Attachment 1 to Staff Report to Ordinance No. 18-1419

Metro Title 10 Review Sounding Board

Final Report

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Background

Metro is charged with protecting water quality, fish and wildlife habitat, and creating opportunities to enjoy nature close to home. Title 10 of the Metro Code regulates the use of Metro owned or operated Parks and Nature facilities by members of the public in order to provide protection for wildlife, plants and property, and to protect the safety and enjoyment of any person visiting these facilities.

Several members of the community have expressed a desire to include new uses at Metro parks and natural areas or expand existing uses. With several new nature parks in development and Metro's natural area portfolio continuing to expand, the agency is reviewing Title 10 for potential updates, and revisiting provisions that are of interest to the public and partners

Sounding Board Members and Process

Metro engaged stakeholders through a Sounding Board process to help inform the Title 10 update process. Sylvia Ciborowski, JLA Public Involvement, facilitated the meeting as a neutral third party. JLA documented meeting outcomes and developed meeting summaries.

The Sounding Board was made up of stakeholders that represented diverse interests, including conservation groups, recreational interests, and neighborhood representatives. The group met three times to discuss issues and opportunities related to modifying the uses currently allowed at Metro owed parks and nature facilities.

Metro staff will use Sounding Board input, along with input by other stakeholders such as agency staff and partners, as well as technical information, to make a report to the Metro Council that could include a recommendation on changes to Title 10. Metro Council will make any final decision regarding potential changes to Title 10.

Sounding Board members include:

1. Tony Deis, *Trackers Earth Portland*
2. Jorge Guzman, *Vive Northwest*
3. Mike Houck and Ted Labbe (alternate), *Urban Greenspaces Institute*
4. Arlene Kimura, *Hazelwood Neighborhood Association*
5. Ken McCall and Brian Cook (alternate) , *Oregon Hunters Association*
6. Micah Meskel, *Audubon Society*
7. Jim Thayer, *Oregon Recreational Advisory Council*
8. Philip Wu, *Kaiser Permanente*

Other invited members that were unable to participate in meetings include Greg Wolley (City of Portland and African American Outdoor Association) and Chad Brown (Soul River).
Meetings were facilitated by an external, neutral facilitator and attended by Metro project team members Dan Moeller and Suzanne Piluso, as well as additional Metro staff as needed.

Key Outcomes

Sounding Board members developed a list of priority topics to discuss, and discussed each in turn. For some they came to consensus as to recommendations for how to address the topic within Title 10. For others they had divergent opinions. Key comments for each of the discussion topics are included below.

A full summary of discussion from the three Sounding Board meetings is included as an appendix, along with additional scientific literature and email comments provided by members.

Smoking

Consensus was reached by the group that a smoking ban should be included in Title 10 (except where allowed by a special-use permit). The key concerns regarding smoking are the risk of fire and health impacts of second-hand smoke. Members also recommended increasing signage about smoking and the risk of causing forest fires.

Alcohol Use

Consensus was reached by the group that an alcohol ban should be included in Title 10, except where allowed by a special-use permit. They noted concerns about park visitors who use alcohol irresponsibly and indicated that a prohibition on alcohol would be easier to enforce than a more nuanced policy. They support the current policy of allowing alcohol by special-use permit, especially the use of alcohol for cultural reasons or celebrations.

Use of Drones

Consensus was reached by the group that drones should be prohibited in Title 10, except where allowed by a special-use permit. Some suggested expanding the current prohibition on power-projected model airplanes to include drones. They noted that acceptable allowable uses to use drones could include research, art, nature, agricultural and wildlife management reasons.

Geocaching

Consensus was reached that Title 10 should prohibit geocaching except in applications that support Metro's environmental education goals. The biggest concern about geocaching is that it encourages, participants to go into natural areas that are not meant to be disturbed.

Dogs and Other Domestic Animals

Consensus was not reached by the group. Many opinions and important pieces of information were shared both in favor, and in opposition, to changing Title 10 with regards to dogs on Metro parks and natural area property. Key comments and points of discussion include:

- **Diverse views on managing dogs.** Members had diverse views on whether and to what extent to prohibit dogs in Metro parks and natural areas. Most felt that the current policy is appropriate and appreciate the exceptions it already makes for regional trails and boat ramps. Most were concerned about the negative impact dogs have on wildlife and do not support increased access for dogs. Others felt that this disturbance is not severe enough to warrant a complete prohibition on dogs. One member also noted that a complete dog ban could potentially raise the frequency of off-leash dogs and be even more harmful to wildlife.
- **Discussion on equitable access for dog-owners.** One member noted that it is inequitable to reduce access to Metro properties for the many dog-owners in the Portland metro area, particularly since there are not many large swaths of land where one can walk their dog. Others noted that a map (provided by Metro staff) shows that there are many areas in the region where dogs are allowed.
- **Discussion on social conflicts**. Some members noted that allowing dogs on Metro property might make some people uncomfortable (i.e. children, certain cultural groups). Under-represented groups might perceive dogs as a threat and not feel comfortable if dogs are allowed on Metro property. Some noted that improved signage and education could be used as tools to prevent conflict between property users.

- **Discussion on enforcement of the policy**. Some noted that a complete dog ban is the easiest for Metro to manage with their limited resources. Others supported a more nuanced policy and support additional resources to enforce a policy allowing limited leashed-dog access at select properties. Members generally noted there is not enough enforcement of regulations prohibiting unleashed dogs.
- **Comments about literature studied by Metro.** A member was concerned about the scientific literature that Metro has reviewed in consideration of revisiting the ban on domestic animals, and felt that the studies in the review are outdated and included small sample sizes. The member requests inclusion of an additional scientific document which suggests that leashed dogs have only a marginal impact on wildlife and natural areas*: The ecological impact of humans and dogs on wildlife in protected areas in eastern North America* (attached to this report). This member also requested inclusion of the Statewide Comprehensive Outdoor Recreation Plan Report (SCORP), available at http://www.oregon.gov/oprd/PLANS/Pages/SCORP_overview.aspx. Other members responded by warning against placing too much importance on one individualized study, and instead would like Metro to look at all of the studies' conclusions as a whole.

Hunting

Consensus was not reached by the group regarding changing Title 10's prohibition on hunting. However, there was general agreement that:

- ***further study should be conducted to understand the impacts of hunting on wildlife and people.***
- ***there should be consideration for limited hunting on Chehalem Ridge with restrictions.***

Comments and points of discussion on the topic of hunting included:

- **Hunting on the Chehalem Ridge property**: There was general agreement around having a policy prohibiting hunting with firearms, but ideas were expressed that a special use permit could be considered for bow hunting or other limited hunting on Chehalem Ridge, in recognition of the historic practice of hunting in this area.
- **Hunting as animal management**: Members noted the importance of managing animal populations to prevent overpopulation of certain game, and some expressed support for regulated hunting to appropriately manage animal populations.
- **Hunting concerns:** Concern was expressed about whether hunting would make certain communities feel uncomfortable on properties. There was also concern about toxicity of certain ammunition.
- **Limitations on hunting:** Members discussed that any allowed hunting should be in line with Metro's mission, should focus on the educational component of hunting, and should be regulated by permit. Members discussed the possibility of organized hunts in which experienced hunters are allowed on specific parks to conduct a certain hunting functionality.
- **Loss of hunting lands**: Metro's purchase of numerous small pieces of land has contributed to hunters losing available hunting land in the region. Members also discussed hunter and recreational access to privately owned forest lands.

Unsupervised Children

Members generally felt that the Metro rules as written are sufficient. The key concerns on this topic were protecting the safety of small children, allowing older children to have enough opportunities for play in natural areas, and keeping older children/minors liable for destruction they cause in nature areas.

There is desire to have better signage and communications materials to increase awareness about nature play opportunities and how to stay safe (outside of scope of Title 10).

Demand/desire trails and foraging

Members support updating the Title 10 to specifically prohibit demand trails.
Members support updating Title 10 to allow small-scale personal consumption of forest products, but prohibit commercial harvesting or excessive personal harvesting.
The key concerns on this topic were preventing degradation in areas where people tend to go off trail, but also not discouraging personal foraging practices that help connect people to nature. Members support allowing demand trails and larger-level harvesting under special use permits, as is the current practice.

Rule Enforcement and Safety

Members did not suggest any specific changes to Code language. They did make suggestions about signage, programs and communications materials that could help increase safety and security.
For nearly all topics described above, members expressed concern about the ability to enforce any prohibitions or restrictions. They also discussed a desire for more safety and security in parking areas to prevent vehicle break-ins, as well as engaging neighbors and park users in promoting safety and reporting suspicious activity.

Metro Title 10 Review Sounding Board Final Report

Appendix

Contains:

1. Metro Sounding Board Meeting #1 Summary
2. Metro Sounding Board Meeting #2 Summary
3. Metro Sounding Board Meeting #3 Summary
4. Email comments submitted by Sounding Board members
5. Article submitted by Sounding Board member: Biological Conservation, *The ecological impact of humans and dogs on wildlife in protected areas* (2016)

Metro Title 10 Review Sounding Board - Meeting #1 Summary

Friday, June 16, 2017, 1:00 to 3:00 p.m.
Location: Metro Regional Center, Room 270: 600 NE Grand, Portland, OR

Sounding Board Members Present

Arlene Kimura, *Hazelwood Neighborhood Association*
Jim Thayer, *Oregon Recreational Advisory Council*
Jorge Guzman, *Vive Northwest*
Ken McCall, *Oregon Hunters Association*
Micah Meskel, *Audubon Society*
Mike Houck, *Urban Greenspaces Institute*
Ted Labbe (alternate), *Urban Greenspaces Institute*
Philip Wu, *Kaiser Permanente*
Tony Deis, *Trackers Earth Portland)*

Staff Present
Dan Moeller, *Metro*
Suzanne Piluso, *Metro*
Laura Oppenheimer Odom, *Metro*
Katy Belokonny, *JLA Public Involvement*
Sylvia Ciborowski, *JLA Public Involvement*

Introductions and Agenda Review

Sylvia Ciborowski, JLA Public Involvement, introduced herself and thanked members for attending the meeting. She said that the meeting purpose is to get a better understanding of Metro's role in the region, including Metro's Title 10 Code; review the Sounding Board's purpose, guidelines, expectations, and desired outcomes; as well as to begin identifying issues and opportunities related to recreational uses at Metro-managed parks and natural areas. Sylvia reminded the Sounding Board that they will meet three times in total to get their input on recreational uses.

Members introduced themselves, along with their affiliations, and shared their favorite natural area or park in the region.

Jim Thayer, Oregon Recreational Advisory Council, asked what the full process for the Title 10 review will include beyond the evaluation of this Sounding Board. Dan Moeller, Metro, said that agency staff will review the Sounding Board's findings, in combination with additional public input and scientific information, to create a recommendation and staff report that will be presented to the Metro Council to help them determine if a Title 10 amendment is warranted.

Thayer asked for more information regarding the specific scientific technique and public process that Metro plans to use. Moeller said that the broader public involvement approach has not yet been identified, but that it will likely include members of the public reviewing the Sounding Board's comments. Moeller explained that Metro staff will help determine which available science is most appropriate to help inform Metro's staff recommendation.

Metro Title 10 Presentation

Moeller explained his role at Metro and said that the agency is in the process of reviewing and updating Title 10 of the Metro Code. Moeller explained that Title 10 spells out what people are permitted to do and prohibited from doing in Metro parks and natural areas, as well as how Metro enforces these rules. He thanked participants for their willingness to provide their unique perspectives, and said that he wanted to present the Sounding Board with a broad overview of the system so that members start their committee work with a shared understanding.

Moeller's PowerPoint presentation included the following:

Parks and Nature - An Oregon Story: The common denominator of why Oregonians love the region is nature.

Mission Statement: Voters have asked Metro to act as the steward of over 17,000 acres across the greater Portland region. The Parks and Nature Department's mission is to protect clean water, restore fish and wildlife habitat, and connect people with nature close to home. Metro fulfills this mission by providing a connected network of parks, trails and natural areas. Providing this network requires collaboration with other regional partners to ensure that the agencies not only avoid duplicative efforts, but implement complementing plans.

Role in the Region: Metro fills a niche between urban and rural park providers by focusing on large sites. Metro is unique nationwide because there are very few other urban areas that place such a high emphasis on connecting people with nature. The mission is challenging to implement as it has an inherent tension: protect the landscape and provide opportunities for people to engage with the landscape.

A Quarter Century of Investment: In the early 1990s Metro began implementing the community's vision for a regional park, natural area, and trail system. Two bonds, allowing for substantial land acquisitions, and two levies, allowing for continued operation of these lands, have been approved since 1995 to support Metro in achieving this vision.

Graham Oaks, Newell Creek Canyon, Chehalem Ridge: Many of the sites Metro manages today would have looked substantially different without the agency's ownership.

Volunteer and Education Programs: A key agency goal is to foster education programs, community partnerships and volunteer opportunities. This effort has recently been enhanced with last year's renewed levy.

Historic Cemeteries: Metro manages 14 historic cemeteries that provide places to enjoy nature, as well as burial space.

Regional Trails: Metro plays an important role in planning the broader trail system with regional partners.

Planting New Roots: It is a time of tremendous growth for Metro's system due to the levy that was renewed last year.

Restoration and Maintenance: Metro places a high emphasis on caring for the land and creating healthy habitats from weed control to large restoration projects.

Access to Nature: Metro creates opportunities for people to experience more of the land they've directed the agency to protect, while minimizing the impact on the habitat.

Community Investments: Metro has developed a robust community investment program, distributing a portion of the bond measures to local jurisdictions to help them achieve their innovative, restoration, education, and trail projects.

Parks and Nature System Plan: Metro finished the System Plan last year outlining the agency's mission and role, portfolio of land, operating model and priorities moving forward. The document is intended to guide investments and decision-making, and contains the rules currently under review. Agency priorities outlined in the Plan include:

1. Science will guide Metro's portfolio
2. Ensure full portfolio is knit together into an integrated system
3. Meet needs of color and low-income communities
4. Use diversified businesses to do Metro's work
5. Invest in partnerships that work toward achieving a shared vision of an interconnected regional network
6. Identify stable, long term funding

Moeller assured members that Metro staff is available to them to provide information and answer questions as they contemplate recommending Title 10 changes.

Mike Houck, Urban Greenspaces Institute, said that it is important for Sounding Board members to remember the origin and history of Metro when discussing the agency's future. Houck said that Metro was created originally because local jurisdictions were not actively protecting parks and natural areas. Houck explained that the agency was always envisioned to be a bi-state, regional system, and not duplicate local park provider initiatives.

Sounding Board Purpose and Participation Guidelines

Ciborowski reviewed the Sounding Board Purpose and Participation Guidelines.

Purpose and Role of Sounding Board
The Purpose and Role of The Sounding Board is as follows:

"The Sounding Board will provide input on current and future recreational uses of Metro's parks and natural area properties. The intended outcome of the Sounding Board is to identify issues and opportunities related to expanding the allowed uses at Metro managed properties, and help assess where there is agreement among diverse stakeholders."

Title 10 Review Process
Metro staff will use Sounding Board input, community feedback, and scientific research to develop a report for the Metro Council to use when considering making changes to Title 10.

Sounding Board Protocols
Ciborowski reviewed the Board membership composition, attendance and alternate expectations, and meeting guidelines. Each member is welcome to name an alternate to attend meetings when the primary member cannot attend, and one member may sit at the table to participate in discussion. There will be time during the last meeting to discuss how the group wants their feedback consolidated and packaged to the Metro Council.

She asked members if they agree to operate under the Sounding Board Process and Operating Procedures, as discussed. The Sounding Board members agreed.

Discussion on Recreational Uses

Ciborowski encouraged the group to begin brainstorming all topics, related to recreational uses on Metro land, that members are interested in discussing throughout the three-meeting Sounding Board process.

The recreational uses, or Title 10 issues, group members most want to address include the following:

- Drones
- Geocaching
- Foraging
- Leashed dogs
- Hunting
- Target shooting, firearms, archery
- Trapping
- Bathrooms
- Disc golf
- Open flames (i.e. stoves, camp fires)
- Marijuana use
- Amplification/noise (i.e. instruments)
- Hazard notification
- Fireworks
- Intelligent park/trail design
    - How to accommodate conflicting uses in a way that eliminates the conflict
    - Informal "desire" trails
- Unsupervised kids
- Spillover onto private lands
- Access to equipment (i.e. lifesaving equipment)
    - Notification if injured

- Homeless and safety
- Enforcement
- What's allowed under special use permits? (i.e. precedence setting)
- Access to information about rules
    - Signage
    - Information in multiple languages
    - Audible information
- Role of parks in public health
    - Specifically to the elderly
    - Access for disabled individuals (ADA requirements)
    - Doctor-recommended for cardiovascular patients

Suzanne Piluso, Metro, noted that staff will review the list in more detail after the meeting to identify any items that are outside of Metro's scope or that may not be applicable to this Title 10 review.

Members discussed several of the topics in turn.

Smoking –

Current Condition:

Metro Code: Title 10 is currently silent about smoking. Although the Code does not address smoking, the Metro Council has an adopted resolution about properties being "smoke free."

