Clean Ocean Action * Columbia River Crab Fisherman's Association * Gulf Restoration Network * Columbia Deepening Opposition Group * Coast Alliance * American Littoral Society * Riverkeeper, Inc. * Waterkeeper Alliance

October 22, 2002

U.S. Commission on Ocean Policy
1120 20th Street, N.W.
Washington, D.C. 20036

Dear Commissioners:

Attached are comments regarding a coordinated national ocean policy. Our organizations represent citizens, fishermen, businesspeople, attorneys, environmentalists, health practitioners, and scientists on the Atlantic and Pacific, and the Gulf of Mexico. We hope that the Commission finds our comments of use. We would be happy to provide additional information. Our addresses are listed below should you need to contact us for additional information. We are also including Clean Ocean Action's phone and email addresses.

Sincerely,

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COMMENTS TO THE U.S. OCEAN COMMISSION REGARDING A COORDINATED NATIONAL OCEAN POLICY

Submitted by Clean Ocean Action, Columbia River Crab Fisherman's Association, Gulf Restoration Network, Columbia Deepening Opposition Group, Coast Alliance, American Littoral Society, and Riverkeeper, Inc.

October 22, 2002

Clean Ocean Action joins with Columbia River Crab Fisherman's Association, Gulf Restoration Network, Columbia Deepening Opposition Group, Coast Alliance, American Littoral Society, and Riverkeeper, Inc., in submitting comments to the U.S. Ocean Commission regarding key ocean pollution and marine resource issues, and methods for addressing these issues that are environmentally safe and economically beneficial. Our comments include detailed scientific and policy information, and recommendations for actions we strongly urge the Commission to take. Our collective organizations represent citizens, fishermen, scientists, attorneys, business people, health practitioners, and policy experts from the Atlantic and Pacific Ocean coasts, and the Gulf of Mexico. We have many years' experience in identifying critical marine issues, and seeking solutions to them.

The U.S. Ocean Commission has stated that its goal is to conduct a review of existing and planned ocean and coastal programs and activities (U.S. Ocean Commission, www.oceancommission.gov.) The Commission has also indicated that it will provide recommendations for a coordinated and comprehensive national ocean policy on a broad range of issues. The identified issues include marine stewardship and pollution prevention. They also include the enhancement and support of marine science, commerce, and transportation.

A comprehensive national ocean policy that seeks to prevent pollution and expand marine stewardship is sorely needed in this country. Fisheries are seriously stressed, habitat is being lost at an alarming rate, and coastal and marine waters continue to experience a barrage of pollution that harms living marine resources. Federal agencies, and the programs and laws that they implement, can sometimes work at cross-purposes. A clear mandate of protection, restoration, and conservation of marine resources needs to be established as an over-arching goal for all marine-related programs. The oceans need this caliber of commitment from the federal government if significant improvements to the marine ecosystem are to be achieved.

The Commission seeks a policy that will speak to stewardship and pollution prevention on the one hand, but that will also speak to the enhancement and support of commerce and transportation. These objectives have sometimes worked at cross-purposes in past and present scenarios, resulting in diminished protections for marine resources and harm to marine ecosystems. For example, dredging ports in order to enhance and support commerce and transportation has led to the disposal of contaminated dredged sediments in marine waters, and the accumulation of contaminants in areas that are adjacent to the dumpsite. This phenomenon has been extensively documented in the New York-New Jersey region, where a zone of ocean floor contamination stretches for 15-square nautical miles, including and extending beyond an ocean dumpsite that originally measured 2-square nautical miles (USEPA, 1997.)

Problems caused by contaminated sediments are not limited to the mid-Atlantic region. Contaminated sediments are found in harbors and water bodies around the United States. The National Research Council reported in 1989 that, "Sediment contamination is widespread throughout U.S. coastal waters and is potentially far reaching in its environmental and public health significance." The director of the Office of Oceanography and Marine Assessment of the National Oceanic and Atmospheric Administration testified before Congress in 1989 that there was a "truly national . .. problem of toxic contamination of sediment, fish, and shellfish throughout the coastal waters of the United States."

There are no sediment quality standards analogous to air or water quality standards. Decisions about whether sediments are appropriate for ocean disposal are made on a case-by-case, region-by-region basis. Guidance for ocean disposal that is developed and used in one region of the country can differ quite markedly from practices used in another region of the country.

It is clear that some portion of the sediments that are dumped in the ocean are contaminated, but the precise amount is unknown. With the advent of improved testing in the early 1990s, estimates of contamination increased dramatically from less than 1% of dredged material, to more recent estimates of 66% or more of sediments dredged from some harbors. For example, improved testing in the New York-New Jersey Harbor resulted in as much as 66% of the sediments failing the ocean dumping standards, while under the out-dated and under-protective tests, less than 5% failed (USEPA, 1999.)

Therefore, several facts are known:

- Sediment contamination is widespread in America's harbors. Numerous agencies -- EPA, NOAA, NRC -- have documented it. Contaminants include metals, PCBs, pesticides, mercury, and PAHs.
- Federal and state agencies, as well as private sector scientists and academics, have documented the negative impacts on fisheries and shellfisheries from exposure to contaminated sediments. These impacts range from mortality, to negative impacts on reproduction and development, to shortened lifespans, to diseases such as fin erosion, tumors and lesions, liver disease, cancer, and genetic mutations
- U.S. harbors are dredged for maintenance and deepening projects, and a significant amount of sediments are dumped in the ocean. On an annual basis, roughly 60 million cubic yards -- approximately 60 million tons -- of sediments are dumped at some of the 100 ocean dumpsites in the Atlantic and Pacific Oceans or in the Gulf of Mexico (USEPA, 1998.) This is the equivalent of 6 million dump truck loads of muck. Coastal waters are also exposed to contaminated sediments, since roughly 350 million cubic yards of sediments are dredged and dumped annually in coastal waters, bays, estuaries, wetlands, and river banks (USEPA, 1998.)
- There are no national sediment quality criteria or standards to protect ocean or coastal waters, and marine life, from exposure to the contaminants found in sediments.

It is clear that the oceans and coasts are being exposed to dangerous contaminants that are at best regulated on an *ad hoc*, region-by-region basis. In the absence of a set of clear national policies, and a national program addressing contaminated sediments, migratory and resident species of marine life will continue to be exposed to debilitating levels of contamination, with negative impacts on the marine ecosystem.

