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OCEANS IN DANGER

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Some 3.6 billion years ago, life on Earth was born in the oceans. Since then, their size and composition, as well as the organisms living in them, have continued to change and evolve. Today, millions of species and numerous ecosystems inhabit the oceans, from coastal areas to abysses more than 11,000 metres deep.

Within their 1.4 billion cubic kilometres of water and 370 million square kilometres of expanse, we can find coral forests, deserts, mountains, volcanoes, minerals, bacteria, algae, complex plants, mammals, fish, reptiles, birds, crustaceans, molluscs and a very long list of life forms, many of which are still unknown to us.

Humankind has been using the oceans for aeons, but not until the last few centuries have our activities become a real threat. Pollution, over-fishing and over-hunting, mining, the destruction of the oceans' richest areas, the massive occupation of the coasts and the alteration of their chemical composition and temperature are leaving a mark that is difficult to erase.

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The vast majority of the planet's ecosystems depend on the oceans to regulate the climate and weather systems essential for life on the planet, including the cycles of water and gases necessary for life on the land to survive.

Contrary to popular belief, it is not the forests but rather the oceans, through phytoplankton, algae and marine plants (which exchange[i] some 200,000 million tons of CO2/O2), that function as the Earth's lungs and are responsible for the creation of the ozone layer that protect us from harmful ultraviolet-B rays. Furthermore, evaporated seawater forms clouds, which empty their contents over the earth to create rivers, lakes and other ecosystems as well as provide the levels of moisture necessary to sustain life.

Oceans are not only where life began on Earth, but also essential for its survival. Everything in the world as we know it depends on their health.

What is threatening the oceans?

Most of the human activities affecting the oceans occur directly in them, but activities that happen inland also take a toll. That is why the measures taken to protect marine life depend not only on good oceanic management, but also on equally effective terrestrial management.

Pollution

Almost 80% of the pollutants dumped into the sea come from inland operations, either through rivers, direct dumping and coastal drainage (44%), or transported through the atmosphere (33%)[ii]. The remaining 20% come from accidental or deliberate spills from vessels and marine facilities.

- ***Hydrocarbons***

Every year, the oceans are used as highways through which more than 6,000 oil tankers transport 1.5 billion tons of crude oil[iii]. On average 25 major accidents, as well as many smaller ones, occur each year resulting in more than 700 tons of crude oil spilled into the sea[iv]. Overall, an estimated 2 to 10 million tons of crude oil are leaked into the oceans on an annual basis[v], 12% of which correspond to the accidents mentioned above and 33% are caused by deliberate dumping from vessels (mainly during the illegal cleaning of tankers on the high seas).

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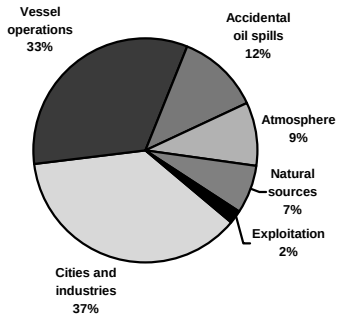
Origin of hydrocarbons in the oceans[vi]:



Some of the biggest hydrocarbon spills[vii]:

1,000 t.	Place	Year	Accident
816	Arab Gulf	1991	Gulf War
476	Mexico	1979	Platform Ixtoc I
267	South Africa	1983	Castillo de Bellver
260	Angola	1991	ABT Summer
234	France	1978	Amoco Cadiz
158	Italia	1991	Haven
146	Canada	1988	Odyssey
145	Trinidad	1979	A. Empress & A. Captain
141	Barbados	1979	Atlantic Empress
135	Greece	1980	Irenes Serenade
130	UK	1967	Torrey Canyon
115	Oman	1972	Sea Star
110	North Sea	1971	Texaco
103	North Pacific	1977	Hawaiian Patriot
100	Kuwait	1981	Tank
95	Spain	1976	Urquiola
92	Turkey	1979	Independentza
85	Portugal	1969	Julius Schindler
85	Portugal	1975	Jacob Maersk
84	Nigeria	1979	Tank
83	UK	1993	Braer
81	Spain	1992	Aegean Sea
80	Morocco	1989	Kharg 5
77	Spain	2002	Prestige
72	UK	1996	Sea Empress
72	Mozambique	1992	Katina P.
71	Iran	1985	Nova

