

# “The Coast” is Complicated: A Model to Consistently Describe the Nation’s Coastal Population

Brent W. Ache · Kristen M. Crossett · Percy A. Pacheco ·  
Jeffery E. Adkins · Peter C. Wiley

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**Abstract** Our nation’s coast is a complicated management area where no single delineation provides all of the demographic statistics needed to address the full range of policy and management issues. As a result, several different coastal delineations are currently being used, yielding a variety of US coastal population statistics. This paper proposes a simple model for generating and applying coastal population statistics at the national and regional level to increase consistency in coastal policy discussions and improve public understanding of coastal issues. The model includes two major components. The first component is “the population that most directly affects the coast,” represented by the permanent US population that resides in a standard suite of Coastal Watershed Counties, where land use and water quality changes most directly impact coastal ecosystems. The second component is “the population most directly affected by the coast,” represented by the permanent US

population that resides in a standard suite of Coastal Shoreline Counties that are directly adjacent to the open ocean, major estuaries, and the Great Lakes, which due to their proximity to these waters, bear a great proportion of the full range of effects from coastal hazards and host the majority of economic production associated with coastal and ocean resources.

**Keywords** Coastal population · Coastal counties · Coastal Watershed Counties · Coastal Shoreline Counties

## Introduction

It is difficult to describe the nation’s coastal population because no single delineation of “the coast” provides all of the demographic statistics needed to address the full range of policy and management issues (Crowell et al. 2007, 2010). As a result, several different coastal delineations are currently being used, yielding a variety of recent US coastal population statistics (NOEP 2009; Crowell et al. 2010; U.S. Census Bureau 2010; NOAA 2012a). Although each set of statistics can be useful in the appropriate context, they are sometimes applied inappropriately (Crowell et al. 2007), adding confusion to policy discussions and public understanding of coastal issues. For example, statistics on the population in coastal watersheds can be useful when discussing estuarine water quality, because people upstream can affect water quality downstream. These same population statistics, however, may be misleading if used when discussing coastal hazards such as tsunamis or hurricane storm surges.

Even when there is general agreement about a particular framework for population reporting, for example, shoreline-adjacent counties, slightly different county suites have been used. At least three Federal agencies—the U.S. Census, the Federal Emergency Management Agency (FEMA), and the

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B. W. Ache · K. M. Crossett (✉) · P. A. Pacheco  
National Ocean Service, Special Projects Division,  
National Oceanic and Atmospheric Administration,  
1305 East West Highway, N/MB7,  
Silver Spring, MD 20910, USA  
e-mail: kristen.crossett@noaa.gov

J. E. Adkins  
NOAA Coastal Services Center,  
National Ocean Service, National Oceanic and Atmospheric  
Administration, 2234 South Hobson Avenue,  
Charleston, SC 29405, USA

P. C. Wiley  
NOAA Coastal Services Center,  
National Ocean Service, National Oceanic and Atmospheric  
Administration, 1315 East West Highway, N/CSC,  
Silver Spring, MD 20910, USA

National Oceanic and Atmospheric Administration (NOAA)—have used different lists of shoreline-adjacent counties for the purposes of reporting coastal population. While rational arguments have been made for each delineation, an increasing number of researchers are calling for consistency in reporting US coastal population statistics (Nicholls and Small 2002; Crowell et al. 2007; Kruk et al. 2010; Lichter et al. 2011; Zhang and Leatherman 2011).

The authors propose a simple model for generating and applying coastal population statistics at the national and regional<sup>1</sup> level. This model builds on the long precedent of using counties as the geographic unit to delineate the coast for the purposes of reporting population (Culliton et al. 1990; Crossett et al. 2004; Henrie and Plane 2006; U.S. Census Bureau 2010). Although counties are a relatively gross level of political geography, their major benefit is easy translation of *what's in* and *what's out* to support policy discussions and public engagement. The model includes two major components:

- “The population that most directly affects the coast,” represented by the US population that resides in a standard suite of Coastal Watershed Counties where land use and water quality changes most directly impact coastal ecosystems; and
- “The population most directly affected by the coast,” represented by the US population that resides in a standard suite of Coastal Shoreline Counties that are directly adjacent to the open ocean, major estuaries, and the Great Lakes, which due to their proximity to these waters, bear a great proportion of the full range of effects from coastal hazards<sup>2</sup> and host the majority of economic production associated with coastal and ocean resources.<sup>3</sup>

If accepted by the larger coastal management community, the value of this model is increased consistency in national and regional level reporting of population and other demographic statistics. The model might also be used to consistently report complementary economic production statistics.

