from Nakauvadra were mainly from the order Phasmatodea commonly known as the stick insects and 'ucikau' in Fijian which literally means resembling a stick. One in particular is the female of *Nisyryus spinulosus* (syn. *Cotylosoma*). This species was first described in 1877. Interestingly, nothing is known about *N. spinulosus* except that it is endemic to the Fiji islands and distributions are also unknown. This find would be a first record for the Nakauvadra ranges. The significance of this phasmid is its amazing body shape (i.e. cupped body, thought to have enabled it to cling to the side of rocks), thus when a species belonging to the same genus (*Cotylosoma dipneusticum*) was first described from a specimen at the Natural History Museum in London, it was described as being semi-aquatic (i.e. having the capacity for dual breathing system in both water and land). However, this was later confirmed to be false and considered a myth. This particular stick insect was found well

The Nakauvadra ranges (top) run parallel to the coast about 7km inland with the highest elevation reaching 866m a.s.l. Two new species of stick insects *Nisyryus spinulosus* (above insert), and *Phasmotaenia inermis* (above) from the Nakauvadra ranges.

camouflaged to the bark of the native dakua tree (*Agathis macrophylla*) having approximately 30cm dbh covered with lichens.

Another unique find was a female of *Phasmotaenia inermis* (syn. *Hermarchus*) first described in 1908. This species is an island endemic to Viti Levu and so far only been recorded from Korovou, Baulevu and Nadarivatu, thus this is also a first record from the Nakauvadra ranges. Also, virtually nothing is known about this species.

These rare, endemic and possibly endangered stick insects should be monitored further to ascertain population numbers, local distribution patterns and seasonality patterns in order to aid in the development of appropriate conservation and protection strategies before these species are lost to the future generations of the Nakauvadra people.



# Entomology work in Fiji

## How much do we really know?

by Hilda Waqa-Sakiti

Fiji's arthropod fauna has received scant attention as there is little current comprehensive information published. For the few major groups documented, most are more than 50 years old and in need of revision. In Fiji, currently most entomological research concentrates primarily on economically important insect pests and less on the study of insect biodiversity, ecology and its conservation needs. For Fiji and other Pacific islands, habitat loss (effectively forest loss) remains the most serious threat to the endemic fauna and flora. Virtually all the lowland areas have seen deforestation of some kind with only small pockets of native fauna and flora remaining in protected areas. Therefore there exists a need to document Fiji's unique fauna before they are lost.

The most diverse group under the Class Insecta is in the Order Coleoptera (meaning sheath wings), commonly known as beetles and there are more

than 300,000 currently named species worldwide. The success of beetles is attributed to the capacity for complete metamorphosis, having elytra (a hard cover or protective shield that covers the soft body beneath) and the presence of mouthparts designed for chewing abundant solid foods. They also show exceptionally diverse adaptations to very different environments and habitats, exploit the most varied types of food and use all possible methods of locomotion. Beetles range in size from one millimetre to 200 mm.

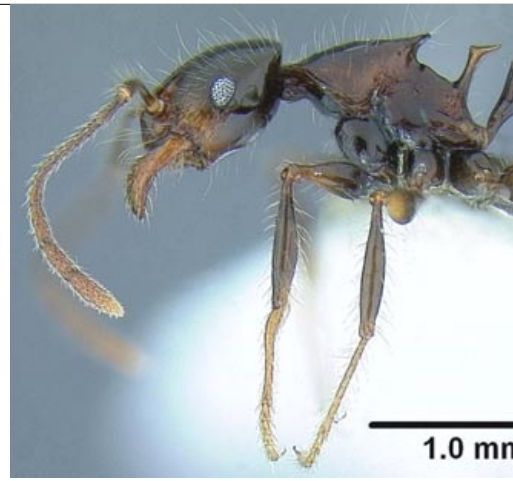
Beetles are of great importance in ecosystems. Because of their great diversity, beetles have the largest biomass compared to all other living animals on earth. Therefore, they play an important role to other animals by being at the bottom of food chains and therefore providing food and energy. They allow for

the recycling of vegetation mainly through decomposition and herbivory, and also act as pollinators. Also recently, some invertebrates (including butterflies, ants and beetles) have been

recognized as important indicators of "forest health".

