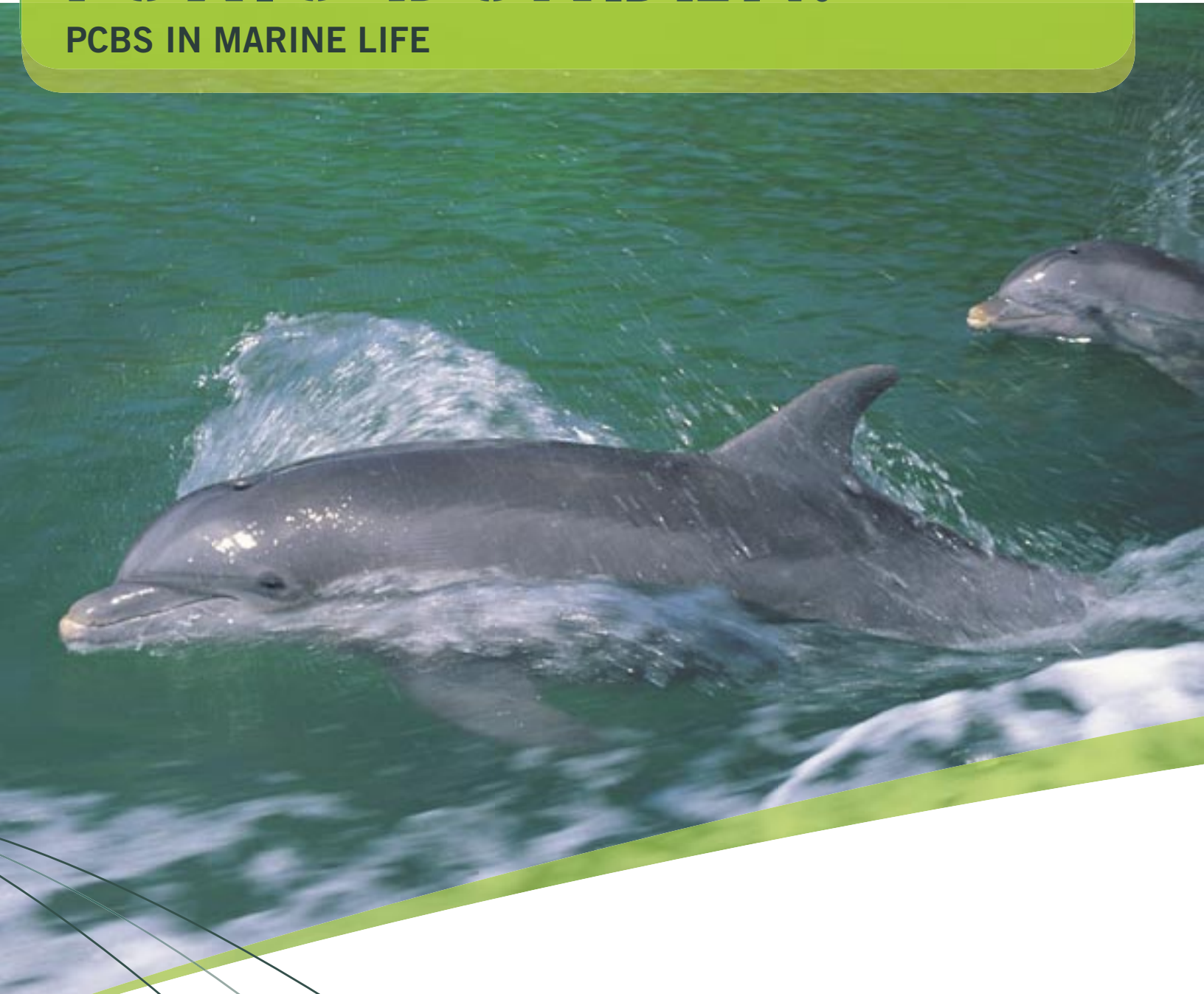


# TOXIC BURDEN:

PCBS IN MARINE LIFE



# FOREWORD

This report tells a story about health problems that continue to occur in marine mammals and human beings because the U. S. government is unwilling to learn from past mistakes and take action to control toxic chemicals that harm our citizens, our marine wildlife and people around the world. Two years ago the Bush Administration signed the Stockholm Convention on Persistent Organic Pollutants, but since then has done everything possible to eviscerate the protection from toxic chemicals the treaty provides.

The “toxic ten” marine mammals described in this report include some of the most beloved animals on earth: seals, dolphins, and whales. Unfortunately, thanks to the development and use of persistent organic pollutants (known as POPs) over the past 70 years, they are not safe—and neither are we.

As a result, POPs, which include DDT, dioxins, and PCBs, are some of the most harmful substances on earth and can be extremely toxic in very small amounts. The most important thing to understand about POPs is that once they are released, it is difficult, if not impossible, to remove them from the environment. POPs tend to travel long distances and accumulate in water, soil, sediments, and plant and animal tissue where they remain for long time periods.

POPs that have been banned in the United States for decades can still be found in the environment. The POP found most commonly in the environment is the group of chemicals called polychlorinated biphenyls, or PCBs. This report details an analysis that found our favorite sea animals have built up toxic levels of PCBs and that people, specifically those whose diets consist primarily of seafood, are not far behind.

The worst part of this story is that our policy makers are not learning from past mistakes. They continue to allow production and use of other chemicals that are very similar to the banned chemicals in that they are persistent and toxic to humans and marine life. In the past few months, new studies have been released showing that chemicals such as polybrominated diphenyl ethers (PBDE), used as a flame retardant in everyday items such as furniture and clothing, and perfluorooctanoic acid (PFOA), used in the manufacturing process for Gore-Tex and Teflon, pose serious health risks to humans and animals. Recent studies based in California have shown that women there have three to 10 times more PBDE in their breasts than either European or



Photo: NOAA

Japanese women. Until more research is conducted the reason for this difference will remain a mystery. Interestingly, PBDEs could not be found in preserved human blood samples from the 1960s.

Consistent with the findings on PCBs in this Oceana report, marine mammals may bear the greatest toxic burden with these emerging chemicals. Harbor seals tested for PBDEs in the San Francisco Bay area have among the highest known levels of these chemicals in the world.

