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Present and Potential Ecological Status of the Diked Disposal Sites in Buffalo Harbor

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PRESENT AND POTENTIAL ECOLOGICAL STATUS OF THE DIKED DISPOSAL SITES IN BUFFALO HARBOR BUFFALO, NEW YORK

by

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ABSTRACT

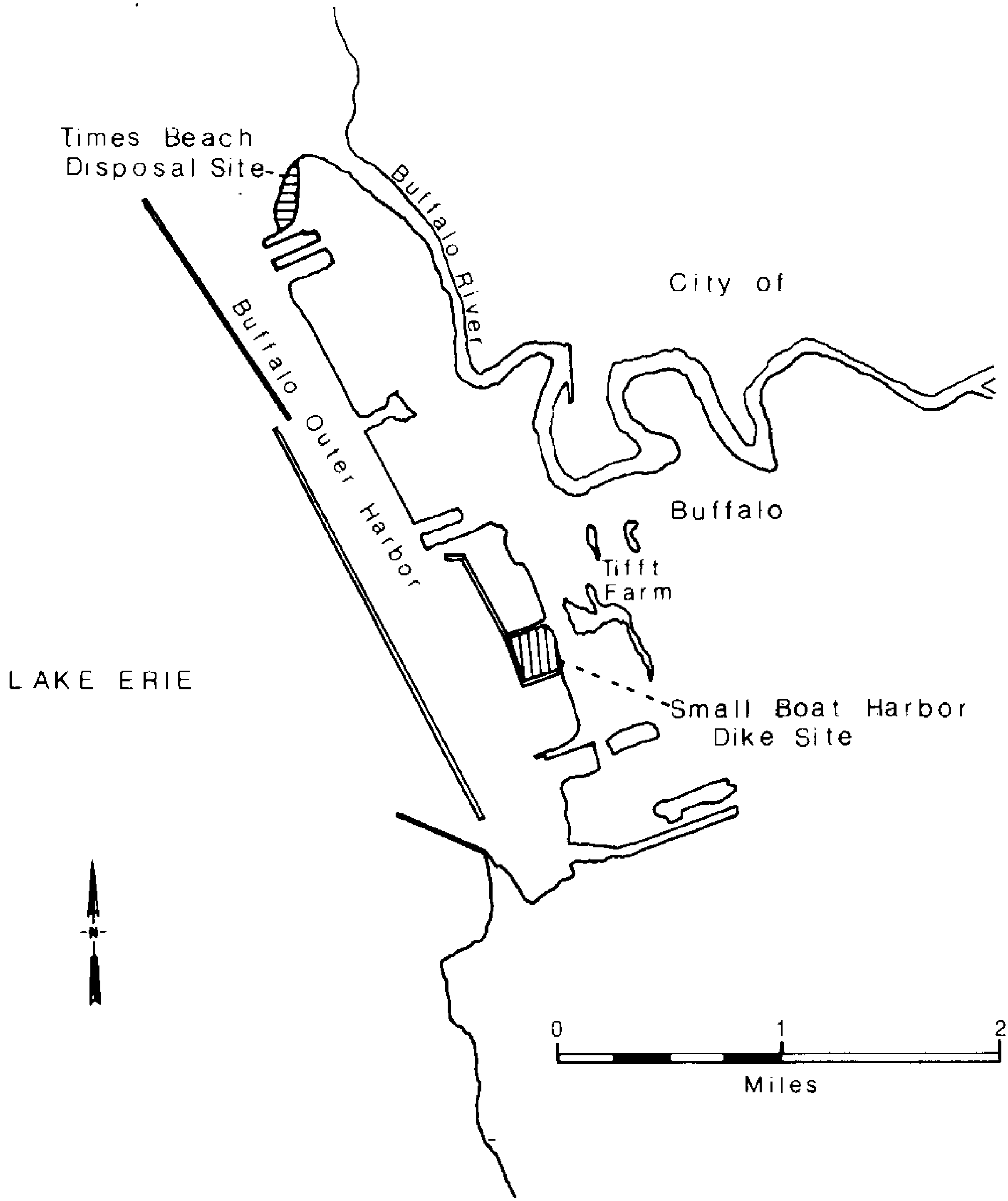
Two years of observing two disposal areas in Buffalo Harbor--the Small Boat Harbor disposal area and the Times Beach site--enabled us to view simultaneously two different periods in a similar successional pattern. The former site, five years older than the latter, is becoming in effect a wildlife refuge without ecological management. Both sites are suitable for such use, though modifications are needed to improve drainage and some important questions remain about mercury contamination and mosquitoes.

