



## Paws on paths:

# Dog walking behaviour and behaviour change interventions to reduce dog disturbance of wildlife

Sarah Papworth and Rebecca Thomas

February 2025



## Contents

Summary .....	2
Review context .....	3
The impacts of dogs on wildlife .....	3
Dog behaviour on and off the lead .....	3
Dog walker awareness and attitudes .....	4
What approaches have been tried and tested to change owner behaviour? .....	5
How effective are signs at preventing disturbance? .....	7
Methodology.....	8
Acknowledgements and Copyright .....	8
References.....	9

## Summary

This review describes the impacts of domestic dogs on wildlife, identifying various studies which suggest these impacts are reduced when dogs are on a lead. Although most people are supportive of dog controls, such as keeping dogs on leads, many owners are not, and this is reflected in the low rates of owners which use leads. A variety of methods have been used to encourage dog owners to change their behaviour, and reduce impacts on wildlife and nature, though most studies use multiple interventions, or focus on owner attitudes and opinions, rather than measuring the effectiveness of these interventions. As signage to ask dog owners to keep ‘paws on paths’ is one approach used to reduce disturbance of ground-nesting birds on UK lowland heaths, evidence about the effectiveness of signage is reviewed, identifying various studies which show signs have been able to effectively keep walkers on ‘main trails’ and reduce the use of unofficial trails.

## Review context

On UK lowland heaths which are part of the Thames Basin Heaths Partnership, a sign requesting dog owners keep ‘paws on paths’ has been used during the ground-nesting bird season (March-September) since 2021. This sign was designed by Natural England in collaboration with local dog owners and has since been adopted by managers at other sites in the United Kingdom. As the effectiveness of this sign in reducing disturbance off-paths has not been assessed, an evaluation is planned which compares the existing sign to a new design. This review was produced to summarise existing knowledge about the impacts of dog walking and behaviour change interventions to reduce disturbance by dogs, to inform the design of this new sign.

## The impacts of dogs on wildlife

Around 51% of publications on domestic dogs in parks and open spaces focus on the effects of dogs on wildlife, with most assessing impacts on birds and particularly shorebirds (Weston et al., 2014). In Australia, domestic dogs are responsible for more wildlife deaths and injuries than cats (Holderness-Roddam & McQuillan, 2014), possibly as their larger size means they can prey upon more species. Species richness of songbirds and riparian herbs were negatively associated with dog density in Germany, whereas there was a positive association with macrophyte species richness (Schafft et al., 2024). Overall though, the effects of dogs seem to be negative: a review of 11 studies on dog walking found all documented negative impacts on birds (Steven et al., 2011). For example, bird abundance and species richness are lower at sites with dog walking in Australia (Banks & Bryant, 2007). This may be because birds are absent from these areas, or it may be because they avoid areas near paths when dogs are present (or likely to be present). The same study compared bird counts at the same locations with and without the presence of a dog and found 41% fewer individuals were detected when dogs were present, creating an apparent 35% reduction in species richness (Banks & Bryant, 2007). This effect was particularly apparent for ground-nesting birds.

Flight initiation distance – the distance at which an animal moves away from an approaching predator – is a commonly used measure of animal disturbance (Stankowich & Blumstein, 2005). Shorebirds in Australia have greater flight initiation distances from humans in areas with less human traffic, and there is evidence that for some species flight initiation distances are greater when humans walk with dogs (Glover et al., 2011; Gómez-Serrano, 2021). Similarly, Snowy Plovers (*Charadrius nivosus*) in Florida, USA (Faillace & Smith, 2016), spent more than three times as long off the nest when flushed by humans with dogs (106 seconds), compared to humans alone (30 seconds). Burrowing Owl (*Athene cunicularia*) responses to humans with dogs was greater than responses to just humans, particularly in urban areas (Cavalli et al., 2016). Even recordings of dog barks have been shown to increase vigilance in Coots (*Fulica atra*, Randler, 2006).

