

Community and Ecosystem Value of Golf Courses

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Collectively, golf courses contribute billions of dollars to the economy and create jobs for local communities. Golf courses also require inputs of water, nutrients and chemicals that can be expensive to maintain and detrimental to the environment. While these immediate direct costs and benefits are fairly well-understood, the indirect contribution to the landscape and the public is not as well-understood, and is motivating work to address the following questions: **(1) What contributions do golf courses make to the landscape within and around courses (ecosystem services)? (2) And how might development of these services affect enjoyment for golfers and other potential course-users?**

Stakeholders of the University of Minnesota Les Bolstad Golf Course (LBGC) community, including local residents, conservationists, resource managers, and individuals from local government and the golf industry, were engaged to advocate their interests during a Stakeholder Workshop. Outcomes of the workshop included documenting participants' perceptions of golf courses, and their assessment of the objectives and attributes that define the value of the greenspace that golf courses occupy. For example, biodiversity and water quality were identified as important attributes for greenspace, while stakeholders also expressed concern for reduced golfer experience as a tradeoff for enhancement of these ecosystem services (attributes).

A major aim of this project was to estimate the value of certain ecosystem services, including attributes related to water quality and biodiversity as identified in the stakeholder workshop, for the 135 golf courses in the Twin Cities Metro Area (TCMA). The Natural Capital Project's InVEST software was used to model carbon sequestration (landscape uptake), pollinator habitat, and nutrient (nitrogen and phosphorus) pollution in runoff. For the University of Minnesota's LBGC, additional models were used to estimate ecosystem services related to urban heat island and stormwater retention and nutrient transport. A **marginal value assessment** approach was used, in which the contribution of golf courses to (or against) a specific ecosystem service was determined by simulating the landscape's total change in the attribute in response to changing the golf course(s) to a different land use (i.e., city park, residential, mixed suburban, industrial, mixed natural, or agriculture). Key outcomes included:

Carbon:

- Greater tree cover increased carbon sequestration for all land uses.
- Relative to golf courses, residential and urban land uses reduced carbon sequestration, while parks and natural land uses increased sequestration.

Urban heat island:

- Simulating the effects of converting Les Bolstad golf course to residential land use resulted in a 0.17 °C increase in mean summer nighttime temperature in the vicinity of the golf course (see figure below).

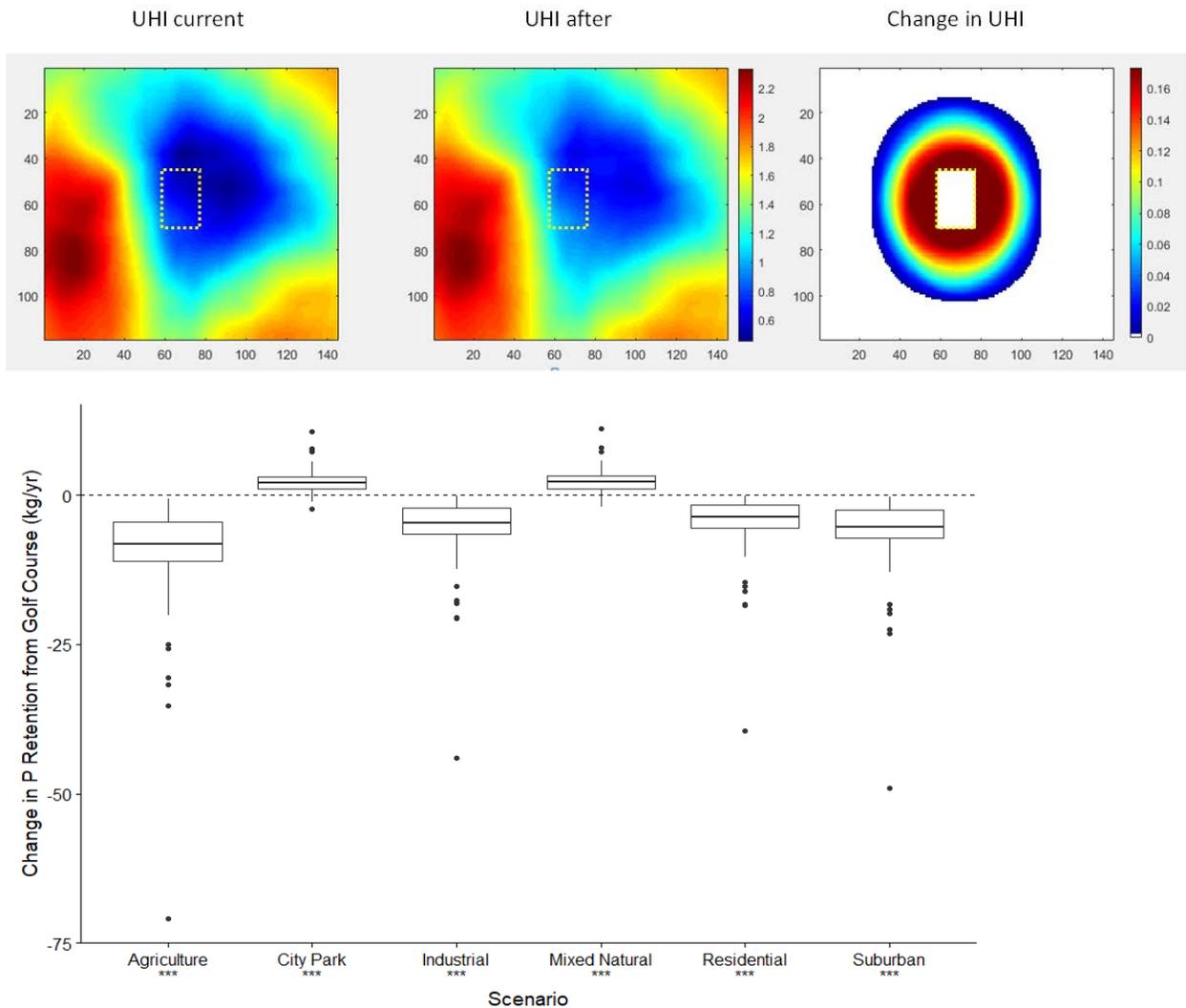
Pollinators:

- Areas surrounding the golf course were important, with natural areas boosting abundance and agricultural areas dampening it.

- For pollinator habitat, golf courses performed well compared to many alternative land uses in urban areas (with the exception of city parks), and larger acreage golf courses also had more pollinators.

Stormwater:

- Golf courses exported less nutrients than residential developments but more nutrients than natural landscapes and parks, due primarily to input (fertilizer) requirements for a golf course vs. a natural landscape. Flatter and larger golf courses also exported less nutrients than smaller or sloped courses.
- Infiltration of rainfall was much higher on the golf course and park land uses (>80% rainfall infiltrated) relative to the more developed, urban land uses.
- Golf courses with poor soil conditions (high slope, low infiltration capacity) demonstrated higher runoff volumes and nutrient export than the baseline golf course, producing export similar to a residential development.



Top: Increase in Urban Heat Island (mean nighttime summer temperature in degrees C) in the vicinity of Les Bolstad Golf Course (right panel) for a change from Current/Golf Course (left) to Residential Land Use (middle); **Bottom:** Change in Phosphorus retention in surface runoff for 6 land uses relative to a golf course (dotted line at P Retention = 0). Park and natural areas have greater retention than golf courses, the other land uses have less.