Chemicals like PFOA and PBDEs are used because manufacturers are not required to prove that they are safe for human health and the environment. The United States needs a system to stop the proliferation of these new toxic chemicals. We should know by now that controlling the production, use, and release of these chemicals prevents their widespread toxic effects.

Chemical manufacturers should be required to prove that new chemicals are not toxic before they are used. Oceana urges Congress to pass legislation to prevent the manufacture, sale, and use of new chemicals that are harmful to the environment—particularly marine life—and human health.

Unfortunately, despite the lofty statements by the President when he signed the treaty, the Bush Administration prevented the passage of legislation that would make the United States a full partner in the international agreement to control POPs. Even though the chemicals in the treaty have already been banned in the United States, the Administration refuses to include provisions that could prevent the production and use of additional toxic chemicals. This short sighted view designed to protect the chemical industry will only result in increased toxicity in wildlife and humans, and as this report shows, many of our most beloved marine mammals will bear the brunt of the burden.

# EXECUTIVE SUMMARY

## PERSISTENT ORGANIC POLLUTANTS—KNOWN AS POPS—ARE AMONG THE MOST HARMFUL SUBSTANCES ON EARTH.

These chemicals are highly toxic in very small amounts, persist in the environment, and tend to accumulate in water, soil, sediments, and plant and animal tissue where they remain for long time periods. These characteristics, combined with their tendency to travel long distances, have created a major, long-term global environmental health crisis. Past and current use of these POPs and other chemicals has left a toxic legacy—in the United States and around the world.

POPs have created a major, long-term global environmental health crisis.

Fortunately, countries around the world have agreed to ban the production, use, and release of the twelve most notorious POPs, known as the “dirty dozen,” and developed a process to

address the dozens of additional POPs currently produced. The international agreement, called the Stockholm Convention on Persistent Organic Pollutants, requires countries to ban the manufacture and use of ten chemicals, and restrict the release of dioxins and furans. Dioxins and furans are not intentionally produced but rather are byproducts of incineration and industrial processes, therefore, their production is more difficult to ban.

### BOX 1: The Dirty Dozen: Twelve Persistent Organic Pollutants Included in the Stockholm Convention

Aldrin	Chlordane
Endrin	DDT
Dieldrin	Dioxins
Furans	Heptachlor
Hexachlorobenzene	Mirex
PCBs	Toxaphene

The United States has already banned the manufacture and use of the ten worst chemicals, but still has not ratified the Stockholm Convention or its protective adding mechanism, which allows for additional chemicals to be banned.

While the United States had already banned the production and use of the ten worst chemicals, the Stockholm Convention is not in force because the requisite 50 countries—including the United States—have not yet ratified it. As a result, use of these ten chemicals continues in some countries, generation of dioxins and furans continues everywhere, and other important initiatives in the Convention have not occurred. The lack of action on POPs does not result from a lack of data. Most countries simply lack the political will to stop the flow of persistent, toxic, and bioaccumulative chemicals into the environment.

Despite the progress made in the United States to phase out production and use of POPs, these toxic substances still have not disappeared from the environment for several reasons:

- 1) Other countries continue to use them;
- 2) Past practices such as disposal in landfills and open water and build-up in agricultural and other soils has resulted in contamination and ongoing leaching into the environment and the food chain;
- 3) Use of PCBs in existing electrical equipment results in continued contamination of air, water, and food; and
- 4) POPs are carried long distances through the atmosphere and water to contaminate areas far from their point of release.

As a result, POPs can be found in every part of our environment, including our own bodies. Oceana is particularly concerned about the presence of POPs in the marine environment and how this affects our health and the health of marine life.

## THE TOXIC TEN— SEA LIFE IS SERIOUSLY CONTAMINATED BY PCBs

Oceana is particularly concerned about the presence of POPs in the marine environment and how this affects our health and the health of marine life.

from 1993 until 2001. Many times, these advisories are not isolated to a specific body of water. In fact, nine states, including Maine, New Jersey, New York and Rhode Island have issued blanket advisories covering the whole state or the entire coastal area of the state.<sup>27</sup> PCBs are also a common contaminant in hazardous waste sites and underwater sediments. Clearly, PCBs represent a threat to the fish-eating public and to marine life.

For this study, we set out to identify wildlife heavily contaminated by PCBs. Unfortunately, the existing scientific literature is insufficient to adequately characterize contamination levels for most populations of animals. This screening analysis instead focused on identifying the individuals of a given species that have been tested and that exhibited the highest level of contamination.

Of the “dirty dozen,” the chemical found most commonly in the environment is the group of chemicals called polychlorinated biphenyls, or PCBs. As of 2001, 38 U.S. states had issued a total of 764 consumption advisories for fish due to PCB contamination. The number of PCB-related fish advisories consistently increased

The results of existing studies suggest that in general, marine life carries higher concentrations of PCBs than other wildlife. Of the ten species with the highest individual PCB levels, nine are marine mammals that depend on the sea for food, including dolphins, whales, and seals. The tenth is a sea bird, which, like the marine mammals, depends on the ocean for its diet. This result is perhaps not surprising, since marine food chains are longer than those on land, leading PCBs to build up to particularly high levels in those animals highest in the food chain.

The most contaminated individual animal we identified was a dead bottlenose dolphin found off the coast of Italy. It was loaded with twice the PCB levels in its blubber as the killer whale and Risso’s dolphin that ranked second and third, and nearly 10 times that of the harbor seal that ranked fourth.

Certain human populations are known to have high levels of PCBs, due to their diets and geographical locations. A group of humans ranked 13<sup>th</sup> in this analysis. They are part of the Inuit population native to Greenland. Their traditional diet includes fat from seals that are heavily contaminated with PCBs. In this case, the contamination value is in fact an average of multiple individuals that were tested.



