An Analysis of The Harbor Springs Sewage Treatment System

Diane Biba
Kevin Dombkowski
Lori Hacker
Peggy Moore

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Statement of Purpose

The problem of dealing with municipal wastes is of an ever increasing magnitude. The options for disposal of these wastes are numerous. Some factors to be considered are: population size, effluent volume, availability of land, cost, and possible environmental effects. In the Harbor Springs area, the population size is small and thus the effluent volume is easily manageable. Both vary greatly with the seasonal resort activities. There is little industry in the area, so industrial wastes do not contribute much to the sewage treatment system. Land is readily available, so this factor is minimized. Because land is abundant and relatively inexpensive, a land disposal system appears to be the method of choice. Harbor Springs does not produce a great enough volume of wastes to justify or necessitate an energy intensive, fast-flowing treatment plant like those used in the nearby areas of Petoskey and Cheboygan. Because of the low effluent volume and the availability of land, the Harbor Springs area has been able to dispose of their municipal wastes rather inexpensively on a land site.

Since land availability, waste volume, and cost have all been optimized by the land disposal system, we are left with one major factor to consider in the determination of a disposal system. The environmental effects of a system are of great concern but are not always easily determined. It is the purpose of this study to ascertain if any environmental hazards do exist at the Harbor Springs wastewater treatment site, and to suggest an appropriate ecologically sound method of continuing treatment in the area.

Results

Several parameters were examined to assess the effectiveness and environmental effects of the present system. The biomass per square foot, percent coverage per square foot, and species diversity were tested as indicators of the condition of the area. These parameters were studied in the flood ponds as well as the spray areas.

In the flood ponds, the specimens for biomass sampling were taken from three 1 ft. sq. plots along a transect from the center of the ponds out to the edge. Percent coverage was determined at hthe same sites. Samples in the spray areas were taken randomly determined transects. Species diversity was calculated along the transects in both areas, using the Sequential Comparison Index method.(Cairns et al, 1968)

Figure 1 shows the results of biomass sampling. In the flood ponds, biomass was found to average 21.9g/ft^2 with the control averaging 10.9g/ft^2. In the spray areas the sampling sites averaged 64.2g/ft^2 for fixed spray and 25.9g/ft^2 for the rotating spray arm areas. Controls averaged 10.5g/ft^2.

¶The percent coverage was found to vary greatly at the flood pond sites. Three sites exhibited grasses as the major foliage, while two had mosses dominant. One site was covered by almost equal amounts of grasses, mosses, and leafy plants. The control areas had much leafy coverage. The fixed and rotating spray areas showed grasses dominant in all cases.

The results of the species diversity samples are shown in Fig. 3. The flood areas had an average species diversity index of o.28, with 0.27 for the controls. The spray areas showed an average diversity of 0.025 for the sample sites and 0.377 for the control.

Analysis and Conclusions

To determine if the Harbor Springs land disposal system is efficiently removing nutrients, the biomass per square foot was examined at each site. It was found that the flood ponds had significantly more biomass than the control areas. In the spray area, the fixed spray sites showed more biomass than either the control or the rotating spray areas. This indicates that the treated areas are indeed removing nutrients and converting them to plant biomass. It may also be suggested from the biomass data that the fixed spray area is more efficient at this nutrient removal than the flood ponds. The spray area biomass was almost three times that of the flood pond site.

Very low species diversity was seen in those sites where the best nutrient removal was exhibited. Although highly diverse systems are thought to be more stable than more homogeneous ones, we feel that the fixed spray area is not likely to be disturbed to the point of lethality of the species present. The rotating spray arm has not been working efficiently for two years, and the area is still thriving and productive, Even if the species now present were removed, new hardier invading species may function as well in nutrient removal.

Another consideration is the duration of the two systems. Signs of forest succession encroaching on the flood ponds, as well asthe build-up of organic matter may eventually fill in the flood areas.

In summary, we found that the land disposal of wastewater is functioning adequately to remove nutrients and convert them to plant matter. We feel that the flood ponds cannot remove these nutrients as efficiently, especially in a similar sized area. The flooding periodically gives plants the nutrients and moisture they require but also involves a ten day waiting period between floodings of a pond. It is doubtful that more frequent flooding would improve nutrient removal. It may damage existing plants by excessive moisture or nutrients. The daily spraying of the alternate area has the advantage of frequent nutrient and moisture exposure without the threat of overdose and possible damage due to the flooding process.

