Post-Fire Regeneration in Nyungwe National Park, Rwanda

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for the Wildlife Conservation Society

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Post-Fire Regeneration in Nyungwe National Park, Rwanda:

Striving to make regeneration interventions appear natural

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FINAL REPORT- December 3, 2007

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Overview of Work Completed

Number of new sites..*4 (Kitabi, Umugote, Gasare, Mubuga)*

Number of new plots in those four sites (average size 500 m^2)... *42*

    Number of new plots in Kitabi... *21*

    Number of new plots in Umugote.. *10*

    Number of new plots in Gasare... *6*

    Number of new plots in Mubuga *6*

Number of person-days of locally hired daily workers *267*

Daily workers employed from.....................*Kitabi (159 person-days) and Banda (208 person-days)*

Daily pay for daily workers... *700 Frw*

Total area of sites established in 2007 (area of hillsides calculated by GIS) ....*495,000 m^2*

Total area of new post-fire regeneration implementation plots (established 2007)........*21,500 m^2*

Total area of post-fire regeneration implementation plots in Umugote (2003-2006)........*9,000 m^2*

Total area of post-fire regeneration research plots (2001-2004)...................................... *12,150 m^2*

Background

Not all fire is bad. Small wildfires started from lightning strikes likely play an important role in creation of forest gaps. However, wildfires have spread through large areas of Nyungwe National Park, killing the majority of trees over vast hillsides. Based on remote sensing and GIS analyses completed in 2004, approximately 12% of Nyungwe National Park has been affected by wildfire in previous years[1]. Much of that area burned in wildfires in 1997, an exceptionally dry year.

Initial colonizers of burned areas include the fern species *Pteridium aquilinum* (L.) Kuhn, which subsequently become the most dominant herbaceous species in burned areas[2]. These ferns colonize new areas by germinating from light, air-borne spores. And once established, ferns can re-sprout from existing rhizomes in the soil. These ferns grow very rapidly and densely, reducing the natural regeneration of tree species.

Results of multiple-year research within Nyungwe National Park have illustrated that routinely cutting the ferns significantly increases the number of regenerating trees, tree height, and (in lower slopes) tree species, thereby accelerating forest regeneration[1]. Although tree regeneration *is* occurring in the areas previously burned in wildfire, regeneration is not uniform; some areas are still void of regenerating trees even after more than 10 years post-fire.

In addition to the research plots, implementation plots were established in 2003 and ferns were removed every 3 months for 3 years. The unnatural appearance of the regenerating trees in these plots (5 x 100 m horizontal lines; see below) has prompted changes in the way new implementation plots are established in the forest. How can we accelerate forest regeneration in burned areas visible from roads and trails, and make it appear natural?

Picture taken of implementation plots in November 2004, immediately after cutting treatment. Today, regenerating trees retain the horizontal lines on the hillsides even though cutting has stopped.

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[1] For complete information, please see Weber, W., M. Masozera, and A. B. Masozera (eds). 2005. Biodiversity Conservation in Rwanda: Collected Works of the Protected Areas Biodiversity Project 2004-2005. Ministry of Lands, Environment, Water, Forestry, and Mines. Funded by the Global Environment Facility and compiled by Wildlife Conservation Society. 398 p.

[2] Plumptre, A.J., Masozera, M., McNeilage, A., Ewango, C., Kaplin, B., and Liengola, I. 2002. Biodiversity surveys of the Nyungwe Forest in South West Rwanda. WCS Working Paper Series No. 19.

Objective

The objective of this work was to establish additional post-fire regeneration plots in Nyungwe National Park in a way that aesthetically blends with the natural landscape.

Site Selection

New implementation plots were established at four sites in Nyungwe National Park- Kitabi, Umugote, Gasare, and Mubuga (see below). Potential sites were identified and prioritized by a four-person team (Amy Vedder, Felix Mulindahabi, Eraste Nzakizwanayo, and Anna Behm Masozera) on September 12, 2007. Sites were prioritized using two key criteria: lack of visible forest regeneration and their visibility and accessibility from the main road. In addition, the opportunity to extend initial work to contiguous hillsides was a secondary criterion.
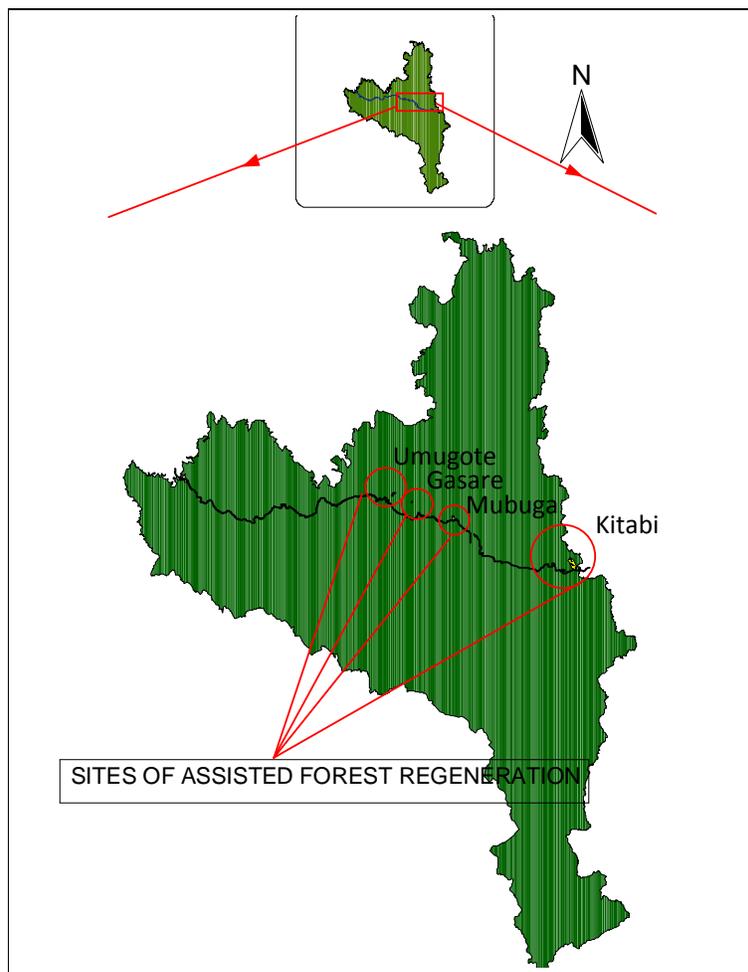
Plot Establishment

