

Kitty Litter Killer: Toxoplasma gondii

Kitty litter contaminated with the parasite *T. gondii* has harmful effects on oceanic ecosystems.

Tag Words: *Toxoplasma gondii*; Parasite; Ecosystem; Harmful; Spores;

Authors: Pedro Castillo, Michelle Lancaster, Jeannie O’Pella with Julie M. Fagan, Ph.D.

Summary

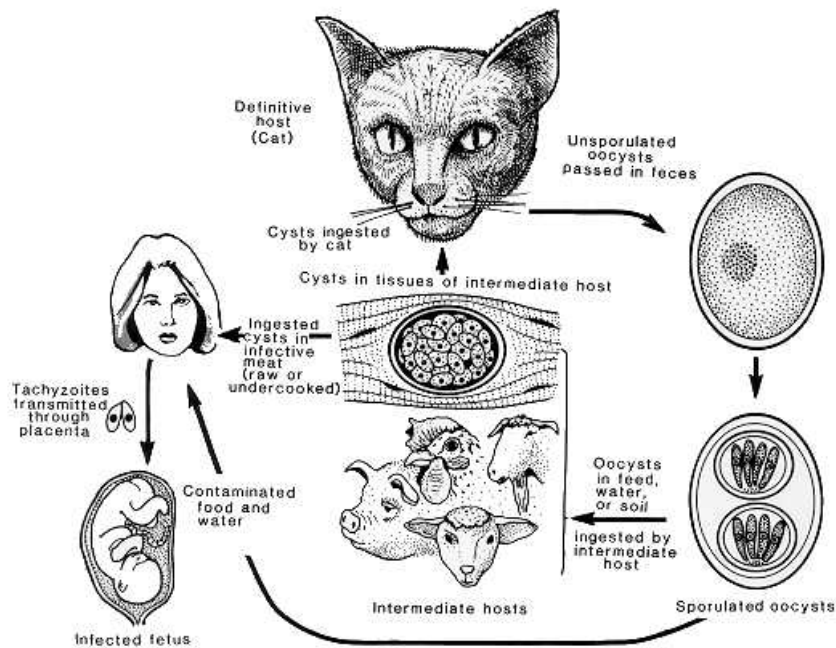
Toxoplasma gondii, which is transmitted through cat feces, has neurological effects on other mammals. When kitty litter is flushed down the toilet, parasitic spores end up in the ocean where mammals such as sea otters ingest the spores. These spores alter the mammals’ brain functions causing them to approach their natural predators rather than avoid them. This has been leading to a decline in sea otter population. This is a serious issue that can be solved by educating the public about the proper ways to dispose of kitty litter.

The Issue: *T. gondii*

TOXOPLASMA GONDII

Toxoplasma gondii is a type of parasitic protozoa that affects the neurological physiology of the mammals it infects. Cats are the definitive host for the parasite, however, it can be passed on to all mammals. *T. gondii* has two life cycles. The first is sexual, in which the members of the cat family, Felidae, are the only hosts in which the cycle can occur. The second life cycle is asexual and can take place in any mammalian or avian species. Once the parasite invades the hosts' cells, it forms parasitophorous vacuoles containing bradyzoites. Bradyzoites are the form of the parasite which slowly replicate inside of the host. Because they are incorporated into the host's cells, these cysts usually go undetected by the immune system and thus can be fairly resistant to antibiotics, making it difficult to get rid of the parasite. Once the cell lyses tachyzoites, which are the motile, asexually reproducing form of the parasite, are released. Ingestion of infected tissue leads to the spread of this disease. For example, cats that ingest an infected mouse can become infected with the parasite. The parasite can then reproduce inside this definitive host and is shed by the feces. Contact with the feces can lead to ingestion, via unwashed vegetables, undercooked meat, ect.

