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DESCRIPTION OF THE PROPOSED OCEAN DUMPING SITE: HERBICIDE ORANGE

Presented by:

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USAF Environmental Health Laboratory
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PROPOSED OCEAN DUMPING SITE

I. INTRODUCTION

A. Using presently available knowledge of ocean characteristics and ecosystems, it is possible to develop criteria for acceptable ocean disposal sites and examine specific locations to determine their suitability for this use. This presentation lists site criteria and describes the area designated for incineration of herbicide Orange.

B. Pequegnat[11], in his testimony to EPA concerning the ocean dumping of incineration waste in the Gulf of Mexico, stated that the general advantages of offshelf disposal of industrial wastes are: 1) the presence of great volumes of water, 2) relatively simple water and air currents, 3) little stratification of the water column, and 4) relatively little productivity in the area. The area chosen for disposal should possess all these characteristics. This position statement will show that the area designated for the disposal of incinerated herbicide Orange is acceptable in all aspects.

II. THE OCEAN ENVIRONMENT

A. General

The open ocean provides the best medium for the disposal of incinerated organic waste. It is one of the least productive areas of the

world.[10] It has the capacity to absorb, without deleterious effects, large amounts of degradable and inorganic wastes. What small effect occurs at the time of incineration is transient due to internal recovery of the ecosystem of the particular area and by immigration from adjacent areas.

Not all marine environments are unproductive. Estuarine and inshore waters, unlike the open ocean, are quite productive. These ecosystems may double the total production (in biomass) of terrestrial agriculture under irrigation and produce up to 30 times more than the open ocean such as the proposed disposal site. Estuaries and inshore waters have the attributes of lower salinity and higher nutrients due to the inflow of fresh water and also have the advantage of shallower depths.[11]

Disposal of materials far from land produces the least environmental impact simply because it is being put immediately into an unproductive ecosystem where it can then degrade. When materials are disposed of on land, eventually they may move through the hydrologic system to rivers, estuaries, and inshore waters where severe environmental impact may be exerted before degradation can take place. Also bioaccumulation of toxic or hazardous materials could occur with still further adverse implications.

With the exception of a total recycling system, incineration in the unproductive open ocean is the most environmentally safe alternative of waste disposal known.

B. Ocean Food Chains

The primary producers are photosynthetic plankton. These organisms assimilate inorganic materials into organic matter. They consist

mostly of microscopic diatoms and dinoflagellates although in some areas green and brown algae may predominate. These organisms are found in the euphotic zone, which in some instances may extend down to 1000 meters, but the bulk of the production is in the upper 100 meters.

Crustaceans and protozoa graze upon the phytoplankton, and they in turn are fed upon by carnivores such as fish. The food chain for carnivores is a long, complex and intermingled web.

Below the euphotic zone nearly all the pelagic animals are predators. The benthic organisms are scavengers or decomposers feeding on detritus falling from the zones above them.[1]

III. DESCRIPTION OF PROPOSED DISPOSAL SITE

A. Location

The disposal site is located between 15° 45' to 17° 45' N latitude and 171° 30' to 172° 30' W longitude. It comprises approximately 9117 sq miles. The reported mean depth is between 4937 and 5486 meters with a minimum depth of 3575 meters and a maximum of 5568 meters. It is located approximately 120 miles SW of Johnston Island and 1200 statute miles SW of the Hawaiian Islands. The area is generally regarded as being one of the least productive areas in the Pacific Ocean.[4, 5] Very little specific data is available for this particular area but several areas in the Pacific Ocean have been studied and data can be taken from these studies.

B. Physical Features

1. pH

High pH in the receiving medium is necessary for adequate chemical dissolution of the pyrolysis products of incineration. Among these

products is HCl which would tend to lower the pH of the receiving water. Ocean water has a strong carbonate buffer system along with borate and silicon systems. The diffusion of CO_2 into the upper ocean levels and biological activity at that level give the ocean an alkaline pH strongly resistant to change. In the Pacific Ocean, the pH profile shows a distinct inflection. A pH maximum of 8.2 - 8.3 in the first 100 m can be attributed to CO_2 diffusion and biological activity. The pH minimum of 7.5 - 7.7 occurs at 200 - 1200 m and is associated with the minimum oxygen profile and is attributed to biochemical processes.[7] Specific values for surface pH in the area 10° to 20° N and 170° to 180° W range from 7.9 - 8.3 with the reading nearest the disposal area being 8.2.