Photo: Freeman Brown, [www.brownlog.dreamhost.com](http://www.brownlog.dreamhost.com)

**Box 2: Marine Animals Contaminated with PCBs at Levels that Cause Health Effects**

Rank	Species	Concentration in parts per million (ppm)	Geographic Location	Tissue Tested
1	Bottlenose Dolphin	2000	Italian Coast	Blubber
2	Killer Whale (Orca)	Over 1000	Dungeness Spit, WA, USA	Blubber
3	Risso's Dolphin	1000	Italian Coast	Blubber
4	Harbor Seal	205	North Atlantic	Blubber
5	Beluga Whale	128	St. Lawrence River Estuary, Canada	Blubber
6	Mediterranean Monk Seal	107	Western Mediterranean	Blubber
7	Common Dolphin	86	Atlantic Ocean	Blubber
8	Gray seal	82	Baltic Sea	Blubber
9	Polar Bear	80	Svalbard, Norwegian Arctic	Fat
77ppm PCBs, known to impair reproductive success in ringed seals Material with PCB levels above 50 ppm is considered hazardous waste under Canadian guidelines				
10	Steller's Sea Eagle	39	Hokkaido, Japan	Breast Muscle
16.5ppm PCBs, known to suppress the immune system and depress vitamin A levels in harbor seals				
13	Human, Inuit	15.7	Greenland	Abdominal Fat

Again, for the marine animals reported here, this analysis is not intended to reflect contamination levels in entire populations. No national or international program has ever systematically tested wildlife, including marine species, to characterize the PCB contamination problem or that of other POPs. Instead, we must rely on snapshots of information taken from different studies, each using different approaches. This report also did not attempt to document the effects of the PCBs on each of the animals in our table; the information available in the literature is simply insufficient to allow a full analysis of associated effects. However, the levels seen in many of these species far exceed levels of concern identified by researchers and government agencies.

**RECOMMENDATIONS**

***The U.S. government must take action to protect sea life and public health.*** To begin the process to reduce the levels of PCBs and other POPs in marine life, other wildlife, and humans, Oceana makes the following recommendations which are discussed further in this report:

- **Congress should enact legislation to implement the Stockholm Convention on Persistent Organic Pollutants that includes a mandatory requirement that EPA address chemicals identified as POPs in the future. Given President Bush's statement of support for this Treaty, the Bush Administration should ensure the passage of such legislation this year.**
- **The United States should play a leading role in identifying candidate chemicals to be added for coverage under the Stockholm Convention.**
- **Congress should pass legislation to prevent the manufacture, sale, and use of new chemicals that are persistent, bioaccumulative and toxic, and restrict activities that result in the release of byproducts with POPs characteristics into our air and water.**

# TOXIC BURDEN: PCBS IN MARINE LIFE

## LASTING TOXIC LEGACY

Persistent organic pollutants (POPs) are chemical substances that linger for long periods in the environment, become magnified through the food web (in the fatty tissue and organs of fish and wildlife), and pose environmental and human health risks. Well-recognized POPs that are cause for concern include pesticides such as DDT (dichlorodiphenyltrichloroethane), chlordane, and aldrin; industrial chemicals like polychlorinated biphenyls (PCBs) and hexachlorobenzene, and byproducts of combustion and chemical manufacturing such as dioxins and furans. Once POPs are released, it is difficult, if not impossible, to remove them from the environment. Controlling the production, use, and release of these chemicals is the only way to prevent their widespread and devastating toxic effects.

Once POPs are released, it is difficult, if not impossible, to remove them from the environment. Controlling the production, use, and release of these chemicals is the only way to prevent their widespread and devastating toxic effects.

Once released into the environment, POPs roam the globe for decades and cause cancer, birth defects, learning disabilities, and immunological, behavioral, neurological, and reproductive problems in humans and other animals. They cause deformities, reproductive failures, and population declines in wildlife. Because POPs accumulate in the fat and organs of fish and other animals, their concentrations increase with every step up the food chain. For this reason, animals at the top of the chain like humans, killer whales, and polar bears carry the greatest burden.

PCBs, man-made chemicals once used as coolants and lubricants in electrical equipment, have been linked to problems in nervous, immune, and hormonal systems. PCBs are considered by the U.S. Environmental Protection Agency (EPA) to be probable cancer-causing agents in humans and animals. Despite the ban on PCB manufacture in many parts of the world, PCBs have not been completely phased out and continue to be used in older electrical equipment, causing significant environmental contamination.

## CURRENT POLICY ON POPS

PCBs became a known public health menace soon after their use began. As a result, production of PCBs and their use in the manufacture of electrical equipment were discontinued in the United States in 1977. However, in spite of this ban, PCBs are still used in older electrical equipment and have become ubiquitous in the environment. Even 25 years after they were banned in some parts of the world, they continue to contaminate humans and wildlife with no end in sight. Thus they provide a good example of the importance of anticipating and preventing contamination by persistent and bioaccumulative chemicals used now and in the future. Once a persistent chemical or group of chemicals is used as heavily as PCBs were, the process of purging them from our air, water, food, land, and our own bodies is likely to take many decades if not more.

To ban the production and use of PCBs and other POPs, the international community came together in Stockholm, Sweden, in May 2001, and signed the Stockholm Convention on Persistent Organic Pollutants. After years of negotiation, more than 150 countries including the United States, signed the Convention, setting forth goals to eliminate or significantly restrict global production, use and/or releases of twelve POPs (see Box 1).

### BOX 1: The Dirty Dozen: Twelve Persistent Organic Pollutants Included in the Stockholm Convention

Aldrin	Chlordane
Endrin	DDT
Dieldrin	Dioxins
Furans	Heptachlor
Hexachlorobenzene	Mirex
PCBs	Toxaphene

### Reviewing New Chemicals

Besides addressing the 12 chemicals known to be toxic, bioaccumulative and persistent, the Convention took an important additional step. Recognizing that new information will identify the dangers of other chemicals, the Convention made provisions for adding other chemicals to the list of internationally banned or severely restricted chemicals. The POPs characteristics as defined by the

Convention include toxicity, persistence, bioaccumulative nature, and the potential for long-range transport. The Convention also requires that new chemicals, which are being considered for use, are tested to ensure that they do not possess POPs' characteristics. Overall, the Convention attempts to stop the continued release of the "dirty dozen" POPs, to address additional chemicals currently manufactured and to prevent new chemicals with similar properties from contaminating our environment and ourselves in the future.

