CLEAR TECHNICAL REPORT NO. 103

FISH IMPINGEMENT AT THE DAVIS-BESSE NUCLEAR POWER STATION DURING 1978

Environmental Technical Specifications
Sec. 3.1.2.a.6 Fish Impingement

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COLUMBUS, OHIO

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3.1.2.a.6 Fish Impingement

Procedures

Between 1 January and 31 December 1978 the traveling screens at the Davis-Besse Nuclear Power Station were operated 221 times. The date, time, and duration of each screen operation were recorded and keypunched, even when the impinged fish were not collected (Table 1). Collections of impinged fish were made by Toledo Edison personnel during 144 of the 221 screen operations by placing a screen having the same mesh size as the traveling screens (¼-inch bar mesh) in the sluiceway through which the backwashed material passed. Fish collected in this manner were placed in plastic bags, labeled with the date and time of screen operation, and frozen. The samples were picked up by personnel of The Ohio State University Center for Lake Erie Area Research (CLEAR) weekly. All specimens in all samples were identified (Trautman, 1957) and enumerated. All specimens, or a representative number thereof, were also weighed and measured.

In addition to the information pertinent to traveling screen operation, the total number and total weight of each species and the length and weight of each individual fish were also keypunched. All these data were stored on magnetic tape at The Ohio State University for use with the Statistical Analysis System: SAS (Barr et al., 1976) on an IBM 370 computer.

Since the time and duration of every screen operation was known, it was possible to determine the number of hours represented by each collection. From this a concentration, fish impinged/hour, was developed and used to estimate impingement on days when samples were not collected.

Results

A total of 6,607 fish representing 20 species was impinged on the traveling screens at the Davis-Besse Nuclear Power Station from 1 January through 31 December 1978 (Table 2). Goldfish was the dominant species impinged representing 49.9 percent of the total. Only 6 other species represented more than 1 percent of the total: yellow perch, [illegible] percent; emerald shiner, 15.0 percent; gizzard shad, 5.9 percent; black crappie, 1.2 percent; freshwater drum, 1.2 percent; and rainbow smelt, 1.0 percent.

Impingement was also computed on a monthly basis (Table 3). Most of the impingement occurred during April (43.5 percent) and December (35.3 percent). Of the 2,875 fish estimated to have been impinged during April, 834 (29.0 percent) were emerald shiners, 799 (27.8 percent) were goldfish, and 1,098 (38.2 percent) were yellow perch. Of the 2,330 fish estimated to have been impinged during December, 1,870 (80.3 percent) were goldfish and 360 (15.5 percent) were gizzard shad.

TABLE 1

TRAVELING SCREEN OPERATION AT THE DAVIS-BESSE NUCLEAR POWER STATION FROM 1 JANUARY TO 31 DECEMBER 1978

DATE	TIME OF SCREEN OPERATION		FISH COLLECTION YES/NO	HOURS SINCE LAST SCREEN OPERATION
	ON	OFF		
2 January 1978	22.09	22.41	Y	46.41
4 "	21.30	22.00	Y	47.59
5 "	16.15	17.05	N	19.05
6 "	16.39	17.17	Y	24.12
8 "	16.01	16.37	Y	47.20
12 "	16.45	17.15	N	96.73
14 "	17.50	18.30	N	49.15
20 "	20.15	20.45	Y	146.15
22 "	17.30	18.00	Y	45.55
24 "	17.00	18.24	Y	48.24
28 "	18.00	19.30	Y	97.06
30 "	20.30	21.00	Y	49.70
1 February 1978	20.45	21.15	N	48.15
3 "	20.55	21.25	Y	48.10
5 "	16.45	17.15	Y	43.91
7 "	17.30	18.00	Y	48.84
9 "	21.00	21.30	Y	51.30
11 "	17.40	18.15	Y	44.85
13 "	20.00	20.40	Y	50.25
17 "	17.00	17.30	Y	92.90
19 "	17.12	17.45	Y	48.15
21 "	20.30	21.20	N	51.75
22 "	18.40	17.20	N	20.00
23 "	19.55	20.50	N	27.30
25 "	20.57	21.40	N	48.90
27 "	18.10	19.40	Y	46.00
1 March 1978	23.00	23.40	N	52.00
2 "	16.30	17.10	N	17.70
3 "	18.00	18.35	Y	25.25
5 "	20.30	21.00	Y	50.65
6 "	21.30	22.00	N	25.00
7 "	20.15	20.50	Y	22.50
10 "	19.40	20.10	Y	71.60
11 "	19.10	19.45	Y	23.35
12 "	17.20	17.50	N	22.05
13 "	17.30	18.00	N	24.50
[illegible] "	17.50	18.22	Y	48.22
[illegible] "	18.50	19.20	Y	48.98
19 "	20.40	21.12	Y	49.92
21 "	19.58	20.28	N	47.16
23 "	20.50	21.26	Y	48.98
25 "	22.40	23.10	Y	49.84
26 "	18.00	18.30	N	19.20
27	20.00	21.05	N	26.75
29 "	21.19	21.56	Y	48.51

TABLE 1 (Con't.)

TRAVELING SCREEN OPERATION AT THE DAVIS-BESSE NUCLEAR POWER STATION
FROM 1 JANUARY TO 31 DECEMBER 1978

DATE	TIME OF SCREEN OPERATION		FISH COLLECTION YES/NO	HOURS SINCE LAST SCREEN OPERATION
	ON	OFF		
2 April 1978	19.06	19.40	Y	93.84
3 "	20.15	20.50	N	25.10
4 "	20.00	20.30	N	23.80
7 "	19.40	20.40	N	72.10
8 "	20.30	21.00	Y	24.60
9 "	20.10	20.40	N	23.40
10 "	21.00	22.00	Y	25.60
12 "	20.50	21.20	Y	47.20
13 "	20.30	21.00	N	23.80
14 "	20.30	21.00	Y	24.00
15 "	17.00	17.45	N	20.45
16 "	16.58	17.36	Y	23.91
17 "	16.30	17.45	N	24.09
18 "	17.25	17.55	Y	24.10
19 "	16.20	17.00	N	23.45
20 "	16.37	17.13	Y	24.13
22 "	18.00	18.35	Y	49.22
24 "	17.32	18.05	Y	47.70
26 "	17.15	17.45	Y	47.40
28 "	18.00	18.30	Y	48.85
30 "	23.20	23.50	Y	53.20
1 May 1978	18.30	19.00	N	19.50
2 "	18.45	19.15	Y	24.15
5 "	10.30	11.00	N	63.85
6 "	21.15	21.45	Y	34.45
8 "	20.25	20.55	Y	47.10
10 "	16.55	17.25	Y	44.70
12 "	22.00	22.30	Y	53.05
14 "	16.30	17.00	Y	42.70
16 "	16.35	17.05	Y	48.05
18 "	16.10	16.40	Y	47.35
20 "	17.00	17.30	N	48.90
22 "	19.00	20.30	Y	51.00
24 "	16.32	17.04	Y	44.74
26 "	14.40	15.10	Y	46.06
28 "	18.03	18.33	Y	51.23
30 "	15.45	16.15	Y	45.82
1 June 1978	16.25	17.00	Y	48.85
3 "	14.50	15.20	Y	46.20
5 "	18.55	19.35	Y	52.15
6 "	18.30	19.15	N	23.80
7 "	21.05	21.35	Y	26.20
9 "	21.36	22.06	Y	48.71
10 "	16.15	16.36	N	18.30
11 "	17.55	18.30	Y	25.94

TABLE 1 (Con't.)

