

Stewardship in an urban world

Civic engagement and human–nature relations in the Anthropocene

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Abstract

Never before have humans wielded a greater ability to alter and disrupt planetary processes. Our impact is becoming so noticeable that a new geological epoch has been proposed – the Anthropocene – in which Earth systems might no longer maintain the stable and predictable conditions of the past 12 millennia. This is particularly evident in the rapid expansion of urban areas, where a majority of humans now live and where environmental changes such as rising temperatures and habitat loss are happening faster than elsewhere. In light of this, questions have been raised about what a more responsible relationship between humans and the rest of the planet might look like. Scholars in sustainability science employ the concept of ‘stewardship’ in searching for an answer; however, with multiple different applications and definitions, there is a need to better understand what stewardship is or what novelty it might add to sustainability research. This thesis investigates stewardship empirically through two case studies of civic engagement for protecting nature in cities – Bengaluru, India and New York City, USA. Further, the thesis also proposes a conceptual framework for how to understand stewardship as a relation between humans and the rest of nature, based on three dimensions: care, knowledge and agency. This investigation into stewardship in the urban context uses a social–ecological systems approach to guide the use of mixed theory and methods from social and natural sciences. The thesis is organized in five papers. **Paper I** reviews defining challenges in managing urban social–ecological systems and proposes that these can more effectively be addressed by collaborative networks where public, civic, other actors contribute unique skills and abilities. **Paper II** and **Paper III** study water resource governance in Bengaluru, a city that has become dependent on external sources while its own water bodies become degraded and depleted. **Paper II** analyzes how locally based ‘lake groups’ are able to affect change through co-management arrangements, reversing decades of centralization and neglect of lakes’ role in Bengaluru’s water supply. **Paper III** uses social–ecological network analysis to analyze how patterns in lake groups’ engagements and collaborations show better fit with ecological connectivity of lakes. **Paper IV** employs sense of place methods to explore how personal bonds to a site shapes motivation and goals in waterfront stewardship in New York City. Finally, **Paper V** reviews literature on stewardship and proposes a conceptual framework to understand and relate different uses and underlying epistemological approaches in the field. In summary, this thesis presents an empirically grounded contribution to how stewardship can be understood as a human–nature relation emergent from a deep sense of *care* and responsibility, *knowledge* and learning about how to understand social–ecological dynamics, and the *agency* and skills needed to influence these dynamics in a way that benefits a greater community of humans as others. Here, the care dimension is particularly important as an underappreciated aspect of social–ecological relations, and asset for addressing spatial and temporal misalignment between management institutions and ecosystem. This thesis shows that care for nature does not erode just because green spaces are degraded by human activities – which may be crucial for promoting stewardship in the Anthropocene.

Keywords: *agency, Bengaluru, boundary object, care, civil society, community, environmental ethics, knowledge, natural resource management, New York City, problem of fit, rigidity trap, sense of place, social–ecological system, urbanization, water governance.*

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Front cover photograph: Urbanization alongside Somasandrapalya Lake, southern Bengaluru.

Backside photograph © Amanda Peçanha Hickey.

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Till Sten-Sture Landström,
som såg fram emot detta mest
av alla,

och Cajsa Landström,
som skrivit fler
doktorsavhandlingar än någon
annan jag känner.

Tack för allt bubbel!

*You never miss your water
Till your well runs dry
Tell me, tell me
Whatcha gonna do when your well runs dry?
Whatcha gonna do when your well runs dry?
Whatcha gonna do when your well runs dry?
I'd like to know*

Peter Tosh. 1976. Till Your Well Runs Dry.
On *Legalize it* [LP]. Kingston, Jamaica: CBS Records

Abstract

Never before have humans wielded a greater ability to alter and disrupt planetary processes. Our impact is becoming so noticeable that a new geological epoch has been proposed – the Anthropocene – in which Earth systems might no longer maintain the stable and predictable conditions of the past twelve millennia. This is particularly evident in the rapid expansion of urban areas, where a majority of humans now live and where environmental changes such as rising temperatures and habitat loss are happening faster than elsewhere. In light of this, questions have been raised about what a more responsible relationship between humans and the rest of the planet might look like, and many scholars in sustainability science use the concept of ‘stewardship’ to try and find an answer. However, with multiple different uses and definitions, there is a need to better understand what stewardship is or what novelty it might add to sustainability research.

This thesis investigates stewardship empirically through two case studies of civic engagement for protecting nature in cities – in Bengaluru, India, and New York City, USA. Further, the thesis also proposes a conceptual framework for how to understand stewardship as a relation between humans and the rest of nature, based on three dimensions: care, knowledge and agency. This investigation into stewardship in the urban context uses a social–ecological systems approach to guide the use of mixed theory and methods from social and natural sciences.

The thesis is organized in five papers. **Paper I** reviews defining challenges in managing urban social–ecological systems, such as ecological fragmentation and rich layers of historical land uses, and proposes that these can more effectively be addressed by collaborative networks where public, civic, private and other actors at multiple scales contribute their unique skills and abilities.

Paper II and **Paper III** study water resource governance in Bengaluru, a city that has become dependent on external sources while its own water bodies become degraded and depleted. **Paper II** analyzes how locally based ‘lake groups’ are able to affect change through co-management arrangements with municipal partners, and implement ecosystem-based management for improved local water supply. This reverses decades of centralization and neglect of lakes’ functions and contributes a more holistic understanding of their importance for Bengaluru’s water need. **Paper III** uses social–ecological network analysis to study patterns in lake groups’ engagements and collabora-

tions. Findings demonstrate that the network of local groups matches the ecological connectivity of lakes at a landscape level better than public authorities do.

Paper IV studies different kinds of civic groups working with stewardship of water bodies and waterfronts in New York City. It employs sense of place methods to explore how personal bonds to a site shapes motivation and direction of one's involvement. Findings point to three types of stewardship engagement: work to restore a previous place, work to protect a current place and work to create an entirely new place.

Finally, **Paper V** proposes care, knowledge and agency as dimensions in a conceptual framework to understand and relate different uses and underlying epistemological approaches in stewardship. The framework is grounded in a literature review of the concept.

In summary, this thesis presents an empirically grounded contribution to how stewardship can be understood as a human–nature relation emergent from a deep sense of *care* and responsibility, *knowledge* and learning about how to understand social–ecological dynamics, and the *agency* and skills needed to influence these dynamics in a way that benefits a greater community of humans and others. Here, the care dimension is particularly important as an underappreciated aspect of social–ecological relations, and an asset for addressing spatial and temporal misalignment between management institutions and ecosystem. This thesis shows that care for nature does not erode just because green spaces are degraded by human activities – which may be crucial for promoting stewardship in the Anthropocene.

Keywords

Agency, Bengaluru, boundary object, care, civil society, community, environmental ethics, knowledge, natural resource management, New York City, problem of fit, rigidity trap, sense of place, social–ecological system, urbanization, water governance

Sammanfattning

Aldrig tidigare har människan haft en större förmåga att ändra och störa planetära processer. Vår inverkan är så märkbar att en ny geologisk epok har föreslagits – Antropocen – där de förhållanden som rått på jorden under de senaste tolv årtusendena inte längre kan tas för givna. Detta är särskilt tydligt då de flesta människor nu bor i städer, vilka täcker större och större landområden och ofta uppvisar snabbare miljöförändringar än andra landskapstyper (till exempel stigande temperaturer, habitatförlust för arter). I och med detta börjar allt fler fråga sig hur en mer ansvarsfull relation mellan människan och resten av planeten skulle kunna se ut, och många hållbarhetsforskare använder begreppet 'stewardship' för att försöka hitta ett svar¹. Stewardship handlar om en ansvarsfull användning och förvaltning av naturen, men är ett mångbottnat begrepp som används i en rad olika sammanhang. Eftersom en tydlig definition saknas (även på engelska) finns det ett behov av att ta reda på vad det egentligen innebär och på vilket sätt det kan bidra med något nytt till vetenskap om hållbar utveckling.

Denna avhandling undersöker stewardship empiriskt, genom två fallstudier av civilt engagemang för naturskydd i Bengaluru (Indien) och New York (USA). Vidare presenteras ett nytt teoretiskt ramverk som beskriver stewardship som en sorts relation mellan människan och resten av naturen, en relation bestående av tre delar: omsorg, kunskap och påverkan. Avhandlingen tar sin utgångspunkt i ett social-ekologiskt synsätt där samhälle och natur studeras som sammanvävda och samberoende, och använder teori och metod från både natur- och samhällsvetenskap.

Avhandlingen består av fem artiklar. Artikel I ger en översikt över de utmaningar som miljövard behöver hantera i urbana social-ekologiska system, såsom ekologisk fragmentering och blandade lager av historisk markanvändning. Den argumenterar för att många av dessa kan mötas bättre i nätverk där offentliga, civila och andra aktörer på olika nivåer samverkar och därmed kan bidra med sina respektive förmågor och kunskaper.

Artikel II och Artikel III studerar vattenresursförvaltning i Bengaluru, en stad som kommit att bli beroende av externa källor efter att lokala sjöar och dammar förorenats och förstörts. Artikel II analyserar den påverkan som lokala boenden får genom att bilda 'sjögrupper' och samarbeta med kommunala

¹ I svenskan översätts både 'stewardship' och 'management' generellt till förvaltning, men engelskan associerar det förra ofta till ett mer ansvarsfullt eller omvårdande angreppssätt – ibland kan svenskans 'miljövard' vara en bättre översättning av stewardship.

aktörer i syfte att driva igenom ekosystembaserad sjöförvaltning för att förbättra lokal vattenförsörjning. Detta har börjat vända trender som under årtionden lett mot ökad centralisering och försummelse av sjöarnas funktion; grupperna bidrar istället till en mer holistisk förståelse för sjöarnas betydelse för Bengalurus vattenbehov. Artikel III använder social-ekologisk nätverksanalys för att studera mönster i hur sjögrupper samarbetar. Resultaten visar att de utgör ett nätverk som är bättre på att ta hänsyn till de ekologiska kopplingar som finns mellan sjöar än vad den offentliga förvaltningen är.

Artikel IV studerar olika sorters grupper i New Yorks civilsamhälle som arbetar för stewardship av strandnära och akvatiska naturområden i staden. Studien använder metoder för att studera gruppmedlemmars 'platskänsla', det vill säga hur personlig anknytning till en plats bidrar till motivation och hur den kan hjälpa oss förstå vad medlemmar vill uppnå med sitt deltagande i sådana grupper. Studien identifierar tre olika sorters målsättningar i stewardshiparbete: att återställa en tidigare plats, att beskydda en nuvarande plats, och att skapa en helt ny plats.

I Artikel V används begreppen omsorg, kunskap och påverkan i ett konceptuellt ramverk; dels för att ge en översikt på existerande litteratur om stewardship, dels för att förstå hur olika sätt att använda begreppet relaterar till varandra.

Sammanfattningsvis bidrar den här avhandlingen med empiriskt grundade insikter om hur stewardship kan förstås som en relation mellan människa och natur; en relation som uppstår ur ett samspel mellan en känsla av *omsorg* och ansvar för sin omvärld, *kunskap* och lärande om hur social-ekologisk dynamik kan förstås, samt *påverkan* och förmåga att påverka denna dynamik på ett sätt som gagnar människa och miljö. Av dessa tre aspekter av stewardship så är omsorg relativt underförstådd inom hållbarhetsforskning – men den spelar en viktig roll i att förbättra samspelet mellan sociala och ekologiska processer och bättre anpassa miljöförvaltning till lokala förhållanden. Avhandlingen åskådliggör att människor även visar omsorg för naturen i miljöer där den är starkt hotad av förstörelse – vilket vi sannolikt kommer behöva alltmer av i framtidens Antropocen.

Nyckelord

Anpassningsförmåga, civilsamhälle, Bengaluru, påverkan, kunskap, miljöetik, naturresurshushållning, New York, omsorg, platskänsla, samverkan, social-ekologiska system, urbanisering, vattenförvaltning

