

# Noise Exposure Assessment among Groundskeepers: A Pilot Study

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## Background

- Noise is considered the most common occupational and environmental hazard (Rabinowitz, 2000). The National Institute for Occupational Safety and Health (NIOSH) estimates that around 30 million workers in the United States are exposed to hazardous noises on the job (Bessette, 2008).
- Noise-induced hearing loss (NIHL) is the most common illness and injury in North America (Bessette, 2008) and accounted for 11% of all occupational illness and injuries reported to the U.S. Bureau of Labor Statistics in 2004-2005 (Tak et al., 2009).
- Specifically here in the United States during the 2004-2005 calendar year, NIHL illness and injuries attributed to NIHL loss are a substantial percentage of the total occupational related illness and injuries in any sector.
- The Occupational Safety and Health Administration (OSHA) mandates that individuals exposed to noise levels at or greater than 85 dBA over an 8-hour period must be enrolled in a hearing conservation program. Even with this mandate, NIHL is still prevalent in noise-exposed workforces (McTague et al., 2013).
- OSHA noise standard (29 CFR 1910.95)
  - Any noise >85 dBA over an 8-hour period is considered hazardous to worker health, and controls must be implemented to limit worker exposure to this noise.
  - Permissible Exposure Limit (PEL) = 90 dBA over the 8-hour period
- Noise exposure controls can be in the form of engineering controls, administrative controls and, lastly, personal protective equipment (PPE).
- Landscapers, groundskeepers, and horticultural specialists use a variety of tools in their everyday working environment (OSHA, 1992). Examples of these tasks include lawn maintenance work, hauling equipment, garbage collection, tree planting/maintenance (i.e., trimming, pruning), and landscape design, building walls, patios and walkways. Tools that could be used by this group are mowers (riding and push), chain saws, weed trimmers ("weed whackers"), carts, trucks and along with many other pieces of equipment.

## Purpose of the Study

- To assess and investigate the noise exposure, the associated hearing effects and the use of hearing protection devices (HPDs) among groundskeepers at East Carolina University (ECU)
- Hypothesis (H<sub>0</sub>): The 8-hour time-weighted-average (TWA) noise exposure of ECU groundskeepers does not exceed the OSHA action limit of 85 dBA.

## Materials and Methods

- A sample of East Carolina University groundskeepers (n=30) were recruited to participate in this study. They were asked to complete a noise survey at the start of the study (i.e., pretest). After completion of an educational training that includes noise exposure and NIHL as topics, they completed the same survey (i.e., posttest). The pretest and posttest assessed worker knowledge and perceptions on wearing personal protective equipment and hearing protection devices, knowledge on the basics of hearing protection.



- A sub-sample (n=5) of different groundskeepers were monitored for personal noise exposure per monitoring day using personal noise dosimeters (Dosebadge™). Workers were monitored over their entire shifts (8-9 hours) over a month period. Dosimeters were fastened securely to a common orange safety vest that was worn by the worker during their complete shift (i.e. the vest should not be taken off during the monitoring period). The personal noise dosimeter was placed at shoulder level of the dominant side of the worker's body 4 inches from the worker's ear. The time-weighted averages (TWAs) and 1-minute averages of noise exposure levels (dBA) and daily noise exposure dose (%) were obtained.

- 2 dosimeter settings were used: OSHA for hearing conservation (90 dBA criterion level, 80 dBA threshold level, 5 dB exchange rate, 115 dBA ceiling, slow response) and NIOSH (85 dBA criterion level, 80 dBA threshold level, 3dB exchange rate, fast response)

- The participants were asked to fill out an activity card of what task(s) they completed that day (i.e. mowed grass from 8-9 AM), if anyone else was in the vicinity while completing the task, what tool was used (i.e. riding Toro mower), work location (i.e. inside or outside), and worker's subjective assessment of how they perceived the noise exposure (i.e. loud, quiet).



- Sound pressure levels (SPLs) produced by various groundskeeping equipment and tools operating at full throttle were measured near the ear of the operator using a Cel-254 digital impulse sound level meter with instrument setting at A weighting, slow response.
- Data was analyzed using SPSS v20.
  - Univariate analysis was employed to describe characteristics, distribution of participants according to KAP, noise exposure levels and equipment type.
  - Bivariate analysis was used to evaluate the associations between worker knowledge, attitudes and PPE use, and to assess the pre and posttest results on worker knowledge and attitudes on noise exposure and HPD usage.

