The Old School, Brewhouse Hill, Wheathampstead,
Hertfordshire AL4 8AN, UK
www.ufaw.org.uk

Animal Welfare 2022, 31: 69-77
ISSN 0962-7286
doi: 10.7120/09627286.31.1.006

A scoping review of freight rail noise and vibration impacts on domestic animal health and welfare

J Trigg*†, A Naweed† and S Kinnear‡

† Appleton Institute, CQUniversity, 44 Greenhill Road, Wayville, SA 5034, Australia
‡ CQUniversity, 554-700 Yaamba Road, Norman Gardens, QLD 4701, Australia
* Contact for correspondence: joshua.trigg@flinders.edu.au

Abstract

Multiple benefits of freight rail activity have been shown for commercial agribusiness, yet the effects of freight rail-related noise and vibration on domestic livestock health and welfare has so far received little research attention. This scoping review examines peer-reviewed and grey literature addressing associations between freight rail noise, vibration and impacts on domestic livestock. Six databases (Scopus, Science Direct, SAGE, TRID, SPARK, ARRB) were searched for relevant literature published from 1980–2019. PRISMA search procedures were used to identify 28 publications relevant to domestic livestock, as well as noise or vibration impact of rail applicable to the freight rail context. Included publications addressed a range of livestock and related species, covering descriptive, review, and experimental findings on noise and vibration impacts. Five publications addressed vibration effects, and 23 addressed noise effects. Effects of noise and vibration on different species indicated that adverse effects vary depending on exposure intensity. The literature indicates that specific thresholds for noise and vibration exposure should be considered when managing freight rail impacts on commercial agribusiness involving avian and mammalian species. Freight rail noise and vibration likely exceeds thresholds for discomfort and harm for avian and mammalian species. Future research should consider case studies that specifically focus on integrating freight rail noise and vibration data to derive species-specific guides for animal health and welfare purposes.

Keywords: *animal welfare, livestock, noise, rail, transport infrastructure, vibration*

Introduction

The health and welfare of domestic livestock is an ongoing social and ethical consideration internationally. Animal welfare issues represent both a social and economic concern to the rail industry, agribusiness and the public (Hampton *et al* 2020). The agribusiness sector already focuses on functional benefits of animal welfare (eg in relation to productivity and therefore profitability) (Sinclair *et al* 2019). However, there is also the need to address animal health and welfare factors as an ethical concern (Cornish *et al* 2016). In the context of this review, the term 'livestock' refers to farmed animals raised for agribusiness purposes, and includes, though is not limited to, fowl, as well as cows (*Bos taurus*), pigs (*Sus scrofa*) and other mammals. This intersection of industry, animals, and the public requires interdisciplinary perspectives, considered data sharing and dialogue with industry to advance animal health and welfare (Wiseman & Sanderson 2019), particularly regarding transport noise and vibration stressors (eg Edwards-Callaway & Calvo-Lorenzo 2020).

Considerable research has explored surface transport noise and vibration impacts on wildlife (Kajzer-Bonk *et al* 2019), and ecological health (Barrientos *et al* 2019), as well as on human physical and mental health (Hanemann & Maddock 2018; KPMG 2018). Comparably, little attention has been devoted to the impacts on the health and welfare of domestic livestock in the context of freight rail transport. This is surprising, given the growing international role and expansion of freight rail in commercial, economic, and social activity (International Energy Agency [IEA] 2019). At the same time, demand for agricultural products is estimated to grow, in Latin America, for example, by 15% from 2019 to 2028, impacting both land and animals (OECD/FAO 2019). Livestock industry turnover, in Australia for instance, increased by 42% from 2013–2014 to 2018–2019, representing $AUD72.5 billion in 2018–2019 (Meat and Livestock Australia 2020). Both forms of expansion are connected, and factor into animal welfare considerations.

