WORK REST RATIOS SHOULD BE DEVELOPED AND FOLLOWED FOR ALL PRESCRIBED, BURNOUT AND DIRECT FIREFIGHTING OPERATIONS FOR WILDLAND FIREFIGHTERS

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Introduction

Heat load is the measurement of heat from the environment plus heat of metabolism minus heat loss. Structural and Wildland firefighters have different work environments but are still both susceptible to heat illnesses. The heat of the day , heat from their gear, as well as the heat added from the fire can cause their body temperature to increase to dangerous heights. Increasing their chances of heat illness.

With a work/rest ratio, firefighters would be able to asses their surroundings and rotate in and out according to the conditions.

Materials and Methods:

Fire temperatures at different distances and different heights were collected during field burns at The Konza Prairie Biological station, Manhattan KS and Wilderness Park, Lincoln NE. A Kestrel 5400 with an attached wind vane, was mounted onto a 1.5 m long pole. The data was stored on the Kestrel and was collected every two seconds.

Temperature samples were taken from three distances from the fire. The distances were 0.9 meters (3 feet), 1.5 meters (5 feet) and 3 meters (10 feet) (all visually estimated in the field). Temperature samples were also taken from three different flame heights. Flames were considered low if they ranged in height from the ground to knee height (0.5 meters). They were considered medium height if they ranged from knee to waist (0.5 to 0.6 meters). And High if they were above the waist (everything above 0.6 meters). (See Fig 1).
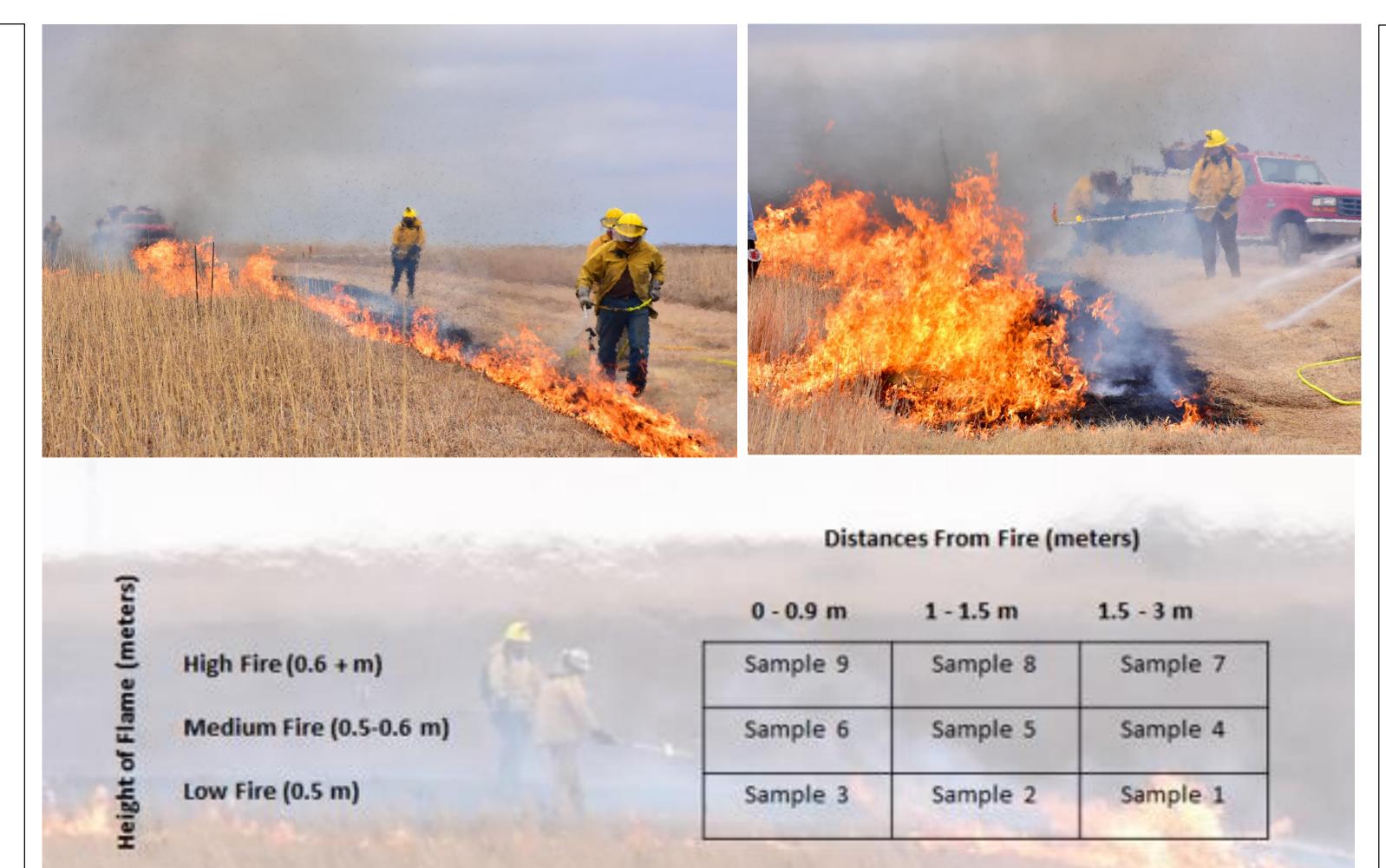

