

Evaluation of the Bacteriological Quality of a Shellfish-growing Area in Kamak Bay, Korea

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The sanitary quality of a shellfish-growing area in Kamak Bay, Korea, was assessed through a bacteriological examination of seawater and oysters from January 2004 to December 2006. From seawater samples collected at 28 stations, the range of geometric mean (GM) and the estimated 90th percentile for most-probable-number (MPN) values of fecal coliforms were <1.8-2.4 MPN/100 mL and 1.8-6.0 MPN/100 mL, respectively. The observed fecal coliform GM and the estimated 90th percentile did not exceed the fecal coliform water quality standards of 14 MPN/100 mL and 43 MPN/100 mL. Therefore, the bacteriological quality of seawater at this shellfish-growing area met the Korean Shellfish Sanitation Program (KSSP) criteria for a growing area used for export. The range of the fecal coliform GM and the estimated 90th percentile MPN values of oyster samples were 19.2-160 MPN/100 g and 20.2-166.9 MPN/100 g, respectively, and the range of the viable cell count was 30-1900 CFU/g. Thus, the fecal coliform value for the oysters and the viable cell count were less than the current shellfish quality standards of 230 MPN/100 g and 50,000 CFU/g, respectively. The bacteriological quality of the oysters complied with the criteria for domestic use and export of shellfish.

Key words: Shellfish-growing area, Sanitary survey, Fecal coliform, Estimated 90th percentile

Introduction

Kamak Bay, Korea, is a shallow, semi-enclosed area with an average depth of 6.3 m and a total area of 112 km² (Lee and Chang, 1982; 1990). This bay has been a major oyster production site for several decades (Lee et al., 1991; 1992), and oysters harvested from this bay are sold directly to the public for raw or cooked consumption. Shellfish are filter feeders that pump large quantities of water through their bodies when actively feeding. In the process of filter feeding, shellfish can concentrate microorganisms, toxigenic micro-algae, and poisonous substances from the surrounding waters (Kator et al., 1994), and they can retain human pathogens derived from sewage contamination (Lipp et al., 1997). Epidemiological evidence suggests that outbreaks of intestinal diseases have occurred because of the consumption of

shellfish harvested from polluted areas (Haller et al., 1986; Rippey, 1994). Therefore, for human health reasons, it is necessary to control the bacteriological quality of shellfish and shellfish-growing waters. To ensure that shellfish are safe for human use, Korea operates the Korean Shellfish Sanitation Program (KSSP). According to the KSSP, seven shellfish-growing areas have been designated as shellfish-growing areas for export; Kamak Bay has been designated as a shellfish-growing area for export since 1987 (MOMAF, 2002). However, this bay is located within a closed basin surrounded by the Yeosu peninsula and Dolsan Island, and tends to be easily affected by various drainage contaminants. Thus, seawater and shellfish from Kamak Bay should be regularly monitored to ensure that both meet established sanitary criteria.

The main objective of this study was to evaluate the sanitary status of the shellfish-growing area in

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Kamak Bay. For this purpose, bacteriological examinations of seawater samples and oysters from Kamak Bay were performed between January 2004 and December 2006. The results of this study are valuable for improving the bacteriological quality of seawater and oysters, which are consumed raw or barely cooked.

Materials and Methods

Sample collection

The sampling stations for seawater (51 stations) and shellfish (five stations) were fixed in consideration of geographic features and the movement of tidal currents in Kamak Bay (Fig. 1); samples were collected monthly from January 2004 through December 2006. Seawater was collected following the methods of the American Public Health Association (APHA, 1970), using clean, sterile 250-mL screw cap bottles to collect surface water. Oysters (*Crassostrea gigas*) were collected from oyster farms using oyster tongs and held in insulated containers. After collection, samples were transported to the laboratory in sealed, refrigerated containers; samples were kept at

temperatures below 10°C until examination. All bacteriological examinations of seawater and shellfish were performed within 6 hours of collection. Surface water temperature, salinity, and pH were determined at each station using a water quality-measuring instrument (YSI 556MPS, USA).

Bacteriological examination

Bacteriological examinations included an assessment of the coliform group, fecal coliforms, and viable cell counts as per the Recommended Procedures for the Examination of Seawater and Shellfish (APHA, 1970). The five-tube, multiple-dilution most-probable-number (MPN) method was used for the detection of the coliform group and determination of fecal coliform density. Viable cell counts were determined by standard plate count analysis. Lauryl tryptose broth (Difco, USA) was used for the presumptive test, and Brilliant green bile 2% broth and EC medium (Difco, USA) were used for the confirmed test for the coliform group and fecal coliforms, respectively.

