Projections • 15. Practices of Health in Unruly Environments

Transdisciplinary Synthesis Research in Unruly Environments: Reflecting on a Case Study of Vulnerability and Urban Fishing in the American Gulf Coast

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ABSTRACT

Transdisciplinary research (TR) is valuable for studying complex environmental health issues. Paying attention to how practices ‘on the ground’ can - and should - inform policy and planning requires disrupting the silos in which these entities frequently operate. Yet in practice, bridging disparate fields of inquiry towards a common goal is a difficult task, and few empirical examples exist to guide researchers interested in using TR to examine environmental health issues in real-world contexts. In this paper, we reflect on the design and execution of a collaborative, transdisciplinary project that examines localized effects of urban and environmental governance on urban subsistence fishing as a foodway with key health implications. We first review the socio-environmental literatures on urban fishing to outline the utility of TR. Next, we present our TR synthesis, which integrates secondary data from federal, state, and municipal agencies in two U.S. Gulf Coast metropolitan areas, including a subset of results to demonstrate TR in action. Finally, we critically reflect on our TR experience in relation to corresponding theory, allowing insight into the strengths and drawbacks of utilizing TR in practice. Benefits include a more holistic linkage of complex socio-environmental components, the illumination of power dynamics between stakeholders, and the co-creation of knowledge in a multidisciplinary research team. The challenges we faced highlight issues of translation across disciplinary methods when framing research questions and when integrating data sources collected for different sectoral purposes. In particular, we discuss the role of synthesis - the triangulation of diverse secondary sources - to the practice of TR. We share these lessons to inform further integrated research on the relationships between place-based health, urban development, and environmental equity.

Introduction

Transdisciplinary urban health research: Pathways and roadblocks

Transdisciplinary research (TR) is a framework uniquely suited to grappling with contemporary environmental health problems that are situated within social and environmental dimensions, and span regulatory, geographic, and political scales ([Gehlert et al. 2010](#); 412). TR is research that 1) considers the complex system of factors that together explain an issue’s current state, 2) addresses diverse perceptions of an issue from science and society, and 3) sets aside the idealized context of science in order to produce practically relevant knowledge ([Pohl 2005](#)). Methodologically, strengths of TR include facilitating co-creation of knowledge through collaborative research design and dissemination, moving away from narrow topics toward real-world problems that cross sectoral and policy boundaries, and engaging with the interests of non-academic stakeholders ([Carew and Wickson 2010a](#); [Klein 2008](#); [Mauser et al. 2013](#); [Serrao-Neumann et al. 2015](#)). TR also endeavors to draw connections between research, policy, and practice, thereby highlighting existing power dynamics in social and environmental relationships ([Lawrence and Després 2004](#); [Serrao-Neumann et al. 2015](#)). TR may engage with stakeholders at different stages of the research process, but differs from participatory action research approaches that involve local stakeholders at every stage of research design or as members of the research team

(Kemmis et al. 2013). At the same time, TR is still a useful approach toward fostering reflexivity, which allows researchers to understand “how they themselves influence the research process,” providing insights which may “further enrich and inform” that process (Sultana 2017).

However, adopting a TR approach has its own complications. For example, using TR-oriented methodology in collaborative projects often entails sensitive negotiations between diverse team members (Klein 2008). Disciplinary approaches in epistemological inquiries play a key role in developing research questions, designing a research project, and approaching data collection and analysis. A key task in TR collaboration, then, is challenging the singular “worldview” espoused by any one discipline while still allowing for each discipline’s sense of autonomy (Mauser et al. 2013). The considerable efforts required in TR to help collaborators understand each other’s “cultures” may lead researchers to view some dimensions of this approach as posing additional demands on their time (Pohl 2005).

Despite the increasing recognition of TR, there is still significant uncertainty about how to implement it in practice. In a review of TR in the sustainability sciences, less than half of the articles sampled described real-world case studies (44%; 104 of 236), and only 6% (14 of 236) pertained to the development of TR methods (Brandt et al. 2013). Thus, while it is clear that TR holds great potential for addressing links between social, environmental, and health problems, more empirical and critical reflections are needed to demonstrate how TR can tackle societal issues “as they manifest in their messy, social, and physical contexts” (Carew and Wickson 2010: 1146). To fill this gap, we reflect on the design of a collaborative, TR synthesis project on urban governance and environmental policy practices affecting the health of urban subsistence fishers in the United States Southern Gulf Coast, undertaken by the authors: six doctoral students from different disciplines (geography, public health, ecology, fisheries science, and urban studies).

Locating fishing in urban areas

Coastal subsistence fishing in urban areas is a common but often overlooked practice which encompasses seemingly disparate themes, including the natural sciences, urban development, and environmental justice. Subsistence fishing is broadly understood as fishing for any reason other than for fun or employment (i.e. to consume, share, or trade harvested fish or use them for other livelihood purposes). People fish across the United States (USA) not only as a cultural leisure activity, but also to supplement their main diet, especially immigrants and racial minorities (Chess, Burger, and McDermott 2005). Although few fishers in the USA consider themselves subsistence fishers, it is appropriate to use this category as many actually eat the fish they catch (Burger 2002). Subsistence fishing is important for livelihood and as a cultural practice, impacting well-being not just through nutrition, but also by articulating individual and community identity as well as place connections (Schumann and Macinko 2007). Therefore, although we understand subsistence fishing as a practice that can enhance diet and nutrition, we also recognize its broader role as a foodway that may be integral to overall well-being among certain populations (Poe, Norman, and Levin 2014a).