Sediment contamination in harbors, estuaries, coastal waters, and at ocean dumpsites, must be recognized as a pollution issue of consequence to the marine environment. Policies that address commerce and transportation in coastal and ocean waters cannot be de-linked from issues that surround the removal, transportation, and disposal of dredged materials, some of which are contaminated. Goals of marine stewardship and pollution prevention, if twinned with goals of transportation and commerce, must responsibly address the threats posed by contaminated sediments.

There have been steps taken on-the-ground, in real-world applications, by state governments, to manage contaminated sediments in such a way that they have been transformed from a handicap to a beneficial resource. The state of New Jersey, beginning under the leadership of then-Governor Christine Todd Whitman, has supported the establishment of sediment treatment, decontamination, and remediation technologies. Now, the state treats and manages more than <u>one million cubic yards (one million tons) of contaminated dredged material</u> on an average annual basis. Processes are used that are both environmentally *and* economically sound. The result has been that the most contaminated materials are no longer dumped in the ocean, protecting the state's economically vital marine resources. The materials are treated and used for brownfields restoration and construction projects. Areas in the state that were waste-lands from contamination have been reclaimed through the application of <u>treated</u> contaminated sediments. This has infused new economic vitality into depressed neighborhoods, increased the local and state revenue base, and created new jobs. The state of New York is also taking steps to manage contaminated sediments through alternative technologies and treatment programs.

There are therefore economically *and* environmentally beneficial uses for contaminated sediments. Ocean resources can be protected. Ports can be dredged. Contaminated material can be handled and used as a resource, not a burdensome waste product. We urge the U.S. Ocean Commission to fully address the issue of contaminated sediments in its report, and recommend the actions that we outline in our comments. Crafting a coherent policy on contaminated sediments and how they can be managed to protect the marine environment and restore environmentally degraded areas, while supporting transportation and commerce needs, would be a major advance for U.S. ocean policy.

Our comments focus on the issue of contaminated sediments, and recommend steps that can be taken that would support transportation and commerce while protecting and restoring marine resources. Our comments discuss:

1. the extent and severity of contaminated sediments in U.S. coastal and ocean waters;
2. threats to fisheries and shellfisheries from exposure to contaminated sediments;
3. a case study that illustrates how contaminated sediments can be treated and re-used, thereby protecting the coastal and ocean environment, restoring degraded areas, and benefiting the

economy; and,

4. recommendations for national actions to address contaminated sediments, including protecting existing methods from weakening changes.

1. THE EXTENT AND SEVERITY OF CONTAMINATED SEDIMENT IN U.S. COASTAL AND OCEAN WATERS.

Sediments line river bottoms and lake beds, and bays, estuaries, coasts, and oceans. Sediments can become contaminated from a variety of sources, such as polluted runoff from farms and streets, air deposition, or point discharges of pollution. For example, 37 million pounds of chemicals are discharged into America's waters every year, according to the Environmental Protection Agency (USEPA, 1997). Chemicals discharged from pipes, and pollution from other sources, can settle onto sediments.

Contaminated sediments contain chemicals at concentrations that pose a known or suspected threat to aquatic life, wildlife or human health (USEPA, 1994). Contaminants, or toxins, found in sediments include bioaccumulative contaminants that bind differentially to lipids and fats, and thus transfer efficiently through the food chain. Other types of toxins include those such as heavy metals or many Polycyclic Aromatic Hydrocarbons (PAHs) that may pose less biomagnification risks but can affect organisms directly by dermal contact or ingestion.

A recent study by Long (2000) of estuarine sediments nationwide concluded that 26 to 27% of sediment samples had chemical concentrations high enough to warrant concern for potential toxicological effects. The study also concluded that slightly degraded conditions were much more widespread than acutely toxic conditions; specifically, 42 to 48% of the sampling stations had slightly elevated chemical concentrations and 43 to 60% of the estuarine areas sampled showed adverse biological effects based on sensitive sublethal bioassays. A recent review by Summers (2001) found that 40, 45, and 75% of estuarine sediments on the United States Atlantic and Gulf coasts are enriched with metals, PCBs, and pesticides, respectively, from anthropogenic sources. As more surveys are completed by state and federal agencies and researchers, more hotspots and areal extents of benthic contamination are likely to be identified.

To assess the extent of sediment contamination nation-wide, the EPA analyzed data from more than 21,000 sediment sampling stations. It found that 75% of the stations had "probable" or "possible but expected infrequently" adverse effects from the level of contamination in the sediments. It identified 96 watersheds that contain "areas of probable concern for sediment contamination." According to EPA:

> *"[These watersheds] are sufficiently contaminated with toxic pollutants to pose potential risks to people who eat fish from them and to fish and wildlife . . . Every state has some sediment contamination . . . . Sites where the highest levels of sediment contamination were measured tend to cluster around larger urban areas and industrial centers and in regions affected by agricultural and urban runoff."* (USEPA, 1997.)

The EPA data therefore indicates that cities, industrial areas, farming communities, and areas around cities experience sediment contamination: in other words, a cross-section of America. The 96 watersheds of concern include large tracts of waters, such as Cape Cod, Narragansett Bay, Southern Long Island, Puget Sound, and San Francisco Bay.

Along with identifying the 96 watersheds in which sediment contamination was a concern, the EPA's *National Sediment Quality Survey* also reported that more than 230 different chemicals or chemical groups were found at the 21,000 sampling stations around the country. The chemicals thought to be causing probable or possible harm numbered 97, and of those, the big offenders were PCBs, mercury and other metals, DDT and other pesticides, and PAHs. Some of these chemicals can be viewed as "legacy" contaminants, such as PCBs, dioxins and DDT. Others are emerging contaminants, such as polycyclic aromatic hydrocarbons, or PAHs. Even the "legacy" toxics can, and do, continue to appear even though their production is banned. For toxics such as hydrocarbons, the production is increasing, as is their appearance in sediments.

