

# WOUNDED LANDSCAPE: ENVIRONMENTAL AND SOCIAL CONSEQUENCES OF (ILLEGAL) MOTOR TOURISM IN FORESTS ON THE EXAMPLE OF WOREK OKRZESZYNA (THE CENTRAL SUDETES ON THE POLISH-CZECH BORDERLAND)

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**ABSTRACT:** Off-road vehicles (ORVs) have recently become a serious problem not only for natural peripheral areas, but also for those rare green enclaves in heavily urbanised regions. The consequences of motor traffic in naturally valuable areas, including forests, affect the environment together with all its users to different extent. The scale and ubiquity of this type of motor tourism in Poland convinced the authors to research the subject and assess its influence on the forest environment, on the example of the mountains surrounding the region called Worek Okrzeszyna on the Polish-Czech borderland. The authors aimed to determine the scale and character of the phenomenon in forests and environmentally valuable areas in Poland, as well as to assess its scope in the examined research area together with the environmental and social effects. A field inventory of all the trails used by motor tourists was carried out, with particular emphasis on the extent of the network and their environmental consequences. In the ranges surrounding Worek Okrzeszyna from the south, a significant negative impact of illegal motor tourism on the vegetation, soil and relief have been revealed. It occurs wherever the phenomenon takes place: on forest roads, tourist trails and beyond them. Although the main research subject is the pressure of motor tourism on the environment, the authors also raise questions regarding social consequences of the phenomenon (noise, worse aesthetic experience), followed by the limits of tourism as such.

**KEYWORDS:** environmental changes, erosion, motor tourism, off-road vehicles (ORVs), Poland, Central Sudetes

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## Introduction

In recent years, off-road vehicles (ORVs, i.e. cross motorbikes, quads or off-road cars) entering the forest for sport, recreational or tourist rides have become a serious problem for both forest managers and users of the natural environment as a whole. To a different extent, the

phenomenon occurs in many regions of the world. Even though its legal assessment varies, it raises controversies almost everywhere because of the environmental damage caused. The scale of the phenomenon and its ubiquity in Poland convinced us to research forest motor tourism and to assess its impact on the forest environment on the example of the mountains surrounding a region called Worek Okrzeszyna on the

Polish-Czech borderland. We posed questions about environmental and social consequences of this activity, illegal both in Polish and Czech forests. The questions impelled us to discuss the limits of tourism wherever freedom to do free-time activities meets the limits of the applicable law.

The authors set the following detailed research tasks:

- determination of the scale and character of the phenomenon of motor tourism using ORVs in forests and environmentally valuable areas in Poland,
- assessment of the scope of motor tourism using ORVs in the studied research area,
- examination of the environmental effects of the analysed phenomenon based on the observations made in the research area and their comparison with the literature, also regarding other forms of tourist activity,
- determination of the possible social effects of motor tourism using ORVs in environmentally valuable areas based on field observations, unstructured interviews and literature indications.

This article represents a group of studies on the effects of tourism, in this case active tourism, in areas of natural value. Based on a number of publications presenting the phenomena in various spatial scales (e.g. Łajczak et al. 1996; Joslin, Youmans 1999; Buchwał, Fidelus 2008; Kolasińska 2015), the main causes of the devastation of the natural environment due to the impact of tourism can be listed (McCool 1994; Liddle 1997; Mika 2004; Wall, Mathieson 2006). On the one hand, there are too many tourists in relation to the carrying capacity of the (natural) environment, inappropriate forms of sightseeing and lack of culture among tourists. On the other hand, improper ways of adaptation of areas, particular assets or facilities to the needs of tourism, inappropriate forms of tourist exploitation of areas or certain assets, and improper locations and forms of tourist facilities can be observed (Kołodziejczyk 2020). In the case of linear forms of tourist penetration, such as presented in the article, negative consequences for the environment result from the concentration of a relatively large number of people in a narrow strip of land (Gaines et al. 2003). Although the literature focuses on the natural effects of active tourism (destruction of

vegetation and soil, erosion, disturbing animals, environmental pollution), the social effects are also important (noise, congestion, conflicts over space – cf. Wall, Mathieson 2006; Buckley 2012). In practice, each of the above-mentioned processes may be related, to some extent, to the effects of motor tourism using ORVs, which is the subject of this study.

## Motor tourism and its environmental consequences

### Definition of motor/drive tourism

Motor tourism (also known as motorised tourism or drive tourism) is based on using motor vehicles for tourist purposes going beyond the sole purpose of transport. What is equally important is the pleasure of driving or riding a vehicle, a sense of authenticity, freedom and adventure, pursuing one's interests (Zawadka 2015; Cater 2017; Frash, Blose 2019). In motor tourism, at least in some of its forms, the benefit and driving force for those who engage in it is the possibility to experience the *flow state* (Csikszentmihalyi 2005; Frash et al. 2018; Frash, Blose 2022), a temporary elimination of problems and worries, resulting from a total focus on the activity being done.

Motor tourism can be done on and off road, wherever it is possible, in the form of short trips as well as long journeys. The phenomenon has wide and varied meaning, including family travels in comfortable camper vans as well as lonely motorcycle journeys to the so-called world's end. In English-language literature, the term drive tourism is very popular (e.g. Prideaux, Carson 2011; Fjelstul, Fyall 2015; Sykes, Kelly 2016; Hanrahan et al. 2017; Qiu et al. 2018), and it usually describes journeys by car or motorcycle on paved roads standing out for their unique values (winding, scenic landscape; cf. Eby, Molnar 2002; Akbar et al. 2003; Denstadli, Jacobsen 2011). Drive tourism might be perceived as a form of an escape from the everyday routine (Frash et al. 2018), or at least as an important source of experiences (Hallo, Manning 2009; Qiu et al. 2018; Scuttari 2019).

When using sport motorcycles, quads or other ORVs, the quasi-sport aspect of this tourist or, more widely, leisure activity seems to be

important. It is connected with testing oneself as a driver and testing the equipment in technically difficult natural conditions, away from a regular trail. Dorocki (2021) notes that considering the benefits from the undertaken activity, motorcycle tourism is more similar to mountain biking, kayaking or climbing rather than other forms of motor tourism (e.g. using cars or camper vans), in which the final destination is key (cf. Carson, Taylor 2008; Pinch, Reimer 2012; Rickly 2016). Ramoa et al. (2021: 13) describe it vividly by saying that "(...) for motorcycle tourists, the journey could be seen as a destination on the move." Such an attitude towards a motor hobby enters also the category of adventure tourism (Price-Davies 2011; Cater 2017). In Europe, motorcycle tourism has been growing for several years and has been noticed by some researchers (Gronau, Große Hokamp 2022), but it is rather analysed from the perspective of motivations and experiences (Ertaş et al. 2022; Heide, Scuttari 2022; Scherhag et al. 2022; Wragg 2022), and to a lesser extent – at least for now – in the context of its negative effects (Chylińska, Kołodziejczyk 2022). This is due to the fact that researchers focus on motorcycling on paved roads, not in natural terrain (the work by Wragg (2022) is an exception here, although also focuses on motorcyclists' experiences). As a result, connections are indicated not only with adventure tourism but also with ecotourism (Ramoa et al. 2021; Scherhag et al. 2022). Given the observations made by the authors of this article, the latter connection may not always be true.

Motor tourism is practised in a specific area of law as riding vehicles requires not only adequate skills but also a license. Furthermore, the limits of driving/riding motor vehicles apply to defined spaces or technical infrastructure. In Poland, entering forests or protected areas using a motor vehicle is illegal, as stated by the Forest Act of 28 September 1991 (Art. 29(1)) and by preservation law (the Nature Preservation Act of 16 April 2014 (Art. 15(1)(18) and Art. 17(1)(1)).

Motor tourism using ORVs, an activity practised away from the network of paved roads and from tourist trails, appears in the scientific literature both in the context of the motivation of its participants (Joy, Antony 2019) and – increasingly often – with respect to the environmental and social consequences caused (Knight, Gutzwiller 1995; Liddle 1997; Joslin, Youmans 1999; Havlick

2002; Gaines et al. 2003; Davenport, Switalski 2006; Ouren et al. 2008). Previous analyses focus on areas where ORV tourism is popular or at least to some extent legal (e.g. the USA, Australia and Saudi Arabia). There are a number of policies and planning documents for ORV routes (WildEarth Guardians n.d.).

### Impacts of ORV tourism

The consequences of the presented phenomenon were subject to analysis in various natural environments, drawing attention to those where ORV tourism is done most frequently: dry lands (Webb, Wilshire 1983; Assaeed et al. 2019), grasslands (Nortjé et al. 2012; Bhandari 2018), seaside (Lucrezi, Schlacher 2010) and forests (Switalski, Jones 2012). Even though each of the mentioned environments has its own specificity and resistance to the negative impact of motor tourism, there are some common environmental consequences which most often include:

1. Reduction of the surface plant layer (undergrowth, undercoat) in places frequently ridden on by ORVs; creating conditions for ecologically unfavourable succession of foreign species, or species different than those dominating in a given environment (Bhandari 2018); uncovering root systems of the high vegetation, their weakening, mechanical damage to the roots and, consequently, over-exposure of plants to pathogenic factors (Ouren et al. 2007: xii);
2. Various forms of erosion, mostly wind (deflation) and water, initiated as a result of removing the surface plant layer from the soil. Linear slits ('ruts'), especially on slopes, facilitate washing out loose material, which results in deluvium into brooks and streams or transport of the material down the slope. According to Ouren et al. (2007: xii), when the surface vegetation, water infiltration and surfaces stabilising the soil are disturbed, the flow rate of the precipitation waters increases, additionally accelerating soil erosion;
3. Soil compaction in sites of frequent rides by motor vehicles, especially in dry season, which limits infiltration (Nortjé et al. 2012);
4. Soil deformation caused by motor traffic, creation of ruts, water retention in holes and changing of local water relations;

5. Stress for animals caused by noise (significantly exceeding the actual area penetrated by ORVs), human interference in natural habitats and wildlife sanctuaries; norms allowed by the local law might be exceeded multi-fold (Lerdsuchatavanich et al. 2017);
6. Air pollution with fumes (mainly  $\text{SO}_2$ ,  $\text{NO}_x$ ,  $\text{O}_3$ ) as well as water and soil pollution with technical liquids used in such vehicles (Joy, Antony 2019: 58).