Evaluation of bacteriological quality

Under the systematic random sampling standard, an evaluation of seawater quality of a shellfish-growing area requires the collection of at least 30 samples (FDA, 2005). For seawater sampled under the systematic random sampling standard, the fecal coliform GM is not to exceed 14 MPN/100 mL, and the estimated 90th percentile should not exceed 43 MPN/100 mL for a five-tube decimal dilution test (Hunt and Springer, 1974; Garreis, 1994). The estimated 90th percentile was calculated using the following equation; Est. 90th percentile value = $\text{Antilog}[(\text{Slog})1.28A + X\log]$, where Slog is the base 10 logarithmic standard deviation, and Xlog = base 10 log mean. The value 1.28 is obtained from the standard normal distribution.

Results and Discussion

Physical seawater parameters

Physical parameters and monthly variations during the survey (January 2004 to December 2006) in temperature and salinity for seawater in Kamak Bay are shown in Fig. 2. The average seawater temperature was 16.2°C with a range of 2.7 to 30.7°C. The lowest temperatures were recorded in February and the highest in August. The average salinity was 32.9‰, and the range was 28.9 to 35.4‰. The average values for seawater temperature and salinity during the oyster harvest season (October to May) were 12.3°C

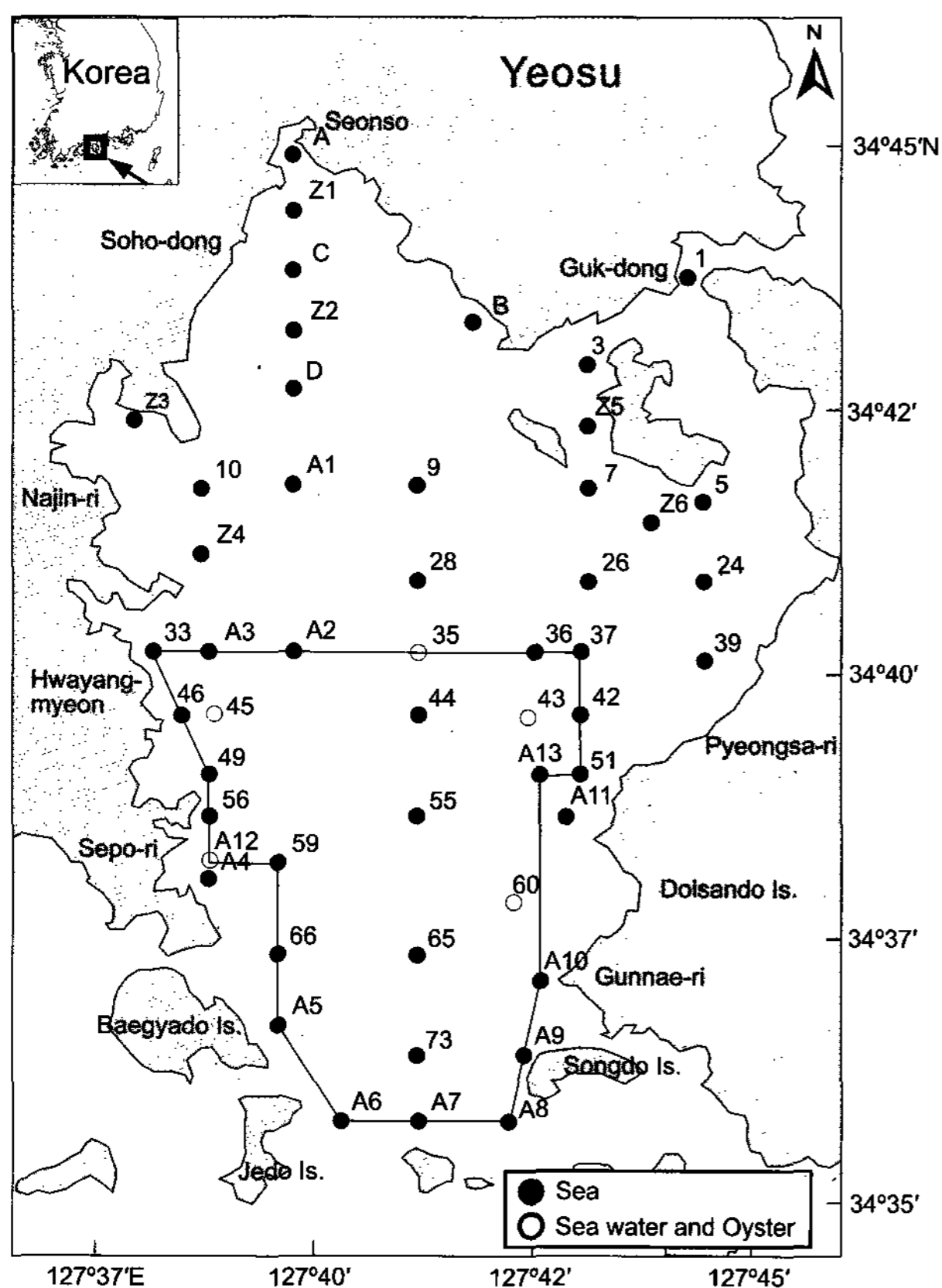


Fig. 1. Location of the sampling stations in Kamak Bay on the southern coast of Korea.

