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FISHERIES RESEARCH BOARD OF CANADA

MANUSCRIPT REPORT SERIES

No. 1289

The Vanlene Oil Spill

by

D. B. Quayle

Pacific Biological Station, Nanaimo, B.C.

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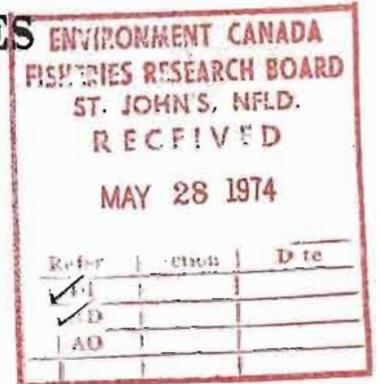
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INTRODUCTION

On the evening of March 14, 1972, the 8,500 ton Panamanian motor vessel "Vanlene" ran aground on a reef close to Austin Island (Fig. 1) in the Broken Group of islands in Barkley Sound adjacent to Imperial Eagle Channel (48°51.6'N 125°18.6'W).

At the time of grounding the bunker "B" fuel content of the ship was estimated to be 400 tons (2,666 bbl. or 112,000 U.S. gallons).

The weather at the time of grounding, and for some time after, was overcast with rain and with southeast winds varying between 15 and 30 knots. This resulted in the oil from the punctured tanks being driven toward the outer islands of the Broken Group.

It is doubtful if an accurate estimate of either the amount of oil spilled or the amount remaining in the hull has been made.

Among other scientific groups the Fisheries Research Board was requested to investigate the consequences of the spill on marine life, particularly that part of economic importance.

Eight visits were made to the scene, relative to the effect of oil spill on invertebrate fauna, between March 17, 1972 and November 6, 1973. Reports have been issued on five of these and the purpose here is to bring the separate reports together and to indicate the general conclusions of the study.

It should be emphasized that the studies were not quantitative or extremely detailed in nature as there was neither the time nor the manpower available to do this. It is doubtful if greater effort would have added materially to the validity of the conclusions.

An important factor was that the investigator had been well acquainted with the specific area for many years as a site for faunal and paralytic shellfish poison studies and a fairly extensive abalone investigation on Bauke, Cooper and Gilbert islands.

THE OIL SPILL

This was a comparatively small oil spill, but if it had all landed on a single confined area of shore the effect may have been quite serious. As it was, a considerable amount, likely most, of the oil was driven out to sea judging from the relatively small amounts found in Barkley Sound. Also, the oil was not uniformly distributed on nearby shores; rather it was quite spotty in its distribution. For instance, no significant amounts landed on Effingham Island, one of the larger islands and only a few hundred yards from the wreck.

The parts of the Broken Group affected by the oil were those islands bounded on the north by Thiepval and Coaster channels, on the west by Loudon Channel, on the east by Imperial Eagle Channel and on the south by the open Pacific. Of the approximately 20 miles of shoreline within this area, oil

occurred on little more than a total of half a mile of beach on only six of the approximately 25 islands.

Photographs are on file (33-9-1) at the Pacific Biological Station, Nanaimo.

CONCLUSIONS

1. In general, there was no significant effect on the invertebrate fauna and flora of the Broken Islands Group from this oil spill. The diversity and abundance of species at various tidal levels have shown no major observable change over the period of the investigation. Nor did the spill significantly mar the aesthetic qualities of the region for long. Without close examination it would now be difficult to locate most sites where the oil was originally deposited. There was an original marginal clean-up with peat moss on one or two beaches.

2. A significant feature of the "Vanlene" spill (and this also applied to the Nanoose Bay spill of March 9, 1972 and in large measure to the "Irish Stardust" spill at Alert Bay) was that the heavy concentration of oil was finally deposited and remained at or near the high-tide mark. This apparently occurred regardless of the tidal conditions at the time. Consequently the effects on the intertidal organisms were largely mitigated except for those at the higher tide levels such as barnacles, littorines and acmeids. At worst the lower tidal organisms were subject to only a fine film of oil.

3. Most intertidal organisms were able to successfully withstand light oil coverings and some species, such as barnacles, were able to survive quite heavy coatings.

4. Whatever slight damage that occurred in this instance was due to the effects of heavy oil cover such as on the thaid gastropods rather than toxic chemical effects.

