**This sabal palm (*Sabal mexicana*) was transplanted to a ranch gate from Garcitas Creek, where a wild population of this species occurs north of the Lower Rio Grande River Valley. The palm's topmost leaf shows the characteristic costapalmate downcurve.** *Photo by Carol Lockett*

The behavior of the species gives clues to its habitat range. It often escapes cultivation, as is happening in Austin. There is now an escaped population reproducing in the wild 300 miles (483 km) northwest of the Lower Rio Grande. Two other escaped populations are growing on rural sites along the Aransas River and near the Guadalupe River. Bill Carr, a botanist with The Nature Conservancy, found sabal palms escaping cultivation so profusely in southern San Antonio that he believes they are probably native to that area (Carr pers. comm.). This supports de Espinosa's observation. There is also evidence that the species' range extended to the San Bernard River, northeast of the rivers listed by Engelmann, where there is a population of palms that appears to be a hybrid of dwarf palmetto (*Sabal minor*) and sabal palm.

In a sense, restoration is already underway. Fruit of ornamental sabal palms is dispersed by runoff and animals, and remnant populations probably exist on private land. But self-restoration will take time, given the sabal palm's slow growth. This would allow too much time for the casual destruction of the species by those (including conservationists) who are ignorant of these palms and their native status. Because so many palm species have been introduced to Texas, it is crucial to educate restoration practitioners, conservationists, and others that not every palm they see is an exotic. If efforts to restore sabal palm are successful, our descendants may someday see this native species overtopping live oaks along south Texas waterways—a sight that might seem exotic to 21st-century residents, but that would have been familiar to La Salle and the Karankawa Indians who inhabited this region 300 years ago.

## References


de Espinosa. 1716. Diary of Fray Isidro Felix de Espinosa. Entry of Thursday, May 14, 1716. Latin American Collection of University of Texas Library, Austin, Texas.

Howell, C.W. 1872. Letter dated March 12, 1872, from Howell to G.A. *Annual Report of the Chief of Engineers for 1875*, Appendix S8, pp. 936-938.

Lockett, L. 1995. Historical evidence of the native presence of *Sabal mexicana* (Palmae) north of the Lower Rio Grande Valley. *Sida* 16(4):711-719.

Lockett, L. and R. Read. 1990. Extension of native range of *Sabal mexicana* (Palmae) in Texas to include central coast. *Sida* 14(1):79-85.


## SER 2003

## 97

### Riparian Plantings and Fencing Help Improve Water Quality in Tillamook River Watershed (Oregon)


*Timothy J. Sullivan, E&S Environmental Restoration, Inc., P.O. Box 84, Corvallis, OR 97339, 541/758-5777, tim.sullivan@EandS.net; M. Wustenberg, Kilchis Dairy Herd Services, P.O. Box 327, Bay City, OR 97107; J.A. Moore, Dept. of Bioengineering, Oregon State University, Corvallis, OR 97331; K.U. Snyder, E. Gilbert and D. Moore, E&S Environmental Chemistry, Inc., P.O. 609, Corvallis, OR 97339; and E. Mallery, Oregon Streamside Services, 11880 Hwy. 101 S, Tillamook, OR 97141*


Tillamook Bay and its watershed, which are located on the north coast of Oregon, have a long history of water quality problems (Oregon Department of Environmental Quality 1994). Despite progress in restoring water quality, both fresh and saline waters often fail to meet water quality standards for bacteria (200 colony forming units {cfu}/100 ml in fresh waters), frequently causing the cessation of oyster harvesting in the bay (Sullivan and others 1998a, Sullivan and others 1998b). Among the proposed solutions to this problem are regulations designed to curb nonpoint pollution by upstream dairy farms.

Many dairy farmers in the watershed remain unconvinced that management activities on their individual farms will make any appreciable difference in the water quality of Tillamook Bay and its tributaries. We believe that farmers are reluctant to remove large portions of their farms from production in order to improve water quality, in part because better information is needed to determine to how best to improve water quality with minimal loss of productive land.

With this problem in mind, we decided to demonstrate and quantify whether the use of streamside fencing, riparian planting, water diversion, enhancement of multiple small wetlands, and changes in manure management practices would reduce the level of fecal coliform bacteria (FCB) in a stream draining forest and farmlands.

The sites selected for the experiment were two of three farms located uppermost in the Beaver Creek watershed. Three major tributary streams flow from the forest to the pastures on these farms. The farm located uppermost on Beaver Creek is a dairy farm with about 100 milking-age Holsteins and about the same number of heifers. The lowermost farm pastures about 50 heifers. The farmer between the two selected sites pastures about 25 beef cattle, but chose not to participate in the experiment. Spreading manure on pastures is a routine activity at the two participating farms. During the summer of 2001, we implemented a manure spreading program that confined manure spreading to further than 25 feet (8 m) from the fencelines along the creek and drainage ditches.