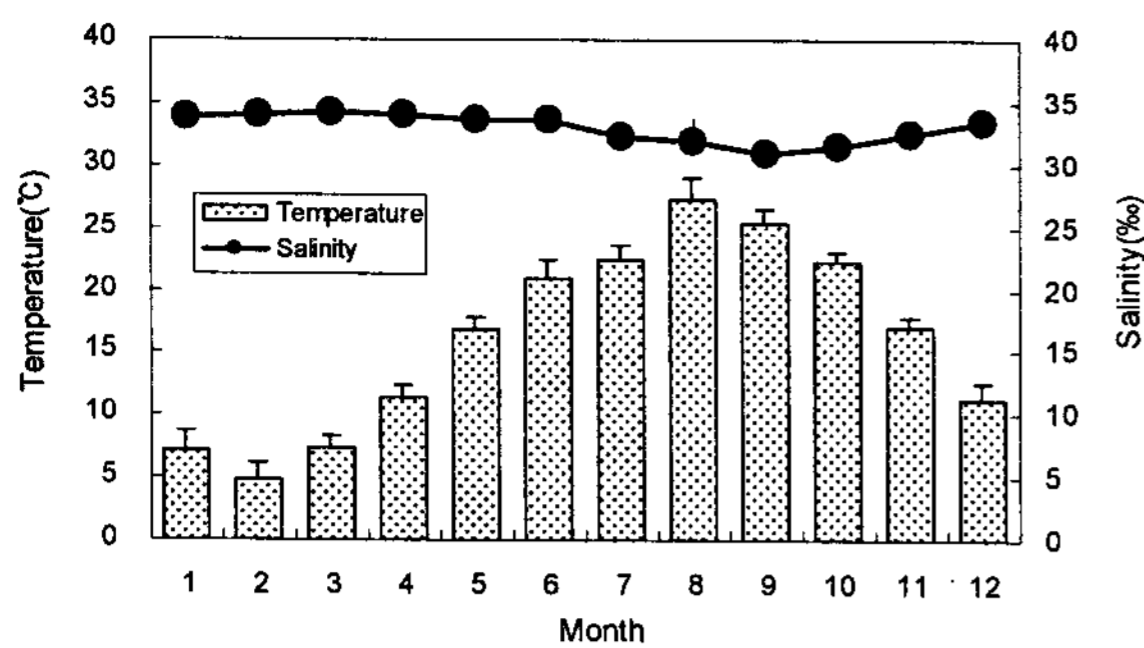


Fig. 2. Monthly variation in temperature and salinity for seawater in Kamak Bay (2004-2006). Data show the mean \pm SD.

and 33.4‰, respectively.

Bacteriological quality of seawater in the designated area

The results of the bacteriological examinations of the seawater samples from each sampling station in the designated area are shown in Table 1 and Fig. 3.

Fecal coliform densities were higher at stations located on the boundary line of the designated area than at stations inside the area. The range of fecal coliform GM and the estimated 90th percentile MPN value of seawater samples collected at all 28 stations were <1.8-2.4 MPN/100 mL and 1.8-6.0 MPN/100 mL, respectively. The observed fecal coliform GM and the estimated 90th percentile did not exceed the fecal coliform water quality standards of 14 MPN/100 mL and 43 MPN/100 mL. Therefore, the bacteriological water quality of the designated area met the KSSP criteria for areas growing shellfish for export.

Bacteriological quality of seawater in the adjacent area

The results of the bacteriological examinations of the seawater samples from the stations in the adjacent area are shown in Table 2 and Fig. 3. Fecal coliform density in the adjacent area was higher than in the designated area. The range of fecal coliform GM and

Table 1. Results of the bacteriological examinations of seawater at the designated area in Kamak Bay (2004-2006)

