COMMITTEE REPORT

SENATE

**Judiciary

4/27/77

[illegible] Date

Mr. President:

The Committee on RESOURCES has had CSHB 137 (Jud) am civil penalties for discharges of oil under consideration. A majority of the members of the Committee

/_7 recommends it do pass

/_7 recommends it do not pass

/_7 recommends it do pass with attached amendment(s)

/X7 recommends it be replaced with SCS for CSHB 137 and that SCS for [illegible] ~~do pass~~ [illegible]

/_7 (and) recommends it be referred to the ______ committee

/_7 reports it back without recommendation

/_7 AND attaches a report of its intent

/_7 (other) ______

MEMBERS SIGNING THE MAJORITY REPORT:

[illegible signatures]

MEMBERS NOT CONCURRING IN THE MAJORITY REPORT:

______ recommends: ______

______ recommends: ______

______ recommends: ______

[illegible signature]
Chairman

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Field studies show oil production and environment remain compatible

EDWARD W. MERTENS
Chevron Research Co.
Richmond, Calif.

EXTENSIVE field studies on the effects of chronic low-level exposure of marine life to oil show:

- Low-level chronic exposure to crude oil has, at most, negligible effect on marine life.
- Platforms provide a structure whereby a thriving, highly complex community of marine life can develop.

Supporting data have been obtained from field studies conducted at Santa Barbara, Calif.; Lake Maracaibo, Venezuela; Bermuda; and Timbalier Bay, La., in the Gulf of Mexico.

No measurable effects have been observed on such indicators of the health of the local marine communities as population levels of various organisms, species diversity, and size, growth rate, or reproducibility of various organisms.

Moreover, there is no evidence of adverse effects such as abnormal growths and biomagnification of petroleum fractions in the food chain.

Available information. Surprisingly, the volume of literature concerning the effects of oil on marine life is extensive. Several comprehensive summaries of the literature have been published.[1 2 3 4] Whether one reviews the literature directly or the summaries that are available, it is apparent that most of the published work concerns laboratory work. Only a few field studies have been conducted.

Laboratory work has proven generally unsatisfactory because its results correlate poorly with field observations. Fortunately, in recent years, some work has been directed toward investigating the effects of chronic exposure of oil on marine life under field conditions. Results of field studies are summarized in Table 1.

Table 1

Conclusions of field studies of oil's impact on marine life

NATURAL OIL SEEPS, SANTA BARBARA:

All organisms are present that would be expected to be in that environment if oil seepage were not there.

Exposure to the natural oil seepage has no effect on either the growth rate or reproductivity of the resident organisms.

No abnormal growths in organisms were observable either by external examination or by dissection.

There is no evidence of bioaccumulation (increase in concentration) of hydrocarbons by transfer up the food chain.

TAR BALLS, BERMUDA:[9]

There is no measurable effect of tar influx on the number of organisms of any species at any locality.

All species identified as native to Bermuda shores prior to the tar-ball influx still remain.

Exposure to the tar influx has no effect upon the reproductivity of the organisms.

Size of organisms is not affected by the exposure to tar influx.

LAKE MARACAIBO, VENEZUELA:

Despite significant discharges of oil into Lake Maracaibo from production of oil and from natural seeps, both laboratory and field data show that the presence of oil has caused no discernible damage to the local ecosystem.

Although low concentrations of oil exist in the lake water, there is no evidence of a buildup of hydrocarbons in selected commercial species of fish or shrimp.

Although fisheries data are limited, no evidence exists that suggests this important renewable resource has yet been diminished.

However, discharge of nonpetroleum wastes, both domestic and industrial, are approaching such levels as to impair water quality. The biological resources of the lake may decline in future years.

TIMBALIER BAY, GULF OF MEXICO:[12 13 14]

Seasonal changes, especially in temperature and salinity, have a far more significant effect on species diversity of marine life and on the population of a given species than does the presence of low-level concentrations of oil.

Even the effects of other less-important natural phenomena, such as floods, upwellings, and turbidity, affect the ecosystem markedly. Their influences completely obliterate whatever effect, if any, results from exposure to oil.

No known biological hazard could be related to any compound or material used in drilling and production.

Timbalier Bay has not undergone significant ecological change. Every indication of good ecological health is present.

Evidently, the platforms have increased the total quantity of marine life. These structures provide surfaces where planktonic larvae of organisms such as barnacles, mussels, sea anemones, and others forms of sessile marine life may settle and flourish to become highly productive, complex communities.

OFFSHORE PLATFORMS, SANTA BARBARA CHANNEL:[16]

A highly complex community has developed under each platform. Communities on either the soft or hard bottom control areas are far less complex and far less abundant.

The pelagic fish population inhabiting the area under the platforms is estimated to be 20,000-30,000 per platform.

Positively identified are at least 50 species of fish, 110 species of invertebrates living on or near the structures, and 77 species of worms inhabiting the nearby sediments.

All sea life appears to be extremely healthy. Mussels 8-10 in. in length are numerous; larger ones have been observed.

Every available underwater surface of the platforms is heavily encrusted with mussels, barnacles, aggregate anemones, or other types of sessile sea life.

Drill cuttings were deposited at the base of the platform. Being sterile, they did not support marine life for 2 to 3 years after the platforms were constructed. Today this pile is covered by a depth of 37 in. of shells and now supports a teeming community of seastars, anemones, nudibranchos, and other benthic organisms.

Santa Barbara seeps. D. Straughan and her associates at the University of Southern California recently concluded a 3-year study concerning the sublethal effects of natural chronic exposure of oil to marine life. Her laboratory was the marine waters at Coal Oil Point near Santa Barbara where natural oil seeps have been known to exist for centuries. The natural seepage there is 50-100 b/d.[5]

Extensive control data were obtained from studies conducted at Pismo Beach (north of Santa Barbara), Gull Island (near Santa Barbara), and Santa Catalina Island

Paper presented at Symposium "Sources, Effects & Sinks of Hydrocarbons in the Marine Environment," American Univ., Washington, D.C., August 1976.

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(near Los Angeles).

Tar balls, Bermuda. A relatively recent phenomenon is the influx of tar balls washing ashore along the Bermuda coastline.[7,8] The Bermuda Biological Station for Research has just concluded a 2-year study to determine whether the influx of tar balls was having any effect upon the local intertidal life.

Control data were obtained by studying beaches that were slightly impacted. Also used were the extensive base-line data developed by annual studies extending back to the 1890's.

These results provide an insight into the potential threat of offshore spills washing ashore to intertidal life. This is especially valid for spills, if they should occur, from platforms in areas 50 or more miles offshore in outer-continental shelf waters.

Such potential production areas exist along the Atlantic Coast. The weathered oil that would wash ashore would be similar in composition and properties to the tar balls appearing on the Bermuda beaches.

Lake Maracaibo. A 3-year study was completed in 1974 by Battelle-Northwest Laboratories (Richland, Wash.) on the impact of offshore production in Lake Maracaibo, Venezuela. Approximately 6,500 wells have been drilled in this lake over a period spanning 4 decades.

Sites in those sections of the lake where oil production does not occur were also studied to obtain control data.

Timbalier Bay. The Gulf Universities Research Consortium (GURC) studied the impact of offshore drilling and production of oil on the estuarine and marine environment in the coastal waters of Louisiana, specifically, in Timbalier Bay.

The study involved 23 principal scientists from the 20 Gulf Coast universities that comprise GURC. Conducted over a period of 2 years, 1972-74, and at a cost of $1.5 million, this study is undoubtedly the most comprehensive study concerning the effects of chronic exposure of oil to marine life ever attempted.

Timbalier Bay contains about 400 oil and gas wells. The first well was drilled in 1937. Several stations within this area were studied. Stations were also studied in adjoining areas, where there never had been oil drilling or production, to obtain control data.

Santa Barbara Channel. Platforms Hilda and Hazel were constructed in the Santa Barbara Channel in 1959 and 1960. During their construction, a survey revealed that the surfaces of these structures quickly became encrusted and a complex marine community including sessile, benthic, and pelagic forms developed.[15]

A year's survey was initiated early in 1975 to assess the extent and complexity of the marine community under the two platforms. This study was conducted by the Southern California Coastal Water Research Project under the direction of the Scripps Institution of Oceanography near San Diego.

The major observations resulting from this survey are also included in Table 1.

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Urethane doughnuts used to protect offshore platform

TWO HUNDRED huge bright-orange doughnut-shaped protectors, made of impact-absorbent urethane are being used to absorb shocks from open-sea docking of tugs, barges and workboats on a new offshore platform.

They are made for Oreco Inc., Lafayette, La., by Goodyear. The 142-lb toroids form a tough 6-in.-thick layer around the steel-platform pilings. Goodyear says that urethane is ideal for fendering material as it converts impact energy into heat which gradually dissipates.

Urethane is also unaffected by saltwater corrosion and can be molded with integral color for high visibility.

The devices, called Bargegard protectors, are installed on the recently placed Pennzoil platform which stands in 180 ft of water, 125 miles southeast of Galveston, Tex. The toroidal protectors measure 9 in. high and have a 31-in. diameter. Twenty of them are slipped over each of the platform's 10 fender pilings. The pilings are mounted so they can deflect and rotate in the horizontal plane for added shock absorbency.

The platform was assembled in two large pieces in the J. Ray McDermott fabrication facilities at Morgan City, La., then towed to the drilling site in the High Island area. The 1,200-ton platform jacket stands on the sea bottom with only 12 ft showing above water. A 1,120-ton work deck is mounted atop the jacket. END

Introduced: 1/28/77
Referred: Resources and Judiciary

BY THE RULES COMMITTEE BY REQUEST OF THE GOVERNOR

IN THE HOUSE

HOUSE BILL NO. 137

IN THE LEGISLATURE OF THE STATE OF ALASKA

TENTH LEGISLATURE - FIRST SESSION

A BILL

For an Act entitled: "An Act relating to civil penalties for discharges of oil."

BE IT ENACTED BY THE LEGISLATURE OF THE STATE OF ALASKA:

* Section 1. AS 46.03 is amended by adding a new section to read:

Sec. 46.03.758. CIVIL PENALTIES FOR DISCHARGES OF OIL. (a) The legislature finds that the discharge of oil causes significant harm to the economy and environment of the state which is often difficult to detect and incapable of quantification, and that, in order to protect the public welfare and insure adequate recourse for the discharge of oil, and to provide an incentive for the safe production, handling and transporting of oil, it is necessary to establish a regulatory mechanism which recognizes and meets the realities of oil pollution.

