

Listening to cities

From noisy environments
to positive soundscapes

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1. Surround sound: our acoustic environment



What is a soundscape?

The International Organization for Standardization (ISO) defines a soundscape as “[the] acoustic environment as perceived or experienced and/or understood by a person or people, in context”.¹⁰ In other words, soundscape encompasses the way people perceive, experience and respond to the full range of sounds in a place at a given time.¹¹ As an emerging discipline, soundscape studies try to look at the issue of urban acoustic environments more holistically, taking a listener-centred perspective.¹² The soundscape approach tends to focus on context, on wanted rather than unwanted sounds, and on individual preference rather than discomfort.¹³

Sounds are complex physical phenomena originating in the vibration from a source that propagates energy into a medium as an acoustic wave. Sounds happen continuously and are everywhere: there is no such thing as ‘silence’ on the planet. As physical phenomena, sounds are neither positive nor negative. They acquire meaning and produce an effect only when considered from the perspective of a listener. When sounds are unwanted, they become noise. When noises are too loud and persist too long, they become noise pollution.

Today, noise pollution is a major environmental problem, cited as a top environmental risk to health across all age and social groups and an addition to the public health burden. Prolonged exposure to high levels of noise impairs human health and well-being, which is a growing concern for both the public and policymakers.¹ Across the European Union, at least 20 per cent of citizens are currently exposed to road traffic noise levels that are considered harmful to health. This estimate is an average, with urban areas showing a far higher percentage.² Noise pollution comes from conventional sources, such as roads, railways, airports, and industry; however, high noise levels may also come from domestic or leisure activities. Traffic and other urban noises affect not only human well-being, but also disturb and endanger the survival of species crucial to the urban environment.³

Decibels (dB) are the units of measure for indicating the intensity or loudness of a sound that help predict thresholds when a noise starts to annoy people or when sleep disturbance emerges. While the loudness of noise is important, the frequency, in terms of high or low pitch, and temporal patterns of sound also determine the physical and psychological effects it has on the listener.⁴

Physically, proximity to very loud abrupt sounds, such as a gunshot over 140 dB, could rupture the ear’s tympanic membrane, causing immediate hearing loss. Listening to music with earphones at the maximum volume – ranging between 90 and 100 dB at the eardrum – could start to cause hearing damage after only 15 minutes per day.⁵ Regular exposure to over 85 dB for an 8-hour day or longer can cause permanent hearing damage. Long-term exposures, even at relatively lower noise levels that are common in urban areas, can also damage both physical and mental health.

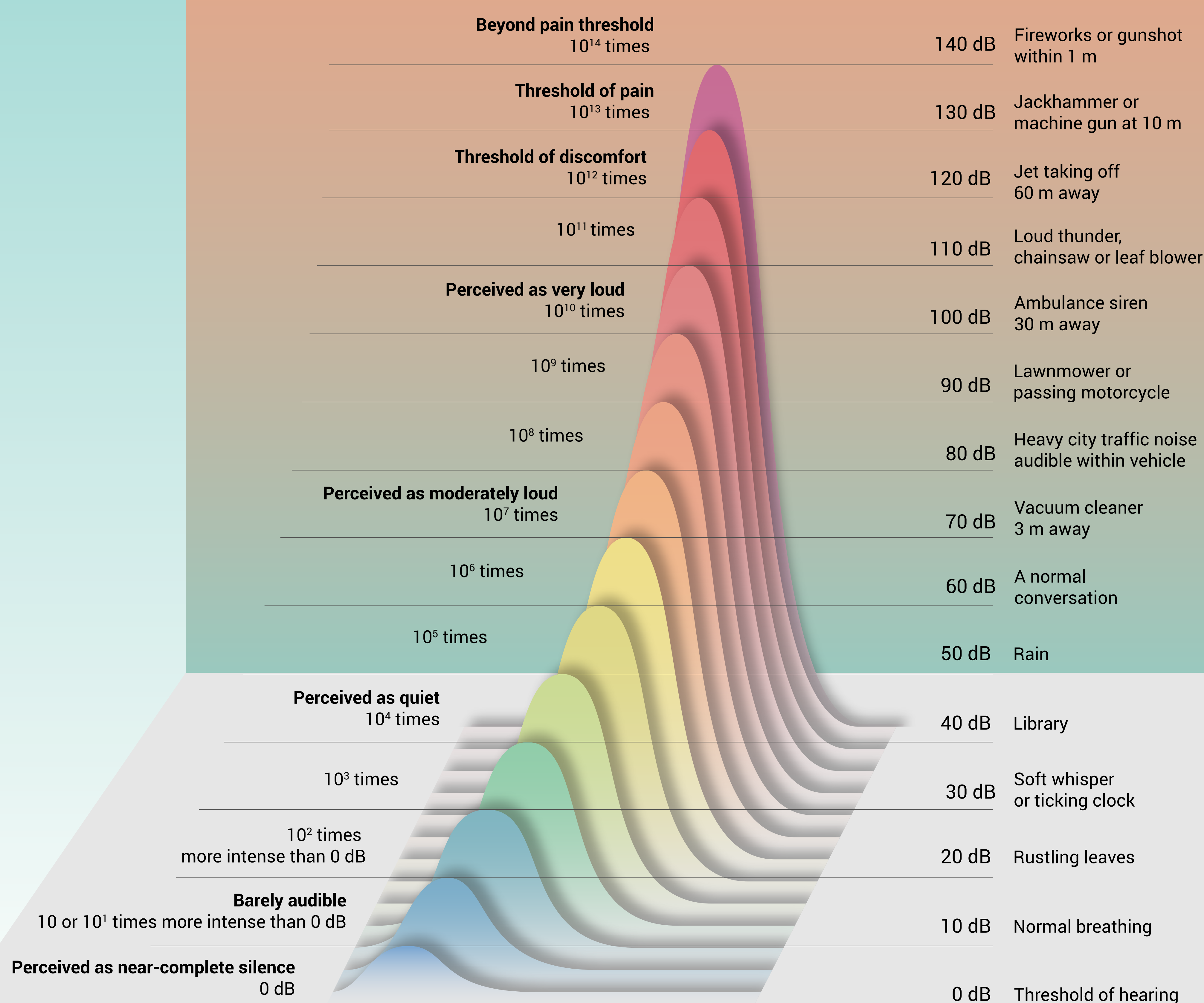
Sound quality cannot be judged only by its physical properties, however. The definition of noise as unwanted sound implies a psychological concept.⁶ While it is necessary to reduce noise levels when they are physically harmful to people, it may not be a sufficiently broad evaluation. It is becoming more relevant to consider soundscapes that contribute to people’s physical as well as psychological well-being, especially in the urban environment.⁷

