Analysis of the *Toxoplasma gondii* freshwater pathway and infection of sea otters (*Enhydra lutris nereis*)

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Background
Pattern

- Pattern: Adult sea otters have higher death rates between January and March than other times of year (Figure 1). Dead otters that are found also have higher infection rates of *T. gondii* in winter months (Figure 2).

- This pattern indicates that *T. gondii* may be more abundant in winter months, or that otters may be more susceptible to acute infections due to other variables.

Goal: To elucidate the spatial and temporal variation of *T. gondii* disease transport and otter population infection rates.
Hypothesis 1: The temporal correlation between acute otter infection rate and time of year is due to higher input of *T. gondii* oocysts in run-off and wastewater effluent outfall during winter months.

- Specific hypothesis 1: Fresh water samples from streams/rivers and wastewater collected during winter months will have higher oocyst concentration than during other times of year.

- Null hypothesis: Water samples will have the same concentration of oocysts regardless of time of year.
Methods

- I will take weekly samples from both freshwater streams and wastewater effluent in Santa Cruz, Monterey, and Moro Bay.
- I will use the method outlined in Kourenti and Karanis (2006) in order to detect *T. gondii* DNA in water samples and determine the concentration.
- I will analyze changes in *T. gondii* concentration over time to see if time of year is related to *T. gondii* presence in water entering the coastal areas.

Predicted results

![Predicted results graph](image)
Specific hypothesis 2: Infection rates of both live and dead otters will increase when Monterey starts releasing wastewater in January.

Null hypothesis: Infection rates will not increase when Monterey begins to use wastewater plant.

Methods

- I will test blood samples from Monterey Bay otters before, during, and after the plant starts operating.
- I will compare otter infection in high outfall years to low outfall years
- I will randomly sample blood from 30 otters of similar age and size each month, and also test all otters found dead.
- I will test the blood samples for *T. gondii* antibodies
Predicted results

Hypothesis 2: Infection rates are correlated with distance from a disease source.
Specific hypothesis 1: Otters within 3 miles of major runoff channels will have higher infection rates than otters more than 3 miles away.

Null hypothesis: There will be no difference in otter infection rates for otters depending on distance from runoff areas.

Method

- I will test blood samples from 10 otters living in habitat within 3 miles of the San Lorenzo River, Aptos Creek, and Elkhorn Slough.
- I will test blood samples from 10 otters living in habitat further than 3 miles from the San Lorenzo River, Aptos Creek, and Elkhorn Slough.
- I will test the blood samples for *T. gondii* antibodies.
Expected results

- Specific hypothesis 2: Otter close to wastewater outfall areas will have higher infection rates than otters living further away.
- Null hypothesis: There will be no difference in otter infection rates for otters close and far from wastewater outfall areas.
Methods

- I will test blood samples from 10 otters living in habitat within 3 miles of the Santa Cruz Wastewater Treatment Plant outfall, Monterey Wastewater outfall, and Moro Bay outfall.
- I will test blood samples from 10 otters living in habitat further than 3 miles from the Santa Cruz Wastewater Treatment Plant outfall, Monterey Wastewater outfall, and Moro Bay outfall.
- I will test the blood samples for *T. gondii* antibodies.

Expected results