Case Study

Organotins in fish

Organotins have been found in many fish species from all over the world. The toxicity of organotins to fish has been established and there is evidence of their hormone disrupting effect.

The widespread contamination of many fish validates WWF's concern that organotins may threaten humans who consume large quantities of fish in their normal diet. Particular risk may be incurred in people consuming fish liver because organotins appear to be concentrated in the liver more than in muscle.

Organotins: a threat to Poles eating Baltic Sea fish

In 1990, 58 fish from nine species taken from Gdansk Bay on the Baltic Coast of Poland were sampled and tested for organotin residues.

Table A – Concentrations of organotins in fish from the Southern Baltic Sea.

	Total organotins (range in brackets) (ng/g wet weight)
Flounder	316
Herring	40
Eel	188
Sea Trout	51 (45-57)
Turbot	39
Cod	19 (14-24)
Eelpout	130
Pikeperch	455
Mackerel	27 (23-20)

The extent of contamination of these species raised questions about the level of exposure of the fish-eating Polish human population. Repeat studies of Gdansk Bay fish sampled in 1997 showed that total organotin concentrations in fish tissues remained high in the Southern Baltic Sea.

The estimated daily intake of organotins in the fish-eating population ranged from 2.2 to 164 ug/person with the intake for one fish, the roach, exceeding the Tolerable Daily Intake (TDI) of 15ug of TBT per 60kg person per day.

Furthermore, due to the greater accumulation of organotins in fish liver as opposed to muscle, the traditional consumption of cod, turbot and salmon liver by Poles, and reports of high fish consumption (up to 250g fish consumed per person per day near the city of Gdansk), the intake of TBT may be much greater than the TDI. At 250g/day fish consumption levels, the TDI of 15ug is exceeded for all the regularly consumed Gdansk Bay fish species studied.

Table B – Concentration (ng/g wet weight) of organotin compounds in selected tissues of fish collected from the southern Baltic Sea and Vistula River

Species	Total organotins		
	Egg	**Liver**	**Muscle**
Herring	370	4,800	78
Ruff	170	1,200	44
Smelt	16	440	170
Flounder	–	–	83
Turbot	–	–	110
Brown Trout	–	–	78
Roach	–	–	3,300
Burbot	39	32	–
Perch	–	410	–
Roach	–	–	100

These studies strongly suggest that a real threat to human health exists from eating organotin-contaminated Baltic Sea fish from the Gdansk Bay area.

Some scientists believe that they are the most toxic chemicals deliberately released into the marine environment.

DIGITAL VISION

Effects on humans eating contaminated fish and marine mammals

Organotins have an endocrine disrupting ability in humans. They disrupt the critical function of human immune cells, particularly killer cells which fight infection. Recent findings have revealed biologically significant levels of organotins in random human blood samples from the USA.

A Tolerable Daily Intake (TDI) of TBT for humans has been set on the basis of TBT's ability to reduce immune function.

Using this, there have been various attempts to analyse whether the level of organotin intake by humans eating marine food should cause concern.

While some have suggested that levels caused by eating contaminated marine species fall short of tolerable or acceptable daily intakes, other recent studies suggest that TDIs have been reached in parts of the world and by particular communities consuming large quantities of seafood. (SEE CASE STUDY)

Nor can exposure to other sources of organotins be ruled out.

Time for a global ban

TBT has caused harm to many marine invertebrates. It is toxic to fish, seabirds and marine mammals. It is an endocrine disrupting chemical. It contaminates marine species used for human consumption to an extent that now threatens some communities.

- **WWF calls on governments to introduce legislation leading to the earliest possible ban on the use of organotins as antifouling agents used on ships and boats.**
- **WWF calls on the IMO to agree a legal instrument to introduce a global ban on the use of organotins as antifoulants by 2003.**
- **WWF calls on the shipping industry to voluntarily replace organotin antifoulants with less toxic or non-toxic antifouling techniques before 2003, and ultimately aim towards eliminating use of all toxic antifoulants.**

This leaflet is based on a report for WWF by G. Linley-Adams (1999). *The Accumulation and Impact of Organotins on Marine Mammals, Seabirds and Fish for Human Consumption*

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WWF works to reconcile the needs of people with the conservation of the natural environment upon which they depend.

