



A river runs through the landscape: Everyday use in an ever changing environment

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ABSTRACT

The meaning of riverine landscapes to society has evolved to serve our ever-changing needs, from harvesting and transporting resources to arenas for outdoor recreation and contemplation. From the 18th century, rivers have been important resources for industry and hydroelectric power. The objective of this study is to explore and describe the rhythms of everyday use of a river environment using multiple quantitative and qualitative methods, and to identify subjective, multiple and often competing relations. We use Lefebvre's concept of *rhythmanalysis* and Ingold's contextual approach as a tool for bridging scientific and methodological disciplines. Our results show a wide breadth in everyday activities and a dynamic relation between people and the river on multiple time scales. The use of the river environment appears orderly and predictable, but the wide spectrum of everyday users on different spatiotemporal scales is diverse and forms multiple rhythms at each locality. The partial lockdown in Norway in response to Covid-19 and the subsequent shifts in people's daily routines changed the rhythm of daily and weekly use patterns, and demonstrates how rhythms can change rapidly in the face of large-scale, societal agitation. We argue that *rhythmanalysis* is a useful analytical tool in interdisciplinary approaches to better understand the use and valuations of landscapes.

1. Introduction

What does *living a good life* entail? Typically, people describe the identity of a place and the benefits they derive from their personal connection to that place. These benefits go beyond material acquisition, satisfaction preferences, or moral duty toward nature, and centers instead around a relationship with place (Williams, 2014). The human-nature relationship is often simplified in the Western culture as a dichotomy between value sets: utilization of natural resources for human prosperity on one side, and nature conservation for the sake of protecting its intrinsic values on the other. However, these dichotomies actually operate on overarching societal, political and ecosystem levels, which makes single cases difficult to assess (Flint et al., 2013). Fortunately, a large community of scholars engage with non-linear and contextual human-nature relationships, including work in the fields of cultural ecosystem services (Himes and Muraca, 2018), coupled human and natural systems (Liu et al., 2007; Kramer et al., 2017), and

socio-ecological systems research (Schlüter and Pahl-Wostl, 2007; Singh et al., 2013; Arias-Arévalo et al., 2017). What is broadly lacking in these approaches is relational values (Mancilla et al., 2020) and the temporal dynamics of human relationships with nature (Terkenli, 2005; Simpson, 2008; Flint et al., 2013), e.g. cross-sectional studies collect data from a single point in time and forgo important temporal variation in human relationships with nature (Xiao and Smith, 2006; Schägner et al., 2017).

A major challenge for including relational values and benefits is that they are inherently difficult to predict and value: how a person relates to nature will vary at individual, demographic, and cultural levels, and the relationships will evolve over time depending on how society, nature and the persons themselves develop (Manzo, 2005; Skår, 2010). Empirical research shows that relational values are highly contextual in time and space, but are very important to people even if they hold multiple and often competing values (Skår, 2010; Williams, 2014; Himes and Muraca, 2018; Mould et al., 2020). In their seminal and still highly relevant article, Patterson and Williams (1998) discussed different

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paradigms in social science regarding studies in nature, and they claimed that there is a need to “*deepen its understanding of the nature of science by exploring recent advances in the philosophy of science*” where they distinguished the traditional perspectives of rationalism from relativism. Specifically, Patterson and Williams (1998) asked for a critical pluralism, suggesting that different scientific perspectives can and should co-exist within disciplines. In our study we incorporate both deductive and inductive perspectives using a mixed methods approach, and we use a somewhat unfamiliar combination of Ingold (2011) and Lefebvre’s (2013, first published in 1992) theoretical perspectives on the contextual and dynamic human-nature relationship.

Human-nature relationships are dynamic and connected to individual, social, and cultural *movements* (Ingold, 2011). In this paper we bring multiple academic fields and research traditions together to study the polyrhythms of the everyday use of a river environment via rhythm analysis. A recurring problem in multi-disciplinary case study research is to have a common analytical perspective to combine the different parts of the research. Using a theoretical and methodological pluralism, the objectives of this article are to:

- a) analyze the question of how the contextual and dynamic everyday use is interwoven and interconnected through different rhythms in a river environment.
- b) elaborate on the potential of rhythm analysis as a tool for crossing scientific and methodological borders in studies of human-nature relationships.
- c) discuss how rhythms and their interrelations can be a fruitful approach in applied river management.

2. Background

2.1. Conceptualizing context and rhythms in everyday use

Our study design, methodology, and use of data sources are inspired by Henri Lefebvre’s concept of *rhythmanalysis* (Lefebvre, 2013). Here, the concept of *rhythm* helps us to analyze the temporal and spatial realization of activities and practices and attempts in that way to contribute to relational landscape and values research (Stenseke, 2018). Rhythm is a “*movement marked by the regulated succession of strong and weak elements, or of opposite or different conditions*” (Anon, 1971, p. 2537). To Lefebvre (2013), rhythms occur every time energy is expended at the interaction of place and time; everything is in constant rhythm. Many biotic and abiotic phenomena exhibit rhythms much slower than the rhythm of the human observer, for example the dynamic succession of a forest or the gradual changes to rock and landforms relative to the daily rhythm of the person in which the earth is experienced. As a human construct, rhythms are socio-natural and include aspects of learning and emergent properties. Thus, we conceptualize rhythms as possessing both quantitative and qualitative characteristics. Through *rhythmanalysis* it is possible to see beyond individual objects or actions and portray them as rhythms among others; a continuous flow or a stream.

It is important to view *rhythmanalysis* as a method for assessing rhythms as both an object and an emergent property, that is, there is no *end point* in a rhythm (Simpson, 2008). *Rhythmanalysis* highlights the differences between time as we actually experience it (real duration, lived time) and the linear, mechanistic time of science (Bergson, 2013, first published in 1910). This approach also attends to Ingold’s relational and dynamic view on the human-nature relationship, inspired by a phenomenological view of humans’ embodied attachment to the world around us (Ingold, 2011). We ground our exploration of short-term and long-term human use in an altered river landscape using these perspectives in order to derive rhythms and connected valuations therein. We also discuss these findings in relation to the management of river landscapes.

