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DIGITAL STOCK

Until Franciscan missionaries like Juipero Serra created missions in the city (like the one above), San Diego was more often a pass-through city than a destination. But with a view of the shoreline like this (below), it was only a matter of time until it grew.

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Almquist found Seaport Village, just north and west of the Convention Center, among her favorites, with plenty of charming shops and the must-ride **Broadway Flying Horses Carousel**. Those in search of a more rambunctious experience might want to brave the **Bazaar del Mundo** (2754 Calhoun, 619-296-3161), where you'll find types of arts, crafts and clothes in an almost-festival atmosphere.

The scenic

To take in a sparkling sunset and maybe catch some whale watching, Auckland suggests getting to **Cabrillo National Monument** (1800 Cabrillo Memorial Drive, Pint Loma, 619-557-5450). This long, narrow peninsula sits on the western edge of north San Diego bay and is accessible only by driving through the U.S. Naval Air Station.

"The drive there is quite enjoyable," Auckland says. "The sunsets are spectacular, as you are high above and looking over the ocean."

It costs $5 to get in with a carload, or $3 if you walk in. At Cabrillo, park rangers will lead walks around the grounds, and there is a wonderful restored lighthouse in the park.

The historic

San Diego has an incredibly rich military pedigree, with no less than six bases, including the *Top Gun*-famous academy at Miramar and the behemoth U.S. Naval Air Station. The area is the home port for 50 ships, nearly one-sixth of the U.S. fleet. It is also home to 100,000 active-duty Marines. Just north of the airport is the **Marine Corps Recruit Depot**, which includes a 110-acre historic district that features 25 buildings that are listed on the National Register of Historic Places. You may recognize many of the sites from *Gomer Pyle, USMC*. To learn more about the history of the Marines, visit the **MCRD Command Museum** (1600 Henderson Ave., Building 26, Suite 212, 619-524-6038).

The beach

Setting one's bare feet to sand and staring at the Pacific is always time well spent, and **Mission Beach and Pacific Beach** are two of the more popular places for water fanatics of all stripes. Whether people watching, strolling, surfing or taking a ride on the Giant Dipper roller coaster at Mission Beach, San Diego offers 70 miles of coast. Ask a local to give you the lowdown, as sometimes surfers can be a bit territorial. The beaches are also a great place to find hole-in-the-wall taco stands that are cheap and good.

Keep in mind

Like any other major urban area, San Diego is not without crime. Know where you are going before you go there, make reservations for restaurants, don't drink and drive and, as always, don't flash around your wallet. Pack wisely and enjoy the show and the sun of San Diego.

DIGITAL STOCK

Luce is a Golfdom contributing editor.

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The Much Bigger Golf Business

BY GEOFF SHACKELFORD

The golf course business (green fees, dues, initiation, food and beverage revenue) generates around $16 billion annually. The golf course maintenance industry (labor, products) is a $9 billion annual business. The golf equipment trade (balls, drivers, Pat Boone white shoes) produces around $4 billion a year in sales.

Final score: golf course industry, $25 billion; equipment business, $4 billion.

Yet the golf course industry has quietly spent the last 80 years lengthening its courses, narrowing its fairways and, in general, responding to equipment advances at the expense of fun and affordable golf. Meanwhile, the USGA and PGA Tour tip-toe around the equipment manufacturers, fearful of upsetting companies that employ a tiny American work force and who generate a small percentage of golf industry revenues.

Two years ago, the USGA dropped its "optimization" ball test that would have put an end to companies skirting around its outdated Iron Byron test. The USGA scrapped this progressive test in favor of a refined Iron Byron, which has since been refined to work around balls already on the marketplace while leaving room for more innovation (i.e., distance).

The PGA Tour has adopted voluntary driver testing starting in 2004. The optional procedure puts an end to the revered tradition of pro golfers policing themselves. That's a big price to pay just to avoid upsetting manufacturers who can't be trusted to give their players conforming clubs.

The governing bodies and professional tours show absolutely no concern for the affects their policies have or will continue to have on the golf course industry. Layouts of all kinds have never been better conditioned on such a widespread basis, yet that's not enough. They need to get longer, narrower, faster, softer and fairer — all to keep up with the deregulated equipment industry.

