BACKGROUND

- **Trawling is an imperfect monitoring tool**
  - Poorly quantitative
  - Expensive
  - Destructive and cannot be conducted in locations like kelp beds
- **We are examining potential alternative tools for monitoring fish**
- **Last quarter you heard about our progress on eDNA**
- **Today you will hear about Vision Artificial Intelligence**
  - Can we use cameras to gather fish abundance data?
  - Formed a partnership with the Crystal Cove Conservancy to explore this possibility

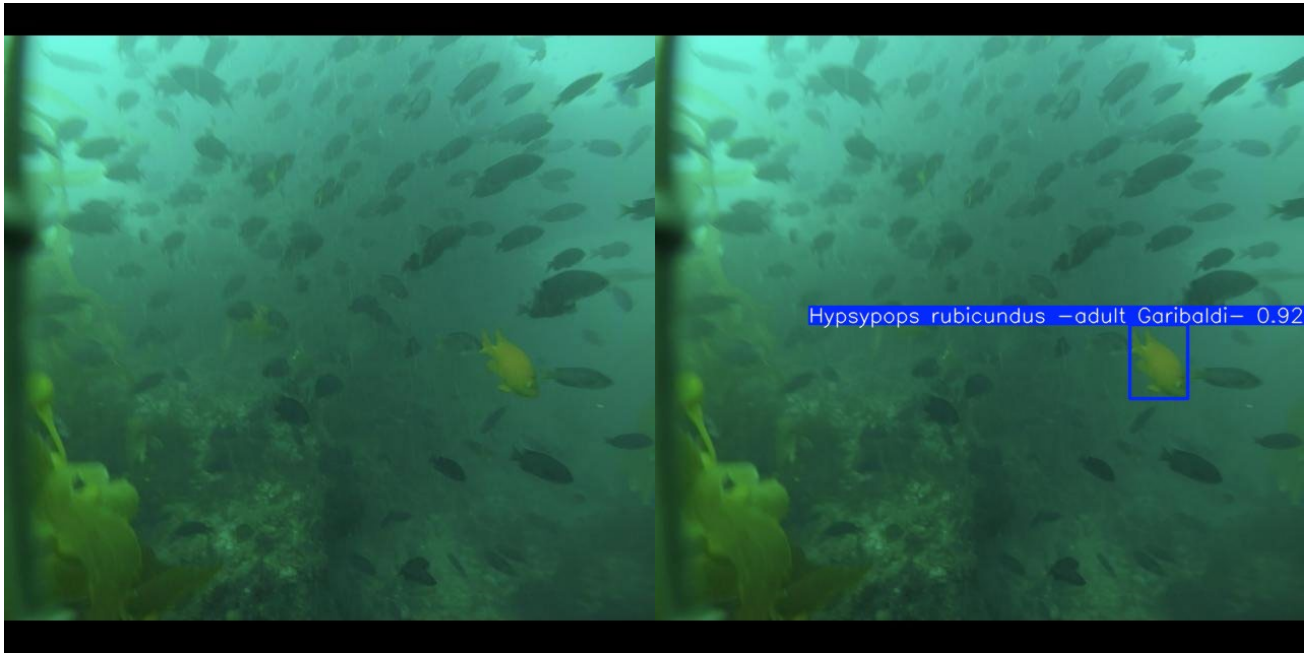
CRYSTAL COVE CONSERVANCY

- **Crystal Cove Conservancy deploys ship-based go-pro underwater cameras in kelp beds several times per week**
  - Collected as part of a school-based education program
  - Usually 5-15 minute videos
  - Over ten years of data (in an MPA)

