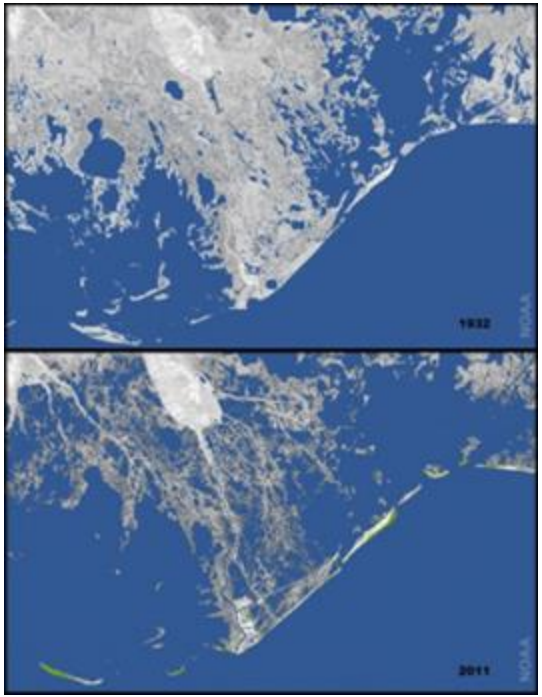
Land Loss Lookout: An effective online platform for crowd classification of coastal wetland loss

ENVIRONMENTAL LAW INSTITUTE
01/09/2023

"Wetlands matter. They're Louisiana's first line of defense against hurricanes, but they're being lost at an alarming rate. Volunteers can help from anywhere in the world by participating in the online..."

https://blog.scistarter.org/2021/07/miss-louisiana-earth-invites-you-volunteer-online-map-where-vital-wetlands-are-being-lost/



https://scistarter.org/land-loss-lookout

What is Healthy Gulf

•Healthy Gulf's purpose is to collaborate with and serve communities who love the Gulf of Mexico by providing the research, communications, and coalition-building tools needed to reverse the long pattern of over exploitation of the Gulf's natural resources.

•Formed in 1994.

•Advocacy group: organizing, legislation, litigation, and watchdog work

•Board members & members from all 5 Gulf states

What is Cartoscope

- Research project @ Northeastern University.
- NSF funded to:
  - develop an open source, crowd sorting **platform for non-profits**.
  - study ways to increase **enjoyment** and **engagement** in and build **community** through crowd source image analysis.

https://cartosco.pe

Cartoscope Research Findings

Key Findings to Date

- Requiring minimums: negative impact on engagement!
- Introducing task variety by switching between types of tasks increases enjoyment and engagement.
- Utilizing data from existing users to generate better sequences of tasks using Machine Learning techniques.
- In-person labeling: collaboration, discussions about projects, equally engaging experiences.

Current Research

Virtual Cairns to tasks

AR platform for multi-player games.

Tile-o-Scope AR: An Augmented Reality Tabletop Image Labeling Game Toolkit (FDG 2020)
Using Q-Learning for Sequencing Level Difficulties in a Citizen Science Matching Game (CHI PLAY 2019)
Does Flight Path Context Matter? Impact on Worker Performance in Crowdsourced Aerial Imagery Analysis (ISCRAM 2018)
A Required Work Payment Scheme for Crowdsourced Disaster Response: Worker Performance and Motivations (ISCRAM 2017)
On Variety, Complexity, and Engagement in Crowdsourced Disaster Response Tasks (ISCRAM 2017)

Why wetlands?

Louisiana's first line of defense:

10 ft surge peak at Grand Chenier vs

2-3 ft surge at Cameron LNG (out for two months)

625k homes hit by TS vs 10k Hurricane

$12 Billion dollars damage from Laura.

how many Billions avoided? ($81 - $180 in Katrina)

Venture Global Liquid Natural Gas (LNG), deny their environmental impact on coastal wetlands, claiming there are “no scientifically accepted methods for evaluation of such impacts” and that assertions that their actions cause climate change impacts that affect wetlands is “speculative” (VGLNG Aug 5th, 65 2019).