Beetles are also known to have significance with the Fijian culture. Fijian tribes closely identify themselves with animals and plants in their environment, resulting in the adoption of totems. A good example is in the province of Namosi where the cerambycid (long-horn) larva ('yavato' in Fijian) is considered to be sacred and solely for the consumption by their traditional high chief. Other Fijians in the provinces of Naitasiri, Tailevu, Serua and Lau groups also consume these 'yavato' as they provide a rich source of protein to their daily diet. The 'yavato' is also used by Fijians as baits, particularly for catching eels.

One particular species in the beetle family Cerambycidae (longhorns) that has captivated global interest is the *Xixuthrus heros*. This species is endemic to Fiji (recorded from Viti Levu, Vanua Levu and Taveuni) and is possibly endangered. It has been reported to be the worlds'



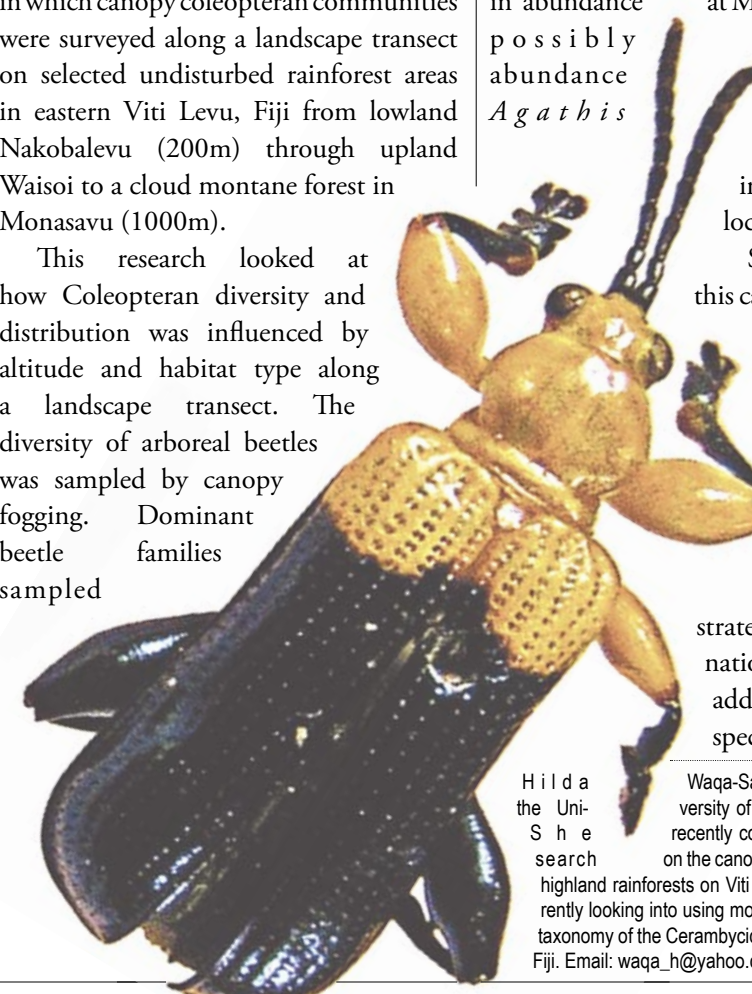
second largest beetle at a massive length of 14-15 cm.

Unfortunately for Fiji and many other Pacific Island countries, the taxonomy, biology and ecology of insects are relatively unknown mainly due to the lack of expertise in this area thus important biodiversity and conservation measures for these unique taxa among our islands will be impossible. In Fiji, virtually no studies of this type have been done. However, a recent study was conducted by the author, in which canopy coleopteran communities were surveyed along a landscape transect on selected undisturbed rainforest areas in eastern Viti Levu, Fiji from lowland Nakobalevu (200m) through upland Waisoi to a cloud montane forest in Monasavu (1000m).

This research looked at how Coleopteran diversity and distribution was influenced by altitude and habitat type along a landscape transect. The diversity of arboreal beetles was sampled by canopy fogging. Dominant beetle families sampled

from the canopy included: Curculionidae (weevils), Chrysomelidae (leaf beetles) and Staphylinidae (rove beetles) and it is probable that this reflects their wide range of feeding habits and exploitation of rainforest habitats. Furthermore, diversity measures revealed a peak at mid-to-high altitude (800-1000m in Monasavu) for the beetle taxa. Plant-host associations with some beetle taxa were also probably evident particularly in the Family Curculionidae which demonstrated a peak in abundance at Monasavu (1000m) possibly due to the abundance of native *Agathis macrophylla* ('dakua makadre' in Fijian) at this location.

