



Land-Sea Pollution: **Are California's Marine Protected Areas *Really* Protecting Marine Life?**

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Our planet is 71% covered in water.²

One out of every 2 breaths we take comes from the ocean.³

The average adult is 50%-65% made of water.⁴

¹ Ju, Siel. "Kit, the cute sea otter pup." Mother Nature Network. <http://www.mnn.com/earth-matters/animals/blogs/kit-the-cute-sea-otter-pup>, February 19, 2010.

² "How much water is there on, in, and above the Earth?" USGS. <https://water.usgs.gov/edu/earthhowmuch.html>, Accessed April 3, 2017.

³ Armbrust, Ginger, "Every (Other) Breath You Take." KUOW Interview. https://www.ocean.washington.edu/story/Every_%2528other%2529_Breath_you_Take, December 5, 2012.

In 2014, marine fish captured worldwide for human consumption totaled 81.5 million tons.⁵

Scientists have found that the oceans are absorbing vast amounts of CO₂ released into the atmosphere by humans.⁶

We need our water as our cognitive, spiritual, physiological, psychological, and emotional well being depends upon being in, on and around water.⁷



We live on a water planet. It is important to understand how healthy water is directly linked to the health of humans. This paper is an exploration of a few specific issues that are harming our waters, including compromising California's marine protected areas, and, thus, harming us.

⁴ Helmenstine, Anne Marie, PhD, "How much of your body is water?" ThoughtCo. <https://www.thoughtco.com/how-much-of-your-body-is-water-609406>, March 29, 2017.

⁵ United Nations Food and Agriculture Organization. [The State of World Fisheries and Aquaculture \(SOFIA\) report. rhttp://www.fao.org/3/a-i5555e.pdf](http://www.fao.org/3/a-i5555e.pdf), 2016.

⁶ Monroe, Rob. "How Much CO₂ can the Oceans Take Up?" The Kneeling Curve, Scripps Institute of Oceanography, <https://scripps.ucsd.edu/programs/keelingcurve/2013/07/03/how-much-co2-can-the-oceans-take-up/>, July 3, 2013. "Estimates have calculated that 26 percent of all the carbon released as CO₂ from fossil fuel burning, cement manufacture, and land-use changes over the decade 2002–2011 was absorbed by the oceans. (About 28 percent went to plants and roughly 46 percent to the atmosphere.) During this time, the average annual total release was 9.3 billion tons of carbon per year, thus on average 2.5 billion tons went into the ocean annually."

⁷ Nichols, Wallace J., PhD. *Blue Mind*, Back Bay Books, 2014.

⁸ The Andromeda Wiki. Fandom. <http://andromeda.wikia.com/wiki/Earth>

Think about the love we all have for our adorable cats. A love and care that extends all the way to dealing with their feces. Unfortunately, cat poop and how we handle its disposal can be very harmful to important species that keep us healthy.

Think of that fertilizer you use to make your plants grow. It seems harmless to our natural environment. Though when it rains, or when you water with your garden hose, it goes into your drain and flows directly to the ocean. Unfortunately, this “healthy” fertilizer harms the marine environment and the organisms that live within it including keystone species.

What do cat poop and agricultural fertilizer have in common? They are both contributors to harmful land-sea pollution.

What Is Land-Sea Pollution?



Imagine you are out for a walk in your neighborhood and you come across a drain that is covered in trash. You see plastic straws, soda cans, plastic bags, plastic to-go containers and lids, a puddle of iridescent oil, and a few plastic water bottles. What is there that you don't see? Pathogens, parasites and fertilizer minerals. Waterways carry water, ultimately to our oceans. These pollutants that you can see and cannot see will make their way to the ocean.

Eighty percent of pollution in our oceans comes from land. One of the biggest sources is called “nonpoint source pollution” which occurs as a result of runoff. Nonpoint source pollution includes many small sources, like septic tanks, cars, trucks, and boats, plus larger sources, such

⁹ “Ganges River Pollution.” Organic Waste. <http://gangapollution.weebly.com/organic-waste.html>
Accessed April 4, 2017.

as farms, ranches, and forest areas.¹⁰ The other 20% of marine debris comes from overboard discharges from ships and discarded fishing gear, which still originate from human sources on land.¹¹

