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Safety Analysis Report: A Comparison of Incidents From Safety Years 2006 Through 2010, Rocky Mountain Research Station Inventory and Monitoring Program

Devon Donahue

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Abstract

This paper is an analysis of 5 years of accident data for the USDA Forest Service, Rocky Mountain Research Station (RMRS) Inventory and Monitoring (IM) Program that identifies past trends, allows for standardized self-comparison, and increases our understanding of the true costs of injuries and accidents. Measuring safety is a difficult task. While most agree that measuring leading indicators (linked to preventative actions) is a better indication for future performance, measuring lagging indicators (accidents, past occurrences) has been the more commonly accepted approach.

Keywords: accident data, Rocky Mountain Research Station, safety, injuries, accidents, inventory and monitoring, trend, costs

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Front cover photos were taken by RMRS field crews.

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Safety Analysis Report: A Comparison of Incidents From Safety Years 2006 Through 2010, USDA Forest Service, Rocky Mountain Research Station Inventory and Monitoring Program

Devon Donahue

Introduction

This paper is an analysis of 5 years of accident data for the USDA Forest Service, Rocky Mountain Research Station (RMRS) Inventory and Monitoring (IM) Program. Due to the nature of the Inventory and Monitoring Program, this accident data is specific to field data collection. Analysis of this historical data provides trends in past safety performance and allows for standardized self comparison. However, it should not be the only information used to evaluate the success of a safety program as the data rely on employees to self report injuries, accidents, and near misses, which are nearly always underreported. A comprehensive safety program review should include an evaluation of proactive measures that indicate current performance.

Methods

This analysis focuses on safety years 2006 through 2010; however, some data were available as far back as 2003. A safety year (SY), which was commonly used to report safety statistics, traditionally starts on July 1 and ends on June 30 of the next year; however, fiscal year (FY) and calendar year (CY) are now becoming more widely used.

Data used in this report were collected from multiple sources. Employee hours and miles driven were retrieved from the Program's Oracle database. End of safety year reports, personal injury reports, and the Safety and Health Information Portal System (SHIPS) were the sources used for personal injury data. These reports were kept in many different formats including calendar year, fiscal year, and safety year. Although the starting and ending dates of all these formats are different, the quarters are all consistent throughout, which allows for easy organization into the proper timeframe, e.g. the first quarter of FY 2006 is the same as the second quarter of SY 2006. Due to the frequent changes in collateral duty safety personnel up through the year 2006 and the varying approaches to record keeping, information from year to year was not easily comparable prior to 2007. All statistics were formatted to the safety year since the Forest Service reports safety statistics using this method and allows comparison among other Forest Service entities.

Injury cost information was collected from the Rocky Mountain Research Station's Budget Analyst and the Program's Budget Assistant. These reports are distributed from the Forest Service Albuquerque Service Center and are 2 years in arrears.

Results and Discussion

Hours Worked

The total hours worked by all employees is recorded by pay period in the Program's Oracle database and was acquired by querying the Oracle database according to safety years. For example, safety year 2006 (SY 2006) was from July 1, 2005, through June 30, 2006. Because these dates normally fall in the middle of pay periods, the safety year quarters were standardized by pay period. The first quarter was defined as pay periods 13–19; second quarter included pay periods 20–26; third quarter included pay periods 1–6; and the fourth quarter included pay periods 6–12. The hours worked include regular hours, overtime, and compensatory time when available. Total hours worked from safety years 2006–2010 are shown in figure 1.

The average hours worked per employee were calculated by using the average number of employees per pay period (due to the seasonal nature of the work) and total hours worked by all employees. The data in figure 2 indicates a slight increase (2%) in total hours worked per employee from safety years 2006 through 2010. The additional hours worked are most likely not a contributing factor to accidents during this timeframe as there was a general decrease in injuries reported (fig. 3).

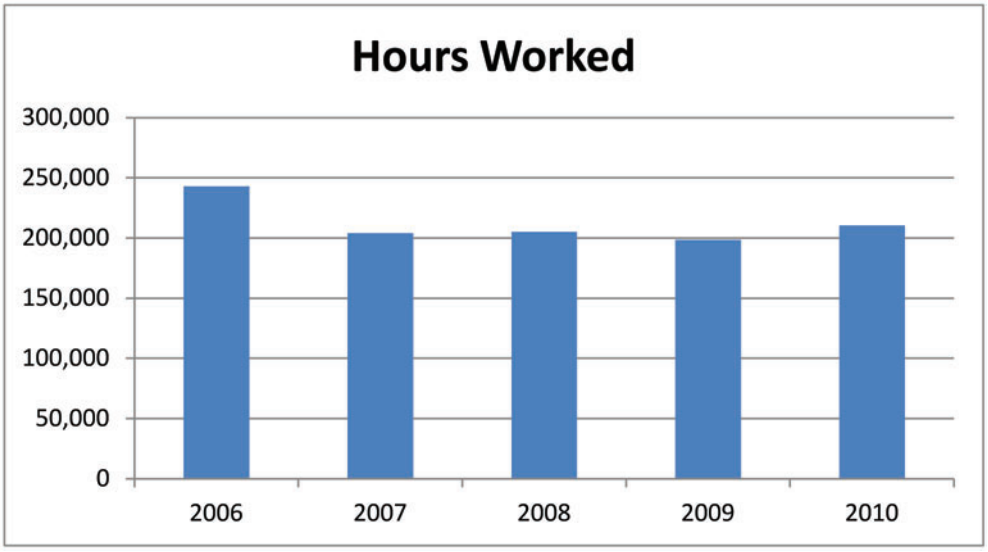

Figure 1: Total hours worked from safety years 2006-2010.

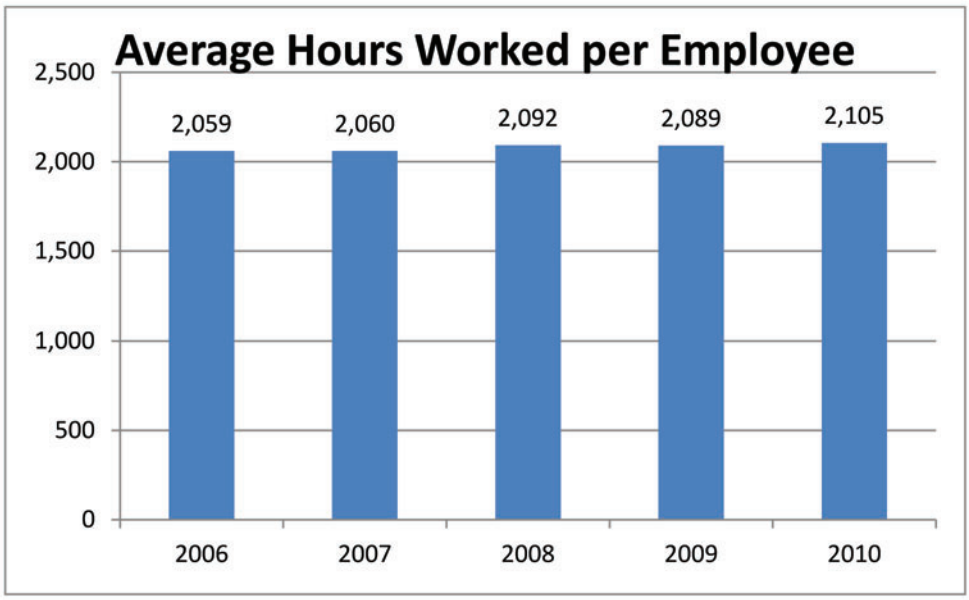

Figure 2: Total hours worked per employee from safety years 2006 through 2010.

