

Low Oxygen Levels Detected Next To Wildland Fires

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Introduction:

In recent years there have been several instances in which fire trucks have stalled while crossing active fire lines on wildland fires. (Figure 1&2) The initial hypothesis was that poor maintenance was the cause. Based on previous observations we hypothesized that stalling was due to low oxygen levels near fire lines. Vehicles that have stalled have burned and in some cases occupants were severely burned.

Figure 1: Engulfed Pumper



Figure 2: Post Rollover

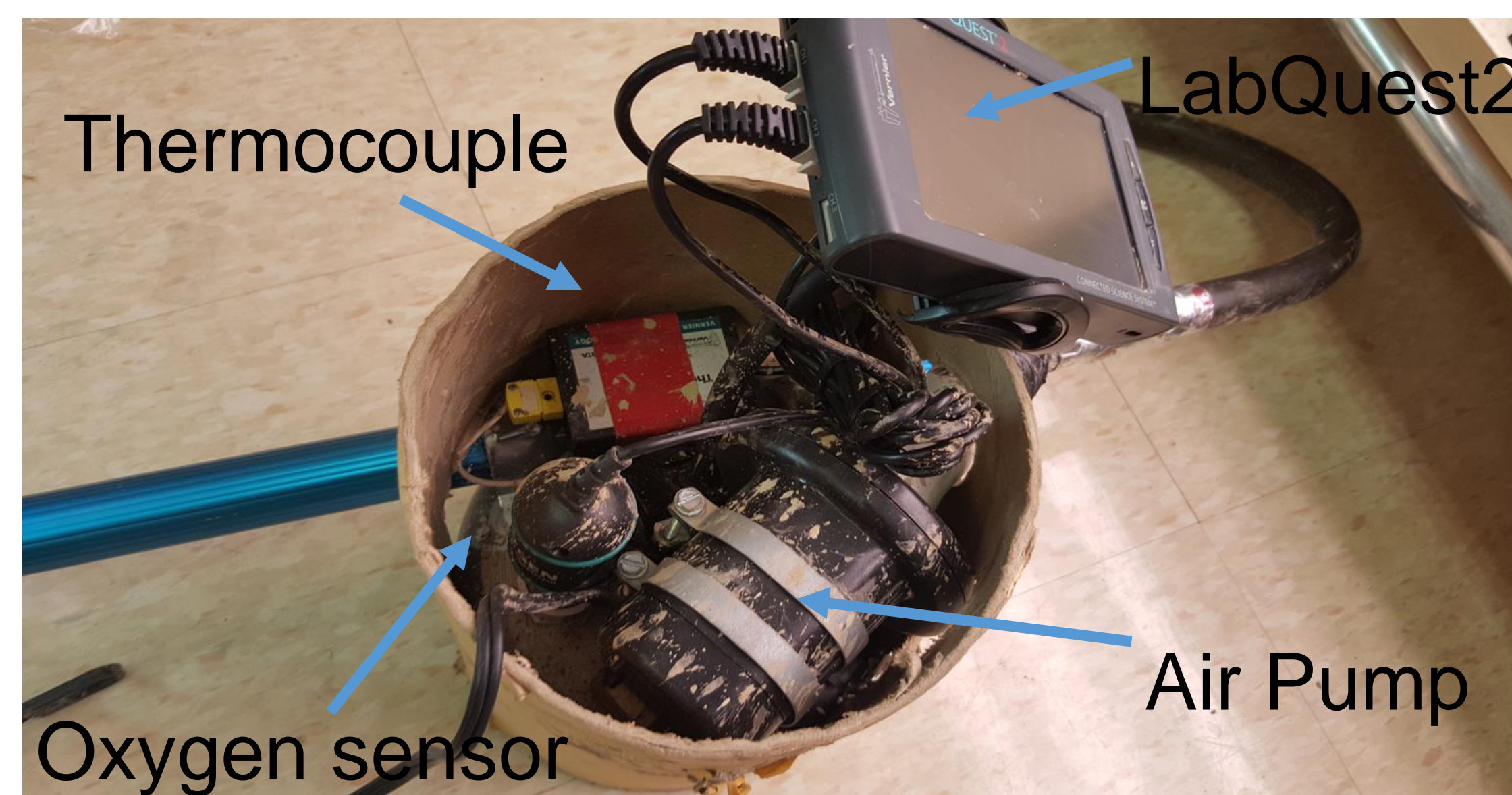


Figure 3: Close up of sampling equipment

Materials:

The sampling device was constructed from the following materials (Figure 3)