At each site, plots were established in varying shapes and sizes to blend to the natural contours and conditions in the forest. Plots are used because it is unrealistic and unnecessary to clear entire hillsides. Plots, essentially "islands" of regeneration, shade out adjacent ferns, and over time dominate the hillside. The use of plots also minimizes any potential erosion or disruption of the soil.

Different shapes were explored, but the following guidelines were maintained:

1) Select areas with few or no regenerating trees were visible.
2) Select areas visible from the main road.
3) Choose a shape and orientation that blends with the natural landscape.
4) Choose a shape and orientation that will minimize potential erosion.

Plots were demarcated by a team of 6 people in advance of the cutting crew. After the plan for each plot was agreed on, daily workers would cut the outline of the plot in two directions, each team followed by a recorder who would measure the length and guide the direction of the workers.

Demarcated plot in Kitabi.

Once plots were demarcated, cutting crews (each crew led by PCFN staff member) cut the ferns within the plots with machetes, and then moved them downhill and outside of the plot. Existing trees were protected throughout this process and 2-5 cm of detritus was left to protect the soil.

PCFN research staff member, Jean Baptiste, removing cut ferns with daily works at the Kitabi site.

BRIEFING OF DAILY WORKERS – The key to proper establishment of post-fire regeneration plots

Why are we doing this?

"Intact forests provide us with benefits. As a whole, they provide us with protection from landslides, clean water, clean air, and a moderate climate among other things. Fire in Nyungwe National Park has not been a good thing for the forest. Many of the trees have died, and the only thing growing well is ferns. These ferns dominate and do not allow young trees to grow. Our plan is to remove the ferns (and ferns only) periodically to giving any existing trees or tree seeds the chance to grow. The goal is to speed up the return of a forest in this area, to provide us with more benefits. **We won't be planting any trees in these plots.** That is why it is important to protect any trees that are there already. Are there any questions?"

Do:
- Cut all the ferns and other herbaceous plants.
- Move the cut ferns downhill and outside of the plot.
- Watch out for and protect any small trees.
- Leave 2-4 cm of detritus (dead plant material) on top of the soil for protection.
- Ask questions at any time.

Don't:
- Cut any trees small, medium, or large.
- Cut or dig into the soil.
- Leave too much detritus that any existing tree seeds cannot germinate and penetrate.

Plot in Kitabi immediately after cutting treatment.

KITABI

Kitabi was selected with the highest priority for post-fire regeneration. These hills offer some of the first impressions of the forest to visitors; the hills are visible immediately upon entering the park along the main road. This site is visible from both directions on the main road.