According to Ingold, “*landscapes are woven into life, and lives are*

woven into the landscape, in a process that is continuous and never-ending” (Ingold, 2011, p. 47). Through individual bodies, senses, backgrounds and experiences, humans take part in the world-in-formation (Ingold, 2011; Williams, 2014). Ingold (2011) illustrates a dynamic perspective on place as “*experience-in-place*” (Manzo, 2005; Himes and Muraca, 2018; Stenseke, 2018), following Bender (2002, p.103) who argues that landscapes are “*created out of people’s understanding and engagement with the world around them. They [landscapes] are always in the process of being shaped and reshaped.*” Human perception of dynamic systems such as rivers depend on the hydrologic stage from moment to moment (Junker and Buchecker, 2008), but also on seasonal changes in the valley, filtered through the lens of experiences, emotions and attitudes. In sum, “*life unfolds along strings in a meshwork where residents are treading their own paths through the meshwork and thereby contributing to its ever-evolving weave*” (Ingold, 2011 p. 71).

Rhythms can influence each other or even depend on each other, such as people’s circadian patterns which follow natural light patterns. Rhythms arise from “*the meshwork*”, which may or may not be noticed, recognized or understood by the human observer (Mels, 2004). Studies of rhythms involve the cyclical or linear temporal organization of space (Edensor, 2010), and highlight rhythm-making processes in both society and nature as vital for shaping our surroundings as well as understanding them (Flemsæter et al., 2018). Lefebvre (2013) suggested a mixed methods approach to locating and understanding rhythms that has the potential to connect multiple scales and domains (Cresswell, 2010; Edensor, 2010; DeLyser and Sui, 2012). Edensor (2011) regards Lefebvre (1991) work as an unfinished project, but nevertheless as “*sufficiently open to adapt and expand notions of rhythm.*” We endeavor to utilize some of the potential that *rhythmanalysis* has for connecting scales, domains and methods. Although rhythm analysis opens up myriad approaches that a number of scholars have engaged through studies of spatiotemporal rhythms for some time (Harris, 1998; Mels, 2004; Edensor, 2010; Krause, 2013; Flemsæter et al., 2018), the body of literature in the field remains relatively small. Some recent investigations explored the synchrony or asynchrony between different rhythms as well as rhythms in rural and urban spaces (e.g. Schwanen et al., 2012; Vergunst, 2012; Kärholm et al., 2015; Lager et al., 2016; Osman and Mulčec, 2017). An important lesson from these studies is that each place has its own rhythmic character, and context and causes may be different despite certain places exhibiting similar rhythmic character (Osman and Mulčec, 2017). Because a large portion of rhythm literature is qualitative ethnographic studies, there is opportunity for further developing *rhythmanalysis*’ methodological and analytical approaches, especially between disciplines and different scientific frameworks (DeLyser and Sui, 2012; Flemsæter et al., 2018). It is along this cross-disciplinary path we describe rhythms of altered river landscapes.

2.2. The valuations of the Mesna river in society

Our case study examines the Mesna river in mid-eastern Norway (Fig. 1). Local’s values and relationships to the Mesna river landscape are mainly expressed through shifting material practices during the last century. Over the years, symbolic and formal Mesna river images of nature and resources have change in consort with changing worldviews. At least three river paradigms were important for the valuation of the materiality rhythm (Skår et al., 2017). First, as a young industrial nation in the early 20th century, Norway prioritized building infrastructure. Trails and roads across the river were (and remain) vital transportation routes, as well as the river itself: log driving was another important material use of the river in the early industrial period. Hydropower production along the Mesna river began in 1894, and a number of industries benefited from harvesting the river’s energy (sawmills, grain production, industrial weaving, paper industry etc.). Second, starting in the late 1880s the upper class introduced early outdoor recreation and established a systematic national focus on nature conservation and



Fig. 1. Photo of the Mesna river in the city site where automatic counting, interviews and systematic moment observations take part (Photo: Vegard Gundersen).

environmentalism. The spectacular waterfalls of the Mesna river were already tourist attractions in the 19th century and the river was a popular motive for many famous painters. The local elite were concerned about the loss of this river character and associated recreational use and nature experiences due to the industrialization of the river for hydropower production. Third, recent decades have experienced increasing urbanization and a rising standard of living (including more recreation leisure time) which has made river recreation more accessible to a broader range of the population (Aas and Onstad, 2013). The trend of increasing public use is important for public health and well-being and has partly led to the precipitous rise of nature-based tourism in rural areas, resulting in increased pressure on natural resources (Flemsæter et al., 2018). The river landscape today is mainly represented as an area for recreation and nature consumption (Skår et al., 2017).

As a consequence of broader changes in the society the river has been revalued several times. Each successive revaluation has had major material as well as experiential impacts on the landscape, which in turn affect landscape practices (Flemsæter et al., 2018). Decisions made in the past based on the valuations and worldviews existing at that time have affected decisions taken at a later stage in an entirely different context. There are currently heated debates about the future use of the river, e.g. climate change necessitates the use of renewable energy sources and flood protection, concurrent with increased recognition of the value of the biodiversity in and along the river and the importance of the river environment for recreation. These debates indicate that changing landscapes in turn affect people's notions of what is "in" or "out of place" along the river (cf. Cresswell 1996). These recurring revaluations interact with and shape the river landscape in a dynamic, rhythmic pattern containing shifting values, practices and material relations. We want to further our understanding of the contextual and dynamic human-nature relationship, by exploring the complex daily river rhythm of a particular temporal manifestation of relational values.