Unfortunately, international law states that the Convention will not enter into force until it is ratified by 50 countries. In many countries, doing so requires passing a domestic law. While neighboring countries such as Canada and Mexico as well as about 30 others have already done so to date, the United States has not yet ratified the Convention. In 2002, a bill that would have set U.S. ratification in motion (S 2118) was introduced in the United States Senate by Senator James Jeffords of Vermont. Unfortunately, the bill was blocked by the Bush Administration. In 2003, another bill was introduced, this time without meaningful language to protect the public or marine life from the effects of POPs. Without strong implementing legislation, the United States cannot officially ratify the treaty and important provisions of the Stockholm Convention will not be binding on the United States, which dramatically reduces the effectiveness of the international agreement.

#### **ANALYSIS OF PCBs ACCUMULATED IN WILDLIFE**

Oceana conducted this analysis of PCB contamination in wildlife to provide a clearer picture of the dangers to marine life and human health resulting from our inaction and failure to control persistent, bioaccumulative chemicals. The analysis focused on one particular group of chemicals, PCBs, which are still found everywhere in the environment, even though their production has been discontinued since 1977. This study was not designed to fully characterize PCB contamination levels in wildlife, as it would be impossible to do so without a more systematic sampling program analyzing PCBs in wildlife and humans. Instead, we have analyzed existing studies to identify the animals that are hardest hit by PCBs, whether they are marine or terrestrial. In addition, we have compared these contamination levels with PCB levels in humans, and with thresholds for toxic effects in wildlife. Our findings provide perspective on the level of PCB contamination in wildlife and humans and demonstrate that we are dealing with levels that are of significant concern.

In developing the top ten list of animals most contaminated by PCBs, we used a conservative approach, excluding mammalian PCB levels measured in organs or tissues other than fat. Liver samples, for example, tend to be considerably higher in PCBs than blubber samples and would have confused comparisons among marine mammals. For non-mammals, however, muscle values were considered. While it is difficult to compare measurements from different animals, even when they are taken from the same organs or tissues, the high levels found in each of these cases are a clear cause for concern. The difficulty in comparing the studies that have been conducted to date shows the importance of developing a more systematic monitoring program. This will be critical if we are ever to fully recognize the magnitude of POPs contamination, not only for the marine environment, but also for terrestrial species, including humans.

In our analysis of PCB concentrations in wildlife, the animals found to have the highest levels of PCBs were all marine species. Of the ten species with the highest individual PCB levels, nine are marine mammals, including dolphins, whales, and seals, which depend on the sea for food and the tenth was a sea eagle, whose diet also depends on the oceans. This is not particularly surprising, since marine food chains are longer than those on land, leading PCBs to build up to particularly high levels in those animals highest in the food chain. A bottlenose dolphin was the most contaminated single individual identified, with PCB levels in its blubber of roughly 2,000 parts per million (ppm). A killer whale had the second highest levels, carrying PCB levels of about 1,000 ppm. Continued sampling of marine wildlife could reveal even more species with similarly high or higher PCB levels.

All of the individuals represented in the "Toxic Ten" (see Box 2) have PCB levels that exceed thresholds that are known to cause problems in some animals. The first effects threshold is 16.5 ppm, a concentration high enough to suppress the immune system and depress Vitamin A metabolism of harbor seals. A higher effects threshold, 77 ppm, has been shown to impair reproductive success in ringed seals.<sup>1</sup> While these values may not be directly transferable to other species, the effects on seals at these low levels are of concern for the seals listed here, and may be of concern for other species as well. All of the species included here exceed the lower effects level, and many exceed both of these thresholds. In addition, nine out of ten of the species in the top ten carried enough PCBs to qualify them as hazardous waste under Canadian guidelines.

## Box 2: Marine Animals Contaminated with PCBs at Levels that Cause Health Effects

Rank	Species	Concentration in parts per million (ppm) <sup>i</sup>	Geographic Location	Tissue Tested	Reference
1	Bottlenose Dolphin	2000	Italian Coast	Blubber	2
2	Killer Whale (Orca)	Over 1000	Dungeness Spit, WA, USA	Blubber	3
3	Risso's Dolphin	1000	Italian Coast	Blubber	2
4	Harbor Seal	205 <sup>ii</sup>	North Atlantic	Blubber	4
5	Beluga Whale	128	St. Lawrence River Estuary, Canada	Blubber	5
6	Mediterranean Monk Seal	107	Western Mediterranean	Blubber	6
7	Common Dolphin	86	Atlantic Ocean	Blubber	7
8	Gray seal	82 <sup>†</sup>	Baltic Sea	Blubber	8
9	Polar Bear	80	Svalbard, Norwegian Arctic	Fat	9
77ppm PCBs, known to impair reproductive success in ringed seals <sup>iv</sup> Material with PCB levels above 50 ppm is considered hazardous waste under Canadian guidelines <sup>iii</sup>					
10	Steller's Sea Eagle	39	Hokkaido, Japan	Breast Muscle	10
16.5ppm PCBs, known to suppress the immune system and depress vitamin A levels in harbor seals <sup>iv</sup>					
13	Human, Inuit	15.7 <sup>iii</sup>	Greenland	Abdominal Fat	11

<sup>i</sup> Concentrations are all in ppm, extracted from fat or blubber, except for the Steller's sea eagle where PCBs were measured in muscle. These values apply to the individuals studied and do not necessarily represent the typical PCB levels in all animals of any given species. Some values shown here are average concentrations<sup>†</sup> representing many individuals, others are maximums, representing only one individual. Where the value reported is an average, clearly some individuals studied had even higher concentrations of PCBs; however those individual values were not presented in the original study. Concentrations without a symbol are the maximum level found in an individual. <sup>ii</sup> Based on Arochlor 1260. <sup>iii</sup> The Canadian standard for hazardous waste is included for comparison only. <sup>iv</sup> From AMAP 2002.

### Methodology

For this report, we set out to identify wildlife heavily contaminated by PCBs. Unfortunately, existing information is insufficient to adequately characterize contamination levels for entire populations of animals. This screening analysis instead focused on identifying the individuals that exhibit the greatest level of contamination. We reviewed 40 different studies that included measurements of PCBs in wildlife or humans and, for individuals of each of 46 species, identified those individuals with the highest PCB concentration. For most studies, there were multiple highly contaminated individuals reported.

