

Application of Citizen Science and Search Theory to Optimally Detect Species at Low Density



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Objectives

- To increase our ability to eradicate marine invasive species to avoid the impacts of their establishment
- To increase our ability for early detection of marine invasive species
 - Essential for the development of successful eradication programs
 - Often species remain undetected or are only detected years after they have become established

Why do species go undetected?

- Probability of detection (POD) is never 100%
- Real-world limitations
- Sparse data

Wanted dead, not alive
INVADING SPECIES

Chinese mitten crab (*Eriocheir sinensis*)



Photo Credit: Lee Mecum

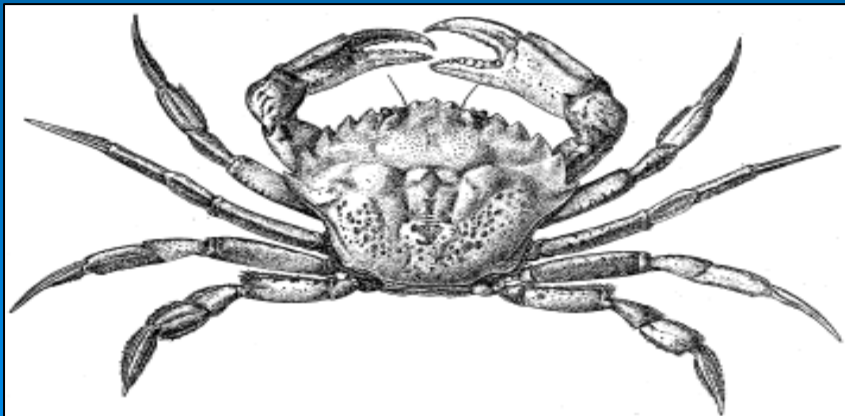
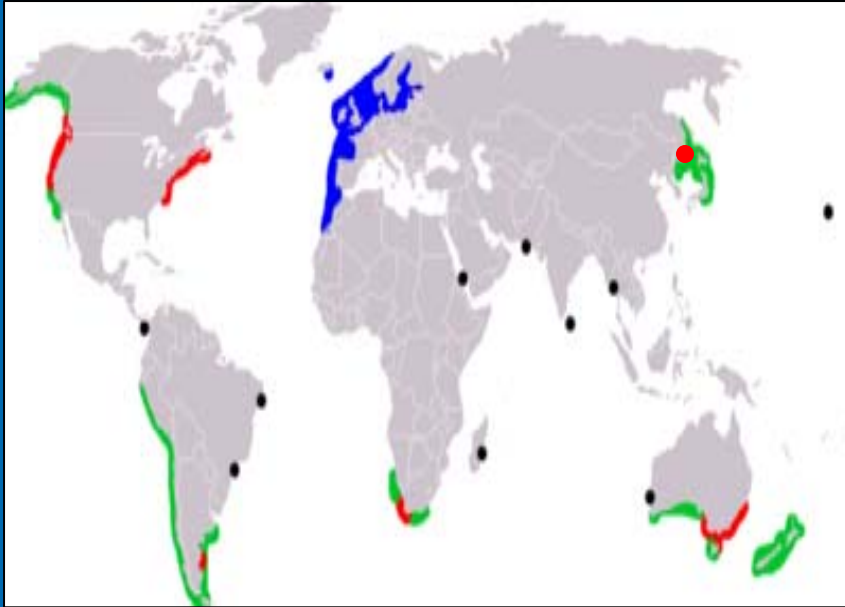
Research Questions

- Is an invader absent in a location, or have we simply not observed it (in terms of probability)?
- What is the optimal monitoring strategy?
- How accurate is volunteer-based monitoring of marine invasive species?