3. Methods

3.1. Study area

The town of Lillehammer (28 000 inhabitants) is situated in rural landscapes 200 km north of the capital city of Oslo at the northern end of Lake Mjøsa- Norway's largest lake. Lillehammer and the Mesna river were chosen as a study area to represent a river system which rhythms are regulated for hydropower production. The river runs from sparsely populated mountain and forested areas, through park-like urban woodlands near the town, and finally through the town center before it empties into Lake Mjøsa. The waterfalls and their potential for

hydropower production were a main driver in the development of Lillehammer, and include among the first power stations in Norway that supplied a city with electric power. Today there are three power generating stations along the length of the river: Tyria I and II (altogether 26 GWh) and Mesna (135 GWh) that utilize the hydrostatic pressure from Lake Nord-Mesna down to Lake Mjøsa. Mesna river is 43 km long and drains an area of 250 km². Mean annual discharge is 5.63 m³/s at the mouth under natural flow regimes, but today the river maintains a minimum flow through the town due to hydropower regulation. While there is no minimum flow requirement in the wintertime, regulations require that the minimum flow of 0.2 m³/s from 1. April to 1. October is maintained (Skår et al., 2017). However, according to the local hydropower operator, our study period from May 8, 2012 to October 6, 2020 had an average flow of 0.15 m³/s and only 23 days with more than 1.0 m³/s through the town (data not shown). Our study area included the regulated river from Lake Nord-Mesna to its outlet in Lake Mjøsa, a total of 10 river-kilometers. We selected sites for the interviews and automatic counting of people passing by the most popular trail segments along the river, altogether 13 sites. Additionally, we selected two observation locations straddling the town limits to include both built and nature areas. Our study occurred over a number of years. Chronologically, we conducted interviews first (yr. 2013) which provided an important knowledge base for the development of the survey questionnaire (yr. 2014) and systematic observation studies (yr. 2018). Automatic counters have been operated the whole period.

3.2. Qualitative methods

The on-site interviews were conducted between August and October 2013 and were carried out in two phases in the town and the forest sites. The first phase consisted of intercepting passersby along the river using short semi-structured interview guides. In all, 35 short interviews (40–60 min) were carried out concerning the person's relationship with the river and the area. Intercepted participants were told about the study and the researcher asked for permission to record the interview. Twenty-four interviews were conducted in the town site, consisting of 13 local inhabitants and 11 tourists from 8 nationalities. Eleven recreational users, all of which were residents in Lillehammer municipality, were interviewed at the forest site. The short interviews gave valuable information about different types of use, different relations they had to the river and for how long, and perceptions of the meaning of the river (Miles and Huberman, 1994).

In the second phase, nine in-depth interviews were conducted with individuals representing different interest groups known to be active long-term users of the river environment (they have used the river for different recreational purposes for more than twenty years). The interviewees included two anglers, two cabin owners, and five individuals that engaged in different kinds of recreational activities. The in-depth interviews (2 h) provided detailed local knowledge and expanded on perspectives of important topics identified in the short interviews (Miles and Huberman, 1994).

3.3. Quantitative methods

The web-based survey was conducted in the autumn of 2014 for the target population of all 28 000 inhabitants in Lillehammer municipality. Data collection started by calling 9402 inhabitants on the phone (age 18 +) to ask them to participate in the survey. The professional polling company (Norstat) made contact with 5346 people, and of these, 1402 were willing to participate in the web-survey by receiving an email with link to the questionnaire. Our sample consisted of the 686 people that answered the questionnaire. This corresponds to a response rate of nearly half (49%) of those who received the questionnaire which is a higher than average response rate using a similar sampling frame (Schonlau and Couper, 2017). Age of participants ranged from 20 to 82 years with an average age of 51. The survey included demographics,

questions about their use and relation to the river area, their appreciation of the river and opinions about the alteration of the river. Web-based surveys are especially prone to overrepresent people who hold strong attitudes or are highly motivated to participate and may result in a non-representative cross-section of the entire population (Schonlau and Couper, 2017). We compared our sample with the municipal demographic distribution and found that people with higher education, elderly people, and men were significantly overrepresented.

The method of behavioral mapping, for supplementing daily rhythm and user behavior, was based on momentary time sampling techniques (e.g. Evensen et al., 2017). Systematic scans were made in predefined areas in the town and the forest. We developed a protocol and registration scheme including a set of observable demographic parameters such as age-group and gender, group size, activities performed by the observed users and kind of equipment used (cf. Gehl and Svarre, 2013).

Development of the methods of systematic moment observations were based on former studies in the case area. For example, the selection of observation sites and definition of behavior categories ensured interrater reliability. We chose one town and one forest observation site, both with good visibility. Systematic moment observations in these two sites addressed type of use, experiences, and behavior typical for river visitors. To avoid intrusion, we kept the fieldwork simple and did not include movement patterns and behavioral maps.

The observations were made between 08:00 and 20:00 on random week/weekend days during the primary tourist season in July and August 2018, totaling 117 h: 67 forest hours and 50 town hours (Table 1). These hours were selected to capture the variety of activities undertaken daily. To enable representative and comparable samples we observed 17 h more in the forest site due to light river user flow. User demographics and activities were analyzed as frequencies and are presented as percentages of total numbers in each category. According to the momentary time sample technique, users were only registered once (Evensen et al., 2017). The interviews and the systematic moment observations complement each other as they are both suitable to describe behavior, such as the kind of use and activities along the river. Not everything is observable at a specific site and rarer activities (e.g. fishing) can be difficult to catch in the observation window. Similarly, the interviews can only to a limited degree cover the temporal variation in a location.

We used an automatic counter with pyroelectric two-way sensor (EcoCounter) that contains a lens that is sensitive to heat radiation emitted by human bodies (Andersen et al., 2014). We selected 13 counting sites that covered the most important trail segments adjacent to the river from the outlet in Lake Mjøsa (123 m a s l) to Lake Nord-Mesna (521 m a s l), including four bridges. Five of the counters were installed at the same sites as the sites for systematic moment observations. The counter by the outlet was installed on May 8, 2012 and is still in operation; this counter represents a reference site. Twelve of the counters were operant during the year of 2013, and six of the counters were reinstalled in 2018 to check the site use consistency over study period. The accuracy of the automatic counters is subject to both qualitative errors, as they can record movements that do not represent actual

people, and technical errors caused by characteristics of the counter or the installation site. The accuracy of the counters (i.e. for the number of people detected) has been intensively tested, and it has been proved to operate within a 5% margin with proper installation (Andersen et al., 2014). Regarding qualitative errors we corrected the number of counts related to installation and operation of the counters. Installation of the counter 1 m above the trail avoided counting dogs and ensured counting adults and older children.