While this approach may not be as comprehensive as we might wish, it provides a first order demonstration that PCBs indeed frequently exist in wildlife, particularly in marine life, at or above levels of concern. The exact level of a chemical that will cause an effect on a given animal is rarely known. However, an effects level for one animal can serve as an indicator for others. Effects levels for harbor seals and ringed seals, documented at 16.5 ppm and 77 ppm PCBs provide a strong indication that levels seen in the other mammals listed here are likely to be high enough to cause effects.

Although it might be argued that one individual could exhibit high contamination levels (possibly responsible for its death and consequent analysis), while the rest of the population is uncontaminated, the evidence in the studies we reviewed suggests otherwise. First, in cases where relatively few individuals have been tested, the fact that high levels have been found in some suggests that many more individuals are likely to be contaminated, some certainly at lower levels, but others potentially at even higher levels than those reported. Second, for those few species where multiple individuals were examined, there was no evidence that the individual with the highest value was dramatically different from the others. For example, in a study of 54 common dolphins the most contaminated animal registered 86 ppm while the average PCB level was 33 ppm.<sup>7</sup> This means that on average the dolphins tested exceeded levels known to cause effects on some marine mammals. Similarly, a study of 89 polar bears found the most contaminated individual to have 80 ppm in its fat, and the average had 28 ppm.<sup>9</sup> Even this average exceeds known effects levels for harbor seals. While the highest level seen in any orca was more than 1,000 ppm, in a study of 47 killer whales from three different groups concluded that "total PCB concentrations...were surprisingly high in all three communities."<sup>12</sup>

# THE TOXIC TEN

## BOTTLENOSE DOLPHIN (*Tursiops truncatus*)



1

PCBs 2000 ppm

Photo: NOAA

A bottlenose dolphin had the highest levels of PCBs in our wildlife contaminant analysis. In fact, in this analysis, bottlenose dolphins from many different areas show very high levels of contaminants. These dolphins are found in warm seas and some temperate seas worldwide. They grow to a maximum of 12 feet long from nose to tail, and live for

about 25 years. Their diet generally consists of fish and squid.

The most contaminated dolphin was an adult male found dead off the Italian coast. Its body was examined to determine the cause of death. The authors of the study noted that the concentrations of PCBs and the insecticide DDT were “higher than those found in animals showing reproductive failure and physiological impairment following prolonged PCB exposure,” and that these contaminants “may be a major causative factor for the large scale deaths of dolphins in the Mediterranean Sea.”<sup>22</sup> All seven of the bottlenose dolphins analyzed in the study had concentrations more than 200 ppm PCBs. Other studies have also found extremely high concentrations of PCBs in this species in areas as diverse as Wales,<sup>13</sup> Florida,<sup>14</sup> and Ireland.<sup>15</sup>

PCBs “may be a major causative factor for the large scale deaths of dolphins in the Mediterranean Sea.”<sup>22</sup>

## KILLER WHALE OR ORCA (*Orcinus orca*)

A killer whale ranked second in our analysis of PCB-contaminated animals. Killer whales are the largest species in the dolphin family, reaching 30 feet long when fully grown. Found in all the world’s oceans, they live in small, close-knit, life-long pods of between six and 40 whales. Some pods always return to the same area each year. These whales are known as “residents.” Other individuals, known as “transients,” travel up and down the coast from year to year.

“She [the whale] basically knocked our instruments off, ... we had no idea we’d see these levels.”<sup>3</sup>  
Researcher Dr. Gina Ylitalo on the high levels of PCBs found in one killer whale.

The North Pacific transients are probably one of the most highly contaminated animal groups in the world. The most likely reason why transients accumulate higher levels of PCBs than resident whales is related to their diets.

Transients tend to eat more marine mammals including seals and whales, which generally carry higher concentrations of contaminants in their bodies than fish, the main diet of resident pods.

The individual cited above was a 22 foot long female killer whale that washed up dead on the shores of the Pacific Northwest in the United States. The



2

PCBs Over 1000 ppm

Photo: NOAA

initial test had to be aborted because the researchers’ equipment could not read the staggering PCB levels. The value given for this individual was so high as to be inexact. According to Gina Ylitalo, a researcher for the National Marine Fisheries Service, “She [the whale] basically knocked our instruments off, ...we had no idea we’d see these levels.”<sup>3</sup> Ylitalo reported that the PCB level in the Dungeness Spit whale’s blubber was about 1,000 parts ppm. Sadly, although this animal was possibly the most contaminated orca ever tested, other killer whales tested have shown very high levels too, often more than 200 ppm.<sup>1, 12, 16</sup>

### RISSO'S DOLPHIN (*Grampus griseus*)



3

PCBs 1000 ppm

Photo: Nancy Black

The Risso's dolphin that ranked third was found washed up dead on the shores of Italy. Risso's dolphins are roughly the same size as their bottlenose cousins, but have a blunt head with no beak. Their main prey is squid and octopus, but they are also

known to eat fish. They are found worldwide in warm temperate and tropical waters. The adult male in our table was analyzed in the same study as the bottlenose dolphin above, and had similarly dangerous levels of both PCBs and DDT.

### HARBOR SEAL (*Phoca vitulina*)



4

PCBs 205 ppm

Photo: NOAA

A harbor seal from the North Atlantic ranked fourth in our study. Harbor seals are widespread in the north Atlantic and Pacific oceans. They are able to dive to depths of 600 feet and can stay underwater for 20 minutes. Their diet consists primarily of fish, octopus and squid. In addition to the highly contaminated individual identified in the table, other studies have found high levels of PCBs in harbor seals from the Arctic<sup>11</sup> and the Pacific Northwest.<sup>17</sup> PCBs at levels lower than those found in this harbor seal are known to cause effects on the reproductive and immune systems of ringed seals and harbor seals.

