Wading with Weirs: An Archaeo-Historical Investigation of Stone Fish Weirs in North Carolina's Great Pee Dee River

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ABSTRACT

This thesis is an archaeological survey and analysis of forty stone fish weirs along a fifteen-mile segment of the Great Pee Dee River, extending from the North Carolina-South Carolina border ending to the north at Blewett Falls Hydroelectric Dam. The research methodology of this thesis systematically documents the targeted stone fish weirs using archaeological and historical archival research, photo-archaeological analysis of historical aerial imagery available on Google Earth, amphibious reconnaissance of sites, and detailed weir survey. This approach establishes the importance of stone fish weirs as archaeological features that indicate continuous riverine resource exploitation over a millennia within the Yadkin-Pee Dee River basin. This thesis also contributes to the growing recognition of fish weirs, particularly stone fish weirs, as culturally significant yet vulnerable archaeological resources. Stone fish weirs require focused documentation and preservation efforts to prevent further losses due to natural erosion or human alteration. Discussion of the survey results also acknowledges challenges in comprehensively

recording fish weirs, including the absence of directly datable materials, which complicates their temporal placement and cultural attribution. Stone fish weirs represent understudied features of North Carolina's collective submerged cultural heritage, offering unique insights into long-term human-environmental interactions, Indigenous riverine archaeological features, and the hidden cross-cultural knowledge transfer processes that have occurred in the riverine cultural landscape over thousands of years.

Key Words: stone fish weirs, settlement and subsistence strategies, Great Pee Dee River, southern Piedmont North Carolina archaeology

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"We acknowledge the Tuscarora people, who are the traditional custodians of the land on which we work and live, and recognize their continuing connection to the land, water, and air that Greenville consumes. We pay respect to the eight state-recognized tribes of North Carolina: the Coharie, Eastern Band of Cherokee, Haliwa-Saponi, Lumbee, Meherrin, Occaneechi Band of Saponi, Sappony, and Waccamaw-Siouan, all Nations, and their elders past, present, and emerging."

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Chapter One: Introduction

Research Questions and Objectives

This thesis addresses fundamental questions concerning the identification, documentation, and interpretation of stone fish weirs within the North Carolina portion of the Great Pee Dee River. The thesis' primary research questions seek to establish whether previously reported stone alignments visible in historical aerial imagery (FIGURE 1) represent authentic archaeological fish weir structures constructed and utilized by Indigenous peoples and subsequent cultural groups, evaluate their current preservation status and potential for absolute dating, and determine whether documented weirs exhibit sufficient morphological consistency to assign meaningful typological classifications applicable to other comparative studies and broader discussions of North American and southeastern fish weirs (Chapman 1975: 1-11; Connaway 2007: 5-16; Trout et al. 2016: 74-80; Peterson 2018: 2-13)

This research has three primary objectives. First, this thesis aims to construct a preliminary inventory of identified stone fish weirs and associated sites and structures within the thesis survey area. Second, to evaluate morphological, taphonomic, and spatial characteristics alongside construction variability among confirmed weirs to identify patterns potentially indicative of temporal change in design principles, cultural identifiers, or functional specializations adapted to specific target species and seasonal exploitation patterns. Third, this research examines geospatial relationships between weir locations and adjacent terrestrial archaeological sites to assess whether fish weirs served as focal points supporting broader settlement-subsistence systems that structured landscape use patterns, seasonal sedentism, and

territorial organization across pre-contact and contact periods (Oliver 1992: 11-27; Ward and Davis 2020).

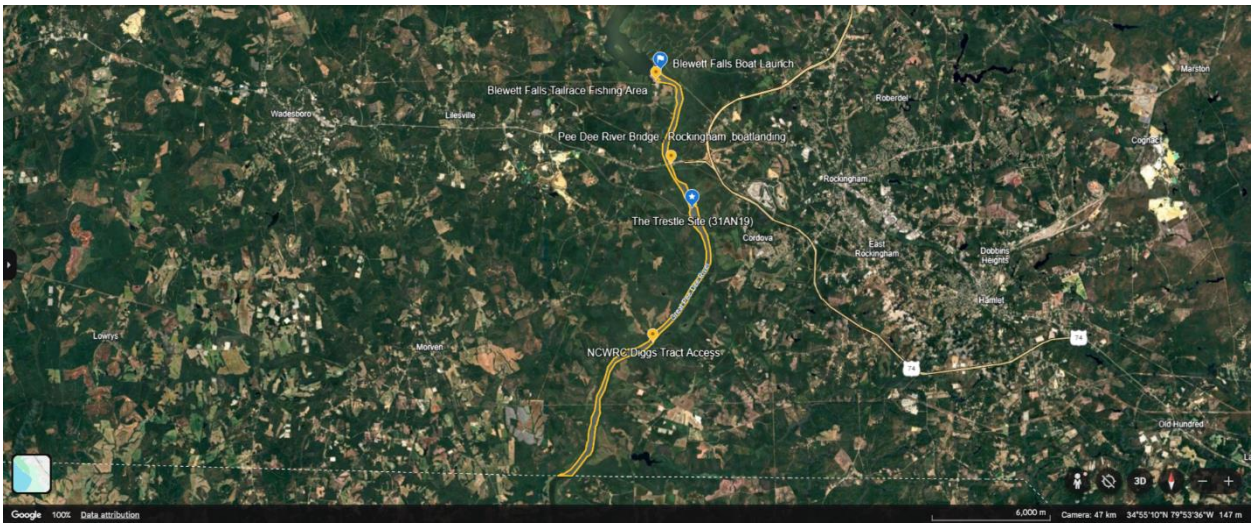

FIGURE 1. Overview of Thesis Survey Area Highlighted in Yellow (Courtesy of Google Earth and the Author).

Through systematic survey employing proven methodological approaches adapted from previous North American fish weir studies conducted in regions including the Tennessee Valley (Chapman 1975: 1-11; Espenshade 2010: 28-37; 2011), Potomac River drainage (Peterson 2018: 2-13; Strandberg and Tomlinson 1969), and New England coastal systems (Goodby et al. 2014: 1-19), this research addresses whether Great Pee Dee stone fish weirs represent pre-contact Indigenous constructions, historic-period modifications incorporating mechanical wooden capture devices, or multi-component palimpsests embodying centuries and possibly millennia of accumulated usage reflecting continuous adaptation to changing environmental conditions, technological innovations, and cultural practices (Bailey 2007: 198-223). The geographical focus on a fifteen-mile segment of North Carolina's Great Pee Dee River, while acknowledging that modern political boundaries held no relevance for pre-contact Indigenous peoples whose

territories and resource use patterns extended across contemporary state lines, provides manageable thesis scope constraints for detailed survey while establishing methodological precedent and baseline data for future regional collaborative studies potentially expanding documentation throughout the entire Yadkin-Pee Dee drainage.

Defining Fish Weirs: Form, Function, and Archaeological Significance

Fish weirs are human constructed structures placed in aquatic environments and specifically designed to direct, concentrate, or impound fish populations for efficient mass-capture through exploitation of predictable behavioral responses to physical obstructions and current patterns (Connaway 2007: 5-16). These structures embody sophisticated understanding of anadromous and resident fish behavior, riverine hydrological dynamics, and seasonal environmental cycles, representing carefully considered environmental adaptations to subsistence procurement challenges that transcend specific cultural traditions and temporal boundaries throughout eastern North America (Peterson 2018: 2-13; Prince 2005: 68-84). Within archaeological contexts, fish weirs provide tangible material evidence of human adaptation to riverine environments, reflecting the complex long-term relationships between communities and aquatic resources that frequently span millennia of continuous or episodic exploitation at specific locations offering optimal combinations of environmental and cultural factors (Mahar 2019: 311-332; Petersen et al. 1994:201-223).

The fundamental operational principle underlying fish weir technology involves strategic manipulation of water flow patterns and fish movement behaviors through calculated obstruction placement that exploits natural tendencies and instinctive responses (Colley 1990: 207-236; Connaway 2007: 5-16) These structures capitalize on the predictable behavioral characteristics of

target anadromous fish species including American shad (Alosa sapidissima), hickory shad (Alosa mediocris), and alewife and blueback herring (Alosa pseudoharengus and Alosa aestivalis), particularly their reactions to current velocity variations, edge-following tendencies during navigation, and schooling behaviors during seasonal up-stream and down-stream migrations (Jennings et al. 2023: 83-87; Stevenson 1899: 147-154). The passive functionality of weirs following initial construction, requiring minimal continuous human intervention during routine capture processes once structures become operational, distinguishes them fundamentally from active fishing methods demanding persistent human presence including spearing, angling, and hand-netting (Connaway 2007: 5-16; Petersen et al. 1984:234-256; Mahar 2019: 311-332).

This passive nature of weirs was particularly valuable for communities practicing mixed subsistence strategies incorporating hunting, gathering, cultivation, and fishing activities that required flexible labor allocation across diverse seasonal tasks, as functioning weirs provided reliable protein acquisition while permitting simultaneous pursuit of other essential resource procurement and processing activities distributed across the landscape (Mahar 2019: 311-332). The ability to position individuals at weir locations during peak migration periods to harvest concentrated fish while other community members engaged in complementary activities including agricultural field preparation, gathering, or terrestrial hunting and active-fishing (FIGURE 2) enabled efficient exploitation of protein-based resources without requiring complete community mobilization or abandonment of other critical subsistence pursuits (Colley 1990: 207-236; Mahar 2019: 36-52).

FIGURE 2. Illustration by John White depicting Indigenous fish weir use (Courtesy of The Trustees of the British Museum).

Stone fish weirs, the primary focus of this thesis, represent a specific material construction by utilizing lithic foundations as primary structural components, often supplemented by wooden stakes, woven brush panels, or basketry elements as secondary components that rarely preserve archaeologically except under exceptional depositional circumstances (Chapman 1975: 1-11; Colley 1990: 207-236; Connaway 2007: 5-16; Daniel 2013:253-268; Petersen et al. 1984: 199-209; Rostlund 1952: 101-104). These lithic features demonstrate remarkable durability in the archaeological record compared to organic fishing technologies, frequently surviving centuries or millennia of environmental changes including catastrophic flooding events, channel migration processes, and intentional anthropogenic modifications during navigation improvements or commercial fishing intensification (Chapman 1975:1-11; (Connaway 2007: 17-46; Jennings et al. 2023:83-87; Trout et al. 2016:74-80). The persistence of stone fish weirs riverine landscapes provides archaeologists with exceptional opportunities to investigate long-term patterns of resource exploitation, environmental adaptation strategies, and cultural continuity across extended temporal spans that would remain archaeologically invisible if dependent exclusively on analysis of organic fishing technologies that preserve only under near-perfect anaerobic conditions (Espenshade 2010: 65-66).

Unlike perishable fishing equipment including nets, wooden stakes, and wicker baskets that rarely survive archaeologically unless deposited in waterlogged contexts with minimal oxygen exposure (Connaway 2007:17-46; White and Roth 2009:183-192), stone weirs offer direct near-permanent material evidence of fishing practices that can be systematically documented, rigorously analyzed through morphological and spatial methods, and confidently compared across diverse regional contexts and temporal periods (Chapman 1975:1-11; Connaway 2007:17-46; Fielder 1939:427-436; Goodby et al. 2014:1-19; Oliver 1992:11-27;

Peterson 2018:2-13; Rostlund 1952:101-104; Strandberg and Tomlinson 1969:312-319). The visibility and accessibility of stone weir sites enables development of regional databases documenting distribution patterns, morphological variability, and environmental associations (Cranford 2024, personal communications).

The archaeological significance of fish weirs extends considerably beyond their functional role as subsistence procurement, encompassing multiple dimensions of social organization, territorial control, knowledge transmission, and landscape modification that fundamentally shaped regional cultural developments (Anderson and Sassaman 2012:1-194; Coe 1964:120-124; Jeffery 2013:30-56; Mahar 2019:36-52; Oliver 1992:11-27; Ward and Davis, Jr. 2020:76-97). These structures represent substantial investments of coordinated communal labor and accumulated environmental knowledge requiring organized group efforts capable of mobilizing work parties, nuanced understanding of river geomorphology and fish behavior patterns transmitted through oral instruction and practical demonstration, and social mechanisms ensuring long-term territorial control enabling communities to maintain access to completed installations across generational spans (Bailey 2007: 198-223; Jeffery 2013:30-56; Mahar 2019:17-23). Construction and maintenance of weir complexes necessitated social structures capable of mobilizing cooperative labor, establishing and defending ownership or use rights potentially contested by competing groups, and ensuring intergenerational transmission of specialized traditional ecological knowledge regarding optimal construction locations, seasonal timing of building and maintenance activities, and effective operational procedures maximizing capture yields (Jeffery 2013: 30-56; Mahar 2019: 54-89).

The integration of weirs into broader settlement-subsistence systems likely influenced fundamental decisions regarding associated fish processing site locations, seasonal residential

mobility patterns alternating between riverine and upland locations, and resource distribution networks connecting fishing specialists with agricultural producers that shaped regional interaction patterns and cultural developments documented archaeologically throughout the pre-contact period (Chapman 1975: 1-11; Daniel 2013:253-268; Mahar 2019:17-23; Rostlund 1952: 101-104). The reliable protein sources provided through weir fishing potentially supported population aggregation, increased sedentism enabling investment in permanent structures and intensive agricultural production, and social complexity including ranked social hierarchies and specialized labor organization characteristic of Mississippian period societies documented throughout the southeastern United States (Coe 1964:6-13; Lawson 1709; Mahar 2019:54-89; Oliver 1992:11-27; Ward and Davis, Jr. 2020:76-97)

Nomenclature and Terminological Distinctions

The terminology applied to fish weirs throughout published archaeological literature (FIGURE 3), historical documents, and contemporary vernacular usage exhibits considerable variation across academic disciplines, geographic regions, and cultural contexts, potentially creating confusion and impeding effective communication when reviewing primary sources or comparing weir features documented under different naming conventions (Connaway 2007:473 – 496; Rostlund 1952:101-104; Stevenson 1899:147-154). Terms including "fish dam," "wing dam," "fish fall," "fish trap," "fish wheel," and regional variants appear throughout historical documents and academic publications, frequently used interchangeably despite potentially significant functional or structural differences that warrant terminological distinction (Connaway 2007:473 – 496; Rostlund 1952: 101-104). This terminological inconsistency reflects both the widespread continental distribution of weirs across North America where diverse cultural groups

developed independent naming conventions, and the varied cultural and historical contexts within which these installations were originally constructed, subsequently documented by European observers, and eventually investigated by professional archaeologists operating under different analytical frameworks (Connaway 2007: 473 – 496).

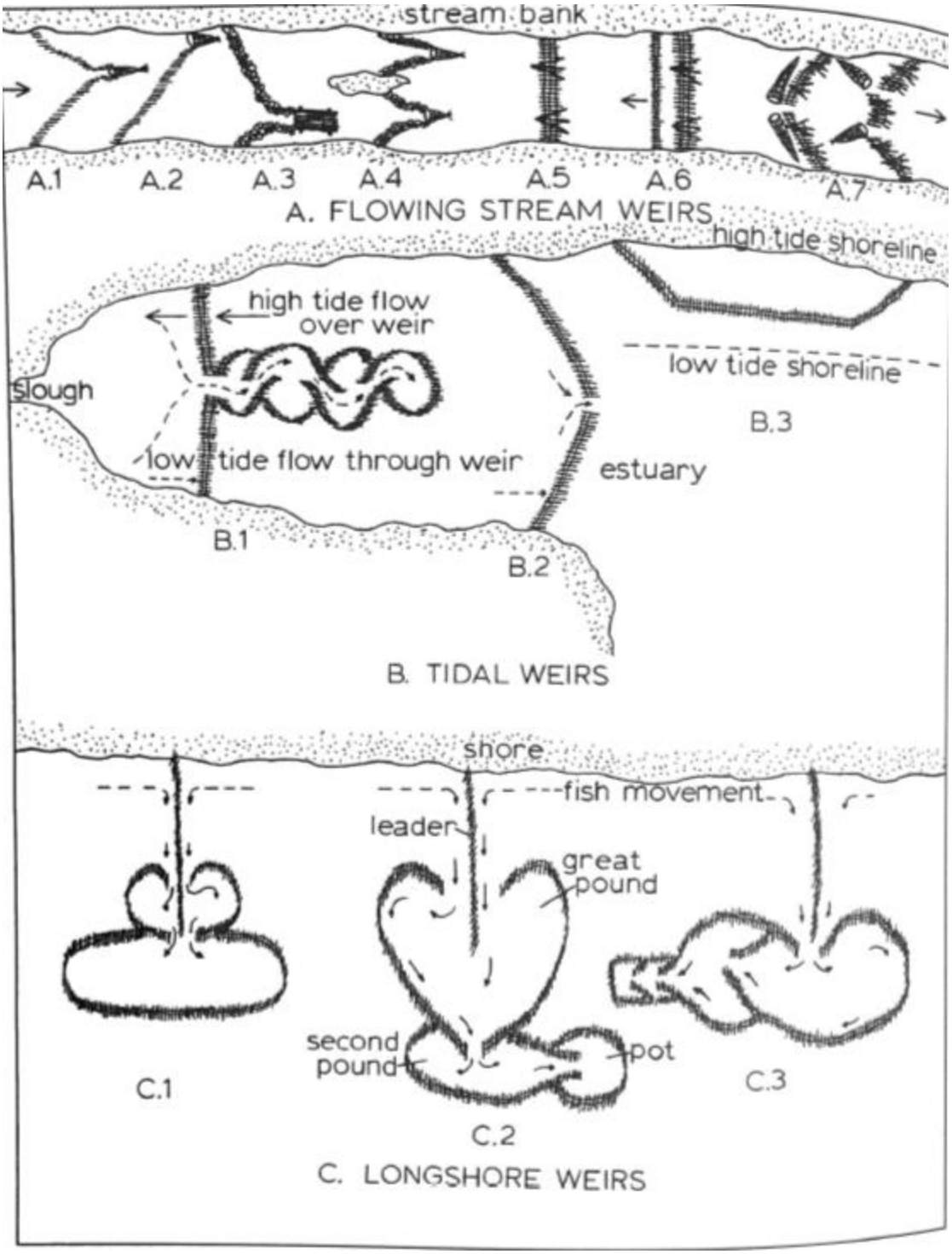

FIGURE 3. A scan of Connaway's Fish Weir Typologies (Courtesy of Connaway 2007).

The term "fish dam", or its variant "wing dam", emphasizes the barrier function of installations, suggesting structures that substantially impede water flow to create upstream

accumulation pools or forcefully redirect current patterns and fish movements (Rights 1929:134-156; Trout et al. 2016:74-80). However, this terminology proves problematic when applied to structures that maintain significant flow-through capacity while effectively capturing fish through directional guidance rather than complete obstruction. Historical documents from colonial North Carolina frequently employ "fish dam" terminology when describing encounters with Indigenous weir sites observed along Piedmont rivers during exploratory expeditions and settlement expansion, yet subsequent archaeological investigations have revealed that many structures functioned primarily as directing or filtering mechanisms rather than true impoundment dams creating substantial elevation differences and slack-water conditions (Lawson 1709; Rights 1929).

The term "fish fall" generally refers to structures positioned at natural elevation drops or rapids where upstream-migrating anadromous fish encounter obstacles during spawning runs, creating concentration points readily exploitable through weir construction (Connaway 2007: 473 – 496). While some stone weirs documented along the Great Pee Dee, including several sites in the central cluster around Lyle's Island exploit such naturally advantageous locations characterized by increased gradient and bedrock exposures, this terminology inadequately describes sites positioned along river segments exhibiting minimal gradient where natural falls or cascades do not occur (Connaway 2007: 473 – 496).

Similarly, the term "fish trap" implies fully enclosed capture mechanisms with restricted or sealed exits preventing escape, fundamentally misrepresenting the open-ended designs characterizing most riverine weir systems that rely on continuous flowing-streams, current, and behavioral manipulation rather than physical confinement within closed spaces (Connaway 2007: 473 – 496).

The term "fish wheel," historically recorded in documents describing fishing installations throughout the Yadkin-Pee Dee drainage and other southeastern river systems (Fielder 1939:427-436; Rights 1929; Rostlund 1952:101-104; Trout et al. 2016: 74-80), specifically designates rotating wooden mechanical devices incorporating buckets or net-lined compartments that captured fish through current-driven revolution, typically installed at weir apex openings where concentrated fish could be scooped from the water through mechanical action (FIGURE 4). Historical documentation explicitly describes fish wheels deployed at numerous Great Pee Dee weir sites during the commercial fishery period of the nineteenth and early twentieth centuries, including the Manship fishery incorporating twenty-two wheels and the Dockery fishery deploying fourteen "dippers" referring to a variant wheel design (Stevenson 1899:147-154; Trout et al. 2016:74-80). While fish wheels represent important technological components enhancing capture efficiency at stone weir sites during historic periods, the term refers specifically to the mechanical devices rather than the underlying stone foundations that preceded wheel installation and potentially continued functioning after wheel removal or deterioration (Trout et al. 2016:101-103).

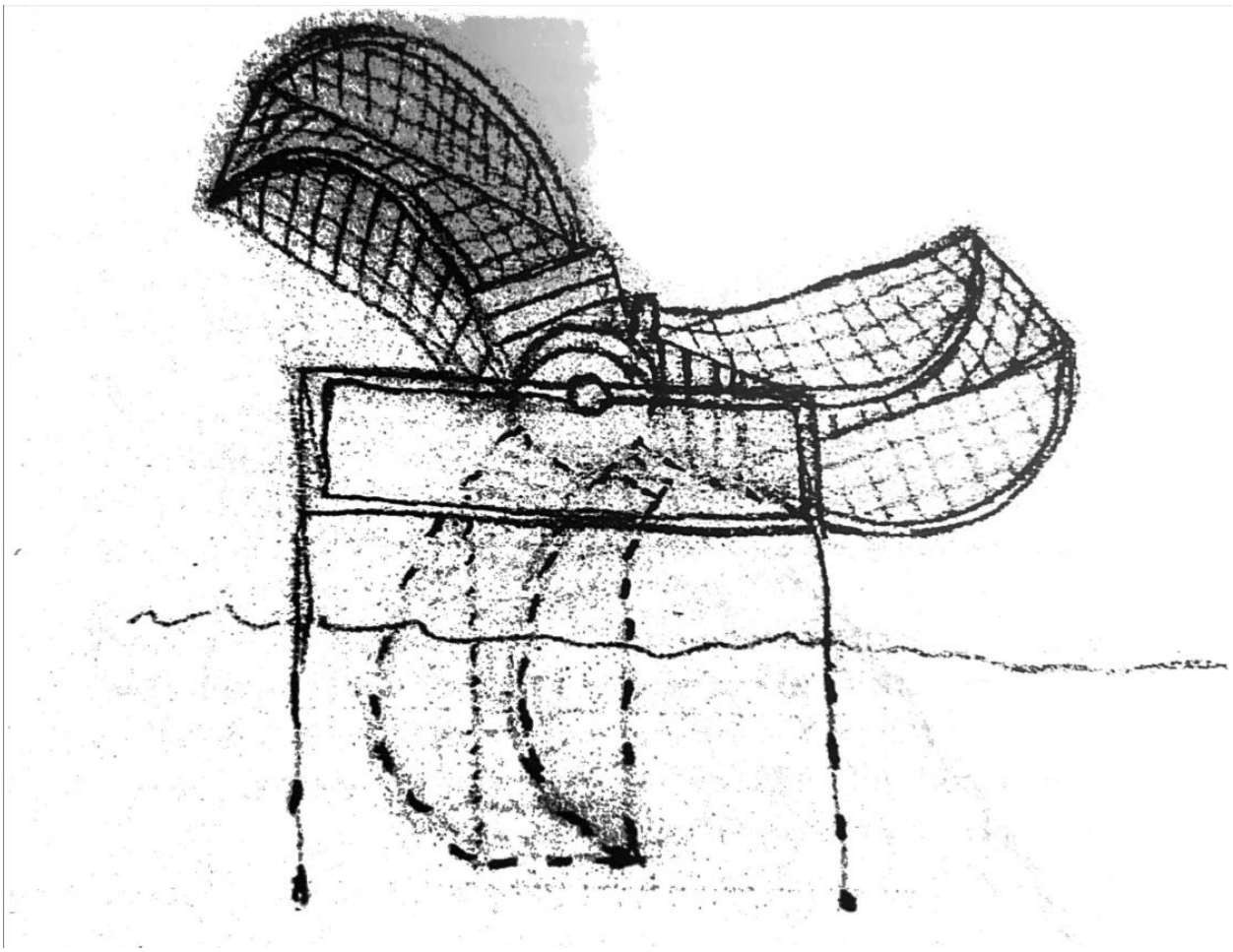

FIGURE 4. Sketch of a Pee Dee Fish Wheel (Courtesy of Trout et al. 2016:103).

For this thesis, "stone fish weir" emerges as the most appropriate and definitionally precise terminology for several reasons. First, this term accurately identifies primary construction materials while avoiding premature assumptions about specific capture mechanisms, operational principles, or functional characteristics that may vary substantially across sites and remain archaeologically ambiguous due to non-preservation of organic components (Connaway 2007:17-46; White and Roth 2009: 183-192). Second, the term "weir" encompasses the full range of morphological designs and functional variations observed archaeologically, from simple V-shaped structures incorporating single apexes to complex multi-component systems with numerous collection points distributed across partial or complete

channel widths (Connaway 2007:5-16). Third, this terminology aligns with contemporary archaeological practice throughout North America, facilitating direct comparison with regional and continental studies employing similar nomenclature and enabling integration of Great Pee Dee data within broader archaeological models addressing riverine adaptation, Indigenous technology, and cultural continuity (Cranford 2024, personal communication; Espenshade 2025, personal communication; Mahar 2019).

Finally, the term "stone fish weir" appropriately acknowledges deliberate human construction for fish capture purposes while remaining neutral regarding cultural attribution, temporal association, and specific operational components or variables that may remain ambiguous without definitive historical evidence and intensive archaeological investigation. The establishment and consistent application of standardized terminology facilitates clear communication across interdisciplinary audiences including academic archaeologists, historians, cultural resource managers, descendant communities, and cultural preservation advocates who benefit from precise, consistent, descriptive language when discussing these significant yet inadequately protected archaeological resources (Cranford 2024, personal communication; Espenshade 2025, personal communication; Jeffery 2013: 30-56).

Typological Classification of Flowing-Stream Stone Fish Weirs

Typological classification systems for stone fish weirs positioned in flowing-stream environments represent attempts to organize the considerable morphological variation observed in weir sites across diverse North American regions and cultural contexts (Connaway 2007). Previous archaeological investigations have identified several recurring configurational forms appearing repeatedly across different cultural traditions and temporal periods, suggesting certain

designs represent optimal environmental adaptations to the universal challenges of riverine mass fish capture that transcend specific cultural preferences or temporal trends (Chapman 1975:1-11; Connaway 2007:17-46; Fielder 1939:427-436; Goodby et al. 2014:1-19; Mahar 2019: 36-52; Oliver 1992:11-27; Peterson 2018:2-13; Rostlund 1952:101-104; Strandberg and Tomlinson 1969:312-319). Understanding these typological categories and their functional implications proves essential for systematically documenting and comparatively interpreting Great Pee Dee River weirs (FIGURE 5) within appropriate regional contexts while recognizing that typological schemes represent arbitrary analytical constructs potentially obscuring continuous variation and hybrid forms characterizing many archaeological sites.

