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### Session C, 2015 First Place: Polyphemus pediculus Survivorship in Insect Repellent Treated Water

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# The DEET Girls:

*Polyphemus pediculus* survivorship in  
insect repellent treated water

Camila Ferguson  
Chloe Blaisdell  
Sarah Lundy  
Michaela Tersmette

# Survey of students in EFB 202 Session C

**Number of students that use insect repellent containing.....**

**15-30% DEET → 20 students**

**40-100% DEET → 18 students**

**DEET Free → 11 students**

**Do not use insect repellent → 10 students**

**Do you think about the fact that there is residual insect repellent on your skin when you jump into the lake?**

**Yes → 4**

**No → 15**

**Sometimes/unsure → 40**





# What is DEET?

- N,N-diethyl-m-toluamide ( $C_{12}H_{17}NO$ )
- Initially created for jungle warfare
- Not considered toxic, carcinogenic, or mutagenic
- No environmental risk assessment conducted
- Studies suggest <20% of DEET is absorbed through the skin (Costanzo et al., 2007)
- Warning labels improved

(U.S. Environmental Protection Agency, 1998)



(Haney, J.F. et al. 2013)

## *Polyphemus pediculus*

- Zooplankton
- One large eye, feeds visually
- 4 pairs of flattened, segmented legs
- Marine predators
- Found within the first few meters of the surface

(Haney, J.F. et al. 2013)



# Our Hypotheses

- Ha: Higher amounts of insect repellent ( $\mu\text{L}$ ) in lake water will result in less survivorship of *Polyphemus pediculus* (# living/minute)
- Ha: Higher concentrations of DEET (% DEET per bottle) in lake water will result in a less survivorship of *Polyphemus pediculus* (#living/minute)
- Ha: There will be less survivorship (Living *Polyphemus*/min) of *Polyphemus pediculus* exposed to insect repellents containing DEET than those exposed to DEET-free insect repellents



**Ingredients: DEET Free**  
Rosemary Oil (0.5%)  
Cinnamon Oil (0.5%)  
Lemongrass Oil (0.5%)  
Geraniol (1.0%)  
Other Ingredients: (97.5%)  
2-Propanol  
Isopropyl  
Myristate  
Wintergreen Oil



**Ingredients: DEET Free**  
Oil of Lemon Eucalyptus (30%)  
Other ingredients: (65%)  
p-menthane-3, 8-diol

Photo credit: Camila Ferguson





## Ingredients:

Ethanol (20-30%)  
Propane (10-20%)  
Isobutane (10-20%)  
Butane (10-20%)  
DEET (15%)  
Water (1-5%)



## Ingredients:

Ethanol/SD Alcohol 40 (43.7%)  
Isobutane (15%)  
DEET (40%)

(Household Products Database)



## Ingredients:

DEET(100%)



# Our Experiment



Collecting *Polyphemus*  
using a zooplankton net






## Sorting *Polyphemus*

- 20 *Polyphemus* per petri dish
- 20 mL lake water per petri dish
- 3 treatments and 1 control per insect repellent



A student with glasses and a colorful hoodie is using a pipette to transfer liquid into a petri dish in a laboratory setting. There are other lab equipment like a large white container and a rack of test tubes in the background.