Decay processes of the surface on which ORV travel may eventually lead to the total destruction of the land, which, in some cases, may disable its further use for off-road journeys. It leads to the widening of the areas 'ridden away' by the researched vehicles and to a kind of migration of the negative effects of this human activity to other places. Furthermore, ORV tourism causes destruction of the technical and transport infrastructure in the natural areas, first and foremost dirt roads, through their overexploitation or using them not in the designated way. The authorities responsible for the natural environment occasionally report events of the purposeful destruction of the devices aimed at limiting entries of mechanical vehicles to the forest, such as barriers and road signs. Social consequences of ORVs entering natural areas are, first of all, conflicts about recreational space between different users. Such consequences include a decrease in the comfort of relaxation and a lowered sense of safety experienced by people using the environment in a different way than motor tourists do (Ouren et al. 2007: xiii). Finally, it means lowering legal culture of citizens in a situation of not respecting the law and, at the same time, ineffective execution of the existing legal norms.

## Research area

Worek Okrzeszyna is located in the south-western part of Lower Silesia (Poland), constituting a small (about 10 km<sup>2</sup>) elongated area surrounded by the border with Czechia from three sides. From the west, it is surrounded by the hills of the southern end of the Krucze Mountains and from the east the Zawory Mountain range. To the south, the valley-like lowering is limited by the forested ranges of Jański Wierch (697 m a.s.l.) and Węglarz (567 m a.s.l.), divided by the

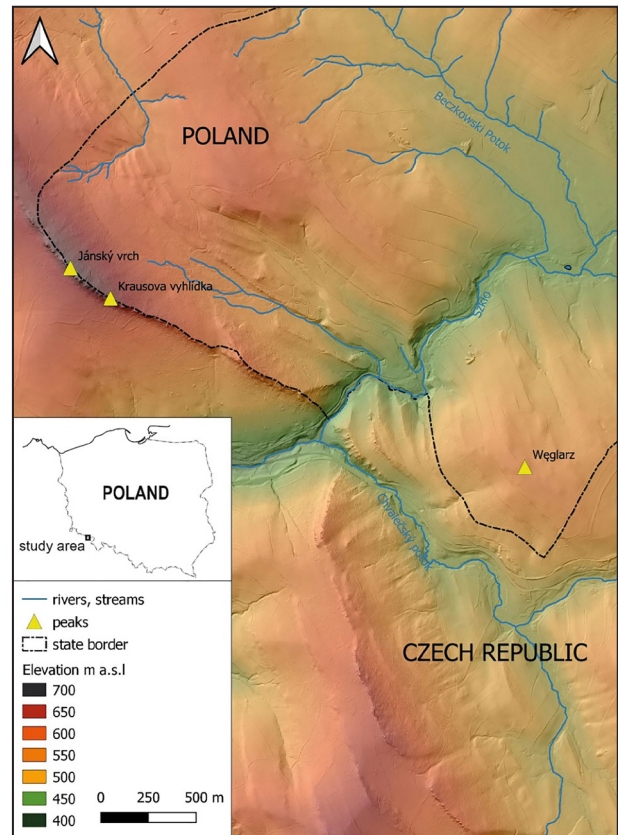


Fig. 1. Land relief of the Jański Wierch (Czech Jánský vrch) and Węglarz ranges surrounding Worek Okrzeszyna to the south and divided by the valley of the Szkło brook.

Source: authors' own research based on the numerical terrain model (NTM) of 1 m × 1 m resolution, retrieved from: [https://mapy.geoportal.gov.pl/imap/Imgp\\_2.html](https://mapy.geoportal.gov.pl/imap/Imgp_2.html).

valley of the Szkło (glass) brook (Fig. 1). An inventory research study focused on motorcycle tourism was concentrated in the latter two ranges and concerned the landscape forms created as a result of off-road rides. According to the physical-geographical division by Solon et al. (2008), in the area of Worek Okrzeszyna the borders of three micro-regions meet: the Krucze Mountains, the Jestřebí hory (majority on the Czech side, with the border range of Jański Wierch) and the Zawory Mountains.

Geologically, Worek Okrzeszyna is part of the Mid-Sudetic basin. The majority of Worek Okrzeszyna is occupied by rock series belonging to the lower layer of Perm – red Rotliegend: to the north, these are porphyry, melaphyre, porphyry tuff, arkosic sandstone and various shales, sandstones and conglomerates. The eastern borders of Worek Okrzeszyna (within Zawory

cueta) are mostly built by variegated sandstone (Triassic) and Upper Cretaceous sandstones. Upper Carboniferous formations only occupy the south-western part of Worek Okrzeszyna. These include variegated slates, clay arkosic sandstones with thin inserts of coal, and arkosic sandstones (Traczyk 2021). Upper Carboniferous rocks creating the Jański Wierch range are mainly polymictic conglomerates, sandstones and multi-coloured mudstones in the roof part. The nature of the pebbles found within the conglomerates makes it possible to claim that these sediments were created as a result of deposition of the rock material coming mainly from denuded and eroded old crystal massifs surrounding the Mid-Sudetic basin (Traczyk 2021).

Worek Okrzeszyna is an example of structural relief characteristic of this part of the Central Sudetes, whose most typical elements are four cuetas. According to Traczyk (2021: 207), "the relief of the surroundings of Jański Wierch [...] is conditioned by the structure of geological substratum: vastness and direction of the layers as well as varying resistance of the rocks against the processes of weathering and denudation." The massif constitutes a cueta of clearly marked asymmetry of the slopes shaped in Upper Carboniferous arkosic sandstones. The slopes exposed towards the SW, that is towards the Czech Petřikovice village, are steeper (up to 72°) than the less inclined area on the Polish side. The central part of the cueta, which is the most varied, is made of niches and denudation spurs, numerous rocks and rock cliffs (10–20 m high), below which rock material accumulates (scree cones and dump heaps). According to Traczyk (2021: 220), block covers deposited below the rock walls of the Jański Wierch cueta and fine-fraction slope formation of the less inclined area on the Polish side were created in the periglacial environment in Pleistocene.

The majority of the hills surrounding Worek Okrzeszowski are covered with mountainous mixed forests, typical of the whole forest district Kamienna Góra with the dominating spruce (84%), beech, larch, alder, sycamore and small addition of other trees (*Nadleśnictwo Kamienna Góra*, 2021). Beech or mixed forests, however, clearly dominate in the ridge parts of the Jański Wierch range and its eastern part towards the bottom of the Szkoło valley. Some of them were qualified as

HCVF3.2. ecosystems, namely, 'rare ecosystems, threatened in Europe (hornbeam, beech forests, fir forests, riparian forests, lower level fir-spruce trees)' and as HCVF4.1 water-protecting forests.

The settlement network of Worek Okrzeszyna is constituted by only two chain-like villages: Uniemyśl in the north and Okrzeszyn more to the south, inhabited by about 300 people in total (according to the last 2011 census). Interestingly, before Second World War, coal mining used to be developed in this area, which is evidenced by overgrown heaps (Staffa et al. 1996). At the time, the level of population and investment was significantly higher. In 1899–1959, trains reached Okrzeszyn, but the line was disassembled because of two main factors: the depopulation of the borderland areas after the Second World War and limitation of raw material extraction. In the 1950s, a uranium mine operated briefly in Okrzeszyn. Nowadays, the peripheral nature, small population and agricultural-forest character make Worek Okrzeszyna an area that is attractive for various forms of outdoor leisure. The relatively closest major settlements motor tourists or day visitors may originate from are towns Lubawka, Kamienna Góra, Mioszów and village Chełmsko Śląskie (around 15 km, 22 km, 18 km and 7 km from Okrzeszyn, respectively) on the Polish side of the border. On the Czech side, it could be towns Trutnov, Žacléř and village-tourist centre Adršpach (10 km, 24 km and 12 km).

## Materials and methods

To estimate the scale and character of the phenomenon of motor tourism in the forests and protected areas in Poland, the survey was conducted using a questionnaire form prepared in the MS Forms application (for more information, see Chylińska, Kołodziejczyk 2022). It was sent by e-mail to 430 forest districts in Poland and 23 national park authorities with a request to be completed by a person with current knowledge of the field situation (e.g. a forest inspector or the commander of the Forest Guard for forest districts). The data collection lasted from December 5, 2020 to January 31, 2021. A total of 349 correctly completed questionnaires were obtained, which constituted 77.2% of all forest districts and 73.9%

of all national parks in Poland. The survey concerned the intensity of the phenomenon of illegal entries of motorcycles, quads and off-road cars (frequency, seasonality, types of vehicles used) to naturally valuable areas, participants in this type of activity, effects and possible countermeasures, including efficiency of legal solutions. Certain results of the survey were developed and presented on maps using QGIS software tools. This article discusses only selected issues relevant to the topic of the article, while full results were presented in another article (Chylińska, Kołodziejczyk 2022). Owing to the fact that the mountains surrounding Worek Okrzeszyna are in the borderland, the survey was to be extended to the forest district (Czech: *lesní správa*) Dvůr Králové on the Czech side of the border. Unfortunately, no response was obtained.