Over the past 80 years, the golf course industry has responded with plenty of "championship," 7,000-yard, hard-equals-good, thread-the-needle, five-hour-round layouts. But the industry has not responded with nearly enough walkable, quirky, 6,200-yard courses with wide fairways and three-hour rounds.

IF SUCH A BALL IS INTRODUCED AND USED AT A FAMOUS CLUB (OR PERHAPS THE MASTERS), A MONUMENTAL MESSAGE WILL BE SENT

Some will point to how golf has grown thanks to equipment advances. We've all heard that golf has gone from 3.5 million players in the 1950s to nearly 27 million today.

The number is more like this: 3.5 million avid golfers back then and 5.9 million avid golfers today.

We heard again in 2003 from the higher-ups that golf will only attract new players and keep the alumni happy if everyone can buy the latest $500 driver or the latest $4 ball that the pros use. That freedom to buy what Tiger and Phil play is the "great thing" about golf, bellowed Curtis Strange during one of many lackluster 2003 golf telecasts.

However, 2004 might be the year something happens. USGA spokesman Marty Parkes confirms that the governing body is considering an addition to the rules that would allow tournament committees to invoke a local rule similar to the existing "one-ball condition."

This means tournament committees or courses could play by USGA rules, while giving them the right to require that a restricted flight competition or Classic Course Ball be used.

If such a ball is introduced and used at a famous club (or perhaps the Masters), a monumental message will be sent: that golf is played to experience the joy of taking on a design, and furthermore golf courses no longer will work around the needs of equipment manufacturers, who are opposed to regulation of any kind.

Ironically, if the golf business stabilizes or grows thanks to a legitimate focus on fun, affordability and shorter rounds, these same equipment industry folks might grow their little $4 billion industry. But they have a long way to go before catching up to the much bigger golf course business.

Contributing Editor Geoff Shackelford can be reached at geoffshackelford@aol.com.

Golfdom's PRACTICAL RESEARCH DIGEST FOR TURF MANAGERS

TURFGRASS TRENDS

ENVIRONMENTAL SAFETY

Nitrogen Fertilization

Does application on the golf course cause water-quality problems?

By Thomas Rufty and Daniel Bowman

North Carolina shares the concerns felt in many areas of the United States about the quality of water supplies. This is especially acute in eastern North Carolina, where periodic algal blooms and fish kills occur. The main culprit in these environmental systems is nitrate nitrogen.

Many articles have been published in the popular press stating that golf course fertilization is a main cause of water-quality problems, but there has been little scientific basis for this conclusion.

We initiated a study several years ago to determine whether golf course fertilization might actually be an environmental problem. When the project began, it quickly became obvious that past research would not supply the answer. Many recent water-quality research projects focused on fertilizer run-off. It seemed unlikely, however, that run-off was a major problem in North Carolina river basins because best management practices (BMPs) are commonly used.

> We have found no evidence that fertilization of fairways causes an increase in nitrate in adjacent streams.

The BMPs for turfgrass fertilization were established by North Carolina State University research/extension faculty many years ago and are widely followed by turfgrass managers throughout the state. They specify that fertilizers should not be applied before anticipated rain and prescribe light watering at the time of application to ensure rapid biological use. Most superintendents are well informed and closely adhere to BMPs to minimize adverse environmental impacts and to control their own costs.

If fertilizer run-off were not a problem, then the main concern would be nitrogen leaching downward in the soil. Indeed, information coming from environmental studies with natural and agronomic systems indicated that nitrate losses occurred primarily through leaching and not surface run-off (Osmond, Gilliam and Evans, 2002).

Nitrate leaching in turfgrass systems had been addressed in research funded by the USGA, but almost all experiments were done on newly constructed plots. Because soil characteristics and the ecology of established turfgrass fairways are different from those in constructed plots, there was no way to extrapolate from the USGA project results to a landscape scale.

