

# DEHYDRATION IN LOGGERS - EFFECTS OF SEASON AND TIME OF DAY

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## Summary

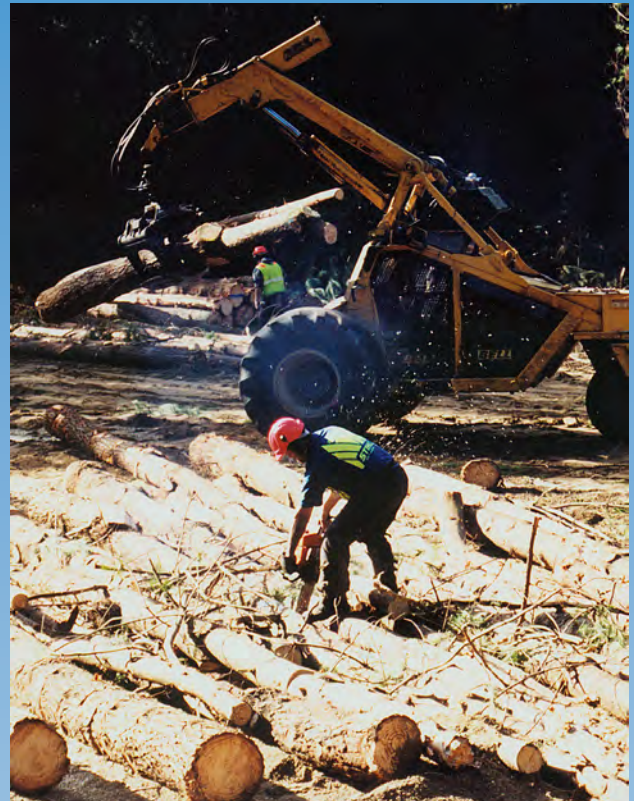
Over one winter and one summer, a total of 24 loggers provided urine samples three times a day for four consecutive days. The specific gravity of each sample was measured using a refractometer. The value of specific gravity indicated the level of hydration of the individual at that time. The specific gravity values indicated that most loggers were insufficiently hydrated, and some were dehydrated (according to the criteria of the Royal College of Pathology, Australia). There were no significant differences between winter and summer values, with poor hydration in both seasons although there were differences in the types of drinks consumed according to the time of year. There were significant differences according to time of day; urine specific gravity was high (indicating poor hydration) before work, decreased by midday and rose again to a high level at the end of the day.

## Introduction

Previous COHFE (and Liro) reports have discussed dehydration in loggers and other workers. Dehydration is one factor that can impair workers' ability to make decisions, which may be safety critical, and can also influence their physical ability to perform these tasks, as dehydration reduces aerobic capacity. Additionally, workers who are dehydrated over long periods of time are exposed to long term consequences of kidney stones and bladder cancer (Michaud et al., 1999). Last year a COHFE Report (Volume 2, Number 2, 2001) outlined the findings of a Pilot Study into Dehydration in Loggers. The study involved over 30 loggers, and evaluated their level of hydration through measurement of the specific gravity of their urine.

The pilot study came to a number of conclusions. Firstly, the methodology - collecting and analysing urine and gathering subjective information from workers - was successful in producing useful hydration related data.

Secondly, results indicated that loggers were either poorly or only just adequately hydrated. Various reasons for dehydration were indicated, including habit, lack of sufficient knowledge, impractical water containers etc. Refer to the full report for details. The pilot study introduced the concept that workers do not have to drink



a certain volume of water but rather should consider the volume and content according to the work they are doing and environmental conditions.

In order to determine their own hydration status, the study proposed workers:

- Drink enough to pass urine at least once during the working day
- Drink enough to have light coloured urine

The report also suggests limiting the amount of caffeinated and sugary drinks.

The study concluded that further work was needed :

- to investigate the effects of seasonal changes in weather conditions,
- to investigate the effects of caffeine on urine specific gravity

This report summarises the work evaluating the effects of seasonal changes and time of day on logger hydration.

## Study aim

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To determine the effects of seasonal weather changes and time of day on dehydration in a sample of loggers.

## Method

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During winter and summer, 24 male loggers volunteered to provide urine samples. Twelve of the loggers were included in both the winter and summer sampling. The loggers provided three urine samples each day, for four consecutive days: on arrival at work, at meal break and immediately before leaving the work site for home.

