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# The "Silent Route" as a quiet place. A case study of a walking trail in the Wdecki Landscape Park (Tuchola Forest, Poland)

**Abstract**: The article presents a case study of Poland's first "Silent Route", located in the Wdecki Landscape Park, as an example of a tourist trail serving as a quiet place. The aim of the study was to assess the acoustic climate along the route, identify the sounds occurring on it, and determine the characteristics relevant to its functioning as a quiet place. The study used secondary source analysis, sound level measurements using a VOLTCRAFT SL-100 meter, and field observations covering the development and use of the route. The results confirm that, despite natural fluctuations in sound levels, the route meets the criteria for a quiet place. The measured average values of equivalent sound level (LAeq) at the measurement points along the route ranged from 30.05 to 47.9 dB, depending on the day and weather conditions. The route is characterised by a low and stable acoustic background, the dominance of natural sounds, and only incidental and short-lived signals from anthropogenic sources. It can be described as a sustainable, nature-based trail with a niche character, characterised by minimal infrastructure and low user traffic. The route enables the development of sustainable tourism, particularly forms supporting health and well-being, and can serve as a tool for nature conservation and environmental education in protected areas.

**Keywords:** quiet areas, soundscape, acoustic environment, quiet trails, nature-based tourism, protected areas

## 1. Introduction

Nowadays, there is a growing demand for contact with nature and peaceful relaxation (Louv, 2012). This is mainly due to general fatigue with civilisation (Pasek and Kochańczyk, 2017; Zhang et al., 2020), living in a polluted environment and man-made noise (Szołtysek and Twaróg, 2012). On the other hand, there is a noticeable increase in public health awareness and a trend towards a healthy lifestyle involving contact with nature (Frumkin et al., 2017). An increasingly sought-after element of healthy living and leisure for modern humans is silence, understood not as a complete absence of sound, but as an acoustic environment that allows for the audibility of delicate, subtle sounds of nature, free from noise and annoying sounds, conducive to regeneration, reflection and positive aesthetic experiences (Bernat, 2011, 2014; Komppula et al., 2017).

However, silence is a scarce resource today. Numerous studies indicate that there is a lack of places in the world free from man-made noise (Hempton and Grossman, 2009; Kagge, 2017; Mamzer, 2020; Bernat and Bernat, 2022). This also applies to areas that are supposed to be peaceful, such as health resorts (Malec, 2019), forests (Bernat, 2013)

and protected areas, including national parks (Barber et al., 2011; Patania et al., 2011; Merchan et al., 2014; Buxton et al., 2017). This disrupts the natural behaviour of animals (European Environment Agency, 2016), reduces the recreational value of areas (Rypiński, 2013) and negatively affects the aesthetic experience of tourists (Bernat, 2014). As a result, natural soundscapes are increasingly treated as heritage that needs to be protected, and their preservation – understood as the protection of subtle, area-specific environmental sounds and the reduction of anthropogenic noise – is considered one of the key challenges of the 21st century (Waugh et al., 2003; Qiu et al., 2018; He et al., 2019; Szpunar, 2020).

In order to protect areas that are still free from excessive anthropogenic noise, the European Union, in accordance with Directive 2002/49/EC (European Parliament and Council, 2002), has introduced the concept of so-called quiet areas. These areas protect natural soundscapes, biodiversity and human health, and are also valuable resources for tourism and recreation (European Environment Agency, 2014). The implementation of the concept of quiet areas as part of the tourist offer is considered an important driver of local sustainable development (Bernat, 2014; Samorząd Województwa Kujawsko-Pomorskiego, 2021a).

In addition to institutional measures to protect silence, there is growing interest in its subjective significance in terms of individual well-being and its role in tourism and recreational experiences. Silence is increasingly seen as an element of quality of life and a facility that enhances the quality of leisure (Waugh et al., 2003; Liu et al., 2017; He et al., 2019; Jiang, 2022). Research indicates that spending time in quiet and peaceful places has a beneficial effect on mental and physical health (Bernat, 2014; European Environment Agency, 2014; European Environment Agency, 2016; Peeters and Nusselder, 2021). Silence promotes regeneration and is an antidote to acoustic, social and visual overload (Mamzer, 2020).

In search of silence, people turn to nature, often traveling to hard-to-reach places such as mountain peaks and caves (Rypiński, 2013; Jiang, 2022) or remote, sparsely populated regions of the world, including polar areas, whose attractiveness is growing due to the opportunity to experience isolation and “primordial silence” (Mamzer, 2020).

The literature on the subject indicates that with the growing demand for silence, it is becoming not only a desirable resource, but also the basis for new tourism products (Bernat, 2011; Rypiński, 2013; Flanz, Jaremczuk, 2021), which, according to Lebiedowska (2009), can compete with other, more sophisticated experiences. Tourists who experience silence and positively valued solitude, enabling reflection and deeper insight into themselves, are described as consumers of a new type of “luxury goods” (Mamzer, 2020). As a result, there is a growing need to identify and protect places that enable contact with nature and guarantee silence (Malec, 2019).

There is a lack of research in the literature assessing the suitability of specific spaces for serving as quiet and peaceful recreational areas and promoting silence as a tourist attraction (Malec, 2019). Silence is also rarely analysed in relation to linear forms of space, such as trails and tourist paths, even though it is precisely these, especially those running through low-noise forest areas, that can serve as spaces of silence and promote calm and psychophysical regeneration. However, this requires in-depth research into their potential and significance as places of silence.