4. Results

4.1. A dynamic relation between people and the river

The web-survey stated that Mesna is a significant part of many resident's everyday use in Lillehammer (Fig. 2). More than half of the respondents (56%) state that they travel at least once a week or daily so that they can see or hear the river, mostly for doing outdoor recreation or exercise, but many residents experience the river on the way to work or when doing various activities in the town center. Use and experience of the river through outdoor recreation, exercise and transportation purposes are similar year round. Residents who live near the river use and experience it most frequently. Men were more likely to fish the river than women, and about 6% of the respondents have fished in the river more than once, with participation in fishing increasing the longer people resided in Lillehammer.

The qualitative and quantitative surveys show a dynamic relation between people and a wide use spectrum in the Mesna river landscape. From the qualitative surveys and observations on site the results showed that walking, exercising and other forms of recreation are the most important activities (Table 2). In addition to being an important destination for outdoor activities, this river is also an important part of the townscape. Many people see and relate to the Mesna river on their way to and from the town center, or by watching it from the many cafés located along the banks. The river and its green surroundings are described by interviewees as a primary positive factor in their everyday life and contribution to their well-being. Many of the interviewees say they like watching the river's motions, witnessing the seasonal changes in the flow and in the vegetation along the river, and hearing the river as they pass. A majority of interviewees wanted natural vegetation in addition to semi-open access to the river banks. The web-survey corroborated the results from the qualitative study - that Lillehammer's identity is tied to the river - wherein 78% of the respondents agree or completely agreed with the statement: "To me, the Mesna river is an important part of the town's history". The mean score was 5.7 (7-point Likert scale), which was the highest score among all 18 statements (Fig. 2).

The web-survey shows that people in general were concerned with the low water level in the river (Fig. 2); the older the respondent is, the more negative the response was. However, the proportion who perceived the river as a natural river is greater than the proportion who believe the river is devastated (32% versus 8%). Those who fish in the river are overrepresented among the latter group. At the identity level,

Table 1
Period of systematic moment observations, number of days and hours, and time of day.

Observation site	Forest			City		
Period of year	25th of June to 29th of July			19th of July to 12th of August		
Temperature	11°C–32 °C			11°C–32 °C		
Weather	All kind: Cloudy, windy, rainy, sunny			All kind: Cloudy, windy, rainy, sunny		
Time of day	Morning	Mid-day	Evening	Morning	Mid-day	Evening
	[8:00–11:59]	[12:00–15:59]	[16:00–23:00]	[8:00–11:59]	[12:00–15:59]	[16:00–23:00]
Hours doing observations	11 h 32min	26 h 15 min	28 h 42 min	6 h 32min	25 h 53 min	17 h 45 min
Hours total	66 h 29 min			50 h 10 min		
Number of people	480	973	603	788	1735	691
People per Hour (mean)	42	36	21	122	69	40

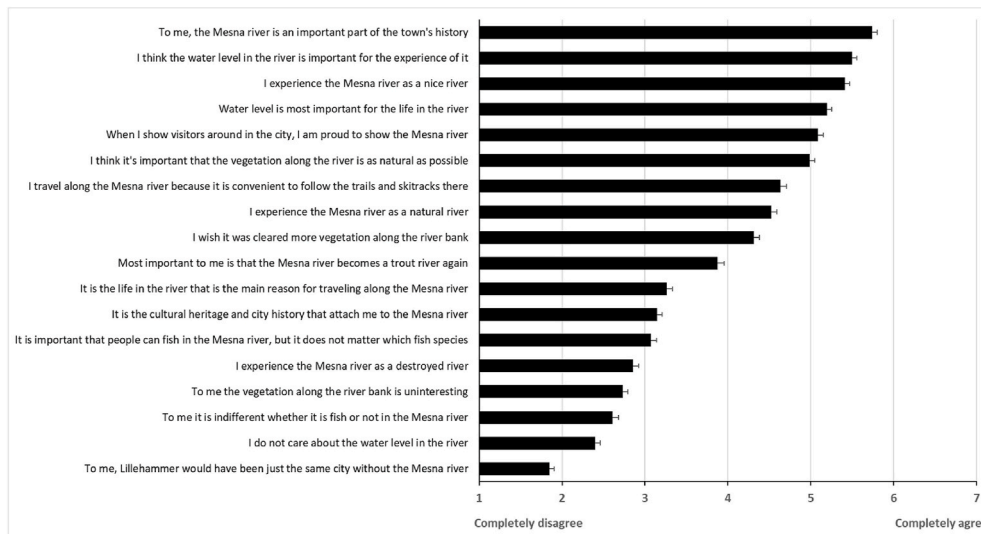


Fig. 2. Results from the questionnaire where respondents were asked to rate their level of agreement with statements regarding experiences and meanings of the Mesna river. The bars show mean values with standard errors based on a representative sample of the target populations of Lillehammer municipality (aged 18+) along a 7-point Likert scale, from 1 (completely disagree) to 7 (completely agree) (n = 686 respondents). The category “do not know” is not shown.

Table 2

Key numbers of demography, group size, time spent, and behavior derived from the observations in the forest and in the city. We have classified the activities into five main classes that is adequate for both the forest and city locations.

	Forest			City		
	Morning	Mid-day	Evening	Morning	Mid-day	Evening
Age (mean/Number of people)	40 (480)	37 (973)	37 (603)	40 (788)	38 (1731)	42 (691)
Gender (Female)	51%	53%	50%	55%	48%	48%
Group size (mean/standard deviation)	1,5 (0,977)	1,7 (1509)	1,6 (0,839)	2,2 (2029)	2,2 (1670)	2,6 (2574)
Spend time (mean)	16 s	17 s	18 s	2min 30	3 min	2 min54
Walking (%)	61,64	62,51	58,54	52,05	54,97	48,46
Walking the dog (%)	10,27	9,68	13,76	2,69	3,22	2,05
Walking with stroller/baby carrier (%)	3,35	1,44	1,16	2,18	0,99	0,73
Running (%)	13,42	11,12	14,43	0,26	1,05	0,73
Biking (%)	6,50	7,62	8,29	0,64	0,41	0,29
Swimming (%)	1,05	5,15	3,48	0,00	0,00	0,00
Photographing (%)	2,31	1,13	0,17	2,31	1,99	2,64
Fishing (%)	0,00	0,21	0,00	0,00	0,00	0,00
Spending time/resting (%)	0,84	0,41	0,00	38,72	35,79	44,66
Others (skiing, shopping, etc.) (%)	0,63	0,72	0,17	1,15	1,58	0,44

the river is most important for the elderly. About 2/3 of the respondents see it as very important that there should be trout in the river. Older men with low education are the group that is most concerned that the river will become suitable for trout fishing in the future.