INTRODUCTION

The wildlife refuge and breeding areas along the New York sections of the Great Lakes shore have been decimated in the past 50 years. These areas, in which young fish and fowl develop, have been filled for urban expansion and have been polluted by urban activities.

In 1967, the US Army Corps of Engineers was directed by executive order to stop dumping polluted dredge spoils from the heavily industrialized Buffalo River and Harbor into Lake Erie. The corps diked an 18-acre spot next to a city marina with slag from the blast furnaces, named it the Small Boat Harbor Pilot Study Disposal Site, and began filling it with dredge spoil. Then they diked in another, bigger, 46-acre area at an abandoned swimming place called Times Beach, near the mouth of the Buffalo River, and began filling it--125,000 cubic yards of dredgings a year.

During the period of this study (1972 to 1973) the Corps of Engineers was just starting to use the Times Beach Disposal Site, and the Small Boat Harbor Dike Site was being phased out as a dike site. (See the figure for the location of these sites.)



Area of Disposal Site Study

GEOGRAPHY

Buffalo Harbor includes inner harbor channels in the lower reaches of the Buffalo River and an outer harbor extending southward from the mouth of the Buffalo River in the City of Buffalo to the adjoining City of Lackawanna.

The Buffalo River and its tributaries--the Cayuga, Cazenovia, and Buffalo creeks--drain a 446-square-mile area. Within the City of Buffalo, the Buffalo River is essentially an artificial channel dredged to navigation depth. The deepening and widening of the channel have historically caused sluggish flow with periods of little or no significant flow. The Black Rock Channel and Tonawanda Harbor projects extend navigation from the north entrance of Buffalo Harbor to the City of Tonawanda; Tonawanda Harbor furnishes access to the western end of the New York State Barge Canal.

Total waterborne commerce in the project areas in 1970 amounted to 16 million tons. Buffalo Harbor commerce accounted for 13.3 million tons of this; principal commodities transported included iron ore, limestone, and grain. Commerce through Tonawanda Harbor and Black Rock Channel totaled 2.7 million tons, mostly coal, iron ore, and petroleum.

Approximately 60 industrial and commercial enterprises are located along the Buffalo River and Buffalo Outer Harbor.

The figure shows existing land uses in the study areas. The land in the immediate vicinity of each dike site is zoned for industrial use. The Tifft Farm region, northeast of the Small Boat Harbor Dike Site, is an undeveloped 260-acre plot adjacent to New York State Route 5. This is the area to which the City of Buffalo proposes to transfer many thousands of cubic yards of material from a former municipal solid waste landfill on Bird Island. Part of the Tifft area, which is nearly 60 percent marsh, will also be used as a nature preserve.

The marina adjacent to the Small Boat Harbor Dike Site is operated by the City of Buffalo. A US Coast Guard base is immediately north of the Times Beach site. Times Beach was once used as a public bathing beach by residents of western New York. The city ceased to use the beach in the late 1940s because of pollution, although some people continued to swim at the site. Sport fishing, primarily for bass and perch, still goes on along the harbor; anglers even fish from the walls of the diked disposal areas.

