



HÁSKÓLI ÍSLANDS

# A systemic approach to assessing the environmental impacts of tourism

and the attractiveness of tourist destinations

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# Áhrif innviða á þróun ferðamannastaða á hálendinu í ljósi kerfisgreiningar

Samband ferðamennsku og umhverfis einkennist af flóknu samspili margra þátta, sem með aukinni uppbyggingu ferðapjónustu getur haft töluverð umhverfisáhrif og smám saman breytt upplifun ferðamanna, og að lokum breytt tegund þeirra ferðamanna sem velja að heimsækja ákveðin svæði. Heildrænn skilningur á orsakasamhenginu á milli hinna ólíku áhrifaþátta er þess vegna grundvallaratriði til að viðhalda hinu viðkvæma jafnvægi á milli ferðamennsku og umhverfis. Til að viðhalda arðsemi ferðapjónustunnar er ekki síður mikilvægt að uppbygging ferðamennsku fari ekki yfir félagsleg og náttúrufarsleg þolmörk hvers svæðis. Til þess að svo megi verða er nauðsynlegt að efla þekkingu og skilning á eðli þeirra breytinga sem hvert stig uppbyggingar innviða og þjónustu hefur á hvort tveggja ferðamennsku og umhverfis svæða. Fullur skilningur næst ekki nema með því að greina orsakatengsl á milli allra áhrifaþátta.

Meginmarkmið þessa rannsóknaverkefnis að meta umhverfisáhrif ferðamennsku á hálendinu með því að greina breytingar á ásýnd umhverfis vegna uppbygginga innviða og þjónustu með tilliti til viðhorfskvarðans. Samkvæmt viðhorfskvarðanum er ferðamönnum skipt niður í ákveðna flokka, frá miklum náttúrusinum (e. strong purists) til þjónustusinna (e. non-purists) eftir mismunandi þörfum, væntingum og umburðarlyndi sem ferðamenn hafa gagnvart manngerðum þáttum í umhverfinu. Í þessu verkefni er sérstök áhersla lögð á heildræna greiningu til að meta orsakatengsl á milli allra áhrifaþátta. Verkefnið er hluti af stærra verkefni sem beinir sjónum að umhverfisáhrifum ferðamennsku á vinsælum gönguleiðum á hálendinu og hvenær breytingar vegna uppbyggingar innviða eru orðnar það miklar að breytt ásýnd er varanleg og ekki unnt að fara tilbaka, og hvaða áhrif það hefur á ferðamennsku hálendisins til langs tíma. Til að greina breytingar á ásýnd umhverfis er stuðst við kerfisgreiningu. Kerfisgreining er sú aðgerð að greina ferli til að skilja orsakasamhengi þess og uppbyggingu. Breytur eru flokkaðar og settar upp í fræðilegt hugrænt líkan, svokallað orsakalíkan (e. causal loop diagram). Allir áhrifaþættir kerfisins eru síðan skilgreindir til að fá heildaryfirlit yfir vægi allra þátta. Á þann hátt er unnt að auðkenna og greina mikilvægustu áhrifaþætti hvers ferlis. Markmið kerfisgreiningar er þannig að auka skilning á samspili allra áhrifaþátta og

auðvelda skilning á orsökum og afleiðingum. Niðurstöður kerfisgreiningarinnar sýna að megin breytur sem hafa áhrif á upplifun og áhuga einstaklinga sem heimsækja náttúrusvæði á hálendinu eru magn innviða og þjónustu ásamt fjölda annarra ferðamanna. Þar sem fjöldi er áhrifa-breyta sem kemur seint inn í orsakakúrfuna er fjöldi ferðamanna ekki hentugur mælikvarði til að meta þróun ferðamannastaða. Hentugri mælikvarði er aðdráttarafl ferðamannastaða, sem nær að fanga þróun og næmni kerfis betur. Niðurstöðurnar undirstrika mikilvægi heildarskipulags og stjórnun ferðamannastaða til að koma í veg fyrir hnignun þess umhverfis sem þeir byggja afkomu sína á, og til að forðast að allir áfangastaðir ferðamanna þróist í sömu átt. Slík þróun minnkar gildi hvers áfangastaðar fyrir allar aðrar tegundir ferðamanna en þjónustusinna. Endastöð slíkrar uppbyggingar er fjöldaferðamennska alls staðar.

Þessi rannsókn er fyrri hluti stærri rannsóknar sem styrkt er af Ferðamálastofu. Við viljum þakka Ferðamálastofu fyrir fjárstuðninginn og frumkvæði að framkvæmd þessarar rannsóknar. Kærar þakkir.

## **Abstract**

Tourism's relationship with the environments in which tourism takes place involves numerous activities that can have an adverse environmental impact, and gradually change the way tourists experience a tourist destination, and subsequently the type of tourists who choose to visit a particular tourist destination. A holistic understanding of the causal relationship between the different impact factors is therefore of fundamental importance in order to sustain the fragile balance between tourism and the environment. The broad aim of this study is to use a systemic approach to examine the impact of tourism destination exploitation upon the perceived attractiveness of a particular destination to different types of visitors using the purism scale, by: i) identifying important key factors influencing the attractiveness of a natural destination which is developed as a tourist destination; ii) devising a causal loop diagram (CLD) in order to obtain a holistic overview and understanding of the key factors identified and their causal relationships; and by iii) clarifying the complex interplay between the identified factors. The major identified variables influencing the individual's perception and enthusiasm when visiting areas of natural beauty are the level of infrastructure and services provided at the site, as well as the concentration of tourists, This reflects the different categories of visitors' varying needs, attitudes, expectations and degrees of tolerance towards anthropogenic impact on the environment. The CLD analysis indicates that "number of visitors" is not a suitable indicator of evolution of a tourist destination since it is an "effect" variable that comes late in the causal chain. A more suitable indicator is a index for "attractiveness". The attractiveness of a tourist destination is made up of a combination of several impact factors that have varying degrees of impact upon attractiveness as well as behaving differently over time. Thus, the attractiveness of a tourist destination captures the evolution of the system and its sensitivity more clearly. The results stress the critical importance of tourism destination planning and management to prevent environmental damage and to avoid a situation where all tourist destinations evolve in the same direction, thereby decreasing the value each destination has for all other categories of tourist than the non-purists that represent mass tourism.