Harmful noise exposure can be broadly defined as sounds that are disruptive to hearing; and harmful vibrations occur where mechanical oscillation about an equilibrium point produces disruptive effects. For reference, noise from a freight train can reach from 80 to more than 100 A-weighted decibels (dB_A) at 15 m (Hemsworth 2008; Asaff *et al* 2019;

IAC 2019), and vibration of 50–160 Hz at 50 m (Guo *et al* 2012). Structural vibrations, via buildings or rail structures can be experienced by humans from as low as 3–30 Hz (Guignard 1971). As rail noise and vibration sources can also have visual impacts, such as train pass-by being visible to domestic livestock (eg startling), this may also raise animal health and welfare considerations. These impacts are possible because environmental change due to human development has long been associated with farmed animal stress and welfare (Lanier 2008). For example, rail infrastructure may be located in close proximity to livestock farming and animal-holding sites.

Rail impacts occur in 'brownfield' and 'greenfield' environments, which refer to commercial land complicated by environmental degradation or contamination, and low-developed vegetated areas with minimal contamination, respectively (Biddle *et al* 2006). As freight rail and agribusiness development and operations span both such environments, involving various husbandry conditions and associated structures, increased research is needed to manage these intersections. As freight rail growth requires consideration of socioenvironmental effects (Ellram & Ueltschy Murfield 2017), and despite potentially lower impacts compared with other transport modes (eg road) (Warner *et al* 2019), rail infrastructure should account for effects on domestic animals.

This review provides an overview of the potential impact of freight rail noise (ie sound) and vibration on domestic livestock and presents findings to inform implementation of field impact assessments and rail infrastructure planning. Because of this scope, findings are not explicitly focused on impacts from rail transport of animals, or road transport, although parallels are drawn from relevant animal model and general rail research. Literature addressing the impacts of freight rail noise and vibration on domestic animals is reviewed for characteristics including species type, focal impacts on animals, impact context, and primary outcomes.

Materials and methods

Inclusion criteria

Individual studies and review materials were included and were required to address domestic livestock (ie poultry fowl, sheep [*Ovis aries*], pigs, and cows), or non-domestic animals and animal models with parallels to rail contexts (eg other mammals, rodent models). Inclusion criteria also required addressing freight rail noise, vibration, or visual effects with potential to impact welfare of domestic animals, and relevance of effects to greenfield or brownfield sites. In this review, animal welfare is broadly conceptualised as encompassing the state of, and disruption to, health and functioning of the animal, though more detailed approaches can be used (eg Five Freedoms) (Carenzi & Verga 2009). No studies were identified that addressed visual impacts of freight rail on domestic livestock. Studies from international sources from 1 January 1980 to 25 October 2019 were included, and grey literature was searched to include relevant industry-based reporting. This date range was used to keep the number of returned studies to a manageable level for screening. Studies were excluded where the primary focus was wildlife, human attitudes, human health, or human residential impacts, experimental designs with low relevance to rail, or where format did not permit data extraction, such as accessibility in abstract form only. Quality was indicated by authors' appraisal of study aim, content, method, and discipline/industry context relevance. Authors reviewed titles and abstracts against the inclusion criteria, with no eligibility disagreements.

Search protocol

Searching followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines (Moher *et al* 2009), capturing the following characteristics: study type (eg research article, technical report), year, and country; focal animal species; study context (eg brownfield, greenfield, experimental, facility); impact type (ie noise, vibration, or other impacts); and the primary outcomes described in terms of impacts on domestic animals. Literature was searched on 25 October 2019 via Scopus, ScienceDirect, SAGE, Transportation Research Information Database, SPARK Rail Knowledge Hub, the Australian Road Research Board Knowledge Base, and Google Scholar. Search terms were varied to fit database searches, including inclusive use of wildcard operators: (animal* or 'livestock' or 'live stock*' or stock* or farm* or agriculture* or cattle or cow or sheep or pig or chicken) and (rail* or freight* or 'freight operations' or train*) and (nois* or vibrat* or visual*) and (impact* or effect* or damag* or disrup* or welfare or health) and (environm* or paddock or *lot or 'feed*' or '*field' or '*land') and language (English) and publication year (1980–2019). Further search terms for future research are noted in the *Discussion*. Backwards citation searching was not included in the protocol, and records were stored in EndNote X9 (v3.1).

