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Combining Revealed and Stated Preferences to design a new urban park in a metropolitan area of North-Western Italy

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A R T I C L E I N F O

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A B S T R A C T

Inclusive and participatory decision-making is a sustainable option for governments and decision-makers to support real transformation and planning of policies and actions. Investigating and gathering the various views and opinions of stakeholders and citizens is particularly effective because it opens up a range of possibilities in co-constructing the city of the future. Among urban areas requiring planning, Urban Green Infrastructures (UGIs) represent spaces designed to improve the character of neighborhoods, as well as to increase the well-being of users. To achieve these goals, planners should adopt a design approach in which UGIs projects are shaped by local community concerns rather than by market conventions in urban design. Focusing on green recreational areas, this study employs an integrated approach combining Revealed (RP) and Stated Preferences (SP) to investigate citizens' preferences regarding urban parks. In particular, the experiment combines Travel Cost Method (TCM) and Discrete Choice Experiment (DCE) for supporting a requalification project in an ex-industrial area of Turin (Italy). In this way, it was possible to understand which facilities can contribute to increasing the citizens' well-being and the overall efficiency of the UGIs provision and maintenance. The proposed methodology represents an operational and replicable procedure to support different renewal projects in which citizens' opinions are crucial for developing long-term sustainable socio-ecological plans and actions.

1. Introduction

Urban Green Infrastructures (UGIs) have been shown to play an important role in addressing challenges related to the 2030 Agenda and the United Nations Sustainable Development Goals (SDGs). This is due to UGI's ability to provide a range of benefits and values for urban dwellers, in general, and for public health, in particular, due to the increased physical activity and social cohesion (Fors et al., 2021; Gómez-Baggethun and Barton, 2013; Meyer and Trandafir, 2023). To achieve some of these benefits, the use of UGIs by residents and city users is required. In this sense, the co-design processes assume a key role for the final design of these spaces thanks to the direct inclusion of stakeholders (Molla, 2020; Rall et al., 2019). Participatory processes increase the workload within the conventional organization for the municipal strategic management of UGIs, but allow the definition of spaces in line with users' actual needs (Ives et al., 2017; Rolf et al., 2019; Vaño et al., 2021). This implies that landscape practices cannot apply a linear logic in which projects develop chronologically and hierarchically, from a plan established by authorities to more detailed projects (Jansson et al. 2020). It becomes urgent a strategic approach characterized by a cyclical process, in which planning, design, construction, and maintenance are viewed from a long-term perspective.

Participatory processes in landscape planning were widely encouraged in international conventions. In 1987, the United Nations drafted the "Our Common Future" report where they introduced the concept of participatory urban planning and sustainable development. This report intended to solve the many problems created by planning activities in meeting citizens' needs. The Local Agenda 21 Action Plan (United Nations Conference on Environment and Development, 1992), the European Landscape Convention (Council of Europe, 2000) and the EU Aarhus Convention (Stec et al., 2000) promoted the protection, management and planning of the landscapes and organizes international co-operation on landscape issues. The importance of social inclusion in planning processes is also confirmed by the Sustainable Development Goals, established in 2015, as part of the 2030 Agenda by the United Nations. In this perspective, Goal 11.3 aims to increase inclusive and sustainable urbanization and the capacity for participatory and integrated planning and management of human settlement in all countries

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by 2030. Furthermore, Goal 16.7 aims to ensure a reactive decision-making process, inclusive, participatory, and representative at all levels. Participatory processes encourage different stakeholders to express their views in the planning process and maximizing benefits for people. Moreover, the collaboration of professionals (planners, architects, designers), institutions and citizens in territorial and urban planning allows to carry out projects and works that meet the needs of the population and increase the achievement of the three pillars of sustainability. With this in mind, a detailed understanding of people's preferences about the socio-ecological systems may inform urban planners to effectively provide and manage them to meet users' needs (Mahmoudi Farahani and Maller, 2018).

It is well understood that preferences for green spaces may differ amongst individuals or groups of people depending on their socio-demographic background, geographic setting, and related cultural traditions and backgrounds (Bravi et al., 2023; Jakstis et al., 2023; Madureira et al., 2018). Several research applications have sought to expand the socio-ecological knowledge of urban green spaces by connecting the domains of green space use and perception with participatory and design techniques (Pinto et al., 2021). These views concern, on the one hand, the right design of interventions and, on the other hand, the rigorous assessment of the consequences, both financial and social, cultural, and environmental in a sustainable development planning perspective. Some authors have focused on the use of Multi-criteria Decision Making (MCDM) approaches to guide policymakers and planners on what the best green strategy is and where it should be located in the city to maximize community benefits (Caprioli et al., 2023; Kasyanov and Silin, 2019; Li et al., 2022; Srdjevic et al., 2022). Nesticò et al. (2022) compare various MCDM methods, such as Analytic Hierarchy Process (AHP), ELimination Et Choix Traduisant la REalité (ELECTRE), Tecnique for Order Preference by Similarity to Ideal Solution (TOPSIS), and Compromise Ranking Method (VIKOR), to select among various project alternatives those that can best contribute to a circular economy and counteract the negative effects of urbanization through the provision of ecosystem services. Li et al. (2022) combined geographic information systems (GIS) and fuzzy hierarchical analysis (F-AHP) to assess the suitability of urban park site selection in Nanjing, China. Kazemi et al. (2022) integrated decision-making methods such as Value Engineering (VE), Multi-criteria Decision Making (MCDM), and Risk Management (RM) techniques to optimize the design of a city park toward economic sustainability in Mashhad, Iran.

In these researches, people's opinions are integrated into the evaluation to a limited extent, often taking into account a stakeholder representing them in the evaluation of the importance of the considered criteria. However, a recent movement to understand public opinion as a key part of decision-making processes is arising (Hong et al., 2018; Hwang et al., 2019; Kopainsky et al., 2017; Shan, 2012; Voinov and Gaddis, 2008; Bottero et al., 2017; La Riccia et al., 2023). Specifically, in the urban context, many researchers have explored the perception and economic value of different existing Urban Green Infrastructures (UGIs) (e.g., Bottero et al., 2022; Chen et al., 2020; Czembrowski and Kronenberg, 2016; Dell'Anna et al., 2022; Dipeolu et al., 2021; Jensen et al., 2021; Tu et al., 2016; Xu and He, 2022; Zhang et al., 2020).