## Dog behaviour on and off the lead

Most owners seem to walk their dogs off-lead, even when local regulations require them to be on a lead (Arnberger & Hinterberger, 2003; Clarke et al., 2006; Dowling & Weston, 1999; Maguire et al., 2018; Rock et al., 2016; Schneider et al., 2020; Taylor et al., 2005; Thomas et al., 2024). On UK lowland heaths, most (always: 85%; always or occasionally: 95%) dogs were walked off the lead even

when signs are present requesting that dogs are kept on a lead (Thomas et al., 2024). In Austria's Donau-Auen National Park, 10% of visitors are dog walkers, of which two-thirds walk their dog off-lead (Arnberger & Hinterberger, 2003). This study also found that off-lead dog walkers are more likely to visit the park at quieter times and tend to use paths closer to human settlements. Maguire et al., (2018) compared compliance with local dog management rules across 69 beaches in Australia. They found the rules were most often followed on 'no-dog' beaches and those with time-based restrictions (e.g. no dogs between 9am and 6pm, and only on a lead at other times), and lowest for beaches which required dogs to be on a lead at all times. Some beaches also had management which required dogs to be under 'effective control', but they did not consider it possible to measure compliance with effective control. However, beaches with this management had the highest numbers of dogs, the lowest proportion of dogs on a lead. A comparison of dog behaviour on and off leads found that time spent sniffing was four times higher when off the lead, and interactions with other dogs were twice as likely (Westgarth et al., 2010).

Dogs on heathlands frequently go off tracks (Clarke et al., 2006), and dogs off leads have been associated with up to a 21% increase in reserve area disturbed on lowland heaths (Thomas et al., 2024). There is mixed evidence about whether off-lead dogs have a greater impact on wildlife than on-lead birds, though more studies seem to report greater impacts from off-lead dogs. Magpie-larks (*Grallina cyanoleuca*) in Melbourne, Australia, were more likely to fly away, and never walked away, from dogs off-lead. In contrast, their most common response to dogs on a lead was to walk away (Barnett et al., 2023). On beaches where 'effective control' of dogs was required, (Maguire et al., 2018) found the greatest number of dogs prints in the beach 'nest zone' for hooded plover and the highest volumes of off-lead dogs. Observations of shorebirds in California USA suggested that 11% of on-lead dogs disturbed birds, compared to 34% of off-lead dogs. Furthermore, on-lead dogs disturbed an average of 5 birds, compared to 22 birds at each disturbance event for off-lead dogs (Lafferty, 2001). However, Vesper Sparrows (*Pooecetes gramineus*) have shorter flight initiation distances from dogs off leads compared to dogs on leads and no difference was found for Western Meadowlarks (*Sturnella neglecta*, Miller et al., 2001). Comparisons between sites in Alberta, Canada, with and without dog leash regulations found no difference in bird species richness or abundance or small mammal abundance (Forrest & St. Clair, 2006).

## Dog walker awareness and attitudes

Although most people seem to walk their dogs off leads, various studies have shown that people expect dogs to be on a lead, or not allowed, in protected areas (van Eeden et al., 2023; Zamora-Nasca & Lambertucci, 2023) and elsewhere (Williams et al., 2009). Dog owners who believe this are also more likely to keep their own dog on a lead (Bowes et al., 2018). Some walkers without dogs report that dog presence detracts from their enjoyment of an area, and 80% of non-dog walkers reportedly dislike being approached by dogs they don't know (Taylor et al., 2005). Across studies, most people surveyed are supportive of dog management options such as requiring dogs to be on a lead (Glover et al., 2011), though support may be lower than for other interventions to protect wildlife, such as adding signage, providing refuges or fencing off some areas (Maguire et al., 2018). In Australia, 62% of people supported designated times or areas for dog walking and 81% supported lead requirements for dogs (Glover et al., 2011). Nevertheless, perceptions of dog disturbance and management differs between dog owners and non-dog owners. In Austria, dog walkers at a park were less likely than other park users to see dog walking as having an impact on wildlife (Sterl et al.,



2008). One study in Burnham Beeches (UK) found that 78% of people thought that a dog chasing or disturbing wildlife was unacceptable, but most owners believe they have their dogs under control (reported in Taylor et al., 2005). Similarly, although most people at Burnham Beeches (dog walkers and non dog walkers together) supported a code for dog walkers, it was opposed by 65% of dog walkers (Taylor et al., 2005).