The aim of this study was to evaluate Poland's first Silent Route by analysing the acoustic climate along the route and identifying its characteristics to determine whether it meets the criteria for a quiet and peaceful place. The analysis covered the level and type of sounds present, elements of development and the way the route is used.

## 2. Theoretical background

Currently, there is a global increase in the number of recreational trails, with routes that enable close contact with nature and promote health becoming particularly important (Godtman Kling et al., 2017; Gobster et al., 2023). This group includes, among others, shinrin-yoku, which allows one to immerse oneself in the atmosphere of the forest (Miyazaki, 2018; Kotera et al., 2020; Farkic et al., 2021; Cvikl, 2022), therapeutic forest trails designed to reduce stress and support convalescence (Ohe et al., 2017; Gürbey et al., 2020), health trails aimed at improving physical fitness and coordination (Połucha et al., 2013; Vukin and Isalović, 2018), as well as sensory trails, engaging various senses in experiencing the environment, used, among others, in the rehabilitation of people with disabilities (Zajadacz and Lubarska, 2019).

The implementation of the idea of routes combining contact with nature, regeneration and conscious experience of the environment can be observed in thematic trails created in mountainous and forested regions of Europe. One example is the trail network marked out in the Trentino region of Italy, including the Sentiero Acqua e Faggi (“Water and Beech Trees”), which encourages immersion in the sounds and smells of the forest (Visit Trentino, n.d.), the Il Respiro degli Alberi (“The Breath of the Trees”), which combines the experience of nature with the perception of contemporary art through artistic installations placed along the route (Alpe Cimbra, n.d.) and Kneipp paths, which use hydrotherapy in mountain streams as a form of stress reduction and immunity improvement. Similar principles are implemented by the Forest Selfness route in the forests of the Cerkno region in Slovenia, where walks are conducted with the participation of experts in relaxation, meditation and personal development (Visit Cerkno, n.d.).

A special category is represented by trails with exceptional acoustic qualities, designed to guarantee silence and a sense of peace (Rogowski, 2008; Bernat, 2013; Ohe et al., 2017). These include the so-called tranquillity trails, implemented as green corridors with limited noise levels, often leading through areas with open views of the landscape. Their concept combines tranquillity with moderate physical activity in the form of a peaceful walk aimed at regeneration. An example of such a route is the Tranquillity Trail in Tramore, Northern Ireland, designated on the basis of a tranquillity assessment tool (TRAPT) that takes into account noise levels and the proportion of natural and cultural features in the landscape (Watts and Bauer, 2022).

Quiet trails certified by Quiet Parks International are the formal implementation of the idea of trails based on silence. The first trail in the world to obtain this status (18 July 2022) is the Cueifong Lake Circular Trail in Taiwan, where sound levels of less than 25 dB were measured on the quietest section (Quiet Parks International, n.d.). These trails are designated in areas of exceptional natural and acoustic value, and their design is intended to enable hiking, cycling or canoeing while maintaining conditions conducive to experiencing silence. Although the standards for the “Quiet Trails” category are still being refined, QPI indicates that an important criterion is a dependable noise-free interval, understood as a predictable period of at least 15 minutes of natural silence free from anthropogenic sounds, currently used in the certification of Wilderness Quiet Parks (Mikkelson, 2023).

Previous studies indicate that recreational trails can combine natural, health and therapeutic values, creating quiet and peaceful spaces conducive to regeneration and conscious experience of the environment. Despite growing interest in this topic, there are gaps in research on tourist trails (Moore and Shafer, 2001; Godtman Kling et al., 2017; Gobster et al., 2023).

At the national level, previous analyses have included studies of the soundscapes of mountain trails in terms of their suitability as quiet and peaceful places (Malec, 2019), studies on the perception of the sound environment along tourist routes (Rogowski, 2008) and an assessment of the impact of road noise on the recreational value of protected areas (Lebiedowska, 2009). The results of these studies confirm the importance of silence and natural sounds as key elements of the quality of recreational spaces, while pointing to the need for further analysis of the conditions conducive to silence on trails and their potential to serve as quiet places.

## 3. Research area and methods

### 3.1. Research area

The subject of the study was the only Silent Route in Poland (as of December 2023), located in the Wdecki Landscape Park, situated within the Tuchola Forest – one of the largest forest complexes in Poland, which has the status of a UNESCO Biosphere Reserve under the Man and the Biosphere (MAB) Programme, covering an area of 3,195 km² (Bory Tucholskie, n.d.). This region, distinguished by its significant natural and cultural values, is one of the most popular tourist areas in the country (Rurek et al., 2022). The landscape of the Tuchola Forest is dominated by pine forests, forming extensive and spatially compact forest complexes with a relatively low level of anthropogenic pressure, thereby contributing to the creation of quiet conditions and the preservation of the natural acoustic background. The Wdecki Landscape Park, established in 1993, is one of four landscape parks in the Tuchola Forest (Fig. 1). It is characterised by a diverse terrain, including moraine plains, undulating hills and river valleys. The Wda River flows through the park, which is one of the key elements of the natural landscape of the Tuchola Forest. Forests cover about 60% of the Wdecki Landscape Park (Parki Kujawsko-Pomorskie, n.d.-c).