## A Proposed Model to Consistently Describe the Nation's Coastal Population

### The Population that Most Directly Affects the Coast

The NOAA Coastal Assessment Framework (CAF) is a comprehensive national framework of coastal, estuarine, and associated fluvial drainage units and provides a consistently derived, watershed-based spatial framework for

managers and analysts to organize and present information on the nation's coastal, near-ocean, and Great Lakes' resources. NOAA has derived a suite of Coastal Watershed Counties from quantitative associations with coastal watersheds delineated in the NOAA CAF (NOAA 2012b). When this county selection methodology is applied, a county is considered a Coastal Watershed County if one of the following criteria is met: (1) at a minimum, 15 % of the county's total land area is located within a coastal watershed, or (2) a portion of or an entire county accounts for at least 15 % of a coastal U.S. Geological Survey (USGS) eight-digit cataloging unit. This “15-percent rule” intends to identify counties that have a more substantial watershed-based impact on coastal and ocean resources. Nationally, five counties are counted as Coastal Watershed Counties that are exceptions to the 15-percent rule. Additionally, since the NOAA CAF does not include Alaska, Hawaii, or the U.S. Territories, all counties (boroughs and census areas in Alaska) that contain the intersection of the shoreline of the 2010 Census County Boundary and a USGS cataloging unit are also included as Coastal Watershed Counties. This affects all 5 counties in Hawaii, 25 counties in Alaska, and all counties within American Samoa, Guam, Northern Mariana's Islands, and U.S. Virgin Islands. All counties (or municipalities) in Puerto Rico are included. Figure 1 presents the location of the resulting 769 Coastal Watershed Counties. The NOAA Spatial Trends in Coastal Socioeconomics (STICS) Web site (NOAA 2012c) provides more detail on the county selection methodology and presents an associated map and summary table of the number of Coastal Watershed Counties by state/territory.

### The Population Most Directly Affected by the Coast

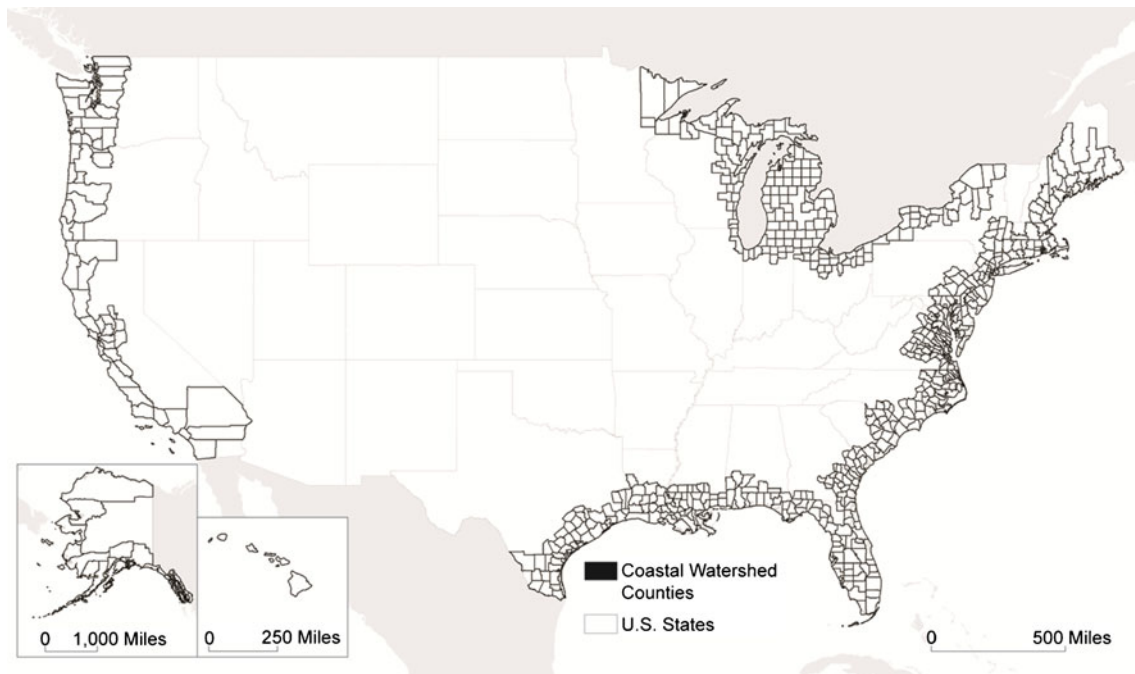
Shoreline-adjacent counties have been used to characterize the coastal population (NOEP 2009; Crowell et al. 2010; U.S. Census Bureau 2010), and because they are directly adjacent to the open ocean, major estuaries, and the Great Lakes, these counties bear a great proportion of the full range of effects from coastal hazards and host the majority of economic production associated with coastal and ocean resources. However, several different suites of “shoreline-adjacent” counties have been used, or could be used, for reporting coastal population. Table 1 presents a summary analysis of a subset of these county suites, each selected because of either its previous use to report coastal population or, in the opinion of the authors, its potential to serve this purpose.