As Dr. Melissa Miller, one of the leading sea otter pathologists, explains: “Land-sea pollution is pollution that originates from multiple sources and ends up in the ocean. This includes fertilizers, pesticides, herbicides, sewage, and garbage. In addition to pollutants that directly originate from humans, sea otters are also affected by biological land-based pollutants such as fungi, bacteria and parasites such as *Toxoplasma gondii* (from cat feces) and *Sarcocystis Neurona* (from opossum feces).”¹²

Land-sea pollution harms our oceans and wreaks havoc on marine ecosystems causing their natural cycles to become unbalanced which negatively impacts all marine life including sea otters, a keystone species. Marine Protected Areas (MPAs) have been established to protect our oceans and coastlines to ensure a healthy ecosystem and protect keystone and threatened or endangered species.¹³ While MPAs, as currently defined, may effectively restrict fishing practices and oil drilling, they are not adequate to ensure that the important species in the water are effectively protected. In other words, MPAs consider what humans are taking out of the ocean, but they do not consider the damage of what humans put into the ocean. For the next generation’s health, they need to.

I believe we can stop the flow of land-sea pollution if we know the origin of the problem and we all work together to solve this crisis. Although there are many land-based pollutants harming our keystone species, here I will be mainly focusing on the parasite *Toxoplasma gondii* and agricultural pollutants -- fertilizers, herbicides, and pesticides -- affecting sea otters.

Toxoplasma Gondii, Your Cat’s Poop, and Sea Otters



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¹⁰ “What Is the Biggest Source of Pollution in the Ocean?” National Oceanic and Atmospheric Administration. <https://oceanservice.noaa.gov/facts/pollution.html>, Last updated October 10, 2017. “Eighty percent of pollution to the marine environment comes from the land.”

¹¹ “The Problem of Marine Plastic Pollution.” Clean Water Action. <http://www.cleanwater.org/problem-marine-plastic-pollution>, 2017.

¹² Miller, Melissa, Dr. Personal Interview. February 21, 2017.

¹³ “What is a Marine Protected Area?” National Oceanic and Atmospheric Administration. <https://oceanservice.noaa.gov/facts/mpa.html> Accessed October 2017.

¹⁴ “Does my cat need a bigger litter box?” Northern Illinois Cat Clinic. <http://www.northernilcatclinic.com/does-my-cat-need-a-bigger-litter-box-2/>

Most people love animals. We like to see wild animals in their natural habitats, and we all love to play with our domestic pets at home. Humans love creating special bonds with their animal friends. This includes caring for the animal, from their food to their feces!

Cat owners have a very important responsibility when it comes to taking care of their animal's waste. If people don't properly dispose of cat scat, it seriously harms the marine ecosystem including those that are supposed to be protected by MPAs. If we educate ourselves about this issue and we all commit to disposing of animal waste correctly, then we can stop the parasites inside the feces from killing marine mammals.

There is a parasite that is negatively impacting marine mammals' ability to survive in their natural habitat: *Toxoplasma gondii*. We will now explore how this parasite ends up in our ocean and how it directly affects sea otters.

Toxoplasma gondii is a microscopic protozoan parasite found in the feces of both wild and domestic cats.¹⁵ The oocytes, which are immature egg cells, are found in the waste of cats. A sea otter becomes infected through consumption of infected prey.

Toxoplasma gondii can be fatal and is believed to be a cause of mortality in the southern sea otter population along the central California coast. *Toxoplasma gondii* can survive in cold waters for many years.¹⁶ This is bad news for sea otters and some pinnipeds because they live in the colder ocean areas.

This parasite was first found in Hawaiian monk seals in 2004, and the mortality of several seals was caused by a *T. gondii* infection.¹⁷ How does it get to the seals in the sea? When people flush their kitty litter with the parasite-infected cat feces down the toilet, it ends up in the ocean where it is ingested by marine animals. This also happens with the outdoor waste of domesticated and wild cats, as that waste becomes runoff into our water system.

How is the parasite ingested by marine mammals? When the infected feces runs into the ocean and into the kelp forest, it creates a biofilm on the leaves of kelp. Turban snails eating the

¹⁵ Mazziello, Fernanda F. M.; Shapiro, Karen; Silver, Mary W. "A New Pathogen Transmission Mechanism in the Ocean: The Case of Sea Otter Exposure to the Land-Parasite *Toxoplasma gondii*." PLOS One. Dec 18, 2013. <http://dx.doi.org/10.1371/journal.pone.0082477>. Accessed March 2, 2017.

