United States Department of Agriculture

Applying Principles and Methods of Risk Analysis: A Case Example of Northern Spotted Owl Research in a Dynamic Pandemic Landscape

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Forest Service

Pacific Northwest Research Station

Research Paper PNW-RP-617

October 2020

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Abstract

Marcot, Bruce G.; Lesmeister, Damon B.; Wilson, Todd M.; Volkman, Eric; Anderson, Paul. 2020. Applying principles and methods of risk analysis: a case example of northern spotted owl research in a dynamic pandemic landscape. Res. Pap. PNW-RP-617. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station. 30 p.

This report presents considerations of potential hazards and mitigation measures associated with conducting field research in the context of a pathogenic epidemic or pandemic situation. We use an example of a specific risk assessment developed for advising decisions on initiating or continuing field activities (in this case, mark-resight and passive acoustic monitoring) associated with ongoing research of northern spotted owls (*Strix occidentalis caurina*) in the Pacific Northwest region of the United States under conditions imposed by the COVID-19 (severe acute respiratory syndrome coronavirus 2 or SARS-CoV-2) global pandemic. We review the structure of a risk assessment procedure that follows USDA Forest Service policy in general and has specifically been applied to owl research during the current pandemic. The risk assessment framework we used included listing job objectives, job tasks, and potential hazards associated with each task. For each task, we evaluated the severity of the hazard (negligible, moderate, critical, or catastrophic) and the probability of a mishap if the hazard was present (rare, unlikely, possible, likely, or almost certain) and assigned a risk assessment code that identified risks as low, moderate, high, or extremely high. We then described mitigation and abatement measures that we posited would reduce the risk severity or probability, and then scored the residual (decreased) severity, probability, and risk level. We briefly review other potential considerations for a job hazard risk assessment under conditions of pathogenic outbreaks, including considerations for additional costs and administrative duties, working in proximity and unexpected encounters in field situations, and changes in behavior of wildlife.

Keywords: Job hazard, decisionmaking, pandemic, epidemic, pathogenic, risk management, mitigation, residual risk, field research, COVID-19.

Contents

Background

In early April 2020, the U.S. Forest Service Pacific Northwest (PNW) Research Station was compelled to decide whether to continue field research for studies of demography and passive acoustic monitoring of the northern spotted owl (*Strix occidentalis caurina*) in the Pacific Northwest region of the United States, under conditions of the COVID-19 (severe acute respiratory syndrome coronavirus 2 or SARS-CoV-2) global pandemic. Studies of the owl are neither easy nor trivial to pursue and require considerable planning and resources. The species inhabits mostly mature and old-growth conifer forests of the region (Lesmeister et al. 2018); these forests fill key roles of providing carbon sequestration, water quality, and other ecosystem services, including recreational value (Creutzburg et al. 2017, Jones and Lynch 2007, Kline et al. 2016). Determining the status and conservation needs of the owl has implications for the economies of local communities and the region as a whole (Charnley et al. 2018).

The status and conservation needs of the owl has implications for the economies of local communities and the region.

The PNW Research Station leads ongoing research on the owl in the form of four demographic and four passive acoustic monitoring study areas in western Washington and Oregon (hereafter, spotted owl research program). Research aims to determine the owl's population demography and status (e.g., Dugger et al. 2016) in part by conducting bioacoustic surveys for the presence and frequency of occurrence of this and other owl species (e.g., Duchac et al. 2020). Data collection for the spotted owl research program is conducted primarily as independent field work with check-in and check-out procedures by crew members carrying handheld radios and satellite communication devices that feature two-way messaging, tracking, and emergency contact capabilities. Daily activities include nighttime call-back surveys as well as daytime work focused on deploying and retrieving autonomous recording units, following up on nighttime detections, conducting nest checks, and capturing and banding owls.

In general, natural resource and personnel management are processes inherently marked by many kinds and degrees of uncertainty (Marcot, in press) (fig. 1). Layered upon these already difficult decision structures was the need to consider additional risk to personnel and the public associated with the COVID-19 situation. Guidelines for dealing with COVID-19 conditions have been issued by the Center for Disease Control and Prevention (CDC), state governments, and others (NASEM 2020). A Congressional Research Service report (Morgan and Sargent 2020) has highlighted how the COVID-19 pandemic is adversely affecting federal research and development (R&D) enterprises, with closures of some R&D laboratories and difficult decisions being made as to which R&D activities to continue as essential to agency missions. Mitigation procedures to contain spread of the

Bruce G. Marcot

Figure 1—As in the classic board game *Risk*, natural resource management is characterized by many types and levels of uncertainty, by multiple players with competing objectives, and by complex decision structures and strategies aimed at reconciling tradeoffs and meeting overall resource management goals.[1]

virus have been in the forefront of national and international efforts (Walensky and del Rio 2020).

During spring 2020, as the threat of COVID-19 contagion was growing throughout the region, along with significant uncertainties about many aspects of the pandemic, the PNW Research Station instituted a procedure for conducting a formal **job hazard analysis**[2] and assessment of the potential risks posed to field-going research crews. At potential primary risk was the health of the 30 field researchers involved with the spotted owl research program, as well as considerations for interactions with other agency and non-agency office and field workers and local community members and the potential burden on local emergency and medical treatment services.

[1] The use of trade or firm names in this publication is for reader information and does not imply endorsement by the U.S. Department of Agriculture of any product or service.

[2] For purposes of this report, it is not critical to formally differentiate the terms job hazard analysis and risk assessment, but they are different. Job hazard analysis does refer to a procedure and documentation covering specific job actions that may be complex and involve multiple steps but are essentially discrete. However, field research activities such as those described in this report are far more multifaceted and complex than a discrete job activity, and are best evaluated using a risk assessment worksheet (see app. 1), which is meant to be a transparent and fairly comprehensive listing of knowable risks and mitigations.

This report presents the concepts, framework, structure, and outcome of a risk analysis that provided the basis for the risk assessment, using the spotted owl research program as a case example. Our purpose is to convey our approach to the process and considerations in our risk analysis in the context of the global COVID-19 pandemic, and more generally for other situations of local or regional pathogenic outbreaks and epidemics.

Differentiating Risk Assessment and Job Hazard Analysis

Risk is defined and evaluated as the intensity or impact of some expected event weighted by its probability of occurring (Aven 2003, Condamin et al. 2006). In the context of a job hazard analysis, a hazard is the possible adverse situation associated with a specific job task, and risk then becomes the intersection of that hazard with its potential severity and its probability of occurring (USDL OSHA 2002).

Risk is the intensity or impact of some expected event weighted by its probability.

Some definitions further denote risk as the intersection of hazard, exposure, and vulnerability (Füssel 2007). **Hazard** is defined as a potential source of danger, loss, injury, or misfortune; **exposure** is specifying of the kinds of assets at risk, such as property, investments, economic values, and personal health; and **vulnerability** is the potential or predisposition for harm given the hazard, often measured by probability. In this definition, a risk analysis can evaluate and compare the most likely and the most extreme hazard events, each with their associated severities and probabilities of occurring.