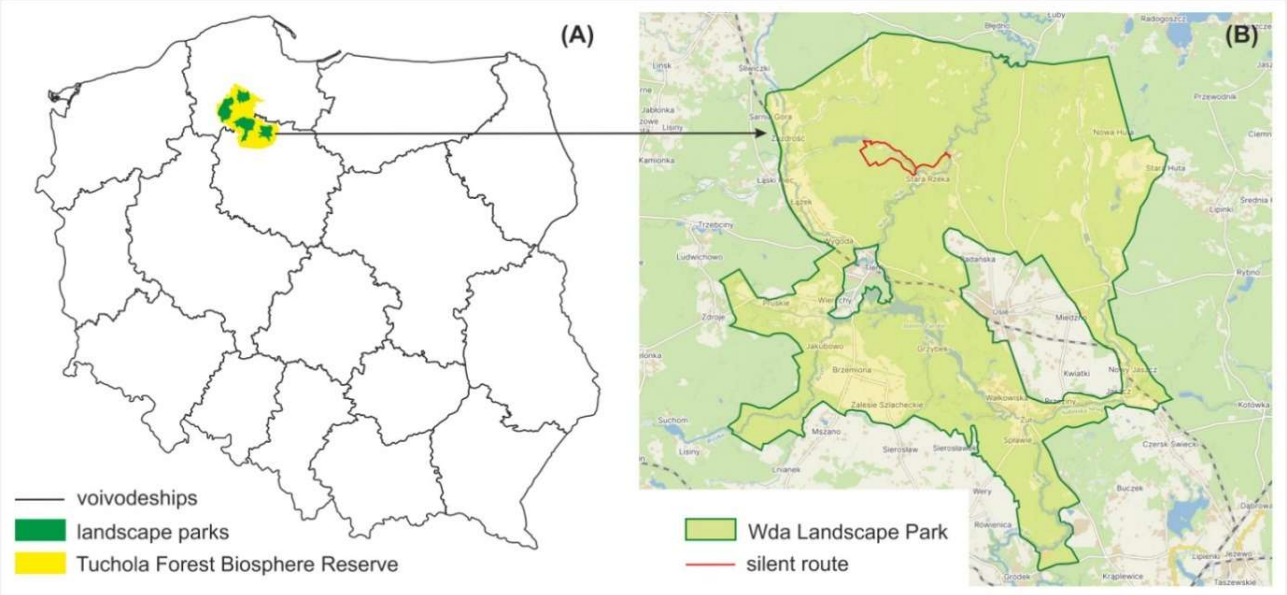


**Figure 1.** (A) The Wdecki Landscape Park against the background of Poland and the Tuchola Forest Biosphere Reserve; (B) Location of the Silent Route within the Wdecki Landscape Park. Source: own elaboration based on geoportal.gov.pl and Mapy.cz

The Silent Route runs through the northern part of the Wdecki Landscape Park, connecting the Wda River valley with Lake Piaseczno (Fig. 2). The entire route runs through forest areas, mainlypine forests with an admixture of birch and mixed forests, as well as fragments of old oak-hornbeam forest and habitats typical of wetlands (Samorząd Województwa Kujawsko-Pomorskiego, 2022a). In two places, the route approaches the Wda riverbed.

There are valuable natural areas located near the route, including the Lake Piaseczno Nature Reserve, which protects the lake's ecosystem due to its scientific, natural and landscape values (Parki Kujawsko-Pomorskie, n.d.-b) and the ecological site in the Czyściewnica spring mire area with a system of beaver dams (Parki Kujawsko-Pomorskie, n.d.-a). The entire area is covered by the Natura 2000 network – Special Area of Conservation “Sandr Wdy” (Wdecki Park Krajobrazowy, 2016).

The Silent Route, created in 2022 during the COVID-19 pandemic, is the result of the ThreeT project “Areas of silence as a tourist attraction”, carried out by the Marshal's Office of the Kujawsko-Pomorskie Province (Samorząd Województwa Kujawsko-Pomorskiego, 2022b; Samorząd Województwa Kujawsko-Pomorskiego, n.d.). The project focused on promoting silence as a tourist attraction in landscape parks by identifying, designating and making available areas of silence[1]. To this end, provisions have been made for marking out tourist trails and dedicated silence routes. According to the concept, these routes should be 4-6 km long (up to a maximum of 8 km), be looped or loop-like in form, be technically easy, accessible to various user groups, and run through areas of natural beauty, away from traffic, large concentrations of tourists and other significant sources of noise (Samorząd Województwa Kujawsko-Pomorskiego, 2022a, 2022b).

## 3.2. Materials and methods

The research was based on an analysis of secondary sources, including a review of scientific literature and project documents concerning areas of silence, as well as field research conducted on the Silent Route. The fieldwork included measurements of the acoustic climate and observations of environmental sounds, inspired by the principles of the sound walk method (Rogowski, 2016; Szpunar, 2020). At the same time, while moving along the route, an inventory of the spatial and infrastructural features of the trail was carried out, and the

[1] The concept of areas of silence implemented as part of the ThreeT project is based on the regulations on acoustic environmental protection in force in Poland. Issues related to the protection of silence are addressed in the Environmental Protection Law (Dz.U. 2020, poz. 1219), which uses the term “quiet area outside an agglomeration”, defined as an area not exposed to traffic, industrial or recreational noise. The ThreeT project can be seen as an attempt to implement this concept in practice by combining conservation objectives with the tourist and educational functions of landscape parks. The ThreeT project was inspired by Finnish experiences, in particular the concept of “silent areas” developed by the Regional Council of Central Finland as part of the “Silence as a Tourism Attraction”, in which silence is treated as a consciously shaped landscape resource and an element of the tourist offer of areas of natural value, linked to the idea of well-being and relaxation in a forest environment. This concept was adapted to the conditions of the landscape parks of the Kujawsko-Pomorskie Province, providing the basis for designating areas of silence and designing silent routes (Rzemykowska, 2021; Samorząd Województwa Kujawsko-Pomorskiego, 2021a, 2022b). The boundaries of quiet areas were designated on the basis of identifying the main sources of noise and defining buffer zones around them. In the delimitation process, illustrative sound level measurements were also carried out in pre-designated areas of landscape parks, which confirmed the validity of their classification as quiet areas. As a result, 30 quiet areas were identified in 8 of the 10 landscape parks in the province, with a total area of 25,382 ha, which represents 14.8% of their total area (Samorząd Województwa Kujawsko-Pomorskiego, 2021b, 2022b).

number and ways in which it was used by visitors was observed.

