The Environmental Effects of the Cruise Line Industry

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Introduction

In the United States a new debate is beginning to emerge, focused on the need for any adjustments to the current legal and regulatory structure governing the foreign cruise line industry. During the last nine years nine bills have been introduced in both the House and the Senate specifically related to the cruise line industry as it operates in U.S. waters. Although some of the bills have focused on taxation and labor issues, the main focus has been on increasing market opportunities for the U.S. domestic cruise line industry. Consideration has been given to market barriers for shipbuilding and ship repair as well as to actual cruise itineraries. In the 106th Congress, Senate Bill 1510 (House Bill 248) was proposed by Senator John McCain in August 1999. This bill, the U.S. Cruise Ship Tourism Development Act, would allow foreign cruise lines, which currently make up 95% of the cruise industry, to offer cruises entirely within U.S. waters on a limited basis until 2006. This action would serve as an exemption from the Jones Act (Merchant Marine Act of 1920, Section 27), which reserves the right of coastal commerce for registered U.S. vessels only. Included in the McCain bill are stipulations requiring cruise vessels that receive permits for coastal cruising to abide by all U.S. maritime laws relative to health, safety, labor, and the environment. In addition, all ship repairs and maintenance would have to be performed in a U.S. shipyard.

Accompanying this congressional attention have been numerous other actions by other agencies regarding the cruise industry. The EPA recently promulgated new air emission guidelines for marine engines on vessels of 50 tons or more with displacements

up to 60 kilograms/liter. This action specifically avoided the regulation of larger engines (60+ tons) like those found in cruise ships, because the EPA believes that larger ship engines will be regulated when international standards are ratified and adopted by a majority of maritime nations. In response to the EPA's decision not to regulate large marine engines, Bluewater Network has filed a lawsuit claiming that a failure to regulate larger marine engines allows those ships to impose a significant pollution burden on U.S. cities and ports, thus offsetting much of the gain made by regulating the smaller engines.

In other developments concerning air pollution, the state of Alaska has created a state implementation plan (SIP) that limits air emissions from cruise ships. This SIP is enforceable by Alaska's Department of Environmental Conservation as well as by the EPA. In March 2000 the EPA cited six cruise lines with failure to comply with Alaska's SIP for visible emissions. After completing their investigation, the EPA issued notices of violation and proposed penalties for five cruise lines—Princess, Norwegian, Celebrity, Holland, and Carnival.

Relative to cruise ship water pollution, Bluewater and 50 other environmental organizations have requested that the EPA look into the effects of the cruise industry's discharge of oily bilge water, sewage, gray water, food waste, and garbage into U.S. waters. In response, the EPA has provided preliminary recommendations in an agency white paper, has held three regional public hearings, and plans to establish an interagency work group that will recommend a course of action. Finally, the Center for Marine Conservation is examining both the environmental and the social/cultural effects of the cruise line industry on indigenous people occupying the areas most heavily traveled by cruise ships.

Until very recently, the environmental impact of the growing cruise line industry had gone largely unchecked. In fact, none of the recently proposed legislation included any analysis of the environmental effects of allowing coastal itineraries for foreign-registered cruise ships. Environmental groups and the media have begun to question how much pollution is actually coming from cruise ships as they operate in U.S. waters, how much would be generated under the proposed legislation, and how much harm is being and would be caused. These questions have not yet been answered. This paper intends to determine what environmental impact cruise ships are having now and what course of action Congress should pursue. The focus of this research will be cruise ship contributions to U.S. air and water pollution, with specific attention given to five criteria air pollutants and the discharge of oily bilge water into U.S. ocean waters. Although this cannot be a comprehensive analysis of all pollution coming from cruise ships, this study should shed some light on whether the foreign-registered cruise line industry currently operating in U.S. waters is a significant polluter.

This study uses two main approaches to calculate the air and water pollution of cruise ships. To assess the air pollution, the study follows the methodology of an EPA study of emissions from cargo ships. That model determines the operation time, time spent in U.S. waters, underway time, and consumption of fuel per day. The fuel consumption figure is then multiplied by different emission factors to arrive at pollution amounts per ship and for the entire industry. To assess water pollution, industry averages of oily bilge discharge are used to calculate total oil discharge by the total fleet per year.

When the extent of the pollution is known, it becomes possible to consider options that Congress might pursue to regulate the cruise line industry. One option

would be to maintain the status quo, that is, to make no exemptions to the Jones Act and to continue lax enforcement of laws already in place. Another option would be to increase funding so that full enforcement of current and future laws regulating the cruise line industry could be a reality. A more moderate option would be to allow some coastal itineraries for foreign cruise ships but to couple that with a modest increase in the level of enforcement. When costs and environmental effects are used to evaluate these options, the more moderate option becomes the recommendation. It allows further growth and economic opportunity for the cruise ship industry, resulting in economic improvement for U.S. ports and cities. At the same time the increase in enforcement of U.S. environmental regulations should lessen the negative environmental impact of the foreign cruise line industry as it operates in U.S. waters.

Background

The concept of cruising for pleasure is not new. In 1844 the Peninsula and Oriental Steam Navigation Company, now known as P&O, began the first operation of cruises in Europe. By the late 1860's cruising was occurring in America. The first U.S.-originated cruise was the 1867 voyage of the *Quaker City.* A major milestone in the cruise industry came in the 1900's with the advent of transatlantic megaships like the *Titanic*. During that period the media focused on the rich who cruised for pleasure, but until the conclusion of World War I the true market focus of the cruise industry was the transportation of immigrants. After World War I the focus of transatlantic cruising began to shift away from the necessity of transportation and toward the idea of pleasure and tourism. This shift was finalized with the introduction of transatlantic air service in 1958.

From that point on, cruising was designed to fulfill Mark Twain's vision of it—" a picnic on a gigantic scale" (*Selling the Sea,* p. 3). Modern cruising gained considerable popularity with the hit 1977 television series "Love Boat," which was filmed in part on an actual operating ship owned by the Princess Cruise Line Corporation. In response to the increased interest of the American public in cruising vacations, the 1970's and 1980's gave birth to companies like Carnival Cruise Corporation, Royal Caribbean Cruise Lines (RCCL), and Princess Cruise Lines, which dominate the current cruise market in the United States and the world.