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- POPs

Persistent Organic Pollutants, known as POPs, are among the most harmful substances on earth. These chemicals can be highly toxic in very small amounts, they persist in the environment and tend to accumulate in soil, sediments and plant an animal tissue where they remain for long periods of time. Some of these chemicals are known to cause cancer and to affect
reproduction in animals and humans. Harmful effects observed in nature include:
1) changes in the reproductive organs, referred to as masculinisation, in marine gastropods (snails?) as a result of exposure to tributyl tin (TBT)
2) feminisation of marine birds as a result of exposure to polychlorinated biphenyls (PCBs),
3) dysfunctional development of fish embryos due to exposure to DDE, which is a breakdown product of the pesticide DDT,
4) reproductive failure in salmon (4-nonylphenol)
5) suppression of the immune systems of marine mammals due to exposure to PCBs and DDT,
6) shell thinning in bird eggs due to DDT exposure[viii], and
7) generally, dysfunction of hormonal and nervous systems, carcinogenic effects, reproductive problems and poisoning[ix].
The level of pollutants in some marine animals including birds and mammals can be between 10 and 100 million times higher than the level found in the water itself[x]. Practically all of the water, sediments and marine animals examined in the world have shown traces of these substances[xi].
A recent Oceana analysis of wildlife studies worldwide showed that marine mammals, due to their diets, accumulate the highest levels of PCBs in the animal kingdom and that humans are not far behind.

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

Forecast of POPs emissions in Europe in 2010[xii]:

POPs	Tonnes/year
PAH (Borneff 6)	14,000-20,000
PCDD/F	3,300-16,000
PCB	47-48
Xylene	100,000-140,000
Atrazine	1,900
Endosulfan	1,300
Fenthion	400
HCB	11-12
Lindane	1,100
Pentachlorophenol	970-2,000
Quintozene	190

- ***Heavy metals***

Heavy metals are among the most harmful pollutants in the environment and can cause cancer, acute poisoning, and damage to the nervous system, muscles and bones. Some metals, such as cobalt, lead and manganese persist in the marine medium for only 1000 years, while others like cadmium, copper, nickel and zinc can last between 1000 and 100,000 years.

Researchers have found fish containing as much as 3.9 ppm (dry weight) of methylmercury in the Persian Gulf[xiii] and dolphins with more than 2200 ppm of mercury and 770 of selenium in the Mediterranean[xiv]. These levels are 1500 times higher than what is safe for human consumption. (We could probably get some fish numbers – things we actually eat – to compare this to, at least for the US.)

Worldwide emissions of heavy metals into the atmosphere (tons each year)[xv]:

Arsenic	Cadmium	Lead	Mercury	Zinc
19,000	7,600	332,000	3,600	132,000

- ***Nutrients***

Every year, the massive use of fertilisers in agriculture, along with faecal waste from farms, sewage from cities, and atmospheric emissions of toxic gases, carry millions of tons of nitrogen and phosphate to the ocean, which can cause “dead zones” in shallow waters and coastal areas.

These areas, devoid of oxygen needed by fish, develop as a result of nutrient driven eutrophication. The nutrients cause a sudden increase in phytoplankton populations. The phytoplankton die and are decomposed by bacteria through a process that consumes a tremendous amount of oxygen. As a result, zones of low oxygen or oxygen-free waters form, suffocating animals such as fish and other marine life which need oxygen to survive. Eutrophication can also lead to 'red tides', in which the phytoplankton that bloom are highly toxic to other marine life and can also affect human health.

Nutrient pollution is continuously increasing, and the use of fertiliser is expected to increase from 150 million tons in 1990 to 225 million tons in 2020[xvi].

There are about 60 areas affected by the temporal or chronic depletion of dissolved oxygen. The most common are found along the eastern and Gulf coasts of the United States, the Caribbean, the North Sea, the Baltic Sea, the Mediterranean and coasts of Japan[xvii].

- ***Sewage***

In many places in the world, industrial waste and city sewage is flushed into the ocean raw, without any treatment. Many of these spills can carry heavy metals, POPs, phosphates, faecal matter, and other contaminants. As a result, the types of pollution in sewage are varied and the effects are far-reaching.

In the North Sea (between the UK and continental Europe), between 10% and 25% of bathing water has higher concentrations of coliform bacteria than allowed under EU regulations[xviii] because of the dumping of faecal matter. In developing countries, these levels can be much higher, as only about 20% of the sewage is treated at all[xix].

These pathogens can cause up to 250 million cases of gastroenteritis every year when people bathe in contaminated water and tens of thousands of cases of typhoid fever, hepatitis A and B, polio and cholera when people consume infected molluscs[xx].

One single bath in what would be considered "acceptable" water in the EU with a concentration of 50 streptococcus bacteria per 100 millilitres could lead to an illness rate of 5% among adults. In other words, one of every 20 people swimming in an area considered suitable for bathing would contract some type of illness[xxi].