Detailed field research was carried out on the example of Worek Okrzeszyna. To illustrate the consequences of illegal motor tourism in forests, the research area was investigated regarding the presence of trails used by this group of tourists. All such stretches were plotted on a map in QGIS software programme, taking into account whether they coincided with forest paths and tourist trails, or whether they were created exclusively by the motor tourists. The slope gradient was analysed, as well as the width of the path, its location regarding the main landscape formations and the surface type. Furthermore, information was gathered regarding the degradation of the slope cover and the presence of erosion and accumulation forms. Attention was also paid to the immediate vicinity of the trails, where tourism-induced degradation may occur. The width and depth of the erosion cuts were established in relation to the edges of these microforms, consolidated by vegetation. In sites where particularly intensive morphogenetic processes were observed, geomorphological sketches and horizontal profiles of the paths were executed. The study was complemented by photographic documentation. The intensity of motorcyclists' entries was determined based on the authors' observations and unstructured interviews with tourists and local residents, which also made it possible to capture some of the social effects of the discussed phenomenon. The core research took place in October 2021 and preliminary research in May 2021, but in the preceding years

(2018–2020), observations of the chosen erosion forms on trails had been carried out.

## Results

### Motor tourism in forests and in protected areas in Poland: The scale of the phenomenon

Illegal motor tourism done with cross motorcycles, quads or other ORVs in forested areas in Poland has been a serious problem in recent years (Chylińska, Kołodziejczyk 2022). At the end of 2019, there were 9,259,000 ha of forests in Poland, equalling 29.6% of the country's area. Their ownership structure is dominated by public forests (80.7%), including forest managed by the State Forests – National Forest Holding (76.9%) (*Lasy Państwowe* 2020). These forests are administered by 17 Regional Directorates of State Forests, within which there are 430 forest districts. Chylińska and Kołodziejczyk (2022) report that out of 332 forest districts participating in the survey aimed at estimating the scale of the phenomenon (77.2% of the total number of the forest districts), as many as 86.45% noted the presence of illegal motor tourism (Fig. 2). A great majority of the forest districts in this group described the problem as growing or staying at the same level (90.59%). The significance of the phenomenon is stressed by the fact that illegal motor tourism was indicated as the main problem by 53 forest districts, namely, 18.47% of the forest districts reporting the existence of the researched phenomenon in forests and 15.96% of all the forest districts which participated in the survey. In over half of the forest districts (53.66%), the forests are destroyed by all kinds of motor vehicles (motorcycles, quads, off-road cars), and in one third (37.98%) by both motorcycles and quads (Chylińska, Kołodziejczyk 2022). Illegal motor tourism takes place also in Poland's most precious environments which are national parks. Out of 23 areas protected with this highest form of preservation, 16 face this problem (including seven affected by all the aforementioned kinds of vehicles), one reports no such phenomenon, six did not complete the survey (Fig. 3). As in the case of the forest districts, the phenomenon affects national parks countrywide, representing

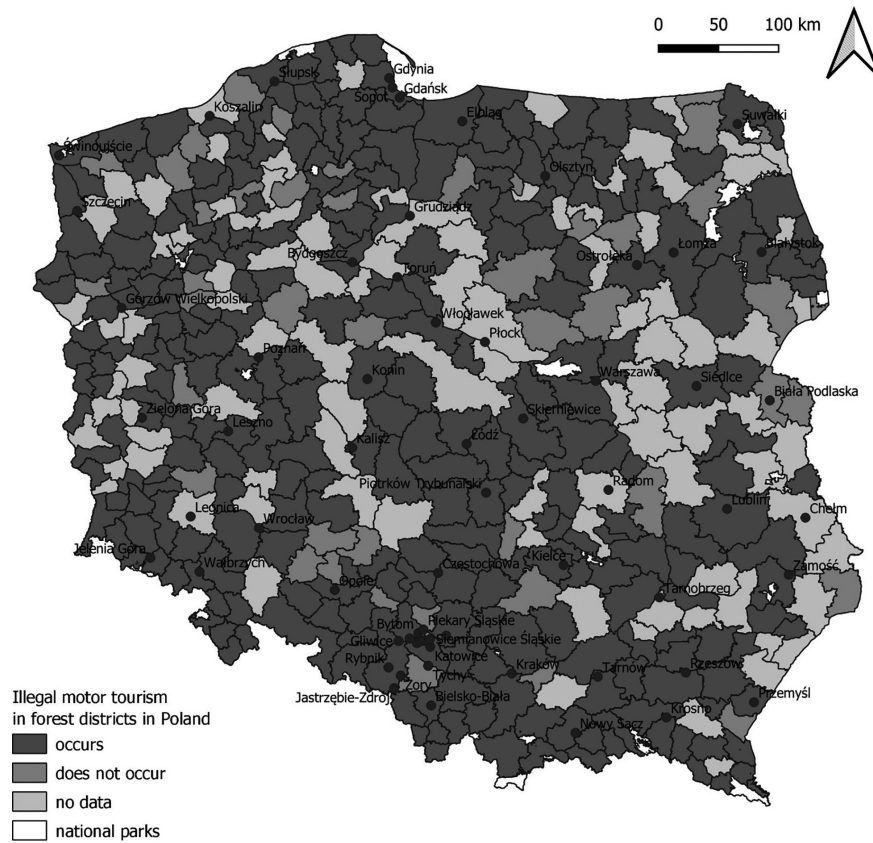


Fig. 2. Illegal motor tourism in forest districts in Poland.  
Source: authors' own study.

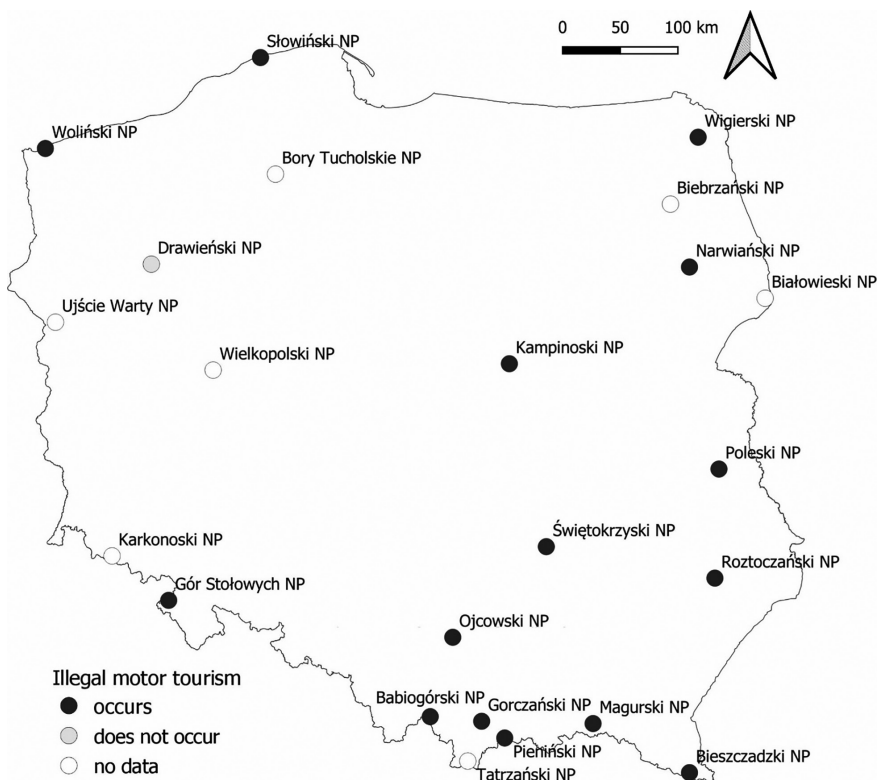


Fig. 3. Illegal motor tourism in national parks in Poland.  
Source: authors' own study.

all types of natural landscapes in Poland. The described problem exists in at least three out of four national parks almost entirely covered by forest (>95% of the surface), namely, Magurski, Roztoczański and Świętokrzyski (Białowiecki National Park did not participate in the survey).

### The network of roads used by motor tourists in Worek Okrzeszyna

In the Jański Wierch and Węglarz ranges motor tourism manifests itself as cross motorcycle rides, which were already reported in 2013. Rides using other ORVs or their traces were not observed. On the basis of the observations carried out by the authors and interviews with tourists using the researched area and the local residents, it can be estimated that on summer weekends this area is used by several dozen motorcyclists a day. On working days, the phenomenon also occurs, although its intensity is clearly lower. Motorcyclists ride in the researched area also in colder seasons – the intensity in this case varies and is difficult to determine. The entire network of roads used by motor tourists was catalogued for this territory, with a total length of at least 14.59 km, out of which 10.03 km in the Jański

Wierch range (western side of Szkló) and 4.56 km in the Węglarz range (Figs 4–7). The routes include: (1) forest roads of different categories (paved or not), (2) hiking trails, and (3) paths created by the motorcyclists themselves.