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# 1. Introduction

Tourism is one of the world's fastest growing industries. According to UNWTO (2015) international tourist arrivals once again hit a new record in 2014, with over 1.1 billion tourists travelling the world that year. That is a nearly 5% increase from the previous year. Corollary with increased tourism, impact from tourism activities is increasing worldwide. Numerous examples show that tourism can be a powerful agent of changes ranging from economic and socio-cultural impacts to environmental impacts (e.g. Williams, 1994; Newsome et al., 2013). Tourism impacts arise as both actual and perceived changes (Kavallinis & Pizam, 1994). Perceived impacts include the perception and attitude of tourism stakeholders such as the local community, tourism entrepreneurs, and tourists. Actual environmental impacts include aspects like air pollution and noise, visual pollution, sewage pollution, solid waste and littering, depletion of natural resources, land degradation, deforestation and intensified use of land for provision of activities and infrastructure development, alteration of ecosystems by tourist activities, disturbance of wildlife, loss of flora and fauna, natural habitat loss, loss of bio- and geodiversity, increased fire frequency, crowding and congestion; vandalism and urbanization (e.g. UNEP, 2015; Kavallinis & Pizam, 1994). Tourism's relationship with the environment thus involves numerous activities that can potentially have adverse environmental effects, and gradually destroy the environmental resources on which tourism depends, as stressed by UNEP (2015). A holistic understanding of the causal relationship between the different impact factors is therefore fundamental in order to sustain the fragile balance between tourism and the environment.

During the past decade tourism in Iceland has grown to be the country's largest export revenue (ITB, 2014). The annual number of international visitors to Iceland reached 997.556 in 2014 (ITB, 2015), which is to say more than triple the Icelandic population (Fig. 1). The major attraction factor for both international and domestic visitors has long been the dynamic and diverse Icelandic landscape with its vast open spaces and wild character (e.g. ITB, 2014; Ólafsdóttir et al., 2015; Ólafsdóttir & Runnström, 2011; Sæþórsdóttir, 2010). These characteristics are magnified in the Icelandic highlands,

which in 2013 attracted nearly 40% of all summer tourists visiting Iceland and 20% of all winter tourists (ITB, 2014).

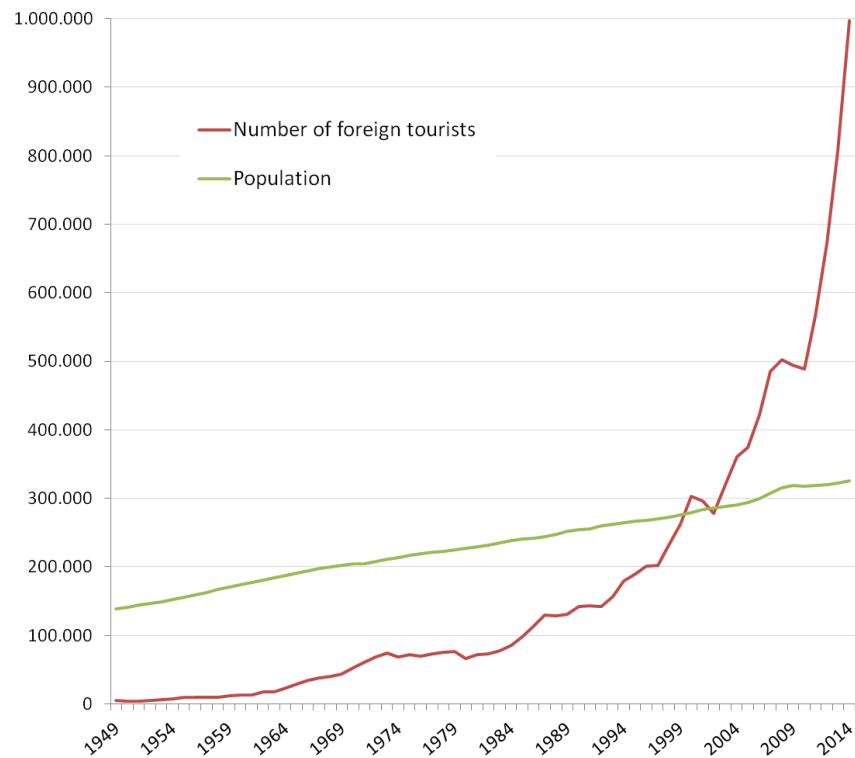


Fig. 1. Number of foreign tourists visiting Iceland 1949-2014 (red line) and the Icelandic population over the same time period (green line). (Source: ITB, 2015; Statistics Iceland, 2015)

The Icelandic highlands are characterized by a large mountainous plateau mainly made up of vast post-glacial lava fields, glaciofluvial deserts, and ice caps (Jóhannesson & Sæmundsson, 2009). Since the Icelandic population primarily inhabits the coastline, the interior highlands have throughout Icelandic history been uninhabited and have therefore been more or less free from anthropogenic interference until relatively recently. In the

early 1970s progressive use of the highlands for powerplant construction began, with resultant increased vehicle access into the highlands (e.g. Ólafsdóttir & Runnström, 2011; 2013). Since then the access has gradually increased and improved, building the platform for the recent tourism expansion in the highlands. The increased level of tourism constantly requires more and better infrastructure and service, resulting in the continual decline of the pristine landscape and gradually changing the face of the original environment.

Increased infrastructure is likely to change tourists' experience of the Icelandic landscape and thereby change the type of tourists visiting the Icelandic highlands, from tourists seeking primitive conditions to tourists who demand a greater level of service. In order to meet tourists' expectations and ensure they are satisfied, and to minimize negative environmental impacts from tourism, it is critical that decision-makers are aware of these causal relationships when developing a tourist destination, and equally that tourism infrastructure and services are generated in such a way as meets the needs of the particular type of tourist desired at each destination.

This study aims to use a systemic approach to examine the impact on different types of visitors of tourism destination exploitation as regards attractiveness using the purism scale. The specific aims are to:

- Identify the key factors in tourism development influencing the attractiveness of a given tourist destination.
- Design a causal loop diagram in order to obtain a holistic overview and understanding of the key factors identified and their causal relationships.
- Clarify the complex interplay between the identified factors.



## 2. Tourism and the systemic approach

A systemic approach considers the system, such as a tourism system, as a whole entity and investigates its structure as well as its static and dynamic behaviour. According to Haraldsson (2004), systemic thinking is a common concept for understanding how causal relationships and feedbacks work within a system. Understanding cause and effect is vital in order to analyse, sort out and explain how changes come about both temporarily and spatially.

System thinking involves both *system analysis* and *system dynamics*. System analysis is a theoretical model representation of a problem, used to map the understanding of the problem and make it transparent and visible through causal loop diagrams (CLD). System dynamics is a mathematical analysis of the problem in order to explain the past and better understand the future (Fig. 2) (*cf.* Haraldsson, 2004).