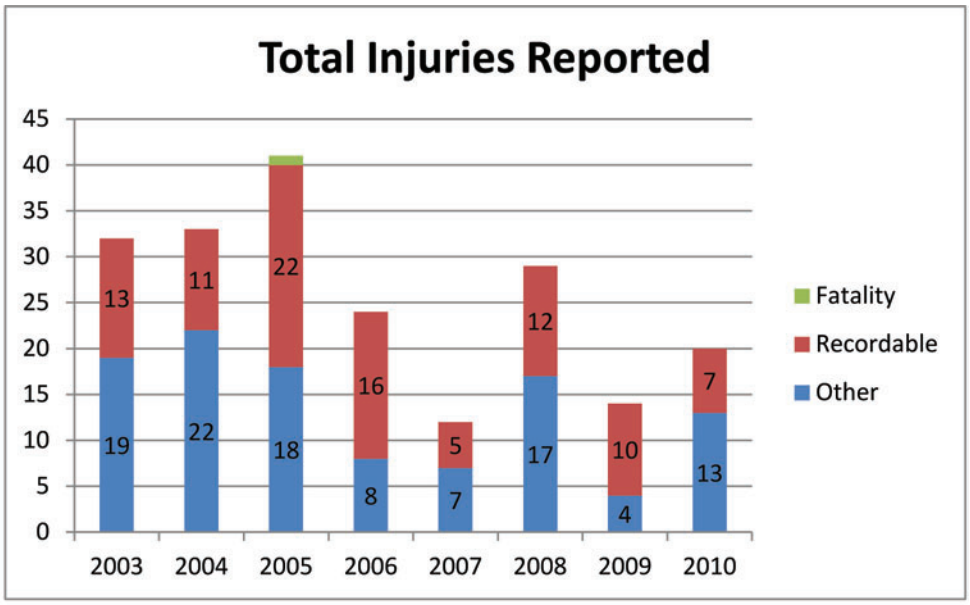

Figure 3: Total injuries reported from 2003 to 2010.

Personal Injuries

All reports utilized indicated injury recordability, which is a common practice to indicate severity. However, based on other information available in the reports, the Occupational Safety and Health Administration's (OSHA's) definition of "recordable" was either not applied or not fully understood (OSHA's reporting requirements changed in 2002). OSHA defines a recordable injury as one that results in

> . . .death, loss of consciousness, days away from work, restricted work activity or job transfer, or medical treatment beyond first aid. You must also consider a case to meet the general recording criteria if it involves a significant injury or illness diagnosed by a physician or other licensed health care professional, even if it does not result in death, days away from work, restricted work or job transfer, medical treatment beyond first aid, or loss of consciousness (29 CFR 1904.7).

Therefore, some data in this report may conflict with previous reports and records.

In this report, all reported injuries were sorted by level of severity regardless of method of payment. The two levels of severity used were "recordable" (as defined above) being most severe and "other" as least severe. In previous reports, cases in which employees elected to use sick leave and were managed by Agency Provided Medical Care (APMC) were not marked as recordable; however, cases do not have to be accepted by the Department of Labor (DOL) Office of Workers' Compensation Program (OWCP) to be considered recordable. APMC was a cost control method the Agency used for cases that could be resolved within a few doctor's visits; it is to be used only on fire related incidents now.

The level of severity indicates costs to the IM Program, both directly and indirectly. Not only do recordable cases generally have more associated medical costs, but employees often are unable to work (lost work days) and frequently have days in which they are not allowed or able to perform normal duties (light duty). More time is required of Forest Service workers' compensation personnel and the IM Program Safety Specialist, and there are other indirect costs that affect the IM Program and the Forest Service. These will be discussed in more detail later.

Figure 3 demonstrates the total number of reported injuries, separated by severity, for safety years 2003 through 2010. For most years, the number of other injuries is double that of the recordable injuries. Heinrich's Accident Pyramid, which has been used as a standard for many years (Petersen 2003), suggests that for every 300 near misses there are 29 minor injuries (still recordable) and one major injury (or 10 other/near misses for every 1 recordable injury). Although Heinrich's theory was found to have no scientific support at the time, recent research shows a similar relationship (Petersen 2003). If these ratios are even close to being accurate, figure 3 demonstrates a lack of near miss reporting in the RMRS IM Program. Possible reasons for this lack of reporting could include a cumbersome reporting system, distrust in the system (information will be used against the injured), or lack of understanding of the benefits of reporting. The IM Program has been trying to increase near miss incident reporting in recent years.

Illness/Injury Location

Injuries were classified according to injury location or by the body part affected. Categories used to sort injuries include injuries to the knee/ankle, upper extremities, skin irritation, back, head and neck, and internal illnesses. Knee/ankle injuries included, but were not limited to sprains, strains, fractures, soreness, and dislocations of knees, ankles, and feet. Figure 4 shows the number of recordable and other reported injuries according to the illness/injury location

