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LISTENING TO THE BUILT ENVIRONMENT: CULTURAL AND SOCIAL URBAN SOUNDSCAPE

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ABSTRACT

Urban soundscapes are an intricate tapestry woven from the cultural and social threads that shape the acoustic identity of cities. This paper explores previous urban soundscape thesis studies conducted at the Build Better Buildings Laboratory (BBB Lab) of Taiwan Tech, highlighting the rich cultural and social dimensions of urban life. By employing various soundscape study methods, these studies not only document valuable intangible cultural and social elements but also immerse students in the art of listening to urban sounds. Through this auditory exploration, the significance of specific urban sounds in daily life is revealed. As we tune in to the built environment, the distinction between "noise" and meaningful sound dissolves, allowing us to appreciate the richness and diversity of the urban acoustic landscape. Ultimately, this study emphasizes the profound connection between sound, culture, and society, encouraging a deeper understanding of the harmonious symphony that defines urban life.

Keywords: urban soundscape, cultural identity, phenomenological listening, soundscape interpretation, intangible heritage

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1. INTRODUCTION

Arkette's question, "How do we describe city space?" [1] initiates a profound inquiry into the sensory dimensions through which we interpret urban environments. While conventional narratives typically emphasize the visual attributes of urban spaces, Arkette proposes an auditory perspective, highlighting the integral role that soundscapes play in shaping a city's cultural and social identity. Critiquing contemporary society's tendency to prioritize visual experiences, she argues that sound constitutes a significant yet frequently overlooked element of our interaction with the built environment. Arkette asserts that urban sounds are never neutral or insignificant; rather, they embody cultural, social, and historical narratives, reflecting the character, identity, and dynamics of specific urban communities. Each urban area possesses a distinct sonic profile, shaped by everyday activities, cultural traditions, historical developments, and the social interactions of its residents, thus making the city a tapestry of diverse auditory experiences.

Similarly, Kang et al. [2] emphasize that soundscapes are defined not merely by their measurable acoustic properties, such as loudness and frequency, but also by their perceptual and emotional effects on individuals. They argue that the appreciation and meaning of sounds are deeply tied to listeners' personal experiences, socio-cultural contexts, and the surrounding acoustic environment. Hence, urban soundscapes should not be understood simply as noise to be managed or reduced, but rather as meaningful resources that contribute positively to a sense of place. This aligns with Dumyahn and Pijanowski's [3] insights into soundscape conservation, underscoring the ecological and social





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significance of soundscapes. Their research reveals that sounds in urban and natural contexts serve as indicators of biodiversity, environmental health, and community well-being. Importantly, they highlight that the perception of sounds - whether perceived as pleasant or disruptive - is influenced less by sound intensity alone and more by context-specific factors such as appropriateness, listener expectations, recreational goals, and cultural norms.

Informed by these perspectives, my students and I approach the study of urban soundscapes by actively engaging with recorded urban sounds, striving to uncover their intangible meanings and values. Instead of predefining the value of urban sounds based solely on acoustic measurements, we explore these auditory environments phenomenologically, seeking deeper connections between sounds, their socio-cultural implications, and their ecological roles. We perceive urban sounds as dynamic and vibrant expressions of urban life, capable of reflecting fleeting yet significant moments of social interaction, cultural practice, and ecological presence. Through this approach, we aim to highlight the intangible yet profound values embedded within urban soundscapes, advocating for their recognition not only as sensory experiences but as essential cultural and ecological resources that merit appreciation and thoughtful conservation.

2. SOUNDSCAPE STUDY METHODS

According to ISO 12913 [4], soundscape study methods encompass a variety of approaches that aim to document, analyze, and understand the sonic environment. These methods can be broadly categorized into both qualitative and quantitative techniques, each providing distinct insights into the perception and characterization of soundscapes.

Sound Walks

Sound walks are a participatory method in which individuals move through an environment, paying focused attention to the surrounding sounds. This method facilitates direct engagement with the soundscape, allowing participants to reflect on their auditory experiences and perceptions. Sound walks are particularly useful for gathering subjective data on how people perceive sounds in specific locations and for highlighting how sound contributes to the overall atmosphere and identity of a place.