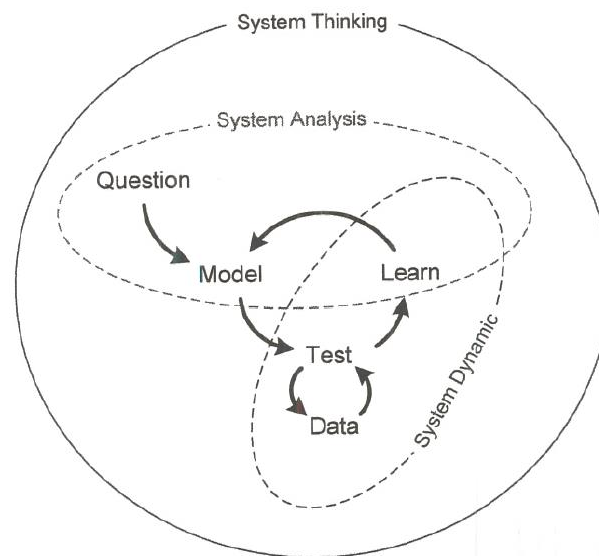


Fig. 2. Systemic thinking includes both theoretical modelling (system analysis) and mathematical modelling (system dynamics). (From Haraldsson, 2004).

System analysis and system dynamics have been used for a long time in interdisciplinary problem analysis and simulations (e.g. Forrester, 1968; Rodrigues et al., 1998; Sterman, 2000; Haraldsson & Sverdrup, 2004; Haraldsson, 2005), and have over the past decade been gaining a foothold within the social sciences (e.g. Luna-Reyes & Andersen, 2003).

In tourism studies however there still seems to be a strong lean towards practical application, limiting studies focussing on theoretical systematization of tourism. Consequently only a few studies exist focussing on system dynamics in tourism (e.g. Walker et al., 1999; Xu & Dai, 2012). Furthermore, using system analysis and system dynamics for analysing the environmental impact of tourism on the different types of tourist is to our knowledge a novel approach.

Butler's (1980) model of Tourism Area Life Cycle (TALC) is one of the best-known and most widely-used tourism models illustrating the relationship between the number of tourists and the hypothetical evolution of a tourist destination over time. The model presents several different stages of development through which a tourism destination is likely to go coinciding with an increase in the number of visitors (Fig. 3). In response to the increased popularity of a tourist destination and resultant higher number of visitors, tourist infrastructure is gradually expanded in order to facilitate more visitors. In the final stage, when the development of tourist infrastructure at the site has reached the site's critical range of carrying capacity, there are several possibilities reflecting a range of options that the evolution of the tourist site can take. If no action is taken the destination will decline. Butler's original premise was thus that an increase in visitors to a tourist destination is often followed by a decrease in visitors once the carrying capacity of the destination is reached. Twenty five years after his TALC disclosure, Butler (2004) states that TALC has been applied with positive results during the intervening decades in a predictive manner, that indicators of change have been identified and the model's stages anticipated. He concludes that TALC is still highly relevant in the applied sense, as apparent absences of management and regulation at many tourist destinations demonstrate that lessons have yet to be learned from past failures. In this regard, it is crucial to keep in mind that each stage in the development of a tourist destination evolution entails changes as regards the number and type of visitors and the relationship between visitors and residents.

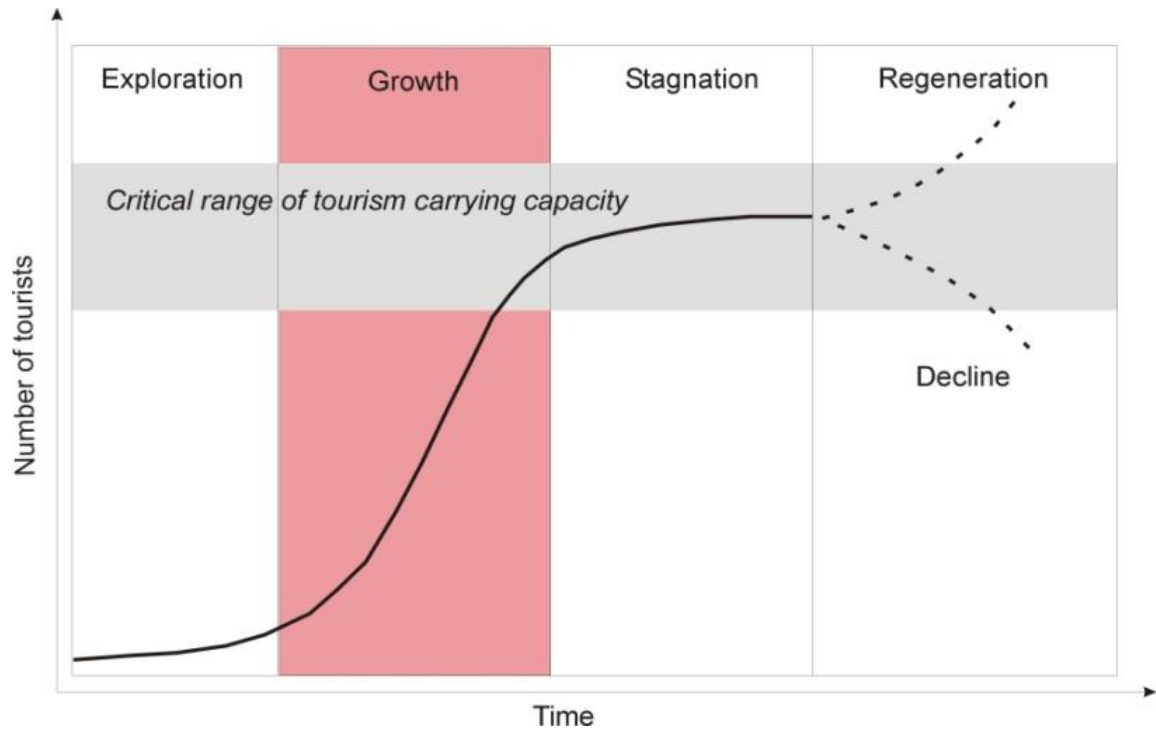


Fig. 3. Major evolutionary stages of a tourist destination over time. Iceland currently represents the growth stage highlighted in red (adapted from Butler, 1980).

