

Prevention of Vector-borne Diseases at National Park Service Units in California: Results from an Employee Survey



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Introduction

Vector-borne diseases (VBD) are infectious diseases that can be transmitted to humans from biting arthropods and rodents. Several VBD are recognized as endemic in California, including those transmitted by mosquitoes (e.g., West Nile virus [WNV]), ticks (e.g., Lyme disease, tick-borne relapsing fever), fleas (e.g., plague), and rodents (e.g., hantavirus cardiopulmonary syndrome [HCPS]). The annual number of human cases of VBD in California ranges from 1-2 for plague or HCPS, to approximately 100 for Lyme disease, to more than 400 for WNV. Though generally rare, some VBD can be severe and occasionally fatal. Therefore, it is important to emphasize prevention of VBD, particularly among persons who are at elevated risk. Risk factors for VBD are actions or behaviors that increase an individual's opportunity for contact with a pathogen-carrying vector. Living or working outdoors, particularly in rural areas, can increase exposure to many important disease vectors.

In recent years, several cases of VBD—including plague, tularemia, HCPS, and relapsing fever—have been identified in persons who worked at or visited National Park Service (NPS) units in the Western U.S. Surveillance conducted by the California Department of Public Health (CDPH) has indicated that the vectors and pathogens for VBD are frequently present at many NPS units in California.

In 2007, the NPS Office of Public Health entered into a 3-year Cooperative Agreement with the CDPH Vector-Borne Disease Section to enhance delivery of VBD services at NPS units in California. To better gauge the risk of VBD for NPS staff in California, the NPS and CDPH conducted a survey of NPS employees to assess their knowledge of VBD and their prevention.

The objectives of the survey were to:

- Assess employee knowledge, beliefs, and practices regarding VBD
- Identify priority areas for enhanced training and/or revision of policy and operating procedures
- Provide recommendations to further reduce the risk of VBD transmission to NPS employees

Methods

During June 23–September 30, 2008, an internet survey link was available to NPS employees at 24 NPS units in California and the Pacific West Regional Office. The survey asked NPS employees to provide information on the following topics: 1) personal characteristics and job title, 2) work activities and exposures, 3) self-perceived risk and knowledge of tick-borne, rodent-borne, and mosquito-borne diseases, 4) occupational safety and health, and 5) education and training. The survey was based on a previous survey developed by VBDS to assess knowledge, attitudes, and practices (KAP) of VBD among California employees of the U.S. Forest Service. Participation in the California NPS KAP survey was voluntary.

Results

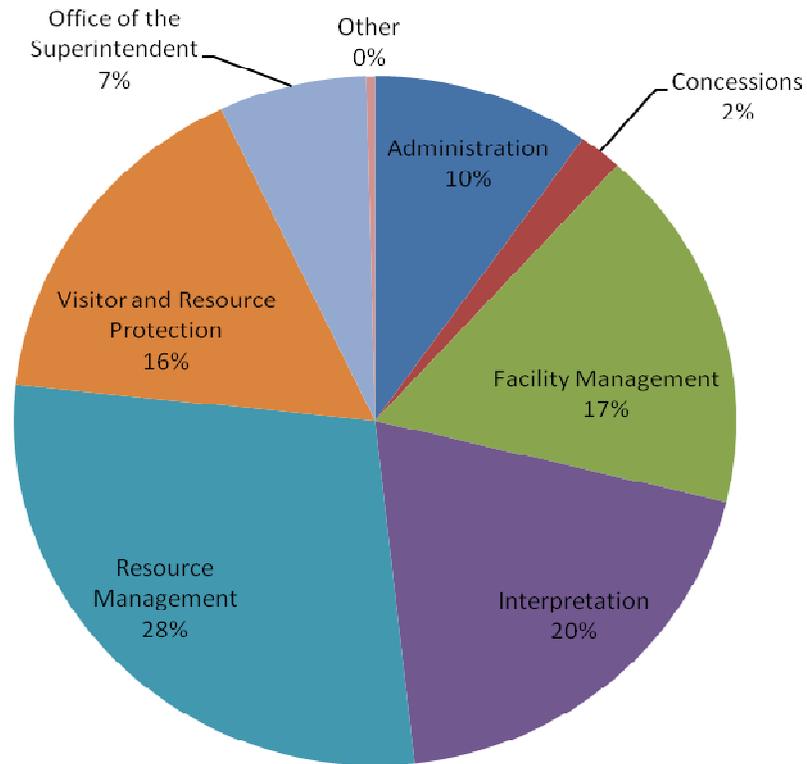
- A. Characteristics of Respondents**—A total of 257 NPS staff from 18 NPS units and the Pacific West Regional Office completed at least part of the survey; 14 respondents (5%) worked at 2 or more units. Most respondents worked in at least one of the following 4 divisions: Resource