ಸಾರಾಂಶ

ಭೂಮಿಯ ಪ್ರಕ್ರಿಯೆಗಳನ್ನು ಮಾರ್ಪಡಿಸುವ ಮತ್ತು ಅಡ್ಡಿಪಡಿಸುವ ಹೆಚ್ಚಿನ ಸಾಮರ್ಥ್ಯವನ್ನು ಮಾನವರು ಹೊಂದಿರಲಿಲ್ಲ. ನಮ್ಮ ಪ್ರಭಾವವು ಒಂದು ಹೊಸ ಭೌಗೋಳಿಕ ಯುಗವನ್ನು ಪ್ರಸ್ತಾಪಿಸಲಾಗಿದೆ ಎಂದು ಗುರುತಿಸಲ್ಪಡುತ್ತಿದೆ - ಆಂಥ್ರೋಪೀನ್ - ಇದರಲ್ಲಿ ಭೂಮಿಯ ವ್ಯವಸ್ಥೆಗಳು ಕಳೆದ ಹನ್ನೆರಡು ಮಿಲಿಯನ್ಗಳ ಸ್ಥಿರ ಮತ್ತು ಉಹಿಸಬಹುದಾದ ಪರಿಸ್ಥಿತಿಗಳನ್ನು ಇನ್ನು ಮುಂದೆ ನಿರ್ವಹಿಸುವುದಿಲ್ಲ. ಇದು ಬಹುಪಾಲು ಮಾನವರು ಈಗ ವಾಸಿಸುವ ನಗರ ಪ್ರದೇಶಗಳ ತ್ವರಿತ ವಿಸ್ತರಣೆಯಲ್ಲಿ ವಿಶೇಷವಾಗಿ ಸ್ಪಷ್ಟವಾಗಿ ಕಂಡುಬರುತ್ತದೆ. ಈ ಪರಿಸ್ಥಿತಿಯಲ್ಲಿ, ಭೂಮಿಯ ಉಳಿದ ಭಾಗಗಳೊಂದಿಗೆ ಹೆಚ್ಚು ಜವಾಬ್ದಾರಿಯುತ ಸಂಬಂಧವು ಹೇಗೆ ಕಾಣುತ್ತದೆ ಎಂಬುದರ ಬಗ್ಗೆ ಪ್ರಶ್ನೆಗಳನ್ನು ಸಂಗ್ರಹಿಸಲಾಗಿದೆ ಮತ್ತು ಸಮರ್ಥನೀಯ ವಿಜ್ಞಾನದಲ್ಲಿ ಅನೇಕ ವಿದ್ವಾಂಸರು ಉತ್ತರವನ್ನು ಪ್ರಯತ್ನಿಸಿ ಮತ್ತು ಗುರುತಿಸಲು 'ಉಸ್ತುವಾರಿ' ಎಂಬ ಪರಿಕಲ್ಪನೆಯನ್ನು ಬಳಸುತ್ತಾರೆ. ಆದಾಗ್ಯೂ, ಅನೇಕ ವಿಭಿನ್ನ ಉಪಯೋಗಗಳು ಮತ್ತು ವ್ಯಾಖ್ಯಾನಗಳೊಂದಿಗೆ, ಉಸ್ತುವಾರಿತ್ವವು ಯಾವುದು ಎಂಬುದನ್ನು ಚೆನ್ನಾಗಿ ಅರ್ಥಮಾಡಿಕೊಳ್ಳುವುದು ಅಗತ್ಯವಾಗಿದೆ ಅಥವಾ ಸಂರಕ್ಷಣೆ ಸಂಶೋಧನೆಗೆ ಯಾವ ಹೊಸತನವನ್ನು ಸೇರಿಸಿಕೊಳ್ಳಬಹುದು. ಬೆಂಗಳೂರು, ಭಾರತ ಮತ್ತು ನ್ಯೂಯಾರ್ಕ್ ನಗರ, ಯು.ಎಸ್.ಎ.ಗಳಲ್ಲಿನ ಪ್ರಕೃತಿಯನ್ನು ರಕ್ಷಿಸುವ ನಾಗರಿಕ ನಿಶ್ಚಿತಾರ್ಥದ ಎರಡು ಅಧ್ಯಯನಗಳ ಮೂಲಕ ಈ ಸಿದ್ಧಾಂತವು ಪ್ರಾಯೋಗಿಕವಾಗಿ ತನಿಖೆ ನಡೆಸುತ್ತದೆ. ನಗರ ಪ್ರದೇಶಗಳು ಈಗಾಗಲೇ ಹೆಚ್ಚಿನ ತಾಪಮಾನ ಮತ್ತು ಆವಾಸಸ್ಥಾನದ ನಷ್ಟದಂತಹ ಭವಿಷ್ಯದಲ್ಲಿ ನಿರೀಕ್ಷಿತ ಹಲವಾರು ಪರಿಸರ ಲಕ್ಷಣಗಳನ್ನು ಪ್ರದರ್ಶಿಸುತ್ತವೆ. ಇದಲ್ಲದೆ, ಮಾನವರು ಮತ್ತು ಪ್ರಕೃತಿಯ ನಡುವಿನ ಸಂಬಂಧವಾಗಿ ಪರಿಚಾರಕತ್ವವನ್ನು ಅರ್ಥಮಾಡಿಕೊಳ್ಳುವುದು ಹೇಗೆ ಎಂಬ ಪರಿಕಲ್ಪನಾ ಚೌಕಟ್ಟನ್ನು ಪ್ರಮೇಯವು ಪ್ರಸ್ತಾಪಿಸುತ್ತದೆ, ಮೂರು ಆಯಾಮಗಳ ಆಧಾರದ ಮೇಲೆ: ಆರೈಕೆ, ಜ್ಞಾನ ಮತ್ತು ಸಂಸ್ಥೆ. ನಗರದ ಸನ್ನಿವೇಶದಲ್ಲಿ ಉಸ್ತುವಾರಿ ಬಗ್ಗೆ ತನಿಖೆ ಸಾಮಾಜಿಕ ಮತ್ತು ನೈಸರ್ಗಿಕ ವಿಜ್ಞಾನಗಳಿಂದ ಮಿಶ್ರ ಸಿದ್ಧಾಂತ ಮತ್ತು ವಿಧಾನಗಳನ್ನು ಬಳಸಿಕೊಳ್ಳುವಲ್ಲಿ ಸಾಮಾಜಿಕ-ಪರಿಸರ ವಿಜ್ಞಾನದ ವಿಧಾನಗಳನ್ನು ಬಳಸುತ್ತದೆ. ಈ ಪ್ರಬಂಧವನ್ನು ಐದು ಪೇಪರ್‌ಗಳಲ್ಲಿ ಆಯೋಜಿಸಲಾಗಿದೆ. ಪರಿಸರ ವಿಜ್ಞಾನದ ವಿಘಟನೆ ಮತ್ತು ಐತಿಹಾಸಿಕ ಭೂ ಬಳಕೆಗಳ ಶ್ರೀಮಂತ ಪದರಗಳಂತಹ ನಗರ ಸಾಮಾಜಿಕ-ಪರಿಸರ ವ್ಯವಸ್ಥೆಗಳನ್ನು ನಿರ್ವಹಿಸುವಲ್ಲಿನ ಸವಾಲುಗಳನ್ನು ವ್ಯಾಖ್ಯಾನಿಸುವ ಪೇಪರ್ I ವಿಮರ್ಶೆ ಮಾಡಿದೆ ಮತ್ತು ಸಾರ್ವಜನಿಕ, ನಾಗರಿಕ, ಖಾಸಗಿ ಮತ್ತು ಇತರ ಮಾಪಕಗಳಲ್ಲಿ ಬಹು ಮಾಪಕಗಳಲ್ಲಿ ಸಹಕಾರಿ ಜಾಲಗಳ ಮೂಲಕ ಇದನ್ನು ಪರಿಣಾಮಕಾರಿಯಾಗಿ ಪರಿಹರಿಸಬಹುದು ಎಂದು ಪ್ರಸ್ತಾಪಿಸಿದೆ. ಪೇಪರ್ II ಮತ್ತು ಪೇಪರ್ III ಅಧ್ಯಯನ ಬೆಂಗಳೂರಿನ ಜಲ ಸಂಪನ್ಮೂಲ ಆಡಳಿತ ಮೂಲಗಳ ಮೇಲೆ ಅವಲಂಬಿತವಾಗಿದ್ದು, ಪೇಪರ್ II ಹೇಗೆ ಸ್ಥಳೀಯವಾಗಿ ಆಧಾರಿತ 'ಕೆರೆ ಗುಂಪುಗಳು' ಪುರಸಭೆಯ ಪಾಲುದಾರರೊಂದಿಗೆ ಸಹ-ನಿರ್ವಹಣೆ ವ್ಯವಸ್ಥೆಗಳ ಮೂಲಕ ಬದಲಾವಣೆಗೆ ಪರಿಣಾಮ ಬೀರುತ್ತವೆ ಮತ್ತು ಸುಧಾರಿತ ನೀರಿನ ಪೂರೈಕೆಗಾಗಿ ಪರಿಸರ-ಆಧಾರಿತ ನಿರ್ವಹಣೆಯನ್ನು ಕಾರ್ಯಗತಗೊಳಿಸುತ್ತದೆ ಎಂಬುದನ್ನು ವಿಶ್ಲೇಷಿಸುತ್ತದೆ. ಇದು ದಶಕಗಳ ವಿಕೇಂದ್ರೀಕರಣ ಮತ್ತು ಕೆರೆಗಳ ಕಾರ್ಯಚಟುವಟಿಕೆಗಳ ನಿರ್ಲಕ್ಷ್ಯವನ್ನು ಹಿಮ್ಮೆಟ್ಟಿಸುತ್ತದೆ ಮತ್ತು ಬೆಂಗಳೂರಿನ ನೀರಿನ ಪೂರೈಕೆಯಲ್ಲಿ ಅವರ ಪಾತ್ರವನ್ನು ಹೆಚ್ಚು ಸಮಗ್ರವಾಗಿ ಅಧ್ಯಯನಿಸಿಕೊಳ್ಳುತ್ತದೆ. ಪೇಪರ್ III ಸಾಮಾಜಿಕ ಪರಿಸರ ವಿಜ್ಞಾನದ ವಿಶ್ಲೇಷಣೆಯನ್ನು ಕೆರೆ ಗುಂಪುಗಳು ಹೇಗೆ ತೊಡಗಿಸಿಕೊಂಡಿವೆ ಎಂಬುದರ ಕುರಿತು

ವಿಶ್ಲೇಷಣೆ ಮಾಡಲು ಬಳಸುತ್ತದೆ, ಮತ್ತು ಇದು ಪ್ರತ್ಯೇಕ ಪ್ರದೇಶಗಳಾಗಿ ನಿರ್ವಹಿಸುವ ಸಾರ್ವಜನಿಕ ಅಧಿಕಾರಿಗಳಿಗೆ ಹೋಲಿಸಿದರೆ, ಭೂದೃಶ್ಯ ಮಟ್ಟದಲ್ಲಿ ಕೆರೆಗಳ ಪರಿಸರ ಸಂಪರ್ಕಕ್ಕೆ ಇದು ಉತ್ತಮ ಅಳವಡಿಕೆಯಾಗಿದೆ ಎಂಬುದನ್ನು ತೋರಿಸುತ್ತದೆ. ಪೇಪರ್ IV ಅಧ್ಯಯನವು ವಿವಿಧ ರೀತಿಯ ನಾಗರಿಕ ಗುಂಪುಗಳನ್ನು ನ್ಯೂಯಾರ್ಕ್ ನಗರದಲ್ಲಿನ ಜಲಪ್ರದೇಶ ಮತ್ತು ವಾಟರ್‌ಪ್ಲಾಟ್‌ಗಳ ಮೇಲ್ವಿಚಾರಣೆಗೆ ಕೆಲಸ ಮಾಡುತ್ತದೆ. ಸೈಟ್ ವೈಯಕ್ತಿಕ ಬಂಧಗಳು ಪ್ರೇರಣೆ ಮತ್ತು ಫಲಿತಾಂಶಗಳನ್ನು ಹೇಗೆ ಆಕಾರಗೊಳಿಸುತ್ತದೆ ಎಂಬುದನ್ನು ಅನ್ವೇಷಿಸಲು ಸ್ಥಳದ ವಿಧಾನಗಳ ಅರ್ಥವನ್ನು ಇದು ಬಳಸಿಕೊಳ್ಳುತ್ತದೆ. ಸಂಶೋಧನೆಗಳು ಮೂರು ರೀತಿಯ ಉಸ್ತುವಾರಿ ನಿಶ್ಚಿತಾರ್ಥವನ್ನು ಸೂಚಿಸುತ್ತವೆ: ಹಿಂದಿನ ಸ್ಥಳವನ್ನು ಪುನಃಸ್ಥಾಪಿಸಲು ಕೆಲಸ, ಪ್ರಸ್ತುತ ಸ್ಥಳವನ್ನು ರಕ್ಷಿಸಲು ಕೆಲಸ ಮತ್ತು ಸಂಪೂರ್ಣ ಹೊಸ ಸ್ಥಳವನ್ನು ರಚಿಸಲು ಕೆಲಸ. ಅಂತಿಮವಾಗಿ, ಪೇಪರ್ V ರ ಮಂಡನೆ, ಜ್ಞಾನ ಮತ್ತು ಏಜೆನ್ಸಿಗಳನ್ನು ಪರಿಕಲ್ಪನಾ ಚೌಕಟ್ಟಿನಲ್ಲಿ ಆಯಾಮಗಳಂತೆ ಪ್ರಸ್ತಾಪಿಸುತ್ತದೆ ಮತ್ತು ವಿಭಿನ್ನ ಉಪಯೋಗಗಳನ್ನು ಮತ್ತು ಉಸ್ತುವಾರಿತ್ವದಲ್ಲಿ ಆಧಾರವಾಗಿರುವ ಜ್ಞಾನಗ್ರಹಣ ವಿಧಾನಗಳನ್ನು ಅರ್ಥಮಾಡಿಕೊಳ್ಳಲು ಮತ್ತು ಸಾಹಿತ್ಯ ವಿಮರ್ಶೆಯಲ್ಲಿ ಚೌಕಟ್ಟನ್ನು ಆಧರಿಸುತ್ತದೆ.

ಸಂಕ್ಷಿಪ್ತವಾಗಿ ಹೇಳುವುದಾದರೆ, ಮಾನವ-ಪ್ರಕೃತಿ ಸಂಬಂಧವು ಕಾಳಜಿ ಮತ್ತು ಜವಾಬ್ದಾರಿ, ಜ್ಞಾನ ಮತ್ತು ಸಾಮಾಜಿಕ-ಪರಿಸರ ವಿಜ್ಞಾನದ ಚಲನಶಾಸ್ತ್ರವನ್ನು ಅರ್ಥಮಾಡಿಕೊಳ್ಳುವುದು ಹೇಗೆ ಎಂದು ತಿಳಿದುಕೊಳ್ಳುವುದು, ಮತ್ತು ಅಗತ್ಯವಿರುವ ಏಜೆನ್ಸಿ ಮತ್ತು ಕೌಶಲ್ಯಗಳಿಂದ ತಿಳಿದುಬಂದಿದೆ ಎಂದು ಉಸ್ತುವಾರಿಗಳನ್ನು ಹೇಗೆ ಅರ್ಥೈಸಿಕೊಳ್ಳಬೇಕೆಂಬುದನ್ನು ಹೇಳುವುದಾದರೆ, ಮಾನವರು ಹೆಚ್ಚಿನ ಸಮುದಾಯವನ್ನು ಇತರರಂತೆ ಪ್ರಯೋಜನ ಮಾಡುವ ರೀತಿಯಲ್ಲಿ ಪ್ರಬವಿಸಬಕನ್ನು ಕಂಡುಬರುತ್ತದೆ. ಇಲ್ಲಿ, ಕಾಳಜಿ ಆಯಾಮ ಸಾಮಾಜಿಕ-ಪರಿಸರ ಸಂಬಂಧಗಳ ಅಸಮರ್ಪಕ ಅಂಶವಾಗಿದೆ ಮತ್ತು ನಿರ್ವಹಣೆ ಸಂಸ್ಥೆಗಳು ಮತ್ತು ಪರಿಸರ ವ್ಯವಸ್ಥೆಗಳ ನಡುವಿನ ಪ್ರಾದೇಶಿಕ ಮತ್ತು ತಾತ್ಕಾಲಿಕ ತಪ್ಪುನಿರ್ಣಯವನ್ನು ಉದ್ದೇಶಿಸಿರುವ ಆಸ್ತಿಯಾಗಿದೆ. ಪ್ರಕೃತಿಯು ಕಾಳಜಿಯು ಮಾನವ ಚಟುವಟಿಕೆಯಿಂದ ಕೆಳಮಟ್ಟಕ್ಕೆ ಇಳಿಯುತ್ತದೆ ಎಕೆಂದರೆ ಆಂಥ್ರಾಪೊಸೀನ್‌ನಲ್ಲಿ ಉಸ್ತುವಾರಿಯನ್ನು ಉತ್ತೇಜಿಸಲು ನಿರ್ಣಾಯಕವಾಗಬಹುದು ಎಂದು ಈ ಸಿದ್ಧಾಂತವು ತೋರಿಸುತ್ತದೆ.

ಪ್ರಮುಖ ಶಬ್ದಗಳು

ಏಜೆನ್ಸಿ, ಬೆಂಗಳೂರು, ಗಡಿ ವಸ್ತು, ಆರೈಕೆ, ನಾಗರಿಕ ಸಮಾಜ, ಸಮುದಾಯ, ಪರಿಸರ ನೈತಿಕತೆ, ಜ್ಞಾನ, ನೈಸರ್ಗಿಕ ಸಂಪನ್ಮೂಲ ನಿರ್ವಹಣೆ, ನ್ಯೂಯಾರ್ಕ್ ನಗರ, ಯೋಗ್ಯತೆಯ ಸಮಸ್ಯೆ, ಬಿಗಿತದ ಬಲೆ, ಸ್ಥಳದ ಅರ್ಥ, ಸಾಮಾಜಿಕ ಪರಿಸರ ವ್ಯವಸ್ಥೆ, ನಗರೀಕರಣ, ನೀರಿನ ಆಡಳಿತ.

List of papers

This thesis consists of the following appended papers, which are referred to in the text by their Roman numerals.

Paper I

Andersson, E., J. Enqvist, M. Tengö. 2017. Stewardship in urban landscapes. Published in C. Bieling and T. Plieninger, editors. *The Science and Practice of Landscape Stewardship*. Cambridge University Press, Cambridge, UK.

Paper II

Enqvist, J., M. Tengö, W. J. Boonstra. 2016. Against the current: Rewiring rigidity trap dynamics in urban water governance through civic engagement. *Sustainability Science* 11(6):919-933

Paper III

Enqvist, J., M. Tengö, Ö. Bodin. Enhancing social–ecological fit from the bottom up: Urban lake networks and grassroots innovation. (Manuscript)

Paper IV

Enqvist, J., L.K. Campbell, R.C. Stedman, E.S. Svendsen. Pathways to environmental stewardship: Sense of place and civic engagement for urban waterfronts. (Manuscript)

Paper V

Enqvist, J., S. West, J.L. Haider, V.A. Masterson, U. Svedin, M. Tengö. Stewardship as a boundary object for sustainability research in the Anthropocene: Linking care, knowledge and agency. (Manuscript submitted to *Global Environmental Change*)

My contribution to papers

Paper I was developed jointly by the authors; I contributed one of the two case studies and shared most of the writing with the first author. I had the original idea for **Paper II**, I collected and analyzed the empirical data and led the writing process. The idea for **Paper III** was developed jointly by the authors; I conducted the network analysis with the third author, and led the writing process. For **Paper IV**, the idea and data collection was designed

jointly by the authors. I led the data collection, analysis and writing. The idea for **Paper V** was developed jointly by all co-authors. I planned the literature review together with the second author, who executed the review; I led the writing of the paper.

Publications outside this thesis

Paper A*. Enqvist, J., M. Tengö, Ö. Bodin. 2014. Citizen networks in the Garden City: protecting urban ecosystems in rapid urbanization. *Landscape and Urban Planning* 130:24-35

Paper B. Masterson, V.A, R.C. Stedman, J. Enqvist, M. Tengö, M. Giusti, D. Wahl, U. Svedin. 2017. The contribution of sense of place to social-ecological systems research: a review and research agenda. *Ecology and Society* 22(1):49

Paper C. Murphy, A., M. Tengö, J. Enqvist. Making Space in a Megacity: The Evolving Stewardship of Bengaluru's Urban Lakes. (Manuscript)

* This paper is based on my master's thesis "Environmental Activism in India's Garden City: The Role of Civil Society Networks for Governance of Urban Social-Ecological Systems in the Global South" (2012).

Abbreviations used in this thesis

BBMP	<i>Bruhat Bengaluru Mahanagara Palike</i> (Greater Bengaluru Municipal Corporation)
BDA	Bangalore Development Authority
BWSSB	Bangalore Water Supply & Sewerage Board
CSO	Combined Sewer Overflow
DEP	Department of Environmental Protection (of New York City)
HEP	New York–New Jersey Harbor Estuary Program
KFD	Karnataka Forest Department
LDA	Lake Development Authority (of the Government of Karnataka)
MLD	Million liters per day
MOU	Memorandum of understanding
NGO	Non-governmental organization
NYC	New York City (alternatively, City of New York)
PPP	Public–private partnership
SBLT	Save Bangalore Lakes Trust
SES	Social–ecological system
U.S.	United States
USFS	United States Forest Service

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Ils doivent envisager qu'une grande responsabilité est la suite inséparable d'un grand pouvoir.

French National Convention
(3rd government of the French Revolution), May 8, 1793

Or, in Swedish:

Den som är väldigt stark måste också vara väldigt snäll.

Astrid Lindgren. 1947. *Känner du Pippi Långstrump?*. Rabén & Sjögren

And English:

With great power there must also come – great responsibility.

Stan Lee. 1962. *Spider-Man*. Amazing Fantasy #15. Marvel Comics.