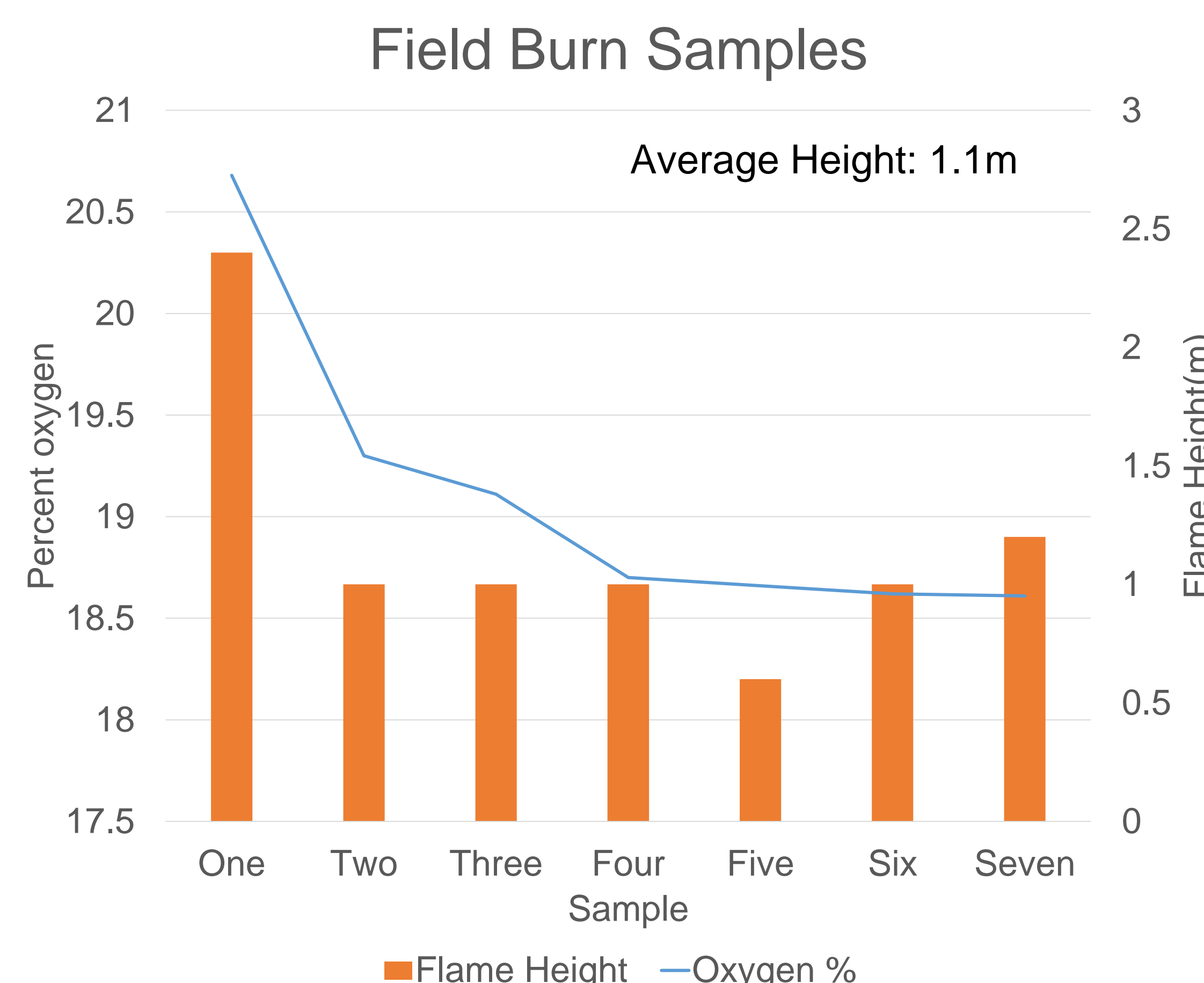
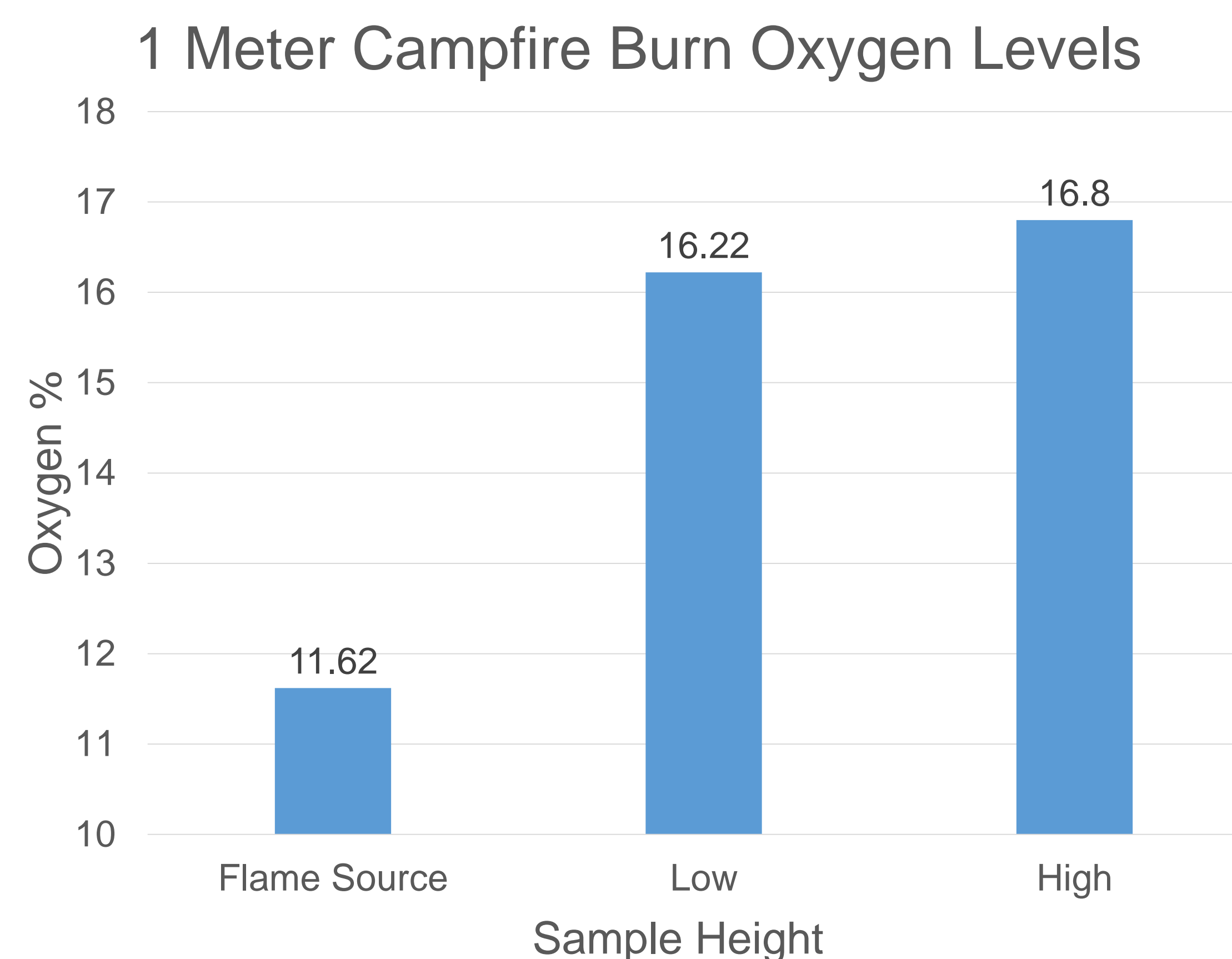
- Vernier Oxygen Probe & Thermocouple
- LabQuest2 Data Logger
- Intex Quick Fill air pump
- Escape 150 rechargeable battery pack