Discussion: Comments made by members include:

- Smoking does not belong in the forest due to its flammable nature.
    - The public is not good about remaining aware of burn-ban status.
    - People can be careless about where they put their cigarette butts.
- Consider specific messaging including signage about the danger of smoking during burn-ban. The messaging should communicate that smoking is a serious fire issue.
- Allowing smoking is a public health concern (i.e. second hand smoke).
- Members discussed whether a ban should also include medical marijuana or just tobacco? They noted that if the reason for the ban is concern about fires in natural areas, then it will be easier to ban all forms of smoking.
- Several members noted that special use permits should still be allowed if a smoking ban is included in the Code.

Outcome:

Consensus was reached by the group that a smoking ban should be included in Title 10.

Alcohol –

Current Condition:

Metro Code: Title 10 currently prohibits alcohol at Metro facilities. There are some exceptions specifically articulated in the Code (i.e. events).

Discussion: Comments made by members include:

- Use of alcohol should be allowed for cultural reasons. Permit applicants should be permitted to explain these cultural sensitivities in applying for special-use permits regarding alcohol.

    - Evaluation criteria for special-use permit review should reflect this.
    - Moeller said that Metro has a Cultural Resource Specialist currently on staff to help the agency review their current practices
- Keeping alcohol prohibited by the Code helps with enforcement.
- Alcohol needs to be prohibited by Code to help regulate individuals who are using alcohol irresponsibly.
- Metro staff clarified that a special-use permit supersedes language in the Code.

Outcome:
Consensus was reached by the group that an alcohol ban should be included in Title 10, except where allowed by a special-use permit.

Drones –

Current Condition:
The Metro Code does not address drones, but prohibits power-projected model airplanes except in areas designated for those uses.

Discussion: Comments made by members include:
- Suggest simply adding "drones" to the current Code language relating to power-projected model airplanes.
- A question was asked if Metro has to obtain a special-use permit if they wish to seek a Code exemption. Moeller clarified that Metro does not have to seek permits for its actions.
- Members discussed the kinds of drones uses that might be appropriate. Different members said that the following uses may be appropriate in certain situations:
    - Research
    - Art/filming
    - Media
    - Nature management
    - Agriculture (i.e. manage farms)
    - Wildlife (i.e. Forestry animal counts)
- Metro staff noted that Metro has complete discretion when reviewing special-use permits, as there are not set evaluation criteria.
- A member asked if there is a fee to file a special-use permit. Moeller said that there are two fees: an application fee and a use fee.
  Concern was expressed that these fees could make requesting a special-use permit cost prohibitive. Moeller said that Metro has discretion to reduce or waive fees when appropriate, and that there is a sliding scale fee structure for non-profit agencies. The Sounding Board supports this procedure.
- Concern was expressed that banning drones could be difficult to enforce, particularly because it is difficult to Identify the drone operator (i.e. operate from phone).
    - Metro staff noted that park rangers are responsible for enforcement. Metro's objective is "willful compliance" through education. Also, Metro does not control air space above 400 feet; that is FAA regulated
- Signage might be important in helping enforcement

Outcome:

Consensus was reached by the group that drones should be prohibited in Title 10, except where allowed by a special-use permit.

Geocaching

Current Condition:

The Metro Code does not address geocaching, but harming natural and built resources on Metro property is prohibited. Although the Code does not specifically address geocaching, Metro staff developed general guidelines in an attempt to pro-actively manage the growing trend (as outlined in the "Geocaching" information sheet).

Discussion: Comments made by members include:

- Suggest making the Code relevant to all augmented reality applications, to include similar popular activities such as "Pokémon Go" and Pokeball.
- The biggest concern about geocaching occurring on Metro properties is that it encourages, and often requires, participants to go into natural areas that are not meant to be disturbed. This type of activity can disrupt species and goes against the philosophy of the agency.
    - Additionally, geocaching requires participants leave an item behind, which essentially is a form of litter.
- Concern was expressed that enforcing an augmented reality prohibition might be difficult
    - A suggestion was made that park rangers could be responsible for collecting the caches which would discourage people from participating in the activity on Metro property.
- Metro clarified that the agency currently attempts to limit geocaching activities by communicating with geocaching.com and requesting that they remove from their website any geocaches located on Metro property.
    - Members questioned how much Metro staff time is being spent on geocaching enforcement.
- There was a question about if there is value in allowing augmented reality activities to occur on Metro properties to help achieve Metro's environmental educational goals.
    - The activity itself is encouraging community members to interact with nature – which is a priority of the agency.
        - There may be value in encouraging augmented reality activities in specific uses through an agency managed program to avoid habitat degradation (i.e. requiring staying on trails, etc.).
        - The messaging would have to be very intentional – consider using a term other than "geocaching" – so that people understand the activity is only allowed through an organized program.

Outcome:

Consensus was reached that Title 10 should prohibit geocaching except in applications that support Metro's environmental education goals.

Hunting

Ken McCall, Oregon Hunters Association, said that Brian Cook will be the alternate attending the July meeting in his place. Due to his absence at the next meeting, McCall said that he would like to start the group conversation regarding hunting on Metro property so that he is able to brief Cook prior to his attendance.

Discussion: Comments made by members include:

- McCall said that Metro's purchase of numerous small pieces of land has contributed to hunters losing adequate available hunting land statewide. The Oregon Hunting Association agrees that hunting should not be a recreational use allowed on Metro's small areas of land, but they see an opportunity for hunting to have an appropriate role on carefully-selected Metro spaces. Questions arose from the group regarding how hunting could play an "appropriate role". McCall explained that some ideas include having educational hunting components and organized hunts in which experienced hunters are allowed on specific parks to conduct a certain hunting functionality (i.e. specific weapon). The Oregon Hunting Association has concern about how private land owners adjacent to Metro land are being negatively affected by animals intruding on their properties. McCall added that a hunting policy change could help manage some animal concerns, especially regarding elk and deer.
- A member added that a piece of property can have a certain animal carrying capacity; and gave an example of ways that other countries regulate, and partner, with hunters to manage this problem.
- A member asked whether hunting was previously allowed at Chehalem Ridge. Moeller confirmed that it was. McCall clarified that the Oregon Hunters Association request is more wide-spread to include consideration at several Metro properties, not just at Chehalem Ridge.

There was agreement among members that hunting would be addressed at the next meeting.

Next Steps

The next meeting is scheduled for Tuesday, July 18, 2017 from 9:00 – 11:00 a.m. Metro staff will sort through the group's recreational uses brainstorming list, prior to the next meeting, to identify which items are relevant to Title 10 and should be discussed further by the Sounding Board. The third, and final meeting, will likely be held in September.

Closing

Moeller thanked the group for their thoughtful participation and said that the robust dialogue has already been tremendously helpful to Metro staff. Sounding Board members agreed that they thoroughly enjoyed the conversation. Thayer thanked Metro staff for allowing input on Title 10 and designing a meaningful engagement process by which to do so.

Metro Title 10 Review Sounding Board - Meeting #2 Summary

Tuesday, July 18, 2017, 9:00 to 11:00 a.m.
Location: Metro Regional Center, Room 370a: 600 NE Grand, Portland, OR

Sounding Board Members Present

Arlene Kimura, *Hazelwood Neighborhood Association*
Jim Thayer, *Oregon Recreational Advisory Council*
Jorge Guzman, *Vive Northwest*
Brian Cook (alternate), *Oregon Hunters Association*
Micah Meskel, *Audubon Society*
Ted Labbe (alternate), *Urban Greenspaces Institute*
Philip Wu, *Kaiser Permanente*
Tony Deis, *Trackers Earth Portland*

Staff Present
Dan Moeller, *Metro*
Suzanne Piluso, *Metro*
Lori Hennings, *Metro*
Laura Oppenheimer Odom, *Metro*
Katy Belokonny, *JLA Public Involvement*
Sylvia Ciborowski, *JLA Public Involvement*

Introductions and Agenda Review

Sylvia Ciborowski, JLA Public Involvement, welcomed members and thanked them for having such a thoughtful discussion last month. Ciborowski reviewed the meeting #1 summary and the morning's meeting purpose. She said that the meeting is intended to be a continuation from last month and that the focus would be on hearing a scientific review given by Lori Hennings, Metro Wildlife Scientist, and discussing how Metro's Title 10 Code should address leashed dogs and hunting. Ciborowski reminded members of the Sounding Board's overarching purpose: "…to identify issues and opportunities related to expanding the allowed uses at Metro managed properties…" and referred to a table, included in the meeting packet, that sorted topics of interest and indicates how they will be addressed in this process. She said that members can directly contact Metro staff if they have information to communicate regarding one of the topics that does not fall under the purview of what the Sounding Board will be evaluating.

All in attendance introduced themselves.

Recreational Uses in Natural Areas Presentation

Lori Hennings, Metro, said that her role for the agency is to review literature and convene groups to explore various topics related to Wildlife Science. Hennings said that some of her work includes the exploration of Recreation Ecology, which is the study of ecological effects due to recreational uses. Hennings said that more than a year ago she did literature review research regarding recreation ecology to help inform Metro's access planning process. Hennings provided a summary of the relevant findings to the Sounding Board regarding the impacts of certain recreational activities on natural areas, as follows:

General Recreation Ecology:

- Horses have the greatest impact on trails, compared to mountain bikers and hikers. The bikers and hikers have a similar effect on trails.
- Horses are the least impactful to disturbing wildlife. Hikers tend to have a much bigger effect, likely due to the sheer quantity of them.
- Any recreational use is likely to have some negative affect on wildlife.
- People do not generally understand that they are having an effect on the environment and wildlife.
- Some animals are more sensitive to human disturbances including migratory birds, migratory mammals, animals that are pregnant, animals that have babies with them, and birds that spend time near the ground.
- It is helpful to study flight initiation distance (i.e. how far away an animal/person is before a bird flies away) when determining impacts of recreational uses.

Analysis of Dogs:

- There is an additive effect of disturbance caused by dogs; wildlife are more disturbed by people with dogs than by people without dogs.
- The disturbance is likely due to dogs being viewed (scent and appearance) as predators by wildlife.
- Dogs that are off-leash are even more impactful to the natural environment as their "markings" act as a wildlife repellant.
- Another potential impact of dogs being in a natural environment is disease. Dog and wildlife bacteria are different and some diseases can be passed to dogs that can be brought back to the pet owner.
- Water quality monitoring shows that E.coli is a concern when dogs are present. Water quality can be compromised from the introduction of dog feces.

A question was asked about if water quality monitoring can differentiate between coyote and dog fecal matter. Hennings said she did not know.

Discussion

Dogs –

Current Condition:

Metro Code: Title 10 currently prohibits dogs, and other domestic animals, on Metro property. Exceptions are made for service animals, pets on-leash at boat ramps, and pets on-leash at regional trails.

Discussion:

Comments relating to research:

- Discussion occurred around the dog and natural habitat literature that Hennings presented, as well as an article that Jim Thayer, Oregon Recreational Advisory Council, circulated to the Board. Comments included:
    - The dated nature of the references used in Hennings' study, as well as the sample size, is concerning.
        - Research technology has changed substantially since the studies referenced in Hennings' research were conducted. Hennings agreed that there are sample size limitations, specifically relating to the on-trail data that was part of her literature.
    - The Board should avoid placing too much importance on one individualized study, and instead look at all studies' conclusions as a whole.

Comments relating to dog management:

- Dog management reduces impacts on natural environments significantly because having a complete dog ban raises the frequency of off-leash dogs which is harmful to wildlife.
- A recommendation was made to change the policy to allow leashed dogs on Metro property.
- Prohibiting dogs completely is also a valid approach to dog management.
- The degree of management (i.e. dogs being leashed or not leashed) does not make a difference on the level of disturbance to wildlife and the natural areas.
- Hennings clarified that wildlife disturbance is caused from a constant stream of dogs, not from introducing an occasional dog.
- Some members like the current policy and appreciate the exceptions it already makes for regional trails and boat ramps.
- A policy change is not appropriate due to the negative impact dogs have on wildlife.
- Metro staff need to communicate to the public the rationale for a dog ban to try to ensure this policy does not impact the public's willingness to support the regional greenspaces or create reluctance to use them.
- A policy exception should be considered for Metro's urban properties.

Comments relating to social conflicts (between dogs and people):

- Concern was expressed about social conflicts between dogs and people without dogs.
- Research should be conducted regarding whether a leashed, versus non-leashed, dog affects that social conflict outcome.
- There needs to be an educational component about appropriate dog-owner etiquette if there is a policy change.
- Having dogs on Metro property might make some people uncomfortable (i.e. children, certain cultural groups).

- It is interesting that Metro is currently evaluating how to better serve under-represented groups (specifically immigrants) at the same time they are contemplating allowing guns and dogs on their properties.
- Under-represented groups might perceive dogs as a threat and not feel comfortable if dogs are allowed on Metro property.
- The geography of Metro's properties, being more destination-based as opposed to easily-accessible city parks, does not lend itself to people naturally wanting to bring their pets.

Comments relating to the policy and Metro's mission:

- A change in policy should be dictated by the degree to which Metro's mission (protect water quality, preserve wildlife and provide human access) is being met.
- A question was asked about if all three of Metro's mission priorities are equally weighted. Dan Moeller, Metro, answered that there is not an official weighting, but that Metro staff evaluates ecological implications, followed by the compatibility of human access with conservation goals.
- The three Metro mission priorities conflict with each other in this case and there are priority tradeoffs between allowing or banning dogs.
- Creating the best policy is somewhat subjective, but a recommendation was made to leave the dog policy in its current form.
- Another member expressed agreement with the current code when considering both Metro's mission and the research presented.
- The Audubon land has a "no dog" policy and the organization has used it as an educational opportunity to teach the public about how dogs negatively affect the natural environment.
- Additional signage might be a tool Metro can use to achieve an educational component similar to The Audubon Society.
- A question was asked about if the current policy was in place because it was easiest to enforce a zero tolerance policy or because it was the policy that had the most merit. Moeller said that he does not know the intent and nuances behind the policy's origin.

Comments relating to the equity of access to natural areas for dog owners:

- Public health should also be a Metro priority. One of the biggest ways to get people outside and moving is to allow the 62 percent of Portland residents who own dogs to bring them onto Metro property.
- A complete dog ban is extreme and an equity issue. Metro property is funded by public tax dollars, and since the majority of those funds come from dog owners, their needs should be met with a less limiting policy.
- Equity for dog-owners is not an issue, as represented by the map showing that there are many areas in the region where dogs are allowed.
- Options are very limited in the Portland Metro area for people to spend time outdoors with their dogs because Weyerhaeuser has purchased much of the land adjacent to the Willamette Valley and the small urban parks do not provide trails and open green spaces wanted by most dog owners.
- The goal should be to manage the presence of dogs through signage and education to prevent conflict between property users.

Concerns relating to enforcement of the policy:

- An enforcement process should be created before a policy modification occurs to allow pets.
- An exception to the policy should be explored to allow dogs on Metro's rural property.

- A complete dog ban, as currently reflected in the policy, is the easiest for Metro to manage with their limited resources.
- There was acknowledgement by several members that ideally the policy would have compromise and meet all needs, but that Metro does not have the ability and resources to enforce a nuanced policy.
- Policies should not be created that cannot be enforced.
- A complete dog ban is the easiest to enforce, but that does not mean it is the best policy in regards to creating properties that can be enjoyed by Metro tax payers.
- Additional resources should be allotted to enforce the leashing requirement of a new policy.

Comments relating to the use of dogs for personal protection:

- The policy should be changed to allow leashed dogs because dogs provide protection for individuals.
- Dogs will not be harmful to wildlife once they (wildlife) are given an opportunity to adapt to their new environment.

Outcome:

Consensus was not reached by the group. Many strong opinions and important pieces of information were shared both in favor, and in opposition, to a Title 10 code change in regards to dogs on Metro property.

Hunting –

Current Condition:

Metro Code: Title 10 currently bans hunting in Metro parks and natural areas. To date, no exemptions to the policy have been made.

Moeller added that it is not Metro, but the state that is responsible for the regulation, and enforcement, of firearms. A member asked for clarification about Metro signs that depict weapons being prohibited on Metro property. Moeller said that the sign illustration is intended to show hunting, not firearms, being prohibited.

Discussion:

Comments relating to allowing hunting on Chehalem Ridge property:

- There was acknowledgement by members that Chehalem Ridge historically allowed hunting and that the hunting ban has changed how people use that property and the culture of the space.
- Hunting should not be allowed, in general, on the basis of incompatibility with Metro's mission. An exception could be made through a special use permit for certain outlying areas (i.e. Chehalem Ridge) for specific types of hunting.
- Some restricted hunting should be considered if it still allows Metro to achieve its mission.
- Many minorities rely on hunting to feed their families and although hunting should remain banned on most Metro property, a policy exception on Chehalem Ridge should be considered.
- There was general agreement around having a policy prohibiting hunting with firearms, but ideas were expressed that a special use permit could be considered for bow hunting on Chehalem Ridge.

Comments relating to use of hunting as animal management:

- The policy should allow for hunting in situations where game has overpopulated a certain area.
- Hunting could also help secure safe passage on logging roads that beavers damage.
- Hunting could be allowed by the policy in a way that prioritizes safety, regulates firearm type (i.e. bows, short-range guns), and is done to appropriately manage animal populations.
- Animal management is a necessity to keep Metro and adjacent properties healthy.
- Discussion occurred about if, and why, wildlife is expected to become over-populated in the near future on Metro properties. There was acknowledgment that some increase in animal populations can be attributed to Metro's thinning project.