Management (RM), 28%; Interpretation (IN), 20%; Facility Management (FM), 17%; and Visitor and Resource Protection (VRP), 16%.

NPS Unit	Number of Respondents	Percentage
CABR (Cabrillo National Monument)	10	3.6%
CHIS (Channel Islands National Park)	6	2.2%
DEPO (Devils Postpile National Monument)	2	0.7%
EUON (Eugene O'Neill National Historic Site)	6	2.2%
GOGA (Golden Gate National Recreation Area)	29	10.4%
JOMU (John Muir National Historic Site)	7	2.5%
JOTR (Joshua Tree National Park)	75	27.0%
LABE (Lava Beds National Monument)	10	3.6%
MANZ (Manzanar National Historic Site)	2	0.7%
MOJA (Mojave National Preserve)	16	5.8%
MUWO (Muir Woods National Monument)	1	0.4%
PINN (Pinnacles National Monument)	3	1.1%
PRSF (Presidio of San Francisco)	1	0.4%
PWRO (Pacific West Regional Office)	2	0.7%
REDW (Redwood National Park)	25	9.0%
RORI (Rosie the Riveter/WWII Home Front National Historical Park)	7	2.5%
SAFR (San Francisco Maritime National Historical Park)	12	4.3%
SEKI (Sequoia and Kings Canyon National Parks)	50	18.0%
YOSE (Yosemite National Park)	14	5.0%
Total	278	100.0%

*Total number of respondents includes multiple counting of employees who worked at 2 or more NPS units.

Survey Respondents by Division (N=257)



Most respondents were female (58.2%), were permanent employees (59.7%), had some college education or higher (94.5%), and were between the ages of 26 and 55 years (73.5%). The average number of years of employment with NPS was 12.8 years, and the average number of years at their current job was 6.2 years.

Respondent Characteristics	Percentage
Gender (N=208)	%
Female	58
Education (N=217)	
Post grad or higher	29
College	42
Some College	24
High School	5
< High School	1

Age group, in years (N=197)

16-25	8
26-35	21
36-45	23
46-55	29
56-65	17
>65	2

Employment status (N=253)

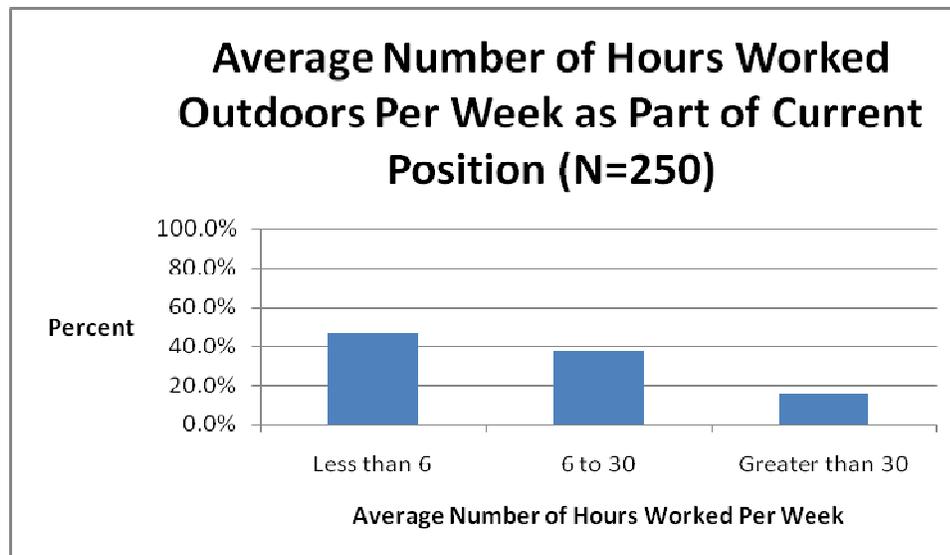
Permanent	60
Permanent but subject to furlough	10
Seasonal	10
Term	15
Other	6