Yet, most people would agree that a silent world is not desirable because sounds can enrich our lives, restore feelings of health and well-being, and convey meaning to our everyday experiences.⁷ They help define the characteristics of places and cultures and shape the quality of life. Some urban sounds may be unique to a community and add to its cultural identity, up to the point of becoming historical acoustic landmarks.⁹ The sounds of Big Ben in London or the calls to prayer from the Masjid al-Haram in Makkah, for example, are evocative experiences. In its broader understanding, acoustic comfort should not be seen merely as the absence of noise, but rather as a situation where environmental sounds offer ample opportunities for people to thrive and look after both their physical and mental well-being.

Noise measurement

The pressure or intensity of sound is commonly expressed in decibels, or dB. Since the range of sound pressure that the human ear can detect is so large, the decibel scale is logarithmic: a scale based on powers of 10.

On the dB scale, the lowest audible sound, perceived as near-complete silence, is 0 dB. A sound 10^1 times greater in pressure than 0 dB is assigned a sound level of 10 dB. But this increment of 10 dB is generally perceived as a doubling of loudness by the ear. A sound 100 times more intense than 0 dB, or 10^2 , is assigned 20 dB, and so on. That is, each increase of 10 dB is equivalent to an increase of sound pressure by another factor of 10.



2. Sound effects



The adverse effects of noise on public health are manifold and are a growing global concern. They cover a broad spectrum of outcomes, ranging from mild and temporary distress to severe and chronic physical impairment. Night-time noise disturbs sleep and affects well-being the following day. Estimates suggest that in Europe 22 million and 6.5 million people suffer from chronic noise annoyance and sleep disturbance, respectively.² The elderly, pregnant woman and shift workers are among those at risk of noise-induced sleep disturbance.^{2,14}

Noise-induced awakenings can trigger a range of physiological and psychological stress responses because sleep is necessary for hormonal regulation and cardiovascular functioning.^{14,15} There is increasing evidence that traffic noise exposure is a risk factor for the development of cardiovascular and metabolic disorders such as elevated blood pressure, arterial hypertension, coronary heart disease and diabetes.¹⁶ A conservative estimate indicates that long-term exposure to environmental noise contributes to 48,000 new cases of ischemic heart disease and causes 12,000 premature deaths annually in Europe.²

Two 15-year-long studies of long-term residents of Toronto, Canada found that exposure to road traffic noise elevated risks of acute myocardial infarction and congestive heart failure, and increased the incidence of diabetes mellitus by 8 per cent, and hypertension by 2 per cent.^{17,18} These studies have already taken into account the confounding effects of traffic-related air pollution that are associated with the same outcomes. An analysis of national health and noise data from Korea estimated that for every 1 decibel increase in daytime noise exposure, cases of cardio- and cerebrovascular diseases increase by 0.17 to 0.66 per cent.¹⁹

The World Health Organization (WHO) Regional Office for Europe conducted systematic reviews to assess the associations between noise and health outcomes to develop guidelines and provide recommendations for protecting human health from exposure to environmental noise originating from various sources.¹ The health outcomes include annoyance; cardiovascular and metabolic effects; cognitive impairment; effects on sleep; hearing impairment and tinnitus; adverse birth outcomes; and quality of life, mental health and well-being. The noise sources considered in these reviews include road traffic, railways, aircraft, wind turbines, and leisure activities such as attending sporting or concert events, listening to music through personal devices, and other recreational pastimes.

Based on these reviews, the WHO recommends certain exposure thresholds to avoid adverse health effects. The thresholds are reported in terms of a day, evening and night noise level combined; and a night only noise level. These are time-averaged noise indicators for the relevant time period, expressed in dB and monitored at the receiving end on the most exposed side of a building. The limits recommended for the night period are always lower compared to the full 24-hour period, since specific noise sources and events may be more noticeable with less activity, leading to sleep disturbance and more awakenings.^{1,20} Scientific evidence used in the WHO review, from studies representing numerous regions on different continents, provides the basis for the recommended exposure thresholds. This comprehensive coverage supports adoption of these thresholds to inform noise control policies around the world.

