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1 "It is Like Diving in a Pea Soup": The Development of the Relationship between Humans and Blue-Green Algae in Finland in the Twentieth and Twenty-first Centuries

Introduction

Eutrophication is a main driver for harmful algal blooms such as cyanobacteria, or blue-green algae, and has gained a fair amount of public, societal and scientific interest in the last few decades.[1] Caused by high levels of nutrient loading, eutrophication can be regarded as a wicked problem[2]; it is an issue whose "dimension goes along with the difficulty in acknowledging and agreeing on the distribution, scale, nature, and intensity of social consequences to and impacts on local people; it largely characterizes coastal communities' experience of environmental change management (–)."[3]

The environmental changes in Finland, which has a significant coastline along the Baltic Sea, have been evident and significantly accelerated during the twentieth century, especially those related to human-induced nutrient loading that causes increased cyanobacteria blooms and hypoxia.[4] These environmental

1 Alix Levain et al., "Green Out of the Blue, or How (Not) Deal with Overfed Oceans. An Analytical review of Coastal Eutrophication and Social Conflict," *Environment and Society: Advances in Research* 11, no. 1 (2020), doi.org/10.3167/ares.2020.110108; Robert J. Diaz and Rutger Rosenberg, "Spreading Dead Zones and Consequences for Marine Ecosystems," *Science* 321, no. 5891 (2008), doi.org/10.1126/science.1156401.

2 See also Horst W. J. Rittel and Melvin W. Webber, "Dilemmas in a General Theory of Planning," *Policy Sciences* 4, no. 2 (1973), http://www.jstor.org/stable/4531523.

3 Levain et al., "Green Out of the Blue," 115–16.

4 Liisa Lepistö, *Planktonlevien aiheuttamat haitat* (Helsinki: Vesi- ja ympäristöhallitus, 1992), 8, http://hdl.handle.net/10138/190455; Floriaan Eveleens Maarse, Sonja Salovius-Laurén and Martin Snickars, "Long-Term Changes in the Phytobenthos of the Southern Åland Islands, Northern Baltic Sea," *Nordic Journal of Botany* 38, no. 10 (2020): 1–2, https://doi.org/10.1111/njb.02751; Eeva-Liisa Poutanen and Kirsti Nikkilä, "Carotenoid Pigments as Tracers of Cyanobacterial Blooms in Recent and Post-Glacial Sediments of the Baltic Sea," *AMBIO* 30, no. 4 (2001): 179, https://doi.org/10.1579/0044-7447-30.4.179.

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https://doi.org/10.1515/9783111215273-002

changes have evoked public discussions on the quality of natural water bodies, which have focused mainly on the algal blooms during the summer and their harmful consequences. At worst, the blue-green algae situation in the coastal areas in the Baltic Sea is, according to our ethnographic research participant, "like diving in a pea soup".[5]

Cyanobacteria have been present in Finnish waters since ancient times, although their wider public acknowledgement has been relatively recent. A study focusing on the history of cyanobacteria blooms in the Baltic Sea suggests that the abundance of cyanobacteria in the Baltic Sea was lower at the beginning of the twentieth century than they are today.[6]

We study human relationships with blue-green algae in Finland from the late nineteenth century to the present day in this chapter. We examine how humans have perceived blue-green algae and how these perceptions have changed over the past decades, in particular exploring how and why blue-green algae have become so undesirable today. We also examine blue-green algae in terms of agency, especially focusing on how humans have perceived the agency (or the lack of it) of blue-green algae in affecting the environmental changes in the Finnish coastal areas and what kind of impact these perceptions have had on people's attitudes and emotions regarding the blue-green algae. Finally, we explore how understanding these trajectories can contribute to understanding human-marine biodiversity relationships and ontologies and support locally accepted environmental management.

Background and Previous Research

Often perceived as algae – hence the alias blue-green algae – this organism is actually a bacterium, more accurately called a cyanobacterium. Cyanobacteria may have existed on Earth more than three billion years, and descendants of these life forms still live on our planet, for instance, in the form of blue-green algae.[7] The

5 Interview record, 2022, TKU/A/22/107, 2022, Humbio Interviews, Collection of Folkloristics and Study of Religion (TKU). Archives of the School of History, Culture and Arts Studies (SHCAS Archives), University of Turku, Finland.

6 Terttu Finni et al., "The History of Cyanobacteria Blooms in the Baltic Sea," *AMBIO* 30, no. 4 (2001), https://doi.org/10.1579/0044-7447-30.4.172.

7 Susanne Rantamäki, "Biophysical Modeling of Photosynthetic Electron Transfer and Practical Applications to Cyanobacteria" (PhD diss., University of Turku, 2013), 9, https://urn.fi/URN:ISBN:978-951-29-5296-0; Patricia Sánchez-Baracaldo et al., "Cyanobacteria and Biogeochemical Cycles through Earth History," *Trends in Microbiology* 30, no. 2 (2022), https://doi.org/10.1016/j.tim.2021.05.008.

prevalence and the quantity of blue-green algae in surface waters are influenced by sunlight and nutrients, especially phosphorus. Weather conditions and high nutrient loads have also been the main explanation for the mass development of cyanobacteria at the beginning of the 20th century, but although their role is important, other environmental factors such as water stratification and fronts also contribute to the formation of blooms.[8] More than half of the blue-green algae are poisonous and contain toxins that damage the human liver and nervous system; people can also get rashes, headaches and fever just from swimming in water containing cyanobacteria.[9] The blue-green algae toxins have occasionally killed animals, but there have been no serious human poisonings in Finland.

