ARMOR

Advanced Response Model for Organism Removal

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Overall Goal

Improve the efficiency and efficacy of boat wash station programs using a machine learning approach.

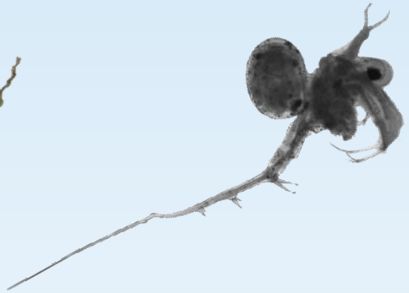
We hypothesized that the identification of watercraft of high risk at their potential points of entry will improve the efficiency and efficacy of detecting and mitigating new invasive species introductions at watercraft inspection stations.

Why we care

- Ecological and Economic impact of Invasive species
- Limited resources should be allocated in the best possible way






Movement of Invasive Species via trailered boats is one of the few points of control

Boats as a vector

Primary mechanism for overland species movement

In New York State

- Up to 7,682 surveys per day
- 15K per year at one site alone (Lake George, Million Dollar Beach)

Other modes possible but we can do something about this!

Boat Wash Stations

- Advantages:
  - Effective
  - Education & Outreach
- Potential Drawbacks :
  - Time
  - Cost

ARMOR aims to make useful, on the ground, real-time decisions to maximize the efficacy and efficiency of Boat Wash stations

Data from boat wash stations

- Location of boat wash station
- Date
- Has the boat been in the water in the last 2 weeks?
- What was the last waterbody the boat was in?
- Is the boat entering or leaving the waterbody?
- What type of boat is being washed?

Leveraging the survey data

Threat levels

- At each **Launch**
  - Location (Lat/long)
  - Number of boats washed (total)
  - Percent of boat arrived with any organism
  - Percent of boats that have arrived with an invasive species

L

- From each **Previous Water Body**
  - Location (Lat/long)
  - Number of boats washed (total)
  - Percent of boats from that water body with any organism
  - Percent of boats from that water body with an invasive species

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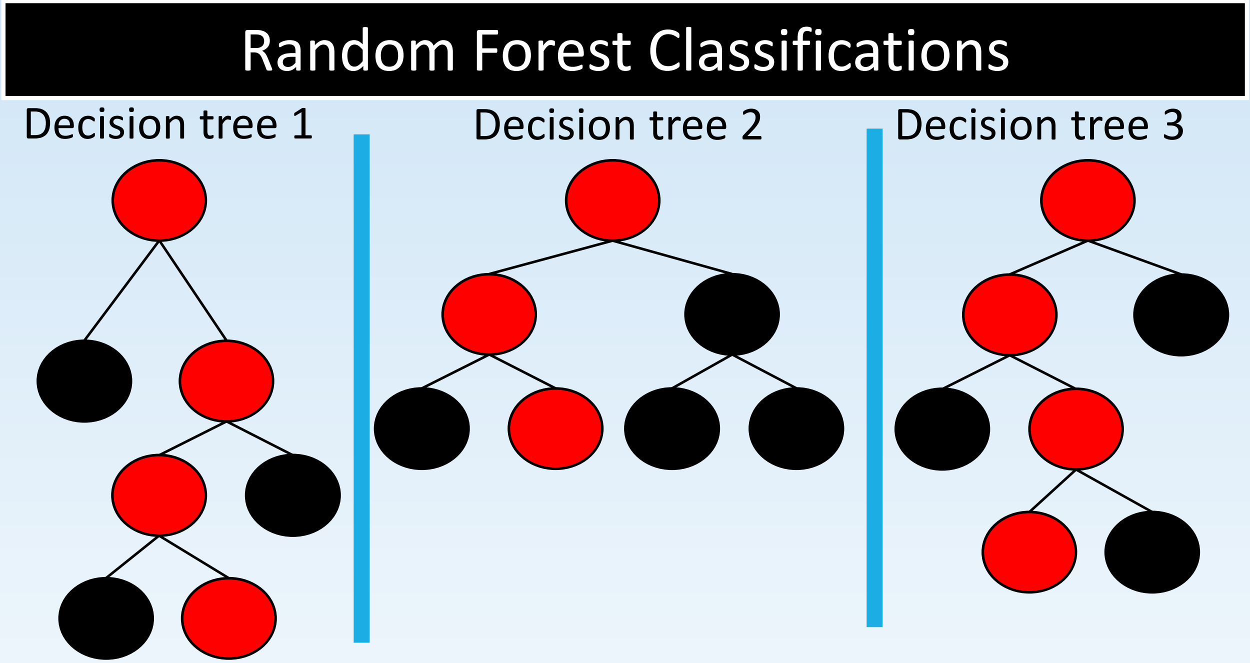
Distance Traveled For Each Boat