¹⁶ Shapiro, Karen; Cox, Justin; Ancheta, Christopher, "How a Parasite in Cats is Killing Sea Otters." UC Davis Veterinary Medicine. <http://www.evotis.org/toxoplasma-gondii-sea-otters/> Accessed June 2017.

¹⁷ Barbieri, Michelle M.; Kashinsky, Elizabeth; Rotstein, David S.; Colegrove, Kathleen M.; Haman, Katherine H.; Magargal, Spencer L.; Sweeny, Amy R.; Kaufman, Angela C.; Grigg, Michael E.; Littnan, Charles L.; "Protozoal-related mortalities in endangered Hawaiian monk seals." Inter-Research Diseases of Aquatic Organisms. <http://www.int-res.com/abstracts/dao/v121/n2/p85-95/>, 2016.

biofilm then ingest it, and the sea otters who eat turban snails become infected by *T. gondii*.¹⁸ Research has proven that this parasite causes a brain infection, and usually the sea otter dies.¹⁹

Farming Our Fruits and Vegetables Affects Our Oceans



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We all like to eat fruits and vegetables because they are delicious and because they are an important part of a balanced and healthy diet. Unfortunately, a lot of the time, the way this produce is grown is very harmful to our environment. The minerals and chemicals that are used to fertilize the soil, produce large harvests, and make the fruit or vegetable look appealing poison our oceans. We can turn this around.

Fertilizer



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¹⁸Mazzillo, Fernanda F. M.; Shapiro, Karen; Silver, Mary W. "A New Pathogen Transmission Mechanism in the Ocean: The Case of Sea Otter Exposure to the Land-Parasite *Toxoplasma gondii*" <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0082477> December 18, 2013

¹⁹Loury, Erin. "The Land to Sea Link: Disease and Contaminants." <http://seaotters.com/2012/03/the-land-to-sea-link-disease-and-contaminants/> March 24, 2012.

²⁰ "3 Best agriculture stocks to buy." TheMotleyFool, <https://www.fool.com/investing/2016/08/25/3-best-agriculture-stocks-to-buy.aspx>

²¹ Fertilizing Hydrangeas, "How Should Hydrangeas Be Fertilized?" <http://hydrangeashydrangeas.com/fertilize.html>

When people use fertilizer in their gardens and in large-scale agricultural production, and then the plants are watered through rain or irrigation, the runoff that results is harmful. It goes into a drain or a waterway, and that leads to a larger body of water such as a river, lake, bay, estuary, gulf, and ocean, including the MPAs off our coast.

Once in the water the nitrogen from the fertilizer causes a microscopic red algae to harmfully bloom which produces domoic acid. This is commonly known as “Red Tide.” Domoic acid accumulates in food sources eaten by sea otters, other marine mammals, and even humans! The nitrogen residue from fertilizer also wreaks havoc on coral reef ecosystems around the globe. The fertilizer issue is a massive problem that needs to be addressed immediately. We can see the negative effects from the smallest organisms living inside coral to the large-scale crab fishing industry and to important marine mammals such as pinnipeds and sea otters.

For marine mammals and humans, domoic acid affects the brain. Once infected marine mammals become lethargic and disoriented, and they have seizures which often result in death. The Marine Mammal Center did a study in which they took a photo of a healthy sea lion's brain and a sea lion's brain that was infected with domoic acid. The hippocampus, which is the part of the brain that determines perception and emotion,²² was significantly smaller in the infected sea lion's brain than it was in the healthy sea lion's brain.²³ The number of affected sea lions is up since last year. As of August 2017, a total of 89 animals had been treated by the Marine Mammal Center in Northern California compared to 70 last year. In years with the biggest algae blooms, such as 2014-2015, numbers of affected animals were well above 200.²⁴

Domoic acid also affects many people's jobs. In 2015, Dungeness crab fisheries on the Pacific coast were shut down temporarily because of the high amount of domoic acid found in the crabs. “During the 2015-16 season, California crab boats caught only 12.3 million pounds, a 48% drop from the previous 5 year average.”²⁵ This decrease in healthy crabs had a negative effect on local fisherman, the tourist industry, and the entire California economy. Not only is the overuse of fertilizer harmful to marine life, it is creating huge problems in the health of our

²² De Brigard, Felipe. “What Does The Hippocampus Do?” Scientific American. <https://www.scientificamerican.com/article/what-does-the-hippocampus-do/> May 2014.

