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DEPARTMENT OF ENVIRONMENT
ENVIRONMENTAL PROTECTION SERVICE
PACIFIC REGION

THE EFFECT OF SEWAGE DISCHARGES FROM ANCHORED
PLEASURE BOATS ON B.C. SHELLFISH
GROWING AREAS

Regional Program Report: 82-10

by

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ABSTRACT

Existing American and Canadian legislation pertaining to vessel sewage discharges is reviewed and discussed. A literature review and summary of B.C. data on the effects of overboard sewage discharges on water quality are also presented. The evidence demonstrates significant localized seasonal bacterial contamination from vessel discharges. Conclusions are drawn as to the efficacy of regulations in preventing sewage contamination from boats.

RÉSUMÉ

On est actuellement en train de revoir et de remettre en question la législation américaine et canadienne concernant les effluents rejetés par les navires. Des documents ont été publiés ainsi qu'une compilation des données relevées en C.-B. sur les effets sur la qualité de l'eau des effluents rejetés par les navires. Il résulte des études faites que les effluents provenant des navires ont à l'origine d'une importante contamination bactérienne saisonnière localisée. On a tiré certaines conclusions portant sur l'efficacité des règlements visant à empêcher la contamination par les effluents provenant des navires.

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CONCLUSIONS

1. Sewage discharges from vessels cause bacteriological contamination of the receiving waters and have resulted in seasonal closures of shellfish harvesting areas.
2. The shellfish growing water standard is not necessarily applicable when dealing with vessel discharges. Fecal coliforms may not be detected due to the type of pollution (i.e. fresh fecal material as opposed to municipal-type waste), mobility of the source and varying hydrographic and flushing features of different anchorage areas.
3. Shellfish tissue bacteriological analysis should be considered as an alternate method to water monitoring in determining the degree and extent of vessel sewage pollution in anchorages.
4. Regulations controlling vessel sewage discharges will not necessarily result in water quality improvement and/or the re-opening of shellfish harvesting areas.

The last conclusion is based upon the experiences of the U.S. MSD program. In reviewing the current status of the program, there are three major observations to be made. Firstly, vessel discharges do cause localized and seasonal contamination in anchorage and marina areas. Secondly, the installation of MSDs, particularly Type III, may not ameliorate environmental impacts from vessel discharges and may in fact worsen environmental conditions in the vicinity of pump out/ treatment systems. Thirdly, the MSD regulations are virtually impossible to enforce without considerable additional resources and many boat owners who have installed approved MSDs are not using them in accordance with the intent of the legislation.

The controversies surrounding the implementation, enforcement, and necessity of the MSD regulations in the U.S. are thought by some to be an example of what can happen when a piece of legislation is written without assessing the socio-environmental impacts. It is therefore prudent and wise that such impacts be fully evaluated in the Canadian situation before consideration be given to regulation development.

In British Columbia, recreational vessel discharges impact most negatively on shellfish harvesting areas (with respect to bacteriological contamination). Therefore, consideration should be given to identifying valuable shellfish resource areas and other ecologically sensitive locations as "no-discharge zones". Similarly, commercial oyster leases should be protected from fecal contamination originating from boat discharges, perhaps through provincial legislation prohibiting anchorage over an oyster lease. These types of regulations would satisfy two objectives. They would ensure the integrity of those areas which are unable to provide sufficient dilution and flushing action to render vessel contamination harmless, and they would significantly ease the enforcement burden that would be required if MSD regulations were developed.

1 INTRODUCTION

The coastline of British Columbia has long been known as one of the finest cruising and sailing areas in the world. The relatively sheltered waters of the Strait of Georgia, and the numerous secluded anchorage areas attract thousands of pleasure craft to British Columbia each year. In 1976, an estimated 107,576 resident boats were used in the Strait of Georgia and an additional 10,000 to 11,000 pleasure boats enter B.C. waters from the United States during the boating season (1).

In 1957, the Province of British Columbia began the development of a system of Provincial Marine Parks. These parks are intended to provide essential facilities for the enjoyment of the boating public, keeping in mind the need to maintain the natural surroundings of the area. Since 1967 the B.C. Parks Branch has acquired 28 Marine Parks in Georgia Strait and has proposed future development of 15 over the next 5 year period (2).

The major points of origin and destinations of recreational boats in the Strait of Georgia has been described by Harrison (1) and are shown in Figure 1 (3).

The utilization of these and other anchorage areas by the boating public is extensive. In some Provincial marine parks over 200 vessels per night have been observed during July and August. Statistics are not available as to the daily boat counts in all the parks however, during 1980, the Ministry of Lands, Parks and Housing recorded 13,271 boats at four marine parks. The use of these marine parks and other anchorage areas is likely to increase. Eby (2) has forecast a 32 percent increase in transient boating by 1985. Non-resident transient boating increased 3% between 1976-1978 and this trend has been assumed to continue (2), with 12,000 non-resident boats forecast by 1985.

Recently, studies conducted by the Environmental Protection Service (4, 5) have show that heavily populated anchorage areas are subject to sewage contamination in sufficient quantities to render the