Figure 1: Visual representation of the heights of fire vs the distance from fire
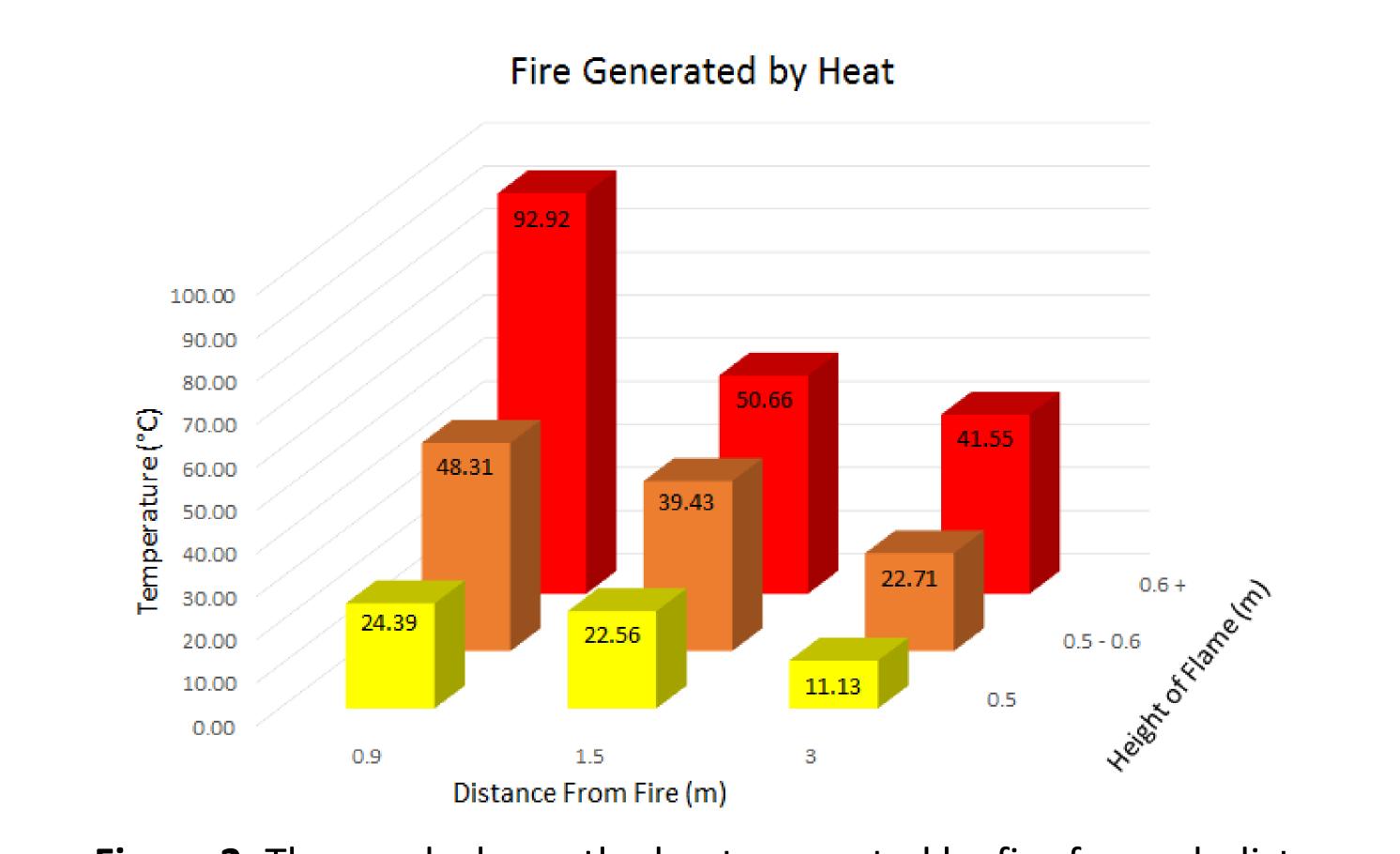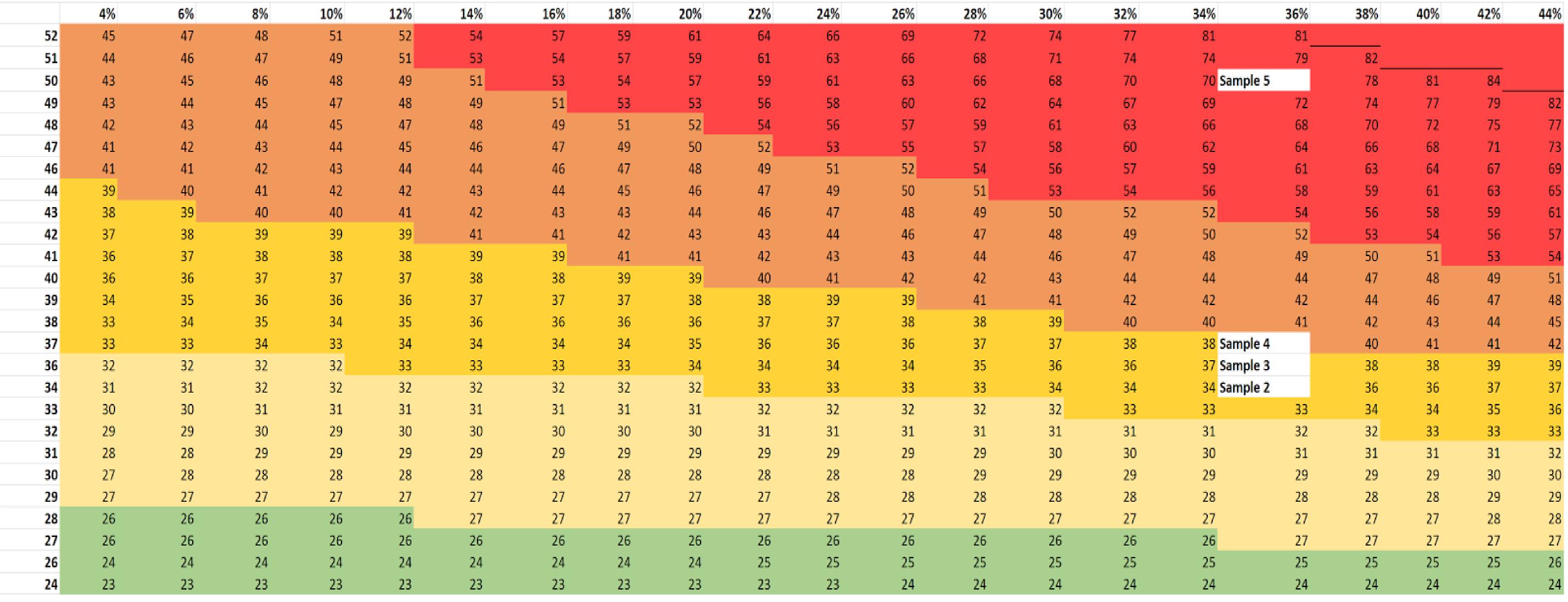