The potential support for dog management described above however, is not consistent with the lack of compliance with dog regulations previously discussed in the section 'dog behaviour on and off lead'. Lack of compliance does not appear to be because of lack of awareness of local restrictions. In Australia, almost all respondents of a survey reported they were aware of dog control regulations on local beaches and the potential fines for non-compliance and had seen signs displaying those regulations (Williams et al., 2009). However, dog owners may be less aware of why these regulations are in place, as less than a third reported receiving any information about dogs and ground-nesting birds. Most owners walk their dog off lead and are protective of their rights to do so (Dayer et al., 2022; Edwards & Knight, 2006). The most frequent reasons owners give for walking their dog off the lead is to allow them to exercise / run freely (Guinness et al., 2020; Thomas et al., 2024). In Canada's Pacific Rim National Park Reserve, owners with their dogs on leads were more likely to agree that doing so kept their dog safe from wolves and was safer for other people (Bowes et al., 2018). They were also less likely to believe that keeping their dog on a lead prevented them from having freedom to run, play, explore and sniff.

## What approaches have been tried and tested to change owner behaviour?

Various approaches to avoid disturbance by dogs are used. For example, approaches across Atlantic flyway beaches in the USA include fines by law enforcement, signage, physical barriers, on-site education, beach stewards and provision of alternative areas (Dayer et al., 2022). Despite low levels of compliance with management interventions, there is evidence that differences in management can have positive effects. A long-term study of Hooded Plover (*Thinornis rubicollis*) compared nesting success between beaches with five different management regimes for dogs. Signs were placed on beaches, but it was not clear in the study how these matched up to, or differed between, management regimes. On beaches where dogs were required to be on leads but could go at any time, none of the 49 clutches observed were successful (Dowling & Weston, 1999). In contrast, clutch success was 12 – 40% on beaches with a least some additional management (e.g. restricted times of access). The strictest regulations (no dogs at any time) were most effective, a finding echoed by Maguire et al. (2018). A survey of UK site managers suggested that when there are some dog-use restrictions for sites, steering people away from sensitive areas is most effective, followed by professional and volunteer wardening (Taylor et al., 2005). Often studies use multiple interventions, making it difficult to evaluate the role of each one in any claimed intervention success. For example, Little Tern (*Sterna albifrons*) nests are more likely to have at least one egg hatch when signs and weekend wardens were present, but it is not clear which of these actions led to this increase (Medeiros et al., 2007), nor what caused nesting failure (i.e. human or dog disturbance).

The study on Little Tern also did not report what message was on the sign, but there are other studies which evaluate the impact of different messages. Seven different persuasive messages were shown to 107 dog owners at Lake McConaughy, USA (Jorgensen & Brown, 2017), and they were asked which would make them most likely to leash their dog (Table 1). These messages were not

tested in the field. The authors note that because of increased law enforcement (dogs must be on a lead of six feet or less, year-round), leash law compliance had increased from 16% to 67% over the two years before the study.

*Table 1. Messages, ranked from greatest (top) to least (bottom) reported impact on dog owner behaviour (Jorgensen & Brown, 2017).*

Leashing your dog will prevent dogs from wandering into other people’s campsites and possibly avoid dog bites and dog fights
Scientific studies have shown unleashed dogs can harm piping plover chicks, a threatened shorebird which nests on the sandy beaches of Lake McConaughy
Nebraska Game and Parks Commission regulations have a leash law in place at Lake McConaughy (actual message displayed at the lake)
High numbers of unleashed dogs may result in a change in regulations which would not allow dogs on beach
Having an unleashed dog can result in a change in regulations which would not allow dogs on the beach
The majority of visitors to Lake McConaughy favor having dogs on the beaches leashed
Leashing your dog will help agencies spend less time and money on enforcement, reduce fellow recreationists’ concerns about unleashed dogs, and reduce risks to wildlife.

Howard et al. (2021) presented 1207 visitors at Great Falls Park, USA, with messages about taking a dog off the lead, walking off trail and littering using three different methods: a booklet, a video and an interactive game. These messages were designed to inform people about the disease consequences of these behaviours. Each method showed the consequences of the behaviour, though in the interactive game people were also allowed to choose whether to do the behaviour. People were asked why they made the decision they did. Most people (92%) chose to keep the dog on the lead, and the most common reason given was safety concerns for the dog. Efficacy of messaging for changing behavioural intentions or actual behaviour was not measured, as the focus was on comparing the method of method communication.