The Cruise Industry: Today and Tomorrow

Today, tourism is the number one employer in the United States and the number two contributor to the GDP (Census, 1999). The cruise line industry, a $13 billion industry, has been "far and away the fastest growing segment of the entire travel and tourism industry—outpacing hotels, restaurants, and theme parks" (*Selling the Sea,* p. 37). Cruising worldwide has gone from a mere 0.5 million passengers a year in 1970 to 9.5 million passengers worldwide in 1998 (GAO, p. 5). Most of this growth has been dominated by the North American cruise market, which grew approximately 8% annually between 1980 and 1999 and accounted for nearly 5.5 million passengers in 1998, roughly 60% of all passengers worldwide (CLIA, p. 5). The worldwide fleet of cruise ships now totals 225, of which approximately 150 operate solely in the North American market (GAO, p. 5). And along with the increased fleet size has come an increase of almost 50% in cruise ship embarkations from North American ports (GAO, p. 5). The major U.S.

ports of call are located in Florida, Alaska, California, Louisiana, Massachusetts, New York, Puerto Rico, and Texas.

Because recent rapid growth trends are expected to continue, the economic future of the North American cruise industry is quite promising. Based on current surveys by the Cruise Line International Association (CLIA), the upcoming five-year cumulative market potential for the cruise industry could be as high as $97 billion (based on those who are interested in cruising). The untapped market for cruises is significant, with only 11% of the U.S. population ever having cruised. New vessels with more activities and amenities, new destinations, new themes and cruise lengths are attempting to reach that vast majority of the U.S. population that has never cruised. With customer satisfaction rates for both first-time and frequent cruisers between 80% and 90% (CLIA, p. 15), there is reason to believe that the cruise market in the U.S. can sustain a high growth rate.

In order to keep up with the expected demand, 47 new ships will be added to the North American fleet between 2000 and 2004 (CLIA, p. 34), representing a 31% increase in fleet size. These new cruise ships will be the largest ever built. Whereas most ships built before the late 1990's had displacements of about 70,000 gross tons with passenger capacities in the 2000-2500 range and a crew size of 1000, the new ships will have displacements of 80,000-150,000 gross tons with passenger capacities over 3000 and crew sizes of 1500 or more. A yearly 8% increase in passenger capacity is forecast for the next five years, resulting in an overall 40% increase (CLIA, p. 40). These new ships will be virtual floating cities.

The economic impact of this impressive growth has been and will likely continue to be considerable. According to a 1997 study done by PricewaterhouseCoopers and

Wharton Economic Forecasting Associates (ICCL, 1997), direct spending of cruise lines and their passengers on U.S. goods and services is expected to increase by 61% to $10.6 billion by 2002. Total U.S. economic impact of the cruise lines and their passengers is expected to grow by 58% to reach $18.3 billion by that same year. Accompanying that growth is a projected 55% increase in U.S. jobs benefiting directly from cruise industry expenditures, bringing total related employment to 273,200 (ICCL, 1997).

Regulatory Structure of the Cruise Line Industry

The regulatory structure that affects the cruise line industry is fairly elaborate, with many components on a national and international level. First of all, ocean-going vessels engaged in international commerce must be registered, or flagged, in order to operate in international waters. Most countries provide registration services, or flags of registry, with different requirements set by different countries. Basic regulations usually pertain to crew nationality and composition, ship-owner citizenship, and shipbuilding standards. For example, in order for a ship to be flagged in the United States, 75% of its on-board personnel must be U.S. citizens or residents; and if the ship will be engaging in coastal trade (i.e., between U.S. ports), then the vessel must be owned by a U.S. citizen and must have been constructed by a U.S. ship-yard. Once a ship is flagged, it is considered an entity of its flag nation and is governed primarily by the laws of that country. The flag nation has the responsibility of ensuring that its vessels meet all established and ratified international standards. Currently, 95% of all cruise ships operating in U.S. waters are foreign flagged (Coast Guard, website). The three countries

with the greatest vessel registry are Panama (18.5%), Liberia (11%), and the Bahamas (5%) (Lloyds, 1999).

Regardless of the flags under which cruise ships operate, they must all observe U.S. pollution standards when they are operating in U.S. waters, which are those within the Exclusive Economic Zone (EEZ). The EEZ extends outward 200 nautical miles from all U.S. shore lines (Proclamation Number 5030, March 10, 1983). The U.S. government can impose civil and criminal penalties for oil and waste that is discharged illegally within the U.S. EEZ by vessels registered to any nation. Within the U.S. EEZ, the following environmental laws apply:

- *Comprehensive Environmental Response, Compensation and Liability Act of 1980* (*CERCLA*) regulates hazardous waste disposal on all commercial vessels operating in U.S. waters. CERCLA imposes civil liability and mandates recovery for damages to natural resources and for pollution clean-up costs incurred by federal and state governments.

- *Oil Pollution Act of 1990 (OPA 90)* imposes liability and criminal penalties for illegal discharge of oil into U.S. waters.

- *Federal Water Pollution Control Act of 1972*, also known as the Clean Water Act, imposes liability and criminal penalties for the illegal discharge of oil, wastewater, sewage, and other toxic and hazardous substances into U.S. waterways.

- *Resources Conservation and Recovery Act (RCRA)* establishes a federal and state permit system for hazardous waste management. Transporters of such waste must meet certain treatment, storage, and disposal regulations.

- *Act to Prevent Pollution from Ships* incorporates the provisions of an international convention (MARPOL 73/78) into U.S. law (U.S.C. 1901-1911). This act regulates the discharge of harmful substances or effluents.

Under these domestic laws, the following discharge standards apply to cruise ships:

- *Plastics* cannot be discharged anywhere.

- *Food waste* cannot be discharged within three miles of the shore. Between three and twelve miles only food ground to less than one inch in size can be discharged. Beyond twelve miles food discharge is permitted without restrictions.

- *Hazardous substances* can be discharged within three miles of the shore as long as they do not exceed the "amounts allowable by law." Cruise ship regulation is unclear under RCRA.

- *Gray water* (i.e., shower/sink drain water) can be discharged anywhere in the ocean.

- *Non-plastic trash* cannot be discharged within three miles of the shore. Between three and twelve miles trash must be ground to pieces one inch or less in size. From twelve to twenty-five miles out from shore, discharge is permitted except for dunnage (i.e., floatable packaging material), and beyond twenty-five miles all trash discharge is permitted.

- *Sewage* may be discharged within three miles of the shore only after it has been treated in a marine sanitation device approved by the Coast Guard. Beyond three miles untreated sewage may be discharged.

- *Oil* can be discharged within twelve miles of the shore only after the vessel is underway and the oil has been processed through an oily water separator, resulting in an effluent that does not exceed 15 parts per million (ppm) and does not cause a visible sheen.

In addition to federal and state environmental laws, cruise lines must also abide by a comprehensive framework of international environmental standards set by the International Maritime Organization (IMO), an arm of the United Nations based in London and comprised of 152 member nations. The IMO sets standards through the adoption of international conventions, or treaties. Those conventions or amendments must then be ratified by member nations through their own legal processes.