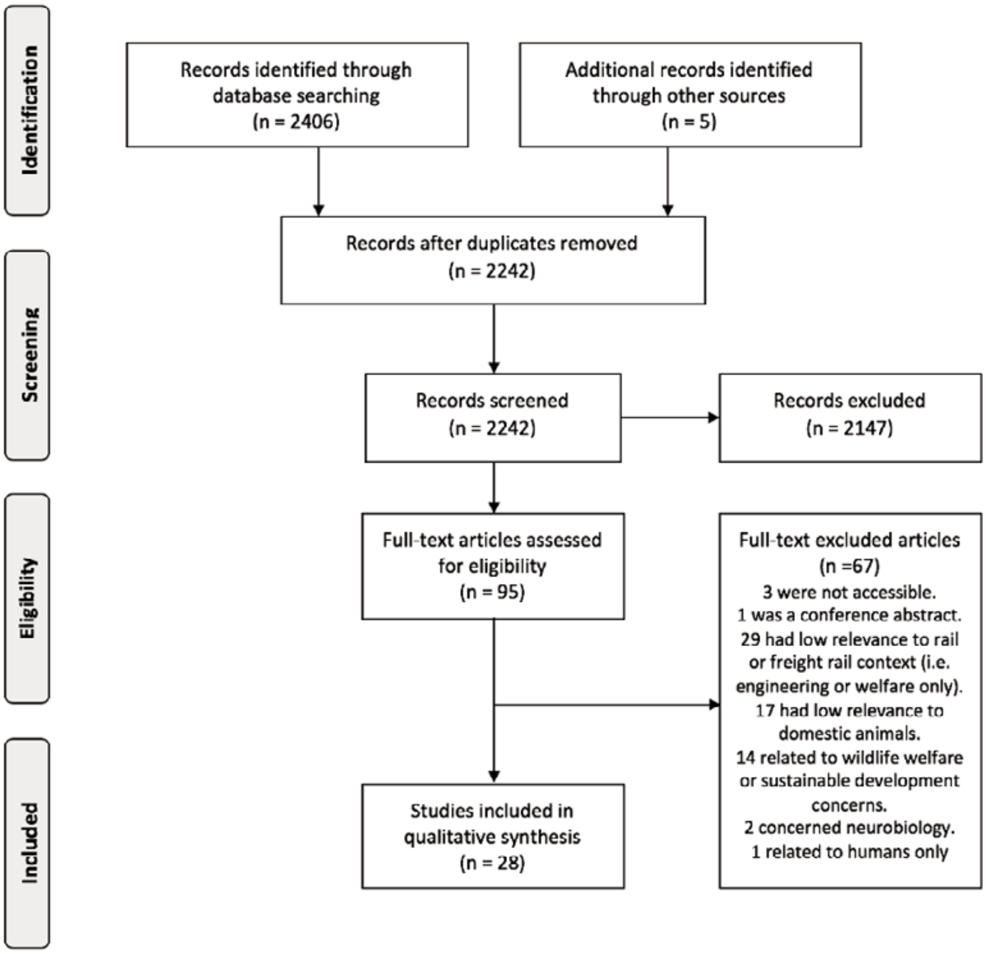
Results

Selection

After removing 164 duplicates, database searching returned 2,242 studies. Title and abstract screening against inclusion criteria left 95 studies for full-text screening. After full-text reading and screening of the 95 studies, 67 were excluded for various reasons as listed in Figure 1. Screening and inclusion criteria and study characteristics were extracted to a data extraction form in Microsoft® Excel. In total, 28 studies were identified against inclusion criteria for narrative synthesis. Full details of all included studies are available as Appendix A (see supplementary material to papers published in *Animal Welfare*: https://www.ufaw.org.uk/the-ufaw-journal/supplementary-material). We note that there are multiple factors that shape the nature of freight rail impacts on animal welfare, such as duration, species-specific concerns, and commercial agricultural practices. Information on this is summarised in Appendix A (https://www.ufaw.org.uk/the-ufaw-journal/supplementary-material), with the original sources providing detail additional to that in this scoping review.

https://doi.org/10.7120/09627286.31.1.006 Published online by Cambridge University Press

Figure 1



PRISMA systematic selection process outcomes.