TRAVELING SCREEN OPERATION AT THE DAVIS-BESSE NUCLEAR POWER STATION
FROM 1 JANUARY TO 31 DECEMBER 1978

DATE	TIME OF SCREEN OPERATION		FISH COLLECTION YES/NO	HOURS SINCE LAST SCREEN OPERATION
	ON	OFF		
12 June 1978	17.00	17.30	N	23.00
13 "	16.35	17.05	Y	23.75
15 "	12.52	13.24	Y	44.19
16 "	18.40	19.10	N	29.86
17 "	13.39	14.10	Y	19.00
19 "	18.45	19.25	N	53.15
20 "	16.25	16.55	N	21.30
21 "	16.07	16.37	Y	23.82
23 "	14.25	14.55	Y	46.18
25 "	16.10	16.50	Y	49.95
27 "	20.30	21.15	N	52.65
28 "	17.25	17.50	N	20.35
29 "	15.50	16.20	Y	22.70
30 "	16.00	16.30	N	24.10
2 July 1978	18.00	18.30	Y	50.00
4 "	17.15	17.45	Y	47.15
6 "	16.20	16.55	Y	47.10
8 "	14.20	14.50	Y	45.95
9 "	18.20	18.50	N	28.00
10 "	18.40	19.20	Y	24.70
11 "	20.45	21.16	Y	25.96
13 "	21.15	21.45	N	48.29
14 "	18.45	19.15	Y	21.70
15 "	16.25	16.55	N	21.40
16 "	16.30	17.00	Y	24.45
17 "	19.20	19.50	Y	26.50
20 "	20.15	20.50	Y	73.00
22 "	19.25	19.55	Y	47.05
24 "	17.00	17.30	Y	45.75
25 "	20.45	21.20	Y	27.90
26 "	20.15	20.45	Y	23.25
27 "	16.55	17.25	N	20.80
28 "	18.25	19.00	Y	25.75
30 "	17.16	17.46	Y	46.46
1 August 1978	17.00	17.30	Y	47.84
2 "	16.20	16.50	N	23.20
3 "	16.35	17.05	Y	24.55
4 "	19.00	19.30	N	26.25
5 "	19.02	19.37	Y	24.07
7 "	16.45	17.15	Y	45.78
9 "	19.30	20.00	Y	50.85
11 "	16.20	16.50	Y	44.50
13 "	16.43	17.18	N	48.68
14 "	22.00	22.30	N	29.12
17 "	20.20	21.30	N	71.00

TABLE 1 (Con't.)

TRAVELING SCREEN OPERATION AT THE DAVIS-BESSE NUCLEAR POWER STATION
FROM 1 JANUARY TO 31 DECEMBER 1978

DATE	TIME OF SCREEN OPERATION		FISH COLLECTION YES/NO	HOURS SINCE LAST SCREEN OPERATION
	ON	OFF		
19 August 1978	18.55	19.29	Y	45.99
21 "	19.20	20.15	Y	48.86
23 "	20.15	20.45	Y	48.30
25 "	18.35	19.10	Y	46.65
26 "	18.05	18.50	N	23.40
27 "	17.37	18.14	Y	23.64
29 "	16.45	17.15	Y	47.01
31 "	17.30	18.00	Y	48.85
1 September 1978	16.38	17.08	N	23.08
3 "	16.13	16.43	Y	47.35
4 "	16.35	17.25	Y	24.82
6 "	16.52	17.23	Y	47.98
8 "	18.07	18.37	Y	49.14
10 "	17.20	18.00	Y	47.63
12 "	20.13	20.45	Y	50.45
14 "	19.15	19.50	Y	47.05
16 "	17.30	18.20	N	46.70
18 "	21.30	22.05	Y	51.85
19 "	22.15	22.50	N	24.45
20 "	20.00	20.30	Y	21.80
22 "	23.00	23.30	Y	51.00
24 "	17.20	18.05	N	42.75
25 "	20.35	21.05	N	27.00
28 "	19.00	19.35	Y	70.30
30 "	16.55	17.25	Y	45.90
2 October 1978	19.25	19.55	Y	50.30
3 "	18.20	18.40	N	22.85
4 "	17.45	18.15	Y	23.75
5 "	16.30	17.01	N	22.86
6 "	20.25	21.00	N	27.99
9 "	16.25	16.55	N	67.55
10 "	17.05	17.36	Y	24.81
11 "	15.05	15.35	N	21.99
12 "	18.43	19.17	Y	27.82
13 "	16.40	17.10	N	21.93
14 "	21.34	22.04	Y	28.94
16 "	17.00	17.30	Y	43.26
20 "	17.20	17.50	Y	96.20
22 "	21.45	22.20	Y	52.70
25 "	18.20	18.50	Y	68.30
26 "	16.30	17.00	Y	22.50
28 "	20.05	20.40	Y	51.40
30 "	21.10	21.45	Y	49.05

TABLE 1 (Con't.)

TRAVELING SCREEN OPERATION AT THE DAVIS-BESSE NUCLEAR POWER STATION
FROM 1 JANUARY TO 31 DECEMBER 1978

DATE	TIME OF SCREEN OPERATION		FISH COLLECTION YES/NO	HOURS SINCE LAST SCREEN OPERATION
	ON	OFF		
1 November 1978	18.45	19.17	Y	45.72
3 "	20.45	21.18	Y	50.01
5 "	20.08	20.40	Y	47.22
6 "	16.25	16.55	N	20.15
7 "	16.48	17.12	Y	24.57
8 "	16.40	17.10	N	23.98
9 "	16.50	17.20	Y	24.10
11 "	18.25	18.55	Y	49.35
12 "	17.05	17.35	N	22.80
13 "	18.15	18.35	Y	25.00
14 "	16.26	17.00	N	22.65
15 "	18.30	19.00	Y	26.00
17 "	20.05	20.57	N	49.57
20 "	19.45	20.30	N	71.73
21 "	20.50	21.20	N	24.90
23 "	16.15	16.45	Y	43.25
24 "	19.00	20.08	N	27.63
25 "	20.00	20.30	Y	24.22
27 "	20.30	21.00	Y	48.70
29 "	20.15	20.45	Y	47.45
1 December 1978	19.15	19.45	Y	47.00
3 "	16.28	17.08	Y	45.63
5 "	16.00	17.34	N	48.26
6 "	17.55	18.25	Y	24.91
9 "	17.55	18.25	N	72.00
10 "	19.46	20.23	N	25.98
11 "	16.30	17.00	N	20.77
12 "	17.45	18.15	N	25.15
13 "	18.04	18.34	Y	24.19
15 "	17.20	17.50	Y	47.16
17 "	18.45	19.15	Y	49.65
18 "	17.34	18.10	N	22.95
19 "	22.20	22.50	Y	28.40
20 "	18.20	18.50	N	20.00
21 "	16.25	16.59	Y	22.09
23 "	19.45	20.15	Y	51.56
24 "	19.35	20.05	N	23.90
25 "	21.50	22.20	Y	26.15
27 "	17.30	18.00	N	43.80
28 "	19.37	20.07	N	26.07
29 "	20.20	20.50	Y	24.43
30 "	17.30	19.30	N	22.80
31 "	18.35	19.08	Y	23.78

TABLE 2

FISH SPECIES IMPINGED AT THE DAVIS-BESSE NUCLEAR POWER STATION: 1 January through 31 December 1978

SPECIES	NUMBER IMPINGED			WEIGHT (grams)			LENGTH (mm)		
	Estimate	95% Confidence Interval		Mean	95% Confidence Interval		Mean	95% Confidence Interval	
		Lower Bound	Upper Bound		Lower Bound	Upper Bound		Lower Bound	Upper Bound
Alewife	4	1	9	4	0	8	75	39	110
Black Crappie	82	53	128	17	16	17	117	116	119
Blackside Darter	1	0.5	4	1	*	*	27	*	*
Bluegill Sunfish	5	3	9	10	9	10	68	67	68
Bluntnose Minnow	1	1	3	1	*	*	25	*	*
Carp	6	3	15	2	1	3	56	51	60
Channel Catfish	3	1	7	0.4	*	*	59	*	*
Emerald Shiner	991	636	1,545	1	1	1	60	60	61
Freshwater Drum	80	55	114	4	3	4	81	78	83
Gizzard Shad	391	201	758	7	6	8	88	87	90
Goldfish	3,299	2,435	4,468	5	5	6	72	71	73
Green Sunfish	5	3	11	12	9	16	58	48	68
Logperch Darter	12	8	21	2	1	2	63	60	67
Pumpkinseed Sunfish	9	3	24	11	9	13	82	77	87
Rainbow Smelt	69	45	107	1	1	1	60	59	61
Spottail Shiner	15	9	25	2	2	2	65	63	66
Stonecat Madtom	1	[illegible]	3	1	*	*	30	*	*
Trout-perch	29	20	41	4	4	5	80	77	82
White Crappie	22	15	[illegible]	8	8	8	88	85	91
Yellow Perch	1,582	1,082	[illegible]	5	5	5	83	83	84
TOTAL	6,607	5,447	8,015	5	5	5	74	74	75

* Confidence intervals could not be computed when no more than one representative of a given species occurred.