However, blue-green algae, although harmful and potentially dangerous to humans and other animals, are also an enabler of all life. Scientists believe that oxygen appeared in the Earth's atmosphere around 2.5 billion years ago as a by-product of photosynthesis by cyanobacteria; thus, in practice, the existence of life on Earth results from the activity of blue-green algae. Therefore, in addition to having created oxygen on Earth countless years ago, cyanobacteria are still extremely important for the Earth's biodiversity as a whole and are responsible for at least one third of the Earth's net primary production.[10]

The cyanobacteria have been studied so far almost exclusively in a natural scientific context. This research is needed, of course, but those studies mainly focus on the biological characteristics of blue-green algae. Conversely, the social aspects regarding blue-green algae have been studied with a primary focus on socioeconomic issues rather than sociocultural ones[11]; what has been largely left unacknowledged is that blue-green algae and humans also share a common history and that humans have had different perceptions of blue-green algae throughout the past.

We explore blue-green algae in this chapter from the perspective of the study of history and culture. There have been only a few works on blue-green algae within these fields of study, and often cyanobacteria are put in a side role and/or discussed very briefly.[12] There are, however, some exceptions that come close to

8 Finni et al., "The History of Cyanobacterial Blooms."

9 Roslyn Wood, "Acute Animal and Human Poisonings from Cyanotoxin Exposure — A Review of the Literature," *Environment International* 91, (2016), https://doi.org/10.1016/j.envint.2016.02.026.

10 Rantamäki, "Biophysical Modeling," 9–10.

11 Geneviève Brisson et al., "Social Construction of Cyanobacteria Blooms in Quebec: A Matter of Perceptions and Risk Management," *SAGE Open* 7, no. 1 (2017), https://doi.org/10.1177/2158244017697361.

12 Brisson et al., "Social Construction of Cyanobacteria Blooms"; T. S. Harvey, "Cyanobacteria Blooms: Maya Peoples between the Politics of Risk and the Threat of Disaster," *Medical Anthropology* 31, no. 6 (2012), https://doi.org/10.1080/01459740.2012.658588; Terttu Finni, Sari Laurila and

our approach. For instance, environmental scientist Jari Lyytimäki has authored an overview focusing on the role of the mass media in shaping public discussion and environmental policies in Finland,[13] political scientist Geneviève Brisson and her colleagues have conducted ethnographic research in Quebec to examine social construction of cyanobacteria blooms[14] and anthropologist T.S. Harvey has studied the cyanobacteria blooms and risk management among the Maya people of Guatemala with ethnographic methods.[15]

Lyytimäki's research with these studies is especially close to our study, but it is framed in the period from the 1990s to the 2010s and does not share our methodological approach,[16] and we have not found any that focus specifically on the long-term relationship between humans and blue-green algae. There are, of course, few mentions of the history of blue-green algae sightings in many natural scientific studies, but these have mainly been dealt with very loosely.[17] For example, many such studies highlight that the first blooms of blue-green algae were recorded at Lake Llangorse in Wales by the priest and historian Gerald of Wales in 1188, but they say no more about the shared history between humans and these algae.[18]

Framework, Material and Methods

Our aim is to fill a gap in previous research by examining the relationship between humans and blue-green algae from the theoretical approach of the environmental humanities, multispecies history and multispecies ethnography.[19] Increasing num-

Simo Laakkonen, "The History of Eutrophication in the Sea Area of Helsinki in the 20th Century," *AMBIO* 30, no. 4 (2001), https://doi.org/10.1579/0044-7447-30.4.264.

13 Jari Lyytimäki, "Gone with the Wind? Newspaper Discourse of Eutrophication and Blue-Green Algae Blooms in Finland," *Water and Environment Journal* 26, no. 3 (2011), https://doi.org/10.1111/j.1747-6593.2011.00301.x.

14 Brisson et al., "Social Construction of Cyanobacterial Blooms."

15 Harvey, "Cyanobacteria Blooms."

16 Lyytimäki, "Gone with the Wind?"

17 See, e.g., G. E. Fogg et al., *The Blue-Green Algae* (London: Academic Press, 1973), 1–2; Lepistö, *Planktonlevien aiheuttamat haitat*, 7–10; Eveleens Maarse et al., "Long-Term Changes in the Phytobenthos."

18 See, e.g., Fogg et al., *The Blue-Green Algae*, 1–2; Lepistö, *Planktonlevien aiheuttamat haitat*, 7.

19 On multispecies history, see, e.g., Sandra Swart, *Riding High: Horses, Humans and History in South Africa* (Johannesburg: Wits University Press, 2010); Otto Latva, *The Giant Squid in Transatlantic Culture: The Monsterization of Molluscs* (London: Routledge, 2023), https://doi.org/10.4324/9781003311775. On multispecies ethnography, see, e.g., Laura A. Ogden, Billy Hall and Kimiko Ta-

bers of marine species have been subjected to this type of research in recent years,[20] yet algae and marine microorganism are rather absent in the field of multispecies history and ethnography, even if ethnobotanical studies regarding seaweed have been conducted more extensively, with the research focus in these accounts being mainly on the nutritional and cultural values of seaweed.[21] From Scandinavia's perspective, archaeological research on utilising the habits of bladderwrack has also been studied only recently,[22] such as the Nordic mythology and folklore regarding seaweed.[23] Research on microorganisms from the multispecies or posthumanism perspective is also scarce, with a few exceptions such as Astrid Schrader's research on harmful algae blooms and phytoplankton.[24]

We also draw inspiration from the multispecies studies in analysing our material through the concept of agency to better understand the ways in which human and cyanobacteria actors are entangled and how their intra-actions play at shaping perceptions of environmental issues. We apply the concept of intra-action as Karen Barad has formulated and see that the entangled agencies are mutually formed and that those agencies emerge through intra-action rather than preceding it.[25]

Our work also contributes to the field of the digital humanities, because our research material comprises a vast number of digitised sources that have been converted into machine-encoded text by optical character recognition (OCR) and used

nita, "Animals, Plants, People, and Things: A Review of Multispecies Ethnography," *Environment and Society* 4, no. 1 (2013), https://doi.org/10.3167/ares.2013.040102.

20 See, e.g., Eva Hayward, "FINGEREYES: Impressions of Cup Corals," *Cultural Anthropology* 25, no. 4 (2010), https://doi.org/10.1111/j.1548-1360.2010.01070.x; Latva, *The Giant Squid in Transatlantic Culture*.

