MOUNT EVEREST FOUNDATION

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BMC BRITISH MOUNTAINEERING COUNCIL

S U M M A R Y R E P O R T FORM

from an MEF and/or BMC SUPPORTED EXPEDITION

Support for an expedition is offered on condition that you submit detailed reports to the MEF and/or BMC. To assist in fulfilling this commitment, it is requested that you fill in this form and return (preferably by E-mail) to the secretary (ies) of the organisation(s) within four weeks of return from the expedition. Please expand/contract the spaces in this form as required. Include or attach at least one good digital photo of your main route, with the line of your route marked.

1 - Name of Expedition: Investigating the drainage system of a Himalayan debris-covered glacier

2 - Expedition Leader/Organiser: Catriona Fyffe
Address: 3 Shipton Lane, Newcastle-Upon-Tyne, England, NE3 3GR

Preferred telephone number(s):
Home: Work: 0191 227 3956 Mobile: 07881822214

e-mail address: catriona.fyffe@northumbria.ac.uk

3 - MEF reference: 19-24 BMC reference:

4 - Country/Region: United Kingdom

5 - Names of all expedition members, indicating leader, climbing members, and support:

Catriona Fyffe, Northumbria University [Grant holder, lead for hydrology research]
Evan Miles, Swiss Federal Research Institute (WSL) [Team leader for expedition]
Marin Kneib, WSL
Simone Jola, WSL
Mike McCarthy, WSL
Alban Planchat, WSL
Reeju Shrestha, ICIMOD

Support provided by Himalyan Research Expeditions, Lazimpat, Kathmandu
Guides:
Laxmi Kumar Rai Kulung
Mahesh Magar
Paragon Ry
Plus support from around 25 porters (mainly to transport equipment to the field site initially) and cooks.

6 - Original objective(s) of expedition – mountaineering / scientific / medical, include location of objective (or study area) with indication of special points of interest (e.g. 'first ascent of NW Ridge') and heights of peaks:

Objectives:

Aim: To increase the understanding of the drainage system and proglacial runoff patterns of thickly debris-covered Himalayan glaciers.

Objectives:
1. To determine the structure (channelized or distributed) and efficiency of each component of the glacier drainage system.
2. Determine how the characteristics of the glacier drainage system and the resulting proglacial runoff signal is influenced by the thickness and topography of the supraglacial debris cover.

Study was on Langtang Glacier. Location of Moromoto base camp next to glacier: 28° 14' 37.02" N 85° 41' 58.98" E.

7 - Overall dates of expedition (e.g. 'March-June 2015'), showing time spent on approach, climbing, and return:

Overall expedition from 28th April 2019 to 28th May 2019. Trekking schedule with the research conducted on each day is given in Table 1. Note that we returned to Kathmandu 3 days early since the scientific objectives were completed and we did not need our additional buffer days.

Table 1 Schedule of trekking and research activities. Note only the hydrology activities are included for brevity.

Trek Days	Dates	Summary	Tasks	Elevation (m.a.s.l.)
	28-Apr	Depart Newcastle		80
	29-Apr	Arr KTM & transfer to hotel.		1400
	30-Apr	Final preparations		1400
	01-May	Bus to Syafrubesi		1400
1	02-May	Trek to Lama Hotel		2500
2	03-May	Trek to Mundu		3870
3	04-May	Trek to Kyanjing and visit Lirung Glacier	Downloaded Langtang discharge time-lapse camera (ICIMOD sensors)	3870
4	05-May	Trek to Langshisa Kharka	Langshisa stream discharge and EC sensors downloaded (ICIMOD sensors)	4140
5	06-May	Research tasks near Langshisa Kharka	Reconnaissance to Langtang Glacier stream, to determine site for gauging station.	4140
6	07-May	Trek to Morimoto Base Camp	Installed Langtang Glacier stream gauging station, including rhodamine fluorometer, conductivity probe and level logger	4600
7	08-May	Research based at MBC	Conducted discharge and water chemistry measurements at gauging station.	4600
8	09-May		AWS installed. Rhodamine dye injection into Stream 1.	4600
9	10-May		Two surface dye traces (one fluorescein, one rhodamine) into connected pond systems. Investigations into trough next to left lateral moraine, but no stream found,	4600
10	11-May		Conducted discharge and water chemistry measurements at gauging station.	4600
11	12-May		Dye tracing with Rhodamine into stream leading into drained lake. Fluorescein dilution gauging of stream discharge.	4600
12	13-May		Surface trace with fluorescein of supraglacial stream leading into a pond. Afternoon off due to heavy snow.	4600
13	14-May		Installed UDG, ablation stake and soil moisture sensors. Water sample from pond next to AWS.	4600

