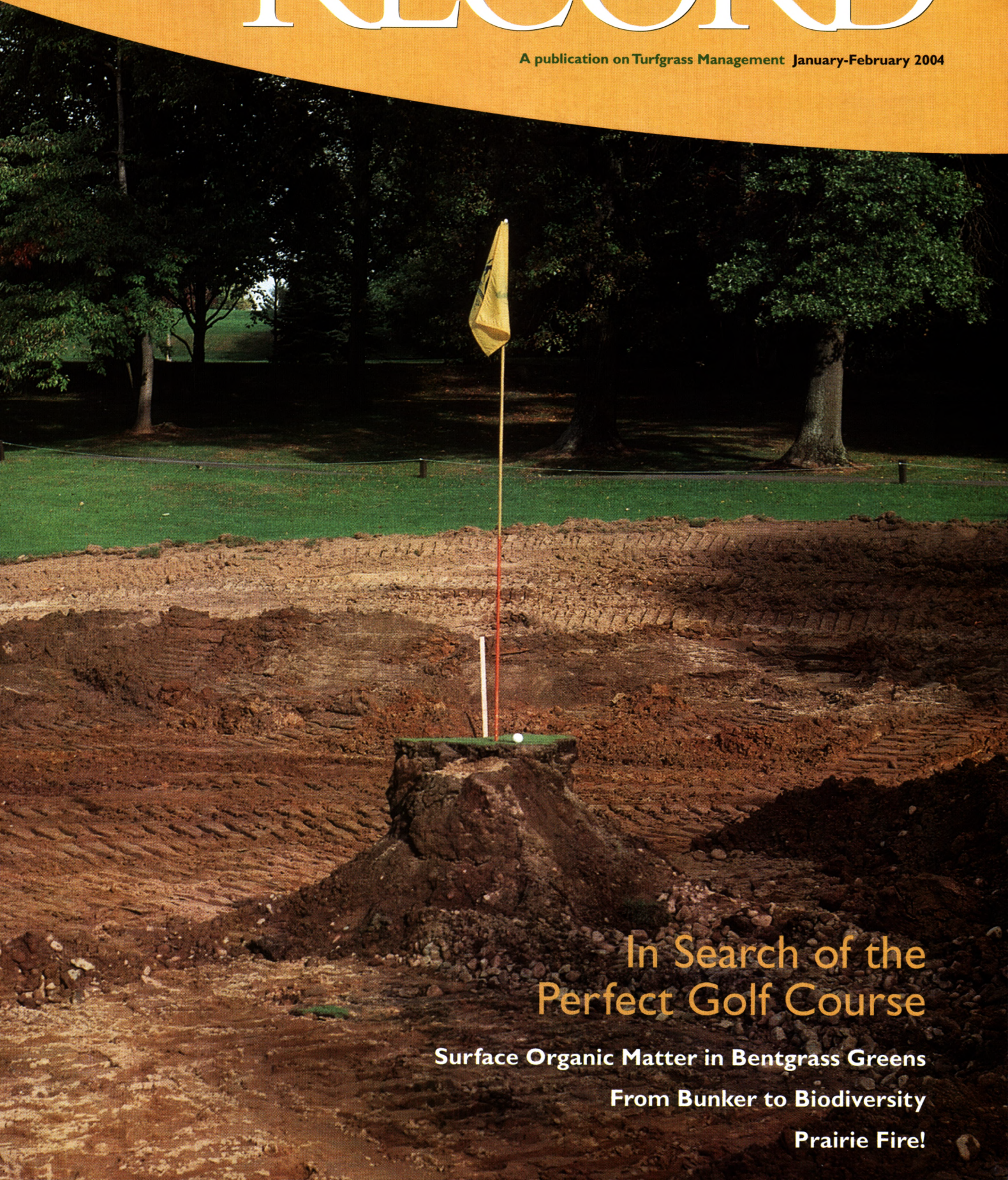


USGA GREEN
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RECORD

A publication on Turfgrass Management January-February 2004



In Search of the Perfect Golf Course

Surface Organic Matter in Bentgrass Greens

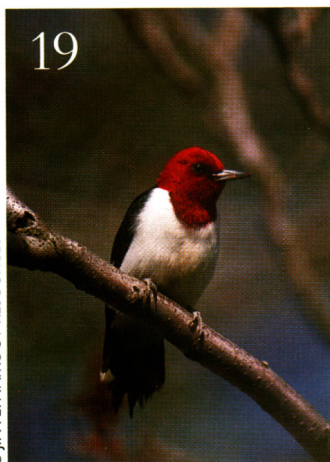
From Bunker to Biodiversity

Prairie Fire!

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Although perfect golf courses are hard to find, good ones are created from the ground up.



IN SEARCH OF THE PERFECT GOLF COURSE

“Perfection has one grave defect; it is apt to be dull.” — W. Somerset Maugham

BY JAMES H. BAIRD

It has become routine to hear golfers state that “the course down the road does not aerate, always has fast greens, and never loses a blade of grass” in spite of the worst weather that Mother Nature could dish out. In other words, the course is perfect! Considering that the Green Section visits roughly ten percent of the more than 17,000 courses throughout North America, could it be possible that we have not seen this utopian golf course? After all, is there really any need to ask for assistance when you’re perfect?

Well, if you’re into lists of who’s the best, then you’ll be interested to know that, at one time or another, the Green Section has conducted Turf Advisory Service (TAS) visits on 93 out of a popular golf publication’s America’s 100 Greatest Golf Courses for 2003–2004. Are all of these golf courses great? You bet. Are they perfect golf

courses? Hardly, but first let’s define *perfect*. According to Webster’s Dictionary, *perfect* is “being entirely without fault or defect.” How then, could 100–200 acres of highly trafficked turf, trees, water, and sand ever be considered perfect? Judging by golfer complaints and demands that prompt many TAS visits, it seems no longer acceptable to have even the smallest area of brown, thin, or bare turf anywhere on the golf course, or turf disrupted by cultivation practices (i.e., aeration), or imperfect lies in bunkers or rough, or earthworm castings, just to name a few.

It is about as unrealistic to expect perfect conditions on the golf course as it is to expect a perfect 18-hole score in golf. More importantly, one has little to do with the other. Then, why is it that some outside agent (possibly poor course conditions) is frequently blamed for a poor round of

Have golfers gone too far in their quest for perfect bunkers?

golf, whereas good conditions rarely get the credit for a great round? By definition, there can be no such thing as a perfect golf course; however, some are less imperfect than others. This article discusses the key elements that can help improve your golf course as well as those that make perfection a very lofty goal.

ARCHITECTURE

Like them or not, various lists or rankings of the “best” golf courses tend to recognize one nearly



Although shale does not represent the best golfing soil, it is indicative of the poor soil upon which many golf courses are built.

indisputable characteristic — great architecture. Classic courses designed by the likes of Banks, Emmet, Flynn, Macdonald, Raynor, Ross, and Tillinghast are “perfect” because they were meant to be imperfect. They were natural before natural was in style, shaped largely by the hands of Mother Nature. Some golfers now realize the beauty in the imperfection and embrace it. Features like tall, sparse grass growing in the rough and around jagged-edged bunkers, and firm, fast, and sometimes brown turf are expected. For others, these are the very signs of a golf course gone awry or a superintendent not doing a good job. Courses like these are the antithesis of the manicured, resort-style golf course or many of those seen on television. The bottom line is, regardless of architectural preference, courses do not have to be perfect to be good.

ENVIRONMENT

“I don’t want to hear any excuses about the weather,” exclaims the perfectionist golfer. After all, bad weather has no effect on a perfect golf

course. What golfers like this fail to realize is that no two golf courses, however close in distance, ever have the same weather conditions, topography, vegetation, growing environments, and soils. Come to think about it, the same holds true for different locations on any single golf course.

Most golfers, perhaps because of their nature, view the world and their golf course as being black or white. If the golf course is green, it’s great. If it’s not, there’s a problem. When it comes to the weather and managing closely mowed turf, golf course superintendents operate in a world of gray. Slight but sudden changes in precipitation, temperature, humidity, and wind can swiftly turn otherwise healthy turf into wilted, diseased, or dead turf. Extreme weather such as extended periods of drought, rainfall, high or low temperatures, and ice cover almost always produces deleterious effects on turfgrass, regardless of the species, experience of the superintendent, or chemical budget. Like it or not, the quality of your golf course is at the mercy of Mother Nature. So if you can’t control the weather, what can you control?

IMPROVE THE GROWING ENVIRONMENT

Show me a putting green that receives ample sunlight and air movement, well-dispersed traffic, and is free from tree root competition, and I’ll show you a green that is healthier (i.e., better able to tolerate lower heights of cut), more tolerant of pests (i.e., requires fewer pesticides), and one that has the best chances of ducking Mother Nature’s best punches. Sounds too good to be true? On many golf courses it is a fact. The presence of trees or poorly placed mounding and bunkering restrict light and traffic flow, and invite the encroachment of weeds like annual bluegrass (*Poa annua*). Although this species is ubiquitous across North America and perennial biotypes can produce an excellent putting surface, in general it is more prone to disease and environmental stress compared to bentgrass or bermudagrass.

On top of that, golfers want fast greens, not just on weekends or for the club championship anymore, but every day. Annual bluegrass weakens as a result of the low height of cut and stressful weather. In the summer, it usually dies as a result of fungal pathogens such as anthracnose, insects such as the annual bluegrass weevil, or simply from being too hot, dry, and/or wet. In the winter, it is usually first to die from direct low-

temperature injury or extended periods of ice cover. The potential for these problems is increased by poor growing environments.

Removing trees that impede sunlight, air movement, and/or uptake of water and nutrients by turfgrass roots is imperative for the health of the turf and achieving a nearly perfect golf course. Trafficked turf requires at least 8 hours of sunlight each day for growth and recuperation. Approximately half of this amount should occur during the morning when photosynthesis is optimum and to help reduce the potential for disease outbreak by helping to dry out the turf canopy. In the northern hemisphere, morning sunlight is favored by removing trees in the east and south directions from the green, tee, or fairway. Keep in mind that the sun rises directly from the east and sets directly in the west during the vernal and autumnal equinoxes only. During the summer solstice, or longest day of the year, the sun rises and sets the farthest from south and its position is highest in the sky. The opposite is true for the winter solstice, or shortest day of the year.

These facts are important to keep in mind when addressing sunlight issues during shorter days of the year when trees located farther to the south of a putting green are likely to block sunlight. Also, don't forget about removing trees that prevent air movement by blocking the direction of the prevailing wind, as well as those trees that were planted too close to a green, tee, or fairway in regard to root competition.

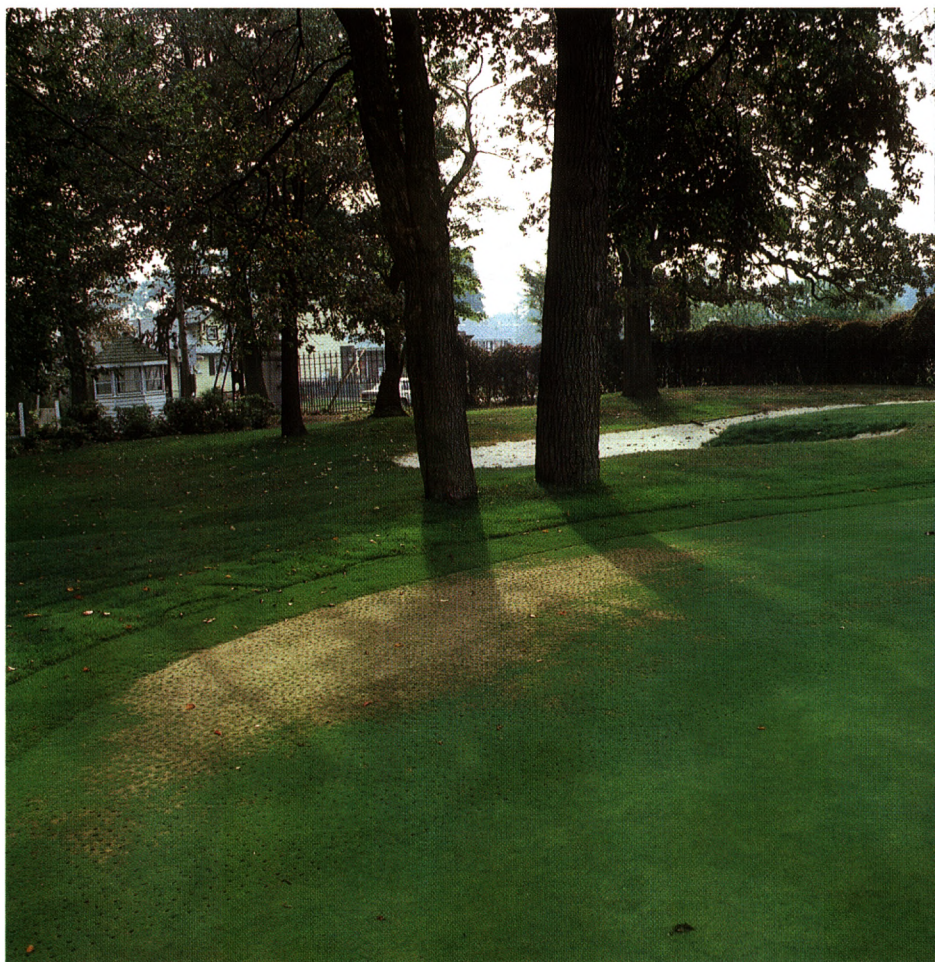
SOIL

Who better to sum up the importance and diversity of soil on golf courses than the legendary architect Donald Ross, author of *Golf Has Never Failed Me*. "A sandy loam is by far the best golfing soil. It provides good drainage and ideal conditions for strong, enduring growth of desirable grasses. It likewise furnishes the exact conditions necessary for the proper playing of golf shots. Soils of a clay mixture are to be avoided if possible. They are difficult to drain and must be given much costly attention to produce satisfactory turf. During the hot months, they are hard and baked. After rains they are apt to be overrun with worms. Unfortunately, such soils are found near a large portion of our major cities."