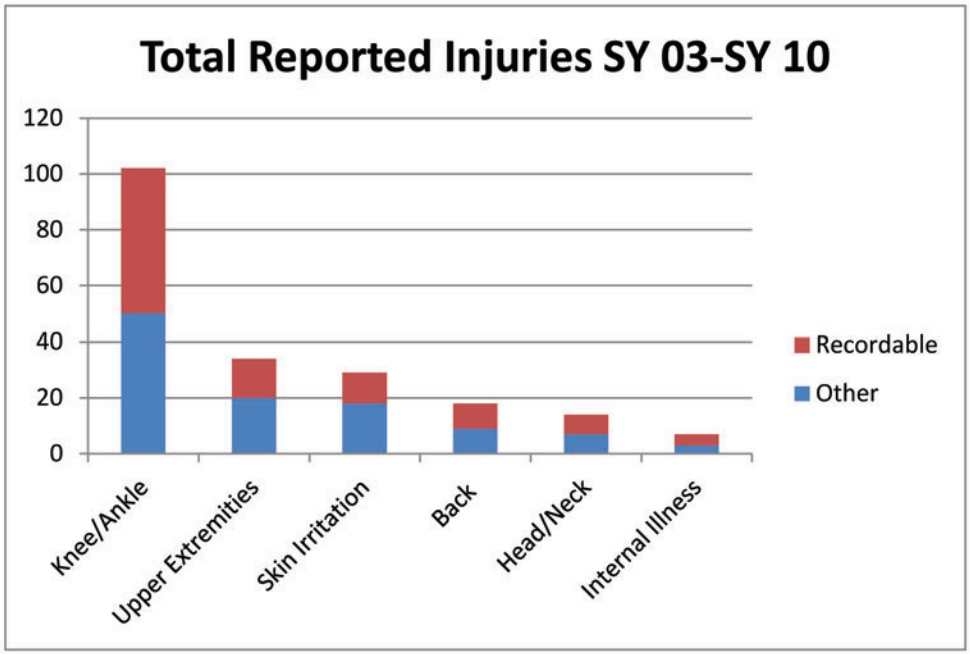

Figure 4: Total reported injuries from SY 2003 to SY 2010.

affected. Upper body injuries included, but were not limited to injuries to the shoulder, abdomen, finger, and wrist. Skin injuries included, but were not limited to blisters, burns, and contact with insects or plants such as poison ivy. Back injuries included, but were not limited to sprains, strains, and disc problems. Internal illnesses included illnesses such as giardia and dehydration. Head/neck injuries included injuries such as sore muscles and injuries to the eyes. It is clear from figure 4 that the most frequently reported injuries (~50 percent) from SY 2003-2010 were those affecting the knees, ankles, and/or feet. This distribution was also demonstrated in Menlove's *Accident and Injury Report 2004*. Figure 5 illustrates that knee, ankle, and/or feet injuries also make up nearly half of all recordable injuries on an annual basis. More than half of the reported knee/ankle/foot injuries were recordable from SY 2006-2010 (fig. 6).

Lost Work and Light Duty

"Lost work" and "light duty" days can be measured to indicate severity of injuries as well as cost. A "lost work" day is one in which the employee is unable to work due to the nature of the injury or because a physician has deemed that there are no acceptable tasks that the employee can complete safely. A "light duty" day, as determined by a physician, is one in which the employee can complete some form of modified work but not their normal duties. Knee/ankle/feet injuries are not only the most reported injury but also require many days lost from work and light duty work until the injured employee can return to regular duties. Lost work and light duty days are notoriously difficult to track, for numerous reasons, but is largely due to the geographical disbursement

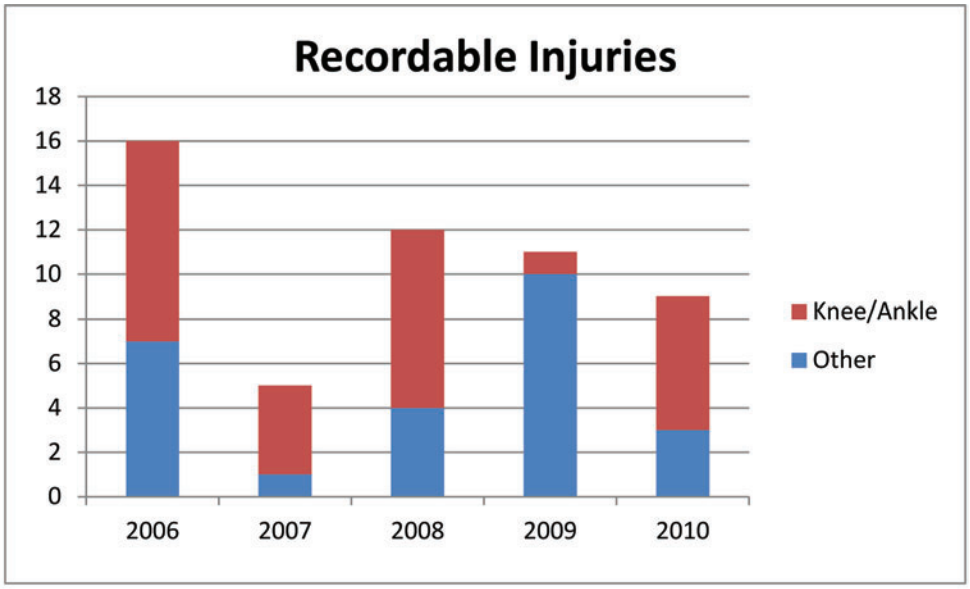

Figure 5: Total recordable injuries from 2003 to 2010.

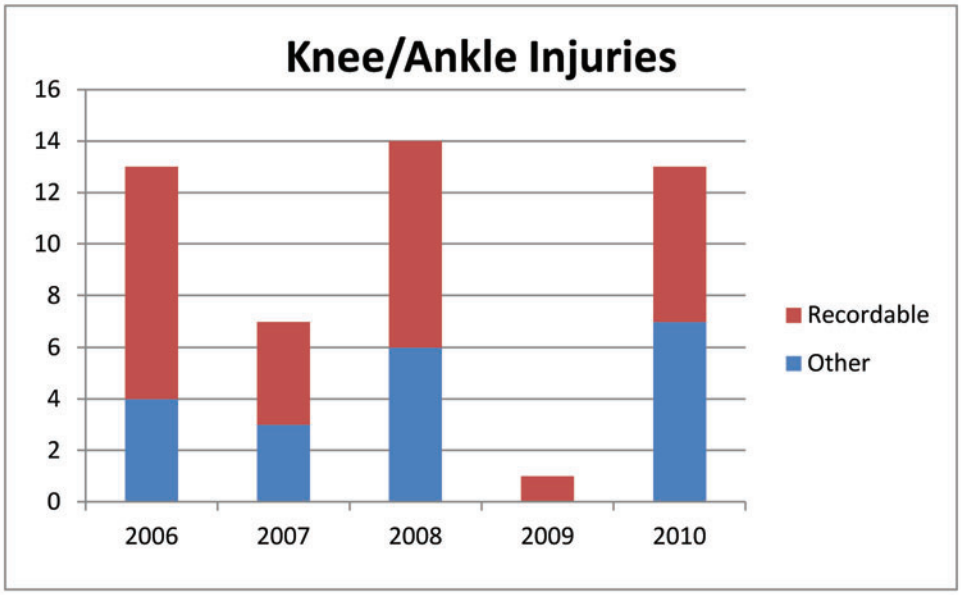

Figure 6: Knee and ankle injuries.

of employees and self-service time and attendance system. However, the implementation of SHIPS has made it somewhat easier and this information should be available for future reports.