A large majority of the respondents in the web-survey is aware that the river is regulated (86%). Younger respondents are less aware than older people that fluctuations in the water level may have to do with the hydro-power development. A majority agrees with the statement that there is too little water in the part of the river that flows through the town center (56%), and more than half disagree with the statement that occasionally low water levels do not affect their experience of the river (Fig. 2). Women’s experiences of the river seem to be less affected by low water flow than is the case for men. The interviews show that the users want so much water in the river that it appears to be flowing river with sound and movement, and not just like a trickling stream in an otherwise dry riverbed. The anglers is concerned with stable and satisfactory water flow to improve the living conditions of trout. As one of our male interviews stated: “Sometimes I get sad when I see how small it is, almost dried up due to hydro-power production.” Where and when people visited the Mesna river varied. Fig. 3 shows the use-intensity derived from 13 trail-segments with associated counters along the Mesna river during the summer. The inner town trail segment had the highest use with an

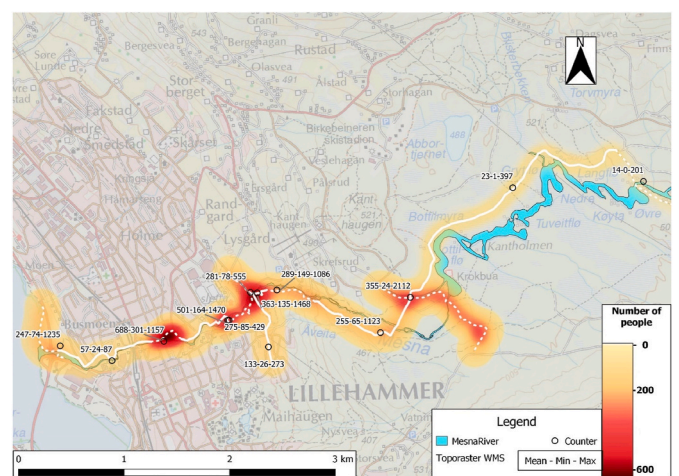


Fig. 3. Trail use intensity based on 13 automatic counters 2013–2020. Each counter represents a path segment indicated by either a solid or dashed line. The numbers at each counter site represent average, minimum and maximum daily use in the period of July, August and September.

average of 688 visitors per day (see photo for this site in Fig. 1). The most remote trail segments (still marked and signed) had averages of only 14 visitors a day. We recognized three hot-spots areas with more than 300 daily visitors in the study area; one in the inner-town, one skirting the city limits, and one in the forest that links to a popular entrance area for outdoor recreation (dark red in Fig. 3). People could use the trail along the river to hike a continuous 10 km hike from lake Mjøsa (247 daily visitors in average) to lake Nord-Mesna (14 daily visitors in average). However, our counter data showed that most visitors used the middle sections of the trail, as both the lower part (average 57 daily visitors) and the upper parts (average 14 and 23 daily visitors) have demonstratively lower visitation than middle trail sections (688 and 501 average daily visitors).

4.2. The rhythm of the everyday use

A total of 579 879 people passed by the automatic counters on the gravel pathway by the river’s outlet over a period of 2428 days from 8. May 2012 to 6. October 2020 (Fig. 4). On average 253 people passed each day (range 0–2125) in almost equal proportions going north (52%) and south (48%). The lowest numbers were in winter (due to heavy snowfall, slippery conditions etc.) and during flooding in early summer. The annual rhythm is quite similar from one year to another. From December to March there were overall few people, whereas April and May saw the highest numbers, particularly after the snow has melted off the trails. During the summer months (July and August), the number of people is somewhat lower than during the spring and autumn. We also see a trend in increasing volume over the entire study period, with an annual increase between 7% and 16% from 2012 to 2019.

Aggregated data (2012–2020) depicting usage frequency during a day or a week indicated some clear patterns (Fig. 5, Fig. 6) such as few nighttime users (23:00 to 07:00). The volume increased in the morning until a mid-day peak at 12:00 (Fig. 6). During weekdays there was a second, smaller peak in the afternoon, and from 20:00 to 23:00 the total volume decreases sharply. During weekends there was only one peak per day. Sundays were by far the most popular day for visiting the river followed by Wednesdays (Fig. 5). Saturdays had a quite low degree of use especially during summer months. These patterns show multiple rhythms over the course of a week, modulated by season. For the reference counter we were able to study the effects of Covid-19 and social distancing measures during the partial lockdown period 13. March to 13. May 2020. The frequency of use increased by 56% in 2020 compared with the baseline of the average of same period in 2018 and 2019 (Fig. 4). Furthermore, during the Covid-19 lockdown and social distancing rules in 2020 there was no clear weekly pattern as exhibited in prior years where there is a similar intensity of use during all days a week and also a single peak curve during all hours a day during 2020 (Fig. 6).

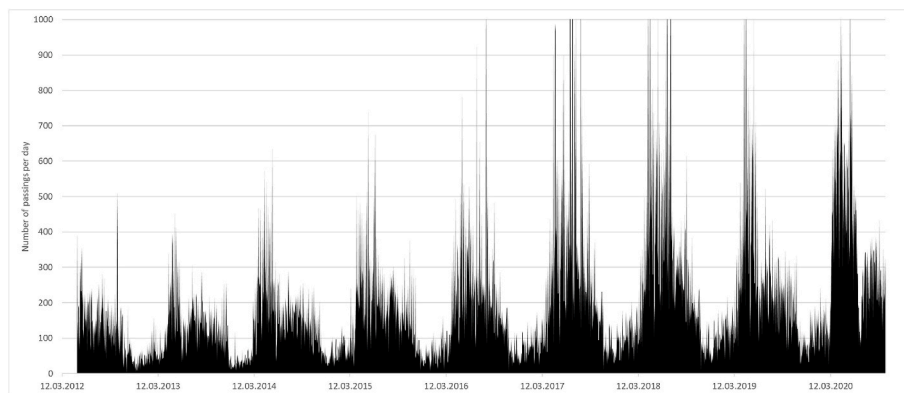


Fig. 4. Number of everyday users (n = 579 879) passing an automatic counter at the outlet of Mesna river from 8. May 2012 to 6. October 2020. In total, 17 days hold more than 1000 passings and are not shown in the figure, and the highest number of passings in a day was 2125 (4. July 2017).