- ***Radionuclides***

Currently, the major sources of anthropogenic radionuclides in the oceans come from spills from nuclear reprocessing plants. These include Sellafield in the UK, La Hague and Marcoule in France, Trombay in India and Tokai-Mura (Japan). Other sources include radioactive materials dumped between the 1950s and the 1980s, nuclear tests, and

radionuclides produced by nuclear plants and various industries. In addition there have been spills from submarines and nuclear weapons in more than 30 accidents resulting in leakage of radioactive materials into the sea over the last 50 years[xxii].

It is estimated that within a 20 km area surrounding the Sellafield reprocessing plant in the UK alone there is two to three times more plutonium than the equivalent to all the nuclear tests released into the atmosphere[xxiii]. Furthermore, the concentration of technetium found in crustaceans has been up to 13 times higher than the Level of Food Intervention of the European Council (CFIL).

There are more than 50 radioactive dumping areas in the sea, near Europe, USA, China, Russia and Japan. One of these areas can be found in the Atlantic Trench, about 600 miles from Galicia in northwestern Spain, where approximately 142,000 tons of low intensity radioactive waste (1 million curies) [xxiv] were dumped over a period of more than three decades.

Some of the most common radionuclides in the oceans:

Radionuclide	Half life
Iodina 131	8 days
Ruthenium 103	40 days
Stronium 89	50 days
Ruthenium 106	1 year
Stronium 90	29 years
Plutonium 238	88 years
Americium 241	432 years
Caesium 134	2,062 years
Tritium 3H	12,346 years
Plutonium 241	14,355 years
Plutonium	24,131

239	years
Cesium 137	30,174 years
Technitium 99	212,000 years

- ***Ocean dumping***

In recent years, most ocean dumping has resulted from dredgers removing sediments accumulated in seaports and river mouths. In many cases these sediments can be highly contaminated.

In 2001, in the North Atlantic, some 72,399,641 tons of dredged material[xxv] were dumped into the ocean, more frequently in coastal areas. Between 80 and 130 million tons of dredged material has been dumped into the north-eastern Atlantic[xxvi].

Obsolete weaponry, including all sorts of ammunition, is another example of authorised dumping material. In fact, in the North Atlantic it is not unusual to find the remains of weaponry on beaches or caught in fishing boat nets. In some cases this debris can be harmful to public health, as in the case of weapons containing mustard gas, sarin nerve gas, phosgene or phosphorous flares[xxvii].

- ***Floating debris***

About 675,000 kilos of rubbish are thrown into the ocean[xxviii] every hour (a total of six million tons per year), 50% of which is plastic. This debris kills 100,000 mammals and sea turtles every year. In fact, some studies have found up to eight million fragments of plastic per square meter floating in the ocean[xxix]; these figures are believed to represent only 10 to 15% of the total amount of plastic found on the seabed and on the coast[xxx].

Shipping routes, fishing grounds and regions where oceans merge are the areas with the highest concentration of floating debris.

The increasing number of holiday cruisers around the world is steadily becoming a major source of this type of spills. A single cruiser can generate up to 4.400 kilos of rubbish every day[xxxi].

- Biological contamination

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- Ballast water

The world's merchant fleet transports on a daily basis between 3,000 and 7,000 tons (about 10,000 tons per year) of different types of ballast water[xxxii]. On average, 30% of merchant vessels' dead weight is ballast water; in an oil tanker that percentage represents some 140,000 tons of ballast water and in a freighter, some 20,000 tons[xxxiii].

Ballast water is often taken up in one port and released in another far-away from the point of origin. When it is taken up, ballast water may contain a variety of plant and animal life, some of which will survive the voyage. When this water is dumped into the sea, some these species (including pathogens) may be introduced in a new ecosystem. This can result in serious damage to the local flora and fauna, as well as other effects to marine-related business that, in some cases can be extremely costly.

Most common invading species [xxxiv]:

