



Sustainability manifesting as a multi-material and -sited network effect: How boat-sourced sewage management facilities serve as governance artefacts advancing sustainability in nautical tourism

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ABSTRACT

Marinas are a part of coastal areas' touristic appeal, but also hotspots for boat-sourced pollution. Considering the manifestation of sustainability in marina operation, we utilize actor-network theory (ANT) in demonstrating a conceptual systems analysis on boat-sourced sewage management (BSSM) as one important socio-eco-technical sub-system of sustainable nautical tourism. We describe a multi-material collective of dynamically interacting human and non-human entities to understand how and under what conditions BSSM facilities advance the sustainability of marina operation. Our analysis insightfully uncovers BSSM facilities as both core marina services and governance artefacts and reveals that managing boat-sourced sewage successfully is an outcome of a multi-sited network of heterogeneous elements that together enable both sustainable boating practices and marina operation. We suggest the presented ANT-based systemic thinking has potential for providing novel perspectives to sustainability analyses in diverse tourism-related contexts.

1. Introduction

Coastal tourism is one of the fastest growing sectors of global tourism and among the major driving forces of local employment and regional economic development in Europe (Ghermandi, 2015). The European Union (EU) specifically highlights the potential in coastal tourism for fostering blue growth (EC, 2010, 2012, 2014a, 2014b). Although providing employment and generating income, coastal tourism risks the health and viability of the ecosystems upon which the tourism livelihood depends (Davenport and Davenport, 2006). For instance, marinas, on which the EU has expressed a special interest (EC, 2016), attract both nautical tourists and visitors arriving by land and can thus benefit local livelihoods as touristic destinations (Paker and Vural, 2016). On the other hand, marinas concentrate boating activities and are hotspots of the environmental impacts of boating (Leon and Warnken, 2008; Hardiman and Burgin, 2010). In ambient waters, boaters moreover often use remote sites away from other sources of impact, representing therefore substantial environmental contributors in these locations especially during holiday seasons (Byrnes et al., 2016). Consequently, boating may

pose local-level sustainability challenges to coastal regions by contributing to processes where beneficiary ecosystem services, granting the coastal environment a recreational value (Ahtiainen et al., 2013), turn into ecosystem disservices (Lyytimäki et al., 2008) that can strain coastal communities by, for instance, financial, maintenance and health burdens (Roy et al., 2012).

Sustainability research widely considers sustainability an integrative concept with environmental, social, and economic concerns as its three fundamental dimensions or so-called supporting pillars (Hansmann et al., 2012). In the marina context, tourism scholars have approached sustainability accordingly. However, a recent bibliometric analysis defining marina-related research trends shows that the sustainability approach is missing from studies specifically addressing the ecosystem changes derived from marinas (Martínez-Vázquez et al., 2021a). On the other hand, research on nautical tourism, and marina operation therein, is in general scarce in relation to the tourism branch's local economic importance in many countries (Martínez-Vázquez et al., 2021b).

When it comes to studies that have explicitly applied the sustainability approach in the marina context, regarding environmental

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concerns, adequate environmental management has been considered advancing sustainability in marina operation (e.g. Dragović and Tselentis, 2015; Dragović et al., 2016), and in terms of social and economic concerns, marina establishments have been considered supporting local well-being and economic activity (e.g. Chen et al., 2016; Moreno and Otamendi, 2017). Interestingly, the systemic interdependence between the sustainability of marina operation as a type of nautical tourism business and the sustainability of recreational boating as a mobile water-based leisure activity has however not been explicitly acknowledged by tourism scholars. The omission is manifested by the fact that studies depicting sustainable marina operation do not elaborate on the insights of existing research on boating that discusses, for example, boaters' viewpoints to managing the environmental impacts of boating (e.g. Curtis et al., 2017; Lepoša, 2017; Viana et al., 2017).

The present paper fills the above-mentioned gap that was identified through a literature review we conducted on the published research concerning sustainable marina operation and boating. We here analyse and describe a socio-eco-technical system, where marina infrastructure has the key role facilitating both the sustainability of boating and marina operation itself. The analysis is based on interview and questionnaire data collected from two marina stakeholder groups – boaters and port actors – during a research project conducted in the eastern Baltic Sea, and the reflection of this data against the reviewed literature. Arising from both the literature review and the project data, boat-sourced sewage management (BSSM) is used as a practical example of a so-called core marina service (Mikulić et al., 2015) that can either serve promoting sustainable nautical tourism business or, if neglected, hinder operating the business sustainably. In other words, our hypothesis is that BSSM can advance the sustainability of marina operation, and we therefore intend to find out how and under what conditions this is possible.

Anchored in the idea of sustainability governance, i.e., public and private interactions operationalising transitions towards sustainable societies while bringing added value for citizens as shareholders (Leal Filho et al., 2016), the paper builds on actor-network theory (ANT, Latour, 2005). The ANT approach is based on the idea that all social phenomena – including sustainability – emerge as network effects in heterogeneous collectives consisting of both human and non-human entities. Our analysis reveals that managing boat-sourced sewage successfully is an outcome of establishing a multi-sited network of heterogeneous elements that together enable both sustainable boating and marina operation practices as network effects. The result is presented as a visualised collective of the interrelated human and non-human entities of marina operation that operate on, but also link together, different spatial scales of society and environment. We suggest this BSSM collective is one important sub-system that can either advance or hinder the materialisation of sustainability under the wider system of nautical tourism, including both the touristic experience and the business perspective.