However, only a few studies have addressed the issue (Hwang et al., 2019; Madureira et al., 2018; Van Dongen and Timmermans, 2019) and they merely provide a ranking of attributes, without a detailed valuation of them. Conversely, this paper proposes an integrated approach that combines Revealed Preferences (RP) and Stated Preferences (SP) to investigate users' preferences about a new urban park project to be created in a downgrade area in the city of Turin (North-Western Italy).

This ex-ante analysis aims to provide a valuation of the project features and, simultaneously, analyze the preference for the new park compared to the actual use of existing green areas. For this reason, the interviewees compare the park they usually visit with the new project and choose the one that provides the greatest utility, assuming the maximization framework. Furthermore, the Marginal Rate of Substitution (MRS) for each attribute is also estimated by referring to each respondent's travel costs and actual visit frequency based on revealed data.

The analysis answers three questions: "Will the new park be able to attract users in a city where the green areas are many?", "What bundle of activities/facilities is able most to meet the users' needs?", "Can the social-economic value of the new park offset, at least in part, the required maintenance costs?". Therefore, the analysis traces a path in defining efficient strategies that attract people to the urban park, starting from the users' behaviors and preferences. In this way, the project under analysis becomes a test-bed to investigate the potential of the integrated approach proposed, replicable in different cases and with other purposes to support municipalities in orienting their scarce resources and providing efficient policies and strategies.

After the Introduction (Section 1), the paper is structured as follows; Section 2 presents a literature review of applications that jointly use RP and SP methods. The methodological framework of the study and the methods used are presented in Section 3. Section 4 concerns the application to the case study. The results are presented and discussed in Section 5. The conclusions follow in Section 6. The questionnaire translated into English is included in Appendix B.

2. Joined revealed and stated preferences methods in literature

In 1989, Morikawa first proposed pooling RP and SP data to include non-existing alternatives and a larger number of attributes in RP estimations (Morikawa, 1989). From this proposal, a variety of applications was developed, as testified by more than 700 publications, consulting the database Scopus and Web of Science in September 2022 (using the following string: TITLE-ABS-KEY ("revealed preference" AND "stated preference"). This analysis has also shown the first attempts at using this integrated approach around the 1990s, then, an increase of publications over 20 in 2005 and 30 in 2015. 1994 was a prolific year in literature with the publications of Adamowicz et al. (1994), Ben-Akiva et al. (1994), Bradley & Daly (1994), Hensher (1994), Morikawa (1994), Swait et al. (1994), Vyvere (1994).

Apart from the work of Adamowicz et al. (1994) and Ben-Akiva et al. (1994), all the other publications are in the transportation sector. Simply limiting the research to transportation, adding to the preview string the following keywords ("transportation" OR "transport" OR "mode"), the analysis has shown that about 50% of the previous results were developed in this field. Moreover, the literature review has highlighted many experiments using this integrated method to analyze the demand for market goods (Adamowicz et al., 1994). On the contrary, unlike the present contribution, fewer works were provided in the field of extra-market valuation goods.

In particular, a literature review performed on Scopus and Web of Science databases result in 22 documents whose topic is connected with environmental economics. The publications of Adamowicz et al. (1994) and Adamowicz et al. (1997) represented the first experiment in pooling RP and SP for valuing environmental amenities. In particular, they tested the combination of revealed and stated preference data for measuring recreational site choice behavior.

Then, the estimation of recreational demand and its benefits are examined by different authors by pooling RP and SP data. Concerning the recreational demand, for example, Boxalla & Englin (2008) examines the impact of forest fires on recreation demand, while Atkinson & Whitehead (2015) for a mountain bike park. Similarly, Hoyos & Riera (2013) used RP data with SP data obtained with contingent behavior methods to compare reported past visits to mount Jaizkibel, a natural area located in the Basque Country (Spain), with convergent validity to stated intended future trips. Whitehead et al. (2008) estimated the changes in recreation demand for southern North Carolina beaches. Whitehead et al. (2010) expanded their previous work by exploring hypothetical scenarios of variation in beach width in explaining trip choices.

Regarding the recreational benefits, Whitehead et al. (2009) estimated the economic benefits of Saginaw Bay coastal marsh with the travel cost and contingent valuation methods. A couple of papers are interested in the estimation of the benefits generated to residential locations. Earnhart (2001) estimated the green aesthetic benefits generated by the presence and quality of environmental amenities. Phaneuf et al. (2013) proposed, instead, the combination of RP and SP data in the context of property value models for the nonmarket valuation of residential amenities. Cord et al. (2015) explored spatial gradients, preferences and motivations regarding short-term recreation as a cultural ecosystem service. DeShazo et al. (2015) collected both RP and SP data for valuing protection and recreational use of tropical rainforests in Malaysia. Johnston et al. (2015) quantified recreational benefit changes under Delaware Department of Natural Resources and Environmental Control beach nourishment and retreat scenarios. Wang et al. (2017) combined RP and SP to measure the effects of park attribute improvement on the tourism demand and recreation benefits. Schmid et al. (2021) used pooled RP and SP travel choice data of Zurich workers to obtain mode-specific values of travel time savings. In particular, they had also data on the respondents' time-use and expenditure allocation, which enabled to estimate their value of leisure (i.e., the opportunity value of liberated time when the duration of a committed activity, such as travel, is reduced). Conversely, Loomis (1997) observed the complementarity of RP and SP data through the investigation of recreation activities at a river in Puerto Rico.

The topic of recreational fishing is also widely analyzed by authors using the combination of RP and SP models. Beaumais & Appéré (2010) assessed the value of health risks related to recreational shellfish harvesting. Whitehead et al. (2011) used telephone survey data on charter boat anglers to estimate demand models to for-hire fishing limits in North Carolina. Cha & Melstrom (2018) estimated recreational paddlefish anglers' preferences for catch-and-release fishing. Whitehead & Lew (2020) modeled recreational fishing behavior and preferences. Hestetune et al. (2020) and Hindsley et al. (2022) measured the demand for angling under current and future environmental conditions.

According to this analysis, it is possible to state that the present paper represents the first application of joint SP and RP in urban design focusing on UGIs provision and management. This application is the first attempt where the citizens' preferences for alternative features of a green area are investigated to help decision-makers to design coherent and effective transformation policies and actions.