Studies such as this can provide further knowledge for these diverse, unique yet understudied taxa so that conservation and management strategies at the national level maybe addressed more specifically.



Hilda Waqa-Sakiti is a PhD student at the University of the South Pacific, Suva. She recently completed her Masters research on the canopy Coleoptera of lowland-highland rainforests on Viti Levu Island. She is currently looking into using molecular tools to clarify the taxonomy of the Cerambycidae (Longhorn beetles) of Fiji. Email: waqa\_h@yahoo.com

Page 24. Bottom left: A 10 m x 10 m sampling quadrat at Monasavu, Viti Levu Island, Fiji. Top: A brentid beetle. Centre: A curculionid (weevil). This page. Left: A chrysomelid (leaf beetle). Top left: *Pheidole colaensis* - endemic to Fiji. (Photo: Eli Sarnat.) Top centre: A damselfly, *Nesobasis* sp. This genus is endemic to Fiji. (Photo: Isaac Rounds). Top: A light trap - targets night flying insects. (Photo: Isaac Rounds). Above: The canopy fogging technique that was employed in the surveys.





# First Steps

## Longhorned beetles of Fiji

By Sunil R. Prasad, Sanjana Lal, Akanisi Caginitoba, & David Olson

**F**iji is home to three species of Longhorned beetles: *Xixuthrus heros*, *X. ganglbaueri* and *X. terribilis* (a Taveuni endemic). After much confusion regarding the taxonomy of the beetles these three names have been decided to identify the longhorns. Reaching a goliath size of 140 mm, the longhorn beetle holds the title of world's second longest beetle, only out-competed by the South American Longhorn beetle *Titanus giganteus* that measures up to 170 mm.

The distribution of the *Xixuthrus* beetles is restricted to the three main island; Viti Levu, Vanua Levu and Taveuni. *Xixuthrus ganglbaueri* and *X. heros* are known from Viti Levu only, while *X. terribilis* is known from specimens from Taveuni and Vanua Levu. Judging from their flight capacity, the distance between the closest point of Taveuni and Vanua Levu (Natewa Peninsula with adjacent forests) can be easily conquered by *X. terribilis*. The adults have to be powerful flyers in order to journey long distance to find mate through pheromones attraction. Some villagers describe the lumbering and awkward flight of the adults resembling “B52s buzzing around and smashing into things”. Simmonds in 1964 ingeniously described the *Xixuthrus* beetles in his article as “my weapons had wings”.

When handled, the adults make a warning sound by rubbing the posterior

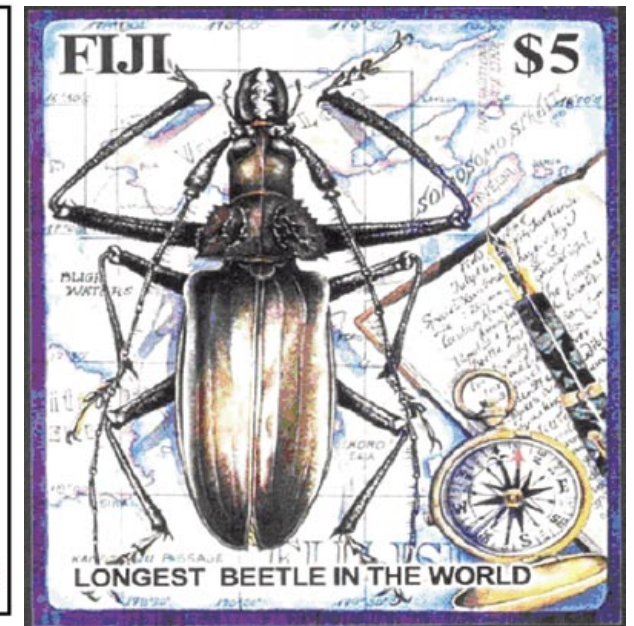
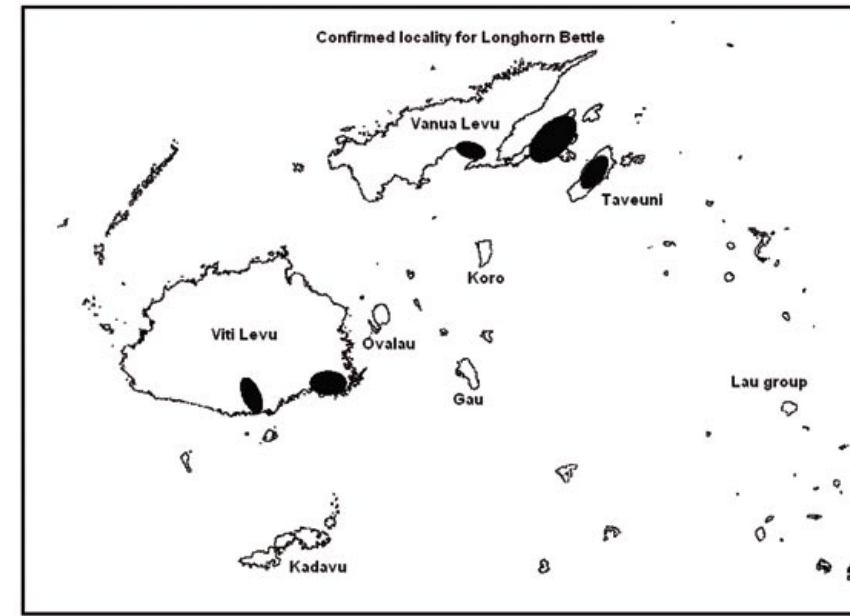