Many toxic pollutants in sediments are persistent chemicals, resist natural degradation, have low solubility (*i.e.* hydrophobic), and remain in the environment for long periods of time. One example of a persistent toxic pollutant is the chemical class of polychlorinated biphenyls (PCBs). PCBs are a group of synthetic organic chemicals that contain 209 possible individual chlorinated biphenyl compounds. They are not produced naturally, but are the products of industrial processes. The major sources of PCBs are environmental reservoirs from past industrial practices, and thus they are considered "legacy" contaminants. Even though these legacy contaminants have been banned or limited in use, they persist in the environment and are a continuing cause for sediment contamination and adverse biological effects. For example, severely high levels of PCBs have recently been measured in Killer Whales (*Orcinus orca;* Hayteas and Duffield, 2000; Ross *et al.*, 2000b) and pose health risks to this species and other marine mammal species (Ross *et al.*, 2000a). Also, these contaminants are causes for existing and new fish consumption advisories throughout U.S. coastal waters (USEPA, 2001).

Other toxic contaminants are emerging as significant threats to marine systems. These include polycyclic aromatic hydrocarbons (PAHs) and mercury. NOAA's National Status and Trends program has found that levels of these contaminants persist in coastal ecosystems and have not decreased (NOAA, 1998). As more research is performed on contaminants, a greater burden of evidence reveals that effects may be occurring to both wildlife and humans at levels lower than previously thought. This is true for PAHs and mercury as well as legacy contaminants such as dioxins and PCBs.

Another emerging concern to marine ecosystems is the threat of multiple contaminant effects, since sediments will be contaminated with more than one toxic pollutant (*e.g.* USEPA, 1997; Long *et al.*, 1998; Myers *et al.*, 1998). Research on cumulative effects from multiple contaminants is emerging as a necessary priority for better understanding sediment contamination and how to predict and minimize effects from contamination.

In its nationwide assessment, EPA did not survey the quality of ocean dumpsites in the Atlantic, Pacific, and Gulf of Mexico. More than 100 designated ocean dumpsites receive roughly 60 million cubic yards (approximately 60 million tons) of dredged sediments every year (USEPA, 1998). Roughly another 350 million cubic yards of sediments are dredged and dumped annually on river banks, in wetlands, and in bays and coastal waters (USEPA, 1998).

Some portion of the sediments dredged and dumped are contaminated: the precise amount is unknown. With the advent of improved testing in the early 1990s, estimates of contamination have increased dramatically from less than 1% of dredged material, to more recent estimates of 66% or more of the sediments dredged from harbors. For example, improved testing in the New York-New Jersey Harbor resulted in as much as 66% of the sediments failing the ocean dumping standards, while under the out-dated and under-protective tests, less than 5% failed (USEPA, 1999.)

However, there are no sediment quality standards analogous to air or water quality standards by which to judge contaminant levels in sediments. Decisions about what is appropriate for ocean disposal or disposal elsewhere are made on a case-by-case, permit-by-permit basis, and the decision-making matrices differ hugely from one region of the country to another.

The presence and disposal of contaminated sediments threaten habitat, and fisheries, shellfisheries, and other marine wildlife. According to the National Research Council, contaminated sediments affect not only individual fish and shellfish, but also entire populations:

> *"Accumulation of contaminants in marine sediments can cause death, reproductive failure, growth impairment or other detrimental changes in the organisms exposed to these contaminants. Such changes can impact not only individuals but also entire benthic [bottom-living] populations and communities . . . These population-scale impacts include decreased population size, decreased reproduction potential, shorter average lifespans and loss of habitat."* (NRC, 1989)

Contaminated sediments are introduced into the ocean and other coastal waters through dredging and dumping activities, threatening critical habitat and fisheries and marine wildlife. Roughly 400 million cubic yards of sediments are dredged and dumped every year, an amount of material nearly ***three times the amount generated in the construction of the Panama Canal.*** The amount dumped in the ocean -- roughly 60 million cubic yards -- is the equivalent of 6 million dump truck loads of mud.

Given the national extent of sediment contamination, and the variety of toxics found, the impact on marine life from exposure to contaminated sediments can be significant.

2. THREATS TO FISHERIES AND SHELLFISHERIES FROM EXPOSURE TO CONTAMINATED SEDIMENTS.

A. *Impacts on marine life*

Contamination can cause a wide variety of biological effects, including those that negatively affect reproduction and development - the biological processes that are essential for maintenance and perpetuation of healthy populations. Negative effects can be categorized in two ways: acute toxicity and sublethal effects. Acute toxicity is death from short-term direct contact and exposure with toxins. Sublethal effects occur as a result of toxin exposure, may result in shortened lifespan, and may cause impaired biological or ecological performance. Examples of sublethal effects include: fin erosion, tumors and lesions, liver disease, cancer, reduced growth, reduced reproduction, developmental abnormalities, and genetic mutations. These effects have been observed in the marine environment and linked to exposure to contaminated sediments.

In the nearshore marine environment, most food-chains involve animals living on and in the sea-floor. These animals living in sediments are called infauna. Infaunal organisms are more likely than other organisms to bioaccumulate contaminants, exhibit effects, and transfer contaminants to higher trophic levels in the food chain. Two reasons why infaunal species are exposed to toxins to the greatest extent are because they actively ingest sediment particles to which toxins are attached, and they are directly exposed by dermal contact.

The term "bioaccumulation" refers to an increase and accumulation of toxin levels in tissue. Depending on concentrations of the toxins in tissue, bioaccumulation can result in acute mortality or sublethal effects. When predators feed on infauna with contaminated tissue, the contaminants can be transferred to and potentially accumulate in the tissue of the predator by trophic transfer. These contaminants can then potentially continue through the trophic levels of the marine food chain, including to mammalian and avian seafood consumers.

- ***Impacts to the benthic habitat***

Of all marine systems, soft-bottom habitats are likely the predominant types of benthic systems in the world's estuaries and coastal ocean areas. These habitats are chemically dynamic, involving exchanges between the sediments, the overlying layer of water, and interstitial waters between the sediment particles. Contaminants of concern such as PCBs, dioxins, DDT, and hydrocarbons are typically hydrophobic and attach differentially to sediment particles and organic matter, and they can also be present in interstitial waters. As a consequence, biota relying on these habitats for shelter and food are also the first to be impacted by sediment contamination since the species are directly in-contact with the contaminated sediment environment.