In 1970 the International Convention for the Prevention of Pollution from Ships (MARPOL) was signed and ratified by most seafaring nations. MARPOL sets international environmental standards for all commercial vessels to prevent ship-generated pollution from oil, garbage, and waste. MARPOL has been amended to include six annexes: Annex I deals with oil, Annex II with hazardous liquid substances carried in bulk, Annex III with hazardous substances carried in package form, Annex IV with sewage disposal, Annex V with plastic disposal, and Annex VI with air pollution (NO_x, SO_x, CFCs). For nations ratifying MARPOL, Annexes I and II are mandatory, but Annexes III, IV, V, and VI are optional. MARPOL has been ratified by more than 90

nations, including the United States and most other maritime nations. However, most nations, including the United States, have ratified only Annexes III and V.

The United States has become primarily a port state, with an average of 7,500 foreign ships calling on its ports each year (Coast Guard, website). As a port state, the United States has the right to conduct its own examinations to verify that any ship, regardless of its flagging, is in compliance with international standards. Currently, the U.S. Coast Guard is the sole arm of the federal government charged with enforcing environmental laws for any vessel operating within the U.S. EEZ. Enforcement mechanisms to ensure compliance include routine and random boardings and inspections, vessel tracking, and aerial reconnaissance. If a vessel is found to be noncompliant, the Coast Guard has the power to detain the vessel and can levy civil penalties up to $25,000 per violation. More serious violations are referred to the Department of Justice for possible criminal prosecution. Some cases are referred by the Coast Guard to the U.S. Department of State for return to the flag nation for further investigation and action.

Problem Analysis

The purpose of this analysis is to accurately estimate the amount of air and water pollution produced by the foreign-flagged cruise ships that operate in U.S. waters. The first of two parts examines the contributions to U.S. air pollution coming from the approximately 150 foreign-flagged cruise ships that operate in the North American cruise market. This assessment considers five air pollutants, those classified by the EPA as criteria pollutants—nitrogen oxide (NO_x), particulate matter (PM_{10}), hydrocarbons (HC), carbon monoxide (CO), and sulfur dioxide (SO_2)—and follows the analytical methods

used in an EPA study calculating the air pollution effects produced by the total U.S. fleet. The results for cruise ships are then compared with current and proposed EPA standards for the U.S. fleet. The second part of this analysis considers the contributions to U.S. water pollution coming from the same foreign-flagged cruise ships—in particular, the oil pollution caused by these ships. The findings are then compared to worldwide sources of oil discharged into the ocean.

Air Pollution

As of April 2000 no study has quantified the amount of air pollution that the cruise industry generates in the United States. Although there is no single approach that can reliably factor in all of the variables, it is possible to get a fairly accurate estimate by determining (1) the total number of days cruise ships operate in U.S. waters, (2) the total amount of fuel consumed during that time, and (3) the level of emissions associated with that quantity of fuel.

Time in U.S. Waters

Since cruise ships are in service 355 to 360 days a year (ICCL, email), the calculation begins by stipulating that a typical cruise ship operates, on average, 357 days each year. Thus, the total operating days for all cruise ships with any U.S. contact becomes 53,550 (357 x 150). It is then necessary to determine how many of those days are actually spent in U.S. waters. (For the purpose of this study, emissions transported by ocean winds are not considered.) In order to calculate U.S. time, the itineraries of the three cruise ship companies most dominant in the North American

market were analyzed--Carnival, RCCL, and Princess. Their cruises can be grouped according to trip length, with each category corresponding to a specific percentage of all trips (see Table 1). For example, the 2-5 day cruises represent 36% of all trips in the North American market. Through careful analysis of the individual itineraries within each category, it is possible to determine, per category, the percentage of time actually spent in U.S. waters (see Table 1) and then to calculate an overall percentage for the entire fleet.

Table 1: Time in U.S. Waters

Trip Length (days)	Average Length (days)	% of All U.S. Trips	Weighted Average Length	%Time Spent in U.S. Waters
2-5	3.5	36	1.3	70%
6-8	7	51	3.6	68%
9-17	13	13	1.7	20%
18+	18	0.3	0.05	10%
Totals		**100%**	**6.7**	**54%**

These statistics indicate that the average North American cruise lasts 6.7 days, of which 3.6 are spent in U.S. waters, or approximately 54%. Applying this percentage to the total cruise days of the entire North American cruise fleet (i.e., 53,550 days) reveals that cruise ships spend approximately 29,000 days each year in U.S. waters.

One other factor must be considered in assessing the amount of time these cruise ships actually cruise, or work their engines, thereby producing pollution. Only the short two- or three-day cruises spend 100% of their time actually cruising at sea. Most cruises of five days or more have multiple stops where the ships dock and are inactive for as much as 10 hours of a day as passengers explore a new port. Again, the itineraries of Carnival, RCCL, and Princess show that, on average, cruise ships are underway only 78% of the total trip time. Thus, each year cruise ships spend roughly 23,000 days (29,000 x .78) actively cruising in U.S. waters.

Fuel Consumption

To determine the amount of fuel consumed daily by the average cruise ship, this analysis again focused on the three main cruise lines dominating the North American market—Carnival, RCCL, and Princess. Their fleets are designed for the mass-market, and their trend is toward ever-increasing ship size—80,000 to 100,000+ tons. These large ships typically use a configuration of six main diesel electric engines, which handle both the ship's propulsion and its electric power generation. In the process these six engines use an average of 195 metric tons of fuel per day (T/d) (Lloyds, personal contact) (Wartsila-NSD, personal contact).

The next step is to apply operational engine factors in order to get a true reading of the amount of fuel actually consumed. A marine engine duty cycle is an attempt to accurately model the range of speed and power at which an engine is operated. The engine duty cycles for commercial ships were developed and standardized by the International Standards Organization (ISO 8178, part 4), they represent ships that spend most of their operational life between 15 and 20 knots, as cruise ships do. Specifically, the E3 duty cycle for heavy-duty marine engines applies to cruise ships (see Table 2).

Table 2: E3 Duty Cycle Calculation

Mode	Fuel Use (T/d)	Engine Power	Time Factor	Tons of Fuel
1	195	0.250	0.15	7.31
2	195	0.500	0.15	1.46
3	195	0.750	0.50	73.13
4	195	1.000	0.20	39.00
Totals			**1.00**	**120.90**

Once the duty cycle is applied, the amount of daily fuel consumption drops to 121 tons per day. Thus, it is possible to calculate the fuel consumption for the current foreign-

flagged cruise ship industry operating in the United States: 3,000,000 tons of fuel per year (121 tons/day x 23,000 days/year).

Emission Factors

Determining the amount of pollution produced by this level of fuel consumption requires the use of engine emission factors. According to Wartsila-NSD, the world's leading manufacturer of cruise ship engines, the six main diesel-electric engines found on typical cruise ships are all medium-speed engines. Table 3 lists the engine emission factors for medium-speed marine engines, as provided by Lloyd's Register of Shipping[1]. Those factors can then be multiplied by the yearly fuel consumption of the cruise ship fleet to determine total air pollutants emitted in U.S. waters.