TABLE 3

A SUMMARY OF MONTHLY FISH IMPINGEMENT
AT THE DAVIS-BESSE NUCLEAR POWER STATIONS: 1 January through 31 December 1978

MONTHS	NUMBER IMPINGED			WEIGHT (grams)			LENGTH (mm)		
	Estimate	95% Confidence Interval		Mean	95% Confidence Interval		Mean	95% Confidence Interval	
		Lower Bound	Upper Bound		Lower Bound	Upper Bound		Lower Bound	Upper Bound
January	45	31	66	13	12	14	104	102	106
February	17	9	31	5	5	6	76	72	79
March	13	7	25	4	4	4	72	70	73
April	2,875	2,157	3,833	5	5	6	79	78	79
May	648	479	874	5	4	5	79	78	79
June	45	29	69	12	7	17	92	86	98
July	7	5	11	9	9	9	79	77	81
August	4	2	8	12	9	14	100	90	110
September	19	12	32	11	9	12	83	80	87
October	28	18	43	10	9	11	59	55	64
November	576	314	1,058	3	3	3	62	61	63
December	2,330	1,594	3,406	3	3	3	68	67	69
TOTAL	6,607	5,447	8,015	5	5	5	74	74	75

Analysis

With the exception of the blackside darter and the bluntnose minnow, all species impinged at the Davis-Besse Nuclear Power Station have been captured within the past 10 years at Locust Point (See Table 2, Section 3.1.2.a.3). However, both the blackside darter and bluntnose minnow have been reported from the island area of Lake Erie and most of the tributaries, including the Toussaint River and Turtle Creek near Locust Point (Trautman, 1957).

With the exception of goldfish and black and white crappies the impinged fish occurred in relative numbers which were not unusual for populations in Lake Erie at Locust Point. These 3 species occurred in relative proportions well above that of the open lake. This indicates probable use of the intake canal as a permanent residence for these species. Furthermore, due to the small sizes of these fish (they were young-of-the-year) and results from previous trawling efforts (Reutter and Herdendorf, 1975), it appears that these species are also spawning within the intake canal and, consequently, these losses should not be considered as a negative impact on lake populations of these species.

Impingement losses at the Davis-Besse Nuclear Power Station during 1978 were extremely low even when compared to other plants on the Western Basin with lower generating capacities (Reutter et al., 1978). Tables 4-6 present sport and commercial fish landings from the Ohio waters of Lake Erie and commercial landings from all of Lake Erie. Although the fish impinged at Davis-Besse were primarily YOY (mean length, 74 mm) and, consequently, much more abundant than the adults taken by commercial and sport fishermen, the total number impinged (including gizzard shad which are not taken by sport fishermen) was only 0.04 percent of the number harvested by Ohio sport fishermen. This figure becomes even less significant when one realizes that the Ohio sport catch was only 83.4 percent of the Ohio 1978 commercial catch and only 15.9 percent of the 1978 commercial catch from all of Lake Erie (Tables 4-6).

The above comparisons make it obvious that impingement losses at the Davis-Besse Nuclear Power Station have an insignificant effect of Lake Erie fish stocks and further justification of this is probably unnecessary. However, it should be noted that although by number impingement losses were 0.04 percent of the Ohio sport fishing harvest, by weight impingement was less than 0.001 percent of the Ohio sport harvest. Furthermore, based on the estimates of Patterson (1976) (See Section 3.1.2.a.5) the impingement of 1,582 young-of-the-year yellow perch, a species which is very important to sport and commercial fishermen, will result in the loss of only 28-75 adults which is from 0.0002 to 0.0007 percent of the number captured by Ohio sport fishermen in 1978.

TABLE 4

ESTIMATED 1978 SPORT AND COMMERCIAL FISH HARVEST FROM THE OHIO WATERS OF LAKE ERIE[a]

SPECIES	SPORT HARVEST		COMMERCIAL HARVEST		TOTAL HARVEST	
	No. of Individuals	Weight (Kilograms)	No. of Individuals	Weight (Kilograms)	No. of Individuals	Weight (Kilograms)
Yellow Perch	11,483,000	1,116,386	9,178,000[b]	890,294	20,661,000	2,006,680
Walleye	1,652,000	1,515,906	0	0	1,652,000	1,515,906
White Bass	1,533,000	334,825	3,380,000[b]	736,842	4,913,000	1,071,667
Freshwater Drum	668,000	363,200	981,000[b]	533,904	1,649,000	897,104
Channel Catfish	218,000	86,033	235,000[b]	92,843	453,000	178,876
Smallmouth Bass	32,000	20,203	0	0	32,000	20,203
Others	c	c	—	1,867,983[d]	—	1,867,983[e]
TOTAL	15,586,000[e]	3,436,553[e]	—	4,121,866	—	7,648,419

[a] Scholl (1979)

[b] Estimated based on mean weight of sport fish.

[c] Data not available.

[d] Thirty-eight percent carp.

[e] Excludes weight of "Others" caught by sport fishermen.

TABLE 5

COMMERCIAL FISH LANDINGS FROM THE OHIO WATER OF LAKE ERIE: 1974-1978*

SPECIES	1974	1975	1976	1977	1978
Buffalo	14,528	14,982	13,620	15,890	16,344
Bullhead	12,258	14,074	19,522	29,056	32,688
Carp	1,284,366	1,265,298	1,196,290	1,249,408	701,430
Channel Catfish	136,200	117,586	101,242	115,316	92,843
Freshwater Drum	307,812	340,500	432,208	361,838	533,904
Goldfish	29,510	23,608	60,836	250,154	343,678
Quillback/Shad**	28,148	60,382	331,874	274,670	752,732
Rainbow Smelt	2,270	4,086	15,890	454	4,994
Sucker	39,952	24,516	28,602	14,982	14,982
White Bass	1,314,330	760,450	680,546	501,216	736,842
Yellow Perch	797,678	675,552	652,852	1,051,913	890,294
TOTAL	3,962,512	3,301,488	3,533,482	3,864,902	4,121,866

* Scholl (1979). Data presented in kilograms.

** This is primarily the quillback carpsucker (*Carpiodes cyprinus*), but occasionally some fishermen include gizzard shad (*Dorosoma cepedianum*).

TABLE 6

COMMERCIAL FISH LANDINGS FROM LAKE ERIE:
1975 - 1978[a]

SPECIES	WEIGHT (Kilograms)				
	1975	1976	1977	1978	MEAN
Bowfin	c	c	15,000	12,000	13,500
Buffalo	30,000	43,000	34,000	25,000	33,000
Bullhead	69,000	64,000	77,000	54,000	66,000
Carp	1,491,000	1,444,000	1,439,000	871,000	1,311,250
Channel Catfish	197,000	155,000	160,000	148,000	165,000
Freshwater Drum	[illegible]	619,000	538,000	692,000	596,750
Gizzard Shad	1,000	301,000	229,000	707,000	309,500
Goldfish	26,000	61,000	250,000	344,000	170,250
Lake Whitefish	c	c	3,000	2,000	2,500
Quillback	60,000	58,000	47,000	47,000	53,000
Rainbow Smelt	7,688,000	7,845,000	9,700,000	11,002,000	9,058,750
Rock Bass	c	c	19,000	10,000	14,500
Sucker	52,000	48,000	31,000	33,000	41,000
Sunfish	c	c	33,000	23,000	28,000
Walleye[b]	114,000	138,000	261,000	295,000	202,000
White Bass	1,932,000	1,162,000	948,000	1,590,000	1,408,000
Yellow Perch	4,597,000	2,903,000	4,801,000	4,918,000	4,304,750
Others	927,00	833,000	928,000	796,000	871,000
TOTAL	17,722,000	15,674,000	19,513,000	21,569,000	18,649,000

[a] Personal communication, Dr. David Wolfert, USFWS, Sandusky, Ohio.

