Mapping local news ecosystems, Phase 1: Meta-review of the literature, a typology of ecosystem studies, and a proposed method for the ideal ecosystem study

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Introduction

There is no question we live in a time of major disruption to journalism and the news industry, with local news being particularly hard hit. Round after round of layoffs and cost-cutting have left local newsrooms decimated, and fewer journalists means fewer eyes on power. However, there is little hard data on the extent of the loss of local news coverage, or on how the health of communities is connected to the health of local news and information ecosystems. Where are the local news deserts in any given state? Do towns that lack local policy news actually fare worse? [1] Asking these questions in this moment, which has been called a moment of communication crisis (Lloyd and Friedland 2016), is important as we work to discern what citizens need, what media provide, and how to close that gap. Closing the gap is one of the goals of this multi-phase project; phase one, in this paper, synthesizes the literature to create a plan for mapping communication spaces, or ecosystems, as we look for those gaps.

It is perhaps because of the uncertainty of this moment, in terms of the still-unfolding transition from legacy to digital and from a news media controlled by big players to one in which we are all, at least potentially, publishers, that scholars have increasingly sought a bird's-eye view of the news and information landscape, something the ecosystem approach offers.[2] The ecosystem approach helps us to see entities as they relate to one another, rather than in isolation, which we hope can highlight weak points in the information environment. In laying out this approach, Anderson (2016) defines a news ecosystem as "the entire ensemble of individuals, organizations, and technologies within a particular geographic community or around a particular issue, engaged in journalistic production and, indeed, in journalistic consumption" (p. 412). As Anderson points out, this encourages us to move outside the newsroom and beyond large players to include many or, ideally, all information creators and distributors in a given space.

By moving outside of the newsroom, we broaden our sphere of exploration beyond news to include information produced by non-journalistic organizations, such as chambers of commerce or community groups. This is in line with a push within journalism studies to acknowledge that the borders of our field are spreading beyond newsrooms to include a broader range of information providers (e.g. Lewis, 2011). Other

[1] Note that we focus in this project on news related to local government and local policymaking because this is the information most in danger of being lost as news organizations contract (see, e.g., The Aspen Institute 2009).

[2] In many studies, the terms "ecosystem" and "ecology" are used interchangeably; here we favor the term "ecosystem," because it denotes an organized field whose structure is less biological and more susceptible to economic forces and other struggles for power (see, e.g., Bourdieu 1990, 1993).

voices in the field argue that the distinctions between journalists and non-journalists, or between newsrooms and civic-information-producing organizations, are increasingly meaningless and largely the product of journalists struggling to maintain authority (Delli Carpini 2017; Coddington 2012).

Digital tools have made ecosystem studies more feasible in recent years, as scraping and visualization software have allowed us to map large landscapes more efficiently. Yet, as we describe below, such efforts still tend to fall into two categories: geographically vast, but shallow (explore several ecosystems but portray only a portion or slice), or geographically limited, but deep (explore at a limited number of ecosystems but in great detail). This tension is not unique to ecosystem studies and is perhaps inevitable; still, the goal of this paper is to try to define the theoretical parameters of an ecosystem mapping method that covers a considerable area while capturing the lived reality of local news ecosystems.

Beyond establishing a method for large-scale mapping of local news ecosystems, our goal is to identify for intervention those communities without regular local government news coverage. Identifying such communities is complicated. The first question is what constitutes a local community. It is tempting to use government-drawn geographical boundary lines, such as municipalities, but people's lives spill over these artificial lines, and local news coverage rarely obeys them either. The second challenge lies in identifying all or even most of the sources of civic news and information, as certain outlets (e.g. ethnic media) tend to be the last to go online, and some of the most vital sources – radio, television, and private Facebook groups – are not easily detected with standard methods.