In contrast, some sounds bring health benefits, particularly sounds from nature. A number of systematic reviews documented empirical research from both clinical physiological and subjective psychological studies of well-being in response to acoustic environments.^{21,22} The reviews reported the positive influence of natural sound and quietness on physical and mental health. The importance of natural sounds to general well-being may also be associated with evolutionary advantages. Natural sounds may signal a safe environment, reduce anxiety and offer mental recuperation, while a lack of natural sound may provoke a more alert and vigilant state, especially for those from vulnerable groups.^{23,24}

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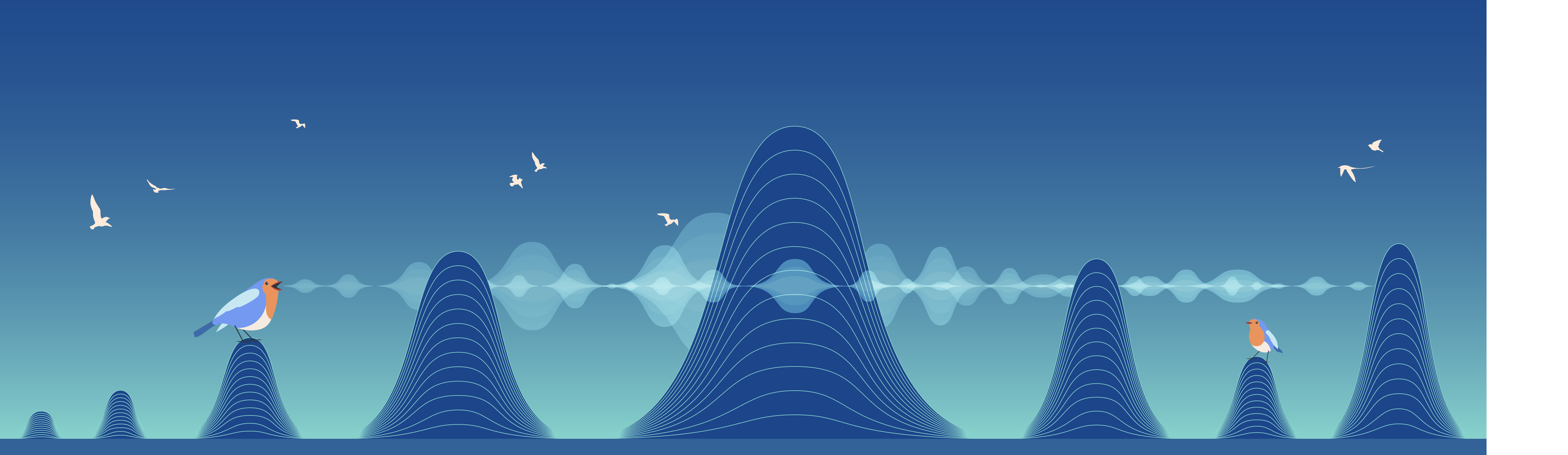
people in Europe suffer from chronic noise annoyance.

WHO recommendations on noise levels

Noise exposure should be kept below the following levels to avoid any harmful health effects.¹

Noise source	Maximum level of day-evening-night noise exposure L _{den}	Maximum night-time noise exposure L _{night}
Road traffic	53 dB	45 dB
Railways	54 dB	44 dB
Aircraft	45 dB	40 dB
Wind turbine	45 dB	(Insufficient evidence to recommend a limit)

Drowned out by noise: Creatures of the city



Acoustic communication is vital for many animal species. Acoustic signals are used in a variety of communication contexts, including territory defence, warning of danger, locating or attracting a mate, and caring for offspring. While abrupt and unpredictable sounds may be perceived as a threat by animals, chronic acoustic disturbance such as traffic noise can interfere with acoustic communication and alter behaviours in a range of species.^{1,25-27}