The analysis covered a section of the Silent Route with a total length of 8.5 km, consisting of two parts: a 1.75 km long linear section leading from “Przystań Stara Rzeka” (Stara Rzeka Marina) (point no. 1) to measuring point no. 8, and a 6.75 km long loop connecting the vicinity of Lake Piaseczno (points 24-25) with the Wda River valley in the area of the Czyściewnica estuary (measuring point no. 9) (Fig. 2). The connection between the linear section and the loop is measuring point no. 8, and points 9-34 mark subsequent measuring points along the loop. Taking into account the return along the same linear section, the total length of the route was 10.25 km. Sound pressure level measurements were taken at 34 measuring points spaced every 250 m, according to the readings from a Garmin GPS receiver (Fig. 2.)

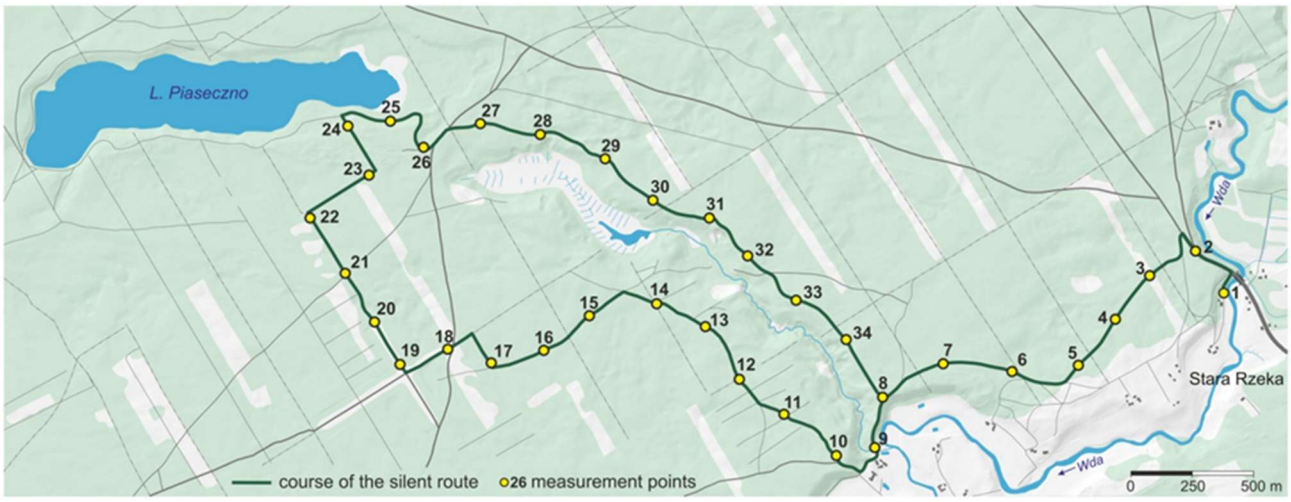


**Figure 2.** Distribution of measurement points along the Silent Route. Source: own elaboration based on geoportal.gov.pl

The measurements were conducted three times: in autumn during the leafless period (6 November 2022), in the summer season (24 June 2023) and in early autumn (8 October 2023) in order to capture the seasonal variation in the acoustic conditions of the environment.: in autumn during the leafless period (6 November 2022), in the summer season (24 June 2023) and in early autumn (8 October 2023) in order to capture the seasonal variation in the acoustic conditions of the environment. The measurements were carried out on weekends, between 11:00 and 15:00, i.e. during the period of potentially highest tourist activity, which allowed the acoustic conditions to be captured at the maximum anthropogenic noise load on the trail. Due to strong wind gusts exceeding 16 m/s (Table 1), the data from the third measurement day (8 October 2023) were treated as supplementary material.

A VOLTCRAFT SL-100 sound level meter (class 2 according to IEC 61672-1, range 30–130 dB) was used for the measurements. Before starting field work, the device was calibrated in accordance with the manufacturer's recommendations. Measurements were taken using a tripod set at a height of 1.5 m, with the microphone facing away from the operator in order to limit the impact of the presence of the person taking the measurement on the result. Three 15-second measurements were taken at each point, on the basis of which the average value was calculated. The device was equipped with a windscreen. Equivalent sound levels (LAeq) were recorded, reflecting the acoustic background, as well as maximum values (LAmax), corresponding to short-term peaks in sound intensity from identified natural and anthropogenic sources, both at and between measurement points. This approach enabled

a comprehensive assessment of the acoustic climate of the route and the identification of sound episodes contributing to its acoustic landscape. The data were recorded in field sheets and transferred to a spreadsheet (MS Excel). At the same time, qualitative notes were taken on audible sound sources. The methodology used made it possible to obtain both a quantitative characterisation of the acoustic background and a qualitative identification of the components of the route's soundscape.