Next time you are about to pass judgment about the condition of one course versus another, first compare the soils underneath. While the better golf course may be blessed with well-

drained native soil that may even meet the USGA recommendations for putting green construction, far more golf courses possess something that is not even worthy of being called "dirt."

How can courses improve poor soil? Usually, the first step is to develop and adhere to an aggressive cultivation program that includes aeration, topdressing, and vertical mowing. Aerating machines can be equipped with solid or hollow tines of various diameters that punch holes into the soil at depths ranging from a few



inches to more than one foot below the turf surface. Sand topdressing is recommended to fill the holes and the turf surface to help modify the existing soil by improving infiltration and percolation of air and water into the rootzone and to help reduce compaction. Sand topdressing also helps to reduce thatch accumulation by dilution and, in time, provides firmer, smoother, and therefore faster putting surfaces. Although it is a considerable and long-term investment, many golf courses are now topdressing fairways along with greens and tees in order to improve drainage and playability as well as to discourage earthworm

What's wrong with this section of the green? This is a good example of how removing trees can improve the growing environment on this green by increasing sunlight and removing root competition for water and nutrients.

activity that results in castings on the turf surface. As Donald Ross further commented about poor soil, "In such cases you must simply make up your mind to accept the limitations of such a course and be prepared to cheerfully and continually spend money for its upkeep and betterment."

BUDGET

Money can't buy love or the perfect golf course, but, if spent wisely, it can help produce a better golf course. Starting with the infrastructure, today's state-of-the-art pump stations are capable of delivering more water in a shorter amount of time while using less energy. Ultimately, this results in a drier golf course with less potential for disease and, of course, greater savings for the golf course.

Likewise, new irrigation systems consist of a greater number of smaller sprinklers spaced closer together with individual control to better account for site-specific water requirements based upon different growing environments, turfgrass species, and mowing heights. In dry climates or during extended drought, a good irrigation system is critical to keep the golf course green but not wet. Otherwise, plan on paying overtime or hiring more staff to chase dry spots all over the golf course.

Another option is to simply tolerate areas of brown turf on the golf course. According to Donald Ross, "I realize the difficulty that greenkeepers and chairmen of the green committee have in letting up on the watering. Criticism comes from members when they see the slightest

sign of a brown patch. Nevertheless, while I do not think it is wise to let a green go completely out of playing condition during the summer, it would be advisable not to overdo the watering of greens during those months." On the other side of the coin, the importance of having adequate drainage cannot be underestimated, as many golf courses in the Northeast and elsewhere discovered last season during one of the wettest summers on record.

LABOR

More than half of most golf course maintenance operating budgets is comprised of labor (salary and benefits). Therefore, the condition of the golf course is often a direct reflection of the resources that are allocated for personnel. The golf course management team should consist of an experienced and well-qualified superintendent, at least one but often two or more assistants to handle important responsibilities like crew supervision, application of chemicals, and maintenance and scheduling of the irrigation system, and at least one qualified equipment technician to oversee the maintenance of a fleet with a value in the neighborhood of \$1 million. Of course, if you want those bunkers raked every day, rough mowed twice a week, and someone else to repair your ball marks and divots, then make sure that there is an ample supporting cast as well. Instead of guesstimating whether or not you have the right number of employees for your golf course, one suggestion is to first convert the line item format of your operating budget (i.e., labor, fuel, chemicals, etc.) to reflect the cost of maintaining each part of the golf course (i.e., greens, tees, fairways, bunkers, etc.). With numbers in hand, next work together with your green committee, board of directors, or ownership to develop a golf course maintenance master plan. In other words, determine which areas of the golf course are most important and the level of maintenance each requires. Is walk mowing the greens (vs. riding) or topdressing them more frequently more important than hand-raking bunkers (i.e., hazards) every day? Although these exercises may indicate the need to hire more employees, more than likely they will help your golf course get the most out of the existing staff, given the current economic challenges and budget cutbacks.

EQUIPMENT

It is surprising to find that many golf courses do not have a capital budget to be used toward the replacement of equipment and general upkeep of the turf care facility. Although you will likely pay more for a new fairway or rough mower than a nice new sport utility vehicle, don't expect that they will last forever, as most heavily used machinery (e.g., mowers, utility vehicles, etc.) lasts about 5-7 years before the need for parts and repairs keeps them in the shop more than out on the golf course. As a starting point, at least 10-15% of the total replacement cost of your current

Concentrating traffic on the golf course using plant or artificial materials leads to excessive wear and little or no turf.



equipment fleet should be appropriated toward the purchase of new equipment each season. If you cannot or choose not to tie up all that money in working capital, then leasing equipment is another option for maintaining a newer and technologically advanced fleet.

TURF CARE FACILITY

Do not forget about the turf care facility. "What's that?" you say. On far too many golf courses, I'm referring to the dilapidated barn that's too small to house all of that expensive equipment, not in compliance with government regulations for pesticide storage and handling, and a poor reflection of the quality of your golf course and the professionalism of your superintendent. Golfers expect nothing less than the best from the clubhouse facility. Do the same for the turf care facility.

GOLFERS, CARTS, AND TRAFFIC

Is it any wonder that there is no such thing as a perfect golf course when golfers fail to repair ball marks and divots, rake bunkers, and follow cart traffic policies? Increasing use of golf carts, especially in conjunction with inclement weather, has resulted in greater turf wear and compaction which, as described earlier, promotes annual bluegrass encroachment and all of the challenges that go along with it. At most courses, gone are the days when the golf course gets a much needed rest from golfers each week or even once a month. Instead of rejuvenation from aeration or other cultivation practices, ball marks and divots abound from golfers in double shotgun outings.

When it comes to etiquette, set a good example by properly repairing more than one ball mark upon reaching the green, picking up your feet when walking to avoid scuffing the turf, and reaching down to pick the ball out of the cup instead of damaging the lip with your putter. In regard to divots, follow the instructions provided by your superintendent. Thick pieces of turf usually will recuperate if properly replaced and tamped down into the divot. Otherwise, fill and smooth the divot with mix (if available) to the level of the turf, avoiding the creation of a mound several inches above it. Take the time to rake bunkers and then place the rake alongside the bunker in a location that is parallel with the line of play. In addition, scheduling times when the management team is present on the golf course to demonstrate proper etiquette to golfers has

brought about positive results on many golf courses.

CONCLUSION

These and many other factors determine just how nearly or not so nearly perfect your golf course can be. Although you cannot fool with Mother Nature, you can help ensure the best possible turf and playing conditions day in and day out by improving growing environments, performing essential cultivation, and providing the resources and infrastructure necessary to meet reasonable golfer expectations. Save the unreasonable expectations for that mythical perfect golf course that exists somewhere out there. Instead of trying to be *the* best, just be *your* best.

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Striving for a perfect golf course should begin with proper etiquette.

Conversion of Ryegrass Fairways to Bluegrass: Impossible Dream?

Colorado State University research suggests converting perennial ryegrass fairways to Kentucky bluegrass is a long shot.

BY TONY KOSKI, PH.D., AND JAMES NEWBERRY

Until recently, Kentucky bluegrass and creeping bentgrass (along with annual bluegrass) were the standard grasses for northern, cool-season zone golf course fairways. The use of perennial ryegrass for new fairways has become increasingly common in the last 10-15 years.³ Further, ryegrass had become a favorite overseeding species for older bluegrass fairways — resulting in the rapid conversion of those fairways to nearly 100% ryegrass.

Perennial ryegrass is easy to establish, can be mowed easily at heights less than one inch, forms little thatch, and allows the safe use of ethofumesate (Prograss) for annual bluegrass control. However, the problem of gray leaf spot on perennial ryegrass has caused superintendents to reexamine its use in some areas of the country. The recent development of Kentucky bluegrass cultivars tolerant of mowing heights in the ½-inch to ¾-inch range has created interest in the use of bluegrass for high-maintenance fairways where ryegrass use has encountered problems.^{1,2}

SO WHERE'S THE PROBLEM?

If one could convert fairways to perennial ryegrass so quickly via overseeding, it stands to reason that conversion to Kentucky bluegrass could be accomplished just as easily — especially when using the new cultivars that performed well under low mowing. However, observations of fairways where bluegrass overseeding had been attempted revealed little or no bluegrass — except in those areas where the ryegrass had



Within two weeks of seeding, bluegrass seeds were germinating in the seeder slits. Some seedlings, although spindly and weak, did emerge from the slits, but the seedlings did not mature into healthy adult plants.

been thinned or killed by disease or winter injury.

A review of the research literature showed that no one had studied overseeding into ryegrass to any extent. Considerable work had examined conversion programs for *Poa annua* fairways, as well as the introduction of new bentgrass cultivars into older bentgrass greens.^{4,5,6} A general conclusion was that conversion (in fairways, for example) to ryegrass via overseeding was relatively easy to accomplish and conversion of older greens to newer bentgrass cultivars was a difficult process — unless the existing bentgrass was intentionally thinned by aggressive cultivation practices prior to seeding. Anecdotal evidence seemed to indicate the same for conversion from ryegrass to bluegrass:

it was usually unsuccessful unless the ryegrass had been significantly thinned prior to seeding.

In the spring of 2000, a study was begun by James Newberry, a graduate student at Colorado State University, to test the effectiveness of different seeding strategies for introducing Kentucky bluegrass into perennial ryegrass fairways.

THE ON-COURSE C.S.U. STUDY

Sponsored by the Golf Course Superintendents Association of America and the Rocky Mountain Golf Course Superintendents Association, a field study was begun in June 2000 at two Denver-area golf courses: Fox Hollow at Lakewood (Bruce Nelson, CGCS,

and Mark Krick) and Rolling Hills Country Club (Bob Kinder, CGCS). The intent was to do a replicated experiment, but using equipment and techniques used by the golf course superintendent. Further, the study areas were in play and maintained identically to the rest of the golf course. Seed was supplied by Jacklin Seed, while Colorado Golf and Turf furnished the Bunton slit-seeder and tractor.

In Year 1, plots were seeded with either 3 or 6 pounds of Award Kentucky bluegrass seed per 1,000 square feet in spring and fall (6 and 12 pounds of seed per 1,000 square feet per year), or in spring/summer/fall (total of 9 or 18 pounds of seed per 1,000 square feet per year). In half of the plots, the plant growth regulator (PGR) Primo (trinexapac ethyl) was applied one week prior to seeding at a rate of 22 ounces per acre. Data were collected every two weeks, including plot quality and species composition.

In Year 2, new plots were started adjacent to the previous year's study, using the same treatments described above. However, the Year 1 plots were also overseeded again to evaluate the cumulative effect of multiple-year seeding. In Year 3, plots were seeded a final time in the spring.

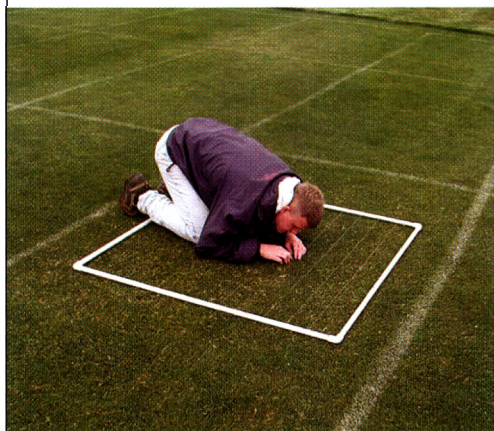
UNIMPRESSIVE RESULTS

Despite cumulative seeding rates as high as 42 pounds of seed per 1,000 square feet over a 2½-year period, no Kentucky bluegrass could be found in the intact areas of any of the plots. In fact, the only bluegrass to be found was in divoted areas that had been overseeded when the divots were still open. It was obvious that slit-seeding Kentucky bluegrass into healthy perennial ryegrass fairway turf, even with the use of a PGR to suppress ryegrass growth, was a totally ineffective method for introducing, much less converting, bluegrass into these fairways.