In an early attempt to solve these challenges, one of the authors of this article piloted a media census approach combining qualitative and quantitative methods to identify local news ecosystems in one state. Initial data was gathered through telephone interviews with key people in local government, usually municipal clerks and mayors, in some of the state's several hundred municipalities. Municipal clerks were asked which local news outlets had sent reporters to recent meetings, in an effort to identify outlets paying attention to municipal activities in such a way that did not rely solely on some form of internet search. This proved unsuccessful due to the challenges involved in reaching and speaking with the large number of subjects, many of whom work irregular hours or are suspicious of answering such questions. There were also inherent problems with relying on information often contained only in interviewees' memories. Furthermore, coverage often crossed municipal lines, especially in small municipalities or in areas with a strong regional identity. This reinforced the inclination to explore the possibility of using different, more organic boundaries to identify local news and information ecosystems.

This paper is the first step, then, in a multi-stage project that tackles the challenges of scalability and boundaries in ecosystem studies. First we survey the literature, focusing mostly on the United States, as this is where most (but not all) of the most prominent ecosystem research has been conducted. The typology that results lays out the dimensions of a method for identifying local news ecosystems that is theoretically sound, operationalizable, and would make intuitive sense to people whose local news ecosystems are being studied. We end by offering methodological paths to that goal. Phase two of the project will involve using this ideal research design to identify all local

news and information ecosystems in one state that will serve as our pilot, in the process evaluating the most common databases used for this purpose. In phase three, we will assess each local news ecosystem for whether it produces a pre-identified amount of civic news and information, thereby producing an accurate, actionable map of news deserts and oases in that state.[3] Ultimately we hope that scholars will apply this methodology in other states to produce for policy-makers, investors and philanthropists a road map for how to best fix the broken local news ecosystems around us.

Characteristics of news ecosystem research: Metaphors, boundaries, and methods

The best news ecosystem studies involve A) the identification of institutions and actors that produce and/or distribute news, B) an empirical assessment of the relative amount and quality of information within the ecosystem, and C) the roles and interactions of the various elements that make up the ecosystem.

Our review of the literature points to three fundamental variables that can be used to assess most if not all ecosystem studies: guiding metaphor, boundary, and method. The guiding metaphor may be environmental, which sees the ecosystem as akin to a biological environment of inhabitants: growing, competing, evolving and decaying within a virtuous circle; while the rhizomatic metaphor focuses on asymmetric flow through the ecosystem, including actors not previously considered to have agency (Anderson 2016). Second, we have observed that boundary lines around ecosystems are either government drawn, e.g. municipal lines, or organic, defined either by the players that make up the ecosystem, or by an issue that extends across many geographies. Finally, the method can be a case study that explores a single news story or a ecosystem, or scaled/scalable study – moving, at least potentially, beyond a single case to describe multiple ecosystems. As Table 1 shows, these characteristics combine to form eight different types of ecosystem studies, each of which we discuss briefly below.

Table 1: Types of ecosystem studies

Metaphor	**Boundary**	**Method**
Rhizomatic	Gov't-drawn	Case study
Rhizomatic	Gov't-drawn	Scaled/Scalable approach
Rhizomatic	Organic	Case study
Rhizomatic	Organic	Scaled/Scalable approach
Environmental	Gov't-drawn	Case study
Environmental	Gov't-drawn	Scaled/Scalable approach
Environmental	Organic	Case study
Environmental	Organic	Scaled/Scalable approach

[3] We will refer in the rest of the paper to government and civic news and information simply as "news," unless further detail is needed.

Metaphors in news ecosystem research: The environmental vs. the rhizomatic

Anderson (2016) offers the most explicit discussion of the guiding metaphors in media ecosystem research: the natural environment and the rhizome. The environmental approach envisions media forms and outlets as species/organisms that evolve, grow, decay, and become extinct. It implies that there exists an equilibrium, which Fuller defines as "a resilient and harmonic balance to be achieved with some ingenious and beneficent mix of media" (Fuller 2005, 4) – and that arriving at this equilibrium is desirable. The environmental metaphor can also underscore how entities evolve to fill niches in the environment, or die off if they become inefficient or attempt to occupy a space that is already full (see also Lowrey 2012). Finally, the environmental approach is human-centered, often normatively oriented toward the effect of a healthy news ecosystem on the ability of people to participate in civic life, and focuses on institutions and newsrooms.

