

# Modeling the impacts of human disturbance in cetaceans and pinnipeds: Do behavioral changes translate to disease consequences?

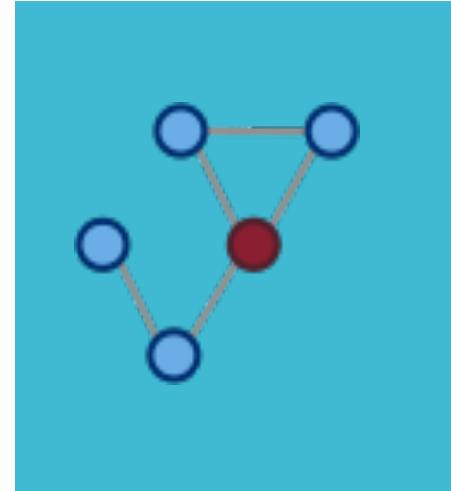
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**SEAMAMMS**

**May 20<sup>th</sup>, 2022**



# Humans are altering wildlife habitats worldwide



According to the 2019 IPBES Global Assessment Summary for Policymakers, 66% of the marine environment has been altered by human disturbance.



Marine mammal disease has been markedly increasing in the past two decades (Gulland and Hall 2007)



How might human disturbances contribute to disease in marine mammals?

# The human factor in marine mammal disease spread



Pathogens have been introduced into marine habitats via storm water runoff and man-made freshwater intrusions



Immune function in many marine species has been shown to greatly deteriorate from exposure to toxic chemicals



**Significant behavioral changes in response to human related activity\*\***



PCDP; NMFS Permit no. 19703

<https://www.algarexperience.com/>

<https://www.sealtours.com/>

PCDP; NMFS Permit no. 19703

**Infectivity**

**Connectivity**

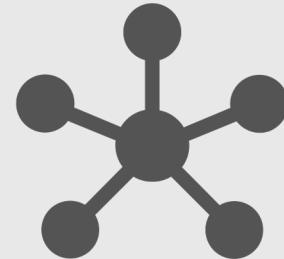
**Susceptibility**

How can behavioral changes affect disease spread?

# Objectives



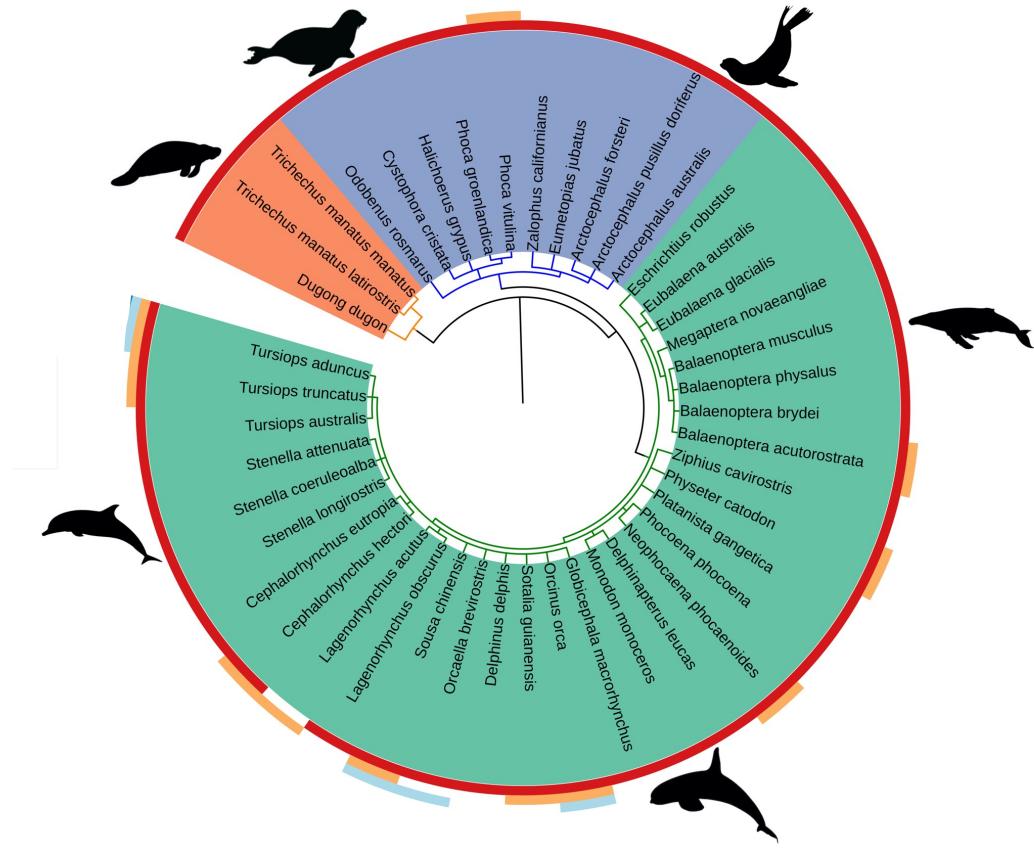
**1. Conduct a systematic literature review**