14	15-May		Water flow through debris experiment using fluorescein. Rhodamine injection into stream leading from pond system.	4600
15	16-May		Discharge and water chemistry measurements at gauging station. Data download and removal of rhodamine fluorometer and conductivity probe. Level loggers remain installed for removal in November.	4600
16	17-May	Trek to Kyanjing		3870
17	18-May	Personal time around Kyanjing		3870
18	19-May		Visit Lirung gauging station (ICIMOD sensors)	3870
19	20-May	Trek to Lama Hotel		2500
20	21-May	Trek to Syafrubesi		1400
	22-May	Jeep to Kathmandu		1400
	23-May	At leisure in Kathmandu	Organise data and equipment, write field report for ICIMOD	1400
	24-May		Organise data and equipment, write field report for ICIMOD	1400
	25-May		Day off in Kathmandu	1400
	26-May		Organise data and equipment, write field report for ICIMOD	1400
	27-May		Day at ICIMOD offices, share data and summarise fieldwork	1400
	28-May	Depart Kathmandu		1400

8 - Give the following details for each route climbed or attempted:
Name of mountain/crag, altitude, estimated route length, dates, grade, style (eg alpine, fixed rope), whether first ascent, successful or not, high point reached, reason for retreat (if applicable), weather conditions, and names of climbers:

Since this was a research expedition, the data collection activities have been summarised below.

1. Gauging station installation.
   A gauging station was installed on the Langtang Glacier stream on 07/05/2019 at 28.23241°N 85.69101°E 4419 m. At this gauging station a level logger was installed alongside a fluorometer and conductivity probe, with data for the latter two instruments logged with a Campbell data logger. At the end of the fieldwork the fluorometer and conductivity probe were removed, leaving the level logger to record until the team return in November. A total of 8 dye dilution gaugings were conducted at a range of flows over 3 days. These will allow the relationship between stream level and discharge to be developed so that the level record can be converted into a continuous record of discharge.

Figure 1 Left: Both installations in pool (angle holds conductivity probe, U-channel has level logger in well sitting within the U-channel and the fluorometer attached at the side). Right: Aluminium U-channel with stage markings.

Figure 2 Looking upstream towards gauging station. Arrow highlights loggers.

2. Dye tracing

The englacial/subglacial traces were conducted primarily with rhodamine (see Table 2Table 2), although the trace on 10/05/2019 actually revealed a connected pond system. Rhodamine traces were detected at the proglacial stream with the Rhodamine Turner Fluorometer installed at the gauging station. The supraglacial traces were conducted primarily with fluorescein, although the tracing on 12/05/2019 was to determine the discharge of the drained lake stream (Table 3). Fluorescein traces were detected with a handheld Fluorescein Turner fluorometer with DataBank Datalogger.

Table 2 Rhodamine WT injections.

Date	Time	Quantity injected (ml)	Location	Location °N	Location °E	Description	Supraglacial discharge
09/05/2019	14:13:00	300	S1: Stream 1	28.23574	85.69993	Flowing stream near ice cliff area	0.0187
10/05/2019	14:13:00	300	S2: Paragon's pond	28.23793	85.6985	Small pond at base of Paragon's moulin	NA
12/05/2019	15:38:43	300	S3: Drained lake stream	28.23824	85.70064	Flowing stream which disappears into debris around three quarters of the way up the slopes of the drained lake. Bed and sides composed of debris.	TBC
15/05/2019	13:48:00	300	S4: Ice cliff stream	28.23932	85.70293	Very small stream leading from a pond which then runs into an undercut/incised ice cliff	0.0005

Table 3 Fluorescein injections.

Date	Time	Quantity injected (ml)	Location	Location °N	Location °E	Description	Supraglacial discharge
10/05/2019	11:48	20	S5: At connected	28.23832	85.6987	Into small seep at 1.60 m	-

			ponds location				
12/05/2019	15:55:13	3	S6: At drained lake stream	28.23824	85.70064	Flowing stream which disappears into debris around three quarters of the way up the slopes of the drained lake. Bed and sides composed of debris.	TBC
13/05/2019	10:39:00	10	S7: At stream draining into Alban's big pond	28.24265	85.70335	Small stream emerging/disappearing into debris. Debris floored.	0.0004
15/05/2019	09:37:00	20	S8: At Debris flow pond.	28.23842	85.6982	50 cm long trench dug into debris, dye spread along this trench.	NA

Figure 3 Dye tracing the drained lake stream on 12/05/2019 with rhodamine.