Station	MPN/100 mL										No. of samples
	Coliform group					Fecal coliform					
	Range	GM	90th	>230		Range	GM	90th	>43		
			No.	%				No.	%		
33	<1.8-240	2.8	9.7	1	2.8	<1.8-79	2.2	5.3	1	2.8	36
35	<1.8-7.8	1.9	2.8	0	0.0	<1.8-2.0	<1.8	1.8	0	0.0	36
36	<1.8-13	2.0	3.6	0	0.0	<1.8-2.0	<1.8	1.8	0	0.0	36
37	<1.8-6.8	2.0	3.0	0	0.0	<1.8-6.8	1.8	2.4	0	0.0	36
42	<1.8-11	2.1	4.2	0	0.0	<1.8-6.1	1.8	2.6	0	0.0	36
43	<1.8-6.8	1.9	2.8	0	0.0	<1.8-6.8	1.8	2.4	0	0.0	36
44	<1.8-34	2.0	4.0	0	0.0	<1.8-17	1.9	3.2	0	0.0	36
45	<1.8-49	2.1	4.9	0	0.0	<1.8-17	2.0	3.8	0	0.0	36
46	<1.8-41	2.3	6.7	0	0.0	<1.8-33	2.1	4.5	0	0.0	36
49	<1.8-130	3.2	16.0	0	0.0	<1.8-49	2.4	6.0	1	2.8	36
51	<1.8-34	2.2	5.3	0	0.0	<1.8-11	1.9	3.3	0	0.0	36
55	<1.8-11	1.9	3.1	0	0.0	<1.8-4.5	1.8	2.2	0	0.0	36
56	<1.8-49	2.2	5.5	0	0.0	<1.8-4.5	1.8	2.2	0	0.0	36
59	<1.8-49	2.1	4.6	0	0.0	<1.8-2.0	<1.8	1.8	0	0.0	36
60	<1.8-27	2.7	7.6	0	0.0	<1.8-14	2.0	3.9	0	0.0	36
65	<1.8-17	1.9	3.2	0	0.0	<1.8-2.0	<1.8	1.8	0	0.0	36
66	<1.8-33	2.5	7.7	0	0.0	<1.8-11	1.8	2.7	0	0.0	36
73	<1.8-7.8	1.9	2.9	0	0.0	<1.8-4.5	1.8	2.2	0	0.0	36
A-2	<1.8-9.3	1.9	3.0	0	0.0	<1.8-4.5	1.8	2.2	0	0.0	36
A-3	<1.8-33	2.3	5.9	0	0.0	<1.8-17	1.9	3.6	0	0.0	36
A-5	<1.8-5.6	1.9	3.0	0	0.0	<1.8-4.5	1.8	2.2	0	0.0	36
A-6	<1.8-33	2.1	4.6	0	0.0	<1.8-7.8	1.8	2.7	0	0.0	36
A-7	<1.8-6.8	2.0	3.3	0	0.0	<1.8-2.0	1.8	1.9	0	0.0	36
A-8	<1.8-11	2.0	3.3	0	0.0	<1.8-4.0	1.8	2.4	0	0.0	36
A-9	<1.8-17	2.4	5.9	0	0.0	<1.8-4.5	1.8	2.3	0	0.0	36
A-10	<1.8-79	2.4	8.2	0	0.0	<1.8-49	2.0	4.3	1	2.8	36
A-12	<1.8-17	2.1	4.0	0	0.0	<1.8-7.8	1.8	2.7	0	0.0	34
A-13	<1.8-130	2.5	7.5	0	0.0	<1.8-33	2.1	4.3	0	0.0	34
Total	<1.8-240	1.9-3.2	2.8-16.0	1	0.1	<1.8-79	<1.8-2.4	1.8-6.0	3	0.3	1,004

Table 2. Results of the bacteriological examinations of seawater at the adjacent area in Kamak Bay (2004-2006)

Station	MPN/100 mL										No. of samples
	Coliform group					Fecal coliform					
	Range	GM	90th	>230		Range	GM	90th	>43		
			No.	%				No.	%		
1	<1.8-3,500	124	1,611	15	44.1	<1.8-1,700	31.4	342.2	18	50	36
3	<1.8-3,500	26.8	366.9	8	20.6	<1.8-490	9.6	107.3	9	25	36
5	<1.8-240	4.6	32.5	1	2.7	<1.8-240	2.9	11.2	1	2.7	36
7	<1.8-240	2.6	9.7	1	2.8	<1.8-22	1.9	3.3	0	0.0	36
9	<1.8-25	2.1	4.6	0	0.0	<1.8-7.8	1.8	2.7	0	0.0	36
10	<1.8-350	2.4	9.8	1	2.8	<1.8-110	2.1	5.5	1	2.8	36
24	<1.8-240	2.4	8.3	1	2.8	<1.8-79	2.0	4.7	1	2.8	36
26	<1.8-23	1.9	3.6	0	0.0	<1.8-4.0	<1.8	2.1	0	0.0	36
28	<1.8-11	1.9	3.3	0	0.0	<1.8-11	1.8	2.7	0	0.0	36
39	<1.8-49	2.3	5.7	0	0.0	<1.8-7.8	1.9	2.7	0	0.0	36
A	2.0-92,000	662	15,136	24	66.7	<1.8-54,000	127.4	3,270	22	61.1	36
A-1	<1.8-11	1.9	2.9	0	0.0	<1.8-3.6	<1.8	2.1	0	0.0	36
A-4	<1.8-240	2.6	9.2	1	2.8	<1.8-130	2.0	5.3	1	2.8	36
A-11	<1.8-11	2.1	3.9	0	0.0	<1.8-11	1.9	3.3	0	0.0	36
B	<1.8-3,500	11	130.7	4	11.1	<1.8-49	2.8	8.4	1	2.8	36
C	<1.8-3,500	14.3	310.7	7	19.4	<1.8-490	5.7	52.7	6	16.7	36
D	<1.8-240	2.4	9.7	1	2.8	<1.8-21	1.9	3.6	0	0.0	36
Z-1	<1.8-24,000	236.8	7,947	18	50	<1.8-2,300	43.9	944.8	18	50	36
Z-2	<1.8-2,400	3.5	24.4	1	2.8	<1.8-240	2.3	7.1	1	2.8	36
Z-3	<1.8-130	2.9	11.8	0	0.0	<1.8-49	2.2	5.5	1	2.8	36
Z-4	<1.8-21	1.9	3.4	0	0.0	<1.8-2.0	<1.8	1.8	0	0.0	36
Z-5	<1.8-240	4.4	30.2	3	8.3	<1.8-240	3.3	17.8	2	5.6	36
Z-6	<1.8-49	2.8	8.8	0	0.0	<1.8-23	2.0	4.0	0	0.0	36
Total	<1.8-92,000	1.9-662	2.9-15,136	86	10.4	<1.8-54,000	<1.8-127	1.8-3,270	82	9.9	828