The TALC model demonstrates that tourist destinations are dynamic and complex systems. The scale and management of the number of tourists as well as the evolution of tourism infrastructure at a destination over time is strongly dependent on many critical factors that all contribute to the increasing complexity of the tourist destination system. The advantages of using the systemic -dynamic approach are according to Haraldsson and Ólafsdóttir (2003) its simplicity and ability to reveal the underlying structure of complex problems, by emphasizing the sorting process itself where cause and effect are in focus in order to better analyse the structural relationship as a whole. By using the systemic approach the causal relations of the identified indicators of change in the TALC model can be better analysed.



## 3. Causal relations

### 3.1. Purism scale – indicator of change

In order to examine the impact of increased tourism infrastructure upon the perceived attractiveness of a given tourist destination to different types of visitors in a tourism destination system, the decision was made to utilise the purism scale approach. The purism scale is a continuum that ranks individuals in terms of a level of purity, or primitiveness, according to their perception of wilderness (Fig. 4). As pointed out by Ólafsdóttir et al. (2015) many variables influence the individual's perception and enthusiasm when visiting areas of natural beauty, such as the Icelandic highlands, based on their background and interests. The major variables are the level of infrastructure and services at the site as well as the density of tourists, reflecting the varying needs, attitudes, expectations and diverse tolerances different types of visitors have regarding anthropogenic impact on the environment. Some visitors are not sensitive to human-induced changes, while such changes can ruin the experience of nature for others (Sæþórsdóttir, 2010). The purism scale approach groups together visitors with similar attitudes to these changes into four purism groups: *strong purists*, *moderate purists*, *neutralists* and *non-purists* (i.e. Hendee et al., 1968; Stankey, 1973). In this study the end groups, i.e. strong purist visitors and non-purist visitors are used to represent the causal sequence of increased infrastructure in a tourism natural destination system.

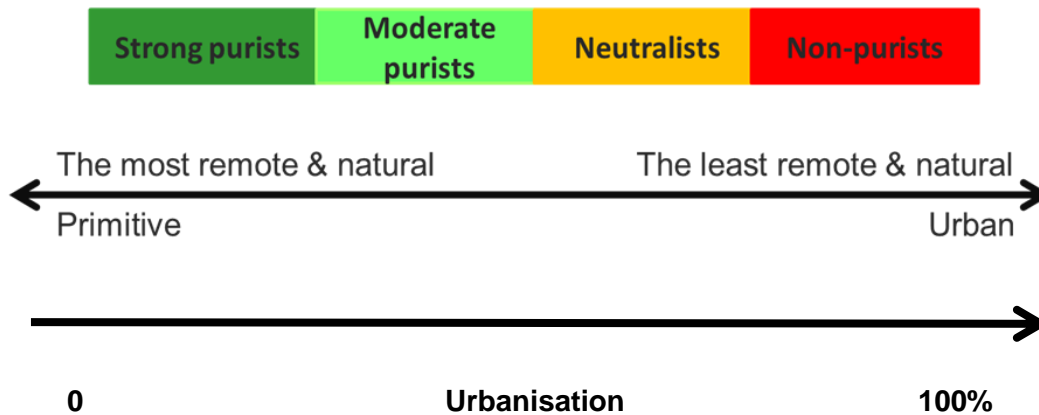


Fig. 4. The purism scale continuum relative to the degree of urbanisation  
(adapted from Ólafsdóttir et al., 2016).

### 3.2. Feedback analysis

The key factors identified as catalysts of changes to the perceived attractiveness of an area of natural beauty through tourism developments are described and analysed in the following CLD (Fig. 5). The idea of the underlying system's is that the different types of visitor, as categorized according to the purism scale i.e. strong purists, moderates, neutralists, and non-purists, who visit an area of natural beauty are initially motivated by the pristineness of an environment. In a CLD, identified cause and effect are variables that either change in the same direction (indicated with a “plus”) or change in the opposite direction (indicated with a “minus”). Additionally, processes that feedback in the same direction are reinforced processes (indicated with R) since they intensify the condition. Likewise, the processes that feedback to give a change in the opposite direction (indicated with B) balance (dampen) out a condition (e.g. Haraldsson & Ólafsdóttir, 2003).