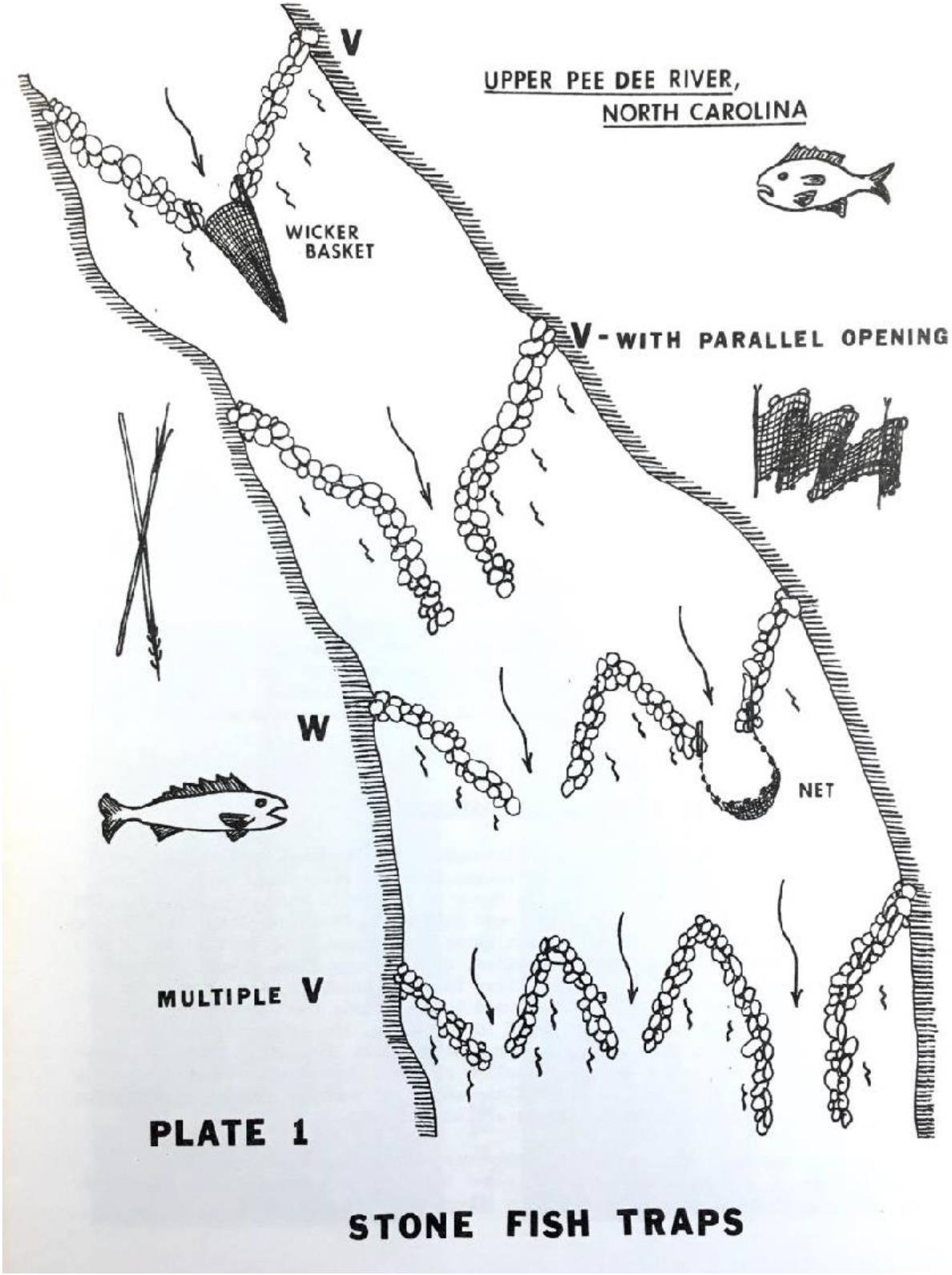
V
UPPER PEE DEE RIVER,
NORTH CAROLINA
WICKER
BASKET
V - WITH PARALLEL OPENING
W
NET
MULTIPLE V
PLATE 1
STONE FISH TRAPS

FIGURE 5. Diagram of Upper Pee Dee River stone fish weirs (Courtesy of Peck 1977 and David Cranford 2019).

The V-shaped weir represents the most widespread and immediately recognizable configurational form documented throughout eastern North American riverine contexts, consisting of two converging stone alignments termed "wings" that create a downstream-pointing funnel or chute terminating in an "apex" where wings meet to concentrate fish for capture (Chapman 1975:1-11; Connaway 2007:17-46; Fielder 1939:427-436; Goodby et al. 2014:1-19; Oliver 1992:11-27; Peterson 2018:2-13; Rostlund 1952:101-104; Strandberg and Tomlinson 1969:312-319). This fundamental design effectively exploits the behavioral tendency of upstream-migrating and downstream-migrating fish to follow obstacle margins during navigation, funneling individuals toward centralized collection points where nets, basket traps, or mechanical devices could be strategically positioned for efficient harvest (Colley 1990:207-236; Connaway 2007:5-16; Jeffery 2013:30-56; Mahar 2019:311-332; Peterson 2018:2-1; Prince 2005:68-84; Stevenson 1899:147-154; White and Roth 2009:183-192). The convergence angle or “apex” formed by wing orientations varies considerably across documented weir sites, ranging from acute angles exhibiting angles under 45 degrees creating narrow funnels to obtuse angles exceeding 120 degrees producing wide capture zones (Connaway 2007: 5-16). These angular variations likely reflect deliberate adaptations to specific local conditions including channel width, flow velocity, target species behavioral patterns, and group preferences transmitted through cultural traditions, with each configuration potentially optimized for particular environmental circumstances or subsistence objectives rather than representing random variation or construction errors (Connaway 2007: 5-16; Rostlund 1952:101-104; Mahar 2019:54-89).

W-shaped or double-V weirs expand upon the basic V-weir design by incorporating multiple distinct apexes, typically two but occasionally three or four, creating several collection points distributed across partial channel widths (Connaway 2007:5-16). These more complex structures potentially served multiple non-mutually exclusive functions including simultaneous mass fish capture by multiple individuals or groups plausibly maintaining separate use rights to specific apexes (Jeffery 2013: 0-56; Mahar 2019:36-52). Operational redundancy provided continued functionality during variable seasonal river flow when certain apexes might become ineffective due to excessive depth or velocity. Selective capture of different species exhibiting varied behavioral responses to different structural elements, flow conditions, and efficient exploitation of wider channels where single V-configurations would require impractically long wings vulnerable to damage during flash flooding encouraged the adoption of W-weir morphology (Daniel 2013: 253-268; Espenshade 2011; Jennings et al. 2023: 83-87). The additional structural complexity evidenced by W-shaped configurations suggests either greater labor investment reflecting larger community involvement capable of mobilizing coordinated construction efforts, or accumulative development through incremental modification and expansion of originally simpler installations over extended temporal periods. (Bailey 2007: 198-223; Mahar 2019:36-52).

Linear or straight weirs, consisting of single stone alignments positioned perpendicular or oblique to current flow without forming distinct V-shaped or W-shaped configurations, appear less frequently in published archaeological literature and comprise merely 7.5 percent of Great Pee Dee installations documented during this investigation (Stevenson 1899: 147-154). These structures typically function to direct fish toward natural collection areas including riverbanks, shallow margins, or pre-existing pools where capture becomes feasible using various active

techniques including spearing or dip-netting rather than passive mechanisms (Colley 1990:207-236; Connaway 2007:473 – 496; Mahar 2019: 54-89; Petersen et al. 1984:199-209; (Rostlund 1952: 81-161). Some linear weirs visible in contemporary conditions may represent incomplete sites where planned extensions were never constructed, or partially preserved remnants of more complex configurations where certain structural sections have been destroyed through flooding, intentional removal during historic navigation improvements, or gradual deterioration through natural taphonomic processes (Daniel 2013:253-268; Jennings et al. 2023:83-87; Trout et al. 2016:74-80). The interpretive challenges associated with determining whether linear alignments represent intentional design categories or natural accumulations of sediments illuminate persistent difficulties in fish weir archaeology where original configurations may be substantially obscured by centuries or millennia of site modification (Cranford 2025, personal communication; Espenshade 2025, personal communication).

Curvilinear weirs, characterized by crescentic or sinuous apexes rather than angular convergence points, demonstrate sophisticated understanding of hydrodynamics and fish behavior responses to complex flow patterns (Connaway 2007:17-46; Jeffery 2013:30-56). A curved apex creates differential flow velocities and turbulence patterns that concentrate fish while potentially maintaining greater structural stability during high-flow events compared to angular configurations experiencing concentrated hydraulic stress at apex corners (Connaway 2007: 17-46; Jeffery 2013: 30-56). These designs may be particularly effective in riverine locations experiencing highly variable seasonal discharge patterns. The relative scarcity of clearly curvilinear configurations in published archaeological literature may reflect either their actual rarity in pre-contact stone fish weir construction traditions, or documentation and

classification biases favoring easily recognizable angular stone formations while misinterpreting curvilinear examples as deteriorated V-shaped installations rather than intentional typologies.

Compound weirs incorporate multiple typological elements, combining V-shaped, W-shaped, linear, and curvilinear segments within localized sites to create complex multi-component mass fish capture systems adapted to specific riverine contexts (Chapman 1975:1-11; Connaway 2007:5-16; Fielder 1939:427-436; Rights 1929; Rostlund 1952:101-104; Stevenson 1899:147-154; Trout et al. 2016: 74-80). These elaborate structures, exemplified by Great Pee Dee installations including NCW-18 with its five apexes and ten wings or NCW-20 spanning 287 meters with six or more apexes, likely developed through incremental modification over extended temporal periods as successive construction episodes added new components or modified existing elements. The presence of compound configurations suggests long-term sustained use and repeated investment in specific fishing locations, potentially indicating sites of particular economic significance, cultural importance, or exceptional productivity within regional settlement-subsistence systems that warranted continuous enhancement across generations (Chapman 1975:1-11; Connaway 2007:5-16; Fielder 1939:427-436; Lawson 1709; Rights 1929; Rostlund 1952:101-104; Stevenson 1899:147-154; Trout et al. 2016:74-80).

Material Components and Construction Techniques

The material composition of stone fish weirs extends considerably beyond simple accumulations of randomly positioned rocks, encompassing systematic selection, deliberate placement, and sometimes intentional modification of lithic components to create effective and durable installations capable of withstanding centuries or millennia of exposure to eroding riverine conditions (Chapman 1975:1-11; Connaway 2007:5-16; Daniel 2001:237-261; Daniel

2013:253-268; Espenshade 2010:56 - 60). Archaeological research examining Indigenous lithic procurement and utilization strategies reveals that weir builders exercised considerable selectivity in material acquisition, favoring particular stone types, dimensional ranges, and morphological characteristics that balanced structural requirements including stability, durability, and hydraulic resistance with practical constraints imposed by available lithic resources and transportation capabilities (Daniel 2001:237-261; White and Roth 2009:183-192). Understanding these material choices and construction techniques provides insight into the technical knowledge, labor organization strategies, and environmental adaptations typically employed by weir-building communities across cultural and temporal contexts.

Primary structural elements typically consist of larger stones, frequently termed "foundation stones" or "anchor stones" in archaeological literature (Connaway 2007:5-16), that establish basic weir architecture and resist displacement by elevated river currents generated during seasonal flooding events (Jennings et al. 2023:83-87). Stone fish weir foundations, often weighing tens to hundreds of pounds depending on local availability and channel conditions (Daniel 2001:237-261), provide fundamental stability against persistent current pressure and catastrophic flood forces while serving as anchoring points for smaller fill materials completing semi-continuous barriers (Connaway 2007:5-16; Stevenson 1899:147-154; Trout et al. 2016:74-80). Foundation stone placement required significant coordinated labor investment and likely involved multi-person groups working cooperatively, particularly when positioning stones in deeper water zones where buoyancy effects and current forces complicated handling and precise positioning (Jeffery 2013:30-56; Mahar 2019:36-52). Archaeological evidence from well-preserved weir sites suggests builders frequently exploited naturally occurring boulders, bedrock outcrops, or erosion-resistant geological features as foundation elements wherever possible,

substantially reducing labor requirements while ensuring long-term positional stability through integration with immovable landscape features (Chapman 1975:1-11; Connaway 2007:17-46; Espenshade 2010:56 – 60; Fielder 1939:427-436; Goodby et al. 2014:1-19; Mahar 2019:54-89; Oliver 1992:11-27; Petersen et al. 1994:197-217; Peterson 2018:2-13; Prince 2005:68-84; Stevenson 1899:147-154; Trout et al. 2016:74-80; White and Roth 2009:183-192).

Secondary fill materials comprising medium to smaller stones create semi-continuous barriers spanning gaps between larger foundation stones (Connaway 2007:5-16). These components demonstrate notable morphological variation reflecting selection from available lithic resources, though systematic patterns observable across well-documented sites suggest deliberate choices rather than entirely expedient utilization of immediately accessible materials without selectivity (Connaway 2007:17-46; Daniel 2001:237-261). The selection and arrangement of fill stones reflects an understanding of hydrology by creating semi-permeable barriers that filter water flow while retaining fish attempting to pass through structural gaps. Stone arrangement porosity could be deliberately adjusted to modify capture efficiency for different target species characterized by varied body sizes, swimming capabilities, and behavioral responses to obstructions, potentially allowing functional modification of weir performance across seasonal periods or in response to changing fish population compositions without requiring complete structural rebuilding (Jeffery 2013:30-56; Mahar 2019:311-332)

Organic components including wooden stakes, woven brush panels, and basketry likely played functional roles in many stone fish weirs based on historical accounts, ethnographic observations, and occasional discoveries of preserved wooden elements in anaerobic deposits (Connaway 2007:5-16; Petersen et al. 1984:199-209; White and Roth 2009:183-192). These components increased weir effectiveness by creating water-filtering barriers capable of retaining

smaller fish directed into the apex providing removable passive-capture containers that could be periodically emptied without requiring dismantling of the entirety of the permanent stone weir foundations (Connaway 2007:5-16). The documented absence of preserved organic components in most archaeological weir contexts, including those found in this thesis, should not be interpreted as evidence of their original absence, as differential preservation severely limits understanding of these important technological elements that may have been essential for effective weir operation. Instead, visible stone foundations likely represent merely the most durable components of originally more technologically complex installations incorporating diverse material types and construction techniques that have been selectively lost through decomposition processes since abandonment.

Stone fish weir construction reveals accumulated environmental knowledge carefully adapted to local river conditions through seasons of observation, experimentation, and refinement. Weir builders demonstrated thorough understanding of seasonal water level fluctuations when selecting construction locations, timing seasonal building, and determining appropriate structural elevations, preferentially choosing sites where natural river channel morphology provided inherent advantages for stone weir placement and long-term structural stability (Bailey 2007:198-223; Mahar 2019:36-52). Weir orientation relative to river current flow direction, height adjustments anticipating seasonal water level variations, and strategic incorporation of natural landscape features including islands, peninsulas, bedrock exposures, and gravel bars reflect accumulated environmental knowledge (Connaway 2007:5-16; Daniel 2013:253-268).

The construction timeline for stone fish weirs, though difficult to reconstruct archaeologically without excavating additional stratigraphic contexts or datable materials, likely

followed seasonal patterns that maximized stone location placement while minimizing risk and environmental impediments. Initial foundation stone placement during the warmer months at predictable low-water periods would establish basic weir structures, followed by incremental addition of fill materials as conditions permitted and labor availability fluctuated (Jeffery 2013:30-56). This approach allowed communities to develop substantial weirs over extended periods of time by distributing labor investment across multiple building sessions as lithic and wood resource surplus and demographic factors enabled weir construction activities without compromising other essential subsistence tasks. The character of stone fish weir construction, maintenance, and modification created structures that physically embodies centuries or millennia of ecological knowledge and adaptation.

Geographic Distribution and Environmental Context of Stone Fish Weirs

The distribution of documented stone fish weir sites across North Carolina reflects complex interactions between subsistence exploitation, cultural practices, and technological innovation that shaped Indigenous and subsequent Euro-American fishing traditions from pre-contact origins through twentieth-century commercial fishing operations (Chapman 1975:1-11; Connaway 2007:17-46; Fielder 1939:427-436; Jennings et al. 2023:83-87; Lawson 1709; Rights 1929; Rostlund 1952:101-104; Stevenson 1899:147-154; Trout et al. 2016:74-80). While comprehensive statewide fish weir surveys remain incomplete, limiting confident assessments of total weir populations and distribution patterns, documented stone fish weirs occur throughout major river systems with particular concentrations in Piedmont physiographic contexts and isolated Coastal Plain and mountainous locations (FIGURE 6) where specific geological and hydrological conditions favor both initial weir construction and long-term archaeological

preservation (Chapman 1975:1-11; Connaway 2007:17-46; Fielder 1939:427-436; Jennings et al. 2023:86; Lawson 1709; Rights 1929; Rostlund 1952:101-104; Stevenson 1899:147-154; Trout et al. 2016:74-80). Understanding these distribution patterns requires consideration of multiple environmental and cultural variables influencing original weir placement decisions, subsequent use patterns, and differential preservation and dismantling determining contemporary archaeological visibility.

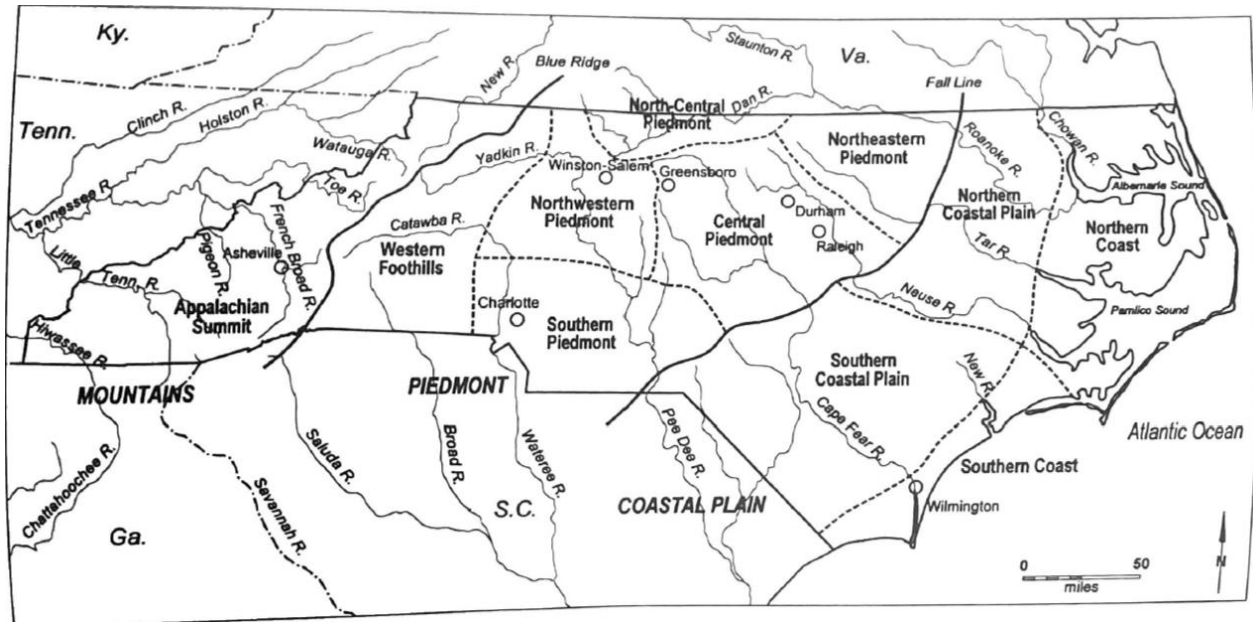

FIGURE 6. Map of North Carolina Regions, Major Cities, and Rivers (Courtesy of Ward and Davis 2020.)

The Piedmont region, characterized geologically by moderate stream gradients, abundant surface stone resources suitable for stone weir construction, and bedrock exposures providing stable foundations, contains the most documented stone weir sites in North Carolina distributed across major drainage systems including the Yadkin-Pee Dee, Catawba, Roanoke, and Tar River basins (Connaway 2007:17-46; Cranford 2024; personal communication; Stevenson 1899:147-

154). Rivers traversing the fall line physiographic boundary where Piedmont metavolcanic rocks from the Uwharrie Mountains transition to Coastal Plain sedimentary formations presented particularly optimal conditions for stone weir construction, as these transitional zones concentrated anadromous fish during seasonal spawning migrations while simultaneously providing rocky substrates suitable for stable foundation placement (Daniel 2001:237-261; Daniel 2013:253-268; Jennings et al. 2023:83-87). The Great Pee Dee River, flowing from the Yadkin River through both Piedmont and Coastal Plain physiographic provinces across its extensive drainage basin into South Carolina and eventually the Atlantic Ocean exemplifies how physiographic transitions influence weir distribution patterns and morphological characteristics (Daniel 2013:253-268; Stevenson 1899:147-154). The concentration of documented weir sites along the fall line suggests these transitional locations held particular environmental advantages exploiting predictable seasonal anadromous species migrations.

Coastal Plain rivers, despite generally lacking readily available surface stone resources compared to Piedmont contexts, contain documented weirs in specific geological settings where erosional processes have exposed older resistant formations or where stone materials were transported from upstream Piedmont sources through either natural fluvial processes or intentional human conveyance (Daniel 2001:237-261; Daniel 2013:253-268). The presence of substantial weir complexes in stone-poor environments indicates their exceptional subsistence and cultural value, as construction required either intensive exploitation of limited local stone sources through systematic quarrying or long-distance transport of materials obtained through trade networks, organized procurement expeditions specifically targeting lithic resources for weir construction, or the construction of composite or wooden weirs instead.

Mountain streams in western North Carolina present distinctly different environmental opportunities and constraints for fish weir construction compared to Piedmont and Coastal Plain contexts. Steep gradients generating light, high-velocity flows and highly variable seasonal discharge patterns limit suitable weir construction locations. (Espenshade 2010:56 - 60). Documented mountain weirs frequently exploit natural cascades, plunge pools, or locations where bedrock constrictions create inherent fish concentration points requiring minimal structural modification to establish effective mass-capture structures (Espenshade 2010:56 – 60). The relative scarcity of documented mountain weirs compared to Piedmont installations may reflect both genuine environmental limitations restricting suitable fish weir construction locations and restricted systematic survey coverage rather than complete absence of mountain fishing weir traditions (Cranford 2024, personal communication; Espenshade 2025; personal communication).

Environmental factors beyond geology and topography significantly influenced historical weir distribution patterns and continue affecting contemporary archaeological visibility. The seasons determined optimal construction periods when temperatures and low-water conditions enabled safe access and efficient anchor stone positioning, and when target fish migrations created mass-capture opportunities (Daniel 2013:253-268; Jennings et al. 2023:83-87; Willard et al. 2005:7-35). The distribution and seasonal abundance of target fish species, particularly anadromous populations including American shad, hickory shad, alewife, blueback herring, and Atlantic sturgeon (*Acipenser oxyrinchus*), fundamentally shaped decisions regarding weir placement locations and justified differing intensities of labor investment in fish weir locations (Bedell et al. 2011:1-22; Chapman 1975:1-11; Fielder 1939: 427-436; Jennings et al. 2023:83-87; Rights 1929; Stevenson 1899:147-154). Rivers supporting reliable annual spawning runs likely

warranted greater labor investment in the construction of stone fish weirs that were anticipated to function across multiple seasons, while locations experiencing variable or unpredictable fish populations might favor more expedient active fishing methods requiring less initial investment and offering greater flexibility.

Contemporary weir distribution patterns visible through photoarchaeological analysis and previous archaeological recordation reflect not only original construction location decisions but also complex differential preservation influenced by environmental processes and anthropogenic modifications over centuries or millennia (Strandberg and Tomlinson 1969:312-319). Natural river channel erosion, catastrophic flooding events, and fundamental sediment regime changes have destroyed, displaced, or obscured unknown numbers of weir sites. Historic modifications implemented for navigation improvements including lock and dam construction, channel dredging, sluice, and wing dam installation; mill dam construction creating impoundments; and twentieth-century hydroelectric dam development fundamentally alter river flow and have disproportionately impacted weir sites located at natural falls, narrow channels, and rapids where Indigenous peoples traditionally concentrated intensive fishing activities (Connaway 2007:17-46; Stevenson 1899:147-154; Trout et al. 2016: 74-80). Understanding current distribution patterns visible through contemporary surveys, such as this one, requires acknowledging these substantial preservation biases while recognizing that documented sites represent merely a fraction of the original extent of stone fish weir construction across North Carolina's many rivers.

Legal and Regulatory Context

The legal status of stone fish weirs in North Carolina presents complex challenges arising from conflicting doctrine between federal and state environmental protections and cultural

resource regulations such as the National Historic Preservation Act and Section 106, and property rights precedents that leave these significant archaeological features vulnerable to modification or destruction (Connaway 2007:47-58; Trout et al. 2016:74-80). Current federal and state legislation provides limited specific protection explicitly addressing stone fish weirs as riverine archaeological features, with preservation occurring primarily as a result of compliance based cultural resource management project reporting that incidentally encompass peripheral terrestrial and submerged cultural resources, rather than directly targeting fish weir protection as explicit policy objectives (Connaway 2007; Cranford 2024, personal communication; Espenshade 2010). Understanding this legal and regulatory context is important for developing fish weir documentation strategies, preservation advocacy, and cultural resource management policies that address fish weirs as archaeological resources and a part of North Carolina's collective maritime heritage.

North Carolina General Statutes, Chapter 70, Article 2, (1981) also known as the Archaeological Resources Protection Act (ARPA), establishes state ownership of any archaeological materials identified on state-controlled lands, waterways, and provides legal guidance for archaeological and historical site protection that allows for regulated investigation under permitted circumstances. However, these statutes primarily address portable artifacts and human remains, offering limited explicit guidance regarding fixed riverine features including stone fish weirs that cannot be readily curated or protected using conventional archaeological repository standards. The ambiguous legal status of cultural structures that exist simultaneously as archaeological features warranting protection and navigational obstructions historically subject to removal complicates their treatment under existing cultural resource legislation designed primarily for terrestrial contexts (Cranford 2024, personal communication; Espenshade

2011). The multi-temporal nature of many weirs constructed or modified by diverse cultural groups across centuries or millennia challenges conventional approaches to significance determination and eligibility assessment under Section 106 and standard preservation models emphasizing clear temporal associations and clear cultural attributions (Espenshade 2010:65-66).

Federal legislation, particularly Section 106 of the National Historic Preservation Act of 1966, requires federal agencies to consider effects on historic properties during undertakings involving federal funding, permits, or management of federal lands (Espenshade 2010). Stone weirs potentially qualifying as Traditional Cultural Properties based on documented ongoing significance to descendant Indigenous communities, or contributing elements to archaeological districts encompassing broader riverine cultural landscapes, may receive protection through Section 106 review processes when federal involvement triggers regulatory requirements (Espenshade 2010:71-72). However, documentation standards for riverine archaeological features remain underdeveloped compared to well-established protocols for terrestrial sites, and many weir structures lack formal determinations of National Register eligibility necessary for ensuring consideration during project planning and permitting processes (Cranford 2024, personal communication; Espenshade 2010:40-41). The practical challenges of establishing clear temporal associations, assessing integrity for structures subjected to centuries of modification and natural deterioration, and demonstrating significance under National Register criteria further complicate eligibility determinations under current regulatory frameworks designed primarily for more straightforward archaeological contexts (Espenshade 2010:40).

Environmental regulations for North Carolina rivers frequently conflict with fish weir preservation objectives despite shared goals of maintaining ecological health and cultural heritage. The Federal Energy Regulatory Commission's oversight of hydroelectric facilities,

United States Army Corps of Engineers' navigation and flood control mandates, and state water quality programs administered through environmental agencies may classify stone weirs as channel obstructions requiring modification or removal to meet contemporary resource management objectives (Bedell et al. 2011:1-22; Fielder 1939: 427-436). Historical modifications implemented for navigation improvement, flood control infrastructure, and hydroelectric development have destroyed numerous archaeological and historical weirs with minimal or absent prior archaeological documentation, representing irreversible information losses (Stevenson 1899:147-154; Trout et al. 2016: 74-80). Contemporary stream restoration projects, while generally beneficial for ecological health and potentially improving conditions for anadromous fish populations, may inadvertently impact archaeological weirs when cultural resource considerations are not adequately integrated into project planning, design, and implementation phases (Jennings et al. 2023: 83-87).

Property rights claims also complicate preservation efforts and research access to fish weir sites. Many fish weirs occur in locations where the water level is low and streambed ownership becomes legally dubious, particularly in waters classified as non-navigable under state law where North Carolina statutes provide limited guidance regarding ownership of riverbed archaeological features. Private property owners may claim ownership of weirs positioned within their riverbed, potentially restricting research access or authorizing modifications without archaeological consultation or regulatory oversight. While the public trust doctrine establishes public rights to navigable waters potentially providing some protection for weirs in larger rivers including the Great Pee Dee, structures in smaller tributaries classified as non-navigable remain vulnerable to unregulated modification or intentional destruction (Stevenson 1899:147-154; Trout et al. 2016:74-80).

The development of comprehensive preservation strategies for stone fish weirs requires addressing these legal ambiguities through policy reform, enhanced stakeholder engagement, and the development of additional cultural resource management approaches adapted to the unique demands of preserving submerged archaeological resources. Clarification of streambed ownership responsibilities, establishment of specific protection measures explicitly addressing fixed riverine archaeological features, and emphasis of cultural resource considerations into environmental planning at federal, state, and local levels would significantly improve preservation outcomes for these vulnerable yet significant contributors to North Carolina's archaeological heritage (Cranford 2024, personal communication). Recognition of fish weirs as archaeologically significant heritage resources by state and federal regulatory agencies, combined with education programs targeting property owners, recreational river users, and cultural resource management professionals, could foster stewardship of stone fish weirs for future research, public interpretation, and descendant community connections to ancestral landscapes (Jeffery 2013: 30-56).