The urine sample was collected in a plastic screw top bottle; researchers wore disposable rubber gloves throughout the procedure, following which the urine sample was discarded. A sub-sample of urine was taken by disposable pipette and the specific gravity (sg) was measured by placing the sample on the viewing platform of a refractometer (Atago instruments).

Researchers recorded:

- Environmental conditions at the time of urine sample collection
- Specific gravity of each sample
- Quantity and type of fluid consumed by each logger in the period from the previous urine sample to the current urine sample
- Age, height and weight of each logger.



All loggers wore the personal protective equipment ensemble required for work in New Zealand forests: helmet and ear muffs, high visibility shirt or vest, chainsaw cut resistant legwear (chaps or trousers) (for those using a chainsaw) and leather or chainsaw cut resistant rubber boots with steel crush resistant toe caps.

The analysis used the individual urine sample as the statistical unit. The statistical model used to partition variance was: Urine specific gravity =  $\mu$  + season (summer, winter) + time of day (before work, mid day, end of work) + error.

Crew and day of the week were not significant effects.

# Results

The physical characteristics of the loggers are shown in Table 1 and Table 2 shows the environmental conditions during the study, with the high globe temperatures indicating the heat being radiated from the highly reflective pumice soils of the Central North Island forests. The loggers were acclimatised to working in the conditions.

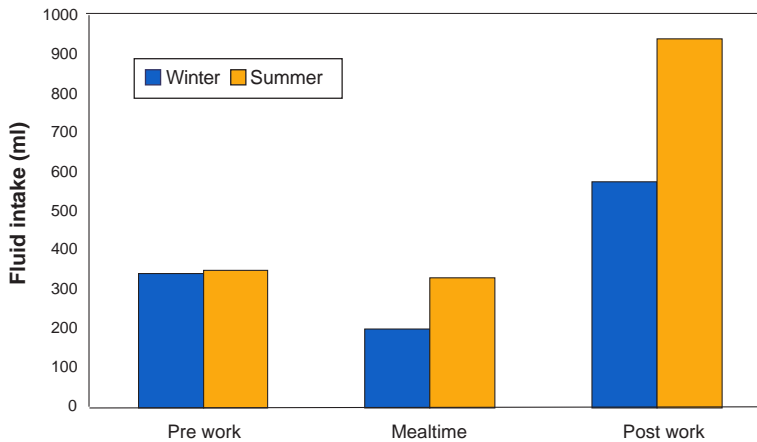
*Table 1. Physical characteristics of the 12 loggers sampled in both winter and summer.*

	Mean	SD	Min	Max
Age (years)	35.1	11.4	18	52
Height (m)	1.78	0.07	1.65	1.92
Weight (kg)	90	21	65	130

*Table 2. Environmental conditions recorded at the time of urine specific gravity readings.*

	Winter		Summer	
	Mean	SD	Mean	SD
Dry bulb	10.9	3.7	18.5	4.5
Wet bulb	7.8	2.2	14.9	3.7
Globe	12.2	3.3	20.7	6.8
WBGT	8.8	2.8	16.3	4.3

The 12 loggers who were measured in both seasons consumed more fluid in summer than in winter: 1640 ml/day in summer and 1130 ml/day in winter ( $p < 0.05$ ). In addition, there was a distinct daily and seasonal pattern of greater fluid consumption later in the day in summer (Figure 1).