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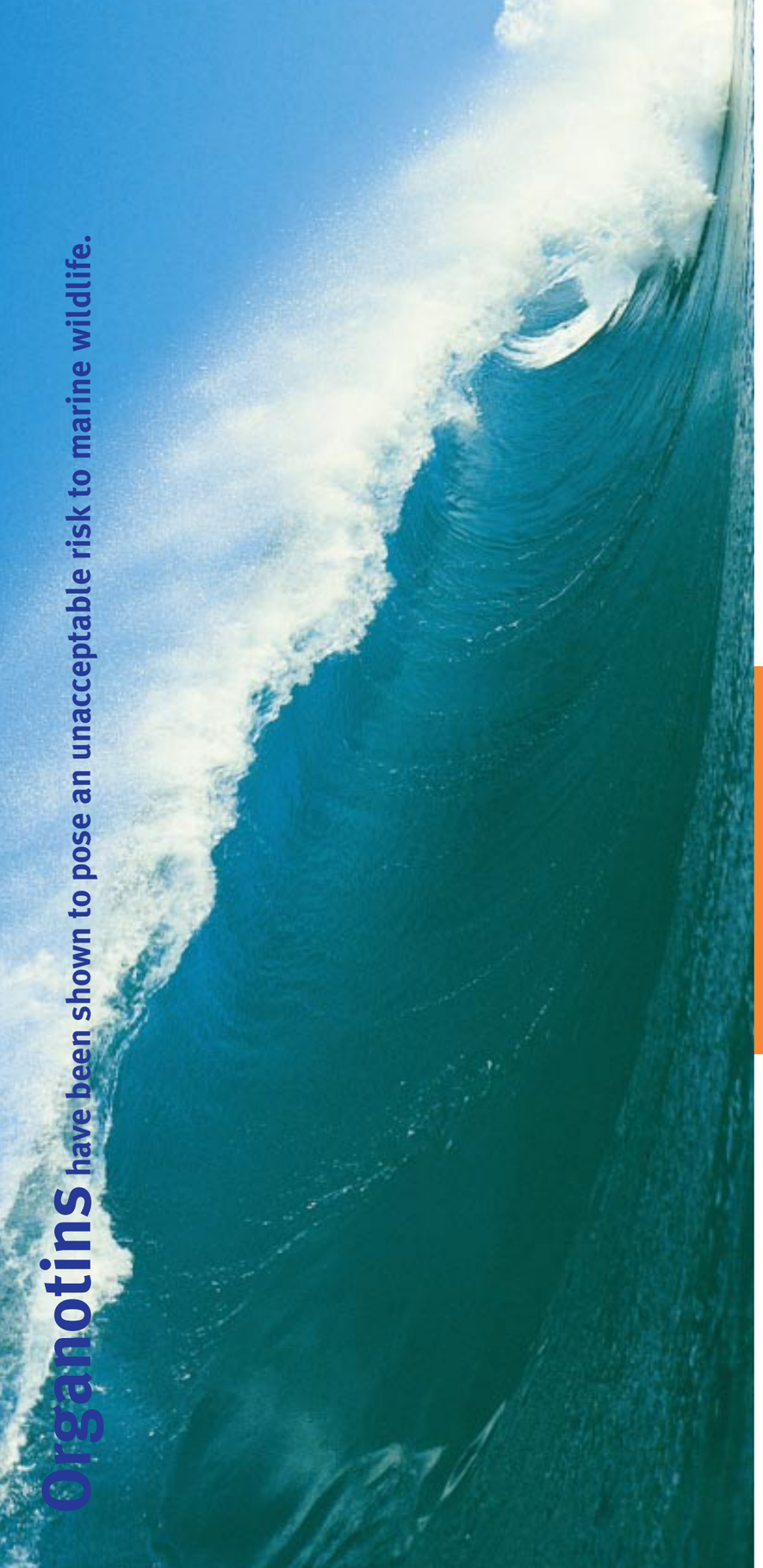
WWF

living seas

The Accumulation and Impact of Organotins on Marine Mammals, Seabirds and Fish for Human Consumption



Organotins have been shown to pose an unacceptable risk to marine wildlife.

For many decades, organotins have been used in antifouling paints on ships and boats. Since their effects were first spotted in oyster farms on the Atlantic coast of France in the early 1980s, a range of edible marine species have been contaminated and affected by organotins.

Their harmful effects on marine invertebrates are well documented. Now, their effects on other marine species – marine fish, seabirds and marine mammals – are being shown all over the world, and humans eating contaminated fish also run the risk of being poisoned.

WWF believes that a complete ban on organotins used in antifouling paints is long overdue.

Effects of organotins on fish, birds and marine mammals

The ecotoxicological impact of organotins on fish, seabirds and marine mammals is not as well understood as the impact on marine invertebrates, particularly molluscs such as the dogwhelk.

Nevertheless, organotins have been shown in a number of studies to be toxic to fish, birds and mammals. They have also been demonstrated to have hormone disrupting properties in these animals.