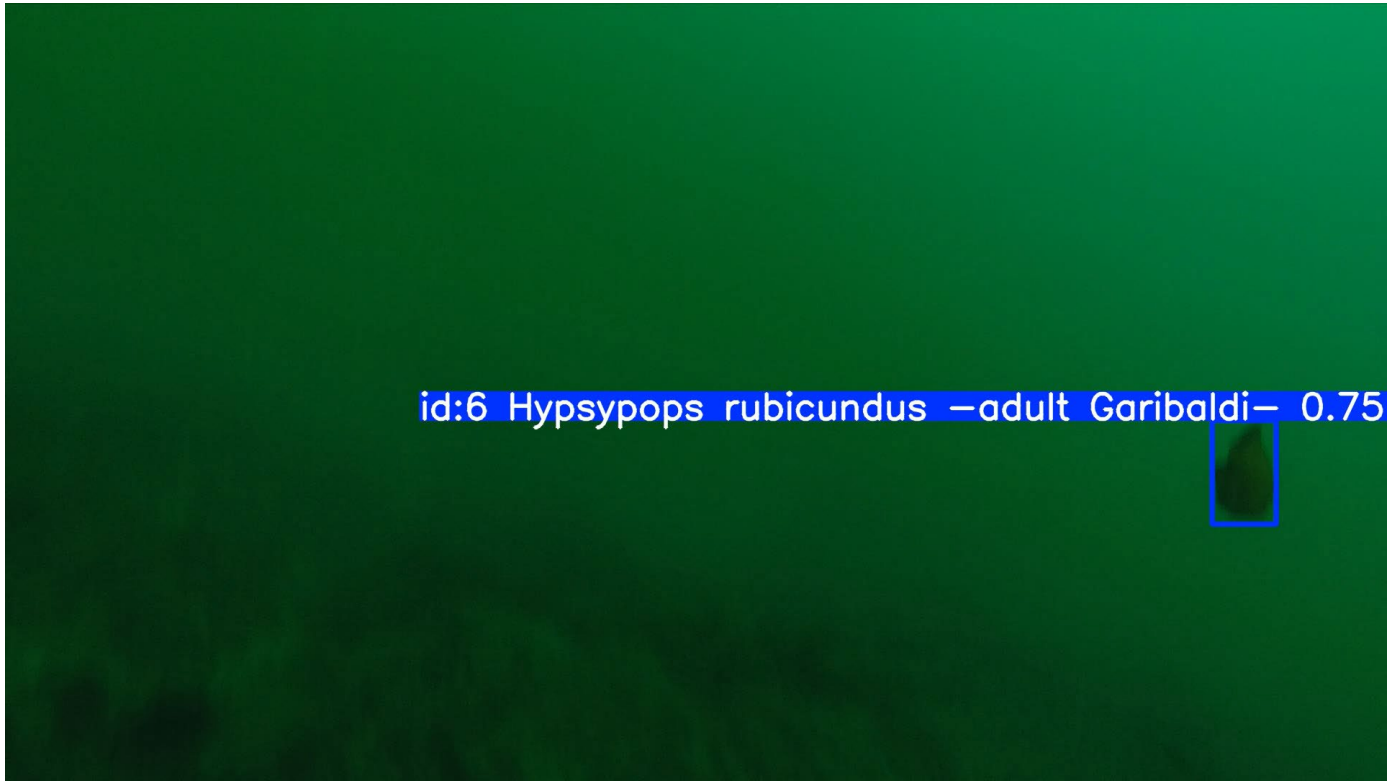
- **Having such data is essential to building an AI model**
  - You need thousands of library images to calibrate a model
  - You need a validation data set that represents realistic conditions for testing the model
  - Conservancy volunteered to annotate footage for us, manually identifying fish

- **Our initial focus has been on Garibaldi**
  - If that goes well, we will expand to include Kelp bass and Sheepshead