Taxonomy of Sound

This method involves classifying the sounds within a given environment based on their characteristics. Sounds may be categorized as natural (e.g., bird calls, weather patterns) or human-made (e.g., traffic, mechanical noises). By identifying and categorizing these sounds, researchers gain a deeper understanding of the diversity and complexity of the soundscape and the roles these sounds play within it.

On-Site Sound Level Measurement

This quantitative method involves measuring sound levels on-site using sound level meters. It provides objective data on the intensity, frequency, and variation of sounds at specific locations. On-site measurements are essential for understanding the physical properties of a soundscape and how sound levels fluctuate in response to variables such as time of day, weather conditions, and human activities.

Video Recording

Video recordings complement auditory data by capturing the visual context of the soundscape. This method enables a more comprehensive analysis of the interaction between sound and the built or natural environment. By documenting both the auditory and visual components, researchers can better understand how the physical characteristics of a space influence the perception and experience of its soundscape.

Questionnaires

Questionnaires are used to collect subjective data from individuals regarding their perceptions and reactions to the soundscape. Respondents are asked to evaluate specific sounds, report their emotional responses, and reflect on how these sounds contribute to their sense of place or overall experience of the environment. This method provides valuable insights into how different individuals perceive and interpret sounds in the same space.

Source-Receiver Path (Sound Itinerary)

An essential assessment method highlighted by Siebein and Siebein [5] involves identifying and analyzing the source-receiver path, or itinerary. This approach entails tracing the journey of sound from its origin to the listeners within the environment. By mapping these auditory pathways, researchers can identify individual sound sources, analyze how sounds travel through space, and assess the interaction of sound with architectural, social, and environmental features along its path. Understanding the source-receiver itinerary is crucial because it reveals how the built environment shapes and transforms sounds, ultimately influencing listeners' perceptual and emotional responses. This method not only explains how sounds are physically





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transmitted but also uncovers deeper layers of meaning, cultural significance, and emotional connections embedded within urban acoustic experiences. Despite these comprehensive methodologies, the interpretation of soundscapes extends beyond mere documentation. Siebein's broader interpretive approach [5] offers a nuanced framework for understanding soundscapes, emphasizing the socio-cultural and ecological contexts that enrich our appreciation of the acoustic environment.

3. URBAN SOUNDSCAPE THESIS STUDIES

The following six urban soundscape studies explore diverse acoustic environments that prominently feature traffic or street noise. Rather than being simply regarded as disruptive, each investigation highlights unique socio-cultural, historical, or ecological interpretations of urban sounds. These examples illustrate how perceived noise, such as vehicle traffic, can carry deeper meanings, evoke cultural memories, enhance experiences, and even influence urban planning and conservation decisions.

3.1 Memory of Sound in the Song Dynasty: The Soundscape Analyses of Qingming Shang He Tu

This study began with a simple yet curious question: can people imagine the soundscape of a city from nearly a thousand years ago? More specifically, does each individual carry within their mind a latent memory - or a constructed perception - of what historical urban life might have sounded like? Using the renowned scroll painting Qingming Shang He Tu, which vividly portrays daily life in the Northern Song capital of Bianjing, this research sought to explore the potential of evoking a "memory of sound" and to reconstruct the acoustic identity of the ancient city using contemporary soundscape methodologies [6].

Although Qingming Shang He Tu is fundamentally a visual artifact, its intricate depictions of street life, social interaction, commerce, and performance suggest a vibrant auditory world beneath the surface. Inspired by this, the study embraced a methodological shift - from observing to listening. Guided by ISO 12913 standards, researchers applied soundwalk-inspired interpretations and developed a taxonomy of sounds across three selected scenes, focusing especially on the Prosperous Bianjing City scene (see Fig. 1). From this, four dominant sound categories emerged: "Sounds and Society," "Mechanical Sounds," "Human Sounds," and "Sounds as Indicators." These categories helped classify the sonic textures implied in the imagery - bustling street vendors, puppet shows, cart wheels clattering

on stone, ceremonial gongs, laughter, and domestic conversations.

Each sound source and its potential receiver were carefully imagined based on the facial expressions, gestures, and contextual clues within the painting. As illustrated in Figure 1, one can infer the wooden creaking of cartwheels, the dialogue between sedan chair carriers and passersby, the barking of dogs, or the murmur of a crowd gathering near a puppet stage. Even the subtle background sounds behind courtyard doors or inside teahouses were considered. These richly suggestive elements offer an immersive glimpse into what the city may have sounded like - transforming a static painting into a living, breathing acoustic environment. It is in these moments of re-imagined sound that we feel as if we've stepped into the streets of Song Dynasty Bianjing, not merely as observers, but as listeners.