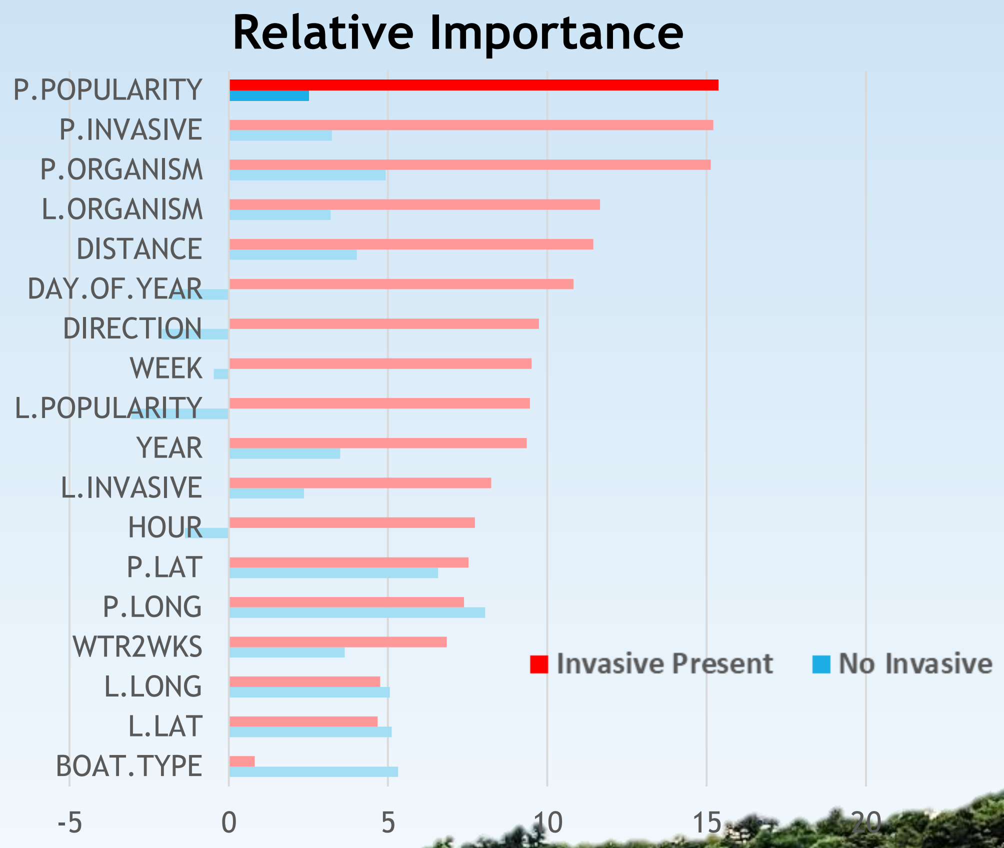
Machine Learning to make predictions

- Best classification we can make based on over 400K surveys
- 70/30 split of the data
- Oversample positive instances