KITABI Site Statistics

Total Area of the Site (calculated with GIS)	369,000 m^2
Aspect of Site	Plots face from East to South
Total Number of Plots	21
Total Area of Plots	10,000 m^2
Total Person-Days of Hired Workers	159
Hired Workers From	Kitabi
Dates	September 17-22
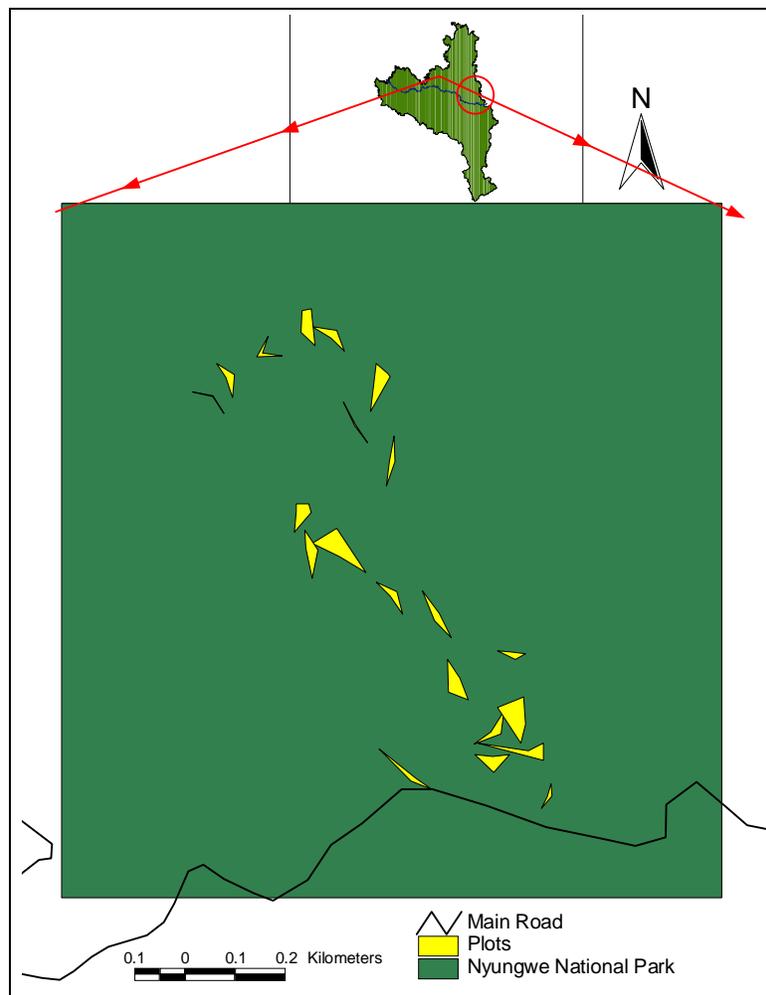
Initial view of regeneration plots as you enter the forest from Kitabi.

Continuing down the road, an additional regeneration plot is visible.

Further down the road (but looking back the way you've come), more plots are visible.
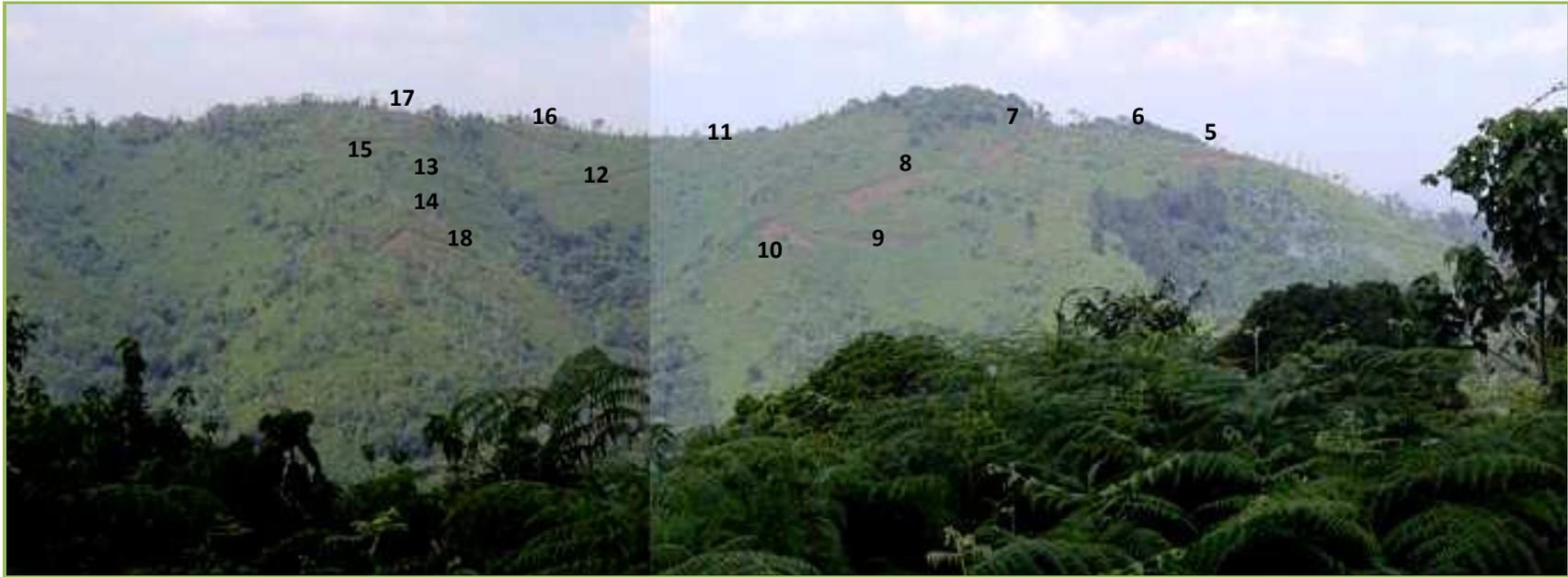
From the main road, it is possible to see most of the Kitabi site, traveling from both directions. This was the most challenging site aesthetically, because the vast hillsides are directly visible from the main road.

UMUGOTE

The site selected at Umugote is adjacent to previous implementation plots. The hillside is very visible from the main road and from a pull-off area. This area is also visible several times from the main road as you approach from the east.