While Qingming Shang He Tu remains a silent scroll, this study proposes that its implied soundscape can act as a form of cultural memory. Even though people today cannot remember sounds from a time they never lived in, the act of careful listening, interpretation, and reconstruction enables a more intimate engagement with the past. By tracing the imagined source-receiver paths embedded within the painting, this research positions soundscapes as "memory texts" - intangible yet deeply resonant narratives that coexist with visual heritage. Though the original acoustic conditions can never be fully restored, the imaginative process of aural archaeology opens new avenues for understanding cultural history - not just through the eye, but through the ear.



Figure 1. Selected scene of the prosperous Bianjing city [6].



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3.2 Soundscape Study of Songshan Airport

This study originated from a simple inquiry: what sounds still exist around Taipei Songshan Airport, apart from the aircraft noise that has long dominated public discourse? Given that aircraft noise has been extensively researched and managed through zoning regulations, government subsidies, and building retrofits, this project turned its attention to what remains less understood - the broader acoustic ecology of the airport surroundings.

The technical aspect of this research involved measuring LAeq and LZpeak levels at five outdoor locations and one indoor site near the airport, across various time periods during both weekdays and weekends [7]. While the quantitative data confirmed expected patterns of aircraft-generated peak noise—often surpassing 90 dB, particularly near runway-facing locations - the findings also revealed moments of acoustic variation when no aircraft were present. During these intervals, natural sounds such as birdcalls, wind, and occasional dog barks were clearly audible, reminding us that even in high-noise zones, fragments of urban nature persist. Fig. 2 shows the taxonomy of sound sources for this study.

Yet what proved most revealing was not only the data itself but the atmosphere at the location directly beneath the flight path. This space has become a kind of informal sound tourism site, attracting aviation photographers and aircraft enthusiasts who gather to experience the visceral thrill of airplanes passing directly overhead. Here, the deafening roar of engines and the ground-shaking vibrations are not regarded as noise, but rather as part of a unique, time-specific acoustic phenomenon. Enthusiasts speak of different sound signatures between aircraft models and eagerly await the brief sonic events that mark a plane's descent or ascent. In these moments, the act of listening becomes intentional, even reverent. The aircraft's roar is no longer framed as a nuisance, but as a sonic spectacle - a defining feature of this place and this era.

In short, while the regulatory focus on aircraft noise remains necessary, this study highlights a more nuanced, culturally aware perspective: that the soundscape of Songshan Airport includes both disruptive and meaningful elements. When examined through the lens of soundscape perception rather than solely noise control, even the most intense acoustic events can shift in meaning - from intrusive to iconic, from background to destination. As such, the

study encourages an expanded view of airport environments—not only as spaces to mitigate noise but as evolving acoustic landscapes rich with layers of human, mechanical, and natural sound.

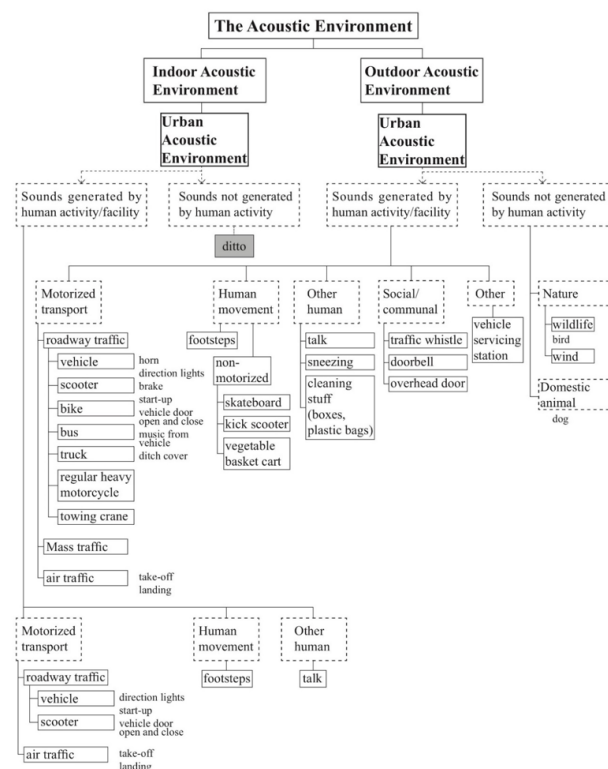


Figure 2. Taxonomy of sound sources of Songshan Airport [7].