BIT (a behavioural insights consultancy) conducted an online evaluation of a new dog-walking leaflet designs for Thames Basin Heaths (Barker, 2020). They found both the control leaflet and the one designed using behavioural insights increased understanding (compared to no leaflet) that a bird flying away is disturbance, though the behavioural insights leaflet (without site branding on the front page) was more likely to be picked up (Barker, 2020). A field trial in Australia tested three types of beach closure – sign only, sign and rope fence, and sign, rope fence and warden. Individuals and dogs within the closure area, and egg-crushing of artificial nests were evaluated. Most people (94%) complied with all three conditions, though eggs were least likely to be crushed when wardens were present, followed by the signs only condition (Weston et al., 2012). Off-lead prevalence was observed at three on-lead parks in Canada before and after consultations on movement to off-lead policies. As a result of these, an off-lead area was created in one park, and the other two parks remained on-lead parks. The number of dogs walked off-lead increased from 47% to 62% at the park which introduced an off-lead area. There was no change at the other park with sufficient sample size, with 74% of dogs walked off-lead both before and after the consultation (Rock et al., 2016).

There are a small number of studies which evaluate behaviour change programs focusing on dog owners. In the Brazilian Atlantic forest, free-ranging dogs often enter forest fragments. Tostes Ribeiro

et al., (2023) compared dog owners in three groups: one shown an informational video about dogs, one a video about dogs impacts on wildlife, and the third the video on dog impacts plus asked them to display a 'dogs from this house do not wander in the woods' commitment sticker. Although some owners did restrain their dogs (e.g. on a lead or kennel) in the month following this intervention, there was no difference between the three conditions. In Australia, a four-week dog behaviour course was designed to increase dog control, with the aim of reducing dog harassment of koalas (David et al., 2019). Dog compliance with 4 of 7 commands (e.g. stay) increased after 4 weeks, though the student did not evaluate the impact on koala harassment. In New Zealand, dogs are required to be registered, and the fees are used to support kiwi conservation. As compliance is low, Walsh (2021) compared the effectiveness of four different messages (kiwi conservation, dog attacks, social comparison nudge and dog loyalty) using a randomised controlled trial. Overall, there was no impact of receiving any message, though further analysis suggested that different audiences responded differently to different messages. For example, the dog attack and kiwi messages had some limited effect in postcodes with low levels of dog registration, and the kiwi message was particularly effective for owners of pig dogs.

### How effective are signs at preventing disturbance?

There are studies which evaluate the role of signs in encouraging other forms of environmentally friendly behaviours. As many management strategies to reduce dog impacts on wildlife aim to keep dogs under control and within (or out of) specific areas, studies which aim to reduce off-trail walking or use of social paths – smaller user made paths which leave the main trail - are perhaps most analogous. A summary of various studies in the USA can be found in Marion & Reid, (2007). Proscriptive messages seem to be effective. A trailhead sign with 'Please do not leave paint-blazed trails' (plus additional information about why) and smaller reminders at each social path (a footprint inside a red 'forbidden' symbol) reduced use of off-trail hiking from 26% to 7% (Hockett et al., 2017). Field trials comparing four messages found a negatively framed message 'Please don't go off the established paths and trails, in order to protect the Sequoias and natural vegetation in this park' was at least twice as effective as other signs (e.g. 'Please stay on the established paths and trails, in order to protect the Sequoias and natural vegetation in this park'), and six times more effective than no sign (Winter, 2006). A study in Canada found that an attribution message ('Your feet have trampled the vegetation on this island. Please stay on the main wood-chipped trail') reduced use of social paths by 36%. When this message was located at the social trail-head rather than the information booth, use of these trails dropped by a further 8% (Bradford & McIntyre, 2007). All these signs were effective and included clear instructions about expected behaviour. In some cases, signs may not be effective on their own, but can change behaviour when combined with barriers are added at the head of social paths (Schwartz et al., 2018).

All of the above studies were conducted in north America, whereas relatively few studies have been conducted in the UK. A study in Brecon Beacons Wales looked at how littering was impacted by three different message frames – social norms (96% of visitors do not drop any litter), identity framing (As a responsible person, you would not litter), and standard messaging (Please do not drop litter) compared to a control with no sign (John, 2021). The fewest number of items was found in the week when the social norms message was used. Interestingly, the lowest weight of litter and second fewest number of items was found when there was no sign, though data was collected at the end of the study and visitor behaviour may have been impacted by the signs over the previous three weeks.