21 See, e.g., Nancy J. Turner, "The Ethnobotany of Edible Seaweed (*Porphyra Abbottae* and Related Species; Rhodophyta: Bangiales) and Its Use by First Nations on the Pacific Coast of Canada," *Canadian Journal of Botany* 81, no. 4 (2003), https://doi.org/10.1139/b03-029.

22 Dawn Elise Mooney, "Charred *Fucus* -Type Seaweed in the North Atlantic: A Survey of Finds and Potential Uses," *Environmental Archaeology* 26, no. 2 (2021), https://doi.org/10.1080/14614103.2018.1558805.

23 José Lucas Pérez-Lloréns et al., "Seaweeds in Mythology, Folklore, Poetry, and Life," *Journal of Applied Phycology* 32, no. 5 (2020), https://doi.org/10.1007/s10811-020-02133-0.

24 Astrid Schrader, "Microbial Suicide: Towards a Less Anthropocentric Ontology of Life and Death," *Body & Society* 23, no. 3 (2017), https://doi.org/10.1177/1357034X17716523; Astrid Schrader, "The Time of Slime: Anthropocentrism in Harmful Algal Research," *Environmental Philosophy* 9, no. 1 (2012), http://www.jstor.org/stable/26169396.

25 Karen Barad, *Meeting the Universe Halfway: Quantum Physics and the Entanglement of Matter and Meaning* (Durham: Duke University Press, 2007), 33.

digital search tools to track the central sources for this study.[26] Our research material comprises digitised Finnish newspaper and magazine articles and interviews, with the newspapers and magazines retrieved from a database digitised by the National Library of Finland, which currently contains over 27 million pages of digitised material from the beginning of the early modern period until 2021.

We used "sinilevä", the Finnish word for blue-green algae, as our keyword to conduct a search of the database. This search produced almost 10,000 hits, which is too much data to go through manually, and we decided, therefore, to limit the time period from 1891, when the first public mention of blue-green algae was published, to the end of 1999, when the amount of news coverage of blue-green algae increased dramatically. This limitation reduced our data to 1,375 hits, which also contains a lot of research material but is still manageable, however, we also checked the textual environment of hits published in the 2000s and 2010s using the AntConc corpus analysis tool.[27] We found from this analysis that attitudes towards blue-green algae have not changed significantly since the 1990s, which also justifies not going through the 2000s and 2010s data manually.

However, definite results cannot be guaranteed, despite the extensive research data. For example, the data digitised by the National Library of Finland contains some OCR errors; thus, we may not have found all possible mentions of blue-green algae in the database. Additionally, not all material published in Finland after the 1930s has been digitised. Nevertheless, the nearly 1,400 articles from newspapers and periodicals published from 1891 to 1999 are a relatively extensive sample to reflect Finnish perceptions and understanding of blue-green algae.

While we limited our careful examination of the newspaper material to the period from 1891 to the end of 1999, we also analysed interviews conducted in spring 2022 to find observations and memories of blue-green algae in the 2000s and earlier. Interviews were semi-structured interviews with 32 participants (three joint interviews) and were designed to seek local ecological knowledge or experience based knowledge on environmental changes in the Finnish coastal areas. Participants were recruited based on their connection to the area through either their place of living, profession or leisure activities, with local people, fishers, divers, sailors, gardeners, scouts and NGO representatives amongst the research participants. All participants were appropriately informed of their rights as participants and details of data archiving according to the guidelines provided

26 Hannu Salmi, *What Is Digital History?* (Cambridge: Polity Press, 2021).

27 On AntConc, see "AntConc Homepage," Laurence Anthony's Website. Accessed November 23, 2023. https://www.laurenceanthony.net/software/antconc/.

by TENK (Finnish National Board of Research Integrity).[28] The interviews were transcribed and the transcriptions were archived accordingly.

Content analysis was applied for the analysis of all the thematic data. Content analysis is often applied in the humanities and the social sciences to analyse written or spoken material and to identify social patterns, for example, while thematic content analysis refers to the analysis method that can help the researchers to recognise repetitive and essential themes and systemically analyse them. The semi-structured interviews did not concentrate on the blue-green algae per se, because the interviews' objective was to examine the participants' perceptions and emotions regarding the environmental changes in the Baltic Sea area on a more general note. However, blue-green algae was brought up often and was highlighted by many participants.

The Volume and Themes of the Public Discussion on Blue-green Algae in Finland

We can conclude from the digitised research material that there was a significant increase in public discussions of blue-green algae since the early 1980s (Figure 1.1). The amount of discussion was low before this decade, although it is not insignificant, because every single source sheds light on our understanding of how our current understanding of blue-green algae has evolved. We discovered several emerging themes in the Finnish blue-green algae discussions after a thorough analysis of all our data, and we examine these themes further in the following sections.

By far the majority of the debate on blue-green algae defines it as an organism harmful to humans. It has been seen not only as an aesthetic nuisance over the decades but also as a dangerous bacterium for humans and animals. Along with this, there has also been much discussion on how to respond or adapt to the harmfulness of blue-green algae; for example, there have been various attempts to eradicate blue-green algae blooms and to control human and animal interaction with blue-green algae. We have divided our research according to these themes; the first section of the chapter deals with how Finns came to understand blue-green algae as an increasingly harmful organism during the twentieth century, while the second section examines the different ways in which attempts have been made to control blue-green algae in Finland.