3.3 Taipei MRT Soundscape

This study initially set out with a straightforward objective: to document the everyday soundscape of the Taipei MRT cabin. However, as the investigation progressed through in-depth soundwalks, careful listening to source-receiver paths, and reflective comparison with MRT experiences from other countries, an unexpected discovery emerged - the use of multilingual announcements in Taipei's MRT was not just a functional feature, but a culturally meaningful design element.

To capture this dimension, the study adopted an integrated methodology combining both qualitative and quantitative approaches [8]. Acoustic events within MRT cabins were classified according to their origins - social, mechanical, and indicator sounds - to establish a clear taxonomy.



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Technical data analysis provided further insight, including sound pressure level measurements and spectrogram visualizations that revealed time-frequency patterns of train operations, such as acceleration, steady travel, and deceleration. Fig. 3, for example, illustrates the ride from Shandao Temple to Taipei Main Station, showing distinct phases in the sound profile that correspond to these operational states.

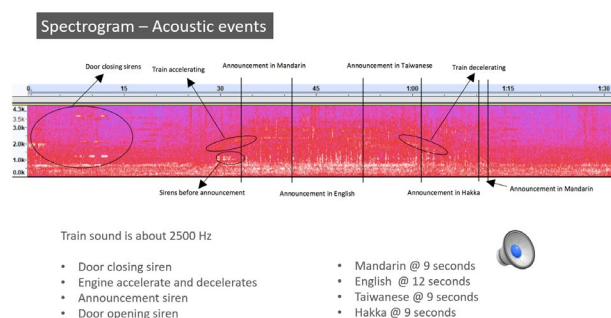


Figure 3. Taipei MRT Cabin spectrogram with acoustic events - trips between Shandao Temple and Taipei Main Station [8].

Perceptual soundwalks - conducted both on-site and through remote video-streaming discussions - allowed for the collection of subjective impressions and cultural interpretations from participants. This experiential method of listening revealed how sound is perceived in real-time travel contexts, bringing attention not only to mechanical noises and station signals, but also to the rhythmic presence of announcements delivered in Mandarin, Taiwanese, Hakka, and English. Initially perceived as routine, these announcements emerged as culturally resonant, evoking reflections on language, identity, and inclusivity within public space.

The findings confirmed that mechanical and indicator sounds dominate the MRT cabin soundscape, with background noise levels at times exceeding 100 dB at specific frequencies. Passenger reactions to the multilingual announcements varied - some appreciated their inclusivity and cultural symbolism, while others questioned their necessity in practical terms. Nevertheless, the study concludes that these announcements do more than guide passengers; they actively participate in shaping Taipei's unique urban identity. As such, they are not only functional, but emblematic of Taiwan's broader socio-political commitment to linguistic equity and multicultural respect.

Ultimately, the Taipei MRT soundscape transcends mere acoustic utility. It stands as a culturally-informed auditory environment - one that reflects Taiwan's legislative and societal values through daily sound experience. By embedding a linguistic mosaic within an urban mobility system, Taipei's MRT exemplifies how transportation infrastructure can serve as a living archive of collective cultural identity, and highlights the broader potential of soundscape design as a meaningful medium for urban expression and conservation.

3.4 Shilin Night Market Soundscape

This study initially set out with a straightforward objective: to investigate just how loud a night market can be. In Taiwan, night markets are typically located in mixed-use neighborhoods where rows of attached buildings feature commercial stalls at the ground level - often extending into covered walkways - while the upper floors remain residential. Given this spatial configuration, it was assumed that the more vibrant and popular a night market becomes, the louder and potentially more disruptive it might be for local residents. It was further hypothesized that such elevated noise levels could negatively impact the visitor experience and potentially reduce the market's long-term appeal.

However, through a combination of on-site observations, sound level measurements, and ISO 12913-standardized questionnaires, the study uncovered a different perspective [9]. While participants widely recognized that the dominant sounds were anthropogenic - such as conversations, vendor calls, and vehicular traffic - most did not regard these as problematic. On the contrary, many associated the soundscape with a sense of excitement, vibrancy, and authenticity. The majority of respondents even expressed a strong willingness to return to the night market in the future.