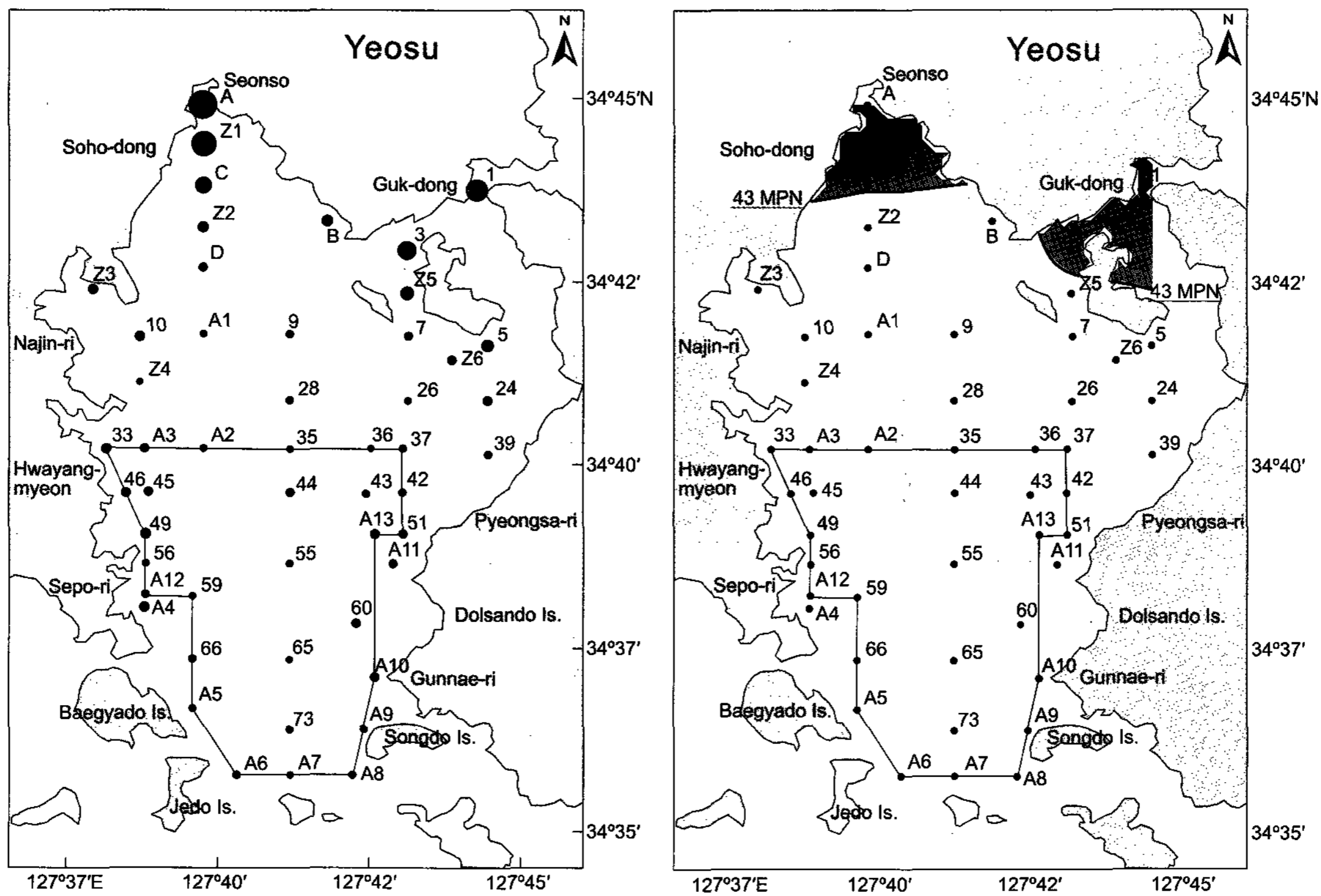


Fig. 3. Levels of fecal coliform at the sampling stations (A) and horizontal distribution (B) of fecal coliform for seawater in Kamak Bay (2004-2006).