2. Dissolved Oxygen

Dissolved oxygen is an important factor in oxidizing pyrolysis products. The presence of oxygen in sea water is due to contact of the water with the atmosphere at the sea-air interface and to the metabolism of photosynthetic organisms. The oxygen concentration present at any given time is the result of a series of biological and physical factors. The diffusion of oxygen into sea water is dependent on the partial pressure of the gas in the atmosphere, the concentration gradient in the surface layer, the atmospheric pressure, temperature and salinity. In most instances there is a maximum oxygen concentration in the euphotic zone due to diffusion and photosynthesis, but there is a steady decline until an oxygen minimum is reached.[7]

The vertical distribution of oxygen in the sea can be summarized as follows: 1) A well mixed layer in equilibrium with the

atmosphere and uniform in oxygen content extending to the thermocline, 2) at lower depths, reactions with organic matter causes a variable decrease in oxygen concomitant with increasing depths, the minimum concentration being found between 700 and 1000 meters, and 3) lower depths may have the same or higher oxygen content due to sinking colder water originating from higher latitudes.[8]

3. Salinity

The mean surface salinity for the proposed disposal site is 34.75 parts per thousand with negligible variation over the course of a year. This value is not significantly different from average open ocean salinity taken from other parts of the world.

4. Light

Light penetration in the ocean has a great effect on the vertical position of plankton. The depth of the euphotic zone, in which the majority of phytoplankton is found, depends primarily on the total amount of light received and the transparency of the water. In tropical regions with high average surface illumination, the vertical distribution of phytoplankton may extend to depths of about 100 meters.

Diel rhythmic vertical migration of plankton is also associated with fluctuations in light. It is believed that this phenomenon is caused by animals moving to a zone of optimum light intensity. This causes an aggregation within certain strata. The phases of migration are described as movement toward the surface in the evening, departure from the surface at or about midnight, return to the surface near dawn, and a sharp return to normal daytime depth as the sunlight begins to penetrate the water. It is estimated that 3/4 of the zooplankton exhibit diel migration rhythms.[8]

In general, pelagic fish follow a diel rhythm in respect to vertical distribution. During daylight hours they tend to be deeper and at night approach the surface to feed. However, due to the low standing biomass and the generally recognized low productivity, these diel rhythms are inconsequential as related to significant rhythmic increases of biomass in the mixing zone.

5. Temperature

The average surface temperature of the tropical Pacific Ocean between 10° and 20° N latitude is 26.4°C (79.5°F) with an annual range of about 3°C (difference between temperature recorded in February and August).[7] The mean yearly temperature of the surface water in the disposal area is 26.9° (80.4°F) with a minimum mean of 24.8° (76.6°F) and a maximum mean of 29.0°C (84.2°F). The vertical temperature distribution in the upper layers consists of an isothermal layer (identical temperatures at different depths), the thermocline (a layer with maximum decrease per unit depth), and a thick lower layer with slowly decreasing temperatures. The thermocline is formed by thermal energy received by the surface layer which decreases the water density thus producing a vertical stratification of progressively increasing stability. The resulting thermocline restricts vertical heat and water exchange. A strong thermocline also inhibits physicochemical and biological vertical exchanges thus greatly affecting both the hydrographical and ecological dynamics within the area concerned. The tropical sea has a steep thermocline which has considerable influence on both vertical exchange and animal distribution.[8] The thermocline in the proposed disposal area is located at a depth of about 250-350 feet.[1]