Comments relating to concerns of hunting on Metro properties:

- Allowing hunting on Metro property will likely cause some communities to not feel comfortable in the space.
    - This could be managed by making certain areas off-limits to the general public during a limited-duration of allowable hunting because hunting season is not the same as prime hiking season.
    - A proposal was made to change the policy in a way that would allow a very limited number of hunters, sponsored by the Oregon Hunters Association, to participate in controlled hunting that makes all park participants feel welcome.
    - The demographic breakdown of the current Oregon Hunters Association membership illustrates that hunting in this region is an inclusive activity.
- Hennings said that in addition to the general disturbance to wildlife, hunting could trigger the predator/shelter effect (i.e. pushing deer and elk onto adjacent sites that do not allow hunting).

Comments relating to regulation of hunting on Metro properties:

- If some hunting was allowed on Metro property, it would take a lot of time before implementation because of the substantial oversight and regulation by other entities.
- Toxicity of the ammunition (non-lead as opposed to lead) should be regulated if hunting is allowed.
- The following two requirements should be written into any hunting policy allowances:
    - A subsistence versus trophy hunting requirement.
        - It was suggested that this could be achieved by issuing permits allowing one deer per hunter.
    - A master-hunter training certificate; made economically accessible.
- There needs to be strong emphasis on an educational component if hunting is allowed.
- Before making a policy change, Metro staff should gather demographic data about who would hunt in these areas, as well as research how hunting would affect the health of the park, wildlife and adjacent properties.

Outcome:

Consensus was not reached by the group regarding a hunting Title 10 code change. However, there was general agreement that:

- ***further study should be conducted to understand the impacts of hunting on wildlife and people.***
- ***there should be consideration for limited hunting on Chehalem Ridge with restrictions.***

Prioritization of Discussion Topics

Ciborowski read the list of topics originally identified by the Sounding Board and said that it is unlikely they can all be covered in the remaining meeting. The members agreed that the following topics are the most important to cover at their next, and final, gathering:

- Unsupervised children
- Rule enforcement and safety
- Demand/desire trails
- Foraging and gleaning

Ciborowski suggested that members submit comments to Metro staff regarding the topics that will not be discussed by the Board due to time constraints. Board members agreed.

Closing

Suzanne Piluso, Metro, thanked members for another productive meeting and said that she is going to send out a doodle poll to facilitate scheduling the September meeting.

The meeting adjourned shortly before 11:00 a.m.

Metro Title 10 Review Sounding Board - Meeting #3 Summary

Wednesday, September 20, 2017, 9:00–11:00 a.m.
Location: Metro Regional Center, Room 270, 600 NE Grand Ave., Portland, OR

Sounding Board Members Present
Tony Deis, *Trackers Earth Portland*
Arlene Kimura, *Hazelwood Neighborhood Association*
Ted Labbe (alternate), *Urban Greenspaces Institute*
Ken McCall, *Oregon Hunters Association*
Micah Meskel, *Audubon Society*
Jim Thayer, *Oregon Recreational Advisory Council*
Philip Wu, *Kaiser Permanente*

Staff Present
Dan Moeller, *Metro*
Suzanne Piluso, *Metro*
Sylvia Ciborowski, *JLA Public Involvement*
John Todoroff, *JLA Public Involvement*

Introductions and Agenda Review

Sylvia Ciborowski, JLA Public Involvement, welcomed Sounding Board members and provided a recap of the previous Sounding Board meeting on July 18, 2017. She noted that topics for discussion at today's meeting include four key topic areas that were identified as most important at the meeting in July: unsupervised children, rule enforcement and safety, demand trails, and foraging.

Sounding Board members introduced themselves.

Sylvia and the group reviewed the Meeting #2 summary. One member requested that the meeting summary include letters and other written comments. Sylvia noted that the final report will include any letters, comments, and studies that members want to submit.

Members provided additional comments on the two topics discussed at Meeting #2: access by leashed dogs and hunting. Comments included:

- Members noted the difficulty of public access on large swaths of private lands. There may be a role for Metro to negotiate public access on privately owned forest lands (e.g. Weyerhaeuser property), although this issue might not necessarily be addressable under Title 10. Recreational pressure on public lands near Portland could be relieved by opening up private lands for recreation. Currently there is a high demand to obtain scarce and expensive permits to access private land. Dan Moeller, Metro, noted that there is an opportunity for further discussion on this issue.

- The Oregon Department of Fish and Wildlife's Access and Habitat Program Board is an appropriate venue for discussing the issue of hunter access to privately owned forest lands. There are other landowners besides Weyerhaeuser who are also expected to enact programs that will restrict recreational access.
- There is concern from one member about the scientific research presented by Metro at the last meeting. The member noted it relies on dated research, small sample sizes and anecdotal evidence. He described a separate, more robust and more recent study suggests that humans, more than dogs, are the main impact on wildlife and leashed dogs only have a marginal impact.
- There is not enough enforcement of policies prohibiting unleashed dogs at other sites that allow dogs. Another member suggested placing signs notifying visitors of the dollar amounts of fines for violating leash policy.
- The Statewide Comprehensive Outdoor Recreation Plan Report (SCORP) shows there is a huge demand for more land for dog walking, and this should be a high priority for Multnomah and Washington counties.

Discussion

Unsupervised children

Current Condition:

Current rules do not address children (with the exception of banning children under 5 from swimming in Blue Lake).

Discussion:

Comments made by group members include:

- Parents' responsibility for children and teen's behavior can be a gray area. There should be clarification about what age group we are discussing. Using the word "minors" (which includes teenagers) has a somewhat different implication than "children", in terms of safety and accountability. The concern with young children is the safety of the child in natural areas and particularly around open water; whereas the concern with minors/older children is accountability for reckless actions.
- Parents are often uncertain about how much autonomy children can have or are allowed to have in the forest. Independent recreation is important for children's development. Rules should not discourage parents from allowing that. Parks and forests are important venues for children to develop their imaginations.
- Children should be allowed to play unsupervised when liability is not an issue. Dan Moeller clarified that liability is not an issue for Metro at Oxbow (and other natural areas), even though there are occasional deaths in swimming holes there.
- Children today have relatively little access to the "sacred space" of natural areas, and relatively little opportunities to play with freedom from parents, compared to the past.
- There is need for nature play areas in Metro parks — semi-structured play areas where parents will feel comfortable bringing their children.

- Metro should increase awareness among parents, many of whom do not understand the rules or what is permitted, or mistakenly believe that children are not allowed to play alone in natural areas.
- Suggest creating a version of safety rules and fire prevention tips that is written to be age-appropriate, fun and accessible for a young audience. This kind of informational material would have the added benefit of being accessible to audiences that do not speak English as their primary language.
- There need to be clear warnings about swimming and/or fishing in waters that have contamination problems (e.g. bacteria). A good example is the dock signage at Sauvie Island.

Outcome:
Members generally felt that the Metro rules as written are sufficient. There is some desire to have better signage and communications materials to increase awareness about nature play opportunities and how to stay safe (outside of scope of Title 10).

Demand/desire trails and foraging

Current Condition:

Suzanne explained that current rules prohibit creation or alteration of trails and prohibit foraging without a permit. However, enforcement is an issue, and enforcement of mushroom harvesting does not happen at all in practice.

Discussion:

- Demand/desire trails:
    - Agreement among the group that explicit prohibition of demand trails should be added to the code so that regulations can be printed on signs and enforced. They noted that demand trails should particularly be prohibited around single track biking trails—where demand trails are more of an issue. They would still like demand trails to be allowed under special use permits.
    - There is pressure to build trails, so Metro needs to be proactive about adding explicit prohibition in the code.
    - Forest Park deals with demand trails well.
- Foraging:
    - The rules should recognize the distinction between small-scale foraging for personal consumption versus larger-scale commercial harvesting, or between foraging for on-site consumption versus removal from the park or natural area. Commercial versus non-commercial foraging is the most important distinction.
    - Some harvesters forage a large amount for their own personal consumption.
    - Regulations should not prohibit small-scale personal foraging, since that can discourage families from using natural areas.
    - There is general agreement that small personal consumption should be allowed but large scale commercial operations (or large-scale personal foraging) should be prohibited.
    - Consider cultural values and traditions pertaining to foraging.

- It is unlikely that there is currently a significant amount of large-scale commercial activity occurring on Metro land, however, consider unanticipated future uses as Metro acquires more land.
- There is current regulation prohibiting disturbing plants and soil, therefore illicit cultivation of agricultural products (e.g. cannabis) is already prohibited.

Outcome:

- ***Members support updating the Code to specifically prohibit demand trails.***
- ***Members support updating the Code to allow small-scale personal consumption of forest products, but prohibit commercial harvesting or excessive personal harvesting.***
- ***Both demand trails and larger-level harvesting should be allowed under special use permits, as is the current practice.***

Rule enforcement and safety

Current Condition:

Current code states that Metro has the authority to enforce rules, revoke permits, and cite or exclude people. There is an internal manual for rangers guiding how they implement enforcement policies. There are only 14 rangers employed on Metro land, so adequate enforcement is an issue.

Discussion:

Comments from members include:

- Security in parking lots is a concern, especially break-ins and theft. Consider adding warning signage, or providing a contact number for rangers on signs in parking lots and on trails.
- Suggest providing rule documentation and outreach that is accessible to people (adults and kids), written in an entertaining and engaging way. “Kid-friendly” rule guides would also benefit communities (e.g. immigrants and refugees) with low education and/or low English comprehension. Signage and guides should be made accessible with illustrations and simple language.
- Engage park neighbors about problems and provide information about how to report suspicious activity. Be careful to avoid problems associated with NextDoor social media, such as prejudiced response toward minorities.
- Good enforcement is necessary to prevent vigilantism. Members suggested that Metro engage with neighbors and self-organized groups to train them in proper methods of neighborhood watch type activities and avoid the problems associated with vigilantism, for example uncompassionate response to homelessness.

Outcome:

- ***Members did not suggest any specific changes to Code language. They did make suggestions about signage, programs and communications materials that could help increase safety and security.***

Project wrap-up discussion

Sylvia asked Sounding Board members to reflect on what they feel is the most important issue or key takeaway regarding recreational uses on Metro-owned properties.

- It is important to involve and communicate with non-English speakers and illiterate people, and to build trust in Metro among immigrant and disadvantaged communities. Cultural relevance is important. One way to communicate with non-English speakers and the wider populations is through use of symbols on signs—rather than words.
- The discussion of cultural issues has been eye opening, and the Oregon Hunting Association intends to engage the hunting community to try to be more inclusive. The Association would support allowing some hunting on properties (with a permit)
- The current rules are well written and flexible, and this conversation is more about refining them and making them more adaptable. Appreciate Metro's adaptability.
- Hope that Metro infuses some flexibility and creativity in the update of Title 10 and management of parks and natural areas. Avoid total prohibitions, and aim for more flexible and responsive ways to deal with problems.
- Metro's Equity Strategy is an important lens for considering updates to regulations.
- Metro's mission is foundational and should be the underpinning for any regulation updates.
- Develop a way to be flexible within the context of Metro's large portfolio of public lands.
- Suggest producing a condensed summary of the outcome of this project and changes to the Code as an example and guide for other parks agencies in the area. There was also a suggestion to present at the Oregon Recreation & Park Association annual conference, reaching out to other communities to share what has been learned in this process.

Final Report and Next Steps

Dan thanked the group for their contributions and for their collaboration on these issues. He said that the time spent here has been very valuable and productive.

Next steps:
JLA will produce a summary report of the process by mid-October, which will be sent to the group for review by the end of the month. In October and November Metro staff will review issues brought up in these discussions. Staff will produce a report (including meeting summaries) to present to Metro Council in the first quarter of 2018.

Sounding Board members should send any further comments, letters, or other information to Suzanne Piluso (Suzanne.piluso@oregonmetro.gov), ideally within the next two to three weeks.

Ted suggested continuing the discussion about negotiating with Weyerhaeuser or other private land owners regarding allowing public uses. He will organize this discussion by email.

The meeting was adjourned.

Appendix: Email Comments Submitted by Metro Title 10 Review Sounding Board Members

From: Mike Houck [mailto:mikehouck@urbangreenspaces.org]
Sent: Thursday, June 15, 2017 2:28 PM
To: Dan Moeller
Subject: UGI DRAFT Position on Title 10 Recreational Use of Metro Natural Areas

The following are my reactions to the topics for conversation

As per the 1992 Metropolitan Greenspaces Master Plan and Systems Management Plan, any uses must respond to the first priority of ecological integrity of Metro's natural areas.

I have issues with page 10.01-3 definition of Park in the context of Metro's program and will bring that up ("playground, recreation center,)

page 10.01-5 I think the angling statement is inconsistent with the discussion piece on angling

ALCOHOL: I think it best to not allow alcohol with a special permit,which should help with enforcement. We all know people will bring a bottle of wine/beer and that's not really a problem. If you legalize alcohol then enforcement will be a nightmare

DOGS: No dogs off or on leash!

DRONES: No drones unless for a Metro research, restoration, management purposes. Must be on contract with Metro to use a drone.

GROCHACHING/LETTER BOXING: Yes, but only as per adopted Metro policies. I think this is highly problematic and want to discuss further with Metro staff

FISHING: In designated areas; No dogs allowed; No alcohol allowed

HUNTING: No way, no how!

SMOKING: Prohibit

Mike Houck, Director
Urban Greenspaces Institute
PO Box 6903
Portland, OR 97228-6903
503.319.7155
mikehouck@urbangreenspaces.org
www.urbangreenspaces.org

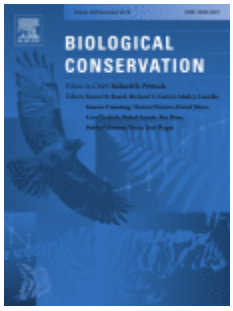
Endless Pressure, Endlessly Applied
In Livable Cities is Preservation of the Wild

From: Jim Thayer [mailto:Jim@thayers.org]
Sent: Thursday, July 13, 2017 1:34 PM
To: Suzanne Piluso
Cc: Lori Hennings; Dan Moeller; Laura Odom; Sylvia Ciborowski
Subject: Re: Materials for Metro Code Title 10 Sounding Board mtg #2 (July 18)
Importance: High

Suzanne
At the onset of this process I expressed misgivings about the nature of the scientific information that would be presented to this group. Much as I respect Lori Henning's work, her literature review reflects Metro's historic perspective and it does not include information that I purposely provided to Metro that reflects more recent findings. A brief review of the materials cited in Lori's summary reveals that much of the material is 5-10 years old. More recent studies, such as the study cited below, have found that dogs, people and wildlife can cohabitant natural areas with much less disturbance that the older literature suggests. Moreover the studies do not reflect upon the issues of equity that wholesale banning of dogs has on the population of Portland, which has clearly expressed a need for more dog walking facilities with 97% of the Metro population expressing this need (SCORP 2017). Banning dogs from all of Metro's park establishes an equity conflict since it uses public tax monies to benefit less than half of the population, not as a result of a casual exclusion, but by imposing a purposeful inequity.

Since my prior efforts to ensure the distribution of a broader scope of research on this subject into the agenda were ignored, I herewith re-submit the following 2016 study that involved a much larger sample size than the earlier studies that Lori reviewed. This 2016 study involved 52,863 detections of native wildlife, 162,418 detections of humans and 23,332 detections of dogs over 42,874 camera nights.

Our results indicate that humans are perceived as a greater risk than coyotes, and this increases when dogs accompany their owners. The concentration of dogs on the trail with their owners, and relatively minor behavioral impacts on prey, contrasts the strong negative ecological effects found in studies of free-ranging dogs. We found dog management to be effective: prohibiting dogs in protected areas reduced their use of an area by a factor of 10 and leash laws increased leashing rates by 21%.



ELSEVIER Biological Conservation
Volume 203, November 2016, Pages 75-88

The ecological impact of humans and dogs on wildlife in protected areas in eastern North America

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[b] Department of Forestry & Environmental Resources, North Carolina State University, 2800 Faucette Blvd, Raleigh, NC 27607, USA
[c] Smithsonian's National Museum of Natural History, 10th St. & Constitution Ave. NW, Washington, DC 20560, USA
[d] Smithsonian Conservation Biology Institute, 1500 Remount Rd, Front Royal, VA 22630, USA
[e] Oregon Department of Fish and Wildlife, 1401 Gekeler Lane, La Grande, OR 97850, USA
[f] The Nature Conservancy, 4245 Fairfax Drive, Arlington, VA 22203, USA
https://doi.org/10.1016/j.biocon.2016.09.001Get rights and content

Highlights

- Citizen-scientists helped conduct a camera-trap survey in U.S. protected areas.
- Dogs were common in protected areas and most were leashed.
- Most of dogs were on the trail (99%) and/or accompanied by a human (97%).
- Leash laws reduce the incidence of free-ranging dogs.
- Wildlife perceived free-ranging dogs as a relatively low threat.