Two Study Organisms:

European green crab

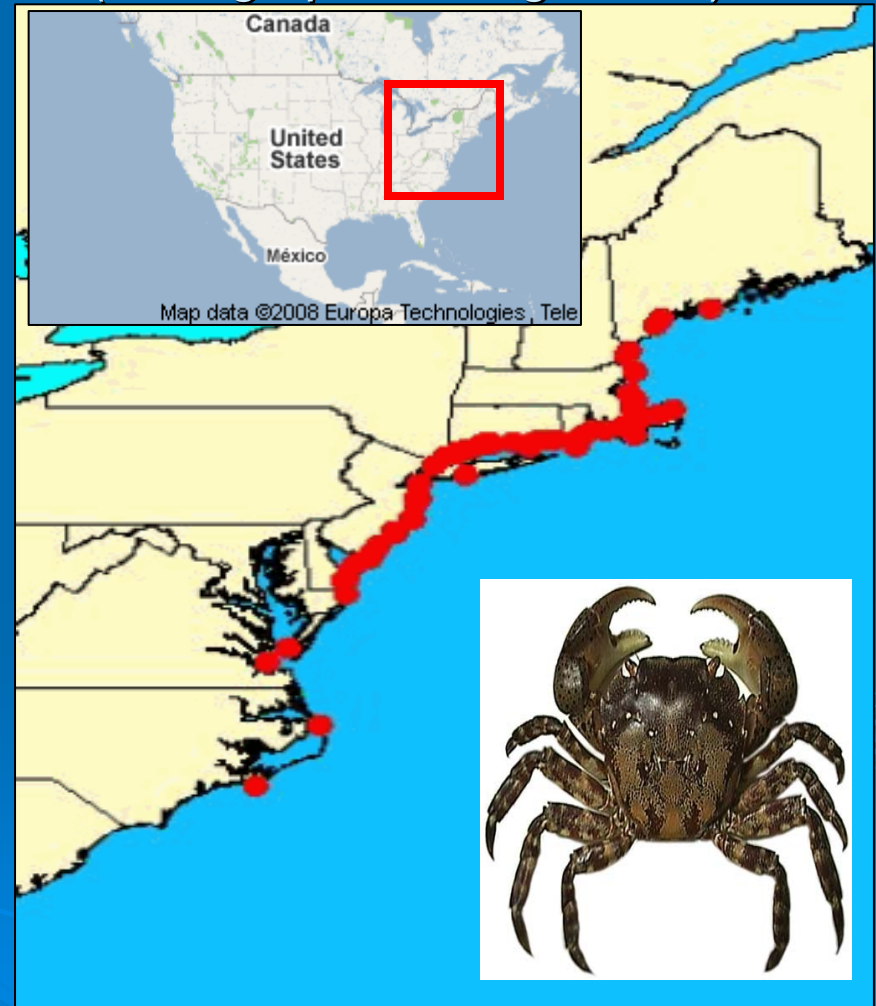
(*Carcinus maenas*)