Toxoplasma gondii impacts the behavior of the animal it infects. For instance, uninfected rats instinctually stay away from cats, since they are natural predators. However, infected rats appear to do the opposite and are drawn to cats. *Toxoplasma gondii* alters the behavior of its intermediate host to increase the rat's chance of being predated by cats, ensuring entry into the definitive host for the sexual reproduction portion of its life cycle.



HOW THE PARASITE SPREADS

While many believe fresh water runoff contaminated with cat feces is to blame, there is no definitive science on the source of infection. The truth is that waste treatment facilities do not adequately destroy *T. gondii*, the parasite in question. An increase of prevalence of toxoplasmosis was observed among breeders of pedigree cats. This increase was attributed to handling offal. Additionally, *T. gondii* antibodies between two groups (having and not having a cat in the house) were significantly different [31.8% and 19.3%, respectively; odds ratio 1.96, 95% confidence intervals (CI)]. Furthermore, a study in Illinois, USA reported an association between cat infections with *T. gondii* and increased risk of human infections through soil contact as a likely mechanism for transmission. Indeed, the risk of infection from cleaning contaminated cat litter trays as relates to kitchen hygiene was considered as a potential risk factor. These studies suggested that infected cats might be a significant source for *T. gondii* infection for humans.

The world's first and largest toxoplasmosis outbreak associated with a municipal water supply was recognized in 1995 in Victoria, British Columbia, Canada. It was hypothesized that cat faeces contaminated a surface water reservoir with *T. gondii* oocysts. One year after the outbreak, an extensive investigation of the Victoria watershed documented the presence of an endemic *T. gondii* cycle involving the animals inhabiting the area, and cats were observed throughout the watershed. Moreover, serological evidence of *T. gondii* infection was demonstrated among domestic cats living in the Victoria area. Of the 94 individuals with outbreak-related acute cases who lived in the capital regional district, (88%) lived in the area served by one water distribution system (Humpback Reservoir). The incidence rate of acute infection among individuals residing in the area served by Humpback Reservoir was more than three times that for areas served by other sources, and acute *T. gondii* infection among 3812 pregnant women was associated with the incriminated distribution system. Increased *T. gondii* seroprevalence with consumption of municipal and unboiled water (well/spring water) supplies was recognized. Drinking beverages prepared with unboiled water was a strong risk factor for *T. gondii* infection in pregnant women in Armenia. *T. gondii* seroprevalence was increased with drinking water other than bottled water among pregnant women in Aydin province, Turkey. Therefore, contamination of the drinking water supply with *T. gondii* oocysts is a possible risk factor for Toxoplasma infection.

The association observed between the consumption of unpasteurized milk or milk products with toxoplasmosis is unexplained. *T. gondii* tachyzoites have been isolated from goats' milk and cows' colostrum, but the tachyzoites, the stage most likely to be present in milk, are thought to be destroyed immediately by gastric juice. The association may be due to oocyst contamination by dirty production techniques or to confounding by other lifestyle factors, such as eating undercooked organically produced meat. However, evidence indicates that ingested tachyzoites can cause infection. There has been a case of acute toxoplasmosis in a breastfed infant.

SEA OTTERS



Sea otters, or *Enhydra lutris kenyoni*, belong to the phylogenetic family Mustelidae and are the only species of this family to live primarily in water. Although sea otters are the largest species in their family, they are also the smallest marine mammal. However, they still grow up to 5 feet in length and reach 70 pounds. They are social animals and are often seen in groups usually separated into male and female groups. Unlike other marine mammals, sea otters do not have blubber and thus rely on their extremely fine fur to keep them insulated in the cold waters where they live. They have many adaptations to their environment including the ability to drink salt water. However, despite these adaptations there is an energy cost for keeping warm. Sea otters must consume and average 25% of their body weight in food on a daily basis in order to metabolize enough heat to survive the harsh environments they inhabit. They live in the shallow coastal waters and feed on clams, mussels, and urchins that are found on the ocean floor. They are most common in areas where there is protection from ocean winds such as kelp forests, barrier reefs and rocky coast lines. They inhabit areas around the world including the coastlines of British Columbia, Washington, California, and Alaska, as well as the islands surrounding Eastern Asia.