1. Introduction

Never before have humans wielded a greater ability to alter and disrupt planetary processes. The suggested designation of a new geological epoch, the Anthropocene, is supported by evidence of unprecedented increases in the impact humans have on natural systems (Crutzen 2002, Steffen et al. 2015). The forces now at the hands of humanity threaten processes at a planetary scale (Rockström et al. 2009) and have fueled discussions about what a responsible relationship to the natural world might look like. In sustainability science, there is growing attention to the concept of ‘stewardship’ as an umbrella term for actions to prevent and reverse environmental degradation, especially in the face of the unknown conditions of the Anthropocene (Chapin et al. 2010, Steffen et al. 2011, Folke et al. 2016). Stewardship has a long and broad usage (Welchman 2012; **Paper V**); its environmental associations are often traced to Aldo Leopold’s (1949) seminal work on a ‘Land Ethic’, and it has subsequently often come to signify community involvement in managing public spaces in general and greenery in particular. But what can the idea of stewardship contribute with when the task is not to care for a patch of land but the planet as a whole; when the stakes are not the loss of individual species but of the planet’s capacity to support life as we know it?

For the foreseeable future, life as most humans know it will be urban. Cities – as highly modified landscapes, teleconnected hubs of an increasingly globalized economy, and with generally greater wealth fueling higher resource consumption – embody several defining features of the Anthropocene (Grimm et al. 2008, Elmqvist et al. 2013a, Steffen et al. 2015). They are therefore sometimes used as proxies to study what environmental conditions will define the planet in coming decades (Groffman et al. 2016). Ongoing and projected urban expansion is already a sustainability challenge at a planetary scale, threatening freshwater reserves (McDonald et al. 2014), agricultural lands (Bren d’Amour et al. 2016), biodiversity hotspots as well as global carbon pools (Seto et al. 2012). The growing majority of people living in cities thus face environmental conditions that as are expected to grow increasingly common globally if current trends continue (Pickett et al. 2011), including “elevated temperatures, atmospheric CO₂ levels, nitrogen (N) deposition and pollutants (for example, ozone, heavy metals), dramatically altered water balances, invasive species introductions, and rapid timescales of transition” (Groffman et al. 2016, page 39). Urban life typically also implies increasingly limited exposure to natural environments and connection to nature, reducing likelihoods of people engaging in pro-environmental behaviors (Nisbet et al. 2009, Beatley

and Newman 2013, Restall and Conrad 2015). Despite or perhaps because of these conditions, there is a rich literature on civic engagement in urban environmental stewardship (Conrad and Hilchey 2011, Romolini 2013, Andersson et al. 2014b, Krasny and Tidball 2015, Svendsen et al. 2016). As I will demonstrate, the urban setting provides an important arena for studying not only future environmental challenges – but also more responsible ways to relate to nature in the Anthropocene, including how they emerge, can be nurtured, and how they might contribute to sustainability.

The aim of this thesis is two-fold: to make a contribution to our understanding of stewardship by proposing a conceptual framework, and to explore the relevance of this framework through empirical studies of civic engagement in urban environmental stewardship. I view stewardship as something more than specific actions, moral norms or approaches to management; I engage stewardship as a type of relation between humans and the rest of nature. Based on the empirical and conceptual work that I present in this thesis, I propose the following definition of this relationship:

Stewardship is the responsible use and management of ecosystems and their natural resources, emergent from (a) personal and societal values and norms of care, (b) learning and knowledge about human–ecosystem interdependencies, and (c) capacity and agency to accountably influence these dependencies for the long-term benefit of both oneself, others and the system itself.

The three dimensions (a-c) presented in this definition are chosen based on their combined ability to capture a wide set of notions of what stewardship *is*. This is analytically distinct from, but still relevant for what stewardship can *do* – i.e. what we can expect from it. This is demonstrated in the three case studies of this thesis, where I study how civic groups’ motivation might shape what goals they work toward, how they may contribute to more ecologically sound management, and their ability to affect and catalyze change. Common for all these studies is an emphasis on understanding stewardship by focusing on the relation between humans and nature, as opposed to either of the two in isolation (Bodin and Crona 2009, Jackson and Palmer 2015, Chan et al. 2016, Pascual et al. 2017). This is also rooted more generally in the emerging academic tradition of social–ecological systems (SES) research, which emphasizes the interdependencies and complexity of human–nature dynamics (Berkes and Folke 1998, Berkes et al. 2000, see also Fischer et al. 2015). There are also links to urban ecology, where a critical future challenge has been identified as “refining [our] understanding of humans as components of ecosystems to create a deeper and more useful understanding of human–environment interactions” (Groffman et al. 2016, page 39).

1.1. Scope of thesis

This thesis contributes empirical, methodological and theoretical insights on these human–environment interactions and how they can be studied. First, my case-based research contributes to scholarship on how civic groups and actors exert agency and influence management of urban ecosystems. SES research has described the importance of individuals, collectives and networked actors for environmental stewardship (e.g. Westley 2002, Ernstson et al. 2010, Ostrom 2010, Boonstra et al. 2016). Here, I demonstrate how civic groups can influence social–ecological dynamics in rigidity traps (*sensu* Scheffer and Westley 2007, see also Carpenter and Brock 2008), and inspire and support broader public engagement around new visions for the role of urban ecosystems.

The second area where my case studies contribute is fairly well-researched in SES literature: it focuses on the need for knowledge and understanding of local conditions and cross-scale processes (Folke et al. 1998, Olsson and Folke 2001, Berkes et al. 2003). This research field increasingly acknowledges a broader idea of what forms of knowing is relevant, including e.g. practitioner-based or indigenous knowledge (Barthel et al. 2010, Cornell et al. 2013, Tengö et al. 2017). Here, my most important insights stem from a novel application of social–ecological network analysis to generate a deeper understanding how citizen-led bottom-up approaches improve the social–ecological fit (*sensu* Folke et al. 1998, 2007) between management institutions and ecosystem connectivity – including identification of specific roles in promoting the spread and evolution of ecologically adapted management collaborations.

The third contribution of my empirical studies concerns a more elusive aspect of stewardship: how individual and collectively held values and emotions shape our relation to nature, and our motivation to act for its preservation. This is perhaps where the idea of stewardship-as-a-relation is most relevant, since the relational focus helps us understand how the notion of care can be an expression of identity, of feeling connected to the non-human world (Chan et al. 2016). It is also important given an increasingly urban future, where opportunities to form such connections may be scarcer (Beatley and Newman 2013). Strengthening emotional and cognitive bonds to nature have been argued to be crucial for reaching stewardship at a planetary scale (Folke et al. 2011, Chapin and Knapp 2015), but the tools and conceptual understanding of how to study this still needs development (**Paper B**). To forward this research agenda, I use sense of place theory and methods (Tuan 1974, Stedman 2002) to demonstrate how people–place relations can create a variety of different pathways to stewardship, as well as different objectives for those involved in it.

Combining these empirical and methodological contributions with explorations of what stewardship might mean in literature in general – and in the context of urban landscapes in particular – this thesis also makes three im-

portant higher order contributions. First, I strengthen the case for understanding *care*, including emotions, ethical norms, attachment and responsibility, as a dimension of stewardship. I do this by linking the care dimension specifically to the practical role that local residents can play in urban environmental stewardship – and, importantly, by studying it not simply as an independent variable that drives motivation, but as an integral part of the human–nature dynamics that shape the system and stewardship. Second, I present a new theoretical framework for how to understand and research stewardship (particularly in urban areas), a framework that relates the *care* aspect to already well integrated *knowledge* and *agency* dimensions of stewardship. Third, I show how focusing on civic engagement is particularly useful for understanding stewardship as a relation. Problems of spatial and temporal fit in SES (studied here through network analysis and as social–ecological trap dynamics, respectively) are, at their core, about dysfunctional interactions between natural systems and environmental governance. By exploring the role of civic groups as embedded stakeholders in these systems, I draw attention to these interactions and how stewardship can contribute to a more sustainable relation.

Importantly, this thesis neither sets out to conclusively prove that stewardship consist of these three dimensions; nor do my case studies describe everything there is to know about either of them. Rather, my objective is to use empirical cases to illustrate how care, knowledge and agency can be applied to emphasize specific issues, analyze their relevance, and discuss how they interact to jointly shape stewardship outcomes. As the case studies also inform how I develop the framework, the comparative aspect of having two different case studies also helps inform stewardship at a more conceptual level.

With this aim and focus, there are also important issues related to environmental stewardship that I do *not* study. This includes a thorough comparison between civic engagement in stewardship and more formal governance institutions and processes, such as the politics and power at play in policy-making, legislation, planning and higher-level organization of management schemes; this is beyond the scope of my aim. Further, while I point to agency and capacity to influence outcomes, as well as the co-existence of different relations to place, I do not explicitly study the conflicts of interest or power struggles that stewardship engagement often entail. Here, my contribution lies in demonstrating how values and preferences held by individuals and groups can be studied in relation to these actors' ability to affect change.

1.2. Research questions and approach

As mentioned above, this thesis has a two-fold aim: to investigate stewardship through empirical studies of civic engagements with urban ecosystems, and to contribute a conceptual structure for how to understand different aspects of stewardship.

The empirical part of this aim is guided by three core research questions:

- RQ1. **What influence can civic engagement in stewardship have on environmental management?** This question explores the agency of civic action, its ability to affect change and the mechanisms through which it does so.
- RQ2. **How can it improve understanding of and adaptation to SES dynamics?** This focuses on how civic engagement can contribute knowledge and learning about local conditions and social–ecological processes.
- RQ3. **Why does stewardship engagement emerge and how is it shaped by people’s relation to place?** This draws attention to how civic engagement is rooted in personal care for and sense of place, and how the nature of this bond can shape what specific objectives people work towards.

I address these what-how-why questions throughout the thesis, with each one receiving special attention in one of three case study papers (Figure 1). The thesis first gives an overview of the challenges that define stewardship in urban landscapes (**Paper I**). In the subsequent empirical papers, I use case studies from Bengaluru, India (**Paper II & III**) and New York City (NYC), USA (**Paper IV**), to study civic involvement in stewardship of urban water bodies and waterfronts. More specifically, I describe how civic groups introduce change agency to rewire the trap dynamics that keep a governance system in an undesirable situation (**Paper II**); I explore how locally organized lake groups improve the social–ecological fit between urban lakes and management institutions (**Paper III**); and I demonstrate how a better understanding of actors’ relations to place helps unpack what civic groups want to achieve for a site through their stewardship engagement (**Paper IV**). Last, **Paper V** presents a review of how the stewardship concept is used in the literature, and proposes a conceptual framework for how different uses can be related and potentially connected. By bringing forth and structuring multiple meanings of stewardship, the framework also contributes to and helps organize how I discuss insights from the empirical research.

The combination of conceptual papers and case studies reflects an ongoing process throughout this doctoral project, one that has moved between empirical data collection and analysis on the one hand, and on the other, theoretical discussions around the ontology and epistemology of stewardship – i.e. what stewardship is, and how it can be studied. This process begun while working on my master’s thesis project about people who organize in support of urban nature (see **Paper A**). Trying to characterize such initiatives while simultaneously positioning my research within the sustainability science field, I was exposed to multiple different and sometimes incompatible uses of the stewardship concept. This is what gradually created the two-folded aim of the thesis: to contribute to our conceptual understanding and constructive use of the term

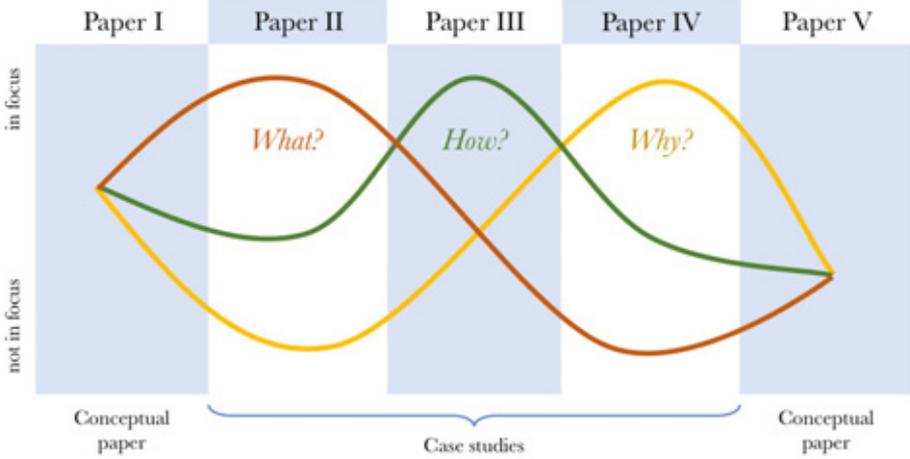


Figure 1 Illustration of the attention given to each of the three research questions throughout this thesis. *What* influence can civic engagement in stewardship have, *How* can it improve understanding of and adaptation to SES dynamics, and *Why* does stewardship engagement emerge and how is it shaped by people’s relation to place?

(**Paper I & V**), and to ground this understanding in, as well as use it to inform analysis of, empirical cases from urban contexts (**Paper II-IV**). Methodologically, this is approached from an interdisciplinary SES perspective, and combines qualitative data, collected primarily through interviews, with quantitative tools and secondary sources.

2. Background

This section gives a brief overview of the SES field with a focus on urban research, followed by an introduction to stewardship as a concept used both in SES literature as well as in research on civic engagement for local environments. This includes brief presentations of specific theoretical concepts used in my empirical studies (**Paper II-IV**). Lastly, I introduce the two studied SES in Bengaluru and NYC.

2.1. Urban social–ecological systems

Within the broader discipline of sustainability science (Kates et al. 2001), this thesis has emerged in a research tradition shaped by an SES perspective (Berkes and Folke 1998, Berkes et al. 2003). This views humans both as being part of and as shaping the ecosystems they depend on for development and wellbeing at local to global scales (Folke et al. 2016, Norström et al. 2017). SES research is typically problem-driven, motivated by the growing urgency of addressing the challenges to environmental sustainability that define our time (Folke 2006). Evidence for human domination of global ecosystems have been compiled by Vitousek et al. (1997), and subsequently extended and more explicitly linked to data on rapidly increasing human activities, to propose a new geological epoch: the Anthropocene (Crutzen 2002, Steffen et al. 2007). Here, SES research seeks to identify ways to intervene (West 2016) and prevent undesirable outcomes for ecosystem resilience – and ultimately, human wellbeing – by fostering adaptive capacity to navigate unpredictable and cross-scale change (Berkes et al. 2003, Folke et al. 2016).

The SES perspective is important for understanding the new dynamics that define this era. For instance, interactions between fossil-fuel based economies, globalization and ecosystem dynamics can both exacerbate of crises in food markets (Biggs et al. 2011, Steffen et al. 2011), and increase the risk of resource depletion by ‘masking’ environmental feedbacks that would otherwise signal a need to reduce pressure on ecosystems (Hughes et al. 2005, Huitric 2005). Masked feedbacks can be particularly pronounced in cities, which are typically well integrated in global markets while also depending on ecosystem goods and services imported from afar, complicating environmental monitoring. In his seminal study of Chicago, William Cronon (1991) details how increasing marketization of natural resource production, processing and consumption

gradually builds a distance between especially urban populations and the ecosystems they depend on. The market functions as a buffer to smooth out seasonal variations in how food crops and lumber are delivered, and masks natural heterogeneity between different compartmentalized production landscapes – creating an illusion of control in the ‘artificial universe’ that is the city (Cronon 1991).

This thesis’ focus specifically on cities is inspired and informed by extensive and multi-faceted research by Stockholm-based SES scholars, exploring e.g. urban biodiversity and ecosystem services (Elmqvist et al. 2004, Andersson and Colding 2014, Andersson et al. 2014a), history of cultural landscapes in relation to biodiversity and conservation (Barthel et al. 2005, Ernstson and Sörlin 2009), how to address mismatches between ecosystem processes and management approaches (Borgström et al. 2006, Ernstson et al. 2010), and how local actors influence management of urban parkland (Andersson et al. 2007, Ernstson et al. 2008, Barthel et al. 2010). In an international context, this work has also contributed to scholarship and influential policy reports including the Millenium Ecosystem Assessment (2005), and the Cities and Biodiversity Outlook (Secretariat of the Convention on Biological Diversity 2012, Elmqvist et al. 2013a).

This area of investigation also builds on decades of work in urban ecology, a field that has developed from a branch of classical ecology to an increasingly interdisciplinary endeavor (McPhearson et al. 2016). It initially started to gain momentum in the 1970s through systematic studies of the patches of greenery found in cities, and how ecosystems and organisms are affected by and adapt to urban environments (Marzluff et al. 2008, McDonnell 2011, Grove et al. 2016). Two decades later, this ‘ecology *in* cities’ began to shift towards an ‘ecology *of* cities’, where also non-green habitats are considered, where spatial patterns of landscape mosaics and connectivity are increasingly important, and where cities are analyzed as ecosystems with their own metabolic exchanges of nutrients, matter and energy with surrounding landscapes (McDonnell and Pickett 1990, Cronon 1991, Cadenasso et al. 2006). Importantly, and similar to SES approaches described above, this approach to urban ecology explicitly acknowledges humans as an integrated part of and actors in urban ecosystems (Pickett et al. 1997, Niemelä 1999, Grimm et al. 2000, Niemelä et al. 2011, see also Mugerauer 2010).