Figure 7 shows the lost and light duty impact of 19 knee/ankle/foot injuries over the past 4 years. Nearly 60 work days have been completely lost while 678 days have been light duty work.

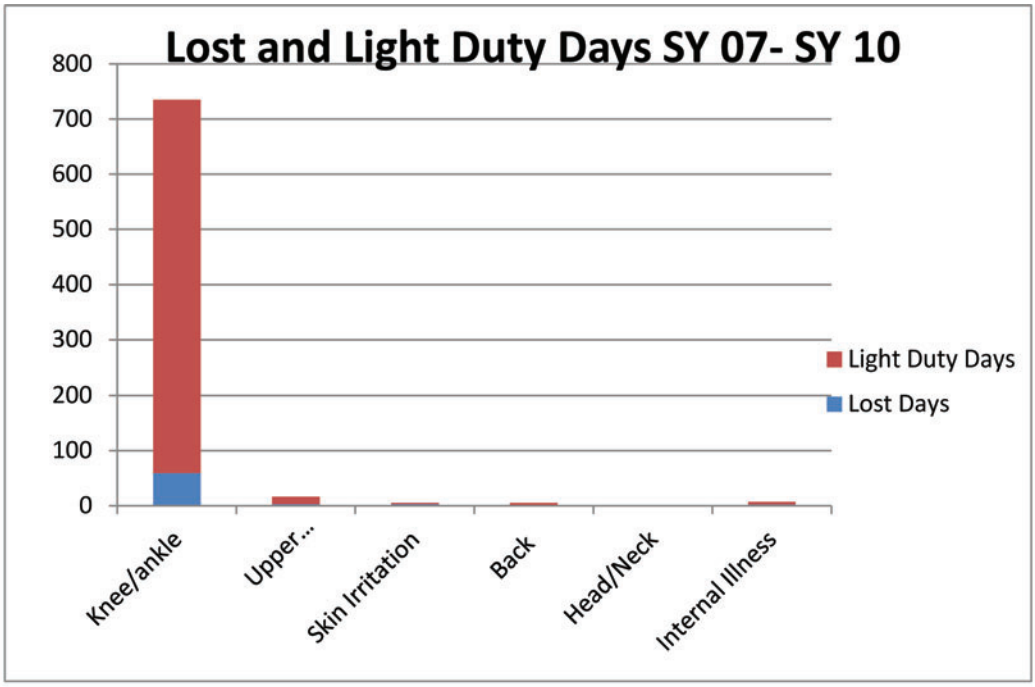

Figure 7: Lost light duty days SY2007 to SY2010.

Cause of Injury/Illness

The exact cause of injury is extremely difficult to determine. Current literature supports the notion that cause is constructed by the investigator according to personal biases and that many factors, not just one single cause, play into the occurrence of an accident. The introduction of SHIPS provided employees the opportunity to record accident cause when entering their accident details. SHIPS provides a drop-down menu of select choices, thus limiting the classification of cause to very general categories. These few choices caused confusion for employees, resulting in some corrections to the data by the IM Program Safety Specialist to more accurately reflect cause at the time of reporting. It should be noted that this information does not take into account contributing factors in accidents and should not be the only source of investigative study. Table 1 illustrates accidents from FY 2007–FY 2010 according to a single cause and indicates the total number of lost and light duty work days (discussed in next section).

Slips, trips, falls, and repetitive motion injuries are the vast majority of reported incidents. As expected, these types of accidents frequently result in injuries to the knees, ankles, and feet. Repetitive motion injuries were almost exclusively due to hiking and the injuries affected knees more than any other body part. Also interesting is the severity of the injuries. Slip, trip, and fall injuries accounted for more lost work days than repetitive motion injuries; however, it is clear that repetitive motion injuries take far longer to heal judging by the light duty days.

Table 1: Single-cause accidents from FY 2007 to FY 2010.

Cause of Injury	*Number of reported incidents*	*Percentage of all incidents*	*Lost days*	*Light duty days*
Slips, trips, falls	**25**	31	9	179
Stressed by (repeated motion)	**21**	26	4	**438**
Bitten by/stung by	10	12	7	0
Cut by	6	7	3	2
Struck by/against (rock, branch)	6	7	0	0
Strain: ATV/vehicle related	5	6	0	0
Lifted, strained	3	4	0	24
Other: rash, burns, giardia, Dehydration	5	6	10	7
Total	**81**	**100**	**33**	**650**

7-Year Trend

Personal injury rates were determined for each of the safety years using the Department of Labor's recommended method, which standardizes data for comparison. The frequency rate of injuries and illnesses is computed from the following formula: (Number of injuries and illnesses X 200,000)/Employee hours worked (July 1–June 30) = frequency rate. The 200,000 hours in the formula represent the equivalent of 100 employees working 40 hours per week, 50 weeks per year, and provide the standard base for the frequency rates. Figure 8 shows the recordable case rates from safety years 2003–2010.

It is extremely difficult to find an industry, private or government, that is comparable to the IM Program. The data collection operation is far different from most research groups as the data are not collected in a controlled laboratory setting. While the actual data collection itself is relatively uneventful, getting to the remote locations is our highest risk activity. Field employees hike many miles and use many diverse modes of transportation, such as four-wheel

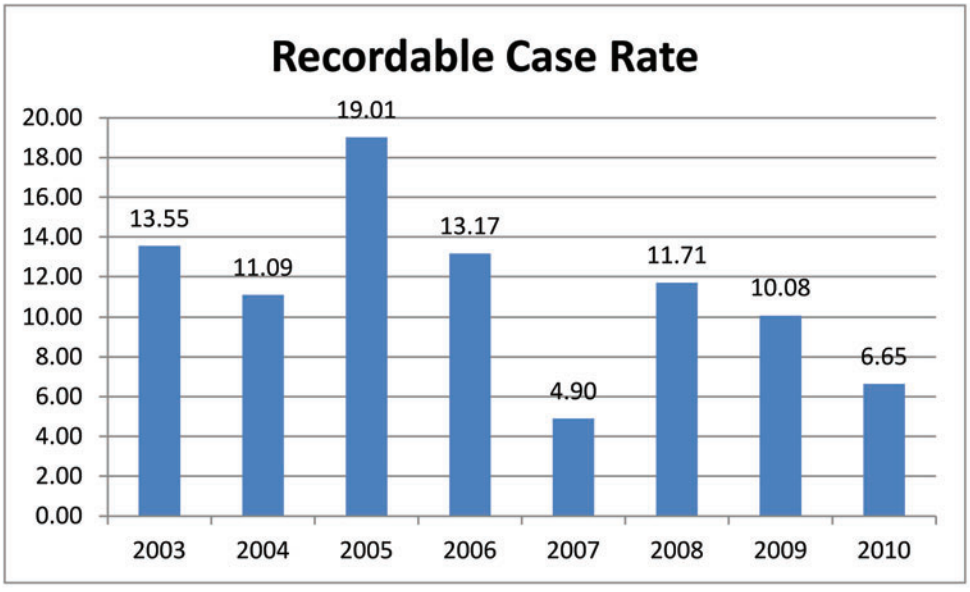

Figure 8: Recordable case rate, 2003 to 2010.

drive trucks and sport utility vehicles, all terrain vehicles, fixed-wing aircraft, rotor-wing aircraft, powered or paddle water craft, or livestock. While field employees are constantly exposed to the varied weather conditions, terrain, and transportation issues, they are generally not engaged in the higher risk activities such as logging and fire management for which reliable statistics exist. Thus, finding recordable case rates for similar organizations has proven difficult.