However, how subsistence fishing is practiced in urban America has not been sufficiently studied from a health or environmental standpoint. Subsistence fish consumption is correlated with lower socio-economic status and non-white ethnicity (Chess, Burger, & McDermott, 2005), raising questions about access and risk that should be further investigated. The gradual divergence between urban planning and public health sectors in 20th century American cities has sometimes masked structural dimensions of health risks among certain communities (Corburn 2004). This divergence is a focus of environmental justice, which is concerned with how the unequal distribution of environmental risks and resources creates disparities in quality of life—that is, the conditions in which people “live, work, and play” (Taylor 2011: 284). Upstream processes of urban planning can result in localized gaps in the accessibility or quality of housing, parks, public transit, fresh food, and clean air, whereby people of color and low-income communities are disproportionately disadvantaged (Taylor 2011; Corburn 2004). Furthermore, critical work on urban natural spaces shows that green spaces and “blue” spaces - bodies of water - are often developed with narrow prescriptions for how those spaces should be used and by whom, excluding foraging or growing practices, among other uses (Cronon 1996; McLain et al. 2014; Heynen 2003; Beatley 2011; Wessells 2014).

Urban subsistence fishing therefore presents an understudied socio-environmental relationship that merits examination through the lens of environmental justice (Chess, Burger, and McDermott 2005). Scholarship on urban food systems demonstrates that “race and class play a central role in organizing the production, distribution, and consumption of food” (Agyeman and Alkon 2011: 4). Place-based inequalities in the built environment, especially through access to healthy food, also directly affect the health of urban dwellers (Arcaya et al. 2016; Beaulac, Kristjansson, and Cummins 2009; Caspi et al. 2012). These findings suggest that paying closer attention to urban food environments is a useful pathway towards bridging urban health disparities. Fish may present an easily accessible source of food for vulnerable communities as fishing licenses, permits, and gear can be fairly inexpensive (Béné et al. 2009); however, how access to healthy fish as a foodway is governed by local agencies remains unclear.

In the USA, fisheries management agencies only distinguish between commercial and recreational fisheries, referring to fish sold for profit versus sport or catch-and-release fishing, respectively. “Subsistence” as a management category only applies to tribal fisheries in certain states, which means that non-tribal subsistence fishing is classified as recreational in state and federal law. The classification of subsistence fishing as recreational has meant that much non-commercial fishing research fails to consider subsistence fishing as a separate practice, despite the fact that many recreational fishers do consume their catch (Cooke et al. 2018). As a result, data on subsistence fishing practices by non-tribal communities in the USA is lacking (Ebbin 2017). With certain exceptions, most research on subsistence fishing practices focuses on subsistence as a feature of rural livelihoods (Lauber et al. 2017; Westphal et al. 2008). Such data gaps complicate our understanding of fish as an urban foodway and obfuscate the efficacy of policies that protect the health of subsistence fishers. Taken together, these findings suggest that from an institutional perspective, subsistence fishing is presumed

not to occur in urban landscapes, leaving little room to consider how urban coastal planning may shape this activity.

Fishing and environmental governance

Environmental health and governance also impact urban subsistence fishers. Because they frequently consume local fish, subsistence fishers risk ingesting harmful levels of contaminants that accumulate in fish tissues ([Morel, Kraepiel, and Amyot 1998](#)). These contaminants include mercury, dichlorodiphenyltrichloroethane (DDT), and polychlorinated biphenyls (PCBs), which are linked to neurodevelopmental disorders, cancer, sterility, immune deficiency, and endocrine disorders in humans (Mahaffey 2005; Beard 2006; Carpenter 2006). Such health concerns motivate the development of fish consumption advisories (FCAs), which are voluntary recommendations about how much and which species of fish should be consumed to limit exposure to harmful pollutants. State and federal agencies are responsible for testing biological and environmental samples to create these FCAs. Although the Environmental Protection Agency (EPA) provides guidelines on toxicology testing and risk communication to state agencies, implementation is inconsistent and varies across geographical contexts. It is unclear whether testing practices account for specific locations where fish for consumption are being caught, as well as the characteristics of the fish. Testing multiple species is required because the level of contamination varies by the ecology and life history of each species - e.g. larger, older, and predatory fish have more opportunities to accumulate contaminants ([Dellinger and Ripley 2016](#)). Thus, if the species that subsistence fishers consume are not the ones tested, health risks may not be adequately assessed.

Furthermore, research suggests other gaps between FCAs and their target users; regional studies within the urban US suggest urban fishers are often unaware, distrustful, or unconcerned about FCAs, with people of color having a lower awareness of FCAs or of fish consumption risks in some cases (Burger, Staine, and Gochfeld 1993; Beehler, McGuinness, and Vena 2003; 2001; Pflugh et al. 1999; J. Burger et al. 1999; Katner et al. 2011). In addition, FCAs do not always match consumption habits in terms of species or levels of consumption (Burger 2013; Hutchison and Kraft 1994; Lincoln et al. 2011). If FCA testing practices do not reflect foodways found in the ethnically and racially heterogeneous subsistence fisher communities, there is increased potential for compounding health risks already experienced by vulnerable socioeconomic groups.