### BELUGA WHALE (*Delphinapterus leucus*)



5

PCBs 128 ppm

Photo: www.ArcticKingdom.com

Ranking fifth in contamination is the beluga whale. Also known as white whales because they turn a whitish color as they get older, belugas are relatives of killer whales and other dolphins. They reach about 14 feet in length and are the only whale that is capable of bending its neck. In the summer their diet consists mostly of fish, as well as some squid and octopus. In the winter their diet is virtually unknown. The individual examined in the study cited above was a male from the St. Lawrence River estuary, a highly polluted waterway in Canada. Other extremely high levels of PCBs in belugas from this estuary have been documented as well.<sup>18</sup>

## MEDITERRANEAN MONK SEAL

(*Monachus monachus*)



6

PCBs 107 ppm

Photo: www.Alonissos.com

A Mediterranean monk seal ranked sixth. This is particularly alarming because this once common animal is now internationally listed as critically endangered. There are probably fewer than 500 individuals left in the world. Besides toxic contamination, other threats to the Mediterranean

monk seal include deliberate killings by fishermen, habitat loss, decreased food availability, and entanglement in fishing gear.<sup>19</sup> As the study shows, some individuals are also highly contaminated, with PCBs and other POPs creating another potential challenge to the survival of the species. PCBs at levels lower than those found in this monk seal are known to cause effects on the reproductive and immune systems of ringed seals and harbor seals.

The high levels of PCBs in Mediterranean monk seals are particularly alarming because this species is internationally listed as critically endangered.

## SHORT BEAKED COMMON DOLPHIN (*Delphinus delphis*)



7

PCBs 86 ppm

Photo: Shane Anderson

Ranking seventh in the Toxic Ten list was the short beaked common dolphin, another marine mammal. The common dolphin is found in all tropical and warm temperate waters. The short beaked species is found more in offshore waters, and measures around eight feet when fully grown. They are usually found in huge herds of hundreds or even thousands, and are often seen riding alongside or behind sea vessels. Common dolphins prey on schooling fish such as herring and pilchards, and squid. They have been known to hunt cooperatively and have also been seen catching fish in mid-air. The animal cited in the above table was from the Atlantic Ocean. Other studies have indicated similar concentrations in other common dolphins from the North Atlantic.<sup>4</sup>

## GRAY SEAL (*Halichoerus grypus*)



8

PCBs 82 ppm

Photo: Jessie Cohen, Smithsonian's National Zoo

The gray seal ranked eighth, with PCB concentrations strikingly similar to the common dolphin and the beluga whale. There are three different populations of gray seals, those in the Western Atlantic, the Eastern Atlantic, and the Baltic Sea. They grow to about six feet long and can live for up to 46 years. Their diet consists mainly of inshore fish, squid, octopus, crabs, and lobsters. The concentration in the table above is the average reading from five gray seal individuals from the Baltic Sea. Some individuals had even higher levels which were not noted in the study. Other studies have also shown high levels of PCBs in Baltic Sea gray seals.<sup>20</sup> PCBs at levels lower than those found in this gray seal are known to cause effects on the reproductive and immune systems of ringed seals and harbor seals.

## POLAR BEAR (*Ursus maritimus*)



9

PCBs 80 ppm

Photo: www.ArcticKingdom.com

Polar bears ranked ninth in our analysis. With their thick fur, muscular limbs and strong swimming abilities, these powerful mammals are very well adapted to the harsh conditions of their home, the Arctic. Polar bears have been found to carry very high levels of some POPs, including PCBs and the pesticide chlordane, most likely because their diet consists mainly of seals—many of which already carry levels of contaminants that exceed environmental guidelines for protecting wildlife.<sup>11</sup> Like other residents of the Arctic, both human and non-human, polar bears are victims of global air transport patterns that bring a disproportionate amount of PCBs and other POPs to high latitude areas such as the Arctic.

In 1998, the Arctic Monitoring and Assessment Program (AMAP) reported high levels of PCBs and DDTs in polar bears from the east coast of Greenland and from around Svalbard.<sup>20</sup> The individual polar bear that had the high PCB concentration in the study was an adult male from Svalbard in the Norwegian Arctic. A more recent AMAP assessment, however, reports that “(R)ecent studies have revealed even higher levels in polar bear from Franz Josef Land and the Kara Sea,” both of which are part of the Russian Arctic.<sup>1</sup> While this might have raised the polar bear’s ranking on our chart, no actual values are provided in the later study, so the polar bear remains ninth.

“Recent studies have revealed even higher PCB levels in polar bear from Franz Josef Land and the Kara Sea.”<sup>1</sup>

## STELLER’S SEA EAGLE

(*Haliaeetus pelagicus*)

The Steller’s sea eagle holds the unenviable title of being the most PCB contaminated bird in the world, and comes in at number ten in our analysis. Unfortunately, this is yet another heavily contaminated animal that is also an endangered species. The heavy PCB level in this bird raises the question of whether POPs could be hindering the recovery of the population.

This relative of the bald eagle breeds in northeastern Siberia, northern Japan and North Korea. Weighing as much as 20 pounds, heavier even than the American bald eagle, and with wings stretching seven feet, the Steller’s is among the largest of eagles. This magnificent bird has been featured on postage stamps in Russia, Korea, China and Japan. Its main food source is large fish, but they also consume mammals including seals and arctic fox, which also have been shown to have high PCB levels. The individual here was an adult female from northern Japan. Her breast muscle was tested and the value is expressed in wet weight. This level is not directly comparable to those of the mammals whose blubber was tested because the values are expressed in different terms; however, this individual is the most heavily contaminated bird reported in the studies we reviewed. Another adult female Steller’s sea eagle from the same study had comparable levels of PCBs, at around 30 ppm.<sup>10</sup>



10

PCBs 39 ppm

Photo: Erik Breden, www.Otterside.com



Photo: Eric Loring

## PCBS IN HUMANS

*(Homo sapiens)*

With diets consisting of fish and other foods known to contain contaminants, humans also exhibit high levels of contamination. Humans did not rank in the top ten, but were very close. It is well documented that

we all have some level of PCBs in our bodies. As with other animals, the level of contaminants, including PCBs, in the human body is largely dependent on diet. Those populations that eat marine mammals and fish high in the food chain are most exposed. For example, a study that examined POPs levels in humans in Canada found that PCB levels in the Inuit were 5.6 times higher on average than in the non-indigenous population of southern Quebec.<sup>11</sup>

PCBs in the abdominal fat of Inuit people in Greenland in 1993 averaged 15.7 parts per million,<sup>11</sup> placing those individuals at number 13 in our table of the most contaminated species on earth. This is a significant concern since the EPA considers PCBs to be probable cancer causing agents in humans, and they also cause a variety of other health effects. These include effects on the immune, central nervous, endocrine, and reproductive systems.<sup>21</sup>

Human populations in northern Canada, northwest Greenland, northern Sweden and northern Russia have all been found to have higher concentrations in their blood than is considered tolerable under Canadian guidelines, which is cause for concern.<sup>11,20</sup> Unlike the concentrations given for the animals above, each of these studies on human contamination provided averages for the population sampled, which means that some individuals were carrying even higher concentrations of PCBs.

