Project Update: September 2018

Brief description: Encroachment of *Acacia drepanolobium* in Maswa Game Reserve is a growing concern in wildlife resources conservation and a potential source for environmental and economic losses. Little is known up to now about why and how woody plant seedlings can so easily flourish and spread and what factors wildlife and livestock play in this process. Field observations and experiments were conducted from 7th June to 1st August 2018, within Maswa Game Reserve, and we summarised the activities in five parts i.e. A: Field observation, B: Herbivores induced factor germination experiment, C: Fire Experiment, D: Irrigation Experiment and E; Stakeholder meetings. Field observation provided a baseline to understand the mega-herbivore interaction with woody plants, while an experiment aimed at examining the role of fire and dung as growing environment in influencing seed germination. Furthermore, an irrigation experiment was conducted to examine the role of rainfall variability on seedling establishment. Meeting and discussion on possible causes of encroachment of *Acacia drepanolobium* and management suggestions to eradicate encroachment were held with different stakeholder.

A. Field survey/observation

Adding more plots to supplement the previous survey that I conducted in March 2018 on herbaceous species under different encroachment intensity was not feasible due to the following factors:

1. Most of the herbaceous species could no longer be identified as they had become dry by the time I wanted to add more plots.
2. Bare ground cover could no longer be assessed as herbivores and wind had flattened grasses (see images below).

Hence, the two data i.e. (June phase and September phase) would not have been comparable due to inability to assess/collect some data during the September phase survey.

Dry grasses and herbs that have been pushed over, making it difficult to identify species and quantify bare ground cover.

Mega-herbivores interaction with *Acacia drepanolobium*; we made a preliminary survey to provide a baseline data and information on how elephants forage on different parts of *Acacia drepanolobium* in encroached landscapes. We established 102 circles with each 15 m radius, within which we assessed number of foraged individual trees and their foraged parts. Furthermore, we used 20 × 20 m quadrats to assess individual trees of *Acacia drepanolobium* knocked down by African elephant, within which we assessed the fate of the trees, i.e. still alive / dead and measured the dimension of each stem and height of the trees. We did this for 60 individual trees. Further efforts are needed to capture and understand spatial-temporal elephant interaction with *Acacia drepanolobium*.

Left: A branch of Acacia drepanolobium that had been foraged by African Elephant. Right: Roots of Acacia drepanolobium being foraged by African elephant (i.e. Elephant uprooted the tree).

Individual trees of *Acacia drepanolobium* that had been knocked down by African elephant

B. Herbivore induced factor germination experiment

We used 2 weeks to search for *Acacia drepanolobium* seeds and / or pods in different herbivore dung. Herbivore dung assessed included African elephant, buffalo, giraffe, zebra and impala, though the main focus was on African elephant. Dung assessment for seeds showed that it was impossible for buffalo, giraffe and impala to release seeds of *Acacia drepanolobium* through their gut system as they strongly digested food particles to the finest level unlike African elephant. Despite African elephant dung being quite coarse we could not find *Acacia drepanolobium* seeds in elephant dung, though we observed seeds of other plant species. We collected seeds and pods of *Acacia drepanolobium* and fed those as food to two cattle. Cattle did not prefer feeding on *Acacia drepanolobium* seeds and pods, hence we mixed 300 seeds with sunflower concentrates and fed cattle followed by monitoring of the cattle for 5 days. We were only able to find five seeds in cattle dung over a 5-day period. When the five seeds were planted and watered they did not grow. We re-designed our germination experiment and tested for the influence of dung and its moisture content as growing/germination environment of *Acacia drepanolobium* seeds. We used African elephant and buffalo dung i.e. dung of the most dominant herbivore species in these encroached landscapes to set germination experiment in the wild.

African Elephant dung experiment: 75 fresh dung heaps i.e. ≤ 1 day old were allocated in the wild, in each dung five seeds were inserted, then covered by the thorn branches of *Acacia* and *Commpihora* trees. The set up was left in the wild for 2 weeks before data collection. Data collected after 2 weeks included the number of seeds germinated, as well as shoot and root heights of the seedlings found within the dung heaps.

Buffalo dung experiment: 70 fresh dung heaps i.e. ≤ 1 day old were allocated in the wild, followed by the same procedure as in elephant dung experiment.