5. There was some apprehension that the effects of the oil during the spring and summer of 1972 would affect the settlement of intertidal plant and animal organisms and this might become evident particularly in 1973. Observations indicated this did not occur.

ACKNOWLEDGMENTS

Appreciation is expressed to Mr. P. Harrison, Fisheries Service, Port Alberni and to Captain J. Thompson and crew of the F.P.V. "Comox Post" for co-operation and assistance during this study.

A D D E N D U M

FIRST REPORT - MARCH 17, 1972

March 17 - To Victoria to join C.G.S. "Vector" which departed 1900 hours for Barkley Sound.

March 18 - Arrived Mayne Bay - unfortunately 8 miles from scene of the wreck.

Proceeded by Boston whaler to Austin Island, examining beaches on the way and noting signs of oil.

At Hand Island (chart location no. 1) about 6 miles from Austin Island there was no sign of oil.

At the eastern tip of Turret Island (2) (Thiepval Channel) there was a fine film of oil on the surface of the water. There was no visible sign of oil on shore and the invertebrate animals appeared normal.

At Effingham anchorage (3) 1.5 nautical miles by sea from the wreck there was a visible skim of light oil on the surface. The only signs of bunker oil were observed in small quantities in convergences. A sample of clams was dug here and there was no sign of oil penetration into the sand. Animal life appeared normal.

In the small passage between Gilbert Island and Effingham Island (10) a thin oil slick about 2 feet wide occurred at the half-tide level. The California sea mussel (Mytilus californianus) on Gilbert Island contained no odor of oil.

The wrecked ship was circled and there was generally a thin skim of oil with thicker patches of bunker oil in the convergences but there were no extensive areas.

The heaviest concentration of oil (not bunker) observed on the shore of Austin Island was in the passage between Austin Island and Effingham Island (4). The shore crabs (Hemigrapsus nudus) and the porcelain crab (Petrolisthes) were as active as usual although the carapaces appeared to be covered with a thin film of oil. The black tegula (Tegula funebris) appeared unaffected as were all species of Thais. The chiton (Katharina tunicata) was still clinging tightly to the rocks as usual and the green anemone (Anthopleura xanthogrammica) reacted to stimulus. The acmeas (Collisella pelta, Notoacmaea persona and N. scutum) were all attached to the rocks as usual. The only specimen that could have been affected was a young leather star (Dermasterias imbricata).

The oil in this area was concentrated on the shore from near zero to about the half-tide level.

On Dicebox Island (5) with a sand gravel beach perhaps 25 yards in length there were small patches of brown crude oil amounting in total to about 50 square feet at or near the high-tide level. This oil was thick and viscous in some spots about 1/2 inch thick. On the surrounding rocks the littorines and Collisella digitalis appeared unaffected.

On an unnamed island north of Batley Island (6) about 2 miles northwest of the wreck a clean shell beach with granite rocks above showed no sign of oil.

A small sand cove at the southeast end of Turret Island (7) was perfectly clean as was the beach on the western end of Wiebe Island (8).

On March 19, after a strong southeast gale during the night, Hand Island (1) was re-examined and found to be uncontaminated as was the bay on the west side of Jacques Island (9).

The "Vector" departed Mayne Bay at 0900 March 19 for Victoria, arriving there 1900 hours.

The conclusion is that the oil from this wreck has not become widely distributed and its main effects are confined to the Effingham, Gilbert, Cooper, Wouwer, Howell and Austin islands complex. There is no indication of significant problems north of Coaster Channel.

The amount of bunker oil observed was small and most of the oil seen consisted of thin slicks either floating or in the mid-intertidal area on the shores.

The invertebrate macro-fauna at the sites examined indicated no significant damage at this time but this could alter when the stress from the contamination has had time to operate.

There has undoubtedly been some effect on the micro-fauna and possibly on newly settled algae.

Further studies on the next low tide period will be made in early April.

A telephone discussion with Dr. W. Austin of Simon Fraser University on March 20 indicated he is studying the effect of the oil spill on intertidal fauna and he chose the most contaminated area he could find which is a small area on the southwest side of Austin Island close to the wreck. He has indicated there are mortalities in certain invertebrate groups such as the small shore crabs and the rock-face gastropods. This is a continuing study with uncontaminated control areas on the Deer Island Group.

SECOND REPORT - APRIL 4, 1972

April 4 - Proceeded to Port Alberni and from there to Ucluelet on the "Caligus".

April 5 - Stormbound in Ucluelet.