28 Interview records, TKU/A/22/17–107, Humbio Interviews.

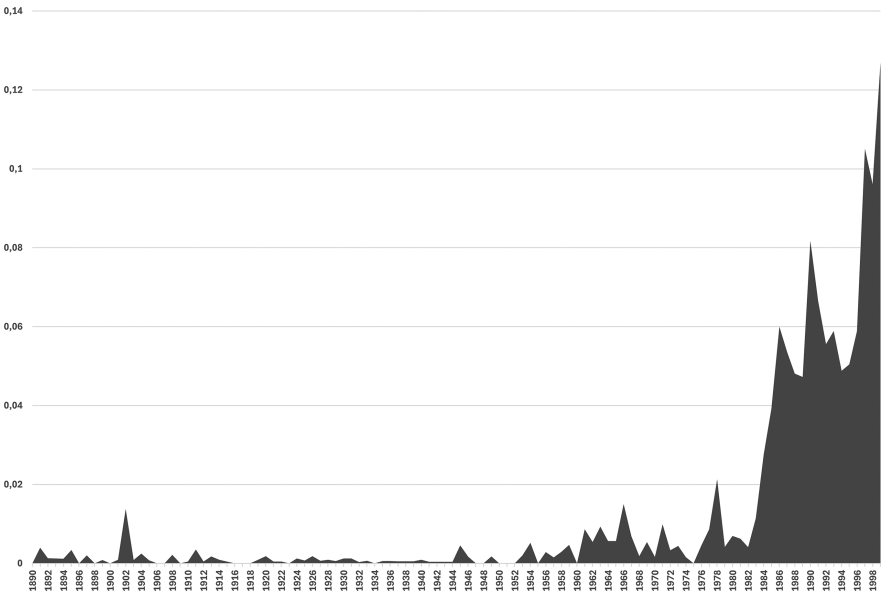

Figure 1.1: This graph shows how often the word "sinilevä" is mentioned in Finnish public discussions during the period under study. The years are below the graph; on the left side of the graph is the percentage of the discussion in relation to all digitised material. Otto Latva on the basis of the National Library of Finland data.

Changing Perceptions of the Harmfulness of Blue-Green Algae Over the Course of Time

Blue-green algae has been present in Finnish waters since the distant past. Historical sources reveal, for example, that in the second half of the nineteenth century there were plenty of blue-green algae blooms in the Baltic Sea.[29] According to our data, however, the blue-green algae was not mentioned before the 1890s. This first mention of cyanobacteria appeared in a newspaper article that reported a meeting of the scientific society Pro Fauna et Flora Fennica, in which the Finnish botanist Fredrik Elving presented dried blue-green algae to the meeting's participants. The report, in addition to describing Elving's collections, also said that

29 Finni et al., "The History of Cyanobacterial Blooms."

some of the species of blue-green algae were so abundant in lakes and seas that they caused a phenomenon known as water bloom.[30]

Thus, blue-green algae were not unknown to Finns at the turn of the 1800s and 1900s.[31] It was apparently already present then in large quantities in water bodies, however, blue-green algae did not cause any great sensation at that time. Blue-green algae had very little visible intra-action with the general public; the public discussions about blue-green algae showed that it was mainly of interest to scholars specialising in the natural sciences whose discoveries of blue-green algae were reported occasionally in newspapers from the last years of the nineteenth century until the war years of the 1940s.[32]

Based on these various observations, it can be said that many bodies of water in southern Finland were already more or less infested with blue-green algae in the early twentieth century. The biologist Kaarlo Mainio Levander was particularly well versed in the study of blue-green algae and wrote detailed descriptions in the early twentieth century of how the water in various Finnish lakes and bays in the Gulf of Finland turned green in late summer and autumn, causing "a phenomenon familiar to fishermen, the blooming of the water".[33] This shows that although intra-action with blue-green algae was not eminent, it still existed within the fish and fishers. Of course, the occurrence of blue-green algae was nowhere near the scale of the late 20th century. For example, an article published in 1945 mentioned that blue-green algae were abundant in the Gulf of Finland, while this was not the case in the Gulf of Bothnia. Studies at that time had found that the deeper water layers of the Gulf of Finland were rich in dissolved phosphorus and nitrogen, while the Gulf of Bothnia was almost phosphorus-free.[34]

However, there was some awareness of the blue-green algae and their distribution in Finland at the beginning of the twentieth century, which also means that they were associated with different meanings. One such meaning was related to the smell and appearance of the algae. Intra-action was demonstrated through sensory elements, which was well illustrated by the biologist Valio Korvenkontio in an article he wrote in 1911, in which he described the algal bloom as follows: "This sight does not

30 "Pro Fauna et Flora Fennica," *Päivälehti*, April 5, 1891, 3.

31 See also Valio Korvenkontio, "'Veden kukasta' ja sen synnyttäjästä," *Luonnon ystävä* 15, no. 5 (1911).

32 See, e.g., K. M. Levander, "Talvieläimistöstä Lohjan järvessä," *Luonnon Ystävä* 1, no. 2 (1897): 33; K. M. Levander, "Selontekoja retkeilystä," *Luonnon Ystävä* 17 no. 5 (1913): 194; "Societas pro Fauna et Flora Fennica,"*Uusi Suomi*, November 11, 1919, 2.

33 K. M. Levander, "Muutamia havaintoja Töölönlahden veden 'viheriöimisestä'," *Luonnon ystävä* 12, no. 4 (1908): 115–16.

34 Erkki Halme, "Itämeren perustuotannosta," *Luonnon ystävä* 49, no. 2 (1945): 58.

in itself offer anything attractive to the eye, on the contrary, such greenish muck seems quite repulsive and poisonous, especially as it often gives off foul-smelling, nauseating gases after standing in the same place for a long time."[35]

Blue-green algae and algae in general were therefore understood, at least in the public discussions, as aesthetic nuisances that also caused a bad smell. However, the concrete danger of blue-green algae to animals became apparent in Finland as early as the 1920s when cows died drinking from Lake Vesijärvi in the Hollola municipality. Levander investigated the case and concluded that the cows had died of blue-green algae poisoning, and supported his claim by pointing out that similar situations had been reported in Sweden.[36] However, the cow deaths were soon forgotten.