## Results

Table 1. Basic Demographics of Survey Participants (N=30)

Variable	N (%)
Age	
Mean	44 years
Standard Deviation	12.67
Range	24-65 years
Gender	
Male	30 (100)
Female	0 (0)
Ethnicity	
White (not Hispanic)	20 (67)
Black (not Hispanic)	7 (23)
Hispanic or Latino	1 (3)
Other	1 (3)
Highest Year of School Completed	
9-12 <sup>th</sup> Grade	5 (17)
>12 <sup>th</sup> Grade	23 (77)
Marital Status	
Married	19 (63)
Single, Never Married	5 (17)
Single, Divorced	4 (13)
Separated	2 (7)
Do you have health insurance?	
Yes	26 (87)
No	2 (7)
Do you smoke?	
Yes	9 (30)
No	20 (67)
Do you consume > 5 alcohol beverages a week?	
Yes	9 (30)
No	18 (60)

Table 2. Job History and Equipment Used during Work of Survey Participants (N=30)

	N (%)
How long have you been a groundskeeper at ECU?	
1-2 years	6 (20)
3-4 years	6 (20)
More than 5 years	17 (57)
Did you work as a groundskeeper before you came to ECU?	
Yes	26 (87)
No	4 (13)
Previous Years as a groundskeeper	
Between 1 and 2 years	2 (7)
Between 3 and 5 years	5 (17)
More than 5 years	17 (57)
Do you do outside groundskeeping work?	
Yes	12 (40)
No	18 (60)
Current number of hours worked groundskeeping outside of ECU	
Between 1 and 5 hours	8 (27)
Between 6 and 10 hours	2 (7)
Between 11 and 15 hours	2 (7)
Have you ever served in the military?	
Yes	5 (17)
No	25 (83)
If yes, were you exposed to excessive noise?	
Yes	2 (7)
No	6 (20)
Were you ever exposed to loud noises at previous jobs?	
Yes	9 (30)
No	15 (50)

Table 3. Sound pressure levels (SPLs) of Equipment and Tools

Equipment and Tools	SPL (dBA)	
	Minimum	Maximum
Wood Chipper	102.1	105.7
Chainsaw	104.5	105
Blower	101.8	102.5
Ventrac	99.8	100.8
Edger	98.8	99.2
Hedge Trimmer	98.1	98.3
Weed Eater	97.8	98
Walk Behind mower	95.8	97
Push Mower	95.8	97
Riding Mower (Groundsmaster 4700-D)	95.2	95.9
John Deere (Tractor)	95.5	95.9
Blower (with Baffle)	94.4	94.8
Riding Mower (Groundsmaster 580-D)	93.5	94.1
Riding Mower (Groundsmaster 345)	93	94
Dingo	93.5	93.8
Riding Mower (Groundsmaster 328-D)	92.1	93.5
Water Wagon (Briggs & Stratton)	91.8	93.5
Fork Lift	92.6	92.9
Skid Steer	84.4	85
Backhoe	82.8	84.2
Hook Lift	75.5	80
Front End Loader	77.9	78.2
Sweeper Truck	75.7	76.1
Front End Loader (Mini Cat)	74.9	75.9

Table 4. TWA Noise Exposures (dBA) and Exceedence Percentages Using 2 Exposure Metrics

University Area	No. of TWAs	TWA, Mean (SD)		Exceedence Percentage			
		OSHA	NIOSH	OSHA		NIOSH	
		>85 dBA	>90 dBA	>85 dBA	>90 dBA		
All areas	81	82.2 (9.2)	87.8 (6.6)	45.7	13.6	76.5	42.0
CMC	20	83.3 (4.5)	89.0 (4.0)	35.0	5.0	80.0	40.0
NRC	7	86.1 (9.0)	90.2 (7.1)	71.4	28.6	71.4	42.9
East	7	75.6 (13.0)	83.1 (9.8)	28.6	14.3	57.1	28.6
WMC	25	85.2 (6.3)	89.6 (4.3)	60.0	20.0	92.0	56.0
HSC	22	78.7 (11.9)	85.4 (8.2)	36.4	9.1	63.6	31.8

- All university areas had readings above 85 dBA (Table 4).
- Highest TWAs were measured at NRC: OSHA (86.1 dBA) and NIOSH (90.2 dBA) (Table 4).