Construction of the diked disposal areas was necessary to contain dredgings spoil too polluted to meet Environmental Protection Agency sediment parameters for open lake disposal. Dredging was and is necessary to maintain and operate the Buffalo Harbor, Black Rock Channel, and Tonawanda Harbor. The Buffalo

Harbor dredging was first authorized by the Rivers and Harbors Acts of 1826, and was included in the Rivers and Harbors Acts of 1866, 1874, 1896, 1899, 1900, 1902, 1907, 1909, 1910, 1912, 1919, 1927, 1930, 1935, 1945, 1960, and 1962. The Black Rock Channel and Tonawanda Harbor dredgings were authorized by the 1888, 1902, 1905, 1916, 1919, 1922, 1925, 1934, 1935, 1945, and 1954 Rivers and Harbors Acts.

The Times Beach site is expected to contain 625,000 cubic yards of dredge spoils when filled to an elevation eight feet above LWD (low water datum). Currently, dredgings are being dumped there at about 125,000 cubic yards annually. The remaining yearly harbor dredgings (about 500,000 cubic yards) are being dumped in Lake Erie in an area of undefined size, centered on a point 1.4 miles S 25^{o}W of the South Buffalo Pierhead Light.

OBSERVATIONS

By depositing dredged materials, the Corps of Engineers created a 46-acre submerged area at Times Beach and an 18-acre habitat, which was in a late xerophytic* stage of succession, at the Small Boat Harbor. Conditions at the latter ranged from a few inches of standing water along the western (lakeward) site to dry regions in the area approaching the old shoreline.

* A xerophyte is a plant structurally adapted for life and growth with a limited water supply, especially by means of epidermal thickening or waxy coat, that limits transpiration or that provides for water storage.

I looked for aquatic plants in two sample plots at the Small Boat Harbor dike site. The first plot, near the dike side, was characterized by low plant diversity. Surface soils appeared to be sandy and loamy. The surface was generally firm, with some wet areas. It would appear that only the larger particles in the dredge spoils remained at the surface at the time this land stabilized. The profusion and type of plants present indicated that if growth-inhibiting materials such as oil or acid were present, they were now at a level below the plant root zone. A number of the observed plants indicated absence of toxic materials. The predominant aquatic and terrestrial plants found in the first sampling area were eastern cottonwood, black willow, barnyard grass, smartweed, sedge, and Johnson grass (see Table 1). There was no indication of saline soil in the area: no salt-tolerant indicator plants were observed.

The second sample plot in the Small Boat Harbor Dike Site, adjacent to the original shoreline of the lake, was found to be characteristic of later successional stage habitats: it had great vegetational diversity and a corresponding decrease in the number within each species. The shoreline sample plot was drier than the dikeside plot, and I observed terrestrial wildlife, including pheasants and rabbits, as well as nesting sites for passerine birds. No eastern cottonwood was growing on the shoreline plot; it was dominated by such plants as princess feather, pigweed, horseweed,

TABLE 1 *Plant Communities Within Small Boat Harbor Diked Disposal Area--Dikeside Plot*

Common Name	Scientific Name
Eastern Cottonwood (Woody Plant)	*Populus deltoides*
Black Willow (Woody Plant)	*Salix nigra*
Golden Willow (Woody Plant)	*Salix alba*
Yellow Foxtail	*Setaria glauca*
Barnyard Grass	*Echinochloa crusgalli*
Smartweed	*Polygonum pennsylvanicum*
Purple Loosestrife	*Lythrum salicaria*
Purple-Stemmed Swamp Beggar-Ticks	*Bidens connata*
Cattail	*Typha angustifolia*
Old Witchgrass	*Panicum capillare*
Common Cocklebur	*Xanthium pennyslvanicum*
Dock (narrow-leaved)	*Rumex crispus*
Sunflower	*Helianthus annuus*
Goldenrod	*Solidago altissima*
Johnson Grass	*Sorghum helepense*
Sedge	(Impossible to key without florets)
Muhlenbergia (grass)	*Muhlenbergia schreberi*

and many types of sedges and knotweed (see Table 2). Again, no plants were found that would indicate the presence of growth-inhibiting toxic materials near the surface of the ground.