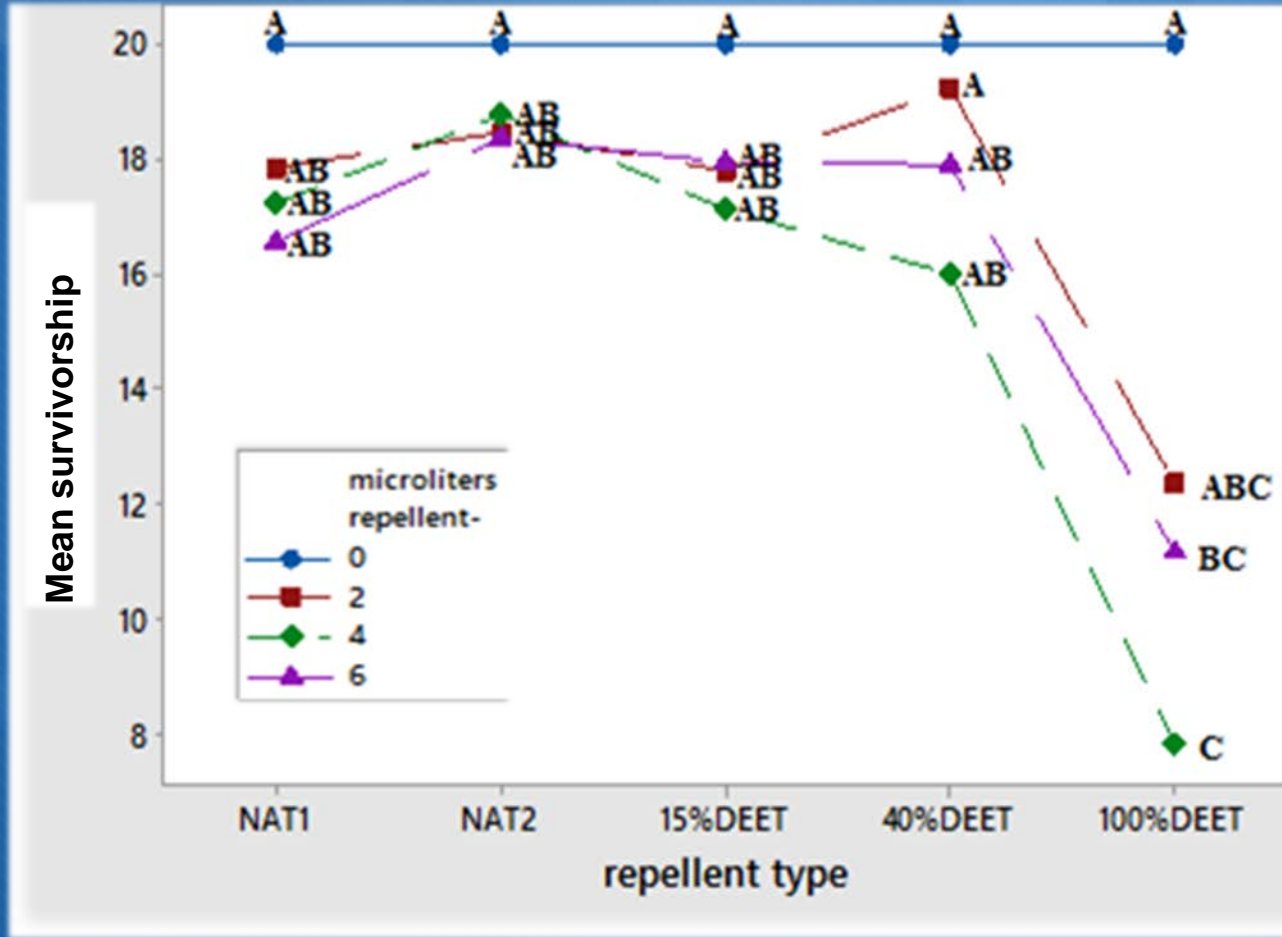
Treating the water  
with insect repellent

A student in a red hoodie is sitting at a desk, writing in a spiral notebook. A petri dish and a pipette are on the desk next to her. A smartphone is also visible on the desk.