## Methodology

This review is part of a project which focused on reducing the impacts of dogs on ground-nesting birds on UK lowland heaths. The three online databases were searched using the strings in the table below, to identify relevant literature which either described the impact of dogs on and off leads on wildlife, or evaluated interventions to reduce these impacts. Papers were reviewed in full if they focused on dogs or dog walkers, and biodiversity impacts and/or behaviour change. This review summarises the studies which were considered most relevant to the context of the wider project, and thus excluded impacts from domestic, but freely ranging, dogs. The systematic literature search was supplemented by requests to relevant conservation professional and government employees for relevant literature, a search was conducted on Conservation Evidence ([conservationevidence.com](http://conservationevidence.com)) website, and limited a Google search. Relevant references cited in paper identified through these processes were also reviewed.

Search engine	Search string	Number of articles identified
Web of Knowledge	TS=((dog* near/2 (lead OR leash OR control OR walk*) AND wildlife))	124
Scopus	TITLE-ABS-KEY((dog* W/2 (lead OR leash OR control OR walk*) AND wildlife)	143
Proquest	(dog* W/2 ( lead OR leash OR control OR walk* ) ) AND wildlife	100
<b>Total unique records</b>		<b>288</b>
<b>Studies identified as relevant</b>		<b>36</b>

## Acknowledgements and Copyright

This report was created by Dr Rebecca Thomas and Dr Sarah Papworth in 2025 under a project which was funded by the Economic and Social Research Council. Dr Sarah Papworth's time was funded by a British Academy Innovation Fellowship. The copyright in the report belongs to Royal Holloway and Bedford New College. The report can be used under the creative commons CC BY-NC-ND licence. If you wish to use the report for any other purpose please get in touch with Dr Rebecca Thomas via [Rebecca.Thomas@rhul.ac.uk](mailto:Rebecca.Thomas@rhul.ac.uk) or Dr Sarah Papworth via [Sarah.Papworth@rhul.ac.uk](mailto:Sarah.Papworth@rhul.ac.uk) to discuss the terms of a licence.



## References

- Arnberger, A., & Hinterberger, B. (2003). Visitor monitoring methods for managing public use pressures in the Danube Floodplains National Park, Austria. *Journal for Nature Conservation*, 11(4), 260–267.
- Banks, P. B., & Bryant, J. V. (2007). Four-legged friend or foe? Dog walking displaces native birds from natural areas. *Biology Letters*, 3(6), 611–613.
- Barker, J. P. Toby. (2020). *Using Behavioural Insights to Reduce Recreation Impacts on Wildlife : Guidance and Case Studies from Thames Basin Heath and the Solent*. Natural England Commission Report 329.
- Barnett, S. C., van Dongen, W. F. D., Plotz, R. D., & Weston, M. A. (2023). Leash Status of Approaching Dogs Mediates Escape Modality but Not Flight-Initiation Distance in a Common Urban Bird. *Birds*, 4(3), 277–283.
- Bowes, M., Keller, P., Rollins, R., & Gifford, R. (2018). Habits, beaches, dogs and leashes: Noncompliance with park regulations. *Parks*, 24(1), 119–130.
- Bradford, L., & McIntyre, N. (2007). Off The Beaten Track: Messages As A Means Of Reducing Social Trail Use At St. Lawrence Islands National Park. *Journal of Park and Recreation Administration*, 25, 121.
- Cavalli, M., Baladrón, A. V, Isacch, J. P., Biondi, L. M., & Bó, M. S. (2016). Differential risk perception of rural and urban Burrowing Owls exposed to humans and dogs. *Behavioural Processes*, 124, 60–65.
- Clarke, R., Liley, D., Underhill-Day, J., & Rose, R. (2006). *Visitor access patterns on the Dorset heathlands*. English Nature Research Reports no. 683.
- David, P., Rundle-Thiele, S., Pang, B., Knox, K., Parkinson, J., & Hussenoeder, F. (2019). Engaging the Dog Owner Community in the Design of an Effective Koala Aversion Program. *Social Marketing Quarterly*, 25(1), 55–68.
- Dayer, A. A., Everly, J., Comber, C. A., & Gore, M. L. (2022). Managers and shorebird biologists' perceptions of enforcement and voluntary compliance techniques to increase compliance with dog regulations on beaches. *People and Nature*, 4(5), 1279–1291.
- Dowling, B., & Weston, M. A. (1999). Managing a breeding population of the Hooded Plover *Thinornis rubricollis* in a high-use recreational environment. *Bird Conservation International*, 9(4), 255–270.
- Edwards, V., & Knight, S. (2006). *Understanding the Psychology of Walkers with Dogs: new approaches to better management*. University of Portsmouth.
- Faillace, C. A., & Smith, B. W. (2016). Incubating snowy plovers (*Charadrius nivosus*) exhibit site-specific patterns of disturbance from human activities. *Wildlife Research*, 43(4), 288–297.
- Forrest, A., & St. Clair, C. C. (2006). Effects of dog leash laws and habitat type on avian and small mammal communities in urban parks. *Urban Ecosystems*, 9(2), 51–66.
- Glover, H. K., Weston, M. A., Maguire, G. S., Miller, K. K., & Christie, B. A. (2011). Towards ecologically meaningful and socially acceptable buffers: Response distances of shorebirds in Victoria, Australia, to human disturbance. *Landscape and Urban Planning*, 103(3–4), 326–334.