The paper contributes to the discussions on sustainable marina operation by addressing that marinas maintaining facilities for managing the environmental impacts of boating do not only mitigate boat-sourced pollution emanating immediately from the marina area, as considered in previous research (e.g. Tselentis, 2008). Rather, as so-called governance artefacts (Woolgar and Neyland, 2013), the waste management facilities installed in marinas steer boaters' environmental behaviour on-site in marinas but also off-site at sea, which simultaneously affects the sustainability of both marina operation and boating. The paper also responds to Paker and Vural's (2016) call for research on marina marketing. The paper demonstrates that boaters value the management of the environmental impacts of boating as a service which is considered affecting marina service performance as a whole. As information on the factors that potentially modify tourists' behaviour is seen as a starting point to managing a tourist destination sustainably (Secondi et al., 2011), the finding bears great relevance in moving towards sustainable marina operation. Finally, when aiming at illustrating

sustainability as a network effect, the paper's ANT approach is applicable in various tourism-related contexts.

2. Literature review

In line with the common general sustainability approaches and theories, the three pillars that are seen to support sustainable marina operation in the existing literature are environmental management, local well-being, and economic development. Many studies exploring sustainable marina operation from an environmental perspective consider meeting the standards of voluntary environmental certifications, such as ISO 14000 or the Blue Flag programme, a valid target for marinas to reach the path to sustainability (e.g. Favro and Gržetić, 2008; Dragović and Tselentis, 2015; Dragović et al., 2016; see also Guerra-García et al., 2021 on assigning Blue Flags to marinas). Emphasizing the importance of the appropriate monitoring protocols to support sustainable marina operation, the general spirit of these studies is that internationally those marinas having introduced environmentally friendly policies and implemented regulations increasing environmental protection and safety, seem to be the ones finally preferred by most boaters (Tselentis, 2008). Nautical quality is moreover considered reliant on the management of both environmental and safety issues (Ivaldi and Ugolini, 2015) and controlling waste flows in marina operation is presented as an eco-efficient win-win activity (Lapinskienė et al., 2011).

Another typical notion in the literature is a statement that nautical tourism can provide economic effects otherwise not possible in coastal areas (Favro and Gržetić, 2008). Marinas represent possibilities for coastal countries to advertise themselves as strong tourist destinations (Kovačić et al., 2011) and to harness nautical tourism as a strategic tool for developing national economies (e.g. Luković, 2012; Chen et al., 2016). Accordingly, marina establishments associate to new economic activities, job creation and emigration prevention as well as improvements in municipal infrastructure and living standards among the destination community (e.g. Favro and Gržetić, 2008; Jugović et al., 2011; Kovačić et al., 2011; Favro and Kovačić, 2015; Kovačić et al., 2016; Moreno and Otamendi, 2017). The public spaces in marinas may also enable encounters between locals and tourists (Lengkeek, 1999).

Existing studies on marina establishments additionally underline the importance of creating local acceptance by contextualizing marina-related tourism development through a bottom-up approach. In some marina establishment cases, top-down economic argumentation has bypassed resistance grounded on both local livelihoods and environmental issues (Heidkamp, 2008). Shoreline resource valorization through marina constructions has also led to environmental degradation due to the lack of proper management measures (Tosun, 2001; Favro and Gržetić, 2008). To the extent visiting boaters partially generate the economic impact of marina operation (Lee, 2001) and marina development generally draws attention on tourism-prone economic benefits (Kizielewicz and Luković, 2013), it is furthermore fundamental tourism growth indicators hardly reveal the social impacts of tourism that are personally felt in the everyday of the host community (Deery et al., 2012). It is also worth noting that to the extent tourism increases economic activity in the destination area, such as transportation services or food production, it simultaneously results to, e.g., increasing energy consumption, emission generation and waste disposal, which may then require additional local environmental management efforts (Ferrari et al., 2018).

From an environmental perspective, existing literature on sustainable marina operation restricts the spatial scope of environmental management to pollution emanating directly from the marina area (e.g. Tselentis, 2008). Even though boaters do not limit themselves to marinas (Luković, 2012), previous studies have not addressed how marinas are involved in the mitigation of the environmental impacts of boating beyond the immediate marina area. An evident reason is that the studies barely refer to existing literature on recreational boating.

Research on recreational boating has found boaters being responsive to (Curtis et al., 2017) and valuing water quality (Lipton, 2004) and biodiversity (Viana et al., 2017), meaning these variables affect the selection of boating site. Simultaneously, several studies have specifically reported boaters facing situational constraints preventing them from properly disposing of boat-sourced sewage both in marinas and other locations where sewage pump-out stations (SPOS) are provided (Cottrell and Graefe, 1997; Baasel-Tillis and Tucker-Carver, 1998; Shafer and Yoon, 1998; Lagerqvist and Andersson, 2016; Pönni and Haaksi, 2017). As a source of marine pollution, boat-sourced sewage is not only harmful for the environment, but it may also impose risks for human health (An et al., 2002) and disturb water-based recreational activities (West, 2004).

Considering these observations, in the context of marina operation, setting ecosystem preservation in the agenda might be a competitive business strategy, as indicated in Cucculelli and Goffi (2016) (see also Capacci et al., 2015; Sipic, 2017). Besides, the yachting tourism experience model by Mikulić et al. (2015), covering core marina services, basic destination attributes, charter product, marina supporting product, and the onshore destination experience, raises the beauty of nature and scenery and tidiness of the marina grounds as prerequisites for a positive experience, even though the authors do not specifically discuss environmental management issues.

On the other hand, even though the love for the sea and the opportunity to spend time in nature are typically among the main reasons for people to pursue boating (Hasselström, 2008), it has been noted that boaters may consider environmental regulation that targets their leisure excessive due to the minor impact of boating to overall marine pollution (Gray et al., 2010). The environmental impacts of recreational boating are however numerous, ranging from fuel, oil and sewage discharges and antifouling paints' toxic compounds dissolving into waters, to propeller- and anchor-induced physical damage, wave action and noise disturbance, as well as spreading invasive species, all of which in different ways affect marine habitat and biota (see Byrnes and Dunn, 2020 and references therein). Often these impacts besides concentrate in popular boating sites (Leon and Warnken, 2008; Hardiman and Burgin, 2010; Byrnes et al., 2016).