Finally, critical scholarship theorizes FCAs as a means through which the government displaces responsibility for managing the risks associated with environmental contamination on the individual, instead of addressing the political and economic processes that give rise to contamination in the first place ([Mansfield 2011](#)). [Besek \(2015\)](#) claims that instead of protecting subsistence fishers, FCAs become a “path of least resistance” for governments who must appear to take action on contamination, while avoiding conflict with local economic and conservation interests. Similarly, [Mansfield \(2012a\)](#) argues that by targeting primarily women, FCAs and public health campaigns serve as little more than a gendered politics of environmental health. [Mansfield \(2012b\)](#) also contends that because of racial disparities in seafood consumption, FCAs indirectly racialize responsibility. Because FCAs warn of risks that disproportionately affect women of color and their unborn

children, health impacts associated with contaminated fish become framed as poor choices rather than indicators of broader environmental health issues. Developing FCAs grounded in an environmental justice framework that more directly reflect subsistence practices may be one step towards better serving affected populations.

Urban subsistence fishing: opportunities for TR

Collectively, toxicology testing, fishing practices, and coastal urban planning form disconnects between policy and the needs of diverse urban populations who fish for food. The disconnect may have compounded implications for vulnerable fishing communities, including racial minorities and those who have low socioeconomic status. Therefore, a TR approach would examine overlaps between policy and sectoral boundaries and pay closer attention to stakeholder practices, thereby harnessing scientific knowledge to meaningfully address these socio-environmental realities. We advocate for using a TR approach to better assess intersections of health, urban equity, and environmental governance related to subsistence fishing. However, we also argue that environmental TR scholarship could benefit from insight into *how* such an approach unfolds on the ground. Therefore, while the empirical results of our study will be published elsewhere, here we reflect primarily on the design, methodology, and experience of the research.

In this paper we engage with health practices on two levels: first, we echo other scholars in recognizing the value of *transdisciplinary research practice* to understand health outcomes of socio-environmental change; second, we shed light on the process of such research by examining the design of our case study on *urban fishing as an environmental health practice*. We describe our synthesis study, including a brief empirical narrative to demonstrate how the project unfolded. Next, we reflect on our process and methodology as an application of TR praxis, augmenting TR theory with our empirical experience. Specifically, we elaborate on the benefits and challenges of TR as a holistic approach towards examining socio-environmental systems amidst the tasks of forming research questions, integrating methods, and harnessing data sources within disciplinary requirements. We demonstrate the tools used to overcome these obstacles, such as the use of boundary objects, team capacity-building, and developing relationships through data-sharing with state and federal agencies. Our work also contributes new understandings about the potential values and challenges of synthesizing secondary data sources within a TR framework.

Urban fishing and FCAs: a case study in TR methods

Research objectives

Our case study synthesizes secondary data to characterize the urban subsistence fishing community and their place in the urban landscape for two metropolitan areas: New Orleans, Louisiana (USA) and Tampa, Florida (USA). We assess whether current urban governance and environmental policy introduce compounded health risks by operating on assumed knowledge of fisher practices, while demonstrating how existing data sources can be utilized to improve policy and lower health risks. As **Figure 1** illustrates, our framework brought

together questions from three disciplinary subfields under one guiding transdisciplinary inquiry. Each of the sub-questions were tackled by smaller teams of two researchers. Through a collaborative TR approach, our team moved beyond our siloed disciplinary fields to ask how seemingly disparate variables work together to impact the health of urban subsistence fishers. Toxicology alone, for example, would have given some information about how well FCAs reflect urban fishing practices, but triangulating these findings with socioeconomic data allowed us to ask *who* was being impacted, which has broad reaching public health implications. The complete results of our study are presented in an empirical article, currently *under review*.

Figure 1. Transdisciplinary inquiry with corresponding research questions and data sources

Case study sites

Our study focuses on two metropolitan areas of the US Southern Gulf Coast region: New Orleans, Louisiana, and Tampa, Florida (**Figure 2**). These choices were based on several motivations. First, we responded to calls for regionally specific FCA research ([Katner et al. 2011](#); [Lincoln et al. 2011](#)). Second, we selected study sites along the Gulf Coast in the southeastern United States because there is currently limited research on non-tribal subsistence fishing or on FCAs in this area. Third, the Gulf of Mexico is home to rich ecosystems and socially and economically significant fisheries ([Ward 2017](#)), as well as a warm climate that allows year-round fishing. Finally, the health and stability of the region's human and marine ecosystems have been, and will continue to be, vulnerable to climate change and extreme environmental events (e.g. Hurricane Katrina in 2005, Deepwater Horizon oil spill in 2010) (Colten 2006). While we do not assume the results of our study will be nationally representative, they illustrate important dynamics between environmental management, urbanization, and fishing occurring in the USA.

Figure 2. Map of study sites, New Orleans, LA (left), and Tampa, FL (right). ESRI-GIS citation text included in lower right-hand corner.

Empirical methods

Our research was designed around the utilization of secondary data, one requirement of the funding source. Based on data availability, we focused on data from 2005 to 2015. To provide a foundation for our critical reflection, we describe the design and methods of our study and present a short empirical narrative to illustrate integrative findings from the TR approach.

Central dataset: Marine Recreational Information Program

A dockside fishing intercept survey, called the Marine Recreational Information Program (MRIP)¹, served as a hub with which to connect the other sources of information used in this TR synthesis. MRIP is overseen by the National Marine Fisheries Service (NMFS) and administered through a collaboration between state, regional, and federal agencies to measure recreational fishing pressure on marine fish resources. MRIP surveys are administered at sites identified on a national site register through a sampling protocol based on fishing activity and seasonality. Surveys are conducted with individual fishers who report fishing activity (e.g. number of fish, species, fish size) from their current trip and their zip code of residence.

