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Spying on Insidious Foe

To say that **Bob Benton** sees red a lot on his job is the truth, but it doesn't mean he's in a constant state of outrage.

The red Benton sees at work is the imagery of aquatic plants in the color infrared photographs he analyzes in his research on plants growing in Lake Livingston.

Benton, research coordinator for the Environmental Monitoring Laboratory of the Remote Sensing Center at Texas A&M University is also an ecologist. So it really wouldn't be far from the truth to say that Benton does see red in the figurative sense. That is when he considers the rapid growth of aquatic plants such as water hyacinth and hydrilla in Texas waterways and realizes that control measures are not keeping up with the rate of spread.

Add coontail, watermilfoil, pondweed and duckweed, and you have the villains of the water community. Their accelerated growth in Texas lakes and reservoirs in recent years is reminiscent of the onset of the problem in Florida. There, noxious plants have ruined water frontage for homeowners; limited water recreation and boating; clogged navigable streams; and blocked intake structures of water supply plants and power generating stations. Further, high transpiration from the massive vegetation accelerates the loss of impounded water, and treatment costs go up because of the presence of rotting plants.

NOT JUST LIVINGSTON

Although the present remote sensing project site is Lake Livingston, the problem is not limited to that area.

Heavy growths of aquatic plants have clogged many lakes in East Texas. Benton says the plant population in Lake Livingston had grown from 50 acres of water hyacinth in 1971 to 2000 acres of hyacinth, coontail, hydrilla and duckweed by the fall of 1974.

The project on which Benton and associates at Texas A&M now are working may provide one of the most important weapons in the struggle to control nuisance plants in Texas lakes. Research, using remote sensing techniques, has been done the past two years to develop a low-cost procedure for detecting infestation, determining which species are present, monitoring the spread over an entire growing season, and evaluating the effectiveness of ongoing plant control programs.

Aerial photography with color infrared film has been used by the team to conduct the study. Infrared photography makes it possible to differentiate between vegetation species as well as to determine the stage of growth, and/or decay, of the plants. For example, water hyacinth produces a magenta image when it is mature--photos of a lush water hyacinth mass appear as dominant areas of rich red tufts on a variegated background. The youthful image of hyacinth is medium lavender, and as it grows older, it becomes magenta and then rust-brown in late maturity. In its old age, its image goes to orange, then yellow, then green, then tan. If the healthy plant has been stressed--treated with herbicides or affected by freezing temperatures-- the image colors go from the lavender or magenta stage to the greenish tan stage in a very short time. One photo can contain all these colors for the single species, in addition to the characteristic colors indicating other aquatic species, plus the hues showing water, land, and land vegetation.

PHOTO DETECTION

The color pictures help the team to detect and assess the infested areas and to monitor areas under treatment in order to determine the effectiveness of the control method being used. At present the major control program on Lake Livingston is conducted by the Texas Parks and Wildlife Department, which applies an

EPA-approved chemical (2,4-D) from spray boats to control hyacinth.

"Aerial photography using color infrared film provides valuable insight into the effectiveness of the plant control work underway," Benton pointed out. Through this process it has been determined that in some cases 2,4-D application may be counterproductive.

"It is a growth hormone, behaving sort of like an ultrafertilizer," Benton explained. "Applied in normal concentrations it quickly grows the plants to death, but as it becomes more and more dilute, it may have some of the effect of fertilizer, stimulating enthusiastic reproduction on the fringe of the application swath." Last year's photos indicate that "unless you can totally eradicate, the use of 2,4-D actually encourages lateseason regrowth in areas where the plants might have withered early if left alone."

The sequence of photographs of the corner of the Lake Livingston "Jungle" where herbicide was applied on water hyacinth reveals the plant's sly behavior, leaving researchers with much to ponder before successful control can be expected.