There was no abrupt ecotone (transition area) between the two sample plots; rather, the quantity and quality of the plants changed gradually.

The Small Boat Harbor Dike Site in general was found to be an excellent wildlife habitat with much plant life. The outer wet edges were characterized by low plant diversity; the inner area, which was filled earlier and was higher and drier, had more diverse plant life.

The Times Beach Dike Site was found to be in an intermediate state of aquatic succession, characterized by emergent aquatic vegetation including cattail (*Typha* sp.) and bur-reed (*Sparganium* sp.) Its surface is all water. Approximately one-fourth of the area grows the emergent aquatics, and the rest, submergent vegetation--primarily hornwort (*Ceratophyllum* sp.) and eelgrass (*Vallisneria* sp.). The entire 46-acre area is presently a feeding and resting spot for migrating waterfowl. Approximately 300 waterfowl were observed in September 1972; dominant species were black duck and blue-winged and green-winged teal.

The Times Beach site is still being filled; dumping goes on intermittently. It is believed that waterfowl will continue to use

TABLE 2 *Plant Communities Within Small Boat Harbor Diked Disposal Area--Shoreline Plot*

Common Name	Scientific Name
Princess Feather	*Polygonum orientale*
White Sweet Clover	*Melilotus alba*
Pigweed	*Chenopodium alba*
Horseweed	*Erigeron canadensis*
Staghorn Sumac	*Rhus typhina*
Boneset	*Eupatorium perfoliatum*
Bull Thistle	*Cirsium vulgare*
Lady's Thumb	*Polygonum lapathifolium*
Sticktight	*Bidens cernura*
Mustardg	(Impossible to identify species)
Squirreltail Grass	*Hordeum jubatum*
Many Sedges	(Impossible to identify without florets)
Burdock	*Arctium lappa*
Muhlenbergia	*Muhlenbergia schreberi*
Yellow Fantail Grass	*Setoria glauca*
Aster	*Aster ericoides*
Knotweed	*Polygonum aviculare*

the Times Beach as a resting and feeding spot as long as water is present and actual dredging operations are not being conducted. While there is a potential problem with oil scum during actual dredging operations, during the study, these operations were completed in less than six weeks; this disruption did not stop the birds from using the habitat after dredging disposal operations ceased.

Table 3 lists waterfowl and shorebirds common to the area. Species were generally limited to diving ducks, which frequently rested in the water and were observed feeding in the area of the containment site.

In general, the acreage created by the dredge spoil containment sites are among the only significant wildlife habitats along the Buffalo waterfront. While small compared to the total acreage of the waterfront, these areas were found to contribute to wildlife resources and support healthy plant life.

TABLE 3 *Birds Common To The Buffalo Harbor Area*

Common Name	Scientific Name
Redhead	*Nyroca americana*
Ring-Necked Duck	*Nyroca collaris*
Canvasback	*Nyroca valisineria*
Greater Scaup	*Fulix marila*
Lesser Scaup	*Fulix scaup*
American Goldeneye	*Glaucionetta clangula*
Bufflehead	*Charitonetta albeola*
Old-Squaw	*Clangula hyemalis*
White-Winged Scoter	*Melanitta deglandi*
Ruddy Duck	*Erismatura jamaicensis*
Hooded Merganser	*Lophodytes cucullatus*
Red-Breasted Merganser	*Mergus serrator*
Mallard	*Anas boschas*
Black Duck	*Anas rubripes*
Green-Winged Teal	*Nettion carolinense*
Blue-Winged Teal	*Querquedula discors*
Gadwall	*Chaulelasmus streperus*
Herring Gull	*Larus argentatus*
Ring-Billed Gull	*Larus delawarensis*
Franklin's Gull	*Larus pipixan*
Bonaparte's Gull	*Larus philadelphia*
Common Tern	*Sterna hirundo*
Caspian Tern	*Hydropygne caspia*
Ring-Necked Pheasant	*Phasianus colchicus*
Sandpiper	*Ereunetes mauri*