²³ “Domoic Acid Toxicity.” Marine Mammal Center. 2017 <http://www.marinemammalcenter.org/science/top-research-projects/domoic-acid-toxicity.html?referrer=https://www.google.com/>

²⁴ Kusmer, Anna. “Algae-Poisoned Sea Lions Inundate Marine Mammal Center.” KQED Science. <https://www.kqed.org/science/2017/08/17/algae-poisoned-sea-lions-inundate-marine-mammal-center/> August 17, 2017. “More California sea lions are dying because of poisonous algae blooms.” Los Angeles Times, <http://www.latimes.com/local/education/la-me-ln-sea-lions-dying-20170419-story.html>; April 19, 2017.

²⁵ “California Dungeness crab industry bounces back with strong season.” San Francisco Chronicle. <http://www.sfchronicle.com/food/article/Dungeness-crab-industry-bounces-back-with-strong-11267878.php> July 5 2017

economy. We need to look at the bigger picture and realize actions upstream always affect that which is downstream.

This fertilizer issue is also a large problem in warmer waters such as the Caribbean. When there is large fertilizer runoff, the nitrogen in the fertilizer causes an important algae that lives in coral, called zooxanthellae, to leave the coral. The zooxanthellae exits the coral because it no longer needs the coral as a nutrient producer because there is already enough nitrogen for the zooxanthellae in the surrounding waters. This is not good for the coral because when the zooxanthellae leaves, the coral no longer has its main food source. Over time the coral reef will bleach and die. Coral reefs are a crucial ocean ecosystem that supports 25% of all known marine fish.^{26 27}

Pesticides



Pesticides are chemicals that have historically harmed animals, even to the point of near extinction. For example, the bald eagle, the peregrine falcon, and the brown pelican nearly became extinct before scientists discovered that the toxic chemical DDT (dichloro-diphenyl-trichloroethane) was causing reproductive failure in these animals. DDT was a major component of most pesticides produced in the US starting in the 1950s.²⁸ DDT was banned for use in the United States in 1972, but it is still used in South America, Africa and Asia.²⁹

All pesticides are toxic, though each pesticide varies in its toxicity to humans and other animals. Two common pesticides that are used on land are Organophosphates and Pyrethroids. Organophosphates contain phosphorus and they work by inhibiting important enzymes in the nervous system of animals. These are very toxic to all animals. Pyrethroids, on the other hand, are not as toxic to humans and other mammals, but are very toxic to fish and invertebrates. When our land-based synthetic toxins end up in our water, it is incredibly harmful. People may think

²⁶ "How Pollution Affects Coral Reef" National Oceanic and Atmospheric Administration." <https://celebrating200years.noaa.gov/visions/coral/side.html>, Accessed June 2017.

²⁷ Ray, Gary, Dr. Personal Interview. St John Virgin Islands. July 2017

²⁸ U.S. Fish and Wildlife Service. <https://www.fws.gov/midwest/eagle/recovery/biologue.html>, June 2007.

²⁹ Fact Sheet DDT. <http://npic.orst.edu/factsheets/ddtgen.pdf>

that using chemicals such as Pyrethroids are less harmful to the environment, but they are not considering how it affects marine life when it ends up in our waterways then into our MPAs where our protected and important marine species live.³⁰ Exposure to pesticides has been linked to cancer, endocrine disruption, neurotoxicity, reproductive failure, and kidney and liver damage.³¹

All of these agricultural pollutants in the water are a major threat to sea otters. A significant reason why is because a sea otter's diet is largely made up of filter feeders, such as mussels, clams, and abalone. Scientists have used mussels to determine the amount of chemicals in the water for many years. This is because mussels are sessile, filter-feeding organisms, which accumulate many contaminants within their tissues such as pesticides, hydrocarbons, and metals, all present in seawater.³²

Karen Worcester is a scientist who oversees the Water Quality Monitoring Program for the Central Coast of California's Water Quality Control Board. She measures the flow of pollutants that is going into the ocean from watersheds that are connected to very large agricultural areas in California. For example, Salinas is the largest watershed in the region, and the greatest issue in that region is the overuse of fertilizers resulting in too much nitrogen going into the marine food chain. This is bad news for sea otters because they are eating contaminated filter feeders.³³

I've mentioned the importance of keeping sea otters alive in our ecosystems -- because they are keystone species! But what does "keystone species" mean?