Some of the best sources for documented effects to benthic community structure are national and regional benthic indices that have been used to assess sediment contamination. The bases of these indices is that sublethal or lethal effects to populations alter benthic community structure and that benthic structure is a sensitive indicator of the biological significance of sediment contaminant levels (*e.g.,* Canfield *et al.*, 1994; Hyland *et al.*, 1999). As these benthic indices have developed, so has a wealth of information on effects to benthos from contamination.

For example, a system (Hyland *et al.*, 1999; VanDolah *et al.*, 1999) for discriminating between nondegraded and chemically degraded sites was applied in a joint USEPA and NOAA survey of southeastern estuaries (Hyland *et al.*, 1999). The survey extended from Cape Henry, Virginia through the southern end of Indian River Lagoon on the east coast of Florida and represented an estimated 11,622 km^2 of estuarine area. In total, 231 sites were sampled for various measures of water and sediment quality, including contaminant concentrations, numbers of species, total faunal abundance, dominance, percent abundance of pollution-sensitive taxa (ampeliscid and haustoriid amphipods, lucinid and tellinid bivalves, hesionid and cirratulid polychaetes, and the isopod *Cyathura burbanki).* The study concluded that 33% of the 231 sites sampled had degraded benthos (with lower number of species, abundance, species diversity, and

Benthic Index of Biotic Integrity (B-IBI) scores) corresponding to sediment contamination levels. A different study found that 44% of estuarine sediments on the U.S. Atlantic and Gulf coasts supported benthic communities in marginal or degraded conditions (*i.e.* benthic communities were less diverse than expected, were populated by greater than expected number of pollution-tolerant species, and contained fewer than expected pollution-sensitive species; Summers, 2001).

The problem of benthic contamination and effects to benthic communities is not localized to urban estuaries because, by their very nature, sediments are mobile. The sediments arrived at estuaries by deposition from land, and they move out of the estuaries to settle further offshore by processes such as river plume movement or dredging/dumping activities. Urban areas are usually found near large estuaries with major rivers. These river plumes can have far reaching effects into the ocean. For example, researchers estimate that the 1995 Salinas River flood carried as much 3 million tons of sediment (and associated nutrients and toxic contaminants) down Monterey Canyon (Perkins, 2001). Another consequence of urban centers near large estuaries is that there is extreme pressure for dredging to deepen and maintain channels. Dredging and ocean dumping activities in particular move benthic contamination directly to offshore areas.

An example of the risk to ocean benthic systems from contaminated sediments is the Historic Area Remediation Site (HARS) in the NY Bight. On September 1, 1997, the Historic Area Remediation Site (HARS), located in the New York Bight Apex, was designated under the Marine Protection, Research, and Sanctuaries Act as an ocean remediation site. The HARS is a 15-square nautical mile benthic area that was concluded by the EPA to be contaminated (USEPA, 1997b). It surrounds the original Mud Dump Site, where contaminated dredged sediments from NY/NJ Harbor were dumped for decades. The dumping caused mounds of sediments in the ocean area, forming new benthic habitat typically of fine particle silts and clays. This not only modified the benthic community type because of sediment particle size, but also because these fine grained harbor sediments were highly contaminated.

The original Mud Dump site was 2-square nautical miles and the resulting remediation site (HARS) is nearly 15-square nautical miles. Baseline surveys of the HARS prior to its designation showed that sediment contamination was high, with possible negative biological effects (USEPA, 1997b). In particular, multiple contaminant levels exceeded sediment quality guidelines, sediments were acutely toxic to shrimp-like amphipods, and infaunal worms were accumulating high levels of specific contaminants from the sediments. Contaminants accumulating in the food chain were PAHs, PCBs, and 2,3,7,8-TCDD dioxin.

The HARS example thus also illustrates the fact that once sediments are contaminated, results are system-wide and not limited to the benthic environment due to processes of bioaccumulation and trophic transfer. The benthos is the beginning of this chain, bringing contamination in concentrated forms to species higher in the food chain. In the NY Bight Apex, area lobsters were and still are contaminated with PCBs and 2,3,7,8-TCDD (dioxin). The HARS area is one culprit for this contamination. According to NOAA (1996, as cited in USEPA, 1997b), total PCB ($\sum_{18}$PCB) concentrations in muscle and hepatic tissue were elevated in lobsters from three sampling areas closest to the historical mud dump site (now within the HARS area, Figure 1) in comparison to the Hudson Shelf Valley, and this spatial trend was consistent over time. Concentrations ranged from 1.8 to 7.4 ppm (wet weight) in the hepatic tissue (NOAA, 1996 as cited in USEPA, 1997).

- ***Impacts to fish populations***

Fish are exposed to contaminated sediments by a number of processes. Risks from exposure vary with life history and feeding methods. Many fish species incubate eggs in soft bottom habitats, posing direct developmental risks through contact with the sediments and interstitial waters. These developmental risks can translate to delayed adverse effects in adults, including reduced fitness.

Species also maintain intimate contact with the benthos by burrowing into sediments and feeding on benthic infauna. Research demonstrates that fish feeding in contaminated sediments are more likely to accumulate contaminants both via prey and sediment ingestion, develop disease, and pass contaminants to predators (*e.g.*, Malins *et al.*, 1988; McElroy and Sisson, 1989; Cal *et al.*, 1994; Meador *et al.*, 1995; DiPinto and Coull, 1997; Horness *et al.*, 1998).

Estuaries are the first coastal environments to be impacted by sediment contamination. This exposes a large number of marine species to sediment contamination. On average, about 75% of the nation's commercial fishery landings of fish and shellfish are composed of species dependent on estuaries for some time in their life cycle (Chambers, 1991) and countless more non-commercially fished but ecologically important species also depend on the estuaries. For migratory fish species, there is undoubtedly a ripple effect from the estuaries to the oceans since species exposed to the contaminated estuary will return to the ocean with increased contaminant loads and possibly reduced fitness.