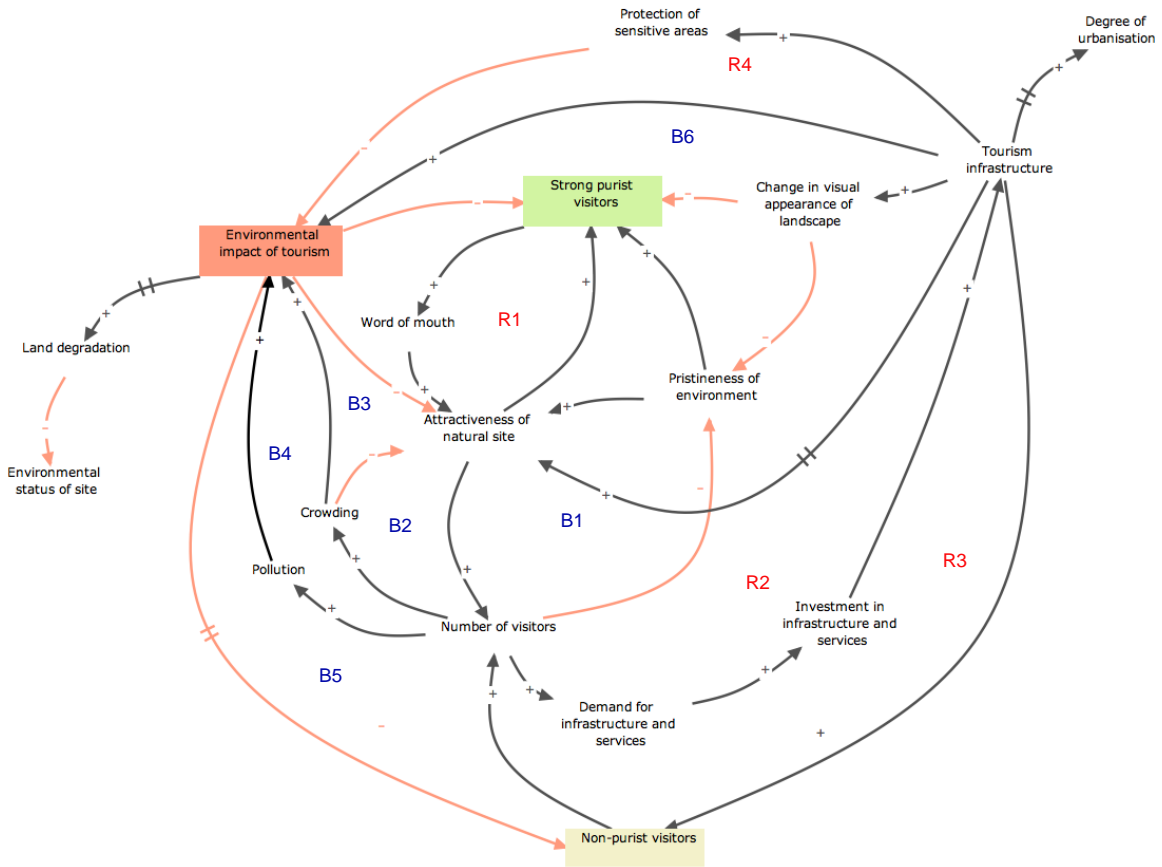


Fig. 5. Causal loop diagram of influencing factors and interacting processes affecting the attractiveness of an area of natural beauty to different types of visitors. Variables that exert a positive influence on the system are marked in black, and variables exerting a negative influence are marked in red. Delayed processes are marked with double lines crossing the arrow-line.

The basic notion illustrated in the CLD is that the pristineness of an environment initially attracts strong purist visitors to a new tourist destination. These are the 'explorers' according to Butler's (1980) TALC model. Through word of mouth these strong purist visitors' experience of the destination increase the perceived attractiveness of the tourist site, resulting in more tourists visiting the site and gradually transforming the site to the growth stage in Butler's (1980) model, thereby decreasing the pristineness of the environment – the very factor which initially attracted the strong purist visitors to the site (Fig. 6).

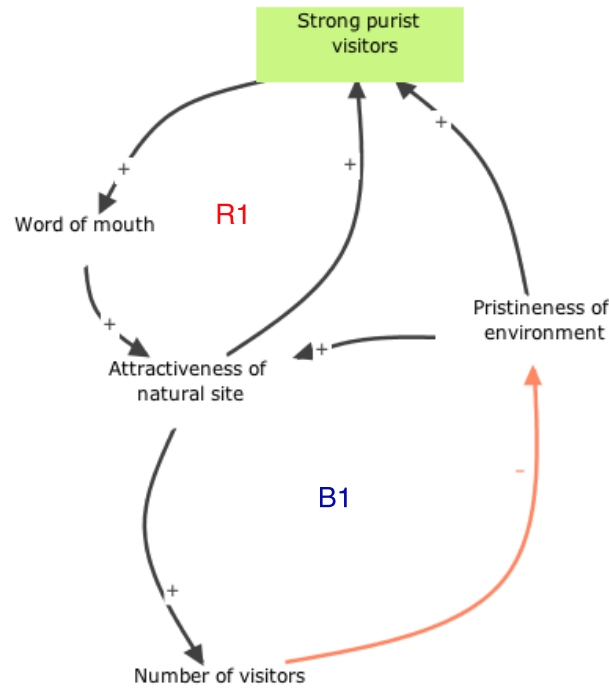


Fig. 6. The core loops and key driving variables in the CLD of attractiveness of a new area of natural beauty in the tourism destination system.

As more tourists now being to visit the site, the demand for tourism infrastructure and services grows, resulting in investment in and construction of these amenities. The expansion of infrastructure has a positive impact on the attractiveness of the site for tourist development since access to the site will improve, as will basic amenities. On the other hand, an increased number of visitors decreases the site’s pristineness since the new infrastructure changes the visual appearance of the landscape at the site, making the area unattractive to the strong purist visitors. Increased tourism infrastructure will in turn attract moderate purists and neutralists, and with the growing number of visitors the demands for more infrastructure and more services increases, ultimately making the area attractive for non-purist visitors, resulting in an increasing acceleration in the number of visitors to the site (Fig. 7).