Contemporary Research Initiatives and Methodological Advances

Recent decades have witnessed renewed scholarly interest in fish weirs as archaeologically significant features deserving systematic investigation and proactive preservation, reflecting broader theoretical and methodological trends in archaeological practice including increased attention to maritime and riverine cultural resources, recognition of Indigenous maritime heritage, and the development of collaborative approaches to heritage management emphasizing descendant community participation (Jeffery 2013:30-56). Methodological advances in remote sensing technologies, Geographic Information Systems

applications, and underwater archaeological documentation techniques have expanded the possibilities for the efficient identification, detailed recording, and photoarchaeological analysis of stone fish weirs, while collaborative research models increasingly incorporate Indigenous knowledge and community perspectives into archaeological interpretations and heritage management decisions (Espenshade 2011; Ringer 2008:133-149; Strandberg and Tomlinson 1969:312-319).

The North Carolina Fish Weir Archaeological Project, initiated and directed by Assistant State Archaeologist Dr. David Cranford, represents the most comprehensive systematic effort undertaken to date for inventorying and assessing fish weirs on a statewide scale. This ongoing project's standardized numbering system employing "NCW" designations and continuation of systematic documentation protocols have facilitated direct comparison across many of North Carolina's rivers while building a comprehensive centralized geodatabase currently containing hundreds of suspected weir sites distributed throughout major North Carolina drainage basins, including the Great Pee Dee (Cranford 2024, personal communication). The strategic integration of citizen science observations contributed by paddling clubs, fishing organizations, river mapping and navigation societies, and interested private individuals has significantly expanded survey coverage while simultaneously building public and academic awareness of stone fish weirs as archaeological resources. The project exemplifies productive collaborations between professional archaeologists and avocational enthusiasts sharing interests in maritime heritage, demonstrating that systematic documentation need not rely exclusively on professional archaeological labor when appropriate training, standardized documentation protocols, and quality control mechanisms ensure data reliability.

Geographic Information Systems technology has revolutionized approaches to fish weir research by enabling accessible landscape-scale spatial analysis of fish weir distribution patterns, morphological quantification, and statistical assessment of adjacent weir site associations that would prove difficult and time consuming using conventional manual mapping and measurement techniques. Spatial analysis tools facilitate statistical analysis of relationships between weir site provenience and environmental variables including river gradient, river channel morphology, composition determined through geological mapping, , and proximity to documented terrestrial archaeological sites providing chronological and cultural context (Espenshade 2010:28-37; Strandberg and Tomlinson 1969:312-319).

Chapter Two: Historical Background of the Great Pee Dee River in the Southern Piedmont

Paleoindian Period (circa 12,000-8,000 BC)

The archaeological narrative of human occupation in the Yadkin-Pee Dee River valley begins with the arrival of the first bands of Indigenous peoples during the Paleoindian period, though direct material evidence for fish weir construction during the earliest occupation phase remains notably absent from regional archaeological records (Coe 1964; Connaway 2007; Daniel 2001; Oliver 1992; Ward and Davis 2020). Understanding this absence requires the consideration of multiple variables including terminal Pleistocene and early Holocene environmental conditions that differed substantially from those characterizing subsequent periods (Daniel et al. 2013:89-112; Willard et al. 2005: 17-35). Paleoindian subsistence strategies emphasizing highly nomadic mobility patterns were incompatible with investment in fixed stone fishing weirs.

The Pleistocene and early Holocene environmental context of the Yadkin-Pee Dee drainage differed dramatically from contemporary conditions documented through historical observations and modern ecological studies. Cooler temperatures and more variable climates characterized the regional landscape, supporting distinctive flora and fauna communities substantially different from those observed during later periods (Daniel et al. 2013:89-112; Willard et al. 2005: 17-35). Rivers responded to precipitation patterns and potential influence from distant glacial meltwater, exhibiting sustained flow and seasonal flooding patterns unlike those documented in recent centuries. While specific palaeoecological data regarding Pleistocene fish populations in the Yadkin-Pee Dee system remain limited, the fundamentally different environmental conditions would have influenced both the feasibility of weir construction and the

potential subsistence returns from the construction of stone fish weirs (Daniel 2013:253-268; Jennings et al. 2023:83-87).

Paleoindian subsistence strategies, as reconstructed from archaeological evidence throughout the Southeast, emphasized nomadic hunter-gather subsistence strategies and flexible opportunistic resource exploitation patterns adapted to dynamic post-glacial environments (Coe 1964:6-13; Ward and Davis, Jr. 2020:27-36; Willard et al. 2005:7-35). Small highly mobile bands likely followed seasonal cycles incorporating diverse resources distributed across regions to their diet, pursuing megafauna and early Holocene game populations while supplementing hunting returns with plant gathering and small game procurement (Anderson and Sassaman 2012: 1-194; Ward and Davis, Jr. 2020:27-36). This mobility-focused adaptation contrasts fundamentally with the territorial stability and sedentism required for effective stone fish weir construction, maintenance, and long-term operational use.

Archaic Period (8,000-1,000 BC)

The Archaic period represents a fundamental transformation in Indigenous relationships with riverine environments throughout the Yadkin-Pee Dee valley, with accumulating archaeological evidence suggesting the potential emergence of fish weir usage during this extended temporal span conventionally divided into the Early (8000-6000 BC), Middle (6000-3000 BC), and Late (3000-1000 BC) subperiods (Coe 1964: 6-13; Daniel 2001:237-261; Mahar 2019:17-23; Ward and Davis, Jr. 2020:47-64). This period witnessed progressive intensification of aquatic resource exploitation paralleling broader regional trends toward increasing semi-sedentary activities, increasing appearance of projectile point typologies, and increased population density (Oliver 1992: 11-27; Anderson and Sassaman 2012: 1-194).

The Early Archaic period (8000-6000 BC) reflects transitional adaptations as Indigenous peoples adjusted to ameliorating Holocene environmental conditions following the end of the Pleistocene ice age. Warming temperatures and stabilizing precipitation patterns fundamentally altered river hydrology and fish population dynamics, potentially creating new opportunities for systematic riverine resource exploitation (Daniel 2013:253-268; Ward and Davis, Jr. 2020:47-64; Willard et al. 2005:7-35). Archaeological assemblages from this period demonstrate increasing lithic typological diversity including implements potentially associated with fishing activities such as notched net sinkers and bone hooks, though definitive functional identification remains challenging (Ward and Davis, Jr. 2020:47-64). While direct evidence for Early Archaic stone weirs remains elusive, the organizational and subsistence foundations necessary for their eventual construction were clearly emerging during this period.

The Middle Archaic period (6000-3000 BC) witnessed continued population growth and societal collaboration creating increasingly favorable conditions for fish weir development (Ward and Davis, Jr. 2020: 63-64). The Morrow Mountain and Guilford archaeological phases characteristic of the North Carolina Piedmont demonstrate markedly increased site density and extended occupation duration suggesting reduced residential mobility and emerging territorial circumscription (Daniel 2001: 237-261; Coe 1964: 120-124). These demographic trends would have encouraged investment in fixed subsistence sites like stone fish weirs requiring territorial control and long-term maintenance commitments, as the labor investment becomes calorically viable when groups maintain sufficient site accessibility to ensure continued use of completed stone fish weirs over many years.

The Late Archaic period (3000-1000 BC) represents the culmination of long-term trends from nomadism towards sedentism, population aggregation in villages, and intensive resource

exploitation strategies documented throughout the Southeast (Daniel 2001:237-261). Archaeological evidence from this period provides the strongest indicators for systematic use of fish weirs throughout the Yadkin-Pee Dee valley during the Archaic period (Mahar 2019:17-23; Ward and Davis, Jr. 2020:47-64). Large Late Archaic sites positioned along major rivers suggest semi-permanent or potentially annual occupations supported by reliable and abundant subsistence resources including riverine species (Ward and Davis, Jr. 2020:47-64). The Savannah River phase prevalent throughout the North Carolina Piedmont and inner Coastal Plain demonstrates technological and social developments consistent with organized communal enterprises such as weir construction and operation (Coe 1964: 6-13; Ward and Davis, Jr. 2020:47-64).

Woodland Period (1,000 BC - AD 1,600)

The Woodland period represents the florescence of Indigenous fishing technologies throughout the Yadkin-Pee Dee River basin, with archaeological and ethnohistoric evidence strongly suggests widespread construction and use of stone fish weirs as integral components of increasingly complex subsistence and village settlement systems (Daniel 2013:253-268; Jennings et al. 2023:83-87; Mahar 2019:311-332; Oliver 1992; Ward and Davis, Jr. 2020:76-97). This period, conventionally divided into the Early (1000 BC- AD 300), Middle (AD 300-800), and Late (AD 800-1600) subperiods, witnessed significant technological innovations, demographic expansions, and social developments that elevated the importance of riverine resources and the installations designed to harvest them efficiently (Mahar 2019:17-23).

The Early Woodland period (1000 BC- AD 300) demonstrates clear continuities with Late Archaic riverine adaptations while introducing innovations that enhanced exploitation

capabilities. The widespread adoption and refinement of pottery including Badin, Yadkin, Vincent, and Clements series pottery types significantly improved food processing and storage capabilities essential for preserving seasonal fish harvests (Ward and Davis 2020:80-85). Ceramic vessels enabled new cooking techniques enhancing both palatability and nutritional value of fish, potentially increasing the dietary importance and cultural significance of aquatic resources within along the Great Pee Dee river (Colley 1990:207-236; Mahar 2019:311-332; Rostlund 1952:145-161).

The Middle Woodland period (AD 300-800) witnessed significant social and ceremonial organization in the form of chiefdoms potentially influencing fish weir construction, ownership, and use patterns (Ward and Davis, Jr. 2020:76-97). The spread of Mississippian ceremonial practices and associated long-distance exchange networks in the southern Piedmont connected the Yadkin-Pee Dee river basin to broader southeastern and midwestern cultural influences, though local populations did not participate fully in core Mississippian ceremonialism (Coe 1964: 99-105; Ward and Davis 2020:97). Material culture evidence for interaction appears in pottery styles, mortuary practices, and the presence of exotic materials indicating expanded social networks that potentially facilitated technological knowledge exchange including weir construction techniques (Coe 1964:118-124).

The Late Woodland period (AD 800-1600) represents the apex of precontact Indigenous cultural development in the Yadkin-Pee Dee river valley, characterized by complex chiefdoms and societies dependent on mixed subsistence strategies incorporating maize agriculture, hunting wild game, gathering herbs and shellfish, and intensive fishing (Mahar 2019:311-332). The emergence of sites with evidence for the Southern Appalachian Mississippian cultural influence around AD 950 represented along the Great Pee Dee River but north of the thesis survey are at

the Town Creek, Leak, and Teal sites (FIGURE 7) which introduced new forms of social organization, ceremonial practices, and agricultural intensification that enhanced existing subsistence strategies (Coe 1964: 6-13; Oliver 1992; Ward and Davis 2020:119). Stone fish weir construction likely reached its greatest extent and most intensive use during this period, serving not only subsistence needs but also important social, political, and ceremonial functions within increasingly stratified societies (Mahar 2019:311-332).

Late Woodland Pee Dee Settlement Sites In and Near the Thesis Survey Area

Teal Site (31AN1) (AD 950 – 1200)

The arrival of the Pee Dee culture in the southern Piedmont of North Carolina and the Great Pee Dee river basin is marked by the Teal site (Coe 1964: 6-13; Oliver 1992; Ward and Davis 2020:132). Previous archaeological excavations at the Teal site reveal that the earliest Pee Dee people at the Teal site built rectangular structures with rounded corners. It is postulated that rituals similar to those observed later at Town Creek may have been conducted in these structures. Archaeological evidence shows that the Pee Dee often buried their dead or cremated and interred their remains in large urns with complex stamped Pee Dee pottery also found at Town Creek and fine cord marked Savannah Creek pottery (Ward and Davis, Jr. 2020:132). While archaeological evidence supports a typical late-Woodland period subsistence model of hunting, gathering, active fishing, and maize agriculture (Ward and Davis, Jr. 2020:132), the Teal site's location on the Great Pee Dee River lends itself to the hypothesis that the Pee Dee introduced or continued stone fish weir use in the region.

Town Creek Site (AD 1200 – 1400)

The Town Creek site is perhaps the most significant example of Southern Appalachian Mississippian cultural influence in the region, and is unique in that evidence for Mississippian

influence only exists in the southern piedmont of North Carolina and does not appear in other pre-contact sites in the state (Ward and Davis 2020:119). The people that migrated from the south up the Great Pee Dee river and through the thesis survey area to occupy the area of what would become the Town Creek site were what archaeologists like Joffre L. Coe (1964) and Rev. Douglas L. Rights (1929), prominent figures in southern Piedmont North Carolina archaeology, called the Pee Dee culture (Coe 1964; Ward and Davis, Jr. 2020: 124-125). The Pee Dee archaeological culture is defined by their differences in settlement and subsistence strategies when compared to the "Piedmont Village Tradition" of their northern neighbors (Ward and Davis, Jr. 2020:124). Rather than building more egalitarian villages and social hierarchies, it would appear that the Pee Dee at Town Creek built ceremonial mounds, plazas, and buried their dead around the periphery of the settlement, reserving burial within the settlement for the remains of cremated children and nobles in Pee Dee seriated ceramic urns, indicating a socially stratified society centered around an elite priestly class that greatly valued communal earthworks and burial ceremony (Ward and Davis, Jr. 2020: 131).

This may provide explanation for the existence of a stone fish weir spanning the width of the channel of the Little River, a tributary of the Great Pee Dee, directly adjacent to the Town Creek settlement site. It is plausible that this stone fish weir was contemporaneous with the Pee Dee occupation of Town Creek and provided a means of mass fish capture for the Pee Dee during the height of mound construction. This would further indicate that social organization is essential for stone weir construction and use. The remnants of the Town Creek stone weir was modified in the 1920s into a repurposed wooden slat fish trap built over the old stone weir foundations when it was photographed by Coe in 1937 (Trout et al. 2016:100).

Leak Site (31RH1) (AD 1400 – 1600)

The Leak site is the last known major Pee Dee settlement site and appears to have been a successor to the Town Creek site as a ceremonial center in the southern Piedmont of North Carolina (Oliver 1992; Ward and Davis 2020:132-133). They appear to have continued structural design from previous Pee Dee sites by constructing ovular structures within which they presumably conducted the rituals synonymous with the Pee Dee culture. Pottery was found to be stamped with the diagnostic Pee Dee seriations. Subsistence strategies appear to have remained the same with possible use of stone fish weirs on the Great Pee Dee due to their close proximity (Oliver 1992; Ward and Davis 2020:132-133).

Trestle Site(31AN19) (Late Archaic – Late Woodland)

The Trestle Site is a tragic example of wasted archaeological potential by cultural resource mismanagement and looting. The Trestle Site, located on Lyle's Island, is directly articulated with confirmed compound stone fish weir complexes NCW-18 and NCW-2 within the central Lyle's Falls stone fish weir cluster researched by this thesis, and was excavated by an archaeological field school led by Catawba College history Professor Peter P. Cooper in the early 1970s (Dr. J. Michael Blitzer 2023, email correspondence with Catawba College faculty; Oliver 1992:71-71). The results of the excavations produced archaeological evidence of a significant, periodically occupied, stratified, Late Archaic to Late Woodland Pee Dee settlement site (circa BC 3000 - AD 1600) (Cranford 2023, Dr. David Cranford 2023, email correspondence with North Carolina Office of State Archaeology; Oliver 1992:71-71). Unfortunately, the Trestle Site artifact assemblage recovered from subsequent field school excavations, likely including many hall-mark diagnostic Pee Dee and pre-Pee Dee artifacts commonly found at other local Pee Dee sites, were given to Cooper's family, local Lyle's Island landowners, and partially documented and preserved at the Rankin Museum of American Heritage in Ellerbe, NC and the North

Carolina Office of State Archaeology artifact repository in Raleigh, NC after Cooper's passing (Dr. J. Michael Blitzer 2023, email correspondence with Catawba College faculty; Dr. David Cranford 2023, email and personal correspondence with North Carolina Office of State Archaeology staff; Brett Webb and Charles K. Craven 2023, email and personal correspondence with the Rankin Museum of American Heritage board). The news of a newly discovered substantial Pee Dee settlement, possibly related to the Town Creek site just several miles north, drew the attention of amateur archaeologists and looters alike. As a result, the Trestle site was extensively looted since its discovery in the 1970s and has likely been irrevocably disturbed and despoiled of much of its diagnostic Pee Dee artifacts and stratified contexts (Dr. David Cranford 2023, email and personal correspondence with North Carolina Office of State Archaeology staff; Oliver 1992:71-71). The artifact assemblages stored at the NCOSA repository were a limited collection of lithic artifacts, Pee Dee/non-Pee Dee stamped seriated pottery, and miscellaneous artifacts associated with the site (Dr. David Cranford 2023, email and personal correspondence with North Carolina Office of State Archaeology staff). Similarly, when the thesis author evaluated the artifact assemblages stored at the Rankin Museum of American Heritage, the museum did not have an extensive collection of artifacts directly attributed to the Trestle site nor did they have archaeological documentation supporting claims of artifacts being collected and donated to the museum by recreational kayakers and sport fishers that privately visited the site. They had many examples of northern piedmont village tradition lithic artifacts and ceramics attributed to Occaneechi and Saponi sites and a few representative examples of Pee Dee artifacts scattered throughout the Great Pee Dee River basin, but none that could be definitively attributed to the Trestle site.

If archaeological site documentation and excavation results were properly preserved, the Trestle site may have provided North Carolina archaeologists and this thesis with direct evidence for how Indigenous cultural groups, like the Siouan speaking Southern Appalachian Mississippian Pee Dee cultural band that inhabited the Trestle site, organized their settlements directly on the Great Pee Dee river and how their subsistence strategy was reflected through their likely use of the expansive stone fish weir complex observed in the Lyle's Falls portion of the Great Pee Dee river that the Trestle site was discovered.

Late Woodland Caraway Phase (AD 1500 – 1700)

The Caraway Phase is a brief archaeological cultural phenomenon that represents the conclusion of the Pee Dee archaeological cultural tradition in the southern Piedmont of North Carolina (Ward and Davis, Jr. 2020:134-137). This cultural subperiod of the late Woodland period is represented by the Poole/Keyauwee village site (31Rd1) on Caraway Creek, NC. It is defined by the continuation of Pee Dee stamped pottery and burial traditions with evidence for post-contact trade in the form of European glass beads and pipes found in burials. A formal typology has not been created for the Caraway Phase, however it is described by Ward and Davis, Jr. (2020:137) as being, "the culmination of Badin, Yadkin, Uwharrie, and Dan River ceramic traditions with an overlay of some Pee Dee influence". The Caraway Phase concludes in the late 1600's as Pee Dee settlements dispersed and adopted the more prevalent Piedmont village traditions of northern cultures, leaving only the archaeological remnants of their settlements and stone fish weirs as a reminder of their presence.

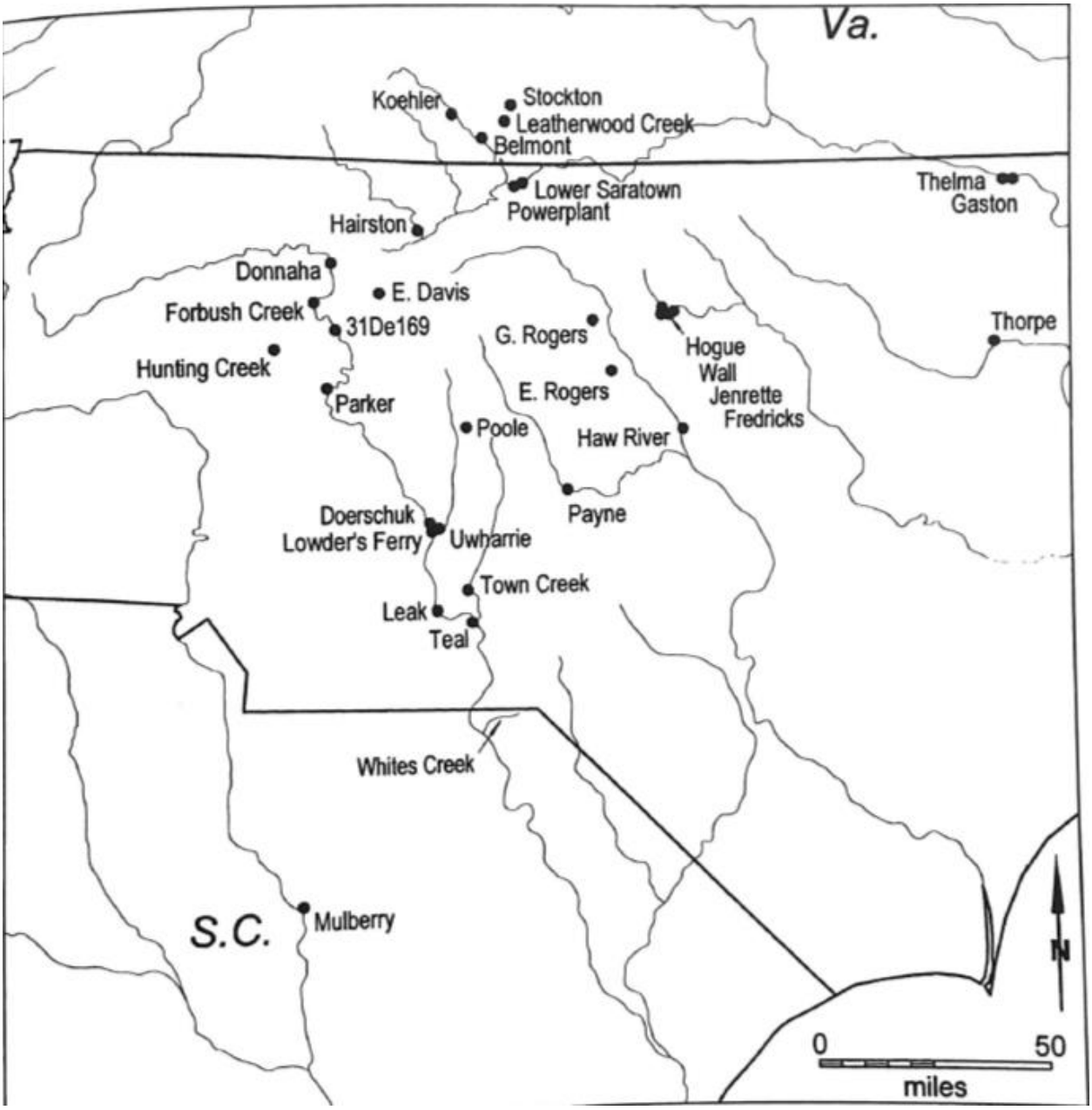

FIGURE 7. Overview of North Carolina Woodland and Mississippian Sites including the discussed Town Creek, Leak, and Teal Sites (Courtesy of Ward and Davis, Jr. 2020:79).

Post-Contact Period (AD 1600-Present)

The Post-Contact period initiated profound transformations throughout the Yadkin-Pee Dee River valley, dramatically affecting Indigenous peoples and their traditional subsistence practices including construction, use, and maintenance of stone fish weirs. European colonization, beginning with Spanish expeditions in the sixteenth century and intensifying with English settlement during the seventeenth and eighteenth centuries, introduced epidemic diseases, new technologies, and economic systems that fundamentally disrupted Indigenous societies (Lawson 1709; Ward and Davis, Jr. 2020:254-278). Despite these massive disruptions, documentary and archaeological evidence suggests continued use and modification of fish weirs by Native American, European, and African American populations throughout the historic period extending into the twentieth century (Lawson 1709; Trout et al. 2016:74-80; Stevenson 1899:147-154).

Initial European observations of North Carolina's coastal and Piedmont regions included numerous, though often brief, references to Indigenous fishing practices. John Lawson's detailed (1709) account of his travels through the Carolinas as a surveyor general of North Carolina describes various Indigenous fishing techniques including the use of stone fish weirs at the "Keyauwee village", identified by North Carolina archaeologists Joffre L. Coe (1964) and Douglas L. Rights (1929), to actually be the previously discussed Town Creek site rather than the Caraway Phase 'Poole' site (Lawson 1709; Ward and Davis, Jr.:120). Lawson notes the abundance of fish in Piedmont rivers, such as the Great Pee Dee, and describes Indigenous methods for capturing them, strongly suggesting the continued importance of riverine resources to Native American communities despite catastrophic population losses from epidemic diseases that had already decimated many groups by the early eighteenth century.

European colonists quickly recognized the value and effectiveness of Indigenous fish weirs and adopted weir structures for their own subsistence and commercial purposes (FIGURE 8). Colonial legislation regarding Great-Pee Dee stone fish weirs appears in North Carolina records as early as the 1770s, primarily addressing navigation concerns and attempting to regulate disputes over fishing rights, river access, and river navigation (Trout et al. 2016:100-103). These laws and legal precedents suggest that both Indigenous and European communities were constructing and operating stone weirs, leading to conflicts requiring legal intervention and regulations (Trout et al. 2016:100-103). The adoption and adaptation of Indigenous weir technology by European settlers represents a common pattern of technological knowledge transfer characteristic of frontier regions where colonists depended on Indigenous knowledge for successful adaptation to unfamiliar environments.

THE RIVER FISHERIES OF THE ATLANTIC STATES.

Fish-nets in the Peedee River. (Sect. v, vol. i, p. 624.)

FIGURE 8. A sketch of Fish Wheels on the Pee Dee (Courtesy of Stevenson 1899).

The eighteenth through to the twentieth centuries witnessed intensive and often destructive modification of Great Pee Dee River stone fish weirs for navigational improvement, mill dam construction, and eventually hydroelectric power production (Lawson 1709; Stevenson 1899:147-154; Trout et al. 2016:74-80). Great Pee Dee River modifications destroyed many stone fish weirs while potentially creating new opportunities for weir construction at mill dams and navigation structures (Trout et al. 2016:74-80). Historical maps and navigation surveys occasionally mark "fish dam" locations along the river, though distinguishing Indigenous constructions from historic-period modifications proves challenging without detailed archaeological investigation (Trout et al. 2016:74-80). The construction of canals and dams for navigational improvements particularly impacted weir sites at natural falls and rapids where Indigenous peoples had traditionally concentrated intensive fishing activities at channel narrows (Stevenson 1899:147-154; Trout et al. 2016:74-80).

Industrial development during the nineteenth and early twentieth centuries profoundly impacted both fish populations and traditional fishing practices throughout the Yadkin-Pee Dee River. Pollution from textile mills, chemical plants, and agricultural runoff severely degraded water quality and dramatically reduced fish populations (Bedell et al. 2011:1-22; Jennings et al. 2023:83-87). The Blewett Falls Hydroelectric Dam construction for hydroelectric power generation permanently blocked anadromous fish migrations, eliminating the spawning runs that had supported Indigenous fishing economies for millennia (Fielder 1939:427-436; Rights 1929). Environmental changes to the Great Pee Dee River fundamentally undermined the economic viability of traditional fishing practices, leading to abandonment of most remaining active stone weir sites by Natives and Europeans alike by the mid-twentieth century.

Chapter Three: Fieldwork

Theory: Approaching Stone Fish Weirs as Multi-Temporal Palimpsests

The theory guiding this thesis conceptualizes stone fish weirs as multi-temporal palimpsests representing persistent places in the Great Pee Dee riverine cultural landscape where environmental and cultural factors converged to create enduring focal points attracting repeated use across temporal and cultural boundaries (Bailey 2007: 198-223). This approach recognizes that visible structural remains likely embody centuries or millennia of accumulated construction episodes, modifications, and repairs that create complex archaeological signatures requiring a wholistic interpretation. Bailey's multi-temporal palimpsest theory emphasizes how certain locations offer optimal combinations of environmental conditions and cultural significance that transcend individual occupation episodes or cultural traditions, creating enduring attractions for human activity that manifest archaeologically as superimposed or environmentally integrated archaeological remains, or stone fish weirs.

Methodology: Multi-Phase Archaeological Survey

The systematic documentation of stone fish weirs along the fifteen-mile survey area (FIGURE 9) required integration of multiple methodological approaches to address the inherent challenges of documenting submerged archaeological features in a dynamic riverine environment. Due to fieldwork constraints associated with water level fluctuations, restricting access points, and the logistical demands of amphibious reconnaissance, comprehensive ground-truthing of all identified stone weir sites proved unfeasible within the thesis timeline. Consequently, the thesis adapted by employing a two-tiered documentation strategy wherein two

stone fish weirs (NCW-2 and NCW-18) that from aerial imagery and kayak reconnaissance appeared morphologically most like stone fish weirs, were near a confirmed pre-contact site (Trestle site), and that were near the Rockingham bridge public boat ramp due to site accessibility concerns received intensive field documentation while the thirty-eight additional stone weir sites identified through aerial imagery, documented encounters, historical records of ownership, and ethnographic accounts were inventoried through photoarchaeological analysis supported by comparative morphological assessment (Chapman 1975; Cranford 2024, personal communication; Lawson 1709; Rights 1929; Stevenson 1899; Strandberg and Tomlinson 1969; Trout et al. 2016).