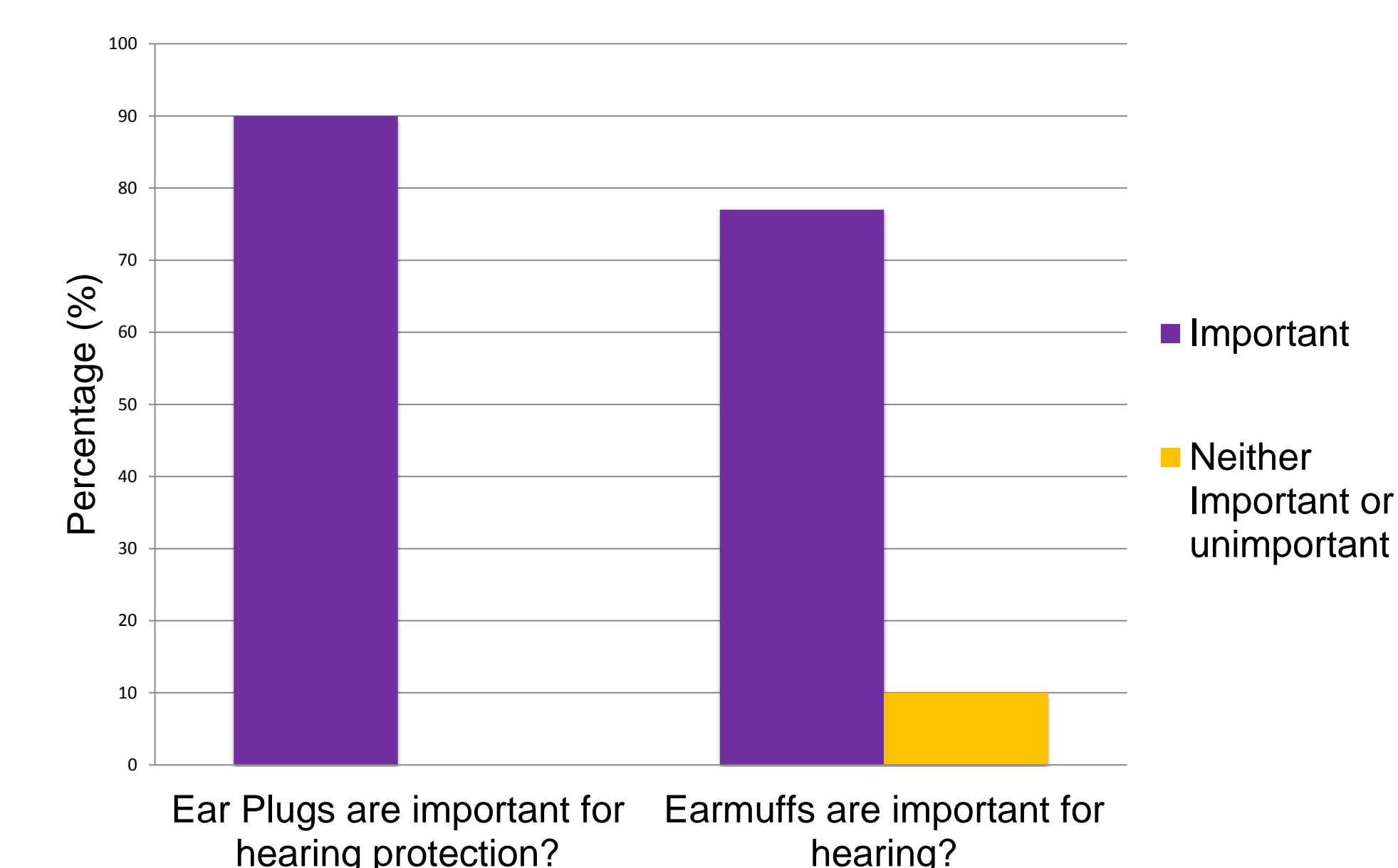


Figure 1. Perception on the Importance of Hearing Protection Devices (HPDs) (N=30)

- 90% said earplugs were important for hearing protection and 77% said earmuffs were important for hearing protection, while 10% were unsure of their importance (Figure 1).