In its latest iteration, ‘ecology *for* cities’, urban ecology moves even closer to SES research by engaging directly with resilience thinking and adopting explicitly interventionist objectives in the form of “a transformational design-ecology nexus [...] where urban ecologists, designers, planners, engineers, residents, and others are actively pursuing a more sustainable future” (Childers et al. 2015, page 3778-9; see also Grove et al. 2016). It is argued that urban challenges and opportunities are best responded to by expanding the SES framing to acknowledge social–ecological–technical/built systems, “to more fully integrate humans, their habits, attitudes, and technologies into conceptual frameworks and empirical research” (McPhearson et al. 2016, page 210).

While inherently complex, emerging research methods are enabling studies that more effectively engage with this complexity and reveal the distinct features of urban ecosystems (Groffman et al. 2016). These include the urban heat island effect; higher precipitation and surface water runoff; lower evapotranspiration and groundwater levels; altered hydrology, nutrient and contamination levels in streams; more impervious and polluted soils; higher biodiversity locally but more homogenized between cities; and strong social differentiation in terms of how ecosystem services and disservices are allocated (Grimm et al. 2008, Pickett et al. 2011).

Urban SES are currently growing at a faster pace in terms of global land cover than actual population (Seto et al. 2011, Fragkias et al. 2013), with the total urban area in 2030 projected to be almost three times larger than that of 2000 (Seto et al. 2012). This expansion is expected to be faster in biodiversity hotspots compared to other areas, for example the Western Ghats in south India where water scarcity poses a threat to the highly endemic biodiversity in local freshwater ecosystems (Güneralp et al. 2013). Urban areas require freshwater for residential, industrial and commercial uses, and over a fifth of the world's urban population is found in cities in semiarid or arid climates where water availability is threatened (Elmqvist et al. 2013b) – including Bengaluru, which depends on water from the Western Ghats (see below). The spatial expansion of cities also brings a special set of governance challenges regarding the land that comes under new forms of management and use. Administrative boundaries, transportation infrastructure and patchworks of different land ownerships create management regimes that are rarely focused primarily on ecological processes and connections (Borgström et al. 2006, Ernstson et al. 2010). Cities often also experience a tension between land use and land management. With dense populations and large proportion of publicly owned spaces (Colding et al. 2013, Nagendra and Ostrom 2014), urban SES and ecosystem services typically benefit large numbers of people who are not involved in the management of the systems that provide them (Svendsen and Campbell 2008, Andersson et al. 2014a).

The speed and scale of ongoing and projected urbanization and expansion has been presented as a “window of opportunity” for sustainability, provided that the connections between urban processes and land-use change are made explicit (Seto et al. 2012). Certain aspects of urban life, such as lower fertility rates and energy efficiency, can contribute to lowering net impacts on the environment (Grove 2009). Further, if steered in the right direction, urbanization can “accelerate a transition to sustainability owing to forces of agglomeration, increased innovation, and increased wealth” (Seto et al. 2010, page 189). This cautious optimism is shared by other recent urban scholars (Elmqvist et al. 2013b, Groffman et al. 2016, McPhearson et al. 2017). A similar focus on potential solutions has resulted in a reevaluation of the role regular people play in the urban landscape. No longer are they viewed simply as external sources of disturbance to ecosystems, but more often “as an inherent part of both the challenges of and solutions afforded by urban ecosystems” (Groffman et al.

2016, page 40; see also Ernstson and Sörlin 2009, Krasny and Tidball 2012). People thereby become viewed as co-producers of the ecosystem services that underpin human wellbeing (Grove 2009, Andersson et al. 2015), which further demonstrates the relevance of approaching urban research from the SES perspective.

2.2. Environmental stewardships and civic engagement

2.2.1. Social–ecological systems and stewardship

In addition to helping understand and conceptualize the challenges of the Anthropocene, the SES perspective is also useful for finding ways to address them. One productive approach has been to treat SES as complex adaptive systems, where uncertainty and surprise are to be expected and cannot be controlled but rather requires the fostering of adaptive capacity. This problem framing is central to resilience thinking and resilience-based approaches to sustainability science (Folke 2016, Folke et al. 2016). While rooted in ecological modeling of population dynamics (Holling 1959, 1973), this body of literature has also come to build on critiques of how approaches to natural resources management sometimes focuses on efficiency and optimization, e.g. though pursuing ‘maximum sustainable yields’, while ignoring ecosystem dynamics and phenomena such as threshold effects and hysteresis (Holling and Meffe 1996, Ludwig 2001). Another important critique focuses on the separation of resource users and managers, and how feedback between them is rarely prioritized in approaches focused on standardized solutions (Ludwig et al. 1993, Berkes 2010).

One way of characterizing the resulting problems has been to describe how well management institutions align with ecological processes and features. The ‘problem of fit’ can occur when a system is managed without adequate recognition of (a) spatial extent or connectivity, such as species dispersal and flow of resources, (b) temporal dynamics, for instance, how fast, how often or how long a pest outbreak can occur, or (c) the ecological functions, e.g. in an agricultural landscape that typically includes not only food production but also pollinator habitats (Folke et al. 2007, Galaz et al. 2008, Keskitalo et al. 2016). As these types of problems restrict the relevance of top-down approaches (Ludwig 2001), SES scholars instead emphasize the importance of collaborations that allow for bottom-up perspectives to shape management. By drawing on system understanding often found in local users and other non-conventional experts, environmental feedbacks can be strengthened over time and space and thus enhance fit (Olsson and Folke 2001, Berkes 2004, Cornell et al. 2013). It has been noted, however, that local participation is not a panacea; it can contribute positively to some aspects of environmental management, while simultaneously holding back others (Schultz et al. 2011).

As keepers of local ecological knowledge, local users have been referred to as ‘stewards’ or ‘wise men’ in traditional societies, and initially engaged with in SES and resilience literature as key actors creating management practices that are adapted to both local ecosystem dynamics and social context (Olsson and Folke 2001, Berkes et al. 2003, Hahn et al. 2006). Olsson and Folke (2001) point out that this requires both the right kind of knowledge as well as institutional arrangement that “make it work” (page 101, see also Andersson et al. (2007), Ernstson and Sörlin (2009), and Barthel et al. 2010) for urban examples). Hahn et al. (2006) and Schultz et al. (2007) argue that adaptive co-management can do just that, since its collaborative approach allows it to stay sensitive to farmers and other local stewards and engage them in the adaptive process of learning and continuous problem-solving. Paired with theory about system dynamics, resilience and change, this empirical work has been drawn on to argue that ‘adaptive’ capacities are important for enabling governing institutions to deal with unexpected shocks and adjust approaches as conditions change (Gunderson and Holling 2002, Folke et al. 2005). Unsustainable practices can often be characterized as lacking adaptive capacity, which sometimes results in ‘traps’ where social–ecological feedbacks reinforce undesirable dynamics and prevent change even when it is broad consensus that the current situation is unsustainable (Scheffer and Westley 2007, Carpenter and Brock 2008).

Drawing on these insights as well as empirical cases from a range of different contexts, adaptive approaches to ecosystem management, co-management and governance have come to be core concepts in the literature about how to approach sustainability challenges in SES (Gunderson and Holling 2002, Armitage 2005, Folke et al. 2005, Olsson et al. 2006, see also West et al. 2016). Today, this focus on adaptive capacity sits at the core of a particular approach to environmental stewardship, variously referred to as ‘biosphere stewardship’ (Elmqvist et al. 2013b, Folke et al. 2016), ‘earth stewardship’ (Chapin et al. 2011b, 2011a, Rozzi et al. 2015), ‘ecosystem stewardship’ (Chapin et al. 2009a, 2010, 2015) and ‘planetary stewardship’ (Steffen et al. 2011, Folke et al. 2011, Seitzinger et al. 2012, Svedin 2015). Generally, this literature views stewardship as a ‘resilience-based’ framework or approach to governance or management, where the goal is “to sustain the capacity of ecosystems to provide services that benefit society by sustaining or enhancing the integrity and diversity of ecosystems as well as the adaptive capacity and well-being of society” (Chapin et al. 2009b, page 320). This is presented as a major shift away from management that attempts to control and minimize variability and change in a resource’s dynamics. Importantly, this iteration of stewardship views ‘the system’ as the starting point. Setting up the right stewardship actions and achieving desirable outcomes depends on knowledge, understanding and continuous learning about SES feedbacks and humanity’s inherent dependence on the biosphere (Steffen et al. 2011, Folke et al. 2016).

2.2.2. Urban environmental stewardship and civic engagement

Another important branch of the stewardship literature, of particular relevance for this thesis, concerns self-organized initiatives or volunteering in programs to take care of greenery and other parts of one's local environment, particularly in urban areas (Svendsen and Campbell 2008, 2014, Asah and Blahna 2012, Andersson et al. 2014b, Dresner et al. 2015, Krasny and Tidball 2015, Buijs et al. 2017). In several city-wide studies carried out by researchers at the US Forest Service (USFS) from 2007 onwards to map and assess community-based stewardship organizations (Svendsen 2009, Svendsen et al. 2016), urban environmental stewardship is defined as “conserving, managing, monitoring, advocating for, and/or educating the public about their local environment” (a definition also used, sometimes while adding “restoring”, by e.g. Fisher et al. 2012, Connolly et al. 2013, Romolini et al. 2013, 2016a, Svendsen 2013, Grove et al. 2016, **Paper A**). Civic involvement and environmental activism have been studied under other labels than stewardship (examples in Diani and Bison 2004). While not the focus of this thesis, it should be noted that civic engagement is often partly facilitated by reforms in local governments aimed at addressing problems in public finance, legitimacy and performance (Foljanty-Jost 2011).

The interest in the role of informal actors in these forms of stewardship stem partly from an acknowledgement that the primary users of urban land are often not its formal owners (Svendsen and Campbell 2008). Simultaneously, city landscapes are highly heterogeneous both in terms of biophysical features and what actors are involved in its governance (Grove et al. 2006), which has motivated several studies of how public agencies, civic groups, businesses and other stakeholders are connected in social networks (e.g. Ernstson et al. 2008, Connolly et al. 2014, Romolini et al. 2016b, **Paper A**). Regular residents that organize locally and/or in networks can compensate for otherwise fragmented and uncoordinated management efforts, raise public awareness and monitor threats to ecosystem services (Wilkinson et al. 2013, **Paper A**). They are important actors for urban SES governance that seeks to “harness diverse local knowledges and ‘eyeballs on the street’ to engage in genuine exchanges and evaluations of information” (Grove 2009, page 239).

Civic engagement in urban stewardship has also proven interesting not only for its potential effect on ecosystems and biodiversity, but also for how it might strengthen communities and neighborhoods. Aside from positive individual-level effects on health and sense of empowerment (Svendsen 2009), community engagement in environmental stewardship has been associated with more active citizenship (Glover et al. 2005), ways to recover from natural disasters (Tidball et al. 2010), build community cohesion after societal shocks (Svendsen and Campbell 2014), strengthen human connections to nature, other humans and institutions (Stedman and Ingalls 2014), and bonds to the culture and history of a place (Krasny et al. 2014). However, the heterogeneous populations of urban areas sometimes have conflicting and incompatible preferences (Grove et al. 2006, Andersson et al. 2007) which implies a risk for conflicts of

interests and less empowered groups being excluded from influencing what outcomes should be prioritized (Baviskar 2003, Ernstson and Sörlin 2009).

In summary, the ‘urban environmental stewardship’ perspective focuses on the activities that constitute stewardship and the potential outcomes it can bring; in other words, the agency of local residents and civic groups, their capacity to affect change and ability to articulate their vision. Importantly, this dimension is not ignored in the ‘ecosystem stewardship’ perspective. For local ecological knowledge to be translated into adaptive governance, it requires functioning institutional arrangements to implement actions (Olsson and Folke 2001, Folke et al. 2005, Hahn et al. 2006). Change agency is also linked to the concepts of transformations (Gunderson and Holling 2002, Folke et al. 2011, Olsson et al. 2014, Feola 2015) and social–ecological traps (Carpenter and Brock 2008, Enfors 2013, Boonstra and de Boer 2014, Brown 2016). Studying what institutional arrangements, strategies and collaborations are needed for stewardship to effectively produce desired outcomes has become an important field in SES research (Olsson et al. 2006, Bodin and Prell 2011, Galaz et al. 2012, Hansen 2014, Chapin et al. 2015), one that therefore has considerable overlap with urban ecology and urban environmental stewardship (e.g. Ernstson et al. 2010, Bergsten et al. 2014, Andersson et al. 2014a, Borgström et al. 2015, Andersson and Barthel 2016, **Paper A**).

2.2.3. Towards an analysis-oriented definition: stewardship as a relation

Aside from these two ways to operationalize stewardship, there are many other perspectives. Examples from around the English-speaking world include references to agricultural, catchment, biodiversity or wilderness conservation and management (Dobbs and Pretty 2004, Gallo et al. 2008, Hobbs et al. 2010, Curtis and de Lacy 2017), while in the corporate sector it is invoked to signify more responsible environmental conduct (e.g. Pattberg 2005, Gulbrandsen 2009).

Rooted in the old English term ‘*stigeard*’, meaning an (appointed and remunerated) servant looking after a hall, manor or estate, stewardship has gradually come to refer to generally caring for something on behalf of someone else. However, the term has been criticized for its historical applications associated with colonial domination of land and resources, patriarchal systems of control and oppression, as well as religious ideas of humans appointed by a higher Being (Welchman 2012). In contemporary use, stewardship often implies a morally decent conduct or ethical relationship between people and nature – a role that anyone can take on without being appointed, and with no expectation of remuneration or specific ‘end of contract’ (Worrell and Appleby 2000, Welchman 2012). The term is invoked more often than it is defined (Welchman 2012), possibly due to assumptions that “stewardship is familiar to the general public and has essentially the same meaning in lay terms as we intend in its scientific usage” (Chapin et al. 2011a, page 45). However, the

term has been applied to label a range of different activities, for example “nurture and enable responsibility” (Brown and Mitchell 1998), “use and protect” (Burger and Gochfeld 2001), “reducing risks” (Snir 2001) “cleanup” (Burger 2002), “care for” (Knuth and Siemer 2004), “connect” (Davis 2005), “manage” (Hansen 2014) and “shaping trajectories” (Chapin et al. 2015). Similar diversity can be found in assumptions about e.g. what actors perform stewardship, what systems or resources can be stewarded, and at what scale it takes place (Bieling and Plieninger 2017).

For this thesis, I have sought a definition that can be helpful for understanding and studying what stewardship *is*. Instead of using actors, actions, moral principles or desirable outcomes as qualifiers, I focus on what elements define the relationship between stewardship actors and the SES they are embedded in and seek to influence. As shown above, one critical dimension of this relation is various forms of knowledge about how humans influence and depend on ecosystems and the services they provide. A second dimension is the agency and capacity to shape what these interactions look like. To these two, it is also necessary to add a dimension of care, i.e. values, motivations and norms that are found at individual or societal level. Academically, studies about this aspect of stewardship are often found in philosophy, religious and ethics literature (e.g. Barrett and Grizzle 1997, Curry and Groenendyk 2006, Welchman 2012).

There are also studies where various notions of care are explored in relation to stewardship frameworks, programs and activities. Examples include studies of care for the planet as a whole (Heise 2008, Nassauer 2011), attachment to place (Chapin and Knapp 2015, Walker and Moscardo 2016), cultural ecosystem services (Flint et al. 2013, Andersson et al. 2014b) and motivations for pro-environmental behavior (Kudryavtsev et al. 2012, Raymond et al. 2015).

One particularly relevant body of work about care comes from sense of place literature. Rooted in social psychology and sociology, sense of place studies the bond people form to physical locations and how this relates to identity, values and behaviors (Tuan 1974, Williams and Stewart 1998). Sense of place is sometimes viewed as having two subcomponents: *place attachment*, i.e. the strength of the bond between an individual and a specific environment; and *place meaning*, i.e. the descriptive or symbolic meanings that determine what ‘kind of place this individual views it as (Stedman 2008, Brehm et al. 2013). It is an area of research that has found application especially in studies of motivations for pro-environmental behavior (Larson et al. 2013, 2015, Krasny et al. 2014). Urban scholars have noted the significance of place-specific characteristics experienced for a city as a whole (Romolini et al. 2016b), in a specific neighborhood (Grove et al. 2006, Giusti et al. 2014), or at the individual level (Grimm et al. 2008). Sense of place has been shown to have considerable potential for SES researchers (Stedman 2016, **Paper B**), and seems well situated to help “increase our nascent understanding of the ways that the values and concerns that people express about the biotic components of urban ecosystems shape the structure and functioning of urban ecosystems” (Groffman et al.

2016, page 41) and answer to the need to understand how the same ecosystems are valued differently depending on one's viewpoint (Pickett et al. 2011, Gómez-Baggethun et al. 2013).

