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Via U.S. and Electronic Mail
Mr. Mickey Sugg
U.S. Army Corps of Engineers
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RE: Figure Eight Island Shoreline Management Project – SAW-2006-41158

Dear Mr. Sugg:

Please accept these comments on the Figure Eight Island Shoreline Management Project Supplemental Draft Environmental Impact Statement ("SEIS"). The Southern Environmental Law Center submits these comments on behalf of the North Carolina Coastal Federation and Audubon North Carolina. Unfortunately, the U.S. Army Corps of Engineers ("Corps") has avoided addressing any of the shortcomings in its Draft Environmental Impact Statement ("DEIS") by refusing to use current shoreline data, accretion rates, and wildlife habitat—including federally designated critical habitat for the endangered piping plover—as the baseline for its analysis. The SEIS is little more than an entrenched defense of the analysis in the 2012 DEIS. The additional data provided regarding the 2012 shoreline only exacerbate the errors of the DEIS that have been carried forward.[1] As such, the SEIS does not provide a basis for the Corps to move forward with any alternative other than Alternative 2—the actual no-action alternative which does not require a Corps permit.

I. The SEIS Fails to Serve Its Only Purpose.

A supplemental environmental impact statement ("EIS") is required when "[t]here are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts." 40 C.F.R. § 1502.9(c)(1)(ii). We requested a supplement because the DEIS could not serve the fundamental purpose of the National Environmental Policy Act ("NEPA"), which is "to help public officials make decisions that are based on understanding of environmental consequences, and that take actions that protect, restore, and enhance the environment." 40 C.F.R. § 1500.1(c). Because it was not based on then-current data, the DEIS

[1] We incorporate by reference our previous comment letters of May 27, 2012 and October 13, 2014 in their entirety. They are included as Attachments 1 and 2, respectively. The SEIS has not resolved the issues presented in those letters. Notably, this includes the failure of the fact that the Figure Eight Island Home Owners Association ("HOA") continues to lack property rights necessary to actually build its preferred terminal groin. As we have stated previously, the Corps should cease work on this project until the HOA demonstrates that it has the property rights necessary to move forward. *See* Attachment 1, Letter from D. Carter, SELC, to M. Sugg, USACE, at 2 (July 27, 2012).

could not evaluated the future environmental impacts of the proposed project and alternatives to it—which is the "heart of the environmental impact statement." 40 C.F.R. § 1502.14. Unfortunately, this SEIS fails to correct the errors regarding the assumed baseline in the DEIS.

Following the release of the DEIS in 2012, we raised the issue of a supplement to the DEIS because "[t]he baseline assumptions regarding inlet location, shoal formations, erosion rates, and beach conditions rely on information most recently collected in 2007."[2] We specifically cited statements regarding continuation of "current" erosion rates at a time that the island was accreting substantially—not eroding.[3] We emphasized that "[e]ssential data regarding erosion rates is at least 5 years old and assumptions based on that data have proven to be false."[4]

In October 2014, we reiterated these points, highlighting that "[t]he entire analysis in the DEIS rests on the assumption that the north end of Figure 8 Island will erode at rates observed between 1999 and 2007."[5] We noted then that "[o]ver two years after preparation of the DEIS, exactly the opposite has occurred."[6] With that letter, we included a report of data collected by Audubon North Carolina demonstrating the importance of the habitat for shorebirds and waterbirds in Rich Inlet and contrasting that habitat use with the hardened Masonboro Inlet.[7]

Rather than incorporate the changed conditions on Figure Eight Island into its analysis, the SEIS openly rejects this new information. Although the Corps acknowledges substantial changes to Rich Inlet, it failed to incorporate those changes into its analysis of either environmental or economic impacts. For environmental impacts, the Corps directly acknowledges that it has ignored the 2012 shoreline,[8] including the substantial additional habitat created by years of accretion. As described in further detail below and in the comments from Audubon North Carolina submitted separately and incorporated by reference, the accreted spit has created significant new habitat for state and federally listed species including piping plover, red knots, and seabeach amaranth. With respect to the economic analysis, the Corps fails to acknowledge the recent accretion, insisting that "[i]f erosion rates continue at their current level" there will be a substantial loss of residential properties.[9] The error in that assessment is plain—the "current level" of shoreline change is adding sand to the beach, not eroding it.

The Fourth Circuit has made clear that "[w]ithout [accurate baseline] data, an agency cannot carefully consider information about significant environment impacts" and therefore the analysis will "result[] in an arbitrary and capricious decision." *N.C. Wildlife Fed'n v. N. C. Dep't of Transp.*, 677 F.3d 596, 603 (4th Cir. 2012) (quoting *N. Plains Res. Council, Inc. v. Surface Transp. Bd.*, 668 F.3d 1067, 1085 (9th Cir. 2011)). It is fundamental that baseline data for the analysis of environmental impacts represent reality. *See Friends of Back Bay v. U.S. Army*

[2] Attachment 1, Letter from Carter to Sugg, at 3.
[3] *Id.* at 4.
[4] *Id.*
[5] Attachment 2, Letter from S. Weaver, SELC, to Col. K. Landers, USACE, at 2 (Oct. 13, 2014).
[6] *Id.* at 3
[7] *Id.* at 4.
[8] SEIS at 194.
[9] *See id.* at 33.

Corps of Eng's, 681 F.3d 581, 588 (4th Cir. 2012) ("A material misapprehension of the baseline conditions existing in advance of an agency action can lay the groundwork for an arbitrary and capricious decision."). Without an accurate assessment of baseline conditions, "the [impact statement] process cannot serve its larger informational role, and the public is deprived of [its] opportunity to play a role in the decision-making process." *N.C. Wildlife Fed'n*, 677 F.3d at 603 (quoting *N. Plains Res. Council, Inc. v. Surface Transp. Bd.*, 668 F.3d 1067, 1085 (9th Cir. 2011)).

The ecological scenario that is the foundation of the SEIS simply does not exist and cannot, therefore, serve as the basis for a lawful NEPA analysis or any agency action. *Friends of Back Bay*, 681 F.3d at 588 ("An unjustified leap of logic or unwarranted assumption, however, can erode any pillar underpinning an agency action . . . ."). The assumptions that the island will continue to erode and that the model provides a reasonable prediction of future erosion are more than "unjustified leap[s] of logic or unwarranted assumption[s]"; they are demonstrably false. Reliance on "demonstrably incorrect assumption[s]" violates NEPA. *Id.* at 589. Further, as demonstrated below, use of more accurate 2012 shoreline data demonstrates that the conclusions in the economic analysis are baseless and unwarranted.

It is indisputable that the Corps has collected a large volume of paper. Most of those analyses refute the very conclusions presented in the SEIS, as described below. But collecting studies is not the purpose of NEPA.[10] *See* 40 C.F.R. 1502.2(a) ("Environmental impact statements shall be analytic rather than encyclopedic."). This SEIS fails to incorporate the recent, substantial changes in Rich Inlet into its analyses in any meaningful way and fails to provide the "clear basis for choice among options by the decisionmaker and the public" because it fails to address adequately "the environmental impacts of the proposal and the alternatives." 40 C.F.R. § 1502.14. Therefore, it violates NEPA and must be rejected.

II. The Delft3D Model is Designed to, and Does, Over-Estimate Erosion on Figure Eight Island.

Buried in Appendix B, the SEIS concedes the error in Delft3D modeling that prevents the Corps from moving forward on this project. The Engineering Report admits that "the Delft3D model's estimated erosion rates on the north end of Figure Eight Island . . . are high in comparison to the present trends."[11] Reviewing the basis for that conclusion—comparisons of actual accretion between 2006 and 2012 to modeled erosion during that time period—reveals the futility of the model. Monitored shoreline change between 2006 and 2012 demonstrates that no part of Figure Eight Island has eroded to any meaningful degree and that from station 80+00 to 110+00, the island has substantially accreted (up to 100 cy/ft/yr). The model, by comparison,

[10] The Corps also appears to have not collected the studies relied on the SEIS. As described more fully in Audubon's separate comments, Audubon's efforts to obtain the report cited as "Cleary, W.J. 2009. Rich Inlet: History and inlet related oceanfront and estuarine shoreline changes. Final report submitted to Figure Eight Beach Homeowners Association. 61 p." were unsuccessful. Audubon contacted the Corps, the author, the HOA, and the consultant who prepared the EIS. None could locate a copy of the report. It appears that the report does not exist despite the SEIS's reliance on it for critical analyses.
[11] SEIS, Appx B at 170.

predicted that the island would erode from 60+00 to 110+00, with substantial erosion (greater than 50 cy/ft/yr) between stations 90+00 to 105+00.

Indeed, overestimating erosion is the only potential result for the Delft3D model—it is based exclusively on a time period that represents the worst erosion ever recorded on the island. The Delft3D model incorporates "worst case" erosion parameters. As described in the SEIS, modeling was based on the 2006 "input parameters (tides, waves, wind, etc.)."[12] The model was calibrated based on waves measured between October 1999 and April 2007.[13] The Engineering Report concedes that "[u]nder these inlet bar channel conditions, the north end of Figure Eight Island normally experiences severe erosion."[14] Therefore, the Delft3D model is designed to create erosion on Figure Eight Island when the island is, in fact, accreting. It assumes "worst case" erosion even as applied to the 2012 shorelines. The only potential outcome of the modeling is to overestimate erosion on Figure Eight Island.

Assuming erroneously high erosion rates precludes compliance with NEPA. The recent decision in *1000 Friends of Wisconsin, Inc. v. U.S. Department of Transportation* is instructive. 2015 WL 2454271 at *8 (E.D. Wisc., May 2015). There, DOT modeled traffic projections based on expected population growth. When population growth estimates were revised to reflect slower growth, the Department of Transportation ("DOT") acknowledged the changed projection but did not revise the model to reflect the reduced growth. In rejecting the DOT's environmental impact statement, the court concluded that "the updated . . . population data will significantly change the traffic projections and consideration of reasonable alternatives that appear in the impact statement." The court held that because DOT did not "discuss the updated data in the context of the traffic projections and the consideration of reasonable alternatives," it failed to make "a reasoned decision based on its evaluation of the significance—or lack of significance—of the new information." *Id.* at *9. The court recognized the effect of DOT's failure, stating that "[i]f it is true that the defendants' projection of traffic volumes is flawed, then one of the key rationales for expanding the highway to four lanes will be undermined." *Id.* at *12.

That exact scenario has transpired here. The DEIS was based on a model which relies on erosion rates that no longer apply. The Corps has acknowledged that the model overestimates erosion rates. Likewise, the Corps has conceded that the assumptions in the model do not reflect current conditions. Yet the agency has elected not to incorporate the 2012 shorelines or the substantial accretion that resulted in the significantly broader beaches in its analysis in any meaningful way. As with DOT's traffic forecasting model, the Delft3D model's projections are flawed and do not support the key rationale for Alternative 5D.

Moreover, the Delft3D model is simply one example of the Corps' failure to properly oversee the preparation of the EIS. Every important judgment is made such that it supports the applicant's preferred alternative by unreasonably inflating erosion rates, overestimating economic costs of non-groin alternatives, and underestimating environmental effects. As discussed below, these assumptions lack support. Critically, they also reveal that the document

[12] SEIS at 194.
[13] *Id.*, Appx B at 135.
[14] *Id.*, Appx B at 148.

does not "serve as the means of assessing the environmental impact of proposed agency actions," but instead attempts to "justify[] decisions already made." 40 CFR 1502.2(g). The Figure Eight Homeowners Association leadership has decided to pursue and advocate for a terminal groin. The consultants who prepared the EIS have consistently and publicly supported that approach. The document reflects that singular purpose. As such, it fails to comply with NEPA.

III. The Purpose and Need is Met by Alternative 2.

In addition to invalidating the SEIS's projections of baseline conditions in the action area, the inlet's natural migration has also rendered the Proposed Action unnecessary, undermining the SEIS's statement of Purpose and Need. The entire SEIS analysis depends on the continuation of "chronic erosion problems along the northern section of Figure Eight Island's ocean shoreline."[15] The SEIS analysis focuses on preventing "economic losses resulting from damages to structures and their contents due to . . . progressive shoreline erosion."[16] The alternatives analysis evaluated options "[t]o alleviate these problems attributed to erosion."[17]

Taking into account the accretion of the beach on the north end of Figure Eight Island, all of the DEIS's erosion-based purpose and need statements are satisfied by the No Action alternative. Erosion rates have reversed. No houses are threatened. There is no indication that the inlet will migrate and erode the northern end of the island within the next 30 years. In sum, these developments undercut the rationale and justification for the proposed action, as well as the entire analysis presented in the DEIS.

IV. The Environmental Analysis is Arbitrary and Capricious.

The environmental analysis in the SEIS is essentially unchanged from the DEIS. Like the DEIS, it is based on 2006 shorelines and erosive conditions.[18] Similarly, it is limited to 5 years.[19] Finally, it relies extensively on Deltf3D modeling that has been proven to be inaccurate. For these reasons, the issues raised in our previous comment letters with respect to building a terminal groin apply equally to Alternative 5D.[20] Specifically, Alternative 5D would destroy critical habitat for the piping plover by eliminating the existing spit and intertidal areas; is far more environmentally damaging than non-groin alternatives; and does not comply with the 404(b)(1) guidelines.[21] In addition, we make the following comments.

First, the Corps cannot lawfully evaluate the environmental effects of only the first 5 years of a 30-year project. That is particularly so here where the indirect effects to the inlet will substantially affect threatened and endangered piping plover, including degrading their

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[15] SEIS at i.
[16] *Id.*
[17] *Id.*
[18] *Id.* at 194
[19] *Id.*
[20] The contentions in our previous letters regarding the adverse effects of prior terminal groin alternatives apply equally to Alternative 5D.
[21] *See generally*, Attachments 1-3.

designated critical habitat. Building a terminal groin will eliminate shoals and intertidal habitat in Rich Inlet.[22]

Second, the Corps cannot ignore the existing habitat available to protected species at the north end of Figure Eight Island. As stated in our 2014 Supplemental Comments, data collected by Audubon North Carolina demonstrates that the expanded spit provides excellent habitat that is significantly better than Masonboro Inlet. As described by Audubon biologists: "The amount and quality of shorebird habitat is much greater at Rich Inlet. These habitats include emergent roosting areas and inter-tidal sand and mud flats. These habitats are largely absent from Masonboro Inlet."[23] The accreted spit also provides habitat for other state and federally listed species, including red knots, sea turtles, and seabeach amaranth. It provides habitat for a multitude of shorebirds and waterbirds, including terns, sanderlings, and dunlin.

The SEIS concedes that the habitat mapping that is the basis of the entire environmental analysis is not representative of existing conditions.[24] Rather than address that shortcoming, and meet NEPA's requirements of disclosing environmental impacts, the Corps proposes to postpone updating the admittedly stale data until "after the completion of Alternative 5D."[25] This proposal violates the fundamental purpose of NEPA by failing to provide the information necessary to make an informed decision.

The error in the SEIS's approach is perhaps most evident when considering seabeach amaranth. Use of the 2006 habitat data, and the Corps' failure to update that data, results in an analysis that ignores the presence of significant numbers of seabeach amaranth on the northern spit of Figure Eight Island. As documented in Audubon's comments, recent surveys revealed 262 plants north of the proposed location of the terminal groin in Alternative 5D. The spit supporting these federally endangered plants would be entirely lost under that Alternative, yet the SEIS does not evaluate that loss because the Corps refuses to address and incorporate current conditions.

By recognizing that the existing habitat map is outdated and choosing not to update it with existing data, the Corps has elected not to evaluate the actual environmental effects of the proposed project or alternatives. Such a decision is illegal in any instance, but particularly where that data involves habitat for endangered species, including federally designated critical habitat which receives its own protections. The omission of any analysis of this habitat and the potential direct and indirect effects on it violates NEPA. *See* 40 C.F.R. § 1502.2(d) ("Environmental impact statements shall state how alternatives considered in it and decisions based on it will or will not achieve the requirements of sections 101 and 102(1) of the Act and other environmental laws and policies.")

[22] *See also* Audubon North Carolina's September 14, 2015 comments, which are incorporated by reference.
[23] Attachment 3, Letter from L. Addison, Audubon, to P. Benjamin, USFWS, at 1-2 (Sept. 25, 2014).
[24] SEIS at 452 ("It is acknowledged that the data in Figure 4.1 within the Rich Inlet complex has somewhat changed from its initial collection due to the ongoing natural shifting that occurs in inlet systems.").
[25] *Id.*

Moreover, the analysis of environmental effects in the SEIS is wholly inadequate. The deficiencies in the analysis include failure to review adequately and present literature regarding the effect of beach nourishment on macroinvertebrates; to address adequately the effects of terminal groins on other inlets in North Carolina and the rest of the Atlantic coastline; to adequately address the expected effects on piping plovers, Wilson's plovers, American oystercatchers, dunlin, sanderlings, least terns, common terns, and red knots—all of which are known to use Rich Inlet; and to address adequately the effect of terminal groin construction on sea turtles, an issue with particular relevance given the destruction of a nest during the Bald Head Island terminal groin construction process. These issues are more fully addressed in Audubon's separate comments, which are incorporated here as if set forth in full.

V. The Corps Cannot Rely On 2006 Shoreline Data.

The SEIS relies on the 2006 shoreline as "worst case in terms of erosive conditions."[26] That reliance is arbitrary and capricious. Under NEPA, the Corps is obligated to evaluate the environmental consequences and alternatives to the proposed action. The proposed action is to build a terminal groin on Figure Eight Island as it currently exists. The HOA has not proposed to wait until conditions return to those experienced in 2006 to build the proposed groin. It has proposed to build the groin under existing conditions with the existing channel alignment, existing shoreline, and existing wildlife habitat. Therefore, the only relevant analysis in the SIS is the analysis of alternatives to that proposed terminal groin and the effect of the proposed project and its alternatives on the existing shoreline.

The SEIS's analysis must be based on current conditions. As described above, courts routinely find that agencies violate NEPA by relying on stale data. *See N.C. Wildlife Fed'n*, 677 F.3d at 603 (4th Cir. 2012), *Friends of Back Bay*, 681 F.3d at 588 (4th Cir. 2012).

If the Corps insists on projecting shoreline changes based on 2006 shorelines and conditions, then it must use the actual results of taking no action in 2006. Modeling is unnecessary to evaluate the consequences of taking no action in response to erosion rates and shorelines as they existed in 2006. In fact, the Engineering Report describes the surveys necessary to use the 2012 shoreline for the purpose of comparison.[27] Therefore, if the Corps is to rely on the anticipated changes to the 2006 shoreline, the modeled changes under Alternatives 3, 4, and 5D must be compared to the actual 2012 shoreline.

VI. The SEIS Fails to Provide Clear Explanation of Shoreline Change Assumptions.

Throughout the SEIS, the Corps must "provide full and fair discussion of the significant environmental impacts and shall inform decisionmakers and the public of the reasonable alternatives which would avoid or minimize adverse impacts or enhance the quality of the human environment." 40 C.F.R. § 1502.1. That is the central purpose of NEPA. Yet the SEIS skirts that responsibility by adding significant caveats to its use of the Delft3D model and inlet

[26] *Id.* at 194.
[27] *See id.*, Appx B at 169.

projections. When introducing the Delft3D model, the SEIS maintains that "[t]he model results are by no means intended to represent predictions of what changes to expect in the future with certainty."[28] With respect to the location of the inlet, the Corps states that "[p]redicting the time when any shifting would occur is not possible due to variability and contingency on weather and storm events."[29] The Corps must present its best analysis of the expected environmental effects of the proposed action and the alternatives. Doing so requires projecting a single shoreline for each alternative and analyzing the economic and environmental effects of that alternative over the same time period, as discussed below.

Moreover, the caveats are not maintained in the document. First, the Delft3D model results were used to predict environmental effects and possibly economic impacts. Second, the SEIS is replete with predictions regarding the location of the inlet as discussed in detail below (each of which not only predicts the movement of the inlet, but predict imminent movement towards Hutaff Island). The Corps cannot insulate its erroneous predictions and conclusions drawn from its analyses by asserting that the very tools it uses to make those predictions are not suitable for that purpose.

A. SEIS Presents Various Projections of Shoreline Change without Necessary Explanation or Consistency.

There is only one Figure Eight Island shoreline, yet the SEIS projects no less than six future shorelines for each current alternative.[30] The analysis of Alternative 2 demonstrates the proliferation of different projections in the SEIS. The SEIS describes scenarios based on:

- Application of past erosion rates to 2006 shoreline;
- Application of past erosion rates to 2012 shoreline;
- Modeled shoreline change based on 2006 shoreline using Delft3D model;
- Modeled shoreline change based on 2012 shoreline using Delft3D model;
- Modeled shoreline change based on 2007 shoreline using GENESIS model; and
- Modeled shoreline change based on 2012 shoreline using GENESIS model.

The use of multiple scenarios creates substantial confusion and inconsistencies in the document. This confusion stems from several factors. First, the SEIS fails to explain what past erosion rates it relies on—frequently using different time periods to describe past erosion rates. Second, the model runs are of different lengths (5, 7, and 10 years) and do not cover the period of time which the SEIS purports to analyze (30 years).

In addition, the SEIS frequently refers to past periods of erosion, but it does so inconsistently and never defines the erosion rates it relies on. For example, on page 30, the SEIS states that if the inlet realigns toward Hutaff Island, "erosion rates along the north end of Figure Eight Island are expected to accelerate and attain rates comparable to those measured between

[28] SEIS at 199.
[29] *Id.* at 18.
[30] Alternatives 5A, 5B, and 5C were not modeled under 2012 conditions. *Id.* at 194.

1993 and 2007." On that same page, the SEIS states that "the economic assessment assumed the shoreline would erode into the existing development at rates comparable to those measured between 1999 and 2007." Similar statements are made on page 33, then followed with "[i]f erosion rates continue at their current level, nine (9) homes on Beach Road North located immediately south of Surf Court are expected to become threatened within the next ten (10) years with an additional eight (8) homes on Beach Road North threatened within the next 25 years." Setting aside for the moment that the "current level" of shoreline change is accretion,[31] not erosion, the SEIS still fails to define what erosion rates it considers "current."

The confusing use of erosion rates continues in Chapter 5. On page 203, in its description of Alternative 1, the SEIS describes shoreline change rates from 1974 to 2007 as ranging "from +1.1 feet/year just north of Bridge Road to -16.8 feet/year in the northern area fronting the sandbags." In describing Alternative 2, the SEIS uses a different time period and a different set of rates. It states that "[f]or the northernmost area of Figure Eight Island, shoreline change rates have varied from -12.6 feet/year to -92.8 feet/year during the 1996 to 2007 time period."[32] The same page references erosion and accretion rates from 1998 to 2007, which we presume is a typographical error, but creates additional confusion nonetheless.

To the extent that the Corps intends to use past erosion rates to predict future shoreline changes it must define those rates. This key aspect of the analysis must be clearly presented. NEPA regulations demand that "[e]nvironmental impact statements shall be written in plain language and may use appropriate graphics so that decisionmakers and the public can readily understand them." 40 CFR § 1502.8.

The SEIS creates additional confusion by using different time periods to evaluate economic and environmental impacts based on different shoreline projects. The economic analysis appears to use a 30-year projection based on undefined "past erosion rates" while the environmental analysis is based on Delft3D modeling.

The SEIS is not consistent or clear regarding the erosion rates used to conduct the economic analysis. In assessing Alternative 1, "the economic assessment assumed the shoreline would erode into the existing development at rates comparable to those measured between 1999 and 2007."[33] In Alternative 2, the assessment states that "shoreline erosion rates along the north end of Figure Eight Island are expected to accelerate with erosion rates approaching rates observed between 1993 and 2007."[34] For Alternatives 3, 4, and 5D, the economic analysis is based on the 5-year Delft3D model runs.[35] Yet in Appendix G, Dr. Schuhmann states that his analysis relies on "Delft3D modeling" to determine that existing structures would be destroyed

[31] In fact, on page 33, the SEIS states "At the present time (2015), the shoreline along the north end of Figure Eight Island is responding positively to the orientation of the ocean bar channel at Rich Inlet"—i.e. accreting. This is one of many contradictions in the SEIS that make it incapable of serving its purpose under NEPA.
[32] *Id.* at 206.
[33] *Id.* at 30.
[34] SEIS at 33.
[35] *Id.* at 51, 60, and 93.

or relocated under Alternatives 1 and 2[36] while simultaneously appearing to rely on past erosion rates.[37] The Corps must clarify how it analyzed economic impacts and can do so by providing simple graphics depicting the expected shorelines for each alternative over the 30-year period presumably analyzed.

Comparing the economic and environmental analyses only adds further complexity because the environmental analysis only covers the first 5 years of the project.[38] The Corps' failure to attempt to evaluate the impacts of the project over the 30-year period used to conduct the economic analysis is indefensible. That omission is puzzling given that the Corps presumably predicted the expected 30-year shoreline in order to estimate economic impacts and that the indirect effects of the proposed terminal groin—specifically to wildlife that depend on the shoals in Rich Inlet—are the most critical environmental impacts.

The disparity between the time periods evaluated in the economic analysis and environmental analysis is misleading. The most substantial purported economic impacts, which occur (if at all) after 5 years, are included in the SEIS while environmental impacts incurred during that same time period are excluded. As such, the document cannot begin to "provide full and fair discussion of significant environmental impacts" or "inform decisionmakers and the public of reasonable alternatives." 40 C.F.R. § 1502.1.

The Corps' failure to project a single expected shoreline for each alternative frustrates the alternatives analysis and violates NEPA. The purpose of that analysis is to "present the environmental impacts of the proposal and the alternatives in comparative form, thus sharply defining the issues and providing a clear basis for choice among options by the decisionmaker and the public." 40 C.F.R. 1502.14. The SEIS fails to provide that clear basis.

B. The SEIS Cannot Rely on 1999 to 2007 Erosion Rates to Predict Future Conditions.

Although the SEIS does not clearly define the erosion rates used in the document, the most frequently cited rates are the "shoreline recession rates observed between 1999 and 2007."[39]. It appears that the Corps has used the erosion rates depicted in Table 6-1 of Appendix B.[40] Table 6-1 erosion rates cannot, however, be projected for the 30-year term identified in the Purpose and Need.

Even focusing on a single time period, it is not clear whether the 1999 to 2007 time period referred to in the SEIS refers to the erosion rates described in the chart as "Oct 1999 to Apr 2007" or the erosion rates described as "1999-2007 Worst Case." Neither set is appropriate for use. As discussed below, those erosion rates are an anomaly in the history of Rich Inlet.

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[36] *Id.*, Appx G at 6-7.
[37] *Id.*, Appx G at 6.
[38] *See* SEIS at 203 ("What impact would each alternative have on the shorelines of Figure Eight Island and Hutaff Island over a 5-year period?").
[39] *Id.* at 23.
[40] *Id.*, Appx B at 27.

Such rates have never been recorded for a continuous 30-year period. This fundamental assumption underlies the entire SEIS analysis, but is refuted by Dr. Cleary's report as well as the respective modeling analyses.

The Engineering Report directly refutes the assumption that maximum erosion rates experienced between 1999 and 2007 are representative of normal conditions in Rich Inlet. Historically, the inlet has most often been aligned such that Figure Eight Island accretes. "Between 1938 and 1993, the ebb channel was oriented predominantly in a southeasterly direction," which "promoted the development of a one-mile long zone of accretion along the figure Eight Island oceanfront immediately south of the inlet."[41] It goes on to make clear that the erosive period that began in the late 1990s was the exception to the historical pattern, stating that as a result of the unprecedented inlet shift "the northern 4,500 foot segment of the oceanfront, ***which has a history of net accretion***, began to experience severe erosion."[42]

Dr. Cleary's report included as sub-appendix A to the Engineering Report further demonstrates that the 1999 to 2007 erosion conditions are atypical and cannot be expected to occur for 30 consecutive years. The report concludes that "for the period May 1938 to April 2007," the net shoreline change on Figure Eight Island is accretion, stating that "the northern shoreline zone between T10 and T18 prograded since 1938; rates ranged from 1 to 2 ft/yr."[43] Dr. Cleary goes on to say that from 1938 to 1996 data "illustrate that the northern zone (T10-T20) protruded at higher time-averaged accretion rates that ranged from 1 to 7 ft/yr."[44] Erasing any doubt about the proper context for the 1999 to 2007 erosion rates, Dr. Cleary concludes: "Although the oceanfront along the northern portion of Figure Eight Island has experienced several periods of erosion since 1938, ***net progradation has characterized the past seven decades of oceanfront shoreline change***."[45]

Failure to explain a crucial assumption—such as assumed erosion rates—is fatal to an EIS. That failure is paramount when the purported supporting documentation contradicts the very assumption drawn. Dr. Cleary's report concludes that inlet realignment, which has already naturally occurred, is the solution to the erosion experienced between 1999 and 2007. He concludes "[g]iven sufficient time natural progradation will again occur along the Figure Eight island [sic] oceanfront."[46] That time has passed and the progradation has occurred. The SEIS must be rewritten to recognize that the 1999 to 2007 erosion rates were the exception, not the rule, on Figure Eight Island.

C. The SEIS Cannot Assume That the Channel Will Shift toward Hutaff Island.

Despite the historical evidence that 1999 to 2007 was an anomaly and stating that "[p]redicting the time when any shifting would occur is not possible due to variability and

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[41] *Id.*, Appx B at 21.
[42] *Id.*, Appx B at 24 (emphasis added).
[43] *Id.*, Appx B, SubAppx A at 36.
[44] *Id.*
[45] *Id.*, Appx B, SubAppx A at 56 (emphasis added).
[46] *Id.*, Appx B, SubAppx A at 59.

contingency on weather and storm events,"[47] the SEIS repeatedly assumes that the inlet will imminently shift toward Hutaff Island. In fact, the entire economic analysis relies on the assumption that erosion rates from 1999 to 2007 exist now and will continue.[48] This fundamental error is described plainly in Appendix G, which calculates expected economic impacts "[a]ssuming the main channel of Rich Inlet will assume an alignment back toward Hutaff Island within the next 5 years."[49] The analysis of Alternative 3 similarly assumes that "the present bar channel condition may only last another 3 to 5 years"[50] without any support for the statement or citation to any supporting documentation. The environmental analysis fares no better, stating that "the bar channel is expected to once again assume a more northern alignment toward Hutaff Island in the future."[51] As discussed above, there is no historical support for such predictions and the SEIS itself says that making predictions regarding the timing of the inlet's movement "is not possible." They cannot, therefore, serve as the basis for any part of the Corps' analysis.

D. The Shoreline Management Plan Erroneously Excludes Recent Accretion.

The Shoreline Management Plan provided on page 456 must be rejected. The SEIS provides no basis for limiting the analysis of shoreline change to the time period 1938 to 2007. Excluding the recent, significant period of accretion is, for the reasons described above in Section II, arbitrary and capricious. The Corps has had ample time and opportunity to assess and incorporate recent accretion rates into the SEIS. The SEIS's failure to explain why changes in existing conditions which undermine the rationale for building a terminal groin are not relevant and reliance on stale data violates NEPA. *See 1000 Friends of Wisconsin, Inc. v. U.S. Department of Transportation*, 2015 WL 2454271, discussed above.

VII. The SEIS Economic Analysis Lacks Any Rational Basis.

As discussed above, the SEIS arbitrarily and capriciously asserts that the worst erosion rates ever recorded at Figure Eight Island will continue, uninterrupted, for the next 30 years.[52] This assumption is baseless given the historical net accretion on the island discussed above and is further undone by the Deflt3D modeling.[53]

Under the Delft3D model, as applied to the 2012 shoreline,[54] none of the houses predicted to be demolished or relocated in the first 5 years will be lost. It bears repeating that the

[47] SEIS at 18.
[48] *See id.* at 30 ("With the expected pending shift of the channel back toward Hutaff Island, the cost to implement Alternative 1 was determined using conditions that existed in 2006. . . .")
[49] *Id.*, Appx G at 7.
[50] SEIS at 36.
[51] *Id.* at 194.
[52] *Id.* at 30 ("[T]he economic assessment assumed the shoreline would erode into the existing development at rates comparable to those measured between 1999 and 2007.")
[53] We do not agree that the Delft3D modeling is adequate as discussed in Section II.
[54] As discussed in Section II, the model results based on the 2006 shoreline are irrelevant and cannot serve as the basis for any rational decision.

Delft3D model is designed to substantially overestimate erosion.[55] Even overestimating erosion, at the end of the 5-year model run, the beach in front of every identified house is projected to accrete, not erode. The disparity between the economic analysis and the Delft3D model results is substantial. For example, Dr. Schuhmann predicts that the house at 5 Surf Court will be demolished or removed in year 5, but the model predicts that after 5 years nearly 70,000 cubic yards of sand will have accreted on the 250-foot segment of beach in front of the house.