In addition to the treatment sites, we also selected a nearby reference watershed. It was similar in size, types of land use, and physiography.

We monitored the streams both above and below the treatment areas and in the reference site subbasin. Monitoring included measurements of rainfall, stream discharge, and sampling of streamwater during five to ten storm events every year for four years.

**Table 1. Total discharge-weighted storm median fecal coliform bacteria concentrations (cfu/100ml) at the primary sampling site in each of the watersheds before and after treatment.**

| | Pretreatment (Years 1 & 2) | Post-treatment (Years 3 & 4) |
|---|---|---|
| *Treatment Site (BEA-FRZ)* | | |
| Median | 431 | 84 |
| 25th Percentile | 282 | 42 |
| 75th Percentile | 1,300 | 709 |
| *Reference Site (TIL-YEL)* | | |
| Median | 366 | 322 |
| 25th Percentile | 261 | 196 |
| 75th Percentile | 677 | 757 |
| *Ratio (BEA-FRZ÷TIL-YEL)* | | |
| Median | 0.78 | 0.26 |
| 25th Percentile | 0.50 | 0.24 |
| 75th Percentile | 1.62 | 0.70 |

Prior to any treatments, we found substantial bacterial contamination in stream waters at both the reference site and the treatment sites. For instance, FCB at both the Beaver Creek monitoring site immediately downstream of the project area and at the reference watershed monitoring site frequently exceeded 2,000 cfu/100 ml during storm events, and occasionally exceeded 6,000 cfu/100 ml. The results also showed significant bacterial contamination in one forested tributary upstream from the farms in the treatment area.

The conditions we found prior to the experiment remained the same in the reference watershed. The levels of FCB downstream from the treatment areas, on the other hand, changed significantly after implementation of restoration actions and management changes (Table 1). We found that, on average, the water leaving the treatment watershed below the farms had lower FCB concentrations than water entering the farms from the forest in one of the tributary streams. However, water quality improvements below the treatment sites were not uniform during all seasons of the year. For example, the improvement in FCB levels during the fourth year ranged from a 45 percent reduction during the fall months to 63 percent in the winter and 88 percent during the spring. In addition, the FCB concentrations below these sites only exceeded the fresh water standard during three storms, all sampled during the fall, and one of those incidents could be attributed to bacteria originating in the forested portion of the watershed. Whereas 80 percent of fall storms sampled prior to treatment resulted in mean FCB greater than 100 cfu/100 ml (and 90 percent throughout the study at the reference site), only 30 percent of fall storms in the fourth year resulted in a mean FCB greater than 100 cfu/100 ml at the downstream treatment monitoring site.

Clearly, our restoration and management activities have helped improve water quality in the Beaver Creek watershed, and our ability to measure such changes holds important implications for setting constructive, but not restrictive, regulatory policy as regards nonpoint pollution and dairy farming. Moreover, we expect that these management strategies will help reduce bacterial contamination in Tillamook Bay.

## Acknowledgments

This research was supported by grants from the Oregon Watershed Enhancement Board, Oregon Department of Environmental Quality, U.S. Environmental Protection Agency, and Tillamook National Estuary Project. Assistance was provided by the Tillamook County Performance Partnership, Oregon State University Extension Service, Natural Resources Conservation Service, Oregon Department of Agriculture, Tillamook County Creamery Association, Tillamook Soil and Water Conservation District, U.S. Bureau of Land Management, Tillamook Bay Watershed Council, J. Bischoff, R. Rees, B. Eilers, G. McGrath, K. Vaché, T. Leonig, D. Peterson, J. Wustenberg, and J. Charles. We also gratefully acknowledge the assistance of the two landowners, the Johnston and Hoffmann families.

## REFERENCES

Oregon Department of Environmental Quality. 1994. Oregon's 1994 water quality status assessment report: 305(b). Portland: Oregon Department of Environmental Quality.

Sullivan, T.J., J.M. Bischoff and K.B.Vaché. 1998a. Results of storm sampling in the Tillamook Bay Watershed. Report to the Tillamook Bay National Estuary Project.

Sullivan, T.J., J.M. Bischoff, K.B.Vaché, M. Wustenberg and J. Moore. 1998b. Water quality monitoring in the Tillamook Watershed: Results of a one-year periodic monitoring and storm sampling program. Report to the Tillamook Bay National Estuary Project.