To our knowledge, the MRIP is the only federal data collection initiative that occurs nationally every year with this level of granularity - for instance, including fisher zip code of residence and intended use of catch. However, for NMFS this information is secondary to the primary aim of quantifying species catch and

informing fish population modelling. We repurposed social data in the MRIP to extract information about fishers, their fishing sites, and their catch to build our secondary dataset.

We filtered the MRIP data to include 1) observations with shore-based fishers (in contrast to boat-based) and 2) fishers who reported residing in zip codes within the 2010 metropolitan statistical area of New Orleans or Tampa. This allowed us to focus on urban subsistence fishers who practice fishing potentially as part of their day-to-day activities in the city, and those who may be less likely to own a boat for fishing. In order to identify top fishing sites, the landings (i.e. number of fish harvested to take home and presumably be consumed) were summed by fishing site. Top fishing sites were those with the highest summed landings. Landings represent the number of recorded fish (i.e. only those accounted for in an MRIP survey) and have not been extrapolated to represent the total number of fish caught at a given site over the timeframe of interest.

Qualitative analysis

Research Question 1 examined how fishing factors into the organization and planning of urban spaces.

Drawing on the methodological approach for qualitative planning document analysis similar to [Piwowarczyk, Kronenberg, and Dereniowska \(2013\)](#), we collected a purposive sample of 30 planning documents from our two study cities. These publicly available documents included: city comprehensive plans, coastal management and restoration plans, and planning documents for significant local development projects. We performed a discourse and content analysis using a framework that was developed using the urban environmental management and fishing literature ([Fairclough 2003](#); [Riley 2016](#); [Balsman and Shoup 2008](#); [Poe, Norman, and Levin 2014b](#)). The framework assessed how government and planning institutions address subsistence fishing through the built environment, public access, environmental conservation, and as a meaningful community activity. To build a deeper understanding of site accessibility, for the top five MRIP fishing sites (by landings) we examined the background and significance of the site using an internet search (e.g. Google, YouTube) and the MRIP site register. The internet search gave us insight into the history of the site and its value to locals. The MRIP site register also lists all MRIP designated fishing sites and provides qualitative information about site accessibility (e.g. hours of operation, if they charge a fee) as well as estimated fishing pressure throughout the day.

Demographic analysis

Research Question 2 quantitatively examined fishing behaviors across neighborhoods with different demographic compositions. To do this, we coupled MRIP survey data to demographic data from 2007-2011 collected by the American Community Survey (ACS), a federal data initiative conducted in non-Census years. ACS data comprised aggregated five-year estimates at the ZCTA (zip code tabulation area) level. We selected demographic variables commonly used in neighborhood disparities research to illuminate socio-environmental inequities in relation to fishing. These included 1) *race* - the percentage of people who are not non-Hispanic white, 2) *transit access* - the percent of households with zero or one vehicle, 3) *ancestry* - the percent of

foreign-born individuals, 4) *food insecurity*, the percent of households receiving Supplemental Nutrition Assistance Program benefits (SNAP), 5) *educational attainment* - percent of individuals with no more than a high school degree/GED, and 6) *income* - the median household income in USD.

In order to connect demographic data to subsistence fishers, we filtered MRIP data for surveys from 2007 to 2011 to match the timeframe of ACS data. We matched the residential zip codes of subsistence fishers recorded by MRIP to ZCTA-level demographic data by ACS. ZCTAs are considered the demographic analogue of zip codes, but the former is administered by the US Census, whereas the latter is administered by the US Postal Service, according to different needs and timelines. Therefore, the two are an approximation of one another but not perfectly equivalent. We summed landings by zip code and normalized landings to account for population densities. Zip codes were then divided into groups, labeled as High, Medium, and Low fishing categories. We implemented a multinomial logistic regression in R (*multinom*) to assess how socioeconomic characteristics of fishers were or were not associated with landing patterns in the surveyed fishing sites.

Environmental and toxicological analysis

Research Question 3 assessed whether fish tested for mercury content to inform FCAs accurately represented fishing practices (i.e. species, trophic level) of urban subsistence fishers. For each case study, we identified the top five most heavily fished sites for urban fishers in each of two distinct time frames to account for temporal shifts in fishing practices. For New Orleans, this was 2005-2009 and 2010-2013. For Tampa, this was 2005-2010 and 2011-2015. The discrepancy between the timelines is due to gaps in the MRIP data for certain years. We used the reported landings from these sites to characterize fishing practices (i.e. species landed, number of fish by species, fish size, trophic level) by subsistence fishers at each site.

We obtained toxicology data by requesting all marine or estuarine contaminant testing prior to 2016 from the Louisiana Department of Environmental Quality and Florida Department of Health. These data typically included the collection site GPS location, fish species name, length, weight, and tissue methylmercury content. We identified all toxicology data collected within 25 (local) and 100 (regional) miles of each fishing site during the same time frame as MRIP data by using spatial analyses packages in R (*sp*, *rgdal*, *raster*) to map the geographical coordinates of testing sites and fishing sites, and to measure distances between them. If a fish species landed by a subsistence fisher was tested within this spatiotemporal scale, it was classified as “Tested”, whereas species that did not meet this criteria were classified as “Not Tested”. We calculated the proportion of landed species that were “Tested”, as well as the proportion of individuals from “Tested” species. As size data was not available for all fish landed or tested, we used a subset of New Orleans data to compare the weights of “Tested” and “Not Tested” fishes by species, using t-tests. Finally, we used FishBase² to record the estimated trophic level of all landed or tested fish species. We compared the average trophic level of fishes that were “Tested” versus “Not Tested” in both case study sites, using a Wilcoxon test.