The U.S. Forest Service developed an operational risk management guide that provides a general process for evaluating safety issues related to job hazards, and a risk assessment template (app. 1) for use in a job hazard analysis (USDA FS 2020). The PNW Research Station adopted the process and template for use in a job hazard analysis risk assessment (app. 1), which involved the following steps:

- Specifying the overall job objectives
- Annotating specific job tasks
- Listing potential hazards associated with each job task
- Estimating the potential severity or consequence and the probability of each hazard
- Summarizing that information into a risk category
- Devising and specifying a set of risk mitigation or abatement measures for each hazard
- Estimating the “residual risk” after implementing the mitigation or abatement measures
- Determining which team members are subject to each task and mitigation measure

- Taking a deliberate approach to dynamic reconsideration of evolving hazards and their consequences and exposure risk

The assessment template is intended to address the dynamic nature of risk under the COVID-19 situation across large and diverse geographic areas and, as such, can provide a template for risk assessments of other projects. The risk assessment procedure outlined above is also intended to address the dynamics of data availability and the changing knowledge base that results in changing uncertainties.

Nature of the Decision

A job hazard risk assessment is not a decision; it is part of a broader set of information on which a designated decisionmaker (hereafter, a "risk decision authority") bases a course of action—in our example, whether to proceed with sending research crews into the field to conduct studies, or not to do so and thereby at least temporarily halt the work. The decision is based in part on the degree to which mitigation measures can be implemented, and their efficacy when in place in achieving the expected reduction in risk levels for each hazard.

Counterbalancing the risk in any decision is the "reward" or benefit that a risk decision authority must consider when weighing options. A full discussion of criteria used to judge the relative merits of an activity, and therefore the decision to conduct that activity in the face of increased risk, is beyond the scope of this report. The interpretation of those benefits is also inherently subjective. However, with regard to the spotted owl research program, the two factors that decisionmakers weighed against the risk were importance and urgency. In this case, the work was deemed important because the owl monitoring is used to inform decisions about timber harvests, regionwide forest plan revisions, and litigation concerning both of those activities. Further, the survey work was deemed urgent in that capturing data on owl nesting rates and success is a seasonal activity; once the nesting season is over, the opportunity to monitor these attributes is lost. Also, the interruption of data collection for 1 year would amplify to a multiple-year loss of inference for some survival and fecundity metrics.

In other scenarios, the factors driving decisionmakers to accept risk could include, among other concerns, the role of budget constraints, personnel limitations, timing of permits, weather-driven accessibility issues, and desire to maintain continuity of long-term studies, although these factors were not specifically quantified in the current example of owl research activities. No matter what the specifics of a decision, its benefits or rewards and the importance and urgency of undertaking an activity, must be weighed against the risk.

The decision reached for the spotted owl research program was also based on gathering county- and state-level information on the presence, spread, and rates of change of COVID-19 cases, COVID-19-related deaths, and availability of emergency services, such as capacity and use levels of local hospital bed space, intensive care units, respiratory equipment, and other factors (see app. 2 for examples). We also solicited information from other local Forest Service units to inform our decisions regarding spotted owl research.

Risk Assessment Worksheet

A **risk assessment worksheet** (RAW) is provided as a template (USDA FS 2020) into which information identifies the following:

- The project, incident, or work activity
- Location of the job or project
- A brief summary of the specific objective of the job or project
- The name and title of the person who primarily prepared the risk assessment information
- Date of the assessment
- Designation of the risk decision authority, or person responsible for the final decision

The RAW template is founded on clearly defining all terms associated with each step in the process and is structured to automatically assign risk levels based on a risk assessment matrix that combines specified levels of hazard severity and hazard probability (fig. 2). Risk levels fall into four categories: low, moderate, high, and extremely high. Low risk entails a hazard outcome with little or no medical treatment required, and little or no damage to equipment, systems, property, or environment. Moderate risk entails a hazard outcome with a degraded capability for meeting the task objective or accomplishing the project, lost work days due to injury or illness not exceeding 3 months, and moderate damage to property or the environment. High risk entails a hazard outcome with a significantly degraded capability for meeting the objective or accomplishing the project, injury resulting in permanent partial disability, or temporary total disability lasting more than 3 months, and serious environmental damage. Extremely high risk entails a hazard outcome with complete or nearly complete failure to meet the task objective, major property or facility damage, death or permanent total disability, severe environmental damage, and loss of a major or critical system or equipment.

Risk Assessment Matrix

Severity/consequences Consequence if mishap occurs	Probability liklihood of mishap if hazard is preseant				
	Almost Certain (Continuously experienced)	**Likely** (Will occur frequently)	**Possible** (Will occur several times)	**Unlikely** (Remotely possible but not probable)	**Rare** (Improbable; but has occurred in the past)
Catastrophic Imminent and immediate danger of death or permanent disability; major property or facility damage; loss of critical system or equipment	Extremely High	Extremely High	Extremely High	High	Moderate
Critical Permanent partial disability, temporary total disability; moderate environmental damage; extensive damage to equipment	Extremely High	Extremely High	High	Moderate	Moderate
Moderate Hospitalized minor injury, reversible illness; minor damage to equipment, property or the environment	High	High	Moderate	Low	Low
Negligible First aid or minor medical treatment; little or no property or environmental damage	Moderate	Moderate	Low	Low	Low

Figure 2—Assignment of risk levels (low, moderate, high, extremely high) as a function of hazard severity and hazard probability.

Definitions used for the levels of hazard severity/consequence and hazard probability in the RAW are presented as qualitative, rank-order categories (box 1). The spotted owl research program used the qualitative definitions, although with some hazards it might be possible and useful to also assign specific quantitative value ranges to each category using clearly specified units of measure. This could help avoid any lexicon uncertainty and ambiguity with such terms as "immediate danger," "minor damage," "remotely possible," "improbable," and others, as defining levels of severity and probability.

Box 1

Definitions of Levels of Hazard Severity and Hazard Probability As Presented in the Risk Assessment Worksheet

Note that definitions are shown as qualitative, ordinal-scale categories.

Severity/Consequences: Both terms are used interchangeably; both refer to the impact that a hazard could have on the objective. Should something go wrong, the results are likely to occur in one of these areas: injury or death, equipment damage, project/fire operations degradation, adverse publicity, environmental damage, property damage, etc.

- **Catastrophic**—Impact to objective (imminent and immediate danger of death or permanent disability; major property or facility damage; loss of critical system or equipment).
- **Critical**—Impact to objective (permanent partial disability, temporary total disability; moderate environmental damage; extensive damage to equipment).
- **Moderate**—Impact to objective (hospitalized minor injury, reversible illness; minor damage to equipment, property, or the environment).
- **Negligible**—Impact to objective (first aid or minor medical treatment; little or no property or environmental damage).