Counting # of  
living *Polypemus*  
over 30 min period



# Results



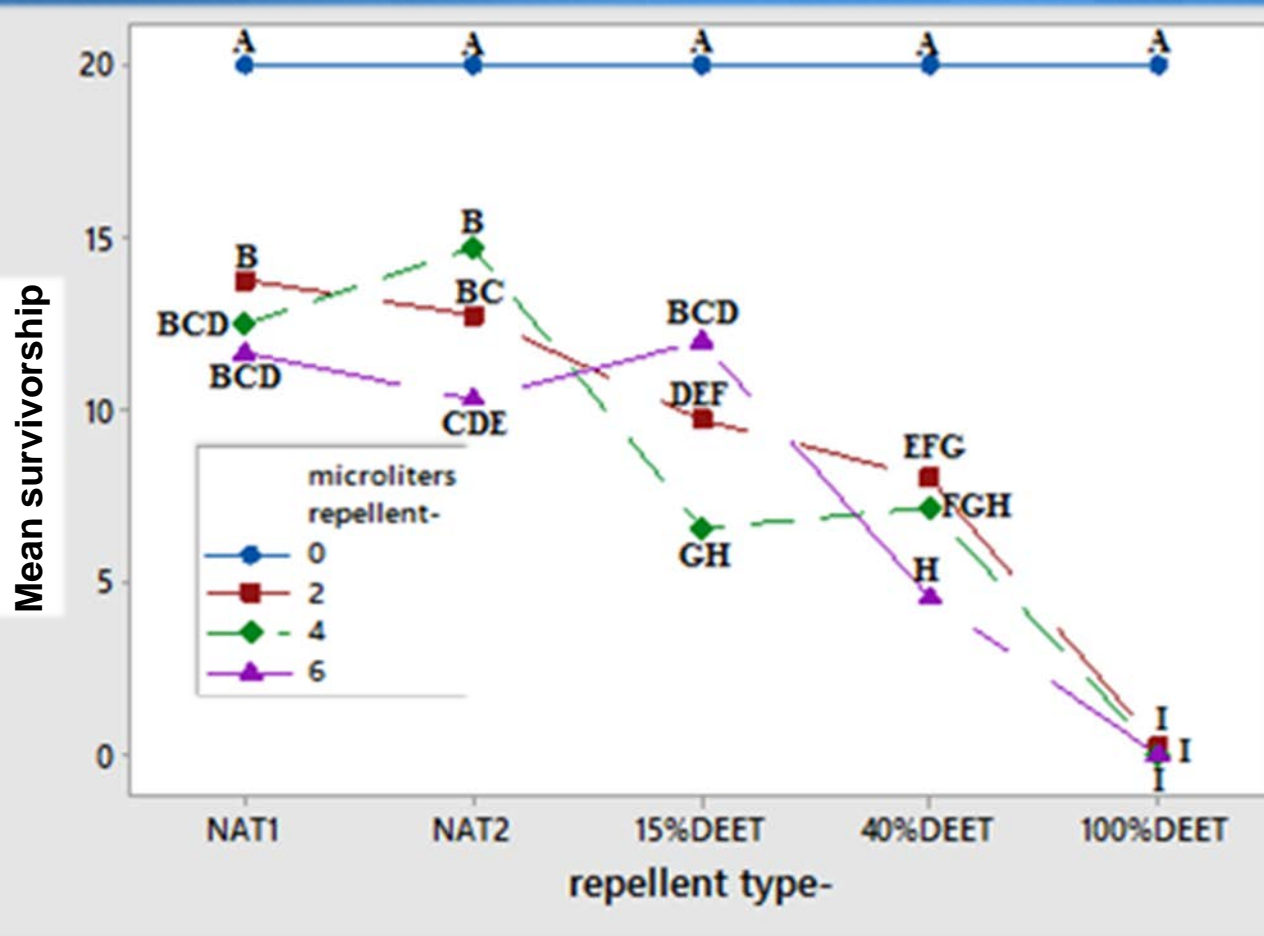
Interaction test  
statistics:  
 $F = 1.52$   
 $p = 0.129$