*Rounding up of percentages may lead to totals not equaling 100%.

B. Risk Activities, Exposures, and Practices to Reduce Vector-borne Diseases

All Respondents

Approximately half (47%) of all respondents worked 6 or fewer hours outdoors; 15% worked more than 30 hours outdoors.



By Division

Results regarding exposures to specific vectors and prevention measures are shown for a) all respondents and b) the 4 divisions largely represented in this survey.

Tick, mosquito, and rodent exposure

- *Ticks*—85% of all respondents reported no tick bites in the past 12 months. 24% of RM and 21% of VRP employees reported at least one tick bite.
- *Mosquitoes*—Most respondents (52%) reported between 1-50 mosquito bites in the past 12 months. Greater than 50 mosquito bites was most commonly reported among VRP employees (31%), followed by IN (10%) and RM (9%) employees.
- *Rodents*—Rodent exposure was uncommon among all respondents. Six RM employees reported having at least one rodent bite in the past 12 months. RM and VRP employees were more likely to have handled live rodents at least once a month (8% and 6% respectively) compared to IN and FM employees (0% and 5% respectively). Occasional (at least once a year) handling of dead rodents, tissues, and/or body fluids was reported by 56% of VRP, 39% of FM, and 36% of RM employees.

	Resource Management (RM)	Interpretation (IN)	Facility Management (FM)	Visitor/Resource Protection (VRP)	All Respondents
In the past 12 months, how many times have you been bitten by a:					
Tick	(n=72)	(n=49)	(n=42)	(n=38)	(n=247)
0	76%	98%	93%	78%	85%
1-5	24%	2%	5%	21%	14%
6-10	0	0	2%	0	.4%
Mosquito	(n=70)	(n=49)	(n=41)	(n=38)	(n=237)
0	31%	45%	51%	18%	38%
1-50	60%	45%	44%	50%	52%
51-100	6%	6%	5%	18%	7%
>100	3%	4%	0	13%	2%
Rodent	(n=70)	(n=49)	(n=41)	(n=38)	(n=239)
0	91%	100%	100%	100%	98%
1 or more times	9%	0	0	0	3%
In the past 12 months, how many times have you:					
Handled live rodents	(n=69)	(n=49)	(n=41)	(n=38)	(n=239)
Daily/Weekly	7%	0	0	3%	3%
Monthly	1%	0	5%	3%	2%
2-3 times Per Year/Yearly	9%	2%	5%	18%	8%
Never	83%	98%	90%	76%	88%

Handled dead rodents, tissues, and/or body fluids	(n=69)	(n=49)	(n=41)	(n=38)	(n=238)
Daily/Weekly	7%	2%	0	3%	3%
Monthly	3%	2%	5%	16%	6%
2-3 times Per Year/Yearly	26%	10%	34%	37%	23%
Never	64%	86%	61%	45%	68%

*Rounding up of percentages may lead to totals not equaling 100%.