It should be noted that we did see bluegrass seed germination in the fairways. Within a couple of weeks of seed-

ing, bluegrass seeds were germinating in the seeder slits (approximately ¼-inch depth). And some seedlings, although spindly and weak, did emerge from the slits. But the seedlings did not mature into healthy adult plants.

Though discouraging, the results were not totally unexpected. Observations over the years by turf extension specialists, USGA agronomists, and many golf course superintendents have noted the general futility of overseeding bluegrass into established ryegrass turf.



The only bluegrass to be found on the research plots was in devoted areas that had been overseeded when the divots were still open. It was obvious that slit-seeding Kentucky bluegrass into healthy perennial ryegrass fairway turf, even with the use of a PGR to suppress ryegrass growth, was an ineffective method for introducing bluegrass into the fairways.

SO WHAT IS THE PROBLEM?

Although there is little research (at least with ryegrass) to provide answers to this question, it would appear that the poor/non-existent bluegrass establishment results from the fact that either perennial ryegrass is an extremely competitive plant that allows little opportunity for bluegrass (especially a seedling) to become established, or perennial ryegrass is allelopathic, producing chemicals that suppress and kill bluegrass seedlings. While there is some evidence in the research literature to indicate possible allelopathy in ryegrass, there is a good amount of disagreement among scientists on the subject.

On the other hand, research published by Dr. Doug Brede in the early

1980s supports the theory that perennial ryegrass is an extremely competitive plant when mixed with a less-competitive one, like bluegrass.^{1,2} Although his work examined ryegrass and bluegrass in seedling mixtures, one could logically conclude that a mature stand of perennial ryegrass is an even more effective competitor against seedling bluegrass plants.

The results of this study, along with anecdotal field observations by agronomists and superintendents over the years, would suggest that the overseeding (via slit-seeding) of perennial ryegrass fairways with any amount of bluegrass is a futile practice. The results of another C.S.U. study, along with recent superintendent trials, would indicate that some level of success might be attained when overseeding is done in conjunction with core cultivation. The larger opening may provide some space in which the young bluegrass seedlings can mature and develop.

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PRAIRIE FIRE!

Using fire to improve
the health and condition
of unmown rough areas.

BY JONATHAN JENNINGS, CGCS

Sending a notification letter to the surrounding property owners is a good way to avoid last-minute phone calls from concerned residents regarding clouds of smoke rising up from the course. Such letters should include contact information for the superintendent and possible burn dates.

Regularly included on Classical Top 100 golf course lists, Chicago Golf Club (Wheaton, Ill.) owes a large portion of its special appeal to the unmown areas of the rough. Dominated by the seedheads of cool-season grasses for most of the season, this area outlines every hole and serves as a potent reminder from architect C. B. Macdonald to keep the ball on the fairway. Above and beyond the rough's obvious visual appeal, it is also a rare haven for numerous bird species and small animals in the sprawling metropolis of the Midwest's largest city. And, by acting as a buffer zone between intensely managed turf areas and the irrigation pond on the 10th hole, it protects the fish and other aquatic inhabitants from possible nutrient and pesticide migration.

Given the enormous value of the unmown rough, it is surprising that golfers often equate its earthy appearance with low-cost or, worse yet, no-cost maintenance. In fact, changing the designation of a large area of the rough to unmown does not necessarily mean that a substantial amount of labor and materials can be trimmed from the budget. To produce the desired look of the unmown rough at Chicago Golf Club, numerous man-hours are spent hand-pulling undesirable plants in highly visible areas around the clubhouse, greens, and tees; treating broad-leaf weeds with selective herbicides; and burning all 80 acres each spring under the direction of a hired professional.

Burning, whether caused by lightning or used as a management tool, has

been an integral part of the prairie life-cycle since the beginning of time. Its benefits include the removal of dead vegetation that hinders new growth, the release of nutrients that enrich the soil, the reduction of noxious weeds, and the encouragement of native species that are attractive to wildlife.

Chicago Golf Club is fortunate, because it is located in unincorporated Milton Township, where controlled burns are permitted for native grass restoration. To evaluate whether or not fire might be a management choice in your area, you should determine if:

- Federal, state, and local regulations permit burning.
- Containment and safety factors are within acceptable risk parameters.

- Endangered species/natural communities are not subject to harm.
- Local residences are not in jeopardy.

If fire cannot be used for these or any other reasons, then other methods for maintaining unmown rough areas must be explored.

The initial step in conducting a controlled burn at Chicago Golf Club is to obtain a permit from the Environmental Protection Agency. This document allows the club to burn anytime throughout a 12-month period, provided all appropriate contacts are made with local officials. As a side note, we also learned during our first year of conducting a controlled burn that it is best to make all neighbors aware of the burn with a notification letter. While variable weather conditions in the spring make it impossible to include a specific date for the burn, our notification letter references a two-week time frame and provides contact information for any questions that may arise.

Once the weather conditions are appropriate for burning, the next step is to contact all emergency response personnel, including the fire and police departments. In our case, we must also keep the DuPage County Sheriff's Department up to date, because the course is located in an unincorporated area of the township. Speaking from personal experience, never assume that one entity will contact another or you will surely be meeting with them the day of your burn.

Before burning commences, each section of the unmown rough is evaluated based on its relevant constraints. When burning on a golf course, these constraints may include uneven terrain, public view of the burn area, smoke problems in relation to residential areas or major roads, the presence of utility poles and wires, adjacent crops or livestock, presence of endangered species, or nesting and fawning areas. It is always best to address as many constraints as possible well in advance of the actual burn date; if not, don't be surprised at

the reaction from neighbors during the burn.

The most important element of a successful controlled burn is weather. Weather controls fire behavior, smoke behavior, fuel condition, and flammability, all of which have a relationship with the safety of the burn. The weather variables most applicable to controlled burns are air temperature, relative humidity, wind speed and direction, precipitation, and air mass stability. A combination of the first three (air



Fire lines are spread along gradual curves with drip torches. Backing fires, set to burn into the wind, do a better job of total fuel consumption due to their hottest temperature at ground level.

temperature, relative humidity, and wind speed) determines fuel condition that, in turn, affects a fire's behavior.

The optimum weather conditions for burning the rough at Chicago Golf Club are an air temperature between 55°F and 70°F, a relative humidity between 25% and 50%, and a consistent wind speed between 8 and 15 m.p.h. The time of day when weather conditions are most apt to be in the optimum ranges is generally between 11:00 a.m. and 4:00 p.m. Burning outside these weather parameters could compromise the results and make the fire more difficult to manage.

Fire behavior and fuel conditions are most unpredictable when temperatures are rising during the morning hours. As the temperature rises and the humidity drops, a fire will tend to grow more intense. Conversely, a good fire will begin to smolder and produce excess

smoke if allowed to continue burning when the temperature drops and the humidity increases in late afternoon.

There are three basic types of controlled fires — backing, head, and flank. Backing fires are started along a prepared baseline, such as a fairway or maintenance road, and allowed to burn into the wind. For the most part, this is the easiest way to burn because of the shorter flame lengths, a slower rate of spread, and a smoke density that is generally less than that of a head or

flank fire. Backing fires also burn hotter at ground level and do a better job of total fuel consumption.

Head fires are the opposite of backing fires in that they burn with the wind. These fires have greater flame lengths, faster rates of spread, greater smoke volumes, and a tendency to burn cooler at ground level than backing or flank fires. Containment of these fires is more critical, however, as wind speed and fuel quantity increase. Before starting a head fire, one should be absolutely certain that the fire will not escape the intended burn area.

Flank fires are a modification of a backing fire in that lines of fire are set at slanting angles to the wind direction. Flank fires are commonly used to secure the flanks of a head fire as the head fire progresses.

Management of a controlled burn is never over until all affected areas are

cold and no longer producing smoke. Post-burn activities include monitoring the perimeter, completely extinguishing all of the smoking and burning patches of fuel, and cleaning up the site. Monitoring the burn perimeter is actually a continuous function from the time the fire is set until it has been determined that the fire is out and cold. To extinguish smoking and/or burning patches, the areas are drenched with the irrigation system, if possible, smothered with soil, and/or raked. To clean up after a burn, the rough is mowed with a tractor-mounted Bush Hog. This work is necessary to even out the clumps of green grass and break up the small piles of dead grass that refused to burn.

The highest priority when conducting a controlled burn of the rough is, of course, safety. If the weather conditions change to unfavorable at any time, the fire is immediately extinguished. Addi-

tionally, safety is promoted with proper employee training, hazard removal, and the use of personal protective equipment. Suffice it to say, without a strong emphasis on safety, it would be impossible to have the continued support of golfers and the neighboring community.

As a final thought, I offer two very good reasons for patience when conducting a controlled burn of the rough. First, the results of burning vary from year to year due to weather conditions and the condition of the area. Second, it can take several consecutive years of burning and follow-up management before an area develops the desired appearance.

Historically, the unmown areas of the rough at Chicago Golf Club were simply cut during the early part of the playing season and then allowed to grow to full maturity. By adopting an

annual burn program that is scheduled during late March or early April, the quality of this area has improved noticeably because of a reduction in woody plants and a slow but steady proliferation of warm-season grasses. Two to three weeks after each burn, the rough begins to show strong signs of recovery, just as the native prairies have for thousands of years.

REFERENCE

Kenneth F. Higgins, Arnold D. Kruse, James L. Piehl. *Prescribed Burning Guidelines in the Northern Great Plains* (www.npwrc.usgs.gov/resource/tools/-burning/burning.htm).

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One of the many benefits of burning unmown rough areas during successive years is the proliferation of native, warm-season grasses that provide year-round interest and valuable habitat.

Surface Organic Matter in Bentgrass Greens

Research reveals the relationship between aeration methods and surface organic matter on sand-based greens.

BY ROBERT N. CARROW, PH.D.

The USGA golf green recommendations were developed to create a rootzone medium that would exhibit good physical properties under continuous traffic, namely water infiltration and percolation, oxygen status, and resistance to soil compaction. Putting greens, however, are dynamic systems where the norm is changing over time, especially within the two-inch surface zone. The greatest changes in total organic matter content, thatch/mat status, turfgrass rooting, and even the nature of the organic matter often occur during the first two years of grow-in, but changes also may continue over future years. All of these factors may influence water infiltration and percolation, as well as soil oxygen status.

Several researchers have documented decreases in saturated hydraulic conductivity (SHC, the infiltration rate under saturated profile conditions) as putting greens mature.^{7,10} Concurrent with a reduction in SHC has been an increase in organic matter content within the surface two inches. An upper limit of 4.5% (by weight) of organic matter in a sand medium was suggested by Murphy et al.⁸ because macropores important for rapid SHC are insufficient above this level. McCoy⁶ recommended a maximum of 3.5% organic matter (by weight) based on his work and a review of others, since macroporosity starts to decline above this value. The decline in root growth often observed within two to three years after establishment has



University of Georgia researchers are investigating how various aeration methods can limit organic matter buildup in newly constructed greens. This example shows the organic matter buildup found in an ultradwarf bermudagrass green after one year if not managed properly.

been attributed to accumulation of organic matter in the surface.

SUMMER BENTGRASS DECLINE: PATHOLOGICAL OR PHYSICAL?

The USGA-sponsored project "Organic Matter Dynamics in the Surface Zone of a USGA Green: Practices to Alleviate Problems" arose from observations in the late 1980s of summer bentgrass decline (SBD) on creeping bentgrass greens in the southern zone of bent-

grass adaptation. From field observations and a review of the literature, I came to the hypothesis that many of the primary problems on high-sand bentgrass/annual bluegrass greens, including SBD, were due to changes in soil physical conditions in the surface two inches. It appeared that either too much organic matter accumulation or rapid death of surface roots could result in reduced water infiltration and higher water-holding capacity. This resulted in decreased oxygen content within the zone and O₂ diffusion across the zone.

Other secondary problems can arise if the primary problem is organic matter accumulation and/or change in the nature of the surface organic matter. These include more disease activity, severe physiological O₂ stress, and further root decline during summer, as well as softer greens. Achieving a reduction in these secondary problems requires correction of the physical conditions within this zone.