Thus, in the first half of the twentieth century, blue-green algae was not considered dangerous in the public discussion. The only meanings connected to blue-green algae were that they gave water not only an unpleasant smell but also an unpleasant taste.[37] The discussion about the unpleasant taste caused by blue-green algae was associated with the fact that the water supply to households in Finland had already been organised in several cities in the early twentieth century[38]; drinking water was purified from nearby water sources that may have contained blue-green algae. Reports of the blue-green algae's unpleasant taste suggest that its impact on tap water was probably already recognised in the 1940s, however, it was not until 1959 that the issue became a matter of public discussion when blue-green algae spoiled the taste of tap water in Helsinki for several days. The incident attracted much press attention, with journalists interviewing the waterworks' managers; they even got the director-general to taste the water, who, after drinking half a glass of water, said that "it tastes like mould".[39] Helsinki's mouldy water was ultimately not an exception, because blue-green algae found its way into drinking water on several occasions in Finland in the second half of the twentieth century.[40] What is also interesting is that, although the effect of blue-green algae in drinking water caused discomfort, it was not considered to be in any way dangerous to health.

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35 Korvenkontio, "'Veden kukasta'", 149.

36 K. M. Levander, "Vesibiologisia havaintoja Vesijärvestä," *Suomen eläinlääkärilehti* 39, no. 8–9 (1933): 182–84.

37 "Jyväsjärven vihreä vesi," *Aamulehti*, July 31, 1942, 4.

38 Tapio Katko, *Finnish Water Services: Experiences in Global Perspective*, (London: IWA Publishing, 2017); Simo Laakkonen, *Vesiensuojelun synty. Helsingin ja sen merialueen ympäristöhistoriaa 1878–1928*, (Helsinki: Gaudeamus, 2001).

39 "Perjantaipäivyri," *Ilta-Sanomat*, September 4, 1959, 5.

40 "Espoolaiset juovat kuollutta sinilevää," *Kansan Uutiset*, August 9, 1966, 1–2; "Raakavesi huonontunut Espoossa," *Uusi Suomi*, August 16, 1980, 5; "Myrkylliset sinilevät yleisempiä kuin on luultu," *Etelä-Suomen Sanomat*, July 5, 1986, 16.

Interestingly even without general public's awareness, blue-green algae and humans have intra-acted. Human induced environmental changes have always contributed to the abundance of blue-green algae and, in turn, their growing abundance has increased and widened the scope, scale and quantity of humans in intra-action with them. Blue-green algae have been present in Finland for a significant amount of time, although it is clear that their occurrence increased significantly in Finland from the mid-twentieth century onwards, particularly due to the increased discharge of eutrophying waste into water bodies.[41] As a result, the impact of blue-green algae was reflected not only in the drinking water but also in people's annoyance at how blue-green algae were becoming a problem for recreational use of water bodies. This was particularly evident in the context of Finnish lakes, where blue-green algae blooms became worse almost every year during the 1960s and 1970s.[42] This may be because the drinking water contaminated by blue-green algae had been purified from lake water and therefore the connection between lakes and blue-green algae had been prominent in the public discussion. However, it is also likely that the lakes were still more affected by blue-green algae than the Baltic Sea in the 1960s. For example, the appearance of blue-green algae in the Bothnian Gulf in 1966 was described in the press as a rare occurrence, while at the same time it was emphasised that blue-green algae were present in several lakes.[43]

In any case, during the 1960s and 1970s, more and more articles began to appear in the press about blue-green algae forming ugly-looking rafts or causing odour problems.[44] Some texts also wondered whether the bad taste of fish caught in blue-green algae waters was due to these bacteria, but blame was also attributed to industrial and domestic effluents and oil spills.[45] All these different writings show that many Finnish water bodies were in very poor condition during the 1960s and 1970s. Moreover, these texts show that blue-green algae in Finland was still perceived mainly as an aesthetic nuisance throughout the 1960s and 1970s, which was understood to spoil the clarity of the water and cause an unpleasant smell.

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41 Poutanen and Nikkilä, "Carotenoid Pigments," 179.

42 See, e.g., "Tuusulanjärvessä sinilevää eräin paikoin 1000 tonnia ha:lle," *Uusi Suomi*, August 15, 1965, 28; "Myrkyllisiä levälauttoja liikkeellä," *Uusi Suomi*, August 17, 1976, 5.

43 "Harvinainen leväesiintymä väistymässä Rauman vesiltä," *Helsingin Sanomat*, August 2, 1966, 13.

44 See, e.g., "Leirin käymälät saastuttivat järven," *Ilta-Sanomat*, September 7, 1964, 9; Allan Viranko, "Vesijärven vesi," *Etelä-Suomen Sanomat*, July 20, 1973, 16.

45 See, e.g., "Sinilevästä mudan maku Perämeren kaloihin," *Helsingin Sanomat*, October 20, 1969, 10; "Jätevesien vaikutus kalojen makuun tutkimuksen alaisena," *Länsi-Savo*, May 5, 1971, 6, 8.

Blue-green algae were not yet understood to be dangerous to humans and there was little talk of their threat to cattle, although their dangerousness to lakes began to be discussed in the 1960s. The deterioration of Lake Tuusula in southern Finland especially received much press coverage, with the lake said to have reached its catastrophic state of blue-green algae only in the previous ten years; limnologist Ilppo Kangas said in a newspaper article that the abundant blue-green algae in the lake, due to the phosphorus in the waste entering the water system, could eventually cause the death of the entire lake, making it a lifeless pool.[46] The death of water bodies became a discourse in the late 1960s, which became even more pronounced in the 1970s when the theme also began to emerge in Finland through popular culture and the visual arts.[47] Discussions about the death of water bodies resulting from blue-green algae continued until the 1980s,[48] after which blue-green algae began to be perceived more as a symptom of eutrophication.