Table 3: Emission Factors of Medium-Speed Marine Engines

Pollutant	**Emission Factor (kg pollutant/ton fuel)**
Nitrogen oxides (NO_x)	57.0
Particulate matter (PM)	1.2
Hydrocarbons (HC)	2.4
Carbon monoxide (CO)	7.4
Sulfur dioxide (SO_2)	60.0

The new totals are expressed as kilograms pollutant/year emitted in U.S. waters by the current cruise line industry (see Table 4).

[1] $S0_2$ data provided Corbett, 1999

Table 4: Total Pollutants

Pollutant	150 Ships (kg pollutant/year)	% EPA Marine Vessels Emissions*
NO_x	156,000,000	73
PM	3,000,000	12
HC	6,500,000	14
CO	20,000,000	26
SO_2	164,000,000	74

* EPA emissions are calculated in short tons: NO_x, 171,000; PM, 3,700; HC, 7,200; CO, 22,000; SO_2, 180,000.

Conclusions

Based on these findings, it is apparent that the foreign-flagged cruise industry that operates in U.S. waters is a significant contributor of air pollution, as compared to all U.S.-flagged marine vessels. As of 1995, the U.S. domestic fleet was comprised of approximately 8000 vessels with a total gross tonnage of 267,000,000 tons (EPA, 1997). The current 150 foreign-flagged cruise ships that operate in the U.S. total approximately 10,000,000 tons. Thus, the number of foreign-flagged cruise ships is only 2% of the entire U.S. fleet, and only 4% by weight, yet cruise ships contribute almost 75% as much SO_2 and NO_x as is produced by the entire U.S. fleet.

This disproportionate amount of emissions is related to the choice of marine fuel, which is often a residual fuel that is "black, thick as molasses and has an odor that's pungent to put it politely"(Brubaker, 1992). "Ships are among the world's highest polluting combustion sources per ton of fuel consumed" (Corbett, 1997). Such high rates of emissions are especially significant because most cruises frequent pristine environmental areas and most ship emissions occur within 235 miles of land (Corbett, 1997). Thus, heavy amounts of the criteria pollutants, especially NO_x and SO_2, are affecting vulnerable U.S. shorelines, ports, and coastal cities. In addition, cruise ship

emissions are contributing to the U.S. acid rain problem, which is caused primarily by SO_2 and NO_x. Another concern with cruise ship emissions is their contribution to the formation of ground-level ozone. Ground-level ozone is produced in the lower atmosphere through the chemical reaction of NO_x and HCs in the presence of sunlight. In many urban areas of the United States—especially ports like Miami, New York, Boston, and Los Angeles—ground-level ozone causes serious respiratory problems for sensitive populations and reduces the quality of life for everyone. Other pollutants from cruise ships, although less in quantity, also have adverse health effects: CO is poisonous at high levels, and PM can aggravate respiratory conditions and lead to decreased lung function. Thus, the emissions produced by cruise ships are a significant concern.

The EPA currently regulates emissions from Category 1 marine engines (e.g., small fishing boats, tour boats) and has proposed regulating Category 2 engines (e.g., tugboats, cargo vessels). However, the agency has recently decided that it does not need to regulate large Category 3 engines (e.g., cruise ships) because Annex VI of MARPOL, which is awaiting ratification, will control air emissions from these large marine engines. Because of that position, the EPA is being sued by Bluewater Network, which has little faith in the ratification process and believes the EPA's decision is a violation of the Clean Air Act.

Water Pollution

The second major area of pollution generated by cruise ships is water pollution. Because of trip durations, provisions needed, and the number of people on board, most modern cruise ships are for all intents and purposes small floating cities. And just like

any other small city, a cruise ship generates significant quantities of waste. However, because cruise ships are at sea the majority of the time, they cannot always dispose of their waste in the same manner as their land counterparts. Cruise ships produce seven main streams of waste: plastics, food, gray water, hazardous substances, non-plastic trash, sewage, and oil. Each of these categories has its own regulations that apply to foreign-flagged cruise ships while they are in U.S. waters. In fact, because most of the cruise ships are flagged in countries that have ratified Annexes I, II, III, and V of MARPOL, everything except gray water and sewage has set limits and discharge rules in all waters. Unfortunately, those limits and rules are often ignored, especially in the case of oil discharge, which is the focus of this analysis. Oil is the substance most commonly discharged illegally and, according to a recent GAO report, was involved in 93% of all confirmed cases of illegal dumping by cruise ships in U.S. waters between 1993 and 1998.

Oil Processing and Regulation

On any large ship seawater is pumped into the ship to cool off the engines. As the water circulates, it picks up loose oil and waste in and on the engine pipes. Much of this water then ends up collecting in the bilge, or bottom hull, of the ship. In addition, oil drips from the engine pipes and machinery fittings and eventually collects in the bilge water. If left untreated, the bilge water can produce hazardous oil vapors; consequently, the bilge must be periodically pumped dry. In order not to contaminate the surrounding area when the bilge water is discharged, environmental regulations (of both the United States and MARPOL) require cruise ships to operate an oily water separator to

filter the oil out of the bilge water. The separated oil is required to be stored on board the ship and then off-loaded in port. The cleansed bilge water can be directly discharged into the ocean as long as the oil content of the discharged effluent is no more than 15 parts per million (ppm) parts of water and will not leave a visible sheen on the water surface. As an aid to enforcement, each time the oily water separator operates, its results are required to be recorded in the ship's oil record book.

To understand the regulation governing bilge water discharge, it can be helpful to think of 15 ppm as the equivalent of 15 drops of oil per 1 million drops of water. In metric terms the proportion is 1 milliliter of oil per 50,000 milliliters of water. At this level of discharge, the oil should be so minute that it dissolves completely in the wake of the ship. However, if bilge water is not processed through an oily water separator, a much higher ppm effluent can be discharged, ranging from 200 ppm to 1600 ppm (EPA, 1999). Thus, if a typical 75,000-ton cruise ship generates 100,000 gallons of bilge water each month (RCCL, website) and does not process it before discharge, a considerable quantity of oil may enter the ocean over the course of numerous years.