The *Forest Inventory and Analysis Fiscal Year 2006 Business Report* (USDA FS 2006) was the first to contain information regarding safety. Included was a short report from each of the field units and a table of safety summary statistics. However, the report only included the frequency of safety incidents, therefore, making a comparison impossible; incident frequency cannot be used to compare units due to the vast difference in number of employees and hours worked. The IM Program has requested that recordable case rates be collected for the annual business report. However, contract employees are usually not included in these statistics, thus recordable case rates among field units may still not be comparable.

Personal Injury/Illness Costs

Direct Costs—True injury and illness costs are very difficult, if not impossible, to determine. Due to the nature of OWCP payments, it is very difficult to track the costs of each individual case, particularly when the employee has had more than one injury. When OWCP is charged to the Program, the specific injury is not provided; therefore, it is nearly impossible to decipher exactly to which injury the costs correlate. Additionally, it is not uncommon for payments to be made years after an injury, furthering the difficulty to match the specific case to a cost. It should also be mentioned that employees will sometimes pay out of pocket for reasonably low charges because of the intricate and lengthy Department of Labor (DOL) OWCP processes. It is reasonable to assume that the direct costs discussed below are conservative.

Direct costs for personal injuries have been paid by both Agency Provided Medical Care (APMC) and the Department of Labor Office of Workers' Compensation Program. APMC was a preferred method of payment for injuries that would likely resolve within two health care visits; it was far less costly and faster than opening a claim with OWCP. However, in 2008, the Forest Service restricted APMC to only fire related events, which may result in an increase in the IM Program's OWCP charges over the next few years.

The direct costs in figure 9 include only medical treatment and compensation payments. Costs were retrieved from fiscal year budget records as well as safety records (AMPC). OWCP costs are not charged to the Agency until 2 years after the incident (2 years in arrears). For example, injuries that occurred in FY 2004 were charged to the IM Program in FY 2006. The OWCP costs were attributed to the year of the corresponding injuries. Figure 9 includes both APMC and OWCP costs for fiscal years 2002–2008.

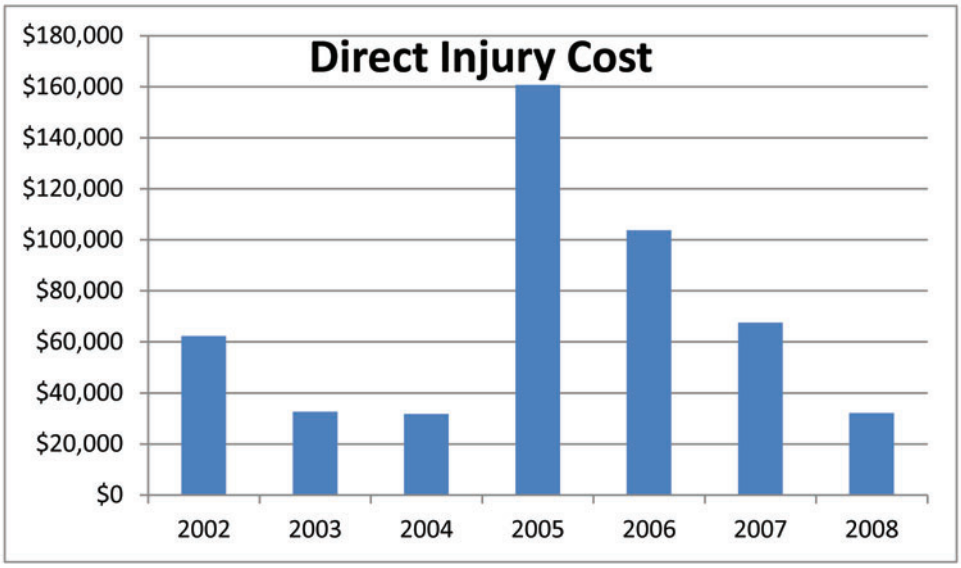

Figure 9: Direct injury cost, 2002 to 2008.

The total direct cost paid by the unit for all injuries during the period was over $490,988. By using the total recordable cases during the period, the average cost of each recordable injury was $5,337.

Indirect Costs—Even though indirect costs are also very difficult to measure, the costs are very real: time lost by the injured employee; time lost by coworkers; interruption in production, recruitment, and training costs for replacement employees; additional time spent on administrative work for supervisors, safety personnel, and FS workers' compensation personnel; additional travel time for coworkers; or the work not being completed in the employees' absences.

Ratios of indirect to direct costs of accidents have been studied extensively in the past, yet no exact ratio can be determined. For many years, a conservative industry standard has been 4:1 while Bird (1974) recommended a ratio ranging from 6:1 to 53:1 (Manuele 2011). However, recent research suggests that no published ratios are currently valid because the increase in direct accident costs has substantially exceeded the increase of indirect costs over the last 15 years (Manuele 2011). Although investigation into the exact ratio is ongoing, it is clear that there are higher indirect costs for claims with low direct costs (Manuele 2011). The most recently published ratios are based on a study in 1981 in which the researchers found that for claims under $3,000 the ratio of indirect to direct costs is 4.6:1 (Manuele 2001). Roughly half of the IM Program's claims are under $3,000. Based on the data, the indirect costs for the 7-year period were most likely between $1,963,952 (4:1) and $2,258,245 (4.6:1) in addition to the direct costs.

Cost per Plot—Throughout FY 2002–FY 2008 (a 7-year period), 14,825 plots were completed by IM employees. This translates to a direct injury cost per

plot of $33. When including indirect costs, the injury cost per plot is between $165 and $185.

