**FIRE PARADOX – GFMC Prescribed Burning Demonstration Network Inventory Sheet**

| **Prescribed Burning Demonstration Sites - Site Description and Objectives -** | | **Local Site Name:** | |
|---|---|---|---|
| Country: Mongolia | Region: Selenge Aimag | | Location: Pine stand near Mandal Soum, Tunkhel village |
| Unit No./Admin. Unit: Tunkel Soum | Owner: Selenge Aimag, Ministry of Nature and Environment | | Site area (ha): 19 ha |
| UTM zone: | UTM (x): 106°38' E<br>UTM (y): 48°44' N | Map / Aerial photo :<br>- Yes (attached) | |
| First established: Date of burn: 4 and 5 June 2008 | Area(s) burnt (ha): 2 ha | Fire return interval (time since last burn): 17 years (see Fig. 27-29 in Photo Annex) | |
| Number of plots (in case of an array of sub-plots for experimental repetitions, particular site differences or high number of operationally burned sites: 2 (1: evening burn; 2: evening burning) | | | |
| Special remarks: plots have been burned for demonstration | | | |

| **Purpose of Treatment:** | |
|---|---|
| Specific Treatment Objectives:<br><br>Decreasing fire hazard using surface backfire to remove forest fuels | Objectives reached?<br>Yes<br><br>Specify: 1-hour forest fuels were removed by burn |

| **Desired burn conditions to reach objectives (optional or if necessary as general prerequisite)** | |
|---|---|
| Wind speed (m/s): see Annex | Wind direction: See Annex (varying) |
| Relative humidity (%): See Annex | Soil moisture: No data |
| Air temperature (°C): See Annex | Burn period (time of year): spring |
| What problems do occur?<br>Wind was veering | |

| **Site description** | | | | |
|---|---|---|---|---|
| Vegetation type (main species): Forest type: Pine forest with grass and herb in mountainous taiga belt. Tree species: *Pinus sylvestris* L., *Betula platyphylla* Sukacz. | | Annual mean precipitation (mm/a): 300 | | Mean precipitation during time of burn (mm): 0 |
| Fuel load (target fuel) (t $ha^{-1}$): 9 | | Annual mean temperature (°C): -2° | | Mean temperature during time of burn (°C): 23° |
| Fuel description: grass + pine forest litter | | | | |
| Topography: mountainous | Slope (%) 15-20 | Aspect: West | Altitude (m a.s.l.): 1300 | Soil conditions: taiga turf soil |
| Other: Description of site is given in materials of First International Central Asian Wildland Fire Joint Conference and Consultation (ICAWFCC), Ulaanbaatar, 2008: See Annex II and http://www.fire.uni-freiburg.de/GlobalNetworks/CentralAsia/ICAWFCC-2008-Programme-Abstracts.pdf | | | | |

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| **Burn team specifications** | |
|---|---|
| Parties involved:<br>GFMC, German Agency for Technical Cooperation (GTZ), The National Emergency Management Agency of Mongolia (NEMA), Ministry for Environment of Mongolia (MNE). Observers: The World Bank, Representatives of the Russian Aerial Forest Fire Center Avialesookhrana; Korean Forest Research Institute and Korea Forest Service. | Specific expertise or training:<br>- Yes<br><br>Please specify:<br>Experimental prescribed burn with personnel training and demonstration for national / local as stakeholders and international observers. |

| **Documentation of demonstration site** | | |
|---|---|---|
| Management plan:<br><br>- Simple management plan | Burn protocol:<br><br>- Yes | Monitoring of<br><br>- Weather data<br>- Fuel accumulation<br>- Fuel consumption<br>- Fire behaviour |
| Presentations: *Further information is available.* | | |
| Photos/ videos: Photos were taken to estimate pre- and post burning conditions, as well as fire behaviour (see also Annex I; detailed photographic documentation available at GFMC). | | |
| **Publications**: First Central Asian Forest Fire Experiment. In: Proceedings of International Conference First International Central Asian Wildland Fire Joint Conference and Consultation (ICAWFCC) Wildland Fires in Natural Ecosystems of the Central Asian Region: Ecology and Management Implications, Associated with the First Central Asian Forest Fire Experiment, 27-31 May 2008, Ulaanbaatar, Mongolia (http://www.fire.uni-freiburg.de/GlobalNetworks/CentralAsia/CentralAsia_3.html) | | |

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**Weather Conditions in the afternoons of the prescribed burning experiments on 4-5 June 2008**