(b) No later than January 1, 1978, the department shall adopt, and may periodically revise, regulations establishing a schedule of fixed penalties for discharges of oil of not less than $5 nor more than $50 per gallon of oil discharged. The schedule shall vary according to the toxicity, degradability and dispersal characteristics of the oil. The schedule shall vary according to the sensitivity of the receiving environment. Variations under this subsection may be by category of receiving environments, specific receiving environments, or both.

(c) Upon the effective date of regulations adopted under (b) of this section, if a discharge of oil not permitted under applicable state and federal law occurs within the territorial jurisdiction of the state, or into or upon the adjacent outer continental shelf of the state, the following persons, in addition to the person causing or permitting the discharge, are jointly and severally liable to the state, in a civil action, for the full amount of penalties established in the regulations:

(1) if the discharge occurs from any commercial or industrial facility other than a vessel or offshore platform, the owner, lessee (or permittee), and operator of the facility;

(2) if the discharge occurs from a vessel:

(A) the owner and the operator of the vessel; and

(B) the bailor of the oil discharged, if the bailment occurred within the territorial jurisdiction of the state; and

(3) if the discharge occurs from an offshore platform, the lessee (or permittee) of the tract or acreage upon which the platform is situated, and the operator of the platform.

(d) The entire penalty specified in the regulations shall be imposed, and no portion of the penalty for which a person is liable under this section may be suspended or deferred.

(e) A person otherwise liable for penalties under (a) of this section is not liable if he demonstrates, by a preponderance of the evidence, that the discharge occurred solely as a result of:

(1) an act of God;

(2) an act of a third person with intent to cause a discharge of oil, unless the third person is a person with whom the person charged is made jointly and severally liable under (e)(1) - (3) of this section;

(3) a negligent or intentional act of the State of Alaska or the United States; or

(4) an act of war.

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(f) Notwithstanding sec. 875 of this chapter, a person liable under this section is not also liable for the discharge of oil under sec. 760(a) of this chapter.

(g) If the application of this section to discharges of oil solely into and upon the adjacent outer continental shelf of the state is held invalid, the application of this section to discharges of oil into and upon the water or land within the territorial jurisdiction of the state is not affected by that holding. This severability provision is intended to clarify, and not limit the severability provision of AS 01.10.030

(h) As used in this section:

(1) "adjacent outer continental shelf" means that portion of the outer continental shelf which would be within the territorial jurisdiction of the state if its boundaries were extended seaward to the outer margin of the outer continental shelf;

(2) "discharge of oil" means the entry of oil into or upon the water or land of the state, regardless of causation;

(3) "offshore platform" means an offshore structure, whether floating or temporarily or permanently secured to the floor of the ocean or other water body, which is used primarily for the exploration for or production of oil or natural gas;

(4) "oil" means petroleum, crude oil, and any substance refined from petroleum or crude oil;

(5) "operator" means the person who, through contract, lease, sublease or otherwise, exerts general supervision and control of activities at the facility; the term includes, by way of example and not limitation, prime or general contractors, the master of a vessel (and his employer), or any other person who, through himself, his agents, or contractors, undertakes the general functioning of the

facility; and

(6) "vessel" means any form or manner of watercraft, whether or not capable of self-propulsion, except offshore platforms.

* Sec 2. AS 46.03.900 is amended by adding a new subsection to read:

(23) "facility" means any offshore or onshore structure, improvement, vessel, vehicle, land, enterprise, or endeavor.

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House Bill 137 An Act relating to civil penalties for discharges of oil."

Alaska currently imposes unlimited strict liability for Damages
*AS 46.03

PROBLEM with this , is receiving compensation for "Damages" will be Burden of proff

i.e. The plaintiff must prove actual loss
precise economic value of loss
causation

With oil spills it is impossible to determine the acutal loss/economic value oil spill damage has on the environment. Cases under this law have languished in cts for years, arguing- negotiatin $ liability

Destruction of Food sources of higher organisms with probable cause of them leaving polluted areas entirely.

Direct Kill.

Inabilities of state to put a dollar figure on loss and harm of oil spill.

AS 46.03
Provides an assement of not less than 500. nor mor than 100,000 based on toxicity and rcvinb environment. Although damage maybe more than 100,000 in a given spillage they can only recover the upper limit of 100,000.

HB 137 amending AS 46.03 is titled An Act relating to Civil Penalties it is designed to constitute a mean ingful stimulus to comply with laws which they enforce instead , As: 46.03 which had a visible Maximum potential fine of 100,000 which fails to even register in the cost benefit analysis of oil handling operations in both intent and nature HB is remedial and regulatory rather than punitive (ie. fines alone)

HB 137 allows for the legisl ature to establish amount of penalty and c criteria for its application with an administrative agency establishing the dollars per gallon schedule by the ranking of releative toxicity of various types of oil. (the technical applicatation of the bill)

The total limit amount of liability depends upon the total amt. of oil spilled.. Amended to 0 - 50 per gallon depending on toxicity, type of oil and sensitivity of receiving environment. Originial 5 - 50 per gal.

The bill establishes vicarious liability.

To extend liabilty for the penalty to certain persons who are in a posiition to control the integrity of operations from which the dschg occured.

*Those who induce and profit from oil handling activities, and who in fact have the ability to control the integrity of those activites, Duty to see that s those operations are conducted in as safe as possible a manner.

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EFFECTS OF OIL ON MARINE ECOSYSTEMS: A REVIEW FOR ADMINISTRATORS AND POLICY MAKERS

DALE R. EVANS[1] AND STANLEY D. RICE[2]

ABSTRACT

A broad selection of recent literature on the effects of oil on marine ecosystems is reviewed. The focus is on studies on crude oil, and the results are discussed with the purpose of providing a summary of findings that will be a useful reference for administrators and policy makers involved in decisions concerning petroleum developments and related activities. The characteristics of crude oil and factors modifying its impact on the marine environment are discussed. Most research on the toxicity of oil has dealt with acute effects and data on long-term impacts at the community level are inconclusive. It is concluded that chronic low-level pollution is potentially more damaging to ecosystems than isolated catastrophic spills. Decision makers are forced to rely on interpretative judgments rather than conclusive data.

Much of the material in this report was gathered as background material for use in preparing the marine section of the final environmental impact statement on the proposed trans-Alaska pipeline system (U.S. Department of the Interior, 1972). Some of the statements are essentially unchanged from the way they were presented in the appendix to volume IV of the impact statement. The impact statement made it clear that not enough data are available to analyze conclusively all of the potential environmental impacts of operation of the pipeline marine terminal facilities at Port Valdez, Alaska, and the transshipment of crude oil by tankers to west coast ports. A conclusion that can be drawn, however, and a message of the impact statement, is that oil poses a significant hazard to marine ecosystems, and a good deal of intensive research is necessary if these hazards are to be quantified and fully understood.

Research on oil pollution published since the impact statement on the pipeline was issued reveals that scant progress has been made, particularly with regard to the effects of chronic low-level oil pollution. Current and projected demands for energy in the United States are prompting accelerated development of offshore petroleum reserves, expanded oil tanker traffic, and proposals for construction of deepwater port facilities to handle the increasing number of supertankers. These developments will not wait for conclusive answers to questions on oil pollution. Recognizing this, we feel it is important that public administrators and policy makers be made aware of the inferences and trends evident in the research findings to date. These findings present a persuasive case that decisions regarding the handling of crude oil and petroleum products should be conservative and in favor of protecting the natural environment. While this report is by no means a complete review of the literature, it is sufficient to illustrate the potential danger of oil pollution to marine ecosystems and provide some guidance for policy decisions.

History is replete with examples of man's scientific and technological advances carrying him into situations he did not fully comprehend and with consequences he could not evaluate. Bella (1970) noted that "our ability to change this world is going to increase faster than our ability to predict what that change is going to be." He concludes that our management procedures must recognize the degree of ignorance we have about this world in which we live.

Pollution of the ocean by oil is a worldwide problem of growing concern to many nations. Spills like the *Torrey Canyon*, the *Arrow*, the Santa Barbara Channel blowout, and other spectacular incidents have helped stimulate international organizations of governments and industry to react to the problem. Viewed pragmatically, international response has been at least as adequate as domestic programs. Predicting the impact of an oil spill on the environment requires an understanding of the complex interactions involved. What

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FISHERY BULLETIN: VOL. 72, NO. 3, 1974.

appears to be universally lacking is the difficult research leading to an understanding of chronic and sublethal effects of oil at the biological community level. The following discussion outlines these complexities and points out how they make most generalizations invalid and the extrapolation of most data dangerous.

DESCRIPTION OF OIL

Crude oil is a complex mixture of many different specific hydrocarbons and a variety of compounds containing sulfur, oxygen, nitrogen, and some trace metals. Hydrocarbons make up the bulk of crude oil and can roughly be placed into one of three classes: paraffinic, naphthenic, and aromatic. From one area to another, crude oils vary in their composition and in density, volatility, and solubility. Their relative toxicity will vary (Ottway, 1971) but is roughly proportional to their aromatic content.

Paraffinic (or aliphatic) hydrocarbons are straight or branched carbon chains and are saturated (thus no carbon-carbon double bonds) with hydrogen or other groups. These hydrocarbons are the least toxic, although they may have an anesthetic or narcotic effect if concentrations are great enough.

Naphthenic compounds (cycloparaffins) contain at least one ring structure that is saturated. With this base, more rings or chains may be attached to form a variety of complex molecules.

Aromatic hydrocarbons also contain a ringed structure, but the ring is unsaturated with hydrogen and contains carbon-carbon double bonds (benzene ring). The simplest aromatic is benzene, which is very toxic and relatively water soluble in comparison to most hydrocarbons found in crude oil. Benzene and other low-boiling aromatics are the most toxic petroleum fractions. High-boiling aromatics act as slower poisons than low-boiling aromatics, but they are equally severe in their effect. In addition, some are known to induce cancer; 3,4-benzpyrene, 1,2-benzanthracene, and some alkylbenzanthracenes have been isolated from crude oil, and their carcinogenic effects on animals and man have been demonstrated (Blumer, 1970).[3]

[3] Blumer, M. 1970. Scientific aspects of the oil spill problem. Presented at NATO Conference, Brussels, 6 Nov. 1970, 21 p., Woods Hole Oceanogr. Inst., Woods Hole, Mass.