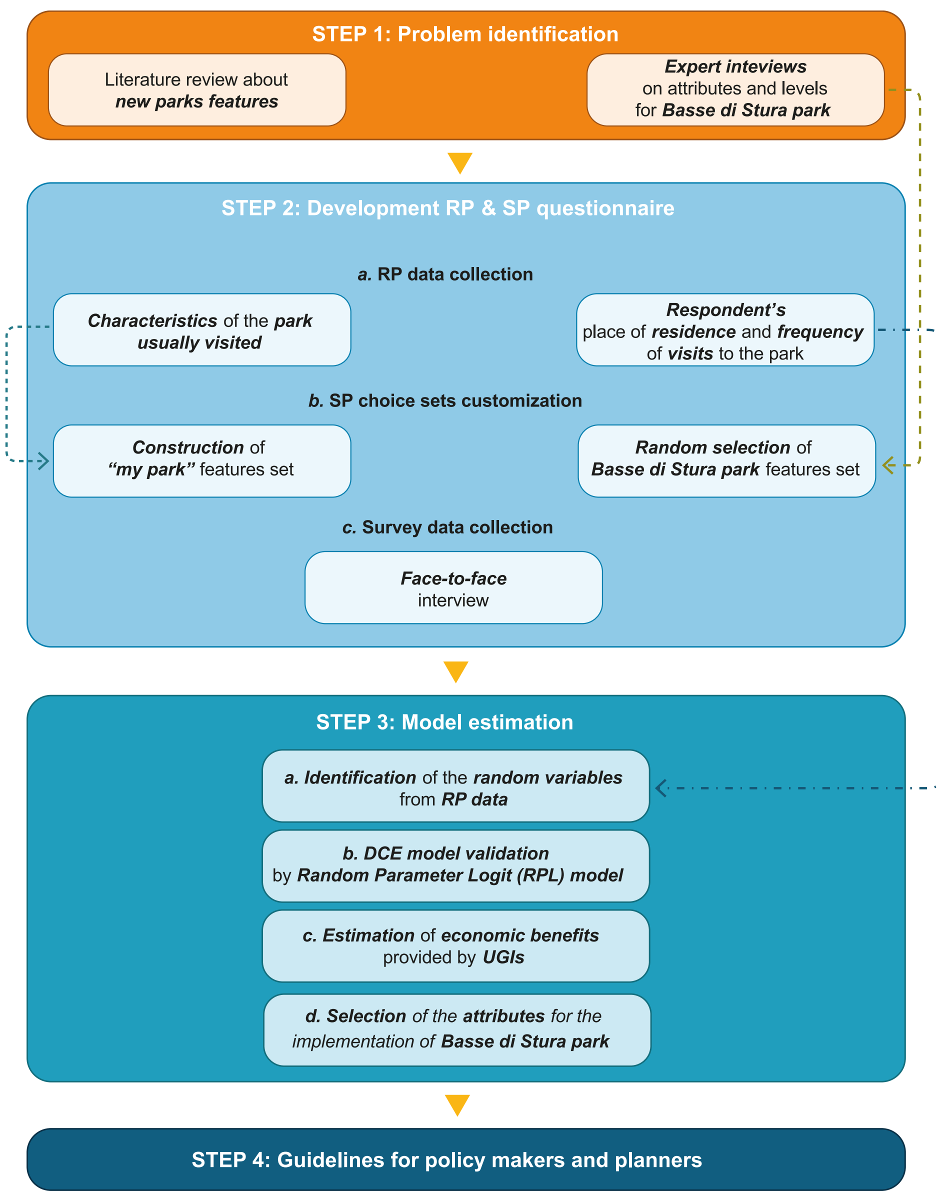

Fig. 1. Study framework.

3. Methodology

3.1. Methodological framework

The methodological framework includes four steps: questionnaire definition, data collection, econometric analysis, and guidelines definition (Fig. 1).

The survey was structured on multi-attribute choice sets, that cover various aspects of the new urban park, designed for the estimation of random utility models (RUMs). The first step involved the investigation of the literature and the analysis of both national and international real cases for the identification of their functions and characteristics. Then, a focus group of experts in the field of planning, policy and landscape architecture selected a set of attributes applicable to the case study under investigation and to Turin's UGIs.

Once the set of attributes was defined, the questionnaire was structured (Step 2). The first part of the survey aimed to collect information from the interviewees on the urban park features they usually visit. Moreover, the place of residence and the frequency of visits to the park – expressed in days per year - were asked (Step 2a). This last information constituted the RP data and made it possible to estimate the random parameters of the model in terms of costs for reaching the park and the number of visits expressed in days per year. Based on the data collected on RP, a Discrete Choice Experiment (DCE) was designed for each interviewee. More specifically, the interviewee identifies the features of the park that he/she usually visit, and these are compared with alternative scenarios. The orthogonal design generates different configurations, based on the attributes defined in the design phase by the experts. Therefore, in Step 2b, the interviewee selects between the park usually visited and a set of scenarios for the area. A binary option is presented to each interviewee for four choice sets, where the park usually visited remains fixed. In contrast, the attributes' levels for the new park are changed. To make the situation of the choice more realistic, the features of the parks that the interviewees usually visit constituted the attributes of the alternative *"my park"*. The customized SP choice sets were very helpful in creating a realistic rather than just hypothetical choice situation (Dubernet and Axhausen, 2020; Louviere et al., 2000). The questionnaire was administered through computer-assisted face-to-face interviews, to have the choice sets of the SP determined simultaneously with the answers previously given by each interviewee by the RP questions (Step 2c). In detail, the online survey was employed in the Limesurvey tool (www.limesurvey.org/). Even if Limesurvey is not directly programmed for DCE, it is able to properly generate random scenarios for each interviewee with a random function based on different choice sets defined in the orthogonal design.

The RP data were transformed into random variables (Step 3a) so that the SP data can be analyzed through a Random Parameter Logit (RPL) model (Step 3b). Once the coefficients of the variables were calculated, the economic benefits of the new park were estimated (Step 3c). Furthermore, the study proposed a selection of the attributes for the implementation of Basse di Stura park according to respondents' needs (Step 3d).

The last step provided guidelines for policymakers and planners of the city of Turin for the optimal management of public UGIs (Step 4).