## 4. Results

### 4.1. Sound pressure level and soundscape structure of the Silent Route

A necessary condition for the functioning of the Silent Route is the maintenance of low noise levels and the dominance of natural sounds over anthropogenic ones. In order to verify these conditions, sound pressure level measurements were carried out and audible sound sources on the route were identified (Table 1). The analysis of the results allows us to assess whether the area meets the criteria for a quiet area, i.e. a place with an average sound level not exceeding 35–38 dB [2], free from nuisance noise sources, and to characterise its soundscape.

On the first day of measurement, 6 November 2022, an exceptionally even acoustic picture of the route was recorded (Fig. 3), resulting from stable atmospheric conditions (wind speed 2.97 m/s, no gusts, temperature 10 °C, full sunshine) (Table 1). The average sound level (LAeq) values ranged from 30.05 to 34.7 dB, and the amplitude was only 4.65 dB. Most values oscillated around 30–33 dB. The average sound level for the entire route was 31.5 dB. The dominant acoustic layer was created by the natural sounds of the forest environment: birds singing, crows cawing, woodpeckers tapping, leaves rustling on the path, drops falling from trees, the subtle sound of the wind, and locally also the sound of water (at measuring point 1, “Przystań Stara Rzeka”). Sporadic anthropogenic sounds, such as passing cars, cyclists and pedestrians talking on the route, were short-lived and did not disturb the perception of silence. In the distance, the sound of a flying aeroplane, a passing train, forestry equipment and a dog barking could also be heard. Overall, the soundscape of the route on that day can be described as natural, calm and balanced, with minimal anthropogenic noise.

The second measurement, on 24 June 2023, was taken in moderate wind conditions (2.83 m/s, gusts up to 8 m/s), at a temperature of 22.2 °C and under partly cloudy skies. Sound levels ranged from 31.0 to 46.7 dB, while the average LAeq value calculated on the basis of measurements at 34 measuring points was 34.7 dB (Fig. 3, Table 1). The highest average LAeq value (46.7 dB) was recorded at “Smażalnia Pstrąga u Basi” (Basia's Trout Fry) (LAmax 53.3 dB) (point 9), where a large number of tourists were present that day. It was the only point on the route where anthropogenic sounds dominated, mainly tourists' conversations and a few car noises. Further along the route, the sounds of nature dominated: birds singing, insects buzzing, leaves rustling and the wind rustling in the treetops. Sporadic anthropogenic sounds were associated with passing cars, cyclists and tourists walking. Most values were in the range of 32–36 dB. Wind gusts caused local increases in sound level to values above 40 dB, but these did not significantly affect the overall assessment of acoustic conditions. The soundscape of the Silent Route retained its

[2] The adoption of the 35–38 dB reference band was based on the results of previous indicative measurements carried out in selected locations of landscape parks preliminarily identified as quiet areas as part of the project “Silence as a tourist attraction”. These measurements showed that the sound level was most often within this range (Samorząd Województwa Kujawsko-Pomorskiego, 2021b).

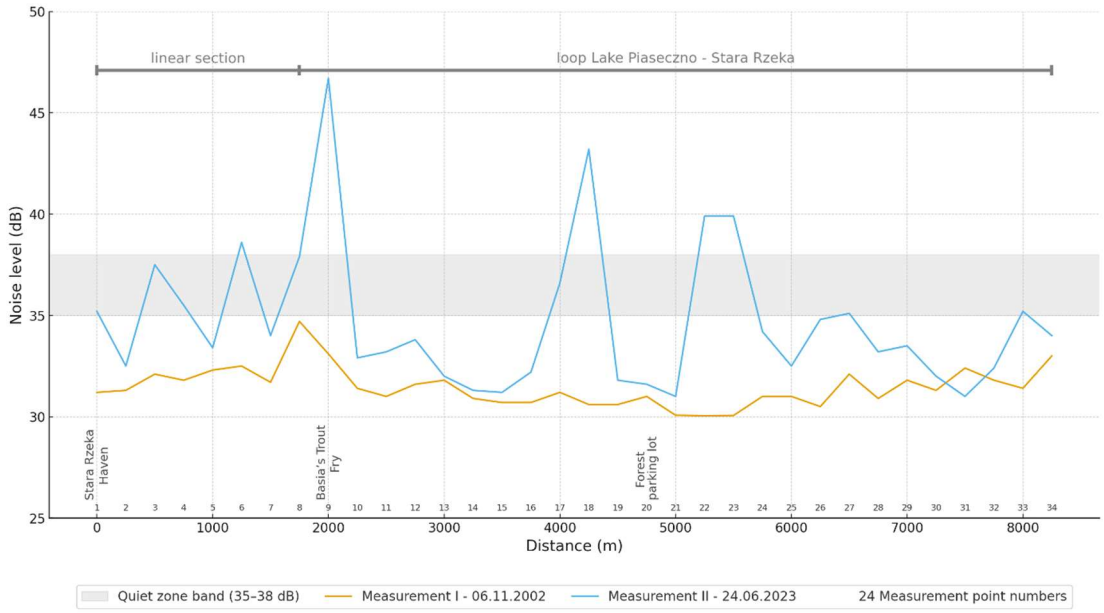


**Figure 3.** Average sound levels (LAeq) recorded at measuring points on the Silent Route. Source: own study based on field research

**Table 1.** Sound levels (LAeq, LAmax) and types of sounds recorded on the Silent Route. Source: field research. Weather data obtained from OGIMET and Garmin Connect.