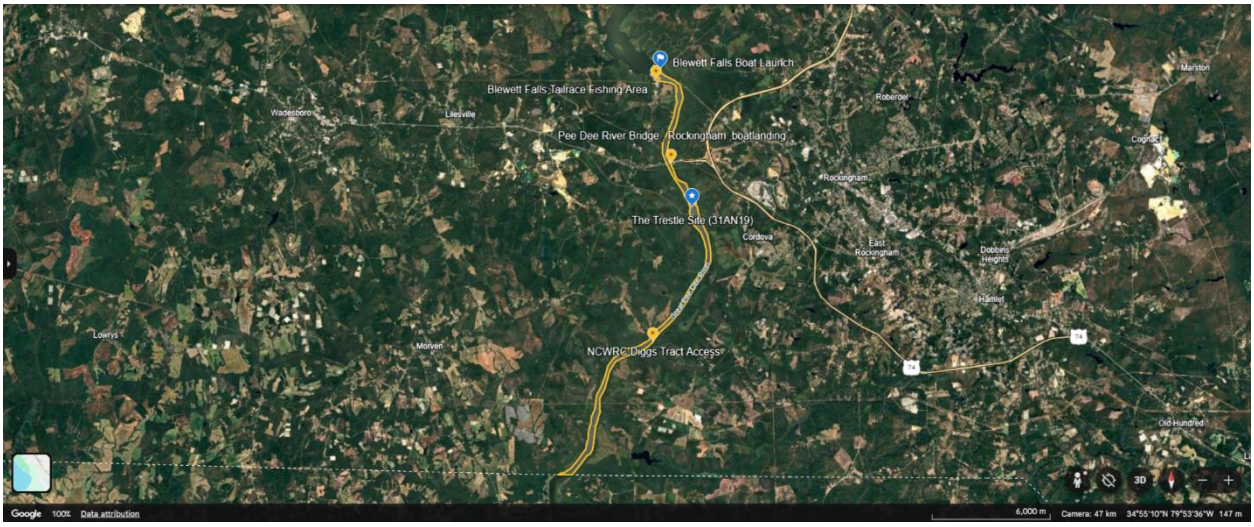

FIGURE 9. Overview of Thesis Survey Area with public river access points and the Trestle Site (Courtesy Google Earth and the Author).

The stone fish weir inventory presents data derived from multiple sources including high-resolution aerial imagery accessed through Google Earth Pro, cartographic resources, primary ethnographic accounts, and cross-referencing identified stone weir sites with the ongoing North Carolina Fish Weir Archaeological Project directed by Assistant State Archaeologist David Cranford. All identified stone weirs received standardized "NCW-" (North Carolina Weir)

designations following Cranford's systematic statewide numbering system, facilitating integration with broader regional geodatabases and enabling future comparative studies of stone weirs. Twelve structures within the study area have received official state archaeological site numbers (designated with the "31AN" prefix indicating Anson County locations), reflecting previous documentation efforts by state archaeologists.

Stone Fish Weir Inventory

The following sections present detailed documentation of forty stone fish weir sites identified, confirmed, inventoried, and photoarchaeologically analyzed for this thesis. The stone fish weir inventory organization begins with the two confirmed stone fish weir sites ground-truthed for the purpose of this thesis then follows geographic sequencing ordered north to south, progressing downstream from Blewett Falls Hydroelectric Dam fifteen miles to the North Carolina-South Carolina state lines. Field collected and approximate geographic coordinates are provided for each site to enable future researchers to relocate identified and confirmed stone weirs for additional documentation. Temporal affiliations proposed for individual weirs reflect assessments based on available historical documentation, morphological characteristics and dimensions potentially indicative of construction traditions, and spatial associations with documented terrestrial archaeological sites. However, the absence of directly datable materials from stone weir sites or the extensive permitting and logistics needed for excavating stone weir sites necessitates appropriate interpretive caution, and proposed temporal affiliations should be regarded as working hypotheses requiring validation through future investigations.

Stone Fish Weir Site NCW-18 (31AN208)

Stone Fish Weir NCW-18, formally designated as archaeological site 31AN208 within the North Carolina state archaeological site file system, constitutes the most substantial and structurally complex stone fish weir site documented during this investigation. Positioned at geographic coordinates 34°55'33"N, 79°51'23"W, this extensive compound weir (FIGURE 10) spans approximately 178.95 meters across the active river channel immediately upstream from the historic Carolina Central Railroad trestle adjacent to the geographic feature locally known as Lyle's Island or the Trestle site (31AN19) (Oliver 1992:71-72; Trout et al. 2016:78). The weir's strategic positioning at this location reflects an understanding of channel morphology and hydrological conditions, as the natural constriction created by Lyle's Island and associated sand bars concentrates strong water flow and creates a funnel for fish to be captured through the apexes of the stone weirs.

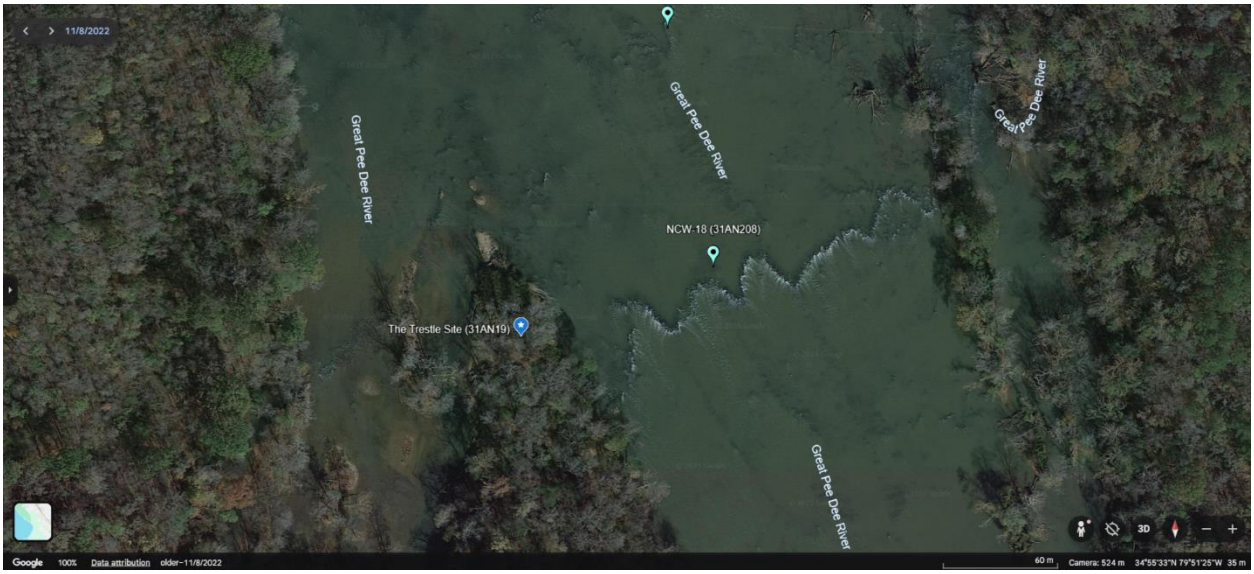

FIGURE 10. Plan view of NCW-18 and adjacent Trestle Site (Courtesy of Google Earth and the Author).

Historical documentation provides important temporal and functional context for interpreting NCW-18 as a compound stone fish weir. Trout et al. (2016:78) cites archival information from Murphy's "Report of Sundry Surveys" conducted by engineers Jennings and Hixon for the Yadkin Navigation Company in 1818, which explicitly identifies this weir as originating as a Native American construction predating European contact in the region. The Yadkin Navigation Company report further documents that company personnel subsequently modified NCW-18 and other Indigenous weirs on the Great Pee Dee, expanding apex openings and installing now dismantled wooden gates or revolving fish wheels to optimize commercial fishing operations while maintaining basic stone foundation structures. This documented sequence of Indigenous construction followed by historic-period Euro-American modification exemplifies the multi-temporal palimpsest character of many Great Pee Dee fish weirs, wherein stone foundations potentially millennia old received technological augmentation through wooden mechanical devices for commercial exploitation in the Contact period (Bailey 2007:198-223).

Field documentation conducted during optimal low-water conditions on March 29th, 2025, enabled photographic recording of three parallel wooden posts rows laying perpendicular to NCW-18 on the opposite side of Lyle's Island (FIGURE 11), which likely represent remnants of historic fish wheel, crib dam, or wooden weir/trestle components referenced in archival sources (Trout et al. 2016: 74-80; Stevenson 1899: 147-154). The preservation of these wooden features, albeit in deteriorating condition, provides rare direct material evidence of the historic wooden additions that transformed Indigenous stone fish weirs into European industrial fishing installations during the commercial riverine fishery period of the late eighteenth through to the early twentieth centuries in North Carolina. The orientation and parallel spacing of the wooden (approximately 1 meter between elements) aligns with historical descriptions of crib dams,

however it is unclear whether this is a diagnostic archaeological feature. Its proximity to the Trestle site, NCW-18, and other Lyle's Falls stone weirs lends credence to its temporal association with the adjacent stone fish weirs or their medication.

FIGURE 11. View facing southwest of wooden remnants near NCW-18 and the Trestle Site (Courtesy of Author).

The NCW-18 exhibits remarkable morphological complexity, consisting of five discernible apexes created by the convergence of ten stone wings exhibiting varying lengths, orientations, and preservation states (FIGURE 12). This compound W-shaped or multiple-V configuration represents one of the most distinctive stone fish weir morphologies documented and is directly comparable to other examples of stone fish weirs described from the Tennessee Valley (Espenshade 2011) and Potomac River (Peterson 2018). The multiple apex design (FIGURE 13) potentially served several non-mutually exclusive functions including distributing capture points across the channel width to maximize mass capture efficiency for fish following along different channel margins and flow zones, providing coverage redundancy during variable seasonal flow conditions when certain apexes might become non-functional due to excessive water depth or velocity enabling simultaneous harvesting operations by multiple individuals or groups. These apexes could have hosted fish wheels or other historic modifications that have been associated with other stone weirs in the Lyle's Falls portion of the Great Pee Dee River.

FIGURE 12. View of NCW-18 facing east (Courtesy of Author).

FIGURE 13. View of NCW-18 and the Trestle Site (Lyle's Island) facing northwest with archaeological field assistant Amanda Triplett in the background (Courtesy of Author).

Stone Fish Weir Site NCW-2 (31AN201)

Stone Fish Weir NCW-2, formally designated as archaeological site 31AN201 (FIGURE 14), occupies a geographic position approximately 1.5 miles upstream from NCW-18 at coordinates 34°55'54"N, 79°51'34"W, situating it within the densest concentration of documented weirs along the thesis study area. The stone fish weir spans approximately 145.93 meters across the active channel, incorporating four identifiable apexes created by eight articulating wings exhibiting variable states of preservation. While slightly smaller in overall lateral extent than the NCW-18 installation, NCW-2 exhibits proportionally longer individual

wings averaging 30 to 40 meters in length, potentially reflecting adaptive responses to different channel characteristics at this particular position in Lyle's Falls including greater channel width, altered substrate composition, or varying flow patterns due to river topography.

FIGURE 14. Plan View of NCW-2 (Courtesy of Google Earth and the Author).

A significant methodological observation regarding NCW-2 concerns the dramatic differences in stone visibility and documentation potential observed between successive site visits conducted under slightly different hydrological conditions. During preliminary reconnaissance efforts in October and November 2024, when river depth measured approximately 2.4 feet at the nearest United States Geological Survey gauging station, the stone fish weir's wings and apexes were clearly visible above the water surface and could be readily mapped using direct measurement and photographic documentation methods (FIGURE 15). However, during the subsequent March 2025 documentation efforts, with river depth measuring 2.8 feet at the same gauging station, representing a difference of merely 0.4 feet or

approximately 12 centimeters, many stones became partially or entirely submerged, significantly limiting documentation potential and the quality of data that could be collected (FIGURE 16).

FIGURE 15. View facing north of NCW-2's westernmost wing on November 24th, 2024 (Courtesy of the Author).

FIGURE 16. View facing north of NCW-2's westernmost wing on March 29th, 2025 (Courtesy of Author).

This observation has implications for fish weir survey methodology and emphasizes the importance of water level monitoring and flexible survey scheduling for successful riverine archaeological investigations where time is of the essence (FIGURE 17). This demonstrates that even minor water level fluctuations measured can dramatically impact stone fish weir visibility and the feasibility of collecting detailed morphological and preservation data essential for comprehensive archaeological analysis. It also speaks to the maintenance required to keep stone fish weirs operating as intended. If a difference of a little over 12 centimeters from the average low river depth for the season can almost entirely submerge the stone weirs, then the labor

required to keep the stone fish weirs operating efficiently may have been more demanding than previously hypothesized. Future stone fish weir investigations in the Great Pee Dee River might potentially require multi-season or multi-year approaches to capture optimal documentation windows for all stone fish weirs identified within the thesis study area.

FIGURE 17. View facing east of NCW-2 on November 24th, 2024 (Courtesy of the Author).

Inventory of Thirty-Eight Additional Stone Fish Weir Sites

The following inventory presents thirty-eight additional stone fish weir sites identified and preliminarily assessed through photoarchaeological analysis of historical aerial imagery, cross-referenced with historical documentation and state archaeological site file records where

available (Fielder 1939; Lawson 1709; Rights 1929; Stevenson 1899; Trout et al. 2016). It should be noted that limitations inherent in aerial imagery identification without ground truthing necessitate appropriate interpretive caution regarding morphological assessments, dimensional measurements, and temporal affiliations proposed for the following stone weir sites.

Brief Glossary of Table Morphology Terms and Table

A table (TABLE 1) was created by the thesis Author of qualitative stone fish weir data and will precede the stone fish weir inventory. The categories listed are: Site ID, State Site # (where applicable), Coordinates, Typology (where applicable), Historical Name/Association (where applicable), Temporal Affiliation (where applicable), and Weir Cluster designation. A glossary of previously described fish weir typology terms used to describe fish weirs on the Pee Dee have been listed below to clarify the typological designations assigned to stone weirs listed in Table 1.

V-shaped: A weir with two converging wings forming a single apex, designed to funnel fish toward a central trap or gap at the apex.

W-shaped: A weir forms a double V or "W" pattern, typically with two or more apexes directing fish toward central traps.

Linear: A straight alignment of stone or material across the channel, often serving as a simple barrier, dam, or fish guide

Curvilinear: A complex weir with curved and interconnected wings and apexes, enhancing fish guidance and retention.

Compound: A fish weir composed of multiple interconnected weir components (such as several apexes or wings), often forming complex shapes to enhance fish capture efficiency.

Unspecified: Morphology cannot be determined from available data or imagery.

TABLE 1. Summary of all forty stone fish weir Site IDs, State Site #, Coordinates, Typology, Historical Name/Association, Temporal Affiliation, and Weir Cluster (Courtesy of Author).

Site ID	State Site #	Coordinates	Typology	Historical Name/Association	Temporal Affiliation	Cluster
NCW-18	31AN208	34°55'33" N, 79°51'23" W	Compound W-shaped	Native American weir (1818 report)	Multi-temporal	Central
NCW-2	31AN201	34°55'54" N, 79°51'34" W	W-shaped	-	Unspecified	Central
NCW-330	-	34°59'08" N, 79°52'36" W	Unspecified	Iron-bound wooden box structure	Historic	Northern
NCW-331	-	34°59'00" N, 79°52'15" W	Unspecified	"Indian Fish dam" (historic map)	Native American	Northern
NCW-332	-	34°58'35" N, 79°51'46" W	Unspecified	Wall Family Fish Traps	Historic	Northern
NCW-333	-	34°58'29" N, 79°51'51" W	Unspecified	Wall Family Fish Traps	Historic	Northern
NCW-141	31AN224	34°57'37" N, 79°52'10" W	W-shaped/Compound	-	Unspecified	Northern
NCW-156	-	34°57'06" N, 79°52'17" W	Unspecified	-	Unspecified	Northern
NCW-334	-	34°57'00" N, 79°52'20" W	Unspecified	-	Unspecified	Northern

NCW-142	31AN225	34°56'53" N, 79°52'18" W	Unspecified	-	Unspecified	Northern
NCW-21	31AN211	34°56'58" N, 79°52'17" W	V-shaped	-	Unspecified	Northern
NCW-335	-	34°56'17" N, 79°51'51" W	V-shaped	Lyle's Falls area	Unspecified	Central
NCW-336	-	34°56'10" N, 79°51'40" W	V-shaped	Dockery Fishery	Historic	Central
NCW-20	31AN210	34°55'50" N, 79°51'34" W	Compound	Adjacent to Trestle Site	Multi-temporal	Central
NCW-43	31AN216	34°55'48" N, 79°51'29" W	Compound	-	Multi-temporal	Central
NCW-14	31AN204	34°55'44" N, 79°51'27" W	Compound	Peninsula-anchored	Multi-temporal	Central
NCW-45	31AN218	34°55'43" N, 79°51'21" W	Linear	-	Unspecified	Central
NCW-104	31AN228	34°55'37" N, 79°51'24" W	Compound (deteriorated)	-	Unspecified	Central
NCW-177	31AN19	34°55'24" N, 79°51'19" W	Compound/Fish fall	Trestle fish weir	Multi-temporal	Central
NCW-46	31AN219	34°55'15" N, 79°51'14" W	W-shaped	Dockery (14 dippers, 2 fall traps)	Historic	Central

NCW-264	-	34°54'58" N, 79°51'13" W	Unspecified	Lyle's Island adjacent	Multi-temporal	Central
NCW-265	-	34°54'52" N, 79°51'01" W	W-shaped	Liles/Bogan Fishery	Multi-temporal/Historic	Central
NCW-17	31AN207	34°54'49" N, 79°51'04" W	W-shaped	Liles, then Boggan Fishery	Multi-temporal/Historic	Central
NCW-22	31AN212	34°54'44" N, 79°51'00" W	V-shaped	-	Unspecified	Central
NCW-145	31AN226	34°54'24" N, 79°50'53" W	Compound (ephemeral)	-	Unspecified	Central
NCW-337	-	34°54'12" N, 79°50'58" W	W-shaped/Compound	-	Unspecified	Central
NCW-59	31AN221	34°54'10" N, 79°50'53" W	W-shaped	-	Unspecified	Central
NCW-111	31AN229	34°53'48" N, 79°51'05" W	W-shaped (possible)	-	Unspecified	Central
NCW-146	31AN233	34°53'29" N, 79°51'25" W	Unspecified	-	Unspecified	Southern
NCW-338	-	34°53'23" N, 79°51'27" W	Unspecified	-	Unspecified	Southern
NCW-16	31AN206	34°51'45" N, 79°53'20" W	V-shaped	"Fish dam PD 4.7" (3' opening)	Historic	Southern

NCW-44	31AN217	34°51'42" N, 79°53'24" W	Curvilinear/Compound	-	Unspecified	Southern
NCW-42	31AN215	34°51'41" N, 79°53'29" W	W-shaped/Compound	-	Historic	Southern
NCW-12	31AN203	34°51'40" N, 79°53'34" W	W-shaped/Compound	Crib dam construction	Historic	Southern

Northern Cluster Sites (Blewett Falls to Lyle's Falls Area)

The northern cluster of stone fish weirs encompasses eleven documented stone weir sites distributed along approximately three miles of river channel extending from the Blewett Falls Hydroelectric Dam downstream to the beginning of Lyle's Falls. This stone weir cluster demonstrates moderate weir site density with stone weirs averaging 400-500 meters apart, suggesting systematic exploitation of favorable fishing locations while maintaining spatial separation potentially reflecting ownership boundaries or functional specialization among different users. The concentration of historically documented commercial fisheries in this zone, including the Wall family operations and sites with explicit "Indian Fish dam" designations on historical maps, indicates long-term recognition of this area's productivity for fish harvesting spanning from Indigenous origins through Euro-American commercial exploitation.

Stone Fish Weir Site NCW-330

NCW-330 (FIGURE 18) represents an anomalous stone weir site incorporating components not documented at other Great Pee Dee weir sites within the study area. Trout et al. (2016:75) describe this structure as a fish dam incorporating a substantial iron-bound wooden box (FIGURE 19) measuring approximately 5 by 7 feet, equipped with corner handles suggesting

functionality related to lifting or manipulation using mechanical hoisting equipment. The box's precise function with the stone fish weir remains speculative, with potential interpretations including use as a tool employed during dam construction or maintenance activities (Trout et al. 2016: 74). The incorporation of iron hardware indicates construction or modification during the historic period when metal fabrication technologies were available, likely dating to the nineteenth or early twentieth century commercial fisheries or dam construction.

FIGURE 18. Plan view of NCW-330 and NCW-331 (Courtesy of Google Earth).

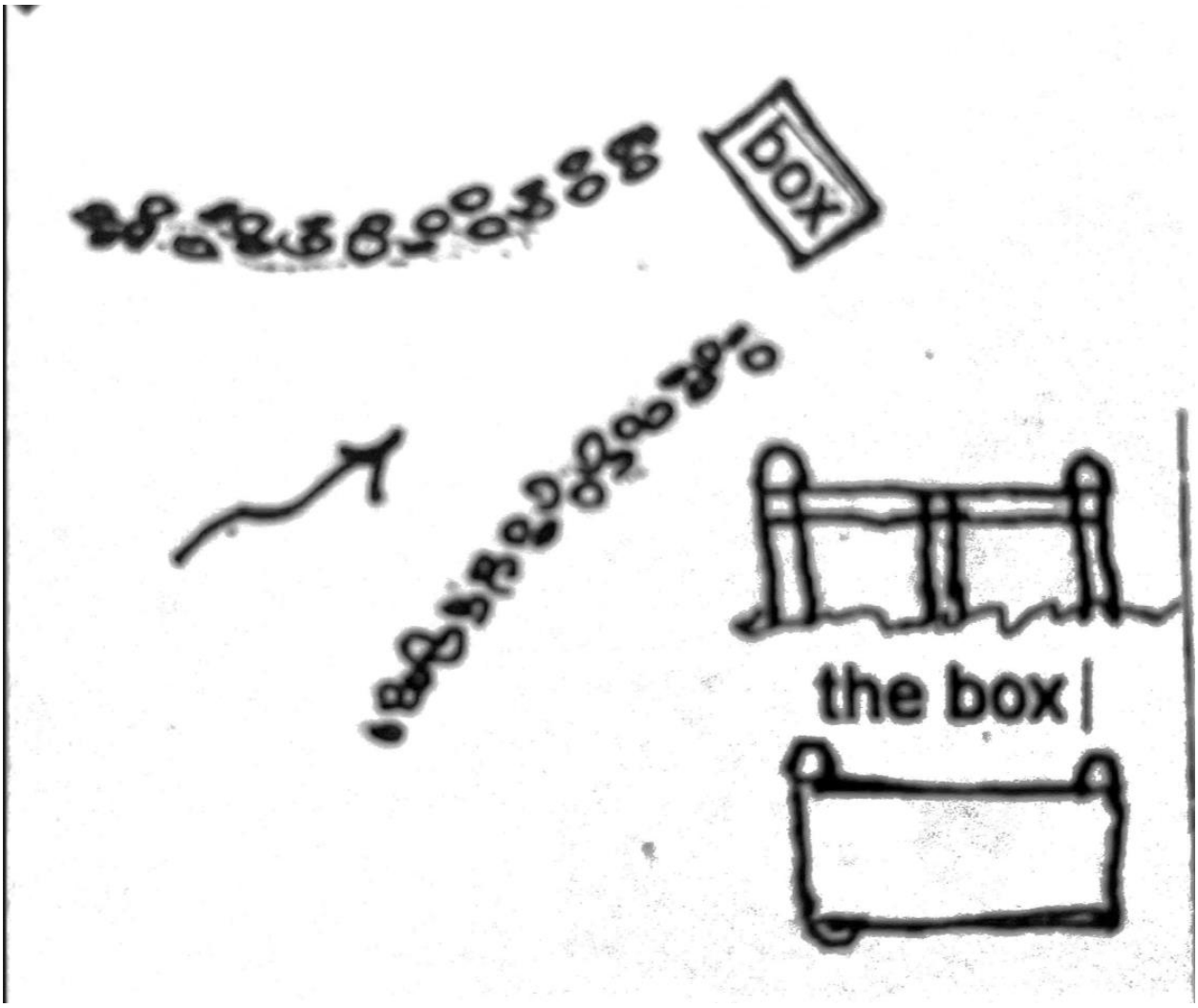

FIGURE 19. Sketch from Trout et al. of NCW-330 and "the box" (Courtesy of Trout et al. 2016).

NCW-330's coordinates are 34°59'08"N, 79°52'36"W and is within the northern portion of the study area adjacent to Blewett Falls. Aerial imagery analysis provides insufficient resolution to determine specific weir typology or measure accurate structural dimensions. The probable temporal affiliation is Historic period (eighteenth through twentieth centuries) based on the presence of manufactured metal components and the functional characteristics suggesting commercial fishing operations or dam construction rather than subsistence-oriented Indigenous practices (Stevenson 1899; Trout et al. 2016). Additional ground-truth documentation would be required to assess preservation status, determine whether stone foundation elements associated

with the wooden box structure remain intact, and evaluate potential for recovering datable materials or diagnostic artifacts that might refine temporal assignment.

Stone Fish Weir Site NCW-331

NCW-331 (FIGURE 18) was identified from historical cartographic sources rather than contemporary aerial imagery analysis. The structure appears explicitly labeled as an "Indian Fish dam" on the Anson County Historical Map spanning 1746 to 1912, compiled by researchers Glenn K. Martin and Henry Garris and referenced by Trout et al. (2016:75). This cartographic designation carries particular significance as it represents one of few explicit textual identifications of Indigenous origins for specific stone fish weirs documented during this thesis through historical sources, though the precision and reliability of such attributions in county-level historical maps compiled decades or centuries after original construction requires appropriate scholarly skepticism.

The coordinates for NCW-331 are 34°59'00"N, 79°52'15"W, positioning the structure in the uppermost reach of the thesis study area approximately 0.5 miles downstream from NCW-330. Contemporary and historical aerial imagery of this location does not reveal clearly defined stone alignments diagnostic of stone fish weir sites, potentially indicating substantial deterioration, obstruction by elevated water levels and sediment accumulation, or removal through historic navigation improvements. The weir's specific typological classification and dimensional characteristics cannot be determined from available sources. The probable temporal affiliation is Native American or Pre-Contact period based solely on the historical map designation, though the possibility of continued Indigenous use into the Contact period or subsequent Euro-American adoption and modification of an originally Indigenous structure cannot be excluded without additional evidence. Future research might investigate whether

archival materials associated with the Martin and Garris historical map project contain additional information regarding data sources, informants, or documentation methods that might clarify the basis for the "Indian Fish dam" attribution.

Stone Fish Weir Site NCW-332

NCW-332 (FIGURE 20) represents one component of a spatially clustered fishing complex documented in historical sources as the "Martin Island Goat Island James Wall & T.G. Wall Fish Traps," indicating operation by the Wall family during the late nineteenth or early twentieth century (Trout et al. 2016: 74-80). The plural designation "Fish Traps" applied to this area suggests multiple stone fish weirs or a single elaborate compound stone weir incorporating numerous capture points distributed across this portion of the channel. The specific relationship between NCW-332 and adjacent sites NCW-333, NCW-141, and NCW-156 remains unclear without ground truthing, though their spatial proximity suggests association.

FIGURE 20. Plan View of NCW-332 and NCW-333 (Courtesy of Google Earth).

NCW-332 occupies coordinates 34°58'35"N, 79°51'46"W in association with the Martin Island and Goat Island, which likely served as anchor points for weir wings and provided

advantageous positions for fishers to access apex collection points. The strategic use of islands as natural structural foundations represents a common pattern in Great Pee Dee stone fish weir construction, reducing labor investment while enhancing structural stability through articulation with stable landforms. Aerial imagery provides insufficient clarity to determine precise typological classification or measure structural dimensions accurately, potentially due to substantial deterioration, sediment accumulation obscuring stone alignments, or the particular river conditions during image capture.

The probable temporal affiliation is Historic period based on the documented association with the Wall family fishing operation. However, the possibility that historic-period commercial fishers adopted and modified pre-existing Indigenous structures cannot be excluded, as this pattern of technological continuity appears widespread throughout the Great Pee Dee River. The 1818 Yadkin Navigation Company reports explicitly cites company policy of modifying existing Native American weirs rather than constructing entirely new installations, suggesting many structures attributed to historic-period operators in documentary sources may incorporate ancient stone foundations overlain by more recent additions or modifications (Trout et al. 2016: 74-80).

Stone Fish Weir Site NCW-333

NCW-333 (FIGURE 20) constitutes a second component of the Wall family fishing complex described for NCW-332, sharing the historical designation "Martin Island Goat Island James Wall & T.G. Wall Fish Traps" documented by Trout et al. (2016:75). The structure's coordinates at 34°58'29"N, 79°51'51"W position it approximately 200 meters downstream from NCW-332, suggesting either tandem operation as components of an integrated capture system or sequential use as environmental conditions or fish populations varied temporally. The close spatial association between multiple weir structures in this reach may reflect particularly

favorable environmental conditions including appropriate channel morphology, reliable fish movements, or substrate characteristics supporting stable weir construction.