UMUGOTE Site Statistics

Total Area of the Site (calculated with GIS)	55,000 m^2
Aspect of Site	Plots face Southeast (150°)
Total Number of Plots	10
Total Area of Plots	5,000 m^2
Total Person-Days of Hired Workers	50
Hired Workers From	Banda
Dates	September 24-26
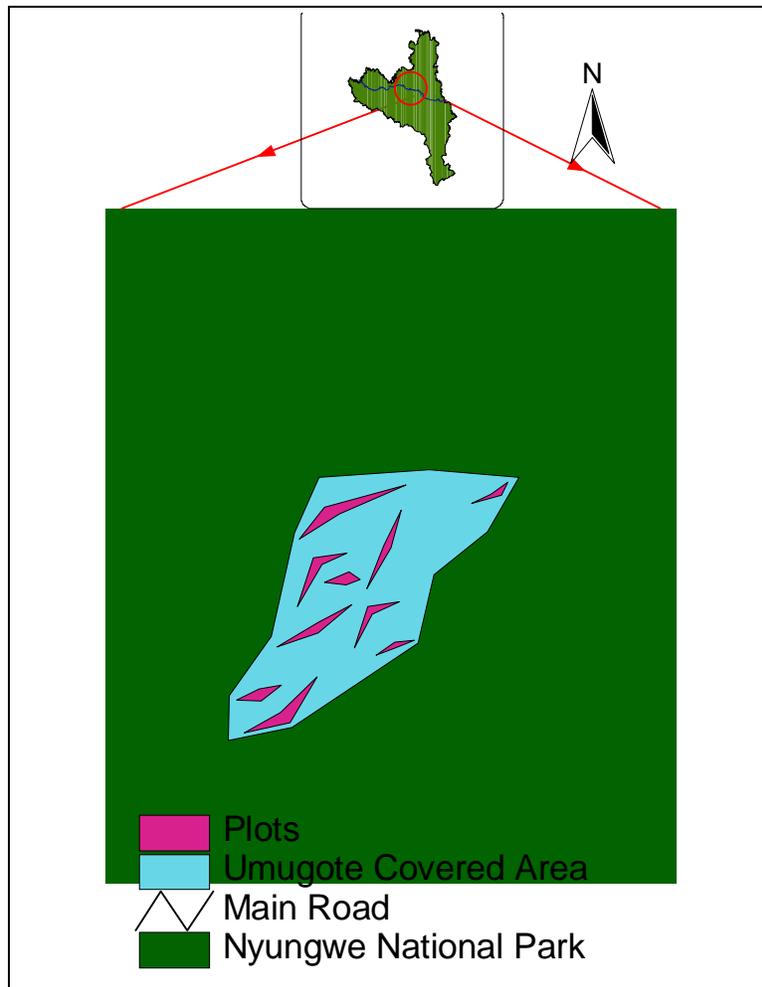
Umugote regeneration site. Implementation plots established in 2003 are circled on the left in purple and new regeneration sites established in 2007 are circled on the right in orange.

View of plots established at Umugote Site in September 2007.

GASARE

The site selected at Gasare is not far from Research Site C. The site is very visible as you approach from the east and descend down a large hill.

GASARE Site Statistics

Total Area of the Site (calculated with GIS)	14,000 m^2
Aspect of Site	Plots face North (360°)
Total Number of Plots	6
Total Area of Plots	2,500 m^2
Total Person-Days of Hired Workers	29
Hired Workers From	Banda
Dates	October 16-17

Shape	ID	Plots	Area /m2
Polygon	1	1	299
Polygon	2	2	575
Polygon	3	3	146
Polygon	4	4	427
Polygon	5	5	279
Polygon	6	6	155

Key

■ Plots
■ Nyungwe National Park

0.02   0   0.02   0.04 Kilometers
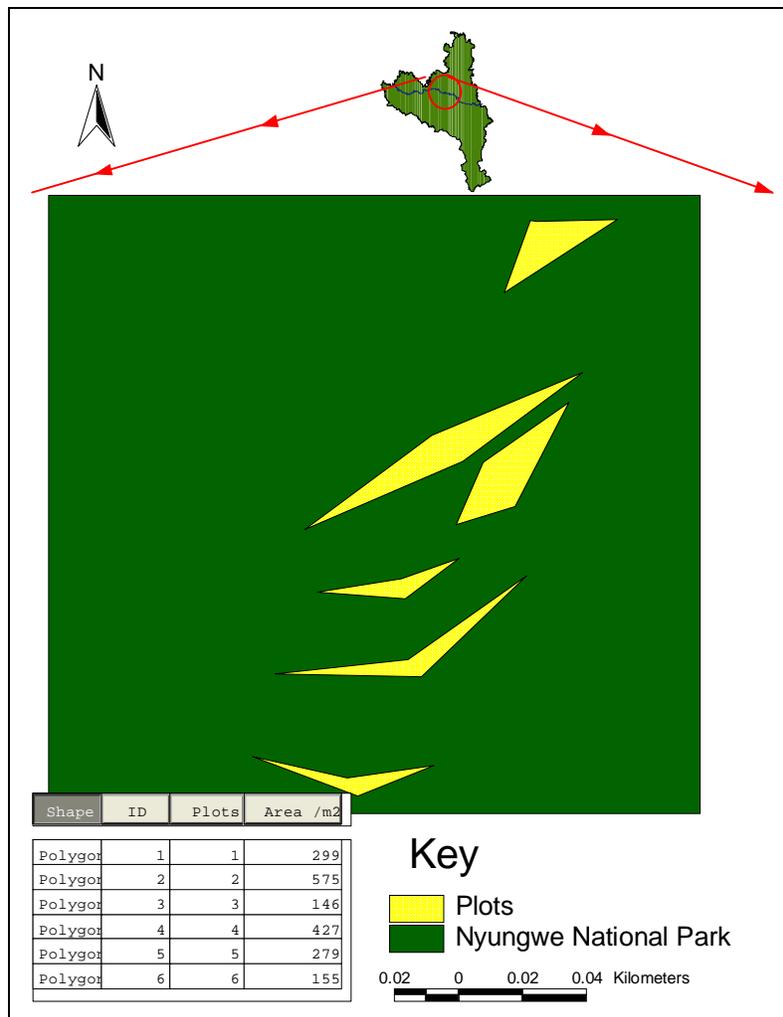
Gasare site as seen from the main road, approaching from the east.