Olefinic hydrocarbons (paraffinlike but unsaturated and containing reactive carbon-carbon double bonds) are not generally found in crude oils but are plentiful in certain gasolines and other refined products. The fate of olefins in the marine environment is poorly understood, but this class of compounds may be quite reactive under certain conditions and may combine readily with hydrogen, oxygen, chlorine, sulfur, and other elements to produce toxic substances. Once incorporated into organisms, olefins may remain intact for surprisingly long times (Blumer, 1967). The full range of olefinic hydrocarbons probably interferes with the reception of chemical messengers, or odors, in the sea by certain marine organisms (Blumer, 1970, see footnote 3).

When crude oil is processed ("cracked"), olefins and other compounds for gasoline and fuel oils may be formed or separated. Fuel oils, commonly involved in spills, are rated from 1 to 6. Those rated 1 are the lightest, most volatile, and most toxic and have the greatest aromatic concentrations; those rated 6 are the least volatile, least soluble, and least toxic and are asphaltic (tarlike).

Hydrocarbons are not foreign to the marine environment; normal paraffins are synthesized by most, if not all, living organisms. Blumer, Guillard, and Chase (1971) characterized the natural hydrocarbon content of 22 species of phytoplankton and cited literature for zooplankton. There are certain characteristic differences, however, between hydrocarbons native to organisms and the hydrocarbons in petroleum, particularly in the relative distribution of the various hydrocarbons. Crude oils and certain petroleum products are complex mixtures that contain molecules of different sizes in ratios not found in any one species of organism. Certain specific paraffins, and some naphthenic and aromatic compounds, are rarely found in organisms not exposed to oil pollution. These characteristic differences have been the basis for several scientific papers (Blumer, Souza, and Sass, 1970; Ehrhardt, 1972; Clark and Finley, 1973; and others).

FACTORS INFLUENCING THE IMPACT OF OIL

The impact of oil on the marine environment is governed by several factors—physical, chemical, and biological—in addition to the inherent complexity of crude oil and refined products. The behavior, effects, and fate of an oil spill involve all of these factors; and because they are interdependent, the reliability of our predictions concerning the impact of a spill is limited by our knowledge of the least understood variable.

Straughan (1972) noted our general inability to predict the environmental impact of a spill because of the complexity of the matter, and identified several factors that govern biological damage caused by a spill: 1) type of oil spilled, 2) dose of oil, 3) physiography of the area of the spill, 4) weather conditions at the time of the spill, 5) biota of the area, 6) season of the spill, 7) previous exposure of the area to oil, 8) exposure to other pollutants, and 9) treatment of the spill. Several of these factors are touched upon below.

Natural Physical Processes Affecting Oil in the Water Column

Once oil is spilled, it is dissipated by evaporation, dissolution, and mixing or dilution in the water column. The natural processes are speeded by wind action and by waves and currents that increase spreading and vertical mixing. Various fractions respond differently to these processes, and the weathered residue behaves differently than the material originally spilled. A contaminated bay may be flushed by freshets, tidal action, or longshore currents. Some oil sinks directly to the bottom, especially in fresh water, where some oil fractions have densities approaching that of fresh water, and in water with high sediment loads. Certain fractions may undergo autoxidation.

Conover (1971) reported that sedimentation of fecal-bound oil that had been ingested by zooplankton may have accounted for up to 20% of the spilled oil entering the water column at Chedabucto Bay, Nova Scotia. Oil can also be removed from the water column by absorption within organisms and accumulation within the food chain. Suspended sediments carried by runoff from a major flood entered the Santa Barbara Channel area immediately before and after the well blowout (Kolpack, 1971). Kolpack noted that adsorption of oil on the flocculated suspended particles followed by decomposition was a major factor in carrying much of the oil to the sea floor. Kinney et al. (1970) reported, however, that in Cook Inlet, Alaska, glacial silt from the inlet had no apparent effect on the emulsion properties or the sinking of the type of crude oil found in that area.

Forrester (1971) noted the extensive distribution of oil particles stirred into the water by wave action after a bunker C oil spill in Chedabucto Bay. Oil particles were found to a depth of 80 m inside the bay and to depths of 45 m at a distance of 65 km outside the bay. Near-surface distribution of particles extended 250 km southwest along Nova Scotia in a band extending up to 25 km offshore. Berridge, Thew, and Loriston-Clark (1969) indicated that the stabilization of emulsions like those observed at Chedabucto Bay and elsewhere was caused by complex chemical components in the nonvolatile residues and not by bacterial activity, marine organisms, or suspended solid matter.

Environmental Differences

The fate and effects of oil spilled in the marine environment are difficult to generalize because several types of environments may be involved. Some extreme comparisons are tropics versus arctic, open ocean versus estuaries, and the differences between the intertidal and subtidal zones.

Within these environments are several diverse physical conditions such as temperature, salinity, oxygen, and nutrient concentrations, as well as biological differences such as species composition, diversity and density, and community metabolic rate. The prediction or assessment of pollution effects on the basis of observations extrapolated from one environment to another is seldom supported by adequate data. Unfortunately, however, few data on pollution effects exist for most areas and species, which has led to the use of information from areas that may be dissimilar in critical respects.

There are arguments as to which environment is the most stable and capable of withstanding attacks by additional pollution stresses. Copeland (1970), discussing the response of ecological systems to stress, suggested the principle that "...those systems already subjected to energy-requiring stresses are more likely to resist the changes than those (such as tropical systems) adapted to relatively constant environments." He concluded that estuarine ecosystems composed of organisms capable of wide adaptations and generalizations, such as north temperate systems, would be relatively unaffected by the same magnitude of disturbance that would drastically alter a tropical system. Odum (1970) noted, however, that many estuarine species are living near the limit of their tolerance range and that any alteration in the environment, such as additional stresses caused by low levels of pollution, could exclude these animals permanently from the estuary.

All healthy balanced ecosystems are generally functioning at or near some critical tolerance limit. In an ecosystem with a variable environment, such as a north temperate estuary, responses to additional stress might not always be the same. For example, even though factors surrounding an oil pollution incident might be outwardly similar in most respects to another spill in a comparable area, the biological impacts may differ. The ability of the local community to absorb the additional stress will be influenced by the coincidence of seasonal variability of natural stresses, the differences in vulnerability of stages in an organism's life cycle, and many other dynamic features of the ecosystem.

Biological Differences

The effects of oil pollution on many different organisms in various habitats may vary from no effect to responses of avoidance and decreased activity, to nonadaptive responses of panic and physiological stress. What kills one species may have little or no effect on another. Affected organisms vary from single cells, to sedentary clams, to highly mobile predators, each of which has different behavioral and physiological interactions with the environment.

Just as different species are affected differently, so may individuals within a species be affected differently. In particular, different life stages such as eggs, hatched larvae, and newly molted individuals may have different sensitivity to the same level of pollution. Mironov (1968), for example, reported that prelarval stages of barnacle, *Balanus* sp., were 100 times more sensitive to oil pollution than the adult form. This contrasts with the relative lack of sensitivity to crude oil by pink salmon eggs and sac fry, which were 10 times more tolerant than older fry (Stanley D. Rice and Adam Moles, Auke Bay Fisheries Laboratory, National Marine Fisheries Service (NMFS), NOAA, Auke Bay, AK 99821, pers. commun.).

Renzoni (1973) conducted a series of experiments on the toxicity of several crude oils and petroleum products to the sperm, eggs, and larvae of the oysters *Crassostrea angulata* and *C. gigas* and the mussel *Mytilus galloprovincialis*. He found a relatively high degree of tolerance by eggs and larvae but reported that the fertilizing capacity of sperm was markedly affected by similar exposures.

Biodegradation

Quantitative data describing the biodegradation of various components of crude oil, especially in arctic and subarctic areas, are limited.

ZoBell (1973a) briefly reviewed the current understanding of microbial degradation of oil, including interactions, limiting factors, problems, and perspectives. Ahearn (1973) stated that research on microbial utilization of hydrocarbons for treatment of oily pollutants in the environment, though more intensive in recent times, is still in an early stage of development. It is known that microorganisms can degrade much of a crude oil, particularly the less toxic paraffinic compounds. No single species can degrade all the compounds, but many different species together can metabolize a large number of the compounds, if not all. The rate of microbial degradation, which is principally aerobic, decreases with a decrease in temperature. Large quantities of oxygen are needed. It has been estimated, for instance, that complete oxidation of 1 gallon of crude oil would require all of the dissolved oxygen in 320,000 gallons of water. This comparison may be unrealistic because most oil is at the surface of water in contact with air and only the outer surfaces of oil can be attacked at any one time. It is reasonable to assume, however, that an oxygen-deficient environment may well occur under some oil slicks and in oil-contaminated sediments.

Glaeser and Vance (1971) studied the behavior of Prudhoe Bay crude oil in controlled spills in the Chukchi Sea but were not able to isolate any microorganisms which could degrade hydrocarbons at the ambient temperatures of the Arctic, although some emulsification of the crude oil was observed. However, ZoBell and Agosti (1972) collected oil-oxidizing bacteria near natural oil seeps from the Alaska North Slope and observed oxidation rates of mineral oil at −1°C and above. They noted that the solid surfaces of the ice crystals appeared to facilitate bacterial growth, because the rate at −1°C was substantial and near the 4°C rate.

The apparent contradiction between the studies is probably best explained by ZoBell's (1973b) continued observations with North Slope bacteria. He found that the nine different crude oils were not degraded as rapidly as purified mineral oil. Glaeser and Vance's studies were with microorganisms from the surface water of the Chukchi where small numbers of bacteria may have been present. Furthermore, the observations of Straughan (1971), who noted the apparent lack of biological damage by the Santa Barbara blowout, may apply here. She discussed the possibility that the fauna had an unusually high tolerance for oil, probably because of adaptation from chronic low-level oil exposures from local natural seepages. The observations of ZoBell and Agosti (1972) on the oxidation rates of oil at −1°C may be an example of similar adaptive response by the North Slope bacteria collected near natural seeps. These oxidation rates and other adaptive responses might not occur from organisms that have not been preacclimated to chronic low-level exposures of oil and may explain why Glaeser and Vance obtained reports of negligible oxidation rates at 0°C from microorganisms from surface water of the Chukchi Sea. Robertson et al. (1973) estimated hydrocarbon-oxidizing bacteria populations were in the order of 1/ml in Cook Inlet and Port Valdez, but less in the Arctic Ocean. Numbers decreased with salinity in Cook Inlet and with depth in Port Valdez.