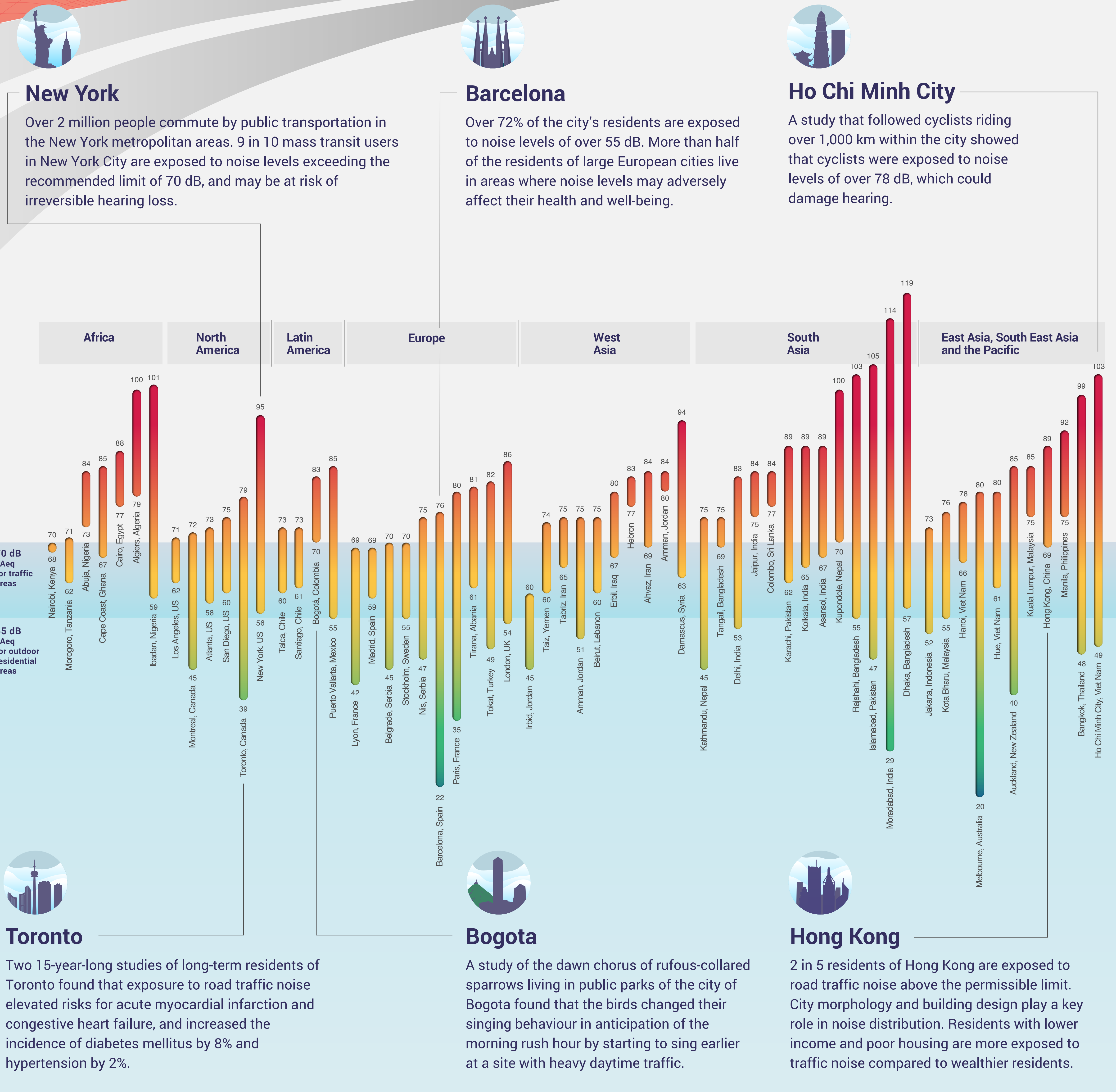
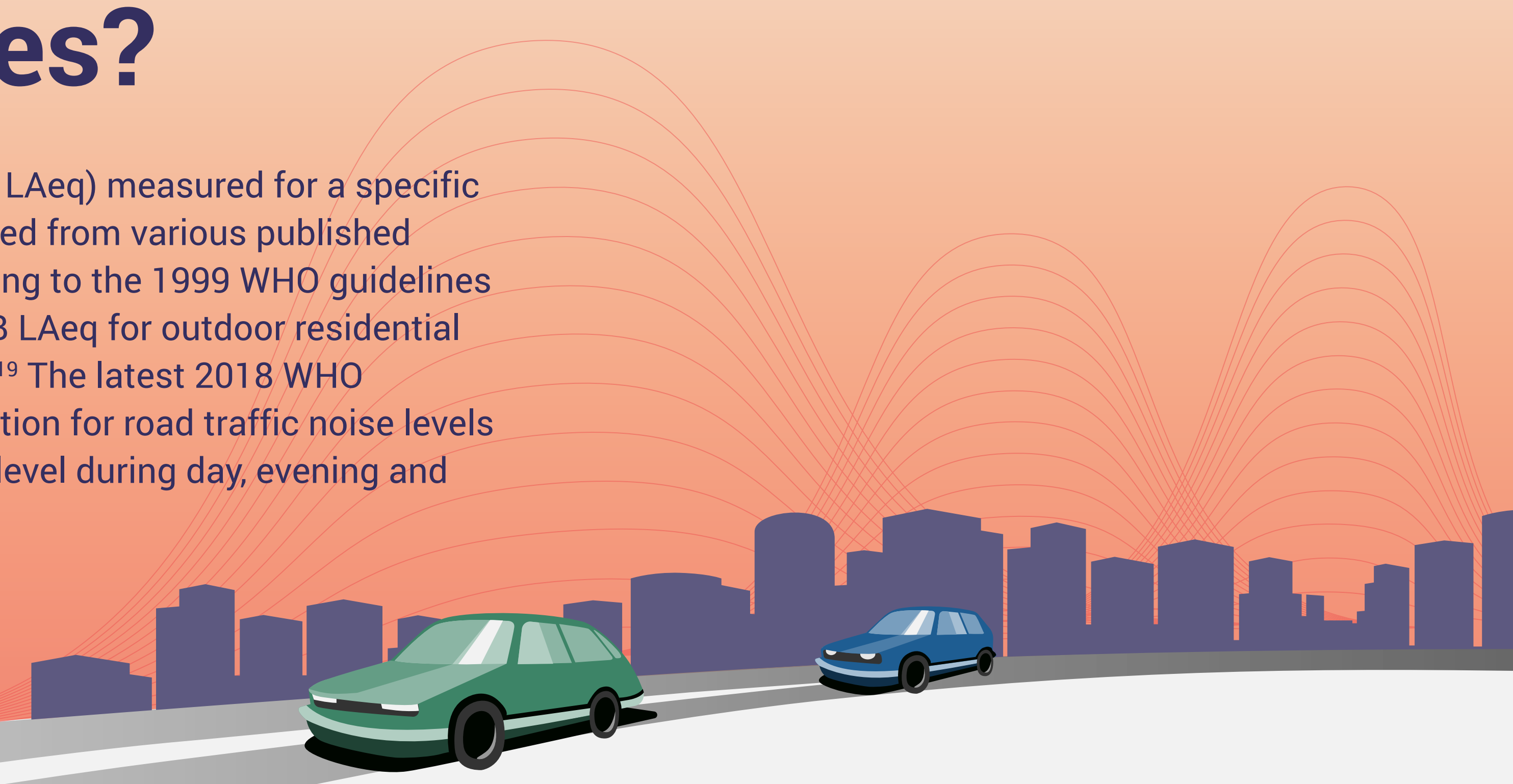
Abandoning noisy sites may seem the obvious response, but some animals adapt to noisy conditions instead, by altering their vocalization timing or pattern to avoid having their signal masked. In European cities, robins seem to sing more at night to avoid high acoustic interference during the day, while in the city parks in Bogota, Colombia, rufous-collared sparrows start the dawn chorus earlier in the morning at a site with heavy daytime traffic.^{28,29} Some frogs exhibit gap-calling behaviour as they time their calls to breaks in noise.³⁰