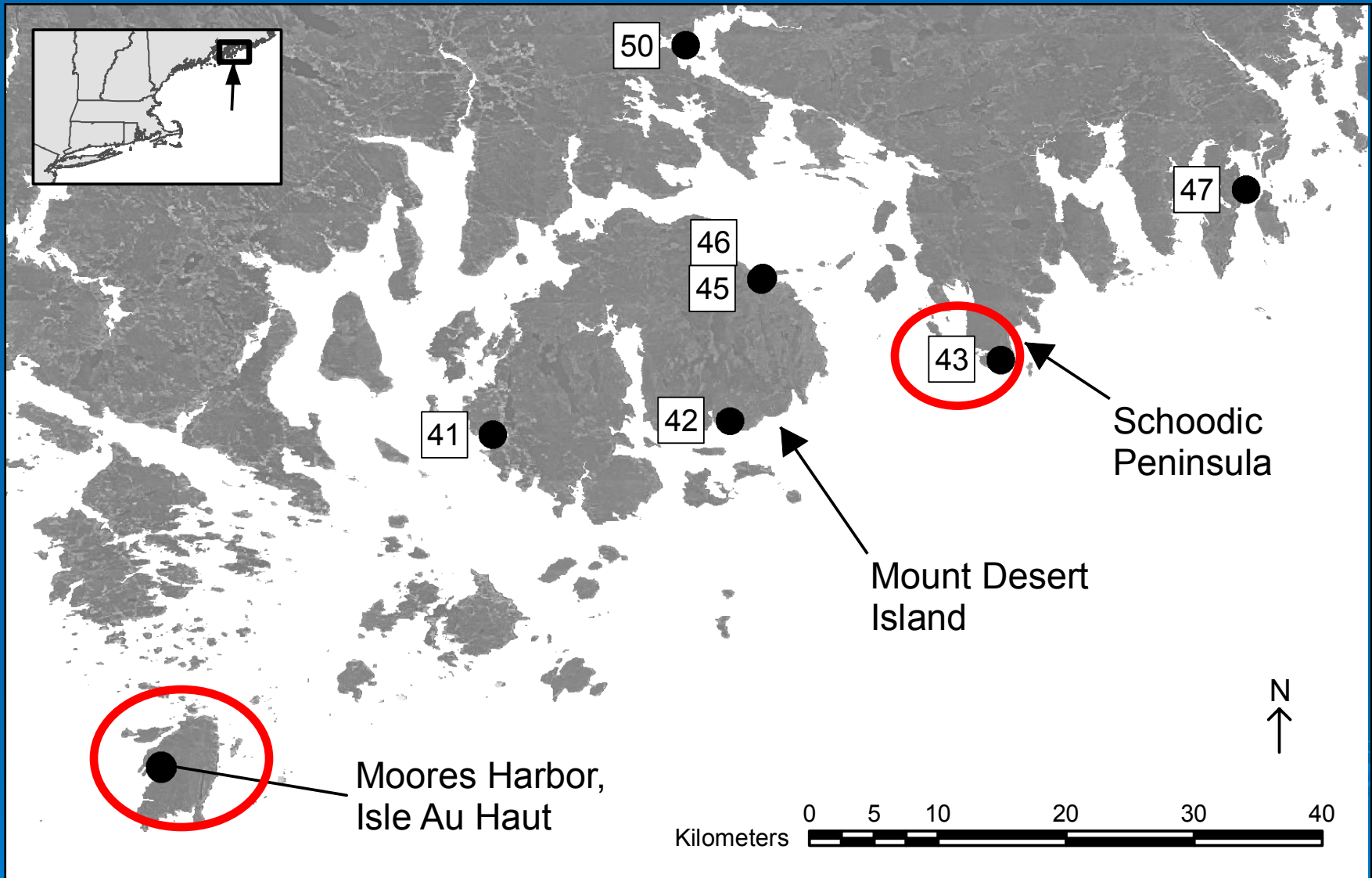
(Modified from Carlton & Cohen 2003)

Asian shore crab

(*Hemigrapsus sanguineus*)



(USGS NAS 2009)



(Delaney *et al.* 2008)

Probability of Detection Experiment

- Sample size: 40 sites
- Area searched: 200 m²
- Density of searchers
 - 0.005 to 0.245 searchers / m²
- Density of invader
 - 0.005 to 0.14 targets / m²
- Sampling strategy
- Mobility of targets

Total Area Search Sessile Targets	Quadrat Search Sessile Targets
Total Area Search Mobile Targets	Quadrat Search Mobile Targets