Demo



Demo

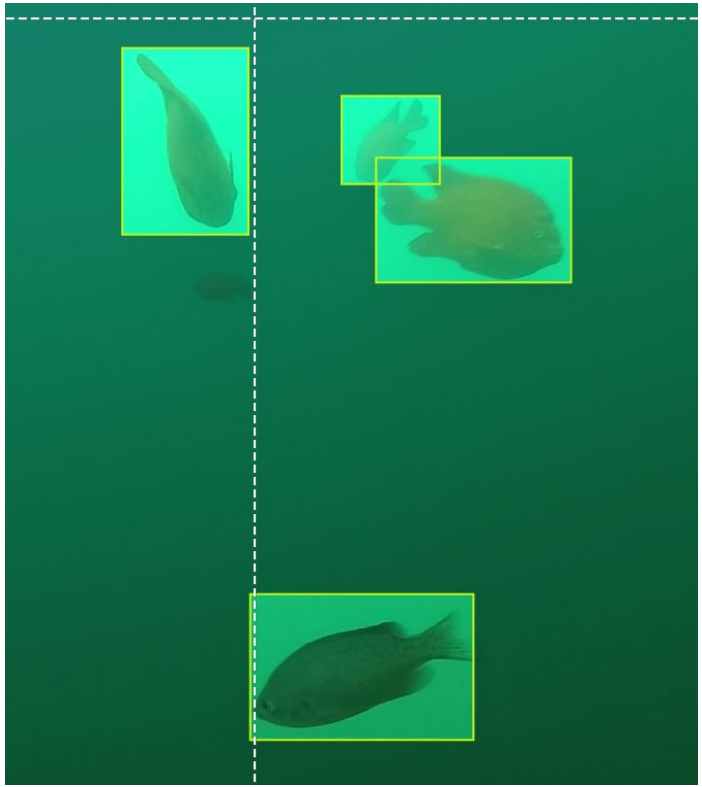


Demo

HOW GOOD IS THE MODEL?

- **Crystal Cove Conservancy helped us create a gold standard**
- **5 Crystal Cove Conservancy experts looked at 800 photographs**
  - Each expert independently identified garibaldi in each image
  - The fish they all agreed on became our validation dataset
- **We also conducted bootstrapping to assess “acceptable” model error**
  - How often do their own experts agree?
  - Provides us the bar against which to judge AI efficacy

How did the exercise work?