HOW TOXOPLASMA GONDII SPREADS TO THE SEA OTTER

The sewer system is comprised of water drained from the toilet, shower, dishwasher, washing machine, etc. The dirty water travels through the pipes to a wastewater treatment plant where the water is cleaned, disinfected and is then released into nearby water supplies, such as creeks, streams or even directly into the ocean. The sewer system is a common pathway into the ocean for *Toxoplasma gondii*.

The new flushable cat litter sounds great in theory, but if a cat is infected with *T. gondii*, then the spores will be flushed down the toilet. Even though the water goes into the wastewater treatment facility, the plant is incapable of killing the spores, because of their hard shell. So even though the water is treated, spores of the parasite still end up in the ocean.



Scientists aren't 100% sure how the otters are getting the *T. gondii* into their bodies, but many have come up with the hypothesis that it could be from eating contaminated shell fish.

AWARENESS AND PREVENTION

There are several steps pet owners can take in order to help prevent *Toxoplasma gondii* and the killing of sea otters. Many of them can begin right in the home. Suggestions for pets include feeding cats only canned or well-cooked food. Cats should not be fed undercooked meat due to the danger of *Toxoplasma gondii* being found in raw and undercooked meat.

Pet owners should also be aware of the dangers involved with flushing cat litter and feces into the toilets. Although some litters are marketed as “flushable”, they should know that there is the potential for runoff into freshwater, and ultimately oceans. When disposing of cat litter, owners should place any feces into tied plastic bags, and disposed of into the trash can.

Cats should also be kept indoors as much as possible, so as to prevent the further spread of *Toxoplasma gondii*. If a cat is a carrier, restricting its ventures outside can help prevent the spread of the parasite.

The Service Project

Education is the key to solving the issue of *Toxoplasma gondii* in cat litter. Several measures will be taken to get the word out on this topic. One method we will employ will be to produce stickers to give to companies to put on cat litter to inform buyers of the dangers of flushing kitty litter. We will contact kitty litter suppliers and present the issues surrounding *T. gondii* along with a sample sticker, which will contain the dangers of the parasite and the proper methods of kitty litter disposal. The stickers come in a pack of 160 and the cost would be \$8.49. The cost of printing which would be an additional \$59.99 for black and colored ink. To further promote our sticker, we have made a facebook group where anyone can join and read our “classipedia”.

Members will be allowed to voice their opinion and post up any questions or comments they have. Another method is to contact magazines and newspapers to educate readers on the issue.

Once the public becomes informed on the issue, there will be a demand for further control of kitty litter disposal to reduce the harmful effects of *T. gondii*. A further approach in the reduction of *T. gondii* dispersal via kitty litter, is to get politicians to take legal action to enforce the proper disposal of kitty litter. Kitty litter companies, politicians, magazines, and newspapers will all be contacted with information on the importance of parasite control efforts. At first we contacted our local PetsMart about placing stickers on kitty litter packages. However, we were told we

would have to deal directly with the producers of the kitty litter. We wrote a letter asking to place warning stickers on the packaging and sent it to several different cat litter companies, including Freshstep, Scoop Away, Tidy Cat, Arm 'N' Hammer. Most companies did not supply a mailing address so they were contacted via internet. We are still waiting to hear a reply back. Listed are the sites we contacted.