The first group is characterised by the smallest inclinations, as they are adapted for transport using forest equipment, hence the erosion consequences of motorcycle tourism are the least developed. Nevertheless, in many places, surface damage by motorcycle vehicles is noticeable (loosening of the material, furrows), especially on more inclined stretches or areas more frequently visited by motorcyclists. The destruction of roadside vegetation is also visible. The last group (paths created by the motorcyclists) exhibits the largest denivelations, as the steepness of the slopes decides on the attractiveness of the routes for the motorcycle tourists. All these stretches are inclined  $>20^\circ$ , and in some places even  $>50^\circ$  (Fig. 7C, D). Together with the lack of previously prepared surface, it creates a significant potential for erosion. Oftentimes, such roads are created on slopes covered with deciduous forests (beech) and mixed forests, where the motorcyclists create a slalom among the trees. Such features and the inclination make the route even more attractive.

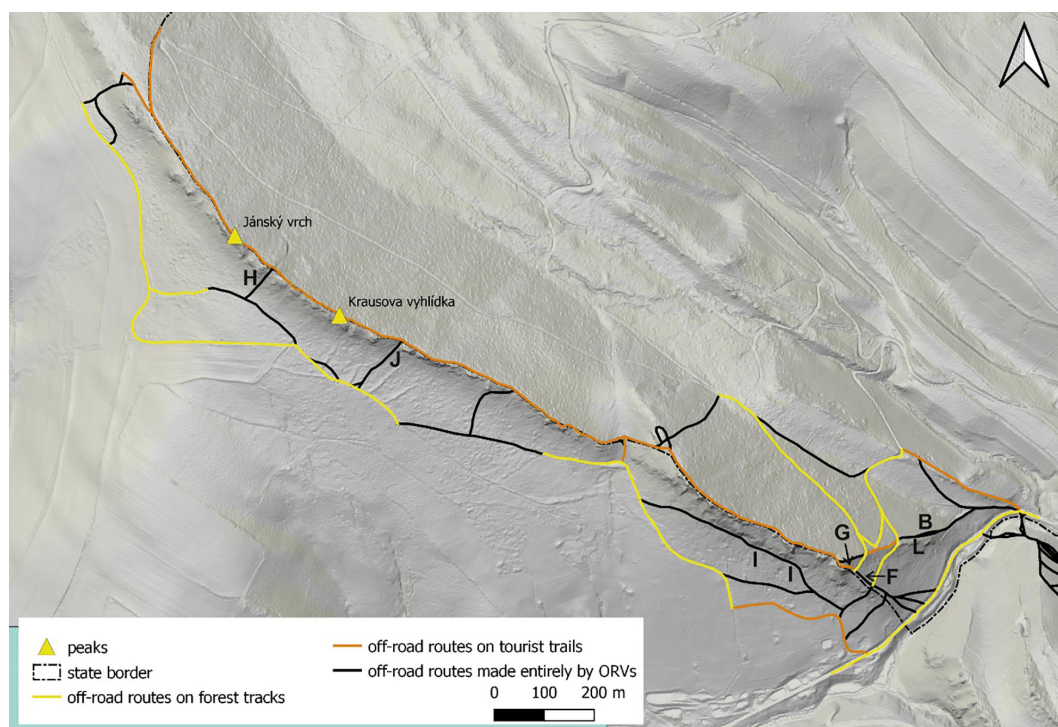


Fig. 4. Off-road routes used by motorcycle tourists in the Jański Wierch range plotted on a relief. Source: authors' own research.



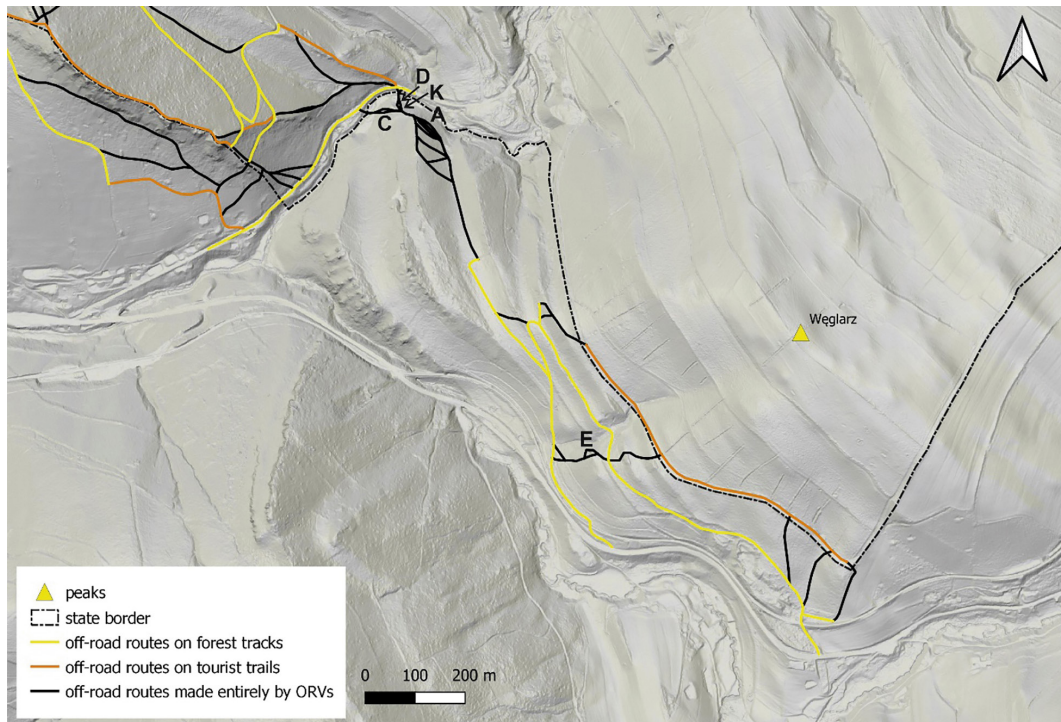


Fig. 5. Off-road routes used by motorcycle tourists in the Węglarz range plotted on a relief. Source: authors' own research.



Fig. 6. Routes used by motorcycle tourists in the Jański Wierch range: A – destroyed stretch of a hiking trail in the eastern part of the ridge (the trail almost doubled, the surface is covered with rock rubble as a result of erosion); B – hiking trail in the western part of the ridge with motorcycle traces (visible material moved by the wheels); C – downward exit from the ridge route to the steep south slope; D – fresh traces of cross motorcycles. Photo: the authors, 2021.

In this category, there are also groups of approximately parallel paths, distant a few up to a dozen metres from each other (a maximum of four such parallel roads were catalogued – mark A in Fig. 5; apart from that, usually two or three – e.g. mark B in Fig. 4, and marks C, D and E in Fig. 5; Fig. 7A), as well as entire sections of the slope destroyed by motorcyclists' rides. The widest such area is located on a steep part of the slope, west of the Szkło valley, below rock outcrops. The eroded area widens down the slope from 5 m up to 15 m width on a 50-m stretch (mark F in Fig. 4). East of the Szkło valley, the largest such zones are about 100 m long with the width of 2.0–2.4 m, and 20 m long with the width of 3–8 m. The middle group (motorcycle routes coinciding with hiking trails; Fig. 6A, B) is the most varied – from the paths of low inclination to very steep stretches. It is the latter type where the most advanced changes

were catalogued. A great durability of the routes used by motorcyclists in a given area is characteristic, which can be demonstrated thanks to the preliminary research from May 2021 and visits in years prior to that.

Motorcycle tourist routes in the Jański Wierch and Węglarz ranges traverse the slopes, and run perpendicular to contour lines and along the ridges. As mentioned before, the steeper the route, the greater its difficulty, hence also attractiveness. As a consequence, many of them cross the steepest slopes, with inclination exceeding  $40^\circ$  (Figs 8 and 9). It is especially visible in the Jański Wierch range with routes on the steep slope of the cuesta, more or less perpendicular to contour lines, and on the slopes of the Szkło valley (Fig. 7A). Another characteristic feature is designating the routes to connect as many technically difficult places as possible (structural thresholds