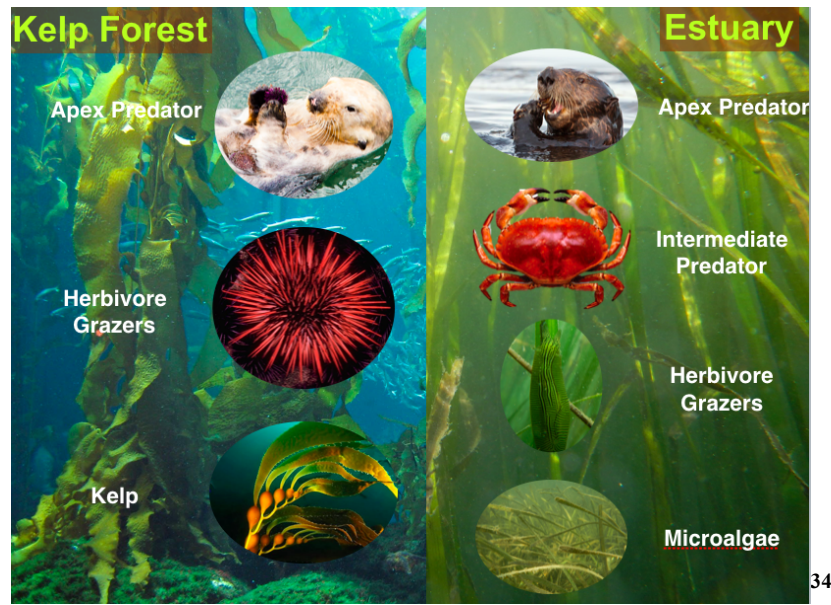
³⁰ "How are pesticides affecting water quality?" University of California Agriculture and Natural Resources Statewide Integrated Pest Management Program. <http://ipm.ucanr.edu/WATER/U/watqual.html> Accessed March 2, 2017.

³¹ "Impacts of Pesticides On Wildlife", Beyond Pesticides. <http://www.beyondpesticides.org/programs/wildlife> Accessed September 2017.

³² Viarengo, A.; Canesi, L. "Mussels as Biological Indicators of Pollution." ScienceDirect, Accessed May 26, 2017

³³ Worcester, Karen, Staff Environmental Scientist, Central Coast Regional Water Quality Control Board, Personal Interview, May 2017.

Sea Otters are Marine Ecosystem Superheroes!



As I mentioned, more than 70% of the oxygen we breathe comes from the ocean, and sea otters help give us that oxygen. They do this, because they are a keystone species that protect kelp. What is a keystone? Imagine a stone arch:



The stone in the middle is called the “keystone” because if you take out the entire arch will crumble. This is the same with sea otters: If you take them out of their marine ecosystem, the

³⁴ Image courtesy of Gena Bentall, Sea Otter Savvy

³⁵ US Stone Industries. Ulrich Museum Stone Arch. <http://www.usstoneindustries.com/gallery/Detail/174>

kelp habitat in which they live will crumble. Sea otters are so important that efforts are made to increase their populations in such places as Elkhorn Slough State Marine Reserve³⁶. Yes, they are that important a species. Sea otters need to re-populate and thrive, so protected areas were established for them. Why you ask?

Sea otters protect kelp. This is because they eat a lot of sea urchins keeping this invertebrate population in check. Urchins eat a lot of kelp. If their predator sea otter is removed from the kelp forest, then the urchins are capable of decimating entire kelp forests resulting in an “urchin barren.” This is when all the kelp in an area has been devoured and there are urchins and other invertebrates everywhere. When there is a healthy, abundant population of sea otters, these “urchin barrens” do not happen.³⁷

Kelp as a marine botanical is very important.³⁸ First of all, kelp is a marine habitat that supports a huge amount of life including: bristle worms, scud, prawns, snails, urchins, anemones, crabs, jellyfish, brittle stars, black rockfish, blue rockfish, olive rockfish, kelp rockfish, grey whales, sharks, sea lions, seals, sea otters, gulls, terns, egrets, great blue herons, and cormorants.³⁹ Additionally, kelp, along with other marine botanicals, give us more than 70% of our oxygen!⁴⁰ Also, kelp absorbs vast amounts of carbon from our atmosphere, and with the help of sunlight and water, it turns the CO₂ into sugars and releases oxygen back into the air.⁴¹ “Their productivity is on par with a tropical rainforest in terms of the amount of carbon they turn over in a year,” says ecologist Chris Wilmers of the University of California, Santa Cruz. Healthy kelp forests create a healthy planet! And sea otters are the key to the health of our kelp forests!