Distance from the source of pollution does not reduce the risk of contamination, a fact that is painfully illustrated by the plight of the Inuit. Though they live far from the pollution and innovations of modern society, the Inuit suffer the highest human contamination levels on Earth, thanks in part to their traditional diet of fish, seals and whales, all of which can be heavily contaminated.

Human and animal populations living at high latitudes also are victims of global atmospheric and ocean transport patterns. Chemicals carried through the atmosphere from their sources are disproportionately deposited at high latitudes, due to air cooling patterns as well as ocean currents and marine mammal migration. As a result, people and animals that live at high latitudes, though distant in many cases from the source of contamination, can be disproportionately affected by POPs.

**The high level of PCBs in fish and marine mammals demonstrates the importance of biomagnification – chemicals like PCBs reach greater levels in animals that are higher up on the food chain.**

## LINKING EXPOSURE AND EFFECTS

This study did not attempt to document the effects of the PCBs on each of the animals in our table. There is simply not enough information available in the literature to allow a full analysis of associated effects. However, some conclusions can be drawn.

### *Thresholds for PCB Effects*

For comparison purposes, there are two regulatory levels set to protect the public against risky exposure to PCBs. The first is the EPA fish consumption advisory level. The EPA recommends against consumption of any fish containing more than .094 ppm PCBs.<sup>27</sup> Unfortunately this value can not be directly compared to the animals in our table since it is intended as a threshold to protect humans who consume fish. However, many fish do exceed this value, especially in the Great Lakes.<sup>23</sup> Consumption of these fish by humans or animals can lead to toxic effects and can contribute to high PCB levels in consumers. The high level of PCBs in fish and marine mammals demonstrates the importance of biomagnification—chemicals like PCBs reach greater levels in animals that are higher up on the food chain. For this reason, simply testing the water or sediments for PCBs tells us little about the risk of buildup in our own bodies.

**“Contaminants do have effects on some species of Arctic wildlife in that they can threaten the survival and reproductive success of individual animals,” and PCBs and other contaminants “may pose a population-level threat to some Arctic wildlife populations.”**

Source: AMAP 2002

Another level for comparison comes from Canada, where material containing PCBs at levels higher than 50 ppm is considered hazardous waste and must be carefully managed to avoid human or wildlife exposure. With the exception of the Steller’s sea eagle, all the animals in the Toxic Ten list have enough PCBs in their fat to require that they be treated as hazardous waste. The killer whale has 20 times this amount in its fat, and the blubber of the bottlenose dolphin listed in the table had 40 times more PCBs than would be needed to classify it as hazardous waste.

### *Effects on Wildlife*

There is mounting evidence that high PCB levels like those shown here are clearly cause for concern. The AMAP in its 2002 report concludes that “there is a correlation between high loads of contaminants in some animal populations in the Arctic and effects on their resistance to infection, reproduction, and behavior.” The authors also conclude that “contaminants do have effects on some species of Arctic wildlife in that they can threaten the survival and reproductive success of individual animals,” and that PCBs and other contaminants “may pose a population-level threat to some Arctic wildlife populations.”<sup>1</sup>





Photo: NOAA

On Svalbard, in the Norwegian Arctic, polar bears with high levels of PCBs are known to suffer from impaired defense against infections. Polar bears from this region also suffer an unusual number of cub deaths and a shorter reproductive cycle than the normal three years. Moreover, some individuals have the sex characteristics of both genders, a condition called pseudohermaphroditism. It has not been proven, however, whether these conditions are a direct result of high contaminant loads.<sup>1</sup>

The AMAP report also documents PCB levels in marine mammals such as killer whales, belugas, long finned pilot whales and harbor porpoises that are high enough to have effects on behavior, reproduction, vitamin A metabolism, and the immune system. The PCB and DDT contaminant load in the diets of these animals exceeds some or all environmental quality guidelines for fish-eating wildlife.<sup>1</sup>

The assessment also highlighted potentially damaging levels of POPs, including PCBs, in other Arctic wildlife such as seals, Steller sea lions, and large seabirds like the great skua, great black-backed gulls, and glaucous gulls. In fact, studies show that PCB concentrations of 16.5 ppm can suppress the immune systems and Vitamin A metabolism of harbor seals, and 77 ppm has been shown to impair reproductive success in ringed seals.<sup>1</sup>

Notably, these effects levels are well below the levels found in many of the individuals listed in our table. Though they may or may not be transferable, it is worth noting that each of these animals is contaminated at levels well above the levels known to be toxic to seals. The bottlenose dolphin, for example, has 25 times more PCBs in its blubber than what was sufficient to impair reproduction in the harbor seal.

While the AMAP findings document the plight of some Arctic wildlife, the problem with POPs is not restricted to the Arctic. In the Toxic Ten, only one animal was from the Arctic region. Highly contaminated wildlife are found in many other parts of the world, with contaminants at levels that cause adverse effects.

Young animals are especially vulnerable to the effects of chemicals like PCBs. Levels of PCBs in the eggs of black-crowned night herons measured in San Francisco Bay averaged 4 ppm. At this level, PCB concentrations negatively affected the growth of the heron embryos.<sup>24</sup> Similar effects have been reported in marine mammals, where contaminants are passed to the young through the mothers' milk.

**In Greenland, between 50 and 95 percent of women of child bearing age exceeded the Canadian level of concern for PCBs in blood.**

It also is likely that effects may occur that are not directly attributed to chemicals, but may have been facilitated by contamination.