Context

Studies were from 2015–2019 (14%; n = 4), 2010–2014 (29%; n = 8), 2005–2009 (25%; n = 7), 2000–2004 (18%; n = 5), 1995–1999 (7%; n = 2), 1990–1994 (4%; n = 1), and 1985–1989 (4%; n = 1). Most were peer-reviewed articles (64%; n = 18), technical reports (18%; n = 5), or conference papers (11%; n = 3), with one technical book and one thesis. Design, aim, species, and focal impacts are detailed in Appendix A (https://www.ufaw.org.uk/the-ufaw-journal/supplementary-material). Study design was categorised as either descriptive (18%; n = 5), experimental (46%; n = 13), mixed methods (0%; n = 0), or review (36%; n = 10). Studies originated in the US (36%; n = 10), UK (14%; n = 4), Canada (7%; n = 2), China (7%; n = 2), and Australia (7%; n = 2), with single studies from New Zealand, Belgium, Brazil, Iran, Slovakia, Spain, Tunisia, and Sweden. Studies related to greenfield (39%; n = 11) or brownfield sites (4%; n = 1), experimental (39%; n = 11), or observational work (7%; n = 2), or were non-classifiable (14%; n = 4). One instance applied to both greenfield and brownfield sites (Hanson 2008).

Species

Studies addressed avian species (eg fowl) (32%; n = 9), and multiple domestic livestock species (eg cows, sheep and pigs) (29%; n = 8), four of which focused only on cows (14%; n = 4). A single study each addressed horses (*Equus caballus*), Maghrebi camels (*Camelus dromedarius*), and working dogs. Two wild fowl studies were retained due to relevance to domestic fowl (7%; n = 2) (Goudie & Jones 2004; Goudie 2006), and five rodent models were included as they were deemed relevant to freight rail noise (18%; n = 5) (Deylam *et al* 2011; Di & He 2013; Di & Zheng 2013; Doggett & San Souci 2018; Brozoski *et al* 2019). One study focusing on warning horn audibility did not specify animal species but was included for noise-impact context. The following sections discuss potential adverse welfare effects in relation to avian and mammalian species broadly.

Vibration impacts

Vibration effects were described in five publications (Randall *et al* 1997; Abeyesinghe *et al* 2001; Brito Garcia *et al* 2008; Aradom *et al* 2012; Doggett & San Souci 2018).

Using rodent models, Doggett and San Souci (2018) indicated that ground vibrations can pass through building slabs to upper levels, despite mitigating features (eg damping). Their findings support that vibration impacts on agricultural buildings should be recorded to accurately determine effects on animal behaviours (eg reproductive activity). Experimental modelling of vertical vibration effects on stress in chickens (ie x-axis 'feet to head' vibration from floor), as indicated by core temperature and weight loss, did not suggest stress at 1–10 Hz (Brito Garcia *et al* 2008). However, vertical vibration at 1 Hz with heated air has been found to produce evidence of stress and fear in chickens (*Gallus gallus domesticus*) (eg avoidance, feeding disturbance) (Abeyesinghe *et al* 2001).

High aversion to vibrations (0.5–10 Hz) has been identified elsewhere (Randall *et al* 1997). In this case, food seeking decreased significantly in response to vibration, with vertical vibration creating more aversive behaviours compared with horizontal. Findings that higher frequency vibration is less aversive to chickens than low (Randall *et al* 1997), support recommendations to map vibration effects (Doggett & San Souci 2018), particularly low frequency freight rail vibration. This is important, as low frequency rail vibrations include ground vibration (~1– 80 Hz), which can overlap with audible sound (~15–80 Hz) (International Union of Railways & De Vos 2017).