As with NCW-332, specific typological classification and accurate dimensional measurements cannot be determined from available aerial imagery. The structure's preservation state and constructional details remain unknown without ground truthing. The probable temporal affiliation is Historic period based on documented association with the Wall family commercial fishing operation, though potential Indigenous origins or multi-temporal use remain possibilities requiring investigation through additional systematic documentation.

The clustering of multiple weir structures (NCW-332, NCW-333, NCW-141, NCW-156, NCW-21, NCW-142) within approximately one mile of river channel represents one of three major concentration zones identified along the thesis survey areas. This northern cluster accounts for approximately 15 percent of documented structures and coincides with increased channel gradient and bedrock exposures associated with proximity to the fall line, creating natural conditions favorable for weir construction and fish concentration (Daniel 2013: 253-268; Jennings et al. 2023: 83-87). The environmental advantages of this location have likely attracted repeated use across cultural and temporal boundaries, though interpreting specific occupation sequences requires additional ground-based fieldwork beyond the scope of this thesis.

Stone Fish Weir Site NCW-141 (31AN224)

NCW-141, (FIGURE 21) formally designated as 31AN224 within the state archaeological site file system, occupies coordinates 34°57'37"N, 79°52'10"W and represents one of twelve structures in the study area that have received official state site numbers reflecting previous documentation by North Carolina archaeological personnel. The structure appears in aerial imagery as a potentially W-shaped or compound V-shaped configuration, though

substantial deterioration and disarticulation of structural elements complicate confident typological classification. Stone alignments appear as discontinuous remnants distributed across a considerable lateral span of the river channel, suggesting either extensive original construction subsequently degraded through natural processes or accumulative building across multiple episodes that created a complex multi-component installation.

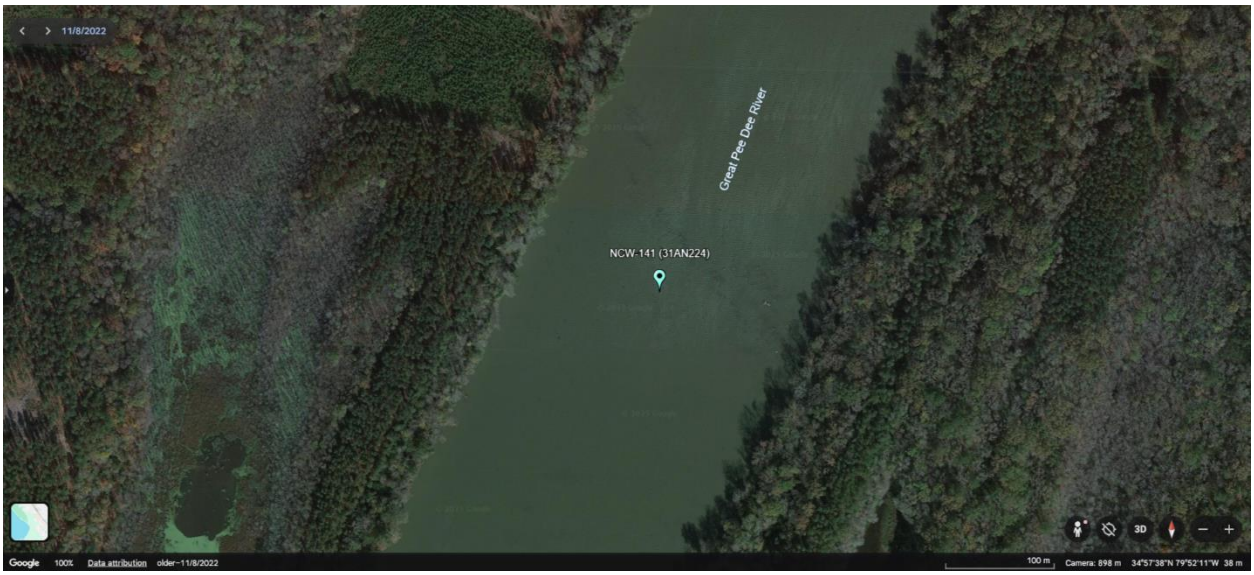

FIGURE 21. Plan View of NCW-141 (Courtesy of Google Earth).

The approximate dimensions derived from aerial imagery indicate disarticulated remnants spanning from bank to bank across the full channel width, potentially representing one of the larger weir complexes documented in the northern cluster. However, the degree of structural deterioration and the difficulty in distinguishing intentional stone elements from natural stone accumulations necessitates ground truthing to confirm interpretations and assess preservation status accurately. The state site designation indicates previous archaeological reconnaissance documented this location, though detailed site records were not readily available for analysis.

Probable temporal affiliations for NCW-141 cannot be proposed with confidence based on available information. The structure's morphological characteristics do not exhibit diagnostic features clearly indicative of specific cultural traditions or temporal periods, and no historical documentation explicitly referencing this particular weir location has been identified in sources consulted for this investigation. The structure may represent Indigenous construction, historic-period modification of Indigenous foundations, entirely historic-period construction, or multi-temporal accumulation spanning centuries or millennia of use.

Stone Fish Weir Sites NCW-156, NCW-334, and NCW-142 (31AN225)

Three additional weir sites, NCW-156 (34°57'06"N, 79°52'17"W), NCW-334 (34°57'00"N, 79°52'20"W), and NCW-142 (31AN225) (34°56'53"N, 79°52'18"W), occupy closely spaced positions within the same general river reach (FIGURE 22), forming a concentrated fishing complex within the northern cluster. The spatial proximity among these structures, spanning less than 500 meters of channel length, strongly suggests functional relationships potentially including coordinated operation as components of an integrated mass capture system, sequential use reflecting temporal shifts in preferred fishing locations as environmental conditions changed, or construction by different cultural groups maintaining distinct territorial claims to specific portions of the channel.

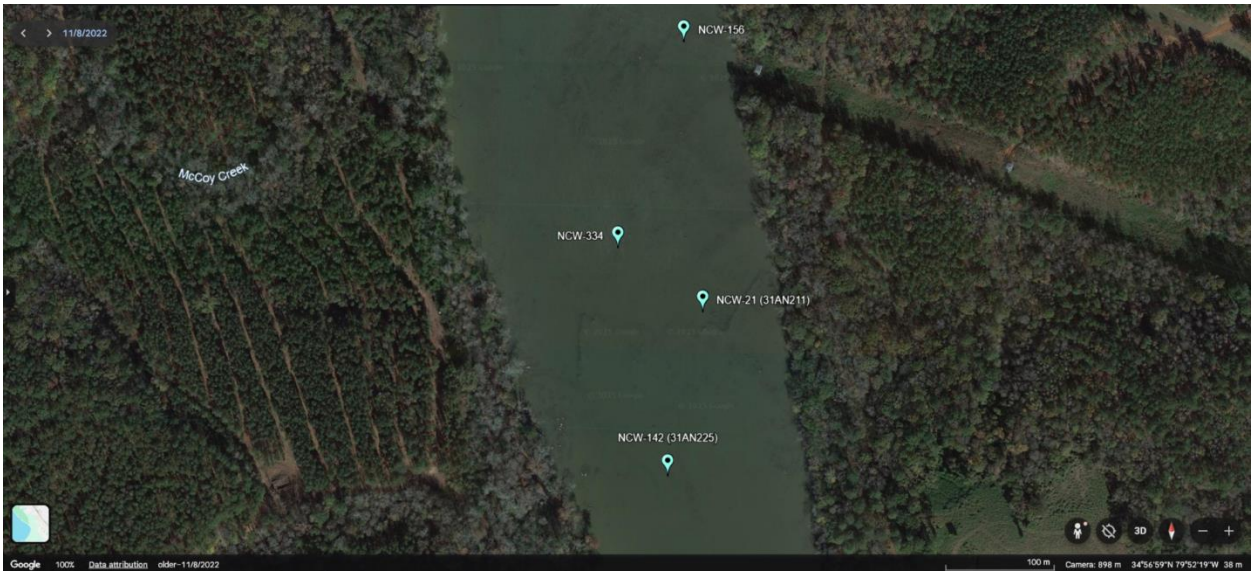

FIGURE 22. Plan View of NCW-156, 334, 21, and 142 (Courtesy of Google Earth).

Aerial imagery analysis provides insufficient information to determine specific typological classifications, measure accurate structural dimensions, or assess preservation states for these three sites. The structures appear as subtle stone alignments or concentrations distinguishable from background geological features with difficulty, suggesting either substantial deterioration, partial burial by sediment accumulation, or the particular water and lighting conditions present during image capture rendered weir elements less visible. NCW-142 has received formal state site designation as 31AN225, indicating previous archaeological documentation, though the level of detail recorded may be minimal.

Probable temporal affiliations for these three structures cannot be proposed confidently without additional documentation. However, their spatial association with NCW-21, described below, which articulates with the eastern river bank and exhibits clearer structural definition, suggests potential functional relationships and possibly shared cultural origins.

Stone Fish Weir Site NCW-21 (31AN211)

NCW-21, formally designated as 31AN211, (FIGURES 22 and 23) occupies coordinates 34°56'58"N, 79°52'17"W and demonstrates clearer structural definition in aerial imagery compared to adjacent sites NCW-156, NCW-334, and NCW-142 described above. The extant stone fish weir exhibits classic V-shaped morphology, characterized by two converging stone wings that articulate with the eastern river bank and extend westward into the active channel to create a single downstream-oriented apex functioning as the primary fish concentration point.

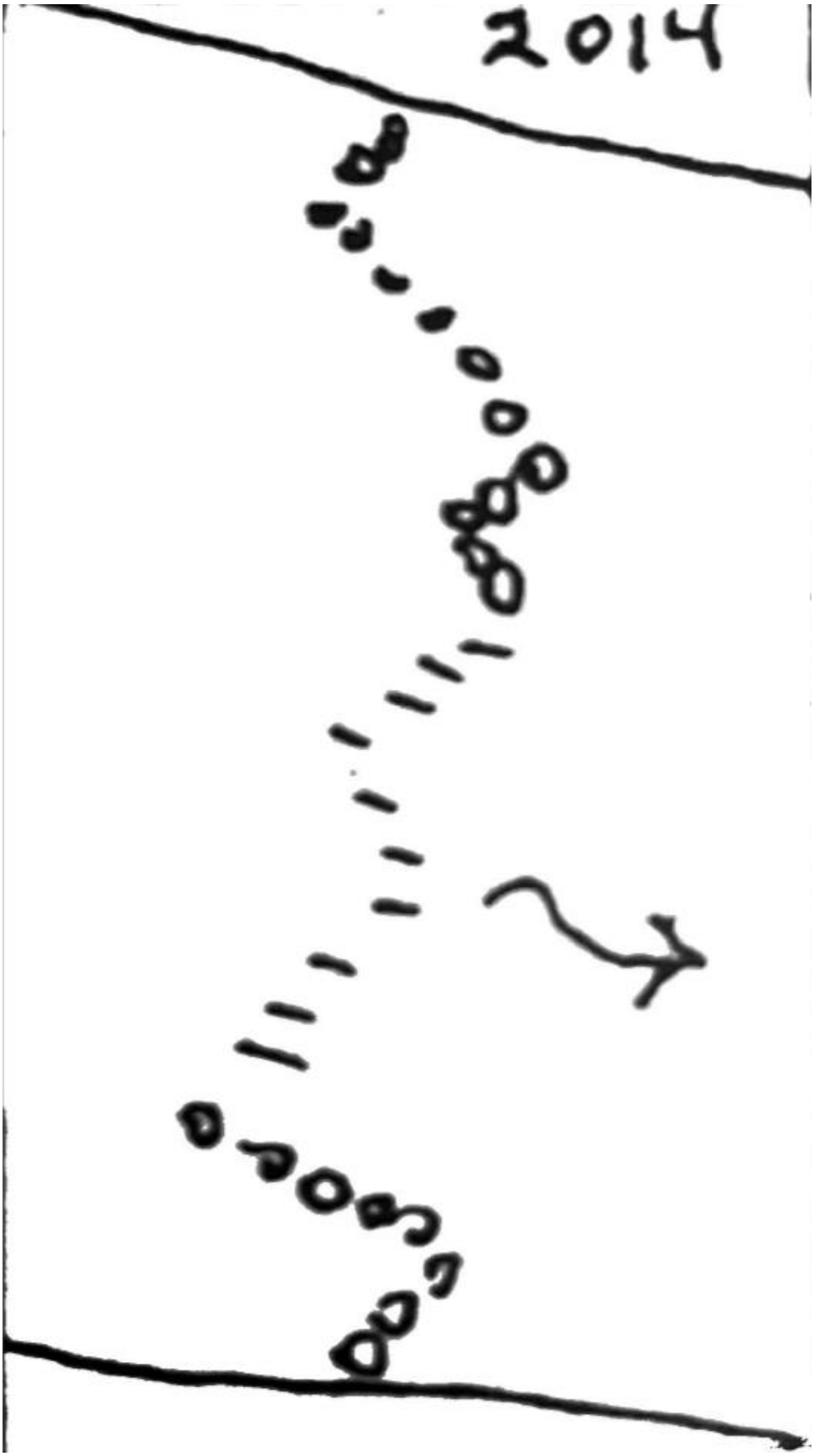
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FIGURE 23. Possible sketch of NCW-21 and NCW-334 (Courtesy of Trout et. al. 2016)

Dimensional measurements derived from aerial imagery analysis indicate the western wing extends approximately 15 meters from the apex into the channel, while the eastern wing measures approximately 64 meters from the apex to its articulation point with the river bank. This asymmetry in wing lengths reflects adaptive response to local channel morphology, with the elongated eastern wing necessary to span the distance from optimal apex positioning to the nearest stable bank anchorage point. The apex opening, representing the functionally critical collection point where concentrated fish would be captured, measures approximately 5 to 7 meters in width—dimensions falling within the standardized range observed across Great Pee Dee weirs and suggesting a standard of recognized constraints imposed by capture device dimensions or optimal opening sizes for efficient harvest operations.

The structure's probable temporal affiliations remain uncertain without ground truthing and systematic investigation of associated weir site NCW-334. However, the spatial proximity to NCW-334, NCW-142, and NCW-156 suggests potential functional relationships and possibly shared cultural origins spanning Indigenous, historic Euro-American, or multi-temporal use scenarios. The V-shaped morphology, while ubiquitous across temporal periods and cultural traditions, does not provide diagnostic features enabling confident temporal placement without additional evidence.

Central Cluster Sites (Lyle's Falls and Lyle’s Island (Trestle site))

The central cluster of stone weir sites represents the largest concentration of stone fish weirs confirmed and identified by this thesis along the entire Great Pee Dee River, incorporating eighteen structures within approximately two miles of channel length (FIGURE 24). This

exceptional weir density, averaging one weir every 180 meters, transforms this river segment into what can best be characterized as a stone weir fishing zone that likely supported regional scale harvesting operations from at least the Early Woodland period to the modern day. The close spatial proximity between this weir concentration containing identified historically modified stone weirs and the extensively occupied Trestle settlement site (31AN19) (Oliver 1992:71-72; Stevenson 1899:147-154; Trout et al. 2016:74-80), provides crucial archaeological context suggesting this location served as a persistent focal point for riverine settlement and subsistence throughout the pre- and post-contact periods, supporting this thesis' theoretical model and hypothesis that stone fish weirs embody the concept of being a multi-temporal palimpsest within a riverine cultural landscape or "taskscape" (Bailey 2007:198-223; Mahar 2019:36-52).

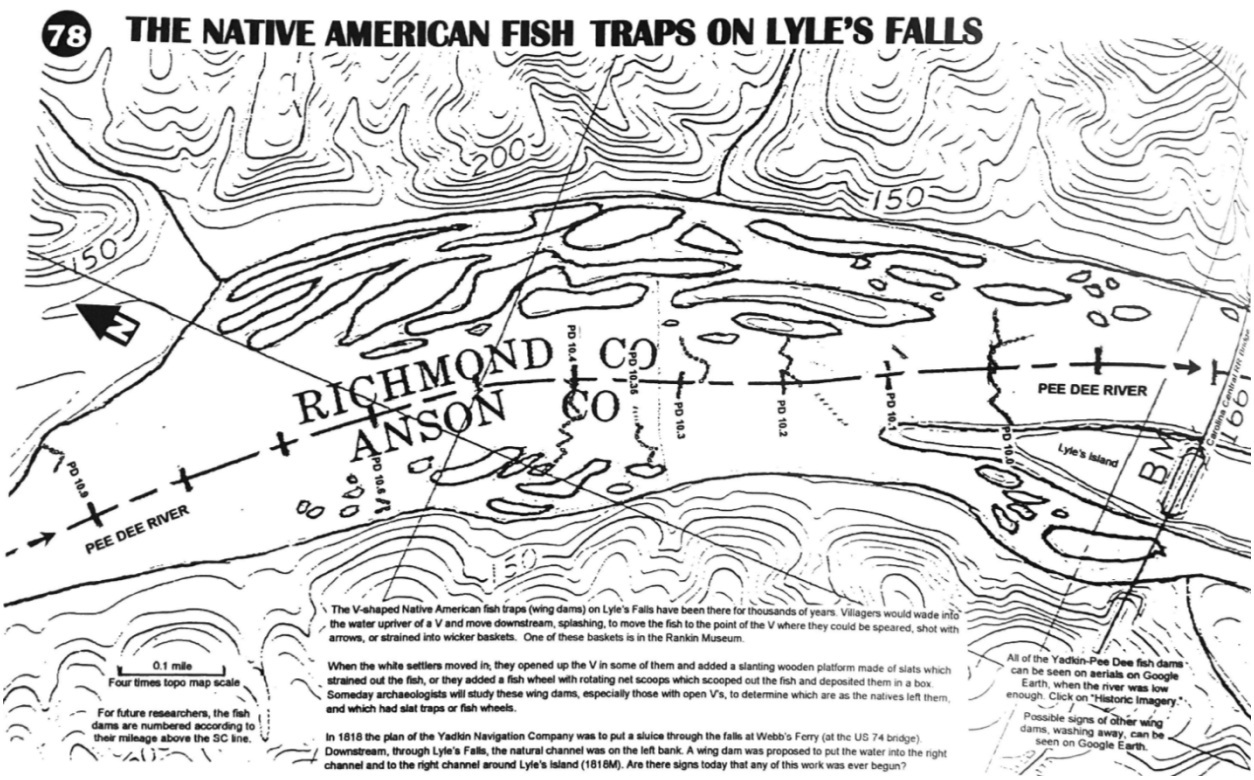

FIGURE 24. A cartographic sketch of the Lyle's Falls stone fish weirs from the Yadkin-Pee Dee River Atlas (Courtesy of Trout et. al. 2016: 78).

Stone Fish Weir Site NCW-335

NCW-335 (FIGURE 25) represents the northernmost documented structure within the geographic area historically known as "Lyle's Falls," a designation appearing on historical maps and in documentary sources referencing this particularly productive fishing zone (Trout et al. 2016: 74-80; Rights 1929:134-156). The structure occupies coordinates 34°56'17"N, 79°51'51"W and exhibits single symmetrical V-shaped morphology consisting of two wings converging to form a single apex oriented eastward, a somewhat unusual orientation compared to the predominantly downstream-pointing apexes characterizing most Great Pee Dee weirs. This eastward orientation may reflect specific river channel flow conditions at this location,

adaptation to capture fish moving along particular flow paths, or functional specialization for harvesting fish during different seasonal periods or specific portions of spawning run migrations

FIGURE 25. Plan View of NCW-335 and NCW-336 (Courtesy of Google Earth).

Dimensional measurements indicate the southern wing extends approximately 36 meters from the apex, while the northern wing measures approximately 32 meters, demonstrating substantial bilateral symmetry suggesting deliberate construction planning rather than expedient or impulsive construction. The apex opening spans approximately 7 to 10 meters in width—dimensions falling toward the upper end of the standardized range documented for Great Pee Dee stone weirs and potentially indicating adaptation to local flow conditions or use of larger capture devices at this particular location. The relatively wide apex opening may have accommodated substantial fish wheels or fall traps documented at other Lyle's Falls area installations, though no specific historical documentation explicitly referencing NCW-335 has been identified in sources consulted for this thesis.

The designation of this location as "Lyle's Falls" in historical sources suggests the presence of increased gradient or natural slope creating conditions particularly favorable for fish concentration and stone weir operation. Natural falls or rapids historically represented preferred

locations for Indigenous fishing installations throughout eastern North America, as anadromous fish navigating these obstacles become concentrated, while the turbulent water conditions mask the presence of capture structures and conceal fishers from approaching schools of fish (Chapman 1975:1-11). The intensive exploitation of this zone, evidenced by the concentration of multiple documented weirs (NCW-335, NCW-336, NCW-20, NCW-43, NCW-14, NCW-45, NCW-104, NCW-177) within approximately one mile of channel, reflects its environmental advantages and probable status as a persistent multi-temporal place attracting repeated use across cultural boundaries. Probable temporal affiliations for NCW-335 cannot be interpreted confidently from available documentation. The structure's morphology does not exhibit diagnostic features clearly indicative of specific cultural traditions or construction periods, and no historical sources explicitly identifying this particular weir have been located.

Stone Fish Weir Site NCW-336

NCW-336, historically documented as the "Dockery Fishery," occupies coordinates 34°56'10"N, 79°51'40"W and represents one of several installations explicitly named in historical sources consulted for this investigation (Trout et al. 2016: 74-80). The Dockery family's operation of this fishing site during the late nineteenth or early twentieth century is documented in commercial fishery records, though the origins of the stone foundation and whether it represents originally Indigenous construction subsequently adopted by Euro-American commercial operators remains unclear without further archaeological investigation. The historical attribution to a named family fishing operation provides temporal context suggesting active use during the Contact period in the Great Pee Dee river, though does not preclude substantially greater antiquity for underlying stone foundations.

Aerial imagery analysis indicates NCW-336 exhibits V-shaped morphology consisting of two wings and a single southward-facing apex. The western wing extends approximately 25 meters from the apex, while the eastern wing measures approximately 49 meters, demonstrating the asymmetrical characteristic of many bank-articulated weirs where wing lengths reflect distances to stable anchorage points rather than deliberate cultural design choices. The apex opening measures approximately 3 meters in width—dimensions falling at the lower end of the standardized range documented for Great Pee Dee weirs and potentially indicating use of smaller specialized capture devices or construction intended to maximize concentration of fish in a restricted collection zone where active harvesting could be conducted efficiently.

The structure's probable temporal affiliation is Historic period based on documented association with the Dockery family commercial fishing operation. However, as discussed previously regarding other historically documented fisheries, the widespread pattern of Euro-American commercial operators adopting and modifying pre-existing Indigenous weir structures means the visible stone foundations may substantially predate the historic-period operation bearing the Dockery name (Trout et al. 2016: 74-80). The 1818 Yadkin Navigation Company reports explicitly document a policy of modifying existing Native American fish dams rather than constructing entirely new installations, suggesting many structures attributed to historic operators in commercial fishery records likely incorporate ancient foundations with more recent wooden additions or modifications (Rights 1929; Trout et al. 2016: 74-80).

The positioning of NCW-336 within the Lyle's Falls central weir cluster and its spatial association with other documented structures including NCW-335 upstream and the massive compound weir complexes NCW-20, NCW-43, NCW-14 downstream suggests this location

participated in a cooperative fishing efforts potentially spanning from Indigenous origins through commercial exploitation.

Stone Fish Weir Site NCW-20 (31AN210)

NCW-20, formally designated as 31AN210, (FIGURE 26) constitutes one of the most extensive and morphologically complex stone fish weir sites documented along the entire Great Pee Dee River system. Positioned at coordinates 34°55'50"N, 79°51'34"W in the middle of the central cluster's fishing zone, this massive compound weir spans approximately 287 meters across the entire river channel from the southwestern to northeastern banks, representing the single largest lateral extent recorded among the forty documented structures and demonstrating extraordinary labor investment reflecting either an intensive single construction event or accumulative building across multiple temporal periods.

FIGURE 26. Plan View of NCW-2, 20, 43, 14, and 45 (Courtesy of Google Earth).

Aerial imagery analysis reveals the stone weir exhibits compound morphology incorporating at least five extant apexes created by more than ten articulating and disarticulating wings of varying lengths, orientations, and preservation states. This stone weir complex

approaches or potentially exceeds the characteristics documented at NCW-18, suggesting NCW-20 represents a primary fishing installation within the regional subsistence system warranting sustained investment and modification across potentially centuries or millennia of continuous use. The multiple apex configuration potentially enabled simultaneous operation by multiple individuals or groups.

The probable temporal affiliation for NCW-20 is multi-temporal, reflecting high confidence that this massive structure embodies accumulative construction and modification spanning from potentially as early as the Late Archaic period through historic-period commercial exploitation. The structure's extraordinary scale and complexity make single-episode construction during any cultural period unlikely, while the spatial association with the extensively occupied Trestle Site provides strong circumstantial evidence for Indigenous origins. Historical documentation does not explicitly reference this particular weir, though its position across the full channel width and its location within the intensively exploited Lyle's Falls fishing zone suggest it likely continued functioning during historic-period commercial operations, potentially receiving modifications including installation of mechanical capture devices.

Stone Fish Weir Site NCW-43 (31AN216)

NCW-43, formally designated as 31AN216, occupies coordinates 34°55'48"N, 79°51'29"W approximately 60 meters downstream from the massive NCW-20 stone weir described above (FIGURE 26). The structure exhibits compound morphology extending approximately 143 meters into the active river channel from the eastern bank, featuring at least three discernible apexes created by numerous undulating wings that demonstrate varying preservation states. The close spatial proximity to NCW-20 suggests potential functional relationships include coordinated operation as components of an integrated fish capture system,

sequential use as environmental conditions or fish population patterns shifted, or construction by different user groups.

The designation of NCW-43 as a compound weir reflects its incorporation of multiple structural elements including V-shaped and potentially W-shaped configurations integrated into a complex. The undulating stone wings may represent intentional features designed to concentrate fish at specific points, or may reflect differential preservation and post-depositional modification of originally more regular linear alignments through natural processes.

The structure's eastern articulation with the river bank potentially facilitated access for construction, maintenance, and harvest activities while providing stable anchorage for structural components. The concentration of three apexes within a 143-meter span suggests intensive exploitation of this particular weir site, potentially reflecting environmental advantages.

Probable temporal affiliations for NCW-43 are categorized as multi-temporal based on the structure's morphological complexity, its position within the intensively exploited Lyle's Falls fishing zone containing documented evidence for both Indigenous and historic-period use, and its spatial association with the adjacent Trestle Site (31AN19) demonstrating millennia of repeated occupation. The compound character of the installation strongly suggests accumulative construction across multiple building episodes rather than single-phase construction, supporting theoretical models conceptualizing elaborate weir complexes as palimpsests characterizing centuries or millennia of an environments' accumulated technological knowledge and labor investment (Bailey 2007).

Stone Fish Weir Site NCW-14 (31AN204)

NCW-14, formally designated as 31AN204, represents another substantial compound installation positioned at coordinates 34°55'44"N, 79°51'27"W within the central weir cluster's

intensive fishing zone (FIGURE 26). The structure extends approximately 184 meters from the western bank of a prominent peninsula located on the eastern side of the river, demonstrating the strategic incorporation of natural landforms as structural elements reducing construction labor while enhancing long-term stability. Aerial imagery analysis reveals compound morphology comprising six identifiable apexes created by ten wings extending from southwest to northeast, representing one of the most intact stone weirs documented in the Great Pee Dee River and directly comparable to the adjacent confirmed NCW-18 and NCW-20 stone fish weirs in scale and complexity.

The utilization of the peninsula as an anchorage point for multiple structural elements demonstrates sophisticated understanding of fluvial geomorphology and its exploitation. Peninsulas provide stable foundations for stone fish weirs by being elevated above typical water levels while offering advantageous positions for fishers accessing apex collection points and monitoring weir operation. The projection of the peninsula into the active channel creates natural flow constrictions and water edge effects that concentrate fish movements, potentially explaining why this particular location warranted such substantial investment in weir construction across the six-apex, ten-wing configuration documented through aerial analysis.

The morphological complexity of NCW-14, particularly the high number of extant apexes and wings, raises important questions about construction sequencing, labor organization, and use patterns. The structure may represent either intensive single-phase construction mobilizing substantial labor efforts and reflecting coordinated community effort, or accumulative development through successive additions and modifications transforming an originally simpler stone fish weir into the complex configuration visible in contemporary aerial imagery. The

interpretation favoring accumulative construction receives support from theoretical models emphasizing persistent places and multi-temporal palimpsests (Bailey 2007).