Species	Place of introduction	Place of origin
Zebra mussel *(Dreissena polymorpha)*	Great Lakes and eastern North America	Russia
Round goby *(Neogobius melanostomus)*	California	Ponto-Caspian
Ruffe *(Gymnocephalus cernuu)*	Great Lakes	Europe
Green crab *(Carcinus maenas)*	California and southern Australia	Europe
Asian kelp *(Undaria pinnatifida)*	Tasmania	North Pacific
Algae *(Caulerpa taxifolia)*	Mediterranean	Tropical waters
Giant fan worm *(Sabella spallanzani)*	Australia	Mediterranean
North Pacific Seastar *(Asterias amurensis)*	Australia	Alaska and North Pacific
Cladoceran water fly *(Cercopagis pengoi)*	Baltic and Great Lakes	Caspian
Mediterranean mussel *(Mytillus galloprovincialis)*	Soutafrica and Hawaii	Mediterranean
Chinese clam *(Potamocorbula amurensis)*	USA	China-Korea
Northamerican comb jely *(Mnemiopsis leidyi)*	Black Sea	Eastern America
Dinoflagellates *(Gymnodinium catenatum)*	Australia	Japan
Polichaetes *(Marenzilleria viridis)*	Western and northern Europe	North America
American razor-shell *(Ensis americanus)*	Western and northern Europe	North America
Asian mussel *(Musculista senhousia)*	New Zealand	Japan
Indio-Pacific crab *(Charybdis helleri)*	Colombia, Venezuela, Cuba and USA	Mediterranean, Red Sea, Indo-Pacific.

Cholera *(Vibrio cholerae)*	Gulf of Mexico and South America	Different origins
Mitten crab *(Eriocheir sinensis)*	Baltic, western North America, western Europe	North Asia

- ***Aquaculture***

Aquaculture has become a source of a variety of different types of pollution. These include wastes from the fish themselves, feed-related wastes, toxic substances used and antibiotics as well as what is referred to as biological pollution, or the introduction of foreign animals into the oceans.

Salmon fisheries are among the industries that have allowed the largest amount of escapes of farmed fish into the natural environment, thereby affecting local stocks. As a result, Atlantic salmon can be found spawning in the Pacific.

In the fjords and coastal areas of Norway, Scotland and Canada (three of the most important producers of farmed salmon in the world), escaped fish are already affecting the local marine ecosystem. Currently, between 10 and 54% of the fish caught in these areas correspond to the species that escaped from aquaculture fisheries[xxxv].

- ***Fishing***

Overfishing

According to the last FAO estimates[xxxvi], 10% of the world fish stocks are depleted, 15 to 18% is overfished and 45 to 50% is being fished at maximum capacity; in only 30% could increased fishing be sustained.

Many fisheries around the world have collapsed, causing serious damage to marine ecosystems,

leading to the loss of thousands of jobs and of an important source of food for millions of people.

Volume of fishing yields worldwide [xxxvii]:

Region	Total yields (tons)
Antarctic Atlantic	102,500
Central western Atlantic	1,722,500
Central eastern Atlantic	3,827,800
North-eastern Atlantic	12,804,000
North-western Atlantic	2,365,300
South-eastern Atlantic	1,688,800
South-western Atlantic	2,311,700
Indian Antarctic	10,600

Western Indian	4,099,100
Eastern Indian	5,226,600
Mediterranean and Black Sea	1,902,900
Pacific Antarctic	700
Central western Pacific	11,669,400
Central eastern Pacific	1,972,600
North-eastern Pacific	2,873,600
North-western Pacific	43,697,300
South-eastern Pacific	13,594,300
South-western Pacific	843,800
Total	**110,713,500**

The enormous tension over these constantly diminishing resources has led to the outbreak of disputes between fleets that, in some cases, have been violent[xxxviii].
Currently, there are some 3.8 million fishing boats in the world[xxxix]. Only 1% operate on a large scale (registering more than 100 gross tons), but they account for 50% of total catches worldwide. New, larger and more powerful boats are being dispatched, such as supertrawlers. These boats, up to 150 metres long and capable of deploying a trawl net with a 30,000 m2 mouth (about the size of 4 football fields) and a rim 1 km in diameter, are able to process approximately 300 tons of fish every day.

Accidental captures

Fishing activity around the world does not only catch species targeted for commercialisation, but also millions of marine animals and plants that are captured every year along with them, causing an added and dramatically higher mortality rate. In addition to the almost 85 million tons of fish caught commercially every year, there are another 27 million tons[xl] of other types of fish, in addition to thousands of marine mammals, sea birds, and turtles and unmeasured amounts of invertebrates such as corals, that the world's fishing fleet throws back into the water as waste.

However, the total amount of accidental captures worldwide is almost certainly higher than this estimate, because many fisheries do not report the amount of non commercial species, making estimates of the latter exceedingly difficult.

Damage to the seafloor: bottom trawling

Heavy fishing gear can damage the seabed while being used to capture numerous species. Bottom trawling causes the most widespread damage to the seafloor. This fishing technique consists of dragging a sack-shaped net over the sea bottom. The mouth of the net is kept open by placing weights (usually chains) in the lower end of the net and floats in the upper end. In addition, the net is equipped with doors that also keep the mouth open by the pressure of the current generated while the boat is moving.