ZoBell (1963) reported that oil is readily adsorbed by clay and silt and suggests that although adsorption of oil by solids renders the oil more susceptible to autobial and microbial oxidation, almost no bacterial decomposition occurs after burial in the bottom sediments, probably because the environment is anaerobic. Blumer and Sass (1972) found that some paraffinic hydrocarbons remained in bottom sediments 2 yr after the West Falmouth oil spill and aromatic hydrocarbons were prominent, which suggests that these more toxic compounds are utilized by bacteria to a minimum degree.

Oil in Sediments

The effect of oil in sediments is poorly understood, although several authors have quantitated oil concentrations and noted its persistence. Scarratt and Zitko (1972) observed little diminution of bunker C oil concentration from soft sediments 26 mo after the wreck of the tanker *Arrow*. The oil reached maximum concentrations in coarse sediments 1 yr after the spill, but the concentrations reduced thereafter. Chemical degradation can occur but is normally restricted to the surface layer of the bottom penetrated by ultraviolet light. Blumer and Sass (1972) noted that "The preservation of hydrocarbons in marine sediments for geologically long time spans is one of the accepted key facts in current thought on petroleum formation." However, in spite of the stability of hydrocarbons in marine sediments, there are characteristic differences between the hydrocarbons in polluted and unpolluted areas. Tissier and Oudin (1973) found that hydrocarbons in polluted sediments differed from those of unpolluted sediments by having lower percentages of heavy components, by not having an odd carbon dominance in the n-alkanes, and by having polycyclic aromatic hydrocarbons with alkyl chains.

Oil residues were observed on sandy beaches by ZoBell (1963) and in marshes and in sediments of the deepest area (15.3 m) near the West Falmouth spill by Blumer, Sass, Souza, Sanders, Grassle, and Hampson (1970).[4] About 2 wk after fuel oil was spilled at Resolute Bay, Northwest Territory, in August 1970, casual sampling revealed that oil penetrated into beach material to a depth of about 3 inches (7.6 cm) (Barber, 1971). Oil may be buried and stay intact for a considerable time, even at the higher temperature of the California coast (ZoBell, 1963). During laboratory experiments, Johnston (1970) determined oil decay rates in sand columns contaminated with various concentrations of oil. Ten percent of the oil was oxidized over a period of several months; the remaining 90% decayed much slower.

The West Falmouth spill provided a unique opportunity for a study of the immediate and long-term effects of an oil spill on an area where the previously existing environmental base was well known (Blumer, Sanders, Grassle, and Hampson, 1971). One effect of the oil was to reduce the cohesion of bottom sediments of tidal marshes and the estuary by killing the benthic plants and animals (Blumer, Sass, Souza, Sanders, Grassle, and Hampson, 1970, see footnote 4). The resulting erosion spread hydrocarbons to new areas, where the process was repeated. Because of the stability and persistence of the hydrocarbons in marine bottom sediments, Blumer, Souza, and Sass (1970) noted that hydrocarbons may be returned to the biosphere by organisms living and feeding in the sediments. This redistribution of hydrocarbons can be

[4]Blumer, M., J. Sass, G. Souza, H. Sanders, F. Grassle, and G. Hampson. 1970. The West Falmouth oil spill. Unpubl. manuscr. Woods Hole Oceanogr. Inst., Ref. No. 70-44, 32 p.

the source of a chronic pollution problem near that spill.

It is quite possible that normal functions of sediments will be disrupted when contaminated by oil. Changes in the sediments that are subtle and difficult to detect, such as decreased nutrient recycling and community metabolism, could result in the loss of significant contributions to the productivity and stability of an area. Although oil in sediments has been monitored and measured after several spills, other aspects of the oil-sediment relation have yet to be studied.

BIOLOGICAL EFFECTS OF OIL POLLUTION

Blumer (1970, see footnote 3) summarizes the potential damage to organisms from pollution by crude oil and oil fractions as follows:

1. Direct kill of organisms through coating and asphyxiation.

2. Direct kill through contact poisoning of organisms.

3. Direct kill through exposure to the water-soluble toxic components of oil at some distance in space and time from the accident.

4. Destruction of the generally more sensitive juvenile forms of organisms.

5. Destruction of the food sources of higher species.

6. Incorporation of sublethal amounts of oil and oil products into organisms (resulting in reduced resistance to infection and other stresses—the principal cause of death in birds surviving immediate exposure to oil).

7. Incorporation of carcinogenic and potentially mutagenic chemicals into marine organisms.

8. Low-level effects that may interrupt any of numerous events (such as prey location, predator avoidance, mate location or other sexual stimuli, and homing behavior) necessary for the propagation of marine species and for the survival of those species higher in the marine food web.

Some of the potential effects described by Blumer may be obvious, such as the direct deaths from acute exposures. Less obvious indirect deaths may occur from effects at either the individual or population level. Individual organisms subjected to sublethal exposures may undergo an "ecological death" if they are less capable of adjusting to and responding to natural changes (stresses) in their physical and biological environments. For example, postmolt Tanner (snow) crab, *Chionoecetes bairdi*, lost legs during short exposures to crude oil (Karinen and Rice, in press). Even though the crabs lived through the exposure, they probably could not have survived in the natural environment because some of them lost as many as seven legs, including both chelae. Moreover, crabs or other adversely but sublethally affected organisms would be more likely to be eliminated by natural selection.

Effects from chronic exposure may be adverse to a population over a period of time if exposed but normal-appearing adults have their ability to reproduce seriously impaired. This loss may be due to physiological changes such as reduced fecundity and delayed ovary development or to impaired behavioral mechanisms which could prevent mate location and identification or homing and timing of spawning. Although the effects at this level might not result in death of the adult, they could induce a trend of decreasing numbers that might eventually eliminate the population or race.

Hydrocarbons in the Marine Food Web

Blumer (1967, 1969) and Blumer, Guillard, and Chase (1971) studied the fate of organic compounds in the marine food web. They found that certain hydrocarbons, even highly unsaturated ones, are stable once they are incorporated into a particular marine organism and that they may pass through many members of the marine food web without alteration and may actually be concentrated in tissue. Most hydrocarbons are lipid soluble and thus may accumulate in food webs to the point where toxic levels are reached. This pathway is illustrated by the well-documented chlorinated hydrocarbon group of pesticides.

The entrance of oil-derived hydrocarbons into marine food webs has been observed several times at several trophic levels. Conover (1971) reported that 10% of the bunker C oil in the water column after the Chedabucto Bay spill was combined with zooplankton and that their feces contained up to 7% oil. Mironov (1968) also noted the ability of some zooplankters to accumulate hydrocarbons. The incorporation of hydrocarbons into the food web at these primary levels assures exposure at all higher trophic levels.

Blumer, Souza, and Sass (1970) and Ehrhardt (1972) reported pollution-derived hydrocarbons in shellfish. Uptake and retention of labeled hydrocarbons of several classes by a marine mussel, *Mytilus edulis*, was noted by Lee, Sauerheber, and Benson (1972). Smith (1968) reported the presence of oil and benzene-ring compounds in the feces of limpets browsing on an oily deposit, and in top shells, *Monodonta*, and limpets, *Patella*, living on oiled rocks. He reported that analysis of the gut indicated "the proportion of oil in material ingested by these animals was estimated as about 20-30 percent in *Patella* and 5-50 percent in *Monodonta*."

Organisms at the highest trophic levels may be affected directly by the oil itself or indirectly by hydrocarbons that have reached them through the food web. Horn, Teal, and Backus (1970) found large amounts of tar in the stomachs of three saury, *Scomberesox saurus*, from a sample of ten in the Mediterranean Sea near Gibraltar. Although saury are generally considered to be carnivorous, the occurrence of tar and also of "vegetable debris" in one of the stomachs examined by Horn et al. (1970) suggests that the species is not a very discriminate feeder. Although all ingested oil was obviously not incorporated into the tissues (some oil was found in feces), such feeding behavior does describe a pathway for hydrocarbons to be directly taken up into the tissues of the organism. Thus, oil ingested, absorbed, and even adsorbed may enter the food chain when contaminated organisms are eaten.

Carcinogenicity

Some doubt may remain as to the direct carcinogenicity to man of crude oil and crude oil residues in marine organisms (Blumer, 1969), but evidence pointing toward this is accumulating (Blumer, 1970, see footnote 3; 1972). A literature search and evaluation conducted for the U.S. Coast Guard by Battelle Memorial Institute (1967) noted that shellfish, although alive, may have been unfit for consumption because of the carcinogenic hydrocarbon 3,4-benzpyrene in their bodies. Oysters that were heavily polluted and contaminated with ship fuel oil were reported to contain 3,4-benzpyrene. The Battelle review also reported that barnacles attached to creosoted poles contained the same carcinogenic hydrocarbon (3,4-benzpyrene). Sarcomas were elicited when extracts from the barnacles were injected into mice. The endemic occurrence of papillary tumors around the rectal opening of soft-shell clam, *Mya arenaria*, was reported, but the author (Battelle Memorial Institute, 1967) did not feel these were due to oil pollution, even though the clams were taken from waters adjacent to areas highly polluted by ship fuel oil. Hyperplasia in reproductive cells of a bryozoan in response to coal tar derivatives was observed by Powell, Sayce, and Tufts (1970). They noted that similar abnormalities may also have occurred in coastal faunas exposed to spills such as the *Torrey Canyon* and the Santa Barbara blowout. However, most observations on these spills were concerned with gross mortality and may not have detected the sublethal effects.