Probability: The likelihood or the chance of an event occurring**.**

- **Almost certain**—Continuously experienced.
- **Likely**—Will occur frequently.
- **Possible**—Will occur several times.
- **Unlikely**—Remotely possible but not probable.
- **Rare**—Improbable, but has occurred in the past.

The spotted owl research program RAW was jointly completed by a team (see app. 1). Through group discussion and group consensus, the team identified job tasks and associated hazards, consequences or severity levels, probability levels, and mitigation and abatement activities with resulting expected reductions in consequences or severity levels and probability levels.

Assessment of Residual Risk

Residual risk is determined after implementing mitigation measures.

Residual risk was determined from the levels of severity and probability of each hazard after successful implementation (and verification) of associated mitigation and abatement measures (USDA FS 2020). Risk level outcomes noted in the general risk assessment matrix (fig. 2) also were denoted for residual risk. The spotted owl research program required daily meetings in person between crew leaders and weekly telephone meetings with the principal investigator. We defined this task as team meetings at a centralized location for daily briefings, debriefing, administrative tasks, assigning daily duties, printing maps, and exchanging equipment. In the context of potentially spreading or contracting COVID-19 while conducting team meetings, we identified hazards as inadequate disinfecting and social distancing, and hazards associated with person-to-person and surface viral transmission. We rated the consequence as critical and the hazard probability as likely, resulting in an initial risk assessment code of extremely high.

We then identified measures that could be taken by field crews to abate or at least mitigate these hazards to reduce risks associated with the tasks. We implemented policies to avoid in-person meetings by using phone and videoconferencing technology to conduct team communication. For tasks related to equipment exchange, we implemented policies to practice CDC guidelines for mask wearing, social distancing, and disinfecting of equipment surfaces. After implementing abatement and mitigation policies, we rated consequences as moderate and probability as rare, resulting in a residual risk assessment code of low.

The Decision Process

Multi-attribute decision problems are best handled with a structured approach that (1) clearly frames the problem and defines objectives and evaluation criteria, (2) uses methods of risk analysis explicitly tied to decision criteria, and (3) implements the decision and monitors outcomes, results of which can feed back to earlier stages in the process (Thompson et al. 2013). Risk analysis can be conducted by topic-area experts, researchers, planners, or a variety of others.

In the PNW Research Station's procedure, the RAW identifies the RAW preparer and the risk decision authority. In the example of the spotted owl research program, the details in the RAW also were reviewed by a risk assessment team

whose members were selected for their collective experiences in associated field research activities, risk assessment, and decision science (see app. 1).

Additional employees (including authors of this report) were further engaged to help compile weekly data on COVID-19 cases summarized by state, county, and research study locality and for informing the weekly deliberation and decision on whether to proceed with field work. The principal investigator conducted weekly telephone interviews with field project crew leaders to ascertain whether mitigation and abatement procedures were being implemented as designed and to gauge their effectiveness in reducing specific hazards identified in the RAW. Information gathered on a weekly basis was used, as appropriate, to update and amend the analyses underlying the RAW, particularly related to any updates on assessments of residual risk levels resulting from implementing the mitigation and abatement procedures. Information brought to bear also critically included the difference—and anticipated decrease—in risk levels of the hazards compared with those residual risk levels resulting from implementing the mitigation and abatement activities. By the end of the owl research field season, no station field employee had either displayed COVID-19 symptoms or had tested positive for COVID-19.

Weekly team meetings reviewed the pandemic conditions and field crew activities to decide whether to proceed.

Critically, then, team meetings[3] were held on a weekly basis to review the week's updated analysis results, any updates to the RAW, and the principal investigator's report to provide considerations and recommendations to the risk decision authority, who was also attending the meeting, on any new concerns that may have arisen. After making individual and independent interpretations of all materials, the team would then advise the risk decision authority on whether to continue, amend, curtail, or cease field crew activities. The team also identified any specific followup duties to track compliance with mitigation activities, trends in hazards, changes in hazard severity, or related conditions.

Mitigation and Abatement Activities

The RAW clearly specified a series of mitigation and abatement activities designed to address and reduce the overall risk of the job, as well as the specific risks expected from each hazard associated with each listed job task. In the case of the spotted owl research program, overall mitigations addressed use of a Safety Empowerment Authority opportunity provided to employees, and direction to follow CDC and state guidelines. Specific mitigation activities were then listed for each job task and associated hazard.

[3] Involved in weekly evaluations of conditions, discussions, and recommendations on status of the spotted owl research program were Bruce Marcot and Raymond Davis (Pacific Northwest Region Old Forest and Northern Spotted Owl Monitoring Lead), and decisionmakers (risk decision authorities) included Eric Volkman, Paul Anderson, and Damon Lesmeister.

Use of the PNW Research Station Safety Empowerment "Yellow Card" Authority

In 2011, the PNW Research Station issued the direction that all employees have the right and responsibility to raise a safety empowerment "yellow card" (fig. 3) that provides them with an authoritative means, with full support of leadership, to express their concern that any job task or activity may, in their judgment, place them or others in an unduly hazardous situation. This action can serve to suspend their work so that their supervisor can address and mitigate the situation. Contents of the yellow card and its direction for use were posted on the station's Intranet website and were provided to all station employees. The spotted owl research program members were each alerted to their authority and responsibility to use this critical tool to ensure that crew safety was maintained as the top priority.

Safety Empowerment Authority

I am responsible for my own safety, as well as that of my fellow employees and the public we serve. I have full authority to call a halt to any activity that looks or feels to be unsafe. I will use this authority with confidence because Forest Service leadership fully supports me taking this action so I can protect myself and others from harm.

Figure 3—Content of the safety empowerment "yellow card" authority provided by the Pacific Northwest Research Station to authorize any employee to alert their supervisor of a desire to cease any job task or activity that the employee believes may present an undue hazard.

CDC and State Guidelines

The mitigation and abatement activities associated with the owl RAW also included an up-front summary of the most current cautionary guidelines provided by the CDC for person-to-person transmission and for surface transmission of the COVID-19 virus.

The CDC guidelines pertaining to person-to-person transmission include the following directions:

- Maintain a 6-ft (2-m) distance between persons ("social distancing"), as it is thought that the virus spreads person-to-person through droplets expelled orally
- Use suitable face coverings in public settings where other social distancing measures are difficult to maintain, especially in areas of significant community-based transmission
- Wash hands frequently for at least 20 seconds with soap and water; if soap and water are not available, use hand sanitizer with at least 60 percent alcohol content
- Avoid touching one's face (eyes, nose, mouth) with unwashed or unsanitized hands.

The CDC guidelines pertaining to surface transmission include direction to clean and disinfect frequently touched surfaces daily, including fuel pumps, field equipment (e.g., cameras, recording units, global positioning system units, callers, binoculars), keys, tables, doorknobs and handles, light switches, countertops, handles, desks, phones, computer, keyboards, toilets, faucets, and sinks.