wing ribs against the edge of the anterior wings. This is a way of communicating with other individuals. These *Xixuthrus* beetles have been erroneously described by some as being extinct. They are very however, rare and are vulnerable to extinction. The Wildlife Conservation Society (WCS) recently conducted a reward-based population survey across Fiji for 24 months, during which only six specimens were collected. The lack of conservation measures and paucity in biological information will most likely lead to the extinction of these rare beetles.

### Reproduction

The adults are attracted to lights and sometimes come towards human habitation; however in its natural range they should occur near coastal forest where water-logged decomposing trees are abundant. This is vital for the larva as moisture is needed for unrestricted growth and for easy excavation of burrows within the logs.

Olfactory glands situated in the antennae are used for attracting potential mates and it is anticipated that this works over long distance. Most Prioninae copulate at night or late in the day, and it is believed that the *Xixuthrus* beetles also follow this rule of thumb. The mating ritual could be very dramatic as male-male confrontation



can arise and might lead to the demise of one individual, since the adults have very heavy armour with spines and they possess mighty jaws. After much exhaustion from mating rituals,

and it stays in this stage for about 11 months. During this stage the pupae blocks the rear passage of the tunnel using its fecal matter. This keeps the front of the passage clear and clean

by the authors in captivity for as long as one and a half months without food but with water.

### Threats

The main threat to the *Xixuthrus* beetles and probably other biota is the loss of large tracts of primary rainforest. *Xixuthrus* beetle larvae are believed to help in the eventual degradation of large fallen trees, thus playing a pivotal role in the cycling of the forest nutrients.

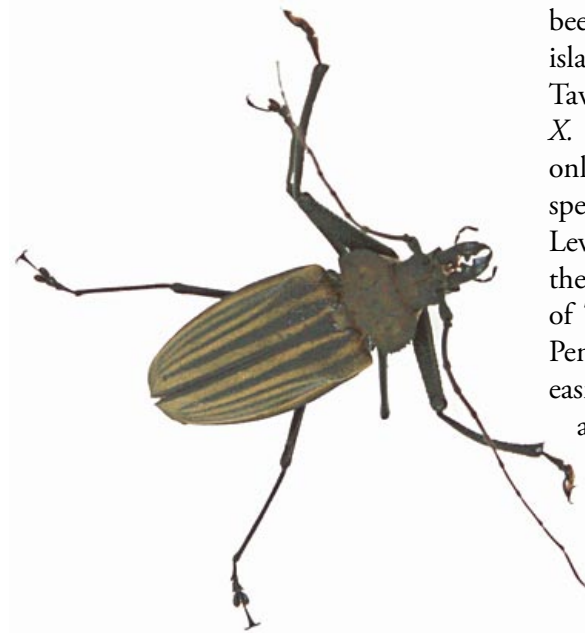
the female would deposit her eggs in a host tree and may mate again. Host specificity is thought to be very strong in the *Xixuthrus* beetles, and suspected trees include *Mako Trichospermum richii*, *Kaudamu Myristica castaneifolia*, *Vota* or *Vure Geissois* spp, and *Bau Palaquiu fidjense*.

A pupa develops once the egg is laid

for eating, and makes a network of tunnels. Blocking the rear passage of the tunnel has its advantages as well; the larvae remain protected from external environmental changes and predators.