Estuarine and marine fish species are exposed to a multitude of stressors. The argument has been made that this multi-dimensional problem restricts science's ability to isolate pollution as a cause for declines in marine resources (NOAA, 1994). However, there is a large body of evidence with which to link effects of chemical pollution to losses of important marine and estuarine resources (Sindermann, 1997 as cited in Long, 2000). For example, there is now a substantial amount of information linking contaminant exposure to impairment of several stages in the reproductive process, increased susceptibility to pathogens due to repressed immune function, and development of diseases in groundfish and salmon in the Puget Sound, WA (Landahl *et al.*, 1997 and references cited therein). Furthermore, these effects may cause substantial decreases in the population growth rate (Landahl *et al.*, 1997).

- ***Contamination of the food chain***

Evidence of contaminated sediments, whether they are in estuaries or in open ocean areas, is found in the marine food chain. Hydrophobic, persistent organic pollutants such as PCBs, dioxin, and DDT have been recognized as those chemicals most likely to be accumulated and efficiently transferred throughout the marine food chain. However, other contaminants can affect food chains, such as trophically-transferred PAHs and their toxic metabolites (Hose *et al.*, 1981; Varanasi *et al.*, 1985; McElroy *et al.*, 1991; Meador *et al.*, 1995). Furthermore, species that feed on benthic infauna in contaminated sediments are not likely deterred by the presence of contaminated prey or sediments (Street *et al.*, 1998) and will accumulate higher levels of contamination than if they were feeding on contaminated prey in clean sediments (DiPinto and Coull, 1997). This places species that rely on the soft-bottom habitat and their predators especially at high and direct risk to effects from contaminated sediments.

Contamination in the food chain is ubiquitous and the best evidence is the incidence of fish consumption advisories for consumption of seafood. The USEPA estimates that 71% of coastal waters of the contiguous 48 states were under advisory in year 2000 and that, nationwide, the total number of advisories has been increasing for four major contaminants, Mercury, PCBs, dioxins and DDT (Figure 3 ; USEPA, 2001). State surveys validate the EPA estimate. Based on surveys completed by states, the contaminants responsible for statewide wildlife and fish advisories in coastal waters are mercury, PCBs, dioxins, and cadmium (USEPA, 2001).

It is important to recognize that animals are typically affected at levels lower than those that would prompt human health consumption advisories. For example, EPA concluded that if wildlife criteria assessments were added to human health based assessments to evaluate sediment contamination on a nation-wide basis, the number of sites classified as sites of concern would have increased from 10,401 sites to 11,004 sites (USEPA, 1997a).

Many species are not exclusive to nearshore and estuarine environments and rather migrate between the open ocean, the nearshore, and sheltered estuaries. These migratory species therefore act as "integrators" of exposure, integrating contaminant exposure over space and time. This food chain effect is the way by which species that may never enter or reside in estuaries are exposed to hotspots indirectly but significantly through the food chain.

For example, the bluefish (*Pomatomus saltatrix*) contains elevated levels of contamination and passes this contamination to its predators, posing significant biological risks. The bluefish is primarily an Atlantic oceanic species widely distributed in warmer seas, but it migrates north and south and between the estuarine and ocean habitats. During migrations into warmer northern waters (*e.g.*, Delaware Bay to Cape Cod) during spring and summer, young bluefish (called "snappers") enter harbors and estuaries while the older bluefish tend to come close to ocean beaches (Bigelow and Schroeder, 1953). They voraciously feed on a diversity of prey species, which represent various levels of the marine food chain but are all connected to sediments through this chain. Prey species in the NY Bight include amphipods, benthic worms, squid, and demersal feeding species such as the windowpane flounder, crabs, and lobsters (USEPA, 1997b). At each foraging area, the bluefish accumulates pollution, and some areas visited by the bluefish may be highly contaminated (*e.g.*, ocean dumpsites, industrialized and urban coastlines) with a cocktail of bioaccumulative toxins including Mercury, PAHs, PCBs, and dioxins. Marine mammal and human predators will then eat the bluefish with significant consequent risks. In the NY Bight, PCBs have accumulated in bluefish to levels exceeding the wildlife criterion developed by EPA to protect avian or mammalian piscivores and there are restrictive fish consumption advisories for bluefish in both New York and New Jersey due to PCBs and dioxin.

The case of the bluefish is by no means unique but provides insight into the challenges that face control of toxics in the ocean environment, since a majority of migratory fish species throughout the world's oceans pass through and forage within contaminated benthic areas (*e.g.*, nearshore, estuarine and bay systems, offshore contaminated areas) at some time in their life cycle or will consume prey that have foraged within these contaminated areas.

- ***Disease in fish populations***

Adult fish in intimate contact with chemically degraded sediments often exhibit contaminant-related diseases. High rates of diseases closely correlate to sediment contamination. Diseases include immunity suppression, fin erosion, lymphocystis, somatic ulcers, pigmentation anomalies, bent fin structures, axial skeletal anomolies, and hepatic lesions (*e.g.*, Ziskowski *et al.*, 1987; Malins *et al.*, 1988; Arkoosh *et al.*, 1994; Myers *et al.*, 1998). Disease prevalence is highest in industrialized and urban areas and has been closely studied in regions throughout the U.S. for over a decade on species such as English sole *Pleuronectes vetulus*, Atlantic tomcod *Microgadus tomcod*, white croaker *Genyonemus lineatus*, mummichug *Fundulus heteroclitus*, winter flounder *Pleuronectes americanus*, starry flounder *Platichthys stellatus*, European flounder *Platichthys flesus*, common dab *Limanda limanda*, and pink salmon *Oncorhynchus gorbuscha* (Myers *et al.*, 1994 and references cited therein; Marty *et al.*, 1997). Contaminants that have been documented to increase risk for disease are PAHs and PCBs (Malins, 1988 and references cited therein; Myers *et al.*, 1994; Myers *et al.*, 1998).