³⁶ California Department of Parks and Recreation. https://www.parks.ca.gov/?page_id=27205. Accessed October 2017.

³⁷ Seaotters.com, “Why Are Sea Otter So Important? No Sea Otters No Kelp” <http://seaotters.com/2013/05/why-are-sea-otters-important-no-sea-otters-no-kelp-forests/> March 23, 2013.

³⁸ Zavaleta, Erika. Coursera Lecture, UC Santa Cruz. <https://www.coursera.org/learn/california-ecosystems/lecture/cuzd8/kelp-forests> 2017.

³⁹ “What Lives In A Kelp Forest?” National Oceanic and Atmospheric Administration. <http://oceanservice.noaa.gov/facts/kelplives.html>, Accessed September 2017.

⁴⁰ Putic, George. “Study: Plankton are a Major Oxygen Source on Earth.” VOA. <https://www.voanews.com/a/plankton-major-oxygen-source-earth/2791960.html> May 26, 2015.

⁴¹ Cannon, John. “Thanks To Sea Otters, Kelp Forests Absorb Vast Amounts Of CO₂.” Seaotters.com, <http://seaotters.com/2012/09/thanks-to-sea-otters-kelp-forests-absorb-vast-amounts-of-co2/> September 7, 2012.

Be a Part of the Solution



Our oceans are facing a tremendous amount of problems, and we humans are direct contributors. We must take responsibility and be a part of the solution. There are many solutions that are simple and can be accomplished by everyone! Others are more policy and legislative in nature. We must be informed about all of the potential solutions in order to become activists in support of a healthy planet.

Toxoplasma gondii Solutions:

Cat owners can stop *Toxoplasma gondii* from harming the marine ecosystem by keeping their cats indoors. If people want to have indoor-outdoor cats, they should train their cats to use a litter box, and have litter boxes inside and outside of the house. Cat feces should be collected from the litter box. DO NOT FLUSH IT DOWN THE TOILET! Put it in a plastic bag and put the bag in the trash to be disposed of in an approved landfill.⁴² It's not ideal, but if you have a cat, it's the best possible scenario to dispose of its poop.

Another way to contribute to the solution is spay and neuter your cat. This will decrease the population of feral cats and reduce the amount of *Toxoplasma gondii* entering our water

⁴² Miller, Melissa, Dr. Personal Interview. January 30, 2017.

systems. If you need more information about proper cat waste disposal, visit this site: <http://www.sfgate.com/green/article/Cat-waste-kitty-litter-should-go-to-landfill-2288768.php> and to find where to spay and neuter your cat, visit this site: <https://www.aspca.org/>

Agricultural Pollution Solutions:

There are simple choices everyone can make to eliminate the use of fertilizers and pesticides in their backyards.

Here are some natural non-nitrogen substitutes to fertilizers:

- Coffee grinds contain calcium, copper, magnesium, phosphorus, and potassium, all of which are important nutrients for plants. Mix the grounds with water and let it sit in the sun.
- Egg shells are largely made of calcium carbonate which is very important for plant growth. Air dry the shells and crush them in your blender into a powder, then sprinkle at the base of your plants!
- Compost is made of food waste mixed with plants (dried stems and branches), paper, sawdust, and/or wood shavings. Put all items in a compost bin, add water, then mix it regularly. After a few weeks, it will be ready to apply to your garden!
- Grow legumes in your garden because they trap nitrogen from the air, which helps the plants grow strong and healthy. Legumes include beans, peas, lentils, and peanuts!

Here are some natural, non-toxic substitutes for chemical pesticides:

- Vinegar and lime juice can be mixed together to make a powerful weed killer. The use of pickling vinegar is even more effective for killing weeds.
- Epsom salts are a natural pesticide that protects plants from beetles, slugs, and snails. If you mix the salts with bran and molasses, it repels grasshoppers from eating your plants. Sprinkling the salt on the leaves will deter deer, groundhogs, rabbits, etc., from munching on your flowers and produce.