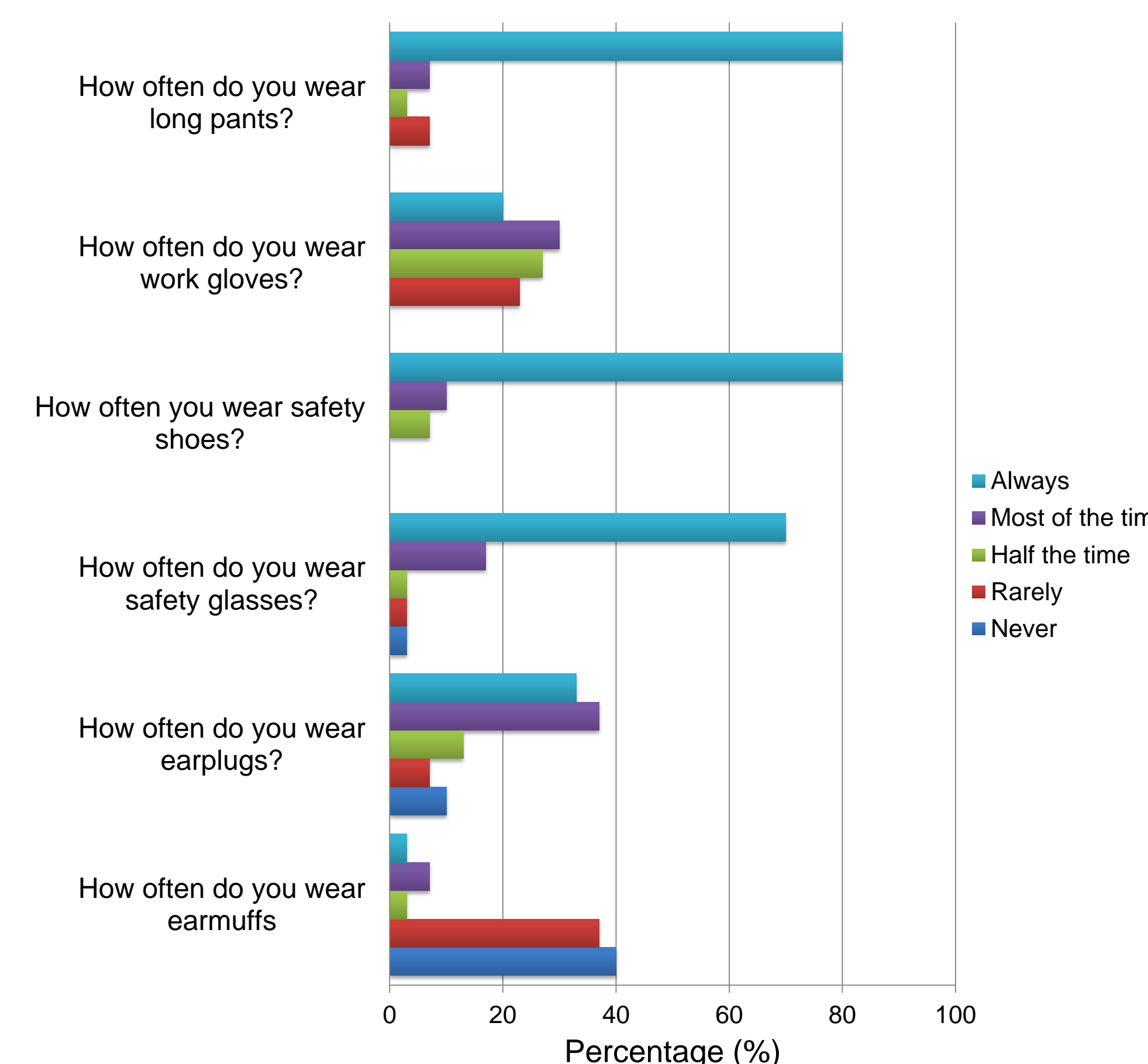


Figure 2. Frequency of Use of Personal Protective Equipment (PPE) Among Survey Participants (N=30)

- Only 35% said they use earplugs "all the time" and only 5% say they use earmuffs "all the time" (Figure 2).