TWO TYPES OF SURFACE ORGANIC MATTER PROBLEMS

The two common surface organic matter problems are suggested from field observations and the turfgrass science literature. The first organic matter problem is excessive accumulation of organic matter in the surface zone. USGA specification greens normally contain less than 3% (by weight) organic matter throughout the rootzone mix. Research has consistently demonstrated

Table 1

Factors favoring rapid organic matter (OM) accumulation.

O.M. accumulation is enhanced by:

- Prolonged cool temperatures on cool-season turfgrasses when temperatures are between 32°F and 55°F, where microbial (especially bacteria) activity declines, and, thereby, OM decomposition declines. Cool, humid temperate climates may have such conditions most of the year, while in the southern regions of bentgrass adaptation this climatic condition may be for 5-7 months per year.
- Use of aggressive bentgrass or bermudagrass cultivars that exhibit high rates of OM accumulation. Many of the newer greens types exhibit this tendency.
- Poor air drainage that allows the surface to remain excessively moist for long periods. This allows for longer periods of anaerobic conditions and stimulates production of adventitious surface rooting, contributing to more OM load. These are often the secluded greens with many trees in the surrounds, little natural air drainage, and shade on the green surface for a period of time.
- Inadequate integration of sand to sustain a medium where sand is the dominant matrix rather than OM. Sand must be applied not just by topdressing, but also in vertical channels by hollow-tine core aeration that removes plugs of OM and allows large quantities of sand to be added.
- Addition of OM to the surface as sod (even washed sod), compost, or OM-containing amendments.
- Acidic pH at < 5.5, which limits bacteria and actinomycete populations and activity.
- Maintenance toward rapid growth or thatch buildup such as high N use, frequent irrigation, high mowing height.
- Low earthworm activity.

that as organic matter content in a sand mix increases to above 4% to 5% (by weight), the percent of larger soil pores (macropores, aeration pores) of >0.08mm diameter between sand particles decreases due to plugging by organic matter.^{6,8} Even with very good turfgrass management, the organic matter content in the surface two inches is often observed to be more than 3.0% by weight.^{2,3}

Table 1 summarizes the most common conditions that cause excessive organic matter accumulation, especially when several of these conditions occur simultaneously. Normally, the extreme instances of organic matter accumulation occur in the cool, humid, temperate climates. However, this is not always the case. In fact, in climates that strongly favor organic matter accumulation, this is likely the most prevalent problem on high-sand greens or athletic fields.

A second situation suggested to cause problems occurs when the nature of the organic matter changes from structured organic matter (mainly as live roots) into a gel-like consistency as roots die, plug macropores, and cause O₂ stress. This situation is most likely to occur on

a cool-season grass during hot, humid weather that induces rapid root death, so this problem would be more common in the warmer regions of bentgrass adaptation.

Root dieback/death occurs every summer to some extent, but microorganisms can sufficiently break down the fresh organic matter to prevent excessive macropore sealing. Under unusually hot, humid weather for one to two weeks or more, root death occurs more rapidly and can induce low infiltration and low aeration. Fresh dead roots hold more water and are gel-like, so macropore sealing occurs. The remaining live, O₂-stressed roots cannot obtain enough water uptake for transpirational cooling. Low soil O₂ in the surface layer where the remaining live roots are present leads to reduced water uptake, stomatal closure, and direct high-temperature kill. This is usually evident by yellowing of the turf and death over one to three days of hot, humid weather when plant and microbial oxygen demand is very high.

As organic matter content increases above 3% by weight, the more likely a massive root dieback from hot, humid

weather would cause a rapid O₂ stress and plant death. It is not the lack of roots from root dieback that is the problem, but the creation of an excessively moist layer with very low O₂ during hot weather in response to the rapid root dieback, resulting in the inability of remaining roots to take up sufficient moisture for transpirational cooling.

In the late 1990s, Huang et al.^{4,5} provided strong evidence of adverse effects of the combination of high temperature and low O₂ on bentgrass root viability. Also, the author conducted oxygen diffusion rate (ODR) measurements within the surface zone in a study from 1992 to 1995 and found numerous periods when ODR was less than 20 to 40 mg O₂ cm⁻² min⁻¹, which is considered sufficiently low to limit rooting of grasses.

RESEARCH APPROACH USED IN THE STUDY

The focus of the research in this study was on management of the second problem: change in nature of the surface organic matter during the summer months. Research was conducted from 1996 to 1998 at Griffin, Georgia, on an experimental golf green with a rootzone mix meeting USGA recommendations. Treatments are summarized in Table 2 and consisted of various non-disruptive cultivation techniques, topdressing, wetting agent, sand substitute, and cytokinin combinations.

SATURATED HYDRAULIC CONDUCTIVITY

One of the most important characteristics for bentgrass golf greens in the summertime is the ability for excess moisture to infiltrate into the surface and percolate through the rootzone. If saturated flow (saturated hydraulic conductivity) does not occur in a rapid fashion, a saturated surface can occur.

In Table 3, SHC values at 1 to 7 and 17 to 26 days after cultivation treatment are presented as the average SHC values of seven summertime measurements

Table 2

Research treatments to investigate the change in nature of surface organic matter during the summer months. Except for the core aeration (CA) treatments in March and October, all other cultivation, supplemental topdressing with sand or Greenschoice sand substitute, wetting agent (WA), or cytokinin (C) treatments were applied in summer.

Treatment ^a	Description	Topdressing per 1,000 sq. ft.	
		Annual ^b	June-Sept.
		----- cu. ft. -----	
Control	No cultivation	10.7	2.5
CA	Hollow-tine core aeration, 5/8" diameter, March and October	19.0	2.5
HJL	Hydroject Lowered, 3" spacing, 1/8" diameter hole, June 1 and every 3 weeks	10.7	2.5
HJR	Hydroject Raised, 3 1/2" spacing, 1/4" diameter hole, June 1 and every 3 weeks	10.7	2.5
HJR + Sand	See HJR. Additional sand topdressing at 0.75 cu. ft. per 1,000 sq. ft. 5 times per summer	14.5	6.3
HJR + Greenschoice	See HJR. Greenschoice as topdressing at 0.75 cu. ft. per 1,000 sq. ft. 5 times per summer	14.5	6.3
HJR + WA	See HJR. Wetting agent (Naid) at 3 oz. per 1,000 sq. ft. 5 times per summer	10.7	2.5
HJR + C	See HJR. Cytokinin as CytoGro (0.005% ai) at 1 oz. per 1,000 sq. ft. 4 times per summer	10.7	2.5
HJR + Sand + WA	See previous treatment descriptions	14.5	6.3
HJR + Sand + WA + C	See previous treatment descriptions	14.5	6.3
LP + Greenschoice I	LandPride dry injection of 0.75 cu. ft. Greenschoice per 1,000 sq. ft. 5 times per summer	14.5	2.3

^aCA = core aeration, HJL = Hydroject run in lowered position, HJR = Hydroject run in raised position, Greenschoice = fired calcined clay, WA = wetting agent, C = cytokinin

^bAll plots received 10.7 cu. ft. sand topdressing per year with 2.5 cu. ft. per 1,000 sq. ft. in the summer at 0.5 cu. ft. per 1,000 sq. ft. every 3 weeks

during 1996-1998. Within 1 to 7 days after cultivation, SHC increased at least 3.4-fold to more than 20.2 inches per hour for all Hydroject (HJR) treatments (HJR = Hydroject operated in the up position to provide a hole of approximately 1/4 inch), compared to 5.9 inches per hour in the non-cultivated control.

The plots that were core-aerated in March exhibited no difference in SHC compared to the control. This illustrates the effectiveness of spring hollow-tine cultivation as SHC declines with time as holes refill with root mass, and suggests that cultivation methods that are normally non-disruptive of the surface (i.e., Hydroject or solid quad-tines) may be necessary to maintain higher SHC during the summer periods.

Comparing HJL (Hydroject operated in the lowered position) to HJR treatments at 1-7 days after cultivation demonstrated that the larger hole formed by the HJR operation was more effective in increasing initial SHC. The LandPride device did not result in any increase in SHC when a sand substitute was injected. LandPride

cultivation alone (without amendment injection) was not evaluated in the study. The same sand substitute amendment when applied as topdressing after HJR cultivation tended to decrease SHC, especially at 17-26 days after cultivation.

At 17 to 26 days after cultivation, all HJR treatments exhibited SHC 2.2 to 3.6 times greater (10.8-18.0 inches per hour) than the control (5.1 inches per hour). The lowest summertime SHC observed on the non-cultivated control was 0.8 inches per hour versus more than 3.2 inches per hour for plots that received cultivation in the summer. The decline in SHC from 1-7 days to 17-27 days after cultivation is expected as the surface starts to reseal from root mass growing across the aeration holes or collapse of the holes themselves.

OXYGEN DIFFUSION RATE

Oxygen diffusion rate (ODR) readings were taken in the surface 1-inch depth during the summer months for selected treatments and results varied by year (Table 3). In 1996, readings were < 20 mg O₂ cm⁻² min⁻¹ most of the time,

regardless of treatment. There were periods of limited O₂ within the surface zone in other years. These results, plus similar ODR findings from a subsequent study,¹⁰ confirmed that critically low O₂ levels can occur even under non-saturated conditions. Low oxygen diffusion rates would be expected more frequently when rain is frequent or daily irrigation is practiced, keeping the surface zone moist.

TURFGRASS QUALITY AND SHOOT DENSITY

Improved turfgrass quality and shoot density were noted for most of the HJR and HJL treatments compared to the control (Table 4). The reduction in turf quality and shoot density of core-aerated plots occurred in the early summer when some residual effects from the spring treatment were still evident. Generally, when sand or a sand substitute was applied immediately after the summer cultivation operation, visual quality and shoot density ratings were not as high as when the topdressing was omitted.

Table 3

Treatment effect on summer saturated hydraulic conductivity (SHC),^c oxygen diffusion at 1.2" depth, and organic matter content in the 0" to 1.2" zone at 30 months after treatment initiation.

Treatment and Contrast	Average SHC (1996-1998)		Lowest SHC	Readings > 0.20 $\mu\text{g O}_2 \text{ cm}^{-2} \text{ min}^{-1b}$			Organic Matter at 30 months (0-3 cm)
	1-7 DAC	17-26 DAC		1996	1997	1998	
	----- inch hr^{-1} -----			----- % -----			% (wt.)
Control vs.	5.9	5.1	0.8	—	—	—	9.8
CA	9.3	5.8	3.2	0	100	87	7.3*
HJL	12.9	13.2*	3.2	—	—	—	9.9
HJR	23.5**	16.0**	7.6	14	84	75	9.1
HJR + Sand	24.0**	18.0**	6.2	—	—	—	9.3
HJR + Greenschoice	20.2**	10.8H	6.4	—	—	—	9.3
HJR + WA	25.6**	16.2**	5.8	29	100	100	8.9
HJR + C	23.0**	15.8*	4.0	—	—	—	10.3
HJR + Sand + WA	20.2**	14.8*	4.5	—	—	—	10.0
HJR + Sand + WA + C	21.5**	14.4*	4.3	—	—	—	9.1
LP + Greenschoice I	7.9	5.9	3.2	—	—	—	9.0
LSD (.05)	9.7	6.9	—				2.2
F-test	**	**	—				.38

^aCore aeration was in March and October, but SHC readings were in the July-to-September period, so SHC for the CA treatment is not at 1-7 or 7-26 DAC

^bAn ODR rate of > 0.20 to 40 $\mu\text{g O}_2 \text{ cm}^{-2} \text{ min}^{-1}$ is considered as non-limiting for root growth, while below this value root growth is less than optimal

^cAverage of 7 time periods during summers of 1996-1998

Only the hollow-tine core aeration treated plots received spring core aeration with sufficient topdressing to fill the holes (Table 2). The surface organic matter accumulation was the least in this treatment, illustrating the importance of hollow-tine core aeration, which allows for more sand to be incorporated into the surface organic matter zone than by topdressing alone. All treatments resulted in organic matter levels greater than the < 4.5% level desired.

IMPLICATIONS FROM THIS STUDY

The immediate increase in SHC following cultivation treatment demonstrates that the surface conditions do control SHC on high-sand greens and that creation of temporary macropores across this zone results in SHC that are substantially higher. One question that often arises is whether the field SHC will be the same as the laboratory SHC for the rootzone mix without a turf sod on the surface. The answer to this ques-

tion is yes and no, depending on the following circumstances.

- If field SHC is taken at several weeks after cultivation and the holes have had time to seal, the SHC can be appreciably less than lab SHC.
- If field SHC is measured within the time period when the cultivation holes may still be partially open, the SHC rate may be intermediate compared to obtaining the SHC rate within a few days after cultivation. SHC measured within a few days after cultivation often is within the same general range as the laboratory SHC if the rootzone mix below the surface couple of inches has not been appreciably altered after construction.