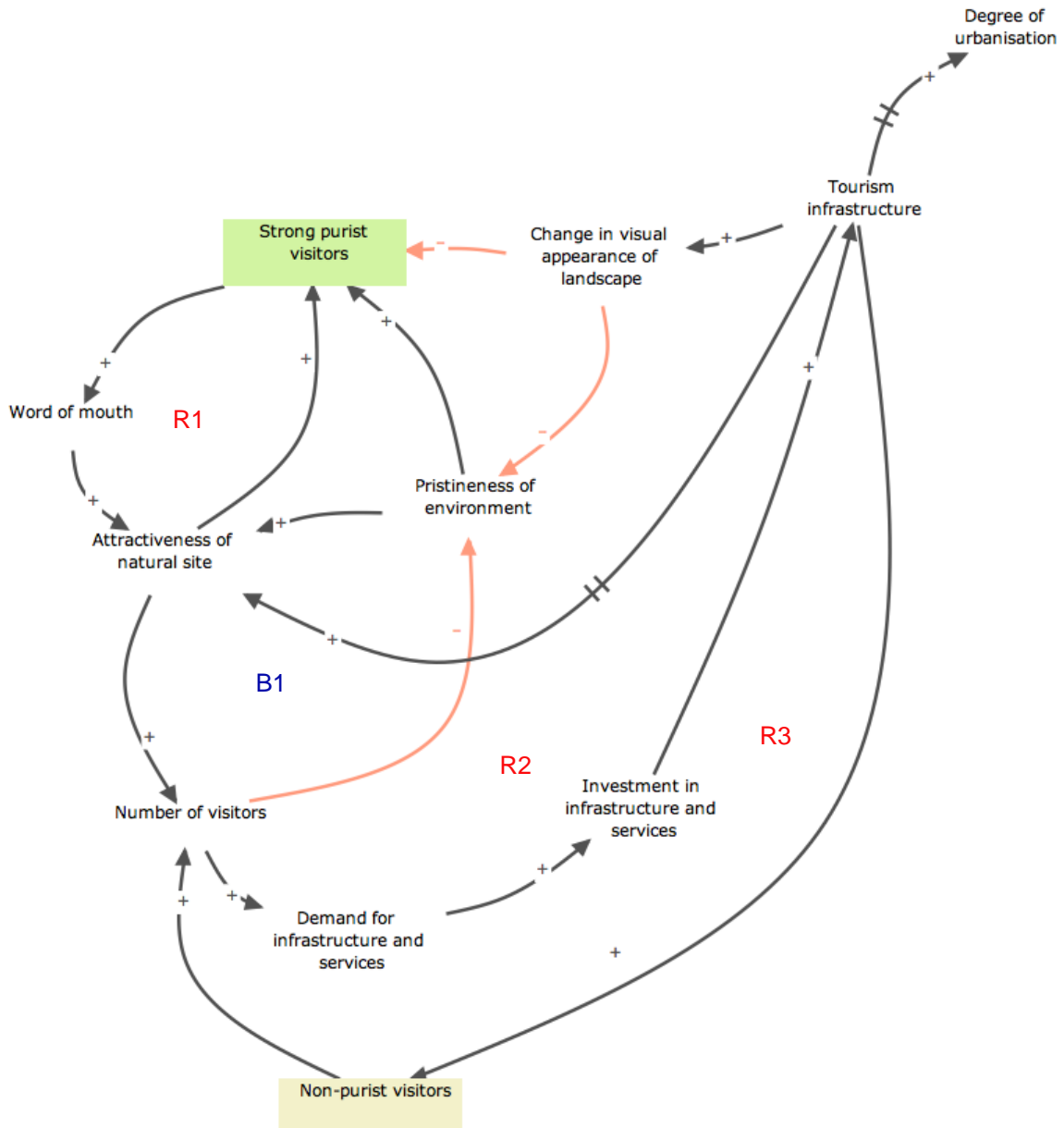


Fig. 7. The impact of tourism infrastructure on the attractiveness of an area of natural beauty to the different categories of tourist, specifically strong purist vs. non-purist visitors.

Coincident with an increased number of visitors, pollution, such as waste and sewage, and crowding increases, negatively impacting the attractiveness of the site. Increased

pollution and crowding will result in a negative environmental impact that in the long run will decrease the number of non-purist visitors visiting the site (Fig. 8).

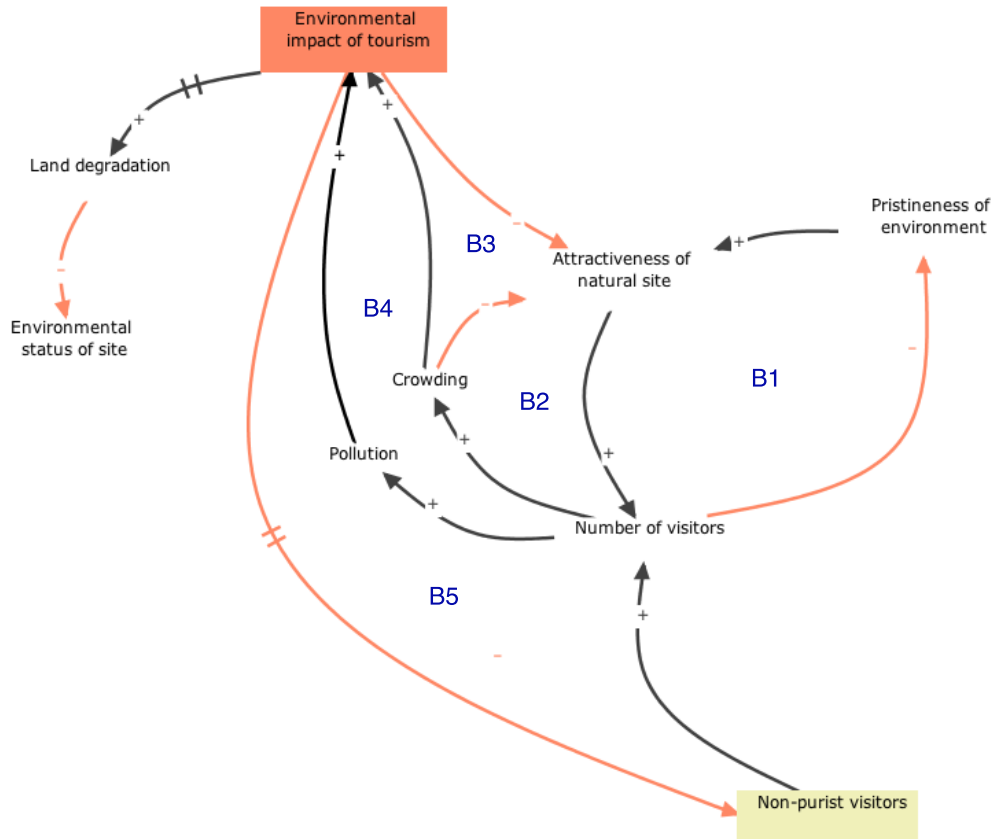


Fig. 8. Impact of increased environmental impact of tourism on the attractiveness of a site and the categories of tourists visiting a site.

According to UNEP (2015) negative environmental impacts from tourism occur when the level of visitor use is greater than the environment's ability to cope with this use. In Iceland the impact of unsuitable forms of tourism can easily trigger land degradation due to the fragility of the country's vegetation and soil cover to external pressure, and eventually change the site's environmental status (e.g. Ólafsdóttir & Runnström, 2009). While increased environmental impact of tourism decreases the natural site's attractiveness, tourism infrastructure has a positive impact on the attractiveness of a site as it increases and improves its accessibility and tourist facilities and services. However,



on the attractiveness of a natural tourism destination are *crowding*, through increased number of visitors, and *environmental impact of tourism*, through crowding, pollution and tourism infrastructure, which together increase the environmental pressure placed upon the destination, while conversely education of visitors and environmental protection decrease environmental pressure (Fig. 10).