## 98

### FROM: Abstracts of the 17th Annual Meeting of the Society for Conservation Biology

## 98.1

**Restoration of a Wild Rice Lake Ecosystem.** Wold, A.P., Fond du Lac Tribal and Community College, 2101 14th St., Cloquet, MN 55720, awold@ezigaa.fdl.cc.mn.us; G. Host and L. Schwartzkopf. P. 194.

As part of the Fond du Lac Natural Resources Program, workers are mechanically removing pickerel weed (*Pontederia cordata*) in an effort to increase the presence of wild rice (*Zizania palustris*) in Perch Lake, Minnesota. Floristic surveys show that pickerel weed and pondweeds (*Potamogeton* spp.) dominate the vegetation community of the lake. The authors note that wild rice is not regenerating as rapidly as they thought in areas where the other plants have been mechanically removed. They theorize that this is because of reduced seed stock of wild rice in areas where pickerel weed previously dominated.

## 99

### FROM: Abstracts of the 88th Annual Meeting of the Ecological Society of America

## 99.1

**Effects of Macrophytes on Lake Eutrophication and Restoration in Relation to Lake Morphometry.** Genkai-Kato, M. and S.R. Carpenter, University of Wisconsin-Madison, Madison, WI.

With the knowledge that phosphorus recycling from a lake's sediment can make restoration of lakes more difficult, the authors studied the relationship of macrophytes to eutrophication. They found that the effect of macrophytes on water clarity depended on mean depth and temperature, but not on lake area. Lakes with a mean depth of about 33 feet (10 m) were most susceptible to eutrophication. Shallow lakes (less than 7 feet {2 m} mean depth) were resistant to eutrophication because of the presence of macrophytes, while deep lakes (more than 66 feet {20 m} mean depth) were resistant because of the large amount of cooler water. The authors conclude that restoration attempts that reduce phosphorus input will likely fail in lakes with intermediate mean depth and that restoration is more difficult in a warmer lake.

# COASTAL COMMUNITIES

## 100

### Demonstration Dock Designed to Benefit Eelgrass Habitat Restoration (Washington)

*Heida L. Diefenderfer, Susan L. Sargeant, Ronald M. Thom and Amy B. Borde, Pacific Northwest National Laboratory, Battelle Marine Sciences Laboratory, 1529 West Sequim Bay Road, Sequim, WA 98382, 360/681-3619, heida.diefenderfer@pnl.gov; Perry F. Gayaldo, NOAA Restoration Center, Silver Spring, MD 20910; Craig A. Curtis and Brian L. Court, Miller/Hull, Seattle, WA 98104; David M. Pierce, Peratrovich, Nottingham & Drage, Inc., Seattle, WA 98104; and David S. Robison, Northwest Maritime Center, Port Townsend, WA 98368*

Eelgrass (*Zostera marina*) beds are essential habitat for federally listed salmonids in the Pacific Northwest, but eelgrass growth is often impaired by the construction and presence of docks and piers. While physical disturbance, the introduction of contaminants, and increased turbidity and propeller scour from boat traffic all affect seagrasses, it is also the reduction of available light by overwater structures that causes harm to these plants (Kelty and Bliven 2003, Shafer 2002). Therefore, stringent building requirements (USACE 2003) and innovative designs are necessary to meet the needs of the environment while allowing for the construction of docks.

From 2001 to 2003, we were part of a committee of marine scientists, architects, engineers, educators, regulators, and citizen groups who met to redesign a 233-ft (71-m) derelict oil dock located on state tidelands in Port Townsend, Washington, for the Northwest Maritime Center. Our objective was to restore nearshore habitat functions, particularly for threatened fisheries resources, while accommodating the center's need to berth vessels ranging from sea kayaks to historic tall ships. A key goal was to restore fragmented eelgrass beds by 1) using best-available technologies and design features to construct a demonstration dock that would improve growing conditions for eelgrass and 2) transplanting eelgrass to connect existing patches.

We evaluated ecological conditions through diver surveys and mapping, and by reviewing controlling factors, such as currents, bathymetry, macroalgae, and substrates. We found that eelgrass beds were healthy on nearby portions of the waterfront, but highly fragmented or nonexistent adjacent to and underneath the dock (Figure 1). Controlling factors appeared adequate to support eelgrass, but modeling the shadow cast by the old structure at solstice and equinox revealed zones corresponding to areas where eelgrass had been lost.

We collected data on the attenuation and diffusion of photosynthetically active radiation at the site and evaluated it relative to eelgrass light requirements previously documented by Thom and Shreffler (1996). We tested various technologies, including a metal halide light, tubular skylight and deck prisms,