Organotins are bioaccumulative in many marine species, including some used for human consumption. TBT and its breakdown products, monobutyltin (MBT) and dibutyltin (DBT), have been detected in a range of marine species including mammals, birds and edible fish, as well as invertebrates such as molluscs, crustaceans and cephalopods.

There is justifiable concern over the level of exposure of humans to organotins consumed in edible marine vertebrates.

Organotins in marine mammals

Marine mammals belonging to a range of species have been found to be contaminated with organotin compounds including TBT, DBT and MBT, no matter from where in the world they were taken. This illustrates the global distribution of organotins in the oceans. The elevated levels of organotins detected in coastal species, and low concentrations found in off-shore species, show the high degree of organotin contamination in many coastal waters. Mammals inhabiting waters of developed countries are, in general, found to contain higher concentrations compared with those collected from the waters of developing countries. While some mammals such as the sea lion can degrade or expel organotins from the body, others such as dolphins show increasing biomagnification of organotins as they grow older.

High doses of organotins have been shown to damage the central nervous system and reproductive mechanisms in mammals. Marine mammals are no different in this respect. TBT, the most widely-used organotin, is an endocrine disrupting chemical in mammals. It is highly likely that negative effects are occurring to marine mammals in the wild from exposure to organotins.

It is also likely that organotin contamination is being passed to humans consuming marine mammals as a significant part of their diet. Although not all marine mammals are utilised for human food, a number of different seals, whales and to a lesser extent dolphins are consumed by humans – particularly, although not exclusively, in artisanal and subsistence fishing communities such as those in remote coastal areas of the Arctic, Atlantic and Pacific Oceans. In some populations, marine mammals provide a very significant proportion of dietary protein and fat intake. The threat to such populations from organotins has not yet been properly studied.

Table 1

Marine mammals known to be contaminated with organotins

Marine mammal	Locations
Whales, dolphins and porpoises	North Sea
Great sperm whale	North Sea
Dwarf sperm whale	East Japan
Pygmy sperm whale	West Japan; Atlantic; UK Welsh coast
Great killer whale	South-east Japan
Short-finned pilot whale	East Japan
Long-finned pilot whale	UK North Sea
Fin whale	UK North Sea
Minke whale	UK North Sea
Stejneger's beaked whale	West Japan
Ginkgo-toothed beaked whale	West Japan
Baird's beaked whale	East Japan
Sowerby's beaked whale	UK North Sea
Blainville's beaked whale	UK Welsh coast
True's beaked whale	UK Irish Sea
Bottlenose dolphin	South-east Japan; North Adriatic; Atlantic; Gulf; Bay of Bengal
Risso's dolphin	South-east Japan; UK west coast
Spinner's dolphin	Sulu Sea, Philippines; Bay of Bengal
Atlantic spotted dolphin	Florida Atlantic
Fraser's dolphin	Sulu Sea, Philippines
Common dolphin	Welsh coast
White-sided dolphin	UK Welsh coast
White-beaked dolphin	UK North Sea
Striped dolphin	UK
Rough-toothed dolphin	South-east Japan; West Pacific
Humpbacked whale	Bay of Bengal
Finless porpoise	Seto inland sea, Japan; East Japan; South Japan; China
Dall's porpoise	Aleutians; Bering Sea; Kamchatka, Pacific; North-east Japan
Harbour porpoise	Black Sea; Polish Baltic Coast; UK
Seals and sea lions	**Locations**
Grey seal	UK
Larga seal	Japan
Ribbon seal	Japan
Northern fur seal	North-east Japan
Steller sea lion	Alaska; Japan

MICHAEL STECIUK/WWF-UK

Organotins in seabirds

Less data exists on organotin residues and their impact in seabirds than for marine mammals. From the limited studies carried out to date, it appears that seabirds such as sea ducks preying on organotin-contaminated marine invertebrates have a greater body burden of organotins, although birds can purge these chemicals by moulting and other shedding of feathers. Even so, high levels of organotins have been found in marine birds in coastal locations. The ecotoxicological significance of seabird exposure to organotins is not known, but laboratory studies have shown TBT to be embryotoxic to birds: it reduces hatching success and fertility and affects enzyme and hormone activity in adult birds.

Table 2

Seabirds contaminated with organotins

Location	Species
Baltic Sea	Long-tailed ducks; red-throated diver; razorbill; great crested grebe; black cormorant; guillemot
Korea	Black-headed gull; black-tailed gull; cormorants
UK North Sea	Oystercatchers
USA, Canada	Various seaducks and scoters
Japan	Cormorants
North pacific	Laysan albatross
India/Philippines	Various migratory birds