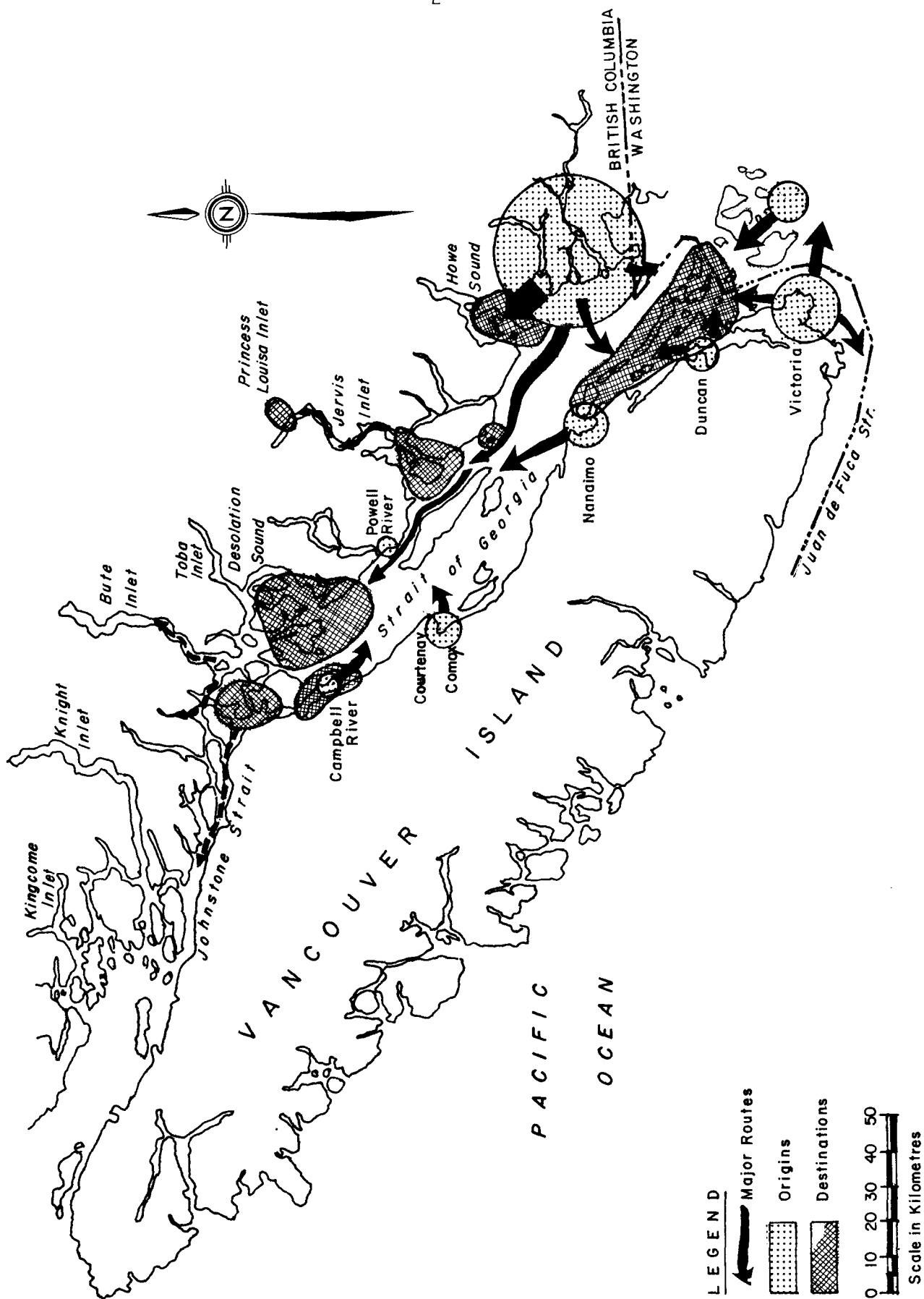


FIGURE 1 MAJOR POINT OF ORIGIN AND DESTINATIONS OF RECREATIONAL BOATERS IN THE STRAIT OF GEORGIA

shellfish unfit for consumption. These studies identified raw sewage discharges from anchored boats as the source of contamination. Consequently, seasonal shellfish harvesting closures were imposed in a number of anchorage areas in B.C. beginning in 1981.

This report presents an overview of current Canadian and U.S. legislation pertaining to vessel discharges, the effects vessel discharges have on water quality and the results of boat anchorage surveys conducted by EPS in 1980 and 1981.

2 CURRENT STATUS OF VESSEL DISCHARGE REGULATIONS IN CANADA AND
 THE UNITED STATES

In Canada, the regulation of commercial ship source pollution is administered by the Department of Transport under the Canada Shipping Act and the Arctic Waters Pollution Prevention Act. However there are no federal regulations directed towards the control of sewage from pleasure vessels. Similarly none of the provincial governments, with the exception of Ontario, have enacted legislation to regulate this pollution source. In the case of Ontario, the province's Boating Regulation became effective in 1969 and requires that all pleasure vessels be equipped with approved retention or incineration devices. A second regulation, enacted in 1970, requires that marinas and yacht clubs provide or arrange pump-out service for customers and members.

In the United States, all pleasure vessels are required to have U.S. Coast Guard approved marine sanitation devices (MSDs). In 1976, the United States Environmental Protection Agency issued final standards of performance for marine sanitation devices under Section 312 of the Federal Water Pollution Control Act and Coast Guard regulations were established to implement these standards. The regulations required that all new vessels be equipped with approved devices by January 30, 1977 and all existing vessels be equipped by January 30, 1980. Three types of marine sanitation devices have been approved by the U.S. Coast Guard and are described below:

Type I Macerates and chemically treats wastes. Also known as "treat and discharge" or "flow-through" system.

Type II Similar to Type I only macerates and treats wastes more thoroughly to standards equivalent to a secondary municipal treatment plant. There is no requirement for this type of system on any boat under 65 feet regardless of area of operation.

Type III No discharge or retention system. Examples: systems with holding tanks or incinerating equipment.

Portable toilets which are not permanently connected and are carried off the boat for emptying ashore are not included under Federal regulations.

Type I and II systems are required to meet effluent standards of 200 fecal coliform/100 ml and suspended solids of 150 mg/l.

The MSD regulations also regulate the locations where effluent may or may not be discharged and the extent of required treatment.

Since the promulgation of these regulations there has been considerable controversy over the usefulness of the marine sanitation device program and EPA has been requested to provide the Congress with a justification of the basis for the MSD program. As a result, the EPA and U.S. Coast Guard have initiated a review of "the costs and benefits of and the alternatives to the current MSD program" (6). This review, which invited public comments and data relating to the existing program and possible alternatives, was ongoing at the time of writing.

A preliminary report prepared by EPA (7) on the MSD program concluded that:

- The regulated community consisted only of owners of vessels with installed toilets, fewer than 10% of the U.S. vessels.
- The concentration of vessels varied from state to state.
- Measurable environmental effects from marine discharges were seasonal and localized in nature.

West (8), conducted a study in Narragansett Bay, Rhode Island, and found that the daily vessel waste discharge being prevented from entering the study area as a result of MSD's was insignificant (3018 lbs of BOD, based on a per capita effluent load of 2.0 kg) in view of the heavy

tidal action. Further, the report suggested that the regulation mandating the elimination of raw sewage by way of Type III MSDs (ie. those requiring pump out) may have the effect of concentrating the effluent discharge at a regional sewage plant where it may or may not be adequately treated. In other words, the sewage may not be dispersed to the same extent as would be the case if the vessels discharged directly.

The information and data obtained to date on the U.S. MSD program will be further discussed in the conclusions of this report.

3 EFFECTS OF VESSEL SEWAGE DISCHARGES ON MARINE WATER QUALITY

The greatest adverse impact of vessel sewage discharges on marine water quality and use occurs in those areas where swimming and/or shellfish harvesting are the main activities. The discussion in this section will deal specifically with the impact on shellfish growing water quality.