Probable temporal affiliations for NCW-14 are categorized as multi-temporal reflecting high confidence that this elaborate structure embodies construction episodes and modifications spanning from potentially Indigenous origins through historic-period use and possible continued modification during commercial fishery operations. The structure's location within the intensively exploited central stone weir cluster all support interpretations of long-term sustained use warranting repeated labor investment and maintenance events.

Stone Fish Weir Site NCW-45 (31AN218)

NCW-45, formally designated as 31AN218, occupies coordinates 34°55'43"N, 79°51'21"W and exhibits linear weir morphology representing a minority typological category accounting for approximately 7.5 percent of documented structures along the study segment (FIGURE 26). The structure spans approximately 60 meters between the peninsula that serves as anchorage for adjacent NCW-14 described above to the west and the eastern river bank, effectively utilizing stable landforms as endpoints while creating a barrier aligned perpendicular or oblique to primary flow direction.

Detailed aerial imagery analysis reveals the structure incorporates two discernible apexes, each measuring approximately 3 meters in width, positioned along the linear undulating wing running east to west. This configuration differs substantially from the more common V-shaped or W-shaped designs characterized by distinctly converging wings creating clearly defined apex collection points. The linear design with embedded apexes may reflect several potential functional strategies including directing fish toward the adjacent NCW-14 installation where more intensive capture occurred, creating a filtering barrier that concentrated certain size classes

or species while allowing others to pass, or representing a later modification or addition to the original compound NCW-14 structure with which it exhibits clear spatial relationships.

The undulating character of the linear wing, rather than exhibiting strictly straight alignment, may represent intentional architectural features designed to create localized flow effects and flow variations, or may reflect post-depositional modification through stone displacement and structural settling. Linear weirs documented elsewhere in North America frequently demonstrate curvilinear rather than strictly linear alignments, suggesting that departure from geometric precision may be characteristic of this typological category rather than evidence of substantial deterioration (Connaway 2007:17-46).

Probable temporal affiliations for NCW-45 cannot be determined confidently without ground-truthing and further archaeological investigation. However, the structure's spatial adjacency with NCW-14 suggests potential functional relationships and possibly shared construction events or cultural origins. The relatively simple morphology compared to adjacent compound installations might indicate either earlier construction predating the larger stone weirs, expedient construction during periods when labor availability or need did not warrant investment in large stone weir complexes, or specialized functional purposes not requiring other typologies/morphologies.

Stone Fish Weir Site NCW-104 (31AN228)

NCW-104, formally designated as 31AN228, occupies coordinates 34°55'37"N, 79°51'24"W and demonstrates compound morphology characterized by four deteriorating and disarticulated apexes created by numerous disarticulated wings (FIGURE 27). The stone weir extends approximately 112 meters from the southern terminus of the peninsula that anchors adjacent weir sites NCW-14 and NCW-45 described above, oriented from northeast to southwest

and spanning a substantial portion of the active channel width. The apparent significant deterioration and disarticulation documented through aerial imagery analysis indicates NCW-104 has experienced substantial degradation through natural processes, anthropogenic modification, or both, rendering confident morphological assessment and accurate dimensional measurement challenging without ground verification.

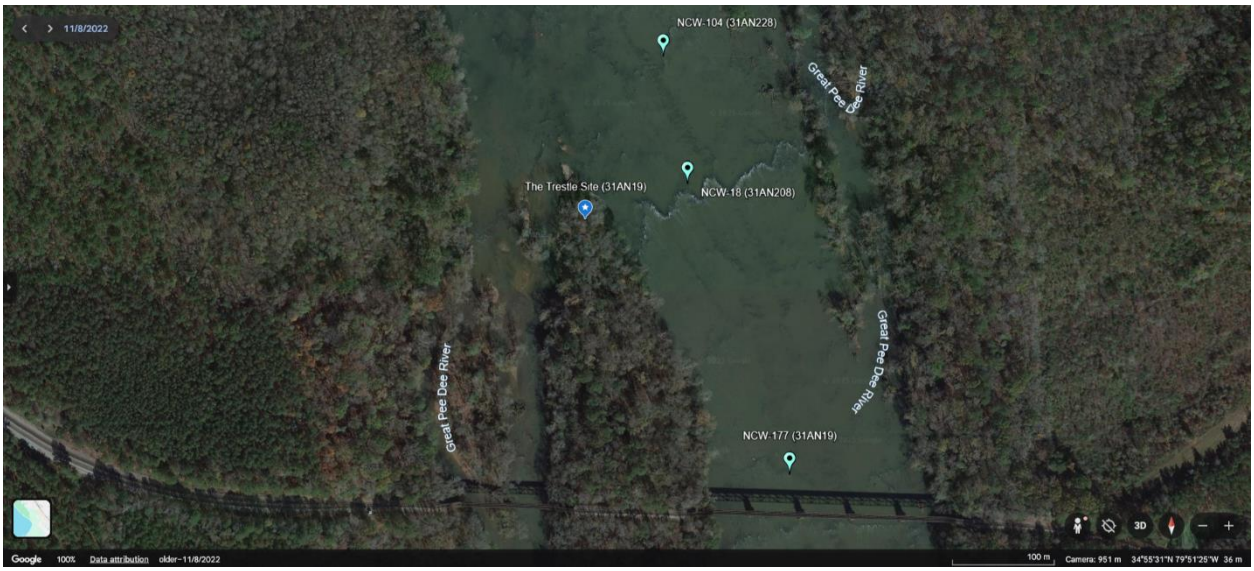

FIGURE 27. Plan View of NCW-104, 18, 177, and the Trestle Site on Lyle's Island (Courtesy of Google Earth).

The positioning of NCW-104 immediately downstream from the peninsula-anchored weir complex (NCW-14, NCW-45) suggests potential functional relationships within a stone weir fishing complex operating across this intensively exploited river segment. The concentration of four substantial compound weirs (NCW-20, NCW-43, NCW-14, NCW-104) within approximately 200 meters of channel length represents exceptional installation density even within the broader context of the central cluster's intensive fishing zone, emphasizing the particular productivity and strategic importance of this location for riverine resource exploitation.

The deteriorated and disarticulated condition of NCW-104 may reflect several potential factors including exposure to particularly intense river conditions during flash flooding events

due to positioning in high-energy flow zones, targeted Contact period modification or partial removal during navigation improvement activities, extended temporal span since last major maintenance or reconstruction events, or selective stone removal for reuse in other construction activities during pre-Contact periods when stone building materials were valued commodities.

Probable temporal affiliations for NCW-104 remain unspecified based on available documentation. The structure's deteriorated condition complicates efforts to identify morphological characteristics or construction techniques potentially diagnostic of specific cultural traditions or temporal periods. However, its position within the intensively exploited central weir cluster characterized by documented multi-temporal use suggests NCW-104 likely participated in long-term patterns of stone fish weir construction and modification spanning from potentially Indigenous origins through post Contact period commercial operations.

Stone Fish Weir Site NCW-177 (31AN19)

NCW-177 coincides spatially with the previously documented Trestle Site formally designated as 31AN19, positioned at coordinates 34°55'24"N, 79°51'19"W and representing one of the most archaeologically and historically significant locations along the entire Great Pee Dee River thesis survey area (*FIGURE* 27). The terrestrial component of the Trestle Site contains stratified archaeological deposits demonstrating repeated Indigenous occupation from the Late Archaic period (circa 3000 BC) through the Late Woodland period (circa AD 1600). The spatial coincidence between this extensively occupied terrestrial site and a substantial stone fish weir complex strongly supports this thesis' primary argument emphasizing integrated Indigenous settlement-subsistence traditions wherein stone fish weirs functioned as focal points along the Great Pee Dee River, structuring broader patterns for interpretation of landscape or "taskscape"

use, semi-sedentary seasonal occupation, and riverine resource exploitation (Bailey 2007; Mahar 2019:311-332).

The stone fish weir itself exhibits compound morphology alternatively classified as a fish fall, characterized by an approximate east-west span of 205 meters running parallel to the historic railroad trestle alignment after which the terrestrial site is named. Aerial imagery reveals the stone fish weir comprises numerous disarticulated apexes and wings that sometimes appear as ephemeral remnants in contemporary aerial imagery potentially representing either extensive original construction subsequently degraded through natural processes and anthropogenic modification, or accumulative building across many centuries creating a multi-temporal stone fish weir complex (Bailey 2007; Oliver 1992:71-72). The designation as a "fish fall" reflects positioning at or near natural elevation drops or rapids that historically characterized this river segment before twentieth-century modifications including railroad trestle construction, channel dredging, and hydroelectric dam development substantially altered the natural geomorphology and hydrology of the Great Pee Dee River (Connaway 2007:473 – 496; Rights 1929; Trout et al. 2016: 74-80).

The identification of NCW-177 as the "Trestle fish weir" by Assistant State Archaeologist David Cranford indicates previous archaeological documentation, though detailed morphological or temporal data was limited in existing state archaeological site records (Cranford 2024, personal communication). The structure's central channel position, articulation with the overhead rail road trestle structural supports, and direct spatial association with one of the most extensively occupied confirmed Pee Dee archaeological sites in the southern Piedmont region all emphasize its probable significance as a primary stone fish weir complex within regional subsistence strategies cross-temporally. The association with intensive terrestrial occupation and

elaborate fishing endeavors at this specific location exemplifies the concept of persistent places where optimal combinations of environmental and cultural factors created enduring focal points for human activity transcending individual occupation episodes or cultural traditions (Bailey 2007; Mahar 2019:36-52). Probable temporal affiliations for NCW-177 remain to be determined through future archaeological investigation, though the direct spatial association with the Trestle Site's Late Archaic through Late Woodland occupation sequence and historic episode of fish wheel modification and likely impacts from rail road trestle construction, provides strong circumstantial evidence suggesting a long chronology of potential weir use at this location.

Stone Fish Weir Site NCW-46 (31AN219)

NCW-46, formally designated as 31AN219, may correspond to the Dockery fishery described by Charles H. Stevenson (1899), Commissioner of Fish and Fisheries, in his comprehensive survey of Atlantic coast shad fisheries conducted for the United States Fish Commission (*FIGURE* 28). Stevenson's account states: "The Dockery fishery, containing 14 dippers and 2 fall traps and yielding 1 roe and 1 buck shad in 1896, and about 60 shad in 1895, is located a short distance below the Carolina Central Railroad bridge, 8 miles above the South Carolina line" (Stevenson 1899:150). This historical report provides rare quantitative data regarding fish weir usage on the Great Pee Dee river and the thesis survey area, historic fish capture yields during specific years, and precise geographic positioning relative to known landmarks that enable confident correlation between documentary sources and visible archaeological remains from aerial imagery.

FIGURE 28. Plan View of NCW-46 (Courtesy of Google Earth).

The structure occupies coordinates 34°55'15"N, 79°51'14"W and exhibits W-shaped morphology consisting of two apexes and four wings oriented east-west from the eastern bank of the river. Dimensional measurements derived from aerial imagery indicate the structure spans approximately 60 meters in total width, with the apexes demonstrating curvilinear rather than angular-linear configurations suggesting they may have functioned as pooling basins designed to temporarily hold captured fish before harvest rather than simply directing fish toward passive capture points. The western apex appears substantially larger than the eastern apex based on aerial assessment, though ground truthing would be necessary to confirm this observation and determine whether size differences reflect original construction, differential preservation, or aerial image distortion.

Wing length measurements indicate the western wings average approximately 16 meters while eastern wings average approximately 12 meters, demonstrating bilateral asymmetry potentially related to local channel morphology, substrate composition, or flow patterns influencing stone fish weir design. The incorporation of curvilinear pooling apexes represents a

morphological variant less commonly documented in this thesis' survey compared to the standard V-shaped or W-shaped stone weir structures with angular converging wings, potentially reflecting specialized functional purposes.

The historical documentation of 14 dippers (fish wheels) and 2 fall traps associated with the Dockery fishery provides exceptional detail regarding mechanical devices deployed at this location during the commercial fishery period. Stevenson's harvest data indicating yields of only 1 roe and 1 buck shad in 1896 and approximately 60 shad in 1895 suggests either declining fish populations by the late nineteenth century, poor fishing conditions during these specific years, or incomplete reporting of actual harvests in commercial records (Stevenson 1899: 147-154). The apparent contrast between stone weir components (14 wheels plus 2 traps) and the minimal documented fish capture numbers raises questions about the viability and operational efficiency of commercial fisheries during this period when anadromous fish populations throughout the Atlantic coast were experiencing documented declines due to overharvesting, dam construction, and water quality degradation (Fielder 1939: 427-436; Rostlund 1952:101-104; Stevenson 1899:147-154).

The probable temporal affiliation is Historic period based on documented association with the Dockery family commercial operation and explicit reference in Stevenson's 1899 fishery survey. However, as discussed previously regarding other historically documented installations, the widespread pattern of commercial operators adopting pre-existing Indigenous stone fish weir sites means the visible stone foundations at NCW-46 may substantially predate the historic-period operation.

Stone Fish Weir Site NCW-264

NCW-264 occupies coordinates 34°54'58"N, 79°51'13"W and exhibits north-south orientation extending approximately 37 meters from the southern bank of the river and the southern terminus of Lyle's Island (FIGURE 29). The structure's typological classification remains unspecified due to insufficient aerial imagery resolution to determine whether visible stone alignments represent V/W-shaped, linear, or compound configurations. The positioning adjacent to Lyle's Island suggests strategic utilization of this prominent river landform as a structural anchor point, though the nature of articulation and the extent of stones extending from the island remain unclear without ground truthing.

FIGURE 29. Plan View of NCW- 264, 265, and 17 (Courtesy of Google Earth).

Lyle's Island represents the geographic center of the central stone fish weir cluster's intensive fishing zone, containing the highest concentration of documented weirs within the fifteen-mile study segment including the massive compound installations NCW-18, NCW-20, NCW-43, NCW-14, and numerous additional structures distributed within approximately one mile of river channel. The extraordinary density of fishing installations throughout this zone reflects exceptional environmental advantages including favorable channel morphology, reliable

anadromous fish migration patterns, abundant stone resources for construction, and strategic positioning relative to terrestrial habitation sites evidenced by the extensively occupied Trestle Site (31AN19) (Oliver 1992).

Probable temporal affiliations for NCW-264 are categorized as multi-temporal reflecting its position within the intensively exploited central stone weir cluster characterized by documented evidence for both Indigenous and European use. The structure's proximity to NCW-265 and NCW-17 described below, both historically documented as components of the Liles and subsequently Bogan fisheries, suggests potential functional relationships and possibly shared construction or operational periods (Trout et al. 2016: 74-80).

Stone Fish Weir Site NCW-265

NCW-265 is potentially associated with fishing installations originally constructed and operated by the Lyles or Liles family and subsequently coopted by the Bogan family during the commercial fishery period of the nineteenth and early twentieth centuries (*FIGURE* 29 and FIGURE 30). Historical documentation referenced by Trout et al. (2016:76) supports identification of an Indigenous stone fish weir complex at this location that was appropriated and modified by successive Euro-American commercial fishery operators.

The structure occupies coordinates 34°54'52"N, 79°51'01"W and exhibits W-shaped or compound morphology characterized by disarticulation from both river banks, positioning the installation in the center-east of the active channel flow. Aerial imagery analysis reveals two extant apexes and four wings of relatively uniform size creating a symmetrical configuration suggestive of deliberate planning and coordinated construction. The total width spans approximately 42 meters oriented southwest-northeast, with the westernmost apex measuring approximately 4 meters in width and the easternmost apex approximately 6 meters in width.

Individual wing lengths average approximately 10 meters, representing substantially shorter dimensions compared to many Great Pee Dee weirs surveyed during this thesis.

The orientation of the stone fish weir demonstrates direct physical or functional articulation with adjacent NCW-17 described below, which shares historical documentation as a component of the Liles-Bogan fishery complex. The spatial proximity and apparent morphological coordination between NCW-265 and NCW-17 suggest they potentially operated as parts of an integrated mass-capture complex distributing collection points across the channel width to maximize fish interception efficiency. The deployment of two coordinated W-shaped weirs rather than a single massive installation may reflect labor organization patterns or distribution among multiple weir operators.

Probable temporal affiliations for NCW-265 are categorized as multi-temporal or Historic period, acknowledging both the historical documentation of Euro-American commercial operation and the strong likelihood that underlying stone foundations represent Indigenous construction subsequently appropriated and modified. Trout et al. (2016:78) explicitly document the 1818 Yadkin Navigation Company policy of modifying existing Native American weirs, and the Liles-Bogan fishery complex's positioning within the intensively exploited central stone weir cluster suggests participation in long-term patterns of fishing installation use spanning from Indigenous origins through commercial exploitation.

Stone Fish Weir Site NCW-17 (31AN207)

NCW-17, formally designated as 31AN207, is explicitly identified by Trout et al. (2016:76) as the "Liles, then Boggan Fishery," providing direct historical documentation of ownership succession and operational continuity at this specific location (*FIGURE* 29 and FIGURE 30). The stone fish weir occupies coordinates 34°54'49"N, 79°51'04"W immediately

adjacent to NCW-265 described above, and exhibits W-shaped or compound morphology disarticulated from both river banks with positioning in the central-western portion of the active channel flow. This mid-channel positioning, characteristic of both NCW-17 and NCW-265, may reflect deliberate design choices intended to intercept fish moving along central flow paths rather than channel margins, or may represent remnants of originally bank-articulated stone weirs whose landward wing sections have been destroyed, buried, or displaced through centuries of channel migration and flooding.

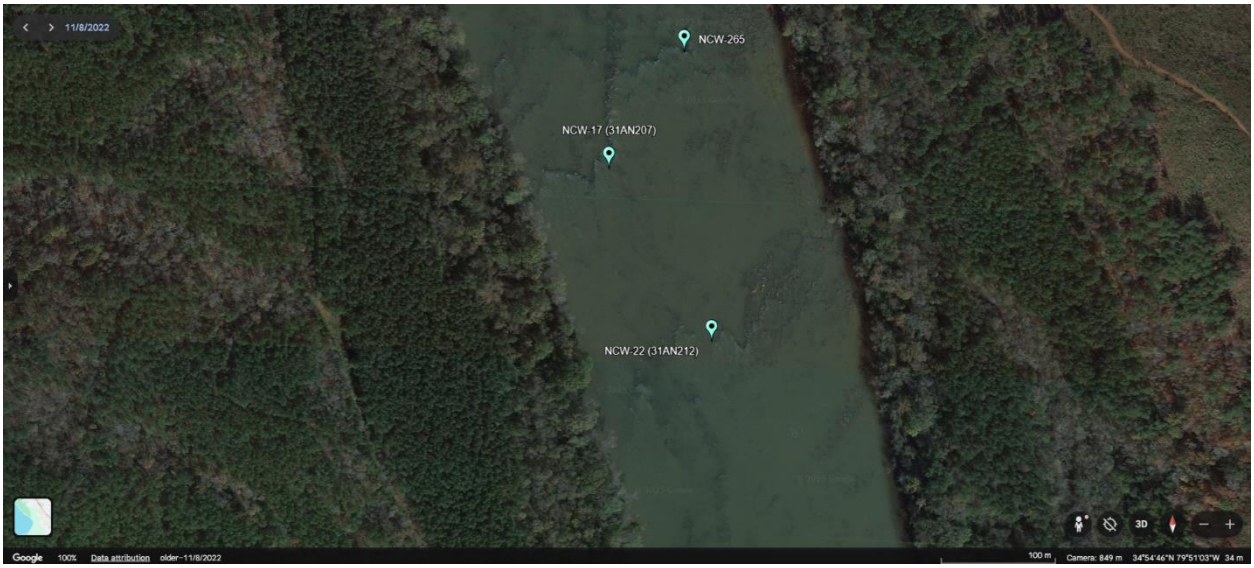

FIGURE 30. Plan View of NCW-265, 17, and 22 (Courtesy of Google Earth).

Dimensional measurements indicate the structure spans approximately 42 meters in total width oriented southwest-northeast, with two extant apexes and four symmetrically sized wings creating a symmetrical configuration. The westernmost apex measures roughly 4 meters in width while the easternmost apex spans approximately 5 meters, dimensions nearly identical to those documented for adjacent NCW-265 and suggesting either coordinated construction following standardized design principles or functional constraints imposed by capture device dimensions. The outer wings extend approximately 46 meters in average length while inner wings measure approximately 16 meters.

The historical documentation explicitly identifying NCW-17 as the Liles-Bogan fishery provides credible temporal and cultural context. The succession of ownership from the Liles (or Lyles) family to the Bogan family suggests continuous commercial fishery operation potentially spanning several decades during the late nineteenth or early twentieth centuries when Atlantic coast shad fisheries reached peak industrial exploitation before catastrophic population collapses in the early twentieth century (Fielder 1939; Stevenson 1899).

The structure's direct spatial and functional articulation with NCW-265 warrants investigation as a coordinated fishing complex rather than isolated weir sites. The remarkable similarity in dimensions, morphology, and symmetry between these two adjacent W-shaped weirs suggests they may represent sister components of a single planned weir complex designed to maximize capture efficiency across the central river channel.

Probable temporal affiliations are categorized as multi-temporal or Historic period, acknowledging documented Euro-American commercial operation while recognizing the high likelihood that underlying stone foundations represent Indigenous construction subsequently appropriated and modified through successive ownership changes. The positioning within the central weir cluster support interpretations of long-term sustained weir use warranting sustained labor investment.

Stone Fish Weir Site NCW-22 (31AN212)

NCW-22, formally designated as 31AN212, occupies coordinates 34°54'44"N, 79°51'00"W and exhibits classic V-shaped morphology characterized by a single downstream-pointing apex created by two converging wings (FIGURE 30). The structure demonstrates east-west orientation within the active river channel with complete disarticulation from both banks, positioning the installation as a mid-channel obstruction designed to intercept fish moving along

central flow paths. This positioning contrasts with the more common pattern of bank articulation observed in the majority of Great Pee Dee stone fish weirs, and raises questions about access for stone fish weir construction, maintenance, and harvest activities that would have been complicated by the lack of stable shore anchorage points.

Dimensional measurements indicate the apex spans approximately 3 meters in width—dimensions falling at the lower end of the standardized range documented for Great Pee Dee weirs and suggesting use of smaller specialized capture devices or construction intended to maximize fish concentration within a restricted collection area. The western wing extends roughly 23 meters from the apex while the eastern wing measures approximately 26 meters, demonstrating substantial bilateral symmetry indicative of deliberate planning. Both wings exhibit relatively linear forms without the substantial curvature or undulation characteristic of some observed stone weirs, suggesting either well-preserved original architectural features or construction techniques emphasizing straight wing alignments. The V-shaped morphology and mid-channel positioning potentially reflect functional specialization for intercepting specific fish species or size classes exhibiting behavioral preferences for central channel movement paths rather than margin-following patterns. Alternatively, the current mid-channel position may represent a preservational artifact wherein originally bank-articulated wings have been destroyed or buried through channel migration and flooding, leaving only the central apex and adjacent wing sections visible in contemporary conditions.

Probable temporal affiliations for NCW-22 remain unspecified without ground truthing or historical documentation explicitly referencing this particular weir location. The structure's relatively simple V-shaped morphology does not provide diagnostic features clearly indicative of specific cultural traditions or temporal periods.

Stone Fish Weir Sites NCW-145 (31AN226), NCW-337, NCW-59 (31AN221), and NCW-111 (31AN229)

Four additional weir sites occupy positions within a concentrated segment of the study area spanning less than one mile of channel length, suggesting another localized fishing complex potentially representing coordinated fishing operations or successive use across changing environmental or cultural periods (FIGURE 31). NCW-145 (31AN226) (34°54'24"N, 79°50'53"W) exhibits compound ephemeral weir morphology with indeterminate dimensions and unspecified temporal affiliations due to substantial structural deterioration or incomplete preservation visible in aerial imagery.

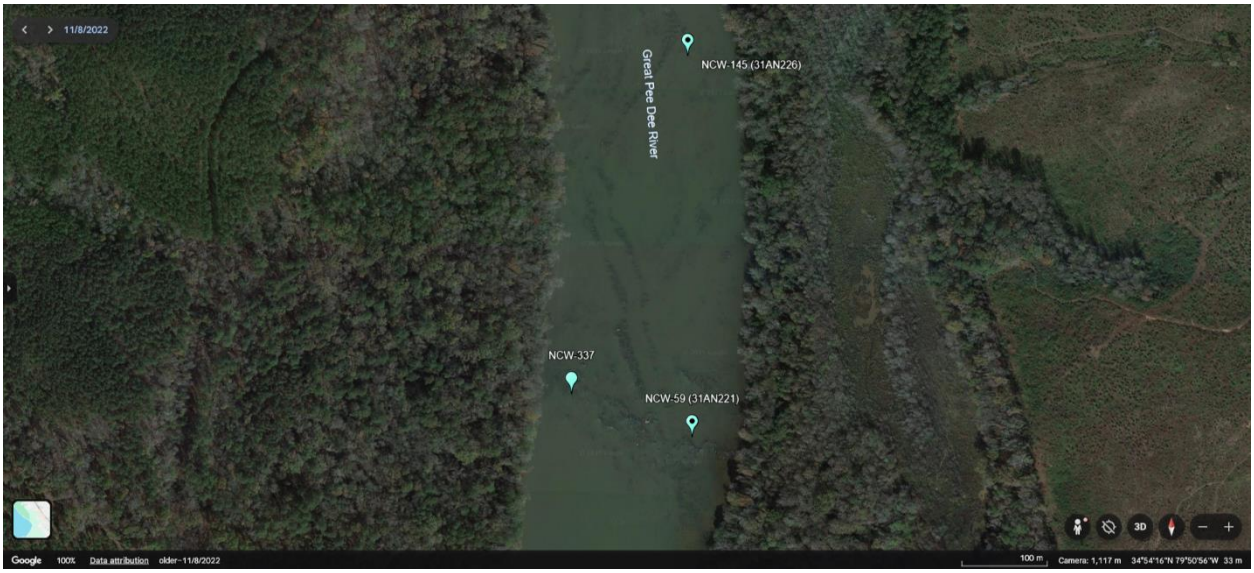

FIGURE 31. Plan View of NCW-145, 337, and 59 (Courtesy of Google Earth).

Stone Fish Weir Stie NCW-337

NCW-337, coordinates (34°54'12"N, 79°50'58"W) demonstrates W-shaped or compound complex configuration, characterized as a disarticulated weir extending approximately 75 meters in width from the western river bank (FIGURE 31). The structure exhibits apparent spatial association with NCW-59 positioned approximately 60 meters downstream on the eastern bank,

suggesting potential functional relationships as components of an integrated capture system distributing collection points across the full channel width.

Stone Fish Weir Stie NCW-59 (31AN221)

NCW-59, state site number 31AN221, coordinates (34°54'10"N, 79°50'53"W), exhibits W-shaped morphology with a total width of approximately 70 meters extending from the eastern river bank (FIGURE 31). The structure features two apexes and four wings, with average apex widths of 3 meters and average wing lengths of 20 meters—dimensions falling well within the standardized ranges documented for Great Pee Dee installations. The structure's formal state site designation indicates previous archaeological documentation, though with a limited level of detail recorded(Cranford 2025, personal communication). The apparent spatial association with NCW-337 warrants investigation as an affiliated stone fish weir complex potentially operated by a single user group or community.

Stone Fish Weir Stie NCW-111 (31AN229)

NCW-111, state site number 31AN229, coordinates (34°53'48"N, 79°51'05"W) occupies a position slightly downstream from the three-weir cluster described above (FIGURE 32). Typological classification proves difficult based on available aerial imagery, though the structure may exhibit W-shaped typology. Both dimensional measurements and probable temporal affiliations remain difficult to determine from aerial imagery analysis alone.

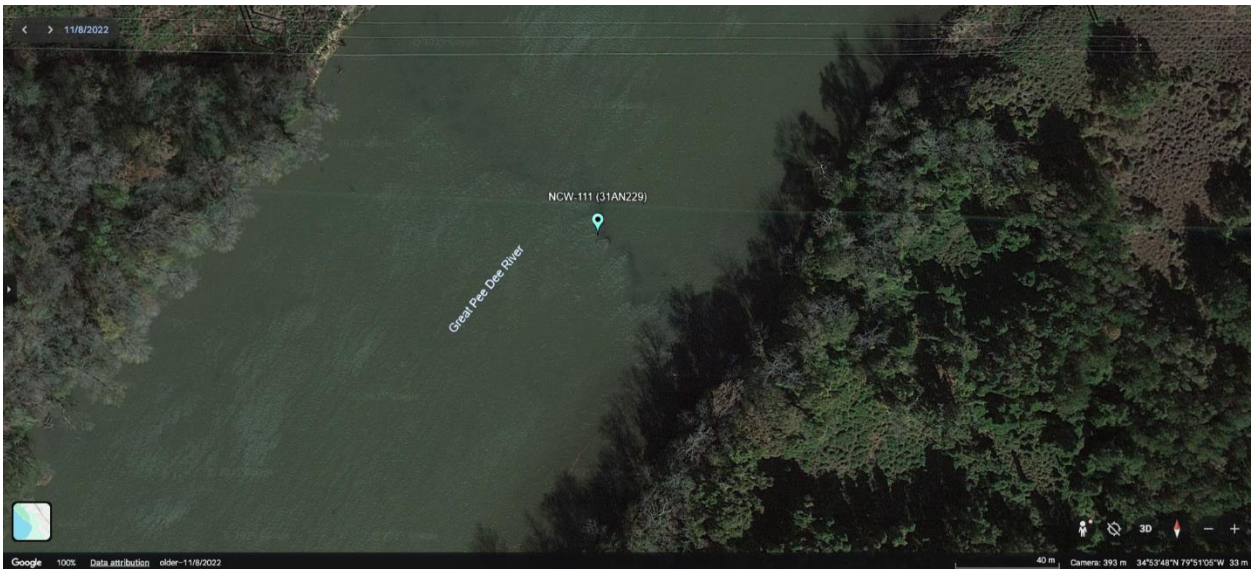

FIGURE 32. Plan View of NCW-111 (Courtesy of Google Earth).