Placement of six plots at Gasare site.

MUBUGA

The site located near kilometer marker 74, is not far from Research Site A. This site showed little sign of natural regeneration and the hillside is visible from the road from both directions.

MUBUGA Site Statistics

Total Area of the Site (calculated with GIS)	57,000 m^2
Aspect of Site	Over two hills, the plots face North (290- 330°)
Total Number of Plots	6
Total Area of Plots	3,500 m^2
Total Person-Days of Hired Workers	29
Hired Workers From	Banda
Dates	October 17 and 19
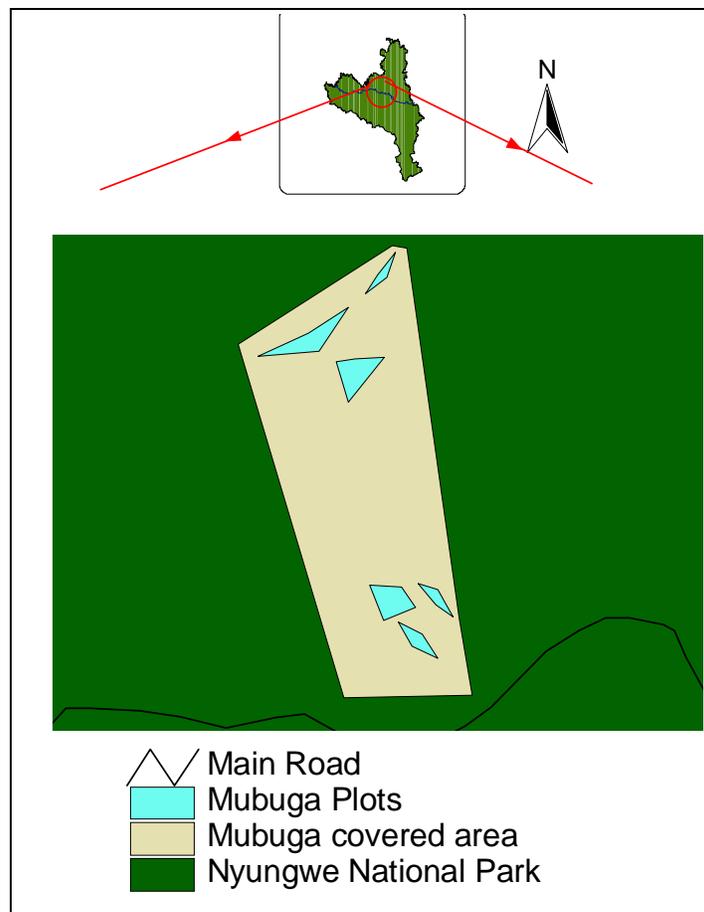
Initial view of plots at Mubuga site, approaching from the east.

Three plots closest to the road at Mubuga site.

Additional three plots located on adjacent hillside at Mubuga.

Brief Assessment of Regeneration Potential of New Sites

Although no data was recorded on the number of existing trees within plots established in 2007, the following observations were made. The majority of the already existing regenerating trees in the plots established in Kitabi, Umugote, Gasare, and Mubuga were *Macaranga* or *Polyscias*. We purposefully placed plots with little or no visible tree regeneration, although every plot contained at least one small seedling. Plots should be monitored with each cutting to assess the rate of regeneration in the plots. With each year that passes under fern cover, it is likely that the viability of the existing seed bank is reduced.

Over the first year, new seedlings generating from seeds should start to appear. And as data from the research plots indicated, additional tree species should start to grow within the plots toward the end of the third year. It is the assumption that this influx of additional species coincides with increased visitation to the sites by birds, bats, and other seed dispersers.

Lessons Learned

The Challenges

Initially it would seem that creating plots of varying shapes and sizes would be an easy task- straight lines are not only not necessary, but undesirable. However, in demarcation and creation of implementation plots, avoiding straight lines is actually a challenge.

Even if you succeed in demarcating a plot with curved and varying edges, due to slope, it may end up looking quite straight from the road. And in addition, when the workers go to cut the ferns in the plot, the plot edges become straight as they roll the cut ferns down the hill and outside of the plot.