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IN THIS ISSUE


it's not about
EMPTY PROMISES

FIGURE 1

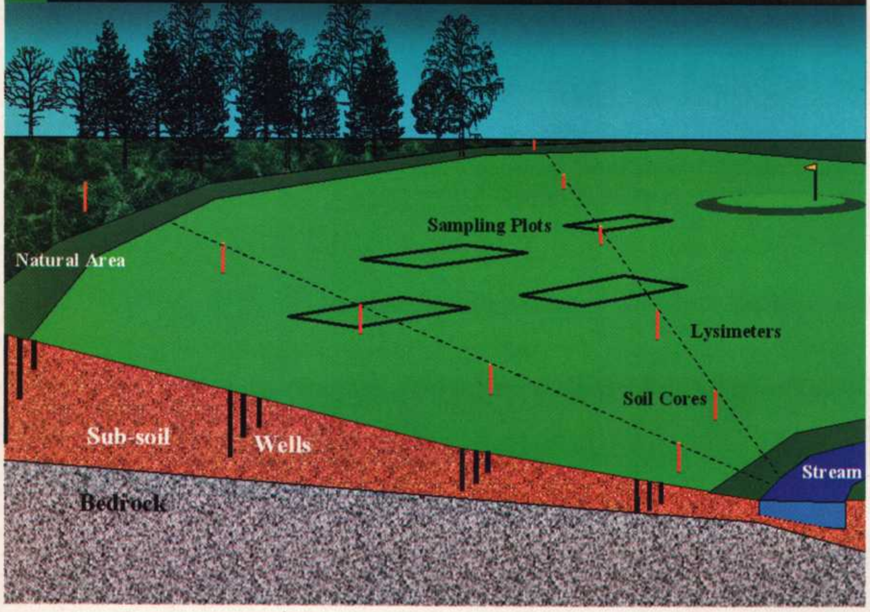

Figure 1: Experimental design for environmental studies at 10 golf courses in eastern North Carolina. Nitrogen fate was followed by analysis of samples from clippings, soil cores, soil solution, shallow wells and streams.

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The research approach

To try to clear up the issue of whether North Carolina golf courses were a major cause of water pollution, we initiated an extensive field research project to follow the fate of nitrogen in bermudagrass fairways. The goal was to develop a nitrogen budget that would account for uptake by bermudagrass, retention and downward movement of nitrogen in the soil profile and any loss of nitrogen (N) into adjacent streams and lakes.

The scope of the project dictated its complexity. Detailing N movement requires crossing several scientific disciplines, including turfgrass agronomy and physiology, soil physics and hydrology, and soil microbiology. As a consequence, a group of research faculty was assembled with expertise in each of the disciplines. The large project was made possible by environmental research grants from the North Carolina legislature and the Turfgrass Council of North Carolina, which offered support even with the prospect of negative results for the turfgrass industry.

Experimental sites were established on 10 golf courses in eastern North Carolina. The locations were chosen based on several criteria. One was that they represented a variety of soil types, because soil texture strongly influences leaching. Secondly, we wanted to examine golf courses of different ages, thinking that older courses could have different levels of organic matter and compaction than younger ones. Thirdly, it was important that the research be located on golf courses willing to cooperate and put up with our intrusion.

As shown in Figure 1, multiple plots were established on each site for periodic collection of clippings during the bermudagrass growing season. Transects were run from adjacent natural areas, across roughs and fairways to a stream. Four transects were used at each site to allow appropriate statistical analysis of data. Soil cores were taken to a depth of 4 feet, four times a year (bracketing fertilization periods) along the transects to resolve patterns of nitrate accumulation in the soil profile.

Suction lysimeters were installed at 6-, 12-, and 18-inch depths, which allowed direct sampling of soil solution for nitrate analysis. The lysimeter samples were collected weekly. "Nests" of shallow wells, 8 feet to 20 feet deep, were installed for sampling of subsurface water flows. Water samples were collected weekly from streams at points where they entered and exited the golf course.

As implied above, this was the first comprehensive study of nitrogen fate in bermudagrass fairways in a natural setting. The experiment ran for three years, and the superintendents were asked to maintain their normal management practices throughout. The general fertilization protocol in this geographical area is to supply 2.5 pounds to 3.5 pounds of nitrogen per 1,000 square feet per year, mostly during the bermudagrass growing season from May through September.

Expected results

Our initial expectation was that we would find high nitrate levels in soil solution and subsurface water beneath the turfgrass system. Consequently, there was a high potential for water pollution. This came from simple reasoning:

- The golf courses ranged from 10 years to 100 years old and, even in the youngest, soil organic nitrogen levels should have been in equilibrium or approaching equilibrium. That meant soil organic nitrogen levels were stabilized and would not increase from year to year.