Abstract

The establishment of protected areas is a key strategy for preserving biodiversity. However, human use of protected areas can cause disturbance to wildlife, especially in areas that allow hunting and if humans are accompanied by dogs (*Canis familiaris*). We used citizen-science run camera traps to investigate how humans, dogs and coyotes (*Canis latrans*) used 33 protected areas and analyzed behavioral responses by three prey species: white-tailed deer (*Odocoileus virginianus*), eastern gray squirrel (*Sciurus carolinensis*) and northern raccoon (*Procyon lotor*). We obtained 52,863 detections of native wildlife, 162,418 detections of humans and 23,332 detections of dogs over 42,874 camera nights. Most dogs (99%) were on the trail, and 89% of off-trail dogs were accompanied by humans. Prey avoided dogs, humans and coyotes temporally, but did not avoid them spatially, or greatly increase vigilance. Our results indicate that humans are perceived as a greater risk than coyotes, and this increases when dogs accompany their owners. The concentration of dogs on the trail with their owners, and relatively minor behavioral impacts on prey, contrasts the strong negative ecological effects found in studies of free-ranging dogs. We found dog management to be effective: prohibiting dogs in protected areas reduced their use of an area by a factor of 10 and leash laws increased leashing rates by 21%. Although millions of dogs use natural areas in North America each year, regulations enacted by protected areas combined with responsible management of dog behavior greatly reduce the ecological impact of man's best friend.

http://www.sciencedirect.com/science/article/pii/S0006320716303603

On 24-Sep-2017, at 7:34 PM, Jim@thayers.org <jim@thayers.org> wrote:

As a member of the Portland area hiking community, I am encouraged that Metro is examining some of its foundational precepts. Nonetheless, as a member of the aforementioned sounding board I feel compelled to question the validity of the "soundings" because the process was marred by:

* reliance on decades-old scientific data,
* a complete omission of relevant state hiking data, and
* a reluctance to address equity costs born by Metro area dog owners

To address these shortcomings individually please consider the scientific data we were presented:

* 75% of the studies referenced in Metro's fvscience literature overview were more than 17 years old.
* Many of the cases were anecdotal, had small sampling sizes, or were geographically disassociated.
* a 2016 study published by the Journal of Biological Conservation differed sharply from these older surveys because of its huge sampling size and the introduction of new camera and monitoring technology.
* the study found that "humans were perceived as the highest perceived risk for wildlife."
* "Dogs by themselves had the lowest perceived risk."
* When dogs and people walked together there was a marginally greater impact on wildlife. Should we exclude the dogs? Why not the humans?
* This recent study also concluded that "prey species adjusted their disturbance response to dogs ...to reflect the relatively low risk posed by an on-trail dog walking with its owner."
* Finally, this study showed "how the responsible control of dog behavior by their owners can minimize disturbance of wildlife." This is what we should be focusing on, instead of dividing our community with inequitable exclusions.

When I introduced the recent study (published by the Journal of Biological Conservation) its findings were rebuffed simply because it determined that a human accompanied by a dog was slightly more threatening than a lone hiker. Logically we should remove the more disturbing critter - the human. Remember, dogs have the lowest perceived risk by wildlife and humans have the highest perceived risk. Poor outdated data does Metro a disservice and undermines its credibility.

The sounding board process was silent on the social costs that arise when the "customary and usual rights" of traditional users are abridged. As citizens of Metro jurisdiction we have twice paid for the purchase and maintenance of these lands, but now half of us will be banned, because we prefer to walk with our dogs. Since when has dog ownership disqualified us from enjoying public investments like trails and parks?

In fact, 49% of the residents of the Metro region have explicitly asked (SCORP) for more trails to exercise their dogs. Instead we're closing off more areas for dogs? Dogs are the second biggest reason people choose to recreate in nature. It's my dog that keeps me active and healthy, but

Metro doesn't appear to value this public health benefit.
A blanket exclusion of dogs is socially inequitable, and will remain a recurring complaint as open spaces disappear and timber companies lock us out of the forests. We can't simply wish this issue away and as our more dog owners are locked out Metro will have to continue to defend the indefensible.

My gratitude to Metro and my fellow observers. In all good conscience I could not support policies that shut half of us out of the woods, nor could I refrain from objectIng to those equity concerns that the "Sounding" appears to have been overlooked in their search for guidance on future park access issues.

Jim Thayer

Sent from my iPad
A

On Sep 24, 2017, at 20:14, Mike Houck <mikehouck@urbangreenspaces.org> wrote:

Jim
Out of curiosity is your consistent take on the dog issue the only portion of the review you take issue with? We're there other issues you take exception to?

Not to "rebut", honoring your right to dissent, but if I read your comments correctly you are claiming half the Metro population is being excluded from Metro properties based on their ownership of a dog(s).

That argument makes no sense to me. I know many dog owners who quite happily support Metro's existing policy based on wildlife disturbance...and frankly negative impacts on other natural area users.

Finally, when Metro issued their two acquisition bonds they stressed water quality, wildlife habitat and, where appropriate, human enjoyment of access to nature. I was involved intimately in both bond measures and there was never a mention of dogs.

Houck

<sm rev UGI logo.jpeg>

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Endless Pressure, Endlessly Applied

In Livable Cities is Preservation of the Wild

From: ken mccall
To: Dan Moeller; Suzanne Piluso; Bryan Cook
Subject: Metro Title 10 Review Sounding Board
Date: Wednesday, September 27, 2017 10:13:19 AM

Hi Dan and Suzanne,

We wish to extend our thanks for the willingness of Metro to pull together the sounding board group and including OHA in the process. We learned a lot and met some great people representing the respective interests of the public.

I wanted to repeat for the record OHA is seeking only consideration for limited, controlled hunting as a traditional public use on large Metro holdings. The loss of hunting on Chehalem ridge is the current example though as Metro expands further into less urban areas, other similar larger parcels may be acquired. We fully understand the basis for the original ban on hunting, our interest is in continuing the social aspects of hunting and beneficial wildlife management.
Reasonable restrictions on numbers of hunters, limited range hunting methods, seasonal timing and information/education are key.
One key element we learned more about is the strong cultural subsistence hunting and fishing element present in under served groups in the urban area.
We are more than willing to discuss the positive values of hunting and how hunting can serve your public and management of the Metro properties.

Thanks for your consideration and inclusion,

Ken McCall
Resource Director
Oregon Hunters Association
541-602-1819
ken@oregonhunters.org

From: Jim@thayers.org [mailto:jim@thayers.org]
Sent: Thursday, September 28, 2017 12:50 AM
To: Mike Houck
Cc: Dan Moeller; tony@trackersearth.com; ken@oregonhunters.org; arlene.kimura@gmail.com; Philip.P.Wu@kp.org; mmeskel@audubonportland.org; Ted.labbe@gmail.com; jguzman@vivenw.org; bryan.cookoha@gmail.com; Sylvia Ciborowski; Laura Odom
Subject: Re: Title 10 Metro Sounding Board

Mike:

There are two aspects of this Sounding board that I find troubling.

1. The reliance on outdated scientific data, and Metro's biased analysis of new data to justify out-dated policies instead of embracing evidence of successful ways to manage interactions between dogs and wildlife.

Despite honest efforts to resolve this conflict, Metro is still handing out decades-old data that was conducted before modern monitoring technology gave us a much sharper image of what's going on in the woods. Apparently little effort was made to find new studies on dog and wildlife interactions. After just a few minutes of searching I found a 2016 study published by the Journal of Biological Conservation that used more than 34,000 data points. When I submitted this study, the response was defensive and focused on a single sentence that asserted that dogs accompanying their owners had a marginally larger impact than lone human hikers. What they ignored was that according to the study, people represent a much higher perceived risk; dogs presented the lowest perceived risk. In Metro's view this justified the expulsion of the least disturbing influence. Metro's approach to the scientific data is not genuine. It's used not used to shed light on the issue, but rather to justify a predetermined policy. Metro's policy-driven analysis of the scientific data will do lasting damage to the agency's reputation. That's my primary concern.

My second concern is that Metro is "taking" away one of our fundamental rights. As the Oregonian expressed it in their March 23, 2016 editorial, "Metro taxpayers have a reasonable right to make customary use of parkland they own".

For more than 40 years I and many Burlington locals have been walking our dogs in Burlington Woods, near the Old Growth Grove whose purchase I helped negotiate 30 years ago.
The Burlington Woods property was initially owned by John Hampton and later by Longview Fiber and both private companies explicitly permitted recreational dog walking. I even wrote a hiking book about this area - targeted to dog walkers that preferred more remote trails.

For 30 years I supported Metro's acquisitions. Then I volunteered to serve on a Metro task force where I learned to my astonishment that dogs were NOT permitted in any Metro park lands. I was stunned. When did we voters approve such a drastic move? How did Metro acquire the right to exclude all dog walkers from its parks?

I checked all the information provided to the public about the two Metro bonds and there was no mention of dogs. Even Metro's website was silent on the matter. None of the Metro's press releases about their new parks mentioned this crucial exclusion. Apparently, it was better to turn people with pets away at the park entrance than to publish the fact that Metro categorically banishes all dogs from their parks. That would have caused a stir, so Metro stayed silent.

Metro even refused to calculate the historical use of the Burlington Woods area by dog walkers, although they did so for every other activity. I challenged the taskforce to present a complete data set, including prior dog use, but they explicitly refused. That's because it had been regularly used by dog walkers like me for over thirty years and the data would have shown that Metro was effectively taking away that customary right.

Mike you're absolutely right that there was no fuss initially, but that's because the backers of the bond didn't want the "taking" of dog owners' rights to cause controversy and potentially spoil our appetite for this bond measure. That's why the documents, the press releases, and the websites were all silent on an issue that directly affects nearly half of Metro's inhabitants.

Mike you're also right that not all dog owners agree with me, but the latest SCORP report by the Oregon Parks and Recreation Department indicates that at least 49% of hikers in Metro's jurisdiction want more trails for walking their dogs.

Nonetheless lots of people do support the ban. Regardless of whether people agree or disagree with allowing dogs into parks, their opinion cannot be used to justify removing other people's rights - without an explicit referendum. People are free to hold whatever opinion they want. If they chose not to exercise their right it doesn't mean that others should also be prevented from exercising their rights. Let's put it more simply. If someone chooses not to vote it doesn't strip them of the right to do so later, nor does it affect the rights of others to vote. If some people don't want to walk their dogs in the woods that's fine, but it doesn't give them the right to "take" my rights away.

What really irks me about this conflict is that it could so easily be avoided. Modern trail design can accommodate many kinds of users from cyclists to dog walkers. I have never advocated that dogs should be given access to all parks. I have been vociferous in calling for better signage and stricter enforcement of leash laws. On the Columbia Land Trust board I have voted against granting access to both dogs and people on sensitive properties. Recent studies show that managing dog and dog owner behavior is effective and that wildlife will adapt. A total exclusion is unnecessary.

Jim Thayer

Sent from my iPad

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The ecological impact of humans and dogs on wildlife in protected areas in eastern North America

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ABSTRACT

The establishment of protected areas is a key strategy for preserving biodiversity. However, human use of protected areas can cause disturbance to wildlife, especially in areas that allow hunting and if humans are accompanied by dogs (*Canis familiaris*). We used citizen-science run camera traps to investigate how humans, dogs and coyotes (*Canis latrans*) used 33 protected areas and analyzed behavioral responses by three prey species: white-tailed deer (*Odocoileus virginianus*), eastern gray squirrel (*Sciurus carolinensis*) and northern raccoon (*Procyon lotor*). We obtained 52,863 detections of native wildlife, 162,418 detections of humans and 23,332 detections of dogs over 42,874 camera nights. Most dogs (99%) were on the trail, and 89% of off-trail dogs were accompanied by humans. Prey avoided dogs, humans and coyotes temporally, but did not avoid them spatially, or greatly increase vigilance. Our results indicate that humans are perceived as a greater risk than coyotes, and this increases when dogs accompany their owners. The concentration of dogs on the trail with their owners, and relatively minor behavioral impacts on prey, contrasts the strong negative ecological effects found in studies of free-ranging dogs. We found dog management to be effective: prohibiting dogs in protected areas reduced their use of an area by a factor of 10 and leash laws increased leashing rates by 21%. Although millions of dogs use natural areas in North America each year, regulations enacted by protected areas combined with responsible management of dog behavior greatly reduce the ecological impact of man's best friend.

1. Introduction

The establishment of protected areas is a key strategy for preserving biodiversity. Although they preserve habitat, protected areas typically do not eliminate human presence. On the contrary, people visit protected areas an estimated 8 billion times around the world every year, including 2 billion in the United States (Balmford et al., 2015). Nature recreation is important for conservation because it helps connect people with nature and broadens the constituency that values protecting land from development (Balmford et al., 2002; Wells and Lekies, 2006). However, human use of these areas can cause disturbance to wildlife, threatening the biodiversity preservation goals of protected areas.

Disturbance of wildlife by recreationists may provoke anti-predator responses such as fleeing, increasing vigilance, and changes in habitat use (Frid and Dill, 2002). Since there is a trade-off between avoiding a perceived risk and other fitness-enhancing activities, like feeding and finding a mate, disturbances by recreationalists can reduce animal fitness by disrupting optimal feeding, parental care, or mate choice (Beale, 2007; Beale and Monaghan, 2004; Frid and Dill, 2002). The risk-disturbance hypothesis provides a framework for understanding wildlife-human interactions, where responses by disturbed animals can be directly attributed to disturbance stimuli, responses being stronger when perceived risk is greater (Frid and Dill, 2002).

Human-caused disturbance can be compounded in areas that allow hunting (Frid and Dill, 2002) and if humans are accompanied by dogs (*Canis familiaris*) (Banks and Bryant, 2007; Miller et al., 2001; Weston and Stankowich, 2014). There are an estimated 78 million domestic dogs living in the United States (Gompper, 2014) and many owners visit protected areas with their dogs each year (Hughes and MacDonald, 2013). Protected areas often have leash laws which could

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limit the interactions of dogs with wildlife, while others prohibit the dogs altogether. However, little data exist to evaluate the effectiveness of these policies in terms of ecological impacts, the extent to which owners obey leash laws, or how often dogs move off-trail and interact with wildlife (Ritchie et al., 2014; Vanak et al., 2014). While the lethal impacts of dogs on wildlife have been shown (Young et al., 2011), the indirect effects of dogs on vigilance (Vanak et al., 2009), feeding rates (Vanak et al., 2009), space use (Grignolio et al., 2011) and fecundity (Sheriff et al., 2009) of native wildlife is of equal concern. In a review of 69 peer-reviewed studies on dog-wildlife interactions, only three concluded that dogs had no impact (Hughes and MacDonald, 2013).

As development encroaches around protected areas in the United States and human use of these areas increases (Radeloff et al., 2010), understanding the impacts of recreation on wildlife is a key priority. Our previous research found that hiking and managed hunting did have an effect on mammal distribution, though to a lesser extent than habitat, however an analysis of the effect of dogs as an agent of disturbance was not considered (Kays et al., 2016). Thus, in this study we used the same camera trapping survey to investigate the use of protected areas by humans and dogs in the eastern United States. We predicted that most humans and dogs would be found on trails, and that leash laws would significantly decrease off-trail dog activity. To put the effects of humans and dogs in perspective, we compared the strength of their indirect ecological effects on wildlife with those of the second largest natural predator, coyotes (*Canis latrans*). We quantified these effects by evaluating the spatial and temporal avoidance of potential predators by three common prey species that vary in activity patterns (crepuscular, diurnal, nocturnal): white-tailed deer (*Odocoileus virginianus*), eastern gray squirrel (*Sciurus carolinensis*) and northern raccoon (*Procyon lotor*). We also examined the effect of predator presence on white-tailed deer vigilance. Based on the risk-disturbance hypothesis, we predicted that wildlife would respond to humans, dogs and coyotes as predators and that the level of the response would be relative to the perceived risk. Specifically, we expected humans to be the highest perceived risk, given that humans actively hunt deer throughout the region. Likewise, we expected humans with dogs to be perceived as a greater risk than humans without dogs given the additional perceived risk imposed by dogs. We expected unattended dogs and coyotes to be perceived as a similar level of risk given their similar size and less predictable movement patterns off trails.