Boaters' resistance to environmental regulation has also been found relating strongly to the symbolic meanings of boating. Regulation on boating and the fear of its expansion easily arouse emotional reactions (Lepoša, 2017) as boaters may perceive legally required environmental chores, such as emptying the boat-toilet at a SPOS, offending the freedom and self-sovereignty they associate with seafaring (Grant-Smith and Mayes, 2017).

Accordingly, Kaaristo and Rhoden (2017) aptly address pump-out procedures as simultaneously mundane and unusual tourist practices: having toilets in boats practically means their contents should be stored onboard for later disposal and thus boaters are supposed to re-encounter their bodily waste when pumping out the sewage. Grant-Smith and Mayes (2017) furthermore suggest resistance on boat-sourced sewage regulation derives from the nature of the recreational boat as a heterotopic space that provides escape from land-based control. Consequently, boaters' approach to pump-out procedures can involve a notable tension between the adoption of a romantic pirate persona and claim to law-abiding citizenship (ibid.). This type of reasoning is supported by the notion of the waterfront, where marinas locate, as an interface between the land-based control and the freedom the wild and untamed sea affords (Karvinen, 1997).

Finally, Lepoša (2017) has claimed that today's neoliberal environmental discourses, such as the blue growth parlance, leave limited room for boaters to unequivocally express care for the marine environment. According to Lepoša (ibid.), allocated to boaters, the role of an environmentally conscious marine environmental citizen (McKinley and Fletcher, 2010, 2012) conflicts with the one of the leisure consumer whose role is to support economic growth through increasing recreational consumption. Lepoša (2017) hence suggests attempts to mitigate

the environmental impacts of boating should not be based on boaters' individual responsibility but on the core of the boating experience: engagement with nature.

Bridging the two bodies of literature, BSSM turns out as a multi-sited waste chore connecting the boat-life boaters lead at sea and marina visits they pay on the waterfront. The existing literature also indicates that in terms of mitigating both the environmental impacts of boating and the impacts of boating on water-based recreational activities, BSSM manifests within the environmental and social sustainability pillars, respectively, whereas it interestingly both supports and conflicts with the economic dimension as boaters' spending contributes to local livelihoods, but considering boaters primarily as leisure consumers may undermine their potential environmental ambitions.

3. Materials and methods

3.1. Materials

The data used in the present study were collected during a research and development project carried out in 2015–2018 in the Eastern Gulf of Finland, Baltic Sea. The present analysis arose from a non-commercial university-led research-oriented work package that analysed the concept of sustainability in the marina context aiming at identifying possibilities for developing marinas in a sustainable manner. The project as a whole involved six marinas in Finland (Fig. 1) and another six in Estonia.

The present case study is based on the views and opinions collected from Finnish representatives of two stakeholder groups: boaters and port actors. It builds on observations made while analysing the content of (Table 1): (1) semi-structured stakeholder interviews carried out with boaters and port actors selected through purposive sampling (Tongco, 2007; see Appendix A) in spring 2017, probing their thinking on sustainable marina operation and opinions on how marinas should be sustainably developed, and (2) open-ended responses from two online questionnaire surveys implemented in summer 2016 and summer–autumn 2017, looking into boaters' perceptions on the concept of a sustainable marina, as well as boaters' needs and preferences concerning existing marina services. Additionally, an extensive literature review on the sustainability of marina operation and boating was conducted, covering scientific and grey literature in English, Finnish and Swedish.

Descriptive data collection details concerning the interviews and the specific open-ended questions included in the analysis are presented in the Appendices A–B. The format and content of the full questionnaires are provided under the Appendix C. As part of the project's communications, a summary on the findings from the stakeholder interviews (Appendix A) have been reported in Luoma et al. (2018), and the questionnaire survey statistics (Appendices B–C) in Parviainen and Lehtikoinen (2016) and Vantola et al. (2018a, 2018b). However, the present data integrative ANT analysis is original and has not been published elsewhere. Importantly, the data behind this analysis were originally collected to analyse the sustainability in the marinas in general, and to widely collect suggestions on how it could be developed. Under the next sub-heading, we describe in detail how the data were utilized in the present study.

3.2. Method

The present study is an ANT-driven qualitative (i.e. soft) systems analysis (see e.g. Bennett and Chorley, 2016), based on the content of the spoken and written statements and opinions of the participating informants, reflected against the reviewed literature. While we were analysing sustainability in the marina context during the above-mentioned project, the preliminary analysis revealed marinas serve boaters primarily as pit stops for craft and crew maintenance and supply restocks, and in this context, waste management plays a focal role (Luoma et al., 2018; Parviainen and Lehtikoinen, 2016; Vantola et al.,