VENTURE GLOBAL LNG

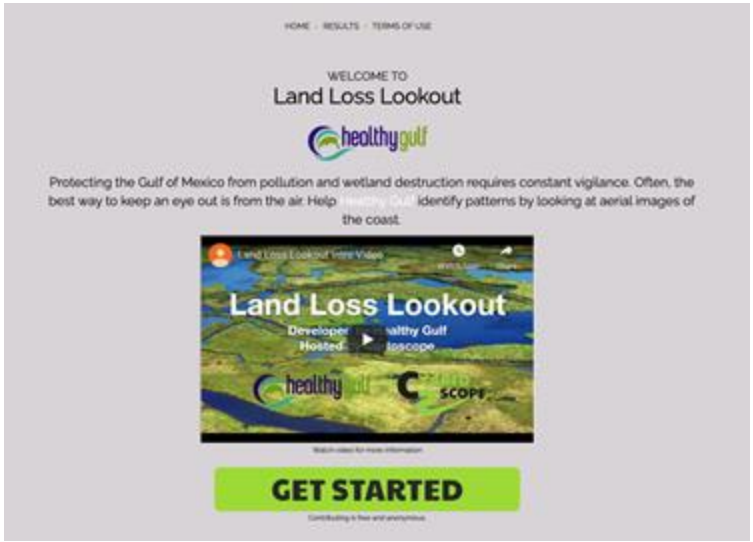
PLAQUEMINES FACILITY

https://ventureglobalLNG.com/project-plaquemines/

https://healthygulf.org/2021/09/13/plaquemines-lng-export-terminal-as-foolish-as-it-is-dangerous/

Land Loss Lookout: Foundation for extending crowd-based wetland analysis to speed up land surveys.