Anderson contrasts this with the rhizomatic approach, which aims to incorporate information generation among producers outside of such newsrooms, and highlights how information flows (changing and evolving) through a dynamic and overlapping series of information networks. As with a biological rhizome, there is no central node or symmetric skeletal structure, implying perhaps a certain inherent inefficiency or inequality. Indeed, Fuller (2005) envisions the rhizome as a network in which the human is just one portion. These studies focus on diffusion, while the environmental ones are more production-focused. In the rhizomatic model, information flows between and among players -- human but also organizations, platforms, or technologies. The rhizomatic understanding is part of a push in journalism studies to look beyond legacy news organizations and explore how information flows, and how audiences interact with and change it. In essence, the rhizomatic metaphor focuses on how information is co-created as it flows through networks: co-created by the initial actors who launch information into the ecosystem, as well as each player that reinterprets and passes it on.

We can think of the environmental approach as mapping existing assets and implying, if not fleshing out, relationships between them, with the goal of understanding how news organizations move toward efficiency – while contributing somewhat inevitably to local democracy. The rhizomatic approach may also involve an inventory, but the focus is on how information flows through the system, which includes entities outside of the traditional journalistic field, and assuming some level of inefficiency and perhaps even counter-democratic tendencies.

Boundaries in news ecosystem research: Government-drawn vs. organic

Geography is inherent in the notion of a local news ecosystem. The most obvious geographic boundaries are the town or city – that is, a government-drawn line within which services are rendered and taxes collected, since these are the levels at which people are most likely to engage with their local policy-scape. Local and regional newspapers traditionally also used such boundaries. Most local data required for ecosystem research,

such as census figures, are organized according to municipal boundaries. While this government-drawn formulation makes sense, it also remains somewhat arbitrary, especially as digital communication increasingly lets people interact outside of boundaries of physical time and space (e.g. Rainie & Wellman, 2012).

On the other hand, identifying a local news ecosystem using an organic boundary may focus on assemblages arising through circulation, use, or relevance of local news and information to disparate or more loosely organized communities. One can imagine community identities spanning municipal lines, as a community bounded by common ethnicity, or by a large employer. This is analogous to field theory's emphasis (e.g. Benson 1999; Bourdieu 1993) on defining players by relations to each other and to the broader power structure.

In other words, spaces of specific practices – such as production and consumption of news – may be identified by the social and cultural logic that operates within those spaces, not by imposed logics such as government-drawn boundaries. This may require using definitions of news organizations themselves, by looking at which geographic areas they choose to report on (and not report on). The space may also be delineated by citizens expressing areas or issues they see as most representing their daily, lived concerns. The primary drawback to organically defined local news ecosystems is that it complicates the process of determining relevant government authorities and data. Another drawback is the methodological puzzle of identifying these organic local news ecosystems.

Methods in news ecosystem research: Case studies vs. scaled/scalable designs

The methodological approach to identifying local news ecosystems has fallen into two camps. Case studies examine a specific place or event and use data collection tools that cannot be easily scaled, like on-the-ground explorations or analog studies of particular news stories flowing through the ecosystem (e.g. Pew, 2015). The scaled/scalable approach, on the other hand, employs methods capable of spanning geographies or news events: surveys, large datasets, or scraping software. We use the term "scalable" to include not only those studies that are already scaled, but also those could be (e.g. Napoli et al., 2015).

News ecosystem case study methods may include fieldwork, ethnography or manual content analysis. The Pew Research Center study of news diffusion in Baltimore, for instance, reconstructed specific local news events by manually analyzing iterations of stories as they evolved in print, broadcast and online (Pew Research Center, 2010). The actors were enumerated through reportorial investigation – digital groundwork, email messages and phone calls to journalists and other stakeholders. Anderson's work on the Francisville Four came out of time spent in Philadelphia newsrooms and activist communities, combining network ethnography and qualitative newsroom analysis (Anderson, 2010). These are classic case study designs. The amount of labor involved in replicating these works at a larger scale is outside the realm of possibility for any academic or industry study.

We argue that a local news ecosystem study is scalable if A) its design does not limit it to a handful of communities, even if it was piloted in one; and B) the news

content need not be limited to a single news event or handful of news events even if the analysis was piloted on a single story; and C) the ratio of programmatic data collection to manual data collection leans toward the former.