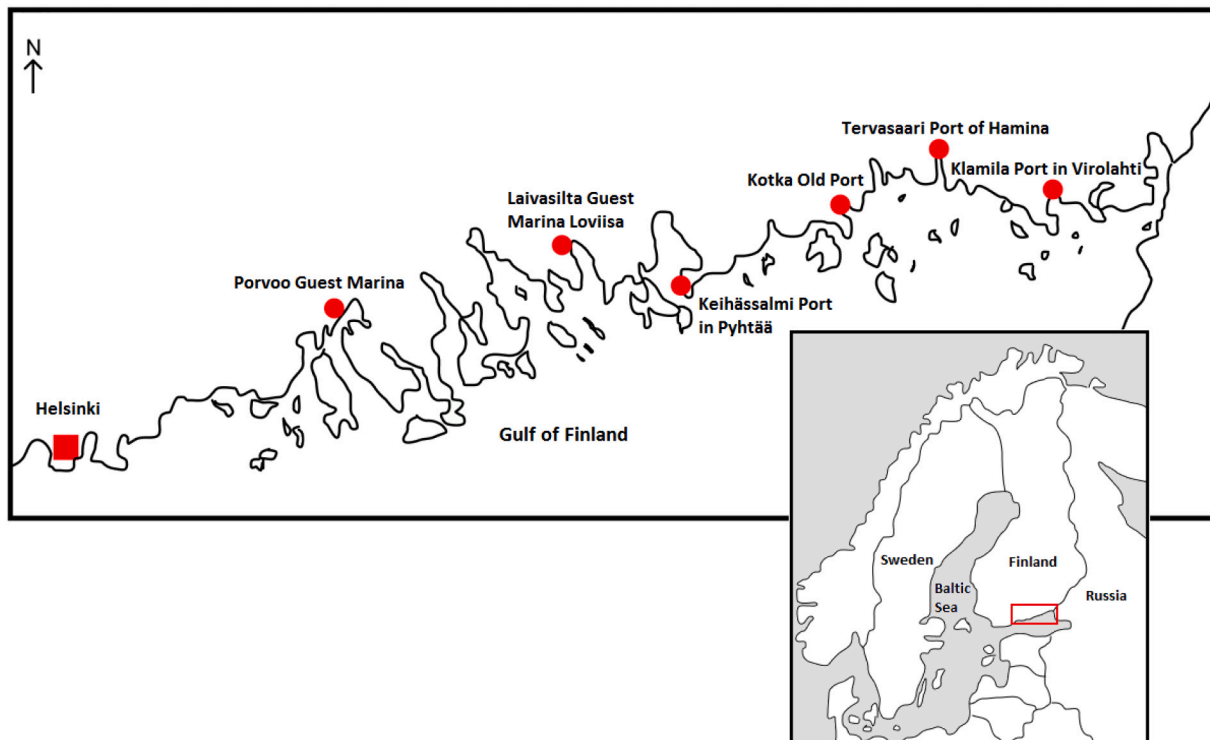


Fig. 1. The study area and the Finnish project marinas in the Eastern Gulf of Finland, Baltic Sea.

Table 1

The data of the present study. For details concerning the data, see the appendices A–C.

Source	Time of collection	Sample size
Stakeholder interviews (Luoma et al., 2018)	Spring 2017	8 interviews (4 boaters, 4 port actors)
Questionnaire I (Parviainen and Lehikoinen, 2016)	Summer 2016	270 boaters
Questionnaire II (Vantola et al., 2018b)	July–December 2017	220 boaters

2018a, 2018b). Waste management issues, and BSSM in particular, was a specific topic around which the discussions on sustainable marina operation repeatedly lingered in the interviews while the issue was also often addressed in the open-ended questionnaire responses (Tables B1–2). Recreational boaters in the study area often seemed to face BSSM issues that the port actors were not aware of (Luoma et al., 2018; Vantola et al., 2018a). The literature review additionally indicated similar BSSM issues were faced by boaters in other parts of the world (e.g. Baasel-Tillis and Tucker-Carver, 1998; Lagerqvist and Andersson, 2016; Grant-Smith and Mayes, 2017). These observations led us to re-analysing the data in order to answer the question: “Given that BSSM plays an important role in sustainable marina development of the study area, how and under what conditions does it actually advance the sustainability of marina operation?”

Following the principles of ANT, we analysed all the mentions of BSSM in the data, in order to track the related human and non-human entities and the mechanisms of their interactions that the informants brought up when considering sustainable marina operation or their personal service needs and preferences as marina clients. This information was reflected against the reviewed literature, to understand the BSSM system even more deeply. To form a coherent description of the interactions among the multi-material collective, and to illustrate how the collective systemically generates sustainability, the gathered information was reorganised into a graphical systems description (a

conceptual map). Fig. 2 visualises the different phases involved in developing the present study.

According to ANT, everything in the social world exists and emerges as network effects that are the products of simultaneously material and discursive relations assembling different types of entities, including human beings, machines, objects, natural materials, ideas and organizations, into heterogeneous collectives (Latour, 2005). Following ANT in empirical research consequently entails paying equal analytical attention to entities of different nature without imposing on any of them and a priori definition of their capacities to contribute to making the social world possible and durable (Latour, 1999). The term *translation* is used when referring to the reordering of the relations that produce social world as network effects. For instance, when a new entity is introduced to a collective, or the role of an existing entity changes, the process of translation takes place as such interaction emerges through which the collective becomes re-established as a new normal (Latour, 1991).

Overall, for ANT, both human and non-human entities are necessary co-producers of the social world, and the collectives they form are the units in which all phenomena, like sustainability, occur. We expected adopting this approach would help us open-mindedly pinpoint the relational identity and role of the different sorts of elements that are actually needed when aiming to understand and advance the sustainable marina operation on a very practical level, which was also the viewpoint of the informants of the study reporting on the BSSM issues. Examples of similarly very practical ANT approaches to varying tourism contexts are Paget et al. (2010), Valkonen (2010), Ren (2011), and Jóhannesson and Lund (2017).

To date, ANT has been inspiring tourism scholars for nearly two decades and applications in the field have demonstrated that tourism cannot be understood without taking into account the role of non-human entities in achieving functional tourism workings (see van der Duim et al., 2017). However, so far, only few studies have made use of ANT to study sustainable tourism development in particular (see van der Duim et al., 2005; van der Duim and van Marwijk, 2006; van der Duim and Caalders, 2008; Hummel and van der Duim, 2012; Buijendijk et al., 2018).