Table 3. Monthly bacteriological results of seawater at the designated and the adjacent areas in Kamak Bay (2004-2006)

Section	Month	MPN/100 mL										No. of samples
		Coliform group					Fecal coliform					
		Range	GM	90th	>230		Range	GM	90th	>43		
			No.	%				No.	%			
Designated area	1	<1.8-4.0	<1.8	2.0	0	0.0	<1.8-4.0	<1.8	2.0	0	0.0	82
	2	<1.8-2.0	<1.8	1.8	0	0.0	<1.8-2.0	<1.8	1.8	0	0.0	82
	3	<1.8-7.8	1.8	2.3	0	0.0	<1.8-7.8	1.8	2.3	0	0.0	84
	4	<1.8-130	2.3	8.0	0	0.0	<1.8-33	2.0	3.6	0	0.0	84
	5	<1.8-41	2.6	6.8	0	0.0	<1.8-17	1.9	2.9	0	0.0	84
	6	<1.8-7.8	1.8	2.6	0	0.0	<1.8-4.5	1.8	2.1	0	0.0	84
	7	<1.8-79	3.4	10.1	0	0.0	<1.8-49	2.4	5.4	1	1.2	84
	8	<1.8-49	2.5	6.8	0	0.0	<1.8-4.5	1.8	2.3	0	0.0	84
	9	<1.8-240	2.9	12.2	1	1.2	<1.8-79	2.3	6.5	2	2.4	84
	10	<1.8-11	2.3	4.5	0	0.0	<1.8-4.5	1.8	2.3	0	0.0	84
	11	<1.8-7.8	1.8	2.2	0	0.0	<1.8-2.0	<1.8	1.8	0	0.0	84
	12	<1.8-9.3	1.8	2.6	0	0.0	<1.8-2.0	<1.8	1.8	0	0.0	84
Total		<1.8-240	<1.8-2.9	1.8-10.1	1	0.1	<1.8-79	<1.8-2.4	1.8-6.5	3	0.3	1,004
Adjacent area	1	<1.8-3,500	4.3	38.0	4	5.8	<1.8-280	2.5	9.5	3	4.3	69
	2	<1.8-490	3.8	29.9	3	4.3	<1.8-48	2.3	6.2	1	1.4	69
	3	<1.8-790	3.0	14.8	1	1.4	<1.8-140	2.2	6.3	2	2.9	69
	4	<1.8-54,000	7.9	207.7	11	15.9	<1.8-4,900	4.0	39.7	8	11.6	69
	5	<1.8-24,000	6.8	100.6	7	10.1	<1.8-490	3.5	20.6	8	11.6	69
	6	<1.8-54,000	5.0	96.4	8	11.6	<1.8-54,000	3.7	44.2	8	11.6	69
	7	<1.8-92,000	10.5	272.7	13	18.6	<1.8-7,900	5.3	58.9	10	14.3	69
	8	<1.8-35,000	6.1	123.6	7	10.1	<1.8-3,300	4.0	44.5	8	11.6	69
	9	<1.8-7,000	7.7	137.9	7	10.1	<1.8-4,600	4.6	51.3	9	13.0	69
	10	<1.8-24,000	9.7	302	13	18.8	<1.8-7,900	6.1	99.2	14	20.3	69
	11	<1.8-2,300	5.0	65.1	7	10.1	<1.8-790	3.1	18.3	6	8.7	69
	12	<1.8-7,900	6.1	72.5	5	7.2	<1.8-490	3.6	21.3	5	7.2	69
Total		<1.8-92,000	3.0-10.5	29.9-207.7	86	10.3	<1.8-54,000	2.2-6.1	6.2-58.9	82	9.9	828

the estimated 90th percentile MPN values of seawater samples collected at 23 stations in the adjacent area were <1.8-127 MPN/100 mL and 1.8-3,270 MPN/100 mL, respectively. Fecal coliform GM and the estimated 90th percentile MPN values of stations 1, 3, A, C, and Z-1, located near the drainage areas of Yeosu Harbor and Seonso, exceeded the fecal coliform water quality standards of 14 MPN/100 mL and 43 MPN/100 mL. However, the bacterial density decreased as the distance from the outlet increased. In fact, the bacteriological quality of seawater at stations located 1-2 km away from the boundary line of the designated area met the fecal coliform water quality standard, with the exception of five stations. The bacteriological survey results show that the bacteriological quality of seawater can be affected by contaminants from the drainage area of Yeosu City. To protect the designated area from these contaminants, a buffer zone ranging from 200 m to 4 km wide was established between the shoreline and the designated area. The adjacent area includes this buffer zone. Therefore, the contaminants could not affect the bacteriological water quality of the designated area.

Monthly variation in bacteriological seawater quality

Monthly bacteriological results of seawater quality are shown in Table 3. In the designated area, 1.2% and 2.4% of the samples collected in July and September exceeded bacteriological standards because of rainfall on the day of or the day before sampling (Appendix I). Several studies have reported a relationship between fecal coliform levels and rainfall (Mallin et al., 2001; Chigbu et al., 2004). The level of fecal coliforms in the adjacent area during the 5 months from June to October exceeded bacteriological standards. Elevated fecal coliform levels were associated with rainfall, as in the designated area. Because the adjacent area is close to the drainage area of Yeosu City, it is directly affected by rainfall.