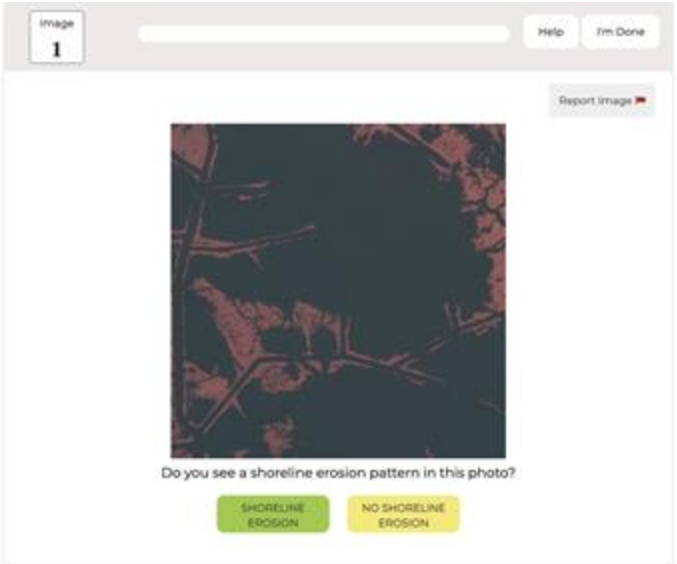
How Land Loss Lookout works



Main Page

6

patterns



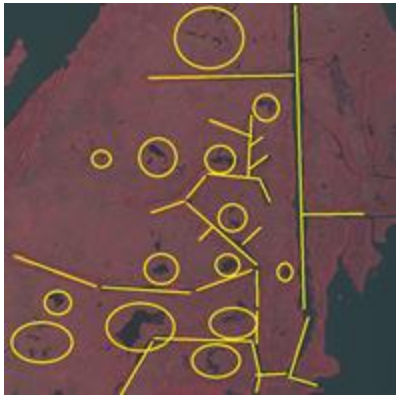
Task

cartosco.pe/landloss

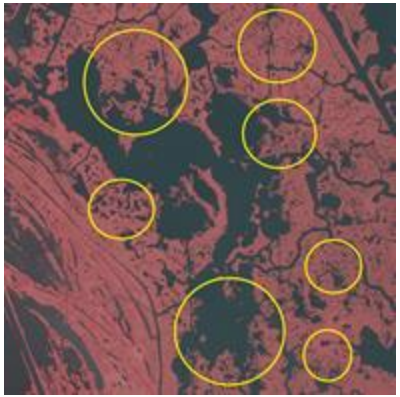
6

patterns

Shoreline Erosion



Oil & Gas



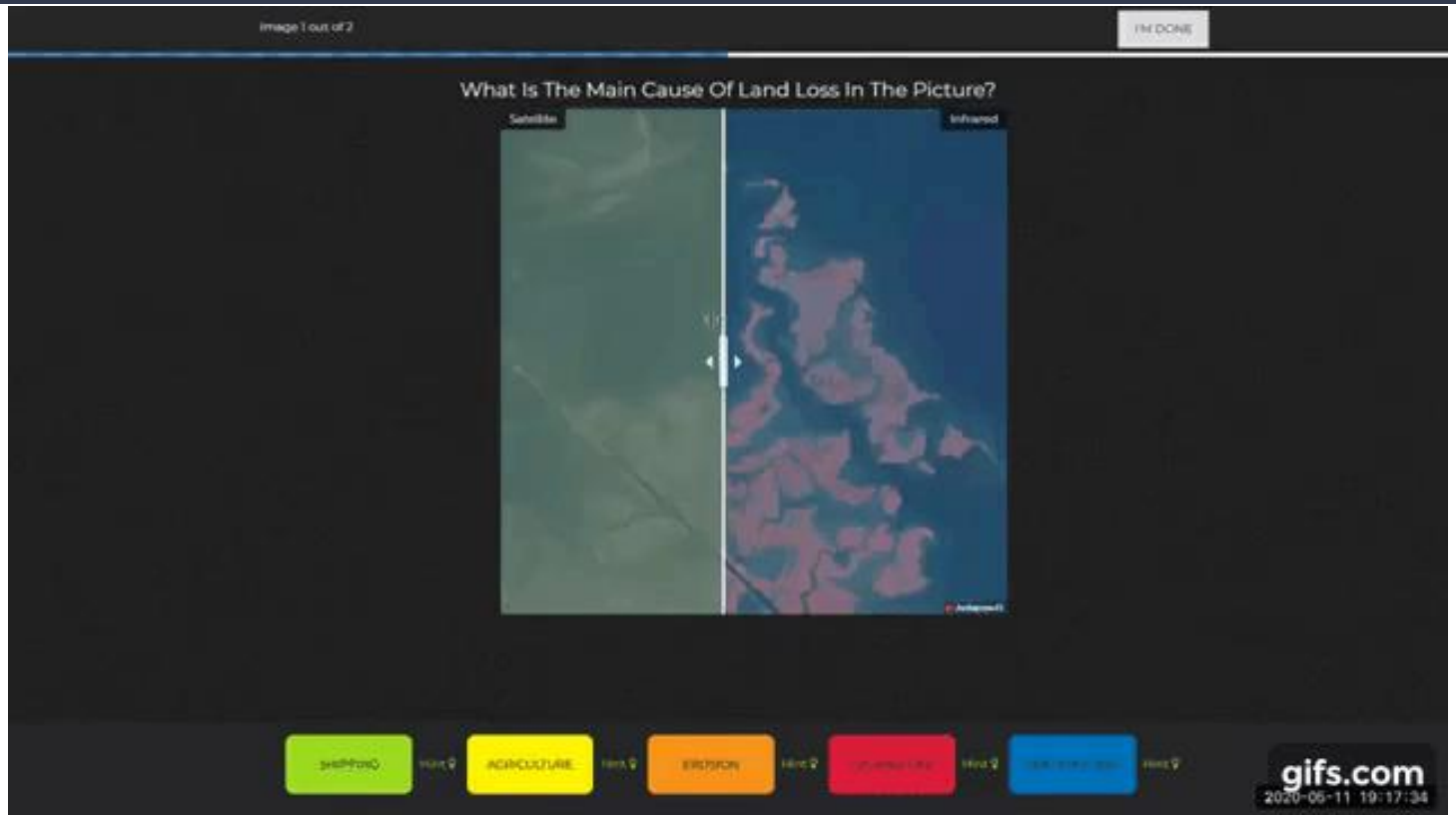
Sea Level Rise

Farming

Shipping

Restoration

Why Use (SONRIS) Color Infrared Aerial Photography?