To determine the approximate gallons of oil discharged in unprocessed bilge water, ppm by weight (expressed in grams) must be converted to a measure of volume (expressed in gallons). The established parameters of 200 ppm and 1600 ppm are the equivalent of 200 grams and 1600 grams per 1,000,000 grams of water. However, the density of diesel fuel, a major component of oily bilge water, is only 0.84 grams/milliliter, whereas the density of water is 1.0 grams/milliliter. Thus, the volume of 200 grams and 1600 grams of oil is 240 milliliters and 1900 milliliters, respectively (200 grams and 1600 grams divided by 0.84 grams/milliliter) per 1,000,000 milliliters of

water. These proportions are the equivalent of 240 gallons and 1900 gallons of fuel oil per 1,000,000 gallons of water. If a typical cruise ship generates 100,000 gallons of bilge water each month and operates nearly 12 months each year (357 days, on average), that ship would produce annually 1,200,000 gallons of bilge water. Without processing, that water would represent 290 gallons to 2300 gallons of oil—the annual output of one ship.

A Case Study: RCCL

On October 25, 1994, a U.S. Coast Guard plane spotted an oil slick trailing behind RCCL's *Sovereign of the Seas* cruise ship. That event sparked a thorough four-year investigation that culminated in five RCCL cruise ships being convicted by the U.S. Justice Department of discharging untreated oily bilge, tampering with oily water separators, and falsifying oil record books to conceal their illegal discharge practices. It was learned that RCCL had used secret bypass pipes to discharge the contaminated bilge water directly overboard without treating it first in the oily water separator. To avoid detection, RCCL altered its oil record books and, in the process, also avoided paying approximately $80,000 a year per ship in maintenance fees to replace the membranes for the separators. In addition, RCCL had avoided port disposal fees for its waste oil—costs that can reach $300,000 a year per ship.

RCCL admitted discharging untreated bilge fleetwide from 1990 to 1998. Thus, its entire fleet of 17 ships had discharged between 5000 gallons and 39,000 gallons of oil each year, or between 40,000 gallons and 300,000 gallons for the eight-year period (see Table 5). And unfortunately, according to those close to the cruising scene, RCCL's behavior was not atypical but was an industrywide practice in varying degrees. Thus, the

entire North American cruise fleet of 150 ships may have discharged between 350,000 gallons and 2,800,000 gallons of oil into the seas over the same eight-year period.

Table 5: Probable Oil Discharge from Cruise Ships

	Effluent of 200ppm	**Effluent of 1600ppm**
Annual Discharge per Ship	290 gallons	2,300 gallons
Annual Discharge of the RCCL Fleet	5,000 gallons	39,000 gallons
8-Year RCCL Fleet discharge	40,000 gallons	300,000 gallons
Annual North American Discharge	43,500 gallons	345,000gallons
8-Year Industry- wide Discharge	350,000 gallons	2,800,000 gal.

Worthy of note is the fact that RCCL continued to illegally discharge untreated bilge water fleetwide even after it was notified of the Justice Department's investigation in 1994. After RCCL's first conviction in 1998 and a fine of $9 million, the Justice Department continued to investigate and found that within a year nine more RCCL ships were guilty of discharging contaminated bilge. Ultimately, six federal jurisdictions successfully prosecuted RCCL and levied additional fines of $18 million.

Conclusions

Oil discharges of these magnitudes have the potential for serious environmental consequences. Even though oil is a naturally occurring substance, it is also toxic to marine ecosystems in a variety of ways.

1. Bioaccumulation of oil in marine animals can become toxic and thus hazardous to

humans that ingest oil-contaminated food.

2. Oil can poison fish and other marine organisms; its byproducts, if ingested, can harm fish, wildlife, and humans. Complications for marine animals include, but are not limited to, skin and eye lesions, liver toxicity, blood disorders, fin erosion, cellular changes, nervous system disturbances, and lung congestion (Bluewater, petition). In addition, because oil is less dense than water, it tends to persist and contaminate the sea surface microlayer. Since the early development of fish, other marine species, and plankton occurs at the sea surface, oil can contaminate eggs and larvae and cause malformation, chromosome alterations, and even death (Bluewater, petition). During larval or juvenile stages even 0.1 to 1 milligram/liter has been shown to be lethal, with sublethal effects at concentrations as low as 1 to 10 ug/liter. Sea birds, shrimp and shellfish, and marsh grasses are also at risk (Impact of Oil, pp. 112-113).
3. Oil damages beaches and recreational areas.
4. Oil can eliminate or decrease populations of certain species.
5. Oil can modify habitats and prevent/delay recolonization.

(Marine Pollution and Its Control, p. 93)

Even though the harmful effects of oil are widely known, it is difficult to make a direct link between cruise ship discharges and environmental damage. The discharge of oil from foreign-flagged cruise ships operating in U.S. waters is only approximately 0.2% of the 250,000 tons of bilge and fuel oil that is annually discharged worldwide into the sea (Marine Pollution, p. 38). How much of this bilge and fuel oil is actually discharged into U.S. waters is unknown, making it impossible to know what percentage cruise ships

are contributing. However, it is important to note that bilge oil and natural inputs are second only to municipal waste sources in annual worldwide discharge of oil into the sea (Marine Pollution, p. 38). If U.S. sources are similar, cruise ships that illegally discharge untreated bilge water are part of one of the larger problems in terms of ocean oil pollution. And with rapidly expanding growth in the cruise industry, that role could become more significant in the near future. Clearly, more research is needed in order to accurately quantify the sources and amounts of oil pollution in U.S. waters.

Another problem is that little is known about where and how cruise ships have been discharging untreated bilge water. RCCL was convicted of dumping everywhere—in sensitive ecosystems like Prince William Sound, in the confines of ports, and along most coastlines. The effects of cruise ship dumping of oily bilge could be greatly magnified by the location of the violations. It could also be greatly lessened if most of the dumping occurred at sea, away from the coast and U.S. ports. In addition, the rate of discharge is important. Large discharges while the ship is moving slowly or is stationary are much more harmful than smaller continuous discharges while the ship is underway. Again, further research is needed to accurately assess the effects of cruise ship discharge of untreated oily bilge.

The Role of the U.S. Coast Guard

The U.S. Coast Guard is a branch of the U.S. Department of Transportation and is responsible for preventing, detecting, and investigating illegal aquatic discharges from all commercial ships. The Coast Guard has a staff of approximately 40,000 full-time employees, 88% of whom are military personnel, with the remainder being civilians or

civil servants. The Coast Guard is broken down into seven different divisions, three of which are of greater concern relative to the Coast Guard's role in regulating cruise ships.

- *Operating Expenses (OE)* is responsible for more than 60% of the Coast Guard's budget—including large accounts like salaries and operating costs. OE is staffed predominantly (90%) by military personnel.
- *Acquisition, Construction, and Improvements (AC&I)* handles the purchase of new equipment and the refurbishing of old equipment. AC&I accounts for roughly 10% of the Coast Guard budget and is staffed fairly evenly by both military and civilian personnel.
- *Research, Development, Test and Evaluation (RDT&E)* is responsible for developing new technologies and programs to improve Coast Guard effectiveness. RDT&E accounts for less than 1% of the Coast Guard budget and is primarily staffed by civilians (70%) (Coast Guard, 2000).