Most common household disinfectants approved by the Environmental Protection Agency (EPA) were presumed effective for preventing surface transmission of the COVID-19 virus. The spotted owl research program used disinfectants appropriate for the surface being disinfected, which, for example, were different for field equipment and vehicle surfaces (see app. 1 for further information on options for disinfectants). Additional guidelines for disinfectants included following the manufacturer's instructions for application and for proper ventilation, ensuring that the product has not exceeded its expiration date, and never mixing household bleach with ammonia or any other cleanser. Other options include alcohol solutions that contain at least 60 percent alcohol, and other common EPA-registered household disinfectants. Following the manufacturer's instructions for all cleaning and disinfection products (e.g., concentration, application method and contact time, etc.) is critical for ensuring their effectiveness.

Additionally, the RAW noted that employees should follow state-level guidelines. Early in the field season, these included stay-at-home orders with exceptions made to purchase food, care for a relative or friend, obtain necessary health care, or fill a job deemed essential. If employees were to be away from their homes, they were to maintain an interpersonal distance of at least 6 ft at all times. Newer measures were later adopted as states implemented phased, county-specific reopening criteria and guidelines.

Examples of Hazard-Specific Mitigation and Abatement Direction

The risk assessment addressed pandemic hazards of office tasks, vehicle use, field work and training, and other activities.

The RAW developed for the spotted owl research program also listed specific tasks and hazards organized under six primary task headings: overarching tasks and program management; office tasks; vehicle use pertaining to travel from office or home to and within field sites; field work; field crew training; and non-COVID-19 emergency and law enforcement assistance. Examples of mitigation and abatement activities associated with each of these six areas follows (see app. 1 for a full listing).

Overarching tasks and program management—
Overarching tasks and program management activities can include team meetings, office tasks, and sundry field preparation activities. One mitigation measure for hazards associated with overarching tasks and program management is the yellow card authority discussed above, along with CDC and state guidelines. These overarching mitigation measures pertained to all parts of the job and all tasks.

Office tasks—
These tasks pertained to working within office environments and on workplace grounds, and included tasks pertaining to team meetings, preparation and transfer of equipment and field gear, conveying information to new employees, and other associated activities. Mitigation measures included conducting remote instead of in-person meetings, preparing and handling field equipment only at the beginning of the field season as far as possible, and minimizing office visits.

Vehicle use pertaining to travel from office or home to and within field sites—
These tasks pertained to use of field vehicles and dealing with situations of shared rides, retrieving vehicles at office compounds, fueling vehicles, operating locking gates, acquiring food for field outings, transporting snowmobile and all-terrain vehicles (ATVs), and securing vehicle maintenance and repair. Mitigation measures included not ride sharing, implementing defensive driving procedures, disinfecting vehicles upon pick-up and drop-off following General Services Administration standards,[4] disinfecting any surfaces that were touched after pumping fuel, avoiding unnecessary contact with the public, preparing extra food rations and an emergency kit for one night, eliminating the use of snowmobiles and ATVs, and other actions. Any of these measures may entail additional cost, which may be figured into the evaluation of continuing or amending field activities (also discussed below).

[4] See "GSA Fleet Vehicle Cleaning & Disinfecting Guidance for COVID-19," updated 4 April 2020. https://www.gsa.gov/cdnstatic/GSA%20Vehicle%20Cleaning%20%20Disinfecting%20Guidance%20for%20COVID-19.pdf.

Field work—
Field work tasks associated with the spotted owl research program included conducting standard owl-calling surveys at night, deploying autonomous recording units in the field, and contacting fellow team members and local administrative units. Mitigations included conducting field work independently, but while using structured communication by radio or other means, engaging in no in-person contact in the field except in case of emergency, and using official government radios capable of contacting local dispatch. Note that each such mitigation measure could entail new challenges of ensuring personal safety of employees working independently or alone.

Field crew training—
Tasks associated with training field crews included teaching specific field methods for conducting call-back surveys, capturing and handling owls, deploying and maintaining autonomous recording units, operating four-wheel drive vehicles in field situations, and learning wilderness first aid skills, although use of snowmobiles and all-terrain vehicles would be deferred in the absence of first-aid training. Associated abatement and mitigation measures included modifying or postponing training sessions that would entail close person-to-person contact; owl capture tasks being performed only by experienced personnel already trained in methods; conducting field work independently in vehicles without passengers; no sharing of equipment or data forms; modifying vehicle training from the trainee as the driver and trainer as a passenger to the trainer following in a separate vehicle; conducting online first-aid training; and other activities.

Non-COVID-19 emergency and law enforcement assistance—
These tasks were related to non-emergency assistance for minor or major injuries and accidents, assisting medical care or law enforcement pertaining to job-related injury, and encountering or witnessing illegal activity. Mitigations included assurance for communication via cell phone, radio, or other means; tracking local availability of emergency services and curtailing field research activities when services are overwhelmed; self-isolating for at least 2 weeks if treating personal injury necessitates violating CDC guidelines for social distancing; and other activities.

Monitoring

Monitoring how field crews understand and implement all mitigation and abatement activities was conducted via the weekly conversations between the principal investigator and crew leaders. These meetings resulted in a weekly summary that was considered by the team evaluating situational conditions when advising the risk decision authority on proceeding with a go/no-go decision.

Monitoring risk mitigation measures included not just ensuring their full and correct implementation, but also at least intermittently evaluating their effectiveness in reducing risk levels as predicted under the residual risk section of the RAW. Effectiveness can be determined in various ways, starting with discussions with field crew leaders, and gathering information on any new hazards that might be used to supplement or amend the RAW.

Examples of Risk Assessments for Housing Facilities

Housing for field-based staff was an important part of our risk assessment consideration during the pandemic. In some cases, field crews provided their own housing and lived alone or with other field crew members, family, or unrelated housemates. We stressed the importance of continued practice of CDC guidelines at home and required employees to communicate immediately if they may have been in contact with someone exhibiting COVID-like symptoms. When government-provided housing was available, there was further decisionmaking space on how best to mitigate the risks associated with shared living spaces.

A primary result from our analyses was that decisions need to take site-specific conditions into consideration. Although none of these facilities was used by the spotted owl research program, we provide here brief discussions on some of the unique decisions made for Forest Service housing facilities at three different experimental forests. (The specific RAWs pertaining to each site are available upon request.)

Cascade Head Experimental Forest

The facilities at this site on the Oregon coast include a main house (six beds) and a secondary smaller house (four beds) that typically are used by crews throughout the year and especially during summer. During the peak fieldwork season, all 10 beds in both houses are occupied. The main house is occupied year-round by a retired volunteer caretaker. In a typical year, there is usually a mix of summer-long field crew members and short-term (a few days to a few weeks) residents who use the bedrooms, bathrooms, and kitchen facilities interchangeably across both houses. After our risk analysis, the decision was made to treat the two houses as two isolated groups of individuals. The main house would be occupied only by the caretaker, who was in a high-risk demographic group, thereby limiting that person's exposure to others. The secondary house would be rented to three summer-long field staff (one per bedroom) who worked with each other on the same Forest Service unit. Potential points of close contact between the two groups was associated with waste/recycling and laundry facilities. Mitigations for these included prescheduling use and sanitization of potential contact areas. Other considerations were made for social distancing related to monthly water testing, weather data

collection, providing house supplies like cleaning products, emergency building repair, and lawn mowing.