The stewardship definition presented in the introduction (page 2) builds on some of the most common ideas of stewardship found in the literature (as reviewed in **Paper V**): responsibility, use, management, nature, long-term sustainability, benefiting others than oneself. Based on the empirical and conceptual work in this thesis, I add three qualifiers for a more specific understanding of stewardship as emergent from

- (a) personal and societal values and norms of care,
- (b) learning and knowledge about human–ecosystem interdependencies, and
- (c) capacity and agency to accountably influence these dependencies.

I propose this definition as a way to draw attention to three dimensions of stewardship as a relation between humans and the rest of nature. It is meant not as a potential disqualifier of other ways to define or operationalize stewardship, but rather as an epistemological tool to structure research about the phenomenon. As such, the three qualifiers (hereafter referred to as *care*, *knowledge* and *agency*) can be visualized as a framework of three overlapping attractors (Figure 2). Although this framework was developed to understand how different uses of the stewardship concept are related (**Paper V**), it can also be used to visualize the proposition in **Paper I** of *care*, *knowledge* and *agency* as three functions that are necessary for effective stewardship in urban landscapes. As these functions are often performed by different types of actors, the framework can serve as an analytical tool to study the complementarity of different roles in collaborations and networks. It is important to emphasize that I do not view stewardship as an exclusively individual effort, but more often a collective endeavor where any action emerges from a combination of different concerns, capabilities and visions.

2.3. Case studies

This section introduces the reader to the two urban SES where the empirical data of this thesis is drawn from. I make no claim that Bengaluru and NYC would be representative of all cities in the world; for instance, as growing ‘megacities’ (defined as having over 10 million inhabitants), they represent neither the small and medium-sized cities where most future urban growth is expected (Fragkias et al. 2013), nor the areas of urban decline that can be found across countries in Europe and North America (Haase 2013). However, they both illustrate important aspects of the Anthropocene. Most of the global environmental impact so far has been driven not by humanity as a whole but primarily



Figure 2 A conceptual framework of three overlapping attractors that constitute different dimensions of stewardship (adapted from **Paper V**).

people in so-called developed countries, who constitute a very small fraction of the global human population. In recent years, a new group has rapidly enlarged its global footprint: the growing middle class populations in BRIC countries – Brazil, Russia, India, and China (Steffen et al. 2015). With cities increasingly acknowledged as potential stewards of the natural systems they depend on for health, livelihoods and reduced vulnerabilities to natural disasters (Seto et al. 2013), NYC and Bengaluru can be seen as representing both of these processes: NYC became the world’s first megacity in the 1930s (Chandler 1987) and has been the heart of the western world and the global economy over a century; Bengaluru on the other hand, is one of the most recent cities to reach the megacity threshold (United Nations 2014), and a prominent example of economic development paired with a well-educated middle class in a BRIC country. It is also located in South Asia, where future urban development pathways may well be what ultimately shapes the trajectory of the Anthropocene (Steffen et al. 2015).

In both study areas, I have chosen to focus on water-based SES: water as public spaces that city dwellers visit and interact with, as well as ecological and hydrological systems that directly and indirectly support the well-being of urban populations. All cities need water, but the amounts vary; typically, poorer urban areas consume less as many people lack adequate access to water, and use fewer water-intensive appliances and technology (McDonald et al. 2013).

Cities also shape the conditions of aquatic ecologies, and the quality and quantity of water that is available for use (Elmqvist et al. 2013b). With altered nutrient loads, increasing levels of pharmaceutical waste products and highly modified physical hydrology, urban aquatic ecosystems can also be harbingers of how water resources more generally are likely to be affected by human activities in the future (Pickett et al. 2011, Groffman et al. 2016) especially as urban water footprints expand into non-urban hinterlands (McDonald et al. 2014).

2.3.1. Bengaluru, India

Globally, the largest growth in urban populations is expected in Sub-Saharan Africa and South and Central Asia (Fragkias et al. 2013). India is one of the least urbanized countries in Asia, with only 30% of its population living in cities (Seto et al. 2013). The country's development focus has historically been mainly rural, but an important shift came with the launch of the Jawaharlal Nehru National Urban Renewal Mission in 2005, focusing on 63 cities throughout the country (Nagendra et al. 2013). This new focus is warranted: India is projected to add 404 million people to the global urban population between 2014 and 2050, more than any other country in the world (McPhearson et al. 2016). This will also have implications for the spatial expansion of cities, which in India is more driven by population growth than e.g. increasing GDP per capita, which is the case in China (Seto et al. 2011).

Some of this urban growth and expansion is taking place in Bengaluru (formerly known as Bangalore), located on the Deccan Plateau in southern India and capital of Karnataka State (Figure 3). Its 8.4 million population in the 2011 census represented a 104% increase from two decades earlier (Sudhira et al. 2007, Government of India 2011); and the city is estimated to have crossed the 10 million mark sometime before 2015 (United Nations 2014, World Population Review 2017a). Part of this growth is attributed to the city's well-known and booming information and communications technology sector, which attracts well-educated engineers and other 'techie' from across the country. Bengaluru also has a diversified economy and a large concentration of small and medium enterprises (Sudhira et al. 2007). Not everyone benefits from the economic success however, as one in four households are under the poverty line (Sudhira and Nagendra 2013).

The economic development has also had serious environmental impacts (Sudhira and Nagendra 2013, Nagendra 2016). While many older neighborhoods were shaped by planning ideals that included numerous parks and large trees along Bengaluru's streets, more recent development is typically driven by economic real estate interests rather than the plans of city authorities. This, paired with densification and road widening in older parts of the city, has resulted in large-scale conversion of green and blue spaces into impenetrable surfaces such as paved streets and buildings (Nagendra 2016).

Lake and streams in Greater Bengaluru

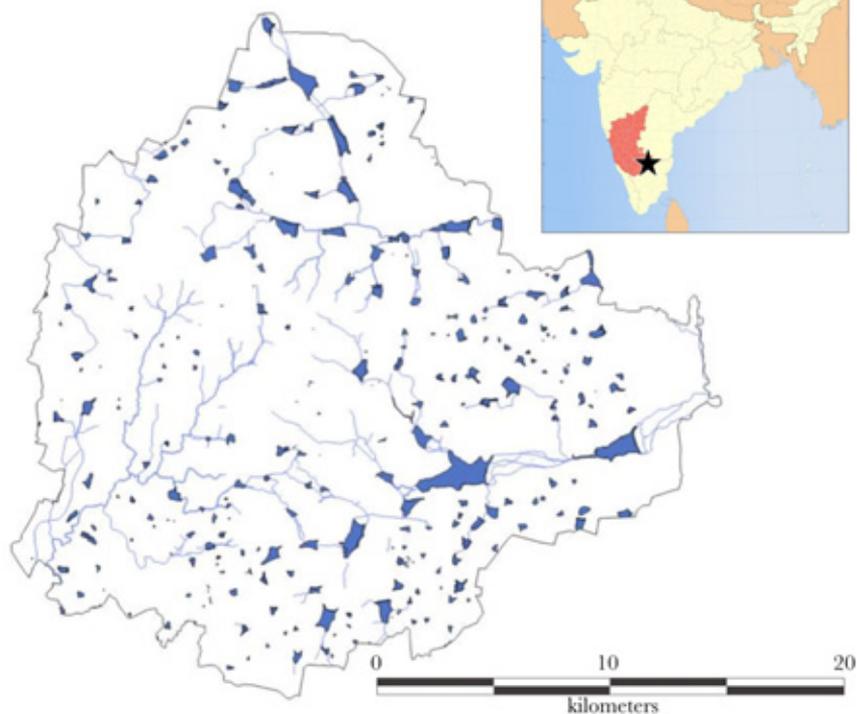


Figure 3 The map shows Greater Bengaluru, demarcated by the administrative boundaries, and all land designated as lake area indicated. Inset shows the location of Karnataka state and its capital Bengaluru.

The loss of lakes is particularly alarming for a rapidly growing city in a semi-arid region without any major river (Sudhira and Nagendra 2013). Originally created by damming small, seasonal streams, the lakes or ‘tanks’ created a buffer of monsoon waters that allowed for human settlements, agriculture and cattle rearing throughout the year (Srinivas 2001, Nagendra 2016). Today, as the city pumps water uphill from a perennial river 100 km outside the city, the lakes’ role for water security is all but forgotten – at least in the approaches to water supply taken by the city’s authorities (see e.g. BWSSB 2014). The external supply does not meet local demand and although lakes are only marginally used as a direct water source, they are crucial for allowing surface water to percolate down and replenish the groundwater reservoirs that millions of Bengalureans depend on (Lele et al. 2013, Sudhira and Nagendra 2013).

Papers II & III focus on Bengaluru’s lakes as a SES of interconnected hydrological units, shaping human dependence on ecosystem services, providing habitats for aquatic biodiversity, and holding significant cultural and historical importance. Some of their specific features are described in these two

papers as well as **Paper I**; other useful sources include Dikshit et al. (1993), Mosse (1997), Srinivas (2001), Nagendra (2016) and Unnikrishnan et al. (2017). Here, I will simply emphasize a few key factors that describe the role of the lake system in the larger landscape:

- The semi-arid climate leaves the region dry for most of the year, while seasonal monsoons temporarily revive streams and flood low-lying areas.
- The physical topography of the undulating landscape allows for the creation of networks of interconnected artificial lakes by erecting dams across the small valleys of the watershed.
- The lakes have been shaped by centuries of cultivation and other land uses by a range of different groups, including the colonial British who continued the work by previous rulers, to secure water supply with lakes and moderate local microclimate through tree planting.
- Traditional and subsequently more modern technical engineering has been applied to construct lake bunds, sluice gates and storm water drains. Village-based societal institutions (historically often linked to the caste system) have structured maintenance and upkeep, as well as regulated access to water and other resources.
- In addition to replenishing underground reservoirs used by local wells, the lakes have served a range of different purposes over the centuries. This includes water for households, irrigation and cattle; harvest of fish, fodder and vegetables; and an growing demand for recreational space in the increasingly dense city.

Together, these characteristics illustrate the social–ecological nature of the network of lakes in Bengaluru. The extent to which this has shaped the urban landscape becomes evident when interactions between human activities and natural dynamics are ignored. For instance, as the channels connecting lakes are encroached on and dried lake beds are developed for housing, the system loses its ability to buffer excess water levels after monsoon-induced fluctuations in precipitation. Instead, residents in low-lying areas – which is often where low-income households and informal settlements are found – face increased environmental risks from flooding and water-borne diseases (D’Souza 2008, Sudhira and Nagendra 2013, Nagendra 2016).

Tapping groundwater is the most common ways for cities to access water, but for this to be sustainable it requires that groundwater recharge exceeds withdrawal (McDonald et al. 2013). Historically in the Bengaluru context, village wells were typically located near the lakes that those villages were in charge of maintaining (Nagendra 2016). Following the introduction of drilled ‘borewells’ in the 1970s, hundreds of thousands of homes now have water delivered directly rather than via a communal well. Withdrawal from groundwater reservoirs is estimated to be four times greater than the recharge, and although systematic groundwater monitoring is lacking, studies have estimated

that groundwater levels are falling about one meter every year, with very high local variability (Grönwall et al. 2010, Sawkar 2012, Subhash Chandra 2012).

Rapid urbanization and associated land-use change in Bengaluru creates several challenges for environmental governance and urban planning in general (D’Souza and Nagendra 2011, Nagendra 2016). The problems with mismanaged lakes have been recognized for at least three decades, after reports from an influential committee led by Laxman Rao (1986). Until the 1960s, many lakes in what is now Bengaluru were still managed and maintained by local villages, but land reform shifted control and responsibilities to central city authorities (D’Souza and Nagendra 2011). A second important step towards centralized control of public spaces (including lakes) came in 2007, when a massive extension of the city’s administrative boundaries increased its area from 226 km² to 741 km² (Sudhira et al. 2007, Grönwall 2008, Grönwall et al. 2010).

While centralization could in theory facilitate landscape-level coordination and planning, Sudhira and Nagendra (2013) have pointed to the challenges of organizing lake management when up to a dozen different public authorities are involved, including the *Bruhat Bengaluru Mahanagara Palike* (Greater Bengaluru Municipal Corporation; BBMP), Bangalore Development Authority (BDA), Bangalore Water Supply & Sewerage Board (BWSSB) and others. Following some of the Rao committee’s recommendations, the Government of Karnataka formed the Lake Development Authority (LDA) in 2002 (Sudhira and Nagendra 2013). LDA has been criticized both for doing too little and for going too far. It has limited powers to influence other agencies to improve management and few resources to restore the four lakes it is directly responsible for. LDA has therefore experimented with new approaches to lake governance, most notably inviting private actors to manage lakes under lease agreements (Unnikrishnan and Nagendra 2014). This provoked strong and partly successful legal protests from local environmental organizations raising concerns over privatization of public space (D’Souza and Nagendra 2011). Following several court rulings favorable to lake protection, and renewed public efforts to restore and fence lakes, some of the environmental impacts of urbanization are beginning to be addressed – however, many lakes still continue to degrade after rejuvenation efforts where no plan for long-term maintenance and monitoring is set up (Sudhira and Nagendra 2013, Nagendra 2016).

There are growing environmental concerns among the residents of Bengaluru, not least among the new middle class emerging as a result of recent economic development (Nagendra 2010, Nagendra and Ostrom 2014). This group is not the first to raise such issues, but it has different resources and connections to act on them – including access to internet and social media for mobilization (Rao 2014, Rao and Dutta 2017). Civic groups sometimes act as a watchdog to hold authorities accountable for mismanagement of urban green spaces. One example is the ‘Green Life’ network described in **Paper A**, which formed as a reaction to extensive cutting of street trees and encroachment on parks for infrastructure development, but has also come to embrace

a range of social justice issues relating to access to the city and its public spaces. Other groups focus more on negotiations and collaborations with city authorities rather than a confrontational watchdog role – such as the lake groups described in **Paper I-III**.

The word ‘stewardship’ is not widely used by these groups, nor is it common India more generally. However, as demonstrated by for example Dwivedi (1997), environmental stewardship and ‘eco-care’ is firmly supported in Hindu religious scriptures. These emphasize the need to consider all living things in the universe as part of one’s extended family: “people must not demand or command dominion over other creatures. They are forbidden from exploiting nature; instead they are advised to seek peace and live in harmony with nature” (Dwivedi 1997, page 32). A specific custom with roots in Hindu tradition is the concept of *shramdaan*, referring to a custom of voluntary labor for a communal good (Nadkarni 2007) – including for the benefit of natural resource management (Sangameswaran 2006). *Shramdaan* has been invoked by lake groups in Bangalore (see **Paper C**), and although these customs and traditions should not be viewed as representing all Indians’ worldviews today, they serve to illustrate the deep ethical foundations for respecting nature that is found in different cultures – even if it is not described as stewardship.

2.3.2. New York City, United States

The U.S. population has been predominantly urban for several decades, and currently almost 82% of Americans live in cities (The World Bank Group 2017). The country’s most populous one, New York City, had 8.6 million inhabitants in 2015 (World Population Review 2017b), while the metropolitan region held over 20 million (U.S. Census Bureau - Population Division 2017). The city has been and still is a key point of entry for immigrants to the country, and has more spoken languages than any other city in the world (McPhearson et al. 2013b).