OE and AC&I are each broken down into seven mission areas. Those most pertinent to cruise ship regulation and enforcement are Search and Rescue (SAR), Marine Safety (MS), and Enforcement of Laws and Treaties (ELT). These three areas of these two divisions are responsible for more than 95% of the actual physical enforcement of the regulations that apply to foreign-flagged cruise ships while they are in U.S. waters—specifically, inspections and boat and aircraft surveillance (Davis, personal communication).

The Coast Guard has four main methods that it uses to detect illegal discharges from cruise ships: vessel inspections, aircraft surveillance, third-party reports, and self-reports. Vessel inspections are carried out quarterly and are used to check for compliance

in safety practices and environmental equipment. The inspections are scheduled in advance and are fairly limited in scope. A typical inspection involves two to four Coast Guard personnel, lasts approximately four to six hours, and usually limits its focus to the inspection of pertinent documents. Limitations in time, staff, and resources make detailed inspections of environmental equipment difficult (GAO, p. 13).

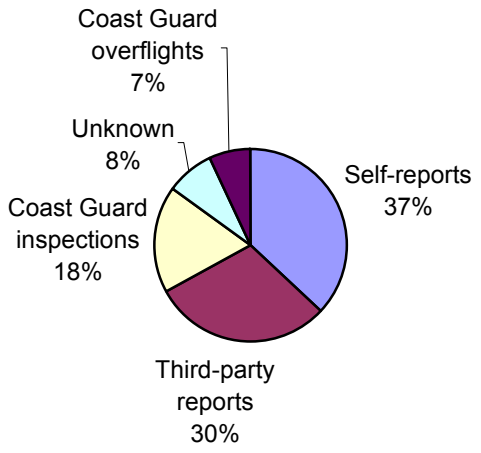
Aircraft surveillance is another method of detecting illegal discharges. Overflights are conducted along primary shipping lanes; and if illegal activity is discovered, it is documented by video. However, only a small percentage of these flights are focused on marine environmental protection; most are associated with drug enforcement, search and rescue, and migrant interdiction. In 1998, Coast Guard planes in District 7, which encompasses most of Florida and therefore has the highest concentration of cruise ships in U.S. ports, spent only 283 hours out of 9,000 total hours of air time monitoring marine environmental compliance. In 1993, 578 flight hours were devoted to that purpose (GAO, p. 16).

Third-party reports occur when someone witnesses an illegal discharge and then reports that incident to the Coast Guard. Finally, self-reports refer to a situation in which the cruise line itself documents an illegal discharge and reports it to the appropriate Coast Guard officials.

Between 1993 and 1998 the Coast Guard documented 87 cases of illegal discharge by cruise ships while in U.S. waters. In addition, 17 other alleged incidents were referred to the cruise ships' countries of origin because the incidents took place outside U.S. waters or because jurisdiction could not be determined. The illegal discharge of oil was the focus of 93% of the confirmed cases. As Figure A shows, the

majority of reports between 1993 and 1998 did not result from active Coast Guard enforcement.

Figure A: Methods of Detecting Illegal Discharge by Foreign Flagged Cruise Ships (GAO, p. 17)



Although it is interesting that self-reports and third-party reports were largely responsible for detecting illegal cruise ship discharges, it is more interesting to look at how the discharges were reported in conjunction with the locations of the reports. The 87 documented cases occurred in three main areas—in port/docked, at sea, and in undetermined areas. Of the self-reports, 66% occurred in port, 1% occurred at sea, and 34% were undetermined. The third-party reports were more balanced: 33% occurred in port, 41% occurred at sea, and 26% were undetermined. Finally, in terms of Coast Guard reports, 72% occurred in port, 19% occurred at sea, and 10% were undetermined. In addition, all of the 17 discharges that were referred to the flag nations occurred at sea. Of these, 10 were determined by Coast Guard overflights, 7 by third parties, and none by

self-report. The implication here seems to be that if a cruise ship is in port or docked and an illegal discharge occurs, there is a fairly good chance that it will be self-reported or discovered by a Coast Guard or third-party observance. However, when the cruise ship is underway in U.S. waters, there seems to be a very low level of self-reporting, coupled with a low level of Coast Guard enforcement.

Unfortunately, this low level of enforcement is most clearly reflected in the in the dramatic drop-off in Coast Guard referrals to flag states as well as in the overall decline of documented illegal discharge cases (see Table 6). In terms of total cases the six-year average is 17 cases per year. However, prior to the Coast Guard's downsizing and budget cuts from 1993 to 1995, 25 cases per year was the average. From 1995 to 1999 that figure dropped to an average of 10 cases per year. These data can be interpreted in a number of ways. Some might be inclined to say that the Coast Guard's heavy-handed presence in the early 1990's sent a clear message to the cruise line industry, which responded with compliance. However, various background pieces do not support that line of thinking. First, it was well documented that RCCL was involved in illegal discharge activities through 1998. In addition, it is very likely that RCCL's practices were being conducted industrywide. If that was the case and the Coast Guard caught only RCCL, it seems to indicate that the Coast Guard was able to detect only a small part of what was occurring. Compounding this lax enforcement is the fact that between 1989 and 1992, 111 cases of alleged discharge violations were referred by the Coast Guard to the flag nations for prosecution, but 89% of those cases received no response or no action. (At the same time the Coast Guard referred 12 cases to the Department of Justice, which produced 10 prosecutions—quite a contrast.)

Table 6: Illegal Discharge Cases Involving Cruise Ships in U.S. Waters
(GAO, p. 9)

Year	Number of Cases Pursued by Coast Guard	Number of Cases Referred to Flag Nations	Total
1993	16	9	25
1994	24	4	28
1995	17	4	21
1996	13	0	13
1997	8	0	8
1998	9	0	9
Total	**87**	**17**	**104**

The Coast Guard today is in a fairly crippled state. Between 1993 and 1998 it experienced an overall personnel downsizing of approximately 13%, even though the cruise line industry has increased its embarkations from North American ports by 50%. In addition, the Coast Guard has suffered serious funding cuts in the mission areas most directly responsible for monitoring cruise ship actions in U.S. waters. Between 1990 and 2000 the AC&I division was cut by 26%, and the impact was severe. For example, when two key aircraft that had devoted significant hours to marine environmental surveillance were retired because of age, the funding was not available to replace them. The Search and Rescue operations of both the OE and AC&I divisions suffered cutbacks (22% and 7%, respectively) at the same time the ELT mission area of the AC&I division was cut by 67%. With RDT&E also experiencing funding cuts of approximately 19%, "it is now extremely difficult for the Coast Guard to perform its marine environmental protection mission as efficiently as it once did" (GAO, p. 37). Basically, the Coast Guard does not have the personnel or financial resources to adequately enforce any of the U.S. regulations or MARPOL annexes relative to foreign-flagged cruise ships operating in

U.S. waters. The downsizing, coupled with the general lack of effective enforcement, creates an atmosphere in which illegal behavior is not deterred.