Figure 2: The graph shows the heat generated by fire for each distance from fire as well as the height of the flame.

Hypothesis: Large fires in close proximity produce more heat, requiring a work/rest ratio guideline to be implemented. Whereas medium fires and small fires, regardless of distance, do not need a work/rest ratio guideline.

Results

Heat generated by the fire was calculated by subtracting maximum ambient air temp during the prescribed burn from the temperature data collected at the flame front. The results match expectations of the bigger the fire, the more heat experienced. As well as, the closer to the fire, the more heat experienced. Fire added heat, ranged from an average low temperature of 11.1 ℃ (51. 98 ℉) to an average high temperature of 92.9 ℃ (199.22 ℉) (See Fig 2).

The lowest temp recorded was 13 ℃ (55.4 ℉) and, not surprisingly, was recorded at a distance between 1.5 m and 3 m with a flame height of 0.5 m. (small fires at a distance.) The highest temp recorded was 124 ℃ (255.2 ℉) (resulting in loss of the kestrel and first degree burns to the researcher) and, not surprisingly, was recorded at a distance of 0.9 m with a flame height of 0.6 m.

Discussion

Fire generated heat was far more substantial than originally estimated. Even the smallest fires can increase the heat experienced by the firefighter by 10 ℃ (18 ℉). All fires that were recorded as medium height (0.5 to 0.6 meters) were found to be in the caution zone. And the fires that were recorded as low height (0.5 meters and below) were shown as the safest.

Therefore, firefighters should have a work/ratio to prevent heat illnesses.

Figure 3: Heat Index Chart With Samples

Sample 1 was not recorded because it was too low in the green.

Sample 6 was not recorded because it was too high up in the Extreme Danger Zone.

Sample 7 was not recorded because it was too high up in the Extreme Danger Zone.

Sample 8 was not recorded because it was too high up in the Extreme Danger Zone.

Sample 9 was not recorded because it was too high up in the Extreme Danger Zone.