3.2. Econometric estimation

Choice Experiment (CE) is a family of multi-attribute methods that can be used for the use and non-use values valuation associated with extra-market goods (SP). Set within the demand theory, CE have its foundation in Random Utility Maximization (RUM) framework. This technique states that consumer utility depends on the features of the good or services under examination (Louviere, 2006). In practice, different sets of choices, also called alternatives or scenarios, are presented to each respondent among which he/she indicates the favorite. Each alternative describes the good by its features, or attributes, expressed with different degrees or levels. In this way, the interviewee evaluates the good as a mix of different attributes. This method allows to obtain contingency tables that provide for each attribute the proportions of choice and an index to establish the degree of influence of the single attributes or the interaction level between them (Lancaster, 1966; McFadden, 1974; Thurstone, 1927). Let assume two alternatives belonging to a specific choice set A, and a generic individual i, distinct by a series of characteristics s and driven by rationality to select the alternative that maximizes his/her utility. $P(x|s,A)$ is the probability that the alternative x (defined as attributes vector) is chosen by the individual belonging to the set of alternatives A, given the individual's characteristics s and set A. Thus, an individual behavior rule (IBR) maximizes a utility function belonging to a set of functions (SIBR) which in turn maximize utility. Starting from this assumption, and according to Random Utility Model (RUM), the greater the probability that a given product is preferred over the other alternatives available, the higher the utility that its purchase can guarantee. The individual evaluates the utility of an alternative according to the RUM shown in Eq. (1):

$$U_{ij} = V_{ij} + \varepsilon_{ij} \tag{1}$$

Where U_{ij} is the utility of the choice of the product j by the individual i, V_{ij} is the deterministic and observable utility, ε_{ij} is the unobserved random error term. The observable utility V_{ij} can be described as follows (Eq.2):

$$V_{ij} = \beta_{ij}X_{ij} + \varepsilon_{ij} \tag{2}$$

Where X_{ij} indicates a vector of observed attributes included in alternative j, and β_{ij} denotes the vector of the coefficients associated with X_{ij}.

McFadden (1974) linked the theoretical RUM to the statistical Discrete Choice Model, with a specification that can be resolved in the Multinomial Logit (MNL) model (or Conditional Logit (CL) model). The parameters of the MNL model, represented by the coefficients β, can be obtained through a Maximum Likelihood Estimator (Hanley et al., 1998). By the multiple interviewee choices, following the variation of the levels of the attributes, the product characteristics influencing the individual's choices can be identified. Furthermore, it is possible to identify the most significant attributes and, implicitly, an ordering of preference (Dell'Anna et al., 2022). Finally, using the coefficients β obtained from the MNL, it is possible to estimate the trade-offs between attributes and evaluate how consumers jointly consider two or more of them. According to the MNL specification, the main assumption is that individuals exhibit homogeneity of tastes toward the investigated attributes. As specified by Scarpa & Thiene (2005), since Train's (1998) pioneering study, the development of this modeling has focused on the possibility of incorporating heterogeneity of consumer preferences into observed choice analysis models. RPL model provides greater flexibility and allows parameters to vary across individuals as well as individual choices (Ghosh et al., 2013; Greene, 2002). The coefficients of the utility function parameters are no longer constant, but indexed by individuals, and vary in the population according to a continuous probability distribution function, which is usually assumed normal (Train, 1998). This specification provides a more realistic representation of population preferences. Moreover, RPL is not subject to the IIA recruitment restrictions and internalizes two levels of heterogeneity. The first is associated with the variability of the parameters, while the second is linked to the differences between individuals. In this application, the RPL model is needed to combine information on the preferred attributes of the new park and the actual behavior represented by the green area usually used. With the purpose to combine RP and SP, a RPL was employed; this form, characterized by randomness in parameters (Hensher and Greene, 2003), accommodates heterogeneity as a continuous function of the same parameters underlying some ex-ante specified distribution. A random component in the parameters is introduced accordingly to Eq. (3):

$$U_{in} = \beta' X_{in} + [\eta_{in} + \varepsilon_{in}] \quad (3)$$

where η_{in} is a random term with zero mean whose distribution over individuals and alternatives generally depends on underlying parameters and observed data relating to alternative *n* and individual *i*; and ε_{in} is a random term with zero mean that is IID over alternatives and does not depend on underlying parameters or data. For any specific situation, the variance of ε_{in} may not be identified separately from β', so it is normalized to set the scale of utility. Since η is not given, the (unconditional) choice probability is the Logit integrated over all values of η weighted by its density as in the following Eq. (4):

$$P_n = \int L_n(\eta) f(\eta|\Omega) d\eta \quad (4)$$

Random parameters are used to capture heterogeneity in preferences through their standard deviation or through the study of the interaction between the mean of the parameters and deterministic segmentation criteria. In these cases, it is assumed that random variables of the indirect utility function are probably not independent from the deterministic ones, and that the variance of the random component is not constant between different individuals or for the same individual over time or in different situations. The choice of the random variables is also linked to how the correlation between alternatives and the choice in different tasks is modelled. Moreover, the choice of distribution for the random parameters is a sensitive point. Inappropriate choice of distribution may lead to bias or counterintuitive signs in the estimated parameters. In this study, for example, unobserved factors may result in parameters that vary spatially between observations. A fundamental parameter that can influence the choice and frequentation of green areas is the location of the respondent with respect to these spaces as an effect of gravitation. If a spatial parameter is found to vary significantly between observations, this implies that each observation has its own parameter. Therefore, including random parameters that vary in the population according to a pre-determined distribution allows for more reliable estimation and a better fit of the model to the data. Many distributions can be, and have been, used for the random parameters. The most common will be the normal, the same employed in this application. To test the presence of a certain gravitational effect, starting from the assumptions of TCM, two parameters to be included in the RPL model were estimated: travel cost and visit frequency. The basic notion is that the economic valuation of recreational goods is related to the gravitational nature of demand behavior (RP). The estimation process is based on the observation of the relationship between visit frequency and travel expenses, calculated based on the distance traveled, plus other variables, as time spent on the site, the recreational activity carried out, and so on (National Park Service, 1949). Starting from this concept, the distances travelled by each interviewee to reach the new park was calculated and considered as cost among the explanatory variables.