The pollution effects of marinas on water quality have been recognized in the Pacific Shellfish Regulations, which prohibits shellfish harvesting within 125 m of any wharf. In most cases, this has shown to be adequate to safeguard the public health. However, until recently, there have been no shellfish closures in other B.C. areas frequented by boats such as anchorages.

Furfari (9) has developed tables which estimate the allowable number of boats in shellfish areas providing the boat discharges are the sole source of coliform organisms (Table 1). Using a theoretical daily per capita total coliform contribution of 80 billion, a population equivalent value of 1.25 for a small boat, and knowing the area and average depth of the anchorage (i.e. available dilution water) it is possible to calculate the allowable number of boats to maintain shellfish growing water quality.

Field studies on the effects of boat wastes on receiving water quality have been few. Udell (10) concluded from a brief summer study that certain sample stations associated with heavy boat populations showed higher levels of pollution than sampling stations outside the anchorage area.

Additional studies conducted by Udell (11) between 1957 and 1963 concluded that where tidal exchanges were large, no detectable increases in pollution levels attributable to boats were apparent. Further, the degree of pollution in confined coves was directly proportional to the number of boats anchored or docked. Since boat populations varied, pollution levels were not consistent. He further

TABLE 1: ALLOWABLE NUMBER OF BOATS IN SHELLFISH AREAS
(No Background Coliform)

Area Sq. Miles	Depth Feet	Number of Boats	Area Sq. Miles	Depth Feet	Number of Boats
0.1	5	3	0.5	5	14
	10	6		10	28
	15	9		15	42
	20	12		20	56
	25	14		25	70
	30	17		30	84
	40	23		40	112
0.25	5	7	1.0	5	28
	10	14		10	56
	15	21		15	84
	20	28		20	112
	25	36		25	140
	30	42		30	184
	40	56		40	224

concluded that bacterial densities did not remain at levels exceeding shellfish growing water standards at all times.

Faust (12) examined the effects of boating activity in a shallow estuarine area of Rhode River, a tidal subestuary of Chesapeake Bay. Concentrations of fecal coliforms increased from 3 to 28 per 100 ml soon after the arrival of boats and persisted during their stay but decreased soon after boats departed the area. Using two variable linear regression analysis, Faust concluded that fecal coliform concentrations were positively correlated with the number of boats. She also concluded that 2.2×10^5 m³ of water was needed per boat (assuming 4 occupants/boat) to dilute fecal coliform levels below 14/100 ml. A study of boat mooring areas in an Atlantic estuary demonstrated that coliforms increased in both the water column and shellfish in direct relation to small boat populations in three of four areas sampled (13). Shellfish suspended in the water of one of the moorage areas displayed radical increases in coliforms in relation to boat population.

Other studies (14, 15, 16) have shown that recreational boats in marinas can cause significant fecal coliform contamination of the receiving waters depending on flushing conditions, boat use intensity and seasonal hydrographic conditions. Although conditions in marinas differ markedly with anchorage areas (with respect to boat use intensity in particular) these studies demonstrate the potential for contamination which exists in anchorages.

4 BRITISH COLUMBIA CASE STUDIES

During July 1980 and August 1981, the Environmental Protection Service conducted shellfish growing water surveys in a number of boat anchorage areas in the northern Strait of Georgia and Sunshine Coast areas (Figure 2). Sampling programs were conducted as part of the Shellfish Growing Water Control Program to assess the bacteriological quality of shellfish production and harvesting waters. In addition to routine water sampling, the program included vessel counts and shellfish tissue bacteriological analyses.

4.1 Field Procedures and Methods

All marine water samples for bacteriological analyses were collected in sterile wide-mouth glass bottles, approximately 15-30 cm below the water surface. The water depth at collection points over shellfish beds did not exceed 1.5 m. Samples were stored in coolers at temperatures not exceeding 10°C until processed. All analyses were conducted on site in the EPS mobile microbiology laboratory, generally within five hours of collection.

The fecal coliform MPN per 100 ml was determined using the multiple tube fermentation technique (three decimal dilutions of five tubes each) as described in Part 908C of the 14th edition of Standard Methods for the Examination of Water and Wastewater (17). The culture medium used was the A-1 medium as described by Andrews and Presnell (18) and further evaluated by Kay (19). A-1 medium was supplied by Gibco Diagnostics.

Shellfish tissue samples were analyzed for fecal coliforms according to APHA procedures (20).

Sanitary surveys were undertaken concurrently with the water quality sampling to identify and evaluate land-based sources of bacterial pollution to the study areas.