Other species modify their signals by switching their vocal frequency, or pitch, and amplitude to counteract low-frequency traffic noise. Many city bird species with natural low-frequency vocalizations sing at higher frequencies in areas of urban noise.³¹⁻³³ Studies in 30 city-forest paired locations in continental Europe, Japan and the United Kingdom have found that urban great tits sing higher-pitched songs than their forest-dwelling counterparts.³⁴⁻³⁶ Zebra finches and white-crowned sparrows slow down their tunes in response to city noise.^{37,38} These types of vocal modification have also been observed in frogs and insects, such as grasshoppers, living next to noisy highways.³⁹⁻⁴²

These changes certainly help animals to be heard in noisy environments, but sometimes altered vocalization patterns are considered less attractive by potential mates, therefore affecting reproductive success.^{3,30} And if species are not behaviourally flexible in producing or receiving signals, the inability to communicate may eliminate them from their habitats, with possible significant ecological implications.^{3,27}

Sound check: How noisy are cities?

The illustration presents traffic-related noise levels (dB, LAeq) measured for a specific daytime duration in different cities. The data are compiled from various published studies, which utilized different methodologies. According to the 1999 WHO guidelines for community noise, the recommended limits are 55 dB LAeq for outdoor residential areas and 70 dB LAeq for traffic and commercial areas.¹⁹ The latest 2018 WHO guidelines established a health-protective recommendation for road traffic noise levels of 53 dB based on the Lden indicator, an average noise level during day, evening and night that differs from the LAeq indicator.



New York
Over 2 million people commute by public transportation in the New York metropolitan areas. 9 in 10 mass transit users in New York City are exposed to noise levels exceeding the recommended limit of 70 dB, and may be at risk of irreversible hearing loss.

Barcelona
Over 72% of the city's residents are exposed to noise levels of over 55 dB. More than half of the residents of large European cities live in areas where noise levels may adversely affect their health and well-being.

Ho Chi Minh City
A study that followed cyclists riding over 1,000 km within the city showed that cyclists were exposed to noise levels of over 78 dB, which could damage hearing.

Toronto
Two 15-year-long studies of long-term residents of Toronto found that exposure to road traffic noise elevated risks for acute myocardial infarction and congestive heart failure, and increased the incidence of diabetes mellitus by 8% and hypertension by 2%.

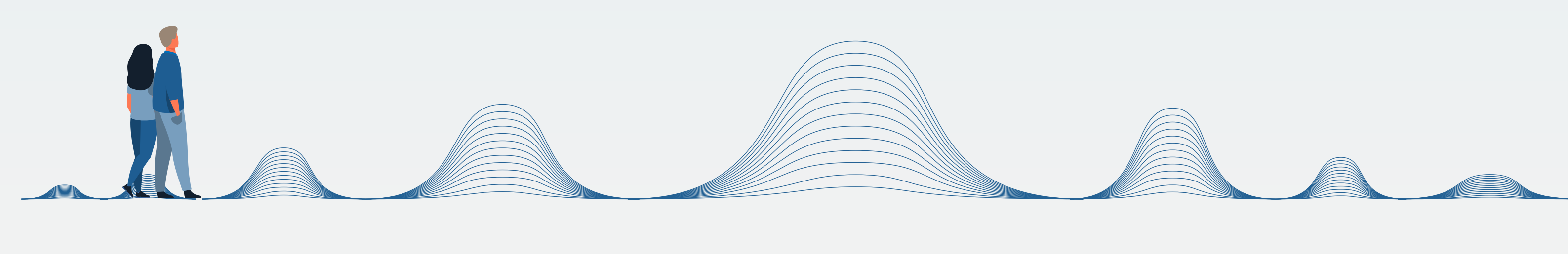
Bogota
A study of the dawn chorus of rufous-collared sparrows living in public parks of the city of Bogota found that the birds changed their singing behaviour in anticipation of the morning rush hour by starting to sing earlier at a site with heavy daytime traffic.

Hong Kong
2 in 5 residents of Hong Kong are exposed to road traffic noise above the permissible limit. City morphology and building design play a key role in noise distribution. Residents with lower income and poor housing are more exposed to traffic noise compared to wealthier residents.

See page 19 for complete references.

Soundscape management: From noise mitigation to desirable soundscape

Exposure to environmental noise sources such as road traffic, air traffic, railways, machinery, industry and recreational activities has well-documented negative impacts on physical and mental well-being. Noise abatement is a public health issue and it has become imperative for urban planners to increasingly create and preserve quiet spaces to deliver pleasant urban soundscapes.



Sight and sound
Both sight and sound influence human perception of surroundings. Landscape affects soundscape, and vice versa. Visual surroundings are a vital consideration in soundscape planning and design.

Green solutions
Vegetation in urban environments can absorb acoustic energy, diffuse noise and reduce street amplification. Tree belts, shrubs, green walls and green roofs have positive visual effects in addition to helping amplify natural sounds by attracting urban wildlife.

Soundscape
Soundscape encompasses the way people perceive, experience and respond to the sounds of a given place at a given time. Soundscape planning aims to deliver pleasant acoustic environments that enhance appreciation of places by people. Soundscape design considers contextual characteristics of the place, including perceived acoustic parameters, physical features, natural factors, purpose, usage and user community.

Tree belts
Roadside tree belts can shield noise when planted in sufficiently high biomass density. Noise attenuation can be enhanced by the correct choice of species, trunk size, length and depth of the belt, distance from noise source, and planting scheme.