An empirical snapshot of top fishing sites

While the findings are not the primary focus of this paper, a brief empirical narrative from a subset of our results illustrates the ground-level work of triangulating research inquiries in TR. Therefore, in this section we present snapshots of the most frequently fished sites from each location to lend insight into the complex regulatory framework and material conditions in which urban fishing takes place. Our snapshots focus on a subset of our timeline: 2005-2010 for Tampa and 2005-2009 for New Orleans. We selected one top most heavily fished site per city as a case study for this paper: site 769 (Tampa) and site 306 (New Orleans) (**Figure 3**).

The names, “769” and “306”, designated by the MRIP’s national fishing registry, represent the North Sunshine Skyway Bridge/Skyway Fishing Pier State Park in Saint Petersburg (part of the greater Tampa metropolitan area) and the Seabrook Boat Launch and Pier in New Orleans. 769 is a long fishing pier created from a collapsed bridge that previously stretched across Tampa Bay. Today, the site consists of a large public state park, and is one of the few recognized MRIP sites that allows 24/7 fishing. 306 comprises a small concrete boat launch and a narrow steel bridge extending over the Inner Harbor Navigation Canal (locally known as the Industrial Canal) as it reaches Lake Pontchartrain.

At each of the two fishing sites, fishers originated from dozens of zip codes, shown in **Figure 3**. The map for New Orleans suggests that visitors to this site reside in a cluster of zip codes that are mostly near the site and within the core of the city. For Tampa, however, visitors to this popular site come from all over the entire metropolitan area. The socioeconomic traits of the people fishing in the two sites relative to the whole city are shown in **Table 1**. While the cities indicate different demographics, they also suggest that there is room to understand how potential indicators of disadvantage might co-occur with fishing levels, especially given the proportions of those with low education levels, proportions of racial minorities, and transit access. Planning documents and socioenvironmental data indicate the sites are subject to distinct administrative forms, FCA governance, and population compositions. This may translate into different opportunities and experiences for those who fish there.

Figure 3. Top fishing site 306 for Louisiana (left) and 769 for Florida (right) with red points, with zip codes recorded as fishing there (dark green), compared to all zip codes in the metro area (pale green).

ESRI-GIS citation text included in lower right-hand corner.

Socioeconomic variable	New Orleans		Tampa Bay	
	Fishers at Site 306	Across all metro zips	Fishers at Site 769	Across all metro zips
Proportion of population with HS/GED as highest educational attainment	28.40%	33.40%	30.80%	30.60%
Proportion of households receiving food stamp/SNAP benefits	13.70%	14.50%	9.20%	9.20%
Proportion of population that is foreign born	7.40%	5.10%	11.70%	11.60%

Median household income (\$)	44,306	46,993	49,372	50,670
Proportion of households with no vehicles	11.50%	9.00%	6.90%	6.10%
Proportion of households with one vehicle	42.30%	36.40%	41.80%	41.80%
Proportion% of families in poverty	15.00%	14.40%	8.90%	9.60%
Proportion of population identifying as a racial minority	51.30%	42.90%	31.80%	29.10%

Table 1

Mean socioeconomic data for residential zip codes of subsistence fishers at each fishing site, compared with the entire New Orleans and Tampa Bay metropolitan areas.

Place, risk, and fishing in two cities

As a state park, Tampa's site 769 is promoted as an attraction for both locals and tourists with its own website, Facebook page, and promotional materials. The site also charges an entrance fee - 4 USD per car and per adult as of January 2019 - and is well-lit, so it is common for fishers and their families to make extended fishing trips of 24 hours or longer. The site is located in Pinellas County, which is the most densely populated county in Florida and makes up part of the Western shoreline of Tampa Bay. The Comprehensive Plan for the County was the only document from those we reviewed that outlined an extensive plan for developing urban fishing infrastructure such as piers, seawalls and catwalks. Although site 769 was built before this planning document was written, the presence of several other top shoreside fishing sites in Pinellas County suggests a general ethos in recognition of the significance of fishing as an urban fishing practice.

Fishers from Tampa's site 769 have landed almost 4 times as many species and over 100 times the number of individual fish as in New Orleans' site 306, perhaps correlating to 769's status as a recognized fishing site (**Table 2**). However, when we examined how toxicology testing reflects subsistence fisher practices, we found that only one-quarter of fish species landed by subsistence fishers were tested within 100 mi of site 769 (**Table 2**). When considering individual *fish* rather than individual *species*, only 3.9% of individuals landed were from tested species. Further, we found that untested species were of significantly lower trophic levels than tested

species ($p < 0.0001$), suggesting that fish tested were of different ecologies than those landed by subsistence fishers (**Figure 5**). Despite the institutional recognition of fishing at this site, it appears that significant proportions of landed fishes are not tested, presenting unknown health risks to urban subsistence fishers.

Figure 4. A “no fishing” sign at MRIP Site 306 attempts to deter urban anglers from a popular fishing spot near the Seabrook Floodgate Complex in New Orleans, LA. Source: L. Drakopoulos

In contrast, despite being a top fishing site, fishing at New Orleans’ site 306 (Seabrook) does not appear in any of the official city planning documents. Following Hurricane Katrina in 2005, the area was significantly redeveloped to prevent future storm surges in the canal. A large floodgate was installed by the Army Corps of Engineers, reshaping the local ecosystem from primarily estuarine to freshwater fish communities. Fishing at this site was not recognized in the project documents, and any ecological considerations appear secondary to flood protection goals. Today the site itself is a nondescript space that is hardly maintained. A “No Fishing” sign near the parking lot creates ambiguity about whether or not fishing can be practiced there (**Figure 4**).