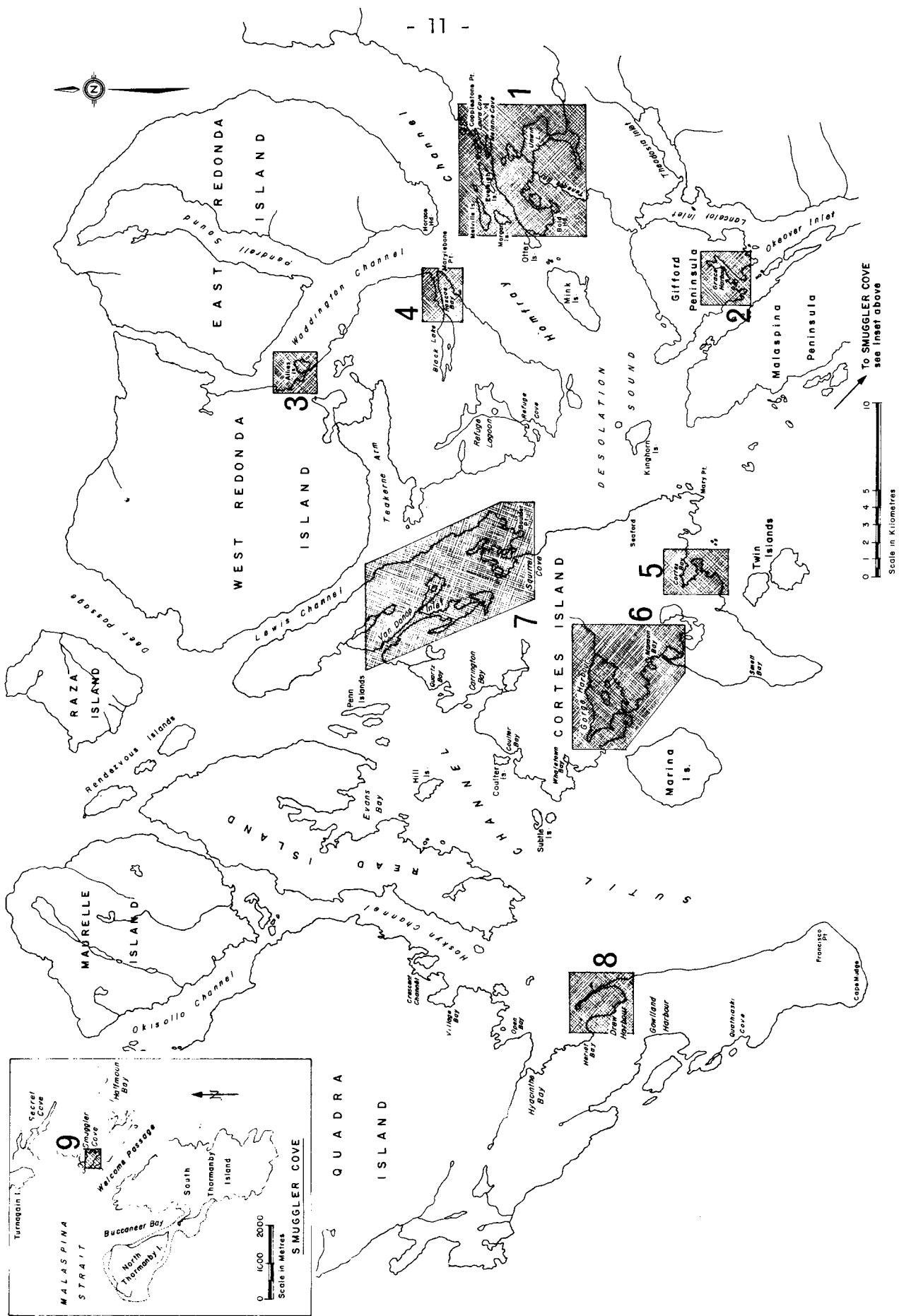


FIGURE 2 BOAT ANCHORAGE STUDY AREAS

4.2 Results

Bacteriological data for marine sample stations in the study areas is summarized in Table 2 and daily boat counts are presented in Table 3. Daily bacteriological results for the sample stations are not included in this report but are presented elsewhere (4,5). Sample locations are shown in Figures 3 and 4.

In all of the anchorage areas sampled the sanitary survey did not identify any onshore sewage sources. Therefore fecal pollution recorded in water samples was attributed solely to overboard sewage discharges. Fifteen of the 58 stations exhibited fecal coliform levels exceeding the approved shellfish growing water standard and all marine stations except one had detectable (i.e. greater than 2/100 ml) fecal coliform levels.

Attempts to correlate the bacteriological data with boat counts were generally unsuccessful. Table 4 presents the results of linear regression analysis on data collected from the most heavily utilized anchorage areas. Only Tenedos Bay showed a significant correlation ($r = 0.9$) between the grouped 90 percentile MPN data and area boat count.

The poor correlations are likely the result of (1) insufficient spatial and temporal sampling regimes, (2) random boat counting, (3) lack of information of flushing and tidal characteristics of the anchorages, (4) nature of the fecal material and method of discharge.

Shellfish analyzed for fecal coliform content were often a more valuable indicator of vessel sewage pollution than the receiving water results. In some cases, oyster tissue fecal coliform levels exceeded the approved market value of 230/100 g despite acceptable overlying water quality (Table 5). However, insufficient samples were collected to attempt to correlate the level of fecal coliforms in tissue with the number of boats.

TABLE 2: SUMMARY OF FECAL COLIFORM MPN DATA FOR ANCHORAGE AREAS

SAMPLE STATION	NO. OF SAMPLES	MPN/100 ml			EXCEEDS SHELL-FISH STANDARD
		RANGE	MEDIAN	90 PERCENTILE	
Area 1- 1	8	L2 - 23	3	13.4	NO
2	8	L2 - 7	2	3	NO
3	7	L2 - 920	L2	287.9	YES
4	8	L2 - 33	2	10.6	NO
5	9	L2 - 49	2	25.6	NO
6	8	L2 - 11	2	11	NO
7	7	L2 - 33	2	21.8	NO
8	8	L2 - 79	5	79	YES
9	6	L2 - 790	L2	61	YES
10	5	L2 - 33	2	28	NO
11	5	L2 - 33	2	22	NO
12	7	L2 - 2	L2	L2	NO
13	7	L2 - 7	L2	3.5	NO
14	7	L2 - 490	L2	77.6	YES
Area 2-15	6	L2 - 13	L2	10	NO
16	7	L2 - 11	2	8.9	NO
17	6	L2 - 8	3.5	8	NO
18	6	L2 - 2	2	2	NO
Area 3-19	6	L2 - 49	L2	19.6	NO
20	6	L2 - 49	3	49	YES
Area 4-21	5	L2 - 5	2	5	NO
22	5	L2 - 1600	L2	802	YES
Area 5-45	6	L2 - 110	22	91.4	YES
46	6	L2 - 110	10.5	63.8	YES
47	6	L2 - 79	2.5	39.4	NO
Area 6-50	6	L2 - 8	L2	5.6	NO
51	6	5 - 130	20.5	71.3	YES
52	6	L2 - 33	6	18	NO
53	6	L2 - 8	6	8	NO
54	6	L2 - 4	L2	2.8	NO
55	6	L2 - 14	2	12.8	NO
56	7	L2 - 5	L2	2.9	NO
57	5	L2 - 2	L2	2	NO
58	5	L2 - 2	L2	L2	NO
59	6	L2 - 5	2	5	NO
60	6	L2 - 49	2	22	NO
61	6	L2 - 2	L2	L2	NO
62	6	L2 - 8	L2	6.2	NO
Area 7-30	8	L2 - 33	3	20.2	NO
31	8	L2 - 920	2	920	YES
32	8	L2 - 23	2	8.6	NO

Continued...