2. Material and methods

2.1. Citizen science camera trap surveys

From 2012 to 2013, 376 trained volunteers deployed 1951 unbaited camera traps across 33 protected areas (15 hunted, 18 not hunted) in the Southeastern United States (Fig. 1). Surveys were predominantly done in summer and fall outside of the hunting season with only a few deployments (<5) extending into the main rifle season. All sites had similar hunting regulations including weapon type allowed and whether hunting with dogs was permitted (Appendix D). All wildlife species examined in this study are legally hunted in the study area and are common in the Southeastern United States with white-tailed deer thought to exist at the highest densities among mammal species in that area (Horsley et al., 2003; Kays et al., 2016). Coyotes are the largest predator in the region, however the similar-sized bobcats (*Lynx rufus*) are also present at some sites. We define "protected areas" as publicly owned and managed land protected from private development. Protected areas were large tracts of core forest from 4 km^2 to 1200 km^2 (average = 140 km^2) surrounded by a range of rural (<0.5 house/km^2) to urban (>1000 houses/km^2) densities of development (Theobald, 2005). Twenty protected areas required that dogs be leashed, nine did not require leashes and four prohibited pets completely (Fig. 1). Each individual camera is considered a "camera site", and these were set in groups of three (hearafter "transect"): on, near (50 m) and far

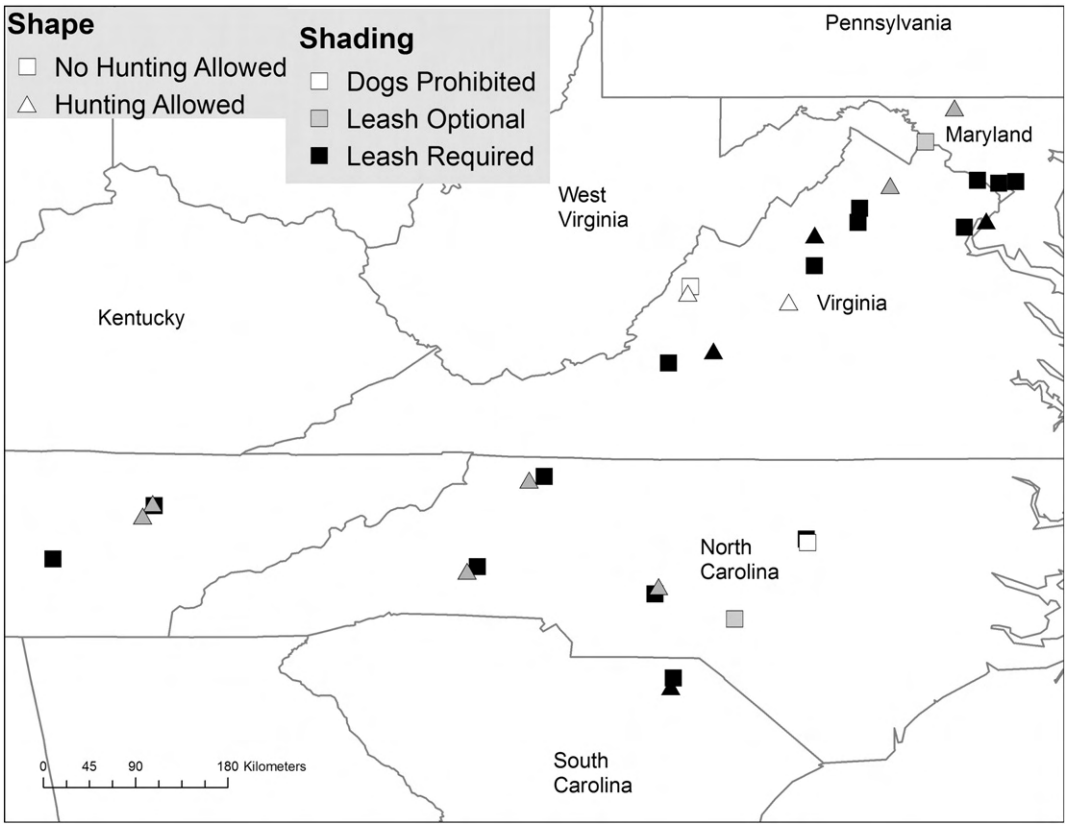

Fig. 1. Site map showing the 33 protected areas sampled and their dog and hunting regulations.

(200 m) from a hiking trail. Trail locations were chosen at random without regard for the distance to the trailhead. Associated 50 m and 200 m cameras were chosen at perpendicular Euclidean distances from the trail camera location and faced in the clearest direction to maximize detection distance. The direction from the trail was determined based on proximity to adjacent transects and accessibility (i.e. slope). Inappropriate off-trail locations (i.e. briar patches, steep slopes) were avoided and cameras were moved to a better location within 20 m of the original point. All adjacent cameras not within the same transect were spaced at least 200 m apart. Volunteers used Reconyx (RC55, PC800, and PC900, Reconyx, Inc. Holmen, WI) and Bushnell (Trophy Cam HD, Bushnell Outdoor Products, Overland Park, KS) camera traps equipped with an infrared flash and attached to trees at 40 cm above the ground and left them for three weeks before moving them to new locations. Cameras were not checked within that three-week period. Cameras recorded multiple photographs per trigger, at a rate of 1 frame/s, retriggering immediately if the animal was still in view. For analysis we grouped consecutive photos into sequences if they were <60 s apart, and used these sequences as independent records for subsequent analysis. We assessed the adequacy of this temporal independence using by-minute temporal autocorrelation functions in Program JMP (SAS, Cary, NC, USA) for each species at their top 10 most active sites (i.e. the sites most likely to have temporal autocorrelation). Initial species identifications were made by volunteers using customized software (eMammal.org) and all were subsequently reviewed for accuracy before being archived at the Smithsonian Digital Repository (McShea et al., 2016). We used the detection rate (the number of detections of a given species divided by the total number of camera-nights, hereafter "DR") to compare the relative activity levels of each species. Though not immune to issues of heterogeneity in detection probabilities, because sites were selected at random relative to animal movement, and not baited, DR is a valid comparison across our sites (Rowcliffe et al., 2013).

2.2. Dog distribution

To evaluate if off-trail dogs were accompanied by a human we examined all three cameras from the same transect that detected the off-trail dog to see if a human passed within 5 min. We used an ANOVA in Program JMP to test for an effect of leash laws on dog activity (DR and % of dogs that went off-trail) and leashing rate (coded from a subset of n = 50 randomly selected photos/protected area).

2.3. Spatial avoidance

We used two-species conditional occupancy models (Richmond et al., 2014) to assess deer, squirrel and raccoon spatial avoidance of each predator (humans without dogs, attended dogs, unattended dogs, coyotes) using Package RMark in Program R (Team, 2011). We included covariates to account for variation in detection and occupancy due to habitat and weather (Appendix A). We diagnosed univariate correlations between covariates using a Pearson correlation matrix, and omitted variables correlated >0.60. All continuous variables were mean-centered. We tested housing density, edge and the amount of forest at two scales, 5 km and 250 m, that most closely reflected reported home range sizes of each species (Koprowski, 1994; Lotze and Anderson, 1979; Walter et al., 2009) and protected area size. We ran a suite of 20 detection probability models for each species except the human predators where we removed People_site as a covariate, then picked the most parsimonious model of each within the top three QAIC points (Burnham and Anderson, 2002) to use in our occupancy models (Appendix B). We ran a suite of 27 occupancy models for each species and used the top models in our two-species models (Appendix B). We compared four 2-species models for each predator/prey combination using QAIC, including models incorporating trail as a categorical grouping covariate, models incorporating the top single-species models and models including DR covariates for each predator not explicitly being modeled (e.g. coyote DR was included in the attended dog models) to account for possible interactions between predators that may influence prey site occupancy (Appendix C).

2.4. Temporal avoidance

We used the time series of detections from a given camera to test the relative avoidance of a site by prey after the passage of a predator. We call these measures Avoidance-Attraction Ratios (AAR), and they can be created either by comparing the time interval after/before a predator passes (T2/T1) or with/without the passage of a predator (T4/T3, Fig. 2). T1 is the length of time between an initial prey passage and the predator passage and T2 is the length of time between the passage of a predator and a subsequent prey passage (Fig. 2). T3 is the average length of time between successive prey detections without a predator in the middle while T4 is the same measure with a predator between (Fig. 2). Because we calculate these values for each camera site separately, these ratios are robust to differences in detection probability between predator and prey species since the passage rates are a relative, not absolute, measure of the use of a site.

T2/T1 could be influenced both by the avoidance of the prey and the attraction of the predator, while T4/T3 is influenced solely by the avoidance of the predator by the prey. Where multiple predators of the same species passed consecutively before the next deer detection, the total time from the first predator detection to the next prey detection was calculated for T2 to account for increases in scent deterring prey. We considered interactions where only one type of predator appeared between successive prey detections in order to avoid potential confounding effects of multiple predator types. We compared T2/T1 ratios between perceived predators for each species using the Wilcoxon method in Program JMP. We tested the effect of hunting on the magnitude of the log transformed T2/T1 ratio on and off trails for each perceived predator using t-tests in Program JMP.

2.5. Deer vigilance

To evaluate if deer perceive dogs as a threat, we analyzed the vigilance behavior of solitary deer in a subset of approximately 100 randomly selected sequences in every protected area. For each sequence of a solitary deer, we recorded whether the individual was exhibiting vigilant (head up, above shoulder), neutral (head below shoulder,

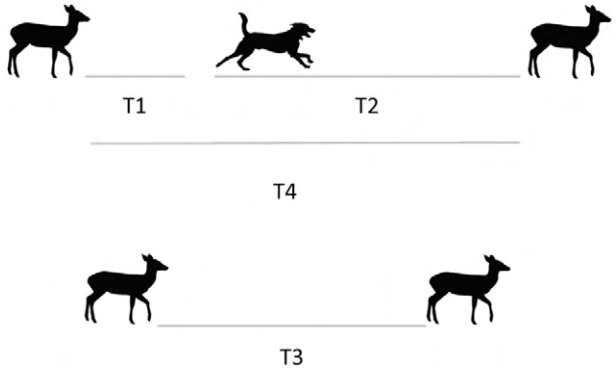

Fig. 2. Procedure for using data from a single camera trap to calculate Avoidance-Attraction Ratios (AARs) estimating within-site temporal avoidance or attraction of two species. T1 is the time from the initial deer detection to the first subsequent predator detection. T2 is the time from that first predator detection to the subsequent deer detection. If multiple predators pass before the next deer T2 is still taken from the first predator. T4 is the sum of T1 and T2 and represents the time between successive deer detections with a predator detection between them, while T3 is the time between successive deer detections without a predator between them. Values >1 for T2/T1 or T4/T3 suggest nonrandom movement between the two species indicating that the prey is avoiding the area after the passage of a predator. Attraction of a predator to a prey could also result in high T2/T1 ratios, but would result in lower ratios of T4/T3.

above knee), or non-vigilant behavior (head below knee) (Lashley et al., 2014). To ensure a more accurate representation of the behavior of each individual, we only scored individuals that had at least five photos within a sequence. If a deer looked at the camera we stopped scoring the sequence to exclude data potentially biased from the presence of the camera. We used a Wilcoxon signed-rank test in Program JMP to compare deer vigilance between sites on and off trails that were and were not used by three classes of "predator": humans without dogs (dogs not detected within 5 min, human not holding a leash), attended dogs (dogs <5 min from a human, leashed or not), unattended dogs (dogs without humans) and coyotes.

3. Results

3.1. Dog, human and wildlife distribution

We obtained 52,863 detections of native wildlife, 162,418 detections of humans and 23,332 detections of domestic dogs with 42,874 camera nights of survey effort across 1951 locations in 33 protected areas. Only 7% of site examined showed temporal autocorrelation >25%. White-tailed deer was the most commonly detected native wildlife species overall (0.64/day) followed by eastern gray squirrel (0.25/day) and northern raccoon (0.08/day). Most dogs (99%) were detected on-trails, where they were more commonly detected than the most common native predator, coyotes (coyote: 0.10/day, dog: 1.58/day). Dogs were less frequently detected off-trails (0.00 dogs/day) than coyotes (0.02/day) but were still more common off-trails than red foxes (*Vulpes vulpes*) (0.006/day), bobcats (0.004/day) and gray foxes (*Urocyon cinereoargenteus*) (0.003/day) (Fig. 3). Most protected areas (88%) had at least some off-trail dogs. The only species examined that were caught actively being chased on camera were white-tailed deer being chased by unattended dogs (recorded 5 times) or coyotes (recorded 4 times). Three incidents of unattended dogs chasing deer were of packs of 2–4 dogs, the remaining incidents were of what appeared to be solitary individuals.

Most (82%) off-trail dogs were detected <5 min from a nearby human. Humans were detected off trails very rarely (0.60% of all human detections). Therefore, we assumed that off-trail dogs not within 5 min of a human on the trail (or off the trail) were unattended. Across all detections, 97% of dogs were accompanied by humans and most unaccompanied dogs were on-trails (87%). Twenty-three percent of unattended dogs were running in packs of 2–4 individuals, likewise 24% of attended dogs were in groups of 2–8. Most dogs were off-leash (on-trail: 60%; off-trail: 84%). Leash laws reduced the frequency of unleashed dogs by 21% (55% with leash law, 76% without). Only 0.80% of dogs were photographed at night, and only 16 dogs were documented running off-trail at night without a leash. Leashing rates decreased farther from the trailhead, suggesting that owners may have let their dogs off leash after their walk began.

We detected dogs in all protected areas sampled, even where dogs were prohibited. Areas prohibiting dogs had 16 times fewer dogs per day than sites allowing dogs ($F = 10.28$, $df = 1895$, $p < 0.0001$), but a higher percentage (13%) of those dogs went off-trail ($t = 7.61$, $df = 280$, $p = 0.0006$, Fig. 4). Dog detections were strongly positively correlated with the rate that humans without dogs were detected, on and off-trails (On: $F = 1029.73$, $df = 665$, $p < 0.001$, Off: $F = 454.96$, $df = 1299$, $p < 0.0001$). However, off-trail dog detections were not significantly correlated with on-trail human detection rate ($F = 0.31$, $df = 648$, $p = 0.58$). Human DR was highest in areas where leashes were required (mean = 8.87, SE = 2.25) and lowest where dogs were prohibited (mean = 3.70, SE = 2.98).

3.2. Spatial avoidance

Across all sites, occupancy was highest for deer followed by gray squirrel and raccoon. The amount of daily cloud cover explained the most variation in detection probability for coyote, raccoon, attended dogs, humans without dogs and squirrels (Appendix B). Measures of edge explained the most variation in occupancy for attended dogs, humans without dogs, deer and squirrels (Appendix B). Our two-species occupancy models showed no significant spatial avoidance, however all prey species tended to avoid trail sites with unattended dogs. The probability of raccoon site occupancy was actually higher where coyotes were present (Fig. 5). A similar increase in occupancy was found for squirrels where unattended dogs were present off trails (Fig. 5).

3.3. Temporal avoidance

All species temporally avoided humans with and without dogs more than any other predator, with the exception of northern raccoons, which temporally avoided coyotes more than humans without dogs. AAR avoidance was significantly stronger for attended dogs than the other predators for all species and ranged from 7 to 3 times higher (eastern gray squirrel and white-tailed deer respectively) than any other predator (Fig. 6). Likewise, AAR avoidance was stronger over all species for humans without dogs than unattended dogs (7–5 times stronger, squirrel and raccoon respectively). AAR avoidance was 3 times stronger for humans without dogs than coyotes for all species except raccoon (Fig. 6). AAR avoidance was weakest for unattended dogs for all species (2–10 times weaker, deer/squirrel and raccoon respectively) but this was only statistically significant for deer (Fig. 6). Deer living in protected

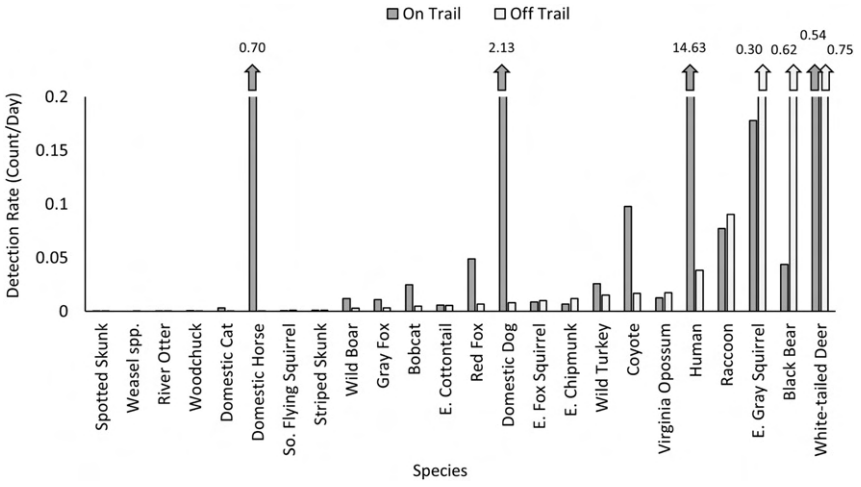

Fig. 3. Detection rates (count/day) for all species detected over all cameras sorted by highest off trail detection rate.