A small strip of the Italian coast in the Adriatic Sea can contain as many as 1000 bottom trawlers[xli]. In the North Sea the area "threshed" by the trawlers [each year?]is equivalent to the size of the entire sea[xlii]. Worldwide, trawlers operate in a region 20 million square kilometres in size[xliii], an area equivalent to twice the size of Europe.

- ***Illegal fishing***

There are an estimated 1300 fishing boats longer than 24 metres operating under flags of convenience (FOCs) around the world, without reporting their yields or following any regulations[xliv].

According to recent FAO studies [xlv], there are hundreds of high-tonnage boats fishing under the flags of Belize, Honduras, Panama, Saint Vincent and the Grenadines, Cyprus, Vanuatu, Sierra Leone and dozens of other countries that do not observe international treaties and exploit the oceans with their fishing gear; these vessels, however, are owned by companies based mainly in Europe (all but a few are from Spain, Portugal, Greece and UK), Japan, China, Taiwan and South Korea.

In some tuna and toothfish fisheries, illegal catches can constitute as much as 30% of total yields[xlvi] and in some others may even be triple the volume of authorised captures. Bluefin tuna, toothfish and swordfish are some of the species most sought after by these "pirates".

OTHER THREATS

- **Mining**

Mining activities in the ocean look beneath the seafloor for the same rich deposits of oil, coal, uranium and other minerals they search for on land.

Every year for the last 15 years, an average of 1000 new oil fields have been opened in the sea. Currently about 6000 of these are active[xlvii].

Phosphates are also regularly extracted from the continental slope, to the point that some of the deposits around certain islands in the Pacific, such as Kiribati, have been exhausted. These operations, however, generate a great deal of business and income in Melanesia and Taiwan.

For now, however, the majority of the operations take place on the continental shelf or within the 200-mile EEZ area, although it has been already proven that most of these resources can be found in international waters or in deeper water regions.

- **Occupation of the coastal areas**

According to different sources, between 40 to 60% of the world's population lives within 100 km from the coast[xlviii], and that percentage is rising. Moreover, more than 70% of the so-called "megacities"[xlix] are located along the coastline (including New York, Bangkok, Cairo, Tokyo and Buenos Aires).

This massive occupation of the coast generates heavy pressure on the littoral ecosystems and leads to the overexploitation and contamination of their resources; the development of numerous facilities, like sea ports, breakwaters, drainage pipes, industries, etc., deteriorates the marine medium.

In many places, such as the shores of the Mediterranean and the Caribbean Seas, this pressure is intensifying due to the visits of millions of tourists.

- **Dams**

Rivers play a very important role for the oceans around the world; they carry fresh water, nutrients and sediments, sustaining rich ecosystems and fisheries. But in only 100 years, the paths of almost 500,000 rivers have been altered[l] with catastrophic effects upon their flora and fauna.

The construction of large dams (of which there are more than 45,000[li]) and channels along the paths of these rivers and their tributaries has deprived the seas of thousands of tons of sediment, affecting the coast. This is the case of rivers such as the Mun-Mekong in Thailand[lii], the Colorado and the Mississippi in North America[liii], the Medjerdah in Tunisia[liv], the Ebro in Spain[lv] and the Parana in South America[lvi], where sediment has decreased by 80 to 99%. Perhaps the worst example is the Nile, where the enormous Aswan dam led to a very sharp decrease in the productivity of the eastern Mediterranean and caused an 80% reduction in sardine fisheries' yields[lvii].

- **Climate change**

Climate change is one of the biggest threats menacing marine ecosystems. According to the United Nations' Intergovernmental Panel for the Climate Change (IPCC)[lviii], the following are the forecasted changes that the oceans will undergo:

- By the year 2100, the sea level will rise between 13 to 94 cm, flooding coastal areas and putting an end to many coastal communities.
- Sea currents will change, altering the migratory pattern of many species and changing the place of origin of many nutrients.
- The average temperature of the upper layers of the oceans will rise between 1 and 3.5 degrees, causing the extinction of species sensitive to changes in temperature.

- The polar icecaps will melt, adding massive quantities of fresh water to the oceans and lowering the salinity level.
- The chemical composition of the sea water and the seabeds will be altered, which might acidify some areas and increase the potential toxicity of some substances in the ocean.

Ecosystems

- **Coral reefs**

Fifty-eight percent of the world's tropical coral reefs are damaged, affecting 93 of the 110 countries that have such ecosystems in their waters; in almost half of these countries, the damage is considered either high or very high[lix]. It is believed that already 10% of the coral reefs are so damaged that their recovery will be impossible and that 30% of them could suffer the same level of deterioration in a mere 20 years. Currently, tropical coral reefs cover a 600,000km2 area[lx].