- Gómez-Serrano, M. Á. (2021). Four-legged foes: dogs disturb nesting plovers more than people do on tourist beaches. *Ibis*, 163(2), 338–352.
- Guinness, S. J., Maguire, G. S., Miller, K. K., & Weston, M. A. (2020). My dog, my beach! Attitudes towards dog management on Victorian beaches. *Australasian Journal of Environmental Management*, 27(3), 329–342.
- Hockett, K. S., Marion, J. L., & Leung, Y. F. (2017). The efficacy of combined educational and site management actions in reducing off-trail hiking in an urban-proximate protected area. *Journal of Environmental Management*, 203, 17–28.
- Holderness-Roddam, B., & McQuillan, P. B. (2014). Domestic dogs (*Canis familiaris*) as a predator and disturbance agent of wildlife in Tasmania. *Australasian Journal of Environmental Management*, 21(4), 441–452.
- Howard, S., Buttke, D. E., Lovejoy, T. E., Clark, K. A., Ashby, E. J., & Alonso Aguirre, A. (2021). The Loop Trail “Quest”: Use of a Choice-based Digital Simulation, An Interactive Video, and a Booklet to Communicate and Analyze Decision-making of Park Visitors. *Environmental Communication*, 15(8), 1025–1044.
- John, C. (2021). *Change and Behavioural Interventions in a UK National Park*. PhD Thesis.
- Jorgensen, J. G., & Brown, M. B. (2017). Evaluating persuasive messages to influence dog leash law compliance at a public area in the great plains. *Great Plains Research*, 27(2), 131–142.
- Lafferty, K. D. (2001). Birds at a Southern California beach: seasonality, habitat use and disturbance by human activity. *Biodiversity and Conservation*, 10, 1949–1962.
- Maguire, G., Miller, K., & Weston, M. (2018). Only the strictest rules apply: investigating regulation compliance of beaches to minimize invasivedog impacts on threatened shorebird populations. In C. Makowski & C. Finkl (Eds.), *Impacts of invasive species on coastal environments*. Springer.
- Marion, J. L., & Reid, S. E. (2007). Minimising visitor impacts to protected areas: The efficacy of low impact education programmes. *Journal of Sustainable Tourism*, 15(1), 5–27.
- Medeiros, R., Ramos, J. A., Paiva, V. H., Almeida, A., Pedro, P., & Antunes, S. (2007). Signage reduces the impact of human disturbance on little tern nesting success in Portugal. *Biological Conservation*, 135(1), 99–106.
- Miller, S. G., Knight, R. L., & Miller, C. K. (2001). Wildlife responses to pedestrians and dogs. *Wildlife Society Bulletin*, 29(1), 124–132.
- Randler, C. (2006). Disturbances by dog barking increase vigilance in coots *Fulica atra*. *European Journal of Wildlife Research*, 52(4), 265–270.
- Rock, M. J., Graham, T. M., Massolo, A., & McCormack, G. R. (2016). Dog-walking, dog-fouling and leashing policies in urban parks: Insights from a natural experiment designed as a longitudinal multiple-case study. *Landscape and Urban Planning*, 153, 40–50.
- Schafft, M., Nikolaus, R., Matern, S., Radinger, J., Maday, A., Klefoth, T., Wolter, C., & Arlinghaus, R. (2024). Impact of water-based recreation on aquatic and riparian biodiversity of small lakes. *Journal for Nature Conservation*, 78, e126545.
- Schneider, T. J., Maguire, G. S., Whisson, D. A., & Weston, M. A. (2020). Regulations fail to constrain dog space use in threatened species beach habitats. *Journal of Environmental Planning and Management*, 63(6), 1022–1036.