Policy Options

Congress has three main options in deciding how to regulate the foreign-flagged cruise industry that operates in U.S. waters. All three have certain costs and benefits, some of which are strictly monetary in nature, whereas others are more qualitative. These costs and benefits can serve as criteria by which to evaluate and prioritize the available options.

Option One: Maintaining the Status Quo

The first option is to change nothing and maintain the status quo. This course of action would sanction no new legislation and would continue existing funding for the Coast Guard. In practical terms this option has two main results. Since the Coast Guard currently lacks the personnel and the fiscal resources to uphold existing laws and regulations pertaining to the cruise industry, this option would continue that minimal enforcement. With rapid growth expected in the North American cruise market, the Coast Guard would likely fall even further behind in its environmental monitoring. In addition, any new regulations, like MARPOL Annex VI, would experience the same lack of enforcement. The other main result of this option would be that current levels of both air and water pollution would continue at constant or elevated rates with the addition of new cruise ships in the North American market.

Costs

The status quo suggests a weak monitoring and enforcement effort, which provides little incentive for compliance with current or future laws and regulations. Thus, with the chance of detection quite slim and the cost of compliance quite high, even more widespread non-compliance is a strong possibility and would have inherent environmental costs. In terms of air pollution, the cost per ton of SO_2 and NO_x has been established by utility companies. The current average trading cost for SO_2 is $150/ton (EPA), and approximately 200,000 tons of SO_2 are being emitted annually by cruise ships in U.S. waters. Therefore, the current cost per year, which would be borne entirely by the United States, would be $30 million dollars. For 200,000 tons of NO_x at the average projected rate of $350/ ton (Brutraw, RFF), the cost per year to the United States would be $70 million. Thus, for just these two emissions, the United States would absorb a cost of $100 million per year. Oil costs cannot be calculated at this time because of a lack of data; however, based on the known properties of oil in marine ecosystems, there are apt to be costs associated with unchecked discharge of oily bilge water.

The status quo also maintains the current revenue base, with no allowance for increased cruise activity between U.S. ports, as called for in the McCain bill.

Benefits

Since maintaining the status quo would incur no new costs for enforcement, other than yearly inflation and cost-of-living increases, additional federal funds could be allocated to other areas of need. The status quo should also appeal to the foreign-flagged cruise industry operating in U.S. waters. Industry growth would be allowed to continue at

its normal pace without any additional requirements or regulations from the government. This relaxed atmosphere should keep the North American market strong in terms of revenue and should continue to benefit U.S. ports.

Option Two: Fully Enforcing All Laws and Regulations

The second option is to require that all current laws regulating the cruise line industry be fully enforced. This option would require significant changes in the current monitoring and enforcement structure. First, the U.S. Coast Guard would need to have adequate resources and personnel at its disposal—more full-time employees, more research and development, new monitoring equipment (planes and sensors). The Coast Guard's most effective monitoring and enforcement tool has been the use of airplane reconnaissance. Currently, the Coast Guard has twenty-two C-130's and twenty-three Falcon jets (HU series) available. Only three of the C-130's have side-looking air radar (SLAR), which is used to detect and map an oil discharge; and only three of the Falcons have SLAR and AIR EYE, an infrared/ultraviolet scanner that is used to determine the depth of an oil discharge. Currently, all of the Coast Guard's aircraft are used for varied missions, and none are actively engaged in monitoring for illegal discharges. Instead, the planes respond to illegal discharges when the need arises. In order to fully monitor U.S. waters, an additional twenty planes (ten Falcons and ten C-130's) would be needed. This would allow four planes for each of the five main cruise regions—Florida, Alaska, West Coast, East Coast, and Gulf of Mexico.

In addition, all cruise ships would need to be fitted with Coast Guard- and EPA-approved pollution-monitoring devices. Air pollution would require continuous emissions

monitoring systems (CEMS); water pollution would necessitate oily-water-separator alarms connected to EPA and/or Coast Guard monitoring stations. CEMS are most typically found in the stacks of power plants and are used as pollutant analyzers, measuring total emission output every 1 to 15 minutes. The data are then documented and stored electronically for later analysis and auditing by oversight agencies such as the EPA. According to EPA officials, the CEMS technology could be transferred to cruise ship smokestacks and would operate in a very similar way. The alarms connected to oily water separators would notify a regulatory agency when bilge water had exceeded international limits (15 ppm). Again, these data would be recorded and stored electronically and then later compared to the cruise ship's discharge records to detect any illegal activity.

Costs

The most significant cost associated with this option is the actual cost of increasing enforcement capability. According to Coast Guard estimates, the cost of additional aircraft and equipment would be $0.5 billion to $1 billion, annual maintenance would be $70 million, and personnel costs would be $15 million. Such an expenditure would be quite substantial, since the AC&I division now receives only 10% of the Coast Guard's $3 billion annual budget for acquisition of new equipment.

The second potential cost associated with this option is that the increase in fines resulting from increased enforcement might prompt the cruise industry to cut back its U.S. operations, thereby reducing the economic benefit for U.S. ports. In addition, the cruise industry might become adversarial, as it did in 1999 when residents of Juneau, Alaska, levied a $5 tax on every cruise ship passenger. Two companies, Princess and

Holland America (owned by Carnival), took retaliatory action: Princess decided to shorten its stays in Juneau and canceled a stop, leading to a loss of revenue for local businesses; and Holland America cut donations to various civic and charitable organizations in Juneau, explaining that the new tax had "prompted a reassessment" of its relationship with the city (Frantz, *New York Times*).

Benefits

Increased enforcement efforts should promote a cleaner environment, with the expense for monitors and alarms being borne by cruise ships themselves as part of the cost of doing business in U.S. waters. The initial cost of a CEMS would likely range between $100,000 and $200,000 per cruise ship, with annual costs between $25,000 and $50,000. The cost of an oily-water-separator alarm is less than $10,000 per unit. The mobile technology to connect the alarm to a land-based regulatory agency is not factored into that cost but could be covered by an additional fee.