Coral reefs are one of Earth's richest and most biodiverse ecosystems, competing with tropical forests, and could give shelter to one third of all marine fish species[lxi]. Overall, 4000 fish and 800 hard coral species have been identified, plus hundreds of other marine organisms. It is believed that there might be between 1 and 8 million species still undiscovered in these ecosystems[lxii].

The discovery in the last few decades of sizeable coral reefs in cold and deep waters (some can be found 2,000 metres deep and more), has clearly shown the enormous risk these ecosystems suffer; in some areas in Europe and North America, large portions of their reefs have been destroyed mainly because of the use of trawling gear over the sea bottom and mining activities. In Norwegian waters, it is estimated that trawling has destroyed between 30 to 50% of the reefs[lxiii].

A single pass by a recent US government trawl survey in Alaska brought to the surface close to 1000 kilos of deep coral[lxiv], and likely damaged considerably more.

- **Marine prairies**

There are some 60 species of marine seagrass in the world[lxv]. The extent of these true plants, which flower and produce seeds, is rapidly decreasing in all oceans due to intense development of coastlines, the construction of artificial beaches and yacht clubs, nutrient pollution, and ploughing of the seabed by the boats' anchors and trawling. In southeast Asia,

between 20 to 60% of all marine prairies have disappeared[lxvi] and in Tampa Bay (Florida, USA) the loss of the marine seagrass in less than a century has reached nearly 70% [lxvii].

In the Mediterranean[lxviii], every year dozens of hectares of *Posidonia oceanica* prairies, an important type of seagrass, are damaged or destroyed. Up to 1400 different species can be found in these ecosystems[lxix], which can generate between 4 and 20 litres of oxygen per square metre and 38 tons of biomass per hectare[lxx].

Several different studies have demonstrated that bottom trawling on these ecosystems can rip up as many as 363,000 leaves per hour[lxxi]. After only ten passes by a trawler, the marine seagrass beds can be reduced up to 10% in area[lxxii]. This technique, although illegal, continues to be used, even though it has been demonstrated that biomass production of unaffected prairies can be double the production of areas where fishing is conducted[lxxiii].

- **Algae**

Algae, with about 6500 different species around the world, are the largest photosynthetic species and the most important oxygen generators of the sea. Among these, a few, like kelp forests or Sargasso mats, stand out because they create unique ecosystems. Kelp is a type of brown algae that can be as tall as 30 metres high and shelter a very rich flora and fauna, most notably sea otters and abalones. Currently, kelp forests are threatened by direct destruction, pollution and destruction from sea urchins, resulting from alteration of the food chain, as well as the increasing frequency of storms[lxxiv], (all possibly tied to climate change).

Sargasso can create vast and almost impenetrable regions, like the famous Sargasso Sea in the Atlantic, a meeting point for juvenile sea turtles, eels (for spawning) and several other juveniles from different species, both commercial and predators like the mahi-mahi (*Coryphaena hippurus*).

- **Maërl, or coralligenous, beds**

In many areas of the continental slope there are concentrations of animals and plants attached to the sea floor, which create optimal conditions for the development of rich and complex ecosystems. Maërl beds, characterised by the presence of algae with a calcareous structure (also known as coralline or coralligenous algae), inhabit vast regions between 40 to 800 metres deep. Gorgonian corals, arborescent sponges and a multitude of other animal species of great beauty and ecological importance are often associated with maerl beds.

These ecosystems give shelter to hundreds of species and in some cases (maërls) can be close to 8,000 years old[lxxv]; therefore, the loss of these ecosystems to destructive fishing gear can cause irreparable damage[lxxvi].

Coralligenous beds have also proven to be extremely sensitive to damage[lxxvii], especially damage caused by bottom trawling, which can seriously reduce their capacity to recuperate and produce by as much as half[lxxviii]. Gorgonian and soft corals could take between 10 to nearly 125 years to recover after the destruction stops[lxxix].

- **Undersea mountains**

The large mountain ranges found under the surface of the ocean around the world are home to many of the world's most important marine ecosystems. Coral reefs, sponges, Gorgonian corals, etc., can be found on their peaks and slopes, creating areas of great biological wealth.

The search for new fishing grounds has led many fleets to encroach upon these regions, which could quickly destroy these areas. Mining also represents a great threat to these regions.

The new trawling fleets can fish as far as 1400 metres deep or more, and the harm caused by this gear is already noticeable[lxxx]. New trawling gear is capable of destroying unique ecosystems and species, as well as some that have not yet been discovered.