Green roofs
Vegetated roofs attenuate sound by absorbing propagation over rooftops from street to quiet sides.

Electric vehicles
Even electric vehicles emit noise when driven at speeds above 50 km/hr from tyre contact with the road. Solutions such as porous asphalt surfaces can lower noise emission at higher speeds.



Pathway intervention
Engineering solutions aim to obstruct the pathway between source and receiver. Measures such as noise barriers along highways or railways, earth berms, gabions, and use of acoustic insulation materials and architectural features in buildings can break the chain of noise propagation.

Mitigation at source
Noise mitigation measures differ in effectiveness. Emission reduction at source is the most effective, including restriction of traffic flow or speed, quieter vehicle engines and low-noise road surfaces.

Noise barriers
Barriers placed near source or receiver can significantly reduce noise. Both traditional and innovative materials, made from recycled materials such as plastic and car tyres, have proved effective. Fibreglass from decommissioned wind turbine blades in Denmark have shown a barrier effect reduction of traffic noise levels by 6-7 dB.

Vegetated noise barriers
Vegetation increases the absorption and reduces the propagation of sound. Customized placement of tree rows behind traditional highway noise barriers or layers of vegetation on rigid noise walls can reduce noise levels by up to 12 dB.

Ecosystem services
The mental health benefits from natural sounds and general wellbeing are considered psychological ecosystem services provided by nature. Exposure to natural sounds contributes to relaxation, stress recovery and psychological restoration.



Green space
Urban green space and vegetation produce positive psychological effects. Public parks, gardens and other small green areas provide pleasant sounds from nature, such as rustling leaves, swaying tree branches and chirping birds. Natural sounds support stress recovery and attention restoration.

Quiet space
Quiet urban areas offer acoustic relief to city inhabitants from noisy surroundings, a prerequisite for mental restoration and well-being. Natural sounds found in urban parks, gardens, and other green spaces positively contribute to peaceful and quiet soundscapes.

Place-making
Everyday sounds of a particular place that are immediately recognizable help create the identity of the place. When these sounds are unique and convey a distinct sense of place, with a significance beyond the local community, they become acoustic landmarks, termed soundmarks.

See page 21 for complete references.

3. Turning down the volume

“When general noise reduction is difficult to achieve overall, it is important to guarantee local access to quietness for people in public spaces.”

Like most sources of pollution, noise is an issue that must be managed. Regulatory frameworks and legal requirements are in place in many countries and are sometimes coordinated multilaterally, such as in the European Union.^{43,44} Common measures usually address the sources of noise as they are the most cost-effective and straightforward to enforce. Source interventions include management of road, rail and air traffic flow, use of low-noise road surfaces and rail tracks, improved aerodynamics and components for aircraft, and shifts away from internal combustion engines to quieter propulsion systems.²

Public bodies, industry, and research have focused mainly on these kinds of technological developments. The alternative receiver-oriented measures, like installing noise barriers, are typically less cost-effective and only solve a problem locally, with potential negative landscape impacts as an additional drawback.

Noise mitigation in cities can also be achieved with indirect approaches. In the national plan to combat noise and reduce its sources, the Government of Egypt has incorporated measures with environmental co-benefits. These include encouraging the use of bicycles, and adopting building energy standards to reduce noise emission from air conditioning systems.^{43,45} In Berlin, Germany, new cycle lanes on wide roads have been used as an indirect noise abatement strategy aimed at reducing the available driving space for motorized vehicles. More than 500,000 residents were originally exposed to night noise levels higher than 50 dB, so many city roads with two lanes per direction and volumes of transit up to 20,000 daily units were narrowed to single-lane roads, releasing space for bicycles and pedestrians. This moved the source of the sound emission towards the middle of the roads, away from residential settings. Overall, it achieved a reduction in night noise levels for more than 50,000 residents.²

In April 2019, the Ultra-Low Emission Zone came into effect in Central London and expanded in late 2021 to include an area encompassing 3.8 million people.^{46,47} While the scheme was mainly driven by a desire to improve air quality, encouraging the use of electric and hybrid vehicles has noise-reduction benefits as these vehicles are much quieter compared with internal combustion engine vehicles, especially at low speeds.⁴⁸ However, the detectability of quiet vehicles may become a safety concern for pedestrians and consequently a new challenge.^{49,50}

Looking at cities with complex vertical development and tight road networks, Hong Kong stands out as a challenging case where land use and urban morphology are key factors affecting the spatial distribution of noise sources in the built environment.^{51,52} With over one million residents exposed to road traffic noise at levels higher than the 70 dB limit, the authorities adopted a relatively aggressive policy centred on infrastructure design and land-use planning, with limited success.⁵³⁻⁵⁵

The WHO noise guidelines also emphasize that policy attention should not simply focus on areas with high noise levels, but also on where positive soundscapes exist or can be created.^{1,56,57} Many environmental noise policies and local authorities' actions acknowledge that when general noise reduction is difficult to achieve overall, it is important to guarantee local access to quietness for people in public spaces.⁵⁷ The focus in most urbanized contexts has, therefore, been on identifying and protecting areas of quietness, and restoration of environmental assets that are embedded in the city fabric.⁴⁵ Quiet urban parks, converted canal towpaths and rail spurs, pocket green and blue areas within apartment blocks, in courtyards, gardens and other leisure areas are places where people can escape city noise. Access to nearby quiet areas contributes to the health and well-being of local communities.⁵⁸ While noise level is an important aspect, soundscape quality is also contextual and influenced by non-acoustic factors, including the feeling of safety, which may be a notable concern for women and for parents.^{23,58,60} Quiet areas are more generally understood as places with pleasant soundscapes or where unwanted sounds are mostly absent; they are often combined with positive landscaping elements, like greenery and water features.^{59,61} Providing or protecting these spaces is a more passive, yet still valuable, way of regulating against noise in urban areas.