TABLE 2: SUMMARY OF FECAL COLIFORM MPN DATA FOR ANCHORAGE AREAS
(Continued)

SAMPLE STATION	NO. OF SAMPLES	MPN/100 ml			EXCEEDS SHELL- FISH STANDARD
		RANGE	MEDIAN	90 PERCENTILE	
33	7	L2 - 350	2	139.3	YES
34	6	L2 - 2	L2	L2	NO
35	6	L2 - 2	2	2	NO
36	6	L2 - 130	3.5	58.6	YES
75	5	12 - 13	2	7.5	NO
76	5	L2 - 23	L2	17	NO
77	6	L2 - 11	L2	7.4	NO
78	6	L2 - 5	L2	3.2	NO
79	6	L2 - 8	3.5	8	NO
Area 8-88	6	L2 - 2	L2	L2	NO
89	6	L2 - 13	L2	8.2	NO
90	6	L2 - L2	L2	L2	NO
91	6	L2 - 11	L2	7.4	NO
92	6	L2 - 5	L2	2	NO
Area 9-101	6	5 - 110	25	63.8	YES
102	6	7 - 240	12.5	125.4	YES
103	6	L2 - 130	23	71.8	YES

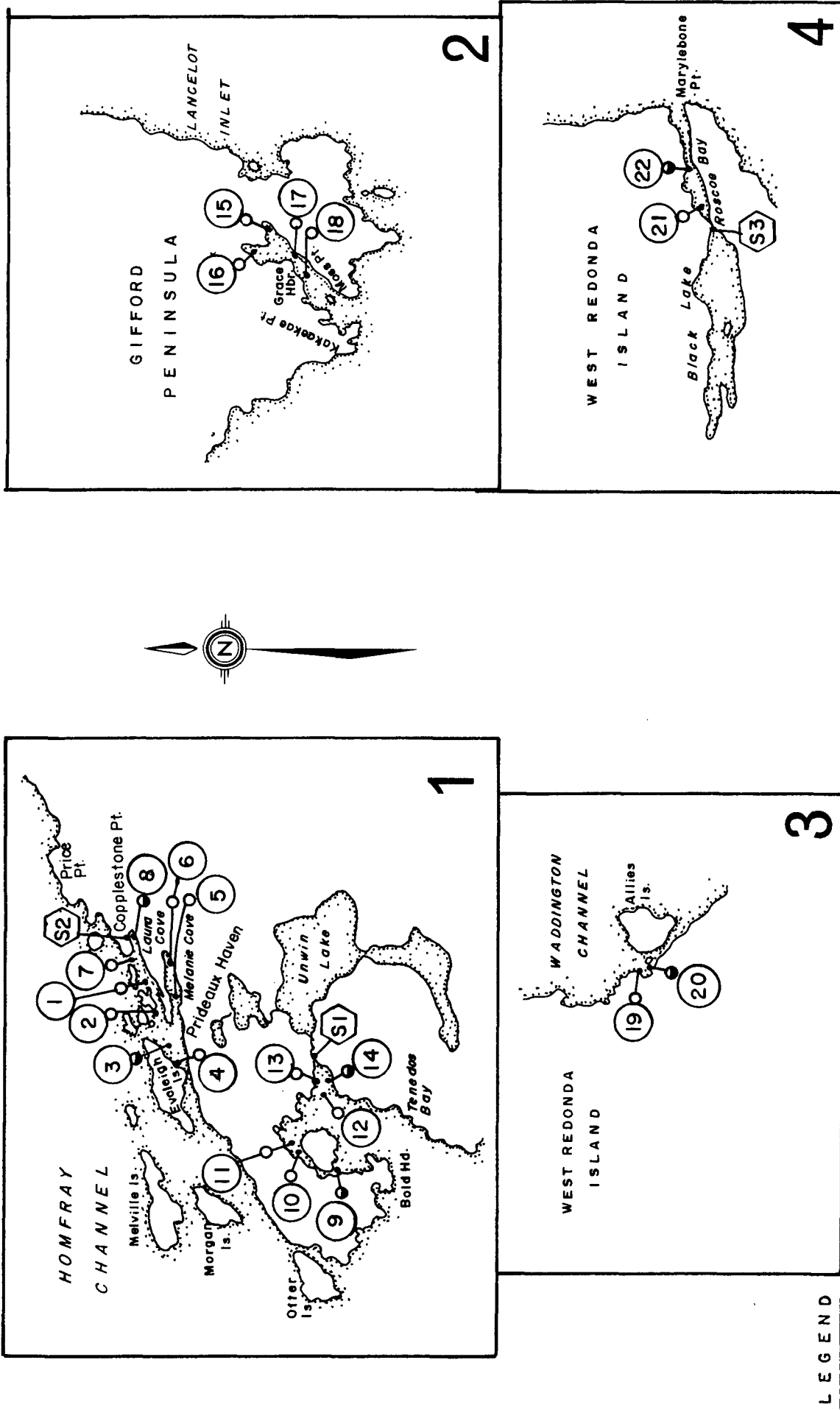


FIGURE 3 STUDY AREA 1-4: PRIDEAUX HAVEN, TENEDOS BAY, GRACE HARBOUR, ALLIES ISLAND AND ROSCOE BAY

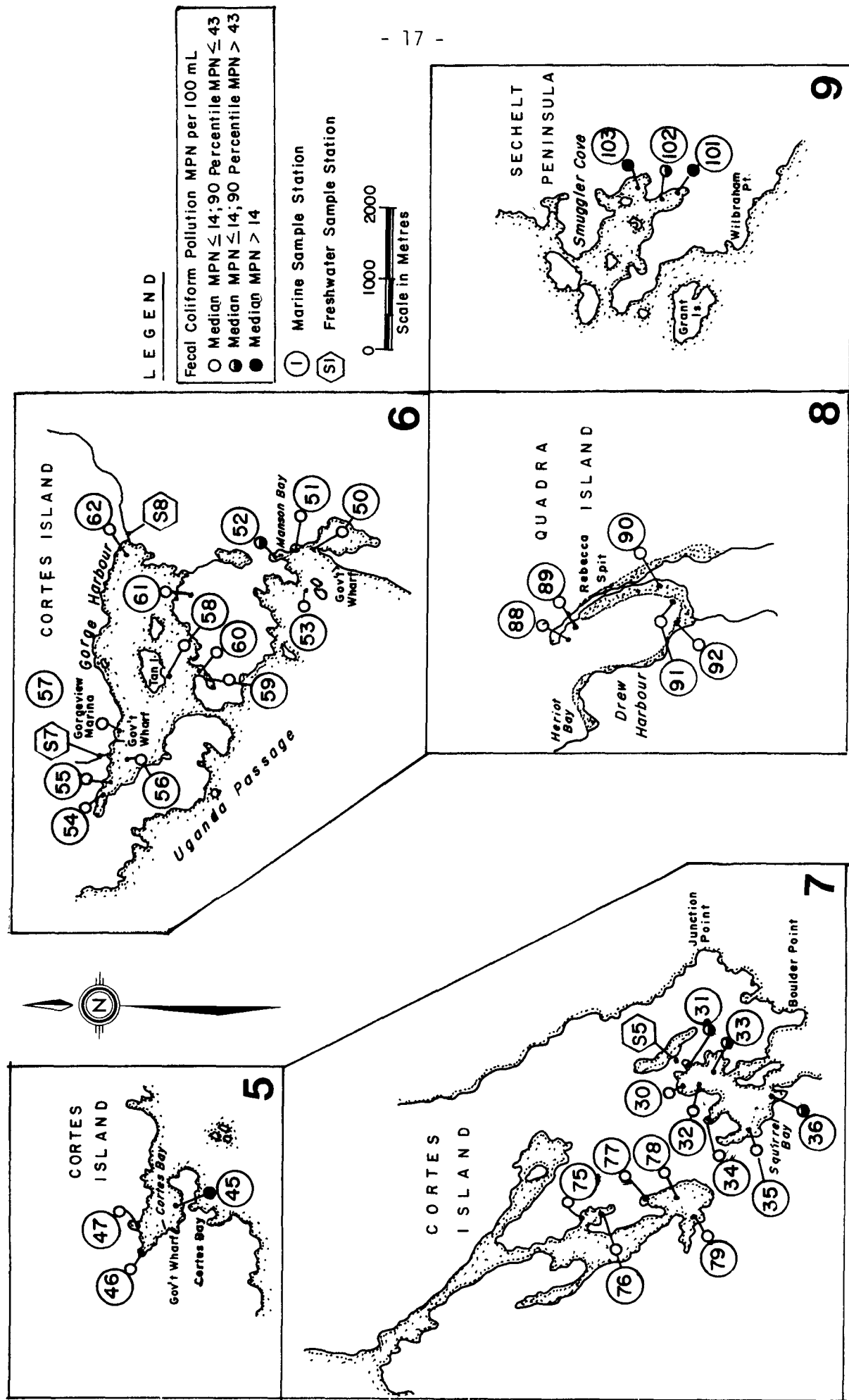


FIGURE 4 STUDY AREAS 5 to 9 ; CORTES BAY, GORGE HARBOUR, MANSON BAY (MANSON'S LANDING); SQUIRREL COVE, VAN DONOP INLET, DREW HARBOUR, AND SMUGGLER COVE

TABLE 4 REGRESSION ANALYSIS OF DATA

AREA	TREATMENT	CORRELATION COEFFICIENT
Areas 1-8	(1) Daily MPN vs Daily boat count	0.02
Areas 1-8	(2) Grouped median MPN vs Area boat count	0.1
Areas 1,7 (Squirrel Cove)	(3) Grouped 90 percentile MPN vs Area boat count	0.05
Area 1 (Prideaux Haven)	(3) Grouped 90 percentile MPN vs Area boat count	0.1
Area 1 (Tenedos Bay)	(3) Grouped 90 percentile MPN vs Area boat count	0.9
Area 1 (Squirrel Cove)	(3) Grouped 90 percentile MPN vs Area boat count	0.06

Explanation of treatments:

- (1) Daily MPN results for each station were regressed against the daily boat count in the immediate vicinity of the station.
- (2) Daily median MPN values for all stations in an area were regressed against the daily total boat count for the area.
- (3) Daily 90 percentile MPN values for all stations in an area were regressed against the daily total boat count for the area.

The boat count data collected during these studies was compared with Furfari's tables of allowable numbers of boats as described previously, and is presented in Table 6. Generally, bacteriological water quality was acceptable in those anchorages which did not exceed the estimated maximum allowable boat count. Prideaux Haven, Allies Island, Roscoe Bay, Squirrel Cove, Cortes Bay and Smuggler Cove all exceeded or came close to the maximum allowable number of boats. These anchorages

TABLE 5 SHELLFISH TISSUE FECAL COLIFORM RESULTS FROM ANCHORAGE AREAS
(C. gigas)

SAMPLE LOCATION	COLLECTION DATE	FECAL COLIFORM MPN/100g	GROWING WATER STATUS ¹