Tick bite preventive actions

- >80% of all respondents reported “always or usually” wearing long pants when preparing to work outdoors; fewer than half reported “always or usually” practicing other measures to reduce tick exposure (e.g. using insect repellent, tucking pants into socks or boots).
- 90% of IN and VRP respondents reported “always or usually” wearing long pants when preparing to work outdoors, the highest percentage among all divisions.
- Rare or no use of insect repellent was most commonly reported among IN (81%) and RM (76%) employees.
- Almost half of all respondents (48%) reported “rarely or never” checking their body or clothes for ticks after working outdoors.

	Resource Management	Interpretation	Facility Management	Visitor/Resource Protection	All Respondents
As part of your CURRENT position, in preparation for working outdoors, how often do you:					
Apply insect repellent to skin and/or clothes	(n=72)	(n=48)	(n=40)	(n=38)	(n=242)
Always or usually	3%	6%	25%	21%	14%
Occasionally	21%	13%	15%	21%	17%
Rarely or never	76%	81%	60%	58%	69%
Wear long sleeves	(n=72)	(n=49)	(n=41)	(n=37)	(n=243)
Always or usually	56%	23%	39%	22%	38%
Occasionally	28%	39%	34%	35%	32%
Rarely or never	17%	39%	27%	43%	30%
Wear long pants	(n=72)	(n=49)	(n=41)	(n=37)	(n=243)
Always or usually	88%	90%	76%	90%	82%
Occasionally	6%	0	12%	5%	6%
Rarely or never	7%	10%	12%	5%	12%
Tuck pants into socks/boots	(n=72)	(n=48)	(n=40)	(n=38)	(n=242)

Always or usually	11%	8%	5%	3%	9%
Occasionally	17%	6%	10%	13%	12%
Rarely or never	72%	85%	85%	84%	79%
Check your clothes and/or body for ticks					
	(n=72)	(n=49)	(n=41)	(n=38)	(n=244)
Always or usually	43%	20%	34%	45%	36%
Occasionally	15%	12%	15%	18%	16%
Rarely or never	42%	67%	51%	37%	48%
Immediately remove and wash clothing					
	(n=72)	(n=48)	(n=41)	(n=38)	(n=243)
Always or usually	32%	10%	34%	21%	24%
Occasionally	11%	25%	12%	29%	19%
Rarely or never	57%	65%	54%	50%	57%

*Rounding up of percentages may lead to totals not equaling 100%.

Mosquito bite preventive actions

- 85% of all respondents reported “always or usually” wearing long pants as a preventive action for mosquito bites. 61% of all respondents reported “rarely or never” using insect repellents. These results were consistent to similar questions asked about tick bite preventive actions.
- RM and IN respondents (70% and 77% respectively) were more likely than FM and VRP respondents (51% and 50% respectively) to “rarely or never” apply insect repellent to skin and/or clothes.
- 57% of all respondents “rarely or never” minimized work activities at dawn and dusk as a mosquito bite prevention measure.

	Resource Management	Interpretation	Facility Management	Visitor/Resource Protection	All Respondents
As part of your CURRENT, position, in preparation for working outdoors, how often do you:					
Apply insect repellent to skin and/or clothes					
	(n=70)	(n=47)	(n=41)	(n=36)	(n=232)
Always or usually	4%	13%	20%	22%	17%
Occasionally	26%	11%	29%	28%	21%
Rarely or never	70%	77%	51%	50%	61%
Wear long sleeves					
	(n=70)	(n=49)	(n=41)	(n=36)	(n=233)
Always or usually	59%	22%	52%	25%	43%
Occasionally	26%	35%	22%	31%	28%
Rarely or never	16%	43%	27%	44%	29%

Wear long pants	(n=70)	(n=49)	(n=41)	(n=36)	(n=235)
Always or usually	89%	90%	78%	89%	85%
Occasionally	7%	2%	10%	3%	6%
Rarely or never	4%	8%	12%	8%	9%
Minimize work activities at dawn and dusk	(n=70)	(n=48)	(n=40)	(n=34)	(n=230)
Always or usually	31%	29%	33%	15%	32%
Occasionally	10%	8%	8%	29%	12%
Rarely or never	59%	63%	60%	56%	57%

*Rounding up of percentages may lead to totals not equaling 100%.