Freight rail vehicles can produce vibration at 4–50 Hz (ISVR 2020), in the known range at which adverse vibration effects are experienced by larger mammals, such as cows (Gebresenbet *et al* 2011). Such effects can include fear, nausea, distress and fatigue (Aradom 2012). There is some suggestion that perpendicular positioning of the animal relative to the vibration origin may reduce stress and associated injury (eg position or orientation of housing structures). Subsequently, Aradom (2012) suggested that positioning of animal holding structures in relation to source of freight rail vibration should be considered. This approach could inform low frequency vibration mitigation measures including rail track structure planning (Connolly *et al* 2016), requiring consultation between rail and agribusiness stakeholders.

Implications from the above findings can be considered in freight rail contexts. Adequate mapping estimates of vibration origins, directions, duration, frequency of occurrence, and frequency range in Hz can be produced to approximate the extent of maximum vibration effects that reach operations involving domestic livestock, particularly poultry fowl. Vibration mapping for animal welfare would assist in identifying risk factors, before vibration levels reach a state where susceptible species are impacted. This approach is seen in mapping infrastructure impacts on ecological systems (Baghli & Thiévent 2011). Note, no studies were identified addressing animal habituation to vibration at freight rail levels.

Noise impacts

More research outputs were identified that described noise effects (n = 23) (Grandin 1989, 1998; McAdie *et al* 1993; Armas 2004; Dooling 2004; Goudie & Jones 2004; Hardy 2004; Campo *et al* 2005; Goudie 2006; Arnold *et al* 2008; Hanson 2008; Haverbeke *et al* 2008; Mestre 2008; Deylam *et al* 2011; Hanson *et al* 2012; Di & He 2013; Di & Zheng 2013; Archer 2014; Atigui *et al* 2014; Brouček 2014; Haas & Scrivener 2015; Owen 2017; Brozoski *et al* 2019), compared with vibrational effects (n = 5). Collectively, these publications suggested that the potential adverse effects of rail noise can vary depending on intensity of sound exposure.

Avian species

Avian species are sensitive to environmental noise. Goudie and colleagues observed that harlequin ducks (*Histrionicus histrionicus*) responded aversively to low-aircraft noise (≥ 100 dB_A) with increased alerting and freezing behaviour, which grew in a dose-response manner in a greenfield environment (Goudie & Jones 2004; Goudie 2006). Given this disturbance, they recommended an 80 dB_A threshold be applied to ducks — a level comparable to freight-rail noise — but a higher broad threshold covering multiple species (SEL 100 dB_A). This latter threshold has been recommended in the high-speed rail literature as an appropriate threshold for aversive behaviour and harm in domestic birds (SEL 100 dB_A, L_{Amax}) (Hanson *et al* 2012), though particular species have different vulnerability. For example, chickens and turkeys experience interrupted brooding and panic crowding/flight at noise levels exceeding 100 dB_A (Hanson 2008). Similarly, industrial mining in brownfield environments has referenced a lower frequent noise threshold of 65 dB_A to minimise impacts on avian and mammalian species (eg alarm, avoidance, feeding disturbance occurred at ≥ 90 dB_A) (Archer 2014). As mining equipment generates noise comparable to freight rail, and exceeding 100 dB_A (eg CAT backhoe, 107 dB_A) (Archer 2014), these parameters can inform freight rail infrastructure and operations.

Hens experimentally subjected to recorded diesel train noise (90 dB; 10 m), avoided the noise source during a trained pecking task, though were more avoidant of recorded hen sounds than of train sounds (McAdie *et al* 1993). This study concluded that hens prefer low-noise environments in the range lower than 90 dB_A. Campo *et al* (2005) later supported a 90 dB_A threshold, as train and aircraft recordings (90 dB_A; 60 min) produced physiological (ie heterophil: lymphocyte ratio) and behavioural (ie immobility, piling) stress indicators. In a test of tonal noise exposure on hearing over 12 h, Dooling (2004), induced partial (50 dB) and full (70 dB) hearing loss in Japanese quail (*Coturnix japonica*). This supports other reported noise thresholds for avian species, and susceptibility to harmful noise effects at relatively low sound exposure levels.

https://doi.org/10.7120/09627286.31.1.006 Published online by Cambridge University Press