Address	Station Estimate[56]	Station Applied[57]	Estimated Demolition or Removal Alt. 2[58]	5-year Change in Sand Volume
3 Comber Rd	88+20	87+50 to 90+00		13,000
4 Comber Rd	89+10	87+50 to 90+00		13,000
5 Comber Rd	76+40	75+00 to 77+50	5	69,000
6 Comber Rd	77+30	75+00 to 77+50	5	69,000
8 Comber Rd	79+10	77+50 to 80+00	5	79,000
9 Comber Rd	80+00	80+00 to 82+50	5	76,000
10 Comber Rd	81+00	80+00 to 82+50	5	76,000
11 Comber Rd	81+90	80+00 to 82+50	5	76,000
12 Comber Rd	82+80	82+50 to 85+00	5	76,000
13 Comber Rd	83+70	82+50 to 85+00	5	76,000
14 Comber Rd	84+60	82+50 to 85+00	5	76,000
15 Comber Rd	85+50	85+00 to 87+50	5	57,000
16 Comber Rd	86+40	85+00 to 87+50	5	57,000
17 Comber Rd	87+30	85+00 to 87+50	5	57,000
3 Inlet Hook Rd	88+20	87+50 to 90+00	5	13,000
4 Inlet Hook Rd	89+10	87+50 to 90+00	5	13,000
5 Inlet Hook Rd	90+00	90+00 to 92+50	5	42,000
6 Inlet Hook Rd	91+00	90+00 to 92+50	5	42,000
7 Inlet Hook Rd	92+00	90+00 to 92+50	8	42,000
8 Inlet Hook Rd	93+00	92+50 to 95+00	8	37,000
9 Inlet Hook Rd	94+00	92+50 to 95+00	11	37,000
4 Surf Court	69+10	60+00 to 70+00	5	142,000
5 Surf Court	76+40	75+00 to 77+50	5	69,000
6 Surf Court	77+30	75+00 to 77+50		69,000
7 Surf Court	71+00	70+00 to 72+50	5	49,000
8 Surf Court	71+90	70+00 to 72+50	5	49,000
9 Surf Court	72+80	72+50 to 75+00	5	59,000
11 Surf Court	74+60	72+50 to 75+00	7	59,000

[55] SEIS, Appx B at 170.
[56] *Id.*, Appx G at 32.
[57] *Id.*, Appx B Sub B at 138.
[58] *Id.*, Appx G at 32.

The GENESIS model similarly predicts that no houses will be lost within the first 10 years.[59] The economic analysis is, therefore, baseless. The SEIS concedes that "none of the oceanfront structures located between Surf Court and Rich Inlet . . . are in imminently threatened status."[60] The accretion predicted by the Delft3D model will not threaten these structures. None of the houses are or will be in imminent danger based on the materials provided in the SEIS. Far from it; the majority will be buffered by more beach than currently exists. Therefore, the cost of Alternative 2 is $0 and the cost of Alternative 1 is limited to maintenance and permitting of sandbags, should the owners of non-threatened houses be allowed to retain them.

VIII. The Proposed Terminal Groin is not in the Public Interest.

The proposed terminal groin would be built partially on private land not owned by the HOA proposing the project and partially on public trust resources owned by North Carolina. The Corps should find that this use of public trust resources is not in the public interest. Not only is the purpose of the project to protect private property on a privately owned, limited access island, it jeopardizes important public recreational resources. Rich Inlet is an extremely popular recreational area that is frequently accessed by the public by boat. Construction of a terminal groin, and the ensuing erosion of the northern spit of Figure Eight Island, would eliminate these recreational resources and eliminate public use of these public trust resources.

IX. The Corps Cannot Issue a Final Environmental Impact Statement.

For the reasons described above, as well as those in our previous comment letters and the comments submitted today by Audubon North Carolina, the Corps cannot lawfully issue a Final Environmental Impact Statement ("FEIS") for this project. Although the SEIS includes additional information about the 2012 shoreline, it does not incorporate or apply that information. It also fails to address the myriad deficiencies identified by our comments on the DEIS. The revisions necessary to bring this document into compliance with NEPA are so substantial that they cannot be resolved in an FEIS. They must be fully explained in a second supplemental EIS and released for public review and comment.

Please contact us at (919) 967-1450 or ggisler@selcnc.org or sweaver@selcnc.org if you have any questions regarding these comments.

Sincerely,

Geoffrey R. Gisler
Senior Attorney

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[59] *See id.*, Appx C, Alt. 2 Results with August 2012 Aerial Photography-year 10 (showing minimal erosion at the inlet and no erosion south of station 80+00).
[60] SEIS at 29.

Sierra B. Weaver
Senior Attorney

GRG/SBW/ao

Enclosures

cc: Todd Miller, North Carolina Coastal Federation
Walker Golder, Audubon North Carolina
Pete Benjamin, United States Fish and Wildlife Service

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July 27, 2012

Via U.S. and Electronic Mail
Mr. Mickey Sugg
U.S. Army Corps of Engineers
69 Darlington Ave.
Wilmington, NC 28403
Mickey.T.Sugg@usace.army.mil

RE: Figure Eight Island Shoreline Management Project – SAW-2006-41158

Dear Mr. Sugg:

Please accept these amended comments on the Figure Eight Island Shoreline Management Project Draft Environmental Impact Statement ("DEIS"). The Southern Environmental Law Center submits these comments on behalf of the North Carolina Coastal Federation, Audubon North Carolina, and the Environmental Defense Fund.[1] As described below, the NEPA process must be halted until the Figure Eight Homeowners' Association ("HOA") can demonstrate that it possesses the necessary property rights to construct its preferred alternatives. If the HOA acquires those rights and the project is reinitiated, certain alternatives violate the Endangered Species Act and/or the Clean Water Act and cannot be lawfully permitted. Further, even if the HOA acquires required property rights to build the groin, scoping of any proposed terminal groin must occur and the DEIS must be supplemented to account for significant, important changes to Rich Inlet that have occurred since data collection and aerial observations stopped in 2007 as well as changes in property values. In its current state, the DEIS does not provide a basis for the Corps to move forward with any alternative other than Alternative 2 – the actual no-action alternative which does not require a Corps permit.

I. THE CORPS MUST ISSUE A SUPPLEMENT BECAUSE THE DEIS WAS PUBLISHED THROUGH IMPROPER PROCEDURES, LACKS NECESSARY INFORMATION, AND RELIES ON OUT-OF-DATE INFORMATION.

A. The Corps Has Not Provided Scoping Notice of Terminal Groin Proposals.

Scoping is a necessary and important part of the NEPA process. As the regulations state, "[t]here shall be an early and open process for determining the scope of issues to be addressed and for identifying the significant issues related to a **proposed action**." 40 C.F.R. § 1501.7 (emphasis added). At the time the scoping notice for this EIS was issued and the scoping meeting was held, the proposed action was inlet realignment. The Corps has not issued a

[1] These comments are amended to add Environmental Defense Fund. No other changes have been made to the comments submitted on July 20, 2012.

scoping notice or held a scoping meeting for proposed actions – a terminal groin – described in the DEIS and is, therefore, in violation of NEPA regulations. The Corps must withdraw the DEIS, issue a scoping notice for the proposed action, and reconsider the DEIS in light of comments received.

B. The HOA Has Not Demonstrated Property Rights Necessary to Construct the Applicant's Preferred Alternative Groin, in Violation of Corps Regulations.

The Corps's decision to issue this EIS without any demonstration that the Figure Eight HOA has the necessary property rights to construct the preferred alternative contradicts the agency's regulation and biases the resulting analysis. Moreover, it is a waste of the agency's resources as well as those of the state and federal commenting agencies and the public's time.

The preferred alternative, a terminal groin built on the northern end of the island, would be built across approximately 15 lots, none of which are owned by the HOA. See Figure 1 (superimposing proposed terminal groin from DEIS on New Hanover County 2012 GIS tax map depicting property boundaries). When a project is proposed to the Corps, the agency's regulations require the applicant to demonstrate "that the applicant possesses or will possess the requisite property interest to undertake the activity proposed in the application." 33 C.F.R. § 325.1(d)(8). Nothing in the DEIS indicates that the HOA owns, has easements or options on, or any other ability to acquire the properties where the terminal groin would be built.

The HOA does not have the authority to force property owners to grant an easement. The HOA, unlike a municipality lacks the power of eminent domain. Similarly, the Association's controlling documents do not give the HOA the authority to condemn an individual's property. The current Restrictive Covenants on Figure Eight Island properties grant the HOA the authority to access individual lots for certain specific, limited uses, but none of those uses grant the Association the authority to permanently take and transform an owner's lot. The reservation of "miscellaneous easements" in the restrictive covenants is limited to utilities including electricity, telephone, gas, sewer, or water, and for these, limited to the rear ten feet or ten feet on the side of a lot. Both directly, and by implication, easements for other structures or purposes are not reserved. In addition, the North Carolina Planned Community Act, N.C. Gen. Stat. § 47F-1-101 et seq., does not empower HOAs with authority to, in essence, condemn private property to construct a terminal groin.

The HOA has provided no evidence in the DEIS that it "possesses or will possess the requisite property interest to undertake the activity proposed in the application" as the "applicant's preferred alternative" as required by Corps's regulations. This is particularly important because construction of a terminal groin will likely substantially decrease the value of the impacted properties. Lacking this demonstrated property interest to construct its preferred terminal groin, the Corps should immediately cease all work on this project so as not to potentially waste even more resources and time of state and federal agencies and the public.

Figure 1. Proposed terminal groin and properties on north end of Figure Eight Island.

C. Data Relied on in the DEIS is Stale and Must be Updated in a Supplement.

The data relied on in the DEIS is stale and cannot serve the role given. The freshness of the data is particularly relevant here, where the focus of the DEIS is the management of a dynamic inlet system. As a federal appellate court recently stated, "[r]eliance on data that is too stale to carry the weight assigned to it may be arbitrary and capricious." N. Plains Res. Council v. Surface Transp. Bd., 668 F.3d 1067, 1086 (9th Cir. 2011). More pointedly, even if it could be assumed that the physical environment was static, that determination alone cannot show that "information regarding habitat and populations of numerous species remains the same as well." Id.

When that reliance on stale data causes important, relevant information to be omitted, the error is fatal to the DEIS. As the Fourth Circuit recently stated, "agencies violate NEPA when they fail to disclose that their analysis contains incomplete information." N.C. Wildlife Fed'n v. N.C. Dep't of Transp., 677 F.3d 596, 603 (4th Cir. 2012). Critically, "[w]hen relevant information 'is not available during the [impact statement] process and is not available to the public for comment[,] . . . the [impact statement] process cannot serve its larger informational role, and the public is deprived of [its] opportunity to play a role in the decision-making process.'" Id. Even more recently, the Fourth Circuit held that "material misapprehension of the baseline conditions existing in advance of an agency action can lay the groundwork for an arbitrary and capricious decision." Friends of Back Bay v. U.S. Army Corps of Eng'rs, 681 F.3d 581, 588 (4th Cir. 2012). "'Without [accurate baseline] data, an agency cannot carefully consider information about significant environment impacts'" and therefore the analysis will "result[] in an arbitrary and capricious decision." N.C. Wildlife Fed'n, 677 F.3d at 603 (quoting N. Plains Res. Council, Inc. v. Surface Transp. Bd., 668 F.3d 1067, 1085 (9th Cir. 2011)).

In light of these cases, the importance of up-to-date, accurate baseline information is paramount. Here, the failure to update stale data is more pronounced due to the dynamic nature of Rich Inlet, and reliance on that data is clearly arbitrary and capricious. The nature of the inlet reveals the first instance in which the use of stale data fundamentally undercuts the EIS. The baseline assumptions regarding inlet location, shoal formations, erosion rates, and beach conditions rely on information most recently collected in 2007. Examples of the use of this outdated data include EIS statements like:

- "Given the shoreline recession rates observed between 1999 and 2007, Inlet Hood Road and Comber Road could be undermined within the next five (5) years . . . ;"
- "Continuation of the present rate of shoreline recession on the extreme north end of Figure Eight Island will imminently threaten an additional four (4) homes on Surf Court within the next 3 years and owners will likely pursue authorization for sandbag placement;" and (26)
- "If erosion rates continue at their current level, nine (9) homes on Beach Road North located immediately south of Surf Court are expected to become threatened within the next ten (10) years . . . ."

It is worth noting that none of these predictions based on the outdated information turned out to be accurate. It has been five years since 2007, and neither Inlet Hook Road nor Comber Road has been undermined. No homes on Surf Court are in jeopardy, and none have been sandbagged.

One prediction does appear to be coming true, but has not been considered in the EIS. The EIS states that "[s]hifts in the channel orientation toward Figure Eight Island would have a beneficial impact on the north end of the island." (39) Given the present accretion in front of the sandbagged houses, that projection appears to have validity, yet was not taken into account in the EIS. See Figure 5.3, p. 18.

Essential data regarding erosion rates is at least five years old and assumptions based on that data have proven to be false. Yet the EIS and the models it relies on depend on that dated information without any documentation to explain how the stale data represents current physical conditions and erosion rates, or, more accurately, why the apparent discrepancies between its assumptions and current conditions are not relevant.

Moreover, it is apparent that the data that is the foundation for the Delft3D model and the EIS does not reflect current conditions. These issues will be discussed in more detail below, but Figure 2. demonstrates that previously estimated erosion rates have not continued to the present and, in fact, current beach conditions suggest that the beach is accreting.

Figure 2. Beach at high tide in front of sandbagged properties in July 2012.

This accretion was not predicted in the models or the EIS and neither have been updated to explain it. The baseline data relied on by the models and the EIS are not only stale, the assumptions used appear to be incorrect, and the projections made are demonstrably wrong. Therefore, the EIS cannot be relied on to comply with NEPA or carry out the Corps's permitting process.

The staleness of the EIS is further demonstrated by the out-dated tax values for the properties on Inlet Hook and Comber roads. The tax assessments included in the economic analysis in the EIS rely on information compiled in 2009. That data is now three years old and fails to reflect current tax values. As will be further discussed below, the properties on Comber and Inlet Hook are worth approximately half of the amount included in the EIS, skewing the cost calculations and biasing the overall EIS. The data regarding lot availability appears to be similarly stale. As with the stale inlet data, reliance on this out-of-date, inaccurate economic data undermines the credibility of the EIS and its usefulness as a decision-making document.

A supplemental EIS is required when "[t]here are significant new circumstances or information relevant to environmental concerns and bearing on the proposed action or its impacts." 40 C.F.R. § 1502.9(c)(ii). The complete failure of the models used to accurately estimate environmental impacts constitutes new information "relevant to environmental concerns and bearing on the proposed action or its impacts." Similarly, the accretion observed in front of the sandbagged houses and updated property values qualify as "new circumstances" that have a direct bearing on the agency's analysis. Therefore, a supplement to this DEIS is required.

II. THE CORPS CANNOT ISSUE A PERMIT FOR EITHER TERMINAL GROIN OR SAND DREDGING ALTERNATIVES BECAUSE DOING SO WOULD VIOLATE THE ENDANGERED SPECIES ACT AND THE CLEAN WATER ACT.

A. Construction of a terminal groin destroys and adversely modifies critical habitat for the piping plover at Rich Inlet and can not be permitted.

The project area at Rich Inlet includes designated critical habitat for wintering populations of piping plover. The area is a key wintering site for piping plovers. A terminal groin as proposed in Alternatives 5A and 5B as well as extensive sand dredging in the inlet will destroy and adversely modify both habitats and inlet processes that constitute primary constituent elements of critical habitat and the Endangered Species Act ("ESA") prohibits issuance of a permit that would authorize these activities.

1. *The Corps may not permit an action that adversely modifies critical habitat by diminishing the value of the habitat for either the survival or recovery of a species.*

Under the ESA, "[e]ach Federal agency shall, in consultation with and with the assistance of the Secretary, insure that any action authorized, funded or carried out by such agency is not likely to . . . result in the destruction or adverse modification of [critical] habitat." 16 U.S.C. § 1536(a)(2). Section 7 of the ESA "requires federal agencies to ensure that none of their activities, including the granting of licenses and permits, will … adversely modify a species' critical habitat." Karuk Tribe of Cal. v. United States Forest Serv., 681 F.3d 1006, 1020 (9th Cir. June 1, 2012) (citing Babbitt v. Sweet Home Chapter, 515 U.S. 687, 692 (1995)). The Corps also has "an independent duty under section 7(a)(2) to ensure that its [action] … [is] not likely … to adversely modify [critical] habitat." Defenders of Wildlife v. United States EPA, 420 F.3d 946, 976 (9th Cir. 2005). (Agency reliance on a faulty Biological Opinion violates its duty under Section 7(a)2) of the ESA).[1]

The regulatory definition of "adverse modification" is found in 50 C.F.R. § 402.02, and states that an "adverse modification" is a "direct or indirect alteration that appreciably diminishes the value of critical habitat for both the survival and recovery of a listed species." In Gifford

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[1] Further, "it is unlawful for any person subject to the jurisdiction of the United States to . . . take any species," which is defined to include "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering." 50 C.F.R. § 17.3. The prohibition on take includes agencies authorizing activities carried out by others that result in take of a listed species. Strahan v. Coxe, 127 F.3d 155, 163 (1st Cir. 1997). (State of Massachusetts was found to have exacted a taking of endangered Northern Right Whales through its licensing and permitting of certain fishing practices that exacted a taking of the species); Sierra Club v. Yuetter, 926 F.2d 429, 438-39 (5th Cir. 1991)(finding Forest Service caused take of endangered red-cockaded woodpecker by permitting logging practices near nesting colonies); Defenders of Wildlife v. Administrator, Envtl Protection Agency, 882 F.2d 1294, 1300-01 (8th Cir.1989)(finding EPA caused take of endangered species through its registration of pesticides for use by others); Loggerhead Turtle v. County Council of Volusia County, 896 F. Supp.1170, 1180-1181 (M.D. Fla. 1995)(holding Volusia County caused take of endangered sea turtles through its authorization of vehicular beach access during turtle mating season).

Pinchot Task Force v. U.S. Fish and Wildlife Service, 378 F.3d 1059, 1070-70 (9th Cir.), the 9th Circuit ruled that "the regulatory definition of 'adverse modification' contradicts Congress's express command," and therefore violates the ESA. The court explained that Congress enacted the ESA "not merely to forestall the extinction of [a] species (i.e., promote a species['] survival), but to allow a species to recover to the point where it may be delisted." Id. at 1070. Because a species needs more critical habitat for its recovery than is necessary for survival, the court found that the regulation was invalid because "[w]here Congress in its statutory language required 'or,' the agency in its regulatory definition substituted 'and.'" Id.

In response to the Gifford Pinchot decision, the U.S. Fish & Wildlife Service ("FWS") issued a directive on the use of the invalidated regulatory definition of "adverse modification" in a Memorandum on December 9, 2004.[2] The Memorandum directs FWS biologists "not cite to or use" the invalidated regulatory definition of adverse modification "at any point in the consultation process."[3] The Memorandum also directs FWS staff "to rely on an analytic framework based on the language of the ESA itself, which requires that critical habitat be designated to achieve the twin goals of survival and conservation (i.e., recovery) of listed species. Under current practice, the FWS "will find 'adverse modification' if the impacts of a proposed action on a species' designated critical habitat would appreciably diminish the value of the habitat for either the survival or the recovery of the species."[4]

The determination whether designated critical habitat would continue to serve its intended conservation role in recovery of a species is determined by whether the critical habitat retains its ability to provide and continue to establish the necessary primary constituent elements ("PCEs"). The FWS defines PCEs as "physical or biological feature[s] essential to the conservation of a species for which its designated or proposed critical habitat is based on."[5] The examples FWS give are "space for individual and population growth, and for normal behavior; … nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, rearing of offspring; … and habitats that are protected from disturbance or are representative of the species' historic geographic and ecological distribution."[6] In a recent revised designation of critical habitat for the Pacific coast population of the western snowy plover, FWS explains that activities that may constitute an "adverse modification" of critical habitat "are those that alter the physical and biological features to an extent that appreciably reduces the conservation value of critical habitat." 77 Fed. Reg. 36,728, 36,774 (June 19, 2012) (to be codified at 50 C.F.R. pt. 17). Agencies must use the "best scientific data" when conducting and relying on these Biological Opinions evaluating whether proposed actions result in adverse modification of critical habitat. Conservation Cong. v. United States Forest Serv., 2012 U.S. Dist. LEXIS 84943, 36 (D. Cal. 2012).

[2] Minn. Ctr. for Envtl. Advocacy v. United States Forest Serv., 2012 U.S. Dist. LEXIS 51853, 44-46 (D. Minn. Apr. 12, 2012) (citing FWS0004205).
[3] Id.
[4] Id. (emphasis added).
[5] FWS, Endangered Species Glossary, available at: www.fws.gov/nc-es/es/glossary.pdf.
[6] Id.

2. *The Rich Inlet area includes designated critical habitat for the recovery of the piping plover.*

FWS designated critical habitat for the wintering populations of piping plovers on July 10, 2001. 66 Fed. Reg. 36,038 (July 10, 2001). The habitat designated "is essential to the conservation of this species." 66 Fed. Reg. at 36,041. Areas containing primary constituent elements that constitute critical habitat were designated in eight states, including 18 units on the North Carolina coast. Unit NC-11: Topsail includes Rich Inlet and the project area:

> This unit extends southwest from 1.0 km (0.65 mi) northeast of MLLW of New Topsail Inlet on Topsail Island to 0.53 km (0.33 mi) southwest of MLLW of Rich Inlet on Figure Eight Island. It includes both Rich Inlet and New Topsail Inlet and the former Old Topsail Inlet. All land, including emergent sandbars, from MLLW on Atlantic Ocean and sound side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. In Topsail Sound, the unit stops as the entrance to tidal creeks become narrow and channelized.

Id. at 36,087.

Designated critical habitat within critical habitat Unit NC-11: Topsail includes those primary constituent elements present in the area as described in the regulation:

> The primary constituent elements essential for the conservation of wintering piping plovers are those habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support these habitat components. The primary constituent elements include intertidal beaches and flats (between annual low tide and annual high tide) and associated dune systems and flats above annual high tide. Important components of intertidal flats include sand and/or mud flats with no or very sparse emergent vegetation. In some cases, these flats may be covered or partially covered by a mat of blue-green algae. Adjacent non-or sparsely vegetated sand, mud, or algal flats above high tide are also important, especially for roosting piping plovers, and are primary constituent elements of piping plover wintering habitat. Such sites may have debris, detritus (decaying organic matter), or micro-topographic relief (less than 50 cm above substrate surface) offering refuge from high winds and cold weather. Important components of the beach/dune ecosystem include surfcast algae, sparsely vegetated backbeach and salterns (beach area above mean high tide seaward of the permanent dune line, or in cases where no dunes exist, seaward of a delineating feature such as a vegetation line, structure, or road), spits, and washover areas. Washover areas are broad, unvegetated zones, with little or no topographic relief, that are formed and maintained by the action of hurricanes, storm surge, or other extreme wave action.

Id. at 36,086.

In designating critical habitat, FWS identified factors that may affect piping plover survival or use of the area:

> Overall winter habitat loss is difficult to document; however, a variety of human-caused disturbance factors have been noted that may affect plover survival or utilization of wintering habitat (Nicholls and Baldassarre 1990a, Haig and Plissner 1993). These factors include recreational activities (motorized and pedestrian), *inlet and shoreline stabilization, dredging of inlets that can affect spit (a small point of land, especially sand, running into water) formation, beach maintenance and renourishment (renourishing the beach with sand that has been lost to erosion),* and pollution (e.g., oil spills) (USFWS 1996). The peer-reviewed, revised recovery plan for the Atlantic piping plover population recognizes the need to protect wintering habitat from direct and indirect impacts of shoreline stabilization, navigation projects, and development. (emphasis added).

Id. at 36039.

The Recovery Plan for the critically endangered Great Lakes piping plover population states that "[i]nlet dredging and artificial structures, such as breakwalls and groins, can eliminate breeding and wintering areas and alter sedimentation patterns leading to the loss of nearby habitat."[7] The 5-year Status Review for Piping Plover states: "The three recovery plans state that shoreline development throughout the wintering range poses a threat to all populations of piping plovers. The plans further state that beach maintenance and nourishment, inlet dredging, and artificial structures, such as jetties and groins, can eliminate wintering areas and alter sedimentation patterns leading to the loss of nearby habitat."[8] The Status Review concludes: "Habitat loss and degradation on winter and migration grounds from shoreline and inlet stabilization efforts, both within and outside of designated critical habitat, remain a serious threat to all piping plover populations."[9]

As discussed in more detail below, Alternatives 5A and 5B propose a terminal groin and related activities to attempt to stabilize Rich Inlet that are specifically identified by FWS and other experts as factors leading to the decline of piping plovers. If authorized at Rich Inlet within critical habitat Unit NC-11, these alternatives would destroy and adversely modify primary constituent elements of plover habitat, permanently alter natural processes that maintain these essential components of plover habitat, and undermine and appreciably reduce the likelihood of recovery of the species.

3. *Alternatives 1, 3, 4, 5A, and 5B will result in the adverse modification of critical habitat and can not be permitted.*

A six year study by Audubon North Carolina[10] documents the use of the Rich Inlet area by piping plovers and other shorebirds.

[7] U.S. Fish & Wildlife Service, Recovery Plan for the Great Lakes Piping Plover (Charadrius melodus) (September 2003) at 23.
[8] U.S. Fish & Wildlife Service, Piping Plover (Charadrius melodus) 5-Year Status Review: Summary and Evaluation (2009) at 31.
[9] Id. at 39.
[10] The results of this study are presented in a letter of July 20, 2012 from Walker Golder, Audubon North Carolina, to Mickey Sugg, U.S. Army Corps of Engineers. The information in this letter is incorporated by reference into this assessment of project impacts on critical habitat.

> Piping Plovers were observed throughout the Rich Inlet system, using all areas of the inlet: the shoals in the main channel and Green Channel, beaches and spits on the northern and southern sides of the inlet mouth, and, much less frequently, beach or sandbar areas at the back of the inlet. Further, the same banded individuals were seen at the north and south sides of the inlet systems, as well as shoals in the inlet channels, and observed moving shifting to different foraging roosting sites as the tide changed. No wintering banded Piping Plover was observed on only one segment of the inlet. [11]

The Rich Inlet area and critical habitat Unit NC-11 annually supports a wintering population of piping plovers, including individuals from both the critically endangered Great Lakes population and the threatened Atlantic Coast population. Figure 3 depicts the distribution of piping plovers documented at Rich Inlet from 2008-2012. Audubon biologists documented banded and unbanded piping plovers during this period and have confirmed 12 individual piping plovers from the critically endangered Great Lakes population using the north end of Figure Eight Island, the Rich Inlet shoals, and southern Hutaff Island since 2008. In designating critical habitat, the FWS states that "areas of high plover concentrations indicate that the areas are important to wintering piping plovers," and goes on to emphasize that "[t]his is particularly true for the endangered Great Lakes population." 66 Fed.Reg. at 36,057.

[11] Id.

Figure 3. Locations of Individuals or Flocks of Piping Plovers at Rich Inlet, July 2008-May 2012.

Alternatives 5A and 5B include construction of a terminal groin that will directly destroy primary constituent elements of designated critical habitat for the piping plover and destroy and adversely modify the natural processes that support habitat components essential to the recovery of the species. Alternatives 1, 3, 4, 5A and 5B include extensive dredging and sand mining within the inlet system that will directly destroy primary constituent elements of designated critical habitat for the piping plover and adversely modify the natural processes that support habitat components essential to the recovery of the species. Section 7 of the ESA prohibits agencies from taking actions that result in destruction or adverse modification of critical habitat, and these alternatives can not be permitted.

Primary constituent elements of critical habitat in the project area that will be destroyed or adversely modified include areas that support foraging, roosting, and sheltering and features necessary to maintain the processes that support these habitat components. These areas include intertidal beaches and flats and associated dune systems and flats above annual high tide; sparsely vegetated sand, mud, or algal flats above high tide; sparsely vegetated backbeach; and spits.

Alternatives 5A and 5B propose construction of a terminal groin on the north end of Figure Eight Island and dredging within the inlet area for initial fill along the ocean beach south of the groin, and periodic dredging for beach nourishment. As discussed previously (see discussion of no action alternative), the impacts of dredging within the existing permitted area must be considered as a part of these alternatives. This is particularly important to the required assessment of impacts to primary constituent elements of critical habitat because the permitted area initially comprised intertidal flats, and much of the area would return to intertidal flats if dredging is halted. Alternative 5B has additional channel dredging impacts resulting from construction of a new channel as an extension of the currently permitted area.

Primary constituent elements of critical habitat would be destroyed and adversely affected by construction of a terminal groin in the following ways:

a. <u>Primary Constituent Element: Intertidal beaches and flats.</u>

Intertidal flats are one of the most important habitats for foraging piping plovers. Figure 3 depicts the extensive use of these intertidal flat areas by piping plovers. Alternatives 1, 3, 4, 5A, and 5B involve extensive mining of sediment from the Rich Inlet area. This sediment is essential for maintaining the intertidal flats that constitute foraging areas and a primary constituent element of the critical habitat for wintering piping plovers. Alternatives 1, 4, and 5B involve extensive and periodic removal of sediment from a previously permitted area which, as discussed previously, must be assessed as a part of these alternatives. Alternatives 3 and 5A include additional channel dredging to remove sediment and reorient or relocate the inlet.

Sediment removal reduces sediment in the inlet system which in turn reduces the extent of intertidal flats. The piping plover status review summarizes these impacts:

> Sand mining, the practice of extracting (dredging) sand from sand bars, shoals, and inlets in the nearshore zone, is a less expensive source of sand than obtaining sand from offshore shoals for beach nourishment. Sand bars and shoals are sand sources that move onshore over time and act as natural breakwaters. Inlet dredging reduces the formation of exposed ebb and flood tidal shoals considered to be primary or optimal piping plover roosting and foraging habitat. Removing these sand sources can alter depth contours and change wave refraction as well as cause localized erosion (Hayes and Michel 2008).[12]

Alternative 1 Current Nourishment would periodically remove sediment from the 44.7 acre Nixon Channel dredge area. Six dredging projects since 1993 have removed between 274,000 and 350,000 cubic yards each. DEIS at 201. Alternative 3 Inlet Management with Beach Fill would initially remove 1.7M cubic yards of sediment to construct channels, dam the existing ebb tide channel, and nourish beaches. Maintenance dredging would remove 716,000

[12] U.S. Fish & Wildlife Service, Piping Plover (Charadrius melodus) 5-Year Status Review: Summary and Evaluation (2009)

cubic yards every five years. DEIS at 225. Alternative 4 Beach Nourishment without Inlet Management will initially remove 400,000 cubic yards of sediment from the Rich Inlet system by mining the Nixon Channel area and continuing to mine any shoals and reappear. DEIS at 256. Alternative 5A Groin with Channel will remove 994,000 cubic yards of sediment from Nixon Channel and also directly excavate 26.8 acres of intertidal shoals. DEIS at 263. Alternative 5B Groin with Beach Fill will initially remove 289,800 cubic yards of sediment from Nixon Channel and then 175,800 cubic yards every five years. DEIS at 281. All of these alternatives will mine sediment from the inlet system which will reduce the extent of shoals and intertidal flats and destroy or adversely modify this primary constituent element of critical habitat.

In contrast with these alternatives, the DEIS predicts Alternative 2 Abandon/Retreat with result in a net increase in sediment in the Rich Inlet system and an increase in intertidal flats. DEIS at 217. This will enhance this component of critical habitat.

b. Primary Constituent Element: Spits.

Construction of a terminal groin on the north end of Figure Eight Island will result in truncation and loss of the spit and associated shoreline and encroachment of vegetation in the now unvegetated or sparsely vegetated areas on the landward side of the groin. The piping plover status report discusses the impacts of groins and inlet stabilization:

> Inlet stabilization with rock jetties and associated channel dredging for navigation alter the dynamics of longshore sediment transport and affect the location and movement rate of barrier islands (Camfield and Holmes 1995), typically causing downdrift erosion. Sediment is then dredged and added back to islands which subsequently widen. Once the island becomes stabilized, vegetation encroaches on the bayside habitat, thereby diminishing and eventually destroying its value to piping plovers. Accelerated erosion may compound future habitat loss, depending on the degree of sea-level rise. Unstabilized inlets naturally migrate, re-forming important habitat components, whereas jetties often trap sand and cause significant erosion of the downdrift shoreline. These combined actions affect the availability of piping plover habitat (Cohen et al. 2008).[13]

The DEIS predicts that after construction of a groin, the area on the inlet side of the groin will become submerged and no longer habitat for plovers. DEIS at 282. While, as discussed previously, the models underlying this prediction are questioned, this outcome is consistent with other groins at other inlets. The DEIS states that any habitat losses from groin construction are "ephemeral," which is wrong. The loss of the spit and associated intertidal shoreline is permanent. As depicted in Figure 3, piping plovers extensively use the spit and shoreline. A groin will destroy and adversely modify this primary constituent element of the critical habitat.

[13] Id.

c. Primary Constituent Element: Sparsely vegetated flats above high tides.

As discussed above with respect to the impacts to the spit, a terminal groin will destroy and adversely modify the flats above high tide on the north end of Figure Eight Island by allowing encroachment of vegetation in the area on the landward side of the groin. The DEIS acknowledges these now open flats above the high tide line will be adversely modified by construction of groin and the resulting vegetative encroachment. DEIS at 282.

d. Primary Constituent Element: Sparsely vegetated backbeach.

