JAMES RENNIE BEQUEST

REPORT ON EXPEDITION/PROJECT/CONFERENCE

Expedition/Project/Conference Title: Bolivia 2005 – A study on the effects of silvicultural intensity on the regeneration of above ground biomass in trees <10cm in diameter

Travel Dates: June 10th – August 20th 2005

Location: La Chonta Forest Concession, Ascension de Guarayos, Santa Cruz department, Bolivia

Group Member(s): Jacob O'Mahony, Helene Goddings, Andrew McKay, Alex Scott-Tonge, Holly Talbot and Ashton Erler

Aims: To investigate trends in the nature of AGB contained in trees <10 cm and to investigate how increasingly intensive silvicultural practices may affect the regeneration of this highly dynamic forestry component.
To contrast, compare, and evaluate through the use of socio-economic questioning, the differences in two forestry concessions working within Bolivia, with respect to their working practices and operations.
To quantify the effects of increasing silviculture practices on canopy coverage, in terms of Leaf Area Index, using hemispherical photography.

The original aims of Bolivia 2005 were to:
Determine the extent to which altered forests have regenerated to their original state, with above ground biomass being used as the marker of regeneration. Unfortunately due to political instability at the time of arrival, movement within Bolivia was limited. Therefore it was not possible to access the Carrasco national park and an alternative project was developed.

The aim of the adapted project was to fill a gap in scientific research by focusing on the growth and biomass of trees that would usually be ignored in large scale studies. This was achieved by focusing on the affect of using silvicultural treatments of varying intensities. The results of this work may aid foresters in Bolivia to maximise the regeneration of commercial forest stands, while also maintaining species diversity.

OUTCOME (not less than 300 words):-

Summary
The successful regeneration of commercial trees is essential for the livelihoods of Bolivian people and in order to maintain biodiversity and biological sustainability. Disturbance promotes diversity but excessive disturbance allows pioneers species to degrade the quality of forest stands. Silvicultural treatments are required and strongly promoted by monitoring agencies and NGOs, in Bolivia. Much research has dealt with the affect of silviculture on the regeneration of commercial species and in promoting biodiversity. This study does not find that there is any evidence to support the promotion of commercial species in regenerating forest stands. Moreover, there seems to be a null or detrimental effect on the diameter and height of trees experiencing levels of silvicultural intensity beyond current levels in trees <10cm DBH. This study also concludes that the different intensities of Silviculture management do not cause significant differences in leaf area index and canopy coverage between treatments.

We find that current estimations of the quantity of biomass contained in trees <10cm, are likely to be valid within Bolivia, but that further studies of heterogeneous forest types are required to full asses the nature of above ground biomass in trees <10cm DBH. The use of hemispherical photography to document and calculate canopy coverage is a successful technique and can be used within these forests to estimate regeneration rates of the canopy over a given time period.

Methods
The study was carried out at the La Chonta timber concession located in the Guarayos Forest Reserve (15º45'S, 62º60'W), Bolivia. The La Chonta forest is classified as tropical humid forest with a mean temperature of 25.3º C and rainfall of 1560 mm (Gil, 1997). Over 100 tree species have been identified with 18 tree species currently regarded as commercially valuable (BOLFOR, 2000). The study area within La Chonta is maintained by the Instituto Boliviano de Investigación Forestal (IBIF) and is composed of three sites each with four treatment blocks of an average of 27 hectares each. The treatments are shown in Appendix 3. (Information obtained from the La Chonta study plan provided by IBIF). The sites are considered homogeneous in their elevation and soil properties. The data was collected between June and July 2005.

The study worked under the standards out lined by the RAINFOR group for the sampling of tropical forest plots, for a comprehensive field protocol see http://www.geog.leeds.ac.uk/projects/rainfor/. A total area of between 0.92 and 1.32 hectares were sampled for each treatment, and were divided between the three sites. In each subplot a 100 meter by 4, 6, 9, or 12 meter transects was performed depending on the number of surveyors. Each tree within the transect was measured for diameter at breast height (1.30 metres). If the tree did not reach 1.30 metres or was not measurable at 1.30 metres, the point of measurement (POM) was recorded. A total of 10,611 trees were measured <10 cm DBH.

The height of every 10^{th} tree was recorded in each transect, 1131 trees in total. Trees were measured under the methods outlined in the RAINFOR protocol (Phillips & Baker 2002), where two independent observers calculate a mean value for the tree. The equation of Uhl (1987) was used to calculate above ground standing dry biomass in Kg m^2.