It is not easy to locate yourself on a hillside in reference to the main road. Ferns grow dense and tall in the burned areas, obscuring views. In addition, rain, mist, and fog are regularly present in Nyungwe National Park, especially during the rainy season.

Although you can have a plan based on what the site looks like from the main road, it is impossible to judge the contours, valleys, existing regeneration, and scale until you are actually on the hillside.

The Strategy

We found that taking a picture of the potential site and printing it before demarcating the plots was very useful. Also, before entering the site, we would also locate reference points (particular trees or other features) to help us orient ourselves once we were within the burned area. We would also identify features that we could work with or extend through the development of plots, for example creating "finger" extensions from a valley (see Kitabi plot 12). If possible, having a "lookout" person on the main road in radio communication with the team could help make the plot placement more precise.

Once in the burned area, it is sometimes difficult to orient yourself on a hillside in relation to the main road due to rain, mist, or fog in addition to the height and density of surrounding ferns.

It is suggested that during subsequent cuttings of the plots, emphasis should be to accentuate the curved and variable borders of each plot.

Varying Plot Size and Shape

When establishing the Kitabi site, we initially kept all the plot size the same, roughly 500 m^2. However, we realized that the plots appeared more natural when the plot sizes were adjusted as well as the shape. For the subsequent sites at Umugote, Gasare, and Mubuga the plot sizes were alternated between a large plot of 750 m^2 and a small plot of 250 m^2.

Rainy Season Establishment of Plots

Establishing regeneration areas may be best timed during the rainy season. Although the rain, mist, and fog makes working in the burned area more difficult and less pleasant, the overcast skies may help any existing trees adapt to the abrupt change in environment. From fern cover to overcast skies is likely more easy to cope with than fern cover to sunny skies.

Acknowledgements

Plot Details

ID	Site	Plot	Easting	Northing	EPE	Shape*	Size (m^2)
1	Kitabi	1	0766528	9720201	9	eye	500
2	Kitabi	1	0766562	9720196	5		
3	Kitabi	1	0766596	9720199	12		
4	Kitabi	1	0766565	9720167	4		
5	Kitabi	2	0766532	9720223	6	eye	500
6	Kitabi	2	0766633	9720209	9		
7	Kitabi	2	0766662	9720224	14		
8	Kitabi	2	0766663	9720193	8		
9	Kitabi	3	0766623	9720225	11	eye	500
10	Kitabi	3	0766579	9720294	20		
11	Kitabi	3	0766595	9720517	10		
12	Kitabi	3	0766627	9720263	4		
13	Kitabi	4	0766588	9720285	8	eye	500
14	Kitabi	4	0766560	9720246	6		
15	Kitabi	4	0766528	9720222	6		
16	Kitabi	4	0766580	9720242	3		
17	Kitabi	5	0766515	9720310	10	eye	500
18	Kitabi	5	0766499	9720348	10		
19	Kitabi	5	0766476	9720386	7		
20	Kitabi	5	0766478	9720324	5		
21	Kitabi	6	0766482	9720431	9	moon	500
22	Kitabi	6	0766458	9720476	8		
23	Kitabi	6	0766426	9720521	12		
24	Kitabi	6	0766451	9720464	5		
25	Kitabi	7	0766375	9720520	8	chevron	500
26	Kitabi	7	0766384	9720477	8		
27	Kitabi	7	0766362	9720514	7		
28	Kitabi	7	0766334	9720538	10		
29	Kitabi	8	0766314	9720558	7	trapezoid	500
30	Kitabi	8	0766263	9720591	20		
31	Kitabi	8	0766209	9720614	20		
32	Kitabi	8	0766257	9720644	19		
33	Kitabi	9	0766208	9720549	10	moon	500
34	Kitabi	9	0766220	9720601	12		
35	Kitabi	9	0766193	9720641	6		
36	Kitabi	9	0766198	9720607	6		
37	Kitabi	10	0766205	9720676	5	chevron	500
38	Kitabi	10	0766175	9720639	6		
39	Kitabi	10	0766177	9720677	7		
40	Kitabi	10	0766178	9720691	5		
41	Kitabi	10	0766200	9720691	5		
42	Kitabi	11	0766355	9720730	10	eye	500
43	Kitabi	11	0766370	9720775	8		