Incidence rates for disease in contaminated estuaries range from less than 10% to nearly 55%, depending on the species and type of disease (Malins *et al.*, 1988; Fournie *et al.*, 1996; Myers *et al.*, 1998). Some studies on diseases have been accomplished on large regional or nationwide scales to include both "hotspot" contaminated estuaries and "background" non-contaminated areas. These studies show that disease prevalence is lower, but existent, in "background" non-contaminated areas as compared to hotspot contaminated benthic areas (Fournie *et al.*, 1996). In the Virginian Province (Cape Cod, MA to Cape Henry, VA) and the Louisianian Province (Tampa Bay, FL to Mexican border along the Gulf Coast), Fournie *et al* (1996) found that skin lesions, mostly fin erosion, cutaneous ulcers and paillomas, were the most prevalent abnormalities. Regional "background" rates of disease varied from approximately 4 to 9 fish with abnormal pathologies per 1,000 fish (0.4 to 0.9%). In both provinces, demersal species were considerably more likely to have pathological abnormalites than were pelagic or piscivorous fish. Disease was more prevalent at sites with chemically contaminated sediments. At smaller spatial scales, for example, in the Back River in Maryland, rates of pathological abnormalities in brown bullheads were high with rates 15-times the background rates for skin lesions. In Galveston Bay, abnormalities were prevalent almost twice the background level of the rest of the province. In the Virginian Province, abnormalities were most prevalent in Chesapeake Bay.

Documented rates of specific diseases in other areas also significantly exceed the southeast's regional "background" levels (for all types of disease) calculated by Fournie *et al.* (1996). For example, liver lesion rates for winter flounder in Boston Harbor is 12% (Myers *et al.*, 1998), for winter flounder in Long Island Sound is up to 7% (Myers *et al.*, 1998), for starry flounder in the Oakland Estuary is approximately 5% (Myers *et al.*, 1998), and for English sole in Eagle Bay, Puget Sound is up to 18% (Malins *et al.*, 1988). These diseases place greater metabolic demands on fish and may reduce fitness by processes such as slowed growth and ineffective mobility and foraging.

- ***Effects at sensitive life stages***

Some of the most devastating risks to marine species from contaminated sediments may likely be mortality or significant developmental abnormalities at the embryonic and larval life stages. The benthic habitat is used by many species as substratum for laying and incubating eggs and developing larvae. In particular, many marine species migrate to estuarine habitats specifically to spawn and develop eggs. These estuaries are plagued with contaminants that reside as industrial and agricultural legacy contaminants or are newly deposited in the sediments, exposing sensitive developmental stages to contaminated sediments and interstitial waters. These combined contaminant stresses are persistent and continue to place reproducing fish populations at higher risk, both in the short term (reproductive and hatching success) and in the long term (fitness, mortality). Contaminants can also be passed through maternal gonadal tissue to embryos with resulting lower hatching success and greater developmental abnormalities (*e.g.*, Hose *et al.*, 1981), placing the young developmental stages of non-demersal egg laying species also at risk from contaminated sediments.

Important to recognize is that while toxicological studies on effects from sediment contamination in fish populations may detect sublethal and lethal responses during experiments, these experiments likely underestimate the real impacts at the population field level. Sublethal responses may be delayed in populations for reasons including that net effects from contaminant exposure require developmental time before research methods detect effects. These net sublethal effects can ultimately lower fitness and increase mortality.

Some of the most comprehensive studies of developmental effects to embryonic and larval life stages in finfish come from studies of the *Exxon Valdez* oil spill (EVOS) aftermath. These studies illustrate the range of potential effects from polycyclic aromatic hydrocarbon (PAHs) contamination to fish (as reviewed by Rice *et al.*, 2001). Effects were noted immediately following the EVOS of less pink salmon abundance and lower growth in oiled locations (Carls *et al.*, 1996; Rice *et al.*, 2001). Evidence has also mounted that there are persistent effects to salmon from EVOS and that PAHs, in particular weathered PAHs, cause developmental abnormalities, growth reductions, reproductive impairment and eventual mortality in salmon as a result of PAH exposure at the juvenile life stages (Rice *et al.*, 2001 and references cited therein).

Similar to other fish species that utilize the benthic habitat during their life cycle, salmon are exposed to PAHs by water, sediments, and oil-contaminated food. Contaminated sediments in particular can prolong the persistence of PAHs by acting as reservoirs and recontaminating overlying and interstitial waters (Rice *et al.*, 2001; Murphy *et al.*, 1999). The long-term sensitivity of embryos has been confirmed in tests using weathered oil on gravel which show that weathered oil is more toxic in chronic exposures than previously suspected and occurs at the parts per billion level (Marty *et al.*, 1997; Heintz *et al.*, 1999). Effects to growth at the developmental stage may not be expressed until long after the exposure has ended, as evidenced in a study by Heintz *et al.* (1996) where results from a coordinated laboratory and field study suggest that increased mortality in a PAH-exposed population resulted from its greater proportion of slower growing individuals. Other evidence for delayed effects come from studies by Marty *et al.* (1997) which suggest that developmental abnormalities in pink salmon larvae exposed to oil-contaminated gravel may be related to adult reproductive impairment.

This example of impacts from PAH sediment contamination in Prince William Sound provides a weight-of-evidence that is applicable to other U.S. regions with high PAH loadings to sediments. Urbanized estuaries often have the lethal combination of weathered PAHs and sensitive developmental life stages of fish species that use these habitats for reproduction. Rice *et al.* (2001) estimate that for every 50 million people, the equivalent of one *Exxon Valdez* oil spill happens every year through a combination of accumulated spills and nonpoint source inputs.

The low-level exposure effects described for the EVOS studies are not unique to salmon and are likely due to the sensitivity of the embryonic fish life stage in general (Rice *et al.*, 2001). For example, Pacific herring embryos also exhibited similar responses to low levels of PAH exposure (Carls *et al.*, 1999). Other fish species rely on estuarine habitats for reproduction and are likely similarly affected by PAH contamination.

Sediment surveys by state and federal agencies demonstrate that PAHs are ubiquitous in high concentrations throughout urbanized areas, are listed as contaminants of concern in sediments, and exceed sediment quality guidelines (*e.g.*, USEPA, 1997a). Comparisons between NOAA studies and research on effects levels to larval developmental stages in fish suggest that levels of PAHs in marine resources are near those causing significant effects to sensitive developmental stages. For example, NOAA's Mussel Watch and Benthic Surveillance Program reports that the nationwide median PAH tissue concentration (based on bioaccumulation by bivalve bioindicators) is 250 ppb and the 85% percentile is 1300 ppb. PAH levels in tissue ranging from 22 to 1400 ppb caused mortality and/or structural abnormalities (lack of jaw development, small jaws, spinal defects, failure to develop fins) in Pacific herring eggs; tissue levels as low as 22 ppb caused yolk sac swelling, jaw abnormalities and premature hatching (Carls *et al.*, 1999). Additionally, results from the National Oceanic Atmospheric Administration's (NOAA) National Status and Trends program demonstrate that, on a nationwide basis, PAHs in sediments are not decreasing (NOAA, 1998).