Vertical distribution of marine invertebrates may be affected by temperature in three ways: 1) Exclusion from water depths with unsuitable temperature, 2) migration to suitable thermal levels within the vertical gradient, or 3) passive transport. Accumulation or dissipation due to hydrographical conditions is vitally important in the vertical distribution of passively floating planktonic forms. Many of these individuals would be lost from the euphotic zone, thus removed from the reproducing population except that they are returned to the lighted zone by upward moving water. At the thermocline these downward movements are sufficiently retarded to allow accumulation. Vertical temperature gradients are more pronounced in the lower latitudes than at the higher latitudes, consequently, vertical distribution is influenced more by temperature in the tropical and temperate regions than in polar regions.[8]

6. Wind and Water Currents

Wind and water currents are favorable in view of mixing and keeping materials away from land masses. The proposed disposal area lies in the westward moving equatorial currents and the prevailing winds are from the east. The nearest land mass, the Marshall Islands, is more than 1200 miles downwind.[1,2]

There are no reported upwellings in the area to bring nutrients to the surface nor does the wake of Johnston Island influence nutrient levels.[5,6]

C. Biological Features

1. Biomass and Primary Productivity

Standing biomass in the proposed disposal area is extremely low. Secchi disk readings for this area are among the highest recorded in

the Pacific Ocean.[5] The high Secchi disk readings indicate extremely clear water with a sparse population of plankton.

No measurement of primary productivity is available from the proposed disposal area but it is generally regarded as low. The reasons are the low nutrient levels in the area, low standing biomass, and relatively low fishing activity.

2. Benthos Abundance

No data is available for this particular portion of the ocean; however, studies in the Gulf of Mexico estimated the total benthic macrofauna biomass, exclusive of fish, to be 0.2 gm/sq meter.[11]

Some of the organisms reported present on the Pacific Ocean floor were starfishes, sea cucumbers, sea urchins, echinoderms and brittle stars. In deeper areas sponges, barnacles, sea lillies and sea squirts were found along with crabs, prawns, isopods and sea spiders.[1]

3. Commercial Fishing

The proposed disposal site will have very little impact on commercial fishing. Commercial fishermen from the Republic of Korea, Taiwan, Japan and Samoa are the ones who frequent this area most with Japanese fishing vessels comprising the majority of vessels in the area. Table 1 shows the catch of commercial species of fish in the area 10° 00' to 20° 00' N latitude and 170° 00' to 180° 00' W longitude as compared to the catch for the entire Pacific Ocean in 1971 and 1972.[3] The northern half of this area (15° 00' - 20° 00' N latitude), which includes the disposal area, is reported to be less productive than the southern half.[9]

TABLE 1 Report of Japanese long line tuna catch in the Pacific Ocean in 1971 and 1972[3]. Figures are given in number of fish caught.

FISH	1971 10°00' to 20°00' N Lat 170°00' to 180°00' W long	1971 Pacific Total	1972 10°00' to 20°00' N Lat 170°00' to 180°00' W Long	1972 Pacific Total
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Skipjack Tuna	473	59,000	151	52,000

1971

Total of 1,313 sets (1 set = min of 1 ship/day)
Total of 2,733, 925 hooks (2,000 + hooks/set)

1972

Total of 451 sets
Total of 986, 625 hooks

IV. SUMMARY

In view of the facts about the proposed disposal site contained in this report--sparse productivity, low standing biomass, acceptable physical and chemical characteristics of the receiving waters, remoteness of the location, favorable wind and water currents, and relatively little commercial fishing activity; the proposed site possesses all the characteristics described in the introduction as criteria for an acceptable ocean disposal site. It is recognized that the addition of any foreign material into a small portion of a tropical ocean ecosystem may have some effect; however, this effect will be transient, minimal and inconsequential as it relates to that ecosystem as a whole.

REFERENCES

1. Anon. United States Department of Commerce, National Marine Fisheries Service, Environmental Impact Statement, Deep Seabed Mining 0 - 25° N Lat, 110 - 155° W Long.

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4. Anders, F. S. 1975. National Marine Fisheries Service, Terminal Island CA. (Personal communication).