H.J. Andrews Experimental Forest

The facilities at H.J. Andrews in Oregon's Cascade Range are much more extensive than at Cascade Head and include several apartment complexes, offices, and laboratories. These facilities are used for permanent staff, long-term research projects, seasonal field projects, and as a retreat for science-related conferences. Because of the site's remote location, field crews working at the experimental forest usually stay overnight at these facilities. Each apartment has five or six bedrooms, two bathrooms, and a shared common area and kitchen. The primary mitigation strategy for H.J. Andrews was to (1) provide individual apartments for nonlocal long-term staff members for overnight use and onsite work space that would not be shared by anyone else and (2) limit the use of other apartments by research teams after careful review. Any such approved teams would be considered a domestic unit, with no socializing or mixing with other units, with one individual assigned per bedroom, and with daily sanitation of shared household contact points (doorknobs, counters, etc.). Mitigation also included checkout of gate keys and equipment at the onset of the field season, with minimal exchange after that point, and designating only one person from each crew to use office facilities on a minimal basis.

Starkey Experimental Forest and Range

Starkey Experimental Forest and Range is a 25,000-ac tract of land in eastern Oregon that is completely surrounded by an 8- to 10-ft-tall game fence that encloses wild populations of deer and elk for study purposes. Onsite housing at Starkey's headquarter facilities includes a bunkhouse, cabin, several parking pads with electrical hook-ups for travel trailers, a separate shower and bathroom facility, and numerous options for remote camping. The primary mitigation for COVID-19 at this site included (1) limiting overnight stays to internal field staff and approved cooperators, with separate individual work spaces; (2) not providing housing or bathroom facilities to outside cooperators; (3) mandating that overnight stays by approved cooperators or contractors be limited to remote locations, using tents or cooperator-provided recreational vehicles away from Starkey's headquarters and other potential sites close to roads commonly used by field staff; and (4) keeping all access gates to Starkey locked. Relatedly, a closure order was made, prohibiting public use of Starkey (there is usually a seasonal opening of Starkey during the summer for camping and recreation). Other mitigation measures related to additional facilities included daily sanitation of all locks at gates used by field crews using gloves and cleaning supplies located at the gate or in vehicles.

A Decision Structure for Evaluating Current and Projected Conditions

In general, decisions on field activities in the face of pandemic conditions are made by evaluating a wide range of factors (app. 2) and weighing risks against benefits. More specifically, the range of factors could be represented in a decision tree or decision table that could be used to advise continuing or amending direction on field activities. An example is presented in appendix 3 that could be embellished for specific criteria to trigger a set of five recommendations or decisions on current field activities: to continue current field activities, reduce current field activities, temporarily pause current field activities with a specified time frame for reevaluation, indefinitely pause current field activities, or cancel current field activities. Each decision point would be based on a set of criteria of changes in expected and residual risks, and on stipulations for documenting those changes along with actions pertaining to changes in field crew activities and field presence. A decision table or decision tree using such a decision structure might be developed based on different criteria and stipulations, depending on the objectives and types of associated field activities. It could be applied to various organizational or geographic levels of field activity.

Other Risk Analysis Considerations

Other considerations may arise in conducting a job hazard risk analysis in the context of the pandemic situation. This section briefly touches on just a few of these.

There may be additional operating costs and procurement considerations associated with mitigation measures to deal with conditions of pathogenic outbreaks, epidemics, or a pandemic. Examples from the spotted owl research program included increased costs of leasing and operating separate field vehicles for individual employees to drive without passengers, procuring sanitizing gear and personal protective equipment (masks, gloves), and additional office administrative assistance for procurement, as well as exchange of vehicles and field gear so as to avoid personal contact. Other research programs may incur additional costs associated with establishing leases, and any costs of needing additional facilities for storage or disinfecting field equipment or vehicles. Additionally, in some instances, there may be lags in securing needed protective and other gear because of supply chain delays, and field activities may need to be temporarily adjusted accordingly until the equipment is in hand.

Considerations should be made to field operations that could entail, or would necessitate, close contact among workers, such as with deploying specific field gear, transferring gear, and other situations. Such operations may call for additional mitigation measures such as wearing masks and gloves, using hand sanitizer, and

carrying tote bags to avoid handling gear immediately touched by other workers, at least intermittently in the field for specific close activities.

A broader consideration pertains to interpersonal interactions with other employees and especially the public while traveling to and from field sites. One priority is to ensure awareness of the potential to transfer the virus to the general public in communities within the study areas. Also of importance is to be cognizant of attitudes in local communities toward field crews operating and coming into contact with local residents. These potential risks of transference can be mitigated with sanitizing steps and by limiting person-to-person (crew-to-public) contacts. However, it may be difficult to overcome any adverse local attitudes toward field crews where close-knit community concerns may be present, but this could also be a transient phenomenon.

It may be useful to provide specific guidance, especially to new employees or those without such experience, as to how to handle unexpected situations such as encountering illegal activities, vehicular accidents, and medical or law enforcement presence. Guidance should include appropriate use of radio communication with local agency administrative units, authorities, and medical or law enforcement emergency contacts.

During extended periods when the general public has been directed to remain sheltered at home, wild animals may become bolder and appear in locations not normally seen. Examples may include deer, foxes, coyotes, cougars, raccoons, and many other species that could be encountered near human habitations. There may be a low risk that such encounters could result in attacks or even zoonotic transmission of other pathogens from wild animal to person or to livestock and to other domesticated animals. Such changes in behavior, however, have not been reported with the owl species of interest in the example given in this report.

Summary

This report discusses procedures used by the Pacific Northwest Research Station to evaluate potential job hazards associated in general with pathogenic outbreak conditions of local or regional epidemics or global pandemics, and specifically pertaining to the current COVID-19 pandemic. As a case example, we describe the structured risk assessment procedures used to underlie decisions about continuing field work in support of the northern spotted owl research program. The risk analysis was designed to help inform decisionmakers—the "risk decision authorities" denoted in the risk assessment procedure—on whether to initiate, continue, amend, or curtail direction for activities of field research crews. The framework presented here is intended to be useful to other risk analysis and decision-advisory situations.