| Criterion | Measurement I 06.11.2022 | Measurement II 24.06.2023 | Measurement III 08.10.2023* |
|---|---|---|---|
| **Wind speed [m/s] ** / wind gusts [m/s]** | 2.97 m/s<br>no gusts | 2.83 m/s<br>gusts up to 8 m/s | 3.7 m/s<br>gusts up to 16 m/s |
| **Temperature [°C]** | 10.0 °C | 22.2 °C | 10.6 °C |
| **Range of average sound levels [dB LAeq] at measurement points** | 30.05–34.7 dB | 31.0–46.7 dB | 37.6–47.9 dB |
| **Average sound level [dB LAeq] for the entire route** | 31.5 dB | 34.7 dB | 42.4 dB |
| **Maximum values of natural sounds (LAmax) *** ** | - birdsong (50.6 dB)<br>- tree rustling (46.0 dB)<br>- raindrops falling from trees (34.2 dB) | - birdsong (67.3 dB)<br>- tree rustling (64.2 dB)<br>- buzzing insects (43.0 dB)<br>- rustling leaves (41.5 dB) | - crows cawing (54.0 dB)<br>- birdsong (56.8 dB)<br>- rustling of trees in gusts of wind (77.6 dB)<br>- creaking of bending trees (48.0 dB) |
| **Maximum values of anthropogenic sounds (LAmax)*** ** | - a passing car (71.8 dB)<br>- a passing electric car (61.0 dB)<br>- an aeroplane in the distance (41.4 dB)<br>- forestry equipment in the distance (32.0 dB)<br>- a train in the distance (31.7 dB)<br>- footsteps of people walking on fallen leaves (72.3 dB)<br>- footsteps and conversations of people on a path (66.6 dB)<br>- a cyclist passing by (46.0 dB) | - a passing car (67.7 dB)<br>- an aeroplane in the distance (43.0 dB)<br>- noise from tourists at “Smażalnia Pstrąga u Basi” (53.3 dB)<br>- a passing cyclist (48.0 dB) | - a passing car (81.0 dB)<br>- a dog running along the path (69.2 dB)<br>- dogs barking in the distance (44.8 dB) |

* Measurement conducted under strong wind gusts (>16 m/s); supplementary data.

** Meteorological data originally given in km/h, converted to m/s.

*** Recorded events varied between individual measurement days.

natural and consistent character, with a predominance of natural sounds. The highest LAeq values and the widest range of variability were recorded on the third day of measurement – 8 October 2023, which was directly related to the occurrence of strong wind gusts (up to 16 m/s). Therefore, these data were used only as supplementary material illustrating the impact of wind on the variability of the acoustic environment. LAeq levels ranged from 37.6 to 47.9 dB, with an average value of 42.4 dB, exceeding the accepted reference band for quiet areas of 35–38 dB. On that day, no permanent anthropogenic sources were recorded, only short-term episodes: a passing car and cyclist, a running dog, and conversations of tourists walking along the route. The dominant sounds were those of nature amplified by the wind: the intense rustling of trees, the creaking of trunks, the voices of birds, including ravens, and the sounds of flying geese, creating a typical autumn soundscape of the forest.

An analysis of the types of sounds revealed that, regardless of the measurement date, the dominant acoustic layer of the Silent Route was created by the sounds of the natural environment, in particular biophonic sounds (birdsong, woodpecker tapping and insect sounds) and geophonic sounds (wind rustling in the treetops, moving leaves, creaking tree trunks, localised water noise), which continuously build the sound identity of the route and define the character of the place, creating an acoustic landscape typical of natural environments with low anthropogenic pressure. Anthropophonic sounds on the trail are sporadic and short-lived, limited to the passage of individual cars (only on selected sections open to car traffic, i.e. in the area of the forest car park – points 19–20, and on the section from “Przystań Stara Rzeka” to “Smażalnia Pstrąga u Basi” – points 1–9), the presence of a few hikers and cyclists, and occasional dog sounds. No permanent sources of traffic or industrial noise were recorded along the entire length of the route, and distant sounds of aeroplanes (heard between points 26 and 27) and trains (recorded only during the leafless period in the area of points 24 and 25 – the railway line is located here at a distance of approx. 3.4 km) did not cause a significant increase in the sound level.

The trail is also characterised by a dynamic but harmonious soundscape. This variability is due to short-term increases in maximum sound level (LAmax), typical of forest environments — primarily associated with wind gusts, which locally raised the sound level of tree noise to over 60 dB, and in conditions of stronger gusts even up to about 77 dB, and from the close vocalisations of birds, increasing the sound level to over 50 dB, in places around 67 dB (Table 1). Episodic maxima were also recorded for a few anthropogenic sounds: individual cars passing by reached 70–81 dB, tourists' footsteps or conversations reached values above 60 dB, a running dog generated sounds of around 70 dB, and a cyclist passing by around 46–48 dB. These events were incidental and did not affect the overall perception of silence or the structure of the soundscape.

## 4.2. Development and use of the Silent Route

In order to determine the characteristic features of the Silent Route, an inventory of its development elements was carried out and the methods and intensity of use of the route were observed. In accordance with the concept of quiet routes (Samorząd Województwa Kujawsko-Pomorskiego, 2022a), the infrastructure was kept to a minimum in order to preserve the natural character of the place. There are three wooden shelters and two information boards along the route. The signage was made in accordance with the rules applicable to educational routes, using white and green squares and directional arrows

at forks (Polskie Towarzystwo Turystyczno-Krajoznawcze, 2022).