Has a local news ecosystem analysis ever been executed at scale? Such a study would examine dozens or hundreds of local communities, identifying journalistic actors in the ecosystem, chronicling news output, and tracing the diffusion of news from one to the next. The answer as of yet is "no," though some work is in progress (Napoli et al., 2018).

Still, a number of published studies *may* be scalable, allowing proliferation of data while keeping research labor in check. These include network analyses, such as Graeff et al.'s (2014) study of the diffusion of news about the killing of Trayvon Martin, or Gordon and Johnson's (2011, 2012) studies of the Chicago digital news ecosystem. Neither were scaled, but their leveraging of computational tools to collect data programmatically opens up broader possibilities. Other types of studies that could be considered scalable are those that leverage existing databases, for instance lists of journalists and publishers that can be repurposed to study local news ecosystems on a large scale. This includes pioneering research by Napoli et al. (2017).

Case studies offer more nuance and depth, but often sacrifice generalizability. Scalable studies can offer generalization, but often sacrifice detail and depth. We argue that it's time for scaled approaches after more than a decade of largely case studies. Below we look more closely at news ecosystem research that employs the eight models of ecosystem studies outlined above, to identify further the strengths and weaknesses of each.

Exemplars of news ecosystem research typologies

Table 2 shows the eight combinations of metaphors, boundaries and methodologies in the empirical literature on news ecosystems that were presented in Table 1, including the studies we discuss below that fit into each model. While our emphasis is on local news, work at levels other than local is included where relevant. Not every study fits neatly into one model or another; we place studies in whichever typology fits best.

Table 2: Summary of studies described in more detail below

Metaphor	**Boundary**	**Method**	**Studies**
Rhizomatic	Gov't-drawn	Case study	Anderson, 2010 Pew, 2010 Nielsen, 2015 Coleman et al., 2016
Rhizomatic	Gov't-drawn	Scaled/Scalable approach	Faris et al., 2017 Gordon & Johnson, 2011, 2012 Ramos et al., 2013
Rhizomatic	Organic	Case study	Graeff et al., 2014 Ball-Rokeach, 2001 Benkler et al., 2013
Rhizomatic	Organic	Scaled/Scalable approach	None though we discuss here Faris et al., 2017
Environmental	Gov't-drawn	Case study	Pew, 2015 Durkin & Glaisyer, 2010 Schaffer, 2010 Fancher, 2011 McCollough & Anderson, 2013 Hindman & Beam, 2014 Powers et al., 2015
Environmental	Gov't-drawn	Scaled/Scalable approach	Etling et al., 2014 Napoli et al., 2015 Napoli, unpublished research
Environmental	Organic	Case study	None But we discuss Atwood, 2012 Schulhofer-Wohl & Garrido, 2009 Gentzkow et al., 2011
Environmental	Organic	Scaled/Scalable approach	None

Rhizomatic, government-drawn, case study approach

The 2010 Pew Research Center study on the local news ecosystem in Baltimore (2010), and Anderson's Francisville Four project (2010) both use a rhizomatic approach within a government-drawn boundary and focus on a singular case study. They trace the arc of individual news events from one node in a locally defined network to the next, highlighting the roles a range of actors play in the creation and shaping of news.

The Pew (2010) study was one of the first to provide a comprehensive look at how news circulates in a local ecosystem. Though it was conducted using analog

methods, the study was rhizomatic because it identified sources of news stories as they were launched into the ecosystem, and tracked how news was amplified and added to by new entrants such as bloggers and non-journalistic local information providers. Because the methodology was deep, detailed, and time-consuming, it would not be scalable.

Anderson's Francisville Four study (2010) was an ethnography, so likewise is not scalable. His tracing of the story of unlawfully arrested Philadelphia activists uses a rhizomatic approach, as he tracks the narrative across an ecosystem that includes legacy news outlets, radical blogs, and other digital-native sites. The study is based within the geographic confines of Philadelphia and within this singular news story, making it a good example of this model. Other examples of this model include a study by Nielsen (2015) tracking the flow of local news through the Danish town of Naestved, using analog methods that would be difficult to scale, including manual content analysis and phone interviews; and an in-depth study of the local news ecosystem of Leeds, England (Coleman et al. 2016).