Miles Driven

The data for miles driven were compiled using the fleet monthly miles reports for both GSA and WCF vehicles, as well as from Oracle queries for privately owned vehicles (POV) and rental car miles driven during the established time periods (fig. 10). Rental car mileage was not available after 2009 due to a change in the national system in which the data was collected. In previous years, rental car miles accounted for less than 1.5 percent of all miles driven.

Based on the total number of fleet vehicles, the average number of miles logged on each fleet vehicle varied between 14,599 and 18,845 miles (fig. 11). In previous reports, the average number of miles driven per employee was provided; however, that is probably not an accurate figure because driving is not always shared equally. Some vehicles are used by a single driver while others are used by a two- or three-person crew.

Motor Vehicle Accidents and Severity

Motor vehicle information was collected from different fleet and safety reports and files. These records were found to be fairly complete, but there were some variations in reporting. To help organize accidents by severity, the Forest Service requires that accidents resulting in damage of $500 or more be recorded as "chargeable." Chargeability recorded in previous reports was standardized for use in this report. Figure 12 shows all reported motor vehicle accidents for the SY 2003–2010. The majority of the accidents were chargeable; however, few were serious nor resulted in personal injuries.

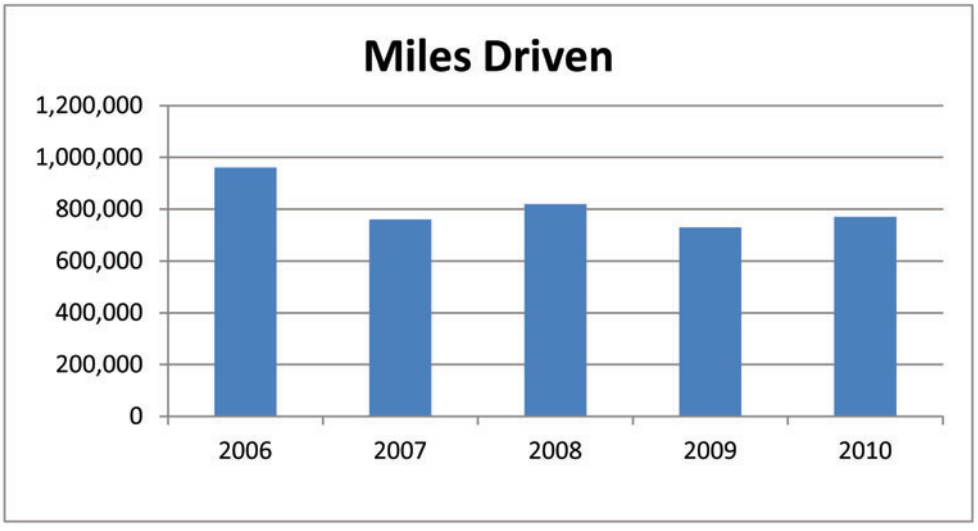

Figure 10: Miles driven, 2006 to 2010.

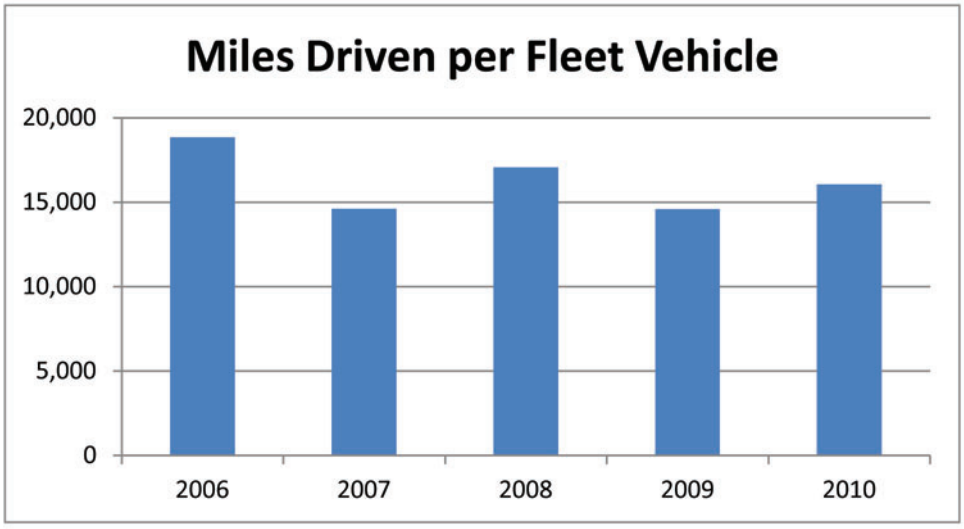

Figure 11: Miles driven per fleet vehicle, 2006 to 2010.

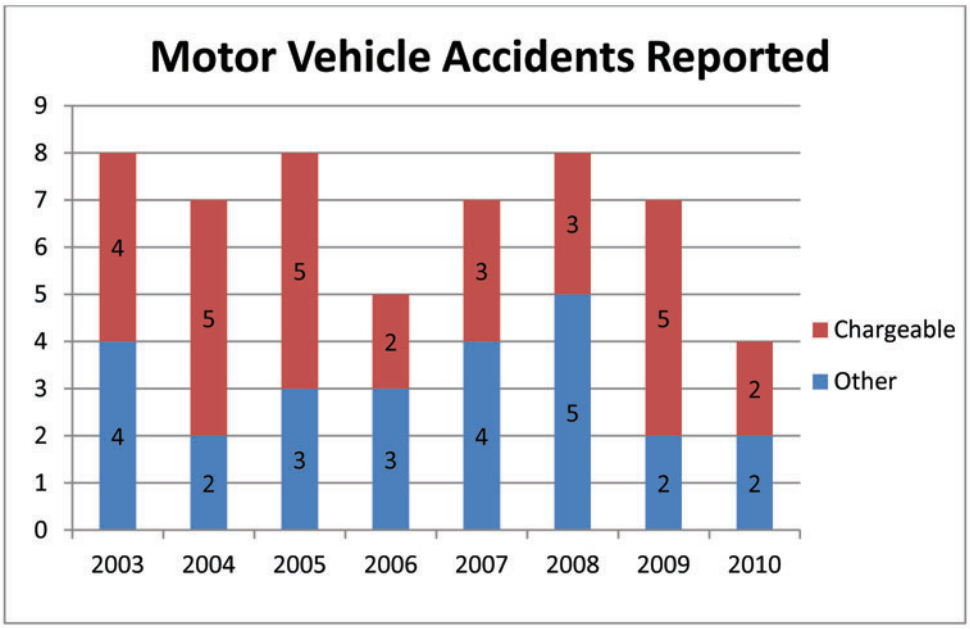

Figure 12: Motor vehicle accidents reported 2003 to 2010.

The accidents were then sorted according to the description of the incident (fig. 13). The category "other" included accidents caused by private citizens, weather damage, and accidents with limited details available.