Sensitive life stages will also be exposed to elevated levels of many other contaminants, increasing risks to survival. As previously discussed, many nearshore benthic habitats are contaminated with a multitude of chemicals. Contaminants include mercury, PCBs, dioxins and pesticides. As embryonic and larval stages are sensitive to PAHs so are they sensitive to these other toxic chemicals. For example, studies have shown that fish embryos exposed to water containing low levels (1-12 ppt) of 2,3,7,8-TCDD resulted in disruption of critical enzyme systems, and hemorrhagic lesions as the liver developed (Wisk and Cooper, 1990a & b)

3. THE NEW YORK-NEW JERSEY REGION: A CASE STUDY IN REMEDIATING OCEAN CONTAMINATION AND TREATING AND REUSING CONTAMINATED SEDIMENTS.

In the past five years, the New York/New Jersey Harbor region has implemented a comprehensive approach to contaminated sediments that includes:

- treating and managing more than 1 million tons per year of contaminated dredged material, using processes that are both environmentally and economically sound;
- researching additional technologies to manage sediments in the future;
- implementing treatment technologies that are creating new industries and jobs;
- meaningful application of efforts to reduce toxin inputs;
- a vision that considers sediments a resource rather than a waste material;
- aggressively linking brownfields restoration and treatment technologies that results in a net environmental and economic gain for the region; and,
- no longer viewing the ocean as the ever-present solution to waste management problems.

The result: today there are more non-ocean alternatives for dredged material than there is dredged material to meet their needs. In other words, the NY/NJ region is in the ironic position of needing to secure sufficient dredged material to support all these alternatives. Providing a reliable source stream of sediment is crucial to the success of these technologies. The ocean off the Jersey Shore is now dumpsite-free for the first time in 100 years. In addition, port interests and marine advocates have common ground recognizing commitments to a healthy marine environment and healthy port.

This new era sprang from conflict. Until the late 1990s, roughly 6 million cubic yards (about 6 million tons) of sediments were dredged annually from the Harbor, and nearly all of that sediment was dumped at the Mud Dump Site located six miles off the Jersey shore.

Until new tests came on-line in 1991, less than 5% of the mud dredged from the Harbor failed the sediment tests conducted by the Army Corps of Engineers. Once the new tests were used to assess the toxicity of sediments, the failure rate jumped to, in some instances, 66%. What citizen and fishing groups, and many scientists, had long argued was the case was proven: much of the mud underlying the Harbor was dangerously contaminated.

At the same time that the new tests were becoming available, a permit application was filed involving 500,000 cubic yards of sediments that the Port Authority of New York-New Jersey wanted dredged from part of the NY-NJ Harbor. Dioxin was found in the sediments. A lawsuit against the proposed dumping of the sediments was filed, and in 1994, then-Governor Whitman established a Dredged Material Management Team that was directed to find and implement environmentally sound alternatives in the region for contaminated dredged materials. What was specifically *off* the table, in terms of options, was the disposal of contaminated sediments in the ocean, or in open-water settings. The Team reported back with a suite of potential treatment, reuse, and remediation technologies, and within months of the Team's recommendations, the lawsuit was won on appeal in 1995. The region was faced with the legal and political need to seriously address its contaminated sediments.

New technologies had been under examination through a federal decontamination program pioneered by Rep. Frank Pallone (D-NJ), which began investigating innovative solutions to contaminated sediments in 1990, and continues today. The technologies got an additional boost when Governor Whitman's leadership on the state level was mirrored by the Clinton

Administration on the national level, which announced that, by September 1, 1997, the ocean dumping of contaminated sediments off New Jersey would forever end. The Administration also designated the dumpsite as an Historic Area Remediation Site.

The 1990s were definitely a decade of change for the region. The decade began with a fledgling decontamination program and ocean disposal of dioxin-laced sediments. The decade ended with the region becoming the first in the nation to permanently end ocean dumping of contaminated sediments implement commercially viable treatment technologies, and begin the process of cleaning-up a contaminated ocean area nearly 15 square miles in size.

Now, the state of New Jersey treats, on an annual basis, 1 million cubic yards of contaminated sediments through a suite of treatment, reuse, and remediation technologies. The state leads the nation in using treated sediments to reclaim brownfields, restore Superfund sites, and create new jobs in the innovative technologies industry.

Work to restore the former ocean dumpsite to health is also underway. The Port has also achieved the level of dredging it sought, with the result that navigation channels have been maintained and are even, now, being vastly deepened.

The region now views contaminated sediments, as well as clean sediments, as a resource. Solutions have been found that have protected the ocean and marine wildlife, and maintained the Port. These solutions need to be expanded to a national level through current and new federal programs. It is time that all urban harbors faced the real issue of contaminated sediments. New federal leadership can take the New Jersey-New York experience and transfer it nation-wide.

4. <u>RECOMMENDATIONS FOR NATIONAL ACTIONS TO ADDRESS CONTAMINATED SEDIMENTS</u>

Contaminated sediments and their associated challenges often elicit paralysis by regulatory agencies. In fact, management of contaminants in sediments is often ignored until the problem expands into human health threats. Only then do regulatory agencies respond, usually by putting fish advisories in place, or in the extreme, by designating the waterbody as a Superfund site. Regrettably, in most cases, these reactionary and unproductive actions are also the final regulatory solutions. The consequence of this approach is to leave marine life vulnerable to adverse affects.

The core problem is that sediments lack respect - there is no legislative protection, no regulatory oversight, no protective standards or criteria. In short, there is no "Clean Sediments Act" that provides protection to sediments. Furthermore, sediments are a wasted resource that, if properly managed, can become a valuable material.

A comprehensive approach to address problems of the past and to prevent future problems would begin with legal recognition and protection of these critical habitats. The goal of a Clean Sediments Act would be to stipulate that:

1) sediments must be healthy, protecting sensitive marine life at sensitive life stages and against bioaccumulation and bio-magnification of toxins;

2) protections must account for synergistic and additive effects from multiple contaminants; and,
3) dredged sediments are a natural resource and should not be wasted by disposal in aquatic habitats.