Freshstep:

<http://www.freshstep.com/contactus.php>

Scoop Away:

<http://www.scoopaway.com/contact.php>

Tidy Cat:

<https://offers.purina.com/ContactUs/ContactUs.aspx?OfferCode=CNT01&pagecode=CONTACT&sourcebrand=16>

Arm 'N' Hammer:

<http://www.econsumeraffairs.com/churchdwright/us/contactus.htm?F1=WEBBS>

Pedro Jose Castillo
Michelle Lancaster
Jeannie O'Pella
Berta Yurkovsky

To whom it may concern:

As students at Rutgers University, we are currently studying the parasite *Toxoplasma gondii* and how it is directly correlated to the high death rate of the sea otter. The parasite is spread through feline fecal matter. When cat litter is flushed down the toilet, spores can survive the sewage treatment plants and up in the ocean where it thrives in shellfish which are consumed by otters. Ultimately the otters contract the parasite and become unable to perceive threat and therefore approach predators instead of fleeing. We would like to expand our research to outward to include public education. We would like to include a sticker on your packages warning people about the effects of *T. gondii*. Enclosed is a sample sticker of what it may look like. We look forward to hear from you.

Thank you for your time,
Students at Rutgers



STICKER NOT ACTUAL SIZE

References

1. http://cats.about.com/cs/parasiticdisease/a/seaotters_2.htm
2. <http://www.cdc.gov/toxoplasmosis/prevent.html>
3. Berdoy M, Webster JP, Macdonald DW (August 2000). "Fatal attraction in rats infected with *Toxoplasma gondii*". *Proc. Biol. Sci.* 267 (1452): 1591–4. doi:10.1098/rspb.2000.1182. PMID 11007336.
4. PMC: 1690701. <http://journals.royalsociety.org/openurl.asp?genre=article&issn=0962-5.8452&volume=267&issue=1452&spage=1591>.
5. http://en.wikipedia.org/wiki/Toxoplasma_gondii
6. <http://gsbs.utmb.edu/microbook/ch084.htm>
7. <http://www.seaotter-sealion.org/seaotter/factsseaotter.html>
8. http://en.wikipedia.org/wiki/Sea_otters

Editorials

The Star Ledger
Submitted online

Re: Star Ledger Content Issues
Pedro J Castillo
XXXXXXXX
XXXXXXXX
XXXXXXXX
XXXXXXXX

To whom it may concern:

I am a student in S.E.B.S., Rutgers, The State University of New Jersey, and we are currently studying the effects of kitty litters on the environment. One of the biggest issues that we current face is the fact that fecal matter that comes from cats have something called Toxoplasma gondii. This parasite can harm sea animals and it can also hurt us. This parasite has been prominent in the coast of California but slow is making its way to our side of the country. California has been dealing with this problem by making laws against dumping kitty litter down the drain. There are some kitty litters that say that they are safe to flush and they are not taking account that a lot of water treatment places miss this parasite. This parasite has had a drastic effect on the sea otter community. The parasite heads to the brain of the mammal and makes it go out to large predators and in result they get eaten. The sea otter community has been diminishing little by little.

Now this is not seen in the east coast but eventually end up here. In a lot of third world countries there is not much research on this matter. So it is believed that this parasite has attached its self to humans. The effect of the parasite leads to humans in having schizophrenia and other mental diseases. We are currently working on more research and would like to keep in contact with you in order to give you more information or if anyone has questions regarding this matter.

My contact information is XXXXXXXXX@eden.rutgers.edu or do not hesitate to contact me at (XXX)-XXX-XXX.

Thank you for time,

Pedro J Castillo
Pet Publishing, Inc.
4642 West Market Street, #368
Greensboro, NC 27407

There are many responsibilities which come along with being a pet owner, one of which involves cleaning up after your pet. Cat owners need to be especially aware of how they are disposing of their pet's waste because of a parasite which is being exposed to and killing sea otters. Toxoplasma gondii is a parasite which lives in the intestines of cats and is passed through into the litter box.

You may be wondering how this affects you, and hopefully, what you can do to help. The biggest thing to remember when disposing of waste is to never flush it down the toilet. Not only will you save lots of money from the plumber, you will help prevent Toxoplasma gondii from making its way through the sewer system and into the water. What if you don't flush your cat's waste in the toilet? The best thing to do is to dispose of the waste in small plastic bags, and then putting it in the garbage. Not only will this help to get rid of any smells, it will also help to keep the waste from getting out. Squirrels and other small animals often find ways to get into trashcans.