As mentioned above, the result of a DCE provides useful information about the relative importance of different attributes. However, the most valuable outcome of a DCE is probably the marginal rate of substitution (MRS). Marginal rates of substitution provide information about the rate at which respondents are willing to exchange one attribute for preferred levels of another attribute. For example, in the context under consideration, this might be the amount of money individuals are willing to pay (WTP) to perform a certain activity in an urban park. Of all the information obtained with a DCE, MRS is the most likely to be used within other analyses to inform decision making. Since it is not always easy to derive the individual WTPs of the green areas characteristics during the design phase, we referred to the assumptions of the TCM for monetizing them. In order to monetize distances from the new park, we calculated an average cost of travel per km.

Once the independent variables have been estimated, the marginal rate of substitution for each characteristic can be calculated as follows (5):

$$MRS = -\frac{\beta_x}{\beta_{TC}} \quad (5)$$

where β_x is the coefficient of the characteristic *x* estimated and β_{TC} is the travel cost coefficient. The MRS was estimated to analyze the marginal effect on the probability of choice and ensures that the estimate can be brought back to the monetary scale.

4. Data and experimental design

4.1. Case study and sample composition

The case study under analysis is an area of 150 hectares, called Basse di Stura, within the municipality of Turin (Italy) (Fig. 2). This site is located at the edge of the city and characterized by the proximity of the river Stura. For that reason, it was initially used for agricultural functions, as it is apparent for the presence of some farmhouses. More recently, factories and car dealerships have occupied the south and east portion of the area. However, for its natural potentials and strategic location, local public administration has recently expressed an increasing interest in the area, proposing an intensive requalification for the creation of a new urban park for the city (Bottero et al., 2020; Bottero et al., 2021). Since the costs of remediation are very high, the city is willing to undertake this project if motivated by the citizens' interest.

The present research is mainly devoted to supporting the municipality in the definition of efficiency strategies able to attract people in the area, starting from the analyses of actual users' behaviors and their preferences, as well as the possibility in the future to use the new urban park.

A questionnaire was prepared for collecting the needed information. The first version of the questionnaire was tested by a group of 20 experts and respondents, that help us respectively in the improvement of the questionnaire from a scientific perspective and in the clarity of information and questions presented. After that, the final version was administered. The interview was conducted through computer-assisted face-to-face interviews to obtain a representative sample of the geographic area. This sample was composed of residents with an age equal or higher than 18 years old and who have lived for at least one year in the city.

The collection of the data lasted about 12 months, starting from May 2021. This long period was necessary to collect the answers of different targets of the population which using UGIs in various ways and different seasons.

4.2. Survey questionnaire design

The final version of the questionnaire consisted of five sections: I) the respondent's attitude regarding different types of green areas in the city, II) the respondent's attitude concerning the urban park that he/she has used the most in the last year, III) the respondent's interest in the future park of Basse di Stura, IV) the respondent's preferences for possible transformation scenarios for the Basse di Stura area (DCE), V) demographic and socioeconomic data of the respondent. The questionnaire, translated into English, is attached in Appendix B.

The interview starts with an introduction section useful for limiting the sample target, i.e., citizens with legal age (≥18 years old) and those who have lived for at least one year in the city of Turin. Moreover, this introductive section is devoted to explaining the aim of the survey and to briefly describing Basse di Stura park and the municipality future scenarios for that area.

Section (I) explores the habits of the respondent concerning the green areas that he/she uses most. So, we ask for some information about the reasons and frequency of use of the selected green areas, the approximate time spent there and the usual transport mode to get there. In this section, we also ask the respondent to approximately locate on

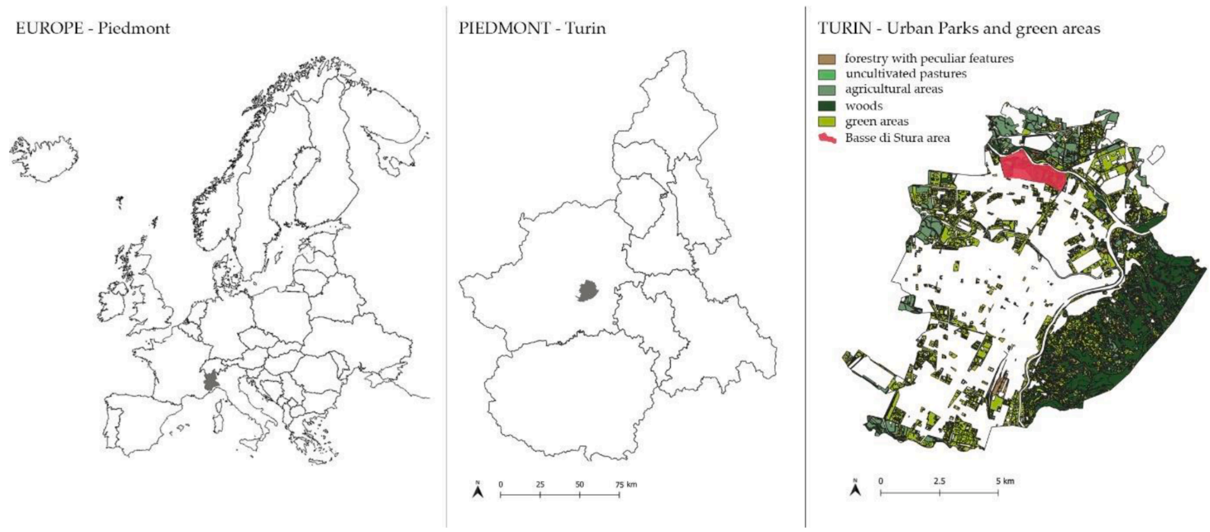

Fig. 2. Location of Basse di Stura area in Turin (Piedmont, Italy) and the classification of green areas in the city.

the map him/her home, his/her workplace and the green areas selected. This phase is useful for understanding the usual travel of each person to go to some green areas.

Section (II) analyzes the yearly behavior of the respondent concerning a specific green area, i.e., the urban park. The respondent selects the urban park that he/she most used in the last year among the complete list in the city of Turin, and, as before, expresses him/her attitudes and habits (such as frequency, time spent, the usual season of use and the mean of transport). This section also includes a specific question on the characteristics of the park used: in particular, the respondent specifies the functions that he/she remembers of the urban park selected. This question is fundamental for the DCE and the comparison between the park actually used and the different scenarios proposed for Basse di Stura.

Section (III) investigates the interest of the respondent in the transformation of Basse di Stura, also examining the potential future habits. In this section, a map with the location of Basse di Stura area is provided to the respondents in order to have a clear idea where it is and how to reach it.