Figure 4 is a photograph of piping plovers foraging on the sparsely vegetated backbeach along the outside of Nixon Channel on January 1, 2012. One of the plovers is from the critically endangered Great Lakes population. The photograph is taken in from the sandbagged house on North Beach Road. Figure 3 documents the extensive use of this sparsely vegetated backbeach area by piping plovers. The proposed terminal groin in Alternatives 5A and 5B would be constructed on this backbeach. As with the spit, the shoreline in this area will erode to submerged land after construction of a groin. The primary constituent element backbeach habitat will permanently disappear in this area. A terminal groin will thus destroy and adversely modify this primary constituent element of critical habitat.

Figure 4. Two piping plovers photographed January 1, 2010 on north end of Figure Eight Island (south shore of Rich Inlet). The terminal groin would destroy this vegetated backbeach habitat which is designated critical habitat under the Endangered Species Act. The color-banded Piping Plover (lower left and insert) is from the endangered Great Lakes population.

e. Primary Constituent Element: Inlet processes.

A terminal groin will fundamentally alter the natural inlet processes at Rich Inlet that form and maintain the other primary constituent elements of critical habitat discussed above. Massive removal of sediment from the inlet system will also alter these natural processes. The purpose of a terminal groin is to modify these natural inlet processes. Construction of a groin will adversely modify these processes and the important role they play in the maintenance of the other primary constituent elements of critical habitat.

Construction of a terminal groin as proposed in Alternatives 5A and 5B will destroy and adversely modify primary constituent elements of critical habitat for the piping plover and can not be permitted.

E. The Terminal Groin Alternatives are the Most Environmentally Damaging Practicable Alternatives and Therefore Cannot Be Permitted.

Under the Clean Water Act, the Corps is only able to permit the least environmentally damaging practicable alternative ("LEDPA"). At the outset, it is clear that Alternative 2 is practicable. Practicable means "available and capable of being done after taking into consideration cost, existing technology, and logistics." 40 C.F.R. § 230.3(q). Therefore, the practicability analysis cannot consider potential benefits included in the DEIS's cost-benefit analysis (i.e. avoiding the loss of land and structures), but must be limited to the cost of carrying out the alternative – the "response/construction costs." See DEIS at 67. On that basis, each alternative is practicable and Alternative 2 is one third the cost of the preferred alternative. Based on the information provided in the DEIS, it is clear that the LEDPA is Alternative 2. Therefore, it is the only alternative that can be permitted.

Excluding Alternative 2, which is clearly the LEDPA because it does not require dredging or beach nourishment, the alternatives fall into two categories. The first includes the non-structural alternatives, whose environmental impacts – dredging, smothering benthic organisms, altered beach profile, etc. – vary by degree. The second category includes the terminal groin alternatives, whose unique environmental impacts – hardening of the shoreline, loss of overwash areas, etc. – are permanent.

In its application of the 404(b)(1) Guidelines, the Corps must evaluate "the nature and degree of effect that the proposed discharge will have, individually and cumulatively, on the characteristics at the proposed disposal sites." 40 C.F.R. § 230.11(a). That effect is measured by how the discharges change the "physical, chemical, and biological characteristics of the substrate" and affect "bottom-dwelling organisms at the site by smothering immobile forms or forcing mobile forms to migrate." 40 C.F.R. §230.20(b).

The analysis of these factors reveals a clear divide. The non-structural alternatives will have varying degrees of impact on infaunal communities in both the dredged areas and the nourished areas. Due to the scope of dredging and beach fill, Alternative 3 – as described in the EIS – appears to have the most severe impact of the non-structural alternatives on substrate and bottom dwelling organisms. Because it would involve no dredging or nourishment, Alternative 2 would have the least impact on substrate and benthic organisms. Unlike any of the non-structural alternatives, however, the terminal groin alternatives will permanently alter the characteristics of the site. The intertidal areas lost in the area that would be impacted by the terminal groin will not redevelop, eliminating the possibility that the benthic organisms buried or displaced could repopulate the area. The groin alternatives will fundamentally change the nature of the northern end of the island, eliminating overwash areas and permanently altering substrate and eliminating habit for benthic organisms. Alternatives 5A and 5B are the most environmentally damaging alternatives when evaluated under the factors in 40 C.F.R. § 230.20.

The Corps must also evaluate "the nature and degree of effect that the proposed discharge will have individually and cumulatively on water, current patterns, circulation including downstream flows, and normal water fluctuation." 40 C.F.R. § 230.11(b). These effects are measured by the "adverse changes" that occur in "[l]ocation, structure, and dynamics of aquatic communities; shoreline and substrate erosion and deposition rates; [and] the deposition of suspended particulates." 40 C.F.R. § 230.23(b).

As with impacts to substrate, Alternative 2 clearly has the least environmental impact on the aquatic communities and deposition of suspended particles. It would not adversely affect aquatic communities and would continue to allow deposition of suspended particles on the overwash areas at the northern end of the island (as would the other non-structural alternatives). By comparison, the terminal groin alternatives would permanently displace aquatic communities at the northern end of the island and eliminate overwash, cementing the accompanying adverse environmental impacts.

The Corps's consideration of the fluctuation of normal water level must include consideration of "modifications [that] can alter or destroy communities and populations of aquatic animals and vegetation, . . . modify habitat, reduce food supply, restrict movement of aquatic fauna, destroy spawning areas, and change adjacent, upstream, and downstream areas." 40 C.F.R. § 230.24.

For the reasons described above and the impacts on the benthic communities, Alternative 2 has the least environmental impact. Alternative 2 would also have the least adverse environmental effect on wet beach habitat, adjacent dry beach habitat, and back beach habitat. Other non-structural alternatives would similarly have environmental impacts to these habitats. Alternatives 5A and 5B would have significant, permanent impacts to these areas. They would eliminate wet beach habitats and the associated benthic organisms, significantly modify dry beach habitats, and result in dense vegetation of what are now sparsely vegetated back beach habitats. They would therefore have the greatest adverse impacts of any of the alternatives.

In addition to the Corps's endangered and threatened species analysis under the ESA, it must also consider listed species under the 404(b)(1) Guidelines. The Corps must compare alternatives based on their potential impact on "nesting areas, protective cover, adequate and reliable food supply and resting areas for migratory species." 40 C.F.R. § 230.30(b)(2).

Alternative 2 and the other non-structural alternatives would allow critical habitat for piping plover to remain on the northern end of Figure Eight Island. As discussed above, Alternatives 5A and 5B would destroy that critical habitat, adversely affecting threatened and endangered species.

Finally, the Corps must consider "the loss or change of breeding and nesting areas, escape cover, travel corridors, and preferred food sources for resident and transient wildlife species associated with the aquatic system." 40 C.F.R. § 230.32(b).

Construction of either Alternative 5A or 5B would eliminate habitat for all shorebirds that rely on relatively unvegetated back beach, wet beach, and intertidal habitats. Therefore, the adverse effects described above for piping plover are likely to be felt by red knots and other shorebirds.

It is clear from the DEIS that under the 404(b)(1) Guidelines, the Corps cannot permit either Alternative 1, 3, 4, 5A, or 5B. All would have significantly greater environmental impact than Alternative 2. Alternative 2 is the LEDPA and is the only alternative that can be permitted by the Corps.

III. THE DEIS FAILS TO PROVIDE THE THOROUGH REVIEW REQUIRED UNDER NEPA AND MUST BE SUPPLEMENTED.

A. Environmental impact analysis based on the Delft3D model must be rejected entirely.

The DEIS relies extensively in analysis of environmental impacts on bathymetry and other predictions of the Delft3D model. As discussed below, the model has grossly miscalculated the bathymetry, movement, and orientation of the inlet and resulting effects on the barrier islands over the last five years. If the model has fundamentally miscalculated the bathymetry, movement, and orientation of the inlet and related effects on the islands without channel dredging, groins, or other alterations, adding these complexities will result in even more useless information.

Although the DEIS relies on the predictions of the Delft3D model, it states that "[t]he model results are by no means intended to represent predictions of what changes to expect in the future with certainty, as this would require an ability to predict future weather and oceanic conditions." DEIS at 165. Instead, the DEIS argues that the model is useful because it "impos[es] the same set of forcing conditions in the model for each alternative and identify[ies] relative differences in the response of the modeled system." DEIS at 165. Even if that were correct,[14] it does not save the DEIS's reliance on the model. Actual behavior of the inlet demonstrates that the "same set of forcing conditions" used to model alternatives has no relation to the actual conditions in the inlet. Using a model to evaluate a fictional set of conditions that have no bearing or connection to reality cannot serve as the basis for the agency's "hard look" and certainly does not reflect reasoned decision making.

NEPA requires that agencies ensure the professional and scientific integrity of environmental impact statements. 40 C.F.R. 1502.24. Any method of interpreting environmental impacts is only as good as its predictive abilities. "Without [accurate baseline] data, an agency cannot carefully consider information about significant environment impacts . . .

[14] Despite this statement that the Delft3D model has no predictive value, the DEIS relies nearly exclusively on the model results to predict performance of the alternatives, environmental impacts, and costs.

resulting in an arbitrary and capricious decision." N.C. Wildlife Fed'n, 677 F.3d at 603 (citing See N. Plains Res. Council v. Surface Transp. Bd., 668 F.3d 1067, 1085 (9th Cir. 2011). Reliance on data that has no credible predictive value "does not constitute the 'hard look' required under NEPA." N. Plains Res. Council, 668 F.3d at 1087 (9th Cir. 2011).

The key test of any model is its predictive capability. The following three figures in Figure 5 illustrate the fundamental failure of the Delft3D model to predict key components of even the baseline inlet's bathymetry, movement, and orientation and related effects over a five year period. Figure 5.1 (Figure 2, Appendix B DEIS) is the "initial bathymetry" for Alternative 2 Abandon/Retreat from 2007. Alternative 2 Abandon/Retreat includes no new channel dredging or terminal groin, and the model is used just to predict how the inlet will change over time.

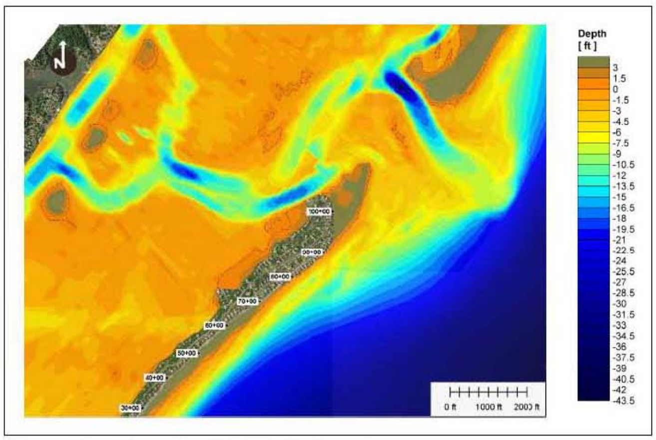

Figure 5.1. Alternative 2, initial bathymetry.

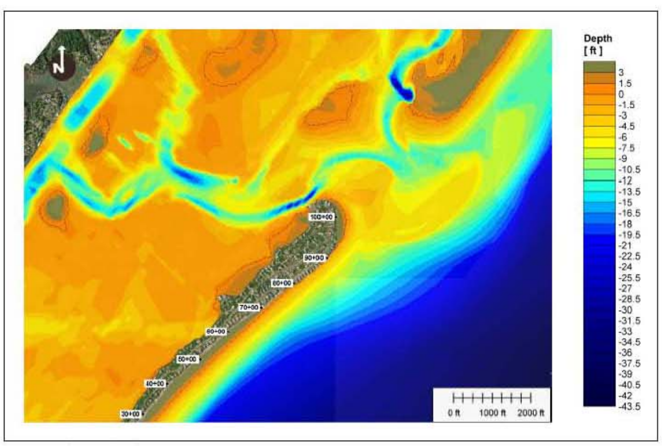

Figure 5.2. Alternative 2, bathymetry after 5 years simulation.

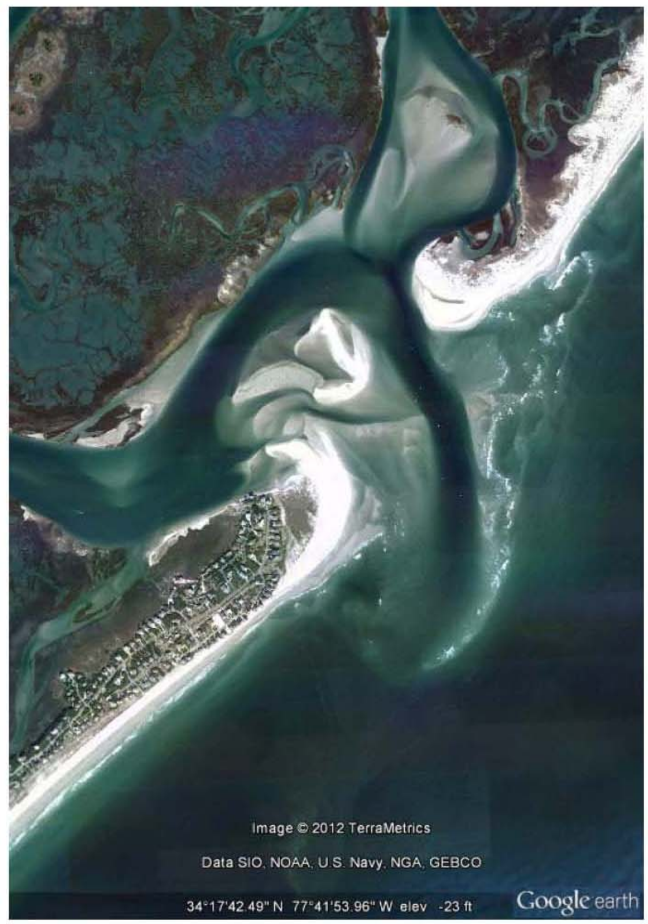

Figure 5.3. Google Earth satellite image of Rich Inlet area, 2012.

Figure 5. Comparison of initial (2007) bathymetry (Figure 5.1) and model predicted (2012) bathymetry (Figure 5.2) with actual 2012 satellite photograph (Figure 5.3).

Figure 5.2 (Figure 5, Appendix B DEIS) is the Alternative 2 bathymetry after five years simulation, or 2012. It predicts substantial movement of the ebb flow channel outlet to the northeast with final orientation to the east-northeast. It also predicts the main channel of Nixon Channel approaching the inlet will swing away from the interior marsh bank and that the higher elevation tip of the spit on Figure Eight Island will substantially erode away. Delft3D predictions of inlet movement, orientation, and related effects on the two islands underlie not only all the analysis of environmental impacts of the alternatives, but also the economic analysis (e.g., frequency of channel dredging or required nourishment).

Figure 5.3 is Google Earth imagery of the actual inlet area in 2012, to contrast with the model predictions in Figure A. The outlet of the ebb tide channel is oriented not to the northeast but nearly due south, Nixon Channel approaching the inlet has not swung away from the back side marsh but instead hugs the back side, and the Figure Eight Island spit is substantially intact. In short, a monkey with a crayon may have done a better job predicting inlet movement, orientation, and bathymetry. These faulty predictions do not even consider the compounding complexities of a terminal groin or channel dredging. Delft3D predictions underlie essentially all of the environmental analysis in the DEIS. Since the DEIS itself demonstrates no predictive capability for this model on essential assumptions underlying the environmental analysis, all the conclusions are open to question, and the entire environmental analysis must be re-done with defensible information and analysis that meets the standards for professional and scientific integrity that NEPA demands.

This gross disparity between the model's prediction and reality should come as no surprise – the model relies on a simplified set of parameters that does not and cannot predict the dynamic inlet area. Even Dr. Clearly, the HOA's expert, is described in meeting minutes included in Appendix A as making the point that "there is so much uncertainty and [that he] does not agree that you can put a lot of faith in the model over five (5) years."[15]

Perhaps the most obvious shortcoming is that the models do not take into account storm activity. It is well known that storms play a controlling role on coastal shorelines. Dr. Cleary, as reported in Appendix A, noted that "storm impacts and the relative location of Rich Inlet" are the primary drivers of erosion and accretion rates.[16] The only model identified as potentially evaluating storms was the Storm Induced Beach Change Model ("SBEACH"). It makes several assumptions that render the findings useless and was, unsurprisingly, inaccurate when compared to even a mild hurricane.

Without any support, the SBEACH relied on several assumptions. First, the model assumes that the median sediment grain diameter across the shoreline is uniform.[17] No data supports this assertion and, given the numerous beach nourishment events that have occurred on the island, there is no basis for assuming it is accurate. The model also assumes, without support, that the influence of structures blocking longshore transport, like the proposed terminal groin, is small. There is no documentation provided to defend that assumption generally or with respect to Figure Eight Island. Indeed, the very purpose of the preferred alternative is to control

[15] DEIS Appendix A, Meeting Minutes at (June 10, 2003).
[16] DEIS Appendix A, Meeting Minutes at 3 (May 3, 2007).
[17] DEIS Appendix B, Subpart B at 97.

longshore transport. Finally, the model assumes that "the existing sandbags along Comber Road and Inlet Hook Road . . . offer negligible protection against storm erosion."[18] No support for that conclusion is provided, and it is almost certainly inaccurate.

When "calibrated" to Hurricane Ophelia, SBEACH was shown to be inaccurate. Along "highly eroded beach," the model predicted erosion nearly four times greater than that actually observed, predicting a total loss of 17.2 cy/ft when only 4.7 cy/ft was actually lost.[19] On Figure Eight overall, the model predicted 9.5 cy/ft of erosion when the observed erosion was significantly less, 5.9 cy/ft.[20] On Lea-Hutaff the model was entirely incorrect, predicting erosion of 6.4 cy/ft when the island actually gained 4.7 cy/ft.[21] Given these results, there is no basis to conclude that SBEACH has any predictive value.

The Delft3D model relied on as the foundation for the EIS is no better. In addition to the shortcomings discussed above, the DEIS provides no explanation for the variation in the model results included in Appendix A. In 2008, when inlet realignment was the HOA's preferred alternative, Tom Jarrett emailed the following model results to the Corps.

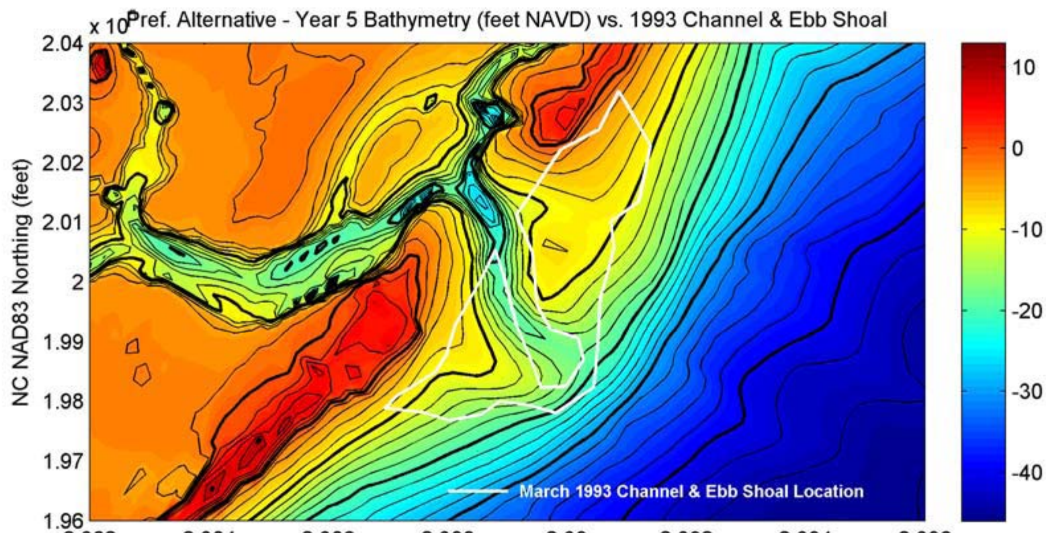

Figure 6. Inlet Realignment – Year 5 2008 Results

As described in Mr. Jarrett's email, the model showed the "predicted inlet reconfiguration after 5-years," which coincided almost perfectly with "[t]he white outline . . . which is basically the target configuration associated with the channel realignment."[22] If anything, the inlet was better positioned than the "target" with respect to promoting accretion on Figure Eight Island.

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[18] Id.
[19] DEIS Appendix B, Subpart B at 98.
[20] Id.
[21] Id.
[22] Email from Tom Jarrett to Mickey Sugg (Sept. 9, 2008).

In the DEIS, which lists the HOA's preferred alternative as the terminal groin, the same model has significantly different results with respect to inlet realignment.

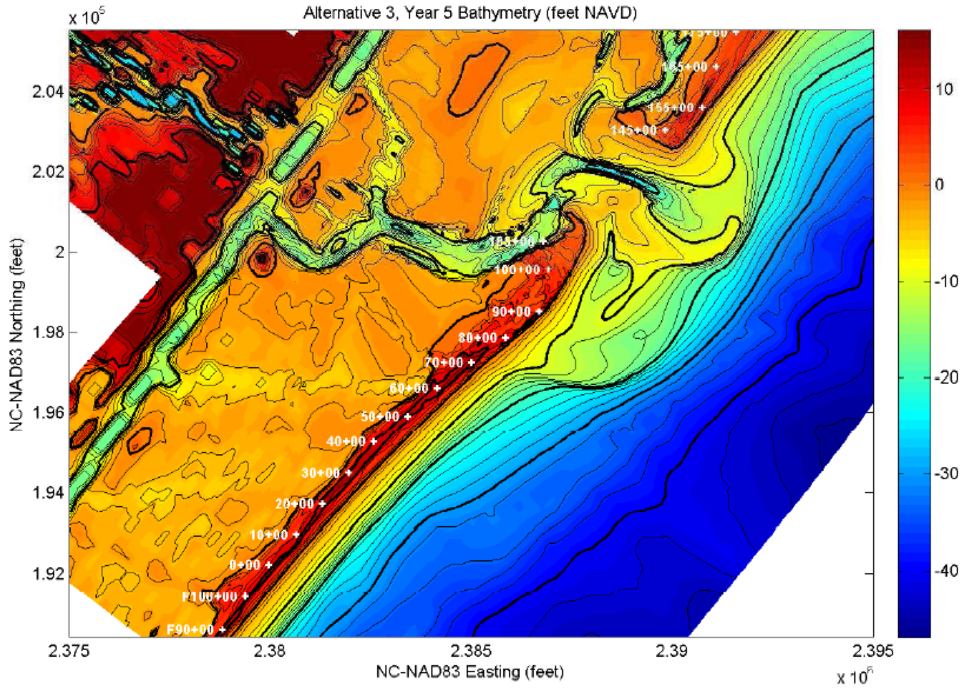

Figure 7. Inlet Realignment – Year 5 DEIS Results

No explanation for the significant variation in the model's results is given in the DEIS. Data collection to support the model appears to have ended 2007, however, and therefore the results should not have varied between 2008 and 2012. This suggests that model was manipulated and the discrepancy between these two model runs must be explained.

B. The DEIS Excludes Cumulative Impacts from Other Terminal Groin Projects.

The Corps has an obligation to evaluate cumulative impacts in addition to the direct and indirect impacts of the alternatives in the DEIS. Here, the agency failed to evaluate what may be the most important cumulative impact – the construction of other terminal groins in North Carolina. As Corps staff stated during one of the PDT meetings, "the biggest concern with the terminal groin alternative includes a hard structure on the beach and this could potentially open the door for other structures at other locations."[23] Despite this concern, the DEIS does not address the cumulative effects of "other structures at other locations."

NEPA requires that analysis. Regulations define cumulative impacts to include "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions . . . ." 40 C.F.R. § 1508.7. Courts have mandated that the analysis of those impacts and that "[c]onclusory statements that

[23] DEIS Appendix A, Meeting Minutes at 5 (May 20, 2009).

the indirect and cumulative effects will be minimal or that such effects are inevitable are insufficient under NEPA." N.C. Wildlife Fed'n, 677 F.3d at 602 (citing Ctr. for Biological Diversity v. United States DOI, 623 F.3d 633, 642-43 (9th Cir. 2010); Davis v. Mineta, 302 F.3d 1104, 1122-23 (10th Cir. 2002).)

In this circumstance, the cumulative impact of "other structures at other locations" is significant. As the piping plover recovery plan states, hardened structures were a primary contributor to the species current status. The DEIS acknowledges that the terminal groin would eliminate key piping plover habitat – destroying primary constituent elements. Loss of that crucial habitat has already been observed at Masonboro Inlet, where hardened structures have been in place for decades.

It is our understanding that at least three other beach communities have been in touch with federal or state agencies, including the Corps, about constructing terminal groins. The Corps must evaluate the cumulative impacts of these proposed groins as well as the potential for other groins at similar inlets in North Carolina.

C. The Economic Analysis is Fundamentally Flawed.

The assessment of economic impacts of the various alternatives in the DEIS is vague, inaccurate, and incomplete. The flaws are so numerous the DEIS must be supplemented to allow public review and comment on an economic analysis of alternatives that is based on accurate information and the full range of economic considerations necessary to evaluate the alternatives. In addition, the Corps must make clear that potential benefits or avoided costs cannot be the basis for the LEDPA determination, that only the cost of developing the alternative can be considered. The basic flaws in the economic analysis are outlined below.

The DEIS bases its assessments of economic impacts on tax value, but grossly and erroneously overstates the tax value of properties "threatened" by movements of Rich Inlet. The DEIS claims the value of the "27 oceanfront parcels located on Surf Court, Comber Road, and Inlet Hook Road – the area directly impacted by the changes in Rich Inlet – have a total tax value of $48.4 million." DEIS at 22. First, the properties on Surf Court should be excluded from this total. These properties are not located on the "bump" or imminently threatened as are the properties on Comber Road and Inlet Hook Road. The imminently threatened properties are the sandbagged properties on Comber Road and Inlet Hook Road identified in DEIS Figure 2.6.

Second, the DEIS erroneously states the tax value of the "threatened" structures. DEIS Table 2.2 presents a "total value" of the "threatened structures" of $23,760,425. The actual tax value based on New Hanover County tax records examined on July 9, 2012 is approximately one-half the claimed tax value in the DEIS or $12,402,700. The actual tax values of the "threatened properties" are presented in Table 1 below and the New Hanover County tax records are attached.

Address of Sandbagged Properties	Land Value	Structures Value	Total Value
5 Comber	$328,100	$379,400	$707,500
6 Comber	$322,900	$490,400	$813,300
7 Comber	$44,500	$0	$44,500
8 Comber	$287,000	$302,000	$589,000
9 Comber	$317,300	$269,800	$587,100
10 Comber	$334,500	$348,200	$682,700
11 Comber	$336,200	$402,100	$738,300
12 Comber	$346,400	$330,100	$676,500
14 Comber	$340,100	$315,400	$655,500
15 Comber	$336,100	$227,400	$563,500
16 Comber	$296,000	$349,500	$645,500
17 Comber	$323,000	$197,300	$520,300
3 Inlet Hook	$341,900	$240,100	$582,000
4 Inlet Hook	$340,200	$349,900	$690,100
5 Inlet Hook	$347,100	$353,800	$700,900
6 Inlet Hook	$362,100	$346,900	$709,000
7 Inlet Hook	$429,800	$289,000	$718,800
8 Inlet Hook	$488,400	$245,000	$733,400
544 Beach Road North	$701,600	$343,200	$1,044,800
TOTAL	**$6,623,200**	**$5,779,500**	**$12,402,700**

Table 1. July 2012 Tax Values of Imminently Threatened Properties.

Third, the DEIS fails to assess and include the decrease in value of at least 13"non-threatened" properties on the ocean-inlet side of the north end of Beach Road North that will result from construction of a terminal groin. A terminal groin in front of these properties will both take parts of these properties and fundamentally change the property from direct frontage and access to ocean-inlet beach to a walled frontage on a groin. Figure Eight Island tax values place a premium on beach or water frontage, with lots having such frontage valued substantially more than interior lots lacking direct frontage and access. The DEIS completely fails to consider the substantial decrease in tax value to the properties that would front a groin in assessing economic impact. The properties affected by construction of the groin are depicted in Figure 1. The current tax values of these properties are presented below in Table 2. As discussed by Dr. Wakeman in his comments submitted in a separate letter, an economic assessment of a proposed terminal groin must consider the decrease in value of the truncated properties.

Address of Properties Fronting Groin	Land Value	Structures Value	Total Value
542 Beach Road North	$46,200	$0	$46,200
540 Beach Road North	$721,800	$803,100	$1,524,900
538 Beach Road North	$696,800	$788,600	$1,485,400
536 Beach Road North	$661,600	$0	$661,600
534 Beach Road North	$662,400	$692,100	$1,354,500
532 Beach Road North	$673,800	$757,700	$1,431,500
530 Beach Road North	$683,800	$429,200	$1,113,000
528 Beach Road North	$700,800	$766,600	$1,467,400
526 Beach Road North	$685,500	$706,800	$1,392,300
524 Beach Road North	$697,800	$285,400	$983,200
522 Beach Road North	$688,900	$1,536,700	$2,225,600
520 Beach Road North	$705,700	$1,059,800	$1,765,500
518 Beach Road North	$766,100	$0	$766,100
TOTAL	**$8,391,200**	**$7,826,000**	**$16,217,200**

Table 2. July 2012 Tax Values of Properties Fronting Proposed Terminal Groin.

Fourth, in assessing economic impacts, the DEIS fails to consider the enhanced value of the interior lots that would become lots fronting the ocean if the existing " threatened" structures are removed or relocated. As noted above, tax values on the island place a premium on ocean or water frontage. If the current threatened structures are removed or relocated, this premium would be transferred to the "second row" properties. The July 9, 2012 assessed tax values and enhanced values are summarized in Table 3.

Address of "Second Row" Properties	Land Value	Structures Value	Total Value
1 Inlet Hook	$481,400	$263,200	$744,600
2 Inlet Hook	$458,300	$0	$458,300
9 Inlet Hook	$761,800	$529,300	$1,291,100
10 Inlet Hook	$801,400	$0	$801,400
1 Comber	$458,400	$338,300	$796,700
2 Comber	$460,700	$871,200	$1,331,900
3 Comber	$458,500	$1,451,900	$1,910,400
18 Comber	$458,700	$351,700	$810,400
19 Comber	$457,800	$313,800	$771,600
20 Comber	$454,000	$385,200	$839,200
21 Comber	$454,800	$1,044,600	$1,499,400
22 Comber	$455,400	$670,600	$1,126,000
23 Comber	$458,600	$909,000	$1,367,600
24 Comber	$454,700	$0	$454,700
25 Comber	$487,100	$743,000	$1,230,100
TOTAL	**$7,561,600**	**$7,871,800**	**$15,433,400**

Table 3. July 2012 Tax Values of "Second Row" Properties

Fifth, the economic analysis fails to consider the enhanced value to existing lots if "threatened" structures are moved to those lots. The DEIS states there are 93 vacant lots on Figure Eight Island. DEIS p. 223. It then understates the potential to relocate structures by stating only 16 lots are currently listed for sale (excluding those that may be for sale but not listed) and overstates the number of threatened structures that require relocation at 40 by unjustifiably adding "structures that may become imminently threatened over the next thirty years" to the 17 structures constructed on the "bump" and "imminently threatened." All but one of the 17 "imminently threatened" structures could be relocated to the 16 lots identified as listed for sale, and the remaining one structure could likely be relocated to one of the remaining 77 lots on the island. The enhanced value of the relocated properties must then be reflected in the assessment of the economic impacts of Alternative 2.

If accurate and complete economic information and analysis are used, Alternative 2 Retreat/Relocate is likely to emerge as the economically preferred alternative. Since it is also the least environmentally damaging practicable alternative it is the only alternative that can be permitted. Because the economic analysis in the DEIS is so fundamentally inaccurate and incomplete, a supplemental DEIS must be prepared to provide the public the opportunity to comment on an analysis of the economic impacts of alternatives based on accurate and complete information. "Agencies shall insure the professional integrity … of the discussion and analyses in environmental impact statements." 40 C.F.R. § 1502.24.

D. DEIS Fails to Account for Realistic Sea Level Rise Projections.

The effect of sea level rise is critical to evaluating the long-term viability and effects of each of the proposed alternatives. Inexplicably, the DEIS relies on a straight-line estimate that does not reflect current scientific understanding, Corps policy, or the best estimates by North Carolina scientists.

Based in large part on the Intergovernmental Panel on Climate Change, last year the Corps released a circular to provide guidance on how the agency should take into account the effects of sea level rise on coastal projects. As stated in the circular, "[p]otential relative sea-level change must be considered in every USACE coastal activity as far inland as the extent of estimated tidal influence."[24] In that consideration, the circular recommends preparing multiple scenarios to account for potential ranges in sea level rise.[25] A multi-pronged approach is necessary to "improve the overall life-cycle performance" of the selected alternative.[26] Among the specific effect of sea-level change that the Corps's supporting materials highlight are "changes in shoreline erosion, inundation or exposure of low-lying coastal areas, changes in storm and flood damage, [and] shifts in extent and distribution of wetlands and other coastal habitats."[27] The DEIS touches on each of these areas to some degree, but fails to do so in a way that meaningfully addresses the potential effect of sea level rise.

To perform a meaningful analysis, the Corps circular states that the agency's analysis "shall include, as a minimum, a low rate which shall be based on an extrapolation on the historical tide gauge rate, and intermediate and high rates, which include future acceleration of [global mean sea level."[28] But the DEIS failed to do anything more than state the "low rate" and move on.