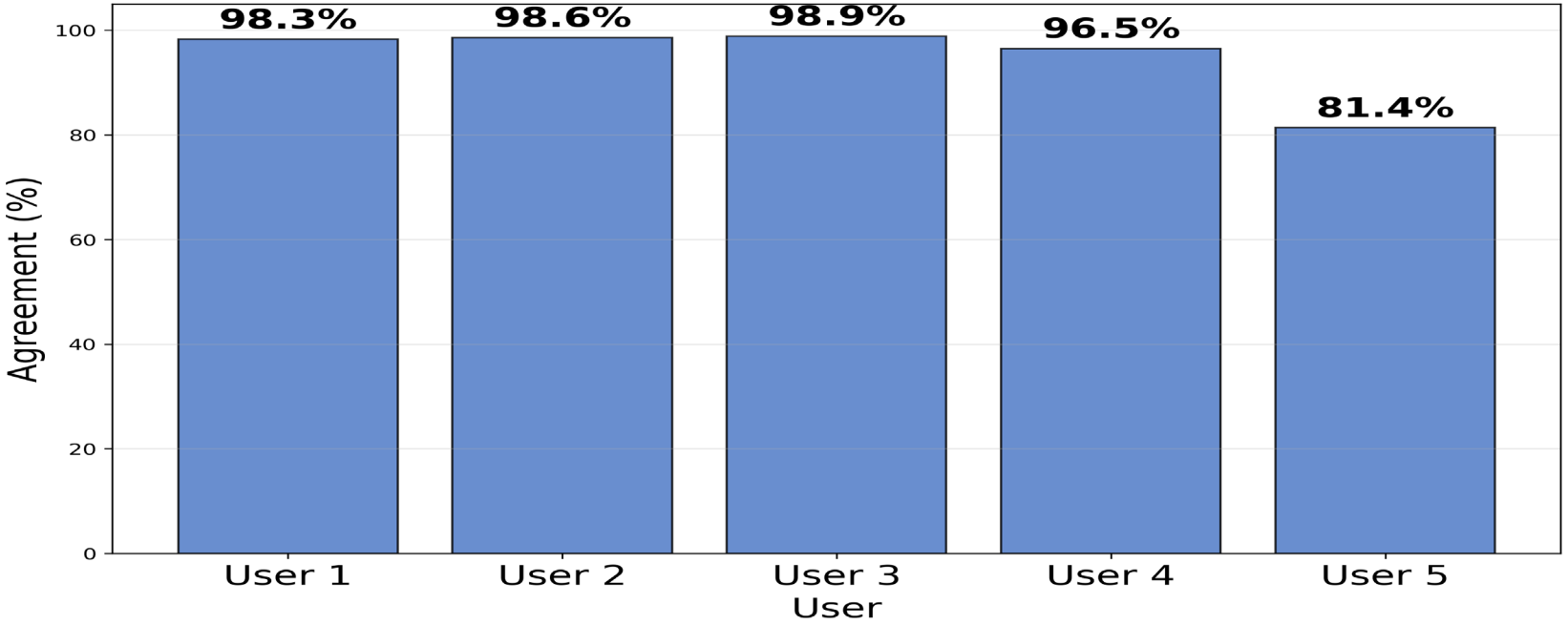


- **We provided 800 images containing 1441 boxes capturing an object to be identified**

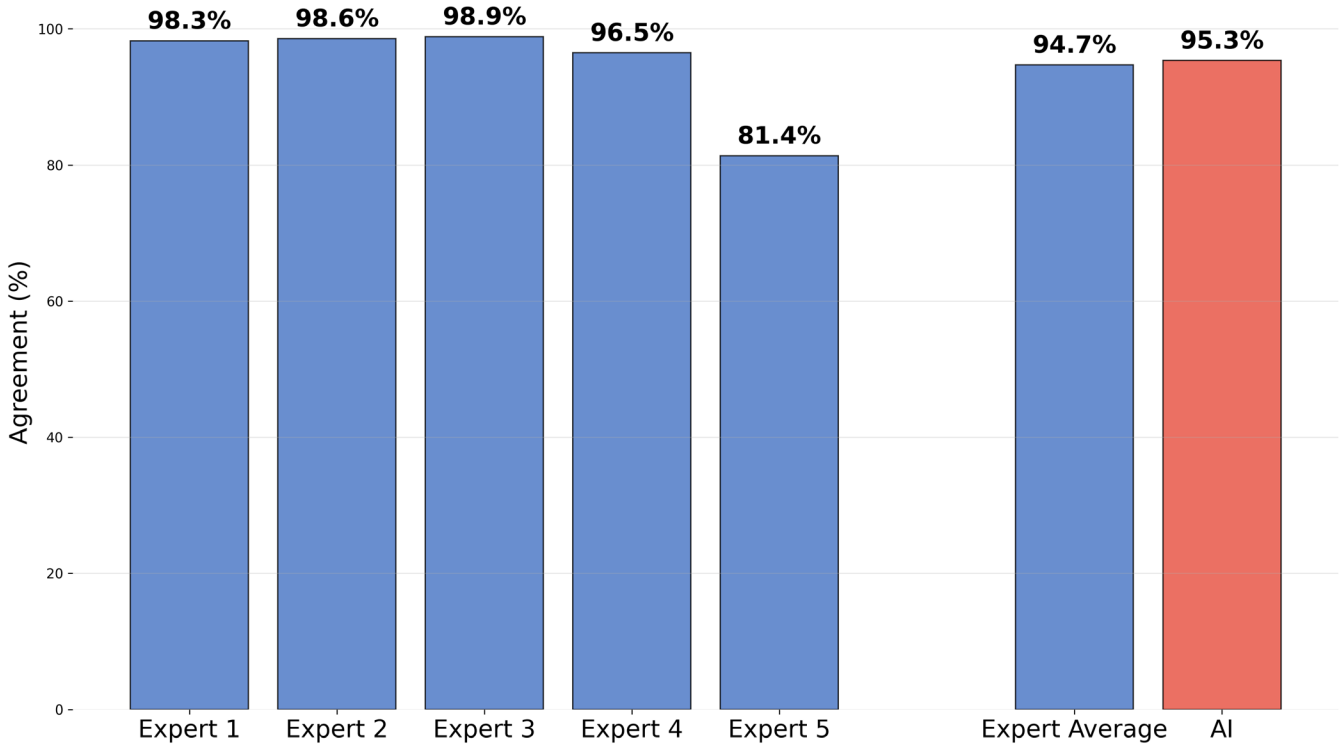
- **Experts placed boxes into a category:**
  - Garibaldi
  - Fish, but not Garibaldi
  - Fish, but not sure what species
  - Not a fish