Area 5-47	July 28/80	40	O.K.
Area 7-30	"	1300	O.K.
Area 7-33	"	330	Over
Area 1-4	July 29/80	330	O.K.
Area 1-5	"	1700	O.K.
Area 1-6	"	330	O.K.
Area 3-20	"	1700	Over
Area 9-101	August 25/81	40	Over
102	"	20	Over
103	"	50	Over
101	August 26/81	490	Over
102	"	120	Over
103	"	20	Over
101	August 27/81	20	Over
102	"	330	Over
103	"	490	Over

¹Growing water status in relation to shellfish standard.

TABLE 6: THEORETICAL MAXIMUM ALLOWABLE BOAT COUNTS IN SOME B.C. ANCHORAGE AREAS

Area Description	Mean Depth	Area	Boat Count	
			Max Allowable*	Max Observed
Manson's Landing	9.2m (30ft)	72.6ha (0.3mi ²)	42	17
Drew Harbour	15m (48ft)	181.9ha (0.7mi ²)	224	19
Gorge Harbour	3.7m (12ft)	8.2ha (0.03mi ²)	3	31
Prideaux Haven	13m (43ft)	59.3ha (0.2mi ²)	56	116
Tenedos Bay	55m (180ft)	103.1ha (0.4mi ²)	G112	70
Allies Island	3m (12ft)	4.8ha (0.02mi ²)	L6	8
Roscoe Bay	7m (28ft)	27.0ha (0.1mi ²)	14	16
Squirrel Cove	7.4m (24ft)	101.6ha (0.4mi ²)	60	58
Cortes Bay	7.4m (24ft)	38.4ha (0.4mi ²)	20	42
Von Donop Inlet	7.4m (24ft)	217.9ha (0.8mi ²)	130	24
Grace Harbour	16m (51ft)	65.1ha (0.3mi ²)	60	25
Smuggler Cove	2.7m (8.9ft)	16.9ha (0.07mi ²)	L10	23

* after Furfari (6)

L = "less than"

G = "greater than"

also had the poorest water quality. However, unacceptable fecal pollution was also observed when the number of boats was less than the theoretical maximum pointing out that care must be taken in the use of these tables. One of the difficulties in estimating the allowable number of boats is the accurate determination of dilution water available to the sewage. The anchorage areas and mean depths presented in Table 6 are only approximations and depths will vary significantly within the anchorage.

In addition to the bacteriological sampling program, pleasure vessels in some of the anchorages were interviewed during the 1980 program. The results are summarized in Table 7.

As expected, the majority of vessels surveyed which were not equipped with treatment systems or holding tanks were of Canadian registry (79%) whereas 88% of all American vessels surveyed were equipped with some form of treatment or holding device. In those cases where the vessel was equipped with holding tanks, most vessel operators said they discharged outside the anchorage areas in open waters. A few American boats were unable to empty their holding tanks since the required pump-out facilities were not available.