- **Underwater hydrothermal vents and volcanoes**

The great depths of the sea are home to fabulous animals whose existence has been unknown until a few years ago and about which we still know very little[lxxxi]. These include fish, molluscs and jellyfish capable of generating their own light (bioluminescence), half-a-metre long worms, scavenger sharks and bacteria that, according to some recent studies, could be the origin of life on Earth.

The old beliefs that considered these areas as wastelands or having little biological value have been challenged by the spectacular discoveries of multiple species capable of surviving in these environments or even dependent on them. These findings include the existence of chemosynthetic bacteria in areas where the maximum temperature can be above 150º C, molluscs, worms and sponges that have symbiotic relationships with bacteria on the seafloor in order to obtain food, as well as fish and crustaceans that profit from this symbiosis and are capable of living under hundreds of atmospheres of pressure[lxxxii].

Coastal areas

- **Estuaries**

The existence of fresh water and rich sediments and nutrients in the mouths and deltas of rivers around the world have made it possible for humankind to develop agriculture and fishing activities. However, these developments have forced fragile environments to sustain large human populations and urban pressures, which deteriorate the systems. Furthermore,

the arrival of large quantities of pollutants to these areas, which come from different drain pipes along river beds, have generated "black spots" where substances that are dangerous for the marine ecosystem have been accumulating. Estuaries are particularly sensitive to pollution from excess nutrients from sewage and agriculture.

At the mouths of rivers like the Ebro, the Rhone and the Po in the Mediterranean, the Rhine in the North Sea, the Mississippi in the Gulf of Mexico, the Yangtze in the Pacific, the Rio de la Plata in the South Atlantic, etc., some of the species and sediments with the largest concentration of toxins in the world can be found.

- **Coastal wetlands**

In the last century, more than half of the planet's wetlands have been destroyed[lxxxiii]. Many have been dried up to create new cultivation areas, while others have disappeared due to the over-exploitation of the resources that sustained them. Many more contain high enough concentrations of toxins to radically modify life within them.

- **Mangroves**

Mangroves are considered one of the most important coastal ecosystems on the planet, producing on an annual basis up to 600 kilos of fish hectares[lxxxiv].

In only one century, more than 50% of the mangroves that use to exist around the world have been lost[lxxxv]. This destruction has been mainly caused by coastal development, the construction of coastal infrastructure and, more recently, the massive expansion of agriculture into these areas.

Endangered and vulnerable species

Within the last couple of centuries, at least 1200 marine species have been exterminated[lxxxvi]. In most cases these were unknown species that inhabited ecosystems as biologically rich as coral reefs.

- **Marine mammals**

Eighty-eight of the 126 endangered marine mammal species in the world (70%) are included in the International Union for the Conservation of Nature (IUCN)[lxxxvii] Red List of Endangered Species. Some are at the brink of extinction, like the blue whale (*Balaenopetra musculus*) in Antarctica, the vaquita (*Phocoena sinus*) in the Gulf of California, the monk seal (*Monachus monachus*) in the Mediterranean or the Northern fur seal (*Callorhinus ursinus*) in Alaska.

The main reasons that these species are endangered are the fact that they were hunted for centuries (e.g. whales), or now are subject to fishing overexploitation, accidental captures, pollution and the deterioration of their habitat. Researchers have found some of the highest levels of pollutants such as toxic PCBs and heavy metals in the fat of these animals. The concentration of these substances was sometimes millions of times higher than the level found in the water they lived in.

- **Sea turtles**

All eight species of turtles found around the globe are endangered and their population is diminishing due to humans' destruction and occupation of their spawning beaches, marine pollution and capture in fishing nets. The number of turtles caught in the world is still unknown, but Mediterranean long-line fisheries capture more than 30,000 turtles every year[lxxxviii], bottom trawling in the Gulf of Gabes (Tunisia), another 5,000[lxxxix] and the nets of shrimp trawlers in the Gulf of Mexico, several thousand more[xc], as well as in other fisheries around the world[xci].

Oil stains and floating debris are also responsible for the extermination of thousands of these marine animals every year, through ingestion and entanglement[xcii].

- **Marine birds**

The changes introduced in many wetlands and coastal areas by humans have deprived many bird communities from their nesting and resting places. The fact that millions of tons of fish are discarded each year has also modified their behaviour and composition. Furthermore, every year, hundreds of thousands of marine birds die because of black tides caused by oil spills or because they are accidentally caught in fishing gear. The North Pacific squid fisheries of the Japanese fleet alone are responsible for the death of more than 1,5 million birds every year[xciii]. In oil spills, such as the one that occurred in France with the tanker *Erika*, the death rate can be as high as 300,000 birds[xciv].