Amount test  
statistic:  
 $F = 8.39$   
 $p = 0.00$

Repellent type test  
statistic:  
 $F = 10.52$   
 $p = 0.00$



# Results

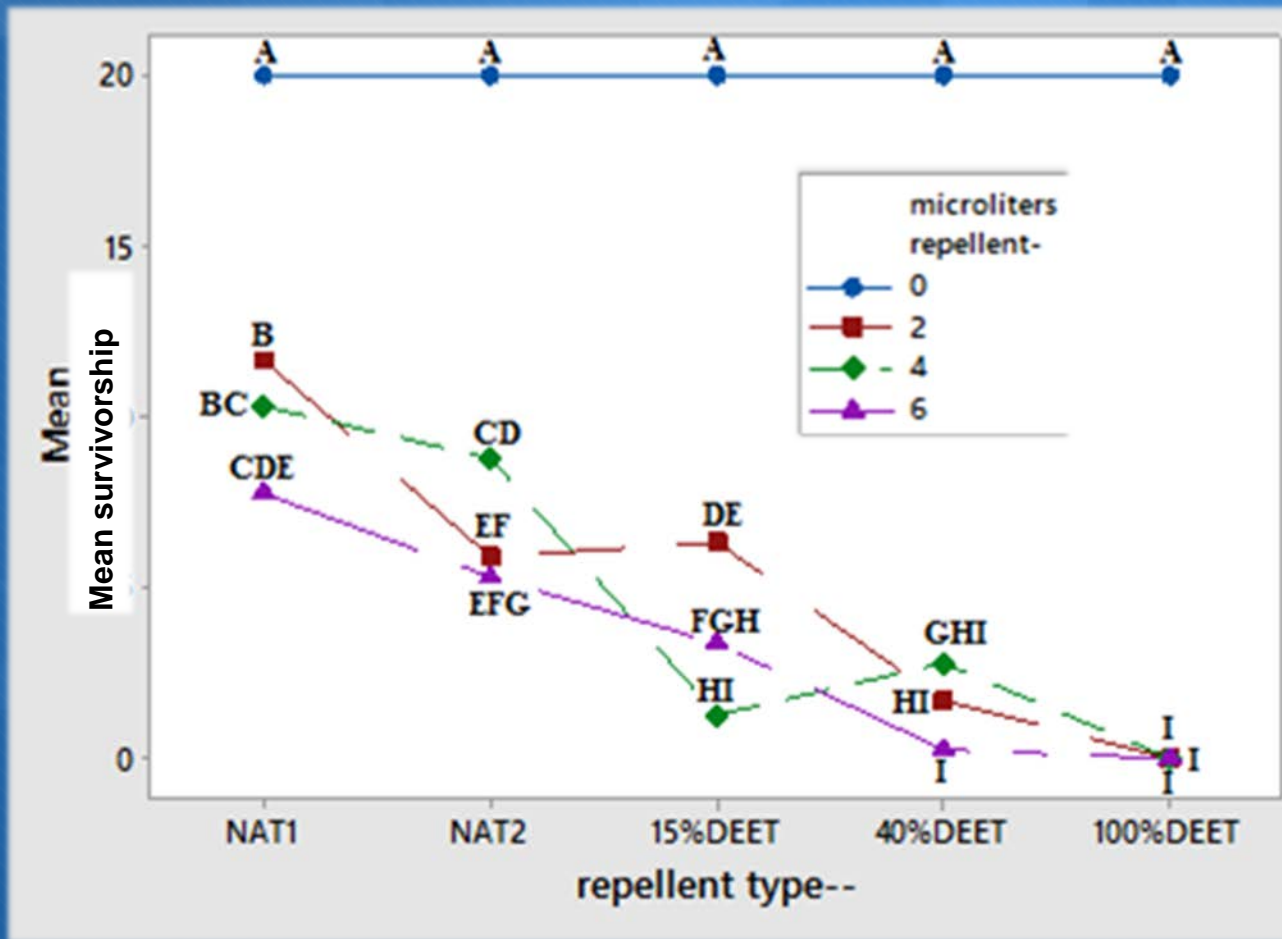


Interaction Test  
Statistics:  
f-value= 26.46  
p-value= 0.00

Amount Test  
Statistics:  
f-value= 495.56  
p-value=0.00

Repellent Test  
Statistics:  
f-value= 174.99  
p-value= 0.00

# Results



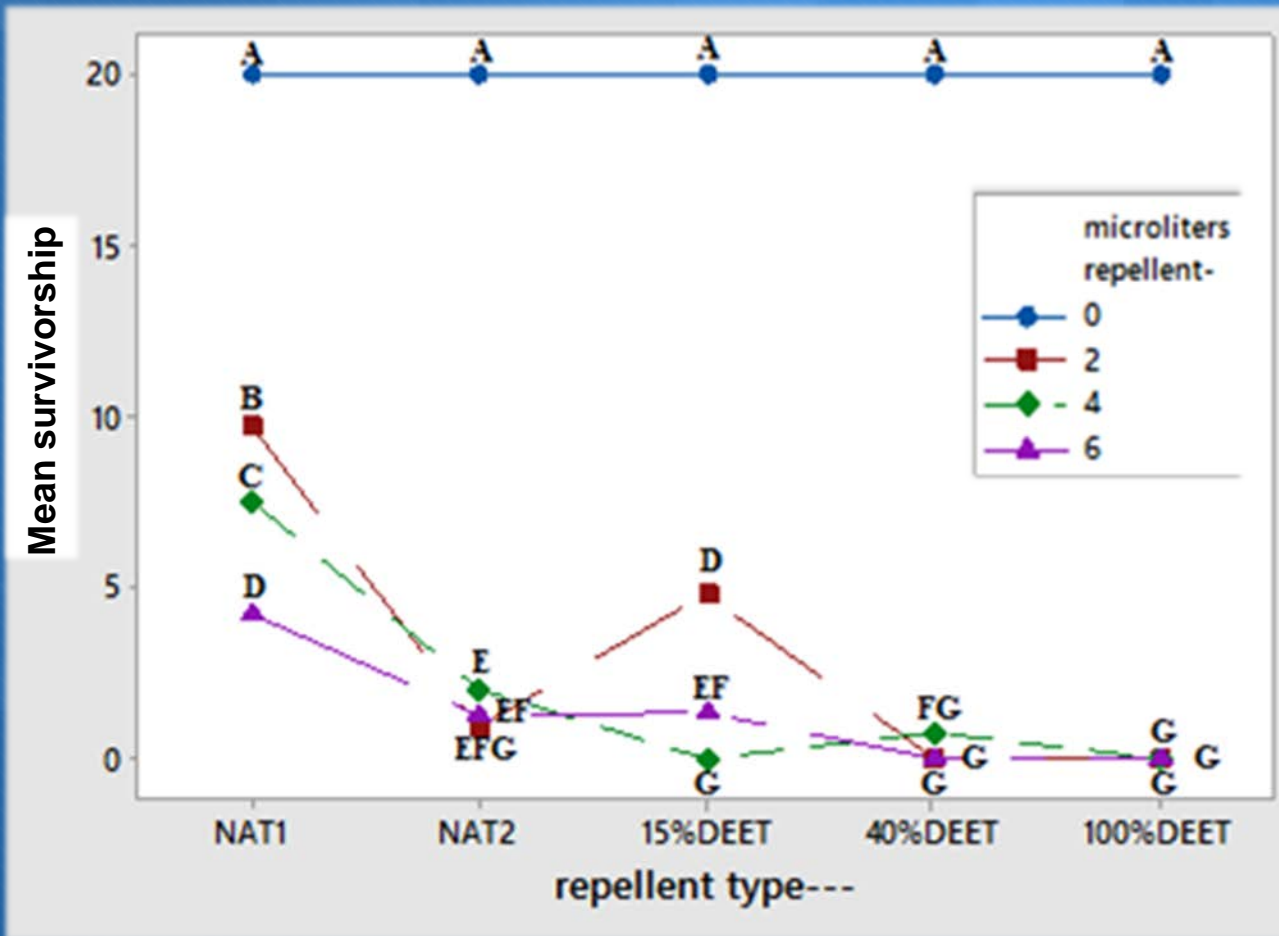
Interaction Test  
Statistics:  
f-value= 20.23  
p-value= 0.00

Amount Test  
Statistics:  
f-value= 1068.83  
p-value= 0.00

Repellent Test  
Statistic:  
f-value= 123.18  
p-value=0.00



# Results



Interaction Test  
Statistics: f-value=  
65.63  
p-value= 0.00

Amount Test  
Statistics:  
f-value= 6862.86  
p-value= 0.00

Repellent Test  
Statistics: f-value=  
322.45  
p-value= 0.00



## What did we find?

- Insect repellents containing a higher percentage of DEET killed *Polyphemus* faster than the insect repellents containing a lower percentage of DEET
- Natural insect repellents are not necessarily better still kill *Polyphemus*, but at a slower rate
- Future experimentation into the effectivity vs. lethality of DEET and DEET-free repellents
- Larger scale experimentation on the effects of DEET on the aquatic environment

Discussion






## Why does it matter?

- Topical products such as DEET affect the bottom of the food chain in marine environments
- Trophic cascades
- The use of insect repellent increases dramatically during the summer months
- A study on another popular topical product sunscreen, shows that sunscreen worn by swimmers is having a negative effect on coral reefs by promoting viral infections leading to coral bleaching (Danovaro et al 2008)

Discussion

- 
- The more insect repellent used per 20mL of water the less survivorship of *Polyphemus*
  - Insect repellents containing DEET versus insect repellents not containing DEET will result in a lower survivorship rate of *Polyphemus*
  - Higher concentrations of DEET within the insect repellents tested resulted in less survivorship of *Polyphemus* than those with lower concentrations of DEET

## Conclusion



# Acknowledgements

Thank you,

Dr. Fiene for providing us with our research room  
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Office staff for aiding us with equipment

Leah Sampson for her insight on *Polyphemus  
pediculus*

Those who lent us their insect repellents

## Works Cited

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ahhh DEET DEET  
*Polyphemus*

To the tune of Get Low



Photo credit: NewMusic  
2014, Haney, J.F. *et al.* 2013  
and Sarah Lundy

# Questions?