Blue-green algae was understood until the 1980s as an organism that was particularly dangerous to lakes but harmless to humans and other animals, but this all changed in 1984 when the news of dogs dying in Porvoo from blue-green algae received extensive media coverage, with non-human animals becoming actors in the network of intra-action. News reports about the case immediately mentioned that blue-green algae was also dangerous for humans and that children in particular had to be watched to ensure they were not exposed to them.[49] It was a very radical change, as blue-green algae had previously been considered harmless to humans. There were only scattered reports in the press from the 1960s and 1970s that blue-green algae had caused rashes in some people,[50] while two newspaper articles published in the 1970s had referred to reported livestock deaths from blue-green algae in the 1920s but, again, had stressed that blue-green algae was harmless to humans.[51] Some experts even told the public in 1979 that "one can go swimming in blue-green algae water. It's only unaesthetic, there is no danger."[52]

The debate on blue-green algae has focused since then less on aesthetic or odour-related harm and more on the danger of blue-green algae to animals and

46 "Tuusulanjärvessä sinilevää," 28.

47 Heta Lähdesmäki, "Susirajalla ja metsäkiistoissa," in *Maamme. Itsenäisen Suomen kulttuurihistoria*, ed. Marjo Kaartinen, Hannu Salmi and Marja Tuominen (Helsinki: SKS, 2016).

48 "Pimjärvi täynnä sinilevää," *Etelä-Suomen Sanomat*, August 21, 1986, 1.

49 "Sinilevä tappanut kaksi koiraa Porvoossa," *Etelä-Suomen Sanomat*, August 10, 1984, 7; Juhani Lehtisalo, "Sinilevävaara ohi tältä kesältä," *Apu*, August 24, 1984, 64.

50 "Sini- ja viherlevää tavallista runsaammin," *Etelä-Suomen Sanomat*, July 12, 1966, 4; "Leväkasvillisuus antaa makua Espoon vedelle," *Etelä-Suomen Sanomat*, July 19, 1967, 3.

51 "Myrkyllisiä levälauttoja," 5; "Viileä alkukesä pitänyt vedet uimakelpoisina," *Etelä-Suomen Sanomat*, August 3, 1978, 4.

52 "Sinilevää Helsingin edustalla," *Uusi Suomi*, August 18, 1979, 1.

humans. The situation was not helped by the fact that the very next year, 1985, two cows died in the Iitti municipality after drinking blue-green algae water from a eutrophic lake. It had also emerged at the same time that there had been a number of pet deaths in other Nordic countries over the previous ten years due to the blue-green algae.[53]

The knowledge of animal deaths caused by blue-green algae, combined with the lack of understanding of the health effects of blue-green algae among experts and authorities, created uncertainty and fear among people, which was reflected in the public discussions; blue-green algae began to be referred to as "the dreaded blue-green algae" and "mysterious poisonous algae".[54] The discovery in 1986 that more than half of the blue-green algae samples taken in Finland turned out to be toxic increased not only awareness of the impact of blue-green algae but also, simultaneously, fear of them.[55] Based on the public discussions, the fear of blue-green algae in Finland was perhaps at its peak in the late 1980s, when the new understanding and knowledge of the harmful effects of blue-green algae on humans and other animals was not yet coherent and experts were giving conflicting advice (Figure 1.2).[56]

People's growing fear of blue-green algae in the late 1980s had wide-ranging effects on how they wanted to use water bodies. The media reported that the situation was reflected, for example, in tourism and also in people's decisions to buy holiday homes on the shores of water bodies.[57] For example, a public opinion piece in 1990 demanded that a buyer of a lakeside cottage should be informed if there was blue-green algae in the lake.[58]

However, people's fear of blue-green algae abated somewhat in the 1990s and later in the 2000s, although blue-green algae populations continued to increase in Finland and, for example, the hot summer of 1997 saw the largest blue-green algae blooms in recorded history.[59] Of course, blue-green algae is still a concern for people, but they have also learned to live with cyanobacteria better than they had in the 1980s. The current relationship between humans and blue-green algae

53 "Sinilevä Iitin lehmäkuolemien aiheuttaja," *Länsi-Savo*, August 30, 1985, 9; "Sinilevä tappanut myös koiria," *Maaseudun Tulevaisuus*, September 7, 1985, 14.

54 Heikki Myyrä, "Toiveita ja epäilyksiä," *Etelä-Suomen Sanomat*, October 21, 1984, 2; Pentti J. Alho, "Salaperäiset myrkkylevät," *Suomen Kuvalehti*, October 18, 1985, 61.

55 "Myrkylliset sinilevät yleisempiä," 16.

56 "Tietämättömyys on leväkohussa pahinta," *Etelä-Suomen Sanomat*, July 26, 1987, 3.

57 See e.g. "Sinilevä mustaa Lahden matkailumainetta," *Etelä-Suomen Sanomat*, July 23, 1987, 1, 3.

58 Aukusti, "Sinilevän uhasta tiedotettava," *Länsi-Savo*, June 7, 1990, 7.

59 Lyytimäki, "Gone with the Wind?," 409.

Figure 1.2: Water bodies infested with blue-green algae began to be portrayed more visually in the press from the 1980s onwards. This photograph of blue-green algae-covered water, taken in 1987, is from the archives of the newspaper *Ylä-Karjala*. Nurmes Town Museum. Ylä-Karjala Photo Archive. Accessed May 3, 2024. https://finna.fi/Record/nurmes.knp-66160. CC BY 4.0.

is, therefore, a good example of adaptation to coexistence with a previously feared organism and the reconfiguration of intra-acting relationships.

The reduced fear of blue-green algae can also be detected from the interviews we conducted. Our interview material clearly indicates that there is no longer an apparent fear of the blue-green algae but, rather, a matter-of-fact attitude towards algal blooms. It was stated by many that they have adapted to observing water during summer and to checking the official blue-green algae reports online or from the radio[60]; it has become a commonly acknowledged fact that one can no longer swim in natural waters in late summer, a change that has been rather rapid.[61] One of our participants said, "We usually have our summer camp [scout camp; authors note] in early August, and nowadays the situation [with blue-green algae; authors note] is quite bad already by then. Really, the beach is like blue-green algae porridge, which of course means there is no way we can do any

60 Interview records, TKU/A/22/20, Humbio Interviews.

61 See, e.g., Interview records, TKU/A/22/44, 46, 69, 71, 83, Humbio Interviews.

swimming activities." In the same interview the participant reminisced about how blue-green algae had caused no such harm during his or her own childhood scout camps, also organised at the beginning of August.[62] Blue-green algae blooms have forced some people to adapt in a very practical way; one diver describes how the blue-green algae rafts in the surface of the Baltic Sea are sometimes so thick that they have to use a pioneer shovel to make a hole where to dive underwater: "One has to dive through the hole, like in winter when ice swimming. So that the visibility has been – not even bad – but pathetic. Sometimes you can even feel it. It's like diving in a pea soup."[63]

It is evident as our research participants reflect on their relationship with blue-green algae through their everyday activities, such as hobbies or livelihoods, that they form their perceptions on blue-green algae through mutual intra-action. People create views through these intra-actions on what kind of agency blue-green algae has and how it has impacted their everyday lives; this contemplation also happens from the historical perspective, and they are well aware of how much things have changed during their lifetime.