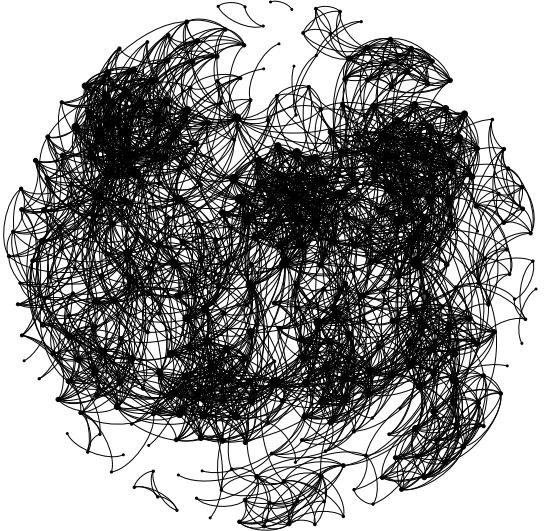
**2. Simulate how these changes alter disease consequences**

# Literature Review Results

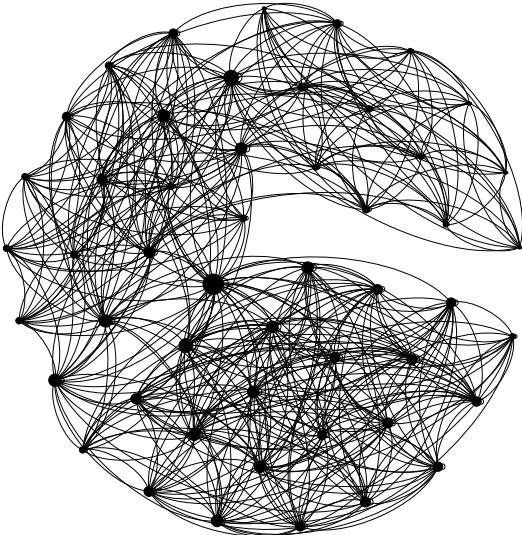
- **Susceptibility:**
  - 79 studies 29 species
  - Changing energy budgets
- **Infectivity**
  - 6 studies 8 species
  - Behaviors indicative of high stress
- **Connectivity**
  - 18 studies 11 species
  - Increased group sizes