Control experiment: A total of 385 seeds were collected from *Acacia drepanolobium* trees and planted in germination trays, watered (20 ml) daily in two weeks period and monitoring of the number of seeds germinated.

C. Fire Experiment

A total of 461 seeds were collected from *Acacia drepanolobium* trees and subjected to three fire treatments i.e. cool fire, hot fire and sub-soil fire experiment.

Cool fire treatment; 201 seeds were placed on soil below grasses in a grassland patch (where the grasses were relatively moist), followed by burning that particular patch of grassland. When fire was off, seeds were collected from the soil and planted in germination trays, Followed by monitoring of how many seeds germinated over a 4-week period.

Hot fire treatment; 220 seeds were placed on soil below the grasses in grassland patch (where the grasses were relatively dry), followed by the same procedures as in cool fire treatment.

Sub-soil fire experiment; 40 seeds were placed in a thin sub-soil layer (0.5 cm deep), dry grasses were placed on top of it to form quadrat of (90cm×70 ×25) and burned. This was followed by the same procedures as in cool fire treatment.
Control experiment; 220 seeds were collected from *Acacia drepanolobium* trees and planted in germination trays, followed by daily watering (20 ml) for 3 weeks period.

D. Irrigation experiment

A total of 495 seeds were collected from *Acacia drepanolobium* trees and subjected to 4 ml, 9 ml and 30 ml irrigation treatment daily, 2 and 7 days frequency, respectively. The experiments were monitored for a period of 5 weeks. Shoot height of the growing seedlings were measured and recorded once every week from the second week after planting the seeds. At the 5th week the seedlings were removed from tray pots and the roots of the seedlings were measured and recorded.

E. Stakeholder meetings

Three meetings were held during this quarter. We met with the Director of Tanzania Game Tracker Safari and his team to discuss mainly on management suggestions to eradicate woody plant encroachment in Maswa Game Reserve. Secondly, we travelled to Saadani National Park to learn about their on-going eradication programme of encroacher species (*Acacia zanzibarica*). Lastly, we met with Project Manager of Maswa Game Reserve and discussed factors contributing to encroachment of woody plants.

S/N	**Stakeholder Meeting**	**People involved**	**Topic**	**Date /Time**
1	Tanzania Game Tracker Safaris (TGTS) –Planned meeting	1. Director 2. Two managers	-Causes of the encroachment of *Acacia drepanolobium* -Possible management suggestions to control encroachment of *Acacia drepanolobium* -Invasive species spread in Maswa -Wildlife habitat degradation on road verge due to erosion	28th June 2018 **Time** 13.45-14.50
2	TAWA –Unplanned meeting	1. Project Manager – Maswa Game Reserve 2. Deputy Project Manager-	-Factors contributing to woody plant encroachment -Concern on invasion of exotic	13th June 2018 **Time** 10.30-11.20

		Tourism department	species in Maswa Game Reserve	
3	Saadani National Park (Study tour)- Planned study tour	1. Saadani National Park Ecologist 2. TGTS manager	Share experience on woody plant encroachment and Learn on on-going eradication project of encroaching *Acacia zanzibarica* in Saadani National Park	17th-19th August 2018

On-going activities

1. Finalising data analysis.
2. Writing scientific paper for publication.
3. Presenting research findings to stakeholders i.e. TAWA, TGTS and in graduate seminars within NM-AIST.


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Left: Seedling growing in a cage i.e. irrigation experiment monitoring. Right: Acacia drepanolobium seed attached to the pod with a fibre tissue.

Left: A fire experiment carried out in grassland area. Right: Collected Acacia drepanolobium seeds after fire treatment i.e. burned seeds.

Left: Seedling growing out of Elephant dung: Right: Seedling growing out of Buffalo dung i.e. experiments for herbivores induced factors.


Left: Acacia drepanolobium seedling found within mega-herbivore dung. Right: Acacia drepanolobium seed with a thin fibre tissue used to attach itself to the pod.


Left: Remain patch of dense trees/encroached patch by Acacia zanzibarica Right: Restored patch that was previous occupied by Acacia zanzibarica in Saadani National Park.


Left: Zebra grazing in restored patch. Right: Stems of Acacia zanzibarica harvested as fire wood to be used by local community.


Remained cut stems of Acacia zanzibarica burned