The route runs mainly along forest roads and paths, mostly outside marked tourist trails, which promotes direct contact with nature (Fig. 4). Only short sections overlap with tourist trails: in the area of Lake Piaseczno with the black trail "Ścieżka Zagłoby", at the Czyściewnica Peat Bog with the "Ścieżka Zagłoby" trail and the red "Stu z nieba" trail, and on the section towards Stara Rzeka with the blue "Szlak Harcerzy Światowida" trail and the "Stara Rzeka" Nordic Walking route (Fig. 5). There are two seasonal catering points on the route: "Smażalnia Pstrąga u Basi" with a trout fishery and "Przystań Stara Rzeka", which has a campsite in the summer. Both places also serve as canoe harbours and water equipment rental points, which connects the Silent Route with recreational activities on the Wda River. Together with the forest car park near Lake Piaseczno (point 20), these places are the main access points to the route.


**Figure 4.** Examples of forest path sections on the Silent Route: (A) Section on the southern side of Czyściewnica - near point 11, photograph taken on 06 November 2022; (B) Section above Lake Piaseczno – near point 25, photograph taken on 06 November 2022; (C) Section near Lake Piaseczno – near point 26, photograph taken on 06 November 2022; (D) Section on the slope of the Czyściewnica spring – near point 28, photograph taken on 24 June 2023. Source: photographs by the author

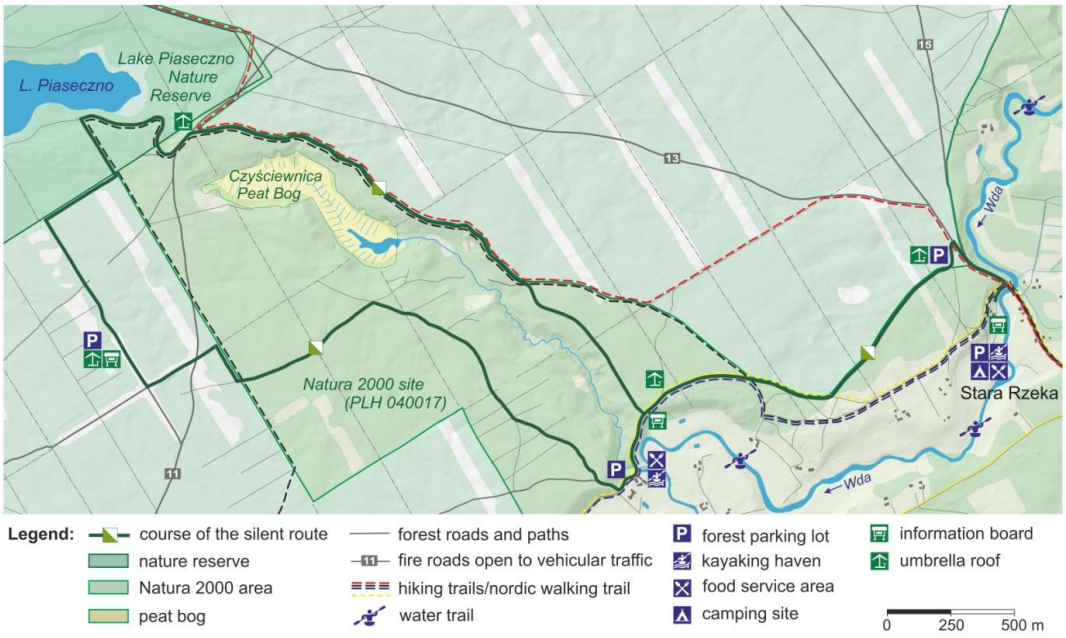


**Figure 5.** The course of the Silent Route in the Wdecki Landscape Park. Source: own elaboration based on geoportal.gov.pl

Field observations indicate low visitor numbers along most of the route. On the first day of measurement (6 November 2022), a total of 12 people were observed: walkers in the vicinity of Lake Piaseczno (points 24–25; 5 people) and the Czyściewnica peat bog (points 28–29; 3 people), 3 mushroom pickers in the area of the forest car park by Lake Piaseczno (point 20) and 1 person at the “Przystań Stara Rzeka” (point 1) (Fig. 2). During the summer measurement (24 June 2023), 10 users were recorded on the route: 7 people heading towards Lake Piaseczno (points 22–24), two tourists staying in a camper van in the car park by Lake Piaseczno (point 20) and one cyclist riding along the Czyściewnica peat bog (points 29–30). On the next autumn measurement day (8 October 2023), the number of visitors was 13. These were mainly mushroom pickers observed in the area of the forest car park by Lake Piaseczno (points 20–21; 6 people) and on the southern side of the Czyściewnica peat bog (points 12–13; 3 people), as well as 3 people staying at the “Smażalnia Pstrąga u Basi” (point 9) and 1 cyclist riding in the area of the “Przystań Stara Rzeka”. The number of users of the Silent Route should therefore be described as low and stable. The traffic intensity at seasonal catering points, which are junctions connecting the route with the river, is different. On 24 June 2023, at 1:00 p.m., there were 146 people at “Smażalnia Pstrąga u Basi” (point 9) and 40 kayaks on the shore, while at 2:30 p.m. at “Przystań Stara Rzeka” (point 1) there were 54 people and 27 kayaks. This indicates that a significant proportion of the people at these points were kayakers rather than users of the route itself, which is confirmed by the small number of parked cars. Despite the relatively high traffic at these junctions, this does not translate into higher attendance on the Silent Route, which remains a rarely visited space and retains its peaceful character. Outside the summer season, when there is no water traffic on the river and the catering outlets are closed, these places are almost empty, with only a few people staying there.