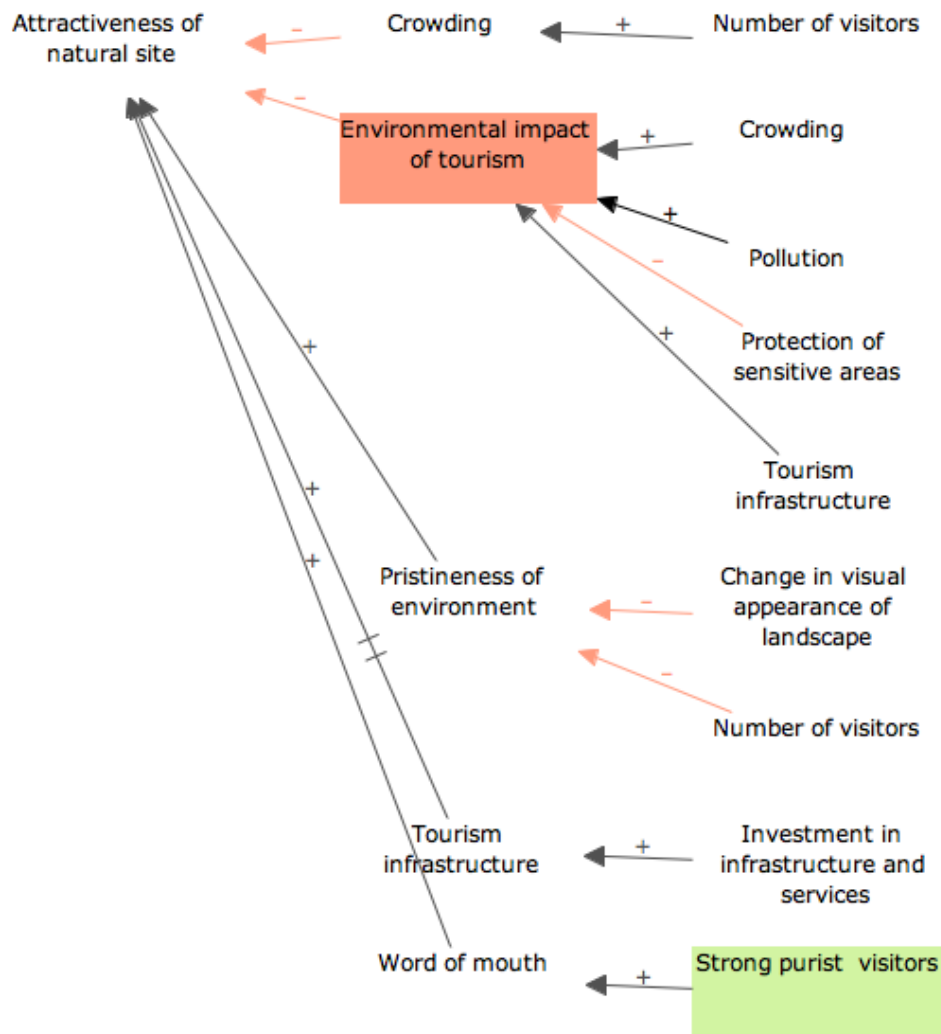


Fig. 10. Causal tree of variables which impact upon the attractiveness of a natural tourism destination.

Decisive variables which increase the environmental impact of tourism are *tourism infrastructure*, in response to a demand for (increased) infrastructure and services, in turn leading to investment and construction of infrastructure; and *pollution* and *crowding* as a result of increased number of visitors, mainly non-purist visitors due to the increased attractiveness of the destination to these types of visitor as a direct result of expansion to infrastructure. Protection is a decisive variable which, conversely, decreases the environmental impact of tourism through managed tourism infrastructure (Fig. 11).

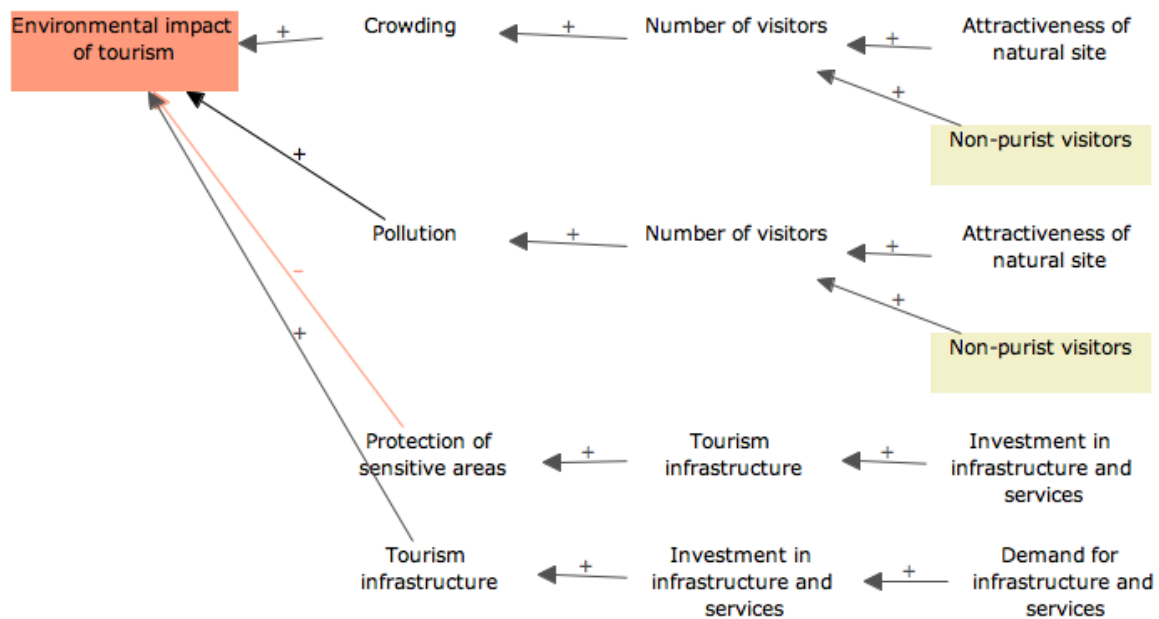


Fig. 11. Causal tree of variables which impact upon environmental impact of tourism.

### 3.3. Optimum size of infrastructure and the point of irreversibility

From a physical land process point of view, it is primarily land degradation that brings about an irreversible condition (*cf.* Fig. 5 & 8). The processes of land degradation are possible to manage through proper tourism infrastructure and site traffic planning. However, such actions raise the issue of visual disturbance and the effect of crowdedness upon the site's attractiveness as regards the different types of visitors, and will

subsequently result in a new target group of visitors to the area. The CLD analysis shows that purist and non-purist visitors are not competing for the same area but rather are connected through the “early adapter” process whereby the purist initially sets out the conditions for the site's attractiveness and thereby created the conditions for other categories of tourist to visit a new tourist destination.

By adapting the CLD results to the stages in Butler's (1980) TALC model, behaviour over time (BOT) of the different factors of the CLD may be indexed through the four phases (Fig. 12). In phase I the purist visitors establish the attractiveness of the site and subsequently increase the number of purist visitors to the site. The non-purist visitors bring the infrastructure with them and thereby both increase the attractiveness of the site and the number of other non-purist tourists visiting the site, while simultaneously reducing the number of purist tourists (Phase II). In Phase III the tourist infrastructure starts to expand in response to the number of non-purist visitors, and accordingly the environmental impact that these visitors have upon the site also increases. This results in a levelling off of the site's attractiveness. In Phase IV the combination of the increased infrastructure, environmental impact and crowding starts to have a detrimental effect upon the site's attractiveness and ultimately reduce the number of non-purist visitors to the site. This last phase represents the destination's point of no return as regards attractiveness to prospective visitors.