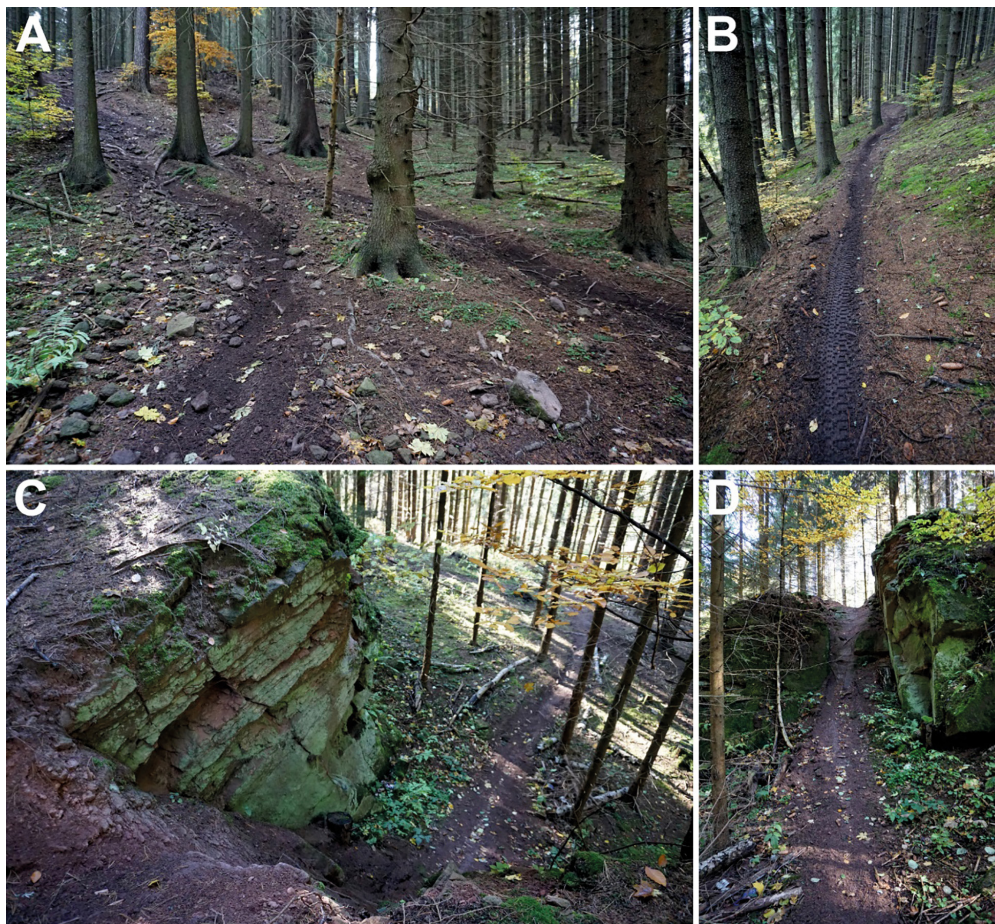


Fig. 7. Routes used by motorcycle tourists in the Węglarz range: A – parallel routes on the slopes of the Szkło valley with extracted rock rubble (mark D in Fig. 5); B – narrow path in a milder part of the slope with clearly visible motorcycle traces; C, D – demanding stretch of the route crossing a rock ridge near village Chvaleč (mark E in Fig. 5).

Photo: authors, 2021.

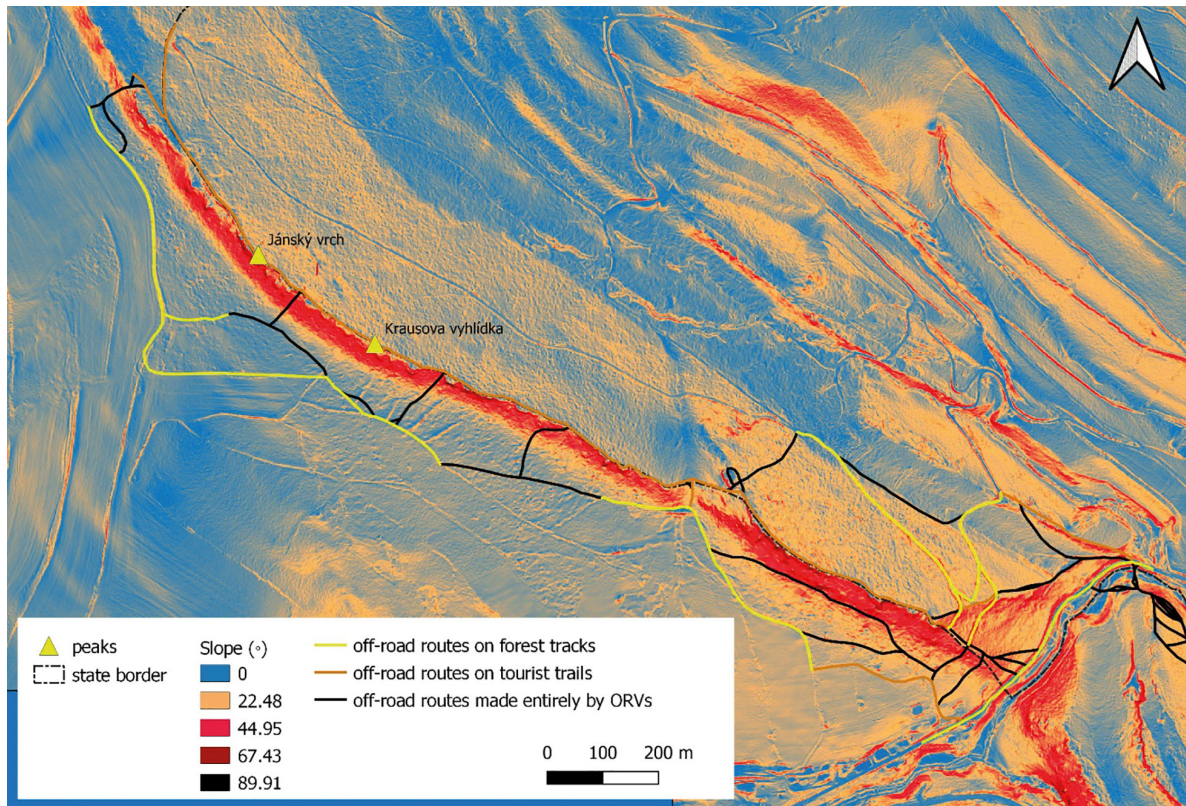


Fig. 8. Off-road routes used by motorcycle tourists in the Jański Wierch range with the inclination of slopes.  
Source: authors' own research.

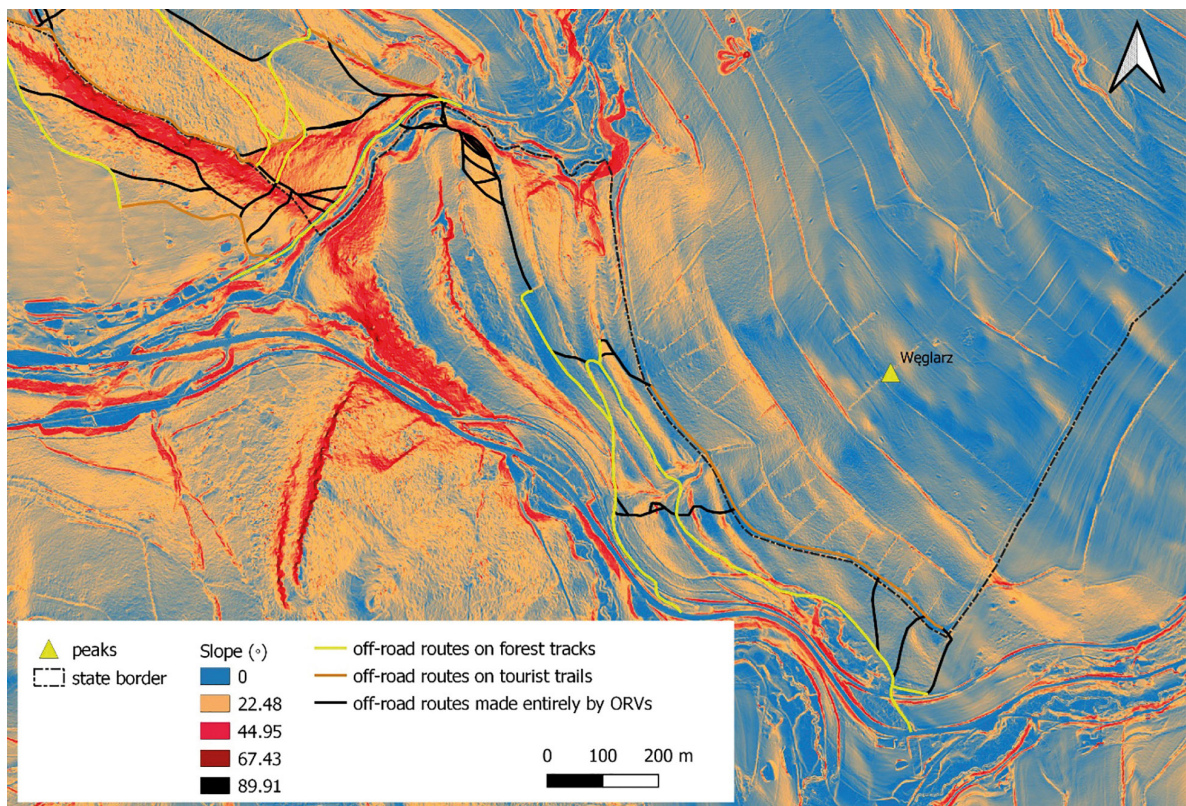


Fig. 9. Off-road routes used by motorcycle tourists in the Węglarz range with the inclination of slopes.  
Source: authors' own research.

– Fig. 7C, D, rock outcrops, dump material at the foot of *cuestas*).

There are 16 points within the research area where the motorcycle routes cross the state border, including three times crossing the border Szkló brook. The phenomenon is thus an international problem affecting both sides of the border. Regarding their length, most routes run on the Czech side, but the places most damaged by erosion initiated by the motorcycle tourism are located along the state border or on the Polish side.

### Environmental consequences of motorcycle tourism in Worek Okrzeszyna

The main consequence of the motorcycle tourism in the Jański Wierch and Węglarz ranges is the intensification of erosion, depending on the inclination of the slope and on the intensity of the tourist use of the trail (erosion is also caused by hiking but to a significantly lower degree than motorcycle tourism, which is evidenced by the intensification of the processes in time when motorcyclists appeared in the area). While braking on descends or while going upwards, the motorcycles' wheels move the mineral material on the path, which might then be blown away or removed by concentrated flow of precipitation waters. Multiple repetitions of the process lead to the development of significant microforms of relief (furrows and erosion cuts) reaching 1 m in depth. The longest, and at the same time the deepest erosion cut was catalogued on the western side of the Szkló valley, at the eastern edge of the rock cliff, stretching along the ridge area of the Jański Wierch range (mark G in Fig. 4). It is 45 m long, the greatest width of the furrow is 3.1 m and the greatest depth is 95 cm (Figs 10 and 11).