We found that 45.5% of landed fish species and 42.1% of individual fish were tested within 100 miles of site 306 (**Table 2**). This suggests that although subsistence fishing at the site is less recognized by urban governing agencies, the agencies responsible for toxicological testing in Louisiana are conducting tests that more

comprehensively reflect local subsistence practices compared to Florida. However, we did find that untested species were at significantly higher trophic levels than tested species ($p < 0.05$) landed at site 306 (**Figure 5**). It is well-documented that trophic level correlates with contamination, with fish of higher trophic levels typically bearing greater contaminant loads (Dellinger and Ripley 2016). Therefore, subsistence fishers at this site are still likely being exposed to contaminant loads greater than is known.

Fishing Site	Number of Species Landed	Percent Landed Species Tested	Number of Individuals Landed	Percent Landed Individuals Tested
LA 306	11	45.50%	209.2	42.10%
FL 769	38	26.30%	6573.1	3.90%

Table 2

Proportions of fish species and individuals tested for sites 306 and 769.

This snapshot demonstrates the many layers of data triangulation within TR necessary to understand place-based dynamics in urban fishing. New Orleans' top site appears to be harder to access and more "illicit", which belies its placement as a top fishing site and begs the question of whether recorded fishing there may even be underestimated. The maps of those fishing at this site also indicate a fairly specific, localized population who fish there. In contrast, Tampa's top site is far more explicitly designed to be a fishing spot within the urban landscape, and fisher origin maps (**Figure 3**) indicate that fishers visit this site from all over the metro area. The socioeconomic makeup of residential zip codes who fish there also suggest different degrees of disadvantage may play a role in fishing level variability. Ecologically, major gaps exist between testing practices and the patterns of fish being caught and eaten, whereby Tampa's site, despite being a more heavily fished location, lags behind New Orleans in testing quality. In the next section, we present a reflection to show what lessons were learned from conducting this type of triangulation through a TR approach.

Figure 5. Average trophic level of tested versus untested fish species for each site (significance determined by Wilcoxon test).

Reflections on the contributions of transdisciplinary synthesis research

Contributions of a Transdisciplinary Research Approach

In attending to multidimensional factors that affect well-being which cannot always be isolated to a single cause ([Gehlert et al. 2010](#); 412), TR is a tool for not only short-term solutions but long-term paradigmatic shifts ([Rosenfield 1992a](#)). Here we discuss how our project reflected many of the reported strengths of TR, including moving beyond narrow topics to real-world problems, illuminating power dynamics in socio-environmental relationships, and building a collaborative research design that engages non-academic stakeholders ([Carew and Wickson 2010b](#); [Klein 2008](#); [Mausser et al. 2013](#); [Serrao-Neumann et al. 2015](#); [Gehlert et al. 2010b](#); [Rosenfield 1992b](#)). We also discuss some corresponding challenges of these domains. Integral to our discussion is how synthesizing secondary data sources can be a valuable pathway through which to implement a TR approach.

First, developing research questions through a TR lens allowed us to move beyond distinct fields of research inquiry to consider new ways for how policies and scientific practices might affect urban subsistence fishers. Intrinsic to this process was questioning the common classification of subsistence fishers as “recreational” fishers. Approaching urban fishing as a *subsistence* practice also meant recognizing its significance as an *environmental health* practice. Thus, our TR approach centered the transdisciplinary question in **Figure 1**: *What are the relationships between urban development, socio-ecological vulnerability, and subsistence fisheries?* This became a container in which to integrate disparate fields, methods, and data sources. Using this question as a guide, we triangulated the socioeconomic composition of subsistence fishing communities, urban planning policies which might govern fishing access, and exposure to unknown health risks introduced by consuming local fish. Our central question thus allowed for a more nuanced understanding of the ways in

which *where and how* someone fishes may compound risks or perpetuate disparities than what would have been otherwise possible using a more siloed approach.

Second, we experienced co-production of knowledge among our research team that led to the emergence of novel, transdisciplinary research questions. Team members were selected specifically to diversify the expertise and training that we could draw upon. From the beginning, we taught each other the contextual importance of each of our disciplines as it applied to the project. These discussions ranged from exploring conceptual models to debating which coding language or statistical software to use as a team. These lessons enriched our understanding of how to utilize available data sources, and analyze and interpret results. Our medley of research backgrounds bridged the disparate policies affecting urban subsistence fishers while paving the way for further research that directly engages stakeholders who fish. Not only have we increased our empathy and understanding of research methods in other disciplines, but we are encouraged to pursue similar projects in the future.

Third, our TR framework was critical in revealing power dynamics among governing agencies and their impacts on land use, public health, and scientific practices. In particular, our multifaceted focus on FCAs—how they are developed and who they impact—offered an entry point into power dynamics since FCAs are produced through collaborations between multiple agencies. We found that finances and politics may influence science and health agencies responsible for FCAs. As indicated in our empirical snapshot, we identified significant data gaps in toxicology testing programs, a result of the stark reality that federal and state science agencies in the US frequently operate under reduced and/or fluctuating budgets. Under these circumstances, agency employees must prioritize their work based on their assumed knowledge of what is most important. Therefore, state agencies are influenced by state and federal power dynamics, and their recommendations are directed towards subsistence fisher communities, who, as we describe in the literature review, do not universally view FCAs as important or useful. Our TR focus thus enabled us to elucidate FCAs as enmeshed within power imbalances between expert knowledge and lay knowledge.