- **Experts were also allowed to draw boxes around other fish they think are Garibaldi**

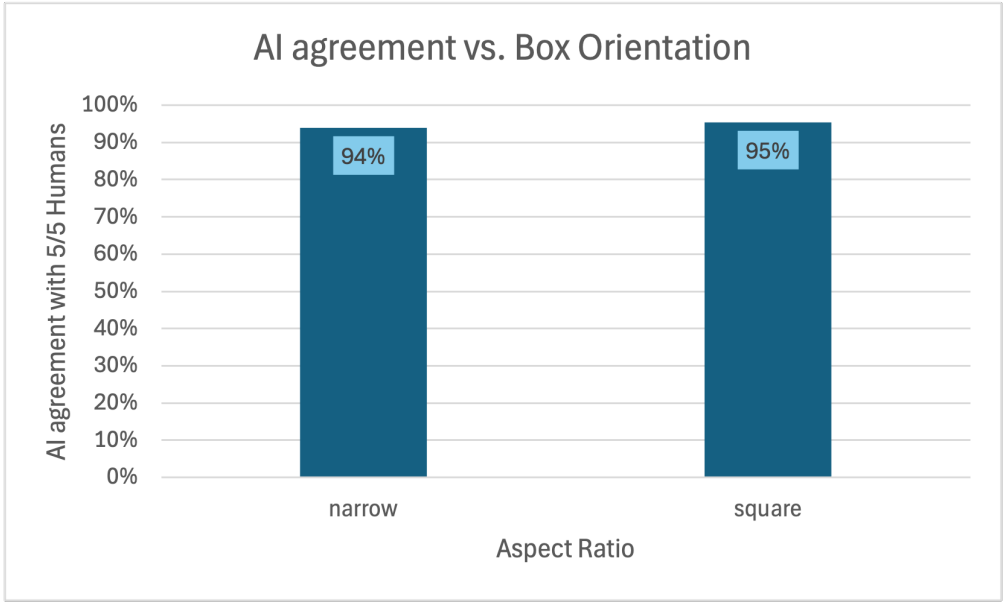
Bootstrap analysis to compare experts



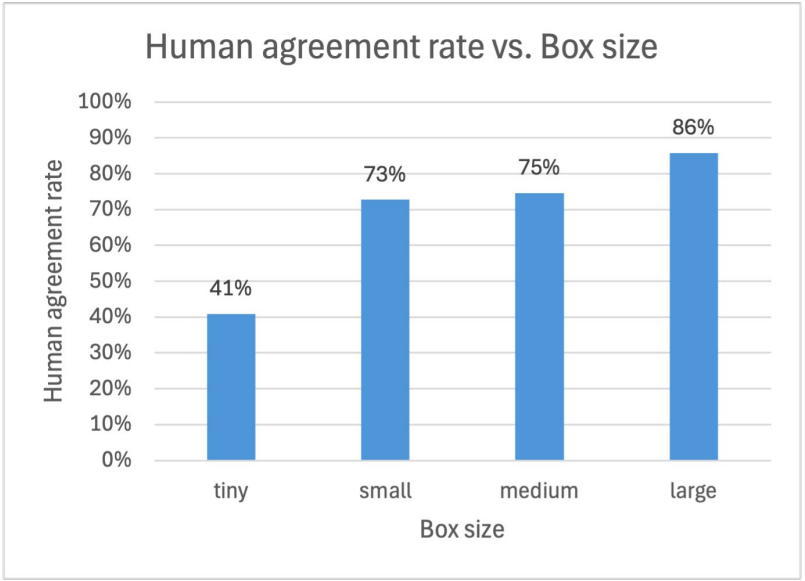
How often does AI agree with the experts?