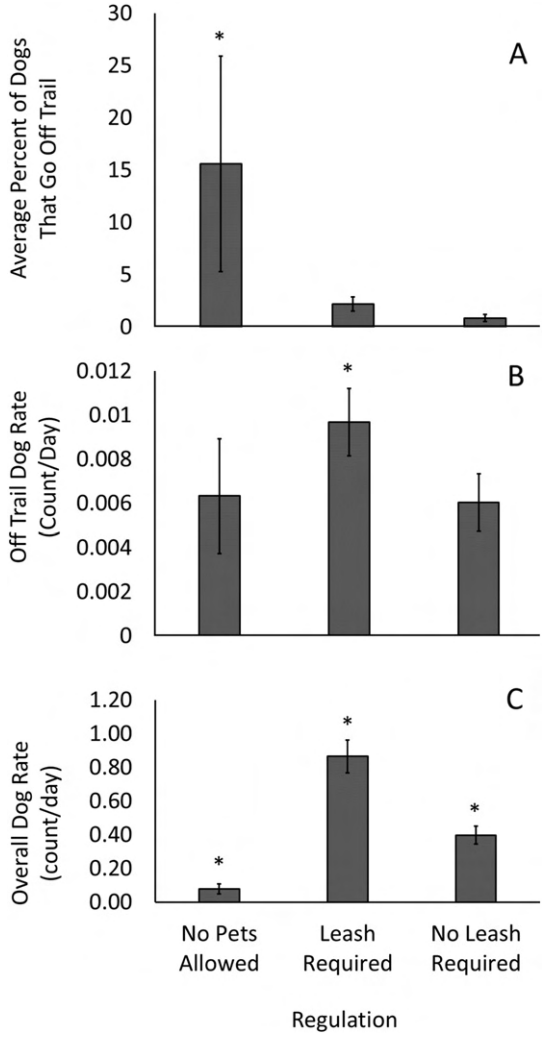

Fig. 4. Leash laws in relation to the (A) average percent of dogs off-trail, (B) average off-trail dog detection rate and (C) average dog detection rate for on and off-trail dogs. Data came from 145 camera sites in areas with no pets allowed, 302 with no leash required and 785 with leashes required. Error bars represent the standard error of the mean, and * indicates a significant difference from the other two regulation categories.

areas with recreational hunting had lower temporal avoidance of attended dogs by (on trails: $t = -3.70$, $p = 0.0002$, off trails: $t = -2.13$, $p = 0.04$). Squirrels also showed significantly less temporal avoidance of on-trail attended dogs in hunted areas (2 times less, $t = -2.44$, $p = 0.02$). We found no other significant differences in temporal avoidance between hunted and unhunted areas.

3.4. Deer vigilance

On average, deer were vigilant 22% of the time, head-down 44% of the time and head intermediate 34% of the time. Deer vigilance was 3% higher at sites where coyotes and humans without dogs were also detected and 2% higher at sites where attended dogs were also detected, though not all of these differences were significant (Table 1). Vigilance was 1% higher at sites without unattended dogs, though this difference was not statistically significant (Table 1). There were no significant differences in vigilance when on and off-trail sites were considered separately (Table 1).

4. Discussion

Our large scale camera trap survey showed that humans and dogs are the two most common mammals using protected areas across the region, but that their activity is highly concentrated along hiking trails. Our analysis of behavioral responses by wildlife to humans and dogs found little significant spatial avoidance, small increases in vigilance behavior, and a variable but important temporal avoidance. These metrics allow us to evaluate the ecological impact of humans and dogs within the risk-disturbance framework (Frid and Dill, 2002) by comparing them with a natural predator (coyotes). Contrasting these factors across parks with different regulations about dogs and hunting also allows us to evaluate the effectiveness of these management decisions on the wildlife-human conflict associated with outdoor recreation.

Of our three approaches to quantify disturbance of wildlife, the measures of temporal avoidance showed the most significant effects. Humans, as predicted, were the highest perceived risk, with all three prey species avoiding sites longest after people passed. Dogs by themselves had the lowest perceived risk in our comparisons. However, temporal avoidance was greatest for people accompanied by a dog. This compounding effect of dogs on the disturbance of wildlife has also been found for birds (Banks and Bryant, 2007; Weston et al., 2014) and other mammals (Mainini et al., 1993; Miller et al., 2001).

Our assessment of wildlife disturbance through spatial avoidance or increased vigilance showed few significant impacts. All species tended to spatially avoid unattended dogs on trails, but the results were not statistically significant. Deer increased their vigilance at sites with humans alone, but not at sites with dogs or coyotes. In a separate analysis of vigilance data incorporating intensity of human activity rather than simple presence/absence, we found that vigilance decreased as human activity increased (Schuttler et al. 2016, unpublished data). This difference is likely due to habituation in areas of heavy human traffic, something we did not examine in detail in this study (Recarte et al., 1998).

The three prey species in our study showed no significant spatial avoidance of unattended dogs, lower temporal avoidance in comparison with other predators, and no changes in deer vigilance related to dog activity. These minor impacts contrast a large body of work showing that free-ranging dogs are more detrimental to wildlife than leashed dogs (Hughes and MacDonald, 2013; Silva-Rodríguez and Sieving, 2012; Weston and Stankowich, 2014). We suspect that this difference is a reflection of the overall rarity of free ranging dogs in the protected areas we surveyed. Given that 99% of dogs are on the trails and 97% are with people, only a small fraction of the interactions between dogs and wildlife will be with truly free ranging dogs. Where these interaction occur, it seems that packs of free ranging dogs may present more of a threat than single dogs. Packs were responsible for at least 60% of recorded interactions with deer in our study, however the majority of dogs did not appear to be in packs and most were attended by people. We suspect that prey species in this region have adjusted their disturbance response to dogs in general to reflect the relatively low risk posed by an on-trail dog walking with its owner.

We expected unattended dogs and coyotes to be similar in perceived risk by prey given their similar size and unpredictable off-trail movement, however, all prey species temporally avoided coyotes more than unattended dogs and showed no significant spatial avoidance of either species. Indeed, spatially raccoons had higher occupancy at sites also occupied by coyotes which could indicate similar habitat preferences or active pursuit by coyotes. We found a similar result for squirrels and unattended dogs off trails. Despite evidence that unattended dogs and coyotes both pursue deer, deer showed no temporal avoidance of either species, no changes in vigilance and relatively low temporal avoidance. Since the extirpation of wolves from the Southeast in the mid-1900s, deer have no predators to regulate their populations, except human hunters (Wallach et al., 2015). Coyotes are a recent arrival to the Southeast and it is unclear whether deer are responding to coyotes as an apex predator in the same way they would wolves. Coyotes do depredate deer, although typically fawns rather than adults in the Southeast (Kilgo et al., 2010). The minimal reactions of deer found in our study suggest that neither coyotes nor humans are perceived as a strong threat by adult deer.

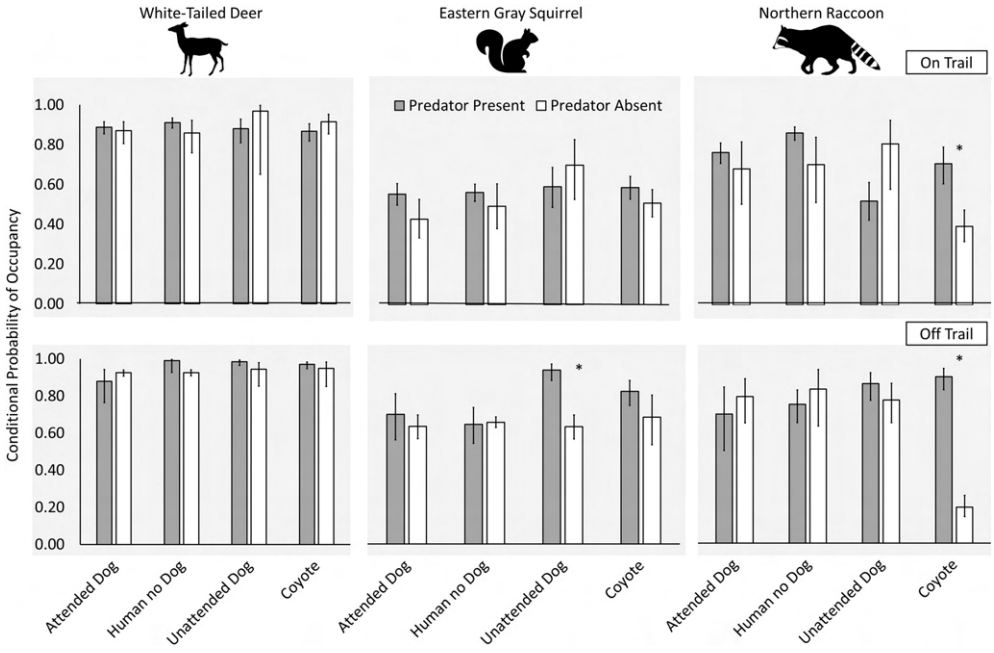

Fig. 5. Conditional probability of white-tailed deer, eastern gray squirrel and raccoon occupancy in the presence and absence of different potential predators on and off trails. Error bars show 95% confidence interval, * indicates a significant difference in occupancy between predator presence and absence based on non-overlapping 95% confidence intervals.

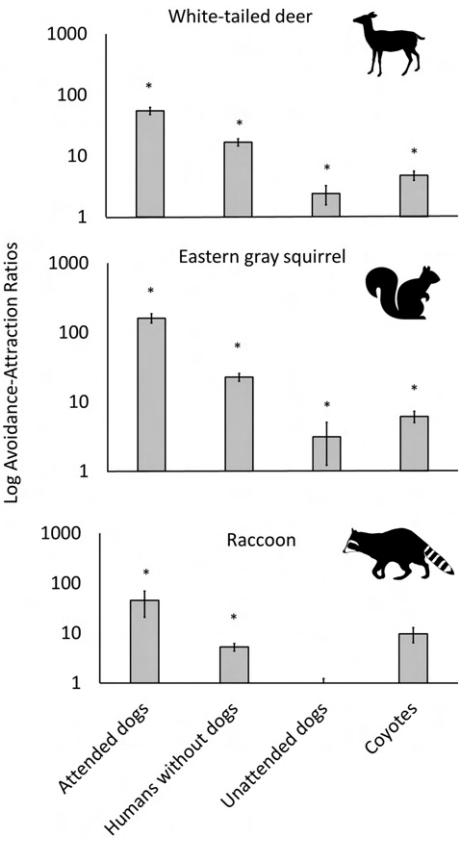

Fig. 6. Temporal avoidance of an area by three prey species after the passage of four different potential predators. Avoidance-attraction ratios (AAR) larger than 1 show avoidance, with larger values indicating longer times before revisiting a site. (*) denotes a significant difference ($\alpha = 0.05$) in AAR from the other three predators. Humans with and without dogs were avoided more than coyotes or unattended dogs by all three species. Only raccoons showed significantly higher avoidance of coyotes compared to humans without dogs.

Our report is the first large scale assessment of dogs in protected areas in the United States, offering the best estimate of what proportion of dogs are free ranging in the region and the effect of management regulations on dog owner behavior. Dogs were abundant in each of the 33 protected areas sampled, and often were the most commonly detected nonhuman mammal. We found widespread disregard for leash laws in parks, especially when hikers got farther away from trailheads where enforcement was more likely. This rate was lower than smaller nearby parks (Leung et al., 2015), but consistent with past studies of compliance from around the world (Weston et al., 2014). Despite this blatant disregard for leashing laws, most dogs were still found on the trail walking with their owners, and thus were not a strong source of disturbance to the region's wildlife (Forrest and St. Clair, 2006; Reed and Merenlender, 2011).

Few studies have investigated the benefits of dog management on reducing impacts of pet recreation on wildlife. Past studies of dog management regulations have found no effect on wildlife diversity and abundance (Forrest and St. Clair, 2006; Reed and Merenlender, 2011), however management that increases leashing rates would conceivably decrease indirect effects of disturbance on fitness (Weston et al., 2014). Despite the general disregard for management regulations, requiring leashes did increase leashing rate by 21%. Likewise, rules prohibiting dogs decreased dog activity by 87% and decreased people walking dogs off trails by 90%. This shows that dog management regulations do help control dog behavior and can succeed in reducing the impact of dogs.

We predicted that protected areas that allowed hunting would have animals more easily disturbed by recreational hikers, since humans would be real threats to wildlife, at least during hunting season. To the contrary, we found that deer and squirrels living in areas that allowed hunting had weaker temporal avoidance of attended dogs. We found no significant effect of hunting for any other predator or prey species, consistent with our earlier study of the effects of recreation on wildlife (Kays et al., 2016). These results are contrary to other studies which have shown increased flight responses to people in hunted populations of ungulates versus unhunted populations (Stankowich, 2008).

Table 1
Deer vigilance compared at sites (on trails, off trail and combined) where potential predator species were and were not detected. Predators were humans without dogs, attended dogs (dogs < 5 min from a human, leashed or not), unattended dogs (dogs without humans) and coyotes. Comparisons were done using a Wilcoxon signed-rank test. Significant differences are in bold.

Predator	Effect size (with-without)	n (with, without)	SE (with, without)	χ^2	df	p
On trail						
Attended dog	−0.11%	(170, 67)	(1.54%, 2.69%)	0.03	1	0.87
Human without dog	2.55%	(208, 29)	(1.45%, 3.41%)	0.22	1	0.64
Unattended dog	0.42%	(50, 187)	(3.33%, 1.45%)	0.12	1	0.73
Coyote	−1.96%	(130, 107)	(1.59%, 2.27%)	0.01	1	0.91
Off trail						
Attended dog	−6.81%	(38, 501)	(2.46%, 0.96%)	3.09	1	0.08
Human without dog	2.42%	(49, 490)	(2.98%, 0.96%)	0.98	1	0.32
Unattended dog	−3.62%	(21, 518)	(3.22%, 0.94%)	0.11	1	0.75
Coyote	2.81%	(98, 441)	(2.11%, 1.01%)	2.09	1	0.15
Combined						
Attended dog	−0.08%	(208, 568)	(1.36%, 0.90%)	0.19	1	0.66
Human without dog	**2.66%**	(257, 519)	(1.30%, 0.92%)	4.03	1	0.04
Unattended dog	0.09%	(71, 705)	(2.54%, 0.79%)	0.01	1	0.91
Coyote	1.51%	(228, 548)	(1.28%, 0.92%)	3.14	1	0.08

5. Conclusions

We found that dogs are the most common non-human mammal using protected areas in the Eastern USA, but that their activity is highly concentrated along trails. We found relatively little spatial or behavioral response of prey species to dogs or humans, but temporal avoidance suggests that humans are perceived as a greater risk by wildlife relative to unattended dogs and coyotes. Furthermore, dogs walking with humans increase the perceived risk, causing wildlife to avoid an area for a greater amount of time than in response to humans alone. Free-ranging dogs were not perceived as a high risk by wildlife, contrasting strong negative ecological effects found in other studies of free-ranging dogs (Vanak and Gompper, 2009; Vanak et al., 2009; Young et al., 2011). These results show how the responsible control of dog behavior by their owners can minimize disturbance of wildlife. We also found that regulations by protected area managers succeed in reducing the impact of dogs; prohibiting dogs in protected areas reduced their use of an area by a factor of 10 while leash laws increased leashing rates by 21% (45% leashed with leash law, 24% without). Although millions of dogs use natural areas each year, regulations enacted by protected areas combined with responsible management of dog behavior by pet owners work together to reduce the ecological impact of dogs and increase outdoor enjoyment by hikers and their pets.

Acknowledgements

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Appendix A. Covariates used for occupancy modeling

Covariates	Shorthand	Units	Source
Detection probability			
Cloud cover	Cloud	Percent, daily	NCEP-DOE surface total cloud cover entire atmospheric column
Temperature	Temp	Celsius, daily	ECMWF interim full daily SFC temperature (2 m above ground)
Precipitation	Precip	Milliliters, daily	NCEP NARR precipitation rate at surface
Year	Year	Year	
Canopy cover	NDVI	Percent, site-average	MODIS land terra vegetation indices 1 km monthly NDVI
Hiker count	People	Count/site	
Hunting	Hunting	Yes/no	
Detection distance	Det_dist	Meters, site specific	
Occupancy			
Housing density (5 km radius)	HDens_5 km	Houses/km^2	Silvis housing density dataset
Large core forest (5 km radius)	LC_5 km	Percent	USGS GAP landcover dataset
Edge (5 km radius)	Edge_5 km	Percent	USGS GAP landcover dataset
Housing density (250 m radius)	HDens_250 m	Houses/km^2	Silvis housing density dataset
Large core forest (250 m radius)	LC_250 m	Percent	USGS GAP landcover dataset
Edge (250 m radius)	Edge_250 m	Percent	USGS GAP landcover dataset
Hunting	Hunting	Yes/no	
Distance to nearest trailhead	Trailhead	Meters	
Latitude × longitude	LatbyLong	Decimal degrees	
On or off trail	Trail	Categorical group	

Appendix B. Single-species occupancy model selection tables. Detection model selection was done using the most parameterized occupancy model. Because of high overdispersion, all model selection was done using QAIC