April 6 - Under adverse weather conditions dropped by the "Caligus" in the Boston whaler off Gilbert Island and several beaches in the area of the wreck were examined. There were still fine oil slicks in the Cooper-Bauke-Effingham island complex.

The clam beach at Effingham Island anchorage (Station 3) showed no signs of oil on the surface but small quantities had penetrated the sand since a fine film of oil appeared on the water surface after the sand was turned over. However, all clams were alive (Mya arenaria, Venerupis japonica, Protothaca staminea, Saxidomus giganteus and Cryptomya californica) as were the mud shrimps Callinassa californiansis and Upogebia pugettensis. The polychaete Glycera robusta was also alive and active. There was no evidence of oil on the rocks.

The shingle beach on the south side of Cooper Island (Station 11) facing the wreck area was quite heavily larded with sticky brown or black oil up to 1/4 or 1/2 inch thick at the higher levels particularly on the logs. No limpets (Collisella persona) typical of the shaded high-tide rocky areas occurring here were found. In the tide pools at about half-tide level the anemone (Anthopleura elegantissima) and the shore crab (Hemigrapsus oregonensis) were active as were the tide pool cottids. The sea mussel (Mytilus californianus) also at about the half-tide level had an evident covering of oil but were living. The Fucus did not appear to be quite normal. However, the oiled area covered no more than about 100 yards on this shore. A more detailed examination and photographs were impossible for the need to leave the shore buffeted by a 25 knot onshore breeze.

The shore on Austin Island (Station 4) was examined briefly. There was much more oil than on the last visit and there were now quite numerous blobs (6 inch diameter) of the brown bunker "B" oil. As on the first visit the shore crabs particularly were covered with a thin film of oil but they (Hemigrapsus nudus and Petrolisthes cinctipes) were as active as ever and there were no dead animals. The nudibranch (Anisodoris nobilis), the gastropods (Thais lamellosa, T. emarginata and Tegula funebris), the anemone (Anthopleura xanthogrammica) and the limpets (Notoacmaea scutum and Notoacmaea persona) all appeared quite normal.

On the way to rejoin the "Caligus" stops were made at Stations 1 and 9 where again there was no sign of oil.

April 7 - The weather was still stormy and a landing was made at Cooper Island (Station 11) with difficulty and photographs taken. Much more surface oil was observed than on the previous day in the area between Cooper and Bauke islands. The remainder of the day was taken up with herring studies and return to Nanaimo.

The conclusion from this rather unsatisfactory survey is that oil is still being released from the wreck but its distribution remains quite localized. So far there appears to be no major mortalities of the intertidal macro-invertebrates.

The Bamfield side of the Sound has still not been examined but this will be done at the earliest opportunity.

THIRD REPORT - APRIL 17, 1972

By courtesy of the Fisheries Service, the F.P.V. "Comox Post" was made available for the period April 17 to 20 to re-examine the effects of the oil spill. The weather was generally good and landings were made at all desired spots. Facilities were available on the "Comox Post" for microscope work.

Shoreline Examination

Most of the northwest shore of the Deer Group of islands was examined as was the shore from Bamfield to Nanat Island. There was no sign of oil despite reports of sightings of floating oil fairly well up Imperial Eagle Channel. It may be concluded from this survey, and supported by information from Dr. Austin of Simon Fraser, in addition to lack of reports from fishermen, that the shoreline of Barkley Sound southeast of Imperial Eagle Channel is clear of oil.

The only area of the northwest shore of the Sound bordering Loudon Channel not previously examined by Mr. Outram or the Department of Fisheries, was the Twin Rivers beach about 5 miles up the channel from Ucluelet. From sightings of floating oil soon after the wreck, it was feared this area may have been affected. Weather made it possible to land on this beach which was walked between the fishery signs. There was no sign of oil and herring eggs on the cast-up eel grass indicated there had been a spawning at or near the area.

All of the islands southwest of Thiepvai Channel were examined in some detail and the areas of oil deposition reasonably well delineated and shown to be confined to the island group south of Coaster Channel. This survey largely confirmed the previous descriptions of the distribution of oil and is supported by Dr. Austin's findings.

Reports from fishermen indicate that considerable quantities of oil were dispersed seaward. The "Comox Post" reported picking up an oil-stained life-ring from the "Vanlene" off Nuchatlitz Inlet, about 100 miles up the west coast of Vancouver Island, 11 days after the wreck.