- Schwartz, F., Taff, B. D., Lawhon, B., & VanderWoude, D. (2018). Mitigating Undesignated Trail Use: The Efficacy of Messaging and Direct Site Management Actions in an Urban-Proximate Open Space Context. *Environmental Management*, 62(3), 458–473.
- Stankowich, T., & Blumstein, D. T. (2005). Fear in animals: a meta-analysis and review of risk assessment. *Proceedings of the Royal Society B: Biological Sciences*, 272(1581), 2627–2634.
- Sterl, P., Brandenburg, C., & Arnberger, A. (2008). Visitors' awareness and assessment of recreational disturbance of wildlife in the Donau-Auen National Park. *Journal for Nature Conservation*, 16(3), 135–145.
- Steven, R., Pickering, C., & Guy Castley, J. (2011). A review of the impacts of nature based recreation on birds. *Journal of Environmental Management*, 92(10), 2287–2294.
- Taylor, K., Anderson, P., Taylor, R., Longden, K., & Fisher, P. (2005). *Dogs, access and nature conservation*. English Nature Research reports no 649.
- Thomas, R. L., Papworth, S. K., & Fellowes, M. D. E. (2024). Unleashed: walking dogs off the lead greatly increases habitat disturbance in UK lowland heathlands. *Urban Ecosystems*, 27(6), 2037–2046.
- Tostes Ribeiro, I., Pardini, R., & Morsello, C. (2023). Committing to behavior change: How to prevent dogs from visiting Atlantic Forest remnants? *Conservation Science and Practice*, 5(12): e13042.
- van Eeden, L. M., Geschke, A., Hames, F., Squires, Z. E., & Weston, M. A. (2023). The leashing behavior of dog owners in different types of natural areas. *Human Dimensions of Wildlife*, 28(4), 356–371.
- Walsh, P. J. (2021). Behavioural approaches and conservation messages with New Zealand's threatened kiwi. *Global Ecology and Conservation*, 28: e01694.
- Westgarth, C., Christley, R. M., Pinchbeck, G. L., Gaskell, R. M., Dawson, S., & Bradshaw, J. W. S. (2010). Dog behaviour on walks and the effect of use of the leash. *Applied Animal Behaviour Science*, 125(1–2), 38–46.
- Weston, M. A., Dodge, F., Bunce, A., Nimmo, D. G., & Miller, K. K. (2012). Do temporary beach closures assist in the conservation of breeding shorebirds on recreational beaches? *Pacific Conservation Biology*, 18(1), 47–55.
- Weston, M. A., Fitzsimons, J. A., Wescott, G., Miller, K. K., Ekanayake, K. B., & Schneider, T. (2014). Bark in the park: A review of domestic dogs in parks. In *Environmental Management* (Vol. 54, Issue 3, pp. 373–382). Springer New York LLC.
- Williams, K. J. H., Weston, M. A., Henry, S., & Maguire, G. S. (2009). Birds and beaches, dogs and leashes: Dog owners' sense of obligation to leash dogs on beaches in Victoria, Australia. *Human Dimensions of Wildlife*, 14(2), 89–101.
- Winter, P. L. (2006). The Impact of Normative Message Types on Off-Trail Hiking. *Journal of Interpretation Research*, 11, 35–52.
- Zamora-Nasca, L. B., & Lambertucci, S. A. (2023). Lack of accessibility and clarity in regulations concerning dog access to protected areas lowers public awareness. *Scientific Reports*, 13(1), 6743.