Factors often observed to alter the SHC below the surface two inches include movement of salts that precipitate within this zone, movement of fine materials during grow-in into the sub-surface, and a high organic matter layer that becomes buried. This may include thatch that develops during grow-in that has not had sufficient sand inte-

grated into it and is buried with subsequent topdressing.

Some observations from the current study and other cultivation studies that the author has conducted over many years are:

- The holes made by HJR, ¼-inch solid quad tines, and the Aerway Slicer 100 greens cultivation device all initially enhance SHC, but by about three weeks their effectiveness starts to decline. The HJR is least affected, probably because a hole is cut out instead of created by pushing materials to the side.
- When hollow-tine core aeration has been conducted with holes filled by topdressing, the duration of improved SHC is usually 5-8 weeks for ½- to ¾-inch diameter holes on high-sand greens.

The responses just noted would suggest that non-disruptive cultivation should be initiated within five to eight weeks after a hollow-tine cultivation operation and repeated on a three-week schedule to maintain high SHC conditions during the summer months.

Table 4

Summary of treatment effects on bentgrass putting green visual quality and shoot density.

Treatment and Contrast	Visual Quality ^a		Shoot Density ^a	
	<	>	<	>
	----- % -----			
Control vs.	—	—	—	—
CA	29	0	29	0
HJL	0	19	0	38
HJR	0	14	0	24
HJR + Sand	0	0	0	0
HJR + Greenschoice	10	0	0	10
HJR + WA	0	14	0	29
HJR + C	0	14	0	14
HJR + Sand + WA	5	19	0	24
HJR + Sand + WA + C	0	0	0	10
LP + Greenschoice I	48	0	33	0

^aBased on percent of ratings (18) when the treatment was significantly less than (<) or greater than (>) the control

An excellent article by O'Brien and Hartwiger (*USGA Green Section Record*, 2003, 41(2):1-7) reports options for controlling the organic matter zone. One question that arises in their article, as well as our study, is, "What is an acceptable level of organic matter in the surface two-inch zone?" The author's views on this question are summarized as follows:

- Regardless of climate zone, greater than 4% organic matter content in the surface two-inch zone becomes a red flag value that indicates the probability of developing low O₂, excessive surface water retention, and reduced SHC. As organic matter content increases above this value, the greater the potential for these problems.
- In the USGA green construction method, organic matter mixed throughout the rootzone mix is capped at about 3% (by weight) since above this level it is difficult to achieve a mix that allows sand to be the dominant medium and maintain a balance between moisture retention versus aeration porosity. If the USGA method requires organic matter levels to be less than 3% for the sake of avoiding problems, then it follows that organic matter should not greatly exceed this level after establish-

ment. Who recommends 4-10% by weight of organic matter within high-sand green mixes?

- Within the southern zone of bentgrass adaptation, the 4% organic matter level is especially critical because the opportunities are greater for low soil O₂ to occur in conjunction with hot, humid, wet weather. However, such hot, humid, wet periods also can occur during certain years in many cooler regions.
- Another reason that organic matter content somewhat greater than 4% seems to occur in some situations (or even at times within a year) at a location without evident problems may be that much of the organic matter is present as live roots. Live roots have a structure that allows better air exchange and water movement compared to when many of the roots die and the organic matter becomes more of a massive, spongy nature with macropores less defined.
- Maintaining sand as the primary surface matrix rather than organic matter (remembering that 1% organic matter by weight equals about 5% organic matter by volume) is also important to maintain a firm putting surface as well as one that will support greens mowers without scalping.

It is informative to remember that since the very early days of USGA greens and high-sand greens that preceded the formal USGA recommendations, early agronomists recommended twice annual core aeration plus heavy topdressing (15-20 cu. ft. of sand per 1,000 sq. ft. per coring operation). Why would this be the recommended practice except to dilute the ongoing problem of organic matter accumulation in the surface?

History often has a story to tell us today.

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UNNATURAL EXPECTATIONS

Proper establishment and maintenance of naturalized areas can increase acceptance by golfers.

BY DARIN S. BEVARD

Naturalized areas are part of virtually every new golf course construction project, and older golf courses are naturalizing out-of-play areas to eliminate unnecessary maintenance. Benefits of these lower-maintenance areas include a reduction in regular maintenance that allows limited resources to be focused on other areas of the golf course. Pesticide inputs can also be reduced. Naturalized areas also provide wildlife habitat if properly maintained for this purpose. Aesthetically, they provide a positive contrast to the manicured look of certain properties. However, these areas are far from *no maintenance* on most golf courses.

In recent years, golfers have developed playability expectations related to every area of the golf course. In the past, high-quality tees, fairways, and greens would make any golfer happy. In recent years, maintenance of bunkers and roughs has received more focus as maintenance technology has improved. Not surprisingly, golfers are now voicing expectations for conditioning of naturalized areas! Consider some common-sense guidelines with regard to establishing and maintaining low-maintenance, naturalized areas, and complaints can be reduced. Those areas that are closest to regular play require the most attention.

ESTABLISHING NATURALIZED AREAS

Different factors impact the concern of golfers over low-maintenance and naturalized areas. Location, selection of plant material, and establishment technique all have significant impact on the acceptance of naturalized areas. Evaluate these factors prior to establishment of low-maintenance areas, and reception by golfers may improve.

LOCATION

The old saying in the real estate business applies to naturalized areas: it's all about location, location, location. If a naturalized area rarely or

never impacts play, it can be established to just about anything with few complaints. Let one of these areas eat golf balls on a regular basis, and it may be described as "gunch," "the weeds," the "tick farm," or other terms that cannot be printed here. Early discontent with naturalized areas can doom their future establishment on other areas of a golf course. Naturalized areas need to be located out of the regular lines of play or established with plant material that allows golfers to locate and advance their balls fairly easily. Otherwise, discontent will result because of lost balls and slow play.

SELECTING PLANT MATERIAL

For in-play areas, fine and hard fescues provide a good base material for naturalized areas. These grasses are not perfect, but they do provide many options with regard to weed control and maintenance. Fine and hard fescues maintain a relatively low growth habit and do not develop the density of some other grasses. With less density, they are more playable than some other grasses. The fine and hard fescues are drought tolerant and need little fertilizer once established. In the Mid-Atlantic Region, fine fescues provide a good base plant material for in-play naturalized areas.

In more out-of-play areas, there are many different options. Lovegrass, bluestems, broom sedge, and wildflowers, to name a few, provide a good appearance for the golf course. The concern for these types of plants close to play is that they can grow very thick and tall over time. This greatly reduces playability. Wildflowers also greatly limit weed control options and often require complete reestablishment every two or three years to remain attractive. Nonetheless, they offer a wonderful contrast in out-of-play areas.

Plant material selected greatly impacts appearance and playability of low-maintenance areas. The goal should be to select plant material that allows reasonable playability in areas that will frequently

be visited by golfers. In more out-of-the-way areas, the options for plant material are limited only by the goals for the appearance of the golf course.

ESTABLISHMENT METHODS

Numerous techniques have been used to establish naturalized areas. This section focuses on thoughts for successful establishment of in-play naturalized areas. Initial establishment of a pure stand of desirable grasses for these areas is critical for good playability. On new golf courses, establishing naturalized areas is easy. Focus on the sections noted above regarding location, plant material selection, and playability at initial establishment.

On existing golf courses, establishment can be more difficult. In many instances, the decision is made to eliminate regular mowing on existing primary rough. The locations of these areas are determined and the grass is allowed to grow up. Good results can be achieved with this method

when the areas are not regularly in play. However, if golf balls will regularly enter the established area, golfer discontent will result. Grasses such as tall fescue, perennial ryegrass, Kentucky bluegrass, *Poa annua*, and bermudagrass will provide dense, unplayable areas of high grass when allowed to grow unchecked. Finding a golf ball and playing a shot from areas established in this manner are nearly impossible.

For in-play areas on existing golf courses, better results can be achieved by killing off the existing turf first. Usually, a non-selective herbicide is sufficient for vegetation removal prior to establishment of a naturalized area. In recent years, some courses have used fumigants prior to establishment. However, this is usually not necessary for establishment of low-maintenance grasses. Once the existing grass is eradicated, the desired low-maintenance grasses can be established. Proper initial establishment is critical for success. With good establishment, a uniform stand of

Allowing naturalized areas that are definitely out of play generally will not raise the ire of golfers. While many reasons are given to eliminate naturalized areas, it usually boils down to playability and lost golf balls.



If golfers can easily locate an errant golf shot in low-maintenance areas, their perception of the golf course is generally positive.



grasses that can be managed for weeds and other problems can be obtained.

MANAGING NATURALIZED AREAS

Naturalized areas are low-maintenance, but not “no maintenance.” Complete elimination of maintenance and weed control can lead to the perception of naturalized areas simply being weed patches. Again, the farther away from regular play these areas are established, the less maintenance will be required. However, mowing, fertilization, and weed-control practices should be considered in low-maintenance areas.

FERTILITY AND IRRIGATION

After initial establishment of naturalized areas, fertilization and irrigation inputs should be kept to an absolute minimum. Apply a starter fertilizer at the time of seeding to aid in grass establishment. Irrigation also will help with establishment, but this should be the extent of fertilization and irrigation in these areas. After all, the goal is to provide an area that is aesthetically pleasing, low maintenance, and playable. Extra fertilization and irrigation will promote a denser grass that may contribute to lost balls and slow play.

MOWING

Mowing frequency of naturalized areas varies among golf courses. Most superintendents mow these areas two times annually, once in the spring and again in the fall. In recent years, additional spring mowing of these areas has been imple-

mented. A properly timed mowing in the mid-spring can reduce density, but still allows for seed stalk development. This allows for a good appearance from a distance, but allows golfers a better opportunity to locate and advance their balls. (From the standpoint of meadow-nesting birds, avoid mowing in May, June, and July throughout the North.)

WEED CONTROL

Most naturalized areas, especially those composed primarily of perennial grasses, receive some weed-control applications. Long residual preemerge herbicides are usually applied in the early spring to prevent the development of summer annual grasses and other weeds. After spring mowing, a broad-spectrum broadleaf herbicide may be applied to reduce weed populations in naturalized areas. Usually these two herbicide applications will control the worst of emerging weeds in naturalized areas. Limited herbicide applications will still allow a neat appearance to be maintained. Some weeds will escape herbicide applications as the naturalized areas seed out. However, as long as there are not too many, they are often viewed as providing character.

Naturalized areas were originally developed to reduce maintenance inputs on out-of-play areas on the golf course. As they have become more prevalent through new construction and establishment on existing golf courses, golfers have developed expectations for these areas. Rightly or wrongly, as golfers play other courses, they bring ideas back to their own course. If they play a course with naturalized areas that allow a nice appearance and good playability, they will prefer them to areas that are thick and unplayable. Proper location of naturalized areas can eliminate many headaches for the golf course superintendent. Selecting grasses and other vegetation for in-play areas that allow golfers to find and advance their golf balls without a long search will increase acceptance of these areas by golfers. If the naturalized areas are in play and extremely penal, there may be an outcry for renovation or outright removal. Keep playability in mind at the time of establishment and during maintenance of these areas to keep golfer complaints about naturalized areas to a minimum.

DARIN BEVARD is an agronomist in the Mid-Atlantic Region. He conducts Turf Advisory Service visits in Maryland, Virginia, Delaware, and Pennsylvania.

Golf Courses and Bird Communities in the South Atlantic Coastal Plain

Recent research provides insight to make golf courses better habitat for birds.

BY DAVID H. GORDON, STEPHEN G. JONES, AND GARY M. PHILLIPS

The new millennium is an exciting and challenging time for bird conservation efforts throughout North America. Bird conservation is receiving more attention than ever before due to concerns about declining bird populations in the face of accelerating human alterations to our natural world. Of particular concern have been the downward trends in many neotropical migratory bird populations, birds that breed in North America and winter primarily in Central and South America.

Biologists, using advanced scientific knowledge gained mostly in the latter half of the past century, have looked closely at a combination of health indicators of species populations, including breeding and wintering distribution, abundance, long-term population trends, and present and future threats to establish conservation priorities for species of concern. Coordinated international, national, regional, state, and local initiatives involving a broad array of public and private partners have developed to establish meaningful bird conservation goals and strategies that are implemented as local on-the-ground habitat conservation projects. Examples of these include the North American Bird Conservation Initiative,¹² North American Waterfowl Management



The recommended method for monitoring golf course bird populations is by using a fixed-radius point count. A grid was established across the golf course to identify the observation stations where observers tallied all of the birds detected visually or by sound during a five-minute time period.

