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The Impact of Land Use Patterns and Watershed Characteristics on China Lake, Kennebec County, Maine

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Introduction

China Lake is located in Kennebec County, Maine. Since 1983 the lake has suffered from yearly algal blooms as a result of the addition of excess nutrients. The nutrient load was amplified by erosion within the watershed. Erosion varies widely depending on a number of factors, including the slope of the land, the type of soil, and the way the land is being used. Certain land use types have a high potential to add nutrients to the environment, while others may help absorb excess nutrients and prevent erosion and runoff into the lake. A comprehensive examination of the China Lake watershed was completed using GIS to calculate the erosion potential for the entire area, taking into account past and present land use patterns. This information will help the towns around the lake to make informed decisions about future development and land management.

Study Area



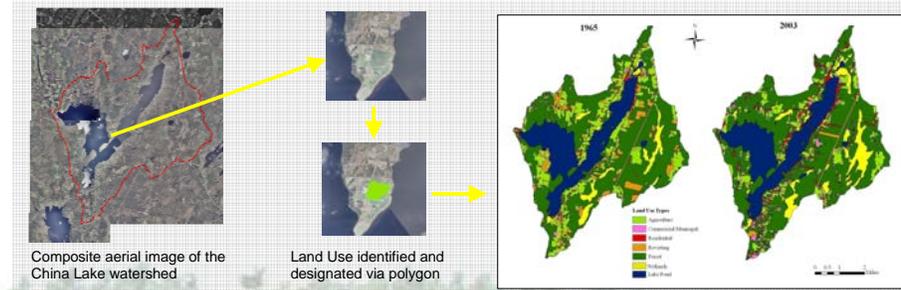
The China Lake watershed is situated within the townships of China, Vassalboro, and Albion. China Lake is located at 44.25° N and 69.33° W, an elevation of 59.1 m (194 ft), and covers a surface area of 1,604 ha (3,963 acres). The shores of China Lake are heavily developed with both seasonal and year-round residences. The lake itself is a popular recreation site and serves as the public water supply for several surrounding towns.

Methods

China Lake suffers annual algal blooms; this is in large part due to the excessive amount of nutrients entering the water through erosion from roads, lawns, and other land uses. Land use in the watershed was determined by analyzing and digitizing aerial photographs from 1965 and from digital orthophoto quadrangles created in 2003. Polygons were drawn, outlining each area of land use. A change map was created comparing the land use patterns from 1965 and 2003.

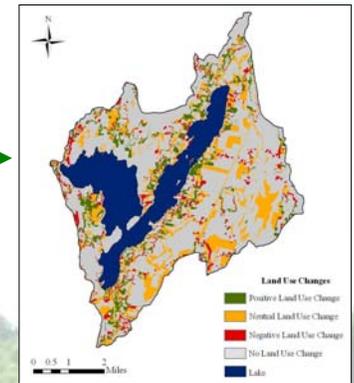
Data regarding the slope, soil type, and uses of land around China Lake were combined to create a model of erosion potential for the entire China Lake watershed. Slope values and soil types were downloaded from the Maine Office of GIS. Each of the maps were weighted according to their contribution to erosion (Land Use 50%, Slope and Soil Type 25% each) and were combined to form an overall erosion potential map for the watershed.

The Process of Land Use Digitization

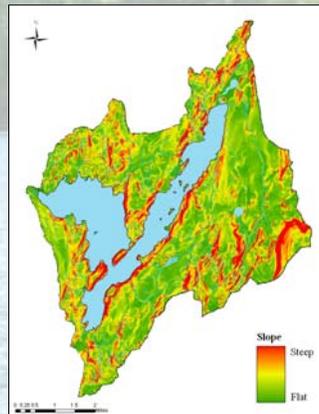


Aerial images of the China Lake Watershed from 1965 and 2003 were used within the GIS framework to designate and digitize different land use types. The 2003 land use map was used in our potential erosion model. A map of the land use change was also constructed. This map highlights the overall condition of the land, distinguishing between areas of positive and negative land use change.

Land Use Change 1965-2003

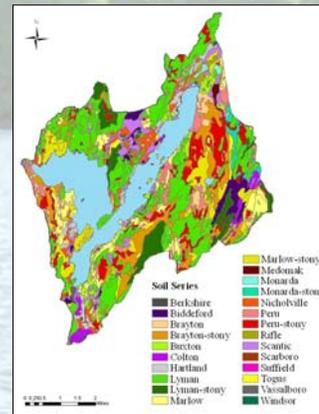


Slope (25%)



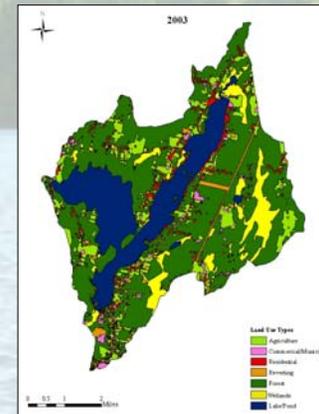
A model of slope values within the watershed. Steep areas are shown in red, flat areas are shown in green.

Soil Types (25%)



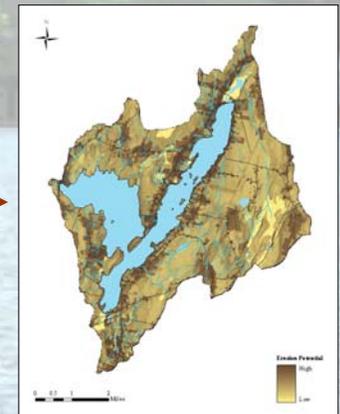
The various types of soil and their locations in the watershed.

Land Use (50%)



A map of the land uses around China Lake in 2003.

Erosion Potential



A model of erosion potential for all of the land within the China Lake watershed.

Results

Relevant changes in Land Use between 1965 and 2003

- Agricultural land decreased by 33%
- Residential land use increased by 250%
- Forest land remained relatively static, increasing by only 4%
- Wetlands increased by 31%
- Reverting land decreased by 64%

Area of Greatest Erosion Potential

Erosion potential is highest near the shores of the East Basin of China Lake. Generally the areas of greatest concern in regard to erosion run parallel to the East Basin throughout the entire watershed. This pattern is found not only close to the shore, but also within areas of high slope. The majority of the area of highest potential erosion is also the area of greatest development.

Recommendations

- Monitor land use development, particularly in proximity to shore line and with reference to slope and soil type
- Ensure that vegetative buffer strips are adequate near the shoreline
- Prevent high impact land use such as logging in areas of high slope and easily eroded soil
- Protect areas of land use that benefit water quality. For the China Lake watershed, this includes forests and wetlands that are able to slow rainfall velocity and reduce erosion
- Standardize and enforce land use and septic ordinances within the watershed
- Continue GIS monitoring of land use changes, noting relative percentages of developed and undeveloped land