

# Data Loggers Help Reveal Old Secrets

Monitoring weather conditions with data loggers can bring a new understanding to some old problems.

BY JIM SKORULSKI



Chris Frielinghaus, superintendent at Glens Falls Country Club, uses a data shuttle device in the field to download temperature data from the data logger to be later transferred to his computer.

The tools available to manage turfgrass continue to improve. Remote sensing, satellite imaging, GPS, GIS, and smart sprayer technology are just a few of the tools that are now being utilized to monitor turfgrass more closely, improve irrigation precision, and manage pests successfully. Technologies to monitor climatic conditions and forecast weather have improved significantly, and advances in satellite technology and weather modeling have improved longer-range weather forecasting. The Internet has made real-time radar and multiple sources of weather data more available to most operations.

Golf course superintendents looking for more site-specific weather data are also realizing the benefits of improved technology. Automated weather stations are available to monitor temperature, relative humidity, wind speed and direction, solar radiation, barometric pressure, rainfall, soil moisture, evapotranspiration, leaf wetness, and more. The machines collect the data and can incorporate it into weather-based forecasting models that have been developed for diseases, insect pests, and weeds of turfgrass. The weather stations are comprised of a sophisticated data logger that collects and stores data from the various sensors. The data are transmitted directly to a computer through hardwire or wireless connections, where the information is used to track weather conditions, program irrigation, and forecast potential pest problems.

A la carte versions of weather stations are available for those who do not require a complete station. The smaller weather station version can be crafted using a battery-operated data logger device equipped with sensors for the specific conditions that will be monitored. The systems can range from simple, inexpensive single-sensor units to more complex multi-sensor devices, depending on the information desired. The smaller systems can be placed at different locations on the golf course to obtain data from various microclimates. The battery life is long and the data storage capabilities in the devices are significant. Unlike most conventional weather stations, the data stored in the data logger must be transferred manually from the field to a computer.

The value of data logger equipment has been realized by those wishing to monitor temperatures or other weather conditions at remote or multiple sites on the golf course. Let's take a



closer look at the devices and how temperature monitoring can improve a management program.

## GETTING STARTED

Creating a weather monitoring system with a data logger can be accomplished for as little as \$400-\$500. The system includes a battery-operated data logger device equipped with both internal and external sensors, a radiation shield to protect the data logger, a USB base station, and software required to launch the device and interpret the data. The USB base station is used to complete a connection between the computer and data logger device. A data shuttle device is not required, but it is a highly recommended accessory that eliminates having to carry a laptop computer in the field to collect data or launch the operation of data loggers in the field.

## PUTTING THE LOGGERS TO WORK FOR YOU

Data loggers can be used on golf courses primarily to monitor winter temperatures. The temperature data have proven useful for managing winter covers and in increasing our understanding of weather, snow, and ice effects on turfgrass survival. The data loggers are set out adjacent to greens in late fall at the same time winter covers are installed and final winter preparations are completed. The data logger contains an internal sensor to measure air temperature and an external port to which a thermocouple is attached to provide green canopy temperature measurements under snow, ice sheets, or winter covers. The data logger is activated to collect temperature data at the time interval desired. The data are downloaded from the data logger either with a data shuttle device or a laptop computer. The data are then available for closer analysis and to formulate charts.

Superintendents managing annual bluegrass in the northern regions have learned that putting green survival in the winter months is often dependent on the plant's exposure to lethal cold temperatures and hydration. Covering systems are being used more often to buffer cold temperatures and prevent excessive plant hydration.

The data loggers provide invaluable temperature information that has improved our understanding of how winter covers influence canopy temperatures and is helping evaluate different types of covers and covering systems. The temperature data are also helpful for evaluating insulating materials that may be used. Finally, superintendents can use the temperature data to help determine when covers should be temporarily lifted in winter or removed in spring.

Our understanding of snow's impact on canopy temperature has improved with the use of data loggers. The temperature data can also be used to document when rapid temperature fluctuations or potentially lethal temperatures have occurred. That information will help a manager gain a better understanding of how and when turf injury has likely occurred, and it



Data logger devices like the one pictured are durable enough for use in the field and will operate effectively for months on their battery source. The device collects and stores large quantities of data that can be transferred to a computer for analysis.

should be useful for formulating strategies to prevent similar damage in the future. It is safe to say that collection of temperature data will increase your understanding of winter injury and its management at your course.