44	Kitabi	11	0766369	9720825	5		
45	Kitabi	11	0766362	9720777	5		
46	Kitabi	12	0766317	9720813	9	eye	500
47	Kitabi	12	0766293	9720847	13		
48	Kitabi	12	0766269	9720893	5		
49	Kitabi	12	0766291	9720847	12		
50	Kitabi	13	0766148	9720984	5	inv. Chevron	500
51	Kitabi	13	0766109	9720988	4		
52	Kitabi	13	0766123	9721023	4		
53	Kitabi	13	0766102	9720982	5		
54	Kitabi	14	0766052	9720947	4	chevron	500
55	Kitabi	14	0766050	9720908	11		
56	Kitabi	14	0766039	9720939	6		
57	Kitabi	14	0765958	9720420	6		
58	Kitabi	15	0766214	9721007	6	moon	500
59	Kitabi	15	0766186	9721034	6		
60	Kitabi	15	0766188	9721073	5		
61	Kitabi	15	0766207	9721078	8		
62	Kitabi	16	0766354	9720953	10	eye	500
63	Kitabi	16	0766334	9720970	6		
64	Kitabi	16	0766361	9720944	6		
65	Kitabi	16	0766324	9720876	7		
66	Kitabi	17	0766254	9721032	6	chevron	500
67	Kitabi	17	0766207	9721043	4		
68	Kitabi	17	0766245	9721024	5		
69	Kitabi	17	0766270	9720996	5		
70	Kitabi	18	0765970	9720913	4	chevron	500
71	Kitabi	18	0766012	9720904	5		
72	Kitabi	18	0766034	9720871	4		
73	Kitabi	18	0766010	9720906	6		
74	Kitabi	19	0766339	9720212	7	moon	500
75	Kitabi	19	0766410	9720155	11		
76	Kitabi	19	0766404	9720150	8		
77	Kitabi	19	0766440	9720132	9		
78	Kitabi	20	0766678	9720141	7	eye	250
79	Kitabi	20	0766672	9720117	6		
80	Kitabi	20	0766679	9720118	8		
81	Kitabi	20	0766662	9720098	8		
82	Kitabi	21	0766572	9720513	7	eye	250
83	Kitabi	21	0766596	9720511	6		
84	Kitabi	21	0766609	9720498	4		
85	Kitabi	21	0766628	9720506	5		
86	Gasare	1	0752753	9725993	14	moon	250
87	Gasare	1	0752728	9725993	8		
88	Gasare	1	0752726	9725993	15		

89	Gasare	1	0752718	9725971	11		
90	Gasare	2	0752742	9725946	8	eye	750
91	Gasare	2	0752696	9725927	7		
92	Gasare	2	0752705	9725918	12		
93	Gasare	2	0752656	9725897	9		
94	Gasare	3	0752660	9725878	13	moon	250
95	Gasare	3	0752686	9725882	4		
96	Gasare	3	0752687	9725876	4		
97	Gasare	3	0752704	9725888	12		
98	Gasare	4	0752738	9725936	4	eye	250
99	Gasare	4	0752704	9725923	7		
100	Gasare	4	0752721	9725904	6		
101	Gasare	4	0752703	9725899	6		
102	Gasare	5	0752725	9725882	4	eye	750
103	Gasare	5	0752688	9725856	5		
104	Gasare	5	0752692	9725851	4		
105	Gasare	5	0752647	9725852	5		
106	Gasare	6	0752696	9725823	4	moon	250
107	Gasare	6	0752669	9725819	4		
108	Gasare	6	0752672	9725814	9		
109	Gasare	6	0752640	9725826	8		
110	Umugote	1	0751057	9726449	6	moon	750
111	Umugote	1	0751016	9726408	5		
112	Umugote	1	0751023	9726399	5		
113	Umugote	1	0750973	9726382	5		
114	Umugote	2	0750967	9726422	8	eye	250
115	Umugote	2	0750991	9726424	5		
116	Umugote	2	0751014	9726440	6		
117	Umugote	2	0750992	9726435	7		
118	Umugote	3	0751012	9726487	5	chevron	750
119	Umugote	3	0751058	9726502	4		
120	Umugote	3	0751098	9726535	6		
121	Umugote	3	0751060	9726515	8		
122	Umugote	4	0751036	9726535	4	eye	250
123	Umugote	4	0751063	9726584	7		
124	Umugote	4	0751092	9726596	6		
125	Umugote	4	0751055	9726591	6		
126	Umugote	5	0751038	9726613	4	chevron	750
127	Umugote	5	0751068	9726651	6		
128	Umugote	5	0751163	9726678	6		
129	Umugote	5	0751084	9726643	7		
130	Umugote	6	0751157	9726649	7	chevron	750
131	Umugote	6	0751137	9726605	7		
132	Umugote	6	0751145	9726604	8		
133	Umugote	6	0751117	9726556	8		
134	Umugote	7	0751156	9726538	9	eye	750

135	Umugote	7	0751118	9726534	7		
136	Umugote	7	0751123	9726524	7		
137	Umugote	7	0751103	9726486	7		
138	Umugote	8	0751173	9726494	6	moon	250
139	Umugote	8	0751150	9726490	6		
140	Umugote	8	0751129	9726477	5		
141	Umugote	8	0751154	9726486	5		
142	Umugote	9	0751284	9726680	8	eye	250
143	Umugote	9	0751265	9726667	8		
144	Umugote	9	0751242	9726657	5		
145	Umugote	9	0751276	9726666	5		
146	Umugote	10	0751109	9726566	5	eye	250
147	Umugote	10	0751096	9726574	4		
148	Umugote	10	0751067	9726562	8		
149	Umugote	10	0751093	9726560	7		
150	Mubuga	1	0756287	9724358	4	eye	750
151	Mubuga	1	0756264	9724371	4		
152	Mubuga	1	0756273	9724381	5		
153	Mubuga	1	0756250	9724394	4		
154	Mubuga	2	0756267	9724402	6	eye	250
155	Mubuga	2	0756240	9724397	6		
156	Mubuga	2	0756254	9724426	6		
157	Mubuga	2	0756224	9724427	4		
158	Mubuga	3	0756121	9724646	4	moon	750
159	Mubuga	3	0756166	9724666	6		
160	Mubuga	3	0756203	9724690	6		
161	Mubuga	3	0756177	9724652	11		
162	Mubuga	4	0756222	9724706	6	eye	750
163	Mubuga	4	0756233	9724721	6		
164	Mubuga	4	0756249	9724742	8		
165	Mubuga	4	0756239	9724721	9		
166	Mubuga	5	0756191	9724639	11	chevron	750
167	Mubuga	5	0756235	9724645	7		
168	Mubuga	5	0756209	9724641	5		
169	Mubuga	5	0756205	9724603	5		
170	Mubuga	6	0756304	9724397	5	eye	250
171	Mubuga	6	0756288	9724411	4		
172	Mubuga	6	0756272	9724429	10		
173	Mubuga	6	0756287	9724424	4		
						TOTAL=	21000