Results
The results show that any level of cutting intensity reduced biomass by a statistically significant figure. However, there did not appear to be any statistical differences in the magnitude of this reduction, and as all plots were cut at the same time there is no significant difference in the regeneration time following silvicultural intensity. The data would seem to indicate that no difference exists in diameter and height on the affect of intensity of treatment in Intensivo and Normale plots, although both are statistically reduced from Testigo values. The results show a clear reduction in the diameter and height of trees following Mejorado treatments, however this does not relate to a reduction in above ground biomass beyond that observed in the Intensivo and Normale treatments. The difference in the diameter and height of trees in the Mejorado vs. the Normale and Intensivo is conceivably due to the very high proportion of trees that were measured below 1.30 metres; 16.1% vs. 9.9% and 8.7% respectively (Table1). The fact that the Mejorado treatment has fewer trees than the Intensivo (Table 1), a reduced diameter and height, but maintains the same mean above ground biomass, indicates the important contribution to biomass dynamics that can be attributed to very small trees.

For detailed results and discussion and a socio-economic study of comparative Bolivian logging concessions, please refer to Bolivia 2005 Expedition Report.

Acknowledgements
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Many thanks from the whole team
9^{th} November 2005

Appendix 1
Financial Summary
The project received a total of £11,450 from 5 grants available to students of The University of Edinburgh. This amount was sufficient for the six-person research team to conduct a 10 week long research expedition.

Fund Contributions;

The Davis Fund (DF)	£5,000
The Alumni and Development, small project grants (SPG)	£2,050
The James Rennie Bequest (JRB)	£1,050
Weir fund (WF) (£1000 awarded to three team members)	£3,000
The University of Edinburgh Travel Awards (TA)	£ 350
Total	£11,450
Additional Personal contributions (PC)	£1,500
Combined total	£12,950

The following is a comprehensive break down of expedition expenditure with the relative contribution of each funding body.

Fund	**Item**	**Cost (£)**	**Comments**	**Negative cumulative total (£)12,950**
TA (£350) JRB (£1050 SPG (£2050) WF (£1650)	6 x Flights @ £850	5,100	TA and JRB are travel specific funds	9,350
WF (£540)	6 x Insurance	540		8,810
WF (£810) DF (£790)	Vehicle	1,600	from private owner	7,210
DF (£700)	Driver mechanic	700	Including gratuity	6,510
DF (£1008)	Research station	1,008	Charged for 8 people per day at £3 each	5,502
DF (£2502) PC (£168)	Food	2,688	8 people at 3 meals a day costing £8 each	2,814
PC (£240)	Medical equipment	240		2,574
PC (£504)	Guides	504	2 guides @ £6/day	2,070
PC (£600)	Fisheye lens and digital camera	600		1,440
PC(£198)	PDA computer	198		1,242
PC (£90)	Satellite phone	90	Rental	1,152
PC (£750)	Tents	750		402
PC (£200)	Replacement Chain Saw	200	Borrowed and Lost?	202
PC (£100)	Waterproof notebooks	100		101
PC (80)	Dry bags	80		21
PC (60)	Photographic development	60		-39
PC (25)	Production of final report	25	Estimate of cost to be incurred	-65
Final Total				**-£65**

The majority of receipts are available upon request although due to the nature of Bolivia, obtaining receipts was not always possible. Certain expenses that were incurred by the team before departure are not listed as these were written off as additional personal contribution.

Appendix 2
Travel Itinerary - Summary

Dates	Week	Location
10/06/05 – 17/06/05	1	Santa Cruz
18/06/05 – 24/06/05	2	IBIF Research Station, La Chonta
25/06/05 – 1/07/05	3	IBIF Research Station, La Chonta
2/07/05 – 8/07/05	4	IBIF Research Station, La Chonta
9/07/05 – 15/07/05	5	IBIF Research Station, La Chonta
16/07/05 – 22/07/05	6	IBIF Research Station, La Chonta
23/07/05 – 29/07/05	7	IBIF Research Station, La Chonta
30/07/05 – 5/08/05	8	Santa Cruz, Discussion with Bolivian contacts and compile data
6/08/05 – 12/08/05	9	Amboro National Park – 2006 Project Research
13/08/05 – 19/08/05	10	Bolivian contact meetings, La Paz and Santa Cruz

Appendix 3
Silviculture Treatments

Treatment				
Testigo (T) Minimal management (Control)				
Plots are not harvested, but minimal liana cutting has taken place, although this is of a negligible impact.				
Normale (N) Normal management				
Harvesting according to current La Chonta logging system. On average 62 trees per plot are extracted.				
Road and logging planning (based on yearly census)	Harvesting above set diameter limits	Lianas to be cut on commercial trees	20% of commercial species to be retained, to act as seed trees	
Mejorado (M), Improved management				
This includes all management strategies of normale management.				
The identification of future crop trees >10cm DBH and the cutting of lianas on the stem and crown of these trees.	Removing a percentage (15 trees per hectare) of poorly formed non-commercial species.			
Intensivo (I), Intensive management				
This includes all management strategies of mejorado management.				
Further identification of future crop trees and liana removal	More intensive removal of non-commercial species (25 per hectare)	Herbicide treatment for lianas	Ground vegetation removal around commercial trees	100% increase on current harvest levels

Appendix 4
H Goddings, J O'mahony, H Talbot, Weecho, Chillin, A McKay, A Scott-Tonge, Victor and A Erler