Section (IV) gathers information about the respondent's preferences on the possible transformation scenarios for the Basse di Stura area through the DCE method. The respondent answers to four experiments and each experiment compares the park most used by the respondent and an alternative scenario for Basse di Stura. The scenario for Basse di Stura is one of the 32 created through the orthogonal design performed in SPSS (https://www.ibm.com/analytics/spss-statistics-software) with the attributes defined in the design phase during the focus group with the experts. The attributes of the most used park do not change during the four experiments since they are related to the choice made by the respondent in Section (II) (question 30) on the characteristics of the park usually visited.

For the Basse di Stura area, 20 dummy variables are combined in the orthogonal design and related to the following 5 clusters of services:

- Social & Educational activities: (1) Educational farm (no-food crops and phytoremediation crops), (2) Educational tour on the industrial history of the area, (3) Social activities hub, (4) Urban allotment garden;
- Natural activities: (5) Camping site, (6) Birdwatching and nature trails of the biodiversity, (7) Butterfly farm, (8) Horse farm;
- Technological activities: (9) Land for no-food crops (for non-food purposes), (10) Area to produce of bio-energy (e.g., solar panels), (11) Research centre, (12) Experimentation area of land phytoremediation;
- Sport activities: (13) Sports fields (soccer/tennis/basket/volley), (14) Skatepark/roller skating spaces, (15) Equipment for outdoor sports, (16) Bicycle lane;
- Organised activities: (17) Children's play area, (18) Area bounded for dogs, (19) Study area, (20) Beaches along the river.

Section (V) is devoted to the collection of the main socioeconomic and demographic data of each respondent, such as age, education level, income and job position.

5. Results

5.1. Descriptive analysis (socioeconomic variables)

Of the study population, 492 subjects completed and returned the questionnaire, 369 of whom were used for the analysis (75% of the total), corresponding to those who answered all questions of the survey.

The main socioeconomic data of the respondents are shown in Table 1. The sample appreciably represents the gender proportion in the city and covers different ages, education levels and income ranges, as it is possible to see in Table 1. According to the age, the sample is not perfectly representative of the Turin population, since there are a larger proportion of young people. However, following the procedures of other authors on the same topic (e.g., del Saz Salazar and García Menéndez, 2007; McCormack et al., 2014), the sampling scheme was designed to

Table 1
Main socio-economic data of the respondents.

	Variables	Frequency (%)
Gender	Male	45.21
	Female	54.79
Age	18–29 y	34.57
	30–39 y	22.11
	40–49 y	12.54
	50–59 y	7.26
	> 60 y	20.51
Education	Low education	2.31
	Compulsory education	35.97
	High education	61.81
Income	<600	3.02
	600–1200	21.75
	1201–2000	34.23
	2001–5000	20.89
	5001–10,000	10.18
	>10,000	9.92

obtain a representative sample of city households considering the 34 districts of the city and for covering all the urban parks in Turin. Additionally, the sample derives from the face-to-face interviews collected in one year (from May 2021), so it is based on the people who visit green areas. According to the aim of this work, we favoured an *in-situ* approach because it can intercept the population with a greater interest in the survey topic, reducing the representation of groups with lower rates of park use or nature appreciation. Respondents voluntarily participated in the survey and no monetary compensation is offered. Concerning the education level, the sample follows the data provided by Italian Statistical Bureau (ISTAT, 2020a), related to the Turin province. According to the data registered in 2020, the percentage of the population without an educational qualification is around 3.4% (compared to our sample of around 2.3%), elementary licenses 15.6% and middle school ones 30.5% (compared to our sample of compulsory education around 36%). At the same time, the percentage of high school graduates and people with tertiary or higher education is around 53% (compared to our sample of high education around 62%). The slight differences between the percentages in the Turin Province and our sample can be perfectly justified by the fact that populations with higher levels of education are concentrated in cities that host universities (such as Turin) (ISTAT, 2020a). Regarding income, the sample also follows the trend of Turin, as registered in 2020 by ISTAT (ISTAT, 2020b). Most of the population, around 50%, has an income between 1200 and 5000 €/month (compared to our sample around 54%). People with a high income (more than 5000 €/month) are around 20% (perfectly in line with the sample). Whereas people who earn less than 1200 €/month are 31% (compared to 25% of the sample). The other socio-economic characteristics are shown in Table A1 Appendix A.

Table 2 shows the respondents' habits and preferential activities in green areas of the city. It is apparent from this table that many respondents (44.25% of the total) currently prefer to spend outdoor activities in urban parks, followed by people who use neighborhood gardens and areas bounded for dogs. Among the motivation to visit these green spaces in the city, the respondents show their preference to relax, enjoy the good weather and fresh air and to take a walk, run and/or cycling. Respondents often benefit from these green areas for a time between 30 minutes and 2 hours, whereas they never stay for less than 15 minutes or more than 4 hours (Table 3). From these data, it is apparent that the length of time spent is almost the same for the entire sample which stands at intermediate values. For the day and season of visit, the sample is largely heterogeneous.

Moreover, the survey gathered information on the time cost and transportation corresponding to visiting the various green areas (Table 4). Most respondents reported that they visit urban parks starting from their home (86.38%) and spending less than 5 min (48.35%) to reach them (respectively, questions 4 and 25 in the questionnaire). This last data is reliable since the city of Turin is one of the greenest cities of Europe, and generally worldwide, rich in parks and green areas, as it possible to see in Fig. 2. Coherently, the mean distance from the starting point (home or work) is about 500 meters. When the participants were asked the most common mean of transport used to go to the green areas, the majority commented by walk (58.75%), whereas 18.61% by public transports, 13.89% by car and 8.75% by bike.

Table 2
Respondents' habits and preferential activities in green areas.

	Variables	Frequency (%)
Type of green area	Dog park	13.45
	Playground	10.09
	Neighborhood garden	24.25
	Urban park	44.25
	Forest/ Natural reserve	7.96
	Sport ground	0
	Urban allotment garden	0
Motivation of visit	Playing sports (football, basketball,..)	8.69
	Walking, running and / or cycling	27.71
	Relax, enjoy the good weather and fresh air	28.90
	Taking the dog out	8.69
	Accompanying the children	6.24
	Eating	6.46
	Studying in the open air	6.76
	Gardening	0.74
	Attending events and various activities	5.79

Since the aim of the research is mainly focused on supporting the definition of coherent and strategic scenarios for the implementation of a new urban park in the downgraded area of Basse di Stura, the survey also investigated the frequency of visit of the urban parks in the city (Table A.2 in Appendix A). This analysis allows to understand if there are some competitors in terms of proximity and substitution of the future park of Basse di Stura.