The error in doing so is particularly clear on the North Carolina coast, an area particularly vulnerable to accelerated sea level rise. The Coastal Resources Commission's Science Panel estimated several scenarios of potential sea level rise, including a minimum of 15 inches by 2100.[29] The panel noted, however, that "various models and observations indicate that accelerated rates of [sea level rise] in the future are likely."[30] Based on their review of peer-reviewed literature, the Science Panel recommended using 1 meter of sea level rise for planning purposes in North Carolina after finding that accelerated sea level rise is "likely."[31]

But despite acknowledging this broad consensus that accelerated sea level rise is expected, the DEIS does nothing to evaluate the effect of sea level rise on each of the

[24] U.S. Army Corp of Engineers, Sea-Level Change Considerations for Civil Works Program, EC 1165-2-212, Circular No. 1165-2-212, 1 (October 1, 2011).
[25] Id. at 2.
[26] Id. at 3.
[27] Id. at B-1.
[28] Id. at B-10.
[29] N.C. Coastal Resources Commission Science Panel on Coastal Hazards, North Carolina Sea-Level Rise Assessment Report, 10 (March 2010).
[30] Id.
[31] Id. at 12.

alternatives. Instead, it summarily states that "[n]o direct or indirect impacts are expected to occur as a result of sea level rise for any of the projects." DEIS at 194. The DEIS then states that "unmanaged areas of the dry beach and dune communities may become more vulnerable to erosion" as a result of sea level rise, but cursorily dismisses that threat because the alternatives "may help protect" those area. Id. This unsupported conjecture cannot constitute the "hard look" required by NEPA. Moreover, the analysis cannot be saved by the DEIS's one-sentence "analysis" of the effect of historic rates of sea level rise on Wrightsville Beach and Carolina Beach nourishment projects.

In short, the DEIS's analysis of sea level rise and its effect on the alternatives is useless. It hardly constitutes a look, much less the "hard look" required by NEPA. It omits anything more than a canned summary of estimates of accelerated sea level rise and provides no analysis of how sea level rise of any degree would affect the project. An agency decision is arbitrary and capricious under NEPA if, as with accelerated sea level rise, the agency "entirely failed to consider an important aspect of the problem." Hughes River Watershed Conservancy v. Johnson, 165 F.3d 283, 287-288 (4th Cir. 1999)

E. The Purpose and Need Is Specific and Restrictive.

The purpose and need statement is an essential guide to the EIS. It "shall briefly specify the underlying purpose and need to which the agency is responding in proposing the alternatives including the proposed action." 40 C.F.R. § 1502.13. The purpose and need in this EIS misses that mark.

The EIS fails to identify a single purpose and need, instead opting for eight. Those eight purpose and needs cover a broad range of issues with a degree of specificity that ensures confusion. As discussed below, the EIS's analysis of alternatives reveals that confusion, with several alternatives being dismissed without legitimate reasons. As a result, the purpose and need statement derails the alternatives analysis, which "must focus on the accomplishment of the underlying purpose and need," but cannot do so because of the unnecessary detail.

F. The Analysis of Each Alternative is Flawed.

1. The DEIS analysis of Alternative 1 fails to account for current conditions, overstates costs, and is incomplete.

a. Alternative 1 is not the No Action Alternative.

Alternative 1 is mislabeled as the No Action alternative. As stated in NEPA regulations, the No Action Alternative is one that "results in no construction requiring a Corps permit." 33 C.F.R. Part 235, Appendix B, Sec. 9.b(5)(b). Alternative 1 requires long-term dredging in Rich Inlet and requires a Corps Permit. Any future dredging requires either the existing modified permit, a new modified permit, or a new permit.

b. The analysis of Alternative 1 fails to account for current conditions.

The EIS's analysis of Alternative 1 is fundamentally undercut by its reliance on dated information and exclusion of up-to-date observations about the condition of the beach and the position of the inlet. The DEIS analysis directly depends on "[c]ontinuation of the present rate of shoreline recession on the extreme north end of Figure Eight Island" as the basis for its analysis. DEIS at 26. Moreover, it relies on the assumption that existing sandbag structures would "either fail or be removed" within five years. DEIS at 26.

Neither of those assumptions are valid. The inlet appears to be reorienting towards Figure Eight Island. As depicted in the photograph on page 18, the channel is no longer aligned in the northeasterly direction that contributed to the "present rate of shoreline recession" at Figure Eight, and therefore the pre-2007 erosion rate is not a legitimate basis for future predictions. As is expected, the natural reorientation has discontinued the pre-2007 erosion rate and has, in fact, caused accretion on the beach fronting the sandbagged houses on Inlet Hook Road and Combers Road. Not only have those sandbags held and remained, additional houses have not been threatened.

These changes in existing conditions are crucial for the evaluation of Alternative 1 and undermine the EIS's conclusion that "[u]nder Alternative 1, the shorelines on both islands would be expected to continue to behave as they have in the past." DEIS at 168. The change in erosion rates will fundamentally change the effect of beach nourishment projects, extending the longevity of the projects and reducing frequency and scope of the projects, thereby reducing costs. The supplement to the DEIS must reevaluate Alternative 1 in light of changed baseline conditions.

c. The Alternative 1 cost analysis dramatically overstates costs.

The cost analysis of Alternative 1 is drastically overstated. The inflated costs have multiple sources. First, the analysis expands the group of threatened structures far beyond those that are actually threatened or can reasonably be expected to be threatened. The DEIS ominously threatens that "present rate of shoreline recession" will result in erosion that threatens 21 houses not currently sandbagged. DEIS at 26. In addition to providing no evidence that the "present rate of shoreline recession" will continue, the DEIS provides no data to show that these properties are or have ever been threatened by erosion. The notion that these properties will be threatened is pure conjecture and is unsubstantiated by any historical or predictive analysis. Moreover, it is arbitrary and capricious because it "runs counter to the evidence before the agency." Hughes River Watershed Conservancy, 165 F.3d at 287-288.

Trimming the 21 houses that have no documented, foreseeable threat shrinks the cost of Alternative 1. Further, updating the value of actually threatened houses and adding in the lost value for those properties that would be bisected by the terminal groin, the overall change in property value under Alternative 1 is significantly reduced from the $25.7 million for lost structures and $57.9 million for lost land estimated in the DEIS. Based on the analysis above, the value of lost structures and land is approximately $12.4 million instead of $83.6 million. In addition, the avoided property loss from those properties that would be fronted by the groin could be significant, and we should expect some increase in value for newly oceanfront lots, meaning the overall loss in property value under Alternative 1 would be much less than estimated. Further, with the current orientation of the inlet, the frequency of beach nourishment will be reduced, decreasing the projected $27.5 million estimated for beach nourishment.

Taking these factors into account, Alternative 1's actual estimated cost will be much lower than the inflated figure in the DEIS. And even that number is likely excessive because it assumes that owners of threatened houses would choose to destroy the houses rather than relocate them to interior or sound-side properties.

d. <u>Failure to model Alternative 1 is arbitrary and capricious.</u>

Although we do not believe the modeling that supports the EIS analysis is valid, the Corps relied on it for the purpose of comparing alternatives. Therefore, it is remarkable that Alternative 1 was not modeled. The DEIS states that "[t]he Delft3d model was not specifically run under Alternative 1 conditions" and that the Corps relied on "results derived from Alternative 2" instead. DEIS at 168. Given that Alternative 1 would include continuation of current beach management activities and Alternative 2 would completely abandon those activities, it is unclear how modeling for Alternative 2 could predict the effect of a fundamentally different Alternative 1. The DEIS does not provide any explanation why the results from Alternative 2 are an appropriate "proxy for Alternative 1." DEIS at 168.

e. <u>Alternative 1 meets the purpose and need.</u>

Alternative 1 meets the purpose and needs listed for this project and is practicable. Alternative 1 reduces erosion along the targeted area. It has provided protection over the last five years and will provide protection into the future – protection that is enhanced by the inlet's natural realignment. It provides compatible beach sand while maintaining navigation in Rich Inlet and allowing continued recreation on the northern spit. Finally, it provides better balance between human activities and natural resources than either of the groin alternatives by allowing the continued development of quality wildlife habitat on the northern spit.

2. The DEIS analysis of Alternative 2 fails to account for current conditions and overestimates costs.

The DEIS analysis of Alternative 2 suffers from the same flaws as the analysis of Alternative 1. It fails to account for existing conditions. That omission has been discussed in detail above, and we will not repeat it here. Similarly, making the same adjustments to the inflated economic analysis reveals that Alternative 2's actual cost would be much lower and clearly practicable.

Unlike Alternative 1, the Delft3D model was run for Alternative 2. The model results, however, are entirely inaccurate when compared with current conditions (which align with year 5 in the model). As discussed above, the model results for Alternative 2 demonstrate the futility in relying on the model to predict environmental impacts or geological changes.

3. The DEIS analysis of Alternative 3 fails to account for current conditions, overestimates costs, is contradicted by previous modeling, and excludes feasible alternatives that meet the purpose and need.

The DEIS's analysis of Alternative 3 is also flawed. Like each of the alternatives, it fails to consider the change in baseline conditions since 2007. As recent imagery has shown, the inlet has shifted in such a way that the erosion on Figure Eight Island has diminished and the beach is widening. For Alternative 3, the natural realignment has significant impacts.

First, it affects the costs associated with realignment and beach nourishment. As the inlet has shifted closer to the HOA's desired location, the amount of realignment necessary to further relocate the inlet and build a dike across the, now partially closed, 2007 inlet. Further, the accretion observed on the north end of Figure Eight means that less sand may be required under the alternative and it may last longer. Finally, because the inlet appears to be re-orienting towards Figure Eight naturally, there is no basis for concluding that it will relocate to its 2007 position every five years.

Even under the model, it is not clear that there is any legitimate basis for estimating that the inlet relocation would require repeat relocations every five years. In 2008, when inlet relocation was the HOA's preferred alternative, the model showed that the inlet would be in the "ideal" location after five years. The results of that modeling run, which are included in Appendix A of the DEIS, are shown below.

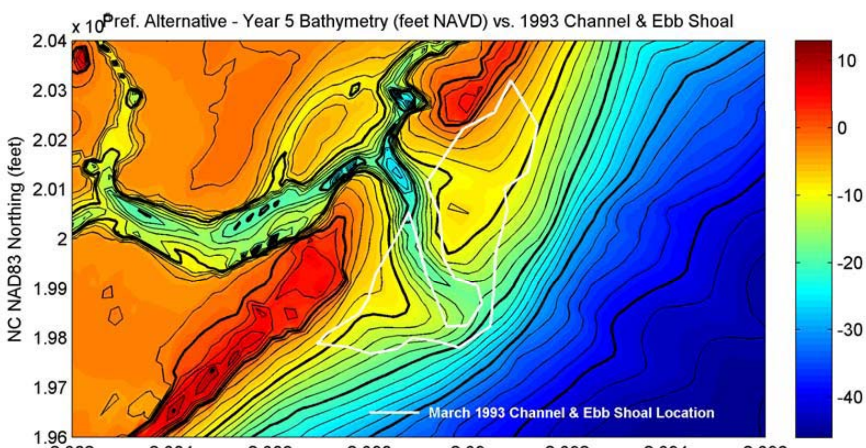

Figure 8. Inlet Realignment – Year 5 2008 Results

As explained by the email accompanying these results, the results show "the predicted inlet reconfiguration after 5-years [sic] following the channel realignment," in which the inlet almost exactly matches the "target configuration" noted by the white outline.[32] Under these results there does not appear to be any approaching need for a second realignment, reducing the overall cost of the project over a 30-year period.

[32] Email from Tom Jarrett to Mickey Sugg (Sept. 9, 2008).

These results conflict with the results included in the DEIS for Alternative 3. In the DEIS, the inlet takes a sudden shift in year 5, returning to the 2007 inlet position. Given the current position of the inlet and the previous modeling results, the estimate does not appear to have any validity.

Moreover, the thresholds relied upon to evaluate Alternative 3 are not supported in the DEIS. The DEIS identifies two thresholds – 60% shoaling of the initial construction volume and location of 50% of the thalweg outside of the initial construction corridor – but does not explain the process for selecting these thresholds or describe why they are appropriate. The DEIS does not identify which purpose and needs would not be fulfilled if one or both thresholds are exceeded and does not assess the effect of exceeding either threshold on erosion rates. In addition, the description of the action to be taken if a threshold is exceeded – namely evaluate maintenance needs – is not consistent with the assumption that the channel will be relocated every five years.

Relocating the channel every five years is also inconsistent with the inlet's history. Dr. Cleary analyzed the inlet's movement from 1938 to 2007. Although the inlet did move during that period, nothing in the record supports the repeated, rapid movement suggested by the model. Critically, neither did Dr. Cleary when preparing his report in support of the inlet realignment during the early stages of this project. At that time, Dr. Cleary determined that "[t]he relocation effort would ultimately lead to a reconfiguration of the barrier's planform along the northern end of F8I and an eventual cessation of the chronic erosion."[33] The report does not anticipate the need to consistently realign the channel, but rather suggests that relocation should provide permanent erosion control. Even more emphatically, the report states that relocation "will reverse the erosion trend that has characterized the oceanfront since the late 1990s."[34] Indeed, the report even notes that historical patterns suggest that erosion on Figure Eight is a less common inlet alignment, stating that "net progradation has characterized the past seven decades of oceanfront shoreline change."[35] In fact, Cleary suggests that mechanical realignment will only act to hasten natural realignment, stating that "[g]iven sufficient time natural progradation will again occur along the Figure Eight island oceanfront."[36]

Dr. Cleary's report obliterates any validity the Delft3D model had with respect to Alternative 3. He stated that natural relocation of the channel would cause accretion on Figure Eight. The channel appears to be moving and it is, in fact, causing accretion. Directly contradicting the model, he predicted that relocation would be a long-term corrective action for Figure Eight. And finally, nothing in his 59-page report suggests that the realigned inlet would relocate to the 2007 location within 5 years. Notably, his prediction is in line with the 5-year model results that Tom Jarrett forwarded to the Corps in 2008.

The Corps must reevaluate Alternative 3 based on the shortcomings described above. During that analysis, the Corps must consider options for Alternative 3 that were prematurely discarded in the DEIS. Specifically, the Corps must reevaluate options that were excluded for

[33] DEIS Appendix B, Subpart A at 2.
[34] Id. at 53.
[35] Id. at 56.
[36] Id. at 59.

reasons that do not appear to have anything to do with meeting the purpose and need. Alternative 3, Option 1 was excluded because of a potential loss of a connection to Green Channel.[37] Similarly, Alternative 3, Option 3 was excluded because it did not include a connection from the main channel to Green Channel. DEIS at 161. Notably, a direct connection to Green Channel is not included in any of the eight purpose and need statements. The purpose and need does include maintaining navigation to Nixon Channel, which both options 1 and 3 do. Therefore, the decision to eliminate these alternatives was arbitrary and capricious.

Options 4A and 4B for Alternative 3 were similarly eliminated based on the potential effect on the connection to Green Channel and a vague statement regarding potential erosion of salt marsh. Neither warrants dismissal of these options without detailed review. As already mentioned, no alternative can be eliminated based on the connection to Green Channel. As for the potential impact to salt marsh, the entire purpose of the EIS is to evaluate the environmental impacts of various alternatives. If only alternatives without environmental impacts were carried forward, only Alternative 2 would survive. Each of the others have environmental impacts that must be weighed in the EIS.

The Corps must also consider options to Alternative 3 that vary nourishment levels. The Engineering Report purported to do so, but ensured two of the options would fail. Of the three options considered in the Engineering Report, two excluded any fill on Nixon Channel[38] despite the Nixon Channel shoreline being one of the focal points of the overall project. <u>See</u> DEIS at 15. It is no surprise, therefore, that the Engineering Report – and as a result the DEIS – dismiss the options that omit Nixon Channel shoreline from the nourishment project.[39] They were designed to be dismissed, leaving only the most extensive and expensive option.

The third nourishment option included nourishment all the way from the inlet to the intersection of Beach Road and Beachbay Lane.[40] Requiring such extensive nourishment increases both costs and environmental impact and does so with no apparent purpose. Much of the area that would receive sand is not imminently threatened or projected to be threatened in the near future. Even the Engineering Report's modeling showed that such extensive beach nourishment was unnecessary and that the erosion between F90 and 30 was insignificant.[41] A smaller nourishment project could provide the same benefits, or greater than the projected benefit given current accretion, at much less cost and with much less environmental impact. The DEIS's failure to evaluate such an alternative is inexplicable given that it is exactly what was done with the preferred alternative. Alternative 5B is described as a version of 5A that involves less nourishment. It is, therefore, cheaper (though still carries the substantial environment effects due to the permanently hardened structure and lost habitat). The DEIS must evaluate a similar option for Alternative 3.

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[37] We note that the loss was predicted by the Delft3D model, which appears, based on current conditions, to have no predictive value.
[38] DEIS Appendix B, Subpart B at 59.
[39] DEIS Appendix B, Subpart B at 65.
[40] DEIS Appendix B, Subpart B at 59.
[41] DEIS Appendix B, Subpart B at 162.

4. The DEIS analysis of Alternative 4 fails to account for current conditions.

Like each of the previous alternatives, the DEIS analysis of Alternative 4 fails is undercut by the DEIS's reliance on stale data and the Delft3D modeling. Alternative 4 should be reevaluated based on the current alignment of the inlet and current accretion rates.

5. The DEIS analysis of Alternative 5 demonstrates that both alternatives fail to meet the purpose and need and underestimates costs associated with the groins.

The terminal groin options are the only alternatives in the EIS that clearly violate the purpose and need statements. Both proposals eliminate the spit on the northern end of Figure Eight Island, causing significant damage to shorebird habitat and eliminating a popular recreational resource. Further, both terminal groin proposals would devalue the properties at the end of the island by replacing their beach with a rubble or sheet pile wall.

The environmental impacts of the terminal groin alternatives are discussed more fully above and will not be repeated here. We do, however, point out that one of the purpose and need statements for the shoreline protection project is to "[b]alance the needs of the human environment with the protection of existing natural resources." DEIS at 15. There is no balance in either terminal groin alternative. Each would eliminate the existing spit, destroying habitat and overwash areas. The environmental benefits of those areas would be entirely lost. Therefore, neither alternative meets the purpose and need to balance human needs and the protection of natural resources.

For the same reason – elimination of the spit – the terminal groin alternatives fail to meet the purpose and need of "[m]aintain[ing] existing recreational resources." DEIS at 15. As acknowledged in the DEIS, the spit that will be eliminated is a popular recreational resource. Even if sand covers the groin, the recreational resource will be permanently lost under either groin alternative.

Likewise, the groins fail to "[m]aintain the tax value of the homes and infrastructure on Figure Eight Island." DEIS at 15. As discussed in more detail above, both groin alternatives would require 15 properties to trade their beachfront for rock rubble or steel sheet pile. As a result, those properties are certain to decline in value.

In addition, the preferred alternative does not even appear to provide the erosion protection described in the purpose and need. One of the purpose and need statements documented that the project was to "[r]educe or mitigate erosion along 3.77km (2.34 mi) of Figure Eight Island oceanfront shoreline south of Rich Inlet . . . ." DEIS at 15. Yet the DEIS did not model Alternative 5B in the Delft3D model and does not provide any other means of evaluating its erosion control potential apart. The DEIS summarily states that "[t]he projected performance of the beach fill for Alternative 5B was based on the volume of initial beach fill retained . . . by the results of the Delft3D simulation for Alternative 5A." DEIS at 285. The document does not provide any explanation as to why reliance on 5A results is appropriate or why the smaller beach fill would function similarly to that of 5A. Such unsupported conclusions cannot be considered a "hard look" at the alternative.

Finally, the cost estimates for both groin estimates are understated. First, the cost of acquiring the property rights to build the groin across the 15 oceanfront lots is entirely excluded. Given the expected loss of value of those lots, there may be significant costs associated with acquiring those rights if those rights can be acquired at all. Second, the estimates appear to be low, and no explanation is given for the discrepancy between costs estimated in the Coastal Resources Commission's Terminal Groin Study and the estimated costs. The Terminal Groin Study found that rubble mound costs ranged from $1,230-5,180 per linear foot in the studied groins and estimated that a 1,500 foot rock rubble groin would cost at least $3,090 per linear foot in North Carolina. Similarly, the study found that sheet pile cost from $4,000 to 4,800 per linear foot in studied cases and estimated that a 1,500 foot sheet pile would cost $4,300 per linear foot. Although the preferred alternative is a hybrid of these two approaches, the DEIS must explain why projected costs are significantly lower than other studied projects and the recently estimated cost.

In addition to underestimating construction costs, the DEIS appears to underestimate maintenance costs. The CRC Terminal Groin Study estimated that annual maintenance and monitoring for a 1,500 ft groin would total $2,250,000 per year. The Engineering Report does not include any estimates for maintenance of the groin and only estimates $1,821,000 in nourishment costs every 5 years.[42] These discrepancies must be explained.

III. THE DEIS DOES NOT MEET THE REQUIREMENTS OF STATE LAW REGARDING TERMINAL GROINS.

As the DEIS recognizes, the change in state law that allowed the HOA to tack on the terminal groin alternatives also imposed certain requirements for any terminal groin proposal. For the reasons stated below, the information in the DEIS fails to meet those requirements.

A. Non-structural Alternatives Are Practical.

Before the Corps can issue a permit for a terminal groin for Rich Inlet, the HOA must demonstrate that "nonstructural approaches to erosion control, including relocation of threatened structures, are impractical." N.C. Gen. Stat. § 113A-115.1(f)(2). Here, each of the non-structural approaches are practical. Therefore, the Corps cannot issue a permit for the preferred alternative or any groin alternative.

B. The Construction of the Groin Will Result in Significant Adverse Impacts to Public Recreational Beach.

The HOA must also demonstrate that its proposed terminal groin will not "result in significant impacts to private property or to the public recreational beach." N.C. Gen. Stat. § 113A-115.1(f)(4). The DEIS's terminal groin alternatives will do both. It will eliminate the beachfront access of properties on the northern end of the island, causing both a loss of private

[42] DEIS Appendix B, Subpart B at 206.

property and a decline in property value. Further, the groin will permanently eliminate the public recreational beach. These impacts to private property and public recreational beach are significant by any definition, and therefore preclude permitting the groin alternatives.

C. The Shoreline Management Plan is Outdated and Relies on Inaccurate Assumptions.

The HOA must provide a shoreline management plan before any permit can be issued for any terminal groin project (assuming it could be issued under the ESA or CWA). The Shoreline Management Plan proffered in the DEIS suffers from the same shortcomings as the remainder of the DEIS – it relies on erosion and shoreline information from 2007. That information is outdated and contradicted by current conditions. The Shoreline Management Plan heavily relies on the erosion caused by a channel orientation that is no longer representative of Rich Inlet. Truncating the analysis in 2007 gives greater weight to the time period from 1996 to 2007, an isolated segment of time during which there was erosion, but nothing in the DEIS suggests that that time period is typical for the inlet long term.

Indeed, the DEIS contradicts that position. As Dr. Cleary's report in Appendix B states, "net progradation has characterized the past seven decades of oceanfront shoreline change."[43] The analysis of shoreline changes in Table 6.2 demonstrates that even at transects 16-19, the long-term erosion rate is a mild -1.1 ft/yr. It is only by excluding the periods of accretion before 1974 that the analysis results in a more significant -16.8 ft/yr. The late 1990s and early 2000s were clearly a period of erosion for the island, but do not typify the long-term erosion patterns for the inlet and cannot be used as the basis for the Shoreline Management Plan. The purpose of emphasizing this time period is transparent, but short periods of erosion that do not reflect the long-term movement of the inlet should not be relied upon to justify permanently altering the inlet system.

The response trigger is inadequate because it relies on the artificially constrained time period of 1974-2007. The use of this time period is inappropriate because it fails to approximate the long-term nature of the island, instead emphasizing a period of greater erosion rates. Setting the threshold of harm caused by the groin based on this truncated time period fails to provide adequate protection or an effective baseline for monitoring.

The proposal for a two year monitoring plan is unreasonable. The terminal groin alternatives would fundamentally alter the nature of the inlet. There is no basis for assuming that the inlet would return to some level of stasis within two years of that dramatic alteration. The DEIS provides no support for the selection of a two year period.

Mitigation measures are ill-defined and unprotective. First, the mitigation plan is necessarily inadequate because it is based on response triggers that assume significant erosion. Second, the mitigation plan fails to describe the quantity of sand available in Nixon Channel, what metrics would be used to determine whether to access that sand or the dredge piles, or what the environmental impacts of those actions would be. In addition, the DEIS fails to describe what standards would be used to determine whether impacts cannot be mitigated.

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[43] DEIS Appendix B, Subpart B at 56.

These failures in the Shoreline Management Plan described in the DEIS violate N.C. Gen. Stat. 113A-115.1 and provide an additional reason that the terminal groin alternatives cannot be lawfully permitted.

D. The DEIS Does Not Include Any Proof of Financial Assurance.

The HOA is required by state law to provide "[p]roof of financial assurance in the form of a bond, insurance policy, escrow account or other financial instrument" before any permit can be issued. N.C. Gen. Stat. § 113A-115.1(e)(6). The DEIS does not identify any financial assurance for the project or describe what proof the HOA intends to present.

IV. CONCLUSION

This DEIS cannot serve the purpose that it is intended to serve under NEPA. Before any further action on this project can take place, the HOA must demonstrate that they have the requisite property rights to carry their preferred alternative forward. That information is not only required by the Corps's regulations, it is essential to the analysis. Further, certain alternatives cannot be permitted and the focus of any future analysis should exclude those alternatives. Finally, if the HOA is able to demonstrate the necessary property rights required to move forward, the analysis in the DEIS must be updated, reassessed, and more clearly explained as described above.

We appreciate the opportunity to submit these comments and the extension of the comment deadline to allow a more-complete review of the DEIS. Please contact us at (919) 967-1450 if you have any questions regarding these comments.

Sincerely,

Derb S. Carter, Jr.
Senior Attorney/Director, Carolinas Office

Geoffrey R. Gisler
Staff Attorney

cc (via email):
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Walker Golder, Audubon NC
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October 13, 2014

Col. Kevin P. Landers, Sr.
Commander
U.S. Army Corps of Engineers
Wilmington District
69 Darlington Avenue
Wilmington, NC 28403

Sent via email to: Kevin.P.Landers@usace.army.mil

RE: Figure Eight Island Terminal Groin Proposal

Dear Col. Landers:

It has come to our attention that the U.S. Army Corps of Engineers ("Corps") plans to imminently release a final environmental impact statement ("FEIS") for the proposed terminal groin on the north end of Figure Eight Island. As our organizations have raised with the agency previously, however, the Corps cannot legally approve this project for numerous reasons. On behalf of the North Carolina Coastal Federation and Audubon North Carolina, the Southern Environmental Law Center again calls on the Corps to discontinue work on the FEIS until the Figure Eight Island Homeowners' Association ("HOA") demonstrates that it possesses the necessary property rights to build the proposed project and goes through the necessary application process with the Corps. In addition, the Corps must issue a new draft environmental impacts statement ("DEIS") that analyzes the existing environmental conditions on Figure Eight Island and the associated effects of the project, and the Corps must complete consultation with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service regarding impacts to threatened and endangered species under the Endangered Species Act ("ESA").

I. The HOA Has Not Met Basic Prerequisites for Implementation of the Project.

Despite the Figure Eight Island terminal groin project having been in the works since at least 2012, it is our understanding that basic prerequisites for building the project still have not been completed. In particular, the Figure Eight HOA does not own the property rights necessary to construct the project and the HOA has not submitted a formal application for approval of the project. We alerted the Corps to these significant deficiencies during the public comment period on the DEIS, see Letter from D. Carter, SELC, to M. Sugg, Corps, at 2 (July 27, 2012), yet further corrective action as not been taken. These issues must be addressed before the Corps can legally take any further action with regard to this project.

The beachfront where the groin would be built intersects more than a dozen lots. These lots would be affected by both the construction of the groin, as well as by the erosion and loss of beachfront that would be caused by the groin. The HOA does not have easements that would allow it to build across the lots and cannot demonstrate "that the applicant possesses or will possess the requisite property interest to undertake the activity proposed in the application." 33 C.F.R. § 325.1(d)(8).

Further, more than two years since publication of the DEIS, the HOA has yet to even submit an application to the Corps. It is a waste of agency time and resources, and a disservice to the public, for the Corps to invest substantial efforts into a project that the proponent cannot build and has not applied for.

II. The Corps Has Not Complied With NEPA.

In addition to the HOA still needing to meet the fundamental prerequisites for proceeding with the project of obtaining the necessary property rights and submitting an application, the Corps and the HOA also must entirely reexamine their May 18, 2012 DEIS. The underlying basis for the DEIS has fundamentally changed since 2012, rendering the document unable to serve its required role under the National Environmental Policy Act ("NEPA"). At base, the DEIS evaluates an inlet that no longer exists in the state analyzed and is, therefore, purely hypothetical. The DEIS cannot provide any information about the existing inlet or the effect of the revised terminal groin project on that inlet, and therefore cannot be finalized as the FEIS for the project.

The accretion at the northern end of Figure Eight Island has dramatically changed baseline physical conditions, even since our July 27, 2012 letter. As a result, the assumptions relied on in the DEIS no longer hold and cannot be relied upon as a basis for analyzing environmental impacts.

NEPA regulations require the Corps to re-analyze the project in a new DEIS if it is to move forward. "If a draft statement is so inadequate as to preclude meaningful analysis, the agency shall prepare and circulate a revised draft of the appropriate portion." 40 C.F.R. § 1502.9(a). This situation is present under the current circumstances, where the DEIS assumes both that "erosion rates [will] continue at their current level," DEIS at 38, and that future erosion will occur approximately as predicted by the Delft3D model. Both assumptions are demonstrably invalid. The north end of Figure Eight Island is accreting, fundamentally altering the baseline conditions represented in the DEIS. As shown in the attached report, satellite imagery clearly demonstrates that the ebb channel has naturally realigned and deposited significant volumes of sand on the northern end of the island. See Rich Inlet Bird Surveys, 2008-2014: Preliminary Summary of Results, L. Addison and T. McIver at 5 (Sept. 2014).

A. The DEIS environmental baseline is demonstrably false.

The entire analysis in the DEIS rests on the assumption that the north end of Figure 8 Island will erode at rates observed between 1999 and 2007. See DEIS at 22, DEIS at 168 ("Under Alternative 1, the shorelines on both islands would be expected to continue to behave as they have in the past."). Under the No-Action Alternative, it is assumed that "the Figure Eight HOA and individual property owners would continue to respond to erosion threats in the same manner as in the past." DEIS at 25. The analysis of the No-Action Alternative assumes a "[c]ontinuation of the present rate of shoreline recession on the extreme north end of Figure Eight Island." DEIS at 26. Based on that analysis, it predicts that up to 40 houses will have to be demolished or relocated within the next 30 years. Id. The DEIS estimates similar consequences for Alternative 2: Abandon/Retreat. DEIS at 28. Over two years after preparation of the DEIS, exactly the opposite has occurred.

The Fourth Circuit has made clear that "[w]ithout [accurate baseline] data, an agency cannot carefully consider information about significant environment impacts'" and therefore the analysis will "result[] in an arbitrary and capricious decision." N.C. Wildlife Fed'n v. N. C. Dep't of Transp., 677 F.3d 596, 603 (4th Cir. 2012) (quoting N. Plains Res. Council, Inc. v. Surface Transp. Bd., 668 F.3d 1067, 1085 (9th Cir. 2011)). It is fundamental that baseline data for the analysis of environmental impacts represent reality. See Friends of Back Bay v. U.S. Army Corps of Eng's, 681 F.3d 581, 588 (4th Cir. 2012) ("A material misapprehension of the baseline conditions existing in advance of an agency action can lay the groundwork for an arbitrary and capricious decision."). Without an accurate assessment of baseline conditions, "the [impact statement] process cannot serve its larger informational role, and the public is deprived of [its] opportunity to play a role in the decision-making process." N.C. Wildlife Fed'n, 677 F.3d at 603 (quoting N. Plains Res. Council, Inc. v. Surface Transp. Bd., 668 F.3d 1067, 1085 (9th Cir. 2011)).

The DEIS errors regarding the existing conditions on Figure 8 are further demonstrated by the model projections used to evaluate environmental and economic impacts of the alternatives. See DEIS at 29 ("The performance of Alternative 3, as well as the other alternatives, was based on the results of a numerical model known as Delft3D."). The 2012 projections of conditions at Rich Inlet could not have been more inaccurate. Figure 5.7 in the DEIS predicts substantial movement of the ebb-flow channel outlet to the northeast with final orientation to the east-northeast. See DEIS at 173. It also predicts that the main channel of Nixon Channel approaching the inlet will swing away from the interior marsh bank and that the higher elevation tip of the spit on Figure Eight Island will substantially erode away. As shown in the attached report, the ebb channel has not migrated as predicted by the model and the northern end of the island has not eroded.

In sum, the scenario that is the foundation of the DEIS simply does not exist and cannot, therefore, serve as the basis for a lawful NEPA analysis or any agency action. Friends of Back Bay, 681 F.3d at 588 ("An unjustified leap of logic or unwarranted assumption, however, can erode any pillar underpinning an agency action . . . ."). The assumptions that the island will continue to erode and that the model provides a reasonable prediction of future erosion are more than "unjustified leap[s] of logic or unwarranted assumption[s]," they are demonstrably false. Reliance on "demonstrably incorrect assumption[s]" violates NEPA. Id. at 589.