Another benefit would be a dramatic increase in fine revenue. A 10-fold increase in funding for cruise ship monitoring would likely lead to at least a 10-fold increase in the number of cases pursued, that is, from 25 cases per year (prior to 1995) to 250 cases. If trends continue and fine structures remain constant, revenue from those cases would provide a grand total of approximately $80 million per year. The likelihood of that revenue source continuing, even in the face of increased enforcement, is quite good since the financial impact of noncompliance is minimal. Companies like Carnival, which registered $1 billion in profits in 1999 (Business Week, March 2000), are not going to be greatly impacted by the Coast Guard's current fine structure, which makes a polluting cruise company pay an average of $500 for ticket cases and $3000 for civil penalties

(GAO, pp. 18-22). Even the largest Department of Justice fine of $18 million (GAO, pp. 18-22), which was levied against RCCL for their fleetwide dumping campaign throughout the 1990's, represents only 2% of Carnival's annual profits. Thus, it seems possible, and perhaps probable, that the largest cruise ship companies would continue to pollute illegally and absorb the cost of increased fines.

If that scenario does not hold true, one other benefit might be a shift in attitude toward compliance by the cruise industry. If monitoring capabilities are strong, the industry might choose to enhance its public reputation by establishing a good environmental record, which could be a valuable marketing tool.

Option Three: Allowing Limited Expansion of Cruise Activity Accompanied by an Increase in Enforcement

The third option is a hybrid of the U.S. Cruise Ship Tourism Development Act (S. 1510). In its current form S.1510 allows for the expansion of foreign cruise itineraries by issuing permits for cruise ships to operate entirely within U.S. waters on a limited basis until 2006. The main purpose of this bill is to allow foreign-flagged cruise ships to tap into the lucrative intercoastal North American market, with the hope that such action would stimulate growth opportunities benefiting U.S. port cities and U.S. business. In order to receive a permit, a foreign-flagged cruise ship would need to establish, to the satisfaction of the Secretary of Transportation, that it would operate in full compliance with all U.S. rules, regulations, and operating requirements relating to health, safety, and environmental protection (S1510, 1999).

Option Three would accompany this bill with provisions for increased monitoring and enforcement. The same anti-pollution technology included in Option Two

is specified here—CAMS and oily-water-separator alarms. In addition, under this option, three existing Coast Guard planes would be converted to full-time marine pollution patrol, with a focus on popular cruise and shipping waterways; and three additional planes, one C-130 and two Falcons, would be purchased.

Furthermore, additional funds would be deposited in the Coast Guard's RDT&E division, earmarked expressly for efforts to apply space-based remote sensing to the monitoring of illegal oil discharges. This technology relies on high-resolution satellite imagery that can depict an area the size of one meter. However, current limitations include a data turn-around time of two days or more, an inability to accurately search wide ocean expanses without a fixed target, and cloud-cover disruptions. Potentially, space-based sensing could alleviate the need for random air and boat patrols, since a satellite could detect any illegal discharge of oil from a vessel in U.S. waters and could relay those data with coordinates to the Coast Guard.

Moreover, a $2-per-passenger tax would be levied on all cruise ships. Half of the tax would be deposited in a liability fund, which would mimic the oil pollution liability fund established under OPA 90. However, a portion of this liability fund could be used to augment the Coast Guard's enforcement and development efforts. The other half of the tax would remain with the individual cruise lines to use in making their ships more environmentally friendly. Expenditures would need to be documented but could include a wide variety of projects. Ships might purchase advanced water-system filters like Rochem's membrane systems, which use a molecular-weight filtering process to filter fine oil droplets as well as other discharge effluents like gray water. Another effective expenditure might be financing the switch to biodiesel, a liquid fuel produced from

renewable sources such as oils and fats—e.g., soy, canola, and mustard oil—and resulting in far fewer harmful emissions.

And finally, Option Three would establish an environmental ranking of cruise lines. Top-performing cruise lines would be identified each year and would qualify for a certain number of intercoastal permits. In addition, in a recognition program similar to the EPA's Blue Sky Series Engines, cruise ship engines that operate 40% more cleanly than mandatory standards would receive public recognition and certification as Blue Sky Engines.

Costs

One main cost associated with this option stems from the increase in U.S. port traffic. Foreign trade is expected to double by the year 2010, which puts pressure on U.S. ports to expand terminal facilities and related infrastructure to accommodate the growth. A major part of the challenge will be dealing with larger and larger ships, especially cruise ships (Coast Guard, website).

Additional costs are incurred for monitoring and enforcement. The costs for pollution-monitoring devices would again be borne by the cruise industry. Cost to the United States would be $100 million for planes, $15 million for annual expenses, and $10 million for the Coast Guard's RDT&E division.

A third area of cost is the environmental pollution that will go undetected until full enforcement and/or compliance can be achieved.

Benefits

Option Three should provide significant amounts of revenue for U.S. businesses. In 1997, without intercoastal permits, the foreign-flagged cruise industry purchased U.S. goods and services worth $7 billion. In Alaska alone, cruise ship passengers spent more than $160 million. In addition, S.1510 requires permit recipients to utilize U.S. shipyards for all repairs and improvements, which will positively benefit U.S. businesses.

Another benefit of Option Three is that monitoring and enforcement efforts should promote a cleaner environment. Mandatory pollution-monitoring devices, coupled with a stronger Coast Guard presence and the use of incentives, should help to foster a climate of compliance.

Conclusions and Recommendations

The purpose of this research endeavor has been to determine the environmental effects of the foreign-flagged cruise line industry currently operating in U.S. waters and then to consider what action Congress should take to put the United States in the best economic and environmental position possible. Each of the three options presented here has positive aspects. However, Option Three (limited expansion plus increased enforcement) puts the United States in the best overall economic and environmental position and is therefore recommended.

First of all, this is the only option that brings added economic benefit to the U.S. economy. Under this plan, domestic ports, cities, and businesses are the beneficiaries of the cruise industry's increased purchase of goods and services. Because of this economic

advantage, this option becomes more politically feasible than the others. However, economic benefits alone are not enough.

What adds to this option's appeal is its innovative and varied monitoring and enforcement strategy. This option protects the environment with current technology—continuous emissions monitoring devices and oily-water-separator alarms—and an improved Coast Guard capability. However, this approach also wisely looks to the future by investing in cutting-edge technology—specifically, space-based remote sensing—which has the potential to markedly transform enforcement. Yet the overall cost is moderate.

Additionally, Option Three builds in a small user fee—the $2 passenger tax—that hurts no one but provides liability insurance for the United States as well as an avenue for environmental improvements industrywide.

Finally, the incentive component of an environmental ranking and a public recognition of extra effort taps into the cruise industry's concern for public image. This option, far more than the other two, builds in a mutually beneficial give-and-take. The benefits are clear for the cruise industry: increased access to the untapped intercoastal markets of the richest nation in the world. The cost is reasonable: some relatively inexpensive pollution-monitoring devices, which can be used as a public relations tool, and a head tax that can be easily recouped from ticket sales and turned into another marketing benefit. The end result should be a win-win situation for all parties involved. Both the cruise line industry and U.S. ports and businesses should enjoy greater profits, even as the environment becomes cleaner and is better protected from future harm.

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