The shape of the cut is adjusted to the terrain relief, coinciding with the course of the tourist trail (nowadays also used by motorcyclists), which is approximately parallel to the rock cliff. In many places, the soil and rock rubble have already been removed, reaching the bedrock, which is evidenced by similar depths of cuts of the axial parts of the furrow (around 40–50 cm deep in the upper part, 80–90 cm in the middle part and 50–60 cm in the lower part of the furrow). As a result, on certain stretches, instead of a V-profile, the cut reaches a box profile, with

steep walls and a relatively flat bottom (Figs 10 and 11). Great advancement of erosion processes in this place results from the gradient of the slope (mostly 30–50°, sometimes >60°), general great dynamics of the relief due to the neighbouring rock cliff (Figs 8 and 10B) and coinciding two types of tourist use of the area (hiking and motorcycle tourism). Additionally, because of the view, tourists want to move possibly close to the cliff's edge, choosing the most damaged route (there are paths further from the cliff but are clearly less exploited, which does not mean that there are no deformations of relief). The lower part of the cut leads to the duct traversing the slope. Here, water loses the ability to move material; thus, an inlet-dump cone was created (Fig. 10C). Because of the terrain relief, the cone is asymmetrical: To the south, its diameter is 4 m, and to the east, it is as large as 7 m (Fig. 10). Larger blocks occur there probably as a result of sliding down the slope, which might be initiated by hikers and motorcycle tourists. Based on the measurements of the length and the depth of the cut set every 1 m along the furrow, it is possible to estimate the possible volume of eroded material at  $22.5 \text{ m}^3$  ( $0.5 \text{ m}^3 \cdot \text{m}^{-1}$  of the path).

Apart from the cut described above, larger erosion cuts were catalogued within the Jański Wierch range. They were found on chosen stretches of the ridge route, which were more inclined (>20°) and on short stretches joining the ridge route with the parallel route at the foot of the rock cliff (in some parts, the inclination there exceeds 50°, Fig. 6C). Moreover, more impressive cuts occur near the Szkló riverbed (the deepest cut is 67 cm) and on the northern slopes, along the state border, which leads here towards the Beczkowski brook. The amount of material removed from the short connecting routes that cut the rock edge can be evidenced by an example located between the viewpoint Krausova vyhlídka and the peak of Jański Wierch (mark H in Fig. 4), where on a slope with a mature beech forest, the soil developed fairly well (the routes farther to the east are more rocky). At the foot of the slope, there is an irregular inflow cone 12 m × 6 m (the irregularity results mostly from being destroyed by motorcyclists). It is clearly visible that the mineral material brought by precipitation water covers the plants previously growing there. Apart from that, in the Jański Wierch range, several

rocks with cuts/scratches made by hard parts of motorcycles were catalogued. Most of them are located in the upper part of the connecting stretches between the ridge route and the route at the foot of the rock edge, in places where the motorcyclists must squeeze through the gaps in rocks. They are also visible on the route at the foot of the eastern part of the rock cliff (mark I in Fig. 4), which was probably designated to test the skills in a rocky terrain. In one of the cuts near the ridge (mark J in Fig. 4), part of the rock was removed mechanically (visible traces of drilling)

to ensure an appropriate width for the motorcycles to pass.

On the eastern side of the Szkło valley, in the Węglarz range, the relief is generally less dynamic (Fig. 7); hence, the potential for erosion is smaller. Nevertheless, erosion cuts were catalogued here, too. The deepest cut was 45 cm deep and 1.3 m wide (mark K in Fig. 5). Greater changes are typical of the immediate vicinity of the Szkło brook, where the slopes are steeper (Fig. 7A) and the motorcycle traffic is channelled; crossing the river takes place in three locations only. The influence

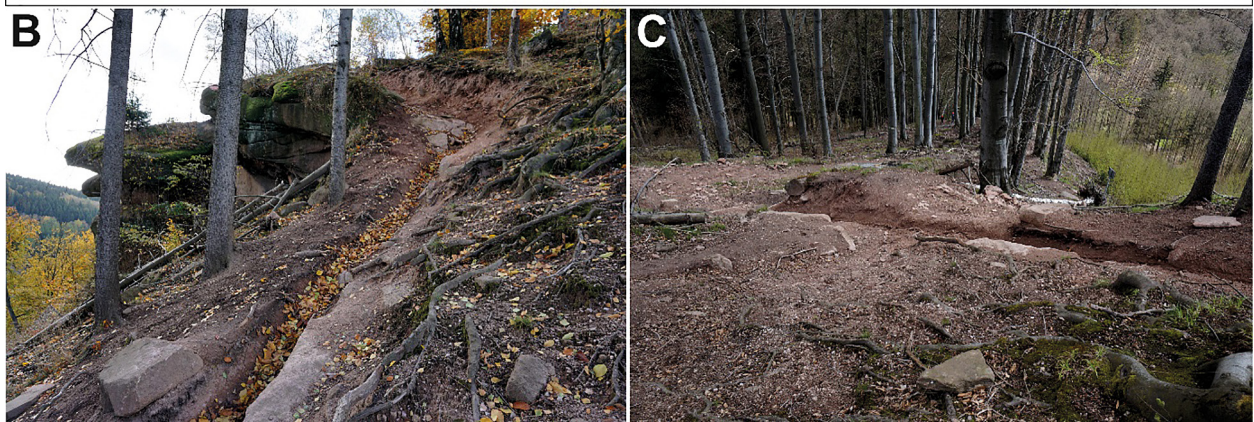
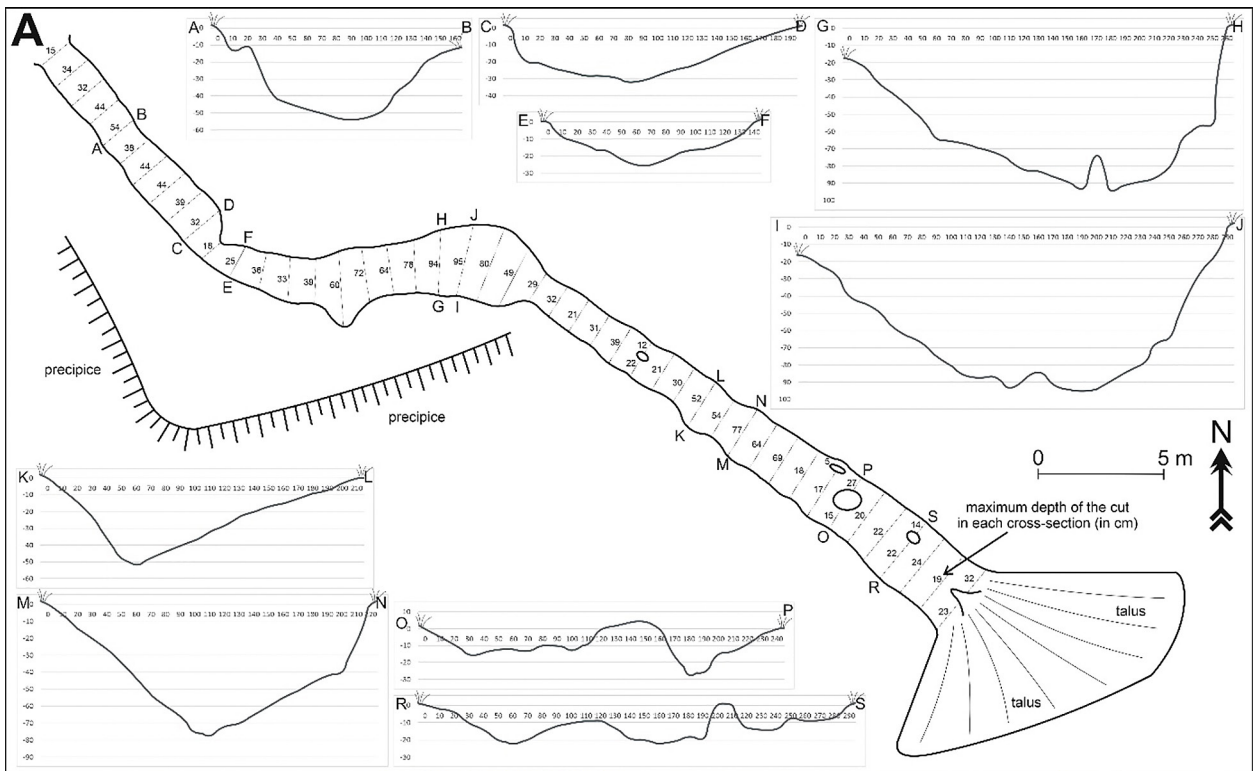


Fig. 10. Erosion cut at the eastern edge of the rock cliff in the Jański Wierch range: A – sketch of the erosion cut; B – middle and upper parts together with the rock edge with attractive views; C – lower part together with an inlet and dump cone (left).

Source: authors’ own research, photos taken by the authors, 2021.