"One month," Benton said, "the stuff would be killed off and we would say 'hurrah for our side,' but the month after that it would come booming back in the cleared area. It has a property within itself which will produce a springlike regeneration after it has been stressed. This seems to be the problem."

Aerial photos were made at roughly six-week intervals from late April 1974 to mid-January 1975. Focusing on the same path each flight, the researchers concentrated on water hyacinth areas in early months and later included several newly-discovered areas of hydrilla outbreak. The photos were processed the day they were taken and were analyzed the next day. On the third day the researchers checked out the photoanalysis by visiting the sites by boat.

TRINITY CONTRACT

The 1975 project is under contract with the Trinity River Authority (TRA). Benton reports his findings on plant spread and growth rates after he analyzes the film. With that information the TRA can decide where they want to concentrate their control efforts.

The 1975 research funding has come from a NASA grant and from the Texas Water Quality Board, which is underwriting the TRA contract. The present project ends in December, and Benton hopes additional funding will be available to continue research, but he is in favor of passing on the techniques learned from the present contract.

"We should not be in the monitoring business as such, and so far we are not. We are, instead, developing procedures. My goal has been to develop a simple, reliable system that can be turned over to people who are doing the plant control. l am a strong believer that the guy in charge of control should also do the monitoring. That way the monitoring can be much more responsive to the specific needs of the control program."

For example, Benton sees monitoring as an activity to be carried out by the Texas Parks and Wildlife Department, or the affected River Authorities, or possi

bly by some commercial organization working on contract. "Once we know how to monitor routinely, it stops being research and becomes knowledge we can transfer to somebody else. Then we can move on to improving procedures or trying something entirely new."

A MUST

But the main point is *monitoring must* be *done* in order to get ahead of aquatic plants and stay ahead. In Florida, where aquatic plants have wreaked the greatest havoc, a total of $15 million per year is now being spent on research and control of the problem. Yet even Florida does not yet use remote sensing for aquatic plant detection and monitoring.

As far as Benton knows, no other state routinely uses remote sensing as an operational feature of its program, yet scientists and water-oriented people with whom he has discussed the subject support remote sensing as "the way to go." The A&M group did not initiate using aerial photography for speciation of aquatic plants, but Benton thinks they may be pioneers in the concept of using this as an operational tool for aquatic plant control.

"I think we're beginning to realize success. We worked with the Trinity River Authority in 1975, and they are reaching the point where they say they would like to try to take over and do it themselves. We agree. We should prefer to look on a 1976 project with them as a final development effort which would permit their taking over the aerial photography and analysis work on Lake Livingston."

In a sense, the Lake Livingston project has been a test case, and the system devised would to an extent apply to other Texas lakes. But Lake Livingston is by no means typical.

For example, Lake Conroe is a younger lake, having been filled only a little more than a year ago. There the lake is near the top of the watershed and the level of nutrients from nearby runoff should be considerably lower than that from the Trinity River inflow into Lake Livingston. Nevertheless, recent photography shows that the spread of aquatic plants on Lake Conroe, particularly the more tenacious submersed plants, is even greater than that on Lake Livingston. By concurrent study of these dissimilar lakes, using present techniques, researchers hope to further refine their procedures to monitor economically, rapidly--and on a continuing basis--many other Texas lakes that have problems with noxious aquatic plants.

Ideally, Benton says, every major lake in Texas should be monitored. The most important first step would be to inventory present conditions on these lakes. A baseline survey would determine the lakes affected, the species now present, and the acreage each species inhabits. Next would be periodic monitoring to determine the rates of change in terms of infestation and coverage. Control efforts could then be based on specific data. At present, most of the evaluation is done at boat deck level, where only a portion of the problem is glimpsed--the big picture is lacking.

If remote sensing is the right route to management --as the problem has grown, the word has changed from 'eradication', to 'control', and now to 'management'--of the noxious plants, Texas is now taking a positive step which may save dollars and tempers. Continued unabated proliferation of the harmful plants could cause lots more people to "see red."