Rodent-borne disease preventive actions

- Because exposures to live or dead rodents were uncommon, many questions in this section were answered as “not applicable”. Due to the small number of respondents, results (particularly by division) should be interpreted with caution.
- Among all respondents who handle rodents, employees were more likely to “always or usually” wear gloves (83%) or disinfect their equipment (69%) compared to other preventive actions; most respondents reported “rarely or never” wearing respirators (78%) or masks (54%).

	Resource Management	Interpretation	Facility Management	Visitor/Resource Protection	All Respondents
When handling live or dead rodents at work, how often do you...					
Wear gloves	(n=32)	(n=10)	(n=26)	(n=27)	(n=106)
Always or usually	84%	80%	92%	70%	83%
Occasionally	3%	10%	0	11%	5%
Rarely or never	13%	10%	8%	19%	12%
Wear long sleeves	(n=30)	(n=9)	(n=22)	(n=26)	(n=98)
Always or usually	60%	33%	64%	31%	51%
Occasionally	20%	44%	9%	23%	20%
Rarely or never	20%	22%	27%	46%	29%
Wear eye protection	(n=29)	(n=10)	(n=23)	(n=25)	(n=99)
Always or usually	31%	30%	74%	32%	44%
Occasionally	10%	0	13%	4%	8%
Rarely or never	59%	70%	13%	64%	47%
Wear a mask	(n=29)	(n=9)	(n=24)	(n=25)	(n=98)
Always or usually	14%	44%	54%	28%	34%
Occasionally	17%	22%	13%	4%	12%
Rarely or never	69%	33%	33%	68%	54%
Wear a respirator	(n=29)	(n=6)	(n=19)	(n=25)	(n=88)
Always or usually	3%	17%	32%	8%	14%
Occasionally	0	0	11%	16%	8%

Rarely or never	97%	83%	58%	76%	78%
Disinfect the equipment	(n=27)	(n=5)	(n=22)	(n=22)	(n=85)
Always or usually	63%	80%	73%	60%	69%
Occasionally	19%	20%	5%	14%	12%
Rarely or never	19%	0	23%	27%	19%

*Rounding up of percentages may lead to totals not equaling 100%.

C. VBD Self-perceived Risk

- Among all respondents, most believed they had a “low, “very low”, or “no risk” of acquiring a tick-borne (78%) or a mosquito-borne (81%) disease; <10% believed they had a “very high” or “high” risk of acquiring a tick-borne (5%) or a mosquito-borne (8%) disease.
- Self-perceived risk varied by division and VBD. A “very high”, “high”, or “medium” risk for a tick-borne disease was reported among 47% of VRP respondents, followed by RM (21%), FM (24%), and IN (14%). A “very high”, “high”, or “medium” risk for a mosquito-borne disease was reported among 38% of VRP respondents, followed by FM (25%), IN (16%), and RM (13%).

	Resource Management	Interpretation	Facility Management	Visitor/Resource Protection	All Respondents
How would you describe your risk of acquiring a disease transmitted by the following vector while at work?					
Tick	(n=72)	(n=49)	(n=41)	(n=38)	(n=246)
Low, very low, or no risk	79%	86%	76%	53%	78%
Medium	18%	12%	24%	26%	17%
Very high or high risk	3%	2%	0	21%	5%
Mosquito	(n=70)	(n=49)	(n=41)	(n=37)	(n=236)
Low, very low, or no risk	87%	84%	76%	62%	81%
Medium	9%	12%	10%	22%	12%
Very high or high risk	4%	4%	15%	16%	8%

*Rounding up of percentages may lead to totals not equaling 100%.

D. Knowledge

Ticks: When asked “Which of the following infectious disease do you believe you are at risk of acquiring from a tick bite while working”, Lyme disease and Rocky Mountain Spotted Fever (RMSF) were the most frequent responses. Below are the answers respondents chose as diseases that one is at risk of acquiring from a tick bite. Diseases that can be transmitted by ticks are highlighted in yellow.