Impacts have been characterized by experts previously

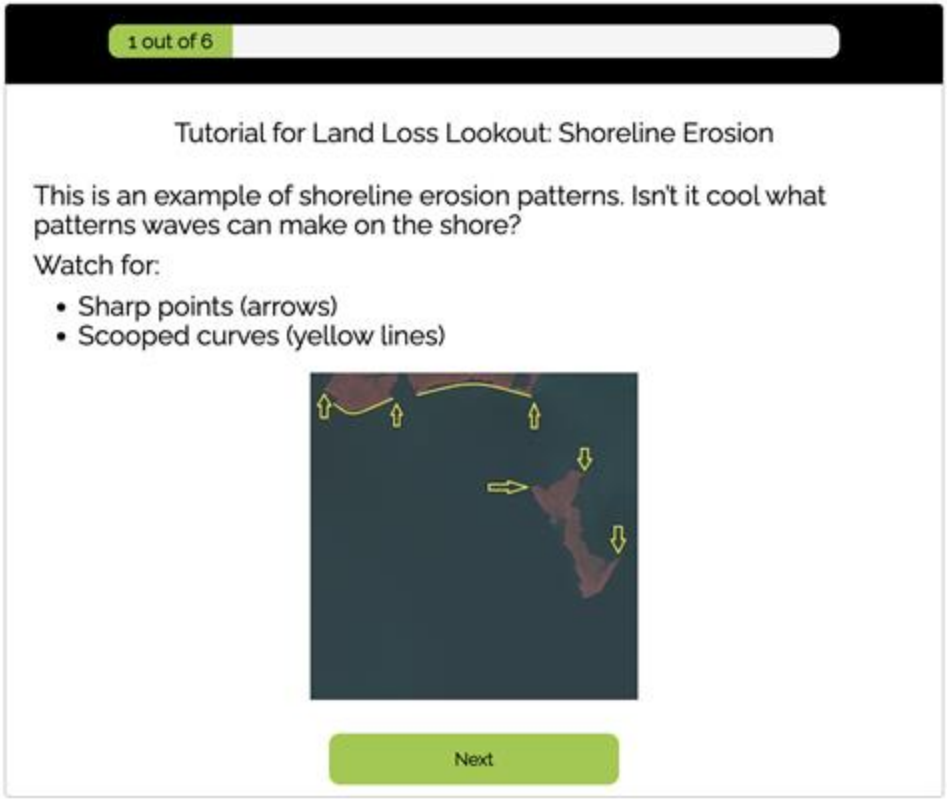
"A mosaic of the fifty maps was created on a single wall of the laboratory and used as reference during a series of open discussions in which similarities in coastal land loss configurations were identified and evaluated.

"Additional information was compiled about coastal land loss processes and landscape activities (cultural and natural) associated with individual areas of loss. This information was used to generate process scenarios for highly expressive coastal land loss formations."