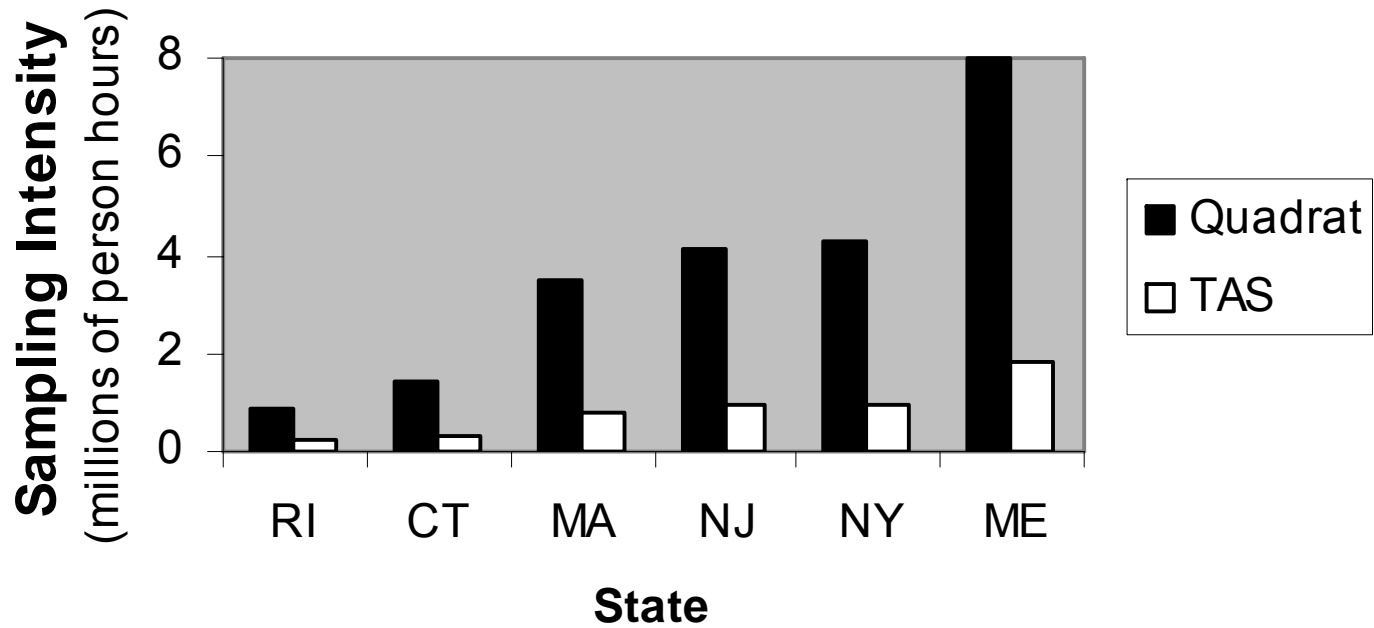
Results

- Refining your sampling strategy is very important.
- Mobility of the target increases the time to first detection but not the overall detection success.

Total Area Search Sessile Targets	Quadrat Search Sessile Targets
Total Area Search Mobile Targets	Quadrat Search Mobile Targets