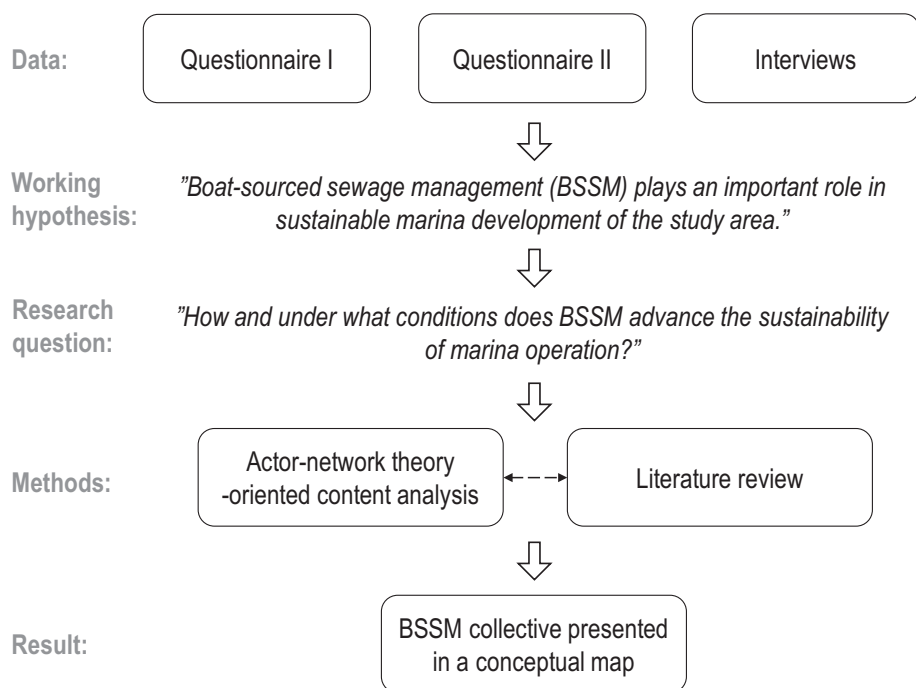


Fig. 2. The study protocol.

Besides the above premises of ANT, we build upon van der Duim and van Marwijk (2006) in considering that pursuing sustainability in tourism requires reorganizing such collectives that uphold unsustainable tourism workings. From here it follows that successful translations create room for such practices that potentially foster the attainment of sustainability objectives and override the inhibitory ones.

Addressing BSSM, our analysis is also contextualised by the related Finnish environmental regulation. Since the year 2005, discharging boat-sourced sewage in the sea in Finland has been allowed only beyond 12 nautical miles from the nearest shore based on the so-called boat-toilet decree (Finnish Government Decree 435/2000). Accordingly, in order to protect the marine environment, the leisure boaters should have sewage holding tanks (SHT) installed in the vessels for storing the contents of the boat-toilet for later disposal at SPOSSs. In Finland, SPOSSs are usually located either in natural harbours or built marinas. In natural harbours in the Finnish archipelago, floating SPOSSs are maintained most often by an environmental association (Keep the Archipelago Tidy Association). Shore pump-out stations located in marinas are in turn maintained by marina operators in accordance with the marina municipalities. The Finnish boat population has, subsequent to the implementation of the decree, become better equipped with SHTs (Askola et al., 2017), but boat-sourced sewage is still illegally dumped in the sea (Pönni and Haaksi, 2017), the most evident outcome being a contribution to the eutrophication of the Baltic Sea (HELCOM, 2014; Öberg, 2016).

4. Results

4.1. Findings

The informant boaters generally related that it is currently common to enact the boat-toilet decree in unintended ways due to malfunctions of SPOSSs in the study area. All the interviewed boaters related there are often situational constraints hindering them from carrying out proper pump-out procedures, and several survey respondent boaters indicated the same. According to the informant boaters, both in marinas and natural harbours, SPOSSs are generally either clumsily positioned, not working properly due to poor maintenance or there are too few of

them.

Bringing up the practical problems encountered at the stations, boaters mainly let understand their environmental behaviour is constrained by infrastructural circumstances beyond their personal control. As stated by one interviewee: “[emptying the SHT at the SPOSS] is sometimes reality only ‘on paper’”. Consequently, we could say that SPOSSs at best function as material mediators that translate the boaters’ environmentally conscious values, attitudes and knowledge into the active role of a marine environmental citizen. However, situational constraints hampering proper pump-out procedures manifest a misfortunate governance outcome as the malfunctions diminish the citizen-making capacities inscribed at SPOSSs and consequently make otherwise environmentally conscious boaters violate the boat-toilet decree as they have no choice but to empty their boat-toilets in the sea.

Related to the positioning of the SPOSSs, one interviewed boater described how the use of them as an environmental issue sometimes intersects with safety concerns due to hazardous situations that emerge at the stations. The interviewee told arriving at the SPOSS with a big boat is sometimes extremely difficult because it is troublesome to attach to a bouncing pontoon of a floating station. The positioning of a SPOSS at a jetty may in turn be constraining in case of hard wind conditions. The boaters overall acknowledged proper pump-out procedures important for not to stress the marine environment but at the same time emphasized the use of SPOSSs ought to be easy and convenient, and even to raise ‘a positive feeling’.

Talking about the constraints related to the SPOSSs’ design, the above interviewee besides illustrated how pump-out procedures involve care for the boat:

We have two SHTs, so one toilet on each side. Then when you can only empty the tank from one side [of the station] you have to weave your way [at the station]. Or you drag the hoses over the boat while they are in dodgy condition and break things on the way. There are many aspects [you need to consider] and you don’t, well, really want the nasty bits on your deck.

Boaters’ actual possibilities for proper pump-out procedures also relate to the fact that SPOSSs are used both by local and visiting boaters. One boater who was interviewed in his home marina illustratively raised

the point of insufficient number of SPOSSs by stating: “*of course it [draining boat-sourced sewage in the sea] doesn't take place in marinas, but in between them there [at sea]*”. The interviewee further noted that if all boaters emptied their SHTs in their home marinas, especially during rush hours, the queues at SPOSSs would be intolerably long.

Overall, the problems and concerns the informant boaters describe encountering at SPOSSs picture the facilities as so-called core marina services (Mikulić et al., 2015): in terms of destination marketing, SPOSSs rarely differentiate a marina from its competitors, but prone to deficiencies due to poor planning and maintenance, which the informants of this study repeatedly related, they are the sort of services that most likely cause frustration and dissatisfaction among visitors.