5. Barkley, R. A. 1975. National Marine Fisheries Service, Honolulu HI. (Personal communication).

6. Barkley, R. A. 1972. Johnston Atoll's Wake. J. Marine Res. 30, 201-216.

7. Horne, R. A. 1969. Marine Chemistry. John Wiley and Sons. New York, 568 pp.

8. Kinne, O. 1970. Marine Ecology. John Wiley and Sons. New York, 681 pp.

9. Klawe, Dr. 1975. Inter-American Tropical Tuna Corporation, La Jolla CA. (Personal communication).

10. Odum, E. P. 1971. Fundamentals of Ecoloy. W. B. Saunders, Philadelphia.

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B. Ocean Food Chains

The primary producers are photosynthetic plankton. These organisms assimilate inorganic materials into organic matter. They consist

mostly of microscopic diatoms and dinoflagellates although in some areas green and brown algae may predominate. These organisms are found in the euphotic zone, which in some instances may extend down to 1000 meters, but the bulk of the production is in the upper 100 meters.

Crustaceans and protozoa graze upon the phytoplankton, and they in turn are fed upon by carnivores such as fish. The food chain for carnivores is a long, complex and intermingled web.

Below the euphotic zone nearly all the pelagic animals are predators. The benthic organisms are scavengers or decomposers feeding on detritus falling from the zones above them.[1]

III. DESCRIPTION OF PROPOSED DISPOSAL SITE

A. Location

The disposal site is located between 15° 45' to 17° 45' N latitude and 171° 30' to 172° 30' W longitude. It comprises approximately 9117 sq miles. The reported mean depth is between 4937 and 5486 meters with a minimum depth of 3575 meters and a maximum of 5568 meters. It is located approximately 120 miles SW of Johnston Island and 1000 miles SW of the Hawaiian Islands. The area is generally regarded as being one of the least productive areas in the Pacific Ocean.[4,5] Very little specific data is available for this particular area but several areas in the Pacific Ocean have been studied and data can be taken from these studies.

B. Physical Features

1. pH

High pH in the receiving medium is necessary for adequate chemical dissolution of the pyrolysis products of incineration. Among these

products is HCl which would tend to lower the pH of the receiving water. Ocean water has a strong carbonate buffer system along with borate and silicon systems. The diffusion of CO_2 into the upper ocean levels and biological activity at that level give the ocean an alkaline pH strongly resistant to change. In the Pacific Ocean, the pH profile shows a distinct inflection. A pH maximum of 8.2 - 8.3 in the first 100 m can be attributed to CO_2 diffusion and biological activity. The pH minimum of 7.5 - 7.7 occurs at 200 - 1200 m and is associated with the minimum oxygen profile and is attributed to biochemical processes.[7] Specific values for surface pH in the area 10° to 20° N and 170° to 180° W range from 7.9 - 8.3 with the reading nearest the disposal area being 8.2.

2. Dissolved Oxygen

Dissolved oxygen is an important factor in oxidizing pyrolysis products. The presence of oxygen in sea water is due to contact of the water with the atmosphere at the sea-air interface and to the metabolism of photosynthetic organisms. The oxygen concentration present at any given time is the result of a series of biological and physical factors. The diffusion of oxygen into sea water is dependent on the partial pressure of the gas in the atmosphere, the concentration gradient in the surface layer, the atmospheric pressure, temperature and salinity. In most instances there is a maximum oxygen concentration in the euphotic zone due to diffusion and photosynthesis, but there is a steady decline until an oxygen minimum is reached.[7]

The vertical distribution of oxygen in the sea can be summarized as follows: 1) A well mixed layer in equilibrium with the

atmosphere and uniform in oxygen content extending to the thermocline, 2) at lower depths, reactions with organic matter causes a variable decrease in oxygen concomitant with increasing depths, the minimum concentration being found between 700 and 1000 meters, and 3) lower depths may have the same or higher oxygen content due to sinking colder water originating from higher latitudes.[8]

3. Salinity

The mean surface salinity for the proposed disposal site is 34.75 parts per thousand with negligible variation over the course of a year. This value is not significantly different from average open ocean salinity taken from other parts of the world.