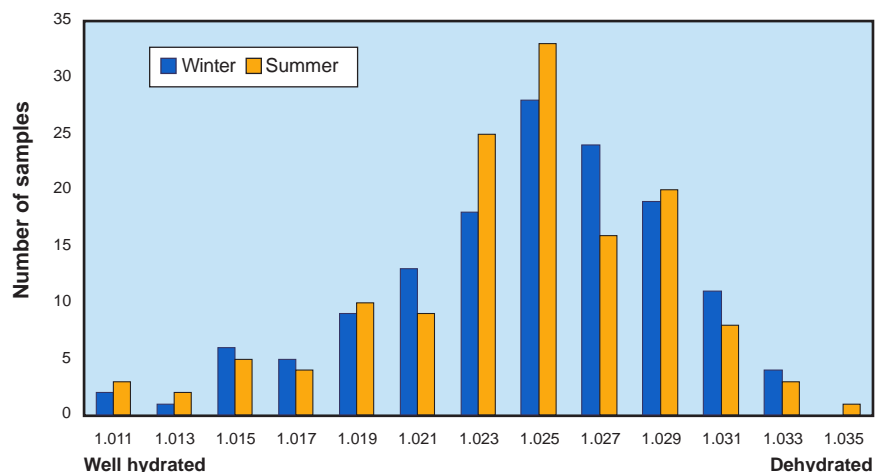


*Figure 1. Average volume of fluid intake by time of day and season*

Ideally, urine specific gravity should be approximately 1.020 g/ml or below (Donoghue et al., 2000). The Royal College of Pathology, Australia considers a value of over 1.030 g/ml to indicate dehydration. Loggers' urine specific gravity ranged from 1.010 g/ml to 1.033 g/ml in winter, and 1.010 g/ml to 1.035 g/ml in summer with the single greatest number of loggers having a urine specific gravity of 1.025 g/ml in both winter and summer (Figure 2). This indicated that some loggers were in a dehydrated state at the time of sampling. The majority of loggers were hypohydrated (between sg 1.016-1.030 g/ml), a term meaning under or less than ideally hydrated.

The type of fluid consumed varied with season. In winter, over half (54%) of the loggers reported drinking only tea or coffee in the period preceding urine sampling and 15% drank soup or hot non-caffeinated drinks like Milo. Only 5% reported drinking only water in winter.

In summer, just under half (46%) drank tea or coffee, none drank soup, 28% drank both tea/coffee and water, 13% drank cordial and only 9% drank only water.



*Figure 2. Urine specific gravity(g/ml) in winter and summer*

## Results (continued)

Urine specific gravity was the same in winter and summer. However there was a significant effect of time of day (Figure 3): urine specific gravity was high before work, decreased by midday and rose again to a high level at the end of the day.

The interaction between season and time of day was not significant indicating that the time of day effect was similar in both summer and winter.

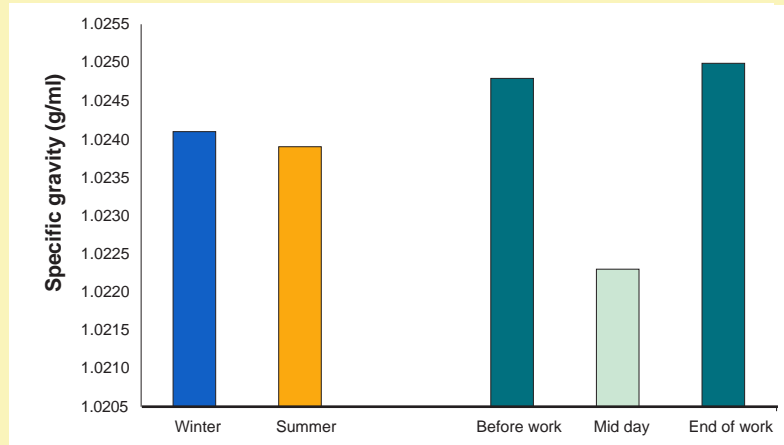


Figure 3. Urine specific gravity relating to season and time of day

## Discussion

A significant proportion of loggers were under-hydrated in both winter and summer. There was no significant difference between mean specific gravity in winter and summer. This may be due to the microclimate against the loggers' skin associated with the additional clothing worn by loggers, limiting the effect of changes in climate. Loggers also changed drinking habits during cooler winter temperatures resulting in less fluid consumption than in summer, and equally poor hydration.

A low proportion of loggers were drinking plain water, perhaps indicating the unattractive nature of this drink. Cordial, which was more palatable to the loggers, was drunk more in summer. However loggers must be alerted to the high sugar content of many cordials and dilute them appropriately. Many loggers drank coffee and tea, which are diuretics, which cause increased urine output - i.e. will increase dehydration effect. Rather than trying to get loggers to replace these drinks with water, a more successful strategy may be to suggest they consume less diuretic drinks and supplement their fluids with cups of dilute cordial or water, particularly in winter.

The variation in both specific gravity of urine and in quantities and types of drinks consumed indicates large differences in fluid requirements (depending on individual differences, job type, clothing insulation, etc.). Rather than prescribe a volume of fluid to consume over a period of time, it is therefore more appropriate to advise loggers to:

- increase their fluid intake
- ensure they need to pass urine regularly
- ensure that their urine is pale in colour.

The use of urine specific gravity as a hydration indicator is a simple measure for use in the field and can also be used to provide direct feedback to the participating workers.

## Acknowledgements

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## References

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