Thanks to its location between the New England and Mid-Atlantic climate zones, and its varied landscapes with old growth forests, grasslands, rocky shores, freshwater as well as intertidal wetlands, NYC boasts exceptional biodiversity (Sanderson and Brown 2007, MCPhearson et al. 2013b). This contributes to a range of local ecosystem services including air purification, temperature regulation, flood control, recreation, educational opportunities and sense of place and well-being (Gómez-Baggethun et al. 2013, MCPhearson et al. 2013a). The city’s geography, situated at one of the world’s largest natural harbors and at the intersection of important waterways (Figure 4), has also contributed to its economic and industrial development into what is now one of the world’s largest city economies (Gandy 2003, MCPhearson et al. 2013b). As one of the first cities in the world with an urban plan, the city’s infrastructure was expanded rapidly in the first half of the 20th century – provoking reactions from residents in the 1950s and ‘60s who questioned the car-centered development and envisioned healthier and more sustainable urban environments (Jacobs 1961, MCPhearson 2011). The city’s waterfronts and wetlands

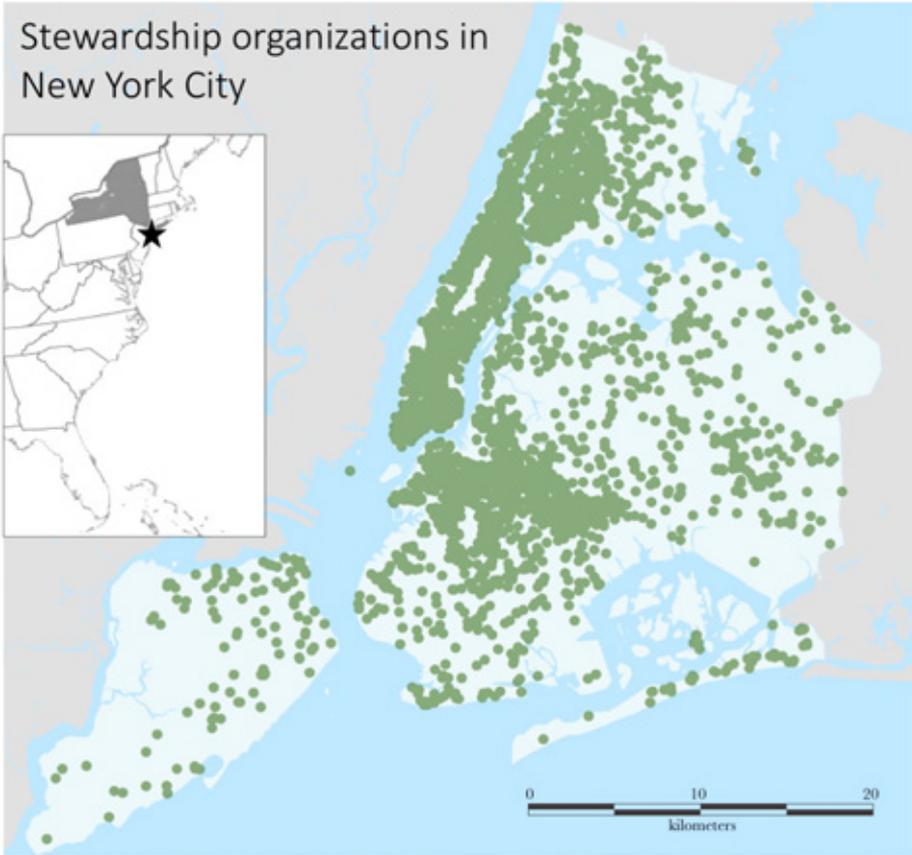


Figure 4 Locations of stewardship organizations New York City, as identified in the STEW-MAP project (Svendsen et al. 2016). NYC is located in New York State (highlighted in inset) on the east coast of the United States. The light blue area indicates the administrative boundaries of the municipality of NYC; the New York metropolitan area also extends into neighboring counties in New York State as well as New Jersey, Pennsylvania and Connecticut. (Adapted from Svendsen et al. (2016), published with kind permission).

have been severely impacted by development and fragmentation, not least by major traffic arteries placed along shorelines, with about 85% of fresh- and saltwater wetlands lost in the past century (McPhearson et al. 2013b).

Although significant improvements have been made to protect NYC ecosystems, the city faces several important challenges: continued population growth in a limited space; local temperatures up to 8°C higher than surrounding non-urban areas; flood risk from rising seas and extreme weather events; reduced air quality; and invasive species – the biggest threat to local plant life after habitat loss (McPhearson et al. 2013b). Another key challenge is a result of the large extent of impervious surfaces and an aging sewer system: heavy precipitation tends to create ‘combined sewer overflow’ (CSO) events where

storm water mixes with untreated sewage, creating eutrophication and threatening recreation and biodiversity in local waterways (NYC DEP 2010, McPhearson et al. 2013b).

NYC municipal authorities have gained international attention for their work to explicitly acknowledge its dependence on ecosystem services, not only through economic valuation but also planning and legislation (Gómez-Baggethun et al. 2013). This is reflected in a number of recent sustainability plans, focusing both on long-term environmental challenges in general (City of New York 2011) and particularly on NYC's waterfronts and water bodies (NYC DEP 2010, 2014, NYC Department of City Planning 2011). The NYC Department of Environmental Protection (DEP) views CSO as the main challenge for improving water quality, and is investing in both conventional 'grey' infrastructure and the 'green' version (such as street trees, green roofs and swales) to reduce water runoff from impervious surfaces (NYC DEP 2010).

An important part in many of the city's efforts is to involve and engage local residents. For example, the recently completed *MillionTreesNYC* (2007-2017) trained 11,256 people to become 'stewards' and help care for newly planted trees in their local neighborhoods (McPhearson et al. 2013b). Extensive research has also been carried out to map and understand the impact of civic engagement specifically as well as their role in urban environmental governance more broadly (Svendsen 2009, Fisher et al. 2012, Connolly et al. 2013, 2014, Campbell et al. 2016, Svendsen et al. 2016). This includes the Stewardship Mapping and Assessment Project (STEW-MAP; Figure 4), initiated by USFS researchers in 2007 and subsequently replicated in a number of cities around the country and increasingly, internationally (Svendsen et al. 2016)².

In a more recent project, USFS has partnered with an umbrella organization for civic groups to survey waterfront stewardship specifically (Boicourt et al. 2016). **Paper IV** draws on this data in a more in-depth, qualitative exploration of how NYC's residents engage with its waters. Just as Bengaluru's lakes, NYC's waterfronts have been shaped by centuries of social-ecological interactions and although they are highly altered, they still hold great biodiversity as well as cultural values which can elicit committed civic engagement (Krasny and Tidball 2013, Krasny et al. 2014). In a broader context, **Paper IV** is motivated partly by the increased attention to the city's waters as described above, but also by studies along the U.S. east coast indicating a shift in urban environmental engagement towards more local engagement, and a focus on both social and environmental issues in combination (Svendsen and Campbell 2008).

² See also https://www.nrs.fs.fed.us/nyc/focus/stewardship_mapping/.

3. Methodological approach

As touched on above, the overarching methodological approach of this thesis has two components. First, I use in-depth and place-based case studies of stewardship, rooted in an assumption that empirical grounding is particularly important when exploring a vaguely defined concept (**Paper II-IV**). Second, I engage in a more general exploration of what has been written about the stewardship phenomenon and concept, for the purpose of setting up a theoretical framework to structure its various applications (**Paper I & V**). Since the thesis studies different aspects of human–nature relations and interactions, I use multiple and mixed methods for data collection and analysis.

This is also a product of the interdisciplinary focus in much of sustainability science (Kates et al. 2001) – not least at my home department (Stockholm Resilience Centre). Interdisciplinary research is challenging due to, for instance, the lack of articulated frameworks, the need for inductive approaches and for group collaborations (Pickett et al. 1999). In my case, both my Bachelor’s and Master’s training and several field studies prior to this doctoral project were entirely interdisciplinary. Thus, I see myself as part of a growing generation of sustainability scholars who only have interdisciplinary degrees and never had a clear ‘home’ in either a natural or social science discipline. Haider et al. (2017) argue that this requires a fostering of both ‘methodological groundedness’ and ‘epistemological agility’. They define methodological groundedness as “the deep understanding and skillful handling of at least one specific methodological approach for data gathering, modeling, and/or analysis”, while epistemological agility requires “an understanding of different ontological and epistemological standpoints and views across multiple disciplines, enabling better communication and collaboration with different researchers” (Haider et al. 2017, page 7). Below, I use these two skillsets to give a brief overview of the main methods used in this thesis and reflect on my role as a sustainability researcher.

3.1. Methodological groundedness

3.1.1. Data collection

The main method used in this thesis is the interview. Interviews were key to all case studies, although often complemented with other analytical tools depending on the specific question being investigated. Formal interviews were

semi-structured and open-ended, using interview guides developed through pilot studies and test interviews in the local setting of the study. Between Bengaluru and NYC, I interviewed almost 100 people (not all included in the papers of this thesis), primarily local residents speaking in their role as members of a stewardship group. Interviewees have also included other key informants, such as civil servants responsible for lake management, staff at international NGOs and umbrella organizations working to promote civic initiatives, local researchers and journalists. Different methods were used to identify respondents; in Bengaluru I relied more heavily on online research and snow-balling (Welch 1975) as there was little to no research available about local civic groups (further details in **Paper II & III**). In NYC, I could benefit from recent surveys of relevant stewardship initiatives (Boicourt et al. 2016) for a more systematic sampling (as described in **Paper IV**).

I have chosen to rely on semi-structured interviews as this allowed for important topics to emerge during the conversation (Kvale and Brinkmann 2009). This has been important since I have sought information on topics that have been scarcely described in previous research: civic environmentalism in Bengaluru, and the role of sense of place in stewardship in NYC. While I have complemented this qualitative data with other sources of information and analytical tools, I felt it necessary to develop a broad, basic understanding of each study area and the issues that concern people there – not least because my fieldwork has been in cultures that are foreign to me.

Various complementary methods were used to triangulate interview information. All interviews were followed by note-taking to capture observations and impressions during the meeting. Notes were also taken along with photographs during visit to the sites that civic groups work with. Further, I used paper and online surveys to check for unidentified lake groups (**Paper II**) and to quantitatively assess various place attachment elements (**Paper IV**). Secondary geographical data was used to model the ecological network in **Paper III**. These choices have been guided by the problem-based research focus, i.e. the nature of the issue under investigation, as opposed to only relying on commonly used methods in one specific discipline.

In addition to these case study methods, **Paper V** involved a process of initially exploratory literature readings, and subsequently a qualitative systematic review (*sensu* Grant et al. 2009). I have initiated, led and coordinated an iterative process of group discussions, identification of emerging coding themes, tests and revisions following further discussions amongst the co-authors. While methodologically distinct from the case studies, this process – especially the subsequent design of the conceptual framework (Figure 2, page 16) – was also informed and shaped by my experiences of and interactions with stewardship groups in the field.

3.1.2. Data analysis

Interviews generated qualitative data, which was analyzed using a coding software program (Atlas.ti, versions 1.0.29-1.6.0). Coding techniques included inductive approaches such as the ‘Noticing-Collecting-Thinking about’ model (Friese 2012), as well as more deductive coding schemes based on theory on rigidity trap dynamics (Boonstra and de Boer 2014, see **Paper II**) and sense of place (Jorgensen and Stedman 2001, Stedman 2003, see **Paper IV**).

Paper III relied on statistical data analysis tools from recent developments in social–ecological network analysis (Bodin and Tengö 2012, Bodin et al. 2016). This employed qualitative interview data to model a social network of collaborations between lake groups. When paired with ecological data, we could study this as a social–ecological network to identify defining patterns and how different social nodes (i.e. lake groups) participate more or less often in configurations that improve fit in the system (Figure 5).

For **Paper V**, a coding scheme was developed to analyze a much larger dataset ($n=1,002$) than in any of the case studies. We used a qualitative systematic review process (*sensu* Grant et al. 2009), which is common when attempting to improve the general understanding of a topic and formulating new theory by identifying and interpreting themes in qualitative data.

3.2. Epistemological agility

The tools described above represent epistemological standpoints with to some extent different disciplinary origins. I illustrate this here by describing how these standpoints have different ways of approaching connections and interactions between humans and nature.

Network analysis, for instance, has roots in both social sciences (Borgatti et al. 2009) as well as in mathematics (graph theory) and biological research (Proulx et al. 2005). More recently, it is also finding application in research on environmental management (e.g. Cumming et al. 2010, **Paper A**) and human–nature interactions specifically (Bodin and Tengö 2012, Bodin et al. 2016). These roots all share a basic set of assumptions regarding the usefulness of modeling phenomena as a set of quantifiable nodes and links, where emergent patterns can be measured to answer questions about said phenomena.

A different way of knowing and understanding human–nature interactions is to focus not on the observable patterns at a specific moment, but rather study the temporal dynamics that develop over longer periods of time. Building on research about ecological dynamics (Gunderson and Holling 2002), this perspective uses concepts like path dependency and rigidity traps (Carpenter and Brock 2008, Boonstra and de Boer 2014) to analyze how historical feedbacks shape SES and set boundaries for what actors in it are able to do. Here, the emergent patterns are observable not spatially across the landscape, but over time by studying the causal linkages between human actions and ecosystem change.

As a third example, sense of place literature is in and of itself an epistemologically diverse and sometimes incoherent field (Trentelman 2009, Lewicka 2011, **Paper B**). Generally, the different perspectives all emphasize the importance of understanding subjectivity when it comes to humans' interactions with their environment (Stedman 2016). One way to approach this has been to emphasize the uniqueness of the lived experience in each place. This typically includes rejecting ideas of standardized measurement and statistical correlations in describing the deeply personal phenomenon of people–place relations. Another approach, adopted in this thesis, still acknowledges the subjectivity of sense of place but argues that this varies systematically depending on the types of people and environments involved. Due to this variation, this approach embraces methods that help make predictions and generalizations about sense of place (Shamai 1991, Stedman 2016, **Paper B**).

In addition to these examples, this thesis also engages directly and explicitly with epistemological tensions through the analysis of stewardship literature in **Paper V**. Here, we use the term 'boundary object' to understand concepts that occupy shared spaces between disciplines (Star 2010), that are malleable enough to be of use to multiple different research communities, but still sufficiently robust to maintain a core set of characteristics across these uses (Star and Griesemer 1989). Throughout this paper, but also more broadly in the thesis, I have attempted to approach different ontological and epistemological standpoints with an open mind. This allows for adopting different approaches in different studies, but requires an awareness of how each approach rests on certain assumptions about how the world works and how knowledge about this can be created.

Further, I have also sought to build epistemological agility by initiating collaborations with researchers who have ended up as co-supervisors and/or co-authors, with backgrounds in fields including ecology, physics, social anthropology, sociology and geography. In addition to fostering my ability to communicate and collaborate with other researchers, I have also sought to develop how I engage with interviewees and stakeholders in ways that build mutual trust and openness. With case studies in two different cultures that are both foreign to me, there are a number of challenges to understanding and interpreting what is observed. While all interviewees spoke excellent English, meaning I never needed a translator, there is still a risk that colloquialisms and cultural references impede conversations. I also stood out as an outsider, especially as a white man moving around in local neighborhoods in an Indian city, and any outsider can be faced with suspicion (although I never experienced this). In the more ethnically diverse NYC I did not stand out so much in terms of the color of my skin, but sometimes sensed differences in terms of class and educational background. As I was car dependent and had access to an official USFS vehicle, some interviewees may also have felt apprehensive about who I was working for. I made sure to clarify all affiliations before requesting interviews, including the USFS collaboration.

As for other steps to address these challenges, I was fortunate enough to visit and familiarize myself as a researcher with both Bengaluru and NYC prior to the field studies, and interact with local colleagues to help develop and adapt my research plan as appropriate. For local transportation in Bengaluru, I primarily used a bicycle, or for longer distances, auto-rickshaws. The bicycle choice was practical, as it was often the fastest way to move through congested streets, but it also allowed me to ‘get a feeling’ for the landscape and its neighborhoods while traveling to interviews. (Biking probably also dispelled most notions of me as an ill-minded or hostile outsider, at least judging by the laughter from school children spotting me.) Interviews were always open-ended and often revealed stories and information I would not have thought to ask about in a more pre-set structure. Based on experiences from previous fieldwork (Enqvist 2010, Stadlinger et al. 2013, **Paper A**), I met interviewees at locations of their convenience – often at the place that their group works with – in order to better understand what they refer to in their responses. I have visited nearly all the water bodies and waterfronts that feature in the studies of this thesis – both Bengaluru and NYC offer an impressive array of sites, including beautifully lush oases, stinking pools of sewage, scenic vistas, unexpected wildlife encounters and shorelines littered with beer bottles and religious offerings.

I have received tremendous hospitality from my interviewees, including great enthusiasm for talking about their groups’ work and expressing appreciation for a student coming from a different country to learn about them and their work. Driving a USFS car may have been less controversial than I first feared, since this agency is federal and does not directly manage any land in NYC – as opposed to the city’s Parks and Recreation Department, which several interviewees claimed were doing inadequate work. Lastly but perhaps most importantly, my impression is that the urban context was a benefit. Many residents in both Bengaluru and NYC are themselves new to the city or the neighborhood they work in, and I never got the impression that anyone saw me as an intruding outsider.

Still, I would not suggest that I was fully embedded in either of the two contexts. The most prominent issue in both cities concerns my omission of interviews with more disadvantaged communities. This was an effect of the scope of my project where there were neither time, resources nor methodological experience for a more in-depth engagement with issues of environmental justice and urban political ecology. Rather than aiming for a broader understanding of all types of civic engagement in either city – or focusing on only one city for the benefit of a deeper scope – I chose to focus on a specific kind of civic groups and explore the dynamics and diversity in that across two different urban contexts.

4. Results

This section provides a summary of the main findings from the papers of the thesis. Each paper is introduced with the main research question it seeks to address. I focus the summary on what is most relevant for the aim and research questions of this thesis as a whole, as set out in the Introduction (RQ1-3; see also Figure 1, page 6).

4.1. Paper I

What characterizes stewardship and stewards in urban landscapes?

This text, originally published as a contribution to a volume on ‘Landscape Stewardship’ (Bieling and Plieninger 2017), is a conceptual paper that outlines the specific challenges associated with stewardship of urban landscapes. We focus on the biophysical conditions of the landscape itself, and on the actors that have potential roles to play in stewardship by virtue of using, or in other ways influencing, the functions of the landscape. Drawing on two examples from previous case studies in Stockholm and Bengaluru, we point specifically to the spatial fragmentation of urban ecosystems, and the particularly rich historical layers of previous land uses that still shape urban landscapes today. We also argue that urban landscapes are different than rural ones, since they have a higher degree of public spaces that are intensively used and shaped by local residents who do not themselves own the land. Heterogeneity and mobility of urban populations also contribute to a diversity of interests that can breed conflicts. This creates a need to not just physically link green spaces, but also bridge between stakeholders and connect knowledge and skills distributed over different individuals, organizations and public authorities.