B. The Project Purpose and Need Has Been Rendered Obsolete.

In addition to invalidating the DEIS's projections of baseline conditions in the action area, the inlet's natural migration has also rendered the Proposed Action unnecessary, undermining the DEIS's statement of Purpose and Need. The entire DEIS analysis depends on the continuation of "chronic erosion problems along the northern section of Figure Eight Island's ocean shoreline." DEIS at i. The DEIS analysis focuses on preventing "economic losses resulting from damages to structures and their contents due to . . . progressive shoreline erosion." Id. The alternatives analysis evaluated options "[t]o alleviate these problems attributed to erosion." Id.

Taking into account the accretion of the beach on the north end of Figure Eight Island, all of the DEIS's erosion-based purpose and need statements are satisfied by the No Action alternative. Erosion rates have reversed. No houses are imminently threatened. There is no indication that the inlet will migrate and erode the northern end of the island within the next 30 years. In sum, these developments undercut the rationale and justification for the proposed action, as well as the entire analysis presented in the DEIS.

III. The Corps Has Not Completed The Required Endangered Species Act Consultation.

Rich Inlet provides habitat for threatened and endangered piping plovers, Atlantic sturgeon, and sea turtles, as well as the rufa red knot, which has been proposed for listing. Because this project "may affect" these listed species and designated critical habitat, the Corps must consult with the expert wildlife agencies – U.S. Fish and Wildlife and the National Marine Fisheries Service – to determine the effects of the project on these resources. 16 U.S.C. § 1536(a)(2). While the DEIS stated that the Corps intended to conduct the consultation required by section 7 of the ESA, DEIS at 5, Corps staff confirmed in an email to the North Carolina Coastal Federation that such consultation has not been initiated, much less completed by the production of a biological opinion. See 16 U.S.C. § 1536(b). Production of such a "biological opinion" is required by the ESA and its implementing regulations unless the Corps determines, with the written concurrence of the expert wildlife agencies, "that the proposed action is not likely to adversely affect any listed species or critical habitat." 50 C.F.R. § 402.14.

The need and basis for formal consultation on this project were gestured at in the DEIS, but as noted in our 2012 comments, the biological information used there was woefully insufficient. The attached reports regarding shorebird use of Rich Inlet and Masonboro Inlet for 2008-2014 provide significantly more detailed, updated, and useful information regarding shorebird use of this habitat. In particular, these surveys examine the superior habitat of the unimproved Rich Inlet, versus the adjacent managed Masonboro Inlet, and document that both piping plovers and red knots used Rich Inlet in "significantly higher numbers" than Masonboro Inlet in 2014. The September 25, 2014, cover letter presenting this data to the U.S. Fish and Wildlife Service stated explicitly, "The amount and quality of shorebird habitat is much greater at Rich Inlet. These habitats include emergent roosting areas and inter-tidal sand and mud flats. These habitats are largely absent from Masonboro Inlet." Letter from L. Addison, Audubon, to P. Benjamin, USFWS, at 1-2 (Sept. 25, 2014).

Notably, Rich Inlet is providing important wintering habitat for the highly endangered Great Lakes population of piping plover. While all piping plovers in the United States are protected by the ESA, the Great Lakes population is listed separately as endangered. In 2013, the Fish and Wildlife Service observed 66 nesting pairs of this small population. Piping Plover-Great Lakes: 2013 Field Season Journal, Field Season 2013 Wrap Up (Sept. 9, 2013), available at http://www.fws.gov/midwest/EastLansing/te/pipl/2013FieldSeason.html. Rich Inlet has proven to be essential migrating and wintering habitat for this small population, with 20 individuals observed in the Inlet since 2008. Rich Inlet Survey at 13. In fact, the majority of banded piping plovers observed at Rich Inlet since 2008 (63%) were from the endangered Great Lakes population. Id.

This recent data indicates that the terminal groin project at Figure Eight Island may be likely to both jeopardize the continued existence of this endangered population of piping plover and adversely modify or destroy its designated critical habitat. Indeed, the Recovery Plan for the Great Lakes population identifies loss of wintering habitat due to "artificial structures, such as breakwalls and groins" as a primary reason that the species is endangered. Recovery Plan for the Great Lakes Piping Plover (*Chadrius melodus*), Dep't of the Interior, U.S. Fish and Wildlife Service at 22 (Sept. 2003). A finding that this project may jeopardize the continued existence of the Great Lakes population of piping plover or adversely modify its critical habitat and may require the modification or abandonment of the project. This is exactly why the ESA requires initiation of consultation early in the project development and provides that a completed biological opinion be presented, at the latest, with a completed FEIS. The Corps may not finalize the EIS until it can comply with this important requirement.

IV. Conclusion.

The Corps may not lawfully issue an FEIS for this project. As we stated in our 2012 comments, the HOA does not have, and cannot acquire through eminent domain, rights to the property needed to construct its preferred alternative. The DEIS evaluates an inlet with erosion rates that simply do not exist. Finally, the Corps has not conducted the required analysis of impacts to protected species required by the ESA. As a result, the Corps cannot comply with NEPA at this time and should not issue an FEIS for the proposed project.

Thank you for your consideration of these comments. Please contact either of us at (919) 967-1450 if you have any questions regarding this letter.

Sincerely,

Sierra B. Weaver
Senior Attorney

Geoffrey R. Gisler
Senior Attorney

Enclosures

cc: Todd Miller, North Carolina Coastal Federation
Walker Golder, Audubon North Carolina
Mickey Sugg, USACE

Audubon NORTH CAROLINA

September 25, 2014

Audubon North Carolina
Coast Office and Sanctuaries
7741 Market Street, Unit D
Wilmington, NC 28411

Pete Benjamin
U.S. Fish and Wildlife Service
Raleigh Ecological Services Field Office
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Raleigh, NC 27636-3726

CC: John Ellis
Kathy Matthews
Derb Carter
Todd Miller
Mike Giles

Dear Sir,

Enclosed please find reports summarizing data collected at Rich Inlet and Masonboro Inlet in the Cape Fear region of North Carolina. Rich Inlet is largely unaltered and is not channelized; at Masonboro Inlet, a jetty was constructed on the north side (Wrightsville Beach) in 1966 and a terminal groin was constructed on the south side (Masonboro Island) in 1981.

The Rich Inlet report summarizes shorebird survey data from 2010-2014 and Piping Plover habitat use and band data from 2008-2014. The Masonboro Inlet report summarizes shorebird survey data from 2010-2014 and Piping Plover data from 2009-2014. Piping Plovers from all three breeding populations, including 20 individuals from the Great Lakes population, used Rich Inlet during the survey period for both overwintering and stopping over on migration. The peak of Piping Plovers during the survey period was 38 (fall 2014). Because peak counts do not incorporate turnover, the actual number of individual Piping Plovers that depend on Rich Inlet is much greater than indicated by peak counts.

Shorebird surveys following the same protocols were conducted at both inlets in 2014, allowing statistical comparison of Rich and Masonboro Inlets. For all bird species combined, significantly higher numbers of birds (Mann-Whitney test, $P<0.001$) were observed at Rich Inlet compared to Masonboro Inlet during 2014. For all shorebird species combined (plovers, sandpipers, and their allies), significantly higher numbers of birds (Mann-Whitney test, $P<0.001$) were observed at Rich Inlet compared to Masonboro Inlet during 2014. Additionally, significantly higher numbers of Piping Plovers (Mann-Whitney test, $P=0.003$) and Red Knots (Mann-Whitney test, $P=0.009$) were observed at Rich Inlet in 2014 compared to Masonboro Inlet. The amount and quality of shorebird habitat is much greater at Rich Inlet. These habitats include emergent roosting areas and inter-tidal sand and mud flats. These habitats are largely absent from Masonboro Inlet.

The amount of suitable open sand nesting habitat is also much greater at Rich Inlet, where extensive spits and shoals are able to form and periodically receive overwash. In addition to a pair of Piping Plovers, 840 pairs of Least Terns nested on the north end of Figure 8 Island in 2014. That colony represented nearly all of southeast North Carolina's Least Tern population and was the largest on record in the state in 41 years of record-keeping. No terns or skimmers have been recorded nesting at the north end of Masonboro Island since 1989.

Inlets are broadly recognized as essential habitat to shorebirds, including Piping Plovers and Red Knots. The USFWS Comprehensive Conservation Strategy for the Piping Plover (*Charadrius melodus*) in its Coastal Migration and Wintering Range in the Continental United States states that non-breeding Piping Plovers' "preferred coastal habitats include sand spits, small islands, tidal flats, shoals (usually flood tidal deltas), and sandbars that are often associated with inlets." The USFWS Proposed Rule for Red Knots and WHSRN's Red Knot Conservation Plan for the Western Hemisphere also describe unimproved tidal inlets as "preferred" Red Knot habitat. Both Red Knots and Piping Plovers are among seven shorebird species that occur in greater abundance at inlets than other coastal habitats.

Among the most significant threats to Piping Plovers, the Comprehensive Conservation Strategy addresses the threat to the species resulting from inlet stabilization and relocation, as well as dredging and sand mining; in particular, "construction of jetties, groins, seawalls and revetments at inlets leads to habitat loss and both direct and indirect impacts to adjacent shorelines." The Proposed Rule for Red Knots concludes that "hard stabilization structures and dredging degrade and often eliminate existing red knot habitats, and in many cases prevent the formation of new shorebird habitats." Multiple shorebird conservation documents also list coastline stabilization projects as a major threat to shorebirds. Both the Comprehensive Conservation Strategy and the Proposed Rule for Red Knots describe the ongoing and increasingly intense cumulative impacts, as hardened structures continue to be installed on the Atlantic and Gulf coasts. As of 2011, 85% of inlets in North Carolina have been modified; within the Piping Plover's Atlantic coast migration and wintering range, 57% of inlets have been modified in some way, and 43% have been stabilized with hard structures.

If requested, we will be happy to provide you with complete raw survey data. Thank you for your attention.

Sincerely,

Lindsay Addison
Coastal Biologist

Rich Inlet Bird Surveys, 2008-2014: Preliminary Summary of Results

Lindsay Addison and Tara McIver
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September 2014

Introduction

Natural coastal inlets are essential habitat for many shorebird species (Charadridae and Scolopacidae), as well as other coastal species, because they provide wintering and nesting habitat, stopover and staging sites during migration, an abundant food supply, and safe roosting areas. Shorebirds typically breed in the far north in order to exploit the seasonal abundance of food resources and during migration commonly stop over in coastal wetlands in order to refuel before continuing (Colwell 2010). In the southeastern U.S., the occurrence and numbers of shorebirds that use coastal habitats tends to be greater at inlet habitats than at other habitat types; seven species in particular, including the endangered and threatened Piping Plover (*Charadrius melodus*) and the proposed threatened Red Knot (*Calidris canutus rufa*), were found to be significantly more abundant at inlets than other coastal habitats (Harrington 2008). The USFWS Comprehensive Conservation Strategy for the Piping Plover (*Charadrius melodus*) in its Coastal Migration and Wintering Range in the Continental United States (2012), the USFWS Proposed Rule for Red Knots (2013), and the Red Knot Conservation Plan for the Western Hemisphere (Niles et al. 2010) all describe inlets as habitats "preferred" by Red Knots and non-breeding Piping Plovers.

Despite ongoing conservation efforts, many shorebird populations, including those of many species that occur at inlets, are declining and are of conservation concern, including six of the seven species that strongly preferred inlets (Brown et al. 2001, Winn et al. 2013). Coastal habitats that are favored by shorebirds are increasingly being degraded or made entirely unsuitable for shorebirds; in North Carolina, 85% of inlets have been modified, and 57% of Atlantic coast inlets in the migration and winter range of the Piping Plover have been modified, including 43% which have been stabilized with hard structures (Rice 2012). Loss or degradation of wintering habitat, including that associated with coastal engineering projects, is identified as a primary threat in the Atlantic Flyway Shorebird Conservation Business Strategy (Winn et al. 2013).

In describing the most significant threats to non-breeding Piping Plovers, the Comprehensive Conservation Strategy includes inlet stabilization and relocation, as well as dredging and sand mining, and states:

> The construction of jetties, groins, seawalls and revetments at inlets leads to [Piping Plover] habitat loss and both direct and indirect impacts to adjacent shorelines (USFWS 2012a).

The Proposed Rule for Red Knots concludes that:

> Hard stabilization structures and dredging degrade and often eliminate existing Red Knot habitats, and in many cases prevent the formation of new shorebird habitats (USFWS 2013).

For many U.S. shorebird species, existing information is inadequate to quantify how anthropogenic alterations to the coast have affected shorebird populations at specific sites or to quantify shorebirds' habitat use. Shorebird surveys can provide population estimates, establish seasonal patterns of abundance, quantify distributions and habitat preferences, identify important stopover sites, assist managers in conservation decisions, and provide information to regulatory agencies. Adequate monitoring and research programs are among the highest priorities in shorebird conservation plans (Brown et al. 2001, Winn et al. 2013). Since shorebirds prefer inlet habitats over other coastal habitats, and since inlet habitats are threatened due to increasing coastal development, shorebird surveys should be conducted in these areas to provide baseline data for conservation.

Prior to 2007, data quantifying the year-round use of inlets in southeastern North Carolina by breeding, migrating, and wintering birds did not exist. In order to fill this knowledge gap, Audubon North Carolina (ANC) began conducting regular bird surveys at three area inlets in 2007: New Topsail Inlet, Rich Inlet, and Mason Inlet (Figure 1). Additionally, ANC began conducting regular bird surveys at Masonboro Inlet in 2009 (Figure 1). The objective of these surveys was to document species composition, abundance, timing, and patterns of habitat use by shorebirds and other bird taxa.

Shorebird surveys of Rich Inlet included the inlet shoreline and shoals and the south end of Hutaff Island from 2007-2009. In September 2009, surveys were expanded to include the north end of Figure 8 Island. Surveys focused on Piping Plovers took place from July 2008-2014. This report summarizes the findings of shorebird surveys from 2010-2014 and Piping Plover data from 2008-2014.

Site Information and History

Rich Inlet is one of approximately 20 inlets in North Carolina. Located in southeastern North Carolina between privately developed Figure 8 Island to the south and undeveloped Hutaff Island to the north, Rich Inlet is an unmodified inlet, unlike the majority of inlets in North Carolina (Figures 1 and 2). Additionally, Rich Inlet is one of the most stable inlets in the state and communicates with the Atlantic Intracoastal Waterway (AIWW) through Nixon Channel on its south side and Green Channel on its north (Cleary and Marden 1999). Rich Inlet is part of the Lea-Hutaff Important Bird Area (Golder and Smalling 2011) and is within Piping Plover Critical Habitat Unit NC-11 which includes Lea-Hutaff Island and the emergent shoals and sandbars within Rich Inlet (USFWS 2001).

As Hutaff Island is unbridged and Figure 8 Island is a private island, Rich Inlet is primarily accessible only by boat. Use of the inlet by boaters is greatest in the summer months, when Hutaff Island, Figure 8 Island, shoals, and marsh shorelines are all accessed. Dogs are required to be on leash on Figure 8 Island, but enforcement appears lax; dogs are allowed on Hutaff Island and elsewhere in the inlet.

Methods

Rich Inlet was surveyed in three sections: Hutaff Island, the north end of Figure 8 Island, and Rich Inlet proper, which encompasses the marsh and dredge island shoreline in Nixon and Green

Channels, the large intertidal shoal in Green Channel (Green Shoal), the large intertidal shoal in the middle of the main inlet channel (Rich Shoal), and any other emergent shoals or sandbars in the inlet system (Figure 3). The survey area encompasses approximately 2.9 km^2. Surveys were conducted by boat and foot, using a boat to access the waterways and view shoreline where landing is impractical or unnecessary. Large shoals and the tips of Hutaff and Figure 8 Islands were surveyed by foot.

Surveys at Rich Inlet were conducted on a monthly basis beginning in the winter of 2007 and transitioned to a weekly schedule in March 2008. Thereafter, surveys were conducted on a weekly basis during shorebird migration (March-May and July-November) and bi-weekly during winter (December-February). Surveys were suspended in June, at the height of the nesting season when ANC staff time was not available and use by migrants is minimal. Surveys were conducted at weekly intervals, rather than at the 10-day intervals proscribed by the International Shorebird Survey, to capture inlet use by migratory species such as Red Knot, Common Tern (*Sterna hirundo*), and Caspian Tern (*Hydroprogne caspia*), large flocks of which may stay for a week or less before departing (Walker Golder pers. obs.).

The surveys focused on shorebirds and waterbirds, but all species were counted, with estimates used as a last resort when conditions did not permit a complete count of a large, moving flock or when other conditions prevented a direct count. At all times, efforts were made to avoid double-counting birds. Observations were made with 8x or 10x binoculars and a 20-60x spotting scope. In order to best assess abundance of shorebirds, preference was given to conducting surveys at high tide, but in order to reflect use of intertidal areas by species such as the Piping Plover, surveys were also conducted at mid and low tide.

The following data was recorded for each Piping Plover observation beginning in 2008: coordinates of individual Piping Plovers or flocks, behavior, habitat, landscape, and substrate.

Figure 1. The study area, showing Rich Inlet, North Carolina.

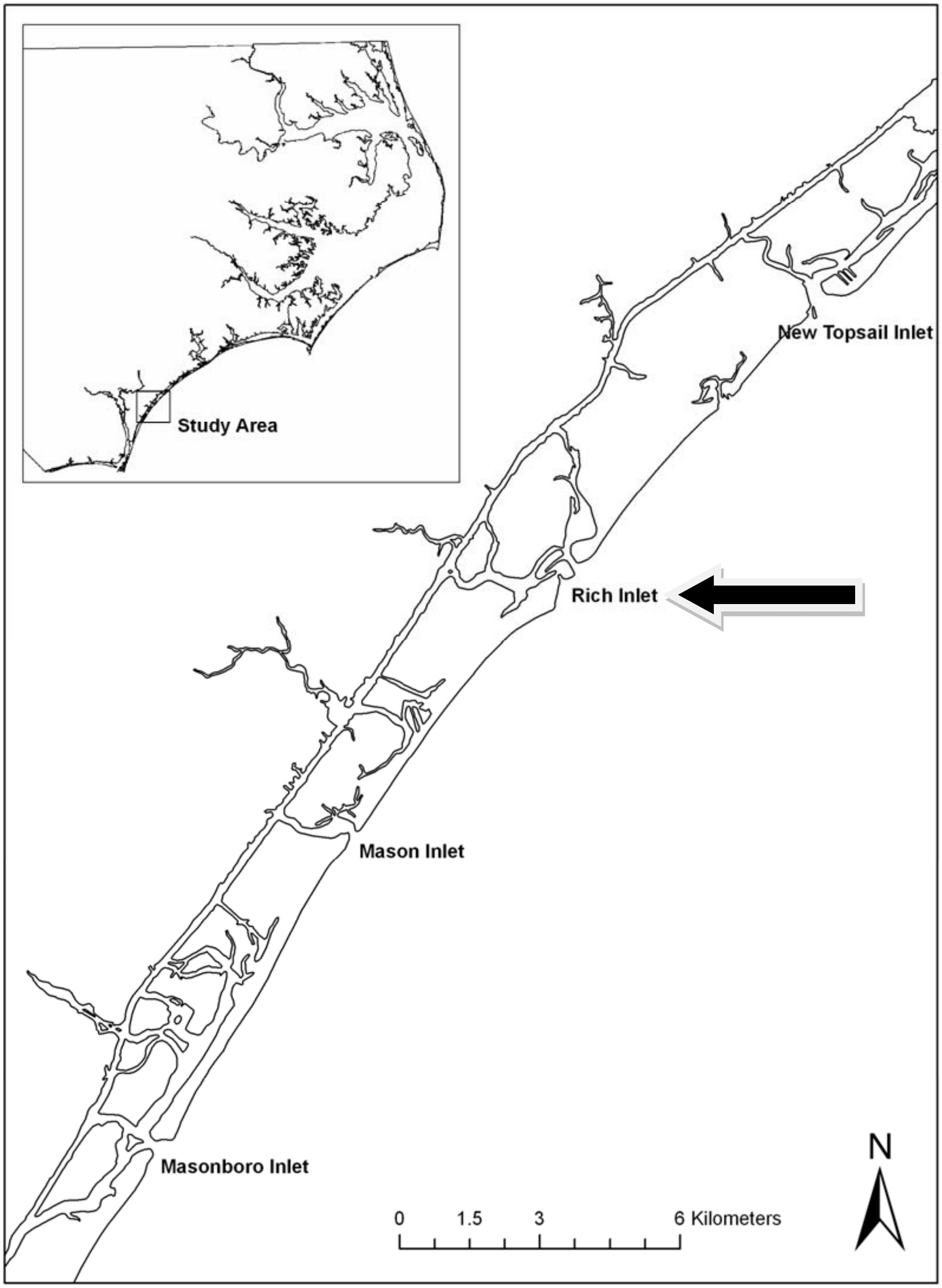


Figure 2. Aerial photographs of Rich Inlet from 1989-2013 (Clearly and Marden 1999, Google Earth 2013).

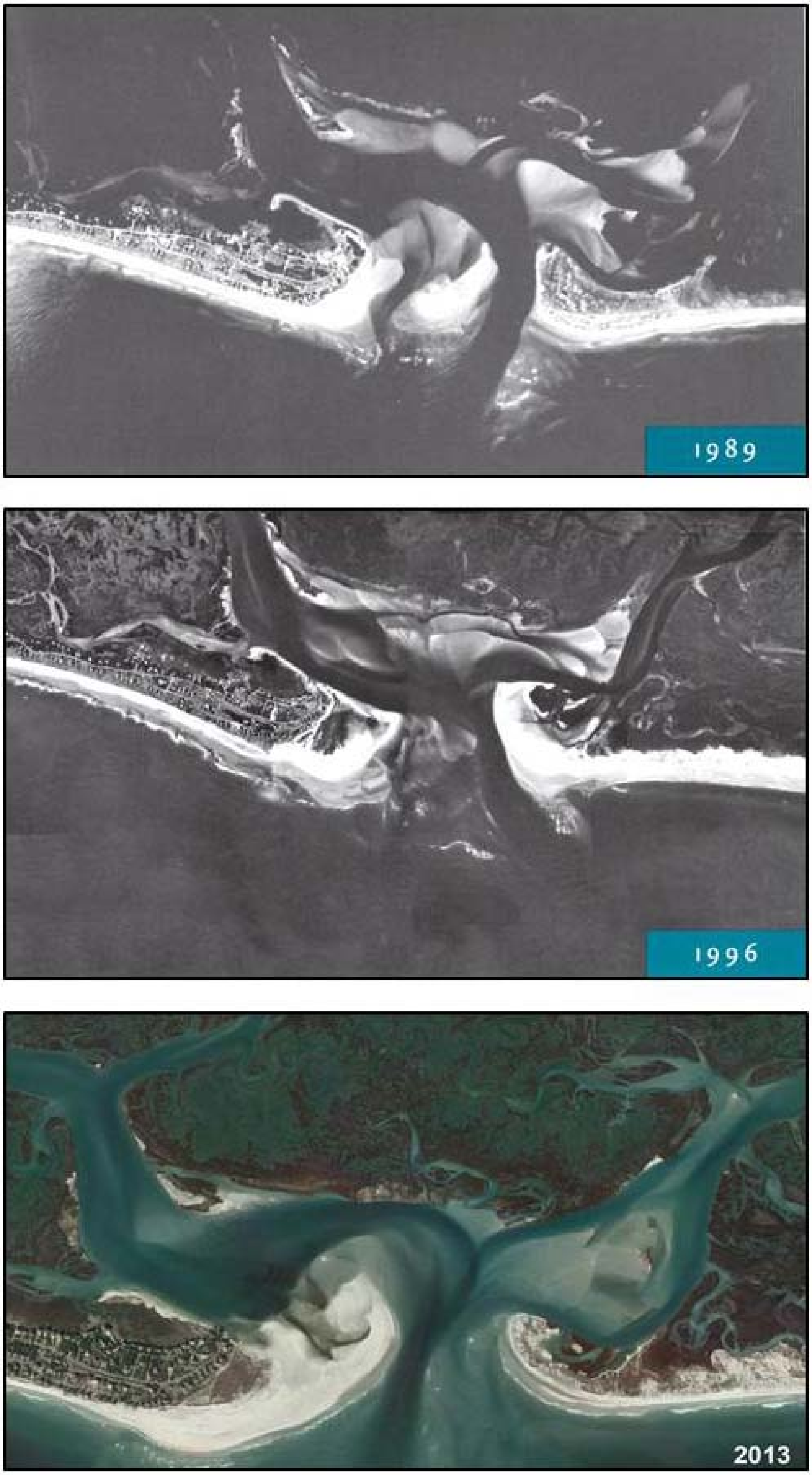
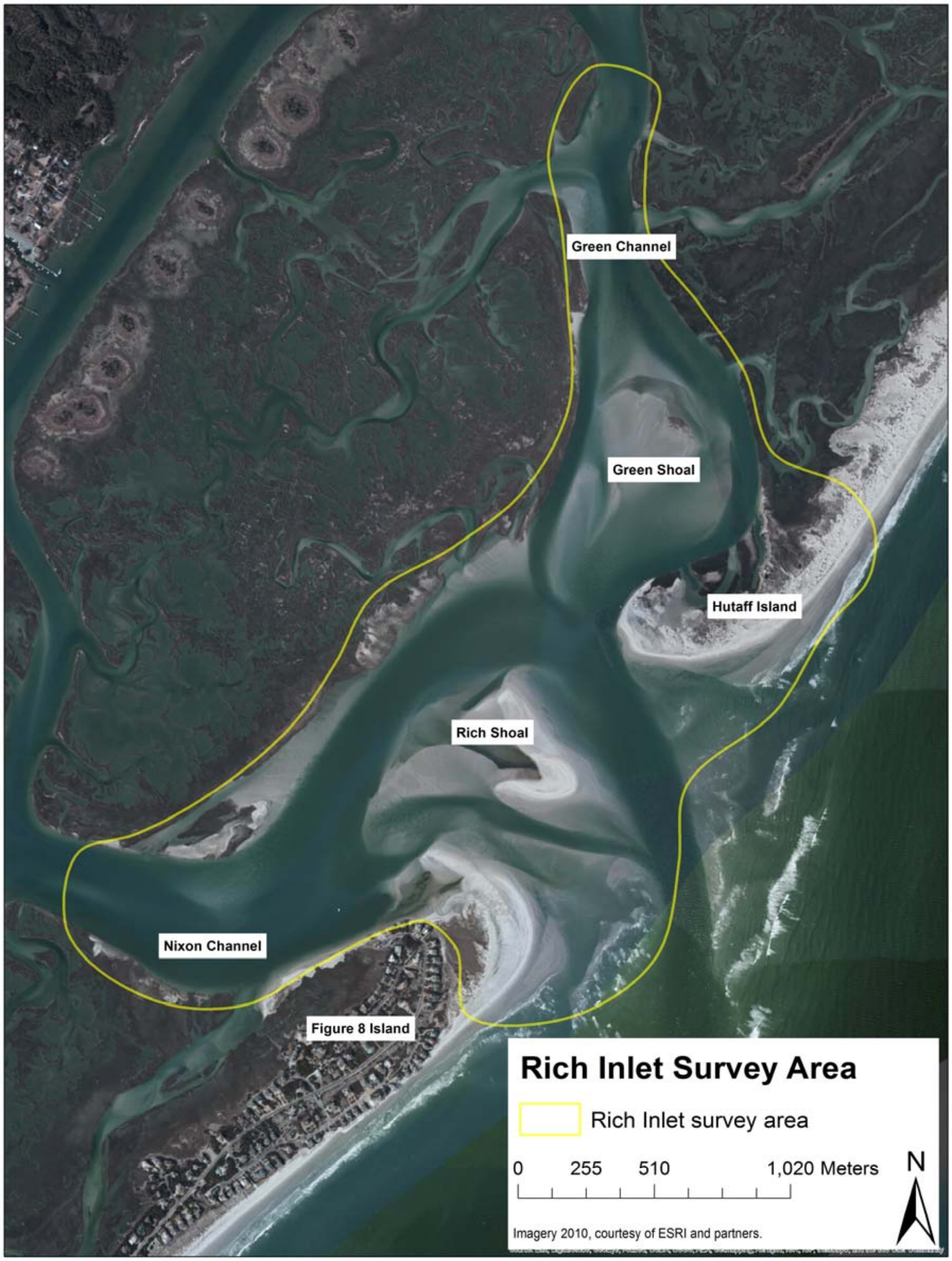


Figure 3. The Rich Inlet survey area.



Results

A total of 228,823 birds, representing 90 species were observed at Rich Inlet from January 2010-September 2014 (Table 1). Individuals of 26 species represented 96% of all birds observed at Rich Inlet. The 26 most abundant bird species, by total number counted and percent abundance from January 2010-September 2014 represent the families Scolopacidae, Charadriidae, Laridae, and one species each in Pelecanidae (Brown Pelican *Pelecanus occidentalis*), Phalacrocoracidae (Double-crested Cormorant *Phalacrocorax auritus*), Ardeidae (Great Egret *Ardea alba*), Threskiornithidae (White Ibis *Eudocimus albus*), and Haematopodidae (American Oystercatcher *Haematopus palliatus*) (Table 2). Seven of these species: Piping Plover (*Charadrius melodus*), Wilson's Plover (*Charadrius wilsonia*), American Oystercatcher, Willet (*Tringa semipalmata*), Common Tern (*Sterna hirundo*), Least Tern (*Sternula antillarum*), and Black Skimmer (*Rynchops niger*) also nest at Rich Inlet, and several species breed in the Cape Fear region (Brown Pelican, Great Egret, Herring Gull *Larus argentatus*, Laughing Gull *Leucophaeus atricilla*, Great Black-backed Gull *Larus marinus*, Royal Tern *Thalasseus maximus*, and Sandwich Tern *Thalasseus sandvicensis*).

Table 1. Species observed at Rich Inlet, January 2010-September 2014. Species are listed in phylogenetic order.

Red-throated Loon	American Black Duck	Wilson's Plover	Long-billed Dowitcher	Razorbill
Common Loon	Green-winged Teal	Killdeer	Short-billed Dowitcher	Mourning Dove
Horned Grebe	Surf Scoter	American Oystercatcher	Buff-breasted Sandpiper	Belted Kingfisher
Pied-billed Grebe	Black Scoter	American Avocet	Bonaparte's Gull	Fish Crow
American White Pelican	White-winged Scoter	Greater Yellowlegs	Laughing Gull	Purple Martin
Brown Pelican	Bufflehead	Lesser Yellowlegs	Ring-billed Gull	Tree Swallow
Double-crested Cormorant	Hooded Merganser	Solitary Sandpiper	Herring Gull	Barn Swallow
Northern Gannet	Common Merganser	Willet	Glaucous Gull	Northern Mockingbird
Great Blue Heron	Red-breasted Merganser	Spotted Sandpiper	Lesser Black-backed Gull	Cedar Waxwing
Great Egret	Turkey Vulture	Whimbrel	Great Black-backed Gull	Yellow-rumped Warbler
Snowy Egret	Northern Harrier	Marbled Godwit	Caspian Tern	Saltmarsh Sharp-tailed Sparrow
Reddish Egret	Bald Eagle	Ruddy Turnstone	Royal Tern	Red-winged Blackbird
Tricolored Heron	Osprey	Red Knot	Sandwich Tern	Boat-tailed Grackle
Little Blue Heron	Merlin	Sanderling	Common Tern	House Finch
Green Heron	American Kestrel	Dunlin	Forster's Tern	
White Ibis	Clapper Rail	White-rumped Sandpiper	Least Tern	
Glossy Ibis	Black-bellied Plover	Western Sandpiper	Gull-billed Tern	
Canada Goose	Piping Plover	Semipalmated Sandpiper	Black Tern	
Mallard	Semipalmated Plover	Least Sandpiper	Black Skimmer	

Table 2. The 26 most abundant bird species at Rich Inlet by total count and percent abundance during January 2010-September 2014.

Species	Total #	%	Species	Total #	%
Dunlin	55,369	24	Laughing Gull	5,140	2
Sanderling	18,563	8	Brown Pelican	4,784	2
Herring Gull	15,721	7	Western Sandpiper	3,888	2
Semipalmated Plover	14,209	6	Willet	3,881	2
Short-billed Dowitcher	13,548	6	Sandwich Tern	2,660	1
Royal Tern	11,192	5	Great Egret	2,518	1
Least Tern	10,789	5	Red Knot	2,489	1
Ring-billed Gull	8,955	4	American Oystercatcher	2,363	1
Black Skimmer	8,288	4	Caspian Tern	1,564	1
Black-bellied Plover	6,786	3	Wilson's Plover	1,399	1
Common Tern	6,562	3	White Ibis	1,394	1
Double-crested Cormorant	6,322	3	Bonaparte's Gull	1,225	1
Forster's Tern	6,095	3	Piping Plover	1,097	1

Shorebird species that both winter and stopover at Rich Inlet showed a general pattern of abundance in which numbers peak during spring migration, generally from March-May, and fall migration, generally from August-October, but including July for some species. During the winter months, smaller numbers were observed (Figure 4). Black-bellied Plover (*Pluvialis squatarola*), Semipalmated Plover (*Charadrius semipalmatus*), Piping Plover, American Oystercatcher, Willet, Sanderling (*Calidris alba*), Western Sandpiper (*Calidris mauri*), Least Sandpiper (*Calidris minutilla*), and Short-billed Dowitcher (*Limnodromus griseus*) showed two seasonal peaks in abundance. All but the Red Knot and the Short-billed Dowitcher showed generally greater peaks in the fall than the spring. Dunlin (*Calidris alpine*) arrived late in the year and overwinter in large flocks at Rich Inlet.