Recommendation

It is our recommendation that the Harbor Springs Municipal Council continue its practice of land disposal of waste water. We feel that the current methods of disposal are adequately removing nutrients without apparent harm to the ecosystem. Spraying- especially with the fixed sprayers - as much as possible is the preferred of the present methods. If Harbor Springs expands and requires larger wastewater disposal facilities in the future, several modifications of the current site could be made. If greater volumes of effluent must be disposed of, it is our suggestion that the pond area be considered for conversion to fixed spray disposal. This study has established that the fixed spray method removes nutrients more efficiently than the flood ponds. For a reasonable additional cost, the disposal site could be expanded to be a fixed spray area covering approximately 45 acres - the equivalent of 7 times the present 6.2 acre fixed spray area, with a capacity of 3.5 million gallons per day. Enlargement of the holding lagoon portion of the treatment plant could be done as necessary. The total system would still be relatively inexpensive and not highly energy intensive.

It is also possible that ethanol production from plant matter grown in the area may one day be economically feasible for a wastewater facility comparable to this one. A suitable crop could be planted on the spray sites and later harvested for production of the alcohol. This would help offset operational costs of the system.

Before any changes are made in the present system, much more testing is necessary. Several factors must be considered. One of these is the airborne transmission of pathogens, and whether this is greater from flooding or spraying. While the spraying-especially the rotating arm- releases the effluent into the air, there is evidence that transmission of pathogens occurs from the micro-zone on the surface of water like the flood ponds. A second is the leeching of materials into the groundwater. It is presumed to be greater in the flood areas. Increased use of the system may effect groundwater quality. A third study should be conducted to conclusively determine the longevity of the flood and the spray areas. Forest succession and deposition of organic materials must be studied for each area.

Literature Cited

1.Cairns,J.,Jr., "The Sequential Comparison Index-A Simplified Method for Non-Biologists toEstimate Relative Differences in Biological Diversity in Stream Pollution Studies." Journal Water Pollution Control. Washington, D.C. 1968