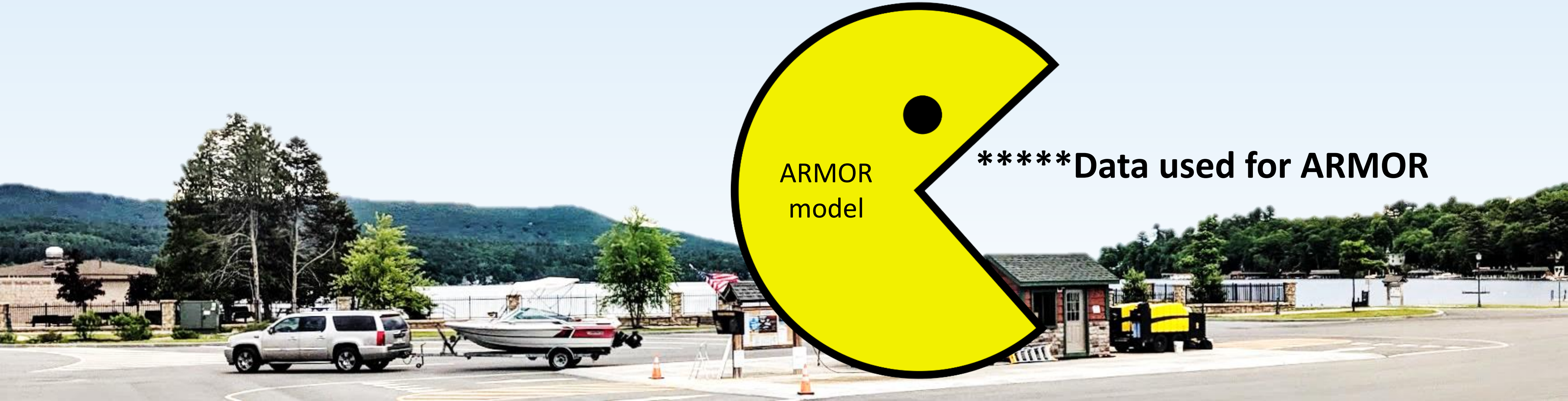
What to expect…

		PREDICTED		
ACTUAL		No Invasive	Invasive Present	Error
ACTUAL	No Invasive	Correctly not washed	Washed but should not have been	Percent of boats washed that were not necessary
ACTUAL	Invasive Present	Invasive allowed to enter the lake	**Removed Invasive Species!**	Percent of Invasives that were allowed in



Initial model development

- Lake George Park Commission established a mandatory boat washing station in 2014
- Each boat arrival and departure is surveyed*
- Boats inspected, washed and any invasive species removed