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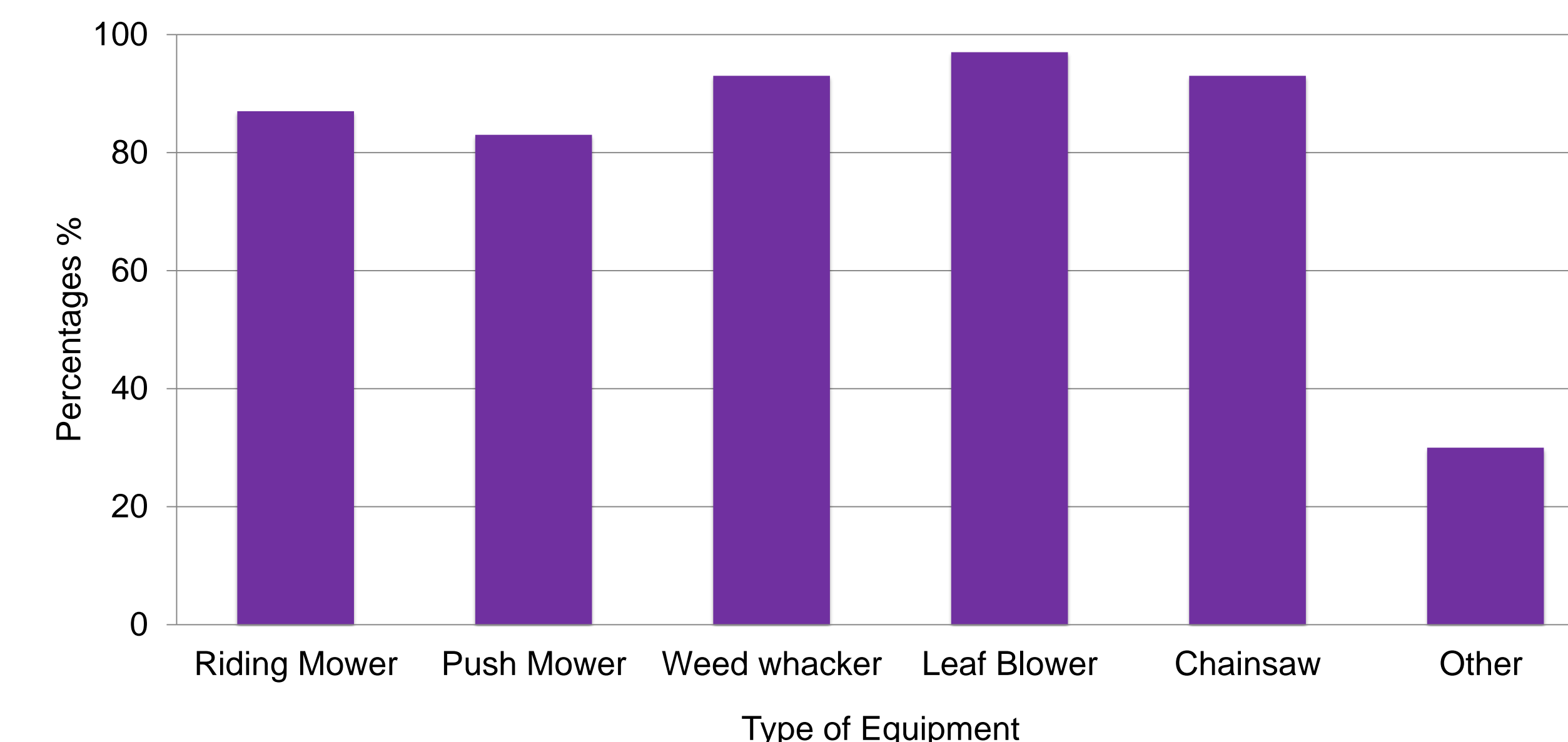


Figure 3. Equipment Used at Work by Surveyed Groundskeepers

- Over 80% of surveyed groundskeepers use mowers, weed eaters, blowers and chainsaws at work (Figure 3).
- 43% of surveyed groundskeepers think that wearing hearing protection is uncomfortable.