ZoBell (1971) reported the natural synthesis and metabolism of carcinogenic hydrocarbons by several marine organisms. Thus, oil pollution is certainly not the only source for carcinogenic hydrocarbon introduction into marine food webs. Suess (1972) recognized that carcinogens were in seafoods but concluded that they would probably not be dangerous unless the foods contained an excess amount of polynuclear aromatic hydrocarbon carcinogens. Carcinogenesis from oil-contaminated marine organisms has not been proved, but Ehrhardt (1972) expressed a need for carcinogenic testing of hydrocarbon fractions extracted from marine organisms contaminated by exposure to oil.

Observed Toxic Effects

A study of the available information on potential toxic effects of oil pollution reveals more unknowns than proven conclusions. Only a decade ago, ZoBell (1963) reviewed the literature on the effects of oil on bacteria and higher organisms and concluded that oil pollution had no great adverse impact on fishery resources in general. He did point out, however, a few reports of toxic effects, tainting of flesh, and damage to vessels and fishing gear.

The quantity of literature on effects of oil spills has increased since the *Torrey Canyon* incident of 1967. Most of the recent work has depended on onsite visual surveys after occurrence of an oil spill rather than on experiments and detailed study. The surveys have been limited mostly to the effects of oil and of cleaning or dispersing agents on primarily adult intertidal organisms and populations. These observations on a restricted segment of the affected ecosystem include only a few of the factors that influence the total impact of oil. Wilson, Cowell, and Beynon (1973) noted that the absence of results from studies at the community level make the interpretation, extrapolation, and use of many observations very difficult. Further, the differences between various crude oils and between the hundreds of petroleum products in their physical and biological effects must always be kept in mind. Comparative data generally are far too few to permit attaching any relative significance to production area or product formulation in this review.

Field Investigations

The utility of many "after-the-fact" studies is limited because of the lack of knowledge of prespill conditions. Data are often collected without proper controls for comparison, and knowledge of natural local fluctuations and species composition of animal populations is usually quite limited. For these reasons conclusions about the impact of a particular spill may vary.

Ehrsam (1972) reported substantial immediate kills of marine life from a fuel oil spill at Anacortes, Wash., and concluded that if larval and juvenile forms of certain organisms were killed, the full impact of the spill may not be known for some time. Katz (1972) observed intertidal transects of the same affected area and concluded that the effects were minor and long-term effects would be unlikely. Webber (1972) pointed out, however, that these after-the-fact studies observed only a small wedge of the total biota. Knowledge of subtidal and benthic organisms as well as larvae and juveniles was lacking.

Other large spills have been studied in greater detail and have contributed significantly to our understanding of the gross effects of oil. Yet, they have been unable to answer many important questions on the effect of pollutant hydrocarbons in the marine environment, and generalizations learned from one spill may not apply to another because each is different.

Field observations of behavior and effects of oil in Arctic ice environments are few. The U.S. Coast Guard investigations in the Arctic have primarily been directed toward gaining knowledge to improve cleanup methods (Glaeser and Vance, 1971; McMinn and Golden, 1973). Campbell and Martin (1973) discussed possible large-scale movements and persistence of oil spilled in the Beaufort Sea. They suggested that the surface waters of the Arctic Ocean and the winter waters of Chedabucto Bay, Nova Scotia, might be comparable, particularly with regard to the physical behavior of oil. Chedabucto Bay is the site of the grounding of the tanker *Arrow* in February 1970 with 2.8 million gallons of bunker C oil aboard. Campbell and Martin (1973) found that highly stable oil-water emulsions formed to a depth of 50 m throughout Chedabucto Bay. They described conditions by which oil reaching the edge of the pack ice could be distributed under the ice.

Thomas (1973) also suggested that results of the studies at Chedabucto Bay might in some respects be applicable to spills in the Arctic. He observed remobilization of oil from beneath the weathered surface of deposits during the summers following the *Arrow* spill and the subsequent re-oiling of some intertidal areas, adding a chronic pollution aspect to the spill. Extensive mortalities of soft-shell clams and salt marsh cord grass, *Spartina alterniflora*, resulted where this occurred. In other areas, clams were visibly contaminated with oil and clam fishing was closed, at least through the summer of 1972 (Thomas, 1973).

When the *Torrey Canyon* broke up near the southwest coast of England in 1967, 15 million gallons of Kuwait crude oil with a high aromatic content were released. Efforts to cope with this first super disaster depended principally upon 2 million gallons of toxic dispersant, which probably caused more damage than the oil, most of which had weathered at sea for a week or more before reaching the shores. Many techniques for oil containment and control on the seas were attempted during the time oil leaked from the tanker; the fact that they all failed reveals the inadequacies of our technology and preparedness for such emergencies.

Extensive investigations of the West Falmouth spill by Blumer and his associates at Woods Hole provide one of the best documentaries of an oil spill. A total of 185,000 gallons of no. 2 fuel oil (41% aromatic content) were spilled in 1969 from a ruptured barge. Intertidal and subtidal benthic organisms of all phyla were killed during the first few days (Blumer and Sass, 1972). Blumer, Souza, and Sass (1970) showed that the uptake of fuel oil hydrocarbons by shellfish left them unfit for human consumption. Later, Blumer and Sass (1972) reported the continued persistence of fuel oil hydrocarbons in the sediments after 2 yr. Although there had been some degradation, the boiling range and composition of the hydrocarbon mixture was basically unchanged.

The 1969 Santa Barbara blowout released an estimated 5,000 barrels of crude oil per day initially (Foster, Charters, and Neushul, 1971), yet biological damage was not reported widespread and the area has started to recover. Foster, Neushul, and Zingmark (1971) observed that much of the damage to intertidal areas corresponded to sand movement, probably from storm damage. Cimberg, Mann, and Straughan (1973) concluded that the blowout had less effect on intertidal marine organisms than did sand movement and substrate stability. Straughan (1971), reporting on investigations at Santa Barbara, noted factors unique to that accident: 1) the long history of natural oil seepage in the Santa Barbara Channel and 2) the unusually heavy winter runoff at the time of the spill, which reduced salinities, increased sedimentation, and possibly increased pesticides in the channel. R. L. Kolpack (pers. commun. cited by Kanter, Straughan, and Jessee (1971)) noted that Santa Barbara crude oil is relatively insoluble in seawater and contains a very low percentage of the toxic aromatic compounds. Thus, information gathered on the effect of the Santa Barbara spill or any other is of limited utility in predicting the ecological effects of crude oil spills or of other oils in other areas.

Several studies have provided encouraging reports of varying degrees of recovery after some of the recent larger spills. Investigations about 1½ yr after the *Torrey Canyon* spill revealed that at least the affected shoreline areas were recolonizing and recovering, although recovery was not yet complete at that time (Spooner, 1969). The areas affected by the 1969 Santa Barbara blowout were recently reported to be recovering (Cimberg et al., 1973), as was a reef affected by bunker C oil spilled from a tanker collision in San Francisco Bay in January 1971 (Chan, 1973).

Too few of the controlled field investigations have been designed to bridge the gap between field surveys after spills and simulative laboratory experiments. Perkins (1970) exposed periwinkles and other intertidal organisms to the oil dispersant BP1002 in the laboratory and then released marked individuals in the natural environment. After recapture of the individuals exposed, he found that survival from doses as low as one three-thousandth of the 24 h LC_{50}[5] was lower than among the recaptured controls. Crapp (1971a) conducted field experiments by applying crude oil and oil emulsifiers to the intertidal zone. Physical damage by the oil was observed, but toxicity damage was not great because the oil had previously been exposed to air; in contrast, the oil-emulsifier mixtures were toxic. Baker (1970) applied a crude oil to salt-marsh plots at different times of the year and monitored the effects on plants. Summer applications of oil severely affected annuals but not perennials.

Laboratory Studies

Experiments in the laboratory also do not provide all the answers about how an oil spill will affect a marine organism or its environment. Laboratory research has demonstrated the toxicity of various crude oils and petroleum products on several forms of marine life. Much of this research has focused on the planktonic life history stages of pelagic and benthic animals. Many of these planktonic larvae are phototactic at their earliest stages and concentrate in the surface layer of the sea. This community of the surface 5 cm, the neuston, is the first affected by most oil entering the water. Thus, many organisms are most sensitive to oil pollution at the time of their greatest likelihood of exposure.

Studies by Mironov (1968) on the development of fertilized eggs of the plaice, *Rhombus macoticus*, showed extreme sensitivity of the eggs to the influence of the oil products in seawater. He noted that injury to the eggs occurred at concentrations of 10^{-4} to 10^{-5} ml/liter (0.1 to 0.01 ppm). In these concentrations of oil products, 40 to 100% of the hatched prelarvae showed some signs of degeneration during development and perished. Mironov (1969a) also demonstrated that 0.001 ml of crude oil per liter was toxic to the eggs of anchovy, scorpionfish, and sea parrots from the Black Sea.

Newly set spat of *Elinius modestus*, an Australian barnacle introduced to Europe, were tolerant of 100 ppm crude oil but showed reduced cirral activity and retarded shell growth (Corner, Southward, and Southward, 1968). Adults of this species also showed reduced activity at 100 ppm (Corner et al., 1968).

Mironov (1969b) tested crude oil on several copepods and a cladoceran, and found that 0.001 ml/liter accelerated death in all forms and that 0.1 ml/liter caused death in less than 1 day. *Acartia* and *Calanus* died at 0.01 ml/liter oil in seawater in 72 to 96 h (Mironov, 1968). Larvae of crab and shrimp died at 1 ppm (Mironov, 1969c).

Little is known of the mechanisms of various

[5] 24 h LC_{50} equals that dose of toxicant that resulted in 50% survival after 24 h exposure.

toxic effects. Damage to cell membranes and the cellular contents of planktonic larvae may occur. Goldacre (1968) demonstrated such cytological damage and death to the freshwater protozoan, *Amoeba proteus*, exposed to crude oil fractions. Brocksen and Bailey (1973) measured increased respiratory response of striped bass and chinook salmon to sublethal concentrations of benzene. The fish recovered to normal activity when they returned to noncontaminated water for several days. Rice and Short were unable to demonstrate changes in the enzyme activity of cholinesterase or Na-K stimulated ATPase in juvenile pink salmon, *Oncorhynchus gorbuscha*, after in vivo and in vitro exposures to Prudhoe Bay crude oil (Stanley D. Rice and Jeffrey Short, Auke Bay Fisheries Laboratory, NMFS, NOAA, Auke Bay, AK 99821, pers. commun.). This is somewhat surprising because various hydrocarbon pesticides have been shown to affect both enzymes.