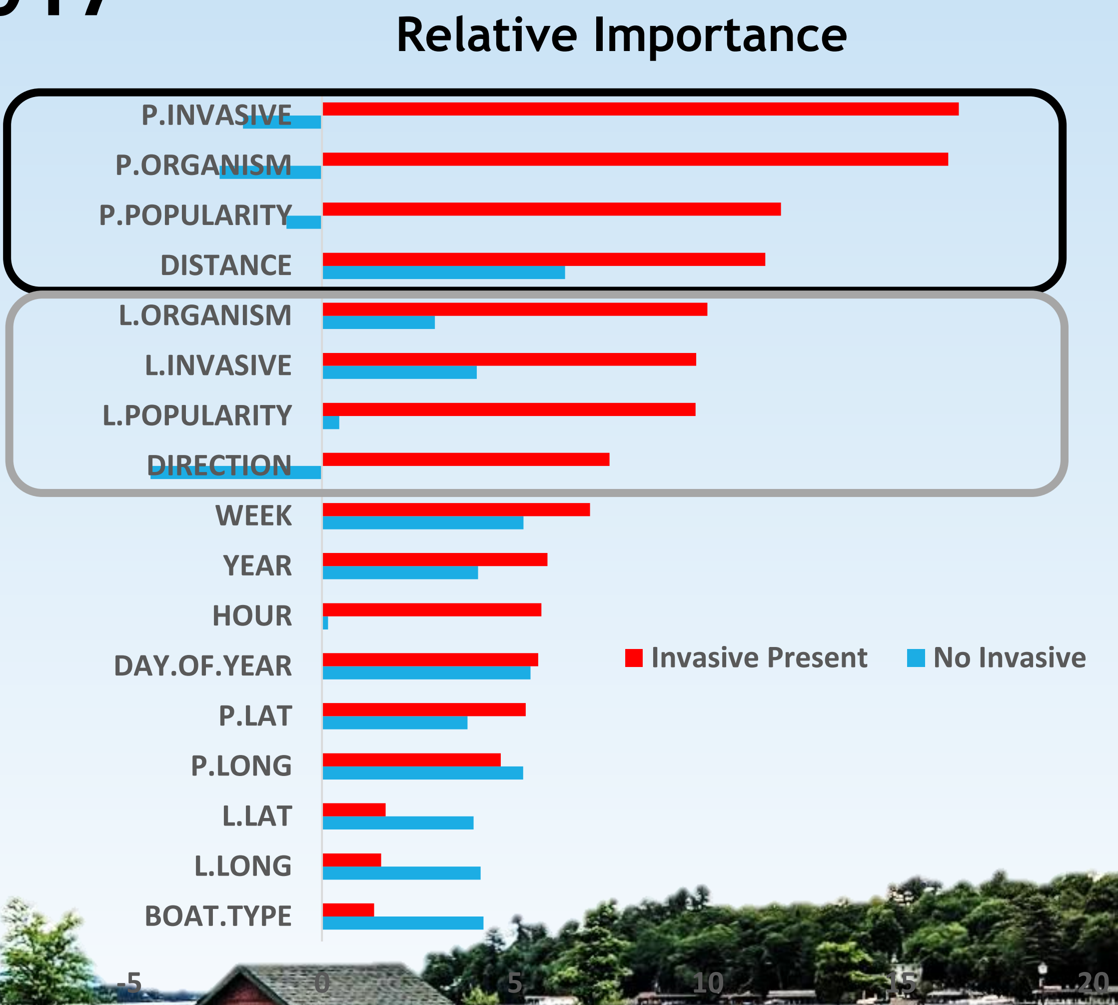
*****Data used for ARMOR

Developing ARMOR for Lake George

2014-2017

	Predicted		
Actual		No	Yes	Error

Actual		No	Yes	Error
	No	19,591	12,023	38%
	Yes	6	126	4.5%

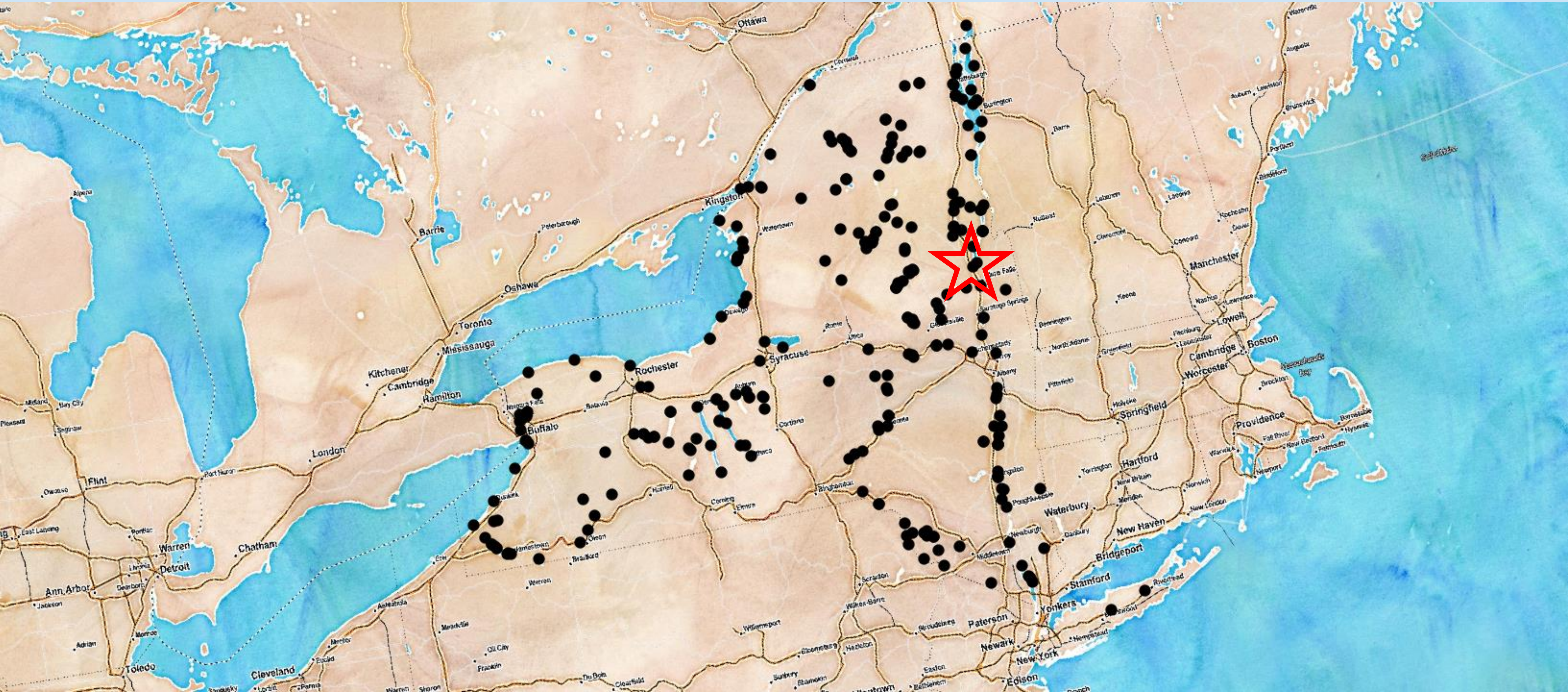


Developing ARMOR for Lake George

2014-2017 applied to 2018

		Predicted		
Actual		No	Yes	Error
	No	87,796	49,482	36%
	Yes	29	572	5%

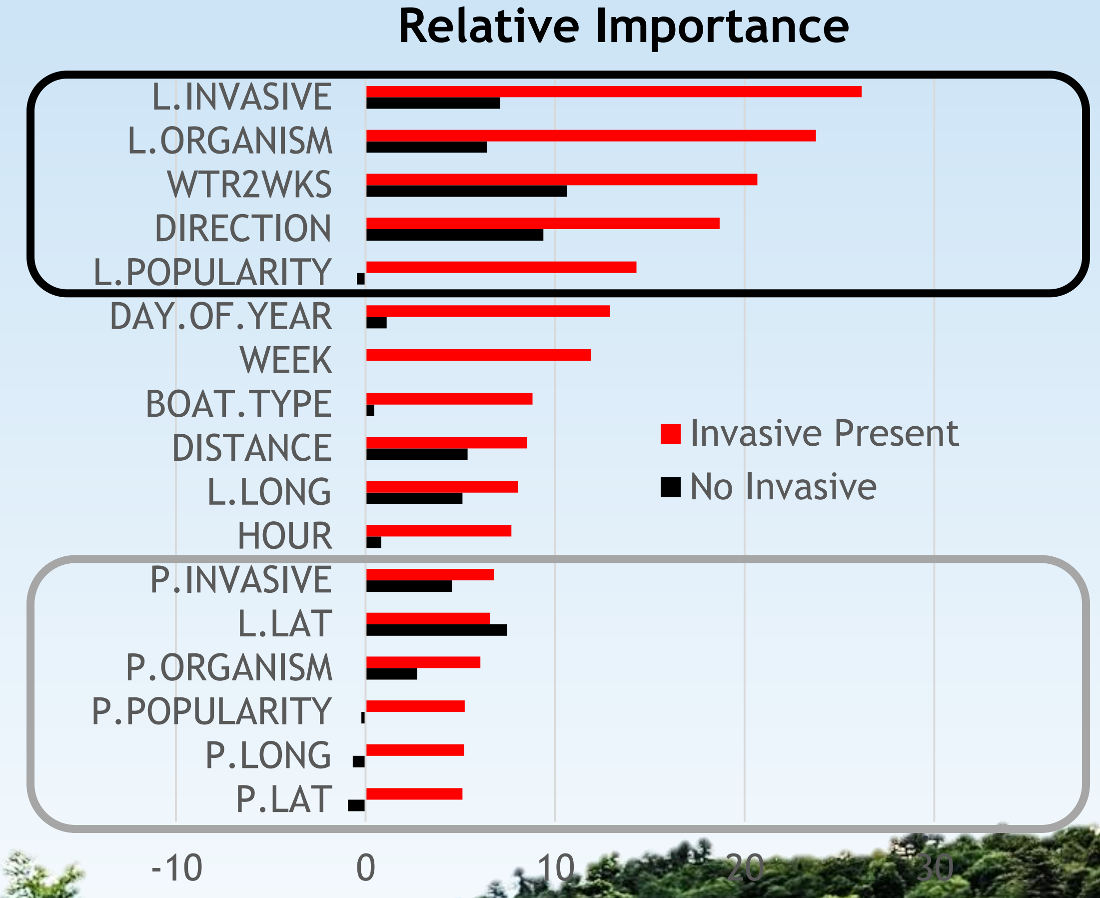
Taking the ARMOR approach to WISPA



ARMOR for all of New York State

2019 - 70% data to build the model - 30% to test the model

		Predicted		
Actual		No	Yes	Error
	No	30,025	37,431	56%
	Yes	146	7,058	2%



Finding the right balance

- Without additional data, model parameters can be modified to make it more or less conservative.
- Risk of invasive species introductions can be reduced (even to 0) **but that comes at a cost.**

More conservative models will yield less benefits in terms of reducing the number of boats that need to be inspected.