Affected Areas

The sites in Table 1 showed a concentration of oil where, in the context of this particular spill, the deposition might be considered heavy. These were very localized and outside these specific sites there was no apparent evidence of oil.

Table 1. Oil Spill Sites.

Site	Station	Density	Approximate distance of shoreline affected (in yards)
Austin Island (SE shore)	16	Heavy	50
Austin Island (NE shore)	4	Medium	50
Bauke Island (W shore)	14	Heavy	300
Howell Island (E shore)	13	Heavy	200
Gilbert Island (SE shore)	12	Heavy	100
Cooper Island (SE shore)	11	Heavy	300
Benson Island (E shore)	15	Medium	50
			1050

At Dicebox Island (Station 5) and in the passage between Gilbert and Effingham (Station 10) which were sites previously having small amounts of oil, there is now virtually none left.

At Benson Island the oil is concentrated on the logs and rocks near the high-tide level and there is no slick affecting the lower tidal levels. At the other sites the oil is concentrated enough to maintain a thin slick down to 2 or 3 feet above zero tide level. Much of the fauna and flora is covered with this slick and it is particularly evident on the rock-weed (Fucus). There is usually a fine slick on the water in the immediate vicinity of these beaches.

The beaches with sand contain oil to a considerable depth but in these cases there is virtually no infauna because of the coarse nature of the sand.

The oil on the logs and rocks at Cooper Island on the April 6 examination was brown in colour; now it is black as are all the others except at Howell Island (Station 13) where it is brown. Bunker "B" oil is apparently black and turns brown when emulsified and black again when weathered.

As indicated in Table 1, the total length of beach with oil is approximately 1000 yards and 300 yards is the greatest extent at any one site.

While spills were observed coming from the vessel on the previous two visits in stormy weather, none was observed on this occasion when relatively calm conditions prevailed.

Fauna

While the main concern here is the marine resources, these are in part dependent on the existence of the eco-system as a whole, so the minor constituents of the biota cannot be neglected. Indeed some of these are more sensitive indicators of the well-being of an environment than the species of economic importance. Most of the intertidal faunal forms were examined but there is little purpose in listing them all in this report.

The invertebrate resources, of present or potential commercial importance in the area, consist of clams, oysters, mussels, urchins, cucumbers and winkles. None of these shows any indication of harm up to the present time; now over 1 month since the original spills.

No major, or even what could be termed minor mortalities are evident in representative sponges, hydroids, polyclads (including larvae), nemerteans, nematodes, sipunculids, bryozoans, polychaetes (including minute forms such as Spirorbis), cucumbers, sea stars, urchins, crustaceans including harpacticoid copepods, shrimp-like forms, brachyuran and anomuran crabs and barnacles, prosobranchs, nudibranchs, amphineurans, tunicates and blenny fish such as Epigeichthys and the cling fish Gobiosox. Most of these were, however, just above zero tide level so both the cover by and exposure to oil would be minimal. The organisms living at higher tide levels such as the gastropods (Tegula), littorines (Littorina), the thalassidroms (Thais lemelloso and T. emarginata), and the shore crab (Hemigrapsus) occur in the zone where the concentration of oil is higher than at the low-tide levels. Here again they appear to be not affected. Dr. Austin has indicated some of the gastropods (Thais) were physically moved off the rocks at Station 16 by the sheer weight of the oil and they could have been so smothered that mortality would ensue.

Having visited the Bauke Island site (Station 14) fairly frequently during the last 20 years there is a general impression that all is not well, although it is difficult to pinpoint a specific reason.

Samples of butter clams, softshell clams and sea mussels from contaminated areas have been sent to the West Water Quality Subdivision of Environment Canada at Calgary for oil analyses.

Flora

Since Fucus is generally the dominant intertidal alga, it is the form visibly most contaminated with oil. At the present time it appears to be not affected. Others such as Lithophyllum, Bossiella, Delesseria and Gigartina have the appearance from discoloration of being affected but this is difficult to determine since it is possible to find some also discolored specimens in uncontaminated areas.

Summary

1. As a result of the spillage from the wreck of the "Vanlene" on Austin Island, oil in some quantity occurs on seven beaches at quite widely separated sites on six different islands in the Broken Group in central and outer Barkley Sound.

2. In the context of this spill, oil on five beaches may be said to be heavy and medium on two. The oil is almost entirely concentrated at these sites, the one exception is a narrow band about 6 to 12 inches wide, about 100 yards in length just below the high-tide level on the west shore of Bauke Island.