USGS Open File Report 00-418

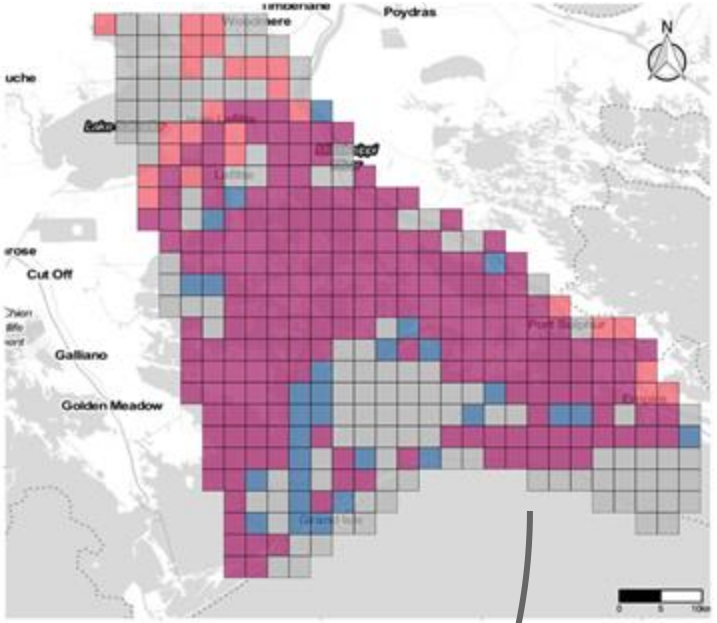
Designing Tutorials

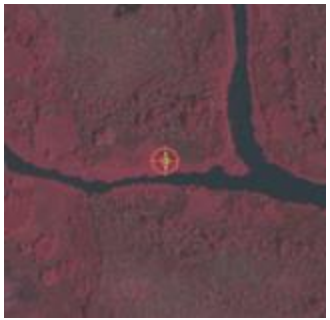
- Six wetland morphologies with visually identifiable patterns.
- Translated scientific terminology into more colloquial terms
    - Goal: understandable to non-specialists



Site Selection

- Area of the lower Barataria watershed on the West Bank of Jefferson Parish, and the East and West Banks of Plaquemines Parish, Louisiana.
- Grid of bounding boxes: 387 locations (images)





CIR photos from SONRIS

Land Loss Lookout Research Findings

https://conbio.onlinelibrary.wiley.com/doi/full/10.1111/csp2.12844

Results

672

Participants

contributing...

144

Labels
(average)

agreeing...

88%

With experts
(all projects)