Terns and skimmers used Rich Inlet before and after breeding. Royal Terns used the inlet during both spring and fall; Least Terns used the inlet almost exclusively during spring migration and also nested there; Caspian Terns, Sandwich Terns, Common Terns, Forster’s Terns (*Sterna forsteri*), and Black Skimmers used the inlet most during the fall when large flocks of Common and Forster’s Terns were recorded stopping over and when large flocks of Black Skimmers stage throughout the fall (Figure 5).

Of the 90 species observed at Rich Inlet, 27 species (30%) are of conservation concern, either as federally listed species, state-listed species or identified as declining or otherwise vulnerable (Table 3).

Figure 4. Peak monthly abundance of key shorebird species using Rich Inlet during 2010-2014.

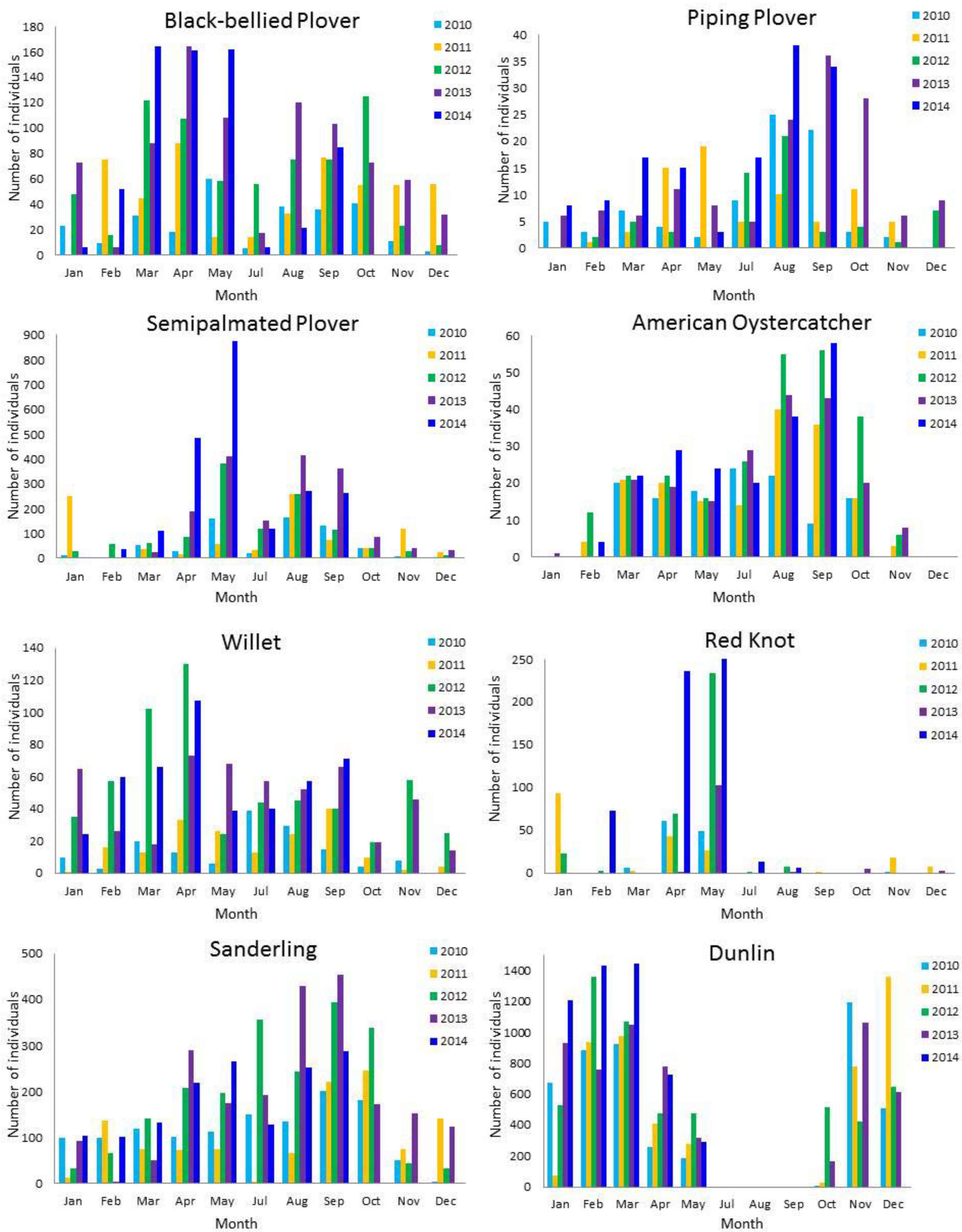


Figure 4. Continued.

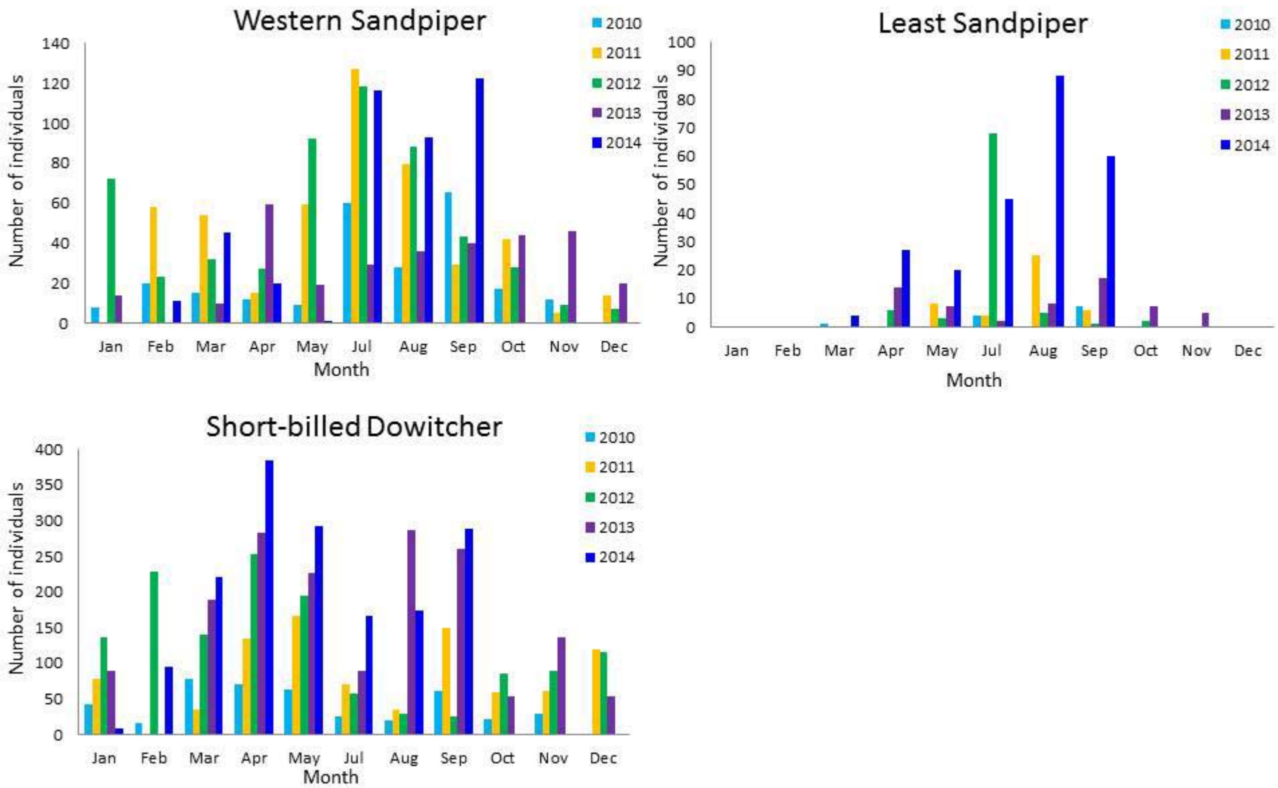


Figure 5. Peak monthly abundance of terns and skimmers using Rich Inlet during 2010-2014.

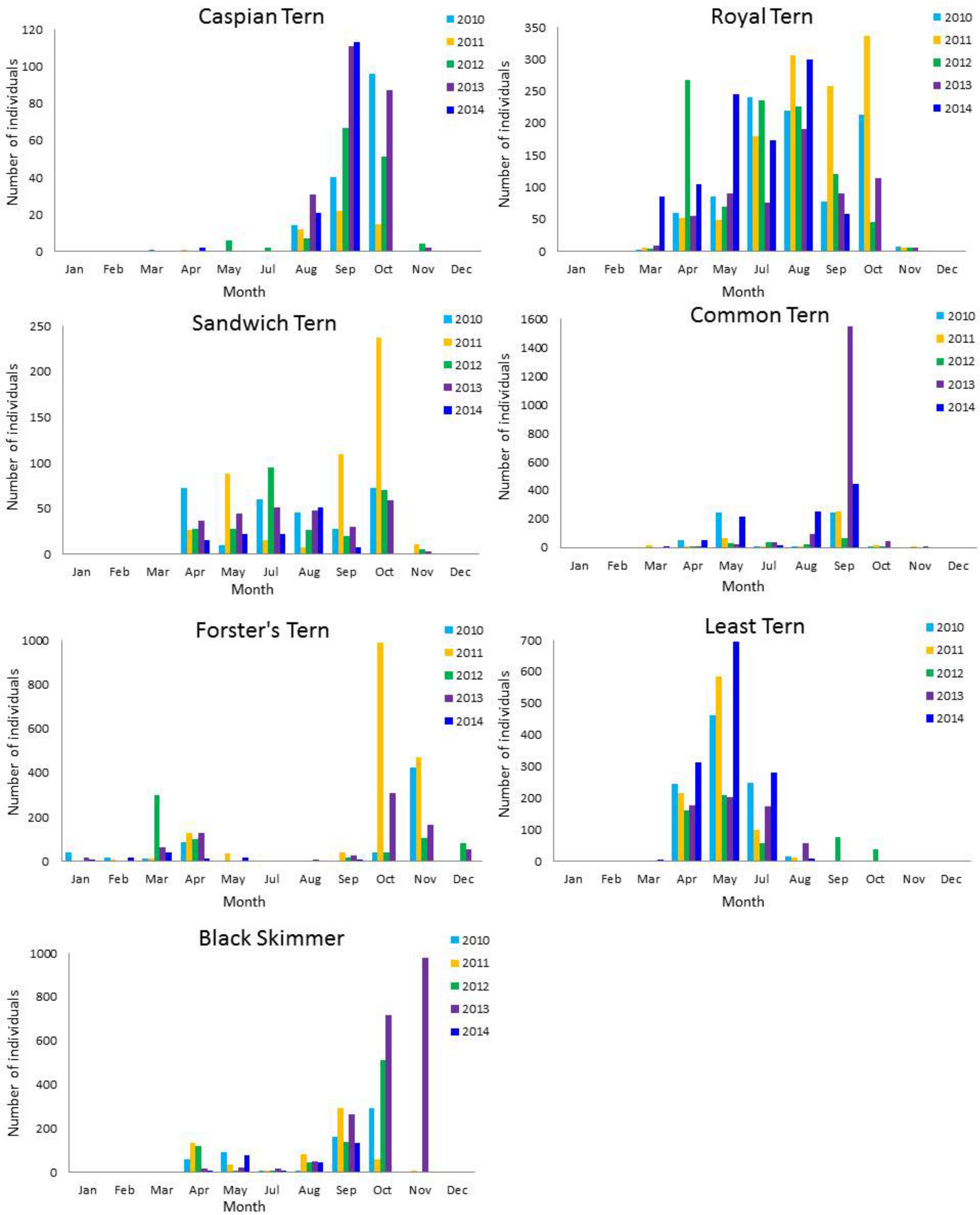


Table 3. Species of conservation concern observed at Rich Inlet, 2010-2014. BCC=USFWS birds of conservation concern in BCR 27 FT=federally threatened PFT=proposed federally threatened NCT=North Carolina threatened SSC=North Carolina species of special concern, USSCP=U.S. Shorebird Conservation Plan highly imperiled or species of high concern; *Birds from the federally endangered Great Lakes population winter at Rich Inlet.

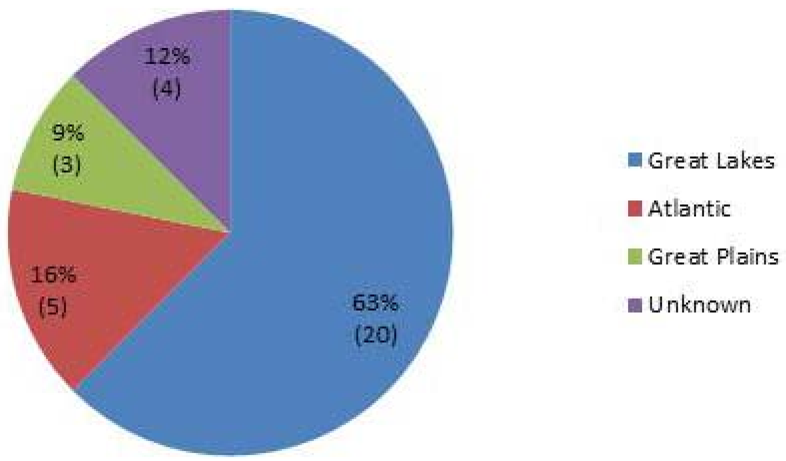
Species	Status	Species	Status
Red-throated Loon	BCC	Sanderling	USSCP
Snowy Egret	SSC	Semipalmated Sandpiper	BCC, USSCP
Tricolored Heron	SSC	Western Sandpiper	USSCP
Bald Eagle	NCT, BCC	Least Sandpiper	USSCP
Black-bellied Plover	USSCP	Buff-breasted Sandpiper	BCC, USSCP
Wilson's Plover	SSC, BCC, USSCP	Dunlin	USSCP
Killdeer	USSCP	Short-billed Dowitcher	BCC
Piping Plover	FT*, BCC, USSCP	Common Tern	SSC
American Oystercatcher	SSC, BCC, USSCP	Least Tern	SSC, BCC
Greater Yellowlegs	USSCP	Gull-billed Tern	NCT, BCC
Whimbrel	BCC, USSCP	Sandwich Tern	BCC
Marbled Godwit	BCC, USSCP	Black Skimmer	SSC, BCC
Ruddy Turnstone	USSCP	Saltmarsh Sharp-tailed Sparrow	BCC
Red Knot	PFT, BCC		

Piping Plover

A total of 1,514 sightings were made of Piping Plovers at Rich Inlet from July 2008-September 2014. The total number of sightings was greatest during fall migration (July-November), but sightings were made in every month of the year. In some years Piping Plovers nested on Hutaff Island (2 pairs 2008, 1 pair 2009, 2 pairs 2010) or Figure 8 Island (1 pair 2014). Nesting plovers may be detected in May and July surveys.

At least 32 individual banded Piping Plovers were resighted at Rich Inlet from 2008-2014 (Great Lakes chicks receive generic "brood marker" combinations and receive unique bands when they begin breeding). Banded Piping Plovers at Rich Inlet were from all three breeding populations, Great Lakes (federally endangered), Great Plains (federally threatened), and Atlantic Coast (federally threatened), with the greatest number of banded individuals from the Great Lakes population (Figure 6). Four were missing some bands and could not be identified to a population.

Figure 6. Number of individual banded Piping Plovers from each population seen at Rich Inlet, July 2008-September 2014.



Banded wintering individuals exhibited fairly high site fidelity. Seventeen of the 32 individuals were only seen at Rich Inlet. Six individuals wintered at Rich at least once; three of those six were only seen at Rich Inlet. Though individuals were recorded at multiple inlets in the study during the winter months on four occasions, sightings away from the preferred inlet tended to occur during spring or fall migration. One female from the Great Lakes population has wintered at Rich Inlet for six years and has only been seen at a different inlet once. Nineteen of the banded individuals only stopped over and were not seen wintering in the region; nine of those migrating individuals were seen on at least two different migrations.

Weekly counts of Piping Plovers show one peak during spring migration and one or two peaks during fall migration (Figure 7). Peak winter counts have increased from the winter of 2009-2010 and 2010-2011 (high counts of five in each season) to seven in 2011-2012 and nine in 2013-2014. Peak fall migration counts have also increased to highs of 36 and 38 in 2013 and 2014, respectively. Spring peaks have fluctuated but increased overall since 2012. Sightings of Piping Plovers were regularly made in every month of the year, reflecting year-round use by breeding as well as migrating and wintering individuals.

Piping Plovers were observed throughout the Rich Inlet system (Figure 8), using all areas of the inlet: the shoals in the main channel and Green Channel, beaches and spits on the northern and southern sides of the inlet mouth, and, much less frequently, beach or sandbar areas at the back of the inlet. Further, the same banded individuals were seen at the north and south sides of the inlet systems, as well as shoals in the inlet channels, and observed moving to different foraging and roosting sites as the tide changed. None of the banded wintering Piping Plovers were observed on only one segment of the inlet (e.g. only on Hutaff Island). Distribution within the Rich Inlet system did not vary by population; banded Great Lakes individuals and unbanded (likely Atlantic population) plovers used the same areas.

Figure 7. Peak monthly abundance for Piping Plover using Rich Inlet during 2008-2014.

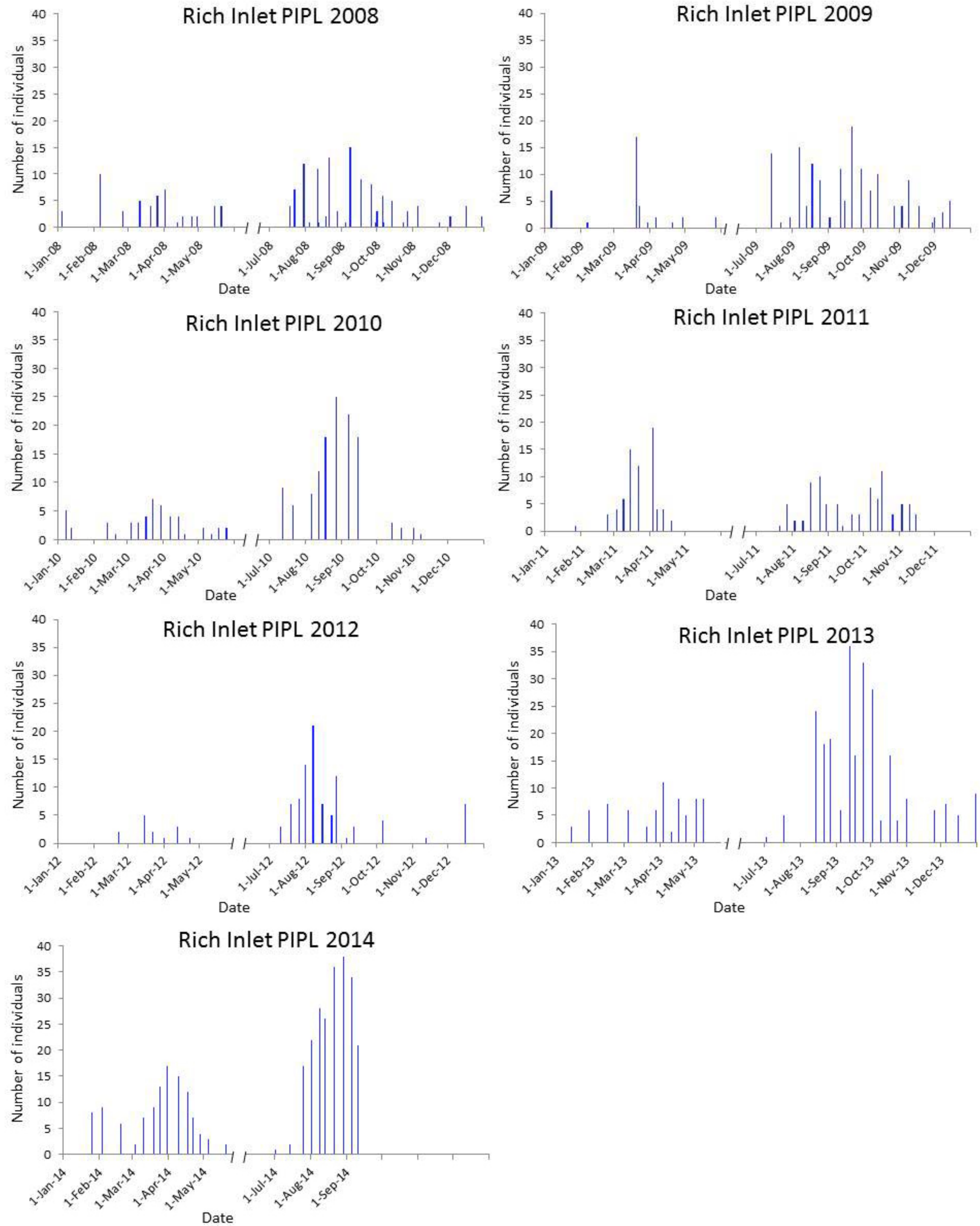
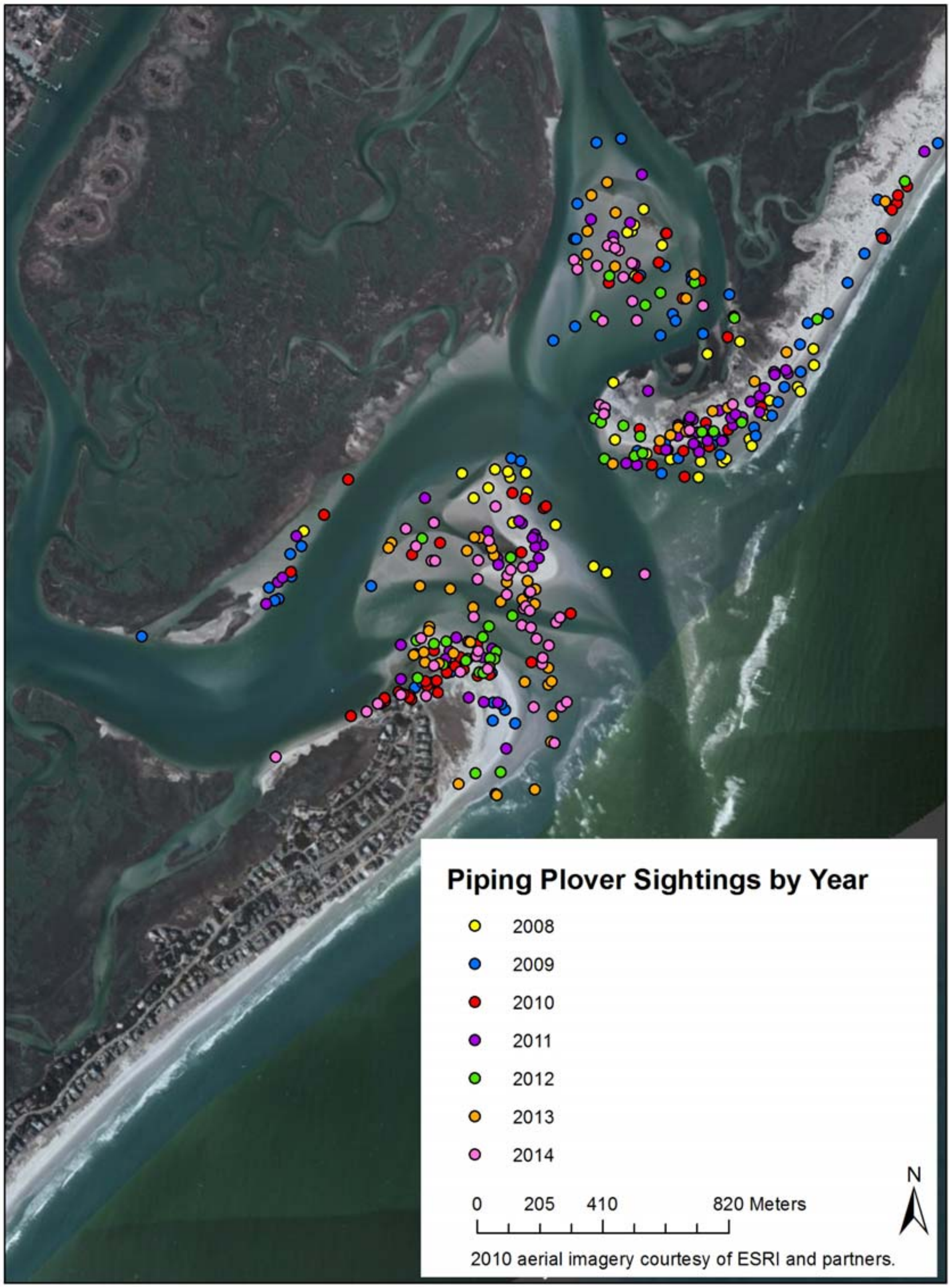
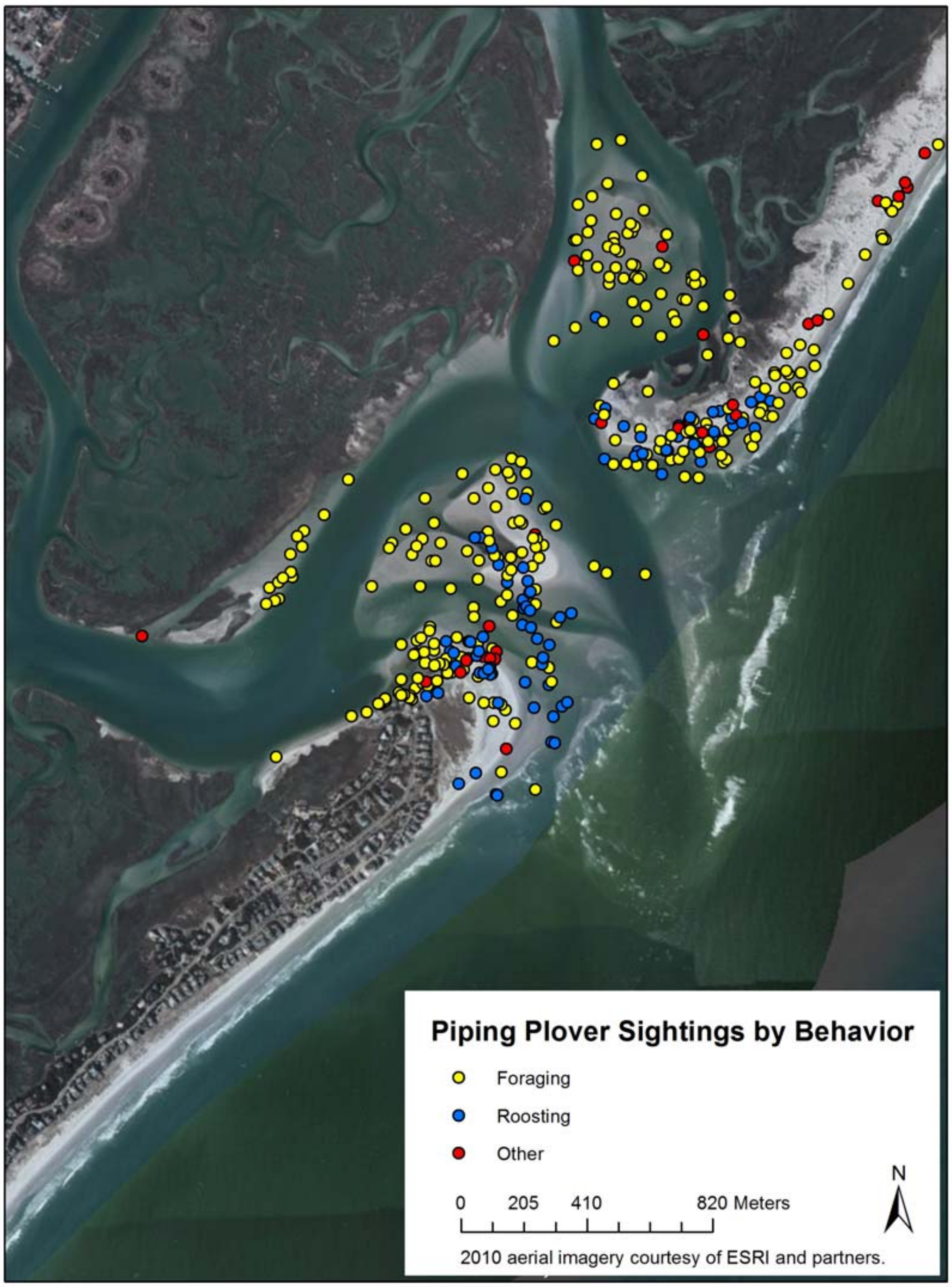


Figure 8. Locations of individual or flocks of Piping Plovers at Rich Inlet, July 2008- September 2014. Surveys did not include Figure 8 Island until September 2009.



Of the 1,514 Piping Plover sightings at Rich Inlet, 909 (60.0%) were of foraging birds, 515 (34.0%) were of roosting birds, and 90 (6.0%) were of birds performing another activity such as preening or agonistic behavior. Of the 909 sightings of foraging Piping Plovers at Rich Inlet, 458 (50.4%) were on shoals or sandbars in Rich Inlet; 201 (22.1%) were on Hutaff Island, typically in the swash zone at mid or low tide, and 250 (27.6%) were on North Figure 8 Island, typically on the low-energy sound side (Figure 9).

Figure 9. Behavior of individual or flocks of Piping Plovers in Rich Inlet, July 2008-September 2014.



Piping Plovers foraged in several landscape types and favored ocean beaches or inlet spits for roosting (Table 4). Of the seven landscape types where Piping Plovers were observed foraging, flood shoal islands were used most frequently (36.6% of observations), followed by ocean beach. However, when taken together, Piping Plovers most often utilized sheltered, low-energy shoals, bay beaches, inlet spits, and sandbars on the sound side of the inlets for foraging (684 observations, 75.2%).

Table 4. Percent of foraging, roosting, and other behaviors observed at different landscape types at Rich Inlet, July 2008-September 2014.*= preening, bathing, flying, aggression, walking, and alert.

	Ocean beach	Bay beach	Inlet spit	Ebb shoal island	Flood shoal island	Sandbar	Tidal creek/lagoon
Foraging	24.9	13.9	13.5	5.9	36.6	4.2	1.0
Roosting	37.1	8.7	51.0	1.6	1.6	0	0
Other*	63.3	20.0	5.6	0	3.3	0	7.8

When foraging, Piping Plovers strongly favored the intertidal zone (89.1% of observations) and were less likely to use wrack or other habitat types (Table 5). Roosting Piping Plovers were most often seen in on the intertidal zone (35.0%), followed by old wrack or backshore. The relatively large number of roosting observations on intertidal areas can be accounted for by the Piping Plovers' use of the wet sand on the sound side of Figure 8 Island.

Table 5. Percent of foraging, roosting, and other behaviors observed at different habitat types at Rich Inlet, July 2008-May 2014. *=preening, bathing, flying, aggression, walking, and alert.

	Intertidal zone	Fresh wrack	Old wrack	Backshore	Dune	Ephemeral pool
Foraging	89.1	2.8	0.7	6.7	0.1	0.7
Roosting	35.0	3.1	33.0	28.3	0.6	0
Other*	70.0	1.1	2.2	17.8	7.8	1.1

Of Piping Plovers that were observed foraging, 54.3% were found on sand substrate and 38.9% were found on mud/sand; 97.1% of roosting Piping Plovers were found on sand (Table 6). Piping Plovers preferred to roost in habitat (backshore and old wrack) and in landscapes (ocean beach or inlet spit) that were most likely to have sandy substrate. For foraging, Piping Plovers overwhelmingly used the intertidal zone, which at Rich Inlet is often sand-based. The lower-energy portions of Green Shoal and Rich Shoal sometimes develop a mud/sand mixture, which is reflected in the portion of foraging observed on that substrate.

Table 6. Percent of foraging, roosting, and other behaviors observed on different substrate types at Rich Inlet, July 2008-May 2014. *=preening, bathing, flying, aggression, walking and alert.

	Sand	Mud/sand	Mud	Algal mat	Peat outcrop	Other	Unknown
Foraging	54.3	38.9	4.5	0.4	0	0	1.8
Roosting	97.1	1.6	0	0	0	0	1.4
Other*	81.1	6.7	1.1	7.8	0	3.3	0

Of the 1,514 total Piping Plover sightings, 755 (49.8%) were made at high tide, 299 (19.7%) were made at mid tide, and 460 (30.4%) were made at low tide. As is expected in a species that forages in intertidal areas, the majority of foraging observations (653, 71.8%) were made at mid or low tide, and the majority of roosting took place at high tide (Table 7).

Table 7. Percent of foraging, roosting, and other behaviors observed at different tidal stages at Rich Inlet, July 2008-May 2014. *=preening, bathing, flying, aggression, walking, and alert.