*Five shapes were used:

Chevron -

Inverted Chevron -

Moon -

Eye –

Trapezoid (meant to be a tear-drop shape) -

SCOPE OF WORK

Post-fire Regeneration Implementation
Nyungwe National Park
September 14, 2007 (modified September 17, 2007)

Background

Areas burned by wildfire in Nyungwe National Park are rapidly and densely colonized by *Pteridium aquilinum* (L.) Kuhn. ferns. These ferns out-compete tree seedlings for valuable sunlight and nutrients. Results of multiple-year research within Nyungwe National Park have illustrated that routinely cutting the ferns significantly increases the number of regenerating trees, tree height, and (in lower slopes) tree species, thereby accelerating forest regeneration[3]. Although tree regeneration *is* occurring in the areas previously burned in wildfire, regeneration is not uniform; some areas are still void of regenerating trees even after more than 10 years post-fire.

On September 12, 2007, a four-person team (Amy Vedder, Felix Mulindahabi, Eraste Nzakizwanayo, and Anna Behm Masozera) identified three sites for establishment of implementation plots- Kitabi, Gasare, and Umugote. Sites were prioritized by 2 key criteria: lack of visible forest regeneration and their visibility and accessibility from the main road. In addition, the opportunity to extend initial regeneration work to contiguous hillsides was a secondary criterion.

Overall Plan

These three sites will be assessed and plots designed to maximize regeneration *and* minimize visible plots *and* minimize potential erosion. Plots will be established for treatment every 3 months for 3 years. Plot size (approximately 500m^2) is based on an implementation site successfully initiated in 2003 by WCS/PCFN. The Kitabi site will contain 20 plots, and the subsequent two sites will contain 10 plots each.

For establishment of plots at the Kitabi site, it is estimated that a crew of 25 people should be able to cut all plots within four days. A few members of the 25 will mark all plots in advance of the cutting crew. For the subsequent sites, due to the limitations in transportation for the crew and time estimated to reach the site, it is estimated to take two days for a crew of 30 people. If possible, the original 15-member cutting crew will be utilized to facilitate training of the new, larger crews.

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[3] For complete information on post-fire regeneration research in Nyungwe National Park, please see Weber, W., M. Masozera, and A. B. Masozera (eds). 2005. Biodiversity Conservation in Rwanda: Collected Works of the Protected Areas Biodiversity Project 2004-2005. Ministry of Lands, Environment, Water, Forestry, and Mines. Funded by the Global Environment Facility and compiled by Wildlife Conservation Society. 398 p.

We therefore estimate eight to nine days of total work to initiate a total of 40 plots in the three sites. A six-person PCFN team will train and oversee the cutting crews (42 person-days supervision), and a total of 225 person-days of labor to cut the plots. Crew members will be paid 700-800 Rwandan Francs per day's labor. Truck transportation (and driver) of the crew will be needed for a total of 4 days.

The proposed schedule is as follows:

Monday, Sept 17	Meet with PCFN/ORTPN staff to finalize plans for plot establishment Plot demarcation for initial four plots
Tuesday, Sept 18	Kitabi site
Wed, Sept 19	Kitabi site
Thursday, Sept 20	Kitabi site
Friday, Sept 21	Kitabi site
Saturday, Sept 22	Kitabi site if necessary
Monday, Sept 24	Gasare
Tuesday, Sept 25	Gasare
Wed, Sept 26	Umugote
Thursday, Sept 27	Umugote

Ferns will again be removed from the plots in December, beginning a cycle of treatment every 3 months for a duration of 3 years.

Specific Responsibilities of the Consultant

Consultant is responsible for designing the layout, orientation, and design of plots at each site. Consultant will work with PCFN/ORTPN research staff to refine the plan and oversee the establishment of plots, with a priority to oversee plot demarcation. GPS information for each site and plot will be taken.

Deliverables

Consultant will produce a brief summary report to document the on-site establishment of plots, with graphic representation of plot design (approx. location, size, orientation, form), to be delivered in printed and electronic format to WCS/PCFN, ORTPN-Nyungwe National Park, and the PAB PMU in Kigali within 3 weeks after work in Nyungwe National Park is complete.

Level of Effort

The consultant will be reimbursed for a maximum of five (5) days. Invoice will be provided with final report.