Based on this analysis, we argue that urban environmental stewardship often depends on collaborative networks consisting of a broad range of actors (including but not restricted to formal authorities and civil society). Such networks help connect fragmented areas, can facilitate negotiations between heterogeneous stakeholders, build vertical links between actors at local and higher scales, and help disseminate information and knowledge. We conclude that this means that stewardship often emerges from the functions that different actors contribute with.

We identify three such functions that are key to stewardship:

- “The *care, creativity and stewardship values* connected to and present in local experiences and initiatives,
- The combined *knowledge and know-how* held by different actors to steer activities towards a desired outcome,
- The *agency, power and resources* needed to negotiate and effect change.”
(see page 83)

Here, we emphasize the role of civic groups as particularly underappreciated, and recommend that stewardship efforts more actively work to identify local initiatives that are already active, promote the emergence of new ones, and facilitate exchanges and learning between different groups across the urban landscape. Last, we provide five recommendations for future research, three of which are to some extent addressed by this thesis: providing empirical studies that characterize stewardship initiatives in the global South (**Paper II & III**), research on how stewardship can emerge and scale up to address landscape-level issues (**Paper III**), and explore how the urban landscape and human–nature interactions shape stewardship (**Paper IV**).

4.2. Paper II

What can civic engagement contribute to ‘trapped’ resource governance?

This paper uses the concept of ‘rigidity traps’ to study stewardship as a source of change in an SES locked in an undesirable state. Rigidity traps can be found in overly bureaucratic systems where efforts to control and preserve current conditions prevent innovation and adaptations as new situations emerge. We describe water governance arrangements in Bengaluru as trapped in a self-reinforcing dynamic of rapid population growth, mismanagement of local lakes and groundwater use, and investments in external water supply. The reluctance to forsake initial investments and the gradual destruction and pollution of the city’s water bodies have reinforced dependence on external sources and undermined the replenishment of groundwater reservoirs still used by many Bengalureans.

In this context, we study how locally organized ‘lake groups’ are able to influence these dynamics and break the trap. In the face of increasing water scarcity, over two dozen groups have formed across the city, organizing to restore, protect, and maintain lakes. For five lakes, this has resulted in groups entering collaborative management agreements with municipal authorities to promote restoration and improve management. Formed by local residents and drawing on expertise from ecologists and other experts, the lake groups are able to not only provide more continuous monitoring to prevent further encroachment into lake areas, but also advocate for restoration plans that

acknowledge the ecological and hydrological functions of lakes. This way, the lake groups counteract trap dynamics and contribute a crucial source of change agency (RQ1) in an otherwise unsustainable management situation. Furthermore, their presence in the local area as well as access to ecological knowledge enables them to contribute solutions that are adapted to the social–ecological conditions at each lake (RQ2).

4.3. Paper III

How does locally based stewardship influence the fit between management and ecosystems?

This paper contributes new insights to a claim that has previously lacked empirical backing, i.e. that bottom-up approaches can address problems of social–ecological fit (however see also Guerrero et al. 2015). We investigate this claim by looking at how civic groups might contribute to management that is more aligned with ecosystem connectivity. Studying the same lake groups as in **Paper II**, we draw on recent theoretical and methodological developments for how to study social–ecological networks. Since Bengaluru’s lakes are interconnected and dependent on water flow from upstream neighbors, the city authorities’ current approach of managing each one in isolation ignores critical factors at the landscape level. We model hydrological connectivity between lakes and interactions between lake groups as nodes and links in a social–ecological network, and quantitatively measure how well the social interactions match water flow between lakes (Figure 5). Our results show that lake groups create a better fit than would be expected if they interacted and worked with lakes randomly, and also better than what city authorities seem to achieve. Further, we are able to identify critical groups that are central in the social network and contribute directly to better fit, as well as influence other groups to do the same.

These findings demonstrate how civic engagement in stewardship holds the potential to adapt management not only to local conditions, but to ecosystem processes at the landscape-level (RQ2). This emerges as the collective effort of lake groups expresses an awareness and understanding of ecological processes that are ignored by the formal governance actors. Further, the study shows how civic engagement can affect change by inspiring and supporting broader engagement from other local residents (RQ1). Here, we pioneer methods to identify how specific actors influence an SES through other lake groups and their engagements with stewardship of interconnected lakes. Lastly, our findings exemplify how the biophysical features of a specific place – i.e., how a lake is connected to other lakes – can matter for whether or not a local stewardship group engages in its restoration (RQ3).

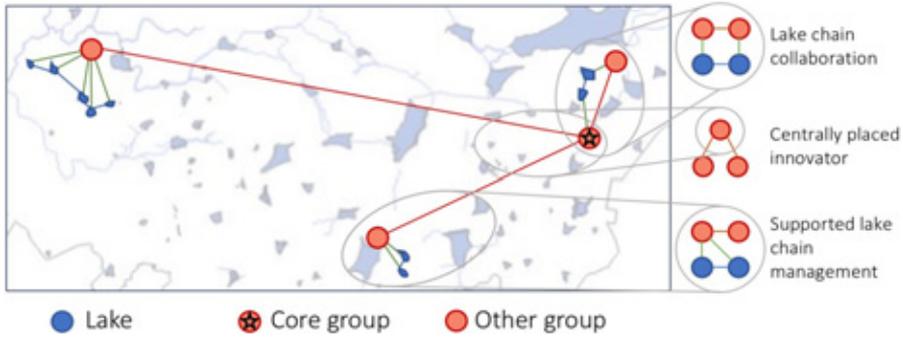


Figure 5 Lake groups in Bengaluru represented as nodes in a network; side panel shows three examples of building blocks used in the analysis to identify good social-ecological fit (illustration based on a subset of the network data presented in **Paper III**).

4.4. Paper IV

How does people's relation to place shape their engagement in stewardship of it (and vice versa)?

For this study, we draw on theory from sense of place literature to analyze how engagement in stewardship activities is shaped by and aims to influence the place that is being stewarded. By emphasizing place attachment and place meanings as two core components of sense of place, we challenge the notion that stronger attachment alone can be assumed to be of benefit to stewardship. The study looks at three types of groups doing stewardship work on waterfronts and water bodies in NYC: community-focused groups, environmental groups and recreational groups. Using interviews and Likert scale surveys, we identified stewardship activities, place attachments and place meanings that members associate with their respective sites.

Our findings show that community group members are more attached to the sites they work with than the members of environmental or recreational groups; however, environmental groups report the greatest effort put into stewardship work. Further, interviews show that groups vary greatly in terms of what place meanings underpin their engagement, and that this variation cannot be explained by whether the group is community-focused, environmental or recreational. In general, members have three ways of engaging with a site: to some it is a part of their home neighborhood, a place where they grew up or have been coming for a long time; to others it is a workplace, a site they come to carry out a task they have been trained and hired to do; and to others it is a place to be used for various purposes, i.e. somewhere they go to arrange or participate in activities or events.

These differences are important findings, considering that the sample contains groups that all claim to do stewardship. The variation in how sense of

place shapes stewardship is also evident in the implications it has for the different sites: some groups work to restore features of a previously existing SES, e.g. restored access to and quality of the water; others work to protect the conditions of a current SES, e.g. through regular cleanup events and educational campaigns to help others discover its qualities; while select groups work to create a new SES entirely, for example by inventing new uses and working to change negative perceptions of an area.

Taken together, this demonstrates how there can be multiple different pathways to stewardship that are not always rooted in strong attachment to a place, but that the idea of what a place should be shapes what activities stewards undertake (RQ3). The study also sheds some light on how ecological understanding and knowledge about a place is important for stewardship, both as a foundation part of how stewards form their sense of place, and since educating the public is often seen as a key part of creating the place one wants (RQ2).

4.5. Paper V

How is 'stewardship' used in the literature and how can we relate and engage with different uses of the term?

In this conceptual paper, we provide an overview of, and a framework to guide engagement with, a growing literature on environmental stewardship. We argue that stewardship is a boundary object, i.e. a term that is flexible enough to be used in multiple contexts, but sufficiently robust to allow for commonalities and a shared identity across these uses. The purpose of this approach is to avoid disciplinary conventions associated with any specific definition of stewardship, and to be inclusive also of research approaches that deviate in their understanding of the term. An exploratory reading identified four themes in how stewardship is studied: as an Ethic; as Motivation leading to certain behavior; as a set of Actions; or as leading to specific Outcomes. These were used in a qualitative systematic review to code 1,002 articles with 'stewardship' in its title or keywords.

Results show a strong dominance of 'stewardship as Action', with strong patterns of co-occurrence especially with the Outcome theme. We also show that research about Action and Outcome are primarily published in natural science journals (including environmental science), while studies about Ethics and Motivation are more likely to be found in social sciences or arts and humanities publications. Along with several internal tensions in how the stewardship concept is studied, this indicates a need for a structured understanding of how different themes relate to each other. To this end, we present a framework using *care*, *knowledge* and *agency* as three underlying dimensions, as a basic structure for interpreting how the themes identified in the literature are linked (Figure 6):

- *Care* helps us understand how Ethic and Motivation relate to each other, since care steers how people direct actions, whether based on rationalized moral principles, or on attitudes and personal preferences.
- *Knowledge* helps us understand and relate Ethic and Outcome, as it concerns the underlying information about, and understanding of, an ecosystem. This informs arguments of what is morally right, as well as helps design and evaluate interventions in terms of the outputs they deliver.
- *Agency* helps us relate Motivation and Outcome by referring to the ability of actors (individual, group, state) to effect change, which matters for one's sense of empowerment as well as the extent to which desired goals can be reached.

Our findings show that stewardship is already effectively a boundary object, as different uses exist that share some common characteristics. However, we also argue that boundary objects need maintenance to retain its properties as both flexible in applications, but with robust common meanings – which is important for efforts to integrate or bridge between different research approaches. For sustainability science, we identify the *care* dimension as a particularly important area for further research – not just treating it as an external driver of stewardship, but also as an integral part of why certain Actions and Outcomes are more feasible or desirable depending on prevailing norms and values.

In summary, these five papers provide a combined effort to advance conceptual understanding of stewardship while simultaneously also test the empirical relevance of a new framework. Drawing on the metaphor of a research journey (Figure 6), the thesis starts by characterizing stewardship actions and functions (**Paper I**), goes on to study how civic stewardship can generate *agency* and change (**Paper II**) and solutions to ecosystem management based on *knowledge* about local dynamics (**Paper III**). It describes how *care* for certain meanings of a place shapes engagement and direction of stewardship (**Paper IV**), before taking a broader perspective to understand how stewardship literature in general can be understood and structured through these dimensions (**Paper V**).

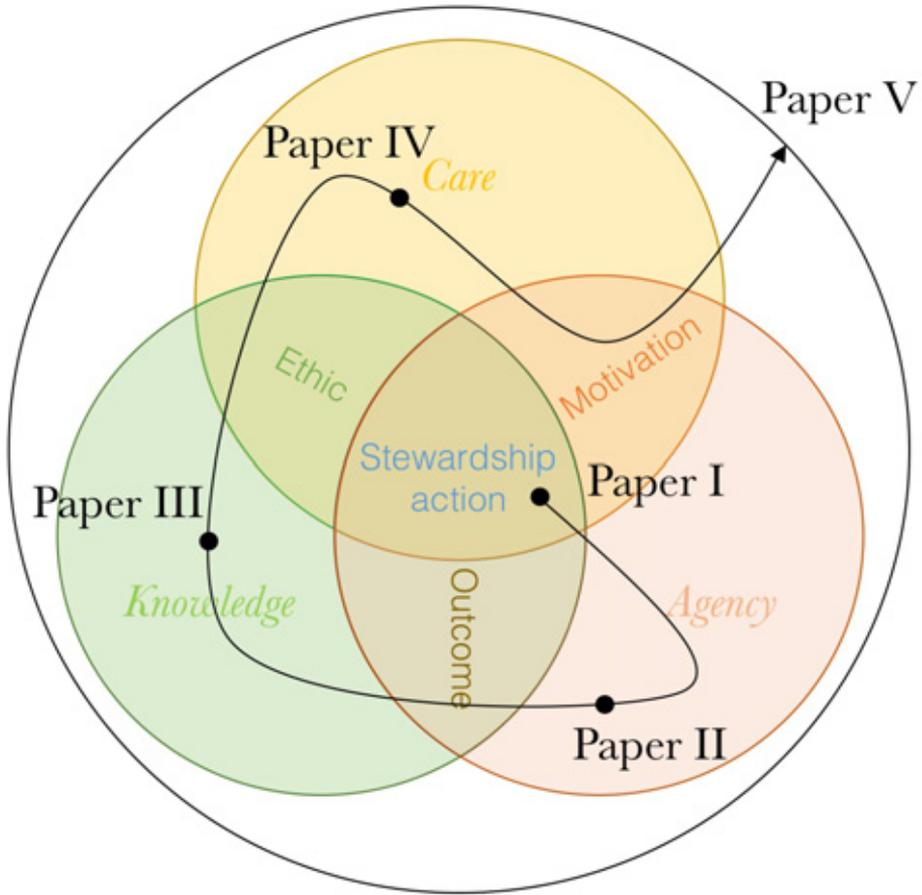


Figure 6 This thesis can be illustrated as a pathway representing the succession from **Paper I** to **Paper V**, where the empirical papers focus primarily on one of the dimensions of stewardship and the final one maps how they fit together. The figure also includes the four overlapping themes identified in stewardship literature, as presented in **Paper V**: Ethic, Motivation, Action and Outcome.

5. Discussion

As stated in the introduction of this thesis, life as most humans know it will be urban for the foreseeable future. The Anthropocene is defined largely by cities – not just because a growing majority of our species live in cities, or because urban land expansion transforms agricultural lands and threatens biodiversity – but also because this new, urban world reshapes how humans interact with the environment. First of all, cities increasingly rely on ecosystem goods and services shipped from distant regions, which often ‘masks’ any signals of unsustainable use (*sensu* Ludwig et al. 1993, Huitric 2005). Further, as economies of scale incentivize monocultures, this consumption is often compartmentalized, sourcing different goods from different places (Cronon 1991, Grimm et al. 2008). Paired with limited access to green areas where one can form bonds to nature to foster pro-environmental attitudes (Beatley and Newman 2013, Giusti et al. 2014), this could indicate that urban inhabitants risk being ‘disconnected’ from the biosphere with little or no ability, incentive or understanding of how to act responsibly towards nature (Folke et al. 2011, Andersson et al. 2014a).

However, there is ample evidence that urban dwellers engage in many different forms of caring for their local environments, as demonstrated in this thesis as well as previous research. Local civic engagement for urban green spaces may even be on the rise (Svendsen and Campbell 2008), which suggests that rather than being disconnected, people in cities are forging a new type of relation to nature – one based on stewardship. Given the importance of cities and urbanization as harbingers of future environmental change (Pickett et al. 2011), it is important to ask what there is to learn from these initiatives. The case studies described in the previous section demonstrate that civic stewardship groups can be critical for protecting urban nature, help resolve undesirable traps and identify new pathways forward, and that they take different directions depending on people’s relation to and vision for the place they work with.

This section uses the conceptual framework presented in Figure 2 (page 16) to further discuss and distill key insights regarding how civic groups interact and engage with the urban environment. The following discussion is structured around the three dimensions of stewardship, *care-knowledge-agency*, as captured in the stewardship definition in the introduction (see page 2). After these three subsections, I reflect on how stewardship can capture a more positive vision for what human–nature relations could look like in the Anthropocene.

5.1. Three ways to understand civic engagement

5.1.1. Personal and societal values and norms of care

A key insight from this thesis is that a stronger sense of care (operationalized as place attachment) does not necessarily lead to more or better stewardship efforts (**Paper IV**). This confirms previous findings regarding pro-environmental attitudes and behavior (Oreszczyn and Lane 2000, Davenport and Anderson 2005, Smith et al. 2011, Masterson et al. 2017) that the specific *meanings* people associate with a place are crucial for understanding what they care about and what changes they might be willing to accept and support (Stedman 2008, **Paper B**).

My case studies give several examples of how stewardship actions are motivated by a broad range of social–ecological place meanings, ranging from physical features (e.g. lake connectivity, **Paper III**), to environmental quality, to childhood memories (**Paper IV**), to direct resource dependence (i.e. water supply, **Paper II**). This provides support for an argument in **Paper B**, that stewardship cannot be understood as a purely social phenomenon but that it is also shaped by biophysical features and, importantly, ecological dynamics that influence ecosystem service provision.

A third important insight relates to the societal or collective side of care and the creation of protective norms. Both lake groups in Bengaluru and stewardship groups in NYC actively incorporate work to alter public perception of the place they work with (**Paper III & IV**, see also **Paper C**). This typically involves promoting both social and environmental values about a place, which supports and extends previous findings about how to create protective narratives by linking cultural and ecological values (Ernstson and Sörlin 2009, Andersson et al. 2014b). Clearly, groups consider work to educate and reshape other people’s relation to urban nature as part of stewardship activities. This shows that civic groups seek to influence human–nature relations in cities also among people who are not directly participating in stewardship themselves.