TABLE 7: SUMMARY OF SMALL CRAFT ANCHORAGE QUESTIONNAIRE

Total number of vessels surveyed	64
Number of vessels with treatment systems ^{1,2}	16
Number of vessels with holding tanks	14
Number of vessels with no treatment or holding tanks	34
Port of registry for vessels with treatment/holding tanks:	
Canada	5
United States	24
Other	1
Port of registry for vessels without treatment/holding tanks:	
Canada	27
United States	3
Other	4
Average number of persons on board	(Range 2-8) 3
Average length of stay in anchorage	(Range 1-28) 2.5 days

¹ 6 of these vessels were also equipped with holding tanks

² includes "Port-a-Potty"

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APPENDIX I

MEMORANDUM

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
PUBLIC HEALTH SERVICE
FOOD AND DRUG ADMINISTRATION

JUN 16 REC'D

RFS

TO : Regional Food and Drug Directors
THROUGH: Chiefs, Special Programs
ATTN: Regional Shellfish Consultants
Regions I, II, III, IV, VI, (X)


DATE: JUN 8 1972

FROM : Director
Division of Shellfish Sanitation (BF-230)

SUBJECT: Classification of Shellfish Waters Subject to Sanitary
Waste Discharges from Boats

1. As you will recall, we solicited your offices, by memorandum of December 20, 1971, for information on State practices regarding the above subject. Replies were reviewed and analyzed by the Northeast Technical Services Unit staff and a summary is enclosed. In addition, a policy statement has been prepared which we believe reflects the intent of the National Shellfish Sanitation Program Manual of Operations.

2. Should there be any further questions on this matter, please let us know.


J. David Clem

Enclosure

SUMMARY

1. Boats must be considered as a source of fresh fecal pollution.
2. The unpredictable aspects of boat or vessel pollution are:
 - a) Variable population
 - b) Mobility
 - c) Intermittent pollution contribution
 - d) Varying modes of treatment ranging from none to holding tanks
 - e) Treatment devices with varying ranges of efficiency which have not been proven or generally accepted
 - f) The epidemiological background of a transitory population contributing fresh fecal pollution is not well defined
3. The Approved Area criterion of 70 Coliform MPN/100 ml does not apply because:
 - a) Unpredictable aspects of boat pollution
 - b) The pathogen to coliform ratio is different in fresh fecal material than in municipal sewage from which the 70 Coliform MPN was derived
 - c) Usual sampling techniques do not apply to fresh fecal material
4. The Manual of Operations of the National Shellfish Sanitation Program clearly states that pollution from boats is a public health problem requiring special consideration for proper classification.
5. Because of the highly variable and unpredictable contribution of fresh fecal material, it is necessary to close areas subject to boat pollution in the vicinity of shellfish beds during the boating season.

POLICY STATEMENT

The National Shellfish Sanitation Program Manual of Operation considers that wastes from boats must be evaluated in the classification of growing areas as sources of fresh fecal pollution. Such areas should not be evaluated by employing the median Coliform 70 MPN per 100 ml criteria for approved growing waters. No bacteriological criteria have been established to evaluate boat discharges because of highly variable indicator to pathogen ratios, freshness of fecal material, lack of dispersion of fecal material in water column, lack of sensitivity for present water sampling methods to detect such random occurrences and poor epidemiological evidence on which to establish reliable guidelines.

It is the intent of the National Shellfish Sanitation Program that waters around marinas, boatyards, and mooring areas be closed to shellfish harvesting during the boating season. The extent and time of the closure will depend upon local conditions such as hydrography, boating population, marine sanitation devices and service facilities, seasonal usage, and location of active and potential shellfish harvest and culturing areas.

INTRODUCTION

Many State shellfish authorities believe that the Manual of Operations of the National Shellfish Sanitation Program (NSSP) does not provide sufficient guidance for classification of shellfish growing waters in and adjacent to marinas and boat haven areas. In response to requests for guidance in classifying such areas, the Division of Shellfish Sanitation has written these National Policy Guidelines for use by State shellfish officials for classifying marina and boat haven areas.

The pollution of shellfish growing waters by boats is discussed in the Manual of Operations, at the 1956, 1968, and 1971 National Workshops, and in numerous reports and conferences on boat pollution around the country. In order to determine the present classification criteria with regard to marinas, the Division of Shellfish Sanitation sent questionnaires through the Regional Shellfish Consultants to twenty of the coastal states which are members of the NSSP. The purpose of the questionnaire was to determine the effects of marinas on shellfish growing waters and the criteria used by each state in determining the effect of a marina.

The responses to the questionnaire indicated that there is no consistency in the classification criteria, that the classification was very subjective, and that a majority of states used the Approved Area criteria. Most states did not classify areas around marinas as either Closed or Conditionally Approved solely because of the presence of the marina. Seven states (37 percent of those responding) considered the presence of marinas as a cause for closure, and then evaluated contiguous waters on their own merits. One state had a few areas closed, but had no hard and

fast criteria for closure. This state established a buffer zone between the marina and growing area based on hydrography and the size of the marina. Eleven states (58 percent) indicated that when the Open Area criteria of less than 70 MPN/100 mls was exceeded, the area around the marina was closed. The other state replied that there was no possibility of having open areas in the vicinity of marinas because of other sources of pollution. Several states noted that the marinas are also subject to other sources of pollution of such magnitude that the pollution contribution from marinas is insignificant in comparison to these other sources.

DEFINITIONS

In the formulation of this National Policy, it was necessary to be concerned only with boats with heads (marine toilets), and to exclude from consideration here boats with holding tanks, holding tank discharge facilities, and other land-based sewage collectors such as clubhouses. These land-based facilities should be evaluated according to accepted established procedures. Some definitions were necessary to insure that this policy will be applied equitably to all areas subject to pollution from boats. The following definitions apply to long and short term dockage in private, semi-public and public areas.

1. Shellfish growing waters are defined as any area capable of sustaining the growth of shellfish. This includes potential transplant or rafting areas as well as existing beds.
2. Marinas are defined as places providing dockage and services for boats.
3. Boatyards are defined as places providing dockage, services and facilities for working on boats.
4. Mooring areas are defined as areas providing recreational anchorage for boats.

Thus, marinas, boatyards and mooring areas are affected by the boat waste disposal problem, and are included in this Policy Statement.