This is a problem I'm sure many of you have never heard of, but prevention is so easy and can begin in your own home. I urge you all to take part in helping to save the sea otters.

-Jeannie O'Pella

Title: Toxic Toxoplasma in Kitty Litter Endangering the Otter

Catch Line: This kitty parasite is a leading cause in the death of the sea otter and you could be to blame!

Michelle Lancaster

Address: XXXXXXXXXXXXX

Phone #: (XXX) XXX-XXXX

Email: XXXXXX@eden.rutgers.edu

Bio: I am currently a student at Rutgers University majoring in animal science. I hope to use my experiences at Rutgers to impact the animal science world.

Have you ever heard the chaos theory quote “It has been said that something as small as the flutter of a butterfly's wing can ultimately cause a typhoon halfway around the world?” Well, there just may be a little too much truth to this statement. *Toxoplasma gondii* is a parasite whose definitive host just so happens to be one of the most common household pets, the cat. The parasite is shed through cat feces and generally ends up in the litter box. While the parasite is making its way into the ocean by several vectors, such as feral cats and groundwater runoff, flushable cat litter seems to be adding fuel to the fire. This has become a problem in California in particular, but should be a concern for cat owners around the globe. Although it is advertised as “biodegradable” and “carbon neutral”, companies fail to acknowledge the fact that sewage plants are unable to effectively treat and kill the parasitic *Toxoplasma gondii* spores. Ultimately these spores enter the ocean and find a new host, which is often any type of shellfish. You may be asking, how exactly does this lead to the death of sea otters? Well, the otters consume the infected shellfish and then become infected with the parasite. The parasite alters the brain function of the otter essentially causing them to be drawn to danger. Here is an example of how the parasite works in rats. Uninfected rats instinctually stay away from cats, since they are natural predators. However, infected rats appear to do the opposite and are drawn to cats. *Toxoplasma gondii* alters the behavior of its intermediate host to increase the rat's chance of being predated by cats, ensuring entry into the definitive host for the sexual reproduction portion of its life cycle. The same appears to be true for the sea otter. Otters have been seen approaching orca whales, despite the fact that the orca preys on the sea otter. The sea otter is currently an endangered animal, but you can help protect the species. It's as simple as proper disposal of your cat litter. So next time, think twice before you flush, you could be harming an otter across the country!

The Daily Targum

126 College Ave. Suite 431

New Brunswick, NJ 08901

John S. Clyde

eic@dailytargum.com

Dear John S. Clyde,

I am a student at Rutgers University and I am doing a project which I believe will be interesting to the student body. I am currently doing some personal research on a parasitic worm called

Toxoplasma gondii. This specific parasite's host is the common house cat but it can infect any mammal including humans. When it lives within the cat gut it does not cause much damage but simply eats what ever the cat eats. However, when it infects another host it enters into the Central Nervous System (CNS) and the brain causing neurological disorders. This is especially harmful to pregnant women because the growing fetus is extremely susceptible to brain deformation due to the parasite. Furthermore, T. gondii (which is shed in cat feces) is ending up in the ocean where it is beginning to infect sea otter populations that are getting infected with the parasite. Due to changes in brain function, it has been observed that infected sea otters do not avoid killer whales and thus there population size is decreasing. It is important to educate cat owners to get there cats treated for the parasite and to dispose of cat feces in zip-lock bags rather than flushing them down the toilet in order to protect the sea otters, the ecosystem, and themselves.

For more information on the topic I can be contacted at XXXXXX@eden.rutgers.edu or XXX-XXX-XXXX.

Berta Yurkovsky

XXXXXXXXXX
New Brunswick, NJ 08901