Cellular membranes of phytoplankton are also damaged by the penetration of hydrocarbon molecules. The cellular contents are extruded, and oil penetrates into the cell. Detergents administered in a concentrated solution also penetrate the plant cells and cause the dissolution of cellular membranes and the extrusion of cellular fluid (Ruivo, 1972). The effects of oils on plant respiration are variable, but an increase of respiration is frequently observed, probably because of an alteration of the mitochondria. This could result in an uncoupling of the oxidative phosphorylation enzymes from the electron transport enyzmes, and the energy release would be lost as heat.

All marine animals ultimately depend on the photosynthetic activity of phytoplankton and algae for the production of biomass. Baker (1971), reviewing the literature, noted that weathered *Torrey Canyon* oil had no apparent effect on the photosynthetic activity of green algae. He did find, however, that green algae treated with fresh crude oil died and that photosynthesis in kelp, *Macrocystis* sp., was reduced when the kelp was exposed to various petroleum products. Kauss et al. (1973) determined the effects of crude oil on several species of freshwater algae in both field and laboratory experiments. In their field studies, response of the algae to a spill varied from suppression of growth to its stimulation. In their laboratory studies, they noted depressed photosynthetic rates in one algal species after it had been exposed to aqueous crude oil and other selected aromatics.

Growth of phytoplankton from axenic cultures and mixed cultures of natural populations was inhibited by water-soluble extracts from no. 2 fuel oil in a laboratory study by Nuzzi (1973). Mironov and Lanskaya (1968) demonstrated that marine phytoplankton vary several orders of magnitude in sensitivity to crude oils and kerosene in oil concentrations ranging from 0.1 to 1,090 ppm. Of the 20 species tested, a diatom, *Ditylum brightwellii*, was the most sensitive. The wide variation in susceptibility may account for the statements in other reviews of low toxicity of crude oils to phytoplankton (Føyn, 1965; Nelson-Smith, 1970) and supports the premise that biological response will differ among species.

Sublethal and Chronic Effects of Oil Pollution

While data are scarce in some of the areas previously discussed, information on the ecological effects of chronic sublethal oil pollution is essentially nonexistent. Observing these effects is difficult because they are not dramatic and may pass unnoticed by the casual observer. A full description would require observations extending over a long period of time.

Lewis (1972), commenting on approaches to the study of chronic pollution, contends ". . . that without a massive expansion of ecological and reproductive data by simultaneous multidisciplinary studies not only will we be unable to detect the significant long-term changes, but we will even remain unaware of the most suitable or important species and methods to build into a monitoring program."

A few studies concerning sublethal effects on organisms have appeared in the literature. Wells (1972) reported deaths of lobster larvae to exposures of 0.1 ml of Venezuelan crude oil per liter, while larvae exposed to 0.01 ml/liter had poor survival rates and were unable to molt to the fourth stage. Decreased limb (cirral) activity of marine larvae exposed to oil has been reported (Smith, 1968). Kuhnhold (1972), while observing toxic effects of crude oils to eggs of cod and to larvae of cod, plaice, and herring noted that the larvae exposed to oil-contaminated water were unable to avoid well-defined milky clouds of toxic oil dispersions. Blanton and Robinson (1973) observed damage to the gills of specimens of seven species of fish that had apparently been exposed to an oil spill off the Louisiana coast.

Crapp (1971b) observed that fucoid algae replaced barnacle and limpet populations near an outfall where the effluent contained about 20-25 ppm oil from treated ballast water of tankers unloading at Milford Haven. Although the relative oil content was low, the cumulative volume discharged was large (20,000 gallons of oil per year), a situation similar to that which may occur at Port Valdez, Alaska, when the trans-Alaska pipeline is completed.

Blumer (1972) discussed how low-level chronic effects of oil may damage marine organisms because of their dependence on natural organic chemical clues for a variety of functions. Salmon and other fishes utilize organic chemical clues in migrations; predators are attracted to prey by organic compounds at the parts-per-billion level (Whittle and Blumer, 1970); and other organisms may use chemical clues for predator avoidance, selection of habitat, and sex attraction. Blumer (1972) discussed the fears that oil pollution may interfere with these fundamental biological processes by masking or blocking, or by mimicking natural stimuli (resulting in false responses). He cited literature discussing the attraction of lobsters to kerosene and to purified hydrocarbon fractions derived from kerosene and noted that many dead lobsters were washed ashore after the West Falmouth spill. Blumer's fears about interference with chemoreception are further substantiated by the observations of Takahashi and Kittredge (1973) on crab behavior. Crabs, *Pachygrapsus crassipes*, exposed to water-soluble extracts of crude oil failed to exhibit feeding behavior or mating behavior responses when given appropriate chemical stimuli. Inhibition of chemoreception of some motile marine bacteria by a crude oil and several other hydrocarbons has been demonstrated by Walsh and Mitchell (1973).

Rice (1973) performed laboratory tests of avoidance of pink salmon fry to Prudhoe Bay crude oil and observed avoidance of oil at concentrations as low as 1.6 mg/liter. He concluded that salmon fry had the capability of detecting sublethal concentrations of oil and that they might avoid areas contaminated with sublethal levels of oil, which would result in confused and nonadaptive migratory behavior. The effect of chronic low-level pollution in areas such as Port Valdez, the terminus of the trans-Alaska oil pipeline, could be as severe as the total loss of all salmon runs in the local area because of altered behavioral responses to sublethal oil pollution.

CONCLUSIONS

Although crude oil generally should be considered toxic to marine organisms and harmful to their environment, most ecosystems can tolerate some pollution because oil can be dissipated or removed by processes like evaporation, autoxidation, dilution, and biodegradation. However, each organism and environment has a limit to how much oil can be absorbed and metabolized. Catastrophic spills are obviously pollution at a level that ecosystems cannot tolerate without damage. However, if the spills are not continued, the oil will slowly be removed and recovery of the area, at least to some degree, will likely occur. There is some evidence for recovery of some affected individuals.

Assessments of the impact of oil pollution cannot depend solely on evaluation of immediate kills of organisms from acute exposures. Chronic low-level oil pollution can cause subtle changes in organisms and is potentially more dangerous to the ecosystem than dramatic catastrophic spills. For this reason, the effects of chronic pollution warrant intensive study so that they will not be underestimated. The cumulative impact of "ecological death" of individuals which have impaired functions may be quite significant, yet difficult to assess because the death is not tied directly to an acute oil exposure. Equally as dangerous is the potential impact on populations where reproductive processes, adversely affected through physiological or behavioral mechanisms, result in fewer progeny. Chronic pollution may eliminate a species from an area entirely, and once eliminated that species may remain suppressed and may not repopulate the area because of continuing pollution or because its niche has been filled by a more tolerant, possibly less desirable, species.

The adverse effects of oil on animal populations has been of wide concern when stocks of special interest, such as those providing the basis of a sport or commercial fishery, have been involved. It should be remembered that changes in populations of lesser apparent significance will also cause changes in the community because each species population interacts with and is dependent on the rest of the community.

The foregoing review of information does little to simplify or ease the problems of policy makers concerned with marine production and transportation of oil and petroleum products. The weight of the evidence leaves little doubt that oil poses a serious hazard to living marine resources, that spills and chronic pollution have happened and will continue to occur, and that the interests of the marine environment are best preserved if marine transportation of oil and petroleum products is minimized. The continuing need for new sources and increased amounts of energy, however, limits many of the conservative and prudent alternatives to these hazards. Until research has provided conclusive data, policy makers must continue to rely on these interpretative judgments for much of their guidance in making decisions that can profoundly affect the well being of marine ecosystems.

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HB 137 alvin

Sponsor Analysis of HB 137

1. Need for the legislation

Oil pollution can and does cause a wide range of harm to renewable resources, and the environment in general. Many types of harm, which can have devastating long-term effects on important marine resources, cannot be quantified. Included within this category are mortality to fish and shellfish larvae, food chain contamination, carcinogenic effects, and chronic toxicity. (See "Effects of Oil on Marine Ecosystems: A Review for Administrators and Policy Makers," Evans and Rice (1974), copy of which is attached to this analysis.)

Much of the damage caused by oil pollution can at least partially be seen -- oil-smothered beaches and inter-tidal areas, dead birds, marine mammals and the like. Yet even here, under existing state and federal law, the public, and the industries which depend upon the productivity of the sea, must bear these damages without compensation. As impressive as oil spill liability statutes may seem on their face, the fact of the matter is that traditional concepts of burden of proof will normally pose an insurmountable barrier to effective redress for the great bulk of harm caused by oil pollution.

In Alaska, the primary remedy for recoving damages for oil pollution is AS 46.03.822, which provides a strict liability remedy for those damaged by oil discharges. Yet it must be remembered that, to receive any compensation under the statute, the plaintiff must prove actual loss, the precise economic value of the loss, and causation. It is naive to believe that in any but the most basic cases can that burden be met. For example, let us suppose that, two years after a major oil spill, the salmon run in the area declines by 30%. Is that decline attributable to the oil spill? Natural fluctuation? Hard winters? Overfishing? A little of each? An even greater problem, of course, arises with regard to the subsistence user, who must prove not only causation, but must also meet his burden of establishing an exact dollar figure for lost subsistence opportunities. As the Court of Appeals for the Ninth Circuit warned in Union Oil Co. v. Oppen, 501 F. 2nd 559 (1974), after holding that commercial fishermen could sue for lost profits due to oil pollution:

> "To [recover any damages] it must be shown [by the fishermen] that the oil spill did in fact diminish aquatic life, and that this diminution reduced the profits the plaintiffs would have realized from their commercial fishing in the absence of the spill. The reduction of profits must be established with certainty and must not be remote, speculative or conjectural. . . . These are not small burdens, nor can they be eased by our abhorrence of massive oil spills. All that we do here is to permit plaintiffs to attempt to prove their case. . ." Id at 570.

The problem, of course, reaches unmanageable proportions when the state, on behalf of the public, seeks redress for harm caused to its natural resources. Here we deal not with lost profits, but with the diminution of the quality of the state -- lost recreational opportunities, decreased tourism, loss of heritage and the like.