3. In terms of oil spills generally, relative to those that have occurred elsewhere and those which might occur in similar circumstances, this may be considered a light, minor spill, both in respect to the amount of oil lost and deposited on the beaches and on the effect on marine life.

4. Oil has been spilling from the ship off and on in variable amounts since time of the wreck.

5. The effect on marine life during the period of a month after the spill appears minimal at this time. There have undoubtedly been minor mortalities although they are not apparent among the macrofauna. Probably the greatest effect may result from the prevention of settlement of this year's crop larval forms and algal spores. However, the loss of one generation over the length of contaminated shoreline should not have a serious long-term effect on the fauna and flora of the general area.

6. Observations should be continued for at least a full year.

FOURTH REPORT - JULY 6, 1972

Again, by courtesy of the Fisheries Service, the F.P.V. "Comox Post" was made available on July 6 and 7 to make a brief examination of a few stations to determine whether there were changes significant enough to warrant a more detailed study at this time. It was found that, although there were reports of continued leakage of oil from the "Vanlene", the shores in the immediate vicinity of the wreck are not being significantly re-contaminated. The species most seriously affected to this time is the rockweed (Fucus). The oil is showing signs of weathering.

Photographs are on file at this Station.

A further more detailed study is planned for late August.

Austin Island (Station 16)

About 500 square yards of yellow emulsified oil was floating near the shore.

The appearance of the oil on the drift logs was little changed from that of the last visit. Barnacles (Balanus glandula) were heavily oiled in spots but were still living. The limpets (Collisella) and the gastropod (Tegula) at the lower tidal levels were alive and active. Sea star abundance was normal. Other than the floating material, there were no signs of fresh oil in this area.

Bauke Island (Station 14)

In this area there were indications of fresh releases of oil evidenced by its occurrence and appearance on small pieces of driftwood cast ashore well below the high-tide level. There were still thin skims of oil in most tide pools, but the usual inhabitants (hermit crabs, shore crabs, anemones and cottid fish) were present and lively. The green alga (Enteromorpha) was growing normally in its usual habitats.

There was significant mortality in the upper part of its range of the rockweed (Fucus) which on previous visits had been quite heavily coated with oil. At the lower tidal levels this species was flourishing as usual.

None of the larger kelps such as Egregia, Nereocystis or Macrocystis was affected, nor were such species as Halosaccion and Leathisia in the mid to lower tidal levels.

Gilbert Island (Station 12)

Here there was a suspicion of new oil but the original material showed signs of weathering. There was good barnacle survival on the oiled rocks. At this station the oil had reached the Distillicus? (Spartina-like grass) above the high-tide level.

Cooper Island (Station 11)

Here there was a 3 to 4 foot wide strip of new oil about 25 yards long 75 yards east of the gravel beach just above mid-tide level.

The 1972 barnacle set was fairly heavy. The rockweed was dead in some spots at the higher tide levels as at Bauke Island.

The oil exposed to sea water was showing signs of weathering, becoming dull in appearance and no longer sticky to the touch. At very high levels where the oil is seldom reached by sea water, the surface sheen was dull but the oil still sticky.

The tide-pool situation was normal, but there was somewhat more than usual mussel (Mytilus californianus) mortality in areas where the oil cover had been quite heavy and had now disappeared.

FIFTH REPORT - AUGUST 31, 1972

Once again by courtesy of the Fisheries Service, the F.P.V. "Comox Post" was made available on August 31 and September 1 to make a final daylight examination for this year of most of the stations previously examined in this study.

Station 4 - Austin Island

There appears to have been no significant additional oil deposited anywhere on Austin Island despite its proximity to the wreck. A small quantity of Fucus at the Station 4 site is affected, some of it covered with oil which still remains tacky to the touch. Barnacles at higher levels are covered with dried oil but the animals are living.

Station 5 - Dicebox Island

Except for a few spots of oil on barnacles this island is now quite clean.

Station 6 - Island 240 north of Batley Island

This island, clean originally, has remained so.

Station 7 - Southeast tip of Turret Island

This area has remained clean.

Station 8 - Wiebe Island

This area has remained clean.

Station 10 - Passage between Gilbert and Effingham islands

This area is now clean.