62%

Images tagged as:
Oil & Gas

61%

Images tagged as:
Sea Level Rise

Farming:
19%

Restoration:
12%

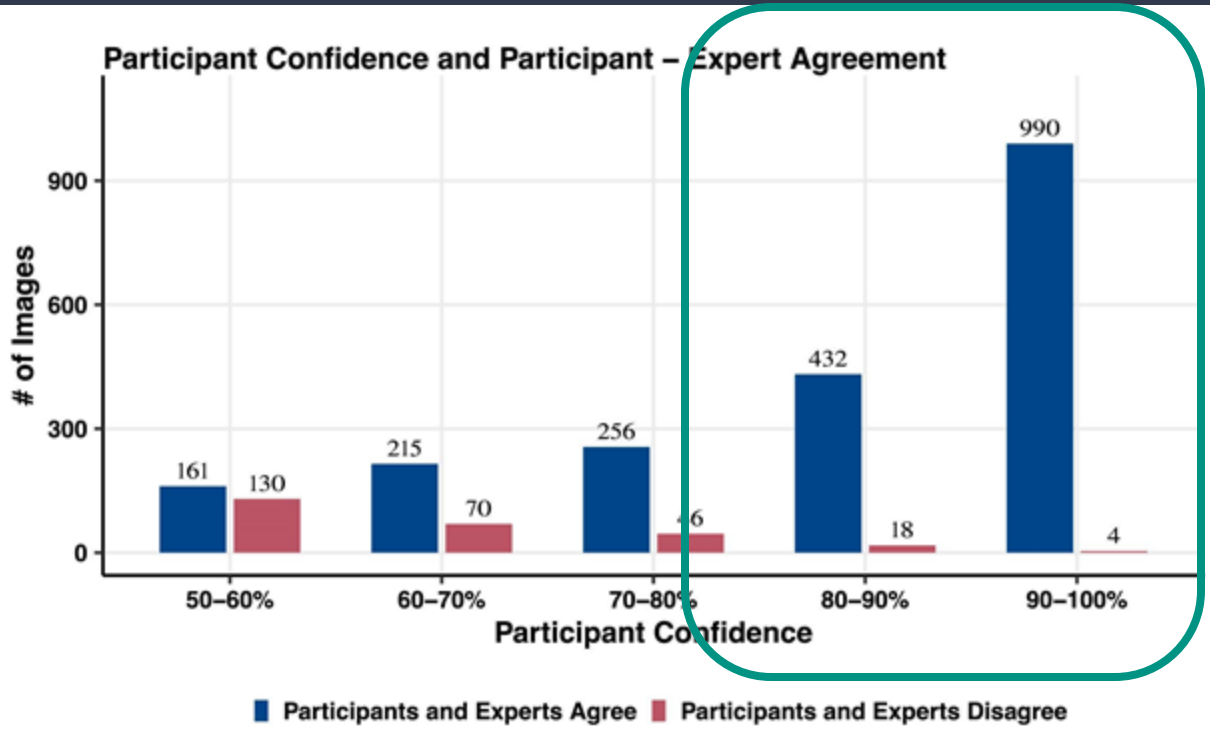
Shipping:
14%

Shoreline Erosion:
45%

Trained volunteers findings agree with experts

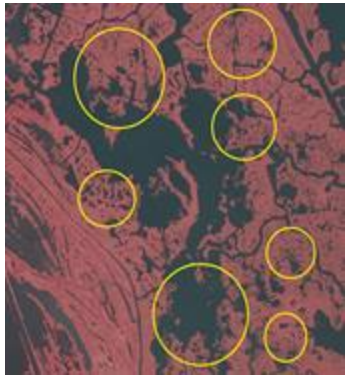
Experts and participants **agreed** on classifications at least 83% and at most 94% of the time.

Higher participant confidence:
Crowd vote **more likely** to agree with expert classification.



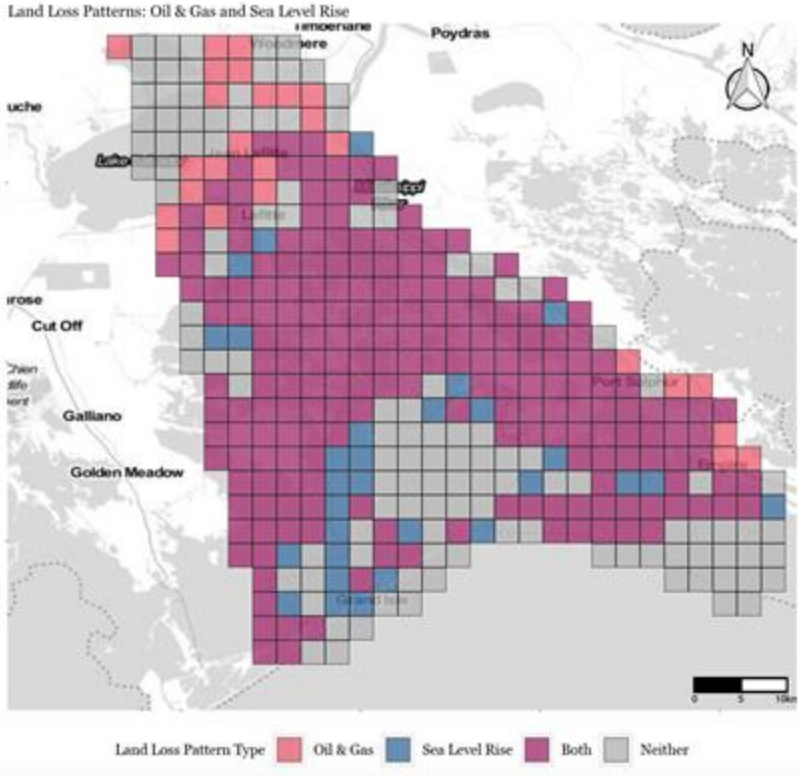
Oil and Gas Extraction and Sea Level Rise were the most common patterns and frequently occur together

Oil & Gas



Sea Level Rise