[b] Not taken commercially in Ohio and Michigan waters.

[c] Included with "Others" during this year.

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3.1.2.b.1

XV

SECTION 3.1.2.b.1

BIRD COLLISION

XVI

SECTION 3.1.2.b.2

VEGETATION SURVEY

XIX

Section 4.2
Fish Impingement Study

4.2 Fish Impingement Study

The fish impingement study is reported in Section 3.1.2.a.6.

XX

Section 4.3
Chlorine Toxicity Study

4.3 Chlorine Toxicity Study

The chlorine toxicity study was not required for the year 1978.

ANNUAL REPORT

DAVIS-BESSE BIRD HAZARD MONITORING CONTRACT

JANUARY 1979

Manfred Temme, William B. Jackson, and William A. Peterman

Environmental Studies Center

Bird mortality at the Davis-Besse site was monitored for the sixth consecutive spring and seventh fall migration season. These data are summarized and compared with those from previous years. Necropsy examinations were continued, and the results updated and integrated into data from the entire period (1972 - 1978). Relationships of meteorological conditions to bird strikes in both migration seasons also are considered. The generating facility came on line, following an extended start-up program during the winter. However, a scheduled maintenance period resulted in the cooling tower not operating during most of the spring migratory period. The fall represents the first period when observations could be made under normal operating conditions.

Mortality Monitoring Pattern During Both Migration Seasons:

During the spring migratory season daily surveys were conducted at the expected height of migration activities (April 30 to May 28). Alternating days were monitored from April 3 to 28 and again on May 31 and June 7 to gain information on earlier and later migrating species. Fall monitoring activities were commenced on September 2; they were continued on September 7, and on an alternating-day basis until September 24. Daily visits to the site were undertaken until October 15; two further surveys on October 21 and on November 28 concluded the field collections.

As in previous years, the routine observations were made around the base of the cooling tower and the area of the new microwave/meteorological station. The perimeter of the Unit I structures and their roofs were not regularly accessible by us. By special arrangements with the security personnel, it was possible to inspect this area on Sunday mornings when working activities were low and security escort readily available. Areas under major guy wires and transmission lines also were checked for bird strikes on Sundays only.

All surveys included the recording of current environmental conditions (estimations of previous weather, temperature, wind direction and speed, percentage of cloud cover, precipitation, and visibility), numbers and species of birds and their locations. All birds were collected, identified to species, and frozen for later necropsy.

Twenty-nine birds in spring and 10 specimens in fall were retrieved from the water basin in the cooling tower a few days after their collision. They were badly decomposed and not examined in detail; identification was only possible by comparison with an extensive reference collection.

Results:

Spring: During the spring migration period a total of 78 bird specimens were found and collected (Table 1). These were 30 birds more than during the same period in 1977 (Table 2). As expected, the Warblers again comprised the greatest proportion of birds killed (69%). Relatively high were the Vireos (14%), while Kinglets and Finches remained very low, with only 1 and 2%, respectively. This also was true for other families (Table 2). A first-time occurrence, a female Golden-winged Warbler, was found on May 13, 1978. This species reportedly has become rarer in Ohio (Campbell, 1968). It is, however, not an endangered species.

No major deviations from mortality patterns observed in previous springs were noted. Since the power plant had been shut down for scheduled maintenance during most of this collection period and the base of the cooling tower drained, the dead birds inside the tower perimeter were picked up where they had dropped. This made it possible, in contrast to fall season 1977, to evaluate the proportions of birds found in each of the four sectors. As in all previous years, the most birds (55%) were found in the NE sector. The number of birds retrieved from the NW sector (25%) exceeded the proportions taken there in previous years. The SE sector ranked third (12%), followed by the SW sector with 8% (Figs. 1, 2). The average of the five-year period shows that bird mortalities during spring were recovered mainly in the NE sector of the cooling tower; the second highest numbers, in the S.E. sector (Fig. 2).

Although several night observations were carried out during the spring migration period, actual collisions were not observed. Presumably, the migrants on their northerly heading collided with the cooling tower and were carried by strong drafts around the structure. Birds not killed on impact may have drifted, fluttering their wings until death occurred. Occasionally birds were found still alive, sitting drowsily near the tower or in the drained base. They may have been able to take to the air again. When the base is water-filled, such birds likely will drown.

Mortalities at the Unit I structures have steadily declined. Six birds were recovered on the ground in the NW sector of the shield building, while only two birds were found on roof four (Fig. 3). Even if the roofs are inspected only once a week, all birds, even in a badly decomposed state, would remain, since no mammalian scavengers have access to the roofs. On the ground, however, undefined losses may occur due to scavenging activities by foxes, skunks, and raccoons. This has been indicated previously by security personnel.

Fall: Mortalities during the fall migration period were relatively low. Only 65 specimens were found at the cooling tower and six birds on the ground in the NW sector of the Unit I structures (Figs. 3 and 4, Table 3). The number was about half that of the previous fall (Table 4). Warblers constituted most of the mortalities (61%); Kinglets and Finches, 10% and 4%, respectively. Generally the proportion of Kinglets was higher, the seven-year average being 24% (Table 5).

As in previous fall seasons, the majority of birds were recovered in the SE sector (37%), followed by NE and SW sectors (both 26%), and the NW with 11%. The five-year mean frequency of mortality by quadrants of the tower shows a clear preponderance of the SE sector (Fig. 2). This also can probably be explained by the existing air currents at the tower, the heading angle at impact, and the drifting of fallin and fluttering birds.

At the Unit I structure mammalian scavengers may have reduced the number of birds found around the perimeter of the building. However, no specimens were found on the roof where predators have no access. These data suggest that bird strikes at both structures were indeed less this fall than in previous years.

The number of mortalities at the Unit I structure is briefly summarized for the entire study period:

Season	Year						
	1972	1973	1974	1975	1976	1977	1978
Spring	--	4	11	16	8	6	8
Fall	5	47	53	15	22	20	6

Necropsy Examination:

Necropsy examination included determinations of the extent of hematoma under the skull, presence or absence of bone fractures (humerus, ulna, radius, tibiotarsus, and tarsometatarsus), bill damage, and "broken" necks and skulls. Each bird collected during the fall was aged by determining the degree of skull ossification. These data are summarized and updated in Table 6. Most frequent injuries were to the head and bill.

Weather and Bird Mortality:

Spring: Synoptic weather patterns were noted for 36 days in the spring, beginning on April 23rd and ending on May 28th. Of these days, 12 had recorded bird mortalities, with the bulk of them occurring between May 10th and May 14th. On these five days there were 61 recorded mortalities. The total for the spring season was 77.

Each day was categorized as to the actual synoptic pattern, and the usual breakdown into seven synoptic types was made. The data for each category and the observed mortalities are given in Table 7.

As in past years, the highest mortalities were associated with weather patterns that favored migration. In the spring this usually occurs with southerly flow in advance of an approaching cold front (synoptic category L-2). Such weather occurred on only two days in the spring of 1978, but on both occasions there were 13 mortalities. The only other category with high mortality was L-1, which resulted in 28 mortalities on May 13th.

May 10th through the 14th presented a strong and somewhat unusual weather pattern. On the morning of May 10th a cold front passed southwestward over Lake Erie and then stalled in western Pennsylvania. On the 12th a low pressure system began forming over Lake Erie. Instead of moving, this low continued to deepen and remained stationary; extensive rain occurred throughout the Great Lakes region during the period. On the 15th the low moved into western Maryland, where it remained, weakening until it dissipated on the 19th. It was during this period that 61 mortalities occurred, the highest being 28 on May 13th when the low was strongest.