Finally, a novel contribution of our project lies in demonstrating the value of *synthesis research through the triangulation of secondary data sources*, which has not been a focus of TR literature thus far. A central tension of conducting such integrative work can be identifying data instruments most appropriate to answer the question; the MRIP emerged as a central dataset within this issue. The MRIP, for instance, is implemented mainly to answer a specific kind of question that pertains to patterns in fishing pressure at certain locales. The fishing site is therefore the primary unit of surveying, with residential zip codes of fishers being a secondary aspect. However, by reorganizing the data, we utilized both types of information equally, allowing us to address a multi-pronged question on the place-based nature of urban fishing and its health implications. Our study integrated the MRIP with other sources, shown in **Figure 1**. Using agency data allows researchers to address TR objectives by building on completed work with expanded temporal and spatial scales, push boundaries by innovatively approaching research questions, and foster relationships with stakeholders.

Synthesizing across these datasets helped us understand the *interrelatedness* of urban planning, toxicology, and health outcomes, which could not have been done by studying each separately.

The availability of NMFS’s MRIP was crucial to our synthesis. While there are alternative data sources with information on fisher practices, we found that only MRIP data has been routinely collected since 1979 and contains neighborhood-level data on fishers. By finding means to complement other data sources to the MRIP timeframe, we avoided the laborious process of primary data collection and integrated 11 years’ worth of data during an 18-month grant cycle (**Table 3**). This allowed us to account for temporal shifts of trends and improve the robustness of our analysis. Public availability of this kind of information enabled six PhD students, at various stages in their graduate careers and working full-time on separate dissertations, to complete a large-scale research project. We therefore recommend that those pursuing TR synthesis projects think creatively on how existing data may be used in novel ways.

	Data Source	Data Time Frame	Agency	Spatial Scale
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Urban Planning	City comprehensive plans	NO: 2010-2012; T: 2008-2009, 2012, 2016-2018	NO: City Planning Commission; T: Hillsborough County City-County Planning Commission, City of Clearwater Planning Department, Pinellas County Planning Department, City of St. Pete Beach	City/ County
	Coastal management and restoration plans	NO: 2017; T: 2010, 2017	NO: Coastal Protection and Restoration Authority; T: Tampa Bay Regional Planning Council, Tampa Bay Estuary Program, Southwest Florida Water Management District, Florida Department of Environmental Protection	City/ County
	Planning documents for local projects	NO: 2005-2014, 2017; T: 2017	NO: City Park Improvement Association, City Planning Commission, City of New Orleans, State of Louisiana's Office of Community Development; T: Hillsborough County City-County Planning Commission	City/ County

Socioeconomic Vulnerability	Marine Recreational Information Program	Both: 2007-2011	Both: National Oceanic and Atmospheric Administration	Zip code
	American Community Survey	Both: 2007-2011	Both: United States Census Bureau	ZCTA
Environmental Testing	Marine Recreational Information Program	NO: 2005-2013; T: 2005-2015	Both: National Oceanic and Atmospheric Administration	GPS location
	Environmental testing data	NO: 2005-2010; T: 2003-2004*	NO: Louisiana Department of Health, Louisiana Department of Environmental Quality, Louisiana Department of Wildlife and Fisheries, and Louisiana Department of Agriculture and Forestry; T: Florida Department of Health, Florida Department of Environmental Protection, Florida Fish and Wildlife Conservation Commission, Florida Department of Agriculture and Consumer Services	GPS location

* Includes data from outside primary study timeframe due to limitations in data availability (see Methods).

Table 3

Spatiotemporal scale and respective agencies for all datasets used in each component of TR synthesis study.

Challenges of a Transdisciplinary Research Approach

Many of the strengths of TR also present their own challenges including integrating discipline-specific methods in a broader research design, working across spatial and temporal bounds in different data sources, and using data from institutions with varying data management practices ([Klein 2008](#); [Mauser et al. 2013](#); [Pohl 2005](#)). Some of these challenges have been conceptually described in the literature, but encountering them in our empirical project was a constructive lesson. Here we focus on our most significant challenges pertaining to TR: articulating a research plan, meaningfully engaging stakeholders, and overcoming disciplinary issues in the synthesis of secondary data sources.

One of the first challenges we encountered was articulating a multidimensional research question that integrated - not merely combined - our disciplines. We worked towards a common language by developing a boundary object, a tangible visual metaphor, to translate our research objectives across varied scientific worldviews ([McGregor 2004](#)). The boundary object developed during our first in-person research meeting - a Venn diagram linking our objectives and questions around the central hypothesis - served as a touchstone throughout our project. Subsequent meetings began by reflecting on and refining the boundary object to continue building shared understanding as our individual work proceeded. Our experience also indicates that the collaboration *process* is integral to building an agreed-upon research question by cultivating trust through capacity building. At the start of the project, our team adopted an egalitarian decision-making process and developed a team research agreement³. In addition, at all in-person meetings, we reserved time for non-work community-building activities, such as shared meals. Over time, this process led to the central TR inquiry guided by its component questions shown in **Figure 1**. Thus, developing boundary objects alongside intentional collaborative practice not only facilitated epistemological translation in a practical sense, but it also established dynamics that carried over to the work environment.