The reason for the special concern for sanitary wastes discharged from boats is that use of the head constitutes a direct discharge of fresh fecal material into the water. The Approved Area criteria of less than 70 coliform MPN/100 mls was based on pollution by municipal sewage and does not apply to fresh fecal pollution for the following reasons:

1. The feces contained in municipal sewage are diluted with wash water, infiltration (ground) water, storm water and industrial process water, whereas, fresh fecal material from boats tends to remain concentrated, protected, localized, and viable.
2. The ratio of pathogenic organisms to indicator organisms is not the same in feces as in municipal sewage, thus, the use of the total coliform count does not present a valid indication of the probable danger to public health.
3. The local public health effects of fecal material discharged from a point source are much more pronounced than the effects of the diluted fecal material in municipal sewage which is widely dispersed and diluted upon discharge into the receiving waters.
4. The difficulty of obtaining high counts where fresh fecal pollution is involved has been widely documented in the literature and is mentioned specifically in the Manual (Part I, page 10).

MANUAL CITATIONS AND INTERPRETATIONS

The following quotations from the Manual of Operations were selected because they dealt specifically with the problem of disposal of sanitary wastes from boats.

Part I

Page 3. "Population Equivalent (Coliform) - This is approximately equal to the per capita per day contribution of coliforms as determined in a metropolitan sewerage system."

Thus, the population equivalent used for computing quantities of adequate dilution water was predicated on metropolitan sewage, not fresh fecal material.

Page 5, Para. 1(a). "It is also recommended that the State have authority to regulate the discharge of sewage, radioactive, and other toxic wastes from boats in the vicinity of approved shellfish growing areas."

This recommendation shows that the NSSP has recognized (the problem) and encouraged positive control of the boat pollution problem.

Page 6. "Examples of changes or developments which have called for revisions of State laws include the wide-scale use of pleasure boats with the resulting probability of contamination of shell-fishing growing areas with fresh fecal material..."

This statement in the Public Health Explanation shows the awareness of NSSP to the "potential" hazards of recent fecal pollution aside from municipal wastes.

Page 10, Para. 1(a). "A comprehensive sanitary survey shall include an evaluation of all sources of actual or potential pollution on the estuary and its tributaries and the distance of such sources from the growing areas;"

By its all inclusive nature, this statement specified that a judgement of the hazard of a harvest area shall include an evaluation of the effects of boat wastes. The only distance involved with boat wastes is depth of water over the shellfish. Time is variable depending on vertical settling rate of particulates and horizontal current velocities.

Page 10, Public Health Explanation. "Investigations made from 1914 to 1925 by the States and the Public Health Service - a period when disease outbreaks attributable to shellfish were more prevalent - indicated that typhoid fever or other enteric disease would not ordinarily be attributed to shellfish harvested from water in which not more than 50 percent of the lcc. portions of water examined were positive for coliforms, *provided the areas were not subject to direct contamination with small amounts of fresh sewage which would not ordinarily be revealed by the bacteriological examination.*"

This statement says essentially that the 70 coliform MPN/100 ml is not to be used universally; that sometimes judgement is necessary and implies that certain instances will arise where the coliform MPN test has to be used discreetly since the test as a sole criteria may give a false sense of security. The crux is "fresh sewage." The indicator organism has lost some of its meaning because the pathogens have not had much time to die off, and small amounts of fresh sewage may not be revealed in the normal water sampling.

Page 10-11. "Water quality criteria (initiated by the States, USPHS, and Shellfish Industry) were then stated as: The area is free from pollution by even small quantities of fresh sewage. The report emphasized that bacteriological examination does not, in itself, offer conclusive proof of the sanitary quality of an area."

Again, small amounts of fresh sewage may not be shown by routine sampling and bacterial analyses.

Page 11. "The purpose of the sanitary survey is to identify and evaluate those factors influencing the sanitary quality of a growing area and which may include sources of pollution, potential or actual;...Sources of pollution include...discharges from pleasure craft, fishing boats, naval vessels, and merchant shipping."

This statement elaborating on the part of Para. 1(a) quoted above, specifically mentions boats as sources of pollution which should be evaluated in a sanitary survey.

Page 13. Public Health Explanation. "Chance contamination of a growing or wet storage area by fresh fecal material which may not be diffused throughout the entire area and therefore not readily detectable by ordinary bacteriological procedures."

"It is well established that shellfish from water having a median coliform MPN not exceeding 70 per 100 ml *and which is also protected against chance contamination with fecal material*, will not be involved in the spread of disease which can be attributed to initial contamination of the shellfish."

Page 15. "Areas which are approved for direct market harvesting of shellfish which will be eaten raw must necessarily meet one general test; i.e., sewage reaching the growing area must be so treated, diluted, or aged that it will be of negligible public health significance. This implies an element of time and distance to permit the mixing of the sewage or fecal material with the very large volume of diluting water and for a major portion of the microorganisms to die out."

Again, the only distance involved with boat discharges is the water depth, and the time involved is the sedimentation time.

"In other cases the sanitary quality of an area may be effected (sic) by seasonal population, or sporadic use of a dock or harbor facility. Such areas may be classified as *conditionally approved*."

Docking areas are considered significant enough to warrant conditional closure of an area when the dock or harbor facility is in use.

Page 16-17. Public Health Explanation. "A protected harbor in a sparsely settled area might provide anchorage for a fishing fleet several months of a year. When the fishing fleet is in, the harbor water would be of poor sanitary quality; however, during the remainder of the year the quality of the harbor water might be satisfactory. The area would be approved for shellfish harvesting only when the fishing fleet is not using the harbor."

This part of the explanation of a Conditionally Approved area could refer to human wastes derived from the boats as well as the accompanying population increase on shore. In either event it provides a means of coping with seasonal pollution from boats.

Page 17, c. "Potential sources of pollution include the following:

4. Other sources of pollution.
 - (a) Sewage from merchant or naval vessels.
 - (b) Sewage from recreation use of area."

Sewage discharges from boats are a potential source of pollution which must be considered in the establishment of a Conditionally Approved area.

Page 19, Public Health Explanation. "Therefore areas containing dangerous concentrations of microorganisms of fecal origin or areas which may be slightly contaminated with fresh fecal discharges, should not be approved as a source of shellfish for direct marketing."

This statement, and those previously quoted, indicate that where there is a chance that an area may be contaminated by fresh fecal material, the area must be classified on a judgmental basis with

emphasis on the potential of chance contamination of shellfish by discharge from boats. Since small boats can go almost anywhere, nearly all populous areas must be surveyed with boats in mind.

However, so far as boats are concerned, an area can be classified in any of the four program classifications; i.e., Approved, Conditionally Approved, Restricted or Prohibited. This depends on numbers of boats, laws and enforcement capability and sometimes season. If boats cannot be kept out, then cessation of shellfishing for direct market or shellfish purification are some of the alternatives.

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