Figure 4 Dye tracing the stream draining into Alban's pond on 13/05/2019 with fluorescein.

3. Water chemistry
   Water samples were collected both at the proglacial stream (10 samples) and from supraglacial streams and ponds (8 samples). They will be analysed later for their bicarbonate and sulphate concentrations which are indictors of the hydrological environment. All samples were filtered in the field through pre-weighed 0.45 µm filter paper and stored in new bottles.

9 - Any other relevant comments (permits, liaison officer, etc):
Permits for the field team were successfully obtained in Kathmandu from the Department of National Parks and Wildlife Conservation, Government of Nepal, prior to leaving for Langtang Vallley.

10 - Expected date of submission of Final Report: 31st July 2019.

Final Report Information

1. A sketch map of the area, and a photograph showing the line of your route(s).

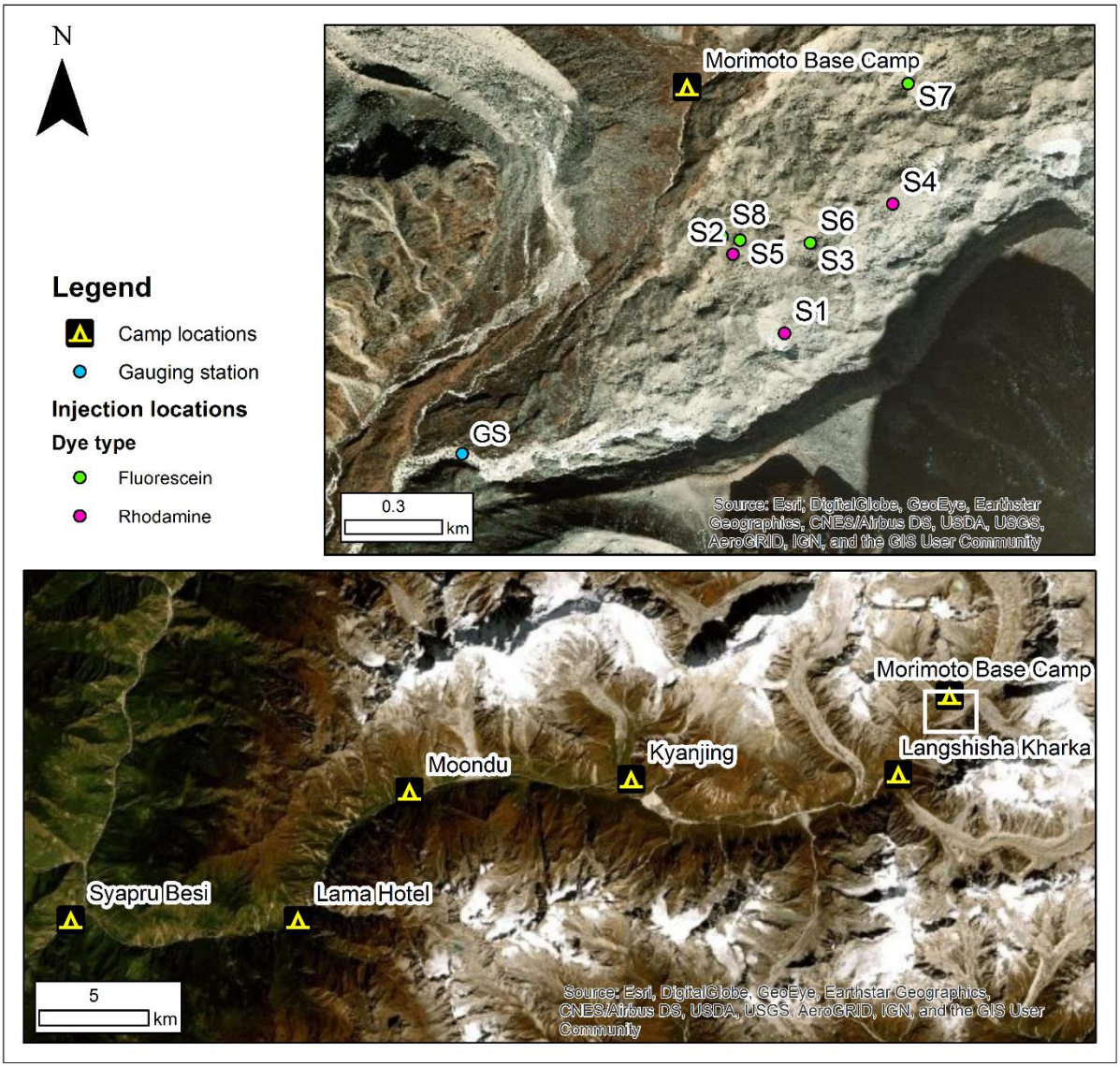

Figure 5 Upper map shows the location of the dye injections and the gauging station located on the Langtang Glacier proglacial stream. See Table 2 and Table 3 for descriptions of the injection locations. Lower map shows the villages and camp locations on the route to Langtang Glacier.

2. Photographs of glaciers for comparison with past and future pictures.

Figure 6 Looking upglacier towards the snout of Langtang Glacier (notice ice cliff in centre), with proglacial stream to the right of the photograph. Photo taken looking approximately north-east. Taken 06/05/2019.

Figure 7 Looking approximately south-east, from the right-lateral moraine of Langtang Glacier (just down a little from Moromoto base camp) looking across to the left-lateral moraine. Taken 16/05/2019.

Figure 8 Looking approximately south and downglacier, from the right-lateral moraine of Langtang Glacier (just down a little from Moromoto base camp) across to the left-lateral moraine. Taken 16/05/2019.

Figure 9 Looking approximately east and upglacier from the right-lateral moraine of Langtang Glaicer across to the left lateral moraine and a tributary glacier. Taken 17/05/2019.

3. Suggestions for new routes or new subjects for study in the area.

After this pre-monsoon field visit there is a need to assess how the efficiency and structure of the hydrological system has changed within the monsoon period. The team plans to return in October/November to repeat the dye traces and to collect another set of water chemistry samples to allow comparison. Funding has been secured by Catriona Fyffe from the National Geographic Society Explorer Grant in order to complete this work. This will further enhance the value of the data collected in May.