	High	Mid	Low
Foraging	28.2	25.5	46.3
Roosting	90.7	8.5	0.8
Other*	35.6	25.5	38.9

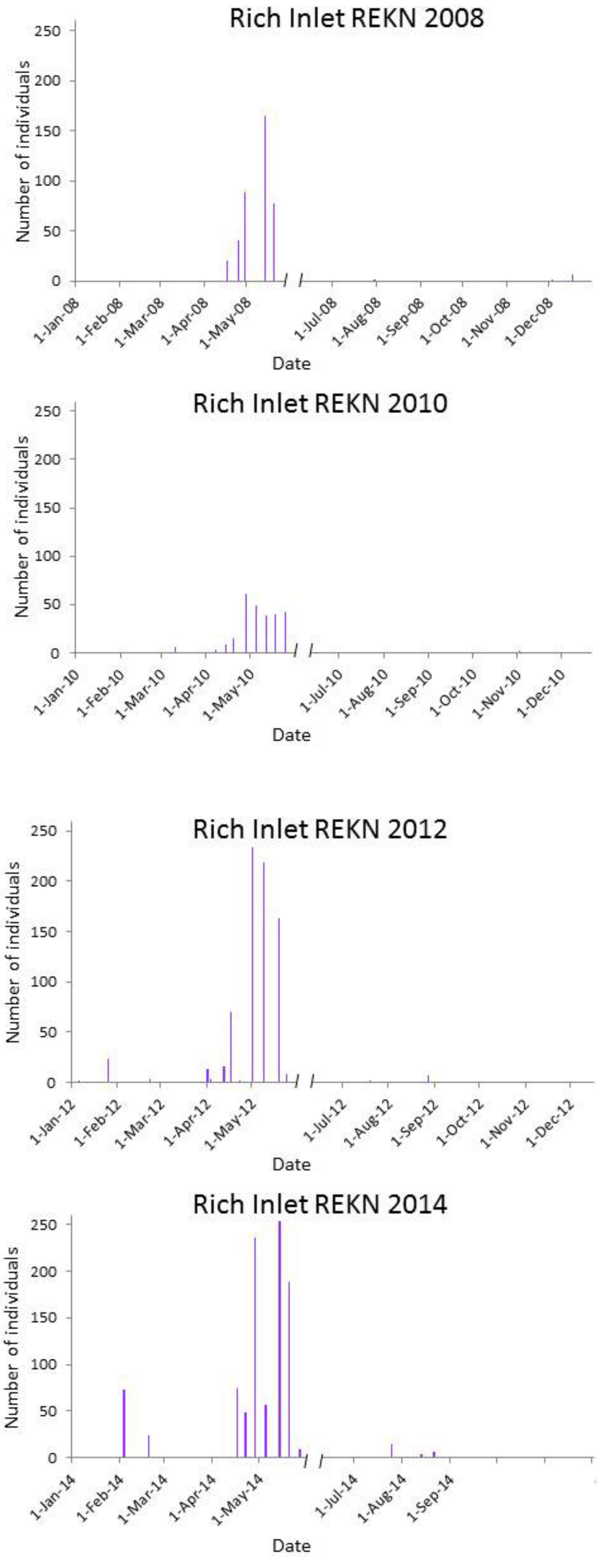
Red Knot

The Red Knot *rufa* subspecies was proposed for threatened status under the Endangered Species Act in 2013. The Red Knot, which is not abundant in southeast North Carolina, was observed in greater numbers during spring migration than on fall migration, with migratory flocks arriving in the area in late spring, sometimes as early as March, but more typically in April and May (Figure 10).

Banded Red Knots were observed on 55 occasions, representing at least 26 individuals. Since not all knots' bands codes could be read completely, and since not all Red Knots have unique bands, the number of individuals is likely underrepresented by this count. Individuals were banded in Florida, Delaware, New Jersey, Massachusetts, and Argentina and resighted in Ontario (breeding), Massachusetts, New Jersey, Delaware, North Carolina, South Carolina, Georgia, and Florida.

The majority of Red Knots roosted on the sound side of Figure 8 Island, with additional roosts on Hutaff Island and Green Shoal. Foraging Red Knots used the ocean beaches of Figure 8 Island and Hutaff Island, as well as Green Shoal.

Figure 10. Peak monthly abundance of Red Knot using Rich Inlet during 2008-2014.



Nesting

Seven species of shorebirds, terns, and skimmers nest in the Rich Inlet system (Table 8). Nesting typically occurs on the spits and among the dunes of Hutaff and Figure 8 Island. In 2010 and 2011, when a flood shoal island was emergent at high tide, Least Terns and a pair of American Oystercatchers nested there. American Oystercatchers also nest on shell rakes along the marsh shore. When the spit on the north end of Figure 8 Island is present, nesting occurs there as well.

Table 8. Species of birds nesting in Rich Inlet by location during 2009-2014. *Nesting is undocumented but likely.

	Wilson's Plover	Piping Plover	American Oystercatcher	Willet	Common Tern	Least Tern	Black Skimmer
Hutaff Island	X	X	X	X	X	X	X
Flood shoal			X			X	
Figure 8 Island	X	X	X	X	X	X	X
Shell rakes			X	*			

Both Hutaff Island and Figure 8 Island have changed in size (Figure 2), and availability of good quality nesting habitat is reflected in fluctuations in nesting birds (Figure 11). Currently, due to the accretion of sand at the north end, there is a large quantity of excellent tern and skimmer habitat on Figure 8 Island, which attracted 840 pairs of Least Terns to the site in 2014 (Figure 12). The colony, which was posted by the Figure 8 Island Homeowners' Association, was the largest on record in 41 years in North Carolina (NCWRC 2014) and the largest on the Atlantic seaboard in 2014. In addition, we detected four pairs of American Oystercatchers, at least eight pairs of Wilson's Plovers, and one pair of Piping Plovers on Figure 8 Island in 2014. The Piping Plovers failed, as did a single pair of Common Terns and 18 pairs of Black Skimmers, but the other nesting species all produced chicks.

Discussion

The shorebird surveys provide critical baseline data that did not previously exist for Rich Inlet. The data documents the use of the inlet by migrating and wintering shorebirds, including significant flocks of migrating Piping Plovers. Generally, greater peaks in abundance during spring or fall migration reflect use of different routes during spring and fall migrations. For the majority of shorebird species, fall peaks are greater than spring peaks. The Cape Fear region is located within Onslow Bay and the larger South Atlantic Bight. Spring migrants typically move northward at a faster rate in order to secure optimal territories and mates on nesting grounds and in the fall move southward more slowly. Both of these factors may affect the relative abundance of spring and fall migrants. Dual peaks in the fall, such as were observed in the Piping Plover, likely reflect migration of different demographic groups since female Piping Plovers tend to depart the nesting grounds before males and juveniles (Elliott-Smith and Haig 2004).

Royal and Sandwich Terns nest in the Cape Fear region on the Lower Cape Fear River, but used Rich Inlet before and after breeding. Black Skimmers followed the same pattern, though they nested primarily at Masonboro Inlet during the study period, not the Cape Fear River. Fall Black Skimmer flocks included young of the year and could constitute birds that bred as far north as Long Island and had partially completed their migrations. Tern and skimmer flocks stayed into October (terns)

Figure 11. Colonial nesting species at Rich Inlet, 1977-2014 (NCWRC 2014).

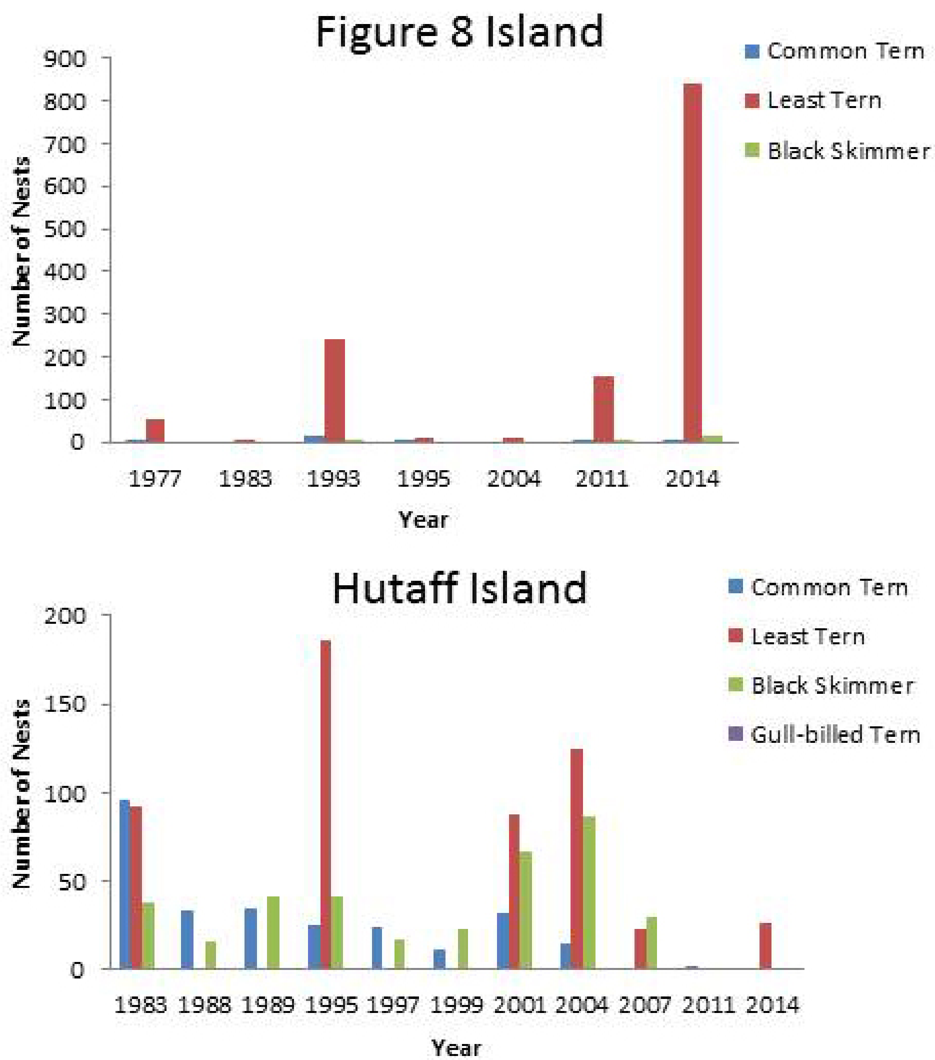
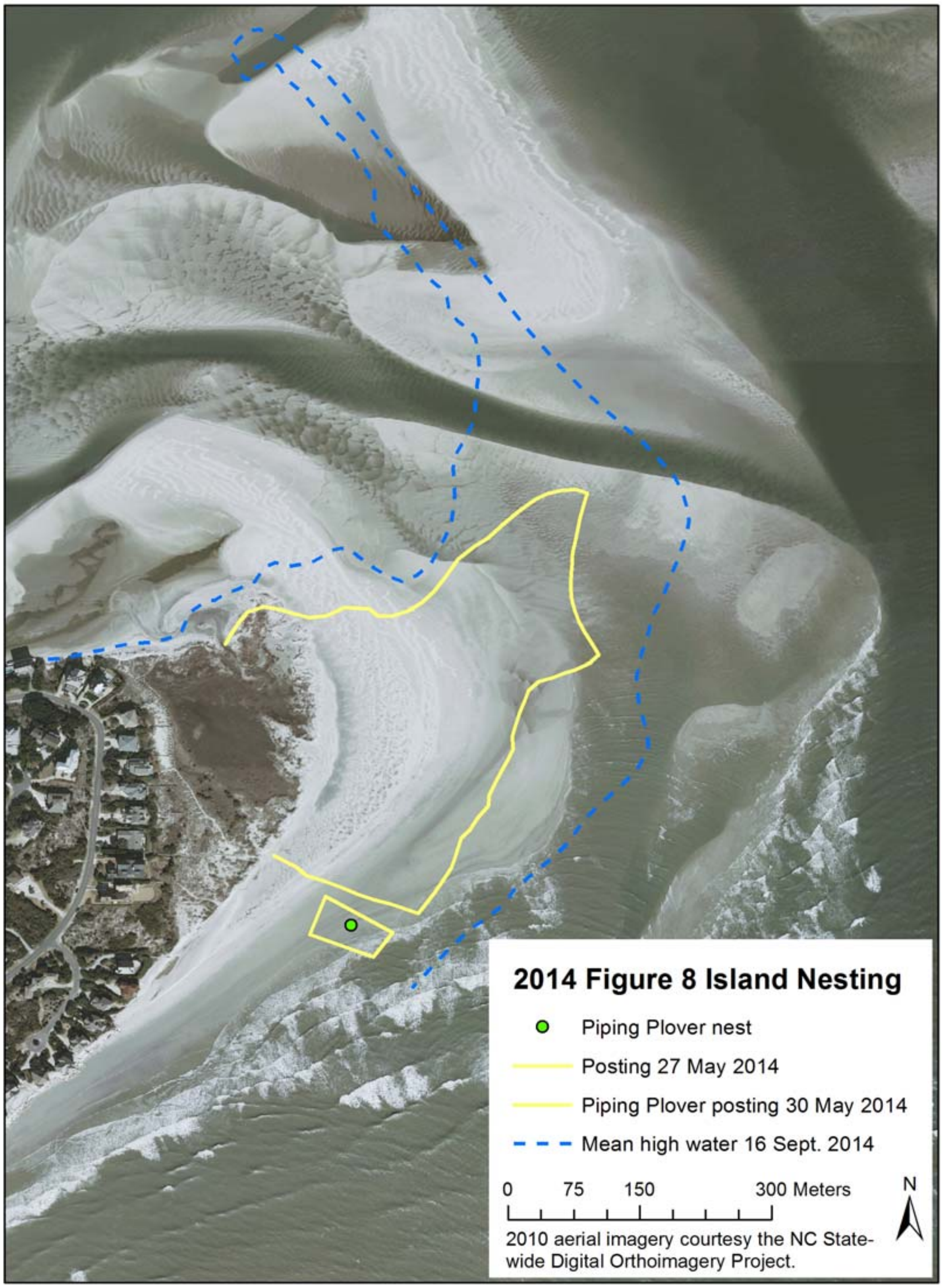


Figure 12. Location of nesting birds at Rich Inlet, 2014.



and November (Black Skimmers), suggesting the inlet's significance to these species as a staging site prior to and during migration.

The distribution of nesting populations of migrating and wintering Piping Plovers observed during this project were similar to those reported in Gratto-Trevor et al. (2009), but for the absence of band records from eastern Canada. The Great Lakes population is extensively banded, and there are proportionally fewer banded Piping Plovers from the Great Plains and Atlantic populations. Most of the unbanded Piping Plovers using Rich Inlet were likely Atlantic population birds, based on the population's known distribution and the absence of bands.

Significant numbers of Piping Plovers from the Great Lakes population and the Atlantic coast population were found at Rich Inlet every year. The Great Lakes population consisted of between 55-71 breeding pairs, or 110-142 breeding adults, from 2008-2014 (Alice van Zoeren pers. com.), an average of 64 pairs or 128 breeding adults. The 20 individuals identified at Rich Inlet represent a large proportion of the Great Lakes population. The population of Atlantic coast breeding Piping Plovers averaged 1,836 pairs or 3,672 breeding adults from 2008-2012 (the most recent years for which final or preliminary data is available) (USFWS 2012b, USFWS 2011, USFWS 2010). The peak counts at Rich Inlet in fall 2013 and 2014 meet or exceed 1% of the Atlantic population. Because peak counts do not incorporate turnover, the actual number of individual Piping Plovers that depend on Rich Inlet is much greater than indicated by peak counts.

During migration and wintering, Piping Plovers engage in two essential behaviors, foraging and roosting. A core wintering area or stopover site must provide habitat suitable for roosting, typically backshore above the high-tide line, and foraging, typically wet sand in low-energy intertidal areas that support invertebrates such polychaetes which are an important prey item for wintering and migrating Piping Plovers (Elliott-Smith and Haig 2004).

These findings conform to other winter studies that found Piping Plovers using different habitats within the same inlet system throughout the tidal cycle and individuals regularly using both sides of an inlet, as well as shoals (Cohen et al. 2008 and Maddock et al. 2009). Piping Plovers at Rich Inlet also exhibited high site fidelity, both during the same year and across several years, as has been observed elsewhere (Noel and Chandler 2006, Drake et al. 2001). Piping Plovers do not use large core winter ranges. Winter territories can be less than 3 km^2 (Drake et al. 2001), which is similar to the size of Rich Inlet. Rich Inlet provides the variety of habitats that Piping Plovers require (Rabon 2006, Drake et al. 2001, Johnson and Baldassarre 1988), particularly flats associated with inlets (Nicholls and Baldassarre 1990). The Piping Plovers stopping over and wintering at Rich Inlet are therefore likely to be nearly or entirely dependent on its resources for the mosaic of foraging and roosting habitats they require.

Throughout the study period, Rich Inlet has supported significant number of shorebirds. The accretion of the north end of Figure 8 Island has expanded Piping Plover roosting and foraging habitat, which appears to have increased the carrying capacity of the inlet for wintering and migrating Piping Plovers. Similarly, natural spit accretion and overwash has created high-quality nesting habitat for terns, skimmers, oystercatchers, and plovers at Rich Inlet. The historic cyclical fluctuations of Rich Inlet's configuration (Figure 2) and consistent use by shorebirds suggest that in its natural state, it will continue to provide high-quality habitat year-round.

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Masonboro Inlet Bird Surveys, 2009-2014: Preliminary Summary of Results

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Introduction

Natural coastal inlets are essential habitat for many shorebird species (Charadridae and Scolopacidae), as well as other coastal species, because they provide wintering and nesting habitat, stopover and staging sites during migration, an abundant food supply, and safe roosting areas. Shorebirds typically breed in the far north in order to exploit the seasonal abundance of food resources and during migration commonly stop over in coastal wetlands in order to refuel before continuing (Colwell 2010). In the southeastern U.S., the occurrence and numbers of shorebirds that use coastal habitats tends to be greater at inlet habitats than at other habitat types; seven species in particular, including the endangered and threatened Piping Plover (*Charadrius melodus*) and the proposed threatened Red Knot (*Calidris canutus rufa*), were found to be significantly more abundant at inlets than other coastal habitats (Harrington 2008). The USFWS Comprehensive Conservation Strategy for the Piping Plover (*Charadrius melodus*) in its Coastal Migration and Wintering Range in the Continental United States (2012), the USFWS Proposed Rule for Red Knots (2013), and the Red Knot Conservation Plan for the Western Hemisphere (Niles et al. 2010) all describe inlets as habitats "preferred" by Red Knots and non-breeding Piping Plovers.

Coastal habitats that are favored by shorebirds are increasingly being degraded or made entirely unsuitable for shorebirds; in North Carolina, 85% of inlets have been modified, and 57% of Atlantic coast inlets in the migration and winter range of the Piping Plover have been modified, including 43% which have been stabilized with hard structures (Rice 2012). Loss or degradation of wintering habitat, including that associated with coastal engineering projects, is identified as a primary threat in the Atlantic Flyway Shorebird Conservation Business Strategy (Winn et al. 2013), as well as in the USFWS Comprehensive Conservation Strategy for the Piping Plover (*Charadrius melodus*) in its Coastal Migration and Wintering Range in the Continental United States (2012), the USFWS Proposed Rule for Red Knots (2013), and Red Knot Conservation Plan for the Western Hemisphere (Niles et al. 2010).

Coastal engineering projects affect the survival of beach-nesting birds and migrating and wintering shorebirds and reduce critical shorebird food resources (Winn et al. 2013). Hard stabilization structures often eliminate existing shorebird habitats and prevent the formation of new shorebird habitats by interrupting the natural processes of overwash and inlet formation. Inlet stabilization projects fundamentally alter the naturally dynamic coastal processes that create and maintain beach and bayside habitats, including those habitat components that shorebirds depend on (USFWS 2013). Hard structures reduce the local supply of beach sediment by restricting natural sand movement, further increasing erosion problems (Morton et al. 2004, Morton 2003, Greene 2002, Cleary and Marden 1999). There is ample evidence of accelerated erosion rates, pronounced breaks in shoreline orientation, and truncation of the beach profile downdrift of perpendicular structures, and of reduced beach widths where parallel structures have been in place over long periods of time (Hafner

2012, Morton 2003, Scavia et al. 2002, Nordstrom 2000, Cleary and Marden 1999, Pilkey and Wright 1988). Inlets should not be stabilized with hard structure due to their ecological significance and the significant adverse environmental impacts that hard stabilization generates, and the current cumulative impacts of inlet manipulation along the U.S. Atlantic coast are significant and adverse (Rice 2009).

For many U.S. shorebird species, existing information is inadequate to quantify how anthropogenic alterations to the coast have affected shorebird populations at specific sites or to quantify shorebirds' habitat use. Shorebird surveys can provide population estimates, establish seasonal patterns of abundance, quantify distributions and habitat preferences, identify important stopover sites, assist managers in conservation decisions, and provide information to regulatory agencies. Adequate monitoring and research programs are among the highest priorities in shorebird conservation plans (Brown et al. 2001, Winn et al. 2013). Since shorebirds prefer inlet habitats over other coastal habitats, and since inlet habitats are threatened due to increasing coastal development, shorebird surveys should be conducted in these areas to provide baseline data for conservation.

Prior to 2007, data quantifying the year-round use of inlets in southeastern North Carolina by breeding, migrating, and wintering birds did not exist. In order to fill this knowledge gap, Audubon North Carolina (ANC) began conducting regular bird surveys at three area inlets in 2007: New Topsail Inlet, Rich Inlet, and Mason Inlet (Figure 1). The objective of these surveys was to document species composition, abundance, timing, and patterns of habitat use by shorebirds and other bird taxa. In July 2009, nesting Least Terns and Black Skimmers failed at Mason Inlet at the north end of Wrightsville Beach and colonized the south end of Wrightsville Beach at Masonboro Inlet. As ANC staff devoted time at the south end of Wrightsville Beach to monitor the nesting colony, bird surveys were instituted at Masonboro Inlet as well. This report summarizes the findings of these surveys from January 2010-September 2014.

Site Information and History

Masonboro Inlet is one of about 20 inlets in North Carolina. Located in southeastern North Carolina between heavily developed Wrightsville Beach to the north and undeveloped Masonboro Island to the south, Masonboro Inlet has been modified by the construction of a rock jetty on south Wrightsville Beach and a terminal groin on north Masonboro Island (Figure 2). The north jetty on the south end of Wrightsville Beach was completed in 1966, and within two years the channel repositioned itself (Clearly and Marden 1999). After several unsuccessful attempts to relocate the channel away from the north jetty with dredging, the construction of a terminal groin on the north end of Masonboro Island was recommended and the south jetty was completed in 1981 (Cleary and Marden 1999). Masonboro Inlet is also dredged regularly for navigation. Masonboro Inlet has no ebb or flood shoal islands as a result of the construction of the two jetties, and relatively few intertidal sandbars (Figure 2). Additionally, the jetty system in Masonboro Inlet has generated much controversy over the erosion that continues to afflict both Masonboro Island and Wrightsville Beach (Cleary and Marden 1999).

Being accessible by car (Wrightsville Beach) and easily accessed by boat (Masonboro Island and the rest of the inlet system, Masonboro Inlet experiences high levels of human use. Leashed dogs are allowed on Wrightsville Beach from October-March and prohibited from April-September, but the ordinance is broken regularly at the south end of the island. Dogs must be leashed year-round on Masonboro Island, but law enforcement is almost non-existent, and local custom is to allow dogs to run off leash.

Methods

During 2009-2013, logistical limitations prevented the entire inlet system from being surveyed with a boat. Therefore Masonboro Inlet was surveyed by foot from the south end of Wrightsville Beach, which provided a partial view of the inlet system, an area of about 2.4 km^2. The south side of the sandbars on Masonboro Island and the south channel of the inlet were not visible; bird detection and identification was challenging on all areas that were distant from the south end of Wrightsville Beach. During 2013, Masonboro Inlet was surveyed nine times by boat, twice in the winter and three times each during spring and fall migration. Areas not visible from a boat such as the ocean side of Masonboro Island were accessed by foot. This allowed for complete coverage of the inlet system and improved survey quality (Figure 3). Boat-based surveys were used exclusively in 2014.

Surveys were conducted on a weekly basis during shorebird migration (March-May and July-November); weekly during June in 2010, 2011, and 2013; and bi-weekly in winter (December-February). Surveys were suspended in June 2012 and 2014, at the height of the nesting season when ANC staff time was not available. Surveys were conducted at weekly intervals rather than at the 10-day International Shorebird Survey intervals to capture inlet use by migratory species such as Red Knot, Common Tern (*Sterna hirundo*), and Caspian Tern (*Hydroprogne caspia*), large flocks of which may stay for a week or less before departing.

The surveys focused on shorebirds and waterbirds, but all species were counted, with estimates used as a last resort when conditions did not permit a complete count of a large, moving flock or when other conditions prevented a direct count. At all times, efforts were made to avoid double-counting birds. Observations were made with 8x or 10x binoculars and a 20-60x spotting scope. In order to best assess abundance of shorebirds, preference was given to conducting surveys at high tide, but in order to reflect use of intertidal areas by species such as the Piping Plover, surveys were also conducted at mid and low tide.

The following data was recorded for each Piping Plover observation: coordinates of individual Piping Plovers or flocks, behavior, habitat, landscape, and substrate.

Figure 1. The study area, showing Masonboro Inlet to the south of Mason Inlet.

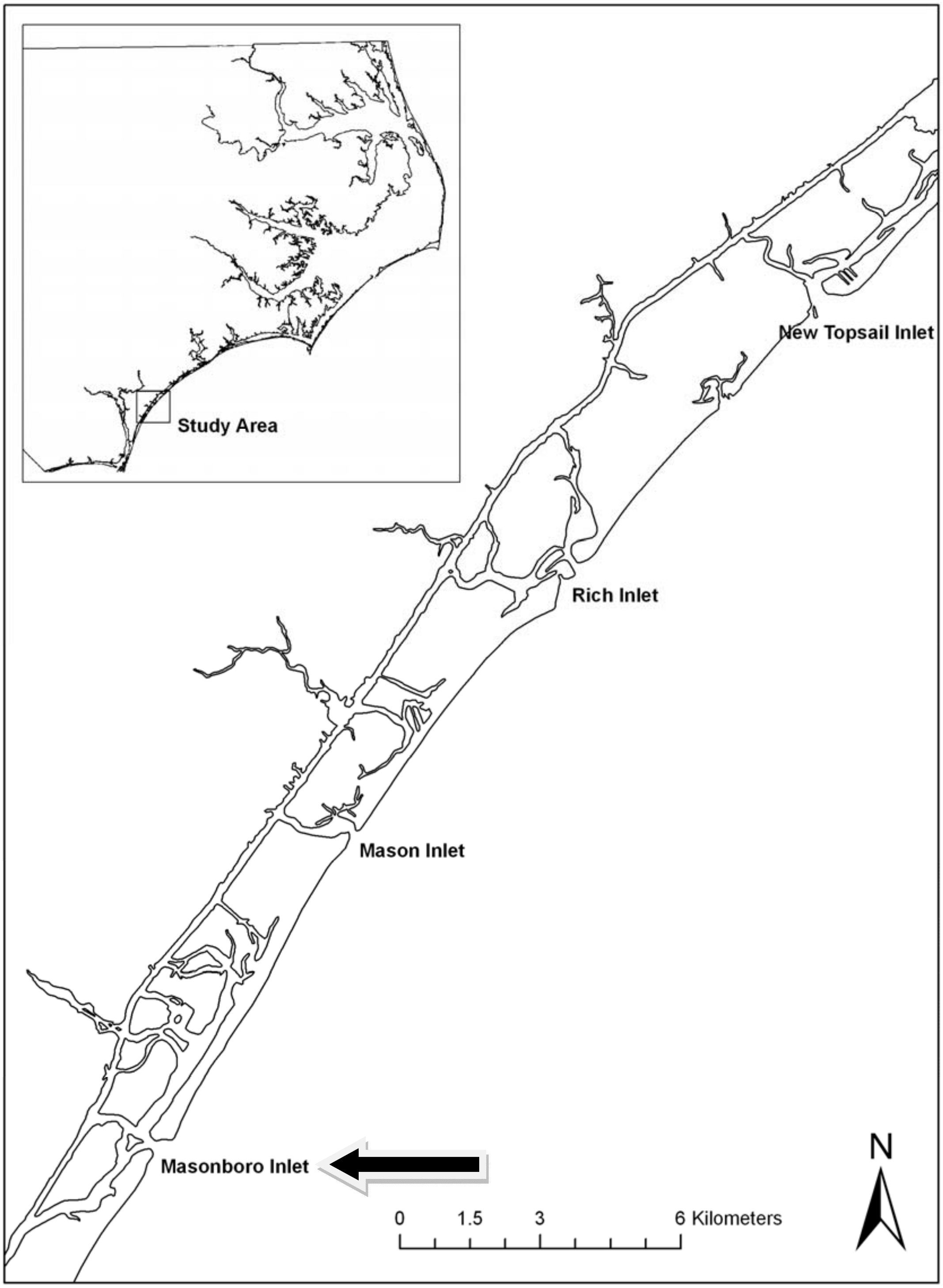


Figure 2. Aerial photographs of Masonboro Inlet from 1956-2013. The north jetty was completed in 1966 and the south jetty was completed in 1981 (Cleary and Marden 1999, Google Earth 2013).

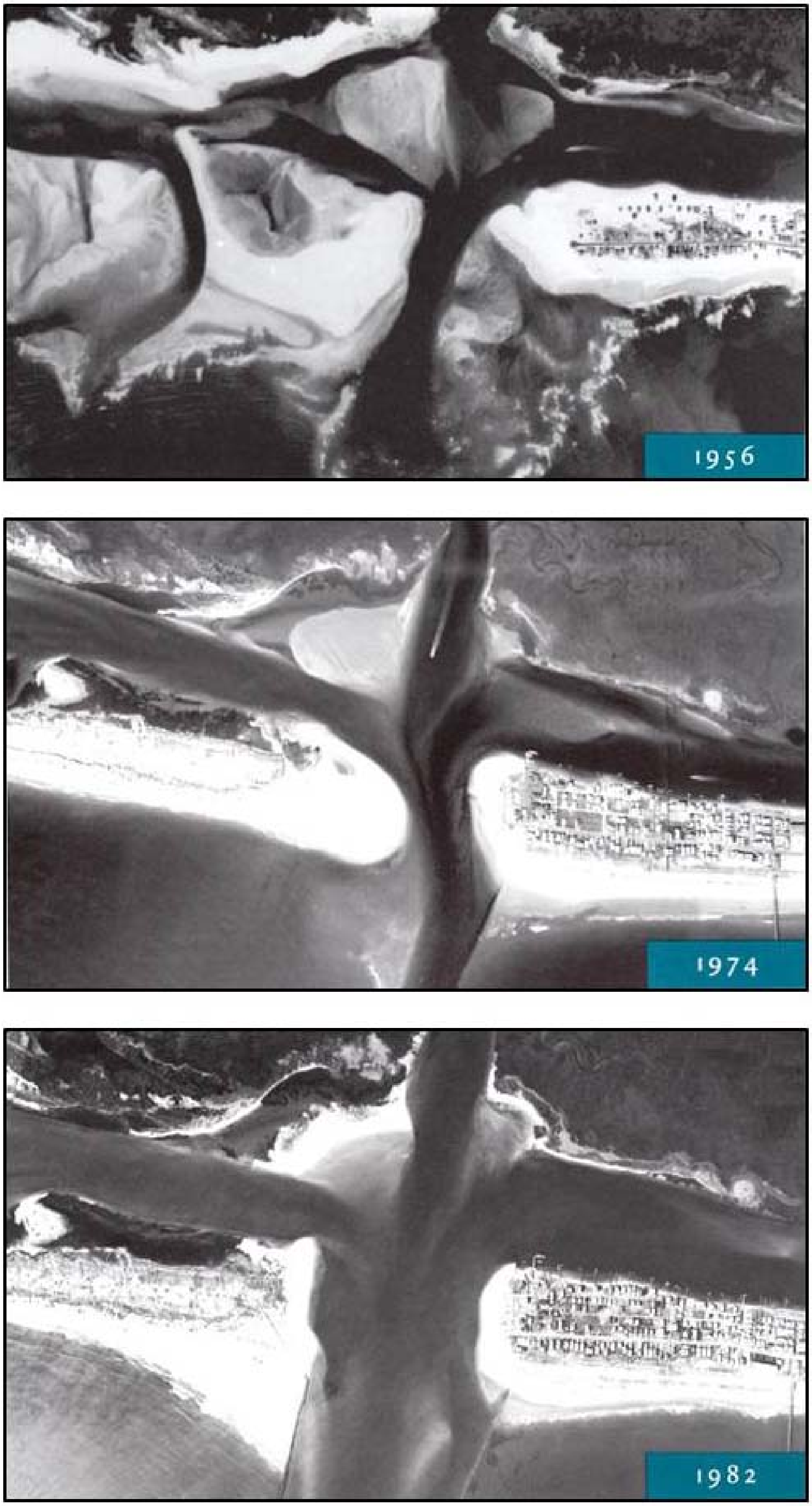


Figure 2. Continued.

Figure 3. The Masonboro Inlet survey areas by boat and foot.