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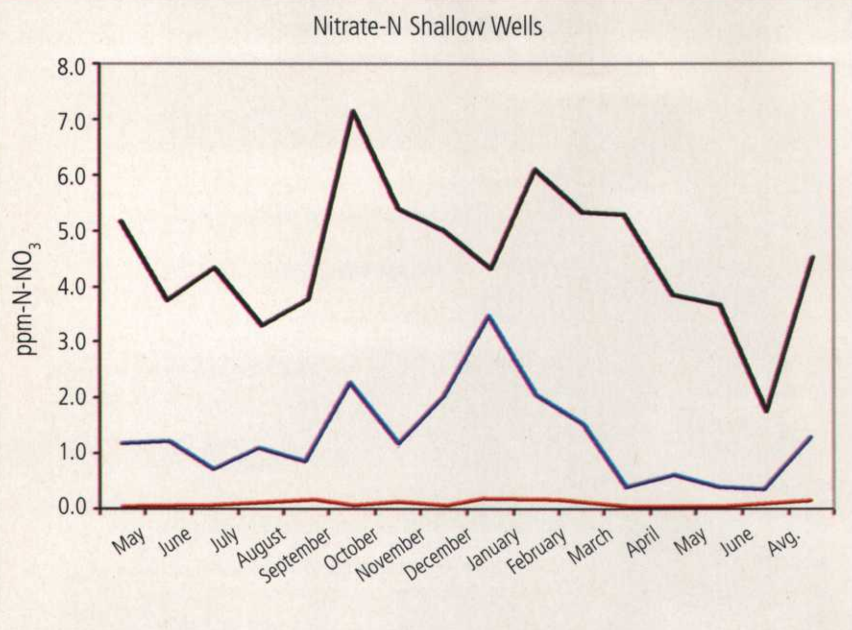
FIGURE 2



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■ Since clippings were not removed from any of the sites, fertilizer inputs should approximate losses. Taking into account fertilization rates and yearly rainfall (about 45 inches per year), it was estimated that groundwater should contain about 50 parts per million (ppm) to 100 ppm nitrate.

From the earliest analyses, it became evident that our initial expectations were wrong.

Nitrogen in the turfgrass/soil system

One of the initial surprises in the study was the realization that more nitrogen was being incorporated into clippings during the growing season than was being supplied in fertilizer.

Nitrogen uptake efficiency was calculated from the clipping harvests and analyses, and values generally ranged from just over 100 percent to as high as 300 percent. The calculation indicates that nitrogen was being rapidly cycled in the system. For example, fertilizer N was taken up into the grass, cut clippings were rapidly being degraded by soil microbes — releasing N back into the soil, and the soil N was being reabsorbed by the turfgrass.

The soil cores revealed that nitrate levels in the soil profile beneath the turf were always very low, ranging from 1 to 3 milligrams (mg) per kilogram of soil. (Lee et al., 2003). The levels were similar to those found in natural areas adjacent to the course that were not fertilized, and much lower than those reported in studies with fertilized agricultural crops.

The nitrate levels were uniformly low with depth from the soil surface, so there was no indication of accumulation anywhere within the soil profile. Also, nitrate was not elevated in the days and weeks following fertilizations, probably reflecting the high uptake efficiency by the turfgrass.

Samples from the lysimeters, which were taken with greater frequency, also indicated that soil solution nitrates were low.

The placement of wells allowed sampling of subsurface water as it flowed beneath fertilized fairways from higher natural areas to low-lying streams. The subsurface flows would contain nitrates that leached downward through the soil to the water table. There were two major findings (Figure 2, see Adams 2001 for details).

First, some elevation in nitrates could be seen as subsurface water moved from unfertilized, natural areas to the fairways, but levels were relatively low, ranging from approximately 2 ppm to 8 ppm. This is much lower than the predicted 50 ppm to 100 ppm range.

Second, and more importantly, nitrates declined to almost undetectable levels (less than 1 ppm) as the flow approached streams.

From the earliest analyses, it quickly became evident that our initial expectations were wrong.

The water samples contained high levels of dissolved organic carbon (8 ppm to 20 ppm). The high carbon levels, coupled with anaerobic conditions, presumably led to denitrification. For example, transformation of nitrates to nitrogen gas that was released into the atmosphere.

In agricultural fields, leaching of fertilizer nitrates generally leads to nitrate accumulation in the soil that bleeds into adjacent streams or lakes over extended time periods. We have

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