The spatial clustering of these four structures within approximately 1,500 meters of channel length suggests this river segment provided environmental conditions favorable for stone fish weir construction and fish concentration. The concentration may reflect natural geomorphological features including bedrock exposures, channel constrictions, or gradient changes that created predictable fish migration patterns exploitable through strategic stone fish weir placement.

Stone Fish Weir Sites NCW-146 (31AN233) and NCW-338

Two additional weir sites occupy closely spaced positions within the same river reach, suggesting potential functional relationships (FIGURE 33). NCW-146 (31AN233) (34°53'29"N, 79°51'25"W) and NCW-338 (34°53'23"N, 79°51'27"W) are separated by approximately 200 meters, with both structures exhibiting indeterminate typologies and dimensions based on available aerial imagery. The spatial proximity between these installations may indicate coordinated operation, sequential use as environmental conditions changed, or construction by different groups maintaining adjacent ownership claims.

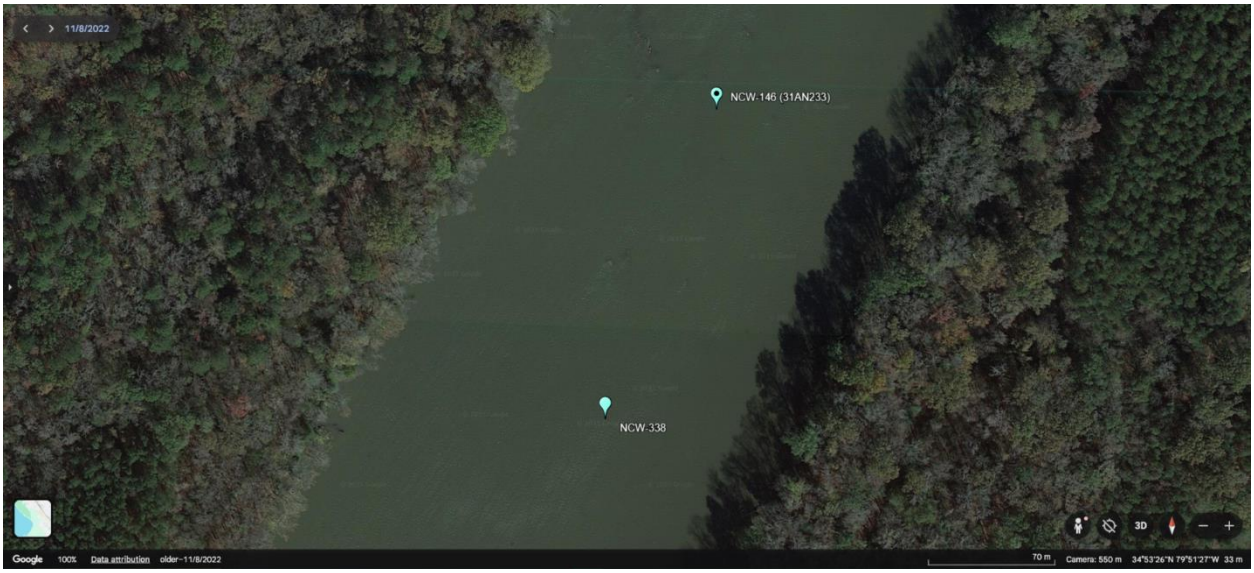

FIGURE 33. Plan View of NCW-146 and NCW-338 (Courtesy of Google Earth).

NCW-146 has received formal state site designation as 31AN233, indicating previous archaeological documentation efforts, though existing site records may contain limited morphological or temporal information (Cranford 2025, personal communication). The probable temporal affiliations for NCW-146 suggest potential association with NCW-338 based purely on spatial proximity, though this inference requires validation through ground truthing and potentially deeper archival research investigating whether historical sources reference fishing operations at this specific location.

NCW-338 similarly exhibits typological and dimensional characteristics difficult to ascertain from aerial imagery analysis exclusively. The probable temporal affiliations may link this structure to NCW-146, though this assessment represents a working hypothesis based on spatial association rather than definitive evidence. The inability to collect detailed morphological data for these structures through aerial imagery underscores the importance of systematic ground truthing with kayaks during optimal low-water conditions, and highlights the limitations inherent

in photoarchaeological approaches that, while valuable for initial site identification and reconnaissance, cannot substitute for direct archaeological fieldwork and documentation.

Southern Cluster Sites (Lower Study Area to State Boundary)

The southern stone fish weir cluster encompasses eleven documented weir sites distributed along the final four miles of the study segment approaching the North Carolina-South Carolina political boundary. This cluster demonstrates the continuation of intensive stone fish weir complexes throughout the lower reaches of the thesis survey area, with particular concentrations of historically documented commercial operations including the Manship fishery with its remarkable array of 22 fish wheels and 7 fall traps, Martin's Fishery, and the potential Diggs and Mowery operations. The prevalence of explicitly documented Historic period sites in this cluster may reflect better preservation of archival records for more recent commercial weir operations, though the potential for underlying Indigenous foundations at these locations remains high given documented patterns of Euro-American appropriation and modification of pre-existing Native American weirs throughout the thesis survey area.

Stone Fish Weir Sites NCW-16 (31AN206), NCW-44 (31AN217), NCW-42 (31AN215), and NCW-12 (31AN203)

Four additional weir sites occupy closely spaced positions forming a concentrated fishing complex within the southern portion of the thesis survey area (FIGURE 34). Historical documentation provides exceptional contextual information for this stone weir cluster, with Trout et al. (2016) referencing archival sources describing specific structural features and operational characteristics.

Stone Fish Weir Site NCW-16 (31AN206)

NCW-16, state site number 31AN206, coordinates (34°51'45"N, 79°53'20"W) is described as a "Fish dam PD 4.7" with a "3' opening at the point" and notations questioning whether a "fish wheel here" (Trout et al. 2016: 74-80). This documentary evidence provides rare quantitative data regarding apex dimensions and suggests installation of wooden fish wheel capture devices during Contact period commercial weir operations (FIGURE 34 and FIGURE 35).

Aerial imagery analysis confirms NCW-16 exhibits V-shaped morphology featuring a single downstream-pointing apex measuring approximately 3 meters in width, dimensions precisely matching the historical description and demonstrating remarkable consistency between documentary sources and the status of its archaeological remains. The northern wing extends approximately 28 meters while the southern wing measures about 26 meters, creating a nearly symmetrical configuration suggestive of deliberate planning. The probable temporal affiliation is Historic period based on explicit documentary references, though underlying stone foundations could predate commercial weir fishery operations and may represent Indigenous construction subsequently modified through the Contact period with fish wheels or other historic capture devices (Trout et al. 2016: 74-80).

FIGURE 34. Plan View of NCW-16, 44, 42, and 12 (Courtesy of Google Earth).

Stone Fish Weir Site NCW-44 (31AN217)

NCW-44, state site number 31AN217, coordinates (34°51'42"N, 79°53'24"W) exhibits curvilinear or compound complex morphology with approximate dimensions difficult to ascertain from available aerial imagery (F*IGURE* 34). The structure's probable temporal affiliations suggest likely association with adjacent NCW-16, NCW-42, and NCW-12 based on spatial proximity, shared historical documentation referencing this general location, and apparent morphological coordination suggesting operation as components of a unified stone fish weir complex.

Stone Fish Weir Site NCW-42 (31AN215)

NCW-42, state site number 31AN215, coordinates (34°51'41"N, 79°53'29"W) demonstrates W-shaped or compound complex morphology spanning approximately 193 meters in total width oriented downstream in a north-south alignment (FIGURE 34). This substantial lateral extent suggests either intensive original construction or accumulative building across multiple episodes creating an elaborate multi-component installation. The probable temporal

affiliations indicate likely connection with adjacent NCW-44, NCW-16, and NCW-12, potentially representing components of a single coordinated stone fish weir operation (Trout et al. 2016: 74-80).

Stone Fish Weir Site NCW-12 (31AN203)

NCW-12 , state site number 31AN203, coordinates (34°51'40"N, 79°53'34"W) receives specific description by Trout et al. as possessing "One wall of fish dam 4.45 is a crib dam" (FIGURE 34 and FIGURE 35) and "The point is open so its a possible fish wheel location" (Trout et al. 2016: 74-80). This primary notation provides exceptional observational detail referencing a historic crib dam construction technique wherein wooden frames were filled with stone to create substantial barriers capable of withstanding significant river flow forces (Connaway 2007:473 – 496). The mention of an open point with possible fish wheel installation indicates incorporation of mechanical capture devices during commercial operations. Aerial analysis confirms W-shaped or compound complex morphology spanning approximately 193 meters in total width oriented downstream north-south, with dimensions nearly identical to adjacent NCW-42 and suggesting coordinated construction events.

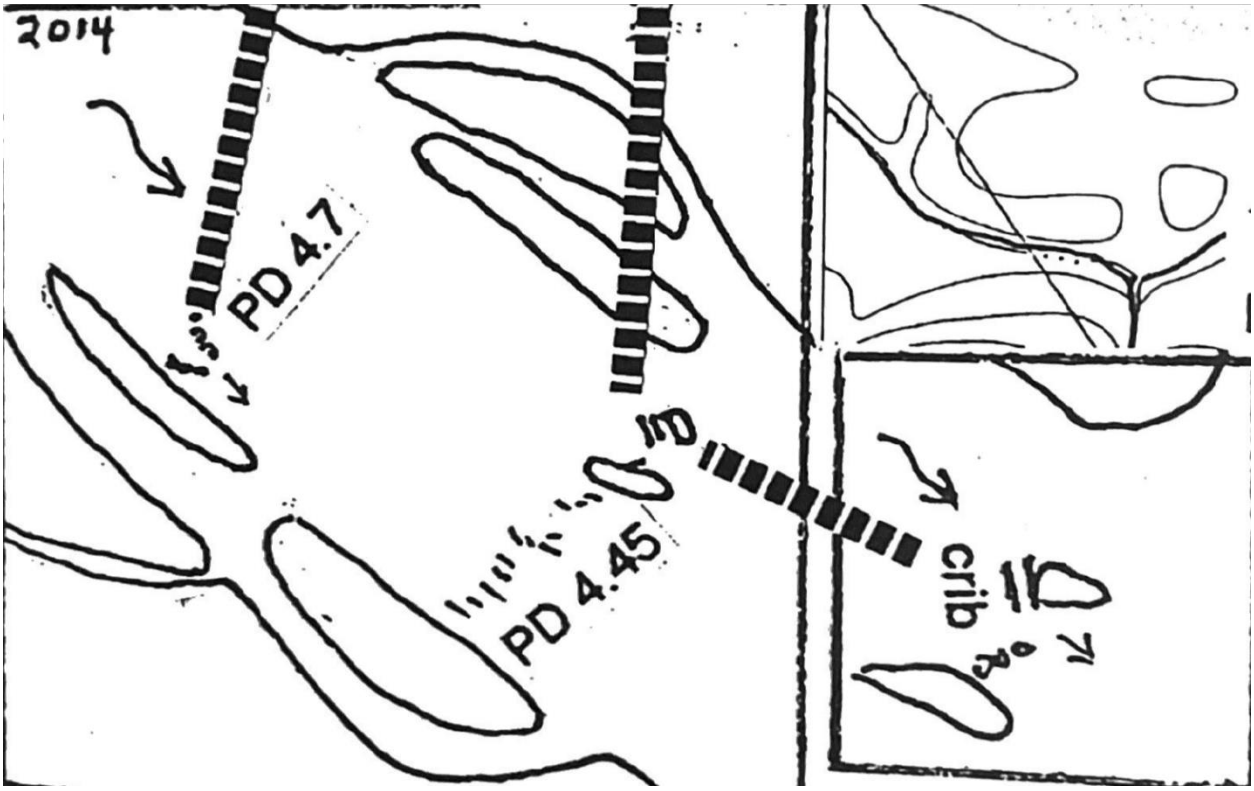

FIGURE 35. Possible Sketch of NCW-16 (PD 4.7) and NCW-12 (PD. 4.45) (Courtesy of Trout et. al. 2016:79).

The probable temporal affiliations for all four structures (NCW-16, NCW-44, NCW-42, NCW-12) are categorized as Historic period based on explicit documentary evidence. However, the widespread pattern of commercial weir operators appropriating Indigenous stone fish weirs along the northern portions of thesis survey area means underlying stone foundations may substantially predate Contact period modifications. The spatial clustering, dimensional consistency, and shared historical documentation all support interpretations of this four-weir complex as an integrated stone fish weir site potentially operated by a single commercial fishery or family during the peak commercial fishery period of the late nineteenth and early twentieth centuries on the Great Pee Dee River (Stevenson 1899; Trout et al. 2016).

Stone Fish Weir Site NCW-339

NCW-339 potentially corresponds to the E.M. Diggs Fishery referenced by Trout et al. (2016:79), providing tentative historical identification based on geographic positioning and temporal context (FIGURE 36). The stone fish weir occupies coordinates 34°51'18"N, 79°54'12"W within the southern weir cluster where documentary sources indicate intensive commercial fishing operations during the late nineteenth and early twentieth centuries. Typological classification as a compound weir proves difficult to ascertain definitively from available aerial imagery, which provides insufficient resolution to determine specific morphological characteristics or measure accurate structural dimensions.

FIGURE 36. Plan View of NCW-339 and NCW-340 (Courtesy of Google Earth).

The E.M. Diggs attribution, while plausible based on geographic correlation with historical sources, remains tentative without definitive documentary evidence explicitly linking this specific weir location to the Diggs family fishery operation. County records, commercial fishery registrations, and land ownership documentation might provide confirmatory evidence enabling confident association between visible archaeological remains and historically linked fishing enterprises.

Probable temporal affiliations and approximate dimensions both remain challenging to determine from aerial imagery. The structure's positioning within the southern weir cluster characterized by documented intensive Contact period commercial exploitation suggests participation in late nineteenth or early twentieth century fishing operations, though potential Indigenous origins or multi-temporal use cannot be excluded.

Stone Fish Weir Site NCW-340

NCW-340 may correspond to the Mowery Fishery documented by Trout et al. (2016:79), providing another example of tentative historical identification based on geographic positioning within the southern cluster (FIGURE 36). The stone fish weir occupies coordinates 34°50'42"N, 79°54'26"W and exhibits typological classification as a compound weir that proves difficult to confirm from available aerial imagery. As with NCW-339 described above, both approximate dimensions and probable temporal affiliations remain challenging to determine. The Mowery attribution represents a working hypothesis requiring validation through archival research and ground-truthing.

The positioning of both NCW-339 and NCW-340 in the southern portion of the study area, proximate to additional documented installations including the Manship fishery (NCW-109) and Martin's Fishery (NCW-9) described below, suggests this river segment supported intensive commercial fishing exploitation during the peak Atlantic coast shad fishery period of the late nineteenth century (Stevenson 1899:147-154). This concentration of historically documented fishing operations may reflect particularly favorable environmental conditions including reliable fish runs, channel morphology, or proximity to transportation infrastructure

Stone Fish Weir Site NCW-109

NCW-109 is possibly associated with the Manship fishery extensively documented by Stevenson (1899:150), who provides exceptional operational details in his comprehensive survey of Atlantic coast shad fisheries (FIGURE 37, FIGURE 38, and FIGURE 39). Stevenson's description states the installation was located "One mile above the North Carolina line... entirely crossing the river, containing 22 wheels and 7 fall traps, and yielding 5 roe and 5 buck shad in 1896, and about 95 shad in 1895" (Stevenson 1899: 150).

FIGURE 37. Plan View of NCW-109 (Courtesy of Google Earth).

The structure occupies coordinates 34°49'06"N, 79°54'55"W, positioning it approximately 1.5 miles from the North Carolina-South Carolina state line, a distance reasonably consistent with Stevenson's description accounting for measurement imprecision in historic river surveys and potential changes in state line recognition on the Great Pee Dee River over 125 years since original weir documentation. Typological classification as a linear or compound complex of weirs reflects morphological characteristics visible in aerial imagery, with the structure articulating between the western river bank and the western bank of an isolated mid-channel island. The approximate dimensions indicate a total width of approximately 50 meters spanning

from bank to island, potentially representing only a portion of the stone weir Stevenson describes as "entirely crossing the river" (Stevenson 1899: 150-151).

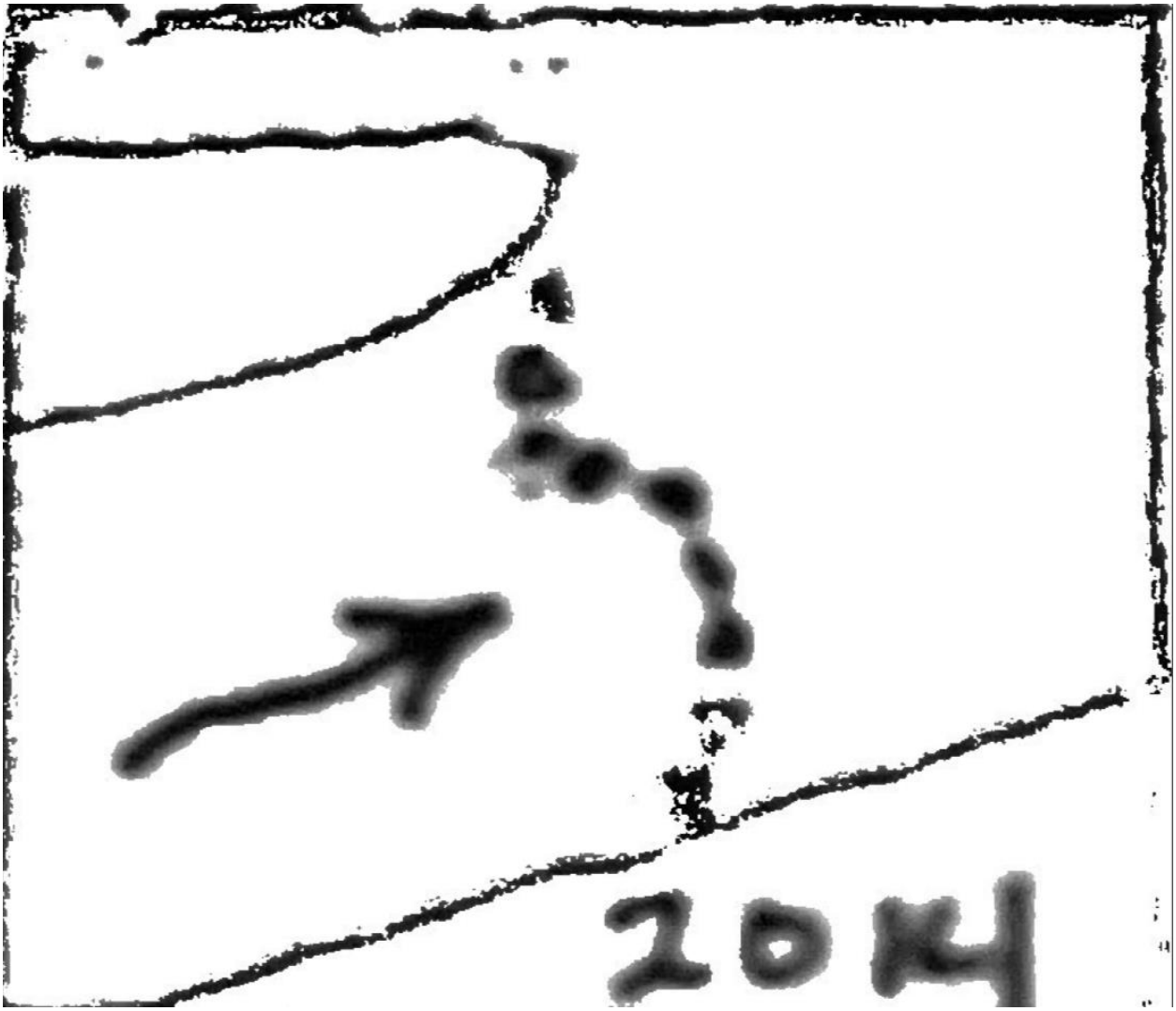

FIGURE 38. Possible sketch of NCW-109 (Courtesy of Trout et. al. 2016:80).

The historical documentation of 22 fish wheels and 7 fall traps represents the most Contact period additions to any stone fish weir recorded during this thesis' survey of the Great Pee Dee River, suggesting this location served as a major Contact period commercial fishing operation potentially employing a substantial array of labor forces and achieving significant fish harvest volumes. However, Stevenson's yield data indicating only 10 shad captured in 1896 and

approximately 95 shad in 1895 reveals the dramatic disparity between infrastructure investment and actual harvest returns that characterized many Atlantic coast fisheries by the late nineteenth century when anadromous fish populations were experiencing precipitous declines due to overharvesting, dam construction, and water quality degradation (Fielder 1939: 427-436; Stevenson 1899: 147-154).

The probable temporal affiliation is Historic period based on explicit documentary evidence from Stevenson's survey. However, the stone foundation elements visible in contemporary aerial imagery likely predate the late nineteenth century commercial operation, potentially representing Indigenous construction subsequently appropriated and heavily modified through the addition of Contact period mechanical fish wheels and fish traps documented in historical sources. The Manship fishery exemplifies the pattern of technological continuity wherein traditional fishing places maintained their productivity and strategic importance across cultural and temporal transitions, receiving successive technological enhancements adapted to changing fishery operational scales and market demands (Trout et al. 2016: 74-80).

Stone Fish Weir Sites NCW-108, NCW-9 (31AN202), and NCW-144

The final three weir sites documented within the thesis survey area occupy positions near the southern terminus approaching the North Carolina-South Carolina state line (FIGURE 39).

Stone Fish Weir Site NCW-108

NCW-108, coordinates (34°48'53"N, 79°55'01"W), exhibits compound weir complex morphology characterized by multiple apexes and disarticulated wings spanning approximately 155 meters in total width oriented northwest-southeast and articulating with the eastern river bank (FIGURE 39). The structure's probable temporal affiliations suggest possible association with NCW-9 positioned immediately adjacent to the south, potentially representing components

of a coordinated fish weir complex operated during Contact period commercial fishery exploitation.

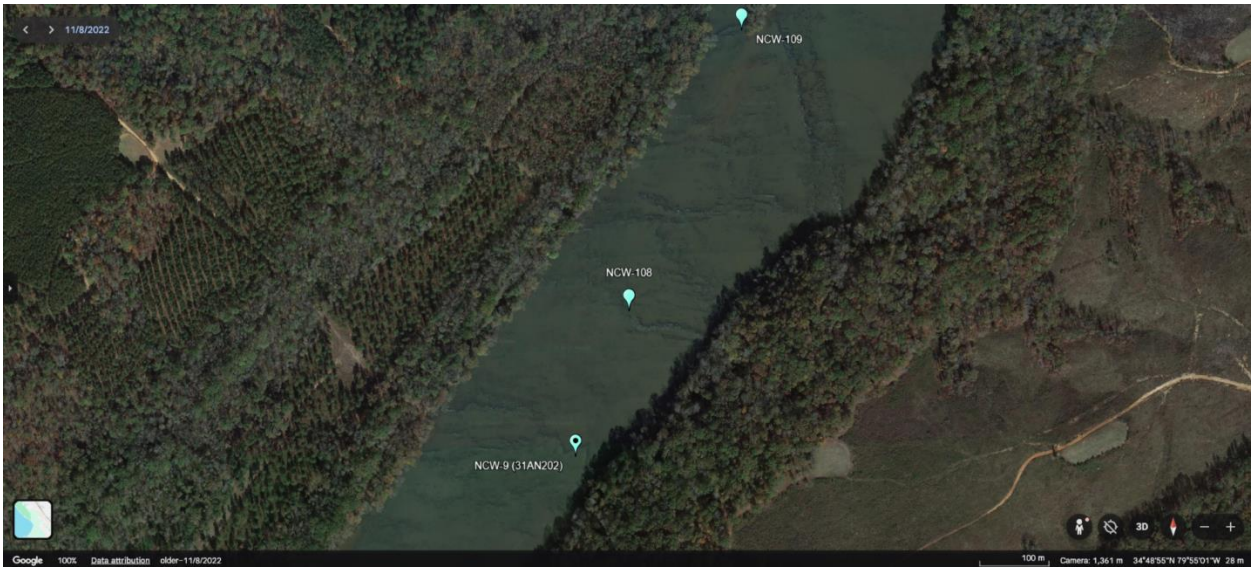

FIGURE 39. Plan View of NCW-109, 108, and 9 (Courtesy of Google Earth).

Stone Fish Weir Site NCW-9 (31AN202)

NCW-9, state site number 31AN202, coordinates (34°48'53"N, 79°55'01"W), is explicitly identified by Trout et al. (2016:80) as "Martin's Fishery," providing direct historical documentation of family ownership and operational identity (FIGURE 39). The structure exhibits W-shaped typology consisting of two apexes, each measuring approximately 3 meters in width, and four wings each extending roughly 30 meters in length. The structure articulates with the eastern river bank and demonstrates downstream east-west orientation characteristic of installations designed to capture upstream-migrating anadromous fish during spring spawning runs. The dimensional standardization and morphological clarity in aerial imagery suggests relatively good preservation compared to many structures documented in the southern cluster.

The probable temporal affiliation is Historic period based on documented association with the Martin family commercial fishing operation. However, as consistently emphasized

throughout this inventory, the potential for underlying Indigenous stone foundations receiving historic-period modifications remains high.

Stone Fish Weir Site NCW-144

NCW-144, coordinates (34°48'23"N, 79°55'32"W), occupies the southernmost documented position within the thesis survey area, exhibiting W-shaped morphology with both approximate dimensions and probable temporal affiliations difficult to determine from available aerial imagery (FIGURE 40). The structure's position at the downstream terminus of the thesis survey area reflects continuation of geographic weir distributions beyond political boundaries into South Carolina, suggesting regional patterns of stone fish weir construction extending throughout the Yadkin-Pee Dee river drainage rather than concentrating exclusively within North Carolina as the thesis originally hypothesized.

FIGURE 40. Plan View of NCW-144 (Courtesy of Google Earth).

Synthesis and General Observations from the Stone Fish Weir Inventory

This comprehensive inventory of forty stone fish weir sites along the fifteen-mile thesis survey area reveals remarkable variations in stone fish weir typologies, morphological characteristics, and states of preservation while simultaneously demonstrating consistent patterns suggesting shared stone weir building traditions and standardized construction principles. The spatial clustering patterns, with 65 percent of documented structures concentrated in three primary zones, strongly supports this thesis' theoretical model and hypothesis emphasizing persistent places where optimal environmental and cultural factors create enduring focal points attracting repeated use across temporal and cultural periods (Bailey 2007; Mahar 2019).

The morphological distribution demonstrates clear predominance of V-shaped configurations (37.5 percent) representing the most ubiquitous and functionally effective design documented throughout North American fish weir studies, followed by W-shaped variants (25 percent) incorporating multiple apexes distributed across partial channel widths, compound configurations (30 percent) reflecting either extensive original construction or accumulative weir additions across multiple building events, and linear designs (7.5 percent) potentially functioning as components of larger weir complexes, river navigation installations, or isolated stone fish weir sites.

The dimensional standardization observed across all forty structures, particularly the remarkable consistency in apex widths clustering between 3 and 7 meters with a mean of 4.8 meters, suggests either widespread sharing of optimal stone fish weir design principles through cultural transmission or functional constraints imposed by standardized capture device dimensions or the environment.

The integration of primary documentary evidence with archaeological data provides exceptional opportunities for investigating stone fish weir design continuity, operational patterns,

and the relationships between Indigenous and Euro-American stone fish weir traditions. The documented pattern of commercial fishery operators appropriating and modifying pre-existing Indigenous stone fish weirs, explicitly referenced in 1818 Yadkin Navigation Company reports and implied through widespread distribution of Contact period fish wheels incorporated into ancient stone weir foundations, emphasizes the persistent productivity and strategic significance of established fishing locations across cultural and temporal transitions (Bailey 2007; Mahar 2019; Stevenson 1899; Trout et al. 2016).