The State of Maine considered it a major victory when a federal district court ruled in Maine v. M/V Tamano, 357 F. Supp. 1097 (D.Me. 1973) that the state could sue for these kinds of damages. The diffi ulty, of course, came afterwards -- in translating the harm from the spill into a dollar figure. Maine was fortunate in this instance. The primary visible harm was the direct coating of commercially valuable clams. The state actually conducted an on-site survey, and counted the dead clams. Yet even here, the inability of the state to put a dollar figure on the value of "in place" clams forced an out-of-court settlement of $750,000.

In most cases, however, the burden on the state will be far more formidable. While dead clams can be more or less effectively surveyed, most species cannot. And what of the indirect damages to commercial species -- such as food chain contamination? And the problem of valuation of non-commercial species? What is the "in place" value of a trumpeter swan, or a whale?

Alaska's answer to this problem has been the modest civil assessment provision of AS 46.03.760, which provides for an assessment of not less than $500, nor more than $100,000 for oil spills, based on the toxicity of the substance discharged, and the receiving environment. The statute is intended to provide "liquidated damages" for harm caused by oil pollution.

The most glaring problem with the statute is the $100,000 upper limit. In light of the fact that in many situations, the only recovery the state will make will be under sec. 760, the $100,000 figure seems ludicrous when applied to a Torrey Canyon or Santa Barbara.

The $100,000 figure is unreasonably low for another reason. Any civil penalty scheme should be regulatory as well as remedial. The penalties should be sufficiently high to constitute a meaningful stimulus to comply with the laws which they enforce. A potential maximum exposure of $100,000 no doubt fails to even register in the cost-benefit analysis of oil handling operations. An illustrative anecdote might be provided here. Last summer, Exxon Corporation willingly paid the U. S. Environmental Protection Agency $100,000 in civil penalties for a 200-400 gallon discharge of oil into the Beaufort Sea, to protect a "tight hole" from potential exposure in litigation. With regard to oil spills, sec. 760 fails its regulatory, as well as its compensatory rcle.

Sec. 760 is primarily addressed to continuing acts of pollution -- by depriving the discharger of the economic incentive of continuing to violate state law. It is not an appropriate enforcement mechanism for single-act oil spills. Even with the presence of the toxicity and receiving environment criteria, it is still exceptionally difficult to apply to any given oil spill. A person simply has no means of assessing his potential liability under the law. A trial to set the amount of the assessment remains largely potluck, and, as a result, there have been none. Cases under the law languish for years, while the private and public bar argue across the negotiating table as to whether the spill in question is a $500, or $50,000 discharge. There are more efficient, as well as more effective ways of protecting the public interest.

2. Major issues regarding HB 137

A. What is a civil penalty?

Although called a "penalty," the primary purpose of a civil penalty is to compensate for public harm, and to effectively encourage the regulated industry to comply with the laws which it enforces. See U.S. v. Mar.-Tee Contractors. _______F. Supp. _______, 8 ERC 1925 (D.N.J. 1976). In both intent and operation, HB 137 is remedial and regulatory, rather than punitive in nature.

B. Why dollars per gallon?

Civil penalty schemes are usually open-ended -- like current sec. 760 -- with a broad range between the lower and upper limits. This inevitably leads to the problems the state has faced with sec. 760.

The consequences of oil pollution should be definitively and unequivocally established from the outset. The dollars per gallon approach objectively grades the penalty according to the degree of public harm caused. The approach also furthers the regulatory purposes of the bill, by increasing the incentives for safe operation according to the amount of oil handled.

C. Why should an administrative agency establish the dollars per gallon schedule?

In the bill, the legislature establishes both the amount of the penalty, and the criteria for its application. What remains is a ranking of the relative sensitivity of receiving environments, and the relative toxicity of various types of oil. That is a technical effort which is properly vested in an administrative agency.

It might be argued that the establishment of a particular dollars per gallon figure should be established on a spill-by-spill basis by the courts. That, of course, would lead to precisely the same problem faced in utilizing current sec. 760. Moreover, courts are simply not equipped to make these kinds of relative judgments.

D. Why $5 to $50 per gallon?

We believe that $5-$50 per gallon is reasonably related to the gravity of the harm caused by oil pollution. In arriving at the figure, we of course recognize that it is impossible to quantify the environmental harm caused by oil pollution. But this bill is not an attempt to rigidly pre-establish damages. It is a penalty scheme in lieu of damages for which the public will never recover. It is also, of course, intended to serve as a meaningful incentive for safe operations.

On this point, it should be noted that a significantly lower range would result in unreasonably low assessments at the low end of the scale. For example, at a maximum range of $1 per gallon, the discharge of 100 gallons of oil to a salmon stream would result in a penalty of $100 -- a sum hardly commensurate with the gravity of that kind of incident.

E. Shouldn't there be an upper limit on liability?

Under HB 137, an upper limit does exist -- $50.00 per gallon. The total limit of liability thus depends upon the total amount of oil spilled.

To place a dollar limit on the total amount that may be assessed would represent a policy judgment that, at a given point, the harm caused by oil pollution should be borne by the public, rather than the discharger. The administration is not prepared to make that judgment. In this regard, it should be noted that Alaska currently imposes unlimited strict liability for actual damages -- as do Maine and Florida. See AS 46.03.822.

Admittedly, the recoveries which might be had under HB 137 are conceptually very high. So, it should be added, is the level of impact which an oil spill catastrophe can cause, as well as the figures which enter into industry's calculations in determining what level of safety is economically justifiable.

F. Why is it necessary to establish vicarious liability?

HB 137 does extend liability for the penalty to certain persons who are in a position to control the integrity of operations from which the discharge occurred. For example, oil terminals are made vicariously liable for spills caused by vessels which load at their facilities. Similarly, the lessee of an offshore platform is made vicariously liable for discharges caused from his platform, even though the actual cause of the discharge may be due to the acts of an independent contractor.

Focusing on the question of vicarious liability for terminals, it should be stressed that the owners of the transported oil are the ones who choose the carriers which handle their products. Because of the terminal's ability to insure that only the safest vessels, and most experienced crews enter Alaska waters, it simply makes sense, as a matter of equity, to hold the terminal responsible for the vessels' actions, while they are in state waters.

It is this philosophy which motivated §204 of the Trans-Alaska Pipeline Authorization Act (43 USC §1653(c)) which makes the owners of the TAPS oil, through the Trans-Alaska Pipeline Liability Fund, vicariously liable for damages (above $14 million) caused by oil spills from vessels which service the terminal. It is this same philosophy which led the State of Maine, in its Oil Discharge Prevention and Pollution Control Act of 1970, to make oil terminals vicariously liable for oil spills caused by "vessels destined for the licensee's facilities." 38 M.R.S.A. §552. This vicarious liability provision was upheld by the Maine Supreme Court in Portland Pipe Line Corporation vs. Environmental Improvement Commission, 307 A 2nd 1 (1973).

There are very real practical reasons for creating vicarious liability, aside from the amount of control which the terminal exercises over the quality of the vessel and its crew. First, the "independent contractor" defense -- which may be available if vicarious liability were not created -- has generally caused severe problems in oil spill enforcement. For example, the dogged insistence of Alyeska Pipeline Service Company that it is not responsible for oil spills caused by independent contractors engaged in Trans-Alaska Pipeline work has frustrated state enforcement efforts in that regard.

Litigation against the owner of the vessel will often be fruitless. The vessel's owner or charterer will often be protected under the federal Limited Liability Act (46 USC §183, 186), which provides that the liability for damages of the vessel's owner or bareboat charterer as a result of a maritime incident will often be limited to the value of the vessel and freight on board after the incident. After a tanker grounding, of course, that value will be rather small. Of course, since HB 137 imposes liability for penalties, and not damages, it will be the state's position that the Limited Liability Act is inapplicable. It is, however, far from certain how the federal courts will treat this hybrid regulatory approach vis-a-vis that act.

The *Torrey Canyon* disaster provides a tragi-comic example of precisely this problem. On March 18, 1967, the Italian master of this Liberian registered flagship ran aground off the coast of England, spilling, over a period of days, most of her 119,000 tons of crude oil. On March 28, the vessel was sunk by RAF bombers.

The Torrey Canyon was owned by Barracuda Tanker Corp., a subsidiary of Union Oil Co. of California. Barracuda owned the boat pursuant to a sale-lease back arrangement with Union.

Barracuda immediately sued to limit its liability. The federal court obliged, limiting Barracuda's liability to $50 -- the value of one lifeboat which survived the bombing. See In Re Barracuda Tanker Corp., 281 F. Supp. 228, 232 (S.D.N.Y. 1968).

The frustrated British and French governments finally resorted to a remedy unavailable to Alaska -- they seized the Torrey Canyon's sister ships in Singapore and Rotterdam and, in a very real sense, held them for ransom. Barracuda's insurers then paid the governments 3 million pounds sterling -- about one-sixth of the clean-up costs incurred as a result of the spill.

Vicarious liability is nothing new to hazardous undertakings -- particularly the handling of oil. Both as a matter of equity, and practical necessity, we believe it is imperative that those who induce, and profit from oil handling activities, and who in fact have the ability to control the integrity of those activities if they so desire, be impressed with a non-delegable duty to see that those operations are conducted in as safe as possible a manner.

Finally, it should be stressed that those upon whom vicarious liability is imposed are not without recourse if the penalty is assessed against them. As the Maine Supreme Court stressed in Portland Pipe Line Corp., supra, we are dealing here with a "mutually beneficial relationship [i.e. between terminal and vessels, and owners and operators where] there is, in the relationship, adequate opportunity to locate, among the business associates, the primary liability."

G. Will federal admiralty law let us do this?

The short answer is yes. Following the United States Supreme Court decision in Askew v. American Waterways Operators, 411 US 325 (1973), which upheld Florida's strict liability oil spill statute, it was argued by some that certain implications in that opinion might limit the state's ability to impose strict liability for sanctions or damages beyond the limits established in the Federal Water Pollution Control Act -- i.e. $14 million dollars for vessels. In upholding Maine's unlimited strict liability oil spill law, the Maine Supreme Court, in Portland Pipe Line Cement, supra, specifically rejected that argument, and Congress has since made it clear that the Maine Supreme Court correctly interpreted its intent with regards to the state's power to enter the domain of admiralty, to seek redress for oil pollution. For example, in establishing the Trans-Alaska Pipeline Liability Fund, Congress stated with regard to vessels:

> "This subsection shall not be interpreted to preempt the field of strict liability or preclude any state from imposing additional requirements." 43 USC § 1653(c)(9).