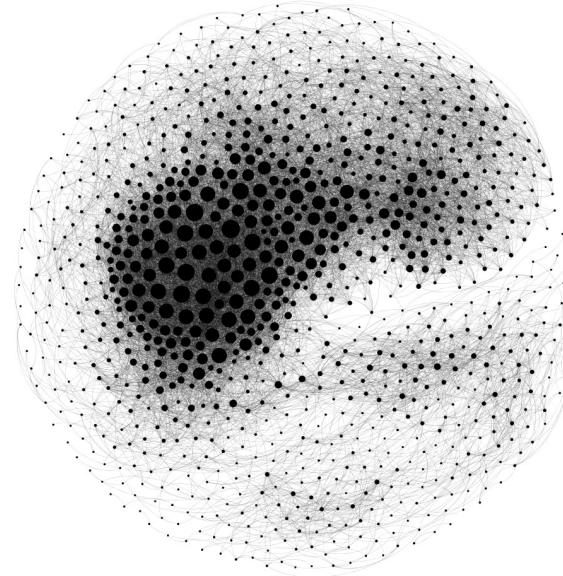
# Simulating disease consequences



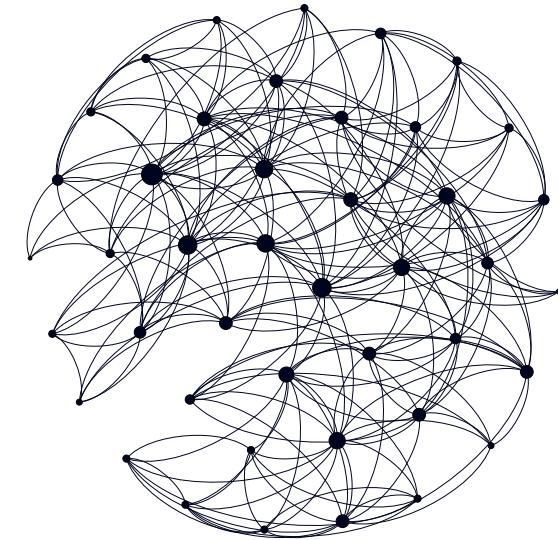
371 Indo-Pacific  
Bottlenose Dolphins



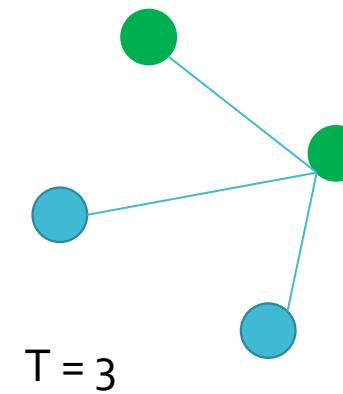
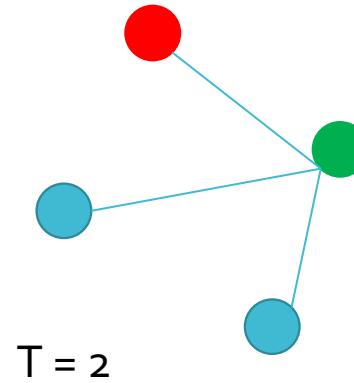
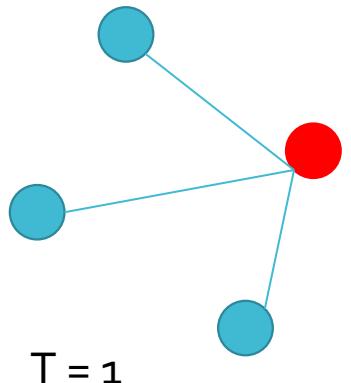
50 Indo-Pacific  
Humpback Dolphins