Acknowledgments

We thank Raymond Davis for weekly compiling data on COVID-19 conditions pertinent to northern spotted owl research sites, for his participation on the weekly risk evaluation team meetings, and for reviewing selected manuscript materials. We also thank the other members of the spotted owl research program Risk Assessment Team, principally Michelle Gerdes, Chris McCafferty, and Stan Sovern for their work on the risk assessment worksheet (app. 1), and PNW Research Station safety and health manager Tammy Verhunc for reviewing various worksheets at different stages of development. We are especially grateful for the spotted owl research program crews and crew leaders for undertaking the field research tasks and adhering to direction on mitigation and abatement tasks. We also acknowledge the contributions to the respective risk assessment worksheets by Ray Touchstone and David Oldenburg (Cascade Head Experimental Forest), Sherri Johnson (H.J. Andrews Experimental Forest), and Michael Wisdom (Starkey Experimental Forest and Range). We thank Dale Blahna, Peter Bloom, Kevin McKelvey, and Fabrice Stephenson for reviews of the manuscript.

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Appendix 1: Risk Assessment Worksheet

Risk Assessment Worksheet	1. Project/Incident/Work Activity	2. Location
	Spotted owl bioacoustics and demography field work	Spotted owl bioacoustics and demography field work
3. Specific Objective	**4. Name and Title of Preparer**	**5. Date**
Field work to maintain long-term data stream	Damon Lesmeister, Research Wildlife Biologist (see attachment for other team members)	4/17/20

6. Risk Decision Authority: (Authority Signature Block) If block 15 is Moderate, High or Extremely High a higher level of authority needs to sign in this block.

Signature/Date:

ERIC VOLKMAN Digitally signed by ERIC VOLKMAN Date: 2020.04.17 12:51:24 -07'00'

Assess Hazards					Identify Risk Mitigation Measures	Residual Risk				
7. Task	8. Hazard	9. Severity/ Consequence	10. Hazard Probability	11. RAC	12. List all mitigation or abatement measures	13. Severity/ Consequences	14. Hazard Probability	15. RAC	16. Necessary (Yes/No)	17. Hazard Control Assigned to:
Overarching tasks, program management	All COVID-19 hazards listed below, including inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission.	Critical	Likely	Extreme	See attachment for list of mitigations	Modera	Unlikely	Low	Yes	
Team meetings at centralized location for daily briefings, debriefing, administrative tasks, assigning daily duties, print maps, equipment exchange.	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Critical	Likely	Extreme	Avoid in person meetings. Conduct remote meetings (e.g., conference call, skype) for daily briefings, debriefing, administrative tasks, assigning daily duties, print maps, resupply of supplies and equipment, etc.	Modera	Rare	Low	Yes	
Transfer/exchange of field equipment and data forms, including gate keys, cameras, sound records, field maps, data sheets, batteries, etc.	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Critical	Possible	High	Check out all field equipment, eliminate unnecessary sharing or exchanging of equipment, including keys and data sheets. If equipment MUST be shared, follow CDC guidelines in attachment. When possible do not exchange equipment in person. Disinfect equipment at drop off and pick up. Keep inventory and tracking history of people using equipment.	Negligil	Unlikely	Low	Yes	
Office tasks not requiring contact with team members (e.g., map printing, resupply of field equipment, computer tasks)	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Critical	Possible	High	Check out all field equipment at beginning of field season, minimize trips to office, a single team member (crew leader) assigned for office entry for each study area. See CDC guidelines in attachment.	Modera	Possible	Moderat	Yes	
On boarding of new employees, office administrative tasks	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Critical	Possible	High	Use virtual on boarding. Minimize time in office to only those tasks that require in-person meeting, which is rare. Check out equipment via non-in person procedures. Follow CDC guidelines in attachment.	Modera	Unlikely	Low	Yes	
Shared field vehicle	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Critical	Likely	Extreme	Avoid commuting to field sites with other personnel. Mandatory single person per vehicle policy, individually assigned vehicle. Track vehicle use, who has been in vehicles.	Negligil	Rare	Low	Yes	
Single person per vehicle, no shared vehicle	Increased number of field vehicles operating	Critical	Unlikely	Moderat	Defensive driving methods, following at safe distance in caravans, driver must get out of vehicle and scout area before turning vehicle around. Disinfect vehicle upon return from field.	Modera	Unlikely	Low	Yes	

Figure A1.1—Risk assessment template.

Assess Hazards					Identify Risk Mitigation Measures	Residual Risk				
7. Task	8. Hazard	9. Severity/ Consequence	10. Hazard Probability	11. RAC	12. List all mitigation or abatement measures	13. Severity/ Consequences	14. Hazard Probability	15. RAC	16. Necessary (Yes/No)	17. Hazard Control Assigned to:
Retrieving field vehicles at compound	Inadequate disinfecting, surface transmission	Critical	Unlikely	Moderat	No in-person contact during retrieving or returning vehicles. Follow CDC guidelines for surface transmission. Request truck at home form approval, 15 day or 90 day.	Negligil	Rare	Low	Yes	All crew members
Fueling vehicles	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Critical	Possible	High	Use pay at pump, self service when possible. Disinfect pump handle, key pad, and credit card before and after use. Only lower window enough to exchange credit card. Follow CDC guidelines in attachment.	Critical	Unlikely	Moderat	Yes	All crew members
Interaction that does not require physical contact with public	Inadequate social distancing, person-to-person transmission	Critical	Unlikely	Moderat	Avoid contact/interaction with public except when absolutely necessary; practice social distancing. Follow CDC guidelines in attachment. Carry mission critical letter.	Negligil	Rare	Low	Yes	All crew members
Opening locks/gates on gated roads	Inadequate disinfecting, surface transmission	Critical	Unlikely	Moderat	Disinfect locks and gate surfaces that are touched before and after opening/closing. Wash hands/hand sanitizer after opening/closing. Follow CDC guidelines in attachment.	Negligil	Rare	Low	Yes	All crew members
Stopping for food while in field	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Critical	Possible	High	Depart for field prepared with adequate food and water for entire shift plus enough for one night emergency stay in field. Crew will also have with them a tent and sleeping bag. No stopping for food permissible.	Negligil	Rare	Low	No	All crew members
Snowmobiling/ATV, sharing trailer to transport vehicles to field.	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Critical	Possible	High	No use of snow mobiles or ATVs during COVID-19 pandemic.	Negligil	Rare	Low	No	All crew members
Vehicle maintenance and repair, interaction with repair shop clerks.	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Critical	Possible	High	Follow CDC guidelines for social distancing and surface transmission. Disinfect credit card, vehicle surfaces before and after drop off and pick up. Transport vehicle with someone in that team members "pod" (e.g., roommate that works in team). Use personal vehicle, mileage reimbursement.	Modera	Possible	Moderat	Yes	All crew members
Conduct standard demography and bioacoustics field work, requiring no in-person contact. No training component.	Rare possibility of surface transmission in environment	Negligil	Rare	Low	Continue fieldwork working independently with communication by radio and/or InReach devices	Negligil	Rare	Low	Yes	All crew members
Contact with fellow team member and/or local administrative units	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Modera	Rare	Low	No in-person contact in field unless emergency. Communicate by FS/BLM radio and/or InReach devices in field.	Negligil	Rare	Low	Yes	All crew members
Demography training for daytime tasks; determining nesting and reproductive status, band reading	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Critical	Possible	High	Discontinue or modify further training to maintain social distancing guidelines. Followed up visits done primarily by experienced crew members. Follow CDC guidelines in attachment.	Negligil	Unlikely	Low	Yes	All crew members

Figure A1.2—Risk assessment worksheet completed for conducting field work in support of the spotted owl research program of the U.S. Forest Service Pacific Northwest Research Station. The worksheet was developed by Damon B. Lesmeister, research wildlife biologist and principal investigator; Michelle Gerdes, biological scientist; Bruce G. Marcot, research wildlife biologist; Chris McCafferty, crew leader; and Stan Sovern, crew leader, and signed by Eric Volkman, acting program manager, who, through group discussion, identified tasks and associated hazards, consequence or severity levels, probability levels, mitigation and abatement activities, and resulting residual consequence or severity levels and probability levels.