Taken together, these insights demonstrate that the care dimension of stewardship is dynamic and malleable, and influenced by both ecological as well as social factors. This also invites further research questions, such as:

- For what types of stewardship activities and outcomes is it advantageous if a group has members with different ideas of what it is that makes their site valuable, i.e. that have a more diverse set of place meanings?
- In what situations does strong attachment to a place impact stewardship outcomes negatively? What happens with stewardship where there is a strong sense of care but for instance, a lack of adequate knowledge, or when agency is constrained by property of access rights?
- How relevant are insights about care when it comes to stewardship at scales beyond a city? If we want urban stewardship to inform human–

nature relations more generally, it is important to understand how people come to care for places that have a larger geographical extent – can the planet be seen as a place to care for?

5.1.2. Learning and knowledge about human–ecosystem interdependencies

The most important types of knowledge that civic groups contribute with in the studied cases stem from their unique position as embedded in the SES that their stewardship is focusing on. As users of and visitors to a site, they can have access to more immediate and detailed information than a manager who visits only occasionally. This is usually the case in Bengaluru, where public authorities have limited resources to spend on lake management (**Paper II & III**), but also at several sites in NYC, where groups organize cleanups, removal of invasive species and water quality testing when municipal authorities do not (**Paper IV**). The embeddedness is particularly evident in the Bengaluru cases of lake group members who depend on borewells for their drinking water. Here, a degraded ecosystem (polluted or dried lake) results in a relatively direct environmental feedback (degraded or depleted drinking water). This helps build an understanding of lakes' connection to water supply, which is crucial in a context where this link is in effect ignored by the authorities in charge of managing water bodies and water supply (**Paper II**).

As a second important insight, the finding that lake groups contribute to better social–ecological fit (**Paper III**) demonstrates SES understanding as an emergent property of groups' collective engagement. This is comparable to notions of social–ecological memories held jointly by stewardship groups in other urban contexts (Barthel et al. 2010, Andersson and Barthel 2016). In Bengaluru, the notion of social–ecological memory is captured in an increasingly common narrative that reiterates lake chains' origins as created by both people as well as nature (see also **Paper C**). Another example of collectively held memories was observed in two groups in NYC, where members described their sites through stories that had been passed down through generations (**Paper IV**). This gives access to knowledge about previous conditions and of ecosystem dynamics that operate over longer timescales, and can also shape place meanings and a stewardship identity (Krasny et al. 2014). In our study, these groups indicated high place attachment and desire to protect their site's current state, which confirms previous findings by Andersson et al. (2007) about a link between place attachment and protective norms.

However, it should also be noted that knowledge in and of itself cannot always be applied towards improving stewardship outcomes. As argued in **Paper I**, collaborative networks involving different actors are important for information sharing and joint learning. In **Paper II**, the coordinator of an umbrella organization for lake groups calls for these groups to take on the task of relaying environmental feedbacks to city-level authorities, as a way to make management efforts more effective. The Bengaluru case also supports previous arguments that vertical connections are important for communication in the

opposite direction (i.e. top-down, see Ernstson et al. 2010), as local groups sometimes need knowledge in the form of technical know-how or hydrology expertise.

These findings show that civic groups often have access to a unique understanding of urban SES, since they are embedded in both the social fabric of the neighborhood, as well as ecosystem dynamics and processes happening day-to-day, or on timescales spanning several generations. What purposes this knowledge can be applied for often depends on how it can be shared with other actors through social networks. This indicates several directions for further research:

- In collaborative stewardship networks, what can enable co-production of knowledge by multiple actors?
- Considering the value of emergent and iterative process of learning and understanding SES, how can local groups' knowledge be formally recognized without being appropriated or controlled?
- Where does knowledge come from, and which knowledge is beneficial for guiding stewardship activities towards sustainability? If an SES is potentially obsolete, e.g. if Bengaluru's lakes would turn out to not be feasibly reintegrated in water supply, is knowledge about it also an obstacle for sustainable development?

5.1.3. Capacity and agency to accountably influence human-ecosystem interdependencies

A first key insight regarding civic groups' agency is how they obtain it. As mentioned above, being based locally gives an advantage in day-to-day monitoring of environmental quality and threats, compared to public authorities that typically depend on staff who tend to several different sites and potentially, different kinds of tasks. Monitoring can be particularly important when public agencies have few resources and rapid urbanization means that encroachment can happen literally overnight. In Bengaluru, where this is the case, groups have been able to leverage their local presence in negotiations with authorities, and use it to successfully advocate for 'ecological' lake restorations and formal recognition in co-management agreements (**Paper II**). This gives them a stronger voice in defining the long-term role of the lakes in the landscape. They have used this to emphasize lakes' importance for water supply, and the need to manage them as an interconnected network of lakes as opposed to isolated water bodies (**Paper II & III**). This approach could have broader applicability since it would be easy to adapt to local conditions – all it requires is local residents with the time and motivation to more actively monitor and report changes at a site they pass on a regular basis, and a formal management agency interested in saving resources and open to acknowledge civic actors as partners contributing valuable information.

A second observation is that agency seems to be self-reinforcing. Groups that are formally acknowledged by authorities gain prestige and recognition

among other groups as ‘success stories’, and are thereby able to inspire and influence how other lake groups approach lake restoration and management, to increase social–ecological fit (**Paper III**). While this indicates that civic involvement would benefit ecosystem management, it could also be a vulnerability if roles and responsibilities are not sufficiently formalized or if critical functions depend only on civic engagement that may fade over time.

A third insight is that being ‘outside’ existing management institutions can come with both disadvantages and opportunities. As outsiders, the lake groups in Bengaluru have often struggled to make their voices heard by city authorities. However, Dorado (2005) has shown that actors outside existing institutions can be critical for identifying pathways forward, that others are blind to, which is key for addressing the rigidity trap described in **Paper II**. Studying transformative agency in SES, Westley et al. (2013) further point out that the ability to affect change rests not only with individual actors, but is also dependent on conditions created by temporal dynamics in the system. This means that ‘windows of opportunity’ may open when conditions are more favorable (Olsson et al. 2006) – in other words, agency may also be found in the ability to wait and be ready for the appropriate moment before acting, and in the meantime experiment with alternative approaches.

Further, it is important to note that civic engagement does not always or necessarily have a universally desirable influence on stewardship. There is tremendous global variation in how cities function (McHale et al. 2013, 2015) and each urban landscape is also likely to be highly varied (**Paper I**). In conflicts of interests, there is a risk that groups empowered as stewards push for outcomes that are disadvantageous for others who may not have the same level of influence. This is particularly relevant in the context of growing middle-class engagement in Bengaluru (**Paper II & III**), as examples from the desires for a ‘clean and green’ urban environment sometimes mean denying access to less affluent members of society (Baviskar 2003). Here, third-party actors – often in the public sector – has an important role to play in terms of ensuring equitable and democratic solutions. This can become problematic; if an agency wants to devolve responsibilities and a local group is eager to gain more influence, other stakeholders may end up at a disadvantage if no one is looking after their interests.

Proposing ‘collaborative networks’ is clearly easier than actually organizing effectively functioning ones. If environmental stewardship is the end goal, it is important to clarify whether this refers to supporting local initiatives or achieving certain outcomes at a higher scale – i.e. a tension between the interests of network members and overarching goals of the collective (Provan and Kenis 2007, see also **Paper A**). The insights above show that civic groups can leverage their position to gain agency in these interactions, but they may still ultimately be constrained by other actors’ willingness to acknowledge them. An alternative approach is to become a watchdog and focus on holding authorities accountable (**Paper A**). More research is needed to develop a typology of

kinds of stewardship and stewardship collaborations in the urban context, relating to, for example, different rates of urbanization. Other useful future research questions include:

- Under what conditions can different kinds of stewardship networks and activities contribute to improved governance of urban nature? What is the potential generalizability of the model of locally embedded stewardship where civic groups work to adapt interventions to local social–ecological conditions?
- How does stewardship agency matter for the co-production of ecosystem services? What ability do (different) local residents have to influence the benefits generated on land they do not own themselves?
- How can equity and environmental justice be studied within a stewardship framework? If stewardship is to be promoted, what mechanisms can help ensure a more just sharing of agency and influence beyond middle and upper class residents?

5.2. Human–nature relations in the Anthropocene

At its core, stewardship is about taking care of something – a place – that you are also a part of and to some extent dependent on. This means that unlike management, stewardship implies being personally invested and having a direct bond to the site in question – which by extension also involves subjective preferences for what kind of place it should be.

Civic engagement in urban environments provides useful cases for studying stewardship. Urban residents may not be as immediately dependent on local ecosystems as a rural farmer or forester, but unlike public authorities and other formal actors, they are the direct users and beneficiaries of green spaces and ecosystem services in the city.

Urban areas share and extend several defining characteristics of the Anthropocene. Some of these contribute to a severed link between humans and nature, in the sense that cities often obscure their dependence on ecosystem goods and services to provide wellbeing for its inhabitants. The notion of a ‘disconnect’ from nature has been studied both in terms of cities’ commodification of ecosystem goods (Cronon 1991), misalignment between administrative boundaries and ecosystem dynamics (Bergsten et al. 2014) and preschool children’s access to nature in cities (Giusti et al. 2014). This shows that urbanization is not merely about spatial expansion and land-use change, but also about relations between people and land. This is illustrated in **Paper II**, where urban ‘development’ has led to encroachment on Bengaluru’s lakes and removal of water supply management from local communities. Together this has reinforced a rigidity trap defined by increasing reliance on distant water sources. Similarly, the compartmentalization of lake management in the city is a key factor for why the lakes are not managed as an interconnected network

at the landscape scale (**Paper III**). Sometimes, nature seems to remind humans that their controlled urban spaces are not as independent and self-sufficient as they might seem. This is evident when the combination of heavy precipitation events, impermeable land cover and ageing infrastructure cause untreated sewage to flow into NYC's waterways, sending a message – by means of odor – to anyone living nearby that the city is not a closed loop system (**Paper IV**). More seriously, this disconnect can also have severe impact on human lives – as seen recently during the rains in South Asia when the degraded wetlands and mudflats in Mumbai reduced the ecosystems' ability to retain and buffer extreme water flows (Nagendra 2017).

Despite the disturbed and degraded status of many city environments, stewardship groups display acts of care for urban nature. As users of the water resources of Bengaluru's SES, and direct beneficiaries of other ecosystem services it provides, locally based civic groups have a different understanding of the lakes than the public authorities managing them from the 'outside' do. This can help them more easily identify interactions between people and nature; in other words, it is much harder to ignore a lake's importance for groundwater levels when your own borewell runs dry (see page i). Whether the misalignment of management arrangements with SES dynamics is spatial (**Paper III**) or temporal (**Paper II**), understanding the human–nature interdependencies is key for addressing this problem of fit.

This understanding is therefore what distinguishes stewardship from management, and why I emphasize the notion of *care* as needing more attention in stewardship research. Civic engagement in stewardship can demonstrate how care and responsibility is relevant for the governance of urban nature (**Paper I**). The care dimension of stewardship draws attention to the values, sense of place and ethical norms that shape human behavior. This thesis, in particular **Paper IV**, treats care as an integral part of social–ecological dynamics and stewardship. I study it using sense of place theory and methods developed in social psychology (see also **Paper B** and Masterson (2016) for further investigation of sense of place's relevance for SES research, and **Paper C** for an application in the Bengaluru context). In stewardship literature more broadly, care – as represented by the two themes Ethic and Motivation in **Paper V** – is predominantly studied by scholars in the social sciences, arts and humanities. This means that for SES research to fully engage with all dimensions of stewardship, including care, there is a need to identify and develop approaches that effectively work to bridge cross-disciplinary divides. There are important examples of recent advances in this regard (Barreteau et al. 2016, Stedman 2016, **Paper B**), and I argue that the framework presented in this thesis provides an opportunity to continue this work also on the topic of stewardship.

Specifically, the framework provides a basis for engaging with *care*, *knowledge* and *agency* in tandem. Care is particularly useful for forwarding our understanding of the other two dimensions, for example how they can emerge and grow from one another. In the cases studied in Bengaluru, engagement often started with a more singular appreciation of, or care for, a place (e.g. for its

scenic beauty), but then gradually broadened as people gained more knowledge about the place (i.e. about biodiversity values, ecosystem services such as flood control) and they began to see the impact of their own agency through the work they had accomplished. This fits with previous arguments that an appreciation of a site's cultural ecosystem services can be a gateway for also safeguarding other benefits of urban greenery (Andersson et al. 2014b, **Paper C**). However, the groups in NYC demonstrate that there are different possible pathways to stewardship, some starting not from care but from a scientific understanding a specific ecosystem, or by being in a position to influence the future of a site. This shows that care, knowledge and agency can be useful for understanding different ways in which stewardship emerges, spreads and develops in urban contexts, which is crucial for creating policies that effectively support and nurture it. Importantly, there is a need for further research from different urban environments – particularly in small to medium-sized cities in the global South – to complement and extend the insights here with a broader understanding of stewardship under different social–ecological conditions.

A related research need concerns the potential scalability of stewardship, and the relevance of insights from local civic groups for national or global-level sustainability challenges. Assuming scalability of the care dimension may be particularly problematic (Heise 2008, Nassauer 2011), as an intimate and personal bond becomes increasingly abstract as the size of the place that is being cared for grows. Behavioral experiments have indicated that small-scale resource users act more responsibly when facing ecosystem uncertainty compared to larger organizations and companies (Schill 2017), which could mean that scaling up stewardship is also problematic in terms of social organization.

As I have argued, cities are relevant for studying future challenges of the Anthropocene, such as the masking of human dependence on nature which undermines environmental awareness. However, it is neither feasible nor particularly desirable to address this problem by reverting back to the direct dependence on local land more common during pre-industrial times. Given that we live in a now urbanized world, what other relationships to nature can be imagined that still promote sustainability?

The findings from this study (in particular **Paper IV**) demonstrate that environmental concern and stewardship takes many forms and comes with different end goals. This includes engagement from people without a strong bond to a specific place's uniqueness, and from residents without deep roots in the local neighborhood, city or even country. Considering increasingly mobile lifestyles of many urban residents, exploring how bonds to 'types of places' affects stewardship may be a productive way forward (Chapin and Knapp 2015). Some of this is captured in the 'pathways to stewardship' described in **Paper IV**, which could be a useful starting point for continued investigation of how stewardship shapes human–nature relations, in cities but also more broadly.

Recent studies reflect an increasingly positive idea of what role regular people can play in collaborations and partnerships to promote the healthy functioning of ecosystems (Chapin et al. 2009a, Ernstson and Sörlin 2009, Krasny and Tidball 2012, Romolini 2013, Groffman et al. 2016). Here, I argue that they can also provide important lessons about what stewardship is and how it emerges and functions in highly disturbed environments. Not only can locally-based groups inform us about how to make environmental management better adapted to social–ecological feedbacks over time (**Paper II**) and to spatial connections in urban landscapes (**Paper III**), they also demonstrate how a range of different stewardship engagements are possible in densely populated environments (**Paper IV**). These are all important lessons going into a future where humanity’s role on the planet will need to be redefined and a more careful relationship developed.

6. Conclusions

Humanity is facing a changing world, where its impacts on the planet are undermining crucial life-support systems. Few places illustrate this better than cities, where most of the human population now live and where everyday life is often distanced from the ecosystems that underpin welfare and wellbeing.

Stewardship has been presented as a term to signify responsible actions for the environment, but with a range of definitions and applications, the concept remains vague and risks having its meaning diluted. The framework introduced here focuses on stewardship as a type of relation between humans and the rest of nature, one that can be understood through three dimensions: *care*, *knowledge* and *agency*. The empirical case studies I have presented demonstrate how all three interact to shape both engagement in stewardship, as well as what it can achieve.

I study stewardship through civic groups in an urban context, and show how they can perform important and unique functions towards sustainability in social–ecological urban systems. This includes contributing crucial change agency to move away from trap dynamics, and promoting social–ecological fit in management or urban lakes networks. Civic groups differ from other relevant actors in that they consist of members who are embedded in the environment they work with; in other words, they not only seek to influence how a site is managed, they are also typically the end users of that site. This is a key characteristic that defines stewardship as opposed to management. It also draws attention to the importance of care as a dimension of stewardship that has received comparatively less attention in research, especially in the environmental and natural sciences. I argue that there is a need to better address this aspect of stewardship, and use sense of place theory to study how caring for a place can result in a range of different commitments and visions for what stewardship goals for that place ought to involve.

Civic groups thus provide important lessons for how to forge positive human–nature relations in highly altered and disturbed environments. They cannot perform all tasks better than other actors; in fact, their impact often lies in being able to inform and influence what others do. However, they represent an embedded and engaged dimension of stewardship that matters for identifying approaches and solutions that are sometimes new and innovative – most importantly, different from what may be most apparent for other actors. Last but not least, they also show us that environmental concern does not necessarily decrease just because healthy ecosystems are on the decline – which might be a promising sign for a future in an increasingly urban world.

7. References

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