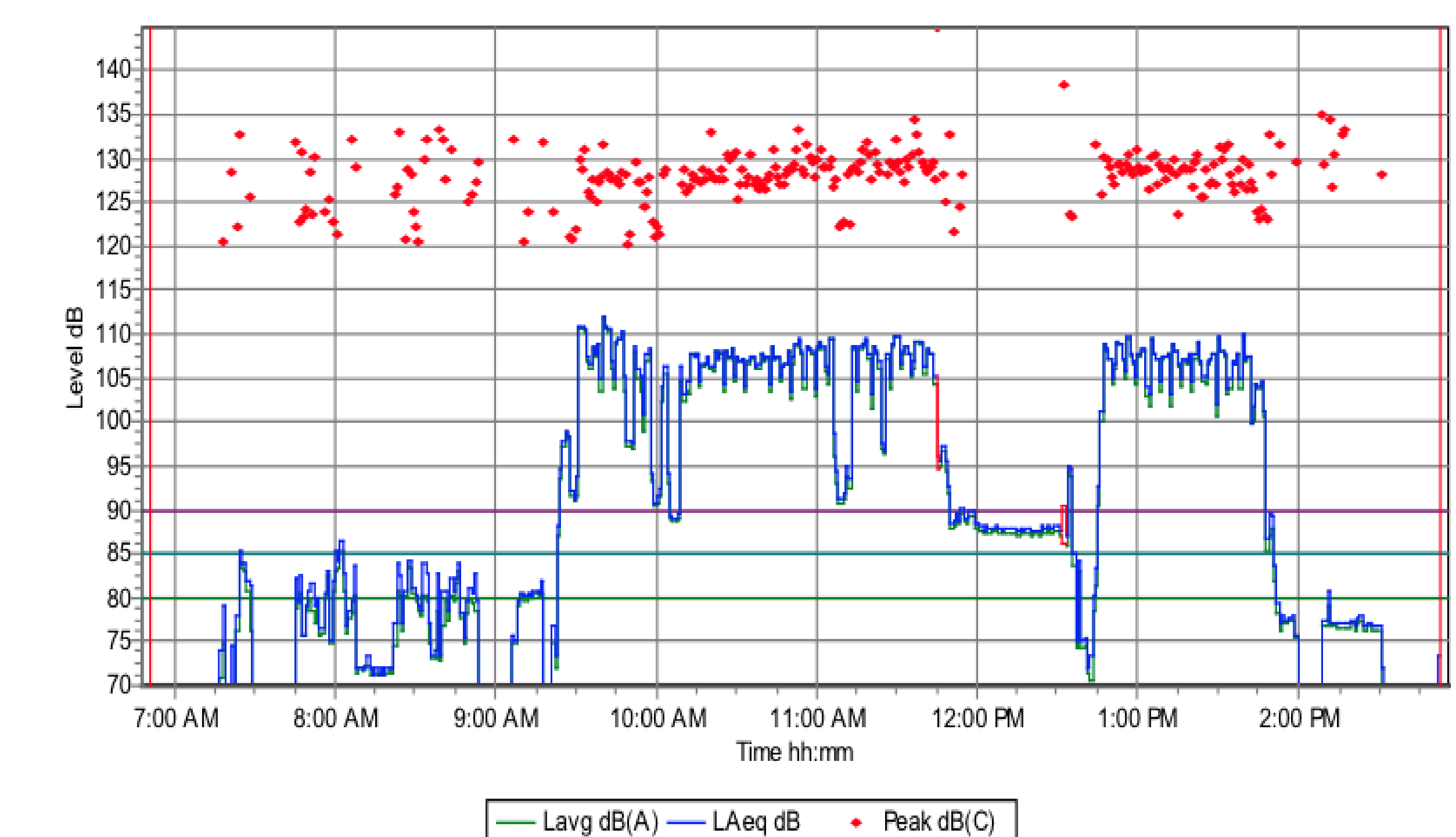


Figure 4. Personal Noise Exposure Profile of a Groundskeeper Working at North Recreational Complex (NRC). The average TWA was 103.2dBA. This particular groundskeeper was operating a Ford tractor with deep tine aerator.

### Strength of the Study

This study is one of the first of its kind to assess noise exposure among groundskeepers as a vulnerable work group. To our knowledge, this study was the first to measure the actual noise exposure among groundskeepers during their workday with personal noise dosimetry monitoring.

## Conclusions

- Groundskeepers working in all university areas monitored had TWA noise exposures over the OSHA action level of 85 dBA.
- Noise exposure levels depended on the type of equipment used and the amount of time that piece of equipment was used.
- ECU groundskeepers must be enrolled in a hearing protection program since the OSHA noise standard states that "whenever an employee noise exposure is equal to or exceeds an 8-hour TWA of 85 dBA" then a hearing conservation program must be implemented and that employee's noise exposure must be reduced below 85 dBA.
- Recommendations to reduce noise exposure of ECU groundskeepers include the following:
  - Participate in the NIOSH Buy Quiet Program when purchasing/upgrading equipment.
  - Consult employees on what types of hearing protection devices (HPDs) they found more effective and comfortable. Provide a different variety of HPDs.
  - Post noise levels of equipment around the workplace/garage to alert employees about dangerous noise levels.
  - Keep at least 50 feet between each worker when weed eating to reduce noise exposure.
  - Utilize worker rotations when completing noisy jobs and limit the amount of time one worker spends using noisy equipment.

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