Mammalian species

Studies exploring the impacts of noise on larger domestic livestock species were also represented in the literature. For example, one review reported a noise exposure threshold of SEL 100 dB_A (L_{Amax}) as suitable, given a range of effects on domestic mammals (Hanson 2008). Negative effects were reported for cows' blood composition (97 dB), milk production (105 dB), pigs' hormonal processes (> 93 dB), and sheep thyroid activity (90 dB), heart rate and respiration (100 dB), and lambing (100 dB) (Hanson 2008). Later, Hanson *et al* (2012) reiterated the 100 dB_A threshold as a maximum exposure level for livestock, drawing on research applicable to both brownfield and greenfield environments. This vulnerability also applies to horses, a subspecies highly sensitive to noise in the decibel range associated with rail activity. Although horses may habituate to loud high-speed rail noise in greenfield environments (< 90 dB_A), noise exceeding SEL 100 dB_A (L_{Amax}) can trigger a fight-or-flight response (Haas & Scrivener 2015), risking both non-human and human safety (Thompson *et al* 2015).

Aviation noise at 100 to 110 dB can trigger harmful physiological and behavioural responses in cows, including stampeding, aggression, stress hormone release and impaired calving (Armas 2004). Accordingly, cows learn to avoid the source of aversive noise, such as hydraulic machinery, after only two to three exposures (Arnold *et al* 2008). In contrast, Owen (2017), reported the livestock such as cows may habituate to noise from 90 to 120 dB over approximately 10 to 30 exposures, in as quickly as one day. The review also noted that milk production is unlikely to be affected by noises up to 99 dB, despite such exposure being associated with heightened stress response indicators (eg cortisol) (Owen 2017). We note that further research should be reviewed relating to the effects of aviation and road noise in cows, to draw parallels for the freight rail context.

In earlier reviews of best practice livestock management, Grandin (1989, 1998) suggested a 100 dB_A threshold (eg sheep) (Grandin 1989), and avoidance of high-pitched noise from 6,000 to 8,000 Hz for cows (Grandin 1998). These reviews also highlighted the potential of using white noise for providing additional environmental stimulation to facilitate animal adaptation to noise. A later review of aviation noise effects on livestock concluded that such effects are highly species-dependent (Mestre 2008). This review drew from a detailed ecological analysis of noise on wild and domestic species (Manci *et al* 1988), which concluded no single dose-response curve could be presumed applicable across species.

In camels, for example, noise-induced startling (dB_A unspecified; 1 m) can significantly delay milk ejection, increasing mastitis risk, indicating need for a low noise environment to support animal welfare (Atigui *et al* 2014). Another study, of military working dogs, showed that air blast noise (110–120 dB, air blast) elevated dogs' (*Canis familiaris*) cortisol levels, indicating a stress response, and that this decreased on re-exposure three weeks later (Haverbeke *et al* 2008). Freight rail reaches these levels, for instance, via warning horn noise (~103 dB_A) radiating from rail vehicles (Hardy 2004). These are levels that can cause discomfort and physical damage in livestock housed in agricultural structures impacted by environmental noise. Brouček (2014) reviewed evidence on this point and concluded that despite some species showing adaptation to discomforting levels of noise (eg cows, 110 dB; sheep < 90 dB), careful planning is essential to avoid stressful or harmful noise exposure.