Comparison using a geographic information system of the county suites presented in Table 1 suggests that the FEMA county suite will best serve as a standard suite of shoreline-adjacent counties that provides the minimum geographic footprint which is able to meet the coastal

<sup>1</sup> For example, the Gulf of Mexico region

<sup>2</sup> Not just storm surge

<sup>3</sup> For example, ports and beach front hotels



**Fig. 1** Location of the Coastal Watershed Counties. A list of Coastal Watershed Counties can be downloaded from the NOAA Digital Coast Web site at [http://csc.noaa.gov/htdata/SocioEconomic/NOAA\\_CoastalCountyDefinitions.pdf](http://csc.noaa.gov/htdata/SocioEconomic/NOAA_CoastalCountyDefinitions.pdf)

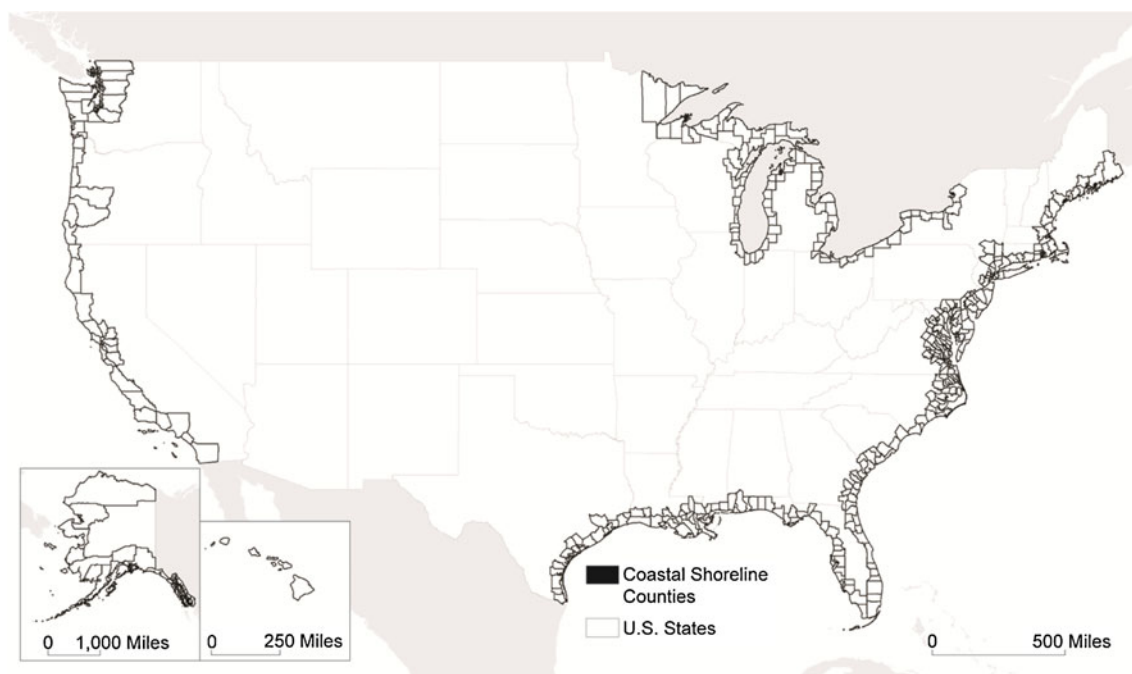
population reporting needs of various federal agencies. In addition, this county suite also has fewer major geographic gaps, as it includes the Great Lakes and the U.S. Territories. Therefore, the authors nominate the FEMA-defined shoreline-adjacent counties as Coastal Shoreline Counties.

The FEMA county selection methodology includes those counties that (1) have a coastline bordering the open ocean or Great Lakes coasts (or associated sheltered water bodies) or (2) contain FEMA-identified coastal high hazard areas (V-zones, coastal A-zones) (Crowell et al. 2010). Figure 2