Fall: The fall 1978 weather patterns in the Lake Erie region were somewhat nontypical for the season of year. Normally the area is dominated by large, slowly moving, mostly polar high-pressure systems that bring cool, dry, "fall-like" weather to the area. This year, particularly in September, there were no strong high-pressure systems, and the numbers of days for which high-and low-pressure patterns dominated were nearly equal for the two-month period.

Weather analyses were carried out for 50 consecutive evenings, beginning on September 2 (evening of the 1st, morning of the 2nd) and ending on October 21; during this period there were 27 days that were classified as high-pressure events and 23 as low-pressure events.

Past observations have shown that bird mortalities during the fall tend to be associated with the occurrence of high pressure; in the spring, with low pressure systems. Thus mortality appears to be related to migratory movements, since the fall migration usually follows a cold frontpassage and is associated with the northerly flow of air at the leading edge of a high pressure system. In the spring the reverse is the case, with migration occurring on the trailing edge of highs in advance of an oncoming cold front.

Again fall 1978 was nontypical. Of the 78 recorded mortalities, 36 were found to be associated with high-pressure systems, while 35 were found to be associated with low-pressure systems. The date with the most mortalities (19) was, in fact, a low pressure event.

September 13th, the date with the 19 mortalities, was not a typical weather pattern for that time of year. In the 24 hours preceding 0700 hours on the 13tn, approximately .6 inch of rain had fallen over the western Lake Erie basin, and rainfall was extensive throughout the Midwest. On the preceding day a weak cold front lav over Lake Erie in an east-west direction. By the 13th this front had begun to reorganize as a warm front associated with a low-pressure system developing over the high plains. Thus during the evening of the 12th and morning of the 13th, cold air lay just north of Lake Erie, while the southern shore was the scene of a developing frontal pattern with warm frontal type precipitation.

Removal of September 13th from the analysis yields a more expected pattern. Of the eight days with the leading edge of a high over Lake Erie, six had recorded mortalities. No other weather conditions resulted in such a high percentage of days with mortalities. In fact, there were 13 (or 36% of the high-pressure days had a mortality recorded. In Table 8 the breakdown of mortalities by synoptic weather patterns is shown.

Analysis of the data as they appear in the table verifies past observations that mortality is most likely to occur when migration is most expected, and that it can and does occur under any synoptic weather condition. Mortalities were most frequent when the leading edge of a high pressure system was over western Lake Erie and the flow of air was northerly. Post-frontal low-pressure patterns (L-4) Also appeared to result in relatively high mortality. This perhaps was predictable in that again the air flow was northerly, which encouraged migration. Category L-4 is in effect a transition from low to high pressure, and the difference between categories H-1 and L-4 is basically that the former has anti-cyclonic flow, while the latter has cyclonic.

Conclusions:

The fall 1978 patterns appear to be consistent with those of the past several years. Significant mortality occurred on one or two days, while it was low on most others. Patterns that encouraged migration were ones that showed slightly higher mortalities. Perhaps the intensity and duration of a "poor" weather event, like September 13th, determines the degree to which mortality occurs. In any case, the observations have and continue to show that mortalities will occur, and that in the fall they are more likely to occur under certain synoptic conditions, particularly those supporting northerly air flow. However, mortalities did not exceed 100 birds in any 24-hour period, thus indicating that the site was within specifications.

Table 1. Species recovered at Davis-Besse Nuclear Power Station site during the spring migratory season, 1978.

Species	A.O.U.[+]	CT	ST	Totals
Virginia Rail	212		1	1
Rock Dove	313		1	1
Long-billed Marsh Wren	725	1		1
Catbird	704	1		1
Swainson's Thrush	758	1		1
Ruby-crowned Kinglet	749	1		1
White-eyed Vireo	631	1		1
Yellow-throated Vireo	628	1		1
Red-eyed Vireo	624	7	3	10
Philadelphia Vireo	626	2		2
Black and white Warbler	636	9		9
Golden-winged Warbler	642	1		1
Blue-winged Warbler	641	1		1
Nashville Warbler	645	1		1
Yellow Warbler	652	1		1
Magnolia Warbler	657	6		6
Black-throated Blue Warbler	654	1		1
Yellow-rumped Warbler	655	3		3
Black-throated Green Warbler	667	2		2
Blackburnian Warbler	662	2		2
Chestnut-sided Warbler	659	2		2
Bay-breasted Warbler	660	3	1	4
Ovenbird	674	2		2
Yellowthroat	681	12	1	13
Yellow-breasted Chat	683	1		1
Wilson's Warbler	685	1		1
American Redstart	687	3		3
Northern Oriole	507	2		2
Slate-colored Junco	567	1		1
Song Sparrow	581		1	1
Unidentified Flycatcher		1		1
Total Birds		70	6	78

[+] = No. after A.O.U. Check-list of North American Birds

CT = Cooling Tower

ST = Unit I Building

Table 2. Families represented in birds recovered at Davis-Besse Nuclear Power Station site during the spring migratory seasons of 1977 and 1978.

Figures in parentheses represent percent values.

	Spring 1977				Spring 1978		
Family	CT	ST	TL	Total	CT	ST	Total
Kinglets (Regulidae)	3(8)			3(6)	1(1)		1(1)
Warblers (Parulidae)	15(38)			15(31)	51(73)	2(25)	53(69)
Finches (Fringillidae)	4(10)		1(50)	5(11)	1(1)	1(13)	2(2)
Mimids (Mimidae)		1(17)		1(2)	1(1)		1(1)
Others	7(17)	5(83)	1(50)	13(27)	15(23)	5(62)	20(26)
Rails (Rallidae)			1	1		1	1
Pigeons (Columbidae)	1			1		1	1
Br.Creeper (Certhidae)	1	1		2			
Wrens (Troglodytidae)					1		1
Thrushes (Turdidae)					1		1
Vireos (Vireonidae)	5	4		9	11	3	14
Icterids (Icteridae)					2		2
Unidentified	11(27)			11(23)	1(1)		1(1)
Total birds	40(83)	6(13)	2(4)	48(100)	70(90)	8(10)	78(100)

CT = Cooling Tower

ST = Unit I Structures

TL = Transmission lines

Table 3. Species recovered at Davis-Besse Nuclear Power Station site during the fall migratory season, 1978.

species	A.O.U.[+]	CT	ST	Totals
Brown Creeper	726		1	1
Golden-crowned Kinglet	748	1		1
Ruby-crowned Kinglet	749	5	1	6
Red-eyed Vireo	624	4	1	5
Philadelphia Vireo	626	1	1	2
Black and white Warbler	636	1		1
Nashville Warbler	645	2		2
Parula Warbler	648	1		1
Magnolia Warbler	657	4		4
Black-throated Blue Warbler	654	2		2
Yellow-rumped Warbler	655	2		2
Blackburnian Warbler	662	5		5
Chestnut-sided Warbler	659	3		3
Bay-breasted Warbler	660	9	1	10
Blackpoll Warbler	661	4	1	5
Ovenbird	674	2		2
Yellowthroat	681	6		6
Canada Warbler	686	2		2
American Redstart	687	2		2
Sharp-tailed Sparrow	549	1		1
Swamp Sparrow	584	1		1
Song Sparrow	581	1		1
Unidentified birds		6		6
Total Birds		65	6	71

CT = Cooling Tower
ST = Unit I Structures

Table 4. Families represented in birds recovered at Davis-Besse Nuclear Power Station site during the fall migratory seasons of 1977 and 1978. Figures in parentheses represent percent values.

Family	Fall 1977 CT	Fall 1977 ST	Fall 1977 Total	Fall 1978 CT	Fall 1978 ST	Fall 1978 Total
Kinglets (Regulidae)	17(13)		17(11)	6(10)	1(17)	7(10)
Warblers (Parulidae)	85(65)	13(65)	98(65)	41(63)	2(33)	43(61)
Finches (Fringillidae)	8(6)		8(6)	3(4)		3(4)
Others	13(10)	2(10)	15(10)	5(8)	3(50)	8(11)
Rails (Rallidae)	1		1			
Pigeons (Columbindae)	1		1			
Woodpeckers (Picidae)	1	1	2			
Flycatchers (Tyranidae)	1		1			
R.br.Nuthatch (Sittidae)	2		2			
Creepers (Certhiidae)	1		1		1	1
Wrens (Troglodytidae)	2		2			
Mimids (Mimidae)	1		1			
Vireos (Vireonidae)	3	1	4	5	2	7
Icterids (Icteridae)						
Unidentified	8(6)	5(25)	13(9)	10(15)		10(14)
Total birds	131(87)	20(13)	151(100)	65(92)	6(8)	71(100)

CT = Cooling Tower

ST = Unit I Structures

Table 5. Avian mortalities recovered at the Davis Besse site during the migratory seasons (1972 - 1978) summarized by families. Figures in parentheses represent percent values.