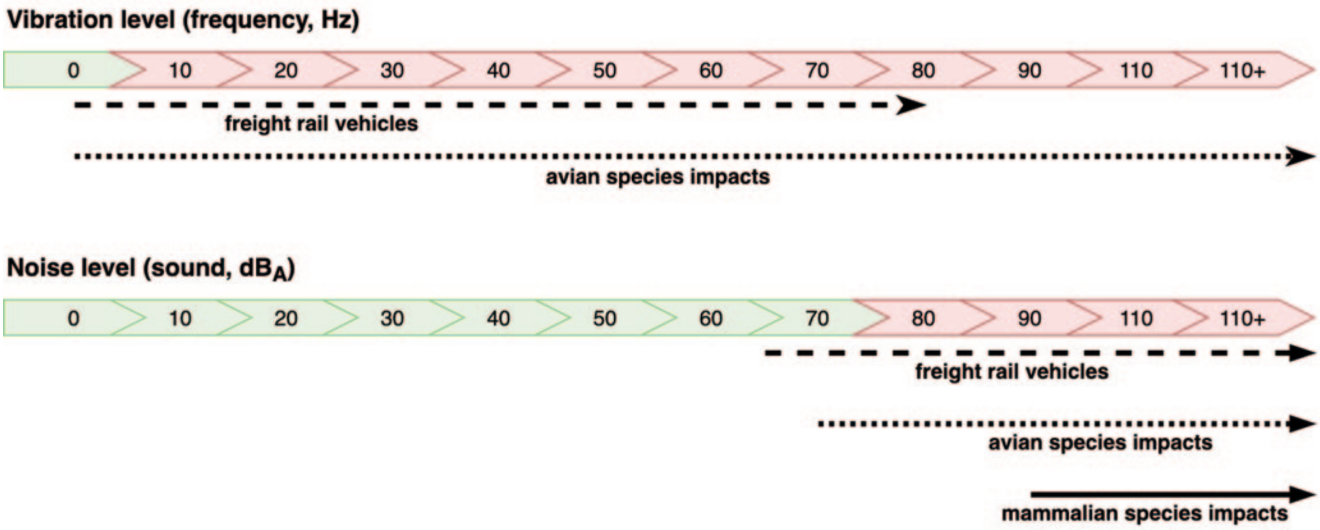
Lastly, four rodent models of noise effects were included, due to partial relevance of findings to the freight rail and livestock context (Deylam *et al* 2011; Di & He 2013; Di & Zheng 2013; Brozoski *et al* 2019). Two studies indicated that exposure to recorded train noise (70 dB_A) induced anxiety reactions in mice (*Mus musculus*), and impaired learning and memory in rats (*Rattus norvegicus*) (Di & He 2013; Di & Zheng 2013). The researchers concluded that exposure to high-speed train noise should not exceed 70 dB_A, to avoid harmful effects. This view is consistent with findings that rats exposed to high intensity noise can show impaired spatial learning (86 to 90 dB_A, stadium noise) (Deylam *et al* 2011), and impaired selective attention (120 dB; 1 h) (Brozoski *et al* 2019).

Discussion

Findings from this scoping review suggest a broad awareness of the extent of sensitivity of avian and mammalian species farmed as livestock to vibration and noise occurring in the same range as produced by freight rail vehicles. Yet, despite existing studies offering clues about thresholds for animal harm and aversion to these effects, this specific field has not yet sufficiently matured to form clearly defined thresholds that cut across varying species and contextual parameters, particularly regarding rail vibration effects on livestock animal welfare. Clearly, studies of environmental responses are complicated by multiple context-dependent factors that impact animal welfare. The research currently supports an interim 'precautionary principle' as rail industry best practice, taking into account the high likelihood of noise and vibration impacting livestock welfare. However, the literature reviewed herein does suggest some suitable interim ranges as guides for potential welfare impacts on avian and mammalian species, and for future research.

Although freight rail vibration effects on livestock welfare require greater research attention, vibration as low as 1 to 10 Hz can elicit a stress response in avian species (Brito Garcia *et al* 2008). Because of this, range, magnitude, duration, and frequency of vibration effects should be estimated and mapped relative to agricultural operations involving avian and mammalian species that may be adversely affected by vibration.

Figure 2



Summary of interim vibration and noise impact ranges in reviewed literature, with likely harmful ranges shown in red.