Second, although one of TR's strengths is the opportunity for stakeholder engagement, this proved to be a major challenge in our research as we sought access to secondary datasets from federal and state agencies. The issue of power dynamics mentioned in the previous section also posed challenges, as our work with multiple agencies revealed some interagency miscommunication. When searching for environmental and fish testing data, it became clear that agency representatives did not always operate from the same information base about how fish testing was conducted for development of the FCAs. However, these setbacks also opened other doors. Because state agencies bear the responsibility for scientifically sound environmental testing and FCA development, through this data-sharing relationship, we now have the opportunity to directly share feedback with policy stakeholders that could reduce inequalities and data gaps perpetuated by current practices. Such improvements may in turn allow for more effective risk communication to subsistence fishing stakeholders.

Third, while synthesizing secondary datasets helped further our TR goals, we also wrestled with the disciplinary limitations of each. This was particularly true, again, for the MRIP survey whose primary aim is to assess recreational fishing pressure, not the characteristics of humans who fish, even though the latter is a

relevant component. For instance, MRIP surveys are only carried out at fishing sites recognized on the national register, which does not include sites where it is illegal to fish even if fishing happens there - as was previously shown in our top site for New Orleans. We also expect that non-native English speakers or fishers without fishing licenses would less likely agree to be interviewed for the MRIP. Collectively these factors may increase the chance that racial minority or lower-income subsistence fishers are underrepresented in MRIP data. Furthermore, the regularity with which a fishing site is surveyed depends upon the perceived popularity of a site, according to MRIP interviewers. Using a TR method, we put the “fish” dimension in conversation with the “fisher” dimension, allowing us to identify pathways through which state or federal agencies might adjust current data collection programs to enhance information on fisher communities and inform policy that affects them.

A fourth TR challenge emerged in spatiotemporal mismatches due to data being collected for an array of other sectoral purposes. Our data sets were reported at several spatial scales, including a GPS-derived latitude/longitude, zip code, ZCTA, city, and county (**Table 3**). An earlier aim within the project was to link levels of fish consumption with health outcomes to more directly assess health risks. However, in environmental health it is difficult to isolate causes of health outcomes when people are enmeshed in a plethora of exposure pathways ([Gehlert et al. 2010b](#)). To prove causal health effects often requires granular data on individuals, including demographic and environmental exposure histories. However, the MRIP survey reported fisher zip codes as the main link between fishing and demographic patterns. Determining if our data was sufficient to “prove” whether urban fishing could have risks for health was therefore a difficult one. Would we look for a correlation, causation, or characterization, and what were the implications of each? In the end, we developed a descriptive, quantitative characterization of place-based fishing practices, while also uncovering patterns of how these neighborhoods may be captured by the way that MRIP surveys are currently implemented.

We encountered similar challenges when considering the temporal scale of our datasets. While the MRIP was temporally the most complete data set we used, the availability of other secondary datasets varied by city and through time (**Table 3**). For example, MRIP survey data is available primarily from 2005 to 2015, but ACS data is not available annually at the ZCTA level. As a result, we used a five-year estimate provided by the ACS database, which aggregates data collected from 2007 to 2011 to approximate the socioeconomic status of ZCTAs during our study time frame. We also faced substantial gaps in the availability of toxicology data, especially for Tampa, likely due to political or economic constraints as described earlier. We addressed this by collecting some supplementary data prior to the main timeframe, while using these data gaps to inform our overall narrative. As TR literature has shown, triangulating information gathered for specific practical and policy purposes sometimes requires flexibility.

Finally, an important limitation in our TR synthesis approach was a lack of qualitative ethnographic data such as interviews and participant observation. Ethnographic and participatory research are powerful tools for

centering the lived experience of communities navigating socio-environmental systems. While our data reveals potential patterns of risk and vulnerability produced through policy, quantitative metrics provide little explanatory power for how and why these processes unfold on the ground. As a result, we are limited in what inferences we can make about specific food practices as they relate to fishing and fish preparation. Despite recent attempts to ‘open’ secondary qualitative data, contributions to online qualitative data repositories are limited at best due to the sensitive, confidential nature of ethnographic data. This issue has not been largely discussed in the TR literature, and it may pose limitations to TR research that employs exclusively secondary data sources.

Conclusion

Our inquiry has implications for health practices on two different levels. First, we present lessons learned in the transdisciplinary research design of a case study in order to rethink the practice of public health and urban planning research toward a more synthesis-oriented, integrated approach that pushes the boundaries of traditional research inquiry. Second, our case study aims to more holistically examine urban fishing as a food-oriented, cultural, and health practice that has implications for agencies and policymakers, particularly environmental agencies and urban planners.

In our case study, government agencies emerge as key figures of policy and practice. First, city planners have the power to create and protect blue spaces for those who depend on readily available fishing sites. Furthermore, there is room for environmental and public health agencies responsible for fish testing and FCA development to reorient toward more equitable practices. The usage of one kind of dataset to synthesize multiple interrelated purposes may be a key method through which agencies could improve data collection. Similarly, the role of the MRIP data - a central organizing dataset in our synthesis that was originally collected for assessing fishing stock - illustrates the health-related repercussions of activities that are often not recognized as such. If transdisciplinary research can be understood as not merely one project but as a broader research perspective, then our case study could be one point amidst a constellation of future projects in which the research questions and priorities of *both* researchers and agencies may be further integrated.

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Footnotes

1. Prior to 2014, the survey was administered as the Marine Recreational Fisheries Statistical Survey. ↵
2. https://www.fishbase.se/manual/English/fishbasetrophic_ecology00002692.htm ↵
3. An informal written document outlining shared expectations for contributions, authorship, participation, and communication. ↵