The interviewed boaters' perception was however not that the current problems only result from SPOSSs' deficiencies. One interviewed boater for instance considered proper pump-out procedures may be more natural for younger boaters who have only pursued boating during the current regulation. An extract from another interviewee in turn describes the skittish attitudes that may be at play especially among older boaters:

I once left boating with an older guy who was talking how 'here it's good when you head to the sea you can nicely drain the SHT empty'. I then remarked that it [the SHT] is not meant for that, it's for storing it [sewage] and for taking it to the right place... but these are questions of attitudes. People easily think like 'hey there's so much sewage draining from Saint Petersburg that this our share is so minuscule compared to that', but to me everybody's share is important. It's just unfortunate how some people... how their attitudes are off the mark.

The quarrel over the purpose of the SHT reported by the boater is illustrative in two senses. On one hand, against existing literature, the extract highlights that the boat-toilet decree demands a waste chore that is simultaneously ordinary and exceptional in the tourism context.

On the other hand, the quarrel demonstrates the SPOSSs' and SHTs' generally conditional capacities as management instruments. Depending on one's environmental values, attitudes and knowledge, as shown in the extract, the SHT can be translated into playing a role completely at odds with the one inscribed at it in environmental legislation. As stated by an interviewed boater: “*it is not enough that [people have] SHTs [installed in their boats]*”, but they also need to be used appropriately. The boater, however, was personally doubtful of such a policy that a SHT would be closed with a seal to prevent from dumping its contents in the sea of which he had heard from another country. The boater also stated posing even a smallest charge on the use of SPOSSs would likely be a catastrophe since some boaters would resist only out of principle.

Related to the quarrel, it is also remarkable that even though all the interviewed boaters brought up the importance of environmental management in terms of the availability of SPOSSs and other waste management facilities, which also proved crucial for boaters in the survey responses, the interviewees at the same time considered the environmental impacts of boating irrelevant in the big picture compared to other sources of marine pollution, such as agriculture.

Regarding measures for alleviating the deficiencies in using SPOSSs and thus for sparking off translations towards more sustainable marina operation and boating, the interviewed boaters also brought up some suggestions. Acknowledging all devices sometimes breakdown and that SPOSSs foremost require maintenance, one interviewee suggested a repair person could regularly check that everything works at the stations situated in the archipelago, at least during the busiest boating season. Additionally, it was reasoned that, besides the phone number of the maintenance person, attaching operating instructions to the station would be helpful. Furthermore, both the interviews and survey responses reasoned that in marinas SPOSSs should be clearly marked with appropriate signs to make them easy to find. On the other hand, agreeing that all boaters hardly empty their SHTs as required by the law, the interviewed boaters generally suggested yacht clubs ought to take a

bigger role in instilling proper pump-out procedures, e.g., through environmental education campaigns. When it comes to all instructions and materials, the importance of several language versions was highlighted during the interviews. Finally, increasing the number of the stations and better planning and zoning were mentioned in the interviews as ways to overcome the current situation, and the survey responses imply a need for the same measures.

In agreement to the informant boaters, the interviewed port actors considered marinas should offer boaters possibilities to act in an environmentally friendly way, but at the same time they stated whether boaters carry out environmentally friendly practices in marinas depends on their will to make use of the facilities that enable them doing so. One port actor illustratively stated that when the SPOSSs are installed in the marina, there is not much more the marina can do. In this regard, SPOSSs were also involved in distributing responsibility among the marina stakeholders.

The port actors' ignorance on the SPOSS issues reported by the boaters also relates to the notion that the interviewed port actors themselves acknowledged the spending of visiting boaters alone does not make marina operation profitable, but marina business is strongly dependent on the localities' permanent residents. Consequently, it seems port actors may overlook facilitating BSSM if they do not consider such efforts money-making. The port actors also specifically brought up that the contracts the marina municipalities offer them are not long enough to create an incentive for them to invest in developing boater-specific services, especially as marina business is moreover a strongly seasonal activity.

4.2. Synthesis

Fig. 3 synthesises the preceding analytical findings into a visualised ANT-based socio-eco-technical network, illustrating the divergent actors and factors of marina operation operating on, but also linking together, different spatial scales of society and environment. SPOSS and SHT are core elements of the BSSM collective.

5. Discussion

We have described BSSM as a multi-material and -sited socio-eco-technical system advancing sustainability in the marina context. Most fundamentally, our analysis illustratively brings up the role of the SPOSS in the BSSM system as a so-called *governance artefact*. Woolgar and Neyland (2013) use the term to discuss how waste management policies expect citizens to form morally constituted governance pairs with waste management facilities. Accordingly, the purpose of waste management facilities as governance artefacts derives from the expectation that the facilities' presence in human settlements results in that people take up such waste practices in making use of the facilities that produce certain intended governance outcomes. Valkonen et al. (2019) similarly demonstrate domestic rubbish bins as settings that connect households' private waste chores into the objectives and outcomes of public waste management. However, as Woolgar and Neyland (2013) remark, governance artefacts are not necessarily successful in implementing the practices they are supposed to since the use of them often involves breach, breakdown, challenge, contestation, failure, misunderstanding, resistance and oversight. Needham and Szuster (2011) accordingly consider waste management facilities an indirect management technique that is by no means compelling but rather works through freedom of choice.