Chapter Four: Discussion of Survey Results, Interpretations, and Limitations

Interpreting Stone Fish Weir Morphology

The preliminary documentation and comprehensive inventory of forty stone fish weirs along the fifteen-mile Great Pee Dee River thesis survey area provides substantial empirical evidence for interpreting the confirmed and identified stone fish weirs as multi-temporal palimpsests, representing formidable archaeological features that defined the riverine cultural taskscape of the Great Pee Dee river valley (Bailey 2007; Coe 1964; Chapman 1975; Fielder 1939; Mahar 2019; Oliver 1992; Rights 1929). The results of this thesis found notable variations in Great Pee Dee stone fish weir typologies, morphological characteristics, and states of preservation while simultaneously demonstrating consistent patterns suggesting shared stone weir building traditions and standardized construction principles. The spatial clustering patterns, with 65 percent of documented structures concentrated in three primary zones, strongly supports this thesis' theoretical model and hypothesis emphasizing persistent places where optimal environmental and cultural factors create enduring focal points attracting repeated use across temporal and cultural periods (Bailey 2007; Mahar 2019).

Integration of primary documentary evidence with archaeological data provides exceptional opportunities for investigating stone fish weir typological continuity, operational patterns, and the relationships between Indigenous and Euro-American stone fish weir traditions. The documented pattern of commercial fishery operators appropriating and modifying pre-existing Indigenous stone fish weirs, explicitly referenced in 1818 Yadkin Navigation Company reports and implied through widespread distribution of Contact period fish wheels incorporated into ancient stone weir foundations, emphasizes the persistent productivity and strategic

significance of established fishing locations across cultural and temporal transitions (Bailey 2007; Mahar 2019; Stevenson 1899; Trout et al. 2016).

Typological distribution of stone fish weir types demonstrates clear predominance of V-shaped weirs (37.5%) representing the most common weir type documented throughout North American fish weir studies, followed by W-shaped types (25%) incorporating multiple apexes distributed across partial channel widths, compound types (30%) reflecting either extensive original construction or accumulative weir additions across multiple building events, and linear designs (7.5%) potentially functioning as components of larger weir complexes, river navigation installations, or isolated stone fish weir sites. The dimensional standardization observed across all forty structures, particularly the remarkable consistency in apex widths clustering between 3 and 7 meters with a mean of 4.8 meters, suggests either widespread sharing of optimal stone fish weir design philosophy through cultural transmission or functional constraints imposed by standardized capture device dimensions or the environment. Simple V-shaped weirs may represent initial constructions at newly exploited locations, expedient seasonal installations requiring minimal labor investment, or installations serving specialized functions not demanding additional structural components. Compound structures, by contrast, suggest accumulative investment through multiple construction episodes spanning extended temporal periods, potentially reflecting intensified exploitation as population growth increased subsistence needs or economic opportunities. Statistical analysis of dimensional patterns reveals remarkable consistency suggesting standardized construction principles operating at regional scales. Average wing length measurements across forty sites indicated moderate variability likely reflecting adaptive responses to site-specific channel conditions. However, apex width measurements demonstrate significant standardization transcending individual site variability and suggesting

either widespread cultural transmission of optimal stone fish weir design principles through teaching and observation or universal functional constraints imposed by additional capture device dimensions including basket trap diameters or fish wheel widths

The spatial clustering patterns documented through photoarchaeological analysis, with 65% of identified stone weir sites concentrated in three cluster zones accounting for 35% of the fifteen mile thesis survey area, demonstrate that certain Great Pee Dee River reaches provided optimal combinations of environmental and cultural proximity creating conditions particularly favorable for intensive stone fish weir construction and long-term sustained use (Strandberg and Tomlinson 1969:312-319). The central stone weir cluster's exceptional site density, incorporating eighteen weir sites within a two-mile segment including elaborate compound structures like NCW-20 spanning 287 meters with six or more apexes and NCW-18 with five apexes and ten wings, represents an intensive fish exploitation zone that likely functioned as a regional fishing center for multiple cultural groups including the Pee Dee culture at the Trestle Site and subsequent occupation by Euro-American commercial fishers (Oliver 1992; Stevenson 1899).

Discussion on Temporal and Cultural Attributions

The absence of directly datable materials from documented weirs sites presents the most fundamental limitation preventing the creation of a chronology, assessment of use duration, or confident cultural attribution for Great Pee Dee River stone fish weirs. Multiple converging lines of circumstantial evidence suggests substantial multi-temporal occupations for at least some identified weir sites, though establishing definitive construction dates remains impossible without application of invasive and potentially destructive dating techniques currently unavailable within this thesis' scope and resource constraints. The proximity of several stone

weir site concentrations to the Trestle Site (31AN19) containing stratified deposits spanning the Late Archaic through the Late Woodland periods (approximately 3000 BC to AD 1600) provide plausible evidence for Indigenous origins in the Pee Dee culture (circa AD 980), however historical research informs that these same stone weir site were later occupied and modified by Post-Contact groups (Oliver 1992:71-72).

Historical documentation provides terminus dates for twelve stone fish weirs explicitly described as having Native American origins with subsequent European modifications during commercial fishery operations. The 1818 Yadkin Navigation Company reports describe pre-existing "Indian fish dams" at multiple locations including current NCW-18 and NCW-331 sites, indicating that by the early nineteenth century these structures were already recognized as ancient Indigenous constructions potentially predating European colonization by centuries or millennia (Lawson 1709; Rights 1929; Stevenson 1899:147-154; Trout et al. 2016: 74-103). The documented progression from Indigenous construction through European modification to intensive commercial exploitation represents multi-temporal palimpsests of fishing traditions accumulating across centuries of continuous use at locations offering persistent environmental advantages for fish concentration and harvest.

Stone fish weir placement in flowing stream rivers are based on an understanding of fluvial dynamics and fish behavior, allowing successive generations to capitalize on natural hydrological patterns and geomorphological features. Strategically situated at points where the river’s current narrows, bends, or flows over natural obstacles such as bedrock outcrops, islands, and peninsulas, stone weirs exploit the tendency of fish to follow channels of least resistance during both upstream and downstream migrations. These locations inherently funnel fish into concentrated areas, where the flow is naturally constricted and the chances of captured are

maximized. The physical presence of stone weirs creates a series of microhabitats within the river channel, including downstream pools, lateral eddies, and upstream backwaters. These anthropogenic niches not only concentrate target fish species like shad by providing refuge and resting zones, but also attract a wider array of aquatic life, creating ecological hotspots that persistently replenish fish stocks year after year. The environmental stability offered by these locations, where food, shelter, and spawning grounds are reliably available, encourages repeated fish capture yields and enhances the long-term productivity of the weir site.

The integration of stone weirs into areas with optimal river depth and current further ensures that the structures remain effective across seasonal fluctuations in water level and flow, allowing fishers to adapt their harvesting techniques as river conditions change. The enduring nature of the stone construction means that, even after floods or high-water events, the basic framework of the weir remains intact, often requiring only minimal maintenance or rearrangement of stones to restore full functionality. This resilience contributes directly to their persistent use, making certain weir locations enduring focal points for subsistence, settlement, and commerce over centuries or even millennia. The placement of stone fish weirs at environmentally advantageous sites exemplifies the ecological knowledge embedded within Indigenous and later Euro-American fishing traditions. It reflects a long-term strategy of landscape modification that harmonizes with the Great Pee Dee river's rhythms while maximizing resource yield, ensuring that each new generation inherits both a productive fishery and a healthy river.

Regional archaeological cultures and sites researched elsewhere throughout the southeastern Piedmont of North Carolina provide additional temporal context for interpreting Great Pee Dee stone fish weirs(Chapman 1975; Coe 1964; Daniel 2013; Fielder 1939; Oliver

1992; Rights 1929; Stevenson 1899; Ward and Davis, Jr. 2020). Fish weirs documented archaeologically throughout eastern North America consistently demonstrate use spanning from the Late Archaic through Contact periods, with many showing clear stratigraphic or morphological evidence for repeated reconstruction and modification across this entire temporal range (Chapman 1975:1-11; Connaway 2007:17-46; Goodby et al. 2014:1-19; Mahar 2019:17-23; Petersen et al. 1994:197-217; Peterson 2018:2-13; Strandberg and Tomlinson 1969:312-319). The vast evidence of stone fish weir usage in Great Pee Dee River indicates a riverine fishing tradition that transcends temporal periods and cultural attributes as the stone fish weirs themselves became focal points in the riverine environment which naturally determined their morphology through taphonomic and hydrological conditioning.

Functional Interpretations and Seasonal Operations

The predominant downstream-pointing orientation documented for 85% of Great Pee Dee stone weirs, with apexes positioned to concentrate upstream and downstream-migrating fish, strongly supports functional interpretations emphasizing capture of anadromous species during predictable spring spawning runs when American shad, hickory shad, alewife, and blueback herring historically migrated from Atlantic waters up the Pee Dee River into Piedmont tributaries (Jennings et al. 2023: 83-87; Stevenson 1899: 147-154). This pronounced directional preference indicates stone fish weir operations focused primarily on exploiting anadromous migrations rather than year-round harvest of resident fish populations, though the remaining 15% of structures exhibiting upstream, downstream, or perpendicular orientations suggest some installations specifically targeted downstream-moving fish or served specialized functions not requiring standard weir configurations.

The apex width standardization documented across all forty sites, clustering tightly between 3 and 7 meters with minimal variation, suggests functional constraints imposed by capture device dimensions, operational requirements, or environmental limitations. These dimensions align closely with ethnographic documentation of traditional basket trap diameters typically ranging from 0.5 to 2.0 meters and gill net deployments commonly measuring 3 to 8 meters in width, supporting interpretations that stone apexes functioned primarily to concentrate fish at collection points where removable devices completed actual harvest operations (Connaway 2007: 5-16; White and Roth 2009: 183-192). The absence of preserved organic capture devices in archaeological contexts reflects differential preservation rather than their original non-existence, as historical accounts explicitly document extensive use of wooden fish wheels, woven and wood panels, and basketry at Great Pee Dee River stone weir sites during commercial fishing operations (Stevenson 1899:147-154; Trout et al. 2016:74-103). Wooden stakes that would have deteriorated many decades ago may have also been fundamental components for supporting stone weirs of greater height, as observed at other southeastern fish weir sites.

Seasonal stone fish weir operational patterns likely followed predictable annual cycles structured by anadromous fish migrations, river flow, and competing subsistence activities requiring flexible labor allocation. Spring spawning runs, typically occurring from March through May when warming temperatures triggered upstream migrations, represented peak fish mass-capture exploitation periods warranting intensive labor investment in stone fish weir monitoring, maintenance, and harvest operations (Stevenson 1899:147-154; Jennings et al. 2023:83-87). Summer and fall low-water periods provided optimal conditions for construction and maintenance activities including stone repositioning, structural repairs following spring

flood damage, and potentially modification or expansion of existing installations. Winter months likely witnessed reduced or suspended weir operations as cold temperatures, reduced fish activity, and potentially hazardous ice conditions made active fishing impractical (Daniel 2013:253-268; Jennings et al. 2023:83-87).

Environmental Relationships and Landscape Modification

The documented stone fish weirs and their builders fundamentally altered the local conditions of the Great Pee Dee River through modification of the river channel, creation of anthropogenic landforms, and establishment of predictable flow conditions that influenced both fish behavior and the ecological composition of the southern Piedmont across potentially millennia of continuous use. Partial barriers created by weir structures generated downstream scour pools through concentrated flow velocities, lateral eddies providing refugia from main channel currents, and upstream backwater zones offering spawning or feeding habitat for both target and non-target species (Daniel et al. 2013:156-178). These anthropogenic modifications created ecological hotspots attracting diverse fish and wildlife populations beyond those directly targeted for harvest, contributing to the productivity and strategic significance of weir locations across generations of use (Oliver 1992 ;Trout et al. 2016).

The systematic exploitation of natural landscape features including islands, peninsulas, canals, and bedrock outcrops as structural anchor points, accounted for 75% of Great Pee Dee stone weirs, demonstrates sophisticated understanding of fluvial geomorphology and efficient terramorphing minimizing labor requirements while maximizing structural stability and subsistence output (Connaway 2007:17-46). The selection of stone fish weir site locations was likely influenced by the availability of suitable terrestrial peripheries for associated fish

processing sites and stone sources of stone weir construction and maintenance. This reflects evidence for the hypothesis that the founders of settlements and occupation sites adjacent to the Great Pee Dee River at least considered availability to stone fish weirs as a determining factor in site selection.

Limitations of Available Data and Interpretive Constraints

Despite the valuable archaeological and historical insights on stone fish weirs generated by this thesis research, substantial limitations constrain site interpretations and highlight critical needs for future research employing expanded methodological approaches and sustained investigation. The reliance on photoarchaeological identification for thirty-eight of forty structures, while methodologically necessary given thesis logistical constraints, fundamentally limits understanding of accurate morphological dimensions, preservation of possibly extant diagnostic organic weir components, and associated terrestrial archaeological sites compared to data obtainable through kayak based ground-truthing. The inability to establish absolute dates represents the most substantial limitation of this thesis, preventing assessment of original construction and use chronologies, evaluation of contemporaneity among spatially associated structures, determinations of cultural significance, or cultural affiliation.

Incomplete preservation of weir structures limits functional reconstruction, comparative analysis, and conclusive interpretations. The absence of organic components originally completing mass-capture processes prevents full understanding of stone fish weir operation, while differential preservation within and between structures complicates efforts to identify construction patterns or recognize temporal changes in stone weir morphology. Environmental changes since periods of active stone fish weir use, particularly twentieth-century elimination of

anadromous fish migration runs through dam construction, fundamentally altered river conditions meaning contemporary observations may poorly represent historical operational contexts.

Chapter Five: Conclusion

Stone Fish Weirs as Understudied Cultural Resources

This thesis presents a photoarchaeological analysis and survey of forty stone fish weirs along the Great Pee Dee River definitively establishing them as culturally significant archaeological resources exemplifying accumulated ecological knowledge, riverine subsistence strategies, and complex social practices. The encompassing fifteen mile thesis survey area represents one of the highest concentrations of stone fish weirs contemporarily recorded in North Carolina, fundamentally arguing against perceptions that fish weirs had marginal effects on settlement and subsistence patterns in the Yadkin-Great Pee Dee River basin. Instead, these stone fish weirs emerged as central components of Indigenous and historic subsistence strategies that shaped regional cultural developments from at least the Late Archaic period in to the Contemporary period (Cranford 2024; email correspondence; Lawson 1709; Oliver 1992; Rights 1929; Stevenson 1899; Trout et al. 2016).

By tracing the spatial distribution and morphological variability of these weirs, this thesis reveals how stone fish weir placement and design both responded to and actively shaped the fluvial landscape, fostering ecological diversity and supporting multi-generational fishing practices that underpinned regional economic and social systems. The consistent association of stone fish weir sites with strategic fishing zones and evidence for ongoing maintenance and adaptation across centuries further underscores their enduring importance, challenging narratives that have historically overlooked the role of aquatic innovations in regional Indigenous subsistence strategies. Ultimately, the cumulative data presented in this thesis position stone fish weirs not only as tangible archaeological features of past ecological ingenuity, but as monoliths

in the evolving narrative of the relationship between riverine environments and the diverse communities who depended upon them, presenting proven methods for future research and preservation efforts that seek to illuminate the full scope of the historical and cultural significance of stone fish weirs.

Contributions to Archaeological Record and Maritime Heritage

This research contributes substantively to the growing recognition within southeastern archaeology that riverine resources, such as stone fish weirs, played central rather than peripheral roles in Indigenous economies (Ward and Davis 2020). The documentation of complex multi-apex stone weir structures comparable in scale to verified stone fish weirs documented elsewhere in North America demonstrates that North Carolina's Indigenous peoples developed fishing innovations rivaling those of regions typically associated with intensive aquatic resource exploitation in North America and globally (Connaway 2007:17-46; Jeffery 2013:30-56).

The methodological approach of this thesis integrating photoarchaeological analysis of historic aerial imagery with targeted amphibious reconnaissance with kayaks provides replicable models for efficient weir documentation applicable to other river systems, potentially enabling rapid expansion of regional databases and continued study of the Great Pee Dee weir sites (Espenshade 2010; Strandberg and Tomlinson 1969).

In addition to these methodological advancements, this thesis emphasizes the broader implications for cultural heritage management and archaeological interpretation, illuminating how stone fish weirs functioned as focal points of subsistence, technological innovation, and social organization within riverine taskscapes (Mahar 2019). By contextualizing the inventoried stone fish weirs within evolving interpretations of settlement and resource use, this thesis

highlights the enduring interplay between ecological adaptation and Indigenous cultural persistence encouraging future research that addresses legal, preservation, and interpretive challenges. As the field of Maritime Archaeology and Indigenous Studies moves toward a more holistic understanding of aquatic resource exploitation, these findings support the call for more comprehensive surveys, collaborative engagement with Indigenous communities and fellow archaeologists, and the adoption of advanced fish weir documentation and dating techniques, ensuring that the anthropological significance and vulnerability of stone fish weirs are fully recognized in ongoing efforts to protect and recognize underrepresented resources in North Carolina's maritime heritage.

Legal and Preservation Challenges

Current legal and cultural regulatory guidance provides demonstrably inadequate protection for stone fish weirs, as evidenced by minimal numbers formally listed on the National Register of Historic Places despite widespread distribution across the state (Cranford 2024; personal communication; Espenshade 2011). The uncertain ownership status of exposed riverbed features, lack of explicit statutory protection, and potential conflicts between cultural resource management goals and infrastructure permitting creates vulnerabilities in a regulatory grey area, threatening these significant cultural resources.

The development of comprehensive preservation strategies for stone fish weirs requires addressing these legal ambiguities through policy reform, enhanced stakeholder engagement, and development of innovative cultural resource management approaches adapted to the unique characteristics of riverine archaeological resources and the often overlooked peripheries of cultural resources terrestrial permitting and survey. Clarification of streambed ownership

responsibilities, establishment of specific protection measures explicitly addressing stone fish weirs as protected archaeological features, and integration of stone fish weir survey for cultural resource management considerations into environmental planning at federal, state, and local levels would significantly improve preservation outcomes for these vulnerable yet significant components of North Carolina's archaeological heritage.

Recommendations for Future Research

A comprehensive stone fish weir survey of the entire Yadkin-Great Pee Dee River should be undertaken to establish full extent and variability of fishing installations, including stone fish weir sites. This expanded documentation effort should incorporate systematic ground-truthing of all identified stone fish weirs during optimal low-water conditions, employing standardized recording protocols and categories developed through referencing this and other cited fish weir investigations to ensure data replicability across survey areas. Core dating of trapped sediments and systematic excavation of adjacent archaeological deposits and sites should be prioritized to address the fundamental limitation of temporal uncertainty currently constraining interpretive possibilities. These chronological investigations should focus on well-preserved stone fish weir structures exhibiting clear stratigraphic relationships with datable terrestrial contexts, potentially including the extensively occupied Trestle Site area where multiple weirs coincide with stratified archaeological deposits. Advanced documentation technologies including bathymetric LiDAR, photogrammetry, and subsurface geophysical survey with ground penetrating radar should be systematically applied to create detailed three-dimensional records of weir structures before additional deterioration occurs and as a less invasive alternative to the destructive processes of archaeological excavation. These digital preservation efforts can generate permanent archival

records enabling future researchers to investigate weir structures even if physical remnants are subsequently destroyed through natural processes or development impacts.

Integration of Indigenous knowledge through genuine collaborative partnerships with descendant communities should be considered for future research initiatives involving stone fish weirs with plausible Indigenous origins. The Lumbee Tribe of North Carolina, Catawba Indian Nation, Occaneechi Band of the Saponi Nation, Coharie Tribe, Meherrin, and other state-recognized tribes maintain traditional canoe and fish weir fishing traditions and generational environmental knowledge that can substantially enrich archaeological interpretations while ensuring research respects Indigenous heritage values and supports contemporary cultural revitalization efforts. Incorporating Indigenous perspectives not only fosters a deeper understanding of the cultural and historical significance of stone fish weirs, but also facilitates the transmission of traditional ecological knowledge essential for the stewardship and interpretation of these weir sites (Jeffery 2013:30-56). Such collaborations can help identify previously undocumented weir sites, refine research questions, and guide preservation strategies that reflect both archaeological due diligence and Indigenous values. As the field advances, prioritizing active engagement with descendant communities will ensure that future studies maintain ethical standards and yield insights that resonate with both academic and tribal stakeholders, ultimately strengthening the legacy of North Carolina's riverine heritage and supporting the broader goal of sustaining meaningful connections between people and place.

Final Reflections: The Enduring Significance of Stone Fish Weirs

The forty stone fish weirs documented along the Great Pee Dee River are enduring monuments to human creativity, environmental understanding, and cultural resilience extending

across thousands of years. These ancient structures represent a mosaic of temporal influences, designed through generations of observation and ecological adaptation, and successfully modified to meet the challenges of shifting environments and unique demands of diverse societies, from Indigenous builders to later European settlers and industrial commercial fishers. Their survival in the archaeological record, despite recurrent flooding, river channel changes, and purposeful destruction, highlights both the persistence of lithic construction and the lasting importance of these fishing locations, which drew repeated use by different cultural and temporal communities.

Preserving these sites is an urgent priority. Each year, natural forces and human activities destroy irreplaceable archaeological data embedded in these cultural landscapes. Losing an undocumented weir is not merely the removal of stones, it is the disappearance of centuries, or even millennia, of accumulated cultural wisdom about sustainable resource use, collective labor effort, and adaptation to river environments. Immediate, sustained action is required, combining professional archaeological research, descendant community collaboration, which means working closely with local Indigenous groups to integrate their perspectives, values, and knowledge into preservation strategies, and robust cultural resource management policy support.

Stone fish weirs offer nuances lessons for the fields of archaeology and history about sustainable resource management, the importance of traditional ecological knowledge, and the need for recognition of the cultural heritage of living taskscapes such as the study area presented in this thesis. In an era marked by concerns over food security, environmental decline, and the continuity of cultural traditions, the stone fish weirs of the Great Pee Dee River provide tangible evidence that past generations developed effective, sustainable methods for river settlement and subsistence. Stone fish weir study and protection is not just an academic endeavor; it is an

important investment in learning how people coexisted productively with aquatic ecosystems since times immemorial, while safeguarding the shared cultural heritage and ecological health of rivers for unforeseen future generations.

References

Anderson, David G., and Kenneth E. Sassaman
2012 *Recent Developments in Southeastern Archaeology: From Colonization to Complexity*. Society for American Archaeology Press, Washington, D.C.

Bailey, Geoff
2007 Time Perspectives, Palimpsests and the Archaeology of Time. *Journal of Anthropological Archaeology* 26(2):198-223.

Bedell, John, Jason Shellenhamer, and Charles Lee Decker
2011 Archaeological Identification and Evaluation Study, Section III Chesapeake & Ohio Canal National Historical Park, Volume II. Final Technical Report Prepared for the National Park Service, Washington D.C. by The Louis Berger Group.

Chapman, James H.
1975 *A Preliminary Report of Aboriginal Fish Weirs in the Southeast.* Unpublished manuscript. Laboratory of Archaeology, Department of Anthropology, Georgia State University, Atlanta, GA.

Coe, Joffre L.
1964 *The Formative Cultures of the Carolina Piedmont*. Transactions of the American Philosophical Society 54(5). American Philosophical Society, Philadelphia.

Colley, Sarah M.
1990 The Analysis and Interpretation of Archaeological Fish Remains. *Archaeological Method and Theory* 2:207-253.

Connaway, John M.
2007 *Fishweirs: A World Perspective with Emphasis on the Fishweirs of Mississippi*. Mississippi Department of Archives and History, Jackson.

Daniel, I. Randolph, Jr.
2001 Stone Raw Material Availability and Early Archaic Settlement in the Southeastern United States. *American Antiquity* 66(2):237-265.

Daniel, I. Randolph, Jr., Christopher R. Moore, and E. Christopher Caynor
2013 Sifting the Sands of Time: Geoarchaeology, Culture Chronology, and Climate Change at Squires Ridge, Northeastern North Carolina. *Southeastern Archaeology* 32(2):253-270.

Espenshade, Christopher T.
2010 Petroglyph Site Inventory and Assessment of a Portion of the Hiwassee River Near the Mission Hydroelectric Project (FERC Project No. 2619). Report to Duke Energy Lake Services in Charlotte, North Carolina from New South Associates in Stone Mountain, Georgia.

Espenshade, Christopher T.

2011 The Sacred Hiwassee Riverscape. Paper presented at the Middle Atlantic Archaeological Conference, Ocean City, Maryland.

Fielder, R.H.
1939 *Fishery Industries of the United States 1939*. Administrative Report 41: 186-550. United States Government Printing Office, Washington D.C.

Goodby, Robert G., Sarah Tremblay, and Edward Bouras
2014 The Swanzey Fish Dam: A Large, Precontact Native American Stone Structure in Southwestern New Hampshire. *Northeast Anthropology* 81(82): 1-22.

Jeffery, Bill
2013 Reviving Community Spirit: Furthering the Sustainable, Historical and Economic Role of Fish Weirs and Traps. *Journal of Maritime Archaeology* 8(1):29-57.

Jennings, Cecil A., Elizabeth P. Anderson, Arthur C. Benke, Tom J. Kwak, Mark C. Scott, and Leonard A. Smock
2023 Atlantic Coast Rivers of the Southeastern United States. In *Rivers of North America*, 2nd edition, edited by Michael D. Delong, Timothy D. Jardine, Arthur C. Benke, and Colbert E. Cushing, pp. 69-109. Academic Press, Cambridge.

Lawson, John
1709 *A New Voyage to Carolina*. London.

Mahar, Ginessa J.
2019 *Gathering Fish: Mass-Capture Fishing Practices and the Rise of a Woodland Civic-Ceremonial Center on the North Florida Gulf Coast*. PhD dissertation, Department of Anthropology, University of Florida, Gainesville, Florida.

1981 NC General Statutes - Chapter 70 Article 2, *Archaeological Resources Protection Act.*

Oliver, Billy L.
1992 *Settlements of the Pee Dee Culture*. PhD dissertation, Department of Anthropology, University of North Carolina, Chapel Hill.

Petersen, James B., Nathan D. Hamilton, J. M. Adovasio, and Alan L. McPherron
1984 Netting Technology and the Antiquity of Fish Exploitation in Eastern North America. *Midcontinental Journal of Archaeology* 9(2):199-225.

Petersen, James B., Brian S. Robinson, Daniel F. Belknap, James Stark, and Lawrence K. Kaplan
1994 An Archaic and Woodland Period Fish Weir Complex in Central Maine. *Archaeology of Eastern North America* 22:197-222.

Peterson, Don
2018 *Native American Fish Traps in the Potomac River, Brunswick, Maryland*. Brunswick Heritage Museum, Brunswick.

Prince, Paul
2005 Fish Weirs, Salmon Productivity, and Village Settlement in an Upper Skeena River Tributary, British Columbia. *Canadian Journal of Archaeology* 29(1):68-87.

Rights, Douglas L.
1929 *A Voyage Down the Yadkin-Great Peedee River*. Winston-Salem Print Shop, Winston-Salem.

Ringer, R. James
2008 The Atherley Narrows Fish Weir Complex: A Submerged Archaic-to-Historic-Period Fishing Site in Ontario, Canada. *Revista de Arqueología Americana* 26:131-151.

Rostlund, Erhard
1952 *Freshwater Fish and Fishing in Native North America*. University of California. University of California Press, Berkeley.

Stevenson, Charles H.
1899 The Shad Fisheries of the Atlantic Coast of the United States. In *Report to the U.S. Commissioner of Fish and Fisheries for 1898*, Part XXIV, pp. 101-269. Government Printing Office, Washington.

Strandberg, Carl H., and Ray Tomlinson
1969 Photoarchaeological Analysis of Potomac River Fish Traps. *American Antiquity* 34(3):312-319.

Trout, III, W. E., John Hairr, and Nancy R. Trout
2016 *The Yadkin-Pee Dee River Atlas: Trying to Tame the Rapids in the Heart of North Carolina*. Virginia Canals & Navigation Society, Madison Heights, Virginia.

Ward, H. Trawick, and R. P. Stephen Davis, Jr.
2020 *Time Before History: The Archaeology of North Carolina*. University of North Carolina Press, Chapel Hill and London.

White, Eric S. and Barbara J. Roth
2009 Fish Traps on Ancient Shores: Exploring the Function of Lake Cahuilla Fish Traps. *Journal of California and Great Basin Anthropology* 29(2): 183-194.

Willard, Debra A., Christopher E. Bernhardt, David A. Korejwo, and Stephen R. Meyers
2005 Impact of Millennial-Scale Holocene Climate Variability on Eastern North America Terrestrial Ecosystems: Pollen-Based Climatic Reconstruction. *Global and Planetary Change* 47(1):17-35.