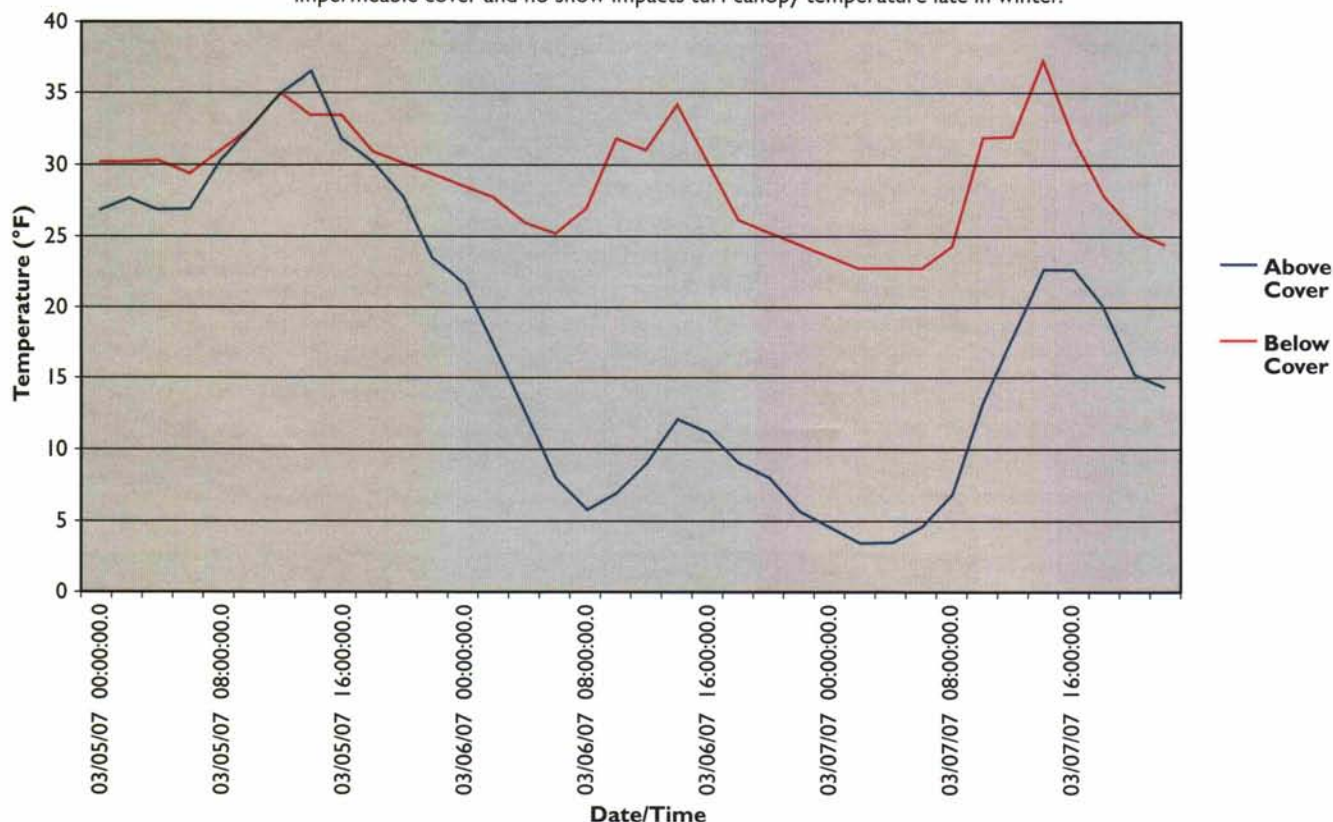
## NOT JUST A WINTER THING

The use of data loggers can be extended well beyond winter. Equipping the data loggers with sensors to measure light intensity, relative humidity, leaf wetness, or other weather condi-



### Tedesco Country Club 3-Day

Data collected over a 3-day period at Tedesco C.C. illustrates how an impermeable cover and no snow impacts turf canopy temperature late in winter.



tions might be useful for comparison purposes or documenting problems at a challenging site.

Temperature data can also be used to calculate degree-day accumulations that are used to predict pest activity. The software provided with the data logger completes the degree-day calculation that measures the difference between average daily temperature and a reference base temperature. The reference base temperature is the temperature that has been determined through research to be optimal for a pest's activity. Accurate degree-day models have been developed for crabgrass and annual bluegrass seed head emergence, and that information is readily available in the literature. Models and base temperatures have also been developed for a number of insect pests, including black turfgrass atenioides, hairy chinch bug, annual bluegrass weevil, and others. A number of these models are currently in place or are being refined and field tested, and that information will soon be available. The degree-day information can be correlated to actual pest activity in the field and used to refine monitoring and spray programs.

So how does a data logger fit into your program? Perhaps it doesn't at this point. But, for northern golf courses dealing with winter injury issues and courses battling pest problems, the small investment in the equipment and time will pay large dividends by increasing your knowledge of the impacts of the weather and management practices used during the winter season. Those in the warmer climates can benefit from the ability to monitor specific site conditions for especially problematic areas or to gain more intimate knowledge of pest activities on the golf course. The technology behind the data loggers and sensors will certainly improve, and with it our ability to manage the golf course.

### REFERENCES AND SOURCES

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