Diseases Respondents Believe Are Acquired from a Tick Bite

Disease	Percent
Lyme Disease	78%
Plague	7%
Hantavirus	7%
Tularemia	3%
Rocky Mountain Spotted Fever	35%
Relapsing Fever	8%
West Nile Virus	7%
Babesiosis	7%
Rabies	3%
None	18%
Other	4%

When respondents were asked which methods are used to remove an attached tick, 69% of respondents answered “pull tick straight out with tweezers”.

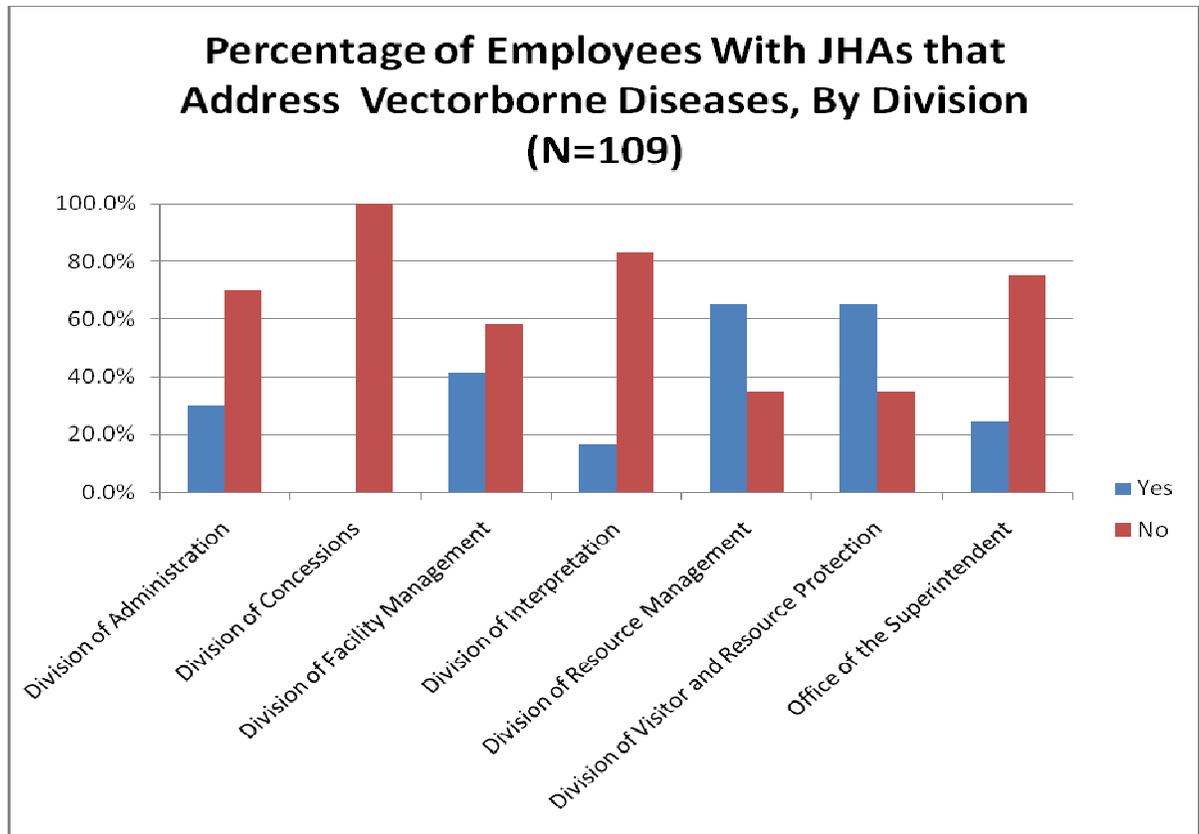
Rodents: When asked “While performing your work duties, which of the following infectious diseases do you believe you are at risk of acquiring from a wild rodent?”, the most common response was hantavirus at 78%, followed by rabies at 60% then plague at 58%. Diseases that can be transmitted by rodents are highlighted in yellow.