Plan,⁸ and North American Waterbird Management Plan.⁴

Considering bird conservation priorities at larger geographic scales has required a different scientific approach to understanding what makes a bird-friendly landscape, and how these landscapes can be maintained, enhanced, and restored. Fortunately, in the past

decade, avian ecologists shifted their focus from bird-habitat relationships at the micro-habitat scale to landscape-scale studies designed to understand how habitat patches as elements of the larger landscape habitat mosaic influence bird communities. As a significant landscape element in many regions of the country, well-designed golf course habitat



Great crested flycatcher (*Myiarchus crinitus*).

patches have a unique role to play in bird conservation at the landscape scale.

GOLF COURSES AS WILDLIFE HABITAT

Golf courses are a frequently occurring landscape unit within the South Atlantic Coastal Plain. As a form of landscape alteration, golf course construction⁵ produces physical and biological modifications within a landscape unit resulting in altered spatial configurations that influence avian habitat selection. Though limited construction and environmental alteration were involved in the establishment of the first courses of the 15th century, current popularity of the game requires building a greater number of courses within areas that involve extensive land disturbance.⁵

Although golf course construction significantly alters natural wildlife habitat, with proper design and management, the post-construction complex of remnant, disturbed, and introduced habitat patches could provide valuable habitat for avian species and community establishment.⁵ Developing golf courses as an integral part of the natural landscape is becoming more popular due to concerns about the effects extensive landscape disturbance may have on ecological functions and values.

Golf courses in the coastal region of South Carolina are typically planned and constructed either as an integral component of private residential developments or as stand-alone landscape units. With hundreds of golf courses being built every year in the United States, land consumption, habitat alteration, and subsequent effects on breeding bird communities are of immediate concern. To achieve the goal of providing an enjoyable recreational facility that is environmentally sound and operated successfully, courses must be carefully designed, properly constructed, and responsibly managed.⁵ Management of the landscape unit can be influenced by independent and joint actions of course operators and property owner associations. Both parties have a vested interest in maintaining an aesthetically pleasing tract of green space, often with a coincidental interest in wildlife values.

The purpose of the project was to assess the value of golf courses to breeding bird species by evaluating how birds occupy golf courses with different designs and habitat configurations. An understanding of bird-habitat relationships will provide golf course superintendents and developers a means to establish design, construction, and management procedures for maintaining

golf courses with suitable habitat for breeding bird communities.

METHODOLOGY

Site Classification. Twenty-four golf course landscape units along the north coast of South Carolina representing a landscape alteration gradient of sites ranging from high to low habitat alteration were selected for study. Highly altered sites were golf courses in which the majority of native vegetation had either been removed or replaced with ornamental vegetation or contained a high level of human disturbance, including residential and non-residential structures. Less-altered sites were considered to be those golf courses in which the majority of native vegetation was left intact with a substantial amount of forested area interspersed throughout the landscape and minimal human disturbance. Using color infrared aerial photography and ground-truthing visits, each golf course was assigned to one of three alteration gradient groups: 1) low ($n = 6$), 2) medium ($n = 11$), or 3) high ($n = 7$).

Bird Counts. Breeding bird species composition and species richness (number of species) were determined using fixed-radius (50-meter) point counts following recommended methodology for monitoring bird populations and avian habitat associations in the southeastern United States.³ A point count is a tally of all birds detected visually or by sound by an observer from a fixed station during a five-minute time period. Point counts were conducted during the breeding season (May-June) by observers between sunrise and 10:00 a.m. A grid of possible point locations 250 meters apart was generated using a computer-based geographic information system to determine the locations of point counts within each golf course. These points were then layered over 1994/1999 color infrared aerial photography of each golf course to help observers navigate to each point in the field.

Habitat Patch Mapping. Habitat patches were determined through a combination of on-site visits and aerial photography interpretation. Patch perimeters were digitized to provide measurements of area and perimeter length per patch. Habitat patches within each golf course were characterized by shape, size, type, number, heterogeneity, and boundary characteristics.⁶

Parameter Estimation. Species richness, species diversity, total relative abundances, and neotropical migratory bird (NTMB) species richness were calculated for each golf course and subsequently applied to each alteration group.

Breeding Habitat Guilds. To examine breeding bird species composition across the golf course alteration gradient groups, all species recorded within each point count were categorized according to breeding habitat association (i.e., wetland/open water, successional scrub/shrub, woodland, or urban habitat). Total relative abundances per breeding habitat association were calculated for each alteration group and tested to examine if there was a relationship between the alteration groups and the type of species found within each group. A community similarity index⁹ was calculated to measure the degree of similarity in the breeding bird community among the three alteration groups.

STATISTICAL ANALYSIS

Landscape Alteration. Mathematical models were constructed to determine if species richness, species diversity, and NTMB richness were statistically different among groups. Golf courses within

each respective group served as experimental unit replicates. Comparisons were then made to determine which group had the highest mean.

Landscape Structure. To determine the influence of landscape structure (i.e., habitat composition and spatial configuration) on bird parameter estimations within golf courses, quantifiable landscape metrics generated for each landscape unit per patch type were included in a regression model. Percentage values of area were used to account for the variation in total land area between golf courses in order to conform to species-area empirical data.

Effects of Forested Area. Because vegetation characteristics (e.g., stem density, basal area, foliage height diversity, etc.) may not be as important as simple measures of forested area in explaining variability among avian community parameters,² regression analyses were conducted to test the effects of forested area percentages on species richness, species diversity, and NTMB richness. Specifically, we tested if parameter estimations increase as percent forested area increases. Positive parameter estimates

would indicate that bird parameters benefit from more highly forested areas.

RESULTS

Bird Counts. Across all 24 golf courses, a total of 5,362 birds, 82 species, and 30 NTMB species were recorded at 599 point count stations for years 1 ($n = 10$) and 2 ($n = 14$). Estimates from years 1 and 2 were pooled for each golf course per group.

Breeding Habitat Associations. Bird communities of the more altered golf courses (medium and high) were most similar as indicated by the community similarity indices and was consistent with the total relative abundance outcomes of breeding habitat associations. Also, the distribution of breeding habitat associations was influenced by the level of alteration. The majority of birds (46.5%) associated with less-developed landscapes (low units) were woodland breeding species, while urban breeding species were found primarily in more altered groups (medium: 32.9% and high: 37.3%).

Landscape Alteration. Average species richness and NTMB richness decreased as landscape alteration increased, but a significant difference in species diversity was not detected among groups.

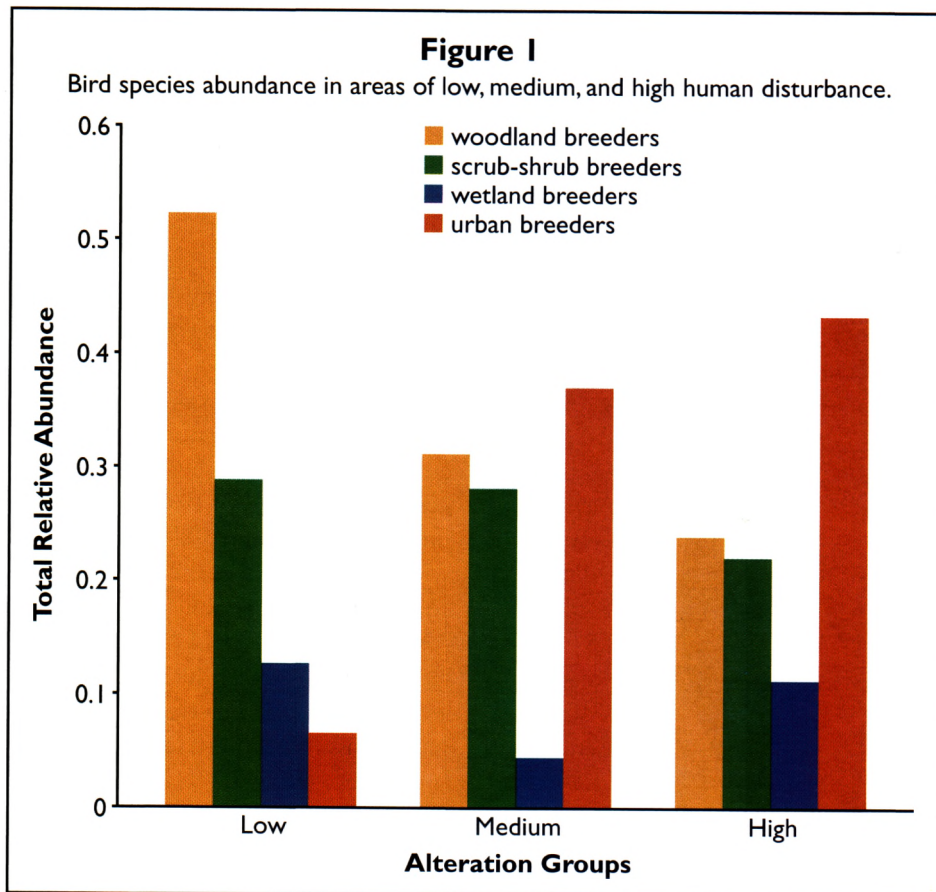
Landscape Structure.

Regression models successfully determined significant



Above left:
Prothonotary warbler
(*Protonotaria citrea*).
© JOHN HEIDECKER

Above right:
Painted bunting (*Passerina ciris*).
© TOM VESO



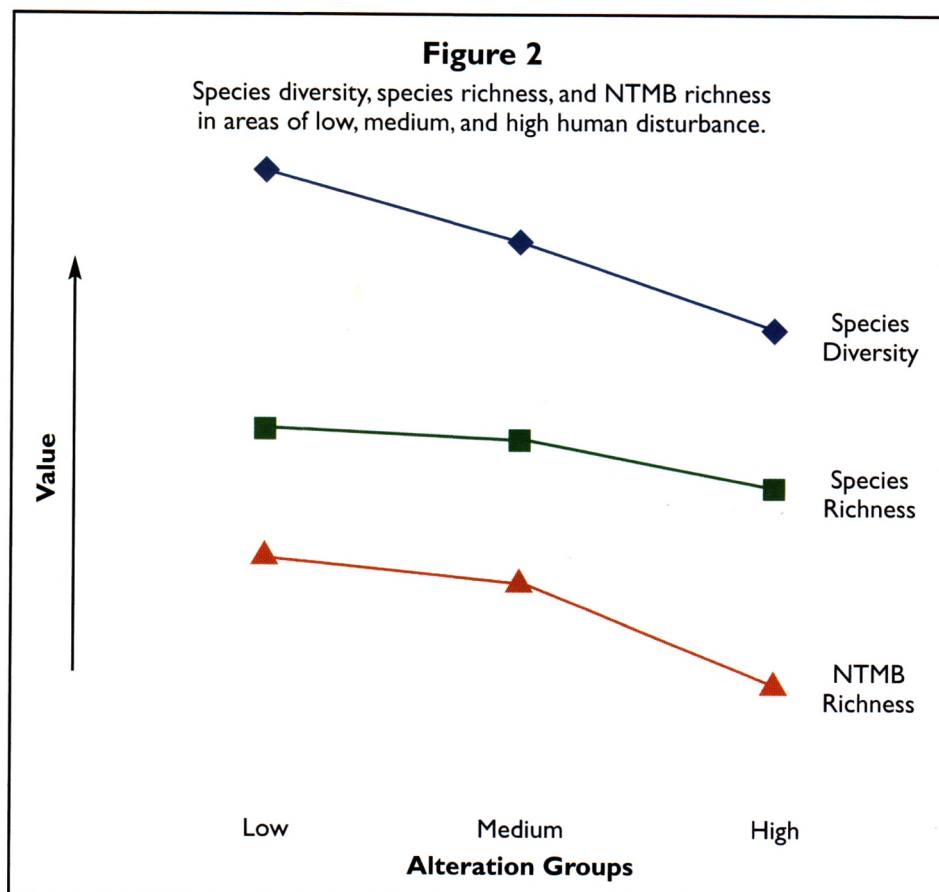
landscape metric variables for explaining the variability within species diversity, species richness, and NTMB richness. Components of forested area, surface water, and disturbed habitat patches, and turfgrass were most influential as significant variables throughout the models at both scales with 45% to 90% of the observed variation explained. Regression analyses revealed significant positive relationships exist between the percentage of forested areas within golf courses and species richness and NTMB richness.

DISCUSSION

Breeding bird communities were influenced by landscape structure and the amount of landscape alteration within golf courses. The most influential landscape attribute throughout this study was the amount of forested area within a golf course.