Survey data further characterized the soundscape of Shilin Night Market as "foregrounded," "stimulating," and at times "disruptive," yet the perceived sound quality was generally rated as acceptable or neutral. Notably, what might be considered "noisy" in other urban contexts was, for many visitors, precisely what lent the market its distinctive charm and energy. As illustrated in Fig. 4, "exciting" and "comfortable" impressions recorded the positive listening impression.

These findings suggest that public perception of urban soundscapes is shaped not only by acoustic intensity or compliance with regulatory thresholds, but also by cultural



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expectations and the intended function of the space. In the case of Shilin Night Market, noise is not necessarily a nuisance to be eliminated, but rather a defining element of its urban identity. This underscores the importance of integrating cultural and experiential dimensions into urban acoustic planning - recognizing that, in certain contexts, sound should not be suppressed, but instead understood, managed, and even celebrated as a vital part of the local soundscape.

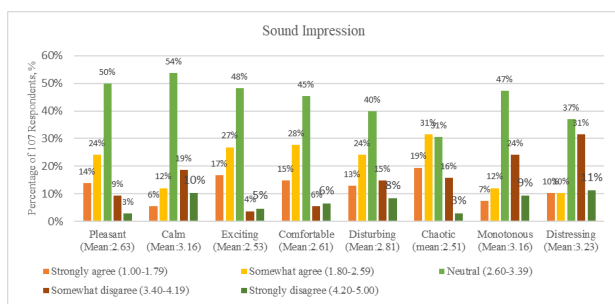


Figure 4. Overall Result in Sound Impression (Public Questionnaire) [9].

3.5 Taipei Performing Arts Center Surrounding Soundscape

The original intention of this study was to investigate the acoustic interaction between the Taipei Performing Arts Center (TPAC) and its surrounding environment - specifically, how the building's distinctive geometric massing (see Fig. 5) responds to and potentially reflects or mitigates traffic noise from its location at the bustling intersection of Jiantan MRT Station and Shihlin Night Market. Central to the investigation were questions about whether MRT and road traffic noise could intrude into the center's performance halls, and whether the sloped and reflective surfaces of the TPAC's architectural form might concentrate and redirect urban noise toward adjacent residential buildings.



Figure 5. Distinctive geometric massing of TPAC [10].

To address these concerns, the study conducted sound measurements at five key locations around the TPAC complex, including areas near the corrugated glass façade, beneath the south plaza cube, and behind the building [10]. A combination of sound level meters, binaural microphones, and video recordings was used to capture and analyze acoustic conditions. Special attention was paid to LAeq and LApeak values, as well as the presence of reflective surfaces and passive noise-mitigating features such as curved glass and perforated metal façades. Initial results confirmed a moderately noisy urban environment, with traffic noise peaks exceeding 90 dB in certain areas. However, measurements near the building envelope indicated relatively low interior sound levels, suggesting that the architectural design performs effectively as an acoustic buffer.

Unexpectedly, while documenting the ambient traffic noise, the researchers observed a distinctive acoustic feature: a sequence of beeping sounds from passing vehicles - particularly buses - with alternating high and low pitches. As shown in Fig. 6, these beeps appeared as strong, patterned signals in the spectrogram recorded at Position 1 (left bottom corner of Fig. 5), peaking at 96.9 dB. What initially seemed like random noise pollution gradually emerged as a culturally embedded auditory phenomenon. These tonal beeps, used to signal turns or alert nearby vehicles and pedestrians, were found to be not merely functional, but socially meaningful—a form of urban signaling unique to Taipei's streetscape.

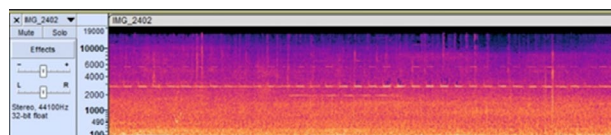


Figure 6. Spectrogram of beeping sound at corner of TPAC and Jiantan MRT [10].