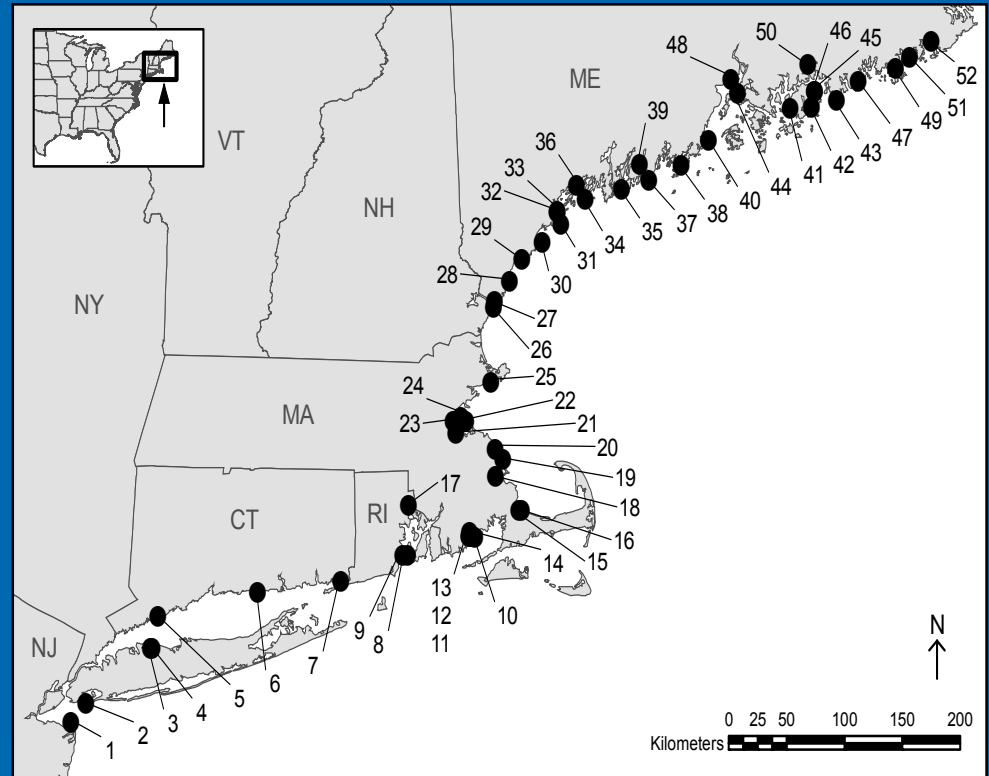
A Personnel Problem



Validation of Citizen Science

Experimental design

- Number of participants: 986
- Independent variables:
 - Education
 - Group size
 - Crab size
- Dependent variable:
 - Whether the species of a crab was correctly identified (yes/no)
 - Native and invasive species
 - 7 species in total



(Delaney *et al.* 2008)

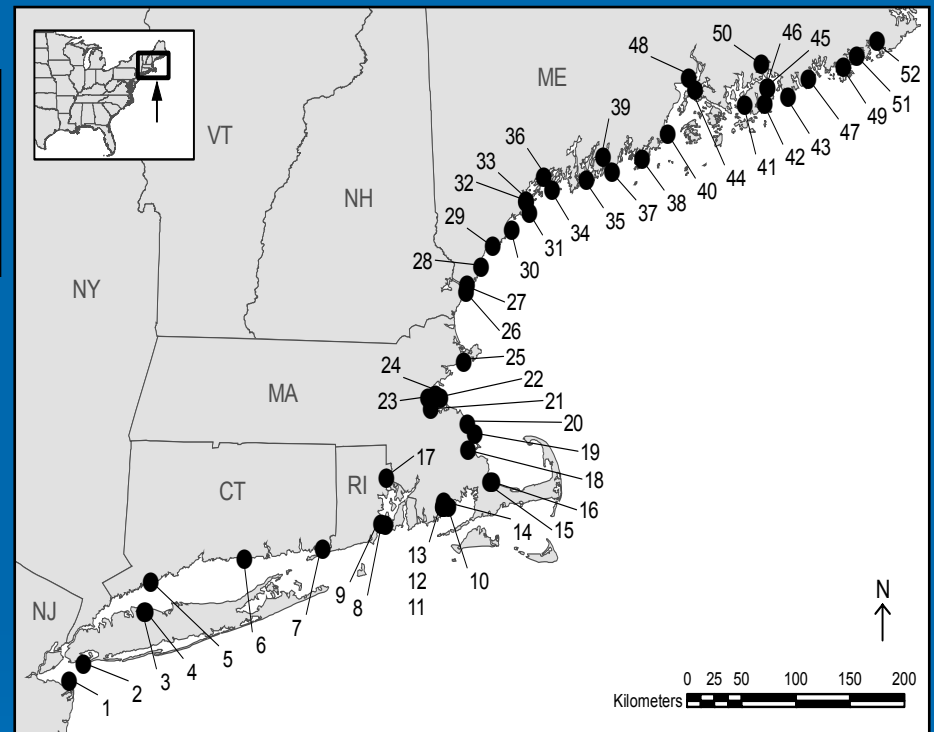
Results of Validation Study

P values:

	Education	Group size	Crab size
Species	0.004	0.375	0.413

Species identification:

- Over 80% accuracy
 - Third-grade students
- Over 95% accuracy
 - Seventh-grade students



(Delaney *et al.* 2008)

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