5.2. Econometric analysis

As mentioned above, this experiment is based on the hypothesis commonly accepted that green areas exert a gravitational effect on the residents living in their immediate proximity and that this decreases with increasing distance. Planning a new green area must therefore consider current preferences related to the use of urban parks. This is the reason why the experiment takes into account the correlation between the choice and preferences related to the new park (SP) and the existent green areas that are represented by the travel costs and visit frequency to the preferred park at the moment of the interview (RP). The choice experiment concerning the new park must therefore be combined with the current preferences characterizing the interviewee. This leads to a mixed structure, where the error terms must be evaluated separately. In this case, RPL, similar to the random coefficients model for linear regressions, can be helpful.

Table 5 shows the results of the reduced model where only the variables with acceptable significance of the estimated parameters are included. Considering that each respondent (i.e., 369) answered 4 choice sets, the total number of observations amounted to 1476.

Out of about twenty attributes (services) proposed to the interviewee in the choice sets (see Section 4.2), only six have a positive coefficient (in order of importance: educational tour, rural lands, research center, play areas, bounded for dogs, or assigned to children, and horses farm). Considering the initial groups of activities/facilities presented in the questionnaire (social & educational, natural, technological, sport, and organized activities), at least one type per group was identified by means of this analysis. There are also three undesirable features: the roller-skating rinks, the beach along the river and the study area, which show a negative sign. From the users' standpoint, the city of Turin has many facilities organized for sport, and probably, there is no need to allocate an area with such environmental characteristics to this type of activity. Evidently the presence of a study area also does not seem coherent.

The constant for the specific alternative that, in this case of a binary choice model, represents the preferred green area at the interview moment, has a significant but negative coefficient. This result reveals, in general, a preference for the new park project, or, even better, the possibility of commuting one's choice if certain activities or services are included in the new project. The single MRSs represents the opportunity costs to switch the visit from the actual park to the new one containing these different activities and facilities. Consistent with the general layout of the model, travel cost and visit frequency have a correct sign and good significance level. The standard deviations of the random parameters are also significant. These results validate both the TCM assumptions and the expectations of the RPL model. Finally, Table 6 shows the estimate, for the entire city of Turin, of the mean of the access cost to green areas, independently of their different characteristics and distances.

Recalling that urban parks are a public good whose access is not regulated, these estimates represent useful monetary indicators for

Table 3
Respondents' frequency of visit of green areas.

	Variables	Frequency (%) *Never*	Frequency (%) *Rarely*	Frequency (%) *Sometimes*	Frequency (%) *Often*	Frequency (%) *Always*
Hours	< 15 min	58.12	27.93	6.84	5.98	1.14
	15 – 30 min	28.53	25.88	19.41	23.24	2.94
	30 min – 1 h	15.52	12.54	22.99	45.37	3.58
	1 h – 2 h	19.28	16.27	17.47	42.17	4.82
	2h-4h	39.83	28.37	14.90	14.90	2.01
	> 4h	73.47	21.57	4.96	0	0
Weekly	Weekday	13.03	14.85	23.33	40.61	8.18
	Holiday	10.39	10.98	20.47	45.99	12.17
		All year round **(%)**	Summer **(%)**	Spring **(%)**	Autumn **(%)**	Winter **(%)**
Season		38.19	21.96	25.30	13.60	0.95

Table 4
Respondents travel attitudes.

	Variables	Frequency (%)	Distance (m)
Starting point	Home	86.38	
	Workplace	13.62	
Average time travel	< 5 min	48.35	
	5–10 min	16.05	
	10 – 20 min	12.89	
	20 – 30 min	6.65	
	> 30 min	16.05	
			612 (Home) 425 (Workplace)
Mean distance from urban park	< 5 min	48.35	
	5–10 min	16.05	
	10 – 20 min	12.89	
	20 – 30 min	6.65	
	> 30 min	16.05	
Means of transport	Walk	58.75	
	Bike	8.75	
	Public services	18.61	
	Car	13.89	

valuing the benefits/costs if one proceeds toward a project's feasibility study. These results could also guide the municipality choices, which can propose, for example, the realization of cultivated rural lands combined with education and horse farms or the organization of the area as a cultural center grounded on the research center, the educational farm, and the educational tours.

6. Discussion

Users of green areas do not pay a fee to access them, but that does not mean the public good has no economic value. For example, the maintenance costs in charge to public administration show that conservation is at least necessary. In this work, a valuation of the potential benefits of new green space has been proposed to compare the provision costs and benefits that would be gained. The model joins an approach based on RP with DCE where consumers' preferences are hypothetical. The latter is however influenced by the distances between the respondent's home and the new park. Not all types of activities/services presented here were great results. Services such as the butterfly house or the beach do not seem to meet great interest, while more replaceable and widespread activities appear more familiar and attractive or irreplaceable, as, for example, children and dogs' areas. This may be trivial. Less obvious are the general results, which nonetheless provide some important indications to the policy makers. The estimation of tMRS provides the following values: the inclusion of the various services offered increases the benefit in a range that goes from 3.64 to 7.33 € per user. The calculation of the overall annual benefits is, in these cases, strongly influenced by the number of actual and potential users. This number is not easily identifiable, which is why residents can be considered as total beneficiaries, taking into account that urban planning standard is calculated as the square meters of green areas per residents. In 2019, 9,700,000 € were spent in the city of Turin on the maintenance of urban

Table 5
Random parameters multinomial logit model estimates.