Findings on interim impact ranges are succinctly visualised in Figure 2, with likely harmful ranges shown in red. For freight rail noise, it is recommended that avian exposure from 70 to 100 dB_A (L_{Amax}), and mammalian exposure from 90 to 110 dB_A (L_{Amax}) particularly be minimised to limit aversive behaviour, and exposure in excess of 100 dB_A (L_{Amax}) be avoided for both species types to reduce likelihood of physiological and behavioural harm. Avian species are likely susceptible to this (eg Dooling 2004), and at moderate to higher levels of exposure, there is evidence of detrimental effects on animals' physiological and cognitive functioning (eg Deylam *et al* 2011; Di & He 2013; Di & Zheng 2013). Specific effects, such as stress and spatial learning impairments are described in the breakdown of reviewed literature in Appendix A (https://www.ufaw.org.uk/the-ufaw-journal/supplementary-material).

Lastly, the potential of mammalian livestock species (such as cattle, sheep) to habituate to noise from 80 to 100 dB_A near freight rail projects should be explored, given that relatively little evidence was identified by the current review that directly addressed potential habituation effects. Further knowledge on habituation is relevant to upgrades of existing track sections where rail noise exposure is unavoidable or difficult to mitigate. Two studies concluded that while larger mammals can experience startling and stress responses at noise levels in the range of that produced by rail freight, that habituation can occur within certain ranges, such as for cows (90–120 dB; Owen 2017) or horses (65–90 dB_A; Haas & Scrivener 2015). A further comparison may be made to lairage areas, where animals are potentially exposed to vehicle and machinery noise in the range of that produced by freight rail (Weeks 2008). As there are qualitative and quantitative differences across noise sources, this should be considered in future analyses (eg meta-analyses). For example, there may be animal habituation and environment familiarity factors that limit comparability across some contexts.

A limitation of this study was the range of search terms and operators used. Future review research should systematically include additional animal terms (eg hens) and search operators (eg wildcards). Generalisation of the above findings is necessarily qualified by contextual, operational, geographical, and mechanical differences that impact on noise and vibration regulations for freight rail. Investigation into potential negative impacts of freight rail vibration on farmed cattle environments in the UK may, for instance, not be directly comparable to farmed sheep environments in the US. Care then needs to be taken in applying findings in relation to local context, as sources indicated no consensus regarding noise and vibration exposure effects or thresholds. Yet, this is not necessarily the ultimate aim. Some studies were performed with particular goals in mind (eg mining impacts assessment), while others were experimental assessments of typical or extreme effects. However, decision-making can still proceed on the basis of the precautionary principle, as conclusive datasets describing local vibration and noise impacts on animal welfare may not always be available.

Animal welfare implications and conclusion

This review describes a range of impacts of freight rail vibration and noise on the health and welfare of domestic animals farmed as livestock. Primarily, we identify a clear need for studies and environmental assessments that purposefully examine freight rail noise and vibration impacts on avian and mammalian species farmed as livestock, and particularly for experimental designs. Most pressing is the relative absence of studies about freight rail vibration impacts in this context. Also, moving forward, it would be helpful to take a targeted look at the parallels that may be drawn from research into the impacts of road transport (eg truck freight) on domestic and wild avian and mammalian species, with regard to potential welfare impacts on livestock.

https://doi.org/10.7120/09627286.31.1.006 Published online by Cambridge University Press

With vibration and noise stressors producing significant physiological and behavioural disruption in avian and mammalian species, and the high international prevalence of animal farming, rail development planning must consider this issue to mitigate associated welfare impacts. Further refinement of what minimum and maximum exposure thresholds and regimes may look like, and in implementation of mitigation strategies are required to improve associated animal welfare standards. However, it will be some time before such a stock of knowledge is available. The next clear step in this space is to undertake a more purposeful synthesis of these impacts on animals, to narrow in on specific thresholds, associated risk factors for welfare impacts, and mitigation strategies. Give this sparse state of findings in this space for broader synthesis (eg meta-analysis), specific species and welfare impacts should first be a focus, as this will help reveal evidence gaps that can be addressed in future studies.

Declaration of interest

The authors declare no conflict of interest or funding in the analysis or interpretation of data for this scoping review, writing or publication of findings.

Acknowledgements

The authors acknowledge two external colleagues, for valuable ideas and comments on an earlier version of this manuscript. They are also grateful to the Australasian Centre for Rail Innovation for funding and supporting the research this work was based on.

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