Assess Hazards					Identify Risk Mitigation Measures	Residual Risk				
7. Task	8. Hazard	9. Severity/ Consequence	10. Hazard Probability	11. RAC	12. List all mitigation or abatement measures	13. Severity/ Consequences	14. Hazard Probability	15. RAC	16. Necessary (Yes/No)	17. Hazard Control Assigned to:
Demography training for daytime tasks; capture, handling, and banding procedures.	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission`	Critical	Likely	Extreme	Discontinue further training on daytime capture and banding methods, conducted only by experienced crew members. Unexperienced crew may observe while maintaining social distancing guidelines.	Negligil	Unlikely	Low	Yes	All crew members
Demography training for nighttime tasks; callback surveys	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Critical	Possible	High	Maintain social distancing, no sharing of vehicle, equipment or data forms, exercise demonstrations from safe distance (>6 ft). Follow CDC guidelines in attachment.	Negligil	Unlikely	Low	Yes	All crew members
Bioacoustics training for deployment and retrieval of sound recorders	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Critical	Possible	High	Maintain social distancing, no sharing of vehicle, equipment or data forms, exercise demonstrations from safe distance (>6 ft). Follow CDC guidelines in attachment.	Negligil	Unlikely		Yes	**Low** All crew members
4x4 off road training and testing	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Negligil	Rare	Low	Waive further 4x4 training and testing that requires more than one person per vehicle. Follow GSA requirements for driving GSA vehicles, valid drivers license and online defensive driving certificate.	Negligil	Rare	Low	Yes	All crew members
Wilderness First Aid training	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Critical	Likely	Extreme	Use online first aid training that does not require in-person trainings.	Negligil	Rare	Low	Yes	All crew members
Assistance for injuries and vehicle accidents related to on-the-job tasks, witnessing of illegal activity	Inadequate disinfecting and/or social distancing, person-to-person and/or surface transmission	Critical	Possible	High	Strict adherence to existing JHA's. Communicate by radio and/or InReach. Self-isolate for 2 weeks if CDC guidelines are not able to be followed.	Modera	Possible	Moderat	Yes	All crew members
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Figure A1.3—Risk decision authority is guidance in the risk assessment worksheet that identifies the administrative level of the decisionmaker, according to the overall risk assessment outcome.

Mitigations for Overarching Tasks and Program Management

- Every team member has the "yellow card" (see fig. 3) which can be raised if they feel situational safety is an issue that needs to be resolved. The yellow card entitles each member to call for a "pause" in which our work is suspended so that the safety and/or risk concerns can be addressed/mitigated by the supervisor. All employees and supervisors have the responsibility and a right to assess safety and risk within the context of any assignment.
- Daily check ins: ensuring every team member is aware and knowledgeable of COVID-19 symptoms (e.g., fever, cough, shortness of breath, loss of sense of smell), tracking employee health, team members are queried and assessed for wellness and symptoms upon start of work day, disclosure of any symptoms of others in their house, disclosure of any activities that may have exposed them to coronavirus. Send symptomatic individuals home and instruct to call healthcare provider.

All team members are instructed and encouraged to practice external situational awareness, which is particularly important when working in environments with COVID-19 risk.

There is a dynamic nature to this COVID-19 pandemic, both spatially and temporally; therefore, we need a dynamic risk assessment process. As such this risk assessment will need to be reevaluated weekly, and more frequently if local conditions warrant. Taking a team approach, the program manager and principal investigator will track local conditions and provide recommendation if field work should continue the following week. For example, use the Johns Hopkins coronavirus map: https://coronavirus.jhu.edu/map.html. This reevaluation process will help address the dynamic nature of COVID-19 risk. A coordinator will be assigned to work and communicate with field crews and local administrative units to assess conditions and infection trends at each study area. The team will track all activities, mitigations, and results on a weekly basis.

- Most mitigations listed below require cleaning supplies. Without available cleaning supplies those tasks must be paused until supplies are available.
- All crew members must follow current and relevant CDC guidance on workplace practices for preventing spread: https://www.cdc.gov/coronavirus/2019-ncov/index.html.
- All crew members must cover coughs and sneezes, sanitize immediately.

It is important to note that in reevaluations of risk assessment that interactions may occur between tasks, mitigation, and resulting residual risk. This could raise ranking of severity/consequences and/or hazard probabilities with increased ranking of residual risks.

Risk assessment team members—

Damon Lesmeister, supervisory research wildlife biologist
Michelle Gerdes, supervisory biological scientist
Bruce Marcot, research wildlife biologist
Chris McCafferty, wildlife biologist
Stan Sovern, wildlife biologist

CDC guidelines for person-to-person transmission—
Maintain 6' distance as virus is thought to spread person-to-person through droplets when person coughs or sneezes. Wash hands frequently for at least 20 seconds with soap and water; if soap and water are not available, use hand sanitizer that's at least 60 percent alcohol. Avoid touching face (eyes, nose, mouth) with unwashed/unsanitized hands.

CDC guidelines for surface transmission—
Avoid touching face (eyes, nose, mouth) with unwashed/unsanitized hands. Wash hands frequently for at least 20 seconds with soap and water, if soap and water are not available, use hand sanitizer that's at least 60 percent alcohol. Clean **and** disinfect frequently touched surfaces daily. This includes gas pump, field equipment (e.g., cameras, recording units, GPS, callers, binoculars), keys, tables, doorknobs/handles, light switches, countertops, handles, desks, phones, computer, keyboards, toilets, faucets, and sinks. For disinfection, most common EPA-registered household disinfectants will work. Use disinfectants appropriate for the surface.

Options include:

- Diluting your household bleach: To make a bleach solution, mix: 5 tablespoons (1/3 cup) bleach per gallon of water **or** 4 teaspoons bleach per quart of water.
- Follow manufacturer's instructions for application and proper ventilation. Check to ensure the product is not past its expiration date. Never mix household bleach with ammonia or any other cleanser. Unexpired household bleach will be effective against coronaviruses when properly diluted.
- Alcohol solutions: Ensure solution has at least 70 percent alcohol.