Random parameters multinomial logit model with panel (369 observations and 1476 experiments)							
Dependent variable = Choice (0,1)	Beta	St. error	z	Prob.	95% Conf. Int.		MRS
Independent variables	Random parameters in utility function						
Travel cost	−0.09364(**)	0.03666	−2.55	0.0106	−0.16550	−0.02179	–
Visit frequency	0.00429(**)	0.00200	2.15	0.0318	0.00037	0.00820	0.05
Nonrandom parameters in utility function (choice-set variables)							
Educational tour	0.68608(***)	0.12529	5.48	0.0000	0.44052	0.93164	7.33
Horses farm	0.34050(**)	0.13535	2.52	0.0119	0.07523	0.60577	3.64
Rural lands	0.49619(***)	0.13730	3.61	0.0003	0.22709	0.76529	5.30
Research center	0.46916(***)	0.13660	3.43	0.0006	0.20143	0.73689	5.01
Roller-skating rinks	−0.28169(**)	0.12402	−2.27	0.0231	−0.52477	−0.03861	−3.01
Play area for children	0.41417(***)	0.12130	3.41	0.0006	0.17642	0.65191	4.42
Play area for dogs	0.42596(***)	0.12006	3.55	0.0004	0.19064	0.66128	4.55
Study area	−0.32657(***)	0.12509	−2.61	0.0090	−0.57174	−0.08139	−3.49
Beach	−0.45451(***)	0.14018	−3.24	0.0012	−0.72925	−0.17977	−4.85
Constant (my park)	−0.46797(**)	0.21089	−2.22	0.0265	−0.88131	−0.05462	−5.00
Std. Devs. Of Random Parameters							
Travel cost	0.27344(***)	0.03881	7.05	0.0000	0.19738	0.34950	
Visit frequency	0.01434(***)	0.00263	5.45	0.0000	0.00918	0.01949	
Log Likelihood Function (LLF)		−866.24558	Chi squared			313.67932	
Restricted LLF		−1023.0852	Significance level			0.0000	
McFadden Pseudo R^2		0.1533007	Inf. Cr. AIC			1760.5	
(***) (**) = Significance at 1% and 5% level.							

Table 6
Travel cost and visit frequency monetary findings.

	N	Minimum	Maximum	Mean	Std. deviation
Travel cost of the green areas at the interview moment (my park)	1476	0.05	22.71	2.88	3.0297
Travel cost for the new park project	1476	1	25	7.19	2.7734
Visit frequency (my park)	1476	1	417.12	88.68	97.0131
MRS (considering x visit frequency at the sample mean)		4.06			

green areas (Città di Torino, 2021), an amount well above the present recreational use benefits just calculated (equal to 4,707,254 € per year for a population of 858,205 residents in 2021). However, if the park will contain no unique features (such as a dog area or a play area for children), the recreational use benefit is lower, because the park will gather a smaller catchment area (i.e., the one closest to park). In particular, the inclusion of these services increases the benefit in an average of 4,485 € per user and the population catched is equal to 8,917 residents living inside the 800 m (i.e., around 10 minutes walk) from the park. This produce a total recreational benefit equal to 39,993 € per year. Additionally, considering that the services provided by UGIs include various ecosystem functions, this estimate must be considered only as a WTP for recreational use.

7. Conclusions

This study proposes an innovative integration of RP and SP methods for supporting the public administration in considering citizens' preferences to design of a new urban park in north-western Italy. This methodology can be replicated in different areas and with other planning and management purposes to support public bodies in orienting their resources and providing efficient policies and strategies.

These main objectives are pursued by the application of this methodology: identyfing the preferred project features and valuing the actual recreational value considering a preference for the new park *versus* the existent UGIs. From the results, the following conclusions and implications were reached. First, the study indicates that a larger percentage of the sampled population, while remaining conditioned by the nearest location of the current green areas, shows an interest in the new park. But this also implies that most of the population has access to the nearest parks and derives the greatest benefit. This means that residents have thought the new park will improve their actual level of utility to the extent that certain activities or services are included or excluded from the project. Considering the high standard of green areas per inhabitant in Turin - which means high maintenance costs - officials and agencies responsible for formulating policies and developing programs to deliver and manage UGIs should focus on improving the quality and not just the quantity of urban green areas. Secondly, the study has also revealed the preferences for certain project features of the future park. The favorite activities for Basse di Stura park are the educational tour, horses farm, cultivated lands, research center and play areas, assigned to children or bounded for dogs. This result suggests that some new facilities are preferred together with those already present in the existent green areas. The consequence is that urban planners and municipal green management must adopt programs related to the provision of green areas to the specific choices of the population to avoid wasting scarce economic resources. A second consideration must be made regarding a bottom-up investment planning process. In this case, it seems necessary to investigate the preferences and needs of the population, and the final design of UGIs should also be informed by other considerations such as cost, location, and accessibility. In other words, it is only by looking at the demand side of this type of services that supply can be optimized by improving the overall well-being and quality of urban life. Finally, it should be noted that the use of a mixed model based on RP and SP has helped to avoid some typical biases of the environmental value elicitation process using SP, such as, for example, the CVM (Contingent Valuation Method). Conversely, it cannot eliminate the issues associated with sample surveys - the size and representativeness of the sample. Unfortunately, representative sample surveys of the entire city population would be particularly burdensome for the municipality and are seldom implemented. This would be added to the high costs of providing and maintaining green areas. This experiment wants to be a small contribution, even if not perfectly exhaustive and definitive.

Indeed, a limitation of this work lies in the fact that the sample is not perfectly representative of the statistical characteristics of the whole population. The resulting sample, based on an in-situ approach, was designed to cover all the urban parks in Turin and the 34 districts of the city, but it has produced a larger proportion of young people with high education. A future improvement of the work will certainly develop a probability sample with the aim to represent every member of the population, also those less interested in park use and visit, and verify the differences with the current analysis. Moreover, the survey was developed immediately after the COVID-19 pandemic. This could have produced a distorting effect on the uses and habits of urban parks. The administration of the questionnaire in a subsequent period could correct some distortions due to the extraordinary event lived between 2019 and 2022 worldwide, and in particular in Italy.

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CRediT authorship contribution statement

Marta Bottero: Conceptualization, Formal analysis, Data curation, Investigation, Methodology, Validation, Visualization. **Marina Bravi:** Conceptualization, Formal analysis, Data curation, Investigation, Methodology, Validation, Visualization. **Caterina Caprioli:** Conceptualization, Formal analysis, Data curation, Investigation, Methodology, Validation, Visualization. **Federico Dell'Anna:** Conceptualization, Formal analysis, Data curation, Investigation, Methodology, Validation, Visualization.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Supplementary materials

Supplementary material associated with this article can be found, in the online version, at doi:10.1016/j.ecolmodel.2023.110436.

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