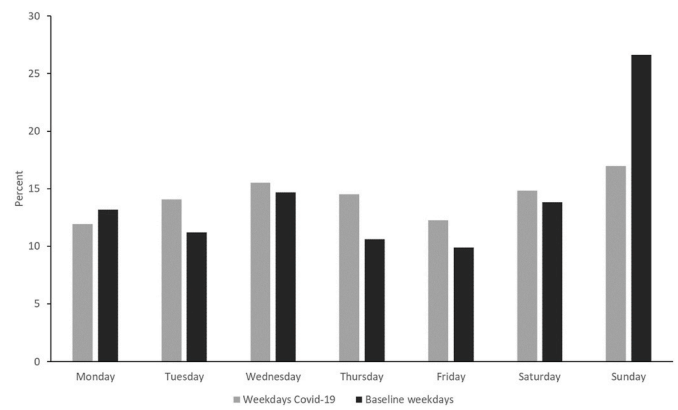


Fig. 5. Diel distribution of everyday users (n = 579 879) passing by an automatic counter at the outlet of Mesna river from 8. May 2012 to 6. October 2020 summarized on different days of the week in the period before and after Covid-19 restrictions (12. March 2020).

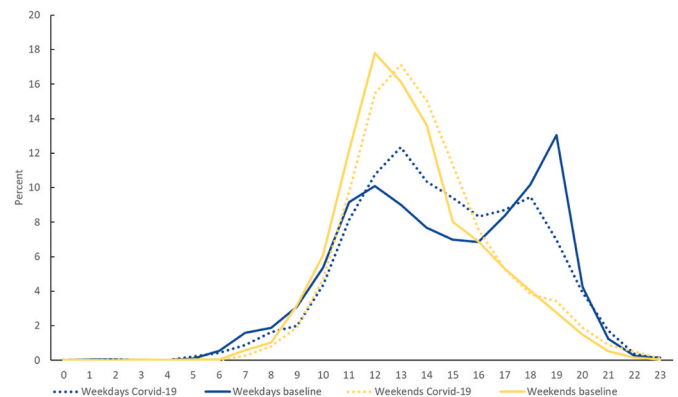


Fig. 6. Diel distribution of everyday users (n = 579 879) passing by an automatic counter at the outlet of Mesna river from 8. May 2012 to 6. October 2020 summarized on weekdays and weekends in the period before and after Covid-19 restrictions (12. March 2020).

The counter data identified the number and temporal distribution of users, whereas the interviews and observations identified their activities. We identified in all 16 main activities from the qualitative interviews: walking, skiing, strolling, running, biking, swimming, barbecuing, informal social happenings, relaxing/resting, fishing, looking at the running water, climbing, photography, crossing for transport, canoeing, and organized trips (school, scout, hike etc.). The

areas along the river have a high diversity of both recreational and transport activities. In the interviews, people told how their activities along the river were part of their everyday routines as well as how experiences and memories, e.g. childhood and adolescence, have affected their current relationship to the river.

We observed a much larger diversity of behavior in the forest than in the town derived from the systematic moment observations (Table 2). In total, 31 categories of activities were classified in the forest compared to 13 in the town (not all 16 activities from the interviews were observed in the town). The reason for this difference was that more sports and leisure activities occurred in the forest. Hiking, biking and running were the most common activities in the forest, while walking and resting were the most important activities in the town. However, resting included a range of secondary activities, such as eating, playing, taking photos, reading, sitting on a bench and being social.

We identified a rhythm connected to behavioral characteristics during a day. For direct comparison between observations in town and forest sites, we extracted all activities into ten common broad categories (Table 2). In the forest there were few or small differences during a day, but we identified more running and biking activities in the morning and evening compared to mid-day. In the town we did not identify clear differences in the types of activities during a given day. There were somewhat more resting activities in the evening than in the morning and mid-day.

There was also a rhythmic element regarding the demographic variations (Table 2). The mean age was highest in the morning in the forest, and in the morning and mid-day in the town. The proportion of women was highest in the morning and mid-day for both the forest and town areas. The group size was highest in the town, and highest during mid-day and evening. The group size was highest mid-day for forest users.

Time spent varied substantially between the forest and the town. In the forest nearly all people were actively passing the observation sites, except for a very few people that stopped and used the river site for photographing or resting ($n = 8$). In the town most of the people were crossing the river (the study area includes a small bridge), but also many spent some time at the site taking pictures or looking at the river in the morning (photo of the town site, see Fig. 1). Playing was the most common activity mid-day for those who purposed to be next to the river.

5. The polyrhythm of the river

The many rhythms connected to human use and perception of the Mesna river have different characters. While some are connected to the river and the natural surroundings, others relate to the society and people's way of living (Fig. 7). Through the combination of quantitative and qualitative methods we are able to "listen" (cf. DeLyser and Sui, 2012; Lefebvre, 2013) to the various rhythms of the Mesna river landscape simultaneously. The river landscape is not a static scene, but

rather a landscape produced continuously through processes that can also be viewed as rhythms (Edensor, 2010). For example, when people are walking or cycling, they leave physical traces on the ground by forming trails along the river, but how these activities and their influence on the trails are perceived by people differ. At the same time, our interviews showed active use of the river landscape also produce emotional and symbolic traces in people's minds (Rybråten et al., 2017). In other words, the landscape not only *is* something, it also *does* something (Lefebvre, 1991). As a dualistic mirror, the qualitative perspectives from interviews reflect the quantitative counter data, as the observations reflect the survey. People's emotional perceptions of the river expressed in the interviews seem to stimulate them into a positive mode: "my mind wanders when I walk along the river." Interviewees described that experiencing the river provides calmness and contentment in everyday life, so that for many the relationship to the river was quite strong. Our work resonates with Ingold (2011), where landscapes and lives are woven together in a continuous and never-ending process, and where human bodies, senses, individual backgrounds, and experiences take part in a world-in-formation (ibid).