**4 June 2008, Mandal experimental site**

| Time (GMT +7) | Temperature (°C) | Relative humidity (%) | Wind (km/h) | Wind direction |
|---|---|---|---|---|
| 16.45 | 21.1 | 30.3 | 4.1 | S/N |
| 17.00 | 23.5 | 30.2 | 6.6 | S/N |
| 17.15 | 24.5 | 29.8 | 4.2 | W/E |
| 17.30 | 23.7 | 30.7 | 3.0 | S/N |
| 17.45 | 22.9 | 36.0 | 7.3 | S/N |
| 18.00 | 23.0 | 31.9 | 1.1 | W/S |
| 18.15 | 22.0 | 37.6 | 2.2 | S/N |
| 18.30 | 22.0 | 38.0 | 1.6 | S/N |
| 18.45 | 22.7 | 32.5 | 3.5 | S/N |
| 19.00 | 21.0 | 34.2 | 0.0 | - |
| 19.15 | 21.3 | 34.8 | 1.6 | S/N |
| 19.30 | 21.1 | 36.2 | 1.8 | S/N |
| 19.45 | 21.2 | 34.2 | 2.0 | S/W |
| 20.00 | 20.3 | 34.0 | 2.2 | W/E |
| 20.15 | 21.1 | 37.5 | 3.0 | S/N |
| **5 June 2008**, **Mandal experimental site** | | | | |
| 17.15 | 25.1 | 31.5 | 8.0 | W/E |
| 17.30 | 25.0 | 31.3 | 9.1 | E/W |
| 17.45 | 23.2 | 35.9 | 3.8 | W/E |
| 18.00 | 22.0 | 37.3 | 9.5 | W/E |
| 18.15 | 20.4 | 38.4 | 8.9 | W/E |
| 18.30 | 22.4 | 37.9 | 6.3 | W/E |
| 18.45 | 21.6 | 38.7 | 16.1 | W/E |
| 19.00 | 20.4 | 39.8 | 9.5 | N/S |
| 19.15 | 20.1 | 39.9 | 7.1 | N/S |
| 19.30 | 19.8 | 38.4 | 3.5 | W/E |
| 19.45 | 18.0 | 41.2 | 4.4 | W/E |
| 20.00 | 18.1 | 39.1 | 3.8 | W/E |