“Quiet areas are more generally understood as places with pleasant soundscapes or where unwanted sounds are mostly absent.”

Amplified effects on the vulnerable and marginalized

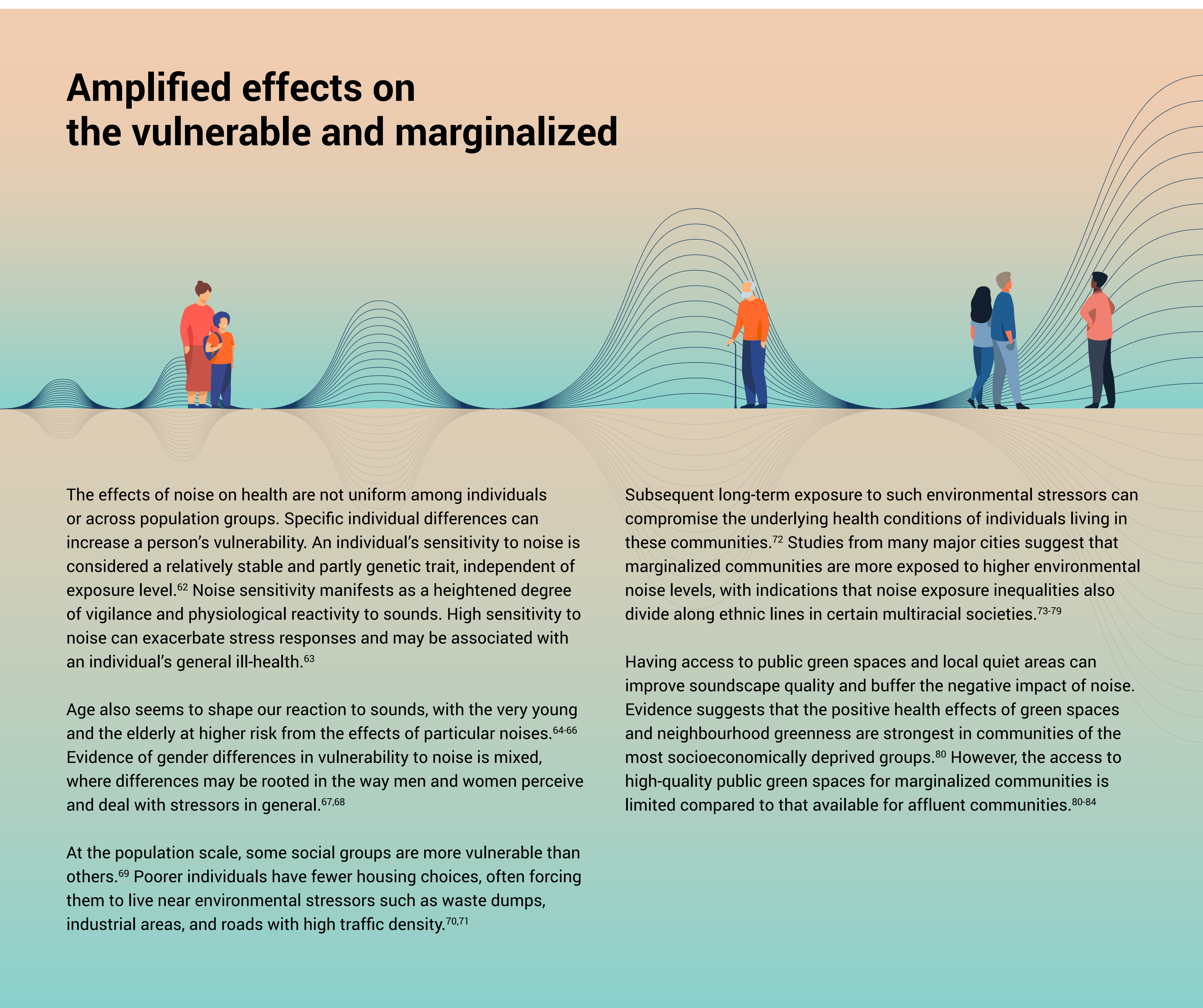
The effects of noise on health are not uniform among individuals or across population groups. Specific individual differences can increase a person's vulnerability. An individual's sensitivity to noise is considered a relatively stable and partly genetic trait, independent of exposure level.⁶² Noise sensitivity manifests as a heightened degree of vigilance and physiological reactivity to sounds. High sensitivity to noise can exacerbate stress responses and may be associated with an individual's general ill-health.⁶³

Age also seems to shape our reaction to sounds, with the very young and the elderly at higher risk from the effects of particular noises.^{64,66} Evidence of gender differences in vulnerability to noise is mixed, where differences may be rooted in the way men and women perceive and deal with stressors in general.^{67,68}

At the population scale, some social groups are more vulnerable than others.⁶⁹ Poorer individuals have fewer housing choices, often forcing them to live near environmental stressors such as waste dumps, industrial areas, and roads with high traffic density.^{70,71}

Subsequent long-term exposure to such environmental stressors can compromise the underlying health conditions of individuals living in these communities.⁷² Studies from many major cities suggest that marginalized communities are more exposed to higher environmental noise levels, with indications that noise exposure inequalities also divide along ethnic lines in certain multiracial societies.⁷³⁻⁷⁹

Having access to public green spaces and local quiet areas can improve soundscape quality and buffer the negative impact of noise. Evidence suggests that the positive health effects of green spaces and neighbourhood greenness are strongest in communities of the most socioeconomically deprived groups.⁸⁰ However, the access to high-quality public green spaces for marginalized communities is limited compared to that available for affluent communities.⁸⁰⁻⁸⁴



4. Healthy decisions for positive soundscapes

“Noise pollution should be considered within a broader range of environmental challenges through integrated policies, particularly for the combination of noise and air pollution.”