Detection models attended dog	df	Neg2LnL	QAIC	Delta QAIC
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + hunting + trail)	8	15,827.39	2374.83	0
p(~Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + trail)	9	15,816.9	2375.27	0.44
p(~NVDI_site + Precip + Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	15,792.61	2375.65	0.82
p(~Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	15,827.39	2376.83	2
p(~Temp + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	15,816.9	2377.27	2.44
p(~Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	15,866.5	2380.66	5.83
p(~Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	15,866.5	2382.66	7.83
p(~1)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	7	15,897.32	2383.25	8.42
p(~Det_dist + Year)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	15,873.11	2383.64	8.81
p(~Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	15,897.32	2385.25	10.42
Occupancy models attended dog				
p(~Cloud)Psi(~Trailhead + Hunting)	5.00	16,840.34	1711.13	0.00
p(~Cloud)Psi(~Edge_5 km + Hunting)	5.00	16,848.77	1711.99	0.85
p(~Cloud)Psi(~Edge_5 km)	4.00	16,871.44	1712.28	1.14
p(~Cloud)Psi(~Edge_250 m)	4.00	16,874.50	1712.59	1.45
p(~Cloud)Psi(~Hunting)	4.00	16,910.15	1716.19	5.05
p(~Cloud)Psi(~1)	3.00	16,935.80	1716.78	5.64
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Edge_5 km + Hunting)	8.00	16,844.84	1717.59	6.45
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Edge_250 m + Hunting)	8.00	16,847.26	1717.83	6.70
p(~Cloud)Psi(~HDens_5 km + Hunting)	5.00	16,907.00	1717.87	6.73
p(~Cloud)Psi(~HDens_5 km)	4.00	16,927.12	1717.90	6.77
p(~Cloud)Psi(~LC_5 km + Hunting)	5.00	16,908.70	1718.04	6.91
p(~Cloud)Psi(~HDens_250 m + Hunting)	5.00	16,908.97	1718.07	6.93
p(~Cloud)Psi(~LC_250 m + Hunting)	5.00	16,910.08	1718.18	7.04
p(~Cloud)Psi(~HDens_250 m)	4.00	16,933.26	1718.52	7.39
p(~Cloud)Psi(~LC_5 km)	4.00	16,933.35	1718.53	7.40
p(~Cloud)Psi(~LatbyLong)	4.00	16,935.29	1718.73	7.59
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Edge_250 m + Hunting + Trailhead)	9.00	16,836.69	1718.77	7.63
p(~Cloud)Psi(~LC_250 m)	4.00	16,935.78	1718.78	7.64
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Edge_5 km + Hunting + Trailhead)	9.00	16,838.32	1718.93	7.80
p(~Cloud)Psi(~LC_5 km + HDens_5 km + Hunting)	6.00	16,906.93	1719.86	8.73
p(~Cloud)Psi(~LC_5 km + HDens_5 km)	5.00	16,927.11	1719.90	8.77
p(~Cloud)Psi(~LC_250 m + HDens_250 m + Hunting)	6.00	16,908.66	1720.04	8.90
p(~Cloud)Psi(~LC_250 m + HDens_250 m)	5.00	16,932.97	1720.49	9.36
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting)	7.00	16,905.64	1721.73	10.60
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Hunting)	7.00	16,907.83	1721.95	10.82
Detection models unattended dog				
p(~NVDI_site + People_site + Temp + Cloud + Precip + Year + Det_dist)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	14	2948.74	1946.15	0
p(~People_site + Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	2964.76	1946.58	0.42
p(~NVDI_site + People_site + Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	2960.57	1947.85	1.7
p(~People_site + Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	2964.76	1948.58	2.42
p(~NVDI_site + People_site + Temp + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	12	2960.57	1949.85	3.7
p(~NVDI_site + People_site + Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	2964.07	1950.13	3.97
p(~People_site + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	2970.97	1950.61	4.46
p(~People_site + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	2970.97	1952.61	6.46
p(~People_site)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	2979.42	1954.11	7.96
p(~People_site + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	2979.42	1956.11	9.96
p(~Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	2980.95	1957.11	10.96
p(~Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	2985.4	1958	11.85
p(~Temp + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	2980.95	1959.11	12.96
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	2987.94	1959.65	13.5
p(~Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	2985.4	1960	13.85
p(~NVDI_site + Precip + Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	2980.04	1960.51	14.36
p(~Det_dist + Year)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	2987.51	1961.37	15.22
p(~Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	2987.94	1961.65	15.5
p(~1)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	7	2996.35	1963.12	16.97
p(~Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	2996.35	1965.12	18.97
Occupancy models unattended dog				
p(~People_site + Temp)Psi(~LC_5 km)	5	3109.00	579.12	0.00
p(~People_site + Temp)Psi(~HDens_5 km)	5	3116.17	580.43	1.31
p(~People_site + Temp)Psi(~LC_5 km + HDens_5 km)	6	3106.31	580.62	1.51
p(~People_site + Temp)Psi(~LC_5 km + Hunting)	6	3106.73	580.70	1.58
p(~People_site + Temp)Psi(~1)	4	3133.72	581.64	2.53
p(~People_site + Temp)Psi(~HDens_5 km + Hunting)	6	3114.58	582.14	3.02
p(~People_site + Temp)Psi(~LC_5 km + HDens_5 km + Hunting)	7	3104.88	582.36	3.25
p(~People_site + Temp)Psi(~Hunting)	5	3128.26	582.64	3.53
p(~People_site + Temp)Psi(~LC_250 m)	5	3129.92	582.95	3.83

(*continued*)

Detection models attended dog	df	Neg2LnL	QAIC	Delta QAIC
p(~People_site + Temp)Psi(~HDens_250 m)	5	3131.50	583.23	4.12
p(~People_site + Temp)Psi(~Edge_5 km)	5	3131.92	583.31	4.19
p(~People_site + Temp)Psi(~Trailhead + Hunting)	6	3121.12	583.34	4.22
p(~People_site + Temp)Psi(~LatbyLong)	5	3132.51	583.42	4.30
p(~People_site + Temp)Psi(~Edge_250 m)	5	3132.87	583.49	4.37
p(~People_site + Temp)Psi(~LC_250 m + Hunting)	6	3124.96	584.04	4.92
p(~People_site + Temp)Psi(~HDens_250 m + Hunting)	6	3126.68	584.35	5.24
p(~People_site + Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting)	8	3104.84	584.35	5.24
p(~People_site + Temp)Psi(~Edge_5 km + Hunting)	6	3127.06	584.42	5.31
p(~People_site + Temp)Psi(~LC_250 m + HDens_250 m)	6	3128.69	584.72	5.60
p(~People_site + Temp)Psi(~LC_250 m + HDens_250 m + Hunting)	7	3124.15	585.89	6.77
p(~People_site + Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Edge_5 km + Hunting)	9	3104.13	586.22	7.11
p(~People_site + Temp)Psi(~LatbyLong + LC_250 m + HDens_250 m + Hunting)	8	3123.57	587.78	8.67
p(~People_site + Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Edge_5 km + Hunting + Trailhead)	10	3104.01	588.20	9.09
p(~People_site + Temp)Psi(~LatbyLong + LC_250 m + HDens_250 m + Edge_250 m + Hunting)	9	3122.18	589.53	10.41
p(~People_site + Temp)Psi(~LatbyLong + LC_250 m + HDens_250 m + Edge_250 m + Hunting + Trailhead)	10	3118.38	590.83	11.72
Detection models humans without dogs				
p(~Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	21,862.51	1951.67	0
p(~NVDI_site + Precip + Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	21,818.95	1951.81	0.15
p(~Temp + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	21,862.51	1953.67	2
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	21,916.92	1954.48	2.81
p(~Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	21,916.92	1956.48	4.81
p(~1)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	7	21,979.33	1958	6.33
p(~Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	21,956.74	1958	6.33
p(~Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	21,979.33	1960	8.33
p(~Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	21,956.74	1960	8.33
p(~Det_dist + Year)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	21,970.02	1961.17	9.51
Occupancy models humans without dogs				
p(~Cloud)Psi(~Edge_250 m)	4.00	23,152.54	2808.32	0.00
p(~Cloud)Psi(~Edge_5 km)	4.00	23,153.03	2808.38	0.06
p(~Cloud)Psi(~Trailhead + Hunting)	5.00	23,139.19	2808.70	0.39
p(~Cloud)Psi(~Edge_5 km + Hunting)	5.00	23,144.58	2809.36	1.04
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Edge_5 km + Hunting)	8.00	23,136.01	2814.32	6.00
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Edge_250 m + Hunting)	8.00	23,138.35	2814.60	6.28
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Edge_250 m + Hunting + Trailhead)	9.00	23,132.50	2815.89	7.58
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Edge_5 km + Hunting + Trailhead)	9.00	23,133.76	2816.05	7.73
p(~Cloud)Psi(~1)	3.00	23,247.03	2817.75	9.43
p(~Cloud)Psi(~Hunting)	4.00	23,237.01	2818.54	10.22
p(~Cloud)Psi(~HDens_5 km)	4.00	23,239.81	2818.87	10.56
p(~Cloud)Psi(~LC_5 km)	4.00	23,242.72	2819.23	10.91
p(~Cloud)Psi(~LC_250 m)	4.00	23,243.13	2819.28	10.96
p(~Cloud)Psi(~LatbyLong)	4.00	23,245.33	2819.54	11.22
p(~Cloud)Psi(~HDens_250 m)	4.00	23,245.82	2819.60	11.28
p(~Cloud)Psi(~HDens_5 km + Hunting)	5.00	23,233.12	2820.06	11.75
p(~Cloud)Psi(~LC_250 m + Hunting)	5.00	23,233.43	2820.10	11.78
p(~Cloud)Psi(~LC_5 km + Hunting)	5.00	23,233.58	2820.12	11.80
p(~Cloud)Psi(~HDens_250 m + Hunting)	5.00	23,236.41	2820.46	12.14
p(~Cloud)Psi(~LC_5 km + HDens_5 km)	5.00	23,239.28	2820.81	12.49
p(~Cloud)Psi(~LC_250 m + HDens_250 m)	5.00	23,242.72	2821.23	12.91
p(~Cloud)Psi(~LC_5 km + HDens_5 km + Hunting)	6.00	23,232.27	2821.96	13.64
p(~Cloud)Psi(~LC_250 m + HDens_250 m + Hunting)	6.00	23,233.32	2822.09	13.77
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting)	7.00	23,228.10	2823.46	15.14
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Hunting)	7.00	23,230.36	2823.73	15.41
Detection models coyote				
p(~Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	10,196.05	2384.25	0
p(~NVDI_site + People_site + Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	10,179.65	2384.44	0.19
p(~People_site + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	10,202.14	2385.66	1.41
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	10,211.14	2385.75	1.5
p(~Temp + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	10,196.05	2386.25	2
p(~NVDI_site + People_site + Temp + Cloud + Precip + Year + Det_dist)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	14	10,162.07	2386.36	2.11
p(~NVDI_site + People_site + Temp + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	12	10,179.65	2386.44	2.19
p(~NVDI_site + Precip + Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	10,188.83	2386.57	2.32
p(~People_site + Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	10,209.01	2387.25	3.01
p(~Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	10,219.27	2387.64	3.39
p(~People_site + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	10,202.14	2387.66	3.41
p(~Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	10,211.14	2387.75	3.5
p(~NVDI_site + People_site + Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	10,198.32	2388.77	4.53
p(~People_site + Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	10,209.01	2389.25	5.01
p(~Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	10,219.27	2389.64	5.39
p(~People_site)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	10,238.55	2392.11	7.86
p(~Det_dist + Year)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	10,230.07	2392.14	7.89

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(*continued*)

Detection models attended dog	df	Neg2LnL	QAIC	Delta QAIC
p(~1)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	7	10,247.89	2392.28	8.03
p(~People_site + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	10,238.55	2394.11	9.86
p(~Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	10,247.89	2394.28	10.03
Occupancy models coyote				
p(~Cloud)Psi(~LC_250 m)	4.00	10,455.31	2434.42	0.00
p(~Cloud)Psi(~LC_250 m + Hunting)	5.00	10,448.26	2434.78	0.36
p(~Cloud)Psi(~Edge_250 m)	4.00	10,459.44	2435.37	0.96
p(~Cloud)Psi(~HDens_5 km + Hunting)	5.00	10,451.14	2435.45	1.03
p(~Cloud)Psi(~LC_250 m + HDens_250 m)	5.00	10,453.57	2436.01	1.60
p(~Cloud)Psi(~HDens_5 km)	4.00	10,464.24	2436.49	2.07
p(~Cloud)Psi(~LC_250 m + HDens_250 m + Hunting)	6.00	10,447.12	2436.51	2.10
p(~Cloud)Psi(~LC_5 km + HDens_5 km + Hunting)	6.00	10,448.11	2436.74	2.33
p(~Cloud)Psi(~LC_5 km + HDens_5 km)	5.00	10,462.27	2438.03	3.61
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Hunting)	7.00	10,446.03	2438.26	3.85
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting)	7.00	10,446.35	2438.34	3.92
p(~Cloud)Psi(~1)	3.00	10,480.97	2438.37	3.95
p(~Cloud)Psi(~Edge_5 km + Hunting)	5.00	10,464.12	2438.46	4.04
p(~Cloud)Psi(~Edge_5 km)	4.00	10,473.17	2438.56	4.15
p(~Cloud)Psi(~Hunting)	4.00	10,474.97	2438.98	4.56
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Edge_250 m + Hunting)	8.00	10,444.08	2439.81	5.39
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Edge_5 km + Hunting)	8.00	10,444.87	2439.99	5.58
p(~Cloud)Psi(~LC_5 km)	4.00	10,479.80	2440.10	5.68
p(~Cloud)Psi(~LatbyLong)	4.00	10,480.83	2440.34	5.92
p(~Cloud)Psi(~HDens_250 m)	4.00	10,480.95	2440.37	5.95
p(~Cloud)Psi(~Trailhead + Hunting)	5.00	10,473.09	2440.54	6.13
p(~Cloud)Psi(~LC_5 km + Hunting)	5.00	10,473.42	2440.62	6.20
p(~Cloud)Psi(~HDens_250 m + Hunting)	5.00	10,474.96	2440.98	6.56
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Edge_5 km + Hunting + Trailhead)	9.00	10,441.87	2441.30	6.88
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Edge_250 m + Hunting + Trailhead)	9.00	10,442.69	2441.49	7.07
Detection models white-tailed deer				
p(~Det_dist + Year)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	47,465.81	1944.46	0
p(~NVDI_site + People_site + Temp + Cloud + Precip + Year + Det_dist)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	14	47,392.05	1951.47	7.01
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	47,808.3	1956.36	11.9
p(~1)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	7	47,871.91	1956.94	12.48
p(~People_site + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	47,796.75	1957.89	13.43
p(~Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	47,808.3	1958.36	13.9
p(~People_site)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	47,859.5	1958.44	13.98
p(~Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	47,811.33	1958.48	14.02
p(~Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	47,871.91	1958.94	14.48
p(~Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	47,873.3	1959	14.54
p(~People_site + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	47,796.75	1959.89	15.43
p(~People_site + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	47,859.5	1960.44	15.98
p(~Temp + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	47,811.33	1960.48	16.02
p(~People_site + Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	47,861.21	1960.51	16.05
p(~Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	47,873.3	1961	16.54
p(~NVDI_site + People_site + Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	47,796.85	1961.9	17.44
p(~NVDI_site + Precip + Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	47,807.59	1962.33	17.87
p(~People_site + Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	47,861.21	1962.51	18.05
p(~NVDI_site + People_site + Temp + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	12	47,796.85	1963.9	19.44
p(~NVDI_site + People_site + Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	47,858.3	1964.39	19.93
Occupancy models white-tailed deer				
p(~Det_dist + Year)Psi(~Edge_250 m)	5.00	47,458.22	1952.59	0.00
p(~Det_dist + Year)Psi(~Edge_5 km)	5.00	47,460.07	1952.66	0.08
p(~Det_dist + Year)Psi(~HDens_5 km)	5.00	47,491.71	1953.96	1.37
p(~Det_dist + Year)Psi(~1)	4.00	47,544.16	1954.11	1.52
p(~Det_dist + Year)Psi(~Trailhead + Hunting)	6.00	47,448.15	1954.18	1.59
p(~Det_dist + Year)Psi(~Edge_5 km + Hunting)	6.00	47,455.36	1954.47	1.88
p(~Det_dist + Year)Psi(~LC_5 km)	5.00	47,505.93	1954.54	1.95
p(~Det_dist + Year)Psi(~HDens_250 m)	5.00	47,536.17	1955.78	3.19
p(~Det_dist + Year)Psi(~Hunting)	5.00	47,538.68	1955.88	3.29
p(~Det_dist + Year)Psi(~HDens_5 km + Hunting)	6.00	47,491.40	1955.95	3.36
p(~Det_dist + Year)Psi(~LatbyLong)	5.00	47,541.83	1956.01	3.42
p(~Det_dist + Year)Psi(~LC_250 m)	5.00	47,543.81	1956.09	3.50
p(~Det_dist + Year)Psi(~LC_5 km + Hunting)	6.00	47,500.26	1956.31	3.72
p(~Det_dist + Year)Psi(~LC_5 km + HDens_5 km)	6.00	47,504.52	1956.48	3.90
p(~Det_dist + Year)Psi(~HDens_250 m + Hunting)	6.00	47,531.77	1957.60	5.01
p(~Det_dist + Year)Psi(~LatbyLong + LC_5 km + HDens_5 km + Edge_5 km + Hunting)	9.00	47,387.07	1957.67	5.09
p(~Det_dist + Year)Psi(~LC_250 m + HDens_250 m)	6.00	47,534.80	1957.72	5.13
p(~Det_dist + Year)Psi(~LC_250 m + Hunting)	6.00	47,538.27	1957.86	5.28
p(~Det_dist + Year)Psi(~LC_5 km + HDens_5 km + Hunting)	7.00	47,499.80	1958.29	5.70
p(~Det_dist + Year)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting)	8.00	47,473.23	1959.20	6.61
p(~Det_dist + Year)Psi(~LC_250 m + HDens_250 m + Hunting)	7.00	47,530.51	1959.55	6.96

(*continued*)