TABLE 4 *Planktonic and Bacterial Analyses, Small Boat Harbor Diked Disposal Site*

Plankton Analysis	Sample 1 7/13/73	Sample 2 8/16/73	Sample 3 8/16/73	Sample 4 8/30/73	Sample 5 9/27/73
Diatoms					
Navicula	22	1	1	500	83
Greens					
Ankistrodesmus	1				
Chlorella	1				
Coelastrum	2				
Hydrodictyon					
Mougeotia					
Oocystis	1				
Pediastrum					
Phizoclonium					
Scenedesmus	1				
Schroederia					
Spirogyra					
Zygnema					
Desmids					
Closterium	1				
Cosmarium	1				
Staurastrum					2
Blue Greens					
Oscillatoria					8
Flagellates					
Carteria					
Ceratium					
Chlamydomonas					
Euglena	P	1	1	20	
Pandorina					
Phacus				40	
Synura			30	3	
Trachelomonas					
Rotifers					
Dicranophorus				1	
Euchlanis					
Gastropus					
Keratella					
Rotaria	1				
Testudinella	P				

Numbers represent total observation.
P = Present

TABLE 4, continued *Plantonic and Bacterial Analyses, Small Boat Harbor Diked Disposal Site*

Plankton Analysis	Sample 1 7/13/73	Sample 2 8/12/73	Sample 3 8/16/73	Sample 4 8/30/73	Sample 5 9/27/73
Miscellaneous					
Acanthocystis				P	
Actinophrys	1	P			
Amoeba	3				
Arcella					
Astasia					
Coleps					55
Copepods					
Cyclops	1	1			12
Daphnia				P	1
Hypotrichs		30	3		
Infusoria		3	2		
Nauplii (Cyclops)				3	60
Nematode	6				
Paramecium				2	
Vampirella					
Vorticella		4			
Bacteriological Analysis					
Coliforms/100 ML	OG	4800	5500	2700	220
Additional Coliform/100 ML Samples		8/2/73 5700			

Numbers represent total observation.

P = Present

TABLE 5 *Planktonic and Bacteriological Analyses, Times Beach Diked Disposal Area*

Plankton Analysis	Sample 1 7/13/73	Sample 2 8/16/73	Sample 3 8/30/73	Sample 4 9/27/73
Diatoms				
Navicula	9	2	100	78
Greens				
Ankistrodesmus				
Chlorella	1			
Coelastrum				
Hydrodictyon			2	
Mougeotia	1			
Oocystis	P			
Pediastrum	1			
Rhizoclonium			1	
Scenedesmus	2			
Schroederia	2			
Spirogyra			2	
Zygnema		3		
Desmids				
Closterium			2	
Cosmarium				
Staurastrum	P		P	
Blue Greens				
Oscillatoria	2		15	
Flagellates				
Carteria				120
Ceratium	P			
Chlamydomonas	1		10	
Euglena	P		200	260
Pandorina	P			
Phaucus			30	85
Synura				
Trachelomonas			50	
Rotifers				
Dicranophorus				
Euchlanis			P	
Gastropus			P	
Keratella				
Rotaria				
Testudinella				

Numbers represent total observation.

P = Present

TABLE 5, continued *Planktonic and Bacteriological Analyses, Times Beach Diked Disposal Area*

Plankton Analysis	Sample 1 7/13/73	Sample 2 8/16/73	Sample 3 8/30/73	Sample 4 9/27/73
Miscellaneous				
Acanthocystis				
Actinophrys				
Amoeba	P		5	55
Arcella	P		4	
Astasia			3	
Coleps			8	
Copepods				
Cyclops		1	P	20
Daphnia			P	
Hypotrichs				
Infusoria	1			
Nauplii (Cyclops)			P	
Nematode	P			
Paramecium				
Vampirella			P	
Vorticella		2		
Bacteriological Analysis				
Coliforms/100 ML	650	4900	OG	450
Additional Coliform/100 ML Samples		8/2/73 1300		

Numbers represent total observation.