Over the past several decades, policymakers have achieved some progress in addressing noise pollution as an environmental and public health issue. However, two major shortcomings have emerged. First is the inherent limitation of using a reactive approach — when the primary focus is retroactively reducing noise levels. The second is thinking of sound only in terms of discomfort, such as transport and industrial noise, rather than investigating how to promote sounds that provide comfort. These two points need to be urgently addressed to achieve livable cities and support for research-informed interventions is crucial in this process.

To overcome the first shortcoming, in any urban development strategy, environmental sounds should be considered at the earliest possible stage of planning and design to prevent them from becoming an afterthought — one that could involve significant expense. According to data from Europe, more than 50 per cent of actions intended to manage noise focus on the source, which is often effective but will not necessarily provide soundscape quality.² A very limited percentage of measures dealing with environmental sounds resort to land use or urban planning, while growing evidence from research indicates that this approach would be the most sustainable path.^{85,86} Therefore, it is crucial that experts in environmental acoustics and urban soundscapes are involved in urban development processes and that they communicate with local stakeholders.⁸⁷

Furthermore, noise pollution should be considered within a broader range of environmental challenges through integrated policies, particularly for the combination of noise and air pollution. Many countries surveyed by the European Environment Agency report successful policies that provide co-benefits, including traffic calming measures, green vehicle fleets, energy-efficient buildings, tree and shrub plantings to create and link green corridors, and incorporating downcycled materials into engineered noise control solutions.²

To address the second shortcoming, there needs to be an extension of the scope of policymaking through a shift from only managing environmental sounds when they cause noise pollution to considering environmental sounds as opportunities for promoting healthy living environments for all age, gender and social groups. The Government of Wales aspires to preserve or cultivate positive soundscapes, defined as “where natural sounds such as flowing water, birdsong, the wind in the trees and human conversation are more prominent than background traffic noise”.⁵⁷

For positive soundscapes to thrive, while keeping noise pollution within acceptable bounds, new approaches need to account for people’s perception rather than just their exposure; this will complement and augment the dB measure to characterize soundscapes. Although desirable for some contexts like urban parks or residential areas, simple silence or quiet cannot be the standard for assessing the quality of every urban space. We need our cities to be aurally diverse and inclusive, to support mixed uses; this is something silence alone cannot deliver.

The link between time spent in natural environments and general well-being is accepted by more people after their pandemic experiences.⁹⁷ The COVID-19 lockdowns brought new appreciation for urban green spaces of every kind.^{98,99} Urban planners are looking to ‘build back better’ after the pandemic by including more green space, and some are particularly concerned that those green spaces, and their benefits, are delivered to often-ignored poorer neighbourhoods and those housing marginalized groups.^{100,101} Policymakers, urban planners, community members and other stakeholders involved in creating more livable cities need to keep the sounds of the new and renewed spaces under consideration.

“We need our cities to be aurally diverse and inclusive, to support mixed uses; this is something silence alone cannot deliver.”

Lockdown soundscapes

When the SARS-CoV-2 virus spread at the end of 2019, governments around the world responded with measures to contain the infection rates.⁸⁸ The halt of most non-essential commercial and social activities, local commuting, and other travel led to less pollution, including noise.⁸⁹

Many research groups and governmental agencies reported decreasing noise levels, particularly in urbanized areas.⁹⁰ In Paris, monitoring detected an average reduction of 7.6 dB for road traffic noise over the whole network with the first lockdown on 17 March 2020.⁹¹ Air traffic noise in the Charles de Gaulle airport area also decreased significantly, with reductions reaching 20.4 dB.

In Madrid, the reduction of road traffic and the absence of people on the streets led to sound level reductions in the 4–6 dB range.⁹² In a study conducted in London across 11 locations, comparing data from the peak of local lockdown measures, an average reduction of 5.4 dB was observed.⁹³ In San Francisco, the sudden drop in human noise meant people could hear more natural sounds, such as birdsong.⁹⁴ In Mumbai, noise levels were monitored at different locations during the Ganesh Chaturthi festival celebrations under COVID-19-related municipal restrictions in 2020. Compared with measurements in 2018 and 2019, noise level reductions ranged between 27.5 and 28.5 dB.⁹⁵ This general pandemic-related quieting could be detected at a global scale via seismologic investigations that reported substantial decreases in noise during lockdown.⁹⁶

The long-term environmental implications of the COVID-19 crisis are still unclear and current global research should provide further insights. The unexpected silence from human sound sources triggered a debate among academic communities and the public on how modern cities could sound and whether we are doing enough to achieve positive soundscapes.

Although there is consensus that the limitations imposed by lockdown measures led to lower noise levels in many cities, the maximum observed reductions for traffic noise were still typically in the region of only 6–10 dB. While this would be perceptually noticeable in most situations, it is not always enough to bring noise pollution to safe levels according to WHO recommendations. For cities to improve their soundscape quality, different strategies for planning and infrastructural changes would develop healthier acoustic environments.



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Sound check: How noisy are cities?

AFRICA

Abuja, Nigeria - Algiers, Algeria - Cape Coast Metropolis, Ghana - Ibadan, Nigeria - Morogoro, Tanzania - Nairobi, Kenya

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LATIN AMERICA

Bogota, Colombia - Puerto Vallarta, Mexico

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**Soundscape management:
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