The results obtained indicate a low degree of development and low intensity of use, which contributes to the preservation of the natural and acoustic values of the route and emphasises its niche character and potential as a space for experiencing silence.

## 5. Discussion and Conclusions

The measurement results indicate that the route is characterised by a low and relatively stable acoustic background, the level of which does not generally exceed the reference band of 35–38 dB adopted for quiet areas, considered typical for landscape parks in the Kujawsko-Pomorskie Province (Samorząd Województwa Kujawsko-Pomorskiego, 2021b). These values are consistent with those reported in the literature, which, according to Karvinen and Savola (2004), range from 35 to 40 dB. The variation in sound levels was mainly due to meteorological conditions and natural activity, rather than permanent anthropogenic pressure. Even in conditions of stronger gusts of wind, the soundscape of the route retained its natural character, with a clear predominance of nature sounds. This confirms the recreational potential of the route based on the qualities of silence.

The dominant layer of the soundscape of the Silent Route is made up of natural sounds: birdsong, the rustling of leaves, the sounds of insects and the rustling of trees, sounds that are generally perceived as positive and relaxing (Zhu et al., 2023). The LAeq and LAmax values obtained indicate a dynamic but harmonious landscape, typical of areas with low anthropogenic pressure, where a quiet background coexists with short-term acoustic impulses of natural origin (Schafer, 1993). Anthropogenic sounds occurred sporadically

and were of a short-term nature, without disturbing the overall acoustic comfort, which is in line with the European Environment Agency's guidelines on quiet areas (European Environment Agency, 2014). In this respect, the route is an example of a hi-fi soundscape as defined by R. Murray Schafer (1993), where the sounds of nature are spatially clear and balanced, and anthropogenic sounds do not dominate the background, which promotes the perception of silence, a sense of calm and psychophysical regeneration (Ulrich, 1984; Kaplan and Kaplan, 1989), which is in line with the principles of acoustic ecology and soundscape ecology (Schafer, 1993; Payne et al., 2009).

The results of the study indicate that linear forms of space development, such as the Silent Route, can serve as quiet spaces. However, this direction remains poorly recognised in the literature, apart from a few studies, including Malec (2019), which showed the dominance of natural sounds (37–70 dB) on two mountain trails in the Beskids and Gorce. For comparison, night-time measurements in the Białowieża National Park showed exceptionally low LAeq values (17.0–18.2 dB), described by the authors as “quietness”, defined as the near or complete absence of sound (Wiciak et al., 2015). These results prove that it is possible to maintain an extremely low level of background noise in areas of high natural value, which justifies the need to identify and protect such places, including those of a linear nature.

The Silent Route can be seen as a new type of linear product in tourism — a walking trail whose main purpose is to bring people into contact with nature and experience silence through practices such as forest bathing or leisurely walking. This extends the functions of the forest to include health and well-being, associated with forest well-being tourism and forest therapy tourism, which have so far been poorly emphasised in Polish literature (Bielinis et al., 2016; Pietrzak-Zawadka and Zawadka, use of acoustic values in the management of 2016). This is in line with current trends in tourism, related to the requirement for green areas and silence, including the 'return to nature' trend (Louv, 2012) and the search for innovative forms of sustainable forest tourism development (Park et al., 2010; Aisyianita et al., 2022; Cvikl, 2022). An analysis of the existing infrastructure and the observed traffic intensity on the route indicates that the Silent Route meets the criteria of a sustainable, nature-based trail (Beeton, 2006; Marion et al., 2023), characterised by minimal infrastructure, low traffic and high natural values, conducive to preserving the authentic character of the place. The trail can provide a space for sound tourism, which focuses on experiencing the acoustic landscape (Rogowski, 2008; Bernat, 2013; Cvikl, 2022; Gobster et al., 2023) and nature tourism, including ornithological tourism, in which listening to bird calls is an important element (Dwyer and Edwards, 2010; Rypiński, 2013; Tryjanowski and Murawiec, 2021). From an educational perspective, it is an alternative to traditional educational trails (Woźniak and Jezierska-Thöle, 2022), offering education based on direct experience of silence and the sounds of nature, as well as multisensory exploration of the natural environment. It is a product dedicated to protected areas, which can support nature conservation by shaping visitors' attitudes of mindfulness and respect for nature and the soundscape.

The results of this study emphasise the importance of designating and protecting quiet spaces in the form of routes with low background noise and a predominance of natural sounds, which can serve as spaces of silence. The Silent Route in the Wdecki Landscape Park is an example of the practical application of the idea of acoustic landscape protection, combining natural, educational, tourist and health-promoting functions. It is an example of a space where the experience of nature's sounds becomes part of a sustainable human contact with nature and the innovative protected and forest areas.

## 6. Recommendations

The analysis carried out allows for a better understanding of the conditions for the functioning of quiet spaces on the example of the Silent Route, which may contribute to the popularisation of the idea of silence trails in Poland as a tool for rational access to areas of natural value and the protection of silence as a contemporary, valuable resource. Therefore, the following courses of action are proposed: taking silence into account in sustainable tourism policies as an environmental resource requiring protection on a par with landscape and biodiversity; planned development of silence trails in forests and protected areas as a tool for sustainable tourism, nature conservation and environmental education; selective and limited promotion of silence trails targeted at audiences seeking peace and contact with nature; developing educational activities concerning the value of silence for the environment and human well-being; developing a certification system for “quiet trails” that takes into account objective acoustic indicators, environmental criteria and users' perceptions; continuing research on the acoustic climate on other trails where silence is the dominant asset.

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