Such studies can look with enough nuance and depth at specific cases to get a full and detailed picture of the ecosystem. Still, the model has two main weakness: first, generalizability is limited; second, too few cases are analyzed to determine any structural causes for the patterns observed.

Rhizomatic, government-drawn, scaled/scalable approach

In this model, a rhizomatic approach is applied to a government-drawn boundary such as a state or municipality using a method that can be scaled to multiple locations. This type of study is relatively rare. Aside from the fact that scaling is complicated, the computational tools that make scaling feasible are relatively new. Most of the studies we discuss are not scaled but *scalable*, because their methods could be applied to a scaled study.

Using the nation as its government-drawn boundary, and the latest digital tools and software, Faris et al. (2017), analyzed 1.25 million news stories from more than 25,000 sources – from legacy outlets to fringe blogs – leading up to the 2016 presidential election. Their rhizomatic study of linking patterns identified the important nodes in the political information network, finding that insurgent "alt-right" publisher Breitbart Media had outsized influence. Because this study was national, it comes close to the rhizomatic, organic, scaled approach. However one could argue that because it focuses on the single issue of the presidential election it also qualifies as a case study.

Another example of the rhizomatic, government-drawn, scalable model are Gordon and Johnson's (2011, 2012) studies of the Chicago news ecosystem. By examining how local websites across Chicago connect through hyperlinks, the authors mapped the structure and flow of local news and information, identifying sites that play a central role in the ecosystem, as well as amplifiers like Facebook that drive traffic to smaller sites. Because the analysis included "greater Chicago," these studies could be considered as using an organic boundary, but we include them here because of their explicit focus on the city.

Finally, guided by questions about the relationships between news organizations, non-journalistic information producers, and audiences, Ramos et al. (2013) studied the changing San Francisco news ecosystem, using network analysis and web crawler

software to look at linking patterns and determine the frequency with which sites linked out and were linked to, and how audiences interacted with sites via comments on specific news stories. Though they focused on San Francisco, we include it here because the method could be scaled to analyze other locations.

Studies of this type allow a wide scope, as in the case of national studies, or comparative analysis. Still, they are limited by their use of government-drawn boundaries, a challenge we discuss further below.

Rhizomatic, organic, case study approach

This model describes studies that look at circulation in an ecosystem that is not delineated by government-drawn boundaries, and is confined to one geography or issue: that is, takes the form of a case study. One example is a study that traced the arc of the news narrative around the 2012 death of Trayvon Martin (Graeff, Stempeck, and Zuckerman 2014), tracking it across digital and analog media sources, including the social web, and accounting for not just the link economy but also the attention economy – a true embrace of the rhizomatic metaphor which emphasizes the interplay between publishers and audiences.

Another example is the series of papers in the Metamorphosis project, led by Sandra Ball-Rokeach (see, e.g., 2001), which looks at the communication infrastructure and circulation of information in ethnic neighborhoods of Los Angeles. The effort is inherently rhizomatic, as it seeks to establish the ways information flows – or is impeded from flowing – through these different neighborhoods. This project's boundaries are organic because they reflect the areas served by the media relevant to the population of interest, as well as the contours of the ethnic neighborhood, which usually cross official city district lines. Similarly, Benkler and colleagues (2013) used the rhizomatic approach relying on organic boundaries in the mapping of the SOPA-PIPA debate. They used a boundary arising out of the contours of the online conversation by performing a linking analysis of the outlets involved. The researchers followed the flow of information between outlets, beginning from the premise that "the relevant communicative sphere [is not] a stable, broad category of sites, ...but rather [is made up of] discrete 'controversies'" (p. 14); in this the approach is distinctly rhizomatic. This study would be difficult to scale because the quantitative social network analysis was supplemented by close reading of many of the articles on the subject as well as interviews with key players.

This model allows for detail and nuance when looking at local news ecosystems, be they issues or geographies where the boundaries arise organically from the activity of information producers and/or audiences. The main weakness is, as before, the limited generalizability from a single case study.