Detection models attended dog	df	Neg2LnL	QAIC	Delta QAIC
p(~Det_dist + Year)Psi(~LatbyLong + LC_5 km + HDens_5 km + Edge_5 km + Hunting + Trailhead)	10.00	47,386.91	1959.67	7.08
p(~Det_dist + Year)Psi(~LatbyLong + LC_250 m + HDens_250 m + Edge_250 m + Hunting)	9.00	47,443.87	1960.00	7.41
p(~Det_dist + Year)Psi(~LatbyLong + LC_250 m + HDens_250 m + Hunting)	8.00	47,528.72	1961.47	8.89
p(~Det_dist + Year)Psi(~LatbyLong + LC_250 m + HDens_250 m + Edge_250 m + Hunting + Trailhead)	10.00	47,438.30	1961.77	9.18
Detection models northern raccoon				
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	16,809.33	1952.53	0
p(~Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	16,801.06	1953.58	1.05
p(~People_site + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	16,802.88	1953.79	1.26
p(~Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	16,809.33	1954.53	2
p(~Temp + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	16,801.06	1955.58	3.05
p(~People_site + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	16,802.88	1955.79	3.26
p(~NVDI_site + People_site + Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	16,786.32	1955.88	3.35
p(~NVDI_site + Precip + Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	16,793.21	1956.67	4.14
p(~NVDI_site + People_site + Temp + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	12	16,786.32	1957.88	5.35
p(~Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	16,856.81	1958	5.47
p(~1)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	7	16,883.99	1959.13	6.6
p(~People_site + Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	16,849.88	1959.2	6.67
p(~NVDI_site + People_site + Temp + Cloud + Precip + Year + Det_dist)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	14	16,766.11	1959.55	7.02
p(~Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	16,856.81	1960	7.47
p(~People_site)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	16,877.95	1960.44	7.91
p(~Det_dist + Year)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	16,860.9	1960.47	7.94
p(~Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	16,883.99	1961.13	8.6
p(~People_site + Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	16,849.88	1961.2	8.67
p(~People_site + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	16,877.95	1962.44	9.91
p(~NVDI_site + People_site + Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	16,846.99	1962.87	10.34
Occupancy models northern raccoon				
p(~Cloud)Psi(~HDens_5 km)	4.00	16,849.72	1952.70	0.00
p(~Cloud)Psi(~LC_5 km)	4.00	16,853.15	1953.10	0.40
p(~Cloud)Psi(~LC_5 km + HDens_5 km)	5.00	16,842.53	1953.87	1.17
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting)	7.00	16,809.86	1954.10	1.40
p(~Cloud)Psi(~1)	3.00	16,881.58	1954.38	1.68
p(~Cloud)Psi(~Edge_5 km)	4.00	16,866.11	1954.59	1.89
p(~Cloud)Psi(~LatbyLong)	4.00	16,866.36	1954.62	1.92
p(~Cloud)Psi(~Trailhead + Hunting)	5.00	16,849.09	1954.63	1.93
p(~Cloud)Psi(~HDens_5 km + Hunting)	5.00	16,849.63	1954.69	1.99
p(~Cloud)Psi(~LC_5 km + Hunting)	5.00	16,851.48	1954.90	2.20
p(~Cloud)Psi(~Edge_250 m)	4.00	16,870.36	1955.08	2.38
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Edge_5 km + Hunting)	8.00	16,806.12	1955.67	2.97
p(~Cloud)Psi(~HDens_250 m)	4.00	16,875.96	1955.73	3.03
p(~Cloud)Psi(~LC_5 km + HDens_5 km + Hunting)	6.00	16,842.25	1955.84	3.14
p(~Cloud)Psi(~Hunting)	4.00	16,878.65	1956.04	3.34
p(~Cloud)Psi(~LC_250 m)	4.00	16,881.40	1956.36	3.66
p(~Cloud)Psi(~Edge_5 km + Hunting)	5.00	16,864.87	1956.45	3.75
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Edge_5 km + Hunting + Trailhead)	9.00	16,801.20	1957.10	4.40
p(~Cloud)Psi(~HDens_250 m + Hunting)	5.00	16,874.02	1957.50	4.80
p(~Cloud)Psi(~LC_250 m + HDens_250 m)	5.00	16,875.86	1957.72	5.02
p(~Cloud)Psi(~LC_250 m + Hunting)	5.00	16,878.53	1958.03	5.32
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Edge_250 m + Hunting)	8.00	16,834.99	1959.00	6.30
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Edge_250 m + Hunting + Trailhead)	9.00	16,820.52	1959.33	6.63
p(~Cloud)Psi(~LC_250 m + HDens_250 m + Hunting)	6.00	16,873.91	1959.49	6.79
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Hunting)	7.00	16,858.75	1959.74	7.04
Detection models eastern gray squirrel				
p(~Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	30,429.77	1947.4	0
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	30,466.31	1947.72	0.32
p(~Temp + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	30,429.77	1949.4	2
p(~People_site + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	30,462.97	1949.51	2.1
p(~Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	30,466.31	1949.72	2.32
p(~NVDI_site + People_site + Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	30,423.85	1951.03	3.62
p(~NVDI_site + Precip + Temp + Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	30,426.38	1951.19	3.79
p(~People_site + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	30,462.97	1951.51	4.1
p(~NVDI_site + People_site + Temp + Cloud + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	12	30,423.85	1953.03	5.62
p(~NVDI_site + People_site + Temp + Cloud + Precip + Year + Det_dist)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	14	30,380.12	1954.26	6.85
p(~Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	30,644.19	1959	11.6
p(~People_site + Temp)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	30,642.14	1960.87	13.47
p(~Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	30,644.19	1961	13.6
p(~Det_dist + Year)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	30,670.21	1962.65	15.25
p(~People_site + Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	10	30,642.14	1962.87	15.47
p(~1)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	7	30,749.68	1963.69	16.28
p(~NVDI_site + People_site + Temp + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	11	30,626.26	1963.86	16.46

(*continued on next page*)

(*continued*)

Detection models attended dog	df	Neg2LnL	QAIC	Delta QAIC
p(~People_site)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	30,746.46	1965.48	18.08
p(~Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	8	30,749.68	1965.69	18.28
p(~People_site + Precip)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting + Trail)	9	30,746.46	1967.48	20.08
Occupancy models eastern gray squirrel				
p(~Cloud)Psi(~Edge_5 km)	4.00	30,391.63	1950.21	0.00
p(~Cloud)Psi(~Edge_5 km + Hunting)	5.00	30,389.77	1952.09	1.88
p(~Cloud)Psi(~Edge_250 m)	4.00	30,469.21	1955.17	4.96
p(~Cloud)Psi(~Trailhead + Hunting)	5.00	30,452.51	1956.10	5.89
p(~Cloud)Psi(~LatbyLong)	4.00	30,489.81	1956.48	6.27
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Edge_5 km + Hunting)	8.00	30,369.33	1956.78	6.57
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Edge_5 km + Hunting + Trailhead)	9.00	30,357.48	1958.03	7.82
p(~Cloud)Psi(~1)	3.00	30,553.16	1958.53	8.32
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Edge_250 m + Hunting)	8.00	30,404.02	1959.00	8.79
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Edge_250 m + Hunting + Trailhead)	9.00	30,380.66	1959.51	9.30
p(~Cloud)Psi(~HDens_5 km)	4.00	30,543.37	1959.91	9.70
p(~Cloud)Psi(~LC_250 m)	4.00	30,546.10	1960.08	9.87
p(~Cloud)Psi(~LC_5 km)	4.00	30,551.52	1960.43	10.22
p(~Cloud)Psi(~HDens_250 m)	4.00	30,552.71	1960.50	10.29
p(~Cloud)Psi(~Hunting)	4.00	30,553.12	1960.53	10.32
p(~Cloud)Psi(~LC_5 km + HDens_5 km)	5.00	30,531.26	1961.13	10.92
p(~Cloud)Psi(~HDens_5 km + Hunting)	5.00	30,543.04	1961.88	11.68
p(~Cloud)Psi(~LC_250 m + HDens_250 m)	5.00	30,544.34	1961.97	11.76
p(~Cloud)Psi(~LatbyLong + LC_5 km + HDens_5 km + Hunting)	7.00	30,482.94	1962.04	11.83
p(~Cloud)Psi(~LC_250 m + Hunting)	5.00	30,546.03	1962.08	11.87
p(~Cloud)Psi(~LatbyLong + LC_250 m + HDens_250 m + Hunting)	7.00	30,486.24	1962.25	12.05
p(~Cloud)Psi(~LC_5 km + Hunting)	5.00	30,551.44	1962.42	12.21
p(~Cloud)Psi(~HDens_250 m + Hunting)	5.00	30,552.69	1962.50	12.29
p(~Cloud)Psi(~LC_5 km + HDens_5 km + Hunting)	6.00	30,530.52	1963.08	12.88
p(~Cloud)Psi(~LC_250 m + HDens_250 m + Hunting)	6.00	30,544.33	1963.97	13.76

Appendix C. Two-species occupancy model selection tables. Single-species detection models were either the most parsimonious detection model within the top 3 QAIC points in Appendix B (p(top)), a trail-only model (p(Trail)) or a null model (p(.)). Single-species occupancy models were either the top models in Appendix B with the addition of predator and trail covariates (psi(topPredsTrail) or a trail-only model (psi(Trail)). Trail only models had only a categorical Trail covariate. Preds indicates that predator DR other than the one explicitly being modeled were included as covariates. Because of high overdispersion, all model selection was done using QAIC. When models did not converge (*), the next best model was used to generate Psi estimates

Deer-attended dog	df	neg2L	QAIC	Delta QAIC	Model did not converge
p(Trail)psi(Trail)	16	18,630.80	1894.21	0.00	*
p(.)psi(Trail)	11	19,509.97	1972.08	77.88	
p(top)psi(Trail)	19	19,377.41	1974.83	80.63	
p(top)psi(topPredsTrail)	27	19,249.04	1978.00	83.79	
Deer-human without dog					
p(Trail)psi(Trail)	16	18,962.43	1846.47	0.00	*
p(top)psi(Trail)	19	20,139.79	1965.13	118.66	
p(.)psi(Trail)	11	20,309.32	1965.35	118.88	
p(top)psi(topPredsTrail)	26	20,128.02	1978.00	131.53	*
Deer-coyote					
p(Trail)psi(Trail)	16	19,218.63	1904.93	0.00	
p(.)psi(Trail)	11	19,866.63	1958.08	53.15	
p(top)psi(Trail)	19	19,798.78	1967.47	62.54	*
p(top)psi(topPredsTrail)	26	19,773.45	1979.00	74.07	*
Deer-unattended dog					
p(Trail)psi(Trail)	16	15,298.25	1957.27	0.00	*
p(top)psi(topPredsTrail)	28	15,280.20	1979.00	21.73	
p(top)psi(Trail)	21	15,404.43	1980.63	23.36	
p(.)psi(Trail)	11	15,606.86	1986.11	28.84	
Squirrel-attended dog					
p(Trail)psi(Trail)	16	16,097.46	1905.70	0.00	*
p(top)psi(topPredsTrail)	24	16,555.41	1975.00	69.30	
p(top)psi(Trail)	16	16,720.94	1978.27	72.57	
p(.)psi(Trail)	11	16,902.77	1989.43	83.74	
Squirrel-human without dog					
p(Trail)psi(Trail)	16	16,379.07	1866.89	0.00	*
p(top)psi(Trail)	16	17,301.50	1970.23	103.34	
p(top)psi(topPredsTrail)	23	17,210.23	1974.00	107.11	

(*continued*)

Deer-attended dog	df	neg2L	QAIC	Delta QAIC	Model did not converge
p(.)psi(Trail)	11	17,467.47	1978.82	111.93	
Squirrel-coyote					
p(Trail)psi(Trail)	16	16,874.01	1933.70	0.00	
p(top)psi(Trail)	16	17,172.45	1967.33	33.63	
p(top)psi(topPredsTrail)	23	17,107.40	1974.00	40.30	
p(.)psi(Trail)	11	17,351.01	1977.45	43.76	
Squirrel-unattended dog					
p(top)psi(Trail)	18	12,995.25	1974.62	0.00	
p(top)psi(topPredsTrail)	25	12,910.68	1976.00	1.38	
p(Trail)psi(Trail)	16	13,056.16	1979.70	5.09	
p(.)psi(Trail)	11	13,262.15	2000.43	25.82	
Raccoon-attended dog					
p(Trail)psi(Trail)	16	13,549.90	1958.33	0.00	
p(top)psi(topPredsTrail)	24	13,561.62	1976.00	17.67	*
p(top)psi(Trail)	16	13,921.39	2011.15	52.81	
p(.)psi(Trail)	11	14,011.23	2013.92	55.59	*
Raccoon-human without dog					
p(Trail)psi(Trail)	16	13,721.70	1906.27	0.00	
p(top)psi(topPredsTrail)	23	14,137.05	1977.00	70.73	*
p(.)psi(Trail)	11	14,496.48	2002.09	95.83	*
p(top)psi(Trail)	16	14,431.41	2003.21	96.94	*
Raccoon-coyote					
p(Trail)psi(Trail)	16	14,312.47	1933.6	0.00	
p(.)psi(Trail)	11	14,635.66	1966.5	32.94	
p(top)psi(Trail)	16	14,571.67	1968	34.44	
p(top)psi(topPredsTrail)	23	14,497.55	1972.2	38.59	
Raccoon-unattended dog					
p(top)psi(topPredsTrail)	25	10,582.86	1960.8	0.00	*
p(top)psi(Trail)	18	10,705.76	1969	8.19	*
p(Trail)psi(Trail)	16	10,729.36	1969.3	8.45	*
p(.)psi(Trail)	11	10,864.22	1983.6	22.80	

Appendix D. List of protected areas surveyed and their characteristics

Name	Size (km^2)	Hunting weapons allowed	Dog hunting allowed?	Species hunted	Deer firearm season length (days)	Camera sites
C & O Canal National Historical Park	82	No Hunting				57
Carvins Cove Nature Reserve	51	No Hunting				65
Catoctin Mountain Park/Cunningham Falls State Park	44	Archery, Muzzleloader, Firearm	Yes	White-tailed deer (antlered and antlerless), coyote, raccoon, squirrel	15	72
Cheraw State Park	28	No Hunting				66
Fall Creek Falls State Park	105	No Hunting				68
Frozen Head State Natural Area	53	No Hunting				68
Frozen Head State Park Emory Tract	125	Archery, Muzzleloader, Firearm	Yes	White-tailed deer (antlered and antlerless), coyote, raccoon, squirrel	51	50
Gambrill State Park	4.5	No Hunting				27
George Washington National Forest	4289	Archery, Muzzleloader, Firearm	Yes	White-tailed deer (antlered and antlerless), coyote, raccoon, squirrel	15	55
Greenbelt Park	4.8	No Hunting				46
Harpers Ferry National Historical Park	15	No Hunting				36
Jefferson National Forest	2792	Archery, Muzzleloader, Firearm	Yes	White-tailed deer (antlered and antlerless), coyote, raccoon, squirrel	15	60
Lone Mountain State Forest	14	Archery, Muzzleloader, Firearm	Yes	White-tailed deer (antlered and antlerless), coyote, raccoon, squirrel	51	53
Mason Neck State Park and Wildlife Refuge	16	Archery, Muzzleloader, Firearm	Yes	White-tailed deer (antlered and antlerless), coyote, raccoon, squirrel	15	75
Morrow Mountain State Park	18	No Hunting				66
Prince William Forest Park	65	No Hunting				80
Rock Creek Park	11	No Hunting				112
Sandhills State Forest	189	Archery, Muzzleloader, Firearm	Yes	White-tailed deer (antlered and antlerless), coyote, raccoon, squirrel	92	66
Shenandoah National Park North	203	No Hunting				58
Shenandoah National Park Central	281	No Hunting				52
Shenandoah National Park South	315	No Hunting				55
South Mountains Gameland	88	Archery, Muzzleloader, Firearm	No	White-tailed deer (antlered and antlerless), coyote, raccoon, squirrel	75	62

(*continued on next page*)

(*continued*)

Name	Size (km^2)	Hunting weapons allowed	Dog hunting allowed?	Species hunted	Deer firearm season length (days)	Camera sites
South Mountains State Park	405	No Hunting				60
Stone Mountain State Park	58	No Hunting				61
Thompson Wildlife Management Area	16	Archery, Muzzleloader, Firearm	Yes	White-tailed deer (antlered and antlerless), coyote, raccoon, squirrel	15	71
Thurmond Chatham Gameland	26	Archery, Muzzleloader, Firearm	No	White-tailed deer (antlered and antlerless), coyote, raccoon, squirrel	75	61
Umstead State Park	23	No Hunting				69
Uwharrie National Forest	205	Archery, Muzzleloader, Firearm	No	White-tailed deer (antlered and antlerless), coyote, raccoon, squirrel	75	68
Warm Springs Mountain TNC Reserve Hunted	69.4	Archery, Muzzleloader, Firearm	Yes	White-tailed deer (antlered and antlerless), coyote, raccoon, squirrel	15	60
Warm Springs Mountain TNC Reserve Not Hunted	56.3	No Hunting				65
Weymouth Woods-Sandhills Nature Preserve	3.70	No Hunting				58
Wintergreen Resort	44.5	Archery, Muzzleloader, Firearm	Yes	White-tailed deer (antlered and antlerless), coyote, raccoon, squirrel	15	60

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