Bacteriological quality of oysters

Five stations (O-3, O-4, O-5, O-6, and O-7) were used to survey the sanitary conditions of cultured oysters, the major shellfish product of Kamak Bay. The results of the bacteriological examinations of these oysters are shown in Table 4 and Fig. 4. The

Table 4. Results of the bacteriological examinations of oysters collected at the designated area in Kamak Bay (2004-2006)

Section	Station	MPN/100 g										No. of samples
		Fecal coliform					Plate count / g, at 35°C					
		Range	GM	90th	>230		Range	GM	90th	>50,000		
			No.	%				No.	%			
Designated area	O-3	<18-130	23.1	38.3	0	0.0	30-950	253.5	585.9	0	0.0	19
	O-4	<18-78	19.2	20.2	0	0.0	80-580	264.3	356.1	0	0.0	17
	O-5	<18-45	22.1	24.1	0	0.0	60-1,600	256.3	458.3	0	0.0	17
	O-6	<18-130	20.4	38.7	0	0.0	80-560	237.1	419.2	0	0.0	20
	O-7	<18-700	160	166.9	2	10	90-1,900	473.6	763.9	0	0.0	20
	Total	<18-700	19.2-160	20.2-166.9	2	2.2	30-1,900	237.1-473.6	356.1-763.9	0	0.0	93

Table 5. Monthly bacteriological results of oysters collected at the designated area in Kamak Bay (2004-2006)

Month	MPN/100 g										No. of samples
	Fecal coliform					Plate count / g at 35°C					
	Range	GM	90th	>230		Range	GM	90th	>50,000		
			No.	%				No.	%		
1	<18-78	21.4	37.3	0	0.0	60-320	165.4	301.4	0	0.0	15
2	<18-130	20.3	40.1	0	0.0	80-1,600	327.9	994.8	0	0.0	15
3	<18-45	18.9	26.1	0	0.0	30-300	144.8	299	0	0.0	15
4	<18-700	30.4	140.9	1	0.0	60-1,900	153.7	494	0	0.0	11
5	<18-460	67.9	606.9	1	33.3	190-500	357.3	719.8	0	0.0	3
10	<18-20	18.1	20.1	0	0.0	240-1,700	440	1034.7	0	0.0	8
11	<18-45	19.1	27.8	0	0.0	100-430	218.8	393.2	0	0.0	11
12	<18-130	18.3	25.3	0	0.0	70-950	158.1	387.1	0	0.0	15
Total	<18-700	18.1-67.9	20.1-606.9	2	2.2	30-1,900	144.8-440	229-1,034.7	0	0.0	93