Bird species richness increased as forested area increased within golf courses. Landscapes with higher percentages of forested area provide for a more diverse habitat mosaic¹⁰ offering resources (e.g., nesting sites, food, shelter, etc.) to a greater number of species. Highly forested golf courses were typically connected to low/undeveloped areas, perhaps allowing birds unimpeded dispersal throughout the landscape¹³ and providing necessary buffering against environmental disturbances many species find unsuitable.^{7,11}

Neotropical migratory bird (NTMB) richness was negatively related to landscape alteration. Neotropical migrants tend to be more abundant in landscapes with a high proportion of forested area¹ and may be avoiding more urbanized landscapes.² Fifty-seven percent of the species categorized as woodland breeders in our study were also NTMBs, and therefore highly altered golf courses may not provide the necessary buffering and forested habitat¹ needed by many NTMB and woodland breeding species (e.g., prothonotary warbler, summer tanager, Swainson's warbler, yellow-throated vireo).





Prothonotary warbler (*Protonotaria citrea*).

Less-altered golf course landscapes (i.e., low units) supported a larger number of woodland breeders than golf courses with a higher degree of alteration. Relative abundance of urban breeders (e.g., European starling, house finch, northern mockingbird) may have been higher in medium-high units because of the species' ability to cope better with human influences.² A higher density of avian urban exploiters is associated with more urbanized landscapes, causing a shift from more native species to more invasive/exotic species as landscapes become more developed. Densities of woodland species (urban avoiders) gradually disappear as landscapes become more developed.

Our results suggested that less-developed golf courses (low units) were of higher conservation value as indicated by a greater density of bird species of

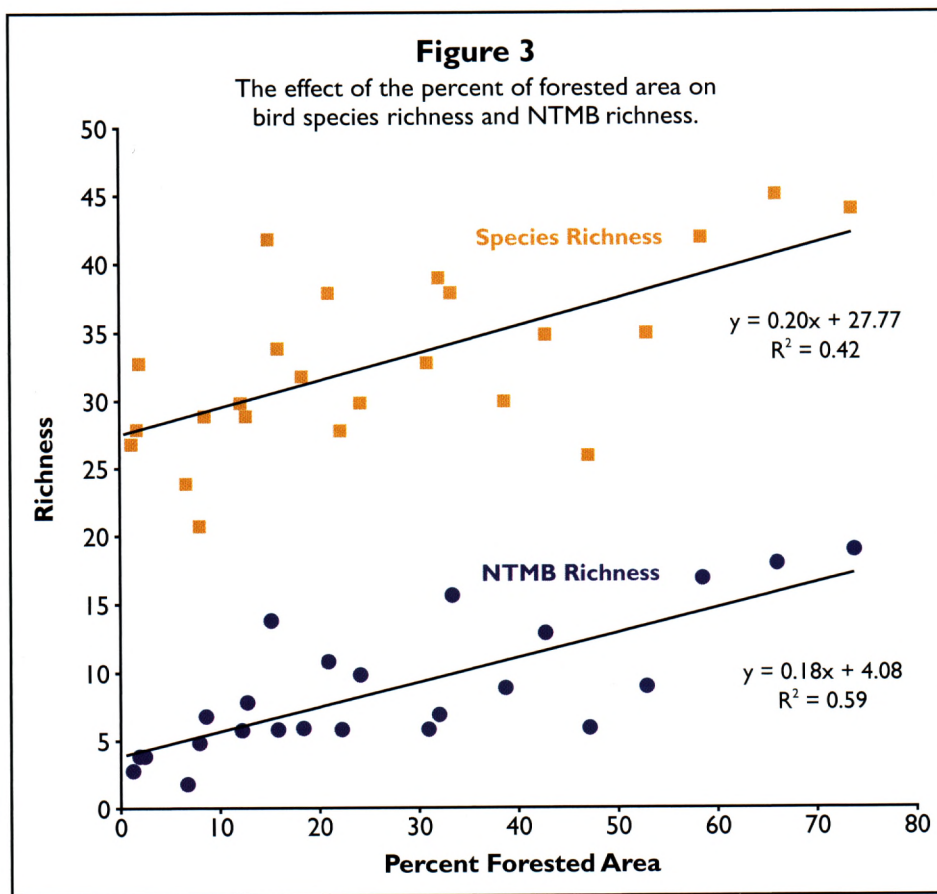
higher conservation concern as ranked by the Partners in Flight approach (e.g., hooded warbler, painted bunting, Swainson's warbler, northern parula, wood thrush). Efforts to properly manage and/or conserve these landscapes are warranted and must be considered.

The positive bird response to landscapes with a higher percentage of forested wetland, pine, and mixed forest habitats underscores the importance of maintaining patches of native vegetation. Our results also suggest small discontinuous turfgrass patches, fewer man-made water areas, and increasing the area of disturbance/scrub-shrub patches may also improve bird habitat on golf courses. Disturbance areas within golf courses created open grassy and scrub-shrub areas and added woody vegetation that is important to disturbance-dependent bird species.

With other intense urbanization development (i.e., business parks, shopping malls, non-forested residential areas) unsuitable to many species, golf course construction and routine maintenance procedures may create vital disturbance areas providing habitat for species in decline (e.g., brown-headed nuthatch, yellow-breasted chat, painted bunting, indigo bunting, orchard oriole, red-headed woodpecker) that require disturbed habitats.

CONCLUSION

Breeding bird species richness and NTMB richness were negatively related to landscape alteration and were greatly influenced by the amount of forested area within golf courses. Landscape structure modeling demonstrated habitat improvements within golf courses are possible by increasing the



amount of forested area within golf courses, particularly forested wetland, pine forests, and pine-hardwood mixed forests. More simply stated, bird communities typical of the forested South Atlantic Coastal Plain region benefited by maintaining greater amounts of native forest vegetation within a golf course.

Although we focused on golf courses as a separate landscape element, golf courses must be considered as an integral component of the larger landscape. Consequently, the composition of bird communities within golf courses is also likely a product of the bird community found in the larger surrounding landscape, although this relationship was not studied at this time.

Our study demonstrates that golf course architects and superintendents in conjunction with owners of associated residential developments can provide significant benefits to breeding bird populations by maintaining suitable habitat within a golf course. Furthermore, golf courses have great potential

to play an important bird conservation role at the local and regional level by working together with adjacent landowners to form on-the-ground partnerships to develop and coordinate complementary habitat management strategies.

ACKNOWLEDGEMENTS

Funding was provided by the U.S. Golf Association through the National Fish and Wildlife Foundation Wildlife Links Program and by the U.S. Fish and Wildlife Service. Cooperators in the project include participating golf courses, the U.S. Fish and Wildlife Service, the Baruch Institute for Coastal Ecology and Forest Science of Clemson University, and the South Carolina Cooperative Fish and Wildlife Research Unit.

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From Bunker to Biodiversity

The Club at Carlton Woods successfully converts a problematic bunker into an attractive wetland habitat.

BY PETER BRONSKI

At The Club at Carlton Woods (The Woodlands, Texas), a five-acre waste bunker that paralleled the fairway on hole No. 17 was a thorn in the side of an otherwise picturesque golf course and an eyesore that drained club resources. Abutting Bear Branch Lake and Reservoir, as well as several dense natural areas, the bunker was a constant maintenance battle against erosion and the encroachment of vegetation — all for what Superintendent Eric Bauer described as “a drab-looking golf hole.”

Rather than pouring resources into a never-ending cycle of needless waste bunker maintenance, the club decided instead to use the adjoining lake and natural areas to its advantage and converted the five-acre waste bunker into a waterway and wetland habitat that also was a visually pleasing addition to the golf course.

THE CONVERSION

The reservoir side of the bunker was excavated and the clay substrate was compacted to create a bank that allowed the former bunker to retain water in the new wetland area. The bank was planted with buffalograss and native bluestem to control erosion and eliminate the need for irrigation. A small island was formed to create a visual and habitat enhancement, and an overflow drain was installed to ensure proper regulation of water levels. Finally, native wetland plants such as

bald cypress, river birch, bull rush, spike rush, pickerel weed, and sagitaria were planted in partially and fully submerged areas.

Just two weeks after the project was completed, wood ducks and black-bellied whistling ducks descended upon the new wetland, and during the summer of 2002,

a pair of black-bellied whistling ducks raised 12 ducklings on the island.



Great blue herons, deer, muskrat, and numerous other wildlife species have become full-time resi-

dents or part-time visitors. From a habitat restoration standpoint, the project was a resounding success. Wood duck boxes and other nestboxes will be added to the wetland area in the near future, adding additional nesting sites for the myriad birds that have come to inhabit Carlton Woods' newest “renovation.”

GOOD FOR THE ENVIRONMENT, GOOD FOR GOLF

“Golfers absolutely loved the idea,” says Bauer, who communicated weekly with club members via e-mail to pro-

vide updates on the project status. “We have had many positive comments on the aesthetics and the wildlife that have been seen in the area.”

While The Club at Carlton Woods set out with aesthetics and wildlife as the motivating factors for the conversion, there's a certain fiscal sense to the project as well. The total project cost weighed in at \$70,000, but despite the relatively high sticker price, the club will see a financial return on its investment in fewer than 15 years. The original waste bunker was a sinkhole for club resources, swallowing \$5,600



Looking toward the Number 17 green, before and after pictures show the dramatic conversion of a five-acre waste bunker to wetlands and lake areas planted with a variety of native plant species.

per year — \$3,800 for maintenance and \$1,800

for repair — that can be reallocated to meet other club needs. Now the club is saving 20 man-hours of labor per month.

Arguably, though, the real benefit here is not measured in dollars. For The Club at Carlton Woods, staying true to its environmental commitment and receiving overwhelmingly positive praise from its members and golfers is priceless.

PETER BRONSKI (pbronski@audubon-intl.org) is a freelance writer as well as staff ecologist for the Audubon Cooperative Sanctuary Program for Golf Courses.

2004 USGA Green Section Education Conference

Friday, February 13, 2004
San Diego, Calif.

CONSTRUCTING NEW PATHWAYS TO THE FUTURE

10:00 - 10:05 a.m.

Welcome

Moderator: BOB BRAME
Director, North-Central Region

10:05 - 10:15 a.m.

Southeast Regional Report

Ideas, trends, and solutions from the Southeast Region.

10:15 - 10:35 a.m.

Research Results in Use Today

DARIN BEVARD
Agronomist, Mid-Atlantic Region
CHRIS HARTWIGER
Agronomist, Southeast Region
DAVE OATIS
Director, Northeast Region

New research results are announced daily, but what does it mean to the golf course superintendent who is managing the golf course every day?

10:35 - 10:45 a.m.

Northeast Regional Report

Travel to the Northeast Region for more good ideas and the inside scoop on what superintendents are doing.

10:45 - 11:05 a.m.

Construction or Renovation — Which Way Should I Go?

PAUL VERMEULEN
Director, Mid-Continent Region
BUD WHITE
Agronomist, Mid-Continent Region
Many courses are updating their greens to remain competitive. When it is your turn, will you choose complete reconstruction or partial renovation?

11:05 - 11:15 a.m.

Presentation of the Green Section Award

BRUCE RICHARDS
USGA Executive Committee

11:15 - 11:25 a.m.

Northwest Regional Report

The search for good ideas and new ways to do things continues — this time in the Northwest Region of the USA.

11:25 - 11:45 a.m.

Green Construction Recommendations

JIM MOORE
Director, Construction Education Program
The "Specs" have changed. How will this affect you and your course when it comes time to build or rebuild the greens? The hows and whys of the new *USGA Guidelines for Putting Green Construction*.

11:45 - 11:55 a.m.

Southwest Regional Report

Catch a glimpse of the unique trends and innovative solutions occurring in the Southwest Region.

11:55 a.m.

Closing Comments

2004 USGA NATIONAL & REGIONAL CONFERENCES

National Conference

February 13 San Diego Convention Center
San Diego, California

Florida Region

November Palm Beach Gardens Marriott
Palm Beach Gardens, Florida

Mid-Atlantic Region

February 23 Radisson Hotel
Monroeville, Pennsylvania
March 16 DuPont Country Club
Wilmington, Delaware

Mid-Continent Region

January 21 KCI Expo Center
Kansas City, Missouri
(with Heart of America Golf
& Turf Conference)
January 26 Polk County
Convention Complex
Des Moines, Iowa
(with Iowa Turfgrass Conference
& Trade Show)
March CDGA/USGA Green Seminar
Chicago, Illinois
March 9 Lakeside Country Club
Houston, Texas

North-Central Region

January 27 Indianapolis
Convention Center
Indianapolis, Indiana

Northeast Region

March 2 New England Turf Conference
To Be Announced

Southeast Region

March 16 Ballantyne Resort
Charlotte, North Carolina

Northwest Region

March 3 Whitefish Lake Golf Club
Whitefish, Montana
March 22 Waverley Country Club
Portland, Oregon
March 23 Lakewood Country Club
Denver, Colorado
March 24 The Country Club
Salt Lake City, Utah

Southwest Region

January 12 Friendly Hills Country Club
Whittier, California
March 15 Castlewood Country Club
Pleasanton, California
March 24 Phoenix Country Club
Phoenix, Arizona

GREEN SECTION STAFF RECOGNITION

Jim Snow, national director of the USGA Green Section, has announced a new staff title, Senior Agronomist, for Green Section regional agronomists who have demonstrated an outstanding commitment and dedication to their work over a minimum period of 10 years on staff.