Rhizomatic, organic, scaled/scalable approach

In this model, studies use a rhizomatic approach to explore an ecosystem whose definitional boundaries arise organically, and apply a method that can be scaled to assess multiple locations.

We are not aware of any existing research that fits squarely within this model, though there are some studies that suggest what such work may look like. For example, Faris et al.'s (2017) study of partisanship, propaganda, and disinformation in the 2016 presidential election – discussed above – was rhizomatic and scaled, and focused on the United States' news ecosystem, which led us to characterize it as a case study. However, given external involvement – via social media – during the run-up to the election, one can see how a study that looked beyond the borders of the United States when necessary (i.e. using an organic boundary) would be even more informative and useful. By the same token, Brietbart is known to be in the process of franchising similar right-wing outlets in other susceptible countries such as England and France, attempting to create a feedback loop for populist and nationalist news to influence events beyond national borders (Sullivan & Mcauley, 2017). A rhizomatic, organic, scaled study of the news ecosystem that looks at Brietbart's influence would include the news and information produced by overseas outlets as they related to the U.S. news ecosystem or different conversations happening globally.

The strength of a rhizomatic, organic, scaled study is that it takes a holistic view of an ecosystem, seeing its borders as they arise out of practice rather than by the default of government-drawn boundaries. Obviously these studies can be very resource-intensive, and therefore may yet be outside the bounds of feasibility for most researchers.

Environmental, government-drawn, case study approach

This model describes ecosystem case studies that analyze media outlets or content within a government-drawn boundary, not focusing on how that information circulates within the ecosystem.

One example is Pew Research Center's (2015) in-depth analysis of the local news ecosystems of three U.S. cities. Researchers conducted an extensive audit of the news providers in each city, content analysis of their output, surveys assessing news engagement, and an analysis of social media. Importantly, they found that much of the local news and information in the cities was still analog, and therefore not available for gathering or analysis through digital tools. While none of our categories explicitly address analog versus digital data gathering, it is clear that scaled or scalable studies are possible only through digital methods. We will return to this conundrum in the discussion section. Another example of the environmental, government-drawn, case-study approach is the series of "information community case studies" conducted by New America Foundation (NAF) in the early 2010s (e.g. Durkin and Glaisyer 2010).[4] They took a holistic look at the locations examined, assessing demography and the local economy, educational institutions, media, and other local information providers such as libraries. They did not explore how information flows between players, making them environmental rather than rhizomatic.

[4] Actually, two of the five case studies -- on Minneapolis/St. Paul and the "research triangle" of Raleigh, Durham, and Chapel Hill in NC -- use organic boundaries, and therefore fit better in the "environmental, organic, case study approach." The other three discussed here are on Washington, D.C., Scranton, PA, and Seattle.

Other examples of this model include a 2010 J-Lab study of Philadelphia's news ecosystem (Schaffer, 2010), a 2011 study of Seattle's local news ecosystem (Fancher, 2011), a 2013 study of New Jersey's statewide media ecosystem (McCollough & Anderson, 2013), a 2014 assessment of Washington state's local news (Hindman & Beam, 2014), and a comparison of the local news ecosystems of Seattle and Toulouse, France (Powers, Zambrano, & Baisnee, 2015) – though some of these engage with the concept of ecosystem more loosely than others.

This approach offers a comprehensive portrait of the news ecosystem of a specific location; looking at only one or a few cases allows for a deep dive and nuanced understanding. Still, the environmental approach does not assess the flow of news and information between providers or between providers and the audience, leaving out an important element of news production and evolution. Second, by confining the study area to a government-drawn boundary, the ecosystem may not be fully or accurately represented.

Environmental, government-drawn, scaled/scalable approach

The Berkman Center's 2014 study of the Russian blogosphere falls into this category (Etling, Roberts, and Faris 2014). Taking the very broad, yet still government-defined, boundary of Russia, this study compares the similarity of texts between two news ecosystems: government-run media outlets, and the more independent blogosphere. Even though it is clearly a digital-age study using the latest crawling and scraping software, because it does not look at how information circulates, this study is characterized as environmental rather than rhizomatic.