P = Present

TABLE 6 *Mosquito Distribution, Small Boat Harbor Site*

Date	Collection Method	Species	Stage(s)
7/14/73	larval dip	None	- - - -
8/4/73	larval dip	None	- - - -
8/16/73	larval dip	*Culex salinarius*	L (2,3,4.)
8/18/73	aspirator (adult)		
	larval dip	*C. salinarius*	L (2,3,4.), A (males)
8/30/73	aspirator (adult)		(males)
	larval dip	*C. salinarius*	L (2,3,4), A(females
9/1/73	larval dip	*C. salinarius*	L (2,3,4)
9/27/73	larval dip	*C. salinarius*	L (3,4)
9/29/73	larval dip	*C. salinarius*	L (3,4)

Times Beach Diked Site

Date	Collection Method	Species	Stages(s)
7/14/73	larval dip	None	- - - -
8/2/73	larval dip	*Culex pipiens*	L (2,2,4)
8/2/73	larval dip (tire)	*Culex restuans*	L (1,2,3,4)
8/4/73	aspirator (adult)		
	larval dip	*Culex pipiens*	L (2,3,4) A(male)
8/18/73	larval dip	None	- - - - - - - -
9/1/73	larval dip	None	- - - - - - - -
9/29/73	larval dip	None	- - - - - - - -

L = larval

A = adult

Numbers in parentheses = instars (larval stages).

TABLE 7 *Chemical and Physical Analyses, Small Boat Harbor Diked Disposal Site*

Sample #	Date	pH	Water Temp.	Air Temp.	R.H.	BOD	Cl	Na	Ca	Fe	Zn
1	7/13/73	7.8	- -	72°F	- -	39	35.0	- -	- -	- -	- -
2	8/2/73	7.6	- -	75°F	75%	10	37.5	- -	- -	- -	- -
3	8/16/73	7.7	- -	68°F	79%	12	32.5	- -	- -	- -	- -
4	8/16/73	7.8	- -	68°F	79%	23	32.5	- -	- -	- -	- -
5	8/30/73	7.4	70°F	75°F	72%	42	75.0	30	- -	9	0.24
6	9/27/73	7.3	64°F	68°F	72%	16	37.5	10	95	- -	- -
				Times Beach Diked Disposal Site							
1	7/13/73	8.0	- -	72°F	- -	1.0	30.0	- -	- -	- -	- -
2	8/2/73	6.9	- -	75°F	75%	26.0	15.0	- -	- -	- -	- -
3	8/16/73	8.0	- -	68°F	79%	2.3	35.0	- -	- -	- -	- -
4	8/30/73	7.3	70°F	75°F	72%	26.0	225	80	- -	20	0.49
5	9/27/73	7.5	64°F	68°F	72%	10.6	57.5	20	50	20	

R.H. = Relative Humidity

All measurements are in parts per million.