Every year, between 44,000 and 145,000 marine birds, mainly albatross and petrels, fall victim to the fish hooks of the long-line fisheries in the Atlantic and its surroundings[xcv]. The situation of some of these species is worrisome; there are only a few dozen couples of Amsterdam albatross (*Diomedea amsterdamensis*) left and the population of the wandering albatross (*Diomedea exulans*) may have been reduced by as much as 40%[xcvi]. Currently 16 of the 21 species of albatross are included in the IUCN Red List[xcvii].

- **Sharks and rays**

Elasmobranches, the taxonomic group that encompasses sharks, rays, sawfish and chimaeras, have inhabited Earth's oceans for millions of years.

Today, all 1000 species of this group still in existence could face total extinction because of human activity. The last IUCN study on 274 species of elasmobranches found that 59 are threatened all over the world and the remaining 84 are either endangered on a regional basis or nearly so.

Every year, more than 100 million sharks are captured by fisheries around the globe; in many cases they are either discarded or only between 2 to 8% of their flesh is kept (their fins), which represents 240,000 tons of wasted meat[xcviii].

Some species like the sawfish (*Pristis pristis*), blue skate (*Dipturus batis*), the smoothback angel shark (*Squatina oculata*) and the whale shark (*Rhincodon typus*) are at the brink of extinction and many others like the basking shark (*Cetorhinus maximus*), the tope shark (*Galeorhinus galeus*) and the devil fish (*Mobular mobular*) are seriously threatened.

- **Deep sea fish**

The development of new fishing technology has made it possible to harvest species that live 500 metres deep or more. In a mere 5 to 10 year span, some of them are already either being over-exploited or their stocks have been drastically reduced, before any of them had been sufficiently studied. Today, close to 1 million tons of these species arrive to our markets[xcix]. Many of them are slow-growing with long life spans, which makes it hard to believe that they could sustain exploitation without causing serious damage to their stocks[c].

New findings show that species like blue ling (*Molva dyterygia*) and Atlantic argentine (*Argentina silus*) can live between 30 to 35 years, roundnose grenadier (*Coryphaenoides rupestris*) up to 60 years and orange roughy (*Hoplostethus atlanticus*) between 125 and 150 years[ci]. Rougheye rockfish (*Sebastes aleutianus*) can live more than 200 years at a depth of 900 metres.

The overexploitation suffered by most stocks found close to the coast and on the continental shelf has led the world's fisheries to move to deeper waters, where the rate of destruction continues.

- **Great migratory species**

There are many species in the sea that migrate thousands of kilometres. Some of them, like red tuna and swordfish, are subject to overfishing, which has brought them to the brink of

collapse. Furthermore, since these species are at the top of the food chain, large quantities of pollutants are concentrated in their bodies, most importantly heavy metals.

The stocks of North Atlantic bluefin tuna (*Thunnus thynnus*) have been drastically reduced in a mere 20 years; however, they are still being captured at a rate 2,5 times higher than what would be necessary for their stocks to recover[cii]; and among those targeting them there are hundreds of "pirate" ships that hunt them even in their spawning areas deep into the Mediterranean. The same is occurring with the southern bluefin tuna, whose biomass could be less than 10% of the original[ciii].

The swordfish (*Xiphias gladius*) is not in much better shape, and in many areas of the Atlantic and Pacific Oceans, its stocks are overexploited. The majority of the fish caught are juveniles.

- **Greatly overexploited species**

Some species have been among the public's gastronomic preferences for many years, and as a result have been relentlessly hunted down and exploited. Because of this abusive harvesting, the stocks of species such as hake and cod have collapsed in some areas around the world, like the Grand Banks off Newfoundland, or are at the brink of collapse, such as in the northeastern Atlantic.

Several other species are under the same kind of pressure, such as rockfish *(Sebastes sp.)*, whiting *(Merlangius merlangus)*, red mullet *(Mullus sp.)*, anglerfish *(Lophius sp.)*, pollock *(Pollachius virens)*; and even some small pelagics like sardine *(Sardina pilchardus)* and European anchovy *(Engraulis encrasicolus)* are showing dangerous levels of exploitation.

The sea has not surrendered to the relentless and reckless exploitation it suffers. Every day it shows signs that it wants to continue playing its vital role in the life of our planet. With a little help from us, the ocean can recover its vitality and continue to supply us with food, medicines and a multitude of other materials—in addition to being the source of wonder that has fascinated us since the dawn of humanity.

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