The most frequently reported accidents included those that involved hitting objects on and off the roadway such as rocks or stumps, backing the vehicle, and animal (deer) encounters. Some preventative measures have been developed to mitigate these types of accidents. For example, while backing, a spotter is required. Nevertheless, in at least one of the accidents reported, a spotter was used and an accident still occurred. Fiscal year 2011 spring field training included a session on backing techniques.

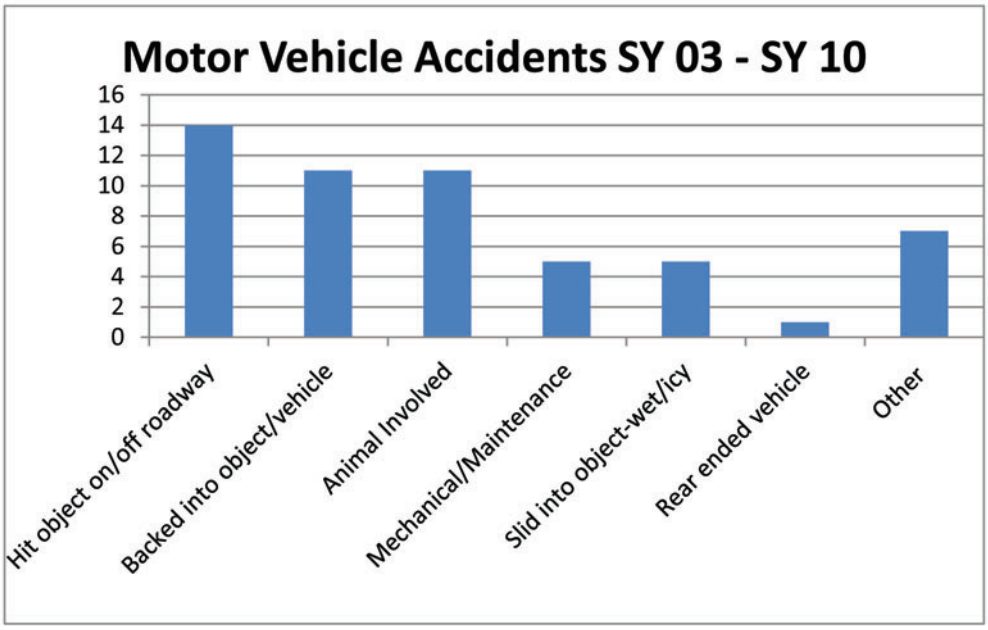

Figure 13: Motor vehicle accidents SY 2003 to SY 2010.

Motor Vehicle Accident 7-Year Trend

The Forest Service, along with other organizations, reports motor vehicle accidents (MVA) in a standardized form for comparison. The MVA frequency rate is calculated in the following format: (number of chargeable MVAs x 1,000,000 miles)/actual miles driven. Figure 14 shows the IM Program's MVA rate from SY 2003–SY 2010 illustrating a slight decline in average but similar across years.

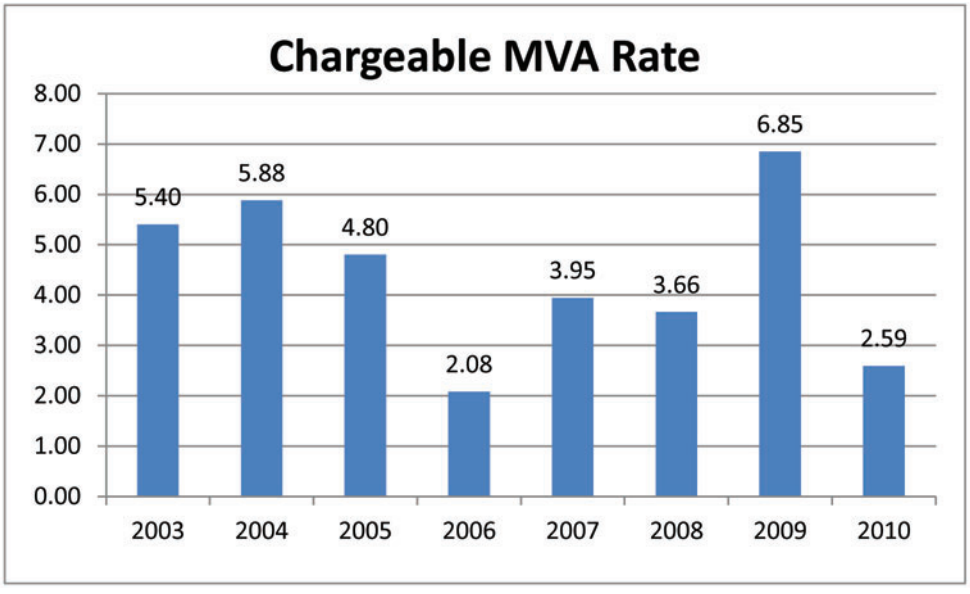

Figure 14: Chargeable motor vehicle accident rate, 2003 to 2010.

Motor Vehicle Accident Costs

Direct Costs—The direct costs related to motor vehicle accidents were recorded. These values only reflect the estimated cost of the repair or replacement. At the time of this report, only the estimated cost of repair is provided in SHIPS. After the vehicle is repaired, the fleet staff does not update the actual costs in SHIPS nor is the information readily available for review. No consideration was given to the time required by the employee, crew member, fleet manager, and safety personnel; cost of transporting an operating vehicle to the employee; or cost of injuries recorded elsewhere (other Forest Service units). Throughout the 7-year period, over $134,170 was estimated for repairs and three vehicle replacements. Figure 15 provides a breakdown of the direct costs by year.

Indirect Costs—Ratios of indirect to direct costs of accidents have been estimated to be between 4:1 and 4.6:1 as mentioned above. According to these ratios, the indirect costs for the 7-year period were most likely between $536,680 (4:1) and $617,182 (4.6:1) in addition to the direct costs.

Motor Vehicle Accident Costs per Plot—From July 1, 2002, through June 30, 2010 (SY 03–SY 10), 17,463 plots were completed by IM employees. The MVA direct cost per plot is about $8. When indirect costs are included, the total MVA cost per plot is between $40 and $45.

Total Costs of Motor Vehicle Accidents and Injuries/Illnesses

When the indirect and direct costs associated with personal injuries, illnesses, and motor vehicle accidents are combined, the results are staggering. A conservative estimate would be over $2,500,000. Together, the total injury and motor vehicle accident cost per plot is likely to be between $205 and $230.