**Table 1** Summary analysis of selected shoreline-adjacent county suites that have been used, or could be used, for reporting coastal population

| Source                           | General definition of county inclusion  | Total number of counties | Approximate percentage (%) of the 2010 US population | Notes on geographic extent  |
|----------------------------------|---|--------------------------|--|---|
| FEMA                             | Counties that (1) have a coastline bordering the open ocean or Great Lakes coasts (or associated sheltered water bodies) or (2) contain FEMA-identified coastal high hazard areas (V-zones and/or Coastal A zones) (Crowell et al. 2007, 2010)                                    | 452                      | 39   | Excludes unorganized atolls in American Samoa (Rose Island and Swains Island) |
| NOAA                             | Counties that intersect NOAA's Medium Resolution Shoreline. This shoreline extends inland to the head of tide (NOAA 2012e)  | 422                      | 42   | Excludes Alaska and U.S. Territories  |
| National Ocean Economics Program | Counties that intersect, in whole or in part, state Coastal Zone as delineated under the authority of the Coastal Zone Management Act of 1972, which are adjacent to an ocean, Great Lake, or included river or bay (NOEP 2009 and personal communication with NOEP) <sup>a</sup> | 355                      | 37   | Excludes U.S. Territories   |
| U.S. Census Bureau               | Counties adjacent to water classified as either coastal water or territorial sea in their Topologically Integrated Geographic Encoding and Referencing (TIGER) system (U.S. Census Bureau 2010)   | 311                      | 31   | Excludes Great Lakes  |
| U.S. Geological Survey           | Counties where some portion of the land was directly exposed to the Pacific Ocean, Atlantic Ocean, or Gulf of Mexico as identified by an intersection with the Coastal Vulnerability Index shoreline (Boruff et al. 2005)   | 219                      | 26   | Excludes Great Lakes  |

<sup>a</sup> NOEP 2009 reports demographic and economic statistics using a slightly different shoreline adjacent county suite than is considered here



**Fig. 2** Location of the Coastal Shoreline Counties. A list of Coastal Shoreline Counties can be downloaded from the NOAA Digital Coast Web site at [http://csc.noaa.gov/htdata/SocioEconomic/NOAA\\_CoastalCountyDefinitions.pdf](http://csc.noaa.gov/htdata/SocioEconomic/NOAA_CoastalCountyDefinitions.pdf)

presents the location of the resulting 452 Coastal Shoreline Counties. The NOAA STICS Web site (NOAA 2012c) provides more detail on the county selection methodology and presents an associated map and summary table of the number of Coastal Shoreline Counties by state/territory.

The FEMA National Flood Insurance Program regularly updates floodplain boundaries on its flood insurance rate maps, or FIRMs, and this process could potentially alter the associated suite of counties, if the same county selection methodology is applied in a few years. The authors propose that the current list of Coastal Shoreline Counties derived from this methodology at this time be used consistently through the release of the Census 2020. This approach will maintain a standard suite of Coastal Shoreline Counties, but allow periodic re-assessment of this county suite as floodplain boundaries change through time.

## Discussion and Conclusion

The proposed 769 Coastal Watershed Counties, inclusive of the Great Lakes region and the U.S. Territories, have been used for reporting coastal population statistics in the peer-reviewed literature (Henrie and Plane 2006; Strobl 2011; Brody et al. 2011), in federal agency reports and Web sites (Culliton et al. 1990; Crossett et al. 2004, 2008; Bricker et al. 2007; NOAA 2008, 2012a), and by nonprofit organizations (NOEP 2009; NACO 2012). The authors propose that the Coastal Watershed Counties continue to serve as a

standard suite of counties to be used when describing the population that most directly affects the coast. In 2010, 52 % of the nation's population lived in the Coastal Watershed Counties, representing less than 20 % of the nation's land area, excluding Alaska (NOAA 2012a). At the same time, the authors propose that the 452 Coastal Shoreline Counties, also inclusive of the Great Lakes region and the U.S. Territories, now begin serving as a standard suite of counties to be used when describing the population most directly affected by the coast. In 2010, 39 % of the nation's population lived in the Coastal Shoreline Counties, representing less than 10 % of the nation's land area, excluding Alaska (NOAA 2012d).

The authors recognize that the proposed model does not incorporate often significant influxes of transient visitors to the coast, for example, for summer beach vacations. This model is most appropriate for describing the permanent coastal population. The authors also recognize that there will be a need for other national and regional coastal population assessments where this model may not be appropriate, such as the population residing on coastal barrier islands (Zhang and Leatherman 2011). However, where the required assessment framework is similar to the coastal county suites proposed in this model, it will provide a good baseline from which to easily describe needed additions and exclusions. As an example, the NOAA Economics: National Ocean Watch, or ENOW, product, which describes the value of the ocean and Great Lakes-dependent economy (NOAA CSC 2012), includes economic production in Multnomah

County, OR, which contains the port of Portland. Currently, Multnomah County is not included in the proposed Coastal Shoreline County suite, but it is one of a few additions or exceptions. Lastly, even with acceptance of the proposed model, there is a continuing need to describe the coastal population that is most vulnerable to coastal inundation and long-term sea level rise, which will be more accurately described using a sub-county delineation of the coast.

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