4. Notes on access, porters, or other issues of interest to future visitors.

Although permits for the field team were successfully obtained in Kathmandu from the Department of National Parks and Wildlife Conservation, Government of Nepal, this was mainly possible through collaboration with ICIMOD and did take some time in advance of the expedition.

Since the 2015 earthquake the path from Syapru Besi to Kyanjing is in good condition, guest houses have been rebuilt (now often several stories high) in Moondu, Langtang (at least in the area of the village remaining above the debris flow avalanche track) and Kyanjing, and there is internet access through Everest link in Moondu and Kyanjing. The locals in Kyanjing suggested that there would be a phone mast installed soon. There were frequent helicopter flights in and out of Kyanjing while we were there (several a day, May 2019).

5. Details of any injury or illness to expedition members and/or porters.

In general the scientists, guides and porters remained well during the trip, except from some mild stomach upsets, and mild symptoms of altitude sickness (occasional sore heads and sleep apnoea on initial nights above Kyanjing).

6. Details of waste disposal.

When camping at both Langshisha Kharka and Moromoto Base camp all rubbish was collected by the guides/porters and was carried back to Kathmandu for disposal. Any harmful wastes (e.g. used batteries) were returned to the UK. Pits were dug for human waste at both camps and these were filled in completely with soil upon leaving. We followed the ‘leave no trace’ principle at the campsites.

While trekking we used toilets in tea houses and guest houses along the route and carried rubbish with us for disposal in Kathmandu or the UK as above. We drank boiled water provided by guest houses or the cooks in camp to avoid the use of bottled water.

7. Summary of expedition accounts, including income and expenditure.

Table 4 Accounts detailing the expenditure on the project and the funding sources which contributed funds.

Expenditure	
Trekking and hotel fees	£3,128
VISA for 30 days in Nepal	£31
Return flights Newcastle to Kathmandu	£742
Per diem in Kathmandu	£92
Rhodamine and Fluorescein dye	£241
Total	£4,234
Income	
Mount Everest Foundation	£1,200
Northumbria University Research budget	£1,867
Northumbria University lab budget	£241
WSL Research budget	£926
Total	£4,234