Fig. 1 BIOMASS/FT^2 OF SAMPLING SITES

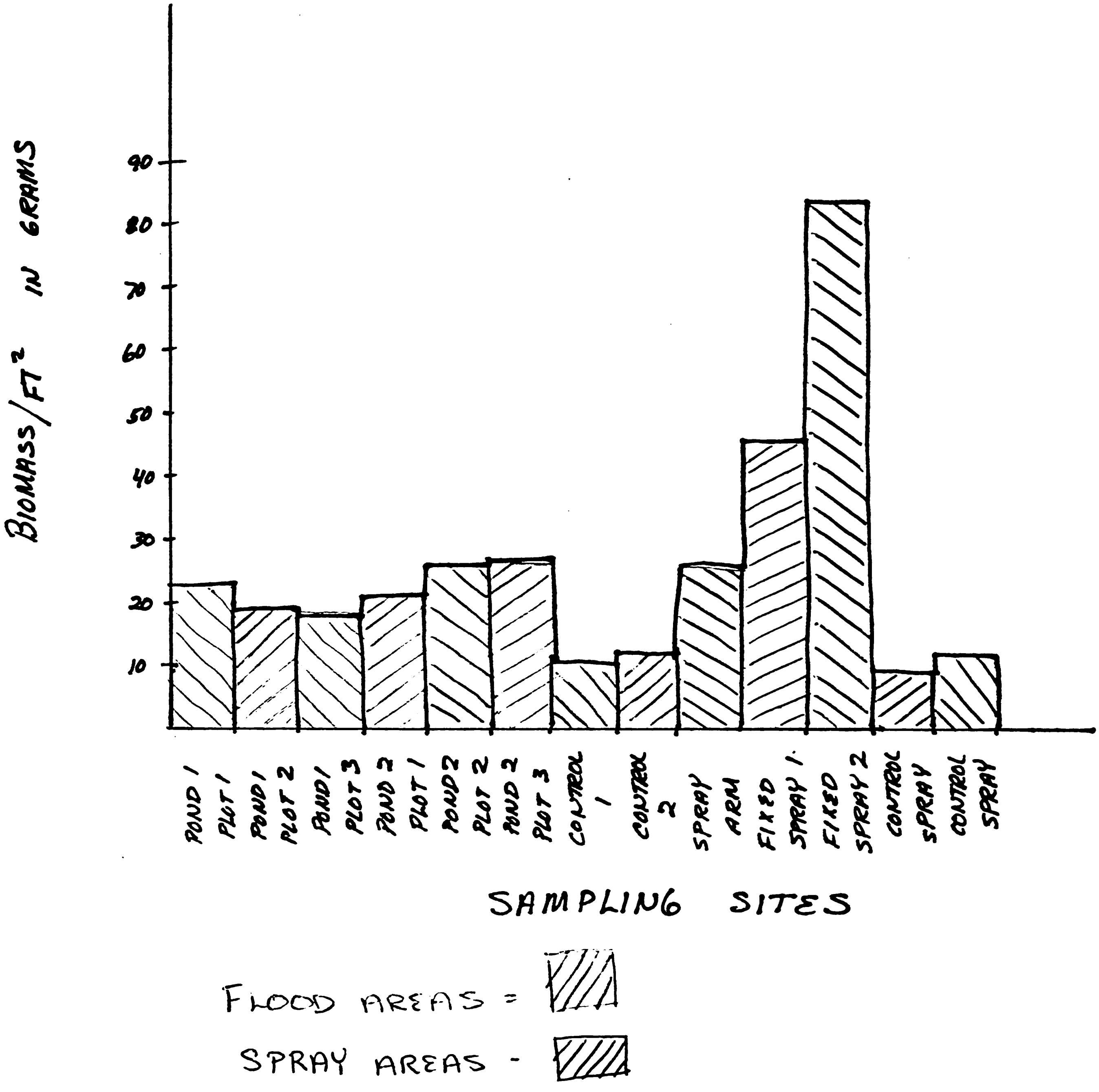


FIG. 2 PERCENT COVER OF SAMPLING SITES

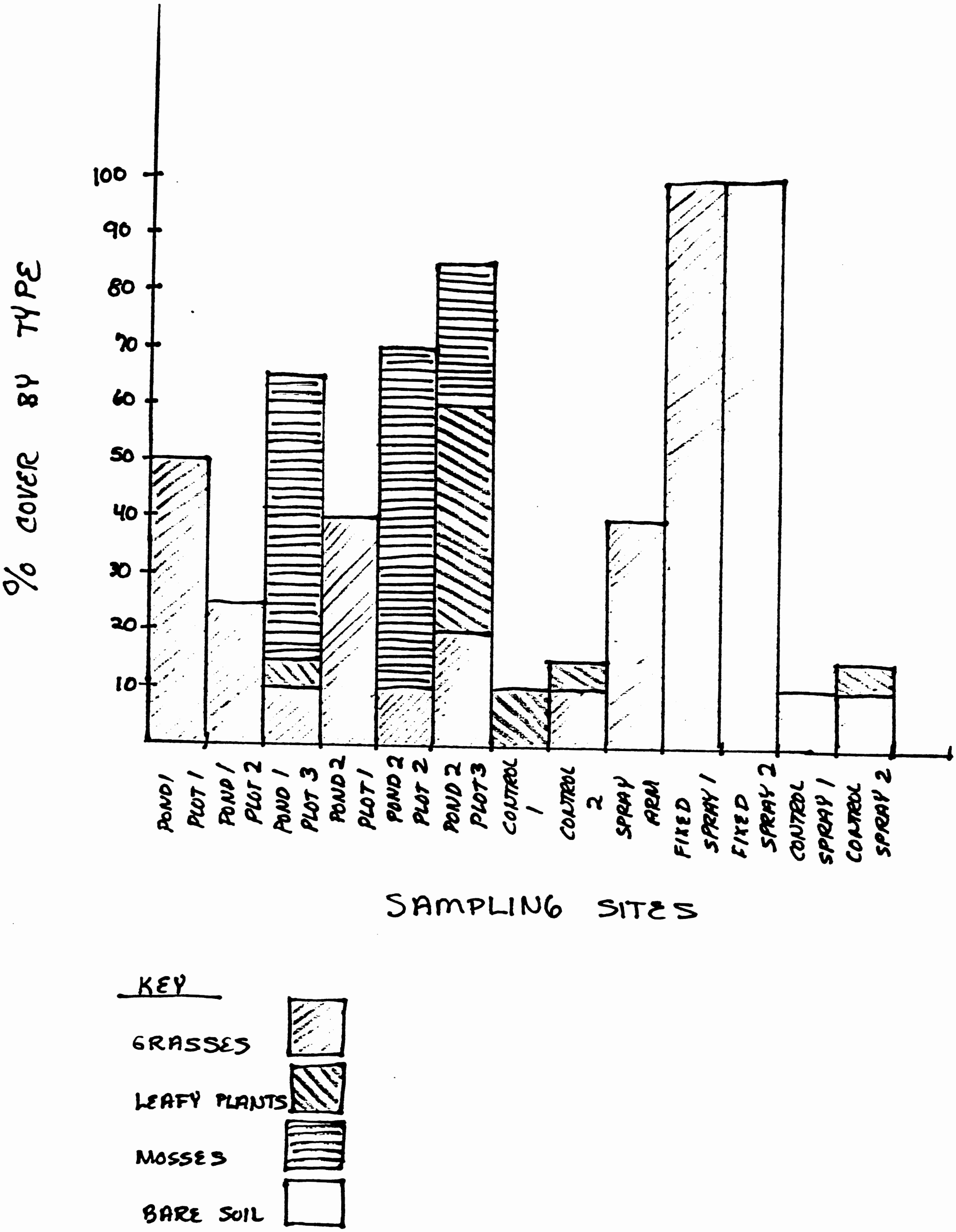
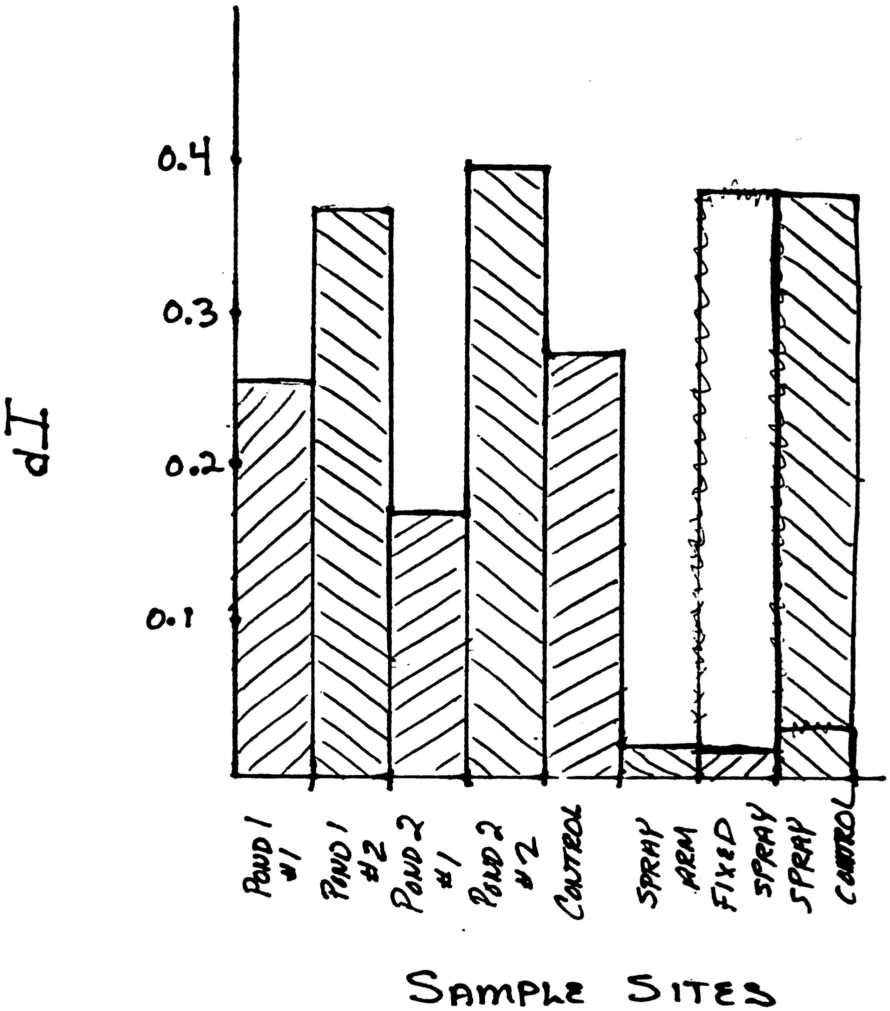


FIG. 3 DIVERSITY INDICES



$$dI = \frac{\#\text{ of runs}}{\text{total }\#\text{ of specimens}}$$

PONDS: RANGE = 0.172 – 0.390

$\overline{X}$ = 0.292

SPRAY AREA: RANGE = 0.02 – 0.377

$\overline{X}$ = 0.142