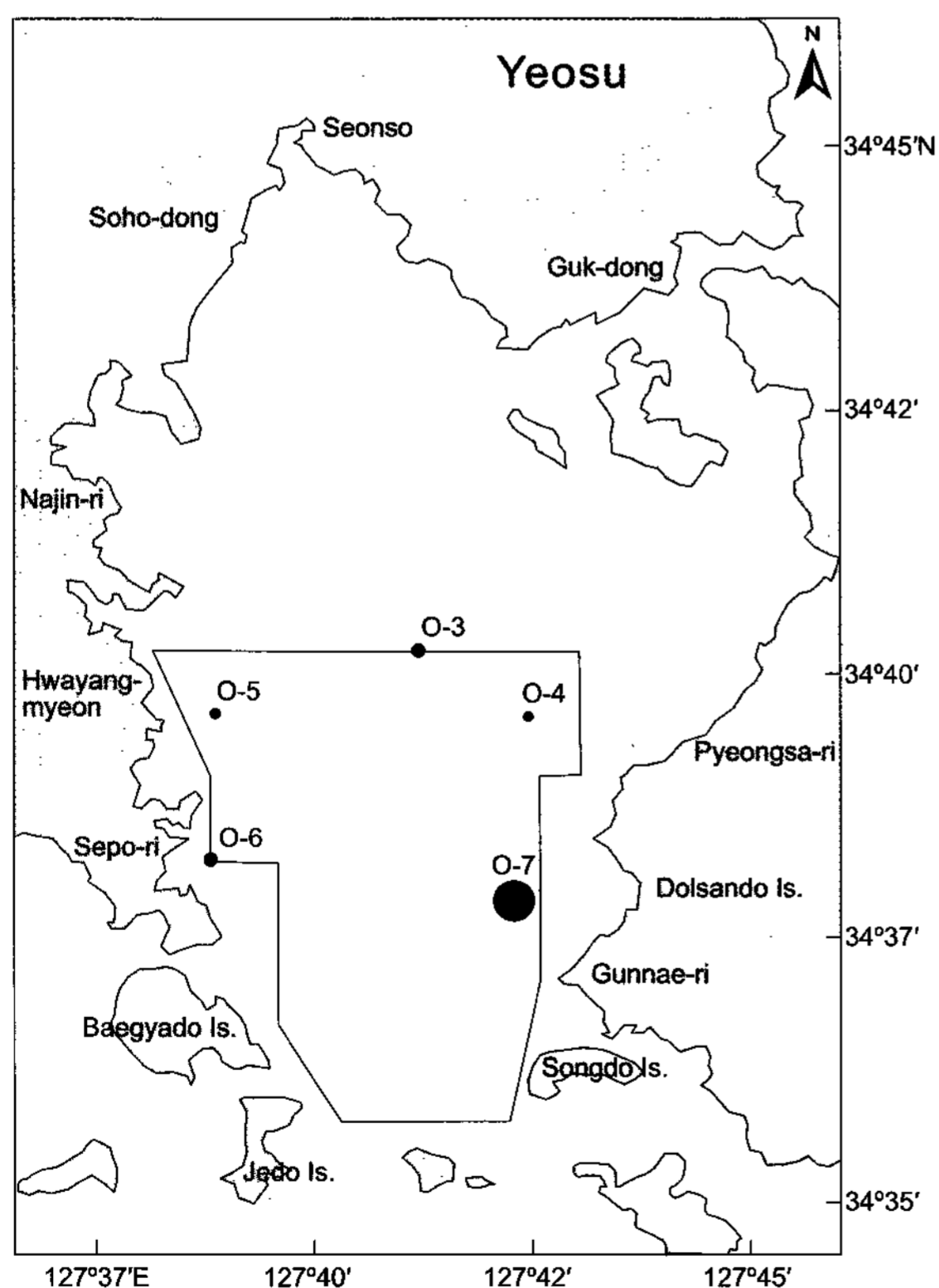


Fig. 4. Levels of fecal coliform for oysters collected at the designated area in Kamak Bay (2004-2006).

range of fecal coliform GM and the estimated 90th percentile MPN values for oyster samples in the designated area were 19.2-160 MPN/100 g and 20.2-166.9 MPN/100 g, respectively. The range of viable cell counts was 30-1900 CFU/g. The fecal coliform value for oysters and the viable cell count were less than the standards of 230 MPN/100 g and 50,000 CFU/g. The bacteriological quality of the sampled oysters thus complied with the bacteriological criteria for domestic use and export of shellfish. Monthly bacteriological results for oysters are shown in Table 5. The fecal coliform level of only two oyster samples, collected at station O-7 in April and May 2006, exceeded the bacteriological criteria for fresh oysters, i.e., 230 MPN/100 g. This result was due to rainfall on the day before sampling. The cases that exceeded the fecal coliform limit occurred during the non-harvest season and thus did not affect the sanitary condition of oysters harvested from the designated area.

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Appendix I. Summary of rainfall on the day and the day before sampling (2004-2006)

Sampling date			Amount of rainfall (mm)			
			Sampling day	1 day prior	2 days prior	3 days prior
2004	Jan.	06	0.0	0.0	0.0	0.0
	Feb.	10	0.0	0.0	0.0	0.3
	Mar.	02	0.0	0.0	0.0	0.0
	Apr.	01	31.5	0.0	2.4	10.5
	May	12	0.0	0.0	0.0	0.0
	Jun.	07	5.0	0.0	0.0	0.0
	Jul.	06	0.0	0.0	42.0	2.0
	Aug.	09	0.0	0.0	0.0	0.0
	Sept.	13	0.0	22.5	39.5	2.5
	Oct.	11	0.0	0.0	0.5	0.0
	Nov.	08	0.0	0.0	0.0	0.0
	Dec.	07	0.0	0.0	0.0	0.0
2005	Jan.	06	0.4	0.0	0.0	0.0
	Feb.	03	0.0	0.0	0.0	0.1
	Mar.	07	0.0	0.0	0.0	0.0
	Apr.	04	0.0	0.4	0.0	0.0
	May	09	0.0	0.0	0.0	4.5
	Jun.	07	0.0	0.0	0.0	0.0
	Jul.	11	35.0	2.0	3.5	36.0
	Aug.	01	11.5	0.0	0.0	21.5
	Sept.	07	0.0	3.0	0.0	0.0
	Oct.	04	10.5	0.0	0.0	19.0
	Nov.	01	0.0	0.0	0.0	0.0
	Dec.	05	0.0	1.5	0.0	0.0
2006	Jan.	03	0.0	0.0	0.0	0.0
	Feb.	09	0.0	0.5	3.0	4.0
	Mar.	13	0.1	0.0	0.0	0.0
	Apr.	10	38.0	10.5	0.0	0.0
	May	08	0.0	0.2	69.5	0.0
	Jun.	12	0.0	0.1	2.5	0.0
	Jul.	03	0.0	0.0	34.5	0.0
	Aug.	07	0.0	0.0	0.0	0.0
	Sept.	04	0.0	0.0	0.0	0.0
	Oct.	09	0.0	0.0	0.0	0.0
	Nov.	13	0.5	0.0	1.0	0.0
	Dec.	11	0.0	0.0	4.0	3.0