Effective October 1, 2003, four members of the Green Section staff will now use the new designation. Bob Vavrek, who visits golf courses in Minnesota, Michigan, and Wisconsin in the North-Central Region, joined the staff in 1990. Keith Happ, now based in Pittsburgh, has spent 10 years visiting golf courses in the Mid-Atlantic Region. Jim Skorulski joined the Northeast Region in 1989 and focuses his visits in the New England area. Bud White has had two stints with the Green Section for a total of 12 years. The first covered the period 1978 through 1987 in the Southeast Region, and the second commenced with the 2002 season in the Mid-Continent Region, where he concentrates on the southern half of the region. Congratulations are extended to these four deserving individuals.

STANLEY J. ZONTEK RECEIVES THE PTC 2003 DISTINGUISHED SERVICE AWARD

The Pennsylvania Turfgrass Council (PTC) annually recognizes an individual who has exhibited outstanding service to the turfgrass industry. A specially appointed President's Committee of PTC announced Stanley J. Zontek as the recipient of the 2003 Distinguished Service Award. Mr. Zontek has been director of the Green Section for the Mid-Atlantic Region since 1985, having first joined the USGA in 1971.



PTC President Jerred D. Golden (left) honored Stan Zontek with the Distinguished Service Award on behalf of the 900 members of the Council.

The award was presented in front of an audience of nearly 600 industry leaders and future turfgrass professionals during the Penn State Golf Turf Conference on November 12, 2003, in State College, Pa. Stanley, a long-term Council member, was honored for championing the Penn State turfgrass program over many years and for his support of initiatives both within Pennsylvania and nationally that have improved the status of the industry.

Now operating out of an office in West Chester, Pa., Stanley is the USGA's longest-tenured employee. Shortly after his graduation from Penn State with a degree in Agronomy: Turfgrass Management, he took a job as agronomist in the USGA Green Section's Northeastern Region. Through the years he has served as director for the Northeast Region and the North-Central Region prior to assuming his present position as director for the Mid-Atlantic Region.

DEDICATION OF THE JAMES B. BEARD TURFGRASS LIBRARY COLLECTION

On July 16, 2003, friends, colleagues, and family members of James B. Beard gathered at Michigan State University's Turfgrass Information Center for the dedication of the James B. Beard Turfgrass Library Collection.

Dr. Beard served at Michigan State University (MSU) from 1961 to 1975

and at Texas A&M University from 1975 to 1992. After his retirement from Texas A&M, he became President and Chief Scientist of the International Sports Turf Institute. Beard's classic *Turfgrass: Science and Culture*, published in 1973 and still in print, continues as the landmark publication regarding turfgrass science. His *Turf Management for Golf Courses*, written in conjunction with the USGA Green Section staff, first released in 1982 and revised in 2002, remains the best-selling reference work in the field.



Dr. Paul Rieke (right) congratulates Dr. Beard on the donation of his turfgrass book collection to the Turfgrass Information Center.

Dr. Beard is a world-renowned turfgrass scientist. He has authored 257 scientific papers, 382 articles, and five books. The Beard Turfgrass Collection is acknowledged to be the finest personal collection of turf-related material in existence. It includes international coverage of the turfgrass research and management literature contained in more than 30,000 books, periodicals, and technical reports. The Beard Collection serves as a non-circulating reference collection within the Turfgrass Information Center in the Main Library. The Turfgrass Information File (TGIF) will provide article-level access to all items within the Collection. TGIF, an online database that indexes and abstracts the literature of turfgrass, is jointly sponsored by the United States Golf Association (USGA) and the MSU Libraries. The MSU Libraries maintain, produce, and host the TGIF. The arrival of the Beard Collection makes MSU the strongest public repository of turfgrass literature in the world.

For additional information on TGIF, contact: www.lib.msu.edu/tgif.

Have We Gone Too Far?

The grass is talking to you. Are you listening?

BY STAN ZONTEK

Why are so many golf courses having problems with moss? Why are putting greens slow to heal from pitch marks? Why is the grass on the greens thin and shallow rooted? Why does a pitch shot to a green gouge out a chunk of grass versus leaving more of a bruise or a dent? While golf is not played on color, why are greens off-color and look, well, hungry? Why does *Poa annua* seem to encroach all too fast into new greens? While the answers to most of these questions are complex, there still may be a simple common denominator — specifically, a lack of fertilizer.

As someone who is old enough to remember the “good old days,” it is easier for me to compare how golf courses were maintained years ago to how they are maintained today. One fact is clear. Except for the initial growth of new greens, golf courses generally are using less fertilizer today than in the past . . . a lot less.

Why do I say this? For a lot of reasons. Putting greens today are having problems with moss, algae, and pitch marks that are slow to heal, etc. It is true that there are many factors contributing to all of these problems, but most center around close mowing, low fertility, and too much water. Some of this water you can control; some you cannot (as witnessed by all the rainfall in the eastern United States this year). Today’s emphasis on green speeds doesn’t allow much wiggle room with putting green mowing heights. With fertility there is more room for change.

Today, few new golf courses have greens built to something other than

sand-based rootzones. Also, essentially every older golf course has modified the top few inches of soil, creating a layer of dirty sand even though the base of the green may be soil with clay.

With today’s emphasis on green speed, the simplest way to achieve fast greens is to reduce the mowing height, limit the use of fertilizer, apply growth regulators, topdress, and roll. Unfortunately, in gauging how much to fertilize greens, superintendents sometimes forget the obvious: That is, clipping removal removes nutrients that would otherwise be recycled. What is the bottom line?

- Count the pounds of nitrogen per 1,000 square feet applied to your greens. Subtract 25–60% of that total as the amount removed by removing clippings. You could also use the arbitrary amount of 2 pounds per year as the approximate amount of nitrogen removed by clipping removal. Subtracting either of these numbers should provide you with an estimate of the *effective* amount of nitrogen applied to your greens per 1,000 square feet per year.

- Remember the old textbook ratios of nitrogen, phosphorus, and potassium that suggest 3–1–2 or 4–1–2 or 4–1–4 ratios? How close are you coming? The grass’s basic fertility needs seldom change.

- How do your greens look? Do they have a moss problem? Close mowing and a lack of fertility contribute to moss invasion. Higher mowing heights and more fertilizer contribute to moss reduction.

- Do your greens lack color? Although golf is not played on color, a nice green

color indicates healthy grass versus the more yellow-green chlorotic-looking grass that needs nitrogen.

- Are your greens slow to recover from traffic, pitch marks, or disease blemishes? This, too, may be a sign that fertility levels are too low, even allowing for the fact that many putting greens are treated with growth regulators.

- Do you have a problem with algae? Maintaining good turf density is an important IPM tool to combat algae.

- Plant health — current research continues to show a link between plant health and less disease.

- Do your greens look hungry? *The grass is talking to you.* Maybe it is time to work more fertilizer into your program.

In summary, our industry always seems to go in cycles. It was not all that many years ago in the middle to northern regions of the country that a basic fertility program on old greens was 1–2 pounds of nitrogen per 1,000 square feet *per month*. We now see golf courses, especially in the North, that fertilize with not a whole lot more fertilizer for an entire season! Obviously, I am not suggesting a return to the days when greens were cut at ¼ inch and fertilized at 12–18 pounds of nitrogen per 1,000 square feet per year (in the North). What I am suggesting is that you look at your grass. Is it talking to you? It probably is. Be a good listener.

STAN ZONTEK is director of the Green Section’s Mid-Atlantic Region.



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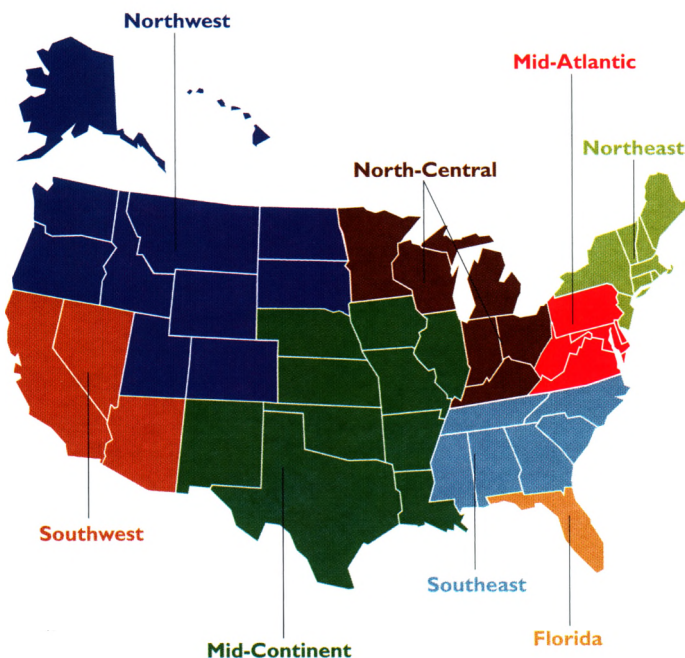
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Subscriptions \$18 a year, Canada/Mexico
\$21 a year, and international \$33 a year
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Subscriptions, articles, photographs, and
correspondence relevant to published
material should be addressed to: United
States Golf Association, Green Section, Golf
House, P.O. Box 708, Far Hills, NJ 07931.

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GREEN SECTION RECORD (ISSN 0041-5502)
is published six times a year in January,
March, May, July, September, and November
by the UNITED STATES GOLF ASSOCIATION®,
Golf House, Far Hills, NJ 07931.

**Postmaster: Address service requested —
USGA Green Section Record, P.O. Box
708, Golf House, Far Hills, NJ 07931-0708.**

Periodicals postage paid at Far Hills, NJ,
and other locations. Office of Publication,
Golf House, Far Hills, NJ 07931.

♻️ Printed on recycled paper

Turf Twisters

Editor's note:

The first Turf Twister in the November/December 2003 issue contained some poor wording that was of concern to some of our readers. Following is a revised version.

Q: I am the Green Chairman at our course, and I have a question about our aeration program. Our superintendent aerates the greens each fall and early spring with large tines. I'm wondering if the spring aeration is really necessary

since we have no play during our cold winter months. Our golfers complain about the appearance and bumpiness of the greens when we use the large tines in the spring. (Eastern Washington)

A: Greens aeration is done to relieve compaction, provide channels of sand for improved water infiltration, and assist in the removal of poor soil or excessive organic matter. If you have significant soil problems or layering problems that pose a threat

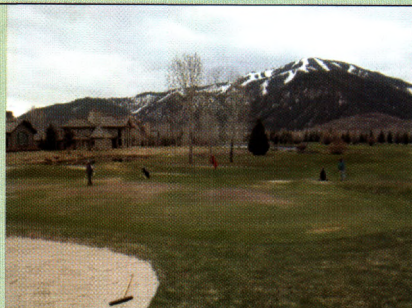
to the health of the turf and the quality of the putting surfaces, then twice-annual aeration with large tines could certainly be

justified. If the aeration is carried out as a routine preventative program on greens that are relatively free of problems, then perhaps your superintendent would agree to eliminate the spring treatment or consider a compromise of using small



tines in the spring to aid the greens while minimizing golfer complaints. The superintendent at your course will be able to provide the background information needed to make the best decision.

Q: How late into the spring should we allow our players to use winter rules? (Wyoming)



A: The best advice is to avoid playing winter rules if at all possible. Next best is to mandate playing the ball down when handicap postings are again accepted. While consistent playing

conditions may not be achievable each spring, the players will benefit most by playing golf as it is meant to be played — with the ball down.

Q: How low can ultradwarf bermudagrass be mowed? (Florida)

A: As part of the selection process with the ultradwarfs, the ability to tolerate a height of cut (HOC) of 0.125 inch was one of the criteria. Since their introduction, heights of cut as low as 0.085 inch have been maintained at a few courses. Golfer demands for faster

putting speeds have forced some superintendents to push the envelope as far as heights of cut. Also, egos can get in the way of sound agronomy when it comes to mowing heights. Discretion and good common sense still need to be exercised. When environmental conditions are

favorable to sustain active growth, the ultradwarfs can be successfully maintained at a HOC in the range of 0.110 to 0.125 inch. During periods of adverse weather and in particular low sunlight intensity, an elevated HOC should be practiced.