Appendix 2: Examples and Sources of Information on COVID-19

Evaluations of hazard conditions and field situations are made using these examples and sources of information on COVID-19, which are gathered on a weekly basis to inform managers on weekly decisions to continue, amend, curtail, or cease field crew activities, pertinent to the risk assessment worksheet shown in appendix 1.

1. COVID-19 Case Numbers and Trends

1.1. COVID-19 Numbers of Cases

1.1.1. Confirmed number of cases per week

Source: https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html?fbclid=IwAR1xIZai9L79GZkhTjp0WtqVsl8gzh5TQG-5OAXuxQP8Cc-WrMv_EviImpoI#/bda7594740fd40299423467b48e9ecf6

1.1.2. Percentage change from previous week, calculated from these data

For the nine counties in Washington and Oregon specifically pertaining to the owl studies, and for Oregon and Washington statewide

1.1.3. Deaths per week (COVID-19 caused)

Source: https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html?fbclid=IwAR1xIZai9L79GZkhTjp0WtqVsl8gzh5TQG-5OAXuxQP8Cc-WrMv_EviImpoI#/bda7594740fd40299423467b48e9ecf6

1.1.4. Death rate (deaths per 100,000) and change in death rate from previous week, calculated from these data

For the nine counties in Washington and Oregon specifically pertaining to the owl studies, and for Oregon and Washington statewide.

1.1.5. Confirmed number of COVID-19 cases by county in western Washington and western Oregon, displayed in GIS map of county outlines, also showing location polygons of the eight owl study areas

Source: https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6

1.2. COVID-19 Per Capita Occurrence Rates

1.2.1. Daily cases per 100,000 population, 7-day rolling average (state maps showing county-specific risk levels in four categories: <1, 1 to 9, 10 to 24, and 25+ cases per 100,000 people)

Source: https://globalepidemics.org/key-metrics-for-covid-suppression/

1.3. COVID-19 Trends

1.3.1. Confirmed cases over time (bar graph, numbers over time; observed and projected with uncertainty)

Source: https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html?fbclid=IwAR1xIZai9L79GZkhTjp0WtqVsl8gzh5TQG-5OAXuxQP8Cc-WrMv_EviImpoI#/bda7594740fd40299423467b48e9ecf6

1.3.2. Average new cases per day

Source: https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html?fbclid=IwAR1xIZai9L79GZkhTjp0WtqVsl8gzh5TQG-5OAXuxQP8Cc-WrMv_EviImpoI#/bda7594740fd40299423467b48e9ecf6

1.3.3. Percentage change in average new cases per day from previous week, calculated from these data

1.3.4. Confirmed case trends for counties with owl study areas (line graph)

Source: https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6

1.4. COVID-19 Transmission Rate

1.4.1. Rt value (average number of people who become infected by an infectious person)

Source: https://rt.live/

2. Testing Levels and Positivity Rates

2.1. COVID-19 test positivity rates for Oregon

Source: Oregon Public Health Division on COVID-19 Weekly Testing Summary

https://www.oregon.gov/oha/PH/DISEASESCONDITIONS/DISEASESAZ/Emerging%20Respitory%20Infections/Oregon-COVID-19-Testing-Summary-2020-07-06.pdf

2.2. Total number of people tested

Source: https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html?fbclid=IwAR1xIZai9L79GZkhTjp0WtqVsl8gzh5TQG-5OAXuxQP8Cc-WrMv_EviImpoI#/bda7594740fd40299423467b48e9ecf6

2.3. Percentage of population tested, calculated from these data

3. Health Care Capacity

3.1. Hospital resource use: all beds, ICU beds, invasive ventilators (line graph, numbers over time, comparing use to total availability, observed and projected with uncertainty)

Source: https://covid19.healthdata.org/united-states-of-america

3.2. Number of available hospital beds

3.3. Number of used hospital beds

For the nine counties in Washington and Oregon specifically pertaining to the owl studies and for Oregon and Washington statewide.

Source: https://covid19.healthdata.org/united-states-of-america

4. Social Behavior

4.1. Social distancing (line graph depicting mean social distancing from cell phone mobility data, scaled as negative percentages from early February 2020 conditions, observed and projected with uncertainty)

Source: https://covid19.healthdata.org/united-states-of-america

5. Narrative Summary

5.1. COVID-19 Weekly Report, Oregon's Weekly Surveillance Summary, Novel Coronavirus (COVID-19); from Oregon Health Authority, Oregon Public Health Division

Contains text narrative summaries, data tables, and graphics on the following:

- Number of cases
- Change in numbers
- Percentage of reported signs and symptoms
- Reported behavioral risk factors
- Trends in numbers of cases by sex and week of onset
- Severity and rates by age group and week of onset
- Severity and rates by race and week of onset
- Severity and rates by ethnicity and week of onset
- Time to recovery among symptomatic people with confirmed COVID-19
- Active outbreaks and resolved outbreaks in care facilities, senior living communities, and congregate living settings
- Active and resolved workplace outbreaks
- Schools and childcare facilities reporting outbreaks
- Hospitals reporting 1–9, and 10 or more, COVID-19 patients
- Cases by ZIP code

Source:

https://www.oregon.gov/oha/PH/DISEASESCONDITIONS/DISEASESAZ/Emerging%20Respitory%20Infections/COVID-19-Weekly-Report-2020-06-24-FINAL.pdf

6. Additional Information Provided Intermittently

6.1. Definitions of reopening phases, by state

Appendix 3: Example of a Decision Structure

The following is an example of a decision structure to advise on continuing or amending field activities depending on epidemiological conditions, such as those associated with the prevalence of and treatment capacities for COVID-19. A decision structure of this type may also denote stipulations for changes in field activities and documentation of reasons for a given decision, and could be applied to specific field locations, or to portions or entire field programs.

The following recommendation or decision pertains to:

Project / Program: _____

Field crew(s): _____

Study location(s): _____

Table A3.1—Example of a Decision Structure

Recommendation or decision (check one)	Description	Criteria for recommendation or decision	Stipulations
□ Continue as is	Continue current field activities	To be determined[a]	Continue current mitigation and abatement activities, communicating results as scheduled.
□ Reduce	Scale down field exposure time, size of field crew, No. of study sites, or other (specify)	To be determined[a]	Identify reason for reduction(s), and degree(s) to which reduction(s) would be implemented; document and communicate response.
□ Temporary pause (specify time frame)	Halt the stated field activity; specify duration for pause	To be determined[a]	Identify reason(s) for work pause and for the specified duration; identify criteria to evaluate at end of pause for reconsidering work status.
□ Indefinite pause (time frame not specified)	Halt the stated field activity	To be determined[a]	Identify reason(s) for work pause; identify criteria to evaluate at any time during the pause for reconsidering work status.
□ Cancel	Terminate the field activities	To be determined[a]	Retrieve field crews and secure equipment from field sites

[a] Criteria for instituting a specific recommendation or decision level could include a variety of factors related to COVID-19, at specified locations or geographic scales, using sources such as those listed in appendix 2.

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