Chapter 17
Measuring Habitat Changes in Barrier Island Marshes: An Example from Southeastern North Carolina, USA

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The rate of change of back-barrier land cover types was computed by gathering, rectifying, interpreting, and digitizing historical aerial photography (from 1938 to 1998) at Topsail Island in southeastern North Carolina. Marsh area has steadily decreased from 1938 to 1998. To quantify the significance of the spatial changes, cross-tabulation matrices were analyzed to create observed versus expected changes. Results indicate that when upland gains, it replaces marsh; when upland loses, marsh replaces it; when marsh gains, it replaces upland; when water loses, marsh replaces it; and there was no clear pattern for what transitions when marsh is lost. A series of tests were conducted to test the accuracy of the rectified photographs, the digitized polygons, and the change detection results. The accuracy of the photointerpretation and digitizing was greater than 80%. The digitized polygons were tested for degree of crenulation, or curviness, and also line generalization tests were conducted which indicated that the interpretation of the photographs was not a factor in the results. Third, a fuzziness test (using derived epsilon bands) was used to identify true changes in the marsh habitats versus positional changes, or sliver polygons. Results indicated that rectification of aerial photography (with an RMS error of less than 1), interpretation, and digitizing did not result in erroneous results. These accuracy assessment techniques are useful for testing the validity of change detection and spatial landscape indices.

17.1 Introduction

Traditionally the disciplines of demography, ecology, and environmental science have performed research independently. However, recently there has been more interdisciplinary research where these disciplines have collaborated using GIS and remote sensing technologies. In coastal environments, GIS and remote sensing have been utilized to address the relationship between population growth and health of
coastal ecosystems (Benfield et al. 2005, Conway 2005, Phinn and Stanford 2001, Ramessur 2002). The purpose for this chapter is to describe methods for mapping and analyzing barrier island salt marshes.

### 17.1.1 Population Growth in Coastal North Carolina

Population growth and decline vary throughout the United States. One popular method for analyzing the changing population is the national Census of Population which occurs every 10 years. From 1980 to 1990, the urban areas of the South, West, and coastal Northeast gained population while large Midwestern cities and rural areas substantially declined. From 1990 to 2000, population change was still largest along the coasts, but the non-coastal cities of Las Vegas, Phoenix, Dallas, and Chicago also grew substantially.

In North Carolina, population growth has been steady, as reflected throughout the southern United States. However, across the state there are spatial patterns of population decline in the rural areas, large population growth in the largest urban centers of Charlotte and Raleigh, and population growth along the southeastern coast (Fig. 17.1). Along the southeastern coast, Wilmington has experienced rapid growth in the city, bedroom communities, and surrounding beaches (Fig. 17.2). The urban area has spread from the City of Wilmington to include a majority of the surrounding counties spreading along major transportation routes and the coastal retirement destinations. The study area chosen for investigation is a typical developed barrier

![Figure 17.1](image)

**Fig. 17.1** North Carolina change in population, by Census Block Group, from 2000 to 2005