TABLE 8 *Meteorological Measurement*

Date	Time	Sky	Wind	Air Temperature	Daily High and Low
7/13/73	8:00 AM	cloudy	SW 20	68	66 low
	10:00 AM	cloudy/rain	SSW 16	68	78 high
	12:00 AM	cloudy	WSW 16	73	
7/14/73	8:00 AM	partly cloudy/ fair	W 13	71	70 low
	10:00 AM	cloudy/hot	W 10	71	77 high
	12:00 PM	partly cloudy	WSW 6	77	
8/2/73	8:00 AM	cloudy/ fair	W 3	72	72 low
	10:00 AM	cloudy/ fair	SW 9	73	78 high
	12:00 PM	cloudy/ fair	SW 9	77	
8/4/73	8:00 AM	partly cloudy/ fair	N 3	66	66 low
	10:00 AM	partly cloudy	SW 4	71	76 high
	12:00 PM	partly cloudy	SW 10	77	
8/16/73	8:00 AM	partly cloudy/ hot	ESE 5	64	64 low
	10:00 AM	partly cloudy	NW 4	73	80 high
	12:00 PM	partly cloudy	E 6	77	
8/18/73	8:00 AM	cloudy/hot	E 5	69	68 low
	10:00 AM	cloudy/fair	E 8	69	78 high
	12:00 PM	cloudy/fair	SSE 6	73	
8/30/73	8:00 AM	partly cloudy/ fair	S 7	76	75 low
	10:00 AM	cloudy/fair	SSW 7	79	85 high
	12:00 PM	partly cloudy/ fair	WSW 2	81	
9/1/73	8:00 AM	partly cloudy/ hot	S 5	77	76 low
	10:00 AM	partly cloudy/ hot	SE	77	84 high
	12:00 PM	partly cloudy/ hot	SW 6	84	
9/27/73	8:00 AM	cloudy	SSW 10	63	63 low
	10:00 AM	cloudy	SSW 10	68	74 high
	12:00 PM	cloudy	SSW 10	74	

TABLE 8, continued *Meteorological Measurement*

Date	Time	Sky	Wind	Air Temperature	Daily High and Low
9/29/73	8:00 AM	partly cloudy	WNW 5	58	58 low
	10:00 AM	partly cloudy	NW 5	69	69 high
	12:00 PM	partly cloudy	NW 6	63	

DISCUSSION

The types of fauna and flora in the diked sites were similar to those found in adjacent areas. When and where particular terrestrial plants became established was determined to a large extent by which plants were in seed, which seed-dispersal mechanisms (e.g., winds, birds, insects) were used, and where ground was exposed because of filling and/or a drop in the water table.

The soil in the diked areas appeared fertile and nontoxic to most species. Nothing in the limnetic habitats seemed to limit the growth of submergent forms, with the exception of turbidity, which remained high for two to three weeks after deposition of dredgings ceased. During filling many of the submergents declined in number and variety.

By controlling the rate of filling and by depositing dredgings in "cells" created by dividing up the diked area, it may be possible to create and manage habitats for plants that also provide the highest degree of shelter and/or forage for the most desirable forms of wildlife.

There does not appear to be any problem with plants absorbing mercury, particularly those plants eaten by the ducks and small mammals in the region (Perrott, 1973). Furthermore, since industry stopped discharging mercury into surrounding waters, the mercury content of the material dredged has been decreasing.

I did not sample the microscopic aquatic forms at either diked site. However, I did assist Jacques A. Berlin, a scientist with the N.Y.S. Dept. of Health in Buffalo, in conducting a mosquito survey of the two sites in July through September 1973. The survey showed that the open water of the Times Beach site inhibited mosquito breeding, but the ponds and pools of the Small Boat Harbor were very attractive to mosquitoes. Berlin concluded that the occurrence of Culex larvae in the area could well have been predicted, since Culex mosquitoes breed in late summer and are found primarily in polluted water. Although Aedes, Culiseta, and Mansonia mosquitoes were not found during the experimental period, this does not mean that they can't breed in a disposal area. In fact, many of the early spring Aedes breeders (Aedes stimulans, Aedes canadensis, and Aedes communis) may well become established in the Small Boat Harbor Dike Site. This area should be examined beginning in April for the presence of the floodwater Aedes species. While it is considered filled site, it is still susceptible to mosquito breeding. The summer of 1973 was relatively dry. However, it was easy to find stagnant water in the area. In addition, discarded applicances, old tires, cans, and other debris created plenty of water pockets--excellent for mosquito larvae. Post-fill debris collects rainwater which does not contain any toxicants that might be in the sludge itself. This situation could be especially dangerous with freshwater species like *Aedes canadensis*, *Aedes stimulans*, *Aedes communis*.