Family	Spring	Fall
Kinglets (Regulidae)	18 (3.8)	242 (24.0)
Warblers (Parulidae)	269 (56.9)	555 (55.1)
Finches (Fringillidae)	47 (9.9)	36 (3.6)
Mimids (Mimidae)	18 (3.8)	2 (0.2)
Others	106 (22.4)	122 (12.1)
Unidentified	15 (3.2)	50 (5.0)
Total Birds	473 (100)	1007 (100)

Table 6. Summary of necropsy examinations of Davis Besse site avian mortalities fall 1972 - fall 1978

Site or type of injury

FAMILY	HEMATOMA ON HEAD light	heavy	HEMATOMA on breast	CRUSHED skull	FRACTURES tibio-tarsus	tarso-meta-tarsus	wing	BILL injury	NECK broken	NO signs	NO. BIRDS[+] examined
Ardeidae			1								1
Rallidae	7	1	1	1	2		2	1			8
Laridae							1		1		1
Columbidae	3		3		1			1			6
Picidae	4		1				1	1			5
Tyrannidae	7	1			1			1		2	11
Corvidae	1										1
Sittidae	1	2						1			3
Certhiidae	1	5						1			6
Troglodytidae	4	5					1	1			10
Mimidae	6	2			1			1		1	9
Turdidae	8	5			1		1		1		13
Regulidae	114	84		2	12		12	49	1	13	211
Sturnidae	1		1								1
Vireonidae	38	34	2	4	8		3	2	3	4	77
Parulidae	375	161		31	46	4	30	118	8	23	559
Icteridae	5	1					1		2	2	10
Thraupidae		1									1
Fringillidae	33	15		3	5		2	6	1	1	49
Ploceidae	1	1									2
Totals	609	318	9	41	77	4	54	183	17	46	984

[+] = a single bird may be cited in one or more columns.

Table 7. Summary of spring synoptic weather patterns

Synoptic Categories	Mortalities	Average
H-1	0,0,0,0,1,6,1	1.1
H-2	0,0,0,0,0,0,0	0.
H-3	2,0,0,3,0,0,0,2	0.9
L-1	0,1,0,28,4	6.6
L-2	13,13	13.0
L-3	0	0.
L-4	0,0,0,0,3,0	0.5

Table 8. Summary of fall synoptic weather patterns

Synoptic Weather Categories		Individual Mortality Observations	Average Daily Mortality
H-1	leading edge of a high pressure system over western Lake Erie (northerly flow)	0,2,0,2,4,2,1,4	1.9
H-2	high pressure center over western Lake Erie (calm or variable flow)	0,0,3,0,0	0.6
H-3	trailing edge of a high pressure system over western Lake Erie (southerly flow)	2,0,4,0,0,0,3,1,0,6,2,0,0,0	1.3
L-1	low pressure center near or over western Lake Erie	0	0.0
L-2	warm sector with a cold front immediately to the west or northwest of western Lake Erie	0,0,0,2,0,0,0,2,0	0.4
L-3	warm front over or immediately to the south of western Lake Erie	0,0,19,1,1,0,0,0	2.6
L-4	post frontal conditions with a low to the east or northeast of western Lake Erie	3,0,0,0,7	2.0

Fig. 1 . Dis ibution of 65 mortalities recovered at the cooling tower during the 1978 spring migration period. Recovery locations indicated by ● .

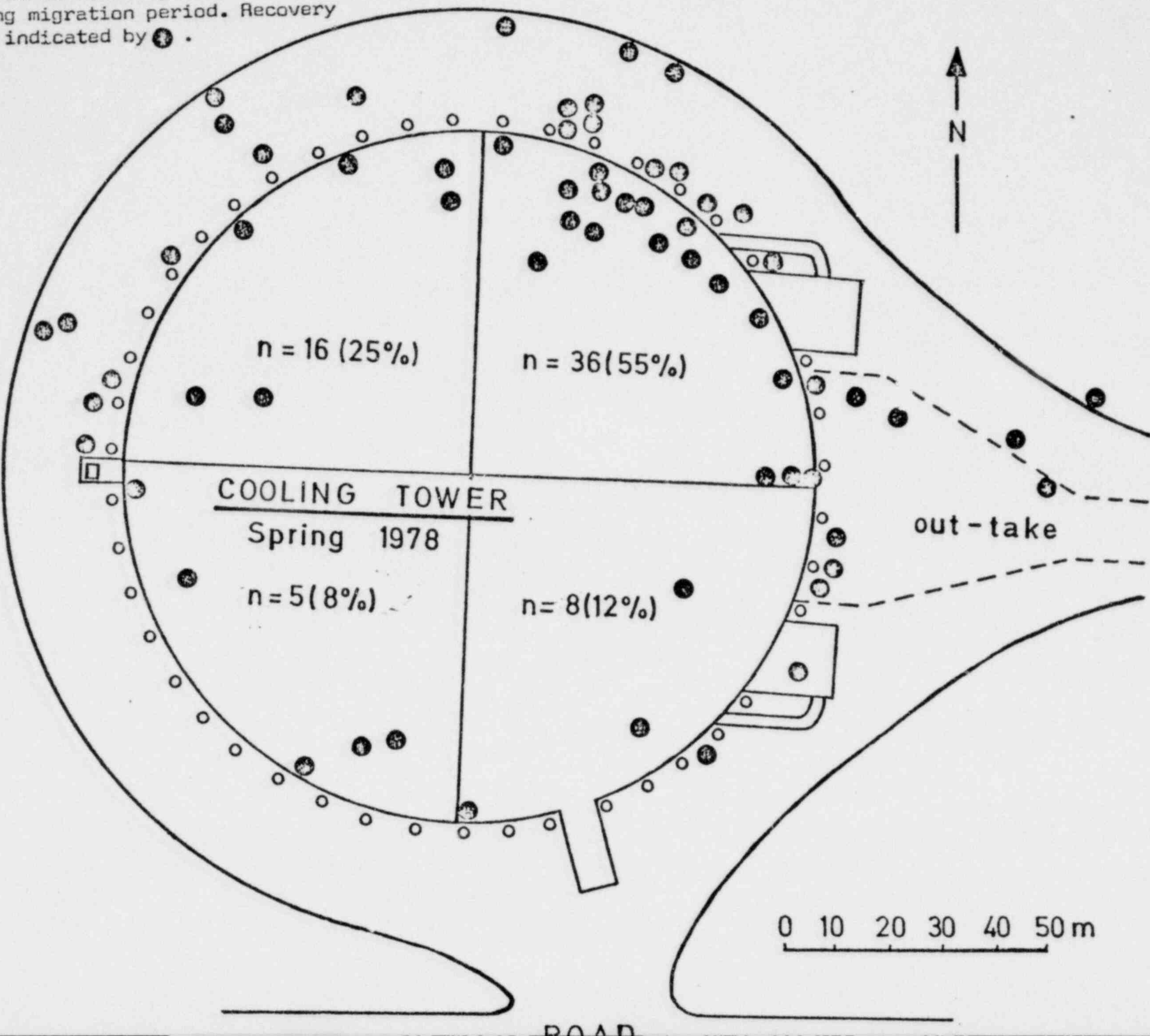


Fig. 2. A) Mean frequency of bird mortalities by ts at cooling tower for the spring periods 1974 - 19

B) Mean frequency of bird mortalities by q nts at cooling tower for the fall periods 1973 - 1978. ... fall 1977 is excluded since the majority of birds were found floating in the tower base.