For Example… Lake George model trained with the 2014-2017 data set and applied to the 2018 observations

		PREDICTED		
ACTUAL		No	Yes	Error
	No	87,796	49,482	36%
	Yes	29	572	5%

Boats Inspected Unnecessarily

Invasives present Not inspected

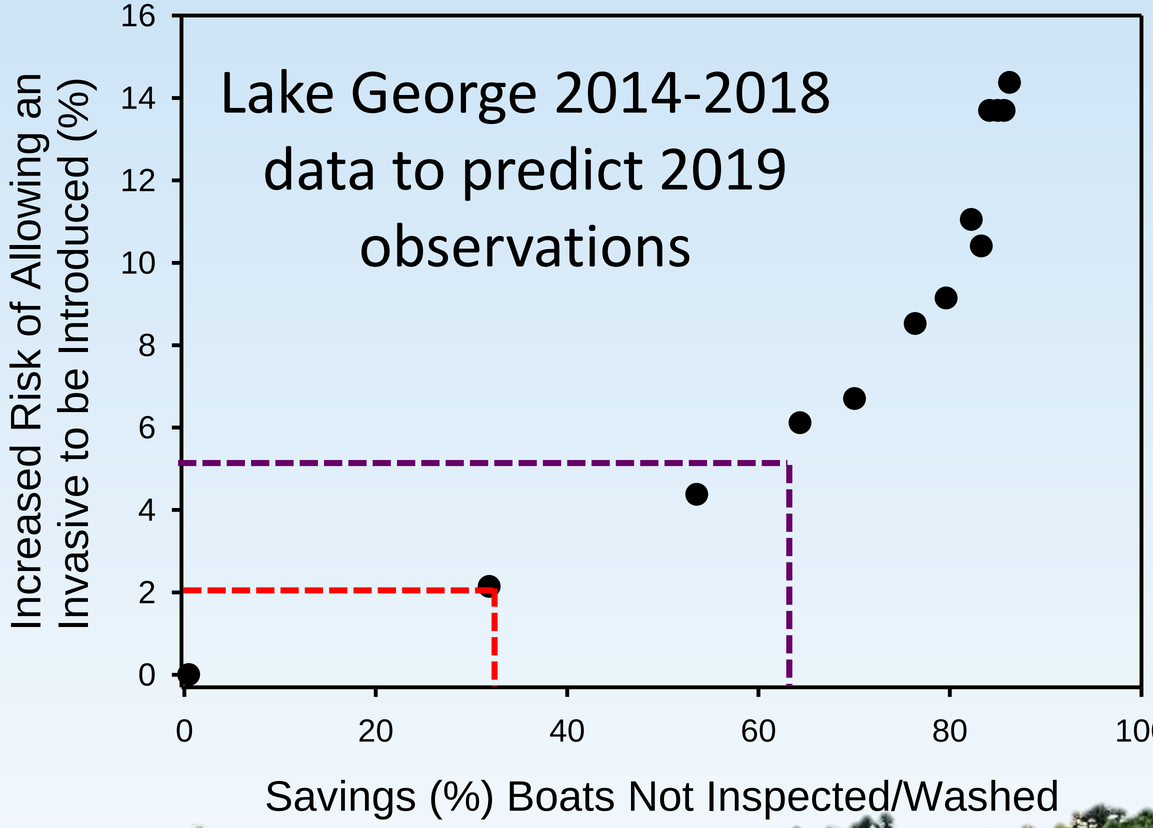
In this case, there would have been a 64% reduction (100 – 36% error) in the # of boats needed to be inspected while risks of an introduction would have increased by ~ 5 %

Is this level of increased risk acceptable???