Fig. 11. Comparison of the condition of part of the erosion cut at the eastern edge of the rock cliff in the Jański Wierch range in 2018 and 2021. The bedrock is uncovered to a much greater degree (green arrows). A fallen tree (orange arrows) might have contributed to the acceleration of the processes but, in turn, it was the result of widening of the cut and uncovering shallow roots. Cross motorcycles passing here contributed to creating and enlarging the cut.

Photos: the authors, 2018, 2021.

of the described process is also expressed in modelling of the riverbed, where big rocks were removed to ensure a safer pass. In the Węglarz range, there are many wetlands, especially along the border. This constitutes an obstacle for both motorcyclists and hikers, resulting in widening the 'official' path or in creating alternative paths that allow for omitting the muddy stretch. As a result, the area used for hiking-motorcycle tourist traffic might be of even 5 m width, within which there are 2-3 paths and a significant area of destroyed (trampled) vegetation.

On the routes used by motorcyclists, vegetation is destroyed in several ways. There is a lot of damage to the tree roots - not only on the stretches where erosion cuts are formed but also in many other places where the motorcycle wheels cause loosening of the topsoil, simultaneously damaging the roots. This problem is especially strong on the route from the Szkło valley to Jański Wierch peak (mark L in Fig. 4) and from the same valley to the east (mark K in Fig. 5). Destroyed undercoat vegetation is visible, as well as plants crushed by the wheels and broken branches along the routes.

### Social consequences of motorcycle tourism in Worek Okrzeszyna

As the described process is illegal in both countries, motorcyclists use the peripheral location of the Jański Wierch and Węglarz ranges. It is especially visible on the Polish side, where

the settlement network is sparse, stretching only along the Szkło valley which is, at the same time, the main road. The forest complexes here are compact, and in former fields, a secondary plant succession occurred, which results in the area being difficult to explore. Moreover, the peripheral nature of the Polish side is decided by the shape of the state border - villages Okrzeszyn and Uniemyśl are surrounded from three sides by the territory of Czechia, and reaching them is only possible using one road from the north. The accessibility from the Czech side is better because along the valley of the Petřikovický brook (the Czech name of the Szkło) and its inflow, the Chvalečský brook, there is a regional road and a local train line. However, the great steepness of the slopes and the lack of decent forest roads are the reasons why the ridge parts of Jański Wierch remain difficult to reach.

The social effects of motorcycle tourism in the research area are more difficult to determine as they are not of a physical nature. They were defined on the basis of the authors' own experiences, conversations with tourists and local residents they met. First of all, the reduced quality of rest (recreation) should be noted. This results from (1) the noise of engines, which spreads very easily in the valley of the Petřikovický brook, and (2) changes in the landscape (significant degraded areas, devoid of vegetation and with active erosion reduce aesthetic impressions and lower the assessment of the landscape among its users).

In the context of the noise spreading, it must be taken into account that on the Czech side, a great part of the buildings are second homes (*cf.* Kubeš 2010; Vágner 2001), which are supposed to be a place to escape from the city with all its disadvantages, including noise. Not without significance is also the deterioration of hiking conditions due to the unfavourably shaped surface of paths (erosion gutter, which is difficult to hike, thresholds, loose rock material).

While it is true that for the motorcycle tourists, the attractiveness of a route is determined largely by its level of difficulty (inclination, winding, stretches on the rocks), landscape values are also of importance. It is evidenced in the fact that the routes lead to viewpoints and rock formations. The axis of the motorcycle route network within the Jański Wierch range goes along the ridge, without major technical difficulties but rich in views. However, other groups of tourists also want to benefit from the landscape values, tourists for whom legal trails have been designated, especially hikers. Legal hiking trails and illegal motorcycle routes coincide on long stretches because they lead to the same places. This may result in potential conflicts. Because of attractive views and rock formations, hiking traffic in the area of Jański Wierch is heavy. It has become even more intense as a result of investments in the tourist infrastructure in recent years. Only the eastern part of the research area is devoid of official tourist trails, i.e. in the Czech territory on the eastern side of Szkló. The exception is the state border, along which there is a Polish hiking trail. Hence, in this area, conflicts between hiking and motorcycle tourism are potentially smaller.

## Discussion

The consequences of the motorcycle tourism observed in the Jański Wierch and Węglarz ranges are typical of the phenomena taking place on hiking and cycling routes in Central Europe. We deal with mechanical destruction of the vegetation (possibly also mycelium) within the path and in its vicinity up to the appearance of the soil, tearing off the turf packets, changes and destruction of the root system, loosening and crushing the mineral material, thus preparing for its washing and blowing out, initiating morphogenetic

processes (mainly surface and line rinsing), eventually erosion of the soil and waste cover to the level of rock rubble or even bedrock. Within the routes, different forms of micro-relief develop (flutes, furrows, erosion cuts, erosion thresholds, shelves between tree roots, etc.). Water circulation changes, too, as the water uses the developing forms of concentrated downflow. Even though the mere processes occurring on motorcycle routes compared to hiking and cycling trails are similar, in the former case, the pace of changes is more intensive because of the weight and power of motorcycles. Additionally, in the area of Jański Wierch and Węglarz, the concentration and durability of motorcycle tourism intensify the processes. It is evidenced by the comparison of the condition of the paths from a few years ago, when the described phenomenon did not occur or occurred to a smaller extent with the recent development of the forms. It can be assumed that the carrying capacity of the research area in terms of penetration by motorcycle tourists has been exceeded. In the case of hiking and cycling, this is not the case, but the combined impact of these three forms causes irreversible damage. It should be emphasised, however, that these are only assumptions, based on observations of changes in the vegetation and relief. The authors did not calculate the carrying capacity.

The scale of the decay in the Jański Wierch and Węglarz ranges is comparable with the processes observed in much higher mountain ranges, more frequently visited by tourists. It must be emphasised that the reference material comes mainly from hiking trails, where the unitary intensity of the destruction processes is smaller. On the other hand, these trails have been used for many years, sometimes over a century, contrary to the routes in the Jański Wierch range, where the intensification of the tourist traffic has occurred in recent years, and in that very period, illegal motorcycle entries appeared too. Erosion cuts on tourist trails developed, e.g. in the nearby Karkonosze (Giant) Mountains. On one of winter trails, erosion cut of maximum depth reaching 1 m and width up to 2 m appeared (Parzóch, Katrycz 2002). In this case, the erosion was particularly intensive for small inclinations of the surface ( $6^\circ$ ); hence, the tourist traffic must be the main reason behind it (it was located on the Śnieżka Plateau, one of the most frequently visited areas of the Karkonosze Mountains). In

another place, the erosion cut on the trail was 20–30 cm deep (Parzóch, Katrycz 2002). Furthermore, Kasprzak (2005, 2006) catalogued 17 erosion cuts developed on tourist trails in the Karkonosze Mountains, with the maximum length of 410 m, width of 5 m and depth of 2.23 m. The volume of the material carried out from a single cut was from 0.77 m<sup>3</sup> to 714.95 m<sup>3</sup>. Calculating this per meter of the trail, the amount of the eroded material in four cases was smaller than in the case of the previously described cut in the Jański Wierch range (Fig. 10); in the remaining 13 cuts, the amount was larger, with the extreme value over seven times higher (3.7 m<sup>3</sup>). The described cuts from the Karkonosze Mountains, however, were generally at least 12 years old (only in one case, it was 6), and the oldest cuts were 60 years old. Kasprzak (2005) estimated that the rate of erosion was from 1.72 mm · year<sup>-1</sup> to 21.06 mm · year<sup>-1</sup>, with the average value of 10.86 mm · year<sup>-1</sup>, which constitutes the largest calculated indices of denudation of the Karkonosze Mountains slopes to date, excluding rockfalls, and rubble and mud runoffs. It must be stressed that almost 70% of the tourist trails in the Karkonosze Mountains go through the areas endangered with moderate, strong and very strong erosion (Jała, Cieślakiewicz 2004). For some cuts in the Jański Wierch range, which at only a few years of age already reach 95 cm depth, the erosion rate must be higher and constitutes around a few or a dozen centimetres per year.

According to the hitherto research, the depth of the cuts on the hiking trails in the Tatras generally did not exceed 50 cm, even though maximum values went >50 cm (even 2.2 m) for a few percent of the trails. The maximum width of the paths was 15–17 m, although they generally did not exceed 2 m in width, and the stretches wider than 5 m were a dozen percent (Fidelus 2008; Gorczyca 2000). The differences in the decay processes caused or exacerbated by intensive tourist traffic closely correlate with the inclination of the slope (Czochański 2000; Szydarowski 2000) and with vegetation (Gorczyca 2000). The most intensive processes take place on steeper slopes where the rate of development of niches cutting into the surface may constitute 4–21 cm · year<sup>-1</sup> (Padarż 1992, as cited in: Szydarowski 2000). The development rate of the erosion cuts in the Jański Wierch range can thus be claimed comparable to the Tatras, being closer to the upper part of the

above outlined range of values. Furthermore, several parallel trails frequently occurred in the studied area, as was the case with hiking trails in the Tatras. In the Czerwone Wierchy Massif in the Tatras, for the trails running in switchbacks, the volume of the removed material was estimated to be 0.8 m<sup>3</sup> · m<sup>-1</sup> of the trail (Gorczyca 2000) and in the Chochołowska Valley even 1.2 m<sup>3</sup> (Krusiec 1996), which is higher than the highest value from Jański Wierch (0.5 m<sup>3</sup>). It must be remembered though, again, that tourist trails in the Tatras are much older and their intensive use has been in place for decades. To compare, the research from the 1990s carried out on the northern slope of the peak area of Pilsko in the Beskid Żywiecki Mountains demonstrated that the average volume of the material carried out from the furrows on trails was 0.4 m<sup>3</sup> · m<sup>-1</sup>. On official trails, functioning for at least a dozen years, this value was 0.7 m<sup>3</sup>, and on unofficial trails, much more recent, it was 0.2 m<sup>3</sup> (Łajczak 1996). In the Pieniny Mountains, the widest tourist trails reached 14 m but <sup>3</sup>/<sub>4</sub> entered the range of 1–3 m. Overall, 70% of them were slightly cut, up to a dozen cm. For 15% of the trails, the depth of the erosion was up to 0.5 m, and for further 15%, it was up to 2 m (Gorczyca, Krzemień 2006).