4. Light

Light penetration in the ocean has a great effect on the vertical position of plankton. The depth of the euphotic zone, in which the majority of phytoplankton is found, depends primarily on the total amount of light received and the transparency of the water. In tropical regions with high average surface illumination, the vertical distribution of phytoplankton may extend to depths of about 100 meters.

Diel rhythmic vertical migration of plankton is also associated with fluctuations in light. It is believed that this phenomenon is caused by animals moving to a zone of optimum light intensity. This causes an aggregation within certain strata. The phases of migration are described as movement toward the surface in the evening, departure from the surface at or about midnight, return to the surface near dawn, and a sharp return to normal daytime depth as the sunlight begins to penetrate the water. It is estimated that 3/4 of the zooplankton exhibit diel migration rhythms.[8]

In general, pelagic fish follow a diel rhythm in respect to vertical distribution. During daylight hours they tend to be deeper and at night approach the surface to feed. However, due to the low standing biomass and the generally recognized low productivity, these diel rhythms are inconsequential as related to significant rhythmic increases of biomass in the mixing zone.

5. Temperature

The average surface temperature of the tropical Pacific Ocean between 10° and 20° N latitude is 26.4°C (79.5°F) with an annual range of about 3°C (difference between temperature recorded in February and August).[7] The mean yearly temperature of the surface water in the disposal area is 26.9° (80.4°F) with a minimum mean of 24.8° (76.6°F) and a maximum mean of 29.0°C (84.2°F). The vertical temperature distribution in the upper layers consists of an isothermal layer (identical temperatures at different depths), the thermocline (a layer with maximum decrease per unit depth), and a thick lower layer with slowly decreasing temperatures. The thermocline is formed by thermal energy received by the surface layer which decreases the water density thus producing a vertical stratification of progressively increasing stability. The resulting thermocline restricts vertical heat and water exchange. A strong thermocline also inhibits physicochemical and biological vertical exchanges thus greatly affecting both the hydrographical and ecological dynamics within the area concerned. The tropical sea has a steep thermocline which has considerable influence on both vertical exchange and animal distribution.[8] The thermocline in the proposed disposal area is located at a depth of about 250-350 feet.[1]

Vertical distribution of marine invertebrates may be affected by temperature in three ways: 1) Exclusion from water depths with unsuitable temperature, 2) migration to suitable thermal levels within the vertical gradient, or 3) passive transport. Accumulation or dissipation due to hydrographical conditions is vitally important in the vertical distribution of passively floating planktonic forms. Many of these individuals would be lost from the euphotic zone, thus removed from the reproducing population except that they are returned to the lighted zone by upward moving water. At the thermocline these downward movements are sufficiently retarded to allow accumulation. Vertical temperature gradients are more pronounced in the lower latitudes than at the higher latitudes, consequently, vertical distribution is influenced more by temperature in the tropical and temperate regions than in polar regions.[8]

6. Wind and Water Currents

Wind and water currents are favorable in view of mixing and keeping materials away from land masses. The proposed disposal area lies in the westward moving equatorial currents and the prevailing winds are from the east. The nearest land mass, the Marshall Islands, is more than 1000 miles downwind and downcurrent.[1,2]

There are no reported upwellings in the area to bring nutrients to the surface nor does the wake of Johnston Island influence nutrient levels.[5,6]

C. Biological Features

1. Biomass and Primary Productivity

Standing biomass in the proposed disposal area is extremely low. Secchi disk readings for this area are among the highest recorded in

the Pacific Ocean.[5] The high Secchi disk readings indicate extremely clear water with a sparse population of plankton.

No measurement of primary productivity is available from the proposed disposal area but it is generally regarded as low. The reasons are the low nutrient levels in the area, low standing biomass, and relatively low fishing activity.