Similarly, a 2018 study by Napoli et al. looks at the quantity and quality of local news in 100 U.S. communities. In addition, Napoli and his co-authors gathered census data about each city, allowing for a statistical analysis of the correlation between different factors and the health of their local news ecosystem. Clearly then, the scaled nature of this study allowed for a strong comparative element not present in case studies. The pilot version of this 2018 study (Napoli et al., 2015) similarly looked at the infrastructure, output, and performance of the local news ecosystems in three New Jersey communities. This study used the same protocol to build a comprehensive picture of all online news providers located *within the geographic limits* of the three communities, including their social media presence and content. Neither study looked at the flow of news, and did not include any outlets that may serve those communities but are physically located outside the communities' government-drawn boundaries.

The scaled or scalable nature of these studies allows for an explicit and well-informed comparative element, which yields important insights into the structural features of local news ecosystems as they correlate with the quantity and quality of the content. The weaknesses are, again, that these studies do not account for the news flow within these ecosystems, and are therefore somewhat static portraits that may not be accurate even a few years later. There are also inherent problems with using government-drawn boundaries, as we discuss in greater detail below.

Environmental, organic, case study

This model is very rare – indeed, we did not find any studies that fit comfortably – because drawing organic boundaries without linking or circulation analysis is unusual. The organically drawn boundaries in the studies discussed were discovered using digital tools that follow a story (as in MIT's Trayvon Martin analysis) or covering a community that crosses city lines (e.g. the Metamorphosis Project).

One example that points in the direction of this model is The Murrow Rural Information Initiative (Atwood, 2012), which identifies local news deserts by looking at the coverage areas of local news outlets. One can imagine a study that uses the coverage areas of local outlets, identifying local news ecosystems based on how audiences are identified by such providers, rather than by city, township, etc.

Studies exploring the civic impact of newspaper bankruptcy use this model as well. Schulhofer-Wohl and Garrido (2009) looked at the effects on Cincinnati and its surrounding suburbs (which crossed the border into Kentucky) of the closing of *The Cincinnati Post*, drawing the boundaries of their study based on the coverage area of the closed paper and its still-existing competitor rather than by the government-drawn city limits. Gentzkow, Shapiro, and Sinkinson (2011) took a similar approach for their longitudinal analysis of the effects of newspaper entry and closure on local electoral politics. Yet none of these studies considers itself an ecosystem study, or indeed really qualifies as one as we have defined them here; they neither take an inventory of outlets within the area nor look at how news circulates. Rather, we propose them as models of how an organic boundary might be drawn.

Environmental, organic, scaled/scalable approach

As with the prior model, there are few, if any, examples of an environmental approach that uses organic boundaries for the ecosystem and is scaled or scalable, because the environmental approach has generally only been applied to geographically distinct (i.e. government-drawn) boundaries, rather than to organic ecosystems.

Discussion: The ideal model and its operationalization

Above, we identified three key dimensions of existing news ecosystem studies: the guiding metaphor (environmental or rhizomatic), the boundary (organic or government-drawn), and the method (case study or scaled/scalable) -- as well as how they've been combined in various studies. It is clear that a range of factors impact how existing news ecosystem studies are studied. In some instances, the empirical research is driven primarily by scholarly concerns; advocacy of the rhizomatic approach to the exclusion of the environmental fits here. Still, much of the empirical news ecosystem work is motivated by normative and policy-oriented concerns, as evidenced by the number of studies published by organizations outside of academia, which tend to use the environmental metaphor.

For all research, practical and bandwidth concerns are a factor. Case studies are more manageable to execute than scaled-up efforts, as evidenced by the large number of

cases above, as are studies that are *scalable*, but have not been scaled. Finally, we should note that the news ecosystem genre is young enough that much of the work is exploratory—another factor that yields case studies and blunter measures, such as municipal boundary approaches. We should also recognize that the literature points out the challenges of doing rhizomatic, organic, scaled research, though growth in this area has been enabled or at least supported by the growing ease of examining large data sets. Finally, rhizomatic, organic studies sometimes can seem outside of the journalism studies tradition, as they encourage the researcher to move out of the newsroom and beyond the strict notion of news, though this approach is increasingly relevant as news production and gatekeeping expand outside of the newsroom.