A. ***Practical implementation of practical solutions***

Contaminated sediments should be addressed by taking the following four steps:

1. locating contaminated sediments and identifying the degree of contamination;
2. reducing contaminated sediments in the ecological system;
3. remediating areas and sediments that are harmful to marine life; and,
4. devising funding strategies to support the identification, reduction, and remediation of contaminated sediments.

1. Locating and identifying contaminated sediments

Recommendation: A nation-wide ecosystem-based approach should be adopted that monitors sediments that threaten marine life. Levels of contaminants that are causing adverse impacts should proactively trigger regulatory and remediation action. A system for identifying and assessing contaminant levels found in biota should also be implemented.

Needed Actions:

- Until such time as protective federal sediment quality criteria are implemented, the assessment system developed by NOAA researchers called the Effects Range Low (ERL) and Effects Range Medium (ERM) guidelines should be applied. These guidelines have been periodically used both by EPA and NOAA for assessing sediment quality, but they are not systematically invoked for sediment decision-making. Other systems similar to the ERL/ERM approach have been applied in states. These guidelines should only serve as interim measures because they do not account for trophic transfer of contaminants.
- EPA should assess all ocean disposal sites for potential bioaccumulation of contaminants in organisms at the site, pursuant to the Ocean Dumping Regulations at CFR 228.10. The assessments should also include the other criteria found at CFR 228.10, including movement of materials from the dumpsites, absence of pollution-sensitive biota, changes in water or sediment quality, and changes in biota. Assessing the dumpsites is critical to developing an accurate picture of the health of the oceans, and to determining the steps that need to be taken to better protect and restore degraded or contaminated areas.
- EPA should compile a report on the ocean dumpsite assessments and transmit the report to Congress and the pubic.
- EPA should develop, as necessary, based on the report, a listing of sites that should be modified or closed, and the restoration activities that should take place at the site to restore the ocean to health.

2. Reducing contaminated sediments in the ecological system

Recommendation: Contamination levels that cause fish advisories for human consumption mean that marine wildlife may already be suffering ill-effects from the levels of contaminants present in the foodchain. To protect marine wildlife, fisheries, and shellfisheries, the flow of contaminants into sediments must be staunched. The massive dredging of harbors that generates millions of tons of dredged sediments, some of which are contaminated, must be replaced with dredging needs that factor in ecosystem needs as well as transportation desires.

Needed Actions:

- EPA should analyze its national contaminated sediment site survey, and the national listing of fish advisories and bans, to identify contaminated sediment sites that require priority removal or clean-up/remediation as a way to eliminate fish advisories or bans.

3. Remediating areas and sediments that are harmful to marine life

Recommendation: The EPA and other federal agencies should promote the national application of treatment, reuse, and remediation programs and/or technologies, for contaminated sediments.

Needed Actions:

- EPA could develop a Memorandum of Agreement (MOA) with the Corps, or the EPA could develop guidance, that would place the use of environmentally sound decontamination, treatment, remediation, and reuse technologies as the preferred approach to managing contaminated sediments. Currently, these approaches are often placed by the Corps at the bottom of the list of management options. EPA, through its ability to review dredging permits issued pursuant to the Clean Water Act and Marine Protection, Research and Sanctuaries Act, and through its ability to establish remediation standards, could create a management hierarchy that would place the remediation, reuse, treatment and decontamination approaches at the top. This would help put these options at the table when decisions are being made about the management of dredged materials.

4. Devising funding strategies to support the identification, reduction, and remediation of contaminated sediments.

Potential funding sources for environmentally sound dredged material management include the following:

- amend the Water Resources Development Act to increase the federal portion of the project cost-share if decontamination technologies or treatment technologies are proposed as part of the project's operations. A financial benefit would accrue to projects that use decontamination technologies or programs.

5. Protecting existing methods for addressing contaminated sediments from weakening changes.

Current federal laws provide important tools that state and federal agencies, and citizens, can use to protect coastal and ocean resources from exposure to contaminated sediments. For example, one important ocean law is the Marine Protection, Research and Sanctuaries Act of 1972 (MPRSA) (Public Law 92-532), and its implementing regulations, the Ocean Dumping Regulations (40 CFR Chapter 1, Part 220-228.15.) The MPRSA outlines protections that must pertain to ocean resources, and the regulations list substances whose disposal in the ocean is prohibited, or strictly limited. This law and its regulations are critically important to ocean dumping issues. Weaken them would result in disastrous consequences for the ocean. Indeed, an attempt by the EPA in 1996 to weaken the Ocean Dumping Regulations resulted in a national uproar, bipartisan action in Congress, and eventual intervention by the White House.

Another important coastal and ocean law is the Coastal Zone Management Act (CZMA) (Public Law 104-150), and its implementing regulations, most particularly the consistency regulations (15 CFR Part 930.) The CZMA grants states the authority to review federally licensed, permitted and conducted activities to ensure that they are consistent with the state's own federally approved coastal management plan. The consistency provision is one of the key, if not *the* key, reasons why 34 coastal states and territories have joined, or are taking steps to join, the federal coastal zone management program. The provision is central to the CZMA's commitment that states will have the ability to ensure that the federal government does not act in ways that run counter to the state's own program of managing state resources. The consistency provision has been used by states with respect to proposals to explore or drill for offshore oil and gas deposits, and it has been used by states to participate in federal proposals to dredge harbors and dump sediments at ocean and coastal dumpsites. This provision cannot be weakened without weakening protection of key coastal and ocean resources. We urge the Commission to include in its report a strong statement of support for both of these important laws -- the MPRSA and the CZMA -- and their implementing regulations.

CONCLUSION

There are economically *and* environmentally beneficial uses for contaminated sediments. Ocean resources can be protected. Ports can be dredged. Contaminated material can be handled and used as a resource, not a burdensome waste product. We urge the U.S. Ocean Commission to fully address the issue of contaminated sediments in its report, and recommend the actions that we outline in our comments. Crafting a coherent policy on contaminated sediments and how they can be managed to protect the marine environment and restore environmentally degraded areas, while supporting transportation and commerce needs, would be a major advance for U.S. ocean policy.