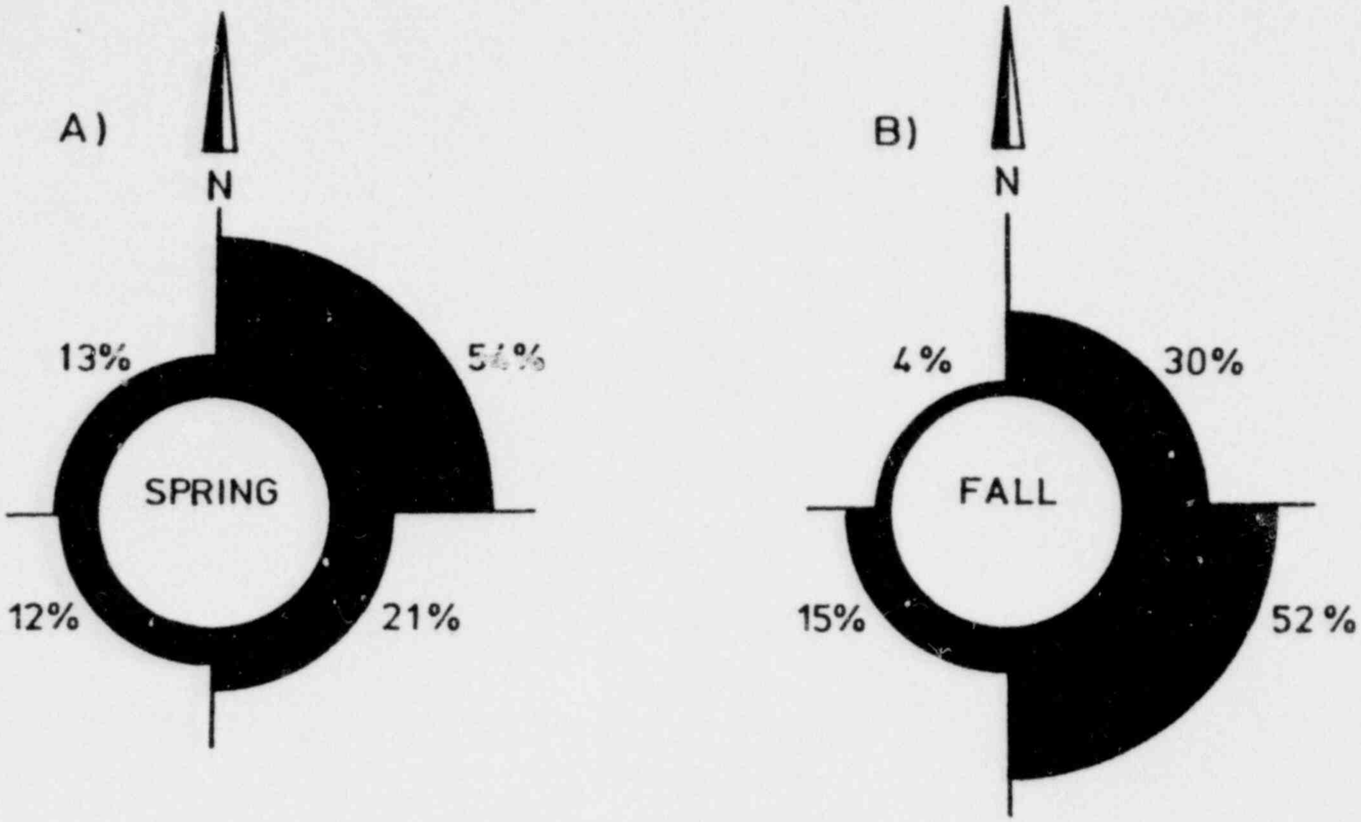


Fig.3 Distribution of 8 mortalities recovered during the 1978 spring ○ and 6 mortalities recovered during the 1978 fall migratory periods at the Unit I structure. Fall recoveries indicated by ● .