Butler's (1980) TALC model illustrates that the ceiling for tourist carrying capacity can be predicted by observing the “growth” and the “stagnation” stage at a tourist destination development. The problem is that once the stagnation stage is reached the attractiveness of the site is already in decline, even if the numbers of tourists per se do not reflect that fact. This is arguably due to “destination reputation”, a phenomenon whereby rumours of a site's bad reputation “lag behind” and the knowledge of the attractiveness or unattractiveness of a particular site have not yet filtered through to prospective non-purist visitors (Phase III and IV in Fig. 12). Since the development of tourist infrastructure often

occurs on a medium- and a long-term basis and is based upon projections of future numbers and types of visitors, the construction of new facilities can end up continuing long after the point at which the attractiveness of the site is in rapid decline (as indicated in Phase IV in Fig. 12). The CLD analysis demonstrates that understanding the driving factors influencing the “attractiveness of site” is the key to understanding the tourist carrying capacity concept. In the early phases (i.e. phase I and II in Fig. 12), positive driving factors are primarily influencing “attractiveness”, but later on the negative factors such as crowdedness and pollution take on a more decisive role, and ultimately this negative feedback will come back to impact upon infrastructure development. Therefore as soon as the attractiveness of a site starts to level off (i.e. phase III in Fig. 12), an action plan should already be in place to mitigate these negative effects.

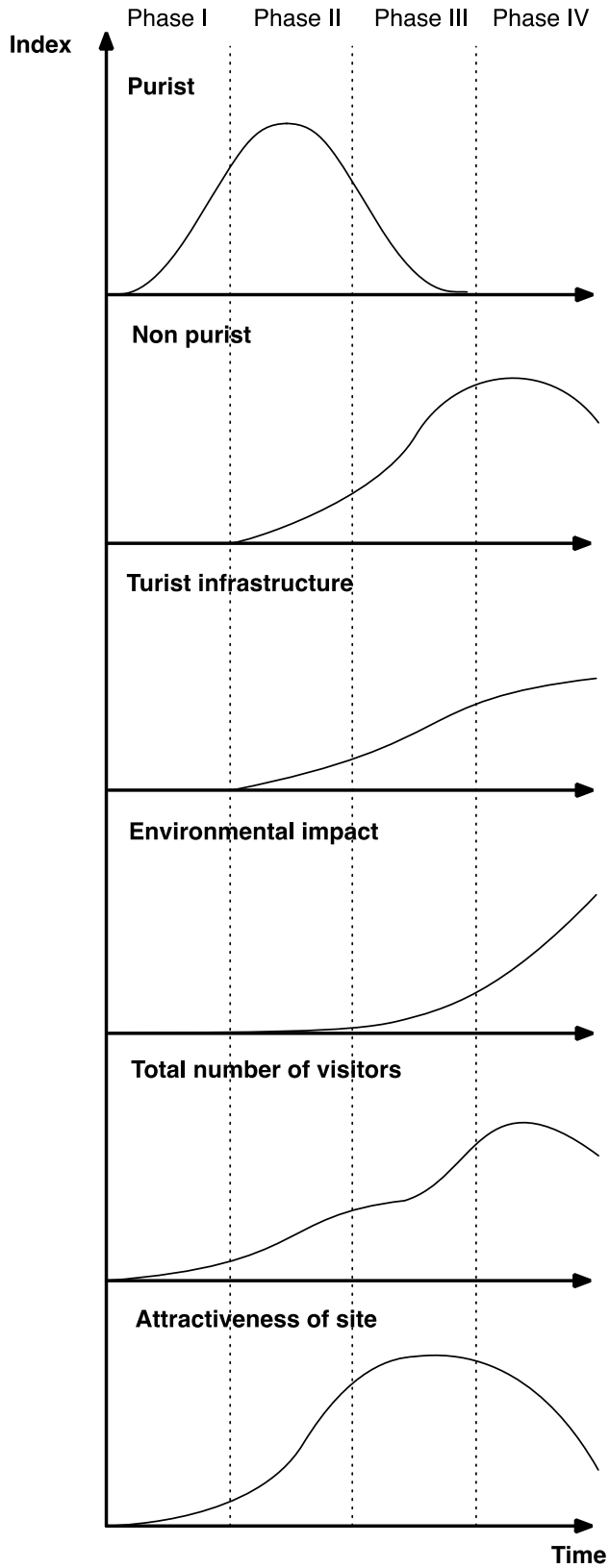


Fig. 12. A relative scale of Behaviour Over Time (BOT) of the CLD analysis and its main indicating variables reflected through four time phases. The graph shows how the stakeholder groups “Purist” and “Non-purist” both affect the attractiveness of the tourist site, but do so in different ways over time.

## 4. Implications

Although the evolution of tourism can be adequately described in general terms according to Butler's (1980) TALC model of evolution of tourists destinations over time, the conceptual analysis of causal relations enables transparency of all interrelated impact factors. The CLD analysis indicates that “number of visitors” is not a suitable measure of evolution of a tourist destination since it is an “effect” variable that comes late in the causal chain. A more suitable measure would be an index for “attractiveness”. The attractiveness of a tourist destination derives from a combination of several impact factors that have different degrees of impact upon a site's attractiveness as well as behaving differently over time. Thus, the variable “attractiveness of a tourist destination” captures the evolution of the system and its sensitivity more clearly than “number of visitors”. The different tourist types, i.e. “purist” and “non-purist”, both affect the attractiveness of the tourist destination, but do so in different ways over time. The CLD and the BOT analysis also show that both these tourist types cannot exist at their own optimum level at the same destination. As regards tourism carrying capacity, this research suggests that the concept needs to be defined through the *maximum site attractiveness*. This does not mean the maximum number of tourists that a site can hold, but rather the optimum size of infrastructure to ensure low environmental impact, low visual effect and low crowding effect. This will define the number of tourists that each site can sustainably support.

This demonstrates the critical importance of tourism destination planning and management in order to prevent environmental damage and avoid all tourist destinations evolving in the same direction, decreasing the value of these destinations for other tourist types than non-purists, viz. the tourist types that represent mass tourism. This conclusion is supported by Ryan (2002), who emphasizes that it is through an individual's sensory system that a destination is experienced. He states that from an industry-structural perspective tourism is a complex network of selling chains, transport patterns, attractions, accommodation and technologies, that can easily change a destination if not managed sustainably. Sustainable tourism planning and management will not be achieved without a

holistic understanding of the causal relations of all influencing factors in the tourism system. All destinations can never please all types of tourists all of the time.

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