In short, what began as a technical assessment of sound reflection and environmental noise mitigation evolved into a broader exploration of cultural sound perception. The TPAC study confirmed the building's acoustic resilience while simultaneously highlighting how everyday traffic sounds - especially vehicle beeping - contribute to Taipei's urban sound identity. These sounds, often dismissed as background noise, are in fact integral to the city's rhythm and social communication practices. As such, they deserve greater recognition in urban acoustic planning and should



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be considered as part of a city's intangible cultural sound heritage.

3.6 Urban Soundscape: White-vented Myna Choruses on Zhongqing Road

This study was originally motivated by a student's personal observation of persistent bird choruses near their residence on Zhongqing Road in Taichung. What began as a casual curiosity about unusually frequent birdcalls soon evolved into a deeper investigation of how urban development may have unintentionally given rise to a new biological soundscape - emerging in a space previously dominated by vehicular noise.

Historically, the White-vented Mynas observed in this study had not been known to inhabit this particular urban corridor. However, as nearby green spaces were cleared to make way for the Shuinan Trade and Economic Park (S.T.E.P.), it appeared that these birds had migrated into the remaining urban greenery - particularly the linear arrangement of trees dividing traffic lanes along Zhongqing Road [11]. Through on-site audio and video recordings, along with sound pressure level measurements, the study documented a regular pattern of bird chorus activity occurring at dawn and dusk. These gatherings followed a daily rhythm, with each dusk chorus lasting approximately 30 minutes and reaching peak sound levels of up to 75.4 dBA - occasionally surpassing the regulatory noise limits for residential outdoor environments in Taiwan (see Fig. 7). Spectrograms further revealed distinct temporal sound signatures that aligned with both bird activity and traffic fluctuations, the latter being tracked via the Intelligent Transportation System (ITS) (see Fig. 8).

For pedestrians and casual observers, the scene became an unexpected form of ecological spectacle - a moment when nature reclaims space in the midst of the city. However, perceptions among nearby residents varied significantly. Interviews and questionnaire responses revealed that many residents were entirely unaware of the bird choruses. Those living in newer high-rise apartments equipped with well-insulated windows and walls often did not hear the birds at all, either because they were asleep during peak activity periods or returned home after the birds had dispersed. One particularly striking anecdote came from a young couple who noted that they only became aware of the bird sounds during the COVID-19 lockdown, when extended time at home allowed them to notice and appreciate the choruses as a calming, even beautiful, dimension of their immediate environment.

This case study illustrates how ecological soundscapes can emerge as a direct response to urban transformation, repurposing traffic corridors into sites of biological acoustic activity. It also underscores how the experience and awareness of sound are deeply mediated by architectural, spatial, and temporal factors. What is heard - or not heard - is not simply a matter of decibels, but of lived context. The White-vented Myna choruses on Zhongqing Road invite us to reconsider the layered complexity of urban soundscapes, reminding us that some of the most meaningful urban sounds may come not from human design, but from unexpected acts of ecological adaptation.



Figure 7. Measured sound pressure levels and residential noise regulation thresholds [11].

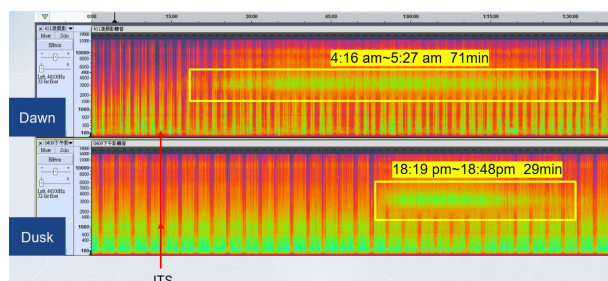


Figure 8. Spectrograms of bird choruses for dawn and dusk with ITS and traffic noise patterns [11].

4. CONCLUSION

This study underscores the importance of listening to the built environment not merely as an acoustic field, but as a complex cultural and social landscape. Through a series of student-led case studies, we have shown that urban sounds - whether historical reconstructions, transportation announcements, or ecological intrusions - carry rich layers of meaning that shape how cities are perceived, remembered, and lived. By integrating ISO 12913 methodologies with phenomenological inquiry and cultural



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interpretation, we advocate for a shift in how sound is valued in urban planning: from a problem to be mitigated, to a resource to be understood, preserved, and celebrated. Urban soundscapes, in their richness and diversity, are vital to the intangible heritage of cities and deserve a central place in the discourse on sustainable and inclusive urban environments.

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