Also, be aware of what growers you are supporting when you purchase your food. Try to shop responsibly by supporting those farmers who do not spray with harmful chemicals and do not overuse fertilizer. If you don't know, research to find out!

Government-Focused Solutions:

The government is responsible for the health of the people. A lot of research has been done that shows the connection between the chemicals and overuse of fertilizer in agriculture and

how they negatively affect our health. It is our right to demand that the government put legislative solutions in place that protect us and our environment, and certainly our food.

Much of our nation's lands are used for agriculture. These big farms use pesticides, herbicides and fertilizers to make produce look more appealing, grow faster, and to keep pests away. The public has been informed that these chemicals are safe and will not cause any harm. The fact is, these chemicals are finding their way into all of our water systems, harming people and our oceans. For example, fertilizer seeps into groundwater, and children who drink water with nitrates above the legal limit can develop a blood disorder called "blue baby syndrome," a condition that cuts off the flow of oxygen to a baby's brain. Even drinking water with nitrate levels below the legal limit could double someone's chances of getting bladder, thyroid or ovarian cancer.⁴³ The nitrates in the water come directly from big agricultural food production.

One low cost solution to agricultural run-off is the creation and use of natural buffers. The government should require agricultural production companies to plant, build, and maintain natural buffer areas to protect our MPAs and our ground water. Buffers are barriers of trees, grass, or other permanent vegetation which is planted along the banks of streams, lakes, and rivers as a border around farms. Buffers reduce run-off of agricultural pollutants which result in cleaner drinking water. Buffers are a sustainable way to increase water quality, improve the health of the local population, and maintain the quality of the soil.⁴⁴

In 2014, President Obama signed into law the current Farm Bill which provides government funding toward healthier agricultural practices. There are conservation programs outlined in the bill that give money to farmers to create buffers, restore forest lands, and improve water quality. According to the 2014 Farm Bill⁴⁵: "The Conservation Reserve Program Provides annual rental payments to producers to replace crops on highly erodible and environmentally sensitive land with long-term resource conserving plantings. The long-term goal of the program is to re-establish valuable land cover to help improve water quality, prevent soil erosion, and reduce loss of wildlife habitat."

This bill is essential for the stewardship of our land, but there are limits on acreage and funding amounts, which make it difficult for farmers to implement important conservation methods once the annual funding limits have been reached. Our job as citizens is to pressure the legislators that are working on the 2019 Farm Bill to increase the amount of money and acreage

⁴³ Cassidy, Emily. "Low-Cost Solutions Can Clean Up Farms' Toxic Water Pollution." AgMag, <http://www.ewg.org/agmag/2016/08/low-cost-solutions-can-clean-farms-toxic-water-pollution> August 24, 2016.

⁴⁴ Natural Resources Conservation Service. USDA. https://www.nrcs.usda.gov/wps/portal/nrcs/detail/national/home/?cid=nrcs143_023568 Accessed September 2017.

⁴⁵ Natural Resources Conservation Service. USDA. <https://www.nrcs.usda.gov/wps/portal/nrcs/main/national/programs/farmbill/>

in the conservation programs. This will result in farmers continuing to sustain the health of our lands and waterways, as well as maintain their businesses.

Let's Do This!

It is clear that healthy humans are dependent upon healthy water, and it has been proven that our well-being is completely connected to our ocean's well-being. We humans have thought a lot about protecting our land, as we have created national parks and reserves, but we have not done as much for our oceans in terms of conservation. Most people do not consider how their daily actions have a significant negative impact on our marine ecosystems. Land-sea pollution, such as parasites from our domestic pets, harmful run-off with agricultural pesticides and fertilizers, plastics, industrial pollutants and sewage are all harming our marine environment.

Take action for the health of our planet **NOW!!**

- Dispose of your cat's waste properly!
- Be responsible in your gardening and purchasing choices!
- Educate yourself about current legislation that affects YOUR health!
- Work together on a local level to push for laws that protect our MPAs and our planet!
- Share this message with friends and family!

We are all connected! Healthy marine ecosystems rely upon healthy keystone species. A healthy ocean relies on healthy marine ecosystems. A healthy planet relies on healthy oceans. And the optimal health of the our human species relies upon all of the above. So let's protect it.

Heirs to Our Oceans is inspiring the next generation of environmental leaders.



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