How to Eradicate or Control Blue-Green Algae and Protect People, Animals and Water Bodies?

Conscious efforts have been made to eradicate and control blue-green algae now that it is understood as both an aesthetic nuisance and an organism dangerous to humans and other animals. The first references to controlling blue-green algae in our data date back to the early 1950s, when attempts were made to eradicate the crayfish plague that was then occurring in Finland by dumping copper scrap into watercourses. The idea was based on the antibacterial properties of copper, which is why it has been used, for example, to brighten water; the objective was to destroy not only the crayfish plague but also the aesthetically unpleasing blue-green algae.[64]

The first eradication operation targeting blue-green algae specifically occurred in 1959 when blue-green algae found its way into Helsinki's tap water; it was no longer just an aesthetic problem after that but began to complicate people's daily lives. The purifying power of copper was relied upon again, with cop-

62 Interview records, TKU/A/22/44, Humbio Interviews.

63 Interview records, TKU/A/22/107, Humbio Interviews.

64 "Rapuruttoa yritetään hävittää," *Länsi-Savo*, July 22, 1953, 3; "Kupariromulla rapuruttoa vastaan," *Ilta-Sanomat*, July 20, 1954, 1.

per sulphate discharged into the River Vantaa to clean the water of blue-green algae before it reached the water treatment plant.[65] Based on our data, copper sulphate was used to control blue-green algae at least until the 1970s,[66] for example, when copper sulphate was sprayed into the lake from an aeroplane when Lake Tuusula started to become badly affected by algae blooms in 1964.[67] The public discussions in the 1950s and 1970s consisted of a few mentions of the potential to utilise blue-green algae as a fertiliser, however, this debate did not advance any further, and the blue-green algae that accumulated in water bodies were not collected; rather, people wanted to get rid of them.[68]

New means of influencing the blue-green algae-infested water bodies started to emerge in the 1960s and 1970s. Intra-action gained new levels of actors, organisations, political bodies and technologies. Water protection associations were set up, and blue-green algae control became part of the wider discussion in Finland. Sewage treatment plants were established in many places that prevented the blue-green algae from getting into tap water, while sewage was no longer discharged into water bodies as such.[69] Conservation measures helped to reduce the blue-green algae, although they did not eliminate it completely. Efforts were also made to reduce the amount of blue-green algae by changing the species distribution of fish in the lakes, with this method increasingly used from the 1980s onwards. The idea was based on the fact that cyprinids, for example, thrive in eutrophic water bodies and contribute to the presence of blue-green algae. Thus, they were fished out of the water and replaced by predatory fish.[70]

Interestingly, these different methods of combating blue-green algae show that although scientists had already pointed out that intensive agriculture was also contributing to the abundance of blue-green algae and to eutrophication in general, this was not acted upon, on the basis of public debate, until the turn of the 1980s and 1990s. For example, Heikki Järnefelt, Professor of Limnology, commented on the blue-green algae situation in the Lake Tuusula in 1961 that, "due to dense settlement and partly intensive agriculture, the lake has been eutrophicat-

65 "Homevesi johtuu sinilevästä," *Suomen Sosiaalidemokraatti*, September 1, 1959, 5.

66 "Myrkyllisiä levälauttoja," 5.

67 "Kuparisulfaattia sinilevään lentokoneesta Tuusulanjärvellä," *Uusi Suomi*, July 14, 1964, 1, 16.

68 "Sinilevät lannoittajina," *Maaseudun Tulevaisuus*, October 30, 1956, 30; "Valtameren näkymätön jättiläinen," *Uusi Suomi*, January 16, 1978, 18.

69 See, e.g., "Tuusulanjärvessä sinilevää," 28; Olavi Salmi and Kalevi Hujanen, "Vantaanjokea pelastamassa," *Apu*, May 5, 1978, 12–14. See also Katko, *Finnish Water Services*.

70 See, e.g., "Tehopyynti ja petokalojen istutus hoitavat vesistöjä," *Etelä-Suomen Sanomat*, April 11, 1987, 6.

ing at an accelerating rate in recent years."[71] However, it was only 30 years later that attention was drawn to the issue.

Some farmers were involved in conservation measures in the early 1990s, but some were also critical of being blamed for the eutrophication of water bodies.[72] The Centre Party, which advocated farmers' rights, became the prime minister's party in Finland in 1991 and were suspected of reversing a law passed the previous year to protect the banks of waterways. As a result, the new government was nicknamed the "blue-green algae government" in public discussion.[73] Our data show that the debate on the contribution of farmers and fish farmers to nutrient pollution of water bodies and thus to the presence of blue-green algae has been lively from the 1990s to the present day.[74]

All the aforementioned measures focused on reducing blue-green algae, however, this has not been the only way to respond to the increased blue-green algae in Finland. Based on our data, attempts have been made to control people and access to blue-green algae-infested waters as well as to inform people about the presence of blue-green algae.