Methods:

We sampled oxygen levels of 2 types of fires; bonfires and wildland fires. Bonfires were sampled by measuring in the flame source, low and high in comparison with flame height. The flame source measurement was taken .6 m from the flame source, Low was within the .3 m of the flame tip and High was within .6 m from the flame tip.(Figure 4) Wildland fires were measured by trying to stay within 15 to 30 cm from the top of the flame. Due to wind and varying flame conditions, this varied as much as 15cm. (Figure 5&6) Sampling started on bonfire type fires and after successful testing, sampling switched to prescribed wildland burns. Due to the length of the inlet boom, there was an approximate 10 second delay until the sample was measured.



Figure 4: The different height measurements taken



Discussion:

Bonfire sampling showed oxygen levels as low as 8.8%. When a vehicle intake was hooked up to run off of this low oxygen zone, the vehicle stalled. Results were less precise than we would like due to variation in wind speed, humidity, the researcher's ability to withstand heat and a 10 second sampling delay due to the inlet boom length. Under moderate to low fires conditions we were able to detect O₂ levels low enough to stall fire engines. Analyzing findings from Wildland Fire Lessons Learned Center (Pine Fire Dozer Entrapment, 2007; Jesustia Fire Burnover, 2009; Bowles Creek Bottom Fire, 2011), hints that moving the vehicle's intake or increasing its length may reduce the possibility of the engine stalling in near fire. In other incidences (Kates Basin Fatality Report, 2000; Bowles Creek Bottom Fire, 2011), we believe that a supplemental oxygen system would be beneficial and reduce the probability of an engine stalling near fire.

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