Results

A total of 86,728 birds, representing 84 species were observed at Masonboro Inlet during 2010-2014 (Table 1). Some of these species prefer habitat that were difficult to survey during the foot-based surveys (Spotted Sandpiper *Actitis macularius*); some are urban birds that occasionally come to the beach from surrounding developed areas (Rock Dove *Columba livia*, Purple Martin *Progne subis*, Northern Mockingbird *Mimus polyglottos*, House Sparrow *Passer domesticus*, House Finch *Haemorhous mexicanus*); some are not species that typically use inlet systems (Red-tailed Hawk *Buteo jamaicensis*, Killdeer *Charadrius vociferus*). Others are often found at inlets, but the habitat they prefer may be scarce at Masonboro Inlet (Wilson's Plover *Charadrius wilsonia*, Red Knot). Conversely, the Purple Sandpiper *Calidris maritima* prefers rocky habitat and is not typically found at natural inlet systems, but is found on the rock jetties on the north and south sides of the inlet mouth.

Table 1: Species observed at Masonboro Inlet, January 2010-September 2014. Species are listed in phylogenetic order.

Red-throated Loon	Surf Scoter	Killdeer	Laughing Gull	Common Ground Dove
Common Loon	Black Scoter	American Oystercatcher	Ring-billed Gull	Rock Dove
Horned Grebe	White-winged Scoter	Greater Yellowlegs	Herring Gull	Common Nighthawk
Pied-billed Grebe	Bufflehead	Willet	Lesser Black-backed Gull	Belted Kingfisher
Brown Pelican	Hooded Merganser	Spotted Sandpiper	Great Black-backed Gull	American Crow
Great Cormorant	Red-breasted Merganser	Whimbrel	Black-legged Kittiwake	Fish Crow
Double-crested Cormorant	Turkey Vulture	Marbled Godwit	Caspian Tern	Purple Martin
Northern Gannet	Northern Harrier	Ruddy Turnstone	Royal Tern	Tree Swallow
Great Blue Heron	Cooper's Hawk	Purple Sandpiper	Sandwich Tern	Barn Swallow
Great Egret	Red-tailed Hawk	Red Knot	Common Tern	Northern Mockingbird
Snowy Egret	Bald Eagle	Sanderling	Forster's Tern	European Starling
Tricolored Heron	Osprey	Dunlin	Least Tern	Northern Waterthrush
Green Heron	Clapper Rail	Western Sandpiper	Gull-billed Tern	Savannah Sparrow
White Ibis	Black-bellied Plover	Semipalmated Sandpiper	Black Tern	Red-winged Blackbird
Canada Goose	Piping Plover	Least Sandpiper	Black Skimmer	Boat-tailed Grackle
Greater Scaup	Semipalmated Plover	Short-billed Dowitcher	Razorbill	House Finch
Long-tailed Duck	Wilson's Plover	Bonaparte's Gull	Mourning Dove	

Individuals of 25 species represented 97% of all birds observed at Masonboro Inlet. The 25 most numerous species by total number counted from 2010-2014 represent Scolopacidae, Charadriidae, Laridae, and one species each in Pelecanidae (Brown Pelican *Pelecanus occidentalis*), Phalacrocoracidae (Double-crested Cormorant *Phalacrocorax auritus*), and Haematopodidae (American Oystercatcher *Haematopus palliatus*) (Table 2). All but five species (American Oystercatcher, Willet *Tringa semipalmata*, Common Tern, Least Tern *Sternula antillarum*, and Black Skimmer *Rynchops niger*) do not breed at Masonboro Inlet. The majority of birds, by species richness and by total number of individuals, use Masonboro Inlet during migration and wintering, although large numbers of Least Terns and Black Skimmers have nested at the inlet since 2009.

Table 2. The 25 most abundant bird species observed at Masonboro Inlet by total counts and percent abundance during January 2010-September 2014.

Species	Total #	%	Species	Total #	%
Black Skimmer	19,133	22	Forster's Tern	1,061	1
Least Tern	10,225	12	Ruddy Turnstone	1,010	1
Dunlin	9,288	11	Bonaparte's Gull	831	1
Ring-billed Gull	6,282	7	American Oystercatcher	710	1
Herring Gull	5,559	6	Common Loon	576	1
Laughing Gull	5,219	6	Short-billed Dowitcher	563	1
Brown Pelican	5,103	6	Black-bellied Plover	540	1
Royal Tern	3,835	4	Willet	519	1
Sanderling	3,410	4	Purple Sandpiper	448	1
Semipalmated Plover	2,778	3	Caspian Tern	426	1
Double-crested Cormorant	2,244	3	Great Black-backed Gull	338	<1
Common Tern	2,203	3	Great Egret	285	<1
Sandwich Tern	1,761	2			

An additional 1,195 unidentified shorebirds (Scolopacids or Charadriids) and 2,415 unidentified Larids were counted on foot-based surveys. This is a greater proportion of unidentified birds than in other ANC inlet surveys; it is an artifact of the distance at which parts of the inlet were surveyed due to the lack of boat access. Most of the shorebirds were likely common flocking species such as Dunlin *Calidris alpina*, Sanderlings *Calidris alba*, or Semipalmated Plovers *Charadrius semipalmatus*. In comparison, on boat-based surveys 22 shorebirds and 33 Larids were unidentified.

Of the 84 species of birds recorded at Masonboro Inlet, 23 species (27%) are of conservation concern either as federally listed species, state-listed species or identified as declining or otherwise vulnerable (Table 3).

Table 3. Species of conservation concern observed at Masonboro Inlet, 2010-2014. FT=federally threatened, PFT=proposed federally threatened, NCT=North Carolina threatened, SSC=North Carolina species of special concern, BCC=USFWS birds of conservation concern in BCR 27, USSCP=U.S. Shorebird Conservation Plan highly imperiled or species of high concern;
* Birds from the federally endangered Great Lakes population winter at Rich Inlet.

Species	Status	Species	Status
Snowy Egret	SSC	Sanderling	USSCP
Tricolored Heron	SSC	Semipalmated Sandpiper	BCC, USSCP
Bald Eagle	NCT, BCC	Western Sandpiper	USSCP
Black-bellied Plover	USSCP	Least Sandpiper	USSCP
Wilson’s Plover	SSC, BCC, USSCP	Purple Sandpiper	USSCP
Killdeer	USSCP	Dunlin	USSCP
Piping Plover	FT*, BCC, USSCP	Short-billed Dowitcher	BCC
American Oystercatcher	SSC, BCC, USSCP	Common Tern	SSC
Greater Yellowlegs	USSCP	Least Tern	SSC, BCC
Whimbrel	BCC, USSCP	Gull-billed Tern	NCT, BCC
Marbled Godwit	BCC, USSCP	Sandwich Tern	BCC
Ruddy Turnstone	USSCP	Black Skimmer	SSC, BCC
Red Knot	PFT, BCC		

Peak species abundance by month shows patterns of seasonal use by commonly seen species (Tables 4-9). Increases in abundance between March-May and August-November indicate use of the inlet by migrating birds such as Sanderlings and Semipalmated Plovers. Higher counts in May and July indicate use of the inlet by nesting birds such as Least Terns and Black Skimmers. Only Dunlin used the inlet in large numbers during the winter.

The Red Knot *rufa* subspecies was proposed for threatened status under the Endangered Species Act in 2013 (USFWS 2013). Red Knots occurred in Masonboro Inlet in very small numbers in 2011, 2013, and 2014. The highest number recorded in all survey years was 16 in August 2014.

Table 4. Peak monthly abundance of commonly seen species at Masonboro Inlet, 2010. *=Total of all species seen, not only of the species listed.

	Month											
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
Black-bellied Plover	12	0	0	0	0	0	0	0	0	0	0	0
Semipalmated Plover	0	2	25	0	0	0	1	0	1	1	64	5
Piping Plover	0	0	0	0	0	0	1	0	0	0	0	0
American Oystercatcher	0	0	3	0	3	3	1	0	0	0	0	0
Willet	0	2	3	1	1	5	1	4	3	1	3	1
Whimbrel	0	0	0	0	0	0	0	0	0	0	0	0
Sanderling	20	27	29	3	0	0	6	3	6	9	9	24
Red Knot	0	0	0	0	0	0	0	0	0	0	0	0
Dunlin	130	70	300	0	1	0	0	0	0	0	440	70
Semipalmated Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0
Western Sandpiper	0	0	0	0	0	2	0	0	0	0	0	0
Least Sandpiper	0	0	0	0	0	0	0	0	0	0	2	0
Short-billed Dowitcher	0	0	0	2	0	0	0	0	0	0	0	0
Royal Tern	0	0	2	27	75	9	0	3	2	9	0	0
Sandwich Tern	0	0	0	15	7	2	0	0	0	1	0	1
Common Tern	0	0	0	6	1	2	4	2	2	0	0	0
Least Tern	0	0	0	33	17	240	300	137	0	12	0	0
Black Skimmer	0	4	0	100	64	112	100	204	54	0	0	0
All Species*	287	233	371	163	173	368	410	345	75	45	518	199

Table 5. Peak monthly abundance of commonly seen species at Masonboro Inlet, 2011. *=Total of all species seen, not only of the species listed.

	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Black-bellied Plover	0	0	0	11	4	0	3	5	7	17	3	4
Semipalmated Plover	2	0	0	2	22	0	0	19	33	24	73	16
Piping Plover	0	0	7	0	0	0	0	0	0	0	2	0
American Oystercatcher	2	3	4	3	3	6	7	6	2	0	0	0
Willet	1	4	1	17	4	5	4	5	8	1	4	5
Whimbrel	0	0	0	2	0	0	0	0	0	0	0	0
Sanderling	17	26	13	21	5	0	1	36	22	42	12	32
Red Knot	0	0	0	0	0	0	0	0	2	0	0	0
Dunlin	125	124	52	32	0	0	0	0	0	3	343	12
Semipalmated Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0
Western Sandpiper	0	15	0	0	27	0	0	1	4	11	0	0
Least Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0
Short-billed Dowitcher	0	0	0	0	0	0	0	0	0	0	0	0
Royal Tern	0	0	7	49	65	42	42	92	331	95	6	0
Sandwich Tern	0	0	3	66	11	0	0	15	87	130	22	0
Common Tern	0	0	29	8	5	1	23	71	137	8	0	0
Least Tern	0	0	0	114	266	414	298	25	1	0	0	0
Black Skimmer	0	0	0	0	0	0	0	0	0	0	0	0
All Species*	179	185	350	495	547	514	566	631	841	653	1036	307

Table 6. Peak monthly abundance of commonly seen species at Masonboro Inlet, 2012. *=Total of all species seen, not only of the species listed.

	Month										
	Jan	Feb	Mar	Apr	May	Jul	Aug	Sep	Oct	Nov	Dec
Black-bellied Plover	0	2	8	12	3	0	3	16	17	1	1
Semipalmated Plover	18	40	150	2	16	0	61	23	43	49	45
Piping Plover	0	3	0	2	0	0	2	0	0	0	3
American Oystercatcher	2	6	9	6	6	12	20	4	0	0	0
Willet	2	1	1	1	4	10	7	4	5	4	2
Whimbrel	0	0	0	0	7	0	0	0	0	0	0
Sanderling	5	74	63	25	20	15	23	29	17	35	8
Red Knot	0	0	0	0	0	0	0	0	0	0	0
Dunlin	240	386	384	0	0	0	0	0	0	397	162
Semipalmated Sandpiper	0	0	0	0	0	0	0	0	0	0	0
Western Sandpiper	0	8	3	0	0	0	0	0	0	0	0
Least Sandpiper	0	0	0	0	0	0	0	0	0	0	0
Short-billed Dowitcher	0	0	0	0	8	0	0	0	0	14	0
Royal Tern	0	0	0	37	45	26	122	42	38	3	0
Sandwich Tern	0	0	0	2	5	8	176	9	15	14	0
Common Tern	0	0	0	3	10	88	156	14	4	0	0
Least Tern	0	0	0	186	481	300	0	0	0	0	0
Black Skimmer	0	0	0	133	205	295	357	111	283	0	0
All Species*	511	781	775	455	755	636	894	408	719	743	262

Table 7. Peak monthly abundance of commonly seen species at Masonboro Inlet, 2013 during foot surveys. *=Total of all species seen, not only of the species listed.

	Month											
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Black-bellied Plover	2	3	4	9	11	0	0	4	1	2	3	8
Semipalmated Plover	0	0	0	0	1	1	0	78	14	0	34	6
Piping Plover	0	0	0	0	0	0	0	0	0	0	6	3
American Oystercatcher	2	8	2	6	9	8	15	15	1	0	0	0
Willet	4	1	0	3	3	4	6	12	4	2	5	1
Whimbrel	0	0	0	0	1	0	0	0	0	0	0	0
Sanderling	19	12	13	33	22	0	3	30	46	4	68	8
Red Knot	0	0	0	0	0	0	0	0	0	0	0	0
Dunlin	383	94	191	64	3	0	0	0	0	5	14	28
Semipalmated Sandpiper	0	0	0	0	0	0	0	0	0	0	0	0
Western Sandpiper	0	0	0	0	5	0	0	0	0	0	0	1
Least Sandpiper	0	0	0	0	0	0	0	0	0	0	1	0
Short-billed Dowitcher	0	0	0	0	0	0	0	5	0	0	0	0
Royal Tern	0	0	10	25	42	65	30	57	79	0	2	0
Sandwich Tern	0	0	0	6	24	1	0	21	5	0	24	0
Common Tern	0	0	0	19	11	15	14	45	186	0	0	0
Least Tern	0	0	0	78	255	257	296	54	0	0	0	0
Black Skimmer	0	0	2	95	236	249	387	339	98	59	217	0
All Species*	3735	298	467	354	609	626	619	528	459	343	946	475

Table 8. Peak monthly abundance of commonly seen species at Masonboro Inlet, 2013 during boat surveys. *=Total of all species seen, not only of the species listed; **=Fish kill.

	Month							
	Jan	Feb	Mar	Apr	May	Aug	Sep	Oct
Black-bellied Plover	3	5	6	22	10	13	4	0
Semipalmated Plover	0	0	55	143	237	59	26	0
Piping Plover	0	0	0	1	0	2	1	0
American Oystercatcher	0	11	8	13	16	8	1	0
Willet	2	2	0	4	11	6	3	0
Whimbrel	0	0	0	0	2	0	0	0
Sanderling	49	143	41	39	81	59	20	10
Red Knot	0	0	0	0	7	0	0	0
Dunlin	128	562	861	286	98	0	0	0
Semipalmated Sandpiper	0	0	0	0	23	0	0	0
Western Sandpiper	0	27	6	8	0	2	0	0
Least Sandpiper	0	0	0	0	1	1	0	0
Short-billed Dowitcher	0	0	2	36	119	0	2	0
Royal Tern	0	0	1	31	47	96	12	3
Sandwich Tern	0	0	0	13	40	23	3	0
Common Tern	0	0	0	3	10	140	38	0
Least Tern	0	0	0	89	150	0	0	0
Black Skimmer	0	0	0	18	183	206	179	38
All Species**	3907**	899	1168	877	1184	769	437	481

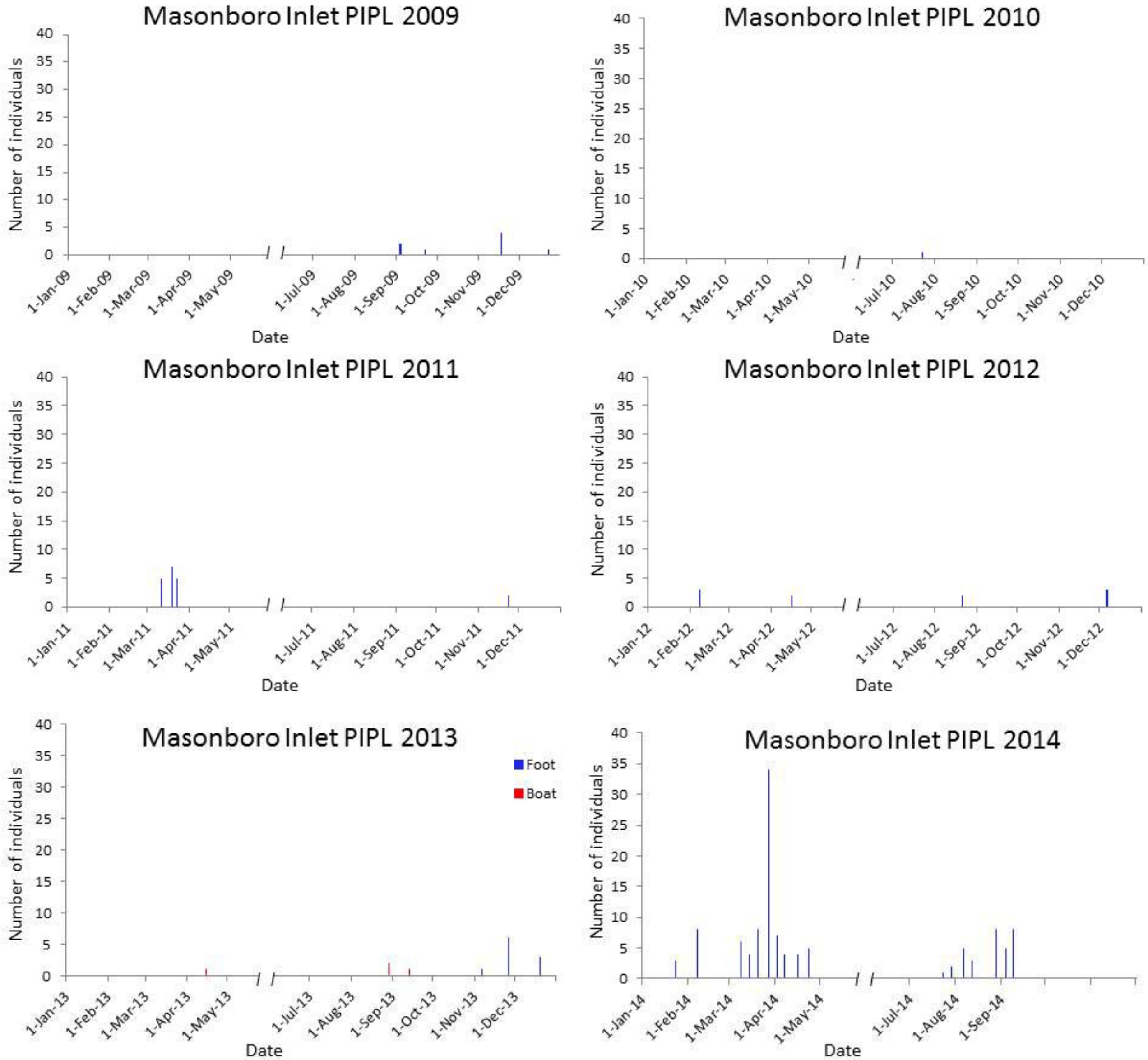
Table 9. Peak monthly abundance of commonly seen species at Masonboro Inlet, 2014 during boat surveys. *=Total of all species seen, not only of the species listed.

	Month							
	Jan	**Feb**	**Mar**	**Apr**	**May**	**Jul**	**Aug**	**Sep**
Black-bellied Plover	3	2	30	44	14	0	6	18
Semipalmated Plover	16	27	42	220	139	59	147	39
Piping Plover	3	8	34	7	0	2	8	8
American Oystercatcher	0	2	9	12	17	20	13	12
Willet	1	1	8	23	14	10	20	8
Whimbrel	0	0	0	4	4	1	6	0
Sanderling	48	15	92	136	61	28	56	26
Red Knot	0	0	0	0	9	0	16	1
Dunlin	128	88	453	427	77	0	0	0
Semipalmated Sandpiper	0	0	0	1	21	0	0	0
Western Sandpiper	1	0	5	15	0	3	7	1
Least Sandpiper	1	0	0	11	2	3	9	2
Short-billed Dowitcher	0	0	9	95	49	26	1	0
Royal Tern	0	0	13	99	69	52	37	60
Sandwich Tern	0	0	0	63	162	80	58	48
Common Tern	0	0	1	116	18	30	94	151
Least Tern	0	0	1	81	61	91	8	0
Black Skimmer	0	0	0	246	362	485	230	0
All Species*	623	595	760	1363	1052	836	621	638

Piping Plovers

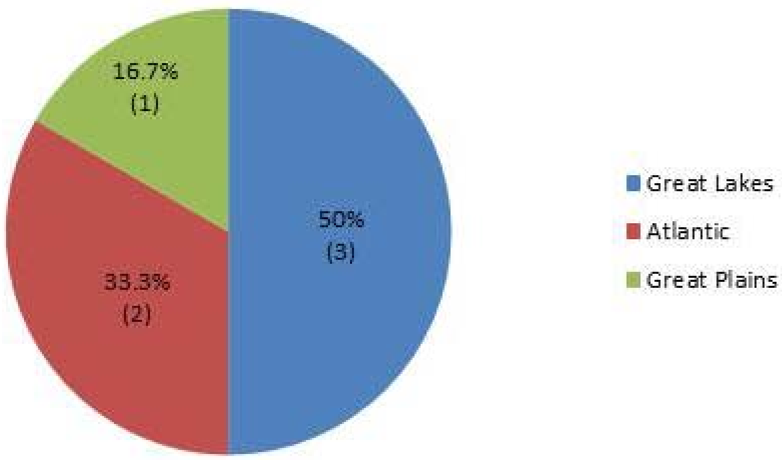
Piping Plovers usually occurred in small numbers at Masonboro Inlet, with increased counts in the spring and fall indicating more use by migrating individuals than by wintering birds (no Piping Plovers nested in the survey area or nearby areas on Masonboro Island during the survey years) (Figure 4). The difficulty of detecting Piping Plovers from a long distance makes assessing their use of the inlet prior to the beginning of boat surveys problematic, but winter 2013-2014 boat and foot surveys found between three and eight Piping Plovers, suggesting a small wintering population at the inlet. In all years, counts only exceeded eight on one occasion when in the spring of 2014 a flock of 34 was found roosting on the unnamed island west of Masonboro Island.

Figure 4. Peak monthly abundance of Piping Plovers using Masonboro Inlet during 2009-2014.



A total of 157 sightings of Piping Plovers were made from July 2009-September 2014. Eighteen of those sightings were of banded Piping Plovers. Six total individual Piping Plovers were identified representing all of the species' three breeding populations (Figure 5); a seventh bird's entire band combination could not be read.

Figure 5. Banded Piping Plovers by population at Masonboro Inlet.



Piping Plovers were seen on the island west of Masonboro Island, the south end of Wrightsville Beach, and both the bay and ocean side of the north end of Masonboro Island (Figure 6). Yearly differences in location of Piping Plover sightings reflect a small regular roost at the south end of Wrightsville Beach in 2009 and 2011 and improved survey area coverage when boat surveys began.

Of the 157 sightings of Piping Plovers at Masonboro Inlet during the study period, one of these was auditory only. As a result, no location, habitat, landscape, or behavior data were recorded. Of the 156 for which data are available, 65 sightings (41.7%) were of foraging birds, 84 (53.8%) were of roosting birds, and 7 (4.5%) were of other behaviors (being alert, walking, and preening).

Piping Plovers were most often observed roosting on Masonboro Island and the south end of Wrightsville Beach in areas that provided the birds with a clear view of their surroundings; foraging most often took place on sheltered shorelines on the sound side of Masonboro Island or in front of a sandbar projecting from island west of Masonboro Island (Figure 7).

Figure 6. Locations of individual or flocks of Piping Plovers at Masonboro Inlet, July 2009-September 2014.

Figure 7. Behavior of individual or flocks of Piping Plovers at Masonboro Inlet, July 2009-September 2014.

Landscape, habitat, and substrate type used by foraging and roosting Piping Plovers indicates their preferred foraging and roosting areas (Tables 10-13). Foraging most often took place on bay beaches (70.8% of foraging observations) and in intertidal areas (93.8%). Foraging substrate was most often sand (63.1%). Seven of the 17 sightings of Piping Plovers foraging on mud/sand were from a flock of seven found on a single day. As is expected due to Piping Plovers' preference for foraging in intertidal areas, most observations of foraging birds were made at mid or low tide.

Roosting Piping Plovers used bay beaches (53.5%), ocean beaches (29.8%), and inlet spits (16.7%). Roosting substrate was most often sand (98.8%); most roosting took place at high tide, when other substrates are usually covered by water.

Table 10. Percent of foraging, roosting, and other behaviors observed at different landscape types at Masonboro Inlet, July 2009-September 2014. * Other behaviors were alert, walking, and preening.

	Ocean beach	Bay beach	Inlet spit	Ebb shoal island	Flood shoal island	Sandbar	Tidal creek/lagoon
Foraging	15.4	70.8	3.1	0	0	10.8	0
Roosting	29.8	53.5	16.7	0	0	0	0
Other*	42.9	57.1	0	0	0	0	0

Table 11. Percent of foraging, roosting, and other behaviors observed at different habitat types at Masonboro Inlet, July 2009-September 2014. * Other behaviors were alert, walking, and preening.

	Intertidal zone	Fresh wrack	Old wrack	Backshore	Dune	Ephemeral pool
Foraging	93.8	4.6	0	1.5	0	0
Roosting	16.7	1.2	42.9	39.3	0	0
Other*	57.1	0	0	42.9	0	0

Table 12. Percent of foraging, roosting, and other behaviors observed on different substrate types at Masonboro Inlet, July 2009-September 2014. * Other behaviors were alert, walking, and preening.

	Sand	Mud/sand	Mud	Algal mat	Peat outcrop
Foraging	63.1	26.2	0	0	10.8
Roosting	98.8	1.2	0	0	0
Other*	100.0	0	0	0	0

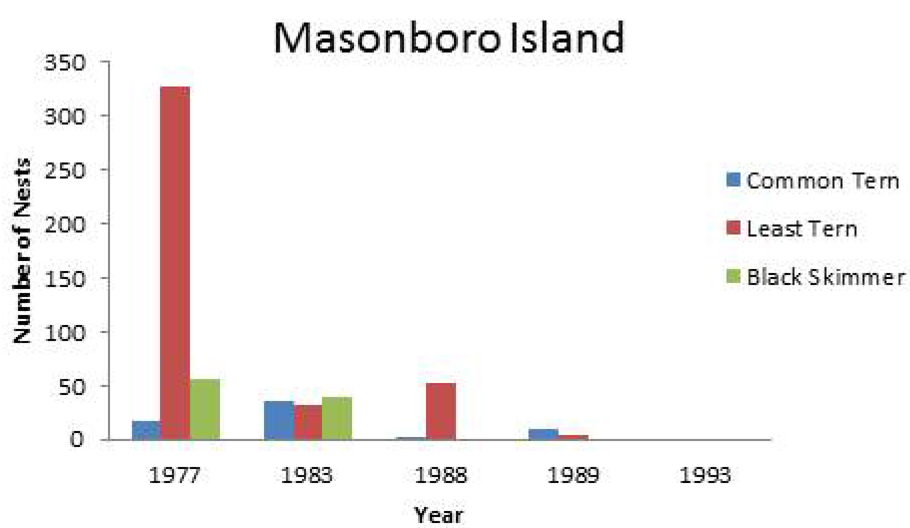
Table 13. Percent of foraging, roosting, and other behaviors observed at different tidal stages at Masonboro Inlet, July 2009-September 2014. * Other behaviors were alert, walking, and preening.

	High	Mid	Low
Foraging	26.2	50.8	23.1
Roosting	83.3	16.7	0
Other*	71.4	28.6	0

Nesting

Historically, large numbers of Least Terns, as well as Black Skimmers and Common Terns, nested on the north end Masonboro Island adjacent to the inlet (Figure 8). The sandy spit that the birds used for nesting was still in place in 1974, 12 years after the jetty was constructed on the south end of Wrightsville Beach; however, after the terminal groin was constructed on the north end of Masonboro Island, the spit was drastically reduced in size and, stabilized by the groin, it began to vegetate, becoming unsuitably overgrown in the mid-1980s (Figure 2). Numbers of nesting birds reflect this change in habitat. In 2013 and 2014 only one oystercatcher pair nested there. No nesting terns or skimmers have been recorded on the north end of the island since 1989, and aerials from 1990 on show no sandy nesting areas remain on the north end of Masonboro Island.

Figure 8. Colonial nesting species at the north end of Masonboro Island, 1977-1989 (NCWRC 2014).



Currently, several species nest in the Masonboro Inlet system, including the American Oystercatcher, Willet, Common Tern, Least Tern, and Black Skimmer (Table 14). However, the majority of the species and the vast majority of nesting individuals are located on the south end of Wrightsville Beach where a sandy spit forms between dredging events. The site was first colonized in 2009, and since then up to 597 pairs of Least Terns, 14 pairs of Common Terns, and 118 pairs of Black Skimmers have nested at the site along with one pair of Gull-billed Terns, four pairs of American Oystercatchers, and four pairs of Willets. These numbers represent up to 15% of North Carolina's nesting Least Terns and up to 20% of the state's Black Skimmers (NCWRC 2014).

Table 14. Species nesting in Masonboro Inlet by location during 2009-2014. * Nesting is undocumented but likely.

	American Oystercatcher	Willet	Common Tern	Least Tern	Gull-billed Tern	Black Skimmer
South Wrightsville Beach	X	X	X	X	X	X
Unnamed Islands	X	*				
Masonboro Island	X	*				

Discussion

Five years of shorebird surveys have detected patterns of phenology, abundance, and habitat use by many species using the Masonboro Inlet system. Terns and skimmers nesting at the south end of Wrightsville Beach increase counts during the spring and summer months, but use of the inlet by other species, including Piping Plovers, peaks during spring and fall migration. Although comparisons cannot be made in 2010-2013 due to differences in survey methods, Masonboro Inlet appeared to host smaller flocks of migrating and wintering shorebirds than other inlets in the study area during those years. The lower numbers of shorebirds would likely be due to a lack of suitable habitat, particularly intertidal flats. Gaps in foot-based survey coverage would also result in some birds at the inlet not being counted. However, during boat-based surveys, large flocks of shorebirds were not encountered in areas excluded or not counted well in the 2010-2013 surveys. In addition to the general lack of intertidal habitat, the sand material making up the bay beaches and small sandbars at Masonboro Inlet may be coarser-grained and lacking the fine-grained material found on low-energy intertidal flats where large flocks of foraging shorebirds are often seen.

Most of the unbanded Piping Plovers using Masonboro Inlet were likely Atlantic population birds, based on the population's known distribution and the absence of bands. Atlantic population Piping Plovers winter along the southern Atlantic seaboard and in the Caribbean, including the Bahamas; members of the Great Lakes population, which is almost entirely banded, winter on the southern Atlantic seaboard and into the Gulf Coast of Florida; and Great Plains individuals winter mostly on the Gulf Coast, but some also use the southern Atlantic seaboard (Gratto-Trevor et al. 2009).

During migration and wintering, Piping Plovers engage in two essential behaviors, foraging and roosting. A core wintering area or stopover site must provide habitat suitable for roosting, typically backshore above the high-tide line, and foraging, typically wet sand in low-energy intertidal areas that support invertebrates such polychaetes which are an important prey item for wintering and migrating Piping Plovers (Elliott-Smith and Haig 2004). Preference for sheltered sound-side beaches and flats during winter, and particularly while foraging, is consistent with other Piping

Plover studies (Haig and Oring 1985, Johnson and Baldassarre 1988, Wilkinson and Spinks 1994, Cohen et al. 2008). Such preferred habitat in Masonboro Inlet is not large. The terminal groin on Masonboro Island limits the formation of an inlet spit on Masonboro Island which might provide Piping Plover habitat, while the jetty on Wrightsville Beach allows a spit to form, but foot traffic and dogs make it less suitable for roosting Piping Plovers and other shorebirds. Although Piping Plovers tend to prefer ocean beaches for roosting (USFWS 2009), the greater use of bay beaches than ocean beaches for roosting may be an artifact of less survey coverage on Masonboro Island. Use of Masonboro Island by people and off-leash dogs may also drive Piping Plover to bay beach roost sites. Backshore on the inlet spit of Wrightsville Beach provided some buffer space between roosting Piping Plovers and human foot traffic and dogs.

Inlet systems are recognized as significant habitat for non-breeding Piping Plovers throughout the southeastern United States (USFWS 2012). Wintering Piping Plovers require a variety of habitats (Rabon 2006, Drake et al. 2001, Johnson and Baldassarre 1988), particularly mudflats associated with large inlets (Nicholls and Baldassarre 1990). However, aerial imagery (Figure 2) shows a small amount of the preferred intertidal foraging areas (sand or mudflats) relative to the size of the Masonboro Inlet system. Though Piping Plovers at Masonboro Inlet show generally expected migration and wintering landscape, habitat, and substrate preferences, the amount of suitable habitat at Masonboro Inlet has substantially decreased since the construction of the jetty and terminal groin.

Beach-nesting species such as Common Terns, Least Terns, Black Skimmers, and American Oystercatchers often nest in association with inlets. These species prefer open, sandy areas for nesting, and while ocean-facing beaches in North Carolina are generally too narrow to provide suitable nesting areas, these species often make use of the spits that naturally occur at inlets. If an area stabilizes and vegetation is not naturally removed by overwash, spits convert from open sand to vegetated dunes, making them unattractive to most nesting species. Willets, which nest in vegetation (Lowther et al. 2001), and American Oystercatchers (American Oystercatcher Working Group et al.), which will nest in a variety of habitats including among dunes, are notable exceptions. Patterns of nesting bird distribution before and after the construction of the jetty and terminal groin at Masonboro Inlet reflect such habitat alteration at Masonboro Inlet.

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