Fig. 3 illustrates the governance artefact idea presenting SPOSS as well as SHT at the core of the BSSM collective. The ANT-based diagram demonstrates the systemic mechanisms through which a SPOSS manifests as a governance artefact linking the material and discursive elements needed to accomplish an environmentally sound procedure for managing boat-sourced sewage. We suggest the presented BSSM collective is one important sub-system that can either advance or hinder the

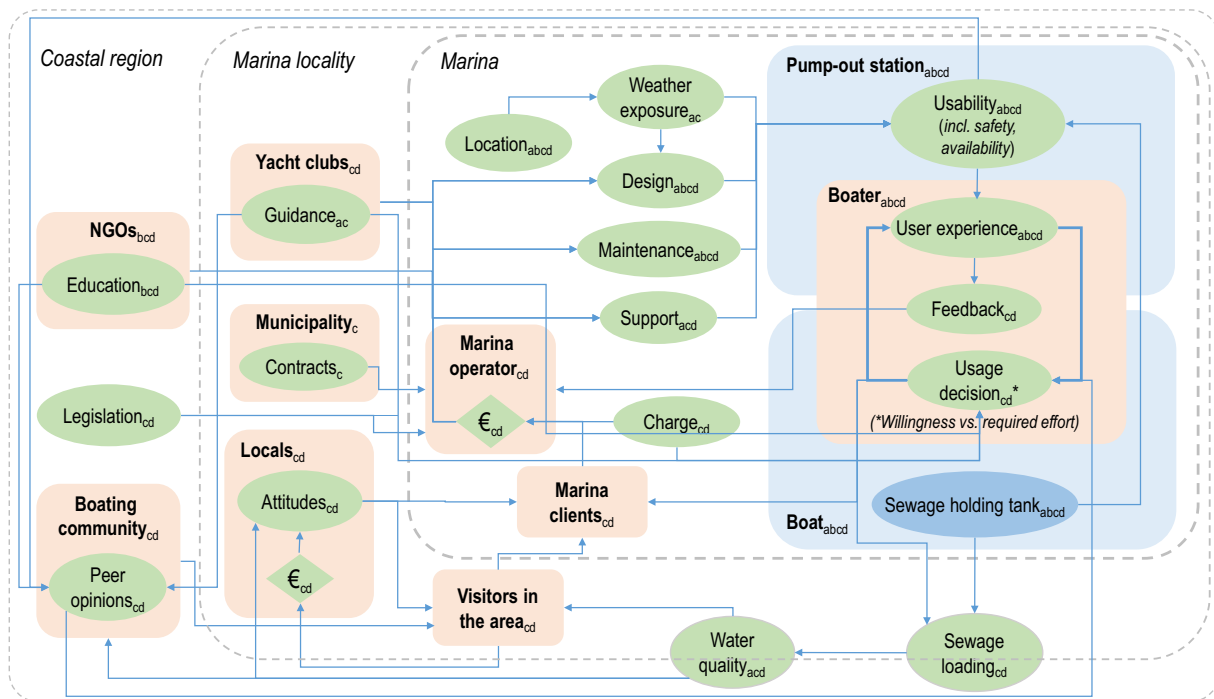


Fig. 3. The BSSM collective (i.e. an actor-network). Pink nodes = human actors; blue nodes = non-human actors; green nodes = key factors. The source of the data is indicated in the subscript: a = Questionnaire I; b = Questionnaire II; c = Stakeholder interviews; d = Literature review. When interpreting the diagram, each arrow can be worded as “affect(s)” or “have/has potential to affect”. A factor node within an actor node should be read as “of/by the actor”, for example “Education by the NGOs” or “Usability of a pump-out station”. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

materialisation of sustainability under the wider system of nautical tourism, including both the touristic experience and the business perspective. If successful, by stabilising environmentally sound practices, the collective advances the sustainability of both marina operation and recreational boating. Whereas if failed, the collective’s effect is inhibitory.

Additionally, three other conclusions derive from our analysis. First, marina facilities, such as SPOs, as well as boat accessories, such as SHTs, seem to play a considerably more fundamental role in sustainable marina operation than previously thought. As governance artefacts, the facilities provide the necessary infrastructural element both for implementing and stabilising sustainable boating practices. Furthermore, as marinas provide pump-out facilities for boaters, they consequently become central sites in steering onboard boating practices to meet the spirit of BSSM related environmental regulation, such as the boat-toilet decree.

Concretising the systemic interplay between the human and non-human elements of the presented BSSM collective, our results moreover indicate paying special attention to waste management services in marinas is likely to put forward a so-called virtuous circle, or a sustainability loop, producing synergies between objectives of environmental management, local well-being and economic development. We found boaters consider SPOs as core marina services (Mikulić et al., 2015), which highlights that environmental variables known to be favored by boaters and preserved by waste management facilities, such as water quality (Curtis et al., 2017) and biodiversity (Viana et al., 2017), ought to be of paramount interest to marina operation if it is to attain holistic sustainability. Adequate environmental management preserves the ecosystem services that are part of the tourism product and prevents them from turning into disservices likely making visitors abandon the site as well as its surroundings in the long run. Based on the presented literature review and analysis, we may also consider SPOs a matter that connects concerns by both visiting boaters, for whom well-functioning facilities bring added value as they enable them act in an environmentally conscious way, and local dwellers concerned on the

state of the environment in their home locality. This waste management infrastructure’s cross-cutting sustainability effect has been accordingly acknowledged in the cruise tourism context (MacNeill and Wozniak, 2017).

Simply installing waste management facilities in marinas does however not straightforwardly translate into intended behaviour. Rather, in relation to Leposa (2017), our analysis confirmed that attempts to mitigate the environmental impacts of boating should not take the responsibility of individual boaters as the point of departure. Breakdowns, operational difficulties, and insufficient number of SPOs that boaters relate prove proper pump-out procedures are precarious achievements of collaboration between heterogeneous entities including boaters, boat accessories, marina facilities and the public and private parties that design, plan, place, provide and maintain them for boaters’ use. The results of the study provide us solid ground to argue marine environmental citizenship (McKinley and Fletcher, 2010, 2012) as a role allocated to boaters is a materially and discursively mediated network effect requiring constant collective effort and active facilitation within the marina networks. Our results highlight that environmental consciousness as an objective of sustainability governance is not an individual attribute, but a network effect that requires wide-ranging stakeholder involvement to produce and maintain favourable socio-technical conditions for environmentally conscious practices to spark off.