The rhythm expressed from observations and counter data showed that visiting the river landscape is a natural part of the people's daily life (Osman and Mulčček, 2017), but that visitation patterns may be constrained by society (e.g. typical business hours, Covid-19 lockdown etc.). Our interviews show that people's rhythms were more adapted to their everyday modern way of living than synchronized with the seasonal dynamics of nature. Such discrepancies are often linked to a distinction between two forms of temporality (Lefebvre, 1991); between cyclic time and linear time (Fig. 7), which manifests itself both in the user's experiences and in the surrounding space (Simpson, 2008; Bergson, 2013). Studying the rhythms of the users required quantitative aspects, for example using data from the automatic counters, and qualitative aspects related to human bodies, senses, individual backgrounds and experiences. People's internal rhythms (such as day and night, needs for experiences, activity preferences etc.) could come in conflict with the linear regularity of modern society (Schwanen et al., 2012). Furthermore, the rhythms of the river included diurnal and seasonal rhythms as well as a diversity of rhythms in ecological and biophysical patterns and structures. Even though the minimum flow requirements of the regulated river are very low in summer, our interviews showed that the users experience cyclic rhythms along the river environment. For example, from our interviews and observation studies we observed that the users expressed wanting experiences with the early morning and late evening activity of birds and animals or being outside during a full moon, but from our counter data we observed that this rarely fits with the rhythm in their everyday life with certain obligations. The use of the forest location had a character of *visiting* the nature as an arena for sports and recreational purposes rather than for spending time in nature and following its rhythm. Experiences of the river environment by resting and spending time was more prominent within the town.

There is an interesting polyrhythmia occurring when people are doing different things at same time in the river environment. This polyrhythmia creates encounters between people and landscapes that would be less likely to occur at other times (Skår, 2010). The Mesna river is not only important for people walking along the river in forest terrain outside the town center, but also for people on their way to the town center or in their daily commute to and from their workplaces. Such rivers thus have a large and varied impact on everyday use and public health (Rybråten et al., 2017). Additionally, the river seems to have an important function for Lillehammer's identity as a small Norwegian city set in rural landscapes and forest as evidenced by the survey where participants voiced opinions against industrial development and commercial activity connected to the river. Additionally, the study showed that reduced flows due to hydropower had a negative effect on many users' perception of the river. For example, the interviewees had different views as to whether the watercourse is *natural* or *destroyed*. Many expressed their view that the river and the riparian forest is a

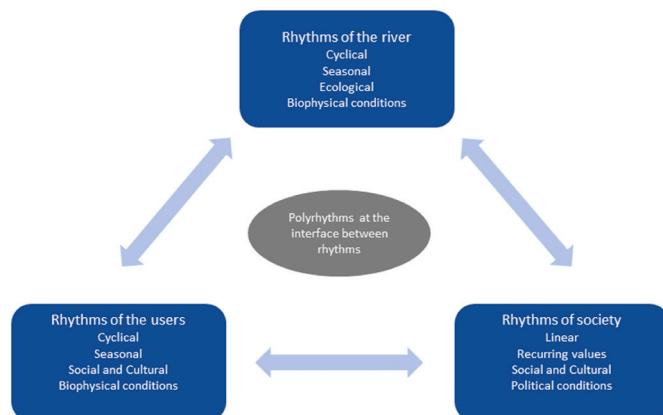


Fig. 7. Conceptual sketch of different rhythms in an river environment system.

living environment. The amount of water is important for the perception of how alive the river is (Junker and Buchecker, 2008). For many, little water means that the river does not seem to function, but for others, the water level is not important. It was important for most of the interviewees that Mesna appears as a running river with sound and movement, and not just as a trickling stream among large boulders in a dry riverbed. Some subjects also believe that the aquatic environment is healthy regardless of water level. The older anglers in interviews expressed that the river had greatly lost its value due to hydropower development and they were concerned with maintaining sufficiently high water flow to improve trout habitat. This illustrates that we cannot fully understand contemporary use (or missing use) without understanding old use and mobilities (Cresswell, 2010). This is especially true when we unpack younger generations' experience of the river as they have accepted other norms for the river environment due to lack of knowledge or experience.

The counter data demonstrated that people visiting the river have temporally recurring patterns that can be divided into somewhat equal units in a metric system. This dynamic depends on the time of day, the day of the week, the season and the weather conditions (Flemsæter et al., 2018). Our observations studies revealed a dynamic, rhythmical, fluid and quite responsive interplay between the individuals and nature, that seemed to embrace a holistic experience of the river's settings – a rhythmic narrative. However, interviews and systematic moment observations revealed certain “doings” along the river that gave nuances to these metrics. The rhythmic visitation patterns may appear predictable and monotonous from the outside, but include reflection and qualities of repetitions that can be compared with qualities of rhythmic music where the underlying pattern give rise to variations and improvisations (Lefebvre, 2013). One example includes variations of resting along the river in the busy town center. Open space along the river was a result of industrial rationality and homogeneity whereas nowadays users recognize that these spaces should reflect creativity and a heterogenous river landscape. Understanding such rhythmic narratives allows users to locate and conceptualize values in the same landscape (cf. Lefebvre, 1991), where even ugly, messy and seemingly insignificant places can have great importance for people (Skår, 2010; Himes and Muraca, 2018).