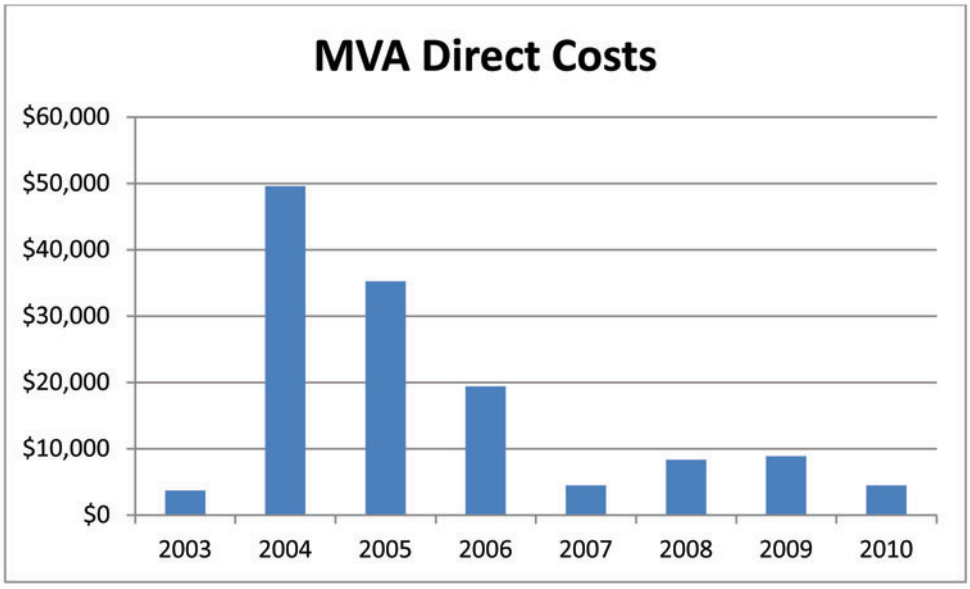

Figure 15: Motor vehicle accident direct costs, 2003 to 2010.

Conclusions

For many years, driving has been considered the highest risk that FS employees face. While the probability of an accident resulting in an injury is relatively low, outcome of a motor vehicle accident is potentially fatal, thus it remains a high risk task; fortunately the IM Program has experienced few driving related accidents that have resulted in employee injuries. The greatest potential for injury in the RMRS IM Program results from employees performing forest inventory data collection duties that require hiking extended distances through often rugged, unforgiving terrain. Although environmental hazards cannot be completely mitigated and human error is inevitable, many of the repetitive motion injuries and slips, trips, and falls can be prevented. The Program should continue to evaluate prevention strategies for these types of injuries.

While it is important to review accident statistics, it is vitally important to remember that this report can only evaluate incidents that have actually occurred and have been reported. The data represented are historical, and nothing can be done now to prevent the injuries nor does it identify accidents that were prevented. This report is not meant to predict future incidents or trends. It measured only lagging indicators, meaning those linked to the outcome of a known accident.

This report should be used in conjunction with leading safety indicators to achieve a comprehensive view of the safety program. These leading indicators focus on the safety process, not just outcomes. The *2010 FIA Safety Perception Survey* (USDA FS 2010; Appendix) and the *2010 Field Debriefing Survey* (USDA FS 2011; Appendix) are two current examples of our attempts to measure leading safety indicators. The results of these surveys were provided for all employees and discussed in detail with leadership.

The IM Program is unquestionably making progress towards a culture that holds personal safety as a top value; however, as identified in this report, there are areas that need significant additional attention to ensure positive change towards fewer severe injuries and accidents. To this end, the Rocky Mountain Research Station has begun implementing a new safety management process (Integrated Safety Management (IMS)), which is an organized approach to managing safety including the necessary organizational structures, accountabilities, policies, and procedures. Additionally, the Forest Service has begun engaging every employee in a discussion called a Safety Engagement Session regarding the cultural change we intend to pursue. Leaders from the IM Program have been trained to facilitate the Safety Engagement Sessions. Though progress will be slow, this foundational step may be the catalyst that changes how employees evaluate and respond to risk.

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Appendix: 2010 Safety Surveys

2010 Field Debriefing Survey

Near the end of the 2010 calendar year, all field-going RMRS employees were emailed an electronic link to the *2010 Field Debriefing Survey*. Employees were instructed that the survey was optional and completely anonymous, and were asked to respond to the open ended questions to provide information that would be used in the continuing effort to improve the safety of all employees.

1. What are your opinions about the new evening check-in?
2. What would you do to improve the evening check-in process?
3. Do you feel you receive adequate safety training?
4. Have the project risk assessments (reviewed at training) been helpful?
5. How frequently does your crew complete a verbal risk assessment?
6. What is your opinion regarding provided personal protective equipment (glasses, hard hat, trekking poles, etc.) and general equipment (tent, pack, etc.)? (e.g. enough, too much, poor quality, lacking something?)
7. Injuries involving the knee, ankle, and or foot are the most frequently reported injuries are our Program. Do you have any suggestions to help prevent these types of injuries?
8. Does your vehicle and vehicle equipment meet your needs?
9. Have you witnessed something unsafe or high risk during the past season? If so, what was it and how did you handle the situation?

2010 FIA Safety Perception Survey

The safety perception survey was designed to provide an accurate picture of the current RMRS FIA safety culture. All FIA employees were asked to complete the anonymous online survey by responding to the questions with their level of agreement; they could provide a more detailed response if desired. Responses ranged from "Strongly Disagree," "Somewhat Disagree," "Neutral," "Somewhat Agree," and "Strongly Agree."

1. Supervisors visibly demonstrate an interest in the safety and health of their employees.
2. Identified safety and health concerns or hazards are addressed or corrected in a timely manner.
3. Rewarding positive, proactive actions is a good way to achieve lasting safety awareness.
4. If I saw another employee engaging in an unsafe practice, I would say something directly to that employee.
5. I feel the Inventory and Monitoring Program is moving toward a real safety culture and not a “safety lip service” culture.
6. Proper and well-maintained personal protective equipment (PPE) is always available to me when needed.
7. The Inventory and Monitoring Safety Award Program is easy to use.
8. My immediate supervisor shows interest in the safety and health of the employees in my area.
9. Health and safety is a high priority when I am performing my job responsibilities.
10. I am primarily field or office; supervisory or non-supervisory. [Employees circled the appropriate choice.]

The Rocky Mountain Research Station develops scientific information and technology to improve management, protection, and use of the forests and rangelands. Research is designed to meet the needs of the National Forest managers, Federal and State agencies, public and private organizations, academic institutions, industry, and individuals. Studies accelerate solutions to problems involving ecosystems, range, forests, water, recreation, fire, resource inventory, land reclamation, community sustainability, forest engineering technology, multiple use economics, wildlife and fish habitat, and forest insects and diseases. Studies are conducted cooperatively, and applications may be found worldwide.

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