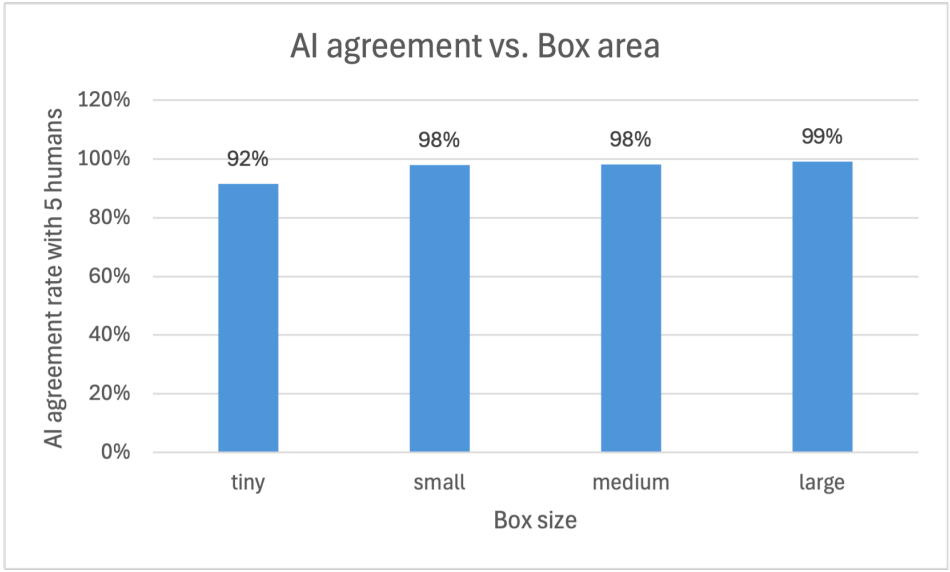


Fish orientation

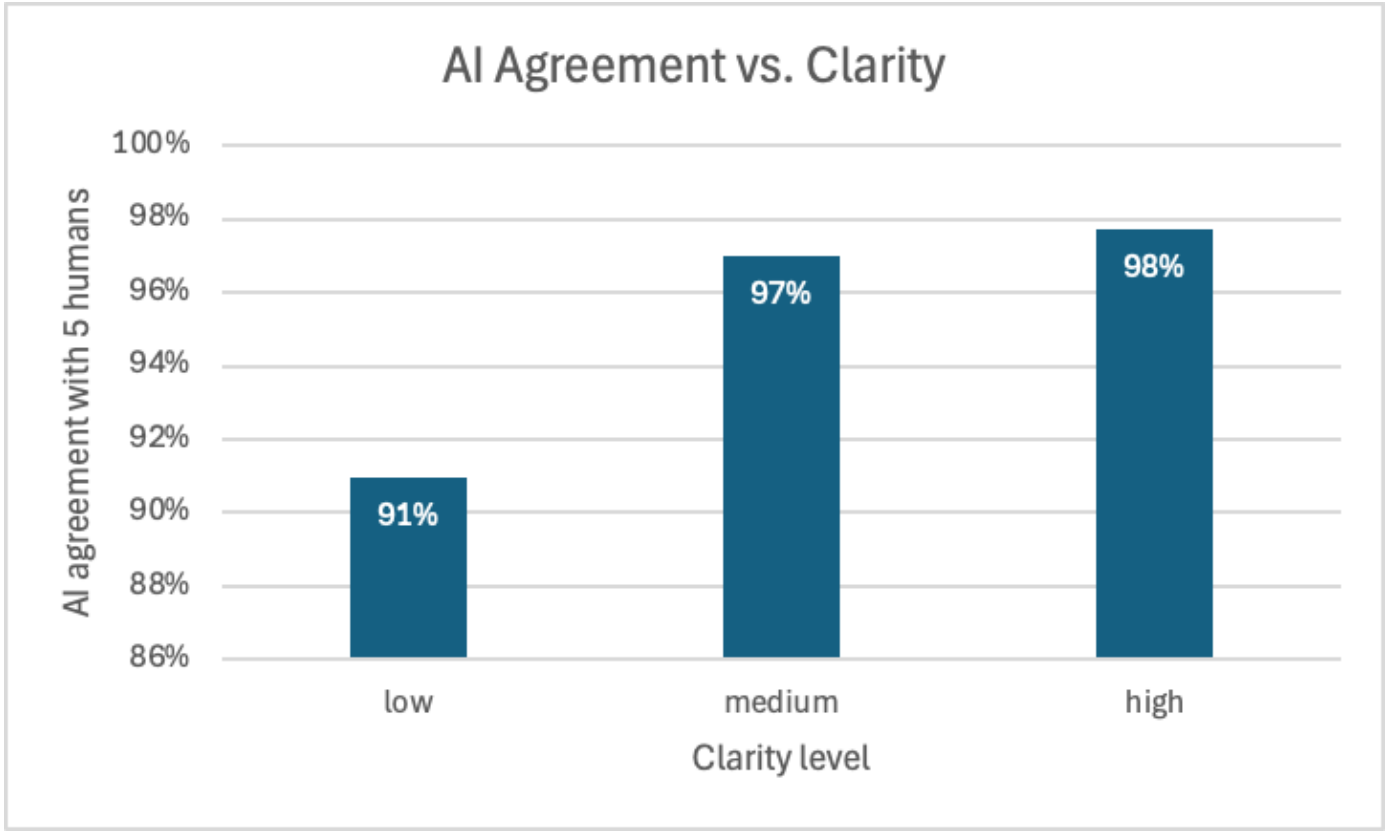


Box Size


Human agreement rate vs. Box size
Human agreement rate
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
41%
73%
75%
86%
tiny
small
medium
large
Box size


AI agreement vs. Box area
AI agreement rate with 5 humans
120%
100%
80%
60%
40%
20%
0%
92%
98%
98%
99%
tiny
small
medium
large
Box size

Water Clarity



EXPAND THE LIBRARY

- **Crystal Cove Conservancy is looking at images where 4 out of 5 experts agreed**
  - To create a gold standard, they conducted the identifications independently
  - To expand the library, the experts are working collaboratively
- **The new images they agree on will be added to the library**
- **Having difficult images in the library is particularly valuable**

TRAWL ALTERNATIVES COMMITTEE

- **Next step is to expand to other species**
  - But first, we want to figure out how you will use this, if successful
- **CTAG has formed a Trawl Alternatives Committee**
  - Look at how we can use AI and eDNA as a supplement or partial replacement for trawling
- **They have even developed a series of charge questions**

COMMITTEE CHARGE

- **Create a monitoring vision**
  - What monitoring questions are we are trying to answer with trawling?
- **Convert that vision to a monitoring strategy**
  - If these new technologies work well, what would an optimal monitoring program look like?
  - Use all three (Trawl, eDNA, Cameras) together?
  - If so, in what combination?
- **How well do the new techniques need to work to implement that vision?**
- **How do we quantify how well they work?**

POTENTIAL NEGATIVE CONSEQUENCES OF USING AI

- **Privacy issues**
  - Concerns about surveillance and extensive data collection
- **Poor transparency**
  - Hard to understand or assign responsibility for AI decisions
- **Societal impact of job displacement from automation**
- **Environmental damage**
  - AI consumes massive amount of energy and water to power data centers

POTENTIAL NEGATIVE CONSEQUENCES OF USING AI

- **Privacy issues**
  - We are only using fish images, so no privacy concerns
- **Poor transparency**
  - We are quantifying error
  - Also trying to understand contributing factors when there is error
- **Societal impact of job displacement from automation**
  - These counts would not have gotten done as no one was signing up to do so
- **Environmental damage**
  - The CO_2 effect of our effort to date is equal to driving three miles