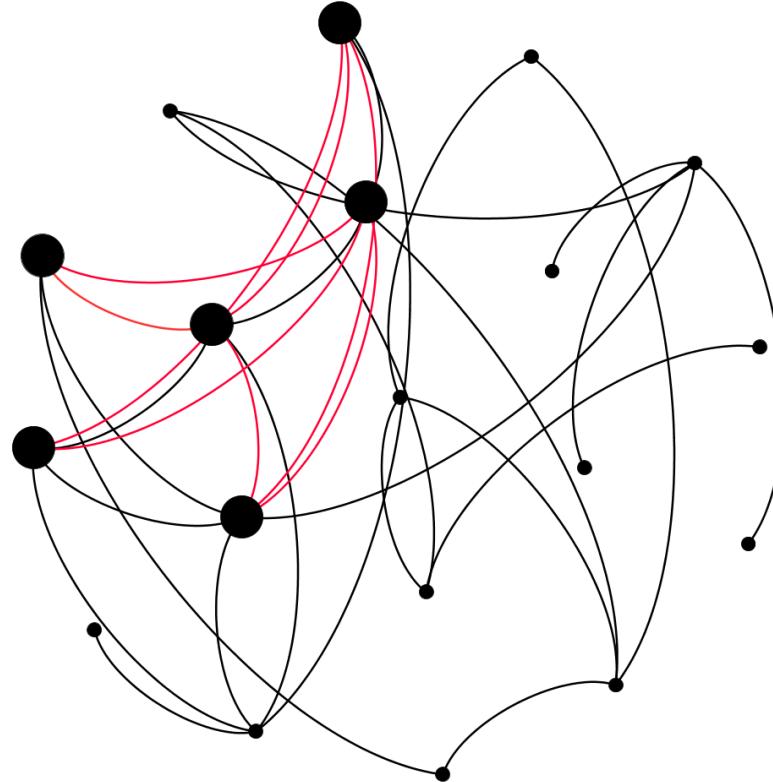


1,007 California Sea  
Lions



48 Killer Whales



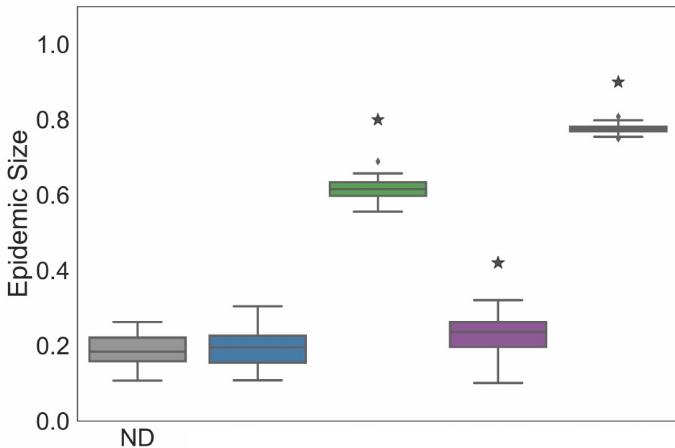


Connectivity

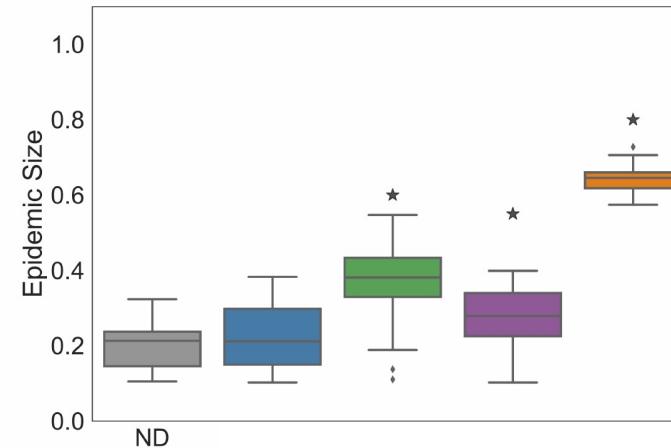
Altering networks to reflect the three changes to host competence

# Model Results

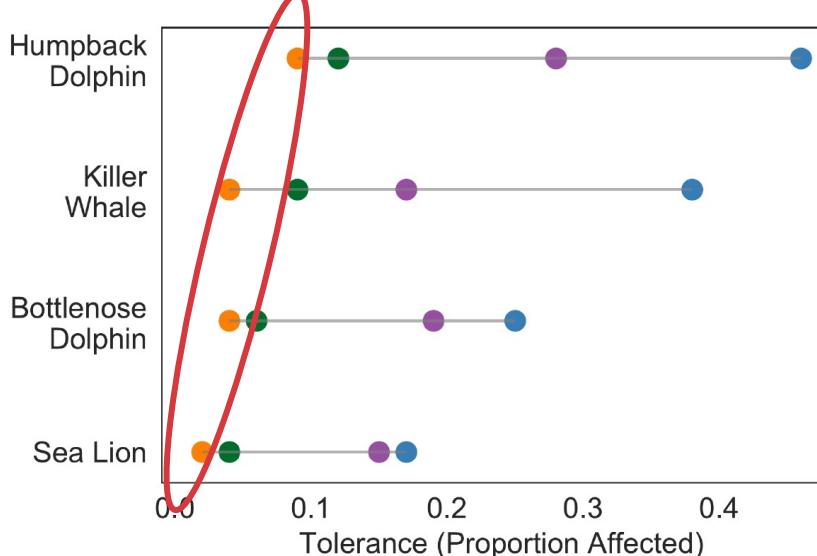
## 15% of Population Simulation:



(A) Sea Lion



(B) Bottlenose Dolphin



Epidemics are 35-300% larger!

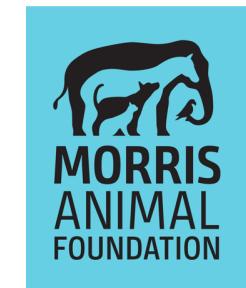
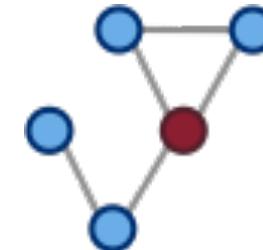
Less than half of a population  
need be disturbed for worse  
epidemics

When all aspects of  
competence are accounted for:  
< 10%

# Conclusions

- Inform management for mitigating future epidemics
  - Establishing more wildlife sanctuaries
  - Reducing pollution and runoff
  - Limiting the number of marine mammal tour boats

- Bansal Lab
  - Dr. Shweta Bansal
  - Dr. Lucila Alvarez-Zuzek
  - Dr. Greg Albery
  - Dr. Casey Zipfel
  - Grant Rosensteel
  - Juliana Taube
  - Andrew Tui
  - Sania Ali
  - Anushka Desai
  - Isabella Turilli
  - Alexes Merritt
  - Eva Rest
  - Colin Murphy
  - Dr. Colin Carlson
- Dr. Janet Mann
- Dr. Bernd Wuersig
- Dr. Giuseppe Notarbartolo di Sciara
- Springer Nature



# Thank you! Questions?