Very little is known about the natural longevity of the *Xixuthrus* beetles however they have been kept

Deforestation, invasive species, harvesting from the wild for food (grubs) and trade (selling pinned adults to insect collectors) are the main threats for the *Xixuthrus* beetles. Dry pinned adults are in demand and prices as high as AUD\$100 have been quoted. Some sites have even listed *Xixuthrus* specimens for auction. To combat the



**Above:** *Xixuthrus* beetle. **Top:** Akanisi gladly volunteering to hold a live *Xixuthrus* specimen. **Page 27: Above left:** Map showing the confirmed localities where the *Xixuthrus* beetles have been found in Fiji. **Above right:** The new \$5 cover stamp with longhorn (wrongly labelled as the world's longest beetle). **Below:** Forest of Fiji and habitat of *Xixuthrus* beetles being altered by agriculture such as the planting of coconut plantations.





The main threat to the *Xixuthrus* beetles and probably other biota is the loss of large tracts of primary rainforest.

Left : *Xixuthrus* beetle and at right on Fiji two dollar stamp.



rise in demand for trade of the *Xixuthrus* beetles, the Ministry of Environment and the National Scientific Council of Fiji has recently decided to include the three species of the *Xixuthrus* beetles under Schedule Two of the Endangered and Protected Species Act. This will prevent the movement of the *Xixuthrus* beetles out of Fiji and hopefully will encourage the repatriation of specimens which are already out of the country.

The main threat to the *Xixuthrus* beetles and probably other biota is the loss of large tracts of primary rainforest. *Xixuthrus* beetle larvae are believed to help in the eventual degradation of large fallen trees, thus playing a pivotal role in the cycling of the forest nutrients. It is estimated that the larva spends about 10-12 years in the larval stage before metamorphosing and emerging as adults. The time scale is indicative of the low nutrient content of the logs, and because of the time scale the logs have to be big enough to sustain the larva for that period of time. Intact rainforests consequently provide a high

abundance of large rotting logs, which is essential for larval nurseries. The conversion of the *Xixuthrus* beetles habitat to plantations is probably a major factor in the decrease of huge logs, available to be used as larval nurseries. Therefore, forests with identified heritage trees are an important habitat for their conservation.

Invasive species such as *Felis catus* (feral cats), *Rattus rattus*, *Rattus exulans*, *Rattus norvegicus* (rats), and *Herpestes javanicus* (small Indian mongoose) are probable decimators of adult and larval populations of *Xixuthrus* beetles. The harvesting of the larval stage by locals for food is thought to contribute significantly to the decrease of the *Xixuthrus* beetles. To a smaller extent harvesting from the wild, especially the final stages may also have an impact on the dwindling population of the *Xixuthrus* beetles. Some researchers believe that harvesting from the wild for food has driven the decline of this species. The survey conducted by Wildlife Conservation Society also found that *Xixuthrus* beetles were absent from Gau island. Since Gau is one of the larger predator (invasive

species) free islands, this might indicate that the *Xixuthrus* beetles already have a limited range.

#### Conservation

Apart from being listed in the Endangered and Protected Species list for Fiji; there have been no major efforts to conserve the *Xixuthrus* species. This species may be "incidentally" present in a few reserves and un-logged areas such as Colo-i-Suva and surrounding intact areas on Viti Levu, the Waisali reserve and adjacent forested areas in Vanua Levu, and Bouma and Ravi Levu reserves on Taveuni Island.

For tribes in the province of Namosi (South-eastern Viti Levu) the Cerambycidae larvae, yavato, are considered sacred and its consumption is only reserved as a special treat for their traditional chief (Tui Namosi). The larvae are considered taboo in this region and destruction of the larvae or even verbally citing its name can be taken as an insult to their chief.

Sunil R. Prasad is working as an Entomology Research Assistant with the Biology Division, USP. The project 'Focus on Fiji: Insect inventories and research' is funded by the Darwin Initiative Project and as its latest project of raising the profile of the terrestrial arthropods, a "Field Guide to the Fijian Butterflies" is in preparation. Sanjana Lal is an entomologist at the Department of Forestry, Fiji government. She is a very experienced taxonomist and has assisted in the curation of the Forestry Department's insect specimen collection. Akanisi Caginitoba currently works for the Wildlife Conservation Society, based in Suva, Fiji, where David Olson was a former country program director. Together the authors have revived interest in research on the *Xixuthrus* beetle in Fiji.

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