Seals such as the harbor and gray seal, for example, have been victims of mass mortalities attributed to viruses. In 1998, about 20,000 harbor seals died in the North Atlantic, resulting in intense public concern. Studies have shown that PCBs and other POPs can suppress the seals' immune systems, making it more difficult for them to fight infection, and increasing their likelihood of death. Virus-induced mass mortalities like the one described above may have been worsened by contaminants such as PCBs.<sup>25</sup>

Even closer to home, the levels of PCBs in human blood and tissue exceed those known to cause effects, especially on children exposed while in the womb. The Canadian level of concern for PCBs in human blood is five parts per billion (ppb). Women from the eastern Canadian Arctic and Northwest Greenland have very high levels of PCBs in their blood (averaging 10 and 14.8 ppb, respectively). In fact, in Greenland as a whole, between 50 and 95 percent of women of child bearing age exceeded the Canadian "level of concern." In one area, more than half of the non-pregnant women exceeded the much higher Canadian "action limit," which is set at 100 ppb.<sup>1</sup>

These high levels in women of childbearing age raise serious concerns not only for the women themselves but also for their children. Neurobehavioral effects in children can occur when mothers have blood levels in the 10 ppb range suggesting that some children in the Arctic may suffer from developmental problems as a result of PCB contamination.<sup>11</sup> Studies of U.S. and Dutch children exposed *in utero* to high levels of PCBs have indicated poorer intellectual function in these children.<sup>26</sup> Other effects that have been linked to PCB exposure to unborn babies include lower birth weight, slower growth, poorer visual recognition, memory, deficiencies in psychomotor development, and poorer intellectual functioning.<sup>1</sup> According to the U.S. Agency for Toxic Substances Disease Registry, for the general population that eats contaminated fish, PCB levels in human serum range from 2.1 to 56 ppb.<sup>21</sup> These additional instances of human PCB contamination demonstrate that PCBs pose serious public health concerns.



# CONCLUSIONS AND RECOMMENDATIONS

**PCBs, a group of persistent and highly toxic, man-made chemical pollutants, are ubiquitous in the natural environment.**

**Marine mammals are consistently the most heavily contaminated with PCBs, especially dolphins, whales, and seals. In some cases, the most contaminated individuals are from populations of endangered or threatened species.**

**PCB levels in marine life are high enough to cause effects on reproduction, disease resistance, development and behavior; all critical functions for the survival of wild animal populations.**

**Humans, especially those whose diets are most dependent on the ocean, can carry dangerously high levels of PCBs; levels that may be causing harmful effects on children.**

**PCB levels in many fish and other marine species far exceed levels that are safe for our consumption, not just for children and women of childbearing age, but for all of us.**

**Though PCBs have been banned for more than 25 years in many countries of the world, their legacy continues, demonstrating a need to remove PCBs from the environment and anticipate and prevent widespread contamination by additional POPs.**

To reduce the levels of PCBs and other POPs in marine life, other wildlife and humans, Oceana makes the following recommendations:

**1. Congress should enact legislation to implement the Stockholm Convention on Persistent Organic Pollutants that includes a mandatory requirement that EPA address chemicals identified as POPs in the future. Given President Bush's statement of support for this Treaty, the Bush Administration should ensure the passage of such legislation this year.**

Given the toxicity, persistence and bioaccumulative nature of POPs, it is clearly not sufficient to repeat the unfortunate history of PCBs for other chemicals. By the time PCBs were eventually banned, due to their previous widespread production and use they were already pervasive in the environment. Twenty-five years later they continue to harm wildlife and humans.

By developing and agreeing to the Stockholm Convention, the international community has created a consistent and thoughtful process for not only banning and phasing out the "dirty dozen" POPs across the globe, but also setting up a process by which other chemicals with similar characteristics can be intelligently managed. This process would prevent future contamination of whales, dolphins, and even humans by other persistent bioaccumulative chemicals.

The provisions for bans and phase-outs of the “dirty dozen” chemicals, while important, are not as meaningful for the United States as is the international process for adding new chemicals, since the United States has already banned or phased out the ten “dirty dozen” chemicals that are intentionally manufactured. (The other two chemical groups, dioxins and furans, are not subject to bans or phase-outs since they are byproducts of combustion and industrial activities.) For that reason, ratifying the treaty without requiring the U.S. to at least formally consider regulating POPs that are banned internationally in the future provides little improvement for the environment and requires little policy change, if any, in the United States.

To avoid repeating the toxic mistakes of the past, Congress must pass legislation that provides the full benefits of the Stockholm Convention including a protective process for formal regulating POPs in the future, and the Bush Administration must ensure that any legislation considered includes such a process.

## **2. The United States should play a leading role in identifying candidate chemicals to be added for coverage under the Stockholm Convention.**

The United States has many of the world’s best trained scientists and scientific institutions. Thus we have an opportunity and an obligation to ensure that the international process uses the best available science.

The United States may not always be the largest producer of future POPs chemicals. International action will be the only effective way to protect the U.S. population from these chemicals which recognize no national boundaries, but move through the air, the oceans and the food chain to threaten human health and the environment on a regional or global scale. Therefore, it is in both the national and the global interest for the United States to provide its expertise to identify the next chemicals to be added to the treaty.



## **3. Congress should pass legislation to prevent the manufacture, sale, and use of new chemicals that are persistent, bioaccumulative and toxic, and restrict activities that result in the release of byproducts with POPs characteristics into our air and water.**

The tragedies of PCB contamination could have been prevented if a careful and appropriately cautious chemical registration process had been in place when PCBs were first introduced. One of the fundamental flaws of our current regulatory system is that chemicals are not affirmatively registered for use under the Toxic Substances Control Act (TSCA). Instead, any chemical can be manufactured unless EPA can prove it poses an unreasonable risk to humans and the environment. New legislation should shift the burden of proof to ensure no new chemicals are manufactured, sold, or used until they have been proven to be safe for human health and the environment.

While it may have been difficult to anticipate the harm they would cause when PCBs were first manufactured, we now have the facts. New chemicals bearing these characteristics are likely to cause similar harm. Oceana, therefore, calls on Congress to pass legislation that shifts the burden of proof and prevents the manufacture of additional persistent or bioaccumulative chemicals.

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