To the same effect is the following provision in the federal law creating the Deep Water Port Liability fund:

> "This section shall not be interpreted to preempt the field of liability or to preclude any state for imposing additional requirements or liability for discharges of oil from a deep water port or a vessel within a safety zone." P.L. 93-697, § 18(k)(1).

Similar provisions are contained in comprehensive oil spill liability legislation now pending before Congress. It is clear that states have a "wide scope" in enacting laws pertaining to admiralty matters, as long as the law does not concern a matter requiring uniformity, or impair the harmony of the admiralty system. See Romero v. International Terminal Operating Co., 358 U. S. 354; Askew, supra. Both the courts and Congress have made it clear that the states' power to legislate in admiralty with regard to oil pollution is particularly broad.

H. Where does the money go?

The administration made a conscious decision, in submitting HB 137, not to specify how the penalties received should be allocated. If the bill is left untouched in this regard, penalties collected would, pursuant to AS 30.25-.220(b), be deposited in the coastal protection fund. We believe it would serve no purpose to over-load the coastal protection fund with the substantial penalties which may be collected under this bill.

We would submit, for the legislature's consideration, that it would be more appropriate to return the penalties to the general fund, providing at the same time that the legislature may annually appropriate an amount equal to the penalties collected for the previous year for the purpose of financing renewable resource enhancement efforts in areas affected by oil pollution. These efforts, of course, could specifically include fish hatcheries. It is our belief that, in light of the extreme unlikelihood of effective recovery by fishermen for the full amount of damages actually caused to them as the result of oil pollution, that this mechanism would come as close as possible to, in fact, making the fishing industry whole after a catastrophe occurs. The department of law will be glad to assist the legislature in drafting a new subsection in this regard if that is the legislature's desire.

STATE OF ALASKA

JAY S. HAMMOND, GOVERNOR

DEPARTMENT OF LAW

OFFICE OF THE ATTORNEY GENERAL

POUCH K – STATE CAPITOL
JUNEAU 99811

May 5, 1977

The Honorable Kay Poland
Senator
Alaska State Legislature
Pouch V
Juneau, Alaska 99811

Re: HB 137

Dear Senator Poland:

The above-entitled bill is presently pending in the Senate Resources Committee. It is a measure which establishes civil penalties for oil pollution. I am writing to you in the hope that you and other members of the Senate will act favorably on this bill before adjournment, since if you do not there will be no meaningful tool available to deal with a major oil spill in Alaska.

Right now, if we had a tanker accident and millions of gallons entered Alaskan waters, we would have three options:

1. We could proceed criminally and obtain a fine of up to $25,000.

2. We could seek a civil fine for liquidated damages of up to $100,000.

3. Finally, if we could prove actual damages to the environment, we could recover for those damages.

On the surface, the final option seems to provide a means for dealing with massive spills. But the problem is that in all the years of statehood this statute has been only used once, and that was for damage to nets as the result of a spill. No one has ever been able to show damages to the environment for the simple reason that our level of scientific knowledge has not reached the point where such damages can be shown to the satisfaction of a court. If, for instance, we had a major oil spill in a productive salmon area, there is no way for us to tell how many salmon fry or eggs were destroyed, what other marine life was affected, such as marine life which would form an essential link in the food chain for salmon, and no way to prove with certainty, even were runs to drastically decrease years later, that the proximate cause of that decrease was the oil spill. I think nearly every marine biologist would agree that major oil spills cause substantial damage, but they would also all agree that there is no way we could quantify that damage under present judicially established rules of evidence.

In the end, it boils down to the fact that we have no meaningful deterrent for those who would cause a massive oil spill in state waters. Legislation adopted last year set stringent standards for tankers which will go a long way toward helping us prevent spills, but there is still the factor of human error which, in spite of the most rigid safety devices, may still lead to massive damage. Once that spill occurs, the state should have some means of proceeding against the company that caused the spill. HB 137 provides that means. The bill is extremely important from the administration's standpoint, since this year will see the commencement of major tanker traffic through Alaskan waters, and if we do have a major accident the state should have the power to take significant steps against those who caused the pollution.

The bill as it passed the House has been substantially changed from the bill which was originally introduced by the administration. The House eliminated from the provisions of the bill all spills of under 10,000 gallons, so as to make the bill applicable to major tanker type spills rather than those from fishing boats. A maximum limit of $100 million has been placed on the fine, which may seem large until you consider the magnitude of profit involved in a single tanker voyage. The house bill also bases the civil fine on the amount of oil spilled less the amount of oil cleaned up, providing a major incentive for cleanup activities.

The basic theory of the house bill is for the Commissioner of Environmental Conservation to establish a sliding scale of penalties for oil spills up to a maximum set by the Legislature, dependent upon the type of oil spill (crude, jet fuel, etc.), and the sensitivity of the receiving environment (open ocean, confined salt water system, etc.). The schedule would be subject to legislative review after it is established. The theory is that penalties for oil pollution should depend on how serious that pollution is and, while we cannot fix damages with the certainty required by law, we can predict with certainty that certain types of oil in certain types of environments cause more serious damage than other types of oil in different environments.

I am enclosing with this letter a section-by-section analysis of the bill so that you will have a basic understanding of the structure of the bill that passed the House. Again I reiterate that we have no effective tool to deal with major oil spills now, and as the administration officer with the responsibility to enforce pollution laws, I want very much to have that kind of a tool before, rather than after, a major spill occurs in state waters. I therefore ask you to please consider this bill seriously in the closing days of this session. Members of my office and all other members of the administration stand available to provide information and to help you in any way in your deliberations on the subject.

Yours very truly,

Avrum M. Gross
Attorney General

AMG:as
Enclosure

SECTION-BY-SECTION ANALYSIS OF CSHB 137 (Judiciary) am

1. Introduction

HB 137 would create a schedule of civil penalties for the discharge of oil on a per gallon basis. It is patterned in large measure on Section 311(b)(2)(B)(iv) of the Federal Water Pollution Control Act. Although the mechanics of the bill are new, its concepts and purposes are consistent with Alaska's existing strict liability civil penalty law.

Under the bill, the Department of Environmental Conservation is to establish, under detailed legislative guidance, a schedule of penalties based, essentially, on the type of oil spilled, and the sensitivity of the receiving environment. Maximum per gallon assessments for various classes of receiving environments are set out in the bill.

Dischargers are strictly liable for the penalties, as they now are under AS 46.03.760 and AS 46.03.822 and the state is required to prove its case at trial both as to liability and the size of the spill. Moreover, penalties will only be assessed on that amount of oil not cleaned up.

2. Subsection (a)

This subsection articulates the purposes of the bill. Paragraphs (1) and (2) stress that, because of the long-term, subtle and unquantifiable nature of oil pollution impact, traditional liability and damage concepts are ineffective in compensating for oil spills.

Paragraph (3) highlights the important incentive aspects of the bill. It recongizes that the per gallon assessment for small oil handlers does not need to be as high as for large handlers in order to induce safe operations.

3. Subsections (b), (c) and (d)

The standards for the establishment of the penalty schedule are set out in these subsections. First, maximum assessments, ranging from $10 per gallon in freshwater to $1 per gallon in salt water, are established. We stress that these figures are maximums -- penalties for unproductive freshwater environments, for example, would be substantially lower than $10 per gallon.

There is nothing magical about the figures used. These are civil penalties, not rigidly pre-established actual damages. In setting penalties, a judgment must be made as to whether the amount chosen bears a reasonable relationship to the purposes of the legislation. We believe the amounts chosen meet that standard.

The base penalties themselves are modest. For example, a 10,000 gallon spill into Kachemak Bay would result in liability of, at the most, $25,000 -- as opposed to potential $100,000 exposure under existing law (AS 46.03-.760). The base penalties, however, increase with the size of the spill, according to a multiplier factor spelled out in subsection (b)(2). The factor is 1 for spills of 10,000 gallons, and reaches 5 for spills of 100,000 gallons or more according to a formula. Thus, our same hypothetical spill in Kachemak Bay, if increased to 100,000 gallons, would result in liability of $1.25 million. In an unproductive environment, this figures would be substantially lower. This formula approach implements the findings of subsection (a)(3) -- that the level of incentive should increase according to the size of the oil handling operation.

Subsection (e)

This subsection establishes liability for the penalties. At the outset, a liability ceiling of $100 million is established. This provision was inserted in the House Judiciary Committee, in response to concerns over the otherwise unlimited nature of liability. The subsection also exempts entirely spills less than 10,000 gallons from the bill's coverage. This admendment was inserted on the House floor.

The subsection also alleviates the problem of the "independent contractor" defense. Usually, an oil company will conduct operations through a contractor. If a mishap occurs, the oil company may disclaim responsibility. Subsection (e) imposes a duty on industry to choose its contractors and carriers well, and to maintain strict quality control, by making, for example, the owner of the oil liable for spills from the vessel carrying its oil, and the offshore lessee liable for the activities of its contractors on the drilling rig.

Liability is extended to spills in the Alaska Outer Continental Shelf. Our state supreme court has strongly indicated that, because of the state's strong interest in the productivity of the OCS, this exercise of authority may be permissible. As a safeguard, however, a specific severability provision with regard to this aspect of the bill has been provided in section 2.

Subsection (f)

This subsection provides that only that amount of oil not cleaned up will be utilized in computing the penalties. It also provides that the court may estimate the amount of oil removed. This latter provision was inserted at the behest of industry, which correctly pointed out that the amount of oil removed cannot be proven with precision.

Subsections (h) and (j)

These subsections set out the available defenses to liability. They include the "normal" strict liability defenses -- act of war, governmental negligence and act of God. The act of God defense will only be available if the act of nature was unavoidable, unpredicatable, and unique to the area in which it occurred.

Acts of sabotage and other intentional acts by a third party constitute a complete defense under the bill. However, if a spill is occasioned by third-party negligence, the penalty may only be reduced by half. This is more generous than most strict liability statutes, where third-party negligence is not a defense at all.

Subsection (k)

This subsection provides that penalties received under the bill will be credited to a special account. The legislature may appropriate funds from this account to finance renewable resource enhancement projects in areas affected by oil pollution.