2. Benthos Abundance

No data is available for this particular portion of the ocean; however, studies in the Gulf of Mexico estimated the total benthic macrofauna biomass, exclusive of fish, to be 0.2 gm/sq meter.[11]

Some of the organisms reported present on the Pacific Ocean floor were starfishes, sea cucumbers, sea urchins, echinoderms and brittle stars. In deeper areas sponges, barnacles, sea lillies and sea squirts were found along with crabs, prawns, isopods and sea spiders.[1]

3. Commercial Fishing

The proposed disposal site will have very little impact on commercial fishing. Commercial fishermen from the Republic of Korea, Taiwan, Japan and Samoa are the ones who frequent this area most with Japanese fishing vessels comprising the majority of vessels in the area. Table 1 shows the catch of commercial species of fish in the area 10° 00' to 20° 00' N latitude and 170° 00' to 180° 00' W longitude as compared to the catch for the entire Pacific Ocean in 1971 and 1972.[3] The northern half of this area (15° 00' - 20° 00' N latitude), which includes the disposal area, is reported to be less productive than the southern half.[9]

TABLE 1 Report of Japanese long line tuna catch in the Pacific Ocean in 1971 and 1972[3]. Figures are given in number of fish caught.

FISH	1971 10°00' to 20°00' N Lat 170°00' to 180°00' W long	1971 Pacific Total	1972 10°00' to 20°00' N Lat 170°00' to 180°00' W Long	1972 Pacific Total
Albocore Tuna	1,601	869,000	1,386	788,000
Bigeye Tuna	24,508	1,272,000	8,919	1,657,000
Yellowfin Tuna	6,886	1,292,000	2,579	1,545,000
Broad-bill Swordfish	391	175,000	172	170,000
Striped Marlin	1,383	394,000	398	262,000
Blue Marlin	2,643	102,000	1,602	125,000
Black Marlin	72	19,000	15	17,000
Sailfish/Spearfish	682	195,000	451	189,000
Skipjack Tuna	473	59,000	151	52,000

1971
Total of 1,313 sets (1 set = min of 1 ship/day)
Total of 2,733, 925 hooks (2,000 + hooks/set)

1972
Total of 451 sets
Total of 986, 625 hooks

IV. SUMMARY

In view of the facts about the proposed disposal site contained in this report--sparse productivity, low standing biomass, acceptable physical and chemical characteristics of the receiving waters, remoteness of the location, favorable wind and water currents, and relatively little commercial fishing activity; the proposed site possesses all the characteristics described in the introduction as criteria for an acceptable ocean disposal site. It is recognized that the addition of any foreign material into a small portion of a tropical ocean ecosystem may have some effect; however, this effect will be transient, minimal and inconsequential as it relates to that ecosystem as a whole.

REFERENCES

1. Anon. United States Department of Commerce, National Marine Fisheries Service, Environmental Impact Statement, Deep Seabed Mining 0 - 25^{o} N Lat, 110 - 155^{o} W Long.

2. Anon. 1974. Disposition of Orange Herbicide by Incineration. USAF Final Environmental Statement.

3. Anon. 1972. Annual Report of Effort and Catch by Area on Japanese Longline Fishery, 1972. Research and Development Dept., Fisheries Agency of Japan.

4. Anders, F. S. 1975. National Marine Fisheries Service, Terminal Island CA. (Personal communication).

5. Barkley, R. A. 1975. National Marine Fisheries Service, Honolulu HI. (Personal communication).

6. Barkley, R. A. 1972. Johnston Atoll's Wake. J. Marine Res. 30, 201-216.

7. Horne, R. A. 1969. Marine Chemistry. John Wiley and Sons. New York, 568 pp.

8. Kinne, O. 1970. Marine Ecology. John Wiley and Sons. New York, 681 pp.

9. Klawe, Dr. 1975. Inter-American Tropical Tuna Corporation, La Jolla CA. (Personal communication).

10. Odum, E. P. 1971. *Fundamentals of Ecoloy.* W. B. Saunders, Philadelphia.

11. Pequegnat, W. E. 1974. Concerning Disposal of Incineration Wastes, Western Gulf of Mexico. Statement to EPA Public Hearing, Houston TX, 4 October 1974.