Disease	Percent
Lyme Disease	8%
Plague	58%
Hantavirus	78%
Tularemia	6%
Rocky Mountain Spotted Fever	5%
Relapsing Fever	3%
West Nile Virus	8%
Babesiosis	1%
Rabies	60%
None	13%
Other	2%

When asked what steps should be taken if bitten by a rodent at work, respondents indicated “notify your immediate supervisor” (88%); “wash the wound with soap and water as soon as possible” (86%); and “seek medical attention immediately” (71%).

E. Job Hazard Analysis

A Job Hazard Analysis (JHA), also known as a Job Safety Analysis (JSA), is a multi-step process designed to study and analyze a job. It breaks down a job into steps and provides a systematic method to identify and eliminate associated hazards. Of 251 respondents who answered questions regarding JHAs, 109 (43%) had completed some type of JHA during their NPS career, and 52 (48%) had completed at least a JHA that addressed VBD in their current position. Over half of respondents from Resource Management (65%) and Visitor and Resource Protection (65%) had completed a JHA addressing VBD.



- Employees who had ever completed a JHA were more likely to:
 - (N=244) Always or usually check their clothes and/or body for ticks after working outdoors (45% vs. 30% for respondents who had never completed a JHA)
 - (N=240) Always or usually wear gloves when handling live or dead rodents (92% vs. 72%)
 - (N=232) Always or usually apply insect repellent to their skin and/or clothes (25% vs. 11%)

F. Education and Outreach

- Compared to other occupational health issues (e.g., injury prevention), 74% of employees rated the importance of preventing/reducing the risk of insect and rodent-borne diseases as “extremely important” or “important”.

- 36% would like their employers to provide them with more information about diseases related to rodents, insects, and ticks, 23% were not sure, and 42% did not want their employers to provide them with more information about VBD.
- Most respondents (70%) identified print brochures/factsheets and internet-based information as “very useful” formats for obtaining information on VBD. Half of respondents (51%) also considered internet-based information a “very useful” way in learning about VBD. “Somewhat useful” techniques secondary to print and Internet include seminars (44%) and visual aides (45%).
- Specific information or topics suggested included:
 - Types of VBD and their vectors
 - Diseases most likely to acquire for particular region working in; prevention; symptoms and treatment if contracted, list of vectors
 - Risk of indoor exposure to rodent feces; mouse droppings in the office workplace and work spaces; appropriate methods of cleanup and excluding animals from old buildings (without using poisons)
 - What to do for snake bites
 - What to do for spider bites

Summary

1. Most NPS employees believed that reducing the risk of VBD in the workplace is important or extremely important.
2. The self-perceived risk of acquiring a VBD at work was higher for mosquito-borne diseases (8% reported a high or very high risk) than for tick-borne diseases (5% reported a high or very high risk).
3. Exposures and risk perception varied by division.
 - a. Potential exposures to VBD were highest for VRP and RM respondents.
 - b. Self-perceived risk of acquiring a VBD was highest for VRP respondents.
4. Most respondents preferred print and online educational materials compared to other formats (e.g. face-to-face trainings) for receiving VBD prevention information.
5. Having completed a JHA was associated with increased use of personal protective equipment and other self-protective measures.

Recommendations

1. Develop and provide division-specific training on VBD that addresses unique exposures, job activities, and concerns. Target preventive information to those divisions/jobs for which likely contact with disease vectors is greatest.
2. Continue to emphasize the importance of completing JHAs prior to conducting job duties. Where appropriate, include basic VBD prevention information and direction to resources for more detailed information.
3. Collaborate with the California Department of Public Health to conduct additional VBD surveillance activities at NPS units and to provide timely and accurate educational materials and trainings, preferably in print and online formats.