Second, we observed that while struggling to make the marina business profitable by targeting multiple customer groups, the port actors seemed to be largely unaware of how boaters as one of the main marina users value the quality of the marinas and their services. In terms of managing the environmental impacts of boating, our results prove especially proper disposal of boat-sourced sewage is a high priority for boaters. However, we identified several constraints deriving from the design, provision, location, maintenance, and misuse of the SPOs currently hindering boaters from carrying out proper sewage procedures in marinas as well as in nature harbours. Based on our results, port actors would benefit from listening more closely how boaters perceive the role

of marinas in mitigating the environmental impacts of boating.

Third, we noticed previous research on sustainable marina operation has disregarded the role of marinas in orienting the environmental practices boaters pursue onboard both on-site in marinas as well as off-site at sea beyond the immediate marina area. Importantly, in terms of environmental management, a bidirectional linkage exists between the infrastructure, instructions and information marinas provide both for resident and visiting boaters and the motivations and knowledge boaters have regarding carrying out environmentally sound practices. Our results prove carefully maintained environmental management facilities both enable and orient boaters to environmentally conscious boating practices while many boaters also particularly expect such service from marinas. We suggest SPOs manifest sustainability governance in marinas and potentially direct so-called transition work (Bjerkan and Ryghaug, 2021). Namely, as the BSSM collective ties together, e.g., boaters and port actors with diverging expectations towards marina development, facilitating collective learning of BSSM issues among the marina stakeholders would allow them to jointly shape BSSM to serve shared tourism-related sustainability efforts.

Whereas the interviewees of the present study were Finnish boaters and port actors from a geographically relatively small area, the questionnaire survey responses may also more generally represent Finnish boaters' views and opinions towards marina services at the Eastern Gulf of Finland as responses were collected online, i.e., throughout Finland. Finnish boating culture and national environmental regulation in any case inevitably affect the informants' thinking and are therefore reflected in the data. We nevertheless believe our findings bear relevance also beyond the case study area, since the related studies from other parts of the world have reported on the same phenomena we observed. Our socio-eco-technical systems analysis has also demonstrated the sort of novel thinking we believe would be valuable in various nature-based tourism contexts, where technological solutions often have a focal role in controlling the stress touristic activities cause on the local environment. However, the level of applicability and generalizability of our findings in different areas and contexts should be evaluated case-specifically. The data we used in the study also focuses on boaters' viewpoints towards marina services from out-of-town visitors' perspective and our interpretations concerning marina localities' residents therefore largely derive from existing literature.

Methodologically, ANT served the purpose of the study well helping us, for instance, revealing how SPOs and SHTs function as governance artefacts as well as discerning the systemic, site- and scale-dependent nature of sustainability. Whereas ANT also allowed us to constructively combine the interview and questionnaire data collected in the project, the results we gained through qualitative ANT-oriented analysis could not have been attained using statistical analysis methods.

In future research, the ANT approach we have presented could be extended, e.g., to facilities placed in marinas for invasive fouling species management (Johnson and Fernandez, 2011). Additionally, while Kaaristo and Rhoden (2017) and Leposa (2018) have conducted ethnography onboard with boaters, they have not taken the environmental impacts of boating as their analytical starting point. We suggest closer investigation on how committing to environmental chores in a boat materializes as embodied spatial practices and distinct engagement with nature. An ethnographic study setting covering a complete calendar year of boat-life including both on- and off-season activities, such as preparing the boat for winter storage and planning the next season, including purchasing new boat accessories or a new boat, would provide valuable information on boaters' environmental reasoning and consequently support more accurate management of different types of boat-source waste and pollution within the marina networks.

Lastly, while constructing the visual systemic representation of the BSSM collective (Fig. 3), we found classifying the elements under the three commonly used sustainability dimensions (environment, social and economy -related factors) impossible, because most of the identified factors are multiply interrelated and do not straightforwardly derive

from any single dimension. ANT questions the meaningfulness of categorising entities into subjects and objects, thus warning of pre-defining the world-making capacities that different entities may have. Indeed, if sustainability actually manifests as a network effect of interrelating multi-material and -sited elements, classifying the sustainability factors under pre-defined analytical categories in exploring sustainability may limit researchers' capacity to perceive the cross-sectoral nature of the phenomenon.

6. Conclusions

Based on these findings, our advice for future marina development in the study area is that within the marina networks that connect both public and private parties, joint effort should be specifically put on facilitating communication between boaters as end users of SPOs and for instance marina operators, municipalities, and environmental organizations as providers of these facilities. While involving boaters closely in the planning phase of the infrastructure likely facilitates its future use, for instance, a mobile application might prove effective as an announcement system in case of already operational but malfunctioning stations. Boaters' view in the data collected in this study is that especially yacht clubs could take a bigger role in instilling proper pump-out procedures, e.g., through environmental education campaigns. Based on our results, it is evident that if implemented, such campaigns need to pay attention to the simultaneous ordinariness and exceptionality of pump-out procedures as waste chores in order to pre-empt reluctant boaters' resistance.

Importantly, the needs for increased communication within the marina networks and better recognition of the user needs and expectations are not limited to our study area. Corresponding BSSM issues have been reported from different parts of the world, including the United States (e.g. Baasel-Tillis and Tucker-Carver, 1998) and Australia (e.g. Grant-Smith and Mayes, 2017), whereas boat discharges, such as sewage spillage, have also been recently identified as the main sustainability risk associated with recreational boating in marinas (Martínez-Vázquez et al., 2021a). Moreover, taking action is urgent: as boat sizes are increasing and the boat industry is turning boats into mobile summer-houses, boaters are becoming more independent from marinas which makes the localisation of the environmental impacts of boating harder to predict (Leposa, 2018).

CRedit authorship contribution statement

Renne Vantola: Conceptualization, Methodology, Investigation, Data curation, Formal analysis, Visualization, Writing – original draft. **Emilia Luoma:** Methodology, Investigation, Formal analysis, Writing – review & editing. **Tuuli Parviainen:** Methodology, Investigation, Writing – review & editing. **Annukka Lehikoinen:** Supervision, Conceptualization, Methodology, Validation, Visualization, Writing – review & editing, Project administration, Funding acquisition.

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.

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Supplementary data

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