Station 11 - Cooper Island

The south shore of this island continues to be the area with the densest concentration of oil. The logs and rocks are covered with old oil now largely dried, for a distance of about 200 yards. There is also indication of two new, though small (50 square yards) deposits of oil on the rocks just below the log line, indicating oil is still being released from the vessel. In this connection there was a thin oil slick covering about 3 acres between Dicebox and Cooper islands. The new oil is above the level of the barnacle zone so the only animal affected would be littorines, in this area, mainly Littorina scutulata.

Station 12 - Gilbert Island

The situation here remains unchanged from the previous visit.

Station 13 - Howell Island

The oil at this station is drying up well except for the deposits deep between the large boulders. There is no sign of new oil.

Station 14 - Bauke Island

The oil here is also drying up and the shore life appears normal except for small patches of dead Fucus. There is no sign of new oil and there are no longer oil films on the water surface of the tide pools.

Station 15 - Benson Island

There has been no change here.

Station 16 - Austin Island

There has been no observable change here.

George Fraser Islands

Good weather permitted an examination of this area near the entrance to Ucluelet Inlet for the first time. There was evidence of oil from the initial spill on four small beaches on the east side of the islands and one of them contained about 10 square yards of new oil with blobs of it (black) floating in small tide pools. The tide was relatively high at the time of the visit so it was not possible to examine possible effects on shore life. The kelps in the area were quite abundant and appeared in good condition.

Chrow Islands

There was a small amount of old oil deep in the rock crevices high on the beach on the south side of the channel between the two islands. There was no evidence of new oil.

Beg and Food Islets

This area between and around these islands east of the entrance of Ucluelet Harbour was examined with no sign of oil.

Coaster Channel

A traverse was made by small boat throughout the Broken Group Islands south of Coaster Channel and along the northern shore of Coaster Channel from Benson Island past Clarke, Owens, Lovett, Trickett, Turret and Turtle islands. The previously listed areas were the only ones with oil presently showing.

Summary

The old oil is weathering and presumably becoming less of a hazard to marine life. Oil is still being released from the ship and small quantities are being deposited on the beaches of some islands in outer Barkley Sound. The amount of oil observed is so small it is unlikely to cause appreciable damage to shore life.

Appreciation is expressed to Mr. P. Harrison, Mr. E. Kasmer of the Fisheries Service, Port Alberni and Captain J. Thompson and crew of the F.P.V. "Comox Post" for the excellent co-operation and assistance given during these surveys.

SIXTH REPORT - APRIL 10, 1973

Again by courtesy of the Fisheries Service the F.P.V. "Comox Post" was made available for the period April 10 to 11 to examine the oil spill situation after approximately 1 year. During the winter the vessel had broken into two parts.

Austin Island

Station 16: All oil remaining had hardened into a thin firm layer. The driftwood was still stained but showed little or no free oil.

Station 4: There was no evidence of free oil at this station.

Bauke Island

There was still sign of oil in the flat areas with broken rock but the beach was largely clear. Both Fucus and Enteromorpha appeared in normal abundance as did the barnacles, littorines and tegulas.

Howell Island

It was difficult to find traces of oil at this once quite heavily coated area.

Cooper Island

Largely clean in comparison to the original situation. The flat boulder area south of the cave still showed hardened oil between the cobbles and there were small floating blobs in the tide pools indicating a probable new deposition.

Gilbert Island

Generally clear except for the sedge grass just about high-tide level.

SEVENTH REPORT - AUGUST 24, 1973

A brief examination was made of the major sites of oil deposits (Stations 16, 4, 14, 13, 11).

All stations were either as before or somewhat improved except for signs of a small fairly new deposit on Cooper Island (Station 11) on the flat rocks east of the gravel beach. This is quite high beyond the habitat of any marine organisms. The rock face near the small cave above the gravel beach at this station, originally heavily covered with oil, is now virtually clean, presumably due to weathering and wave action.

It is now a year and a half since the original spill and there have been two reproductive seasons for the fauna and flora. Settlement of all major species appears normal. The oil is either well weathered or has disappeared.

EIGHTH REPORT - NOVEMBER 6, 1973

The F.P.V. "Comox Post" was again made available for this final examination.

There was a light skim of floating oil covering several acres between Howell and Cooper islands indicating some oil was still being released from the "Vanlene" whose after portion appeared to be deeper in the water.

The soft oil at Cooper Island observed in August has now dried up and is well weathered. Except for this Station (11) and Station 16 there is little evidence that an oil spill had occurred in the area.