Those measures actually only began to be implemented in Finland after the concept of blue-green algae was changed in 1984. Immediately in 1985, a swimming ban was imposed on a lake where two cows had died after drinking blue-green algae water,[75] with the use of swimming bans increasing after this, and in 1990 a newspaper article appeared about how people had to become used to the "swimming ban sign appearing in midsummer".[76] The data show that swimming bans on beaches were less common in the 1990s than in the 1980s,[77] however, swimming bans have been imposed from time to time until today due to blue-green algae.[78]

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71 "Tuusulanjärven likaantuminen huolestuttaa Helsinkiäkin," *Helsingin Sanomat*, September 13, 1961, 16.

72 See, e.g., "Karjatilojen päästöt kuriin neuvonnalla," *Maaseudun Tulevaisuus*, January 23, 1990, 5; "Ojavesien fosforista lihava riita," *Maaseudun Tulevaisuus*, March 29, 1990, 4.

73 Another reason for the name "blue-green algae government" was that the biggest parties in the government were the Centre Party and the Coalition Party, whose colours are green and blue. "Tuula Haatainen varoitti sinilevästä," *Etelä-Suomen Sanomat*, April 14, 1991, 14.

74 See, e.g., "Maatalous ei ole yksin syyllinen päästöihin," *Maaseudun Tulevaisuus*, July 29, 1997, 1, 12. See also Lyytimäki, "Gone with the Wind?," 405–406.

75 "Iitin Sääksjärvi ei ole vaatinut lisää uhreja," *Etelä-Suomen Sanomat*, August 28, 1985, 12.

76 Seppo Kaisla, "Keskinkertainen juhannus," *Uusi Suomi*, June 26, 1990, 3.

77 See, e.g., "Uimakielto uhkasi Hankoa," *Hangötidningen*, July 10, 1997, 5.

78 See, e.g., Iiro Lehtonen, "Rauman uimavedet pääsääntöisesti hyvälaatuisia," *Länsi-Suomi*, July 17, 2021, 8.

Information on blue-green algae sightings was also launched in Finland in addition to the various bans. Official surveys started as early as 1985, and a register of blue-green algae blooms was established in 1992.[79] The Finnish Environment Institute, local environment centres and the Finnish Marine Research Institute started to report on the algae situation nationally on a weekly basis after the record summer of blue-green algae in 1997.[80]

The more flexible implementation of the bans and the increase in information on blue-green algae are certainly some examples of adapting to living with blue-green algae. Adaptation was already being considered in many ways at the turn of the 1980s and 1990s, for example, by demanding more outdoor swimming pools and showers on beaches in Finland.[81] Some action has been taken, but it is clear that Finns are also more used to living now with blue-green algae than they were in the 1980s and 1990s. The public is also increasingly aware of the circumstances leading to cyanobacteria blooms; the nuisance and harm caused by the annual appearance of algal blooms was clearly indicated by our research participants, although they were generally fully aware of the circumstances leading to the increasing amount of blue-green algae. They noted that the "situation is caused by our ancestors", the past and present nutrition load and global warming.[82] It is noteworthy that although many other emerging species causing harm to humans, such as rats or wolves, are directly blamed and even hated by people, blue-green algae does not face similar types of attitudes.[83] We argue that this is largely due to people's awareness of the network of actors involved, which displaces the blame from one species and directs it more towards human actions and its consequences – nutrition load and global warming.

Conclusions

We have previously examined human intra-action with blue-green algae, human perceptions towards blue-green algae and how these perceptions have changed over time. Our research material starting from 1890 clearly shows that the trajectory of blue-green algae perceptions and attitudes begins from the mere scientific

79 "Sinilevien terveysriskit tutkitaan," *Etelä-Suomen Sanomat*, September 26, 1985, 14; "Leväkukinnoista kootaan Suomessa rekisteriä," *Etelä-Suomen Sanomat*, May 25, 1992, 7.

80 "Koleus pitänyt sinilevät poissa," *Maaseudun Tulevaisuus*, June 6, 1998, 12.

81 Nikodemus, "Miksi ei maauimaloita?" *Suomen Kuvalehti*, August 21, 1987, 67; "Mukkulan leirialue kunnostettava," *Etelä-Suomen Sanomat*, September 13, 1989, 3.

82 Interview records, TKU/A/22/21, 68, 79, 82, 87, 88, 90, Humbio Interviews.

83 See the chapters by Heta Lähdesmäki and Tracie L. Wilson in this volume.

interests of researchers and experts but are absent in the more public discussions; the intra-action was merely focusing on the rather marginal groups, like researcher and fishers, which probably reflects that the amount of blue-green algae in Finland was significantly less than its current level. Blue-green algae started to be more apparent during the first half of the twentieth century, but they were still considered rather more of a nuisance than directly harmful. The discussions of blue-green algae were mainly concentrating on the bad odour they caused or the problems with drinking water; the perception of blue-green algae as harmful and even dangerous, despite the upcoming growing interest, did not emerge – with few exceptions – until 1984 when news of dog deaths became public. A clear change of paradigm was observed then, not only among the public but also among researchers and policymakers. People started to perceive the blue-green algae as dangerous to humans, especially to children and animals.

The problems with the drinking water and the growing interest in water conservation became more present in the media from the 1960s on, and blue-green algae was clearly interpreted as an agent of change that grows and destroys water bodies by causing hypoxia. This perception started to change at the turn of the 1980s and 1990s at the same time that the public discussion – visible through media outlets – started to emphasise finding root causes for the rapidly increasing algal blooms and highlighted the role of eutrophication, mainly caused by excessive nutrition loading from agriculture. Blue-green algae still had agency in changing the ways people could practice their livelihoods or leisure time activities, but their role changed from being the scapegoat to being the symptom of human-induced environmental problems.

The emergent need to battle against the blue-green algae thus turned into an emerging need to improve water quality and protect the water bodies. This case of the blue-green algae in Finland shows that the way societal discussion is formulated has the potential to change interpretations towards species, that agencies do indeed form mutually through human and non-human intra-actions instead of preceding them. The ways in which people interpret these intra-actions impacts the ways they either deny, accept or support related environmental policies and the ways they are targeted. Therefore, understanding the development of these created relationships may help to further establish successful attitude changes towards certain species of conservation objectives.

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