Compared to the previous examples, the current forms on the motorcycle routes in the Jański Wierch and Węglarz ranges are generally smaller than similar forms on hiking trails in other mountain ranges. This, however, results from the shorter development time as the rate of development in recent years has been very intensive.

The social consequences of the off-road tourism, mainly cross motorcycle, include the decreased comfort of relaxation in the area which is otherwise attractive for different forms of 'green', sustainable tourism (Ouren et al. 2007). The overlapping of informal routes used by motorcyclists and official tourist trails, typical of the western part of the study area, may lead to dangerous situations. On steep stretches, a speeding motorcyclist may not be able to brake in time or might fail to omit the hikers. The latter group, in turn, may have nowhere to hide from the coming vehicle because of the natural features of the route (e.g. a nearby cliff). During the research, the authors had to leave the path several times to let motorcyclists pass. Several dangerous situations took place in recent years in the nearby Karkonosze



Mountains, where motorbikes were driven down hiking trails marked on a steep slope.

Frequent breach of the law, impunity of the motor vehicle owners and unidentifiability of the riders, masked and without registration plates, cause fear among other users of forests. It is also a source of frustration, pushing some people to undertake potentially dangerous actions aimed at preventing illegal rides through forests. In November 2020, in the Lubawka Forestry belonging to the Forest District Kamienna Góra, cases of metal wires spread between the trees were noted (Lubawka is located north-west of Worek Okrzeszyna). In the survey conducted by the authors, the Forest District Kamienna Góra described ORV illegal tourism as the primary problem in its area among all other problems arising in the forests managed by the State Forests in Poland. The local owners of motor vehicles' are responsible for this issue, described as growing. They enter the forest individually but far more frequently they do it in groups. The entries of motorised groups take place all year round and are clearly a leisure activity because, according to the Forest District Kamienna Góra, they are more intensive at weekends or days off-work. Legal tools and means available in Poland and dedicated to executing the ban on entering the forests by motor vehicles are claimed to be inefficient, both by the Forest District Kamienna Góra and by most forest districts in Poland.

The problem of illegal ORV tourism in forests and protected areas requires systemic solutions and actions undertaken countrywide in many areas of law (Chylińska, Kołodziejczyk 2022). The awareness of the issue exists among the managers of the state forests. It is, however, difficult to say what the direction of their actions is. It is evidenced by a survey (May 2021) carried out by the State Forests targeting off-road fans regarding their use of forests for motor tourism. The survey triggered widespread controversies and was treated by the amateurs of the forest and nature as a form of surrender of the foresters and nature researchers to the demands of one noisy (literally and figuratively) group of forest users. It is worth noticing that from the legal point of view, motorised tourists riding in forests, regardless of their recreational, sport or tourist motivation, are breaking the law, committing an offence. The word 'tourists' that describes them causes

resistance, which is demonstrated by the words of one of the employees of the State Forests:

*"Entering the forest, precisely non-marked forest roads, or (which is much worse) driving through the forest by car or motorcycle, can by no means be named as tourism. It is a simple offence, subject to punishment, bringing sometimes irreparable losses to the nature. People participating in this process are not tourists but pests."* (Adam Zagnieński, fragment taken from an e-mail sent on 20 December 2020)

Illegal rides with motor vehicles are damaging for both the environment and the society. They are also against the rules of sustainable tourism (cf. Hunter 1997; Butler 1999; Swarbrooke 1999; Sharpley 2000; Liu 2003; Buckley 2012) which is based on harmonious matching tourist activities with the specificity and potential of the natural or cultural environment, simultaneously limiting negative consequences of overexploitation. Drilling the rocks, destroying vegetation, frightening animals, chasing tourists away from the trails, or off-road rides through the forest goes significantly beyond the romantic myth of easy riders, becoming an example of (tourist?) vandalism. At the same time, in the simplest psychological view, tourism is connected with voluntary, temporary going beyond tourists' daily routine, with a change made for different reasons (see e.g. Crompton 1979; Iso-Ahola 1980, 1982, 1983, 1990; Carù, Cova 2007). Legal, or sometimes moral, aspects of the activities undertaken in leisure time have never been the basis for defining tourism as such (cf. common definitions of sex or drug tourism). Hence, independently of its social assessment, off-road motor rides can be located within the category of tourist phenomena.

Perceiving and naming illegal entering forests as tourism may, however, bear consequences both in the social perception of the phenomenon and probably in the eyes of the participants themselves. Tourism distances its participants from the social and cultural norms within which they function on everyday basis. According to Moore and Berno (1995), the engagement of tourists in activities that constitute offence or even crime while travelling results from the lack of or lower social control as well as from adopting hedonistic attitudes, described as 'here today, gone tomorrow'. Peripheral location of the mountains of Worek

Okrzeszyna, lack of supervision from authorities on both sides of the border and small risk of inspection or being badly punished all encourage illegal motor activities in this area. The possibility of the chase and being caught, however small, may also constitute an attraction for off-roaders. Thus, even though by definition, illegal entering forests by the enthusiasts of off-road rides falls within the category of tourism or recreation, the 'naming and shaming' strategy should be adopted against such behaviour, emphasising legally doubtful and, as shown in the article, environmentally damaging character of these activities.

The fact that ORVs enter the forest is contested in various communities related to nature conservation, tourism or forest management. The emphasis in the discussion is on legal and technical solutions enabling forest authorities to effectively enforce the existing law (e.g. greater powers of control and monitor, higher fines, confiscation of vehicles). At the same time, however, as shown by the research conducted at the turn of 2021 among Polish forest districts (Chylińska, Kołodziejczyk 2022), one of the proposals indicated by foresters to counteract the phenomenon was to look for legal alternatives to practise this form of leisure activity (tracks/routes outside or in forests, on separated areas, presumably wastelands). Such proposals were usually mentioned right after greater penalisation. Among other solutions was more intensive education, which should focus on stigmatising illegal and environmentally harmful behaviour, breaking the misunderstood local solidarity (local people drive, not strangers) and promoting responsible attitudes within the motoring community itself. Legal motor routes separated from those intended for hikers and cyclists could solve the problem of potential conflicts between various users of tourist and recreational space in forests but will not eliminate the inherent environmental effects of motor tourism (increased erosion, noise, pollution, etc.). Such routes may be similar to single-tracks for MTB cyclists in the Sudetes or special routes only for cyclists in the Alps.

## Conclusions

The research carried out in the ranges surrounding Worek Okrzeszyna to the south

revealed a significant negative impact of illegal motor tourism on the natural environment. It occurs wherever the phenomenon takes place: on forest roads, tourist trails and beyond them. The ORV activity is encouraged by diversified dynamic relief, attractive landscape, peripheral character (borderland, sparsely populated area on the Polish side) and the immediate vicinity of the road infrastructure (the Czech side of the border). The issue discussed, common in the selected research area, is also more and more often observed in the majority of naturally valuable areas in Poland (forests and legally protected areas). It has been noticed by managers of forest districts and national parks, who so far lack effective tools to counteract it. Illegal entering forests is not prevented because of no systemic solutions, first and foremost legal, technical and social ones, connected with executing the existing law.

The problem was previously recognised in areas making up peripheral lands (vast, virgin forests of both Americas, African savannahs, Siberian taiga or Australian 'outback'). Nowadays, it reached densely populated and strongly urbanised areas, where the green enclaves are rare and they are subject to omnipresent anthropogenic pressure. This impels us to adapt the existing or create new ways of counteracting the phenomenon of illegal motor tourism in protected areas. One of the solutions may be arranging separate, legal routes prepared specifically for the needs of ORV users. Owing to the increasing availability of new off-road means of transport, advancing urbanisation and the observed indolence of the authorities in executing the law, we can expect further intensification of the phenomenon, progressive damage to the environment and greater functional conflicts. The existing situation has been the case for at least a decade without major obstacles.

The research carried out in Worek Okrzeszyna addresses the issue present to varying degrees in the entire country. It also paves the way for further research problems going beyond the analysis of an impact of illegal motor tourism on erosion or surface transformation. They might be of a local character, connected with the location, or theoretical, dealing with different universal questions of defining and assessing tourist phenomena. The impact of illegal motor tourism on the condition of high plants remains unrecognised.

The damage caused to such plants is clear in places where the activity in question is the most intensive. Similarly, the impact of motor tourism on the local fauna would also require assessment. Theoretically, the case of Worek Okrzeszyna and the illegal forest motor rides draw attention to the imprecision in defining and describing what tourism is and what it is not, and to the resultant ambiguity of the perception and social assessment of the phenomenon.

### Authors' contributions

Both authors equally contributed to the research idea, equally collected and analysed data, wrote the manuscript and prepared all illustrations, discussed the results and commented on the manuscript.

### Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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