Model parameters can be tuned to target risk & benefit levels

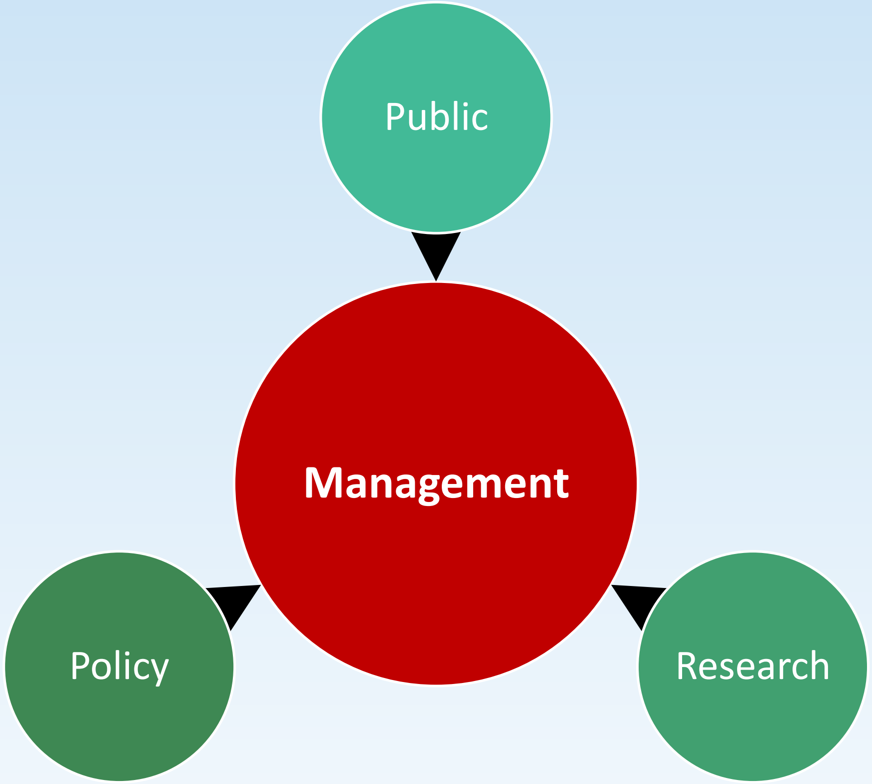
5% increased risk,
62% savings in boat inspections

2% increased risk,
32% savings in boat inspections



Risk Tolerance

Determining the relative amount of risk relative to benefit is an effort that needs to be undertaken by the management community. Not only researchers and academics.

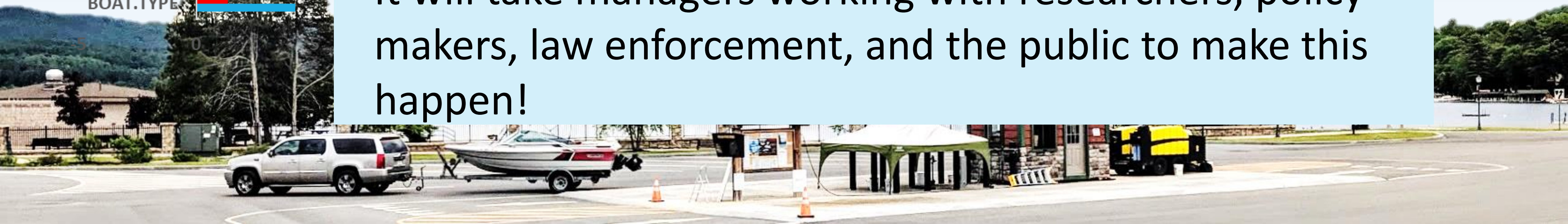


** Better data, however, will help!!!

These variables all require knowledge of where the boat came from. This is a question that is frequently not answered by the boat owner/captain when asked at the site where the boat in being introduced.

None of your F*&%#!ng business

It will take managers working with researchers, policy makers, law enforcement, and the public to make this happen!



Next Steps

RESEARCH

- Explore model (*in silico* experiments) to understand and refine model construction & optimize.
- Continue to collect and improve data.
- Combine network analysis with choosing the right models to build.

IMPLEMENTATION

- Work with NYSDEC and WISPA program to develop implementation plan.
- Develop steward training program for the use of ARMOR.
- Get the message out, public outreach and education.

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Thank you!

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