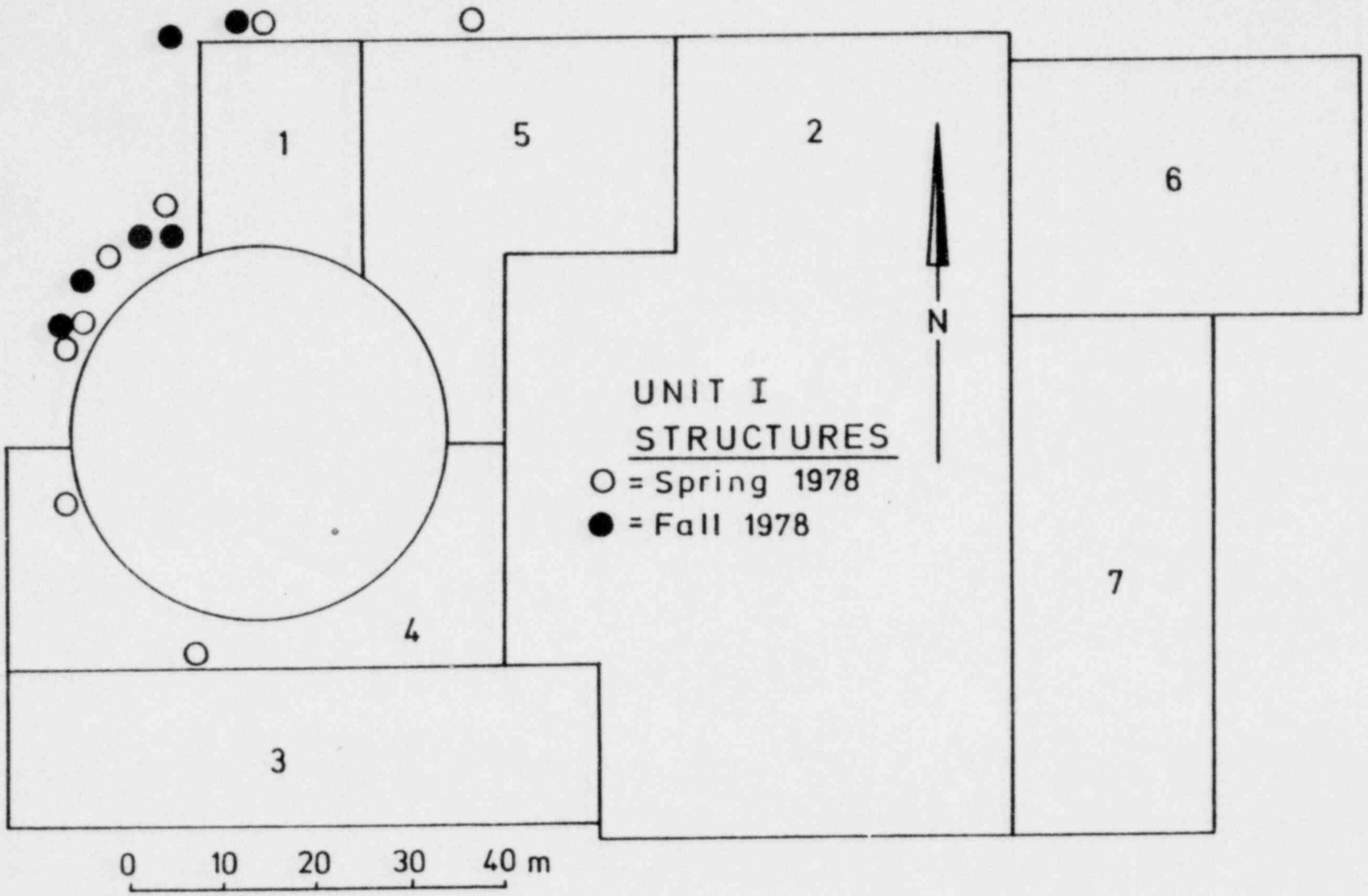
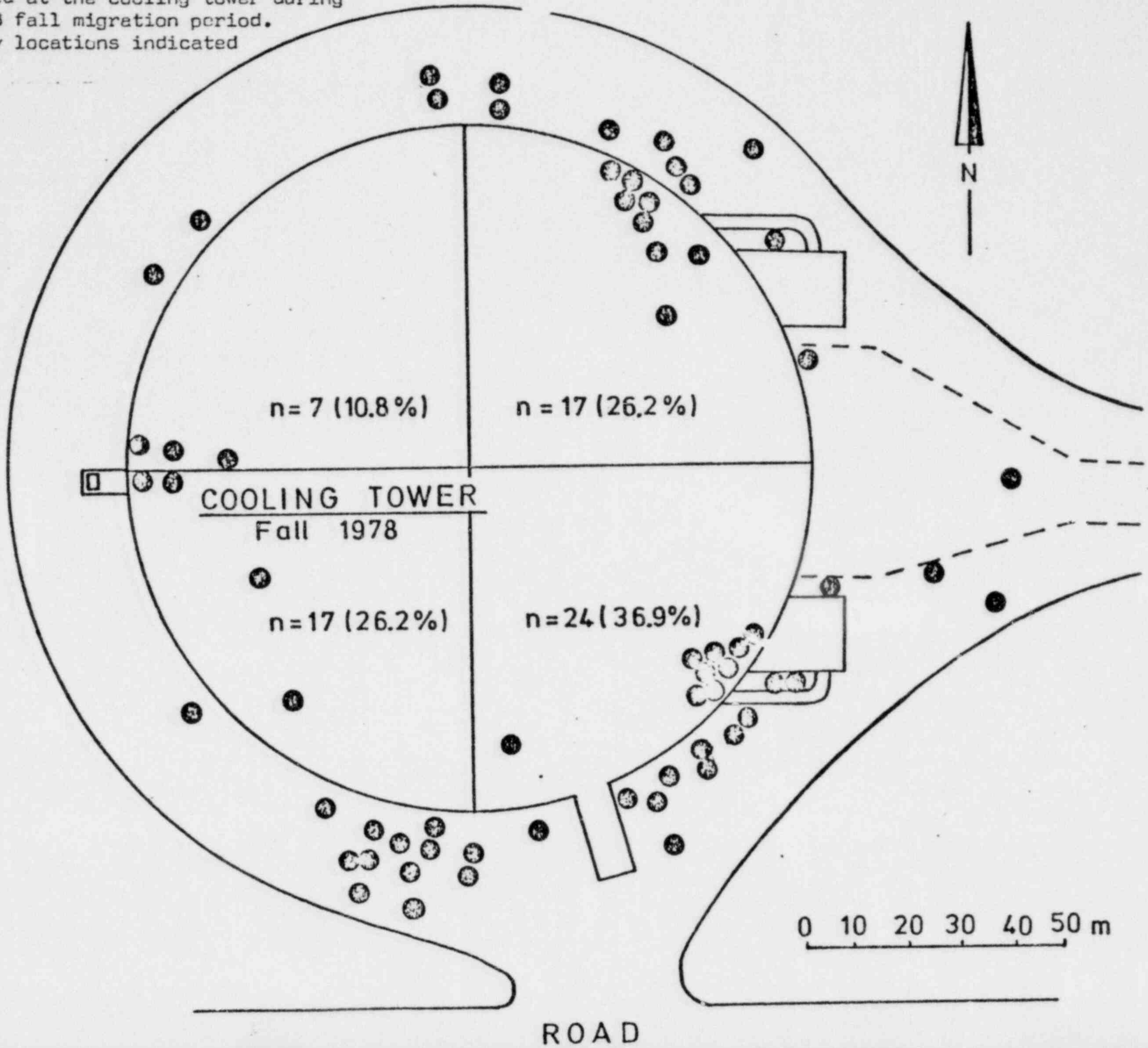
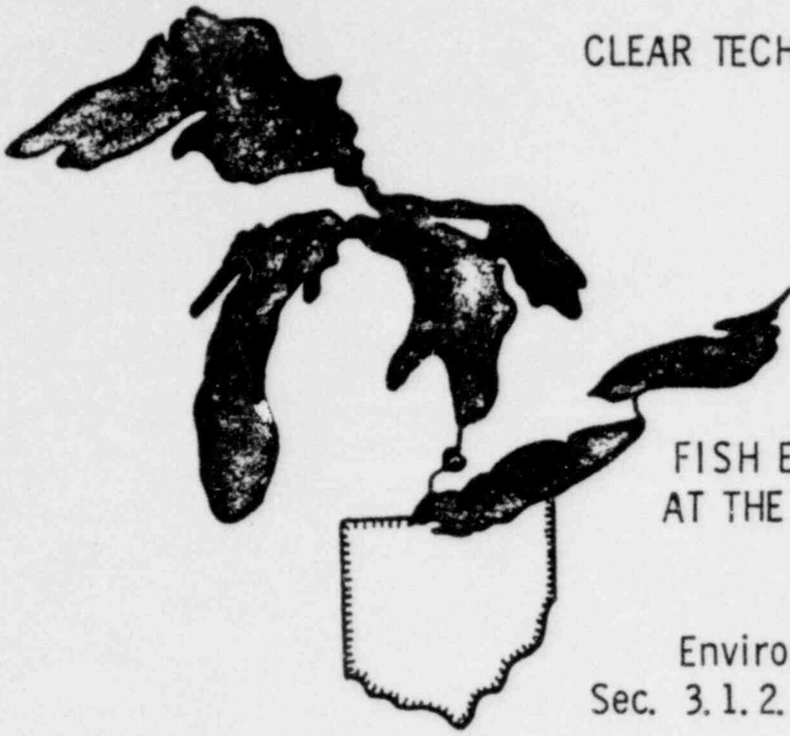


Fig. 4. Distribution of 65 mortalities recov ed at the cooling tower during the 1978 fall migration period. Recovery locations indicated by ●





CLEAR TECHNICAL REPORT NO. 104

FISH EGG AND LARVAE ENTRAINMENT AT THE DAVIS-BESSE NUCLEAR POWER STATION DURING 1978

Environmental Technical Specifications
Sec. 3.1.2.a.5 Fish Egg and Larvae Entrainment

Prepared by

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Prepared for

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THE OHIO STATE UNIVERSITY

CENTER FOR LAKE ERIE AREA RESEARCH

COLUMBUS, OHIO

February 1979

LIMITING CONDITIONS FOR OPERATION

2.1.1

I

Section 2.1.1
Maximum Temperature Differential

2.1.1 Temperature Differential, °F (Daily Averages)

1978	Minimum	Maximum	Average
January	2	14	8
February	2	13	9
March	3	13	11
April	1	17	9
May	-4	5	1
June	-5	3	1
July	-6	1	3
August	-7	0	2
September	-11	6	2
October	-5	10	2
November	2	16	9
December	3	18*	11

* Refer to LER NP-09-78-03 for December 9 and 10 when ΔT exceeded 20°F for approximately one half hour each day.

2.2

II

Section 2.2
This Section is Reserved

2.3.1

III

SECTION 2.3.1
CHLORINE MONITORING

2.3.1 Biocides

Chlorine was the only biocide used at Davis-Besse during the 1978 period. Monitoring of chlorine residuals is covered by the Station's NPDES Permit. The limits of the permit were never exceeded.

IV

Section 2.3.2
pH Monitoring

2.3.2 pH

1978	Minimum	Maximum
January	7.1	8.6
February	7.2	8.0
March	6.8	7.8
April	7.4	7.9
May	7.6	8.0
June	7.2	8.7
July	7.6	7.9
August	7.9	8.6
September	8.0	8.5
October	7.2	8.3
November	7.1	8.5
December	6.6	8.6

V

SECTION 2.3.3
SULFATES MONITORING

ENVIRONMENTAL SURVEILLANCE

2.3.3 Sulfates

1973	Minumum	Maximum	Average
January	100	125	114
February	125	250	164
March	115	220	160
April	120	220	160
May	80	160	140
June	150	180	162
July	100	150	114
August	100	150	119
September	100	150	117
October	80	125	98
November	95	120	112
December	75	175	141

3.1.1.a.1

VI

SECTION 3.1.1.A.1

WATER QUALITY ANALYSIS