Although some polyrhythms are synchronized and harmonious, others create a state of arrhythmia as there is conflict, or dissonance, between different rhythms (Lefebvre, 1991). The river spaces consist of many independent rhythms - the rhythm of the family, the rhythm of the work, the rhythm of leisure time, and the rhythm of traffic to mention a few, which merge and together form polyrhythms of particular landscapes (cf. Kärrholm et al., 2015). But these polyrhythms can be harmonious, depending on how well the different rhythms “play together”. For example, increasing the water level affects many other rhythms and it can become more attractive to spend time in the river environment. We also identified through our interviews that sporting events may separate space use more than today, as for example thousands of runners through the forest “over run” many ordinary users on the day of the event. We have observed a long list of situations where arrhythmia seem to be predominant: low water levels seemed to reduce the attractiveness and scenic values for local users; there was disharmony between tourists presence and trout anglers (Aas and Onstad, 2013); the spectacular attraction of flushing the river once a year had negative effect on the life in the river (Skår et al., 2017); there were different rhythms between different users (e.g. walkers-bicyclists, anglers-swimmers, those spending time-those who pass through); and finally there seemed to be conflict between large scale sports events along the river (skiing, running, bicycling) and everyday users that seek contemplation and nature experience. Observed different rhythms between older and younger residents may result in a “generational divide” (Lager et al., 2016), as emphasized by some of the elderly people that have used the river for fishing.

People's opinions and valuations of the river on a general scale are

expressed in the survey. In order to gain more concrete knowledge about people's preferences in relation to the altered flow regime (resulting from the hydropower withdrawals), experimental studies with different water flows or photo-elicited manipulation should be considered, e.g. the relation between people's perception and ecological integrity (Junker and Buchecker, 2008). Today the landscape around Mesna is largely viewed as an aesthetically pleasing recreational landscape. The rhythm of the long-term sociocultural valuations of the river landscape is linear and non-metric, connected to different discourses and representations throughout history (cf. Mels, 2004; Cresswell, 2010), and may be in conflict with the cyclic rhythm of the river environment users. Nature can be part of a human being and rhythm in the landscape and loss of continuity can be seen as modern society removing culture from nature's rhythm. This linear rhythm in society is derived from the rationalized and streamlined perception of time and space which tends to override the rhythm that emerges from a more lived and perceived experience of time and space; irregular or even chaotic (Bergson, 2013). The polyrhythm of “living” is transformed into the linear rhythm of everyday routine, but still has elements of the “irregular and chaotic” rhythms that do not conform to these bounds (Mels, 2004). We observed an interesting contrast between people performing duties such as training or walking their dog in the forest sites, whereas people in the town more often spent time relaxing by the water, hence seemingly following nature's rhythm despite being in an small green space in an built environment. For example, a moment of sunshine on a grey day gives a spontaneous reason for sun bathing at the river banks and breaking away from the trappings of modern life rhythms. The lack of services and informal environment in both sites seem to be important for spontaneity and affords social experiences that are often missed in the everyday routines (Edensor, 2011).

In the town location, the different rhythms seemed to fit each other despite the high density of users. People relaxed after their daily chores and do not seem much effected by other users. As long as there exists a rough balance between the rhythms they may well co-exist in the state of “eurhythmia”. As long as the different users acknowledge and respect each other, harmony can be maintained and integrated use can be accepted among the users (Evensen et al., 2017). Our counters showed that some of the semi-forested areas along the river in the town-center have very low intensity of use, and these areas function as silent places for contemplation and reflection. Further recreational development in these areas will most certainly cause an arrhythmia for current users, but at same time new facilities could attract more people to hike longer sections along the river and contribute to the betterment of public health.

The analysis of space and time carried out in this interdisciplinary research project around the Mesna river demonstrates the potential of *rhythm analysis* as a tool for crossing divides between sciences and methods. A vital part of the analysis has been to understand the spatial and temporal rhythms of the river landscape, to which degree the different rhythms are beating (a)synchronously, and how they jointly make up their own dynamic polyrhythm. This paper shows individual and the greater social relationships with river landscapes are dynamic and complex according to temporal order of different users and types of use. Managers must sense how these relationships are continuously changing and endeavor to strengthen connections between nature, society and individuals that facilitate “polyrhythm living” (Liu et al., 2007; Himes and Muraca, 2018). Moreover, recognizing that while one type of use may decline, other trends may emerge quickly or be overlooked by current monitoring protocols (Schägner et al., 2017). The dynamic human-nature relationships mean that nature management authorities need to be comfortable operating in complex and changing social and political environments, i.e. designing green spaces (Golcink and Thompson, 2010). By understanding the polyrhythms of a landscape, researchers and managers are better able to handle spatiotemporal tensions between social, cultural and ecological valuations of a landscape (Edensor, 2010), and a better understanding of relational values

will improve the potential for community participation in environmental management policies (Mould et al., 2020). By “listening”, as Lefebvre (2013) terms it, to the rhythms of river landscapes, we argue that a better understanding of the sociocultural and ecological temporal structures, and how they relate, enhances society’s capacity to maintain and manage complex and highly valued landscapes. *Rhythmanalysis* focuses on the pluralism and dynamics in landscapes. Understanding landscapes through the interplays of their rhythms makes us able to shift our perspective on landscape management from focusing on each distinct landscape element to the interface between them.

6. Conclusion

Our mixed methods multiyear research demonstrated how the river environment is used for a diverse range of recreational and everyday activities, and that a distinguished contextual and dynamic relationship between the locals, visitors and the river exists. At macro (societal) scales and longer time horizons, coping with a changing river environment remains highly flexible, whereas at the individual and place (spatio-temporal event) scale the relation to the river environment could change dramatically with each event, mediation or direct intervention. It is necessary to interpret present use in the context of previous use and mobilities. Looking from outside the use of the river environment seems quite orderly and predictable, but the spectrum of different users and spatiotemporal use is diverse and chaotic at each locality. The Covid-19 partial lockdown in Norway illustrates that human rhythms can change in an instant. We advocate for more research that is able to encompass a place-based, relational and ever-changing dynamic relationship between humans and the environment. We think that a deeper understanding of this complex relationship will contribute critical considerations to the dominant value classifications (static, measurable and mutually distinct categories) that limit harmonious planning and management of river environments.

Author statement

V.G. – Vegard Gundersen M.S. – Margrete Skår F.F. – Frode Flømsæter B.K. – Berit Köhler V.G. conceived the idea, designed the study and wrote the first draft. V.G. and B.K. led the quantitative studies. M.S. led the qualitative analysis. F.F. created Fig. 7. All authors take part in the data collection using different quantitative and qualitative methods to secure transdisciplinary research process. All authors commented on and approved further drafts.

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