The mosquito breeding potential of a filled disposal site such as the Small Boat Harbor Dike Site depends on long-term projected use of the site. If the soil height remains as now, so that the site is maintained as a wildlife refuge (wetland) or an undisturbed natural bioclimate (swamp), then mosquitoes will be inevitable. However, if it is filled to a higher level or "leveled off" as a recreation site or park, then there will be little or no mosquito breeding.

The situation is somewhat different in a partially filled disposal area like Times Beach. Several factors may prevent mosquito breeding. A partially filled area contains a significant amount of open water, which inhibits mosquito breeding. The turbulence and influx of spoil materials from the dredging operations would also deter mosquito breeding. And finally, the presence of any toxicants in the spoil pumped into the disposal area would minimize mosquito breeding. But when a partially filled site stabilizes and begins to support plant and animal life, the mosquito breeding potential of the site increases. It also becomes an opportune place for disposing trash and debris. At the Times Beach Dike Site discarded tires were already found containing *Culex* larvae.

The plankton and bacteriological analyses of the disposal sites (Tables 4 and 5) revealed that the sites contained the basic constituents of a eutrophic pond. Table 6 shows the mosquito distribution at the sites. A review of the chemical composition of the water in the disposal areas (Table 7) indicated that the pH of the water was slightly basic and the BOD (biological oxygen demand) was similar to that found in a swamp. The chloride content was not significant. At least for now, these sites would probably not support any of the salt-marsh mosquito species. The meteorological data (Table 8) showed that air temperature was relatively uniform, and ideal for mosquito development. The prevailing southwesterly winds--blowing in from Lake Erie--were, for the most part, gentle. Wind velocity is important in the dispersal of mosquitoes. Adult mosquitoes are not generally active when the wind velocity is over 10 mph. Mosquitoes in swampy areas tend to remain in a resting state near the ground or under cover of tall grass during windy daytime hours, becoming active in the late evening or early morning hours when the winds are gentle or calm. The wind direction is also important: it is just right to blow mosquitoes over the City of Buffalo.

Mosquitoes in western New York are potential vectors of the Eastern, Western, St. Louis, and California arboviruses. The viruses cause mosquito-borne encephalitis; therefore, the mosquitoes represent a potential public health problem.

The mosquito species collected from the diked disposal areas in the 1973 survey were polluted-water breeders. Of these species, only one is a proven vector of the encephalides: Culex pipiens is a strong vector of both St. Louis and Western encephalitis viruses. Although these viruses have not yet been found in humans in western New York, they have been isolated from animals and birds in this area. The other vectors of the arboviruses are mosquitoes that breed in floodwater (Aedes stimulans, Aedes sollicitans) and permanent water (Culiseta impatiens, Culiseta melanura). These species occur in western New York and usually breed in ecological habitats like the diked disposal areas. It may be only a matter of time before these mosquito species become established in the disposal areas.

It should be noted that few mosquito predators, such as fish, were found in the diked areas during Berlin's 1973 study. Whether maintaining open water in the diked site would cause a problem with mosquitoes and other disease vectors in the neighboring area is a matter for speculation. However, if the open-water zone in the diked area contains an ecologically diverse and "balanced" biota, the mosquito population will probably be limited.

The measurements taken by Wright (1973) indicate that the disposal area would not be a suitable base for any substantial structures. Without artificial structures and/or other coastly construction measures, the only open-water habitat that could be maintained, once the diked sites were filled to a height equal to or near the level of the water in the harbor, would be a shallow pond with gently sloping sides. It is doubtful that sufficient depth could be maintained to keep the open-water area from being overgrown with emergents. To do this, it would be necessary to build steplike cells to keep the spoils from sliding into the deeper areas of the open-water zone.

Besides constructing an artificially perched water table, which would probably be expensive, any measures to maintain an open-water zone would mean reduced capacity of the disposal areas. It is yet to be decided whether the ecological benefits that could result would offset this loss as well as the costs of modifying the diked disposal sites for uses as a wildlife feeding and breeding ground.

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