Recognizing that certain combinations of approaches offer specific outcomes, a pattern starts to emerge. Rhizomatic case studies (employing government-drawn or organic boundaries) help push the field in new directions. Environmental case studies (with government-drawn or organic drawn boundaries) illuminate the civic implications of strengths or weaknesses in a local news ecosystem. And case studies, whether rhizomatic or environmental, help capture nuances of any given ecosystem and promote external validity, though many case studies neglect to employ a nuanced, organic community-boundary approach, opting instead for the blunter, government-drawn lines. Policy makers and foundations seeking to address broader systemic breakdowns in local news and information access need generalizable and comparative data to be effective decision-makers. Here is where scalable methods offer the most promise, though the challenge lies in reconciling what one gains with scaled data at the cost of what one loses in nuance.

What would a gold-standard approach to the study of local news ecosystems look like? Setting practicalities aside for the moment, such an approach would provide actionable, robust data for policymakers and other community interventionists, yet also satisfy the misgivings of scholarly critics who contend that too much of the ecosystem work has been overly anthropocentric or industry-focused. A gold-standard approach would provide a bird's-eye view of many communities, or render replication simple, while not abandoning the nuanced descriptive understanding of each local news ecosystem, a problem that results in validity issues, particularly among community stakeholders.

In short, the ideal study combines rhizomatic and environmental metaphors (as the Pew (2010) study of Baltimore did), uses organic boundaries, and employs a scaled approach sensitive enough to maintain face validity (harnessing the spirit of the Napoli et al. studies (see, e.g., 2017)). Given the challenges already inherent in this have-your-cake-and-eat-it-too standard, one of these elements may have to be sacrificed: for example, using municipal boundaries because of their overlap with census data, or using the environmental approach because scraping software to map the flow of news through an ecosystem is still too costly or unavailable. Still, one of the strengths of network analysis is its ability to map ecosystems that are not bound by government-drawn boundaries, but rather by influence, attention, topic, or other formations that organize civic life.

What would a pilot study of the rhizomatic, organic boundary, scaled study of local news ecosystems look like, operationalized? We have several ideas. A rhizomatic study could follow a piece of news through the ecosystem. We could scale this study up

to a region or state by tracing one piece of information through each ecosystem in the area. Mayoral races would enable us to explore an issue of similar relevance across every ecosystem in a state. If we were able to do this for all mayoral races across a state, we would have a rhizomatic, scaled study. This set-up poses a second drawback: if we were to conduct it remotely, tracking the story through online news outlets, we would exclude analog sources. News is of course increasingly available online; still, as we note above, it is still not clear that all or even most local news providers publish online.

Overcoming the drawbacks of remote ecosystem mapping is challenging in a scaled study, which requires exploring organizations across a range of geographies. One way to resolve this is by mobilizing in-person resources in each jurisdiction, perhaps through a campaign targeting people with concerns that mirror ours, such as by engaging local branches of the League of Women Voters or other groups concerned about democracy, which could create audits of their local news ecosystem. This could involve a campaign with videos offering a step-by-step methodology. These groups could help identify offline sources not easily available to researchers, such as neighborhood Facebook pages, while enabling a scaled study.

The final challenge lies in figuring out a way to apply this rhizomatic, scaled study within organic boundaries. Here we could examine a statewide issue or event, for instance a governor's race, through the lens of the various issues raised. Through network analysis software or with access to social media data, we could map the constellation of issues across the state and begin to see organically defined ecosystem boundaries emerge. The major challenge of course is that these organic, issue-specific boundaries may change for each issue, so while this process could be scaled, it may not produce a stable map.

As noted above, our next phase is to adopt an approach that attempts to satisfy these concerns, and pilot it in one state. From there, we plan to assess each ecosystem in the state to determine its relative health, with the goal of producing a map of news deserts and news oases in that state. We hope that other scholars will follow by applying this method in their states or other relevant areas.

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