**Annex I**: Photographic documentation and satellite images of the experimental site

**Fig.1.** View from the stand to open hill sites degraded by illegal logging and fire

**Fig.2.** View of the stand

**Fig.3.** View of the stand, dominated by grass-shrub understory

**Fig.4.** View of the stand, with occasional larger woody fuels

**Fig.5.** View of the ridge between the experimental stand and the neighbouring stand

**Fig.6.** View of the ridge between the experimental stand and the neighbouring stand

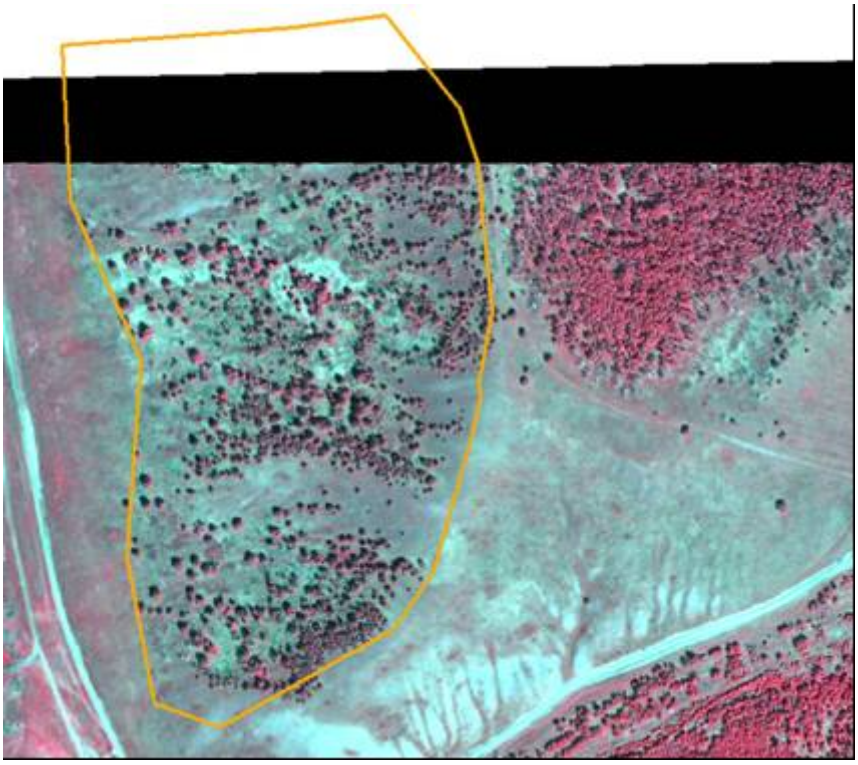

**Fig.7.** Satellite image (Quickbird) of the experimental stand


**Fig.8.** Satellite image provided by Google Earth

**Fig.9.** Three-dimensional view of the experimental stand (from West)

**Fig.10.** Three-dimensional view of the experimental stand (from South)

**Fig.11.** Fuel load measurement on the transect.

**Fig.12.** Fuel load measurement on 20 x 25 cm2 subplots

**Fig.13.** View of the down-slope burning backing fire

**Fig.14.** View of backing fire edge

**Fig.15.** Upslope line ignition

**Fig. 16.** Fire boss supervises line ignition

**Fig.17.** Backing fire edge

**Fig.18.** Flank line ignition

**Fig.19.** View of the backing fire

**Fig.20.** View of the stand after prescribed burn

**Fig.21.** View of burned area

**Fig.22.** View of surface fuel after prescribed burn

**Fig. 23.** Prescribed burn on 5 June 2008

**Fig. 24**. Day after prescribed burn (6 June 2008)

**Fig. 25.** View of burned area

**Fig. 26.** View of burned area boundary

**Fig. 27.** Fire history:

**Fig. 28.** Fire history:

**Fig. 29.** Fire history of the experimental site: The last major fire causing tree stem injury occurred 17 year ago (in 1991).

**Fig. 30.** Post-fire aspect of the experimental site by end of July 2008

**Annex II**: Detailed site description (http://www.fire.uni-freiburg.de/GlobalNetworks/CentralAsia/ICAWFCC-2008-Programme-Abstracts.pdf)

**The Experimental Site**

The main study area is a mountain pine tree forest stand located in Ajnai hills, in Mandal Soum of Selenge Aimag (48°44' N, 106°38' E)

Climate [1]

Mongolia is located in the northern hemisphere, surrounded by high mountains, which isolate the territory from seas and oceans. Thus there is less precipitation with much changes of air temperature. However the territory is separated from oceans still the Arctic, Atlantic and Pacific Ocean air flow comes to the area. They are influenced by the continental climate of Mongolia and stays in clockwise cyclone in warm seasons and in counter-clockwise cyclone in cold seasons of the year. Due to this extreme continental climate repeated natural dryness is observed and it happens in spring and autumns and even in summer sometimes. Therefore fire threatens Mongolia around the year except winter. However with certain weather characteristics such as temperature, moisture and wind speed that mostly influence on fire ignition, spread and stretch fire forecast for risky seasons can be determined.

Geography

Total territory of Mandal Soum, Selenge Aimag, is 4788 $km^2$. The Soum center is located 160 km north of Ulaanbaatar, the capital of Mongolia and in 201km south of Selenge Aimag.

The fire experiment study site we selected is in ca. 20 South East of Zuunkharaa village center and 12 km West of Tunkhel center. This forest area is located in the river basins Kharaa and Orkhon and surrounded by mountains Noyon (1527m) and Khatan, which are relatively low mountain ranges in the far West of Khentee range.

Hydrography

Bayangol, Meheert, Ajnai and other small rivers of Nariin Davaa mountains flow around the study site. Kharaa is the biggest river in the area. The length of this river is 291 km and the river catchment area is 15,000 $km^2$. Sugnugur, Tunkhel, and Bayan rivers that start from Lower Khentii range flow to Kharaa river, so the width of the river extends through the deep bottom and the valley gets wider. The river water is widely used for cultivation.

Weather

Average annual temperature around these branch mountains of Khentee range of this region is -2.0°C degrees. It is not more than +18°C degrees above 0°C in July and not below than -22°C in January. There are approximately 90 days that are not cold. It means that it is relatively cool in summer and less cold in winter if compare to river valleys. However warmth is not enough for vegetation growth. Precipitation is in average 300mm annually and relatively thick snow layer stays in winter.

Annual average air temperature is -1 to -3°C in areas of 1000m above sea level and 0 to 1°C in steppes and river basins. January is the coldest month of the year in all areas, monthly mean air temperature ranges between -20.7 to -5.2°C. The warmest month is July and the mean air temperature ranges between 18.2 to 20.8°C.

However the air temperature reaches below zero in the first ten days in October in valleys between Khentii range mountain chains and it gets above 0°C by the mid of April. Here almost 220 days are cold.

[1] The references for this section were "Agricultural Weather Forecast of Mongolia" (1977, 1997), "Mongolian Climate" by Jambaajamts (1989), and "Mongolian Physico-Geography" by Sh.Tsagmid (1969).

The warm season in this area with more than 10 degrees above zero starts in middle of May and lasts for 110 - 130 days until the third decade of September.

Precipitation is varying between the different areas of the territory. Temporary heavy rains in summer do not penetrate well deep into soil. The soil take 80% of the rainfall of 6 - 10 mm. Rainfalls with more than 5 mm occurs in mid June, and rainfalls of more than 10 mm start in last June and end in late August of the year. In most years the moisture provision during the warm season in this area is 60–70% of the total annual precipitation. The mean annual precipitation is 309 mm.

Wind conditions

Dominating direction of wind is from west or northwest from rivers, high areas and mountains to valleys and lower areas. The mean wind speed is 1.5 m per second. In spring in April to May the mean wind speed reaches 2.4 to 2.5 m/s.

Wind conditions have to be taken into consideration when organizing forest fire fighting. Wind is influenced by atmospheric conditions, airflows, and by regional specific characteristics. The counter clockwise cyclone is based in southern Mongolia and stable in winter, therefore wind is mostly moderate; while in spring and autumn central latitude wind fronts are coming in and out from north and south, so the weather is not stable and affected by winds. Near-ground wind directions are determined by the local topography. For instance, directions of valley winds of rivers located along northwest to southeast are mostly from northwest or southeast, but directions of valley winds of river located along west to east are from west or east. It shows that physico-geographical settings of the area are very important for wind directions. North Western wind dominates around the year. Wind frequency reaches 40 - 70% and the average wind speed is approximately 2.2 m/sec. Days with snowstorms are in average 2.4 per year, the maximum is 5.1. There are in average of 10 days with dust storm per year. Mean wind speed in Khentii mountainous area reaches 2.1-3.5 m/sec. Wind speed is stronger from the first 10 days of March till June comes and snow or dust storms occur. The maximum wind speed occurs in March and April and it reaches 17 - 22 m/sec. Days with dust storms are 15 - 26 days in average and days with snow storms are 5 - 8 per year in average.

Soils

Mountainous taiga turf soil occurs in pine tree forest with grass and herb in mountainous taiga belt where the study site has been chosen (Ogorodnikov, 1981). Mountainous taiga turf soil occurs in the study site along a belt from the outskirt of the forest and dominates in southwestern and northwestern slopes. This area belongs to Khentii region by the Mongolian soil classification. There is a vertical soil zonation in the region: dark brown and brown soil dominates in the height of up to 1400 meter; dark mountain soil in 1400 - 1600m, and mountainous forest grey and mountainous turf taiga ashy soil seen in up to 1800 - 2000 to 2200m. Mountainous meadow peaty thin soil is distributed on flat tops of mountains, and brown and dark brown soil dominates in southern slopes of mountains that are not covered with trees.

Forest and vegetation

The study site is located in Khentii-Chikoin circle of southern natural zone according to the Mongolian forest and vegetation zonation map (source: Forest map of Mongolia, 1982).

| | |
|---|---|
| Forest type: | Pine forest with grass and herb in mountainous taiga belt |
| Forest composition: | 7 *Pinus* 3 *Betula* |
| Tree species: | *Pinus sylvestris* L., *Betula platyphylla* Sukacz. |
| Tree age classification & age: | *Pinus sylvestris* L., – Age class 5 (100 years)<br>*Betula platyphylla* Sukacz. – Age class 5 (50 years) |
| Average height: | Pine – 17m, Birch – 11m |
| Average diameter: | Pine – 24cm, Birch – 12cm |
| Bonitet: | 4, Thickness – 0.4 |
| Reserve per hectare: | $90m^3$; Total reserve: $2430m^3$ |
| Young adult: | Height: 2 m; 2000 pcs/ha |
| Composition: | 4 *Pinus*, 3 *Populus*, 3 *Betula* |
| Species: | *Pinus sylvestris* L., *Populus tremula* L., *Betula platyphylla* Sukacz. |
| Reserve: | *Pinus* 1701 $m^3$; *Betula* $729m^3$ |

Shrubs like *Spiraea media, Rosa acicularis* occur in the area. Grassy vegetation cover is 60 - 70% and *Carex amgunensis, Trisetum sibirica, Thalictrum minus, Artemisia tanacetifolia, Calamagrostis obtusata, Geranium sibirica, Elymus sibirica, Lespedezia dahurica, Zerna pumpelliana* quite common. *Rhytidium regosum* occur in groups (5 - 60%) as well as in patches (20 - 25%). Fuel loads like thin twigs, cones, needles, leaves, and barks are found on ground surface.

**Objectives of the Demonstration Experiment Using Controlled Fire for Wildfire Hazard Reduction**

The main objective of the experiment is to demonstrate that the use of controlled fire in feasible to reduce the hazard of a wildfire, which would damage and further degrade a pine forest. The effect of a controlled fire is to consume the surface fuels (needle and grass layer, twigs, branches). A reduced fuel layer will reduce the potential of a wildfire of high intensity.

**Procedures of the Demonstration Experiment Using Controlled Fire in Tunkhel Soum**

Following the international expertise, and particularly the experience of the Global Fire Monitoring Center (GFMC), the fire will be set by the GFMC team to demonstrate the safe and efficient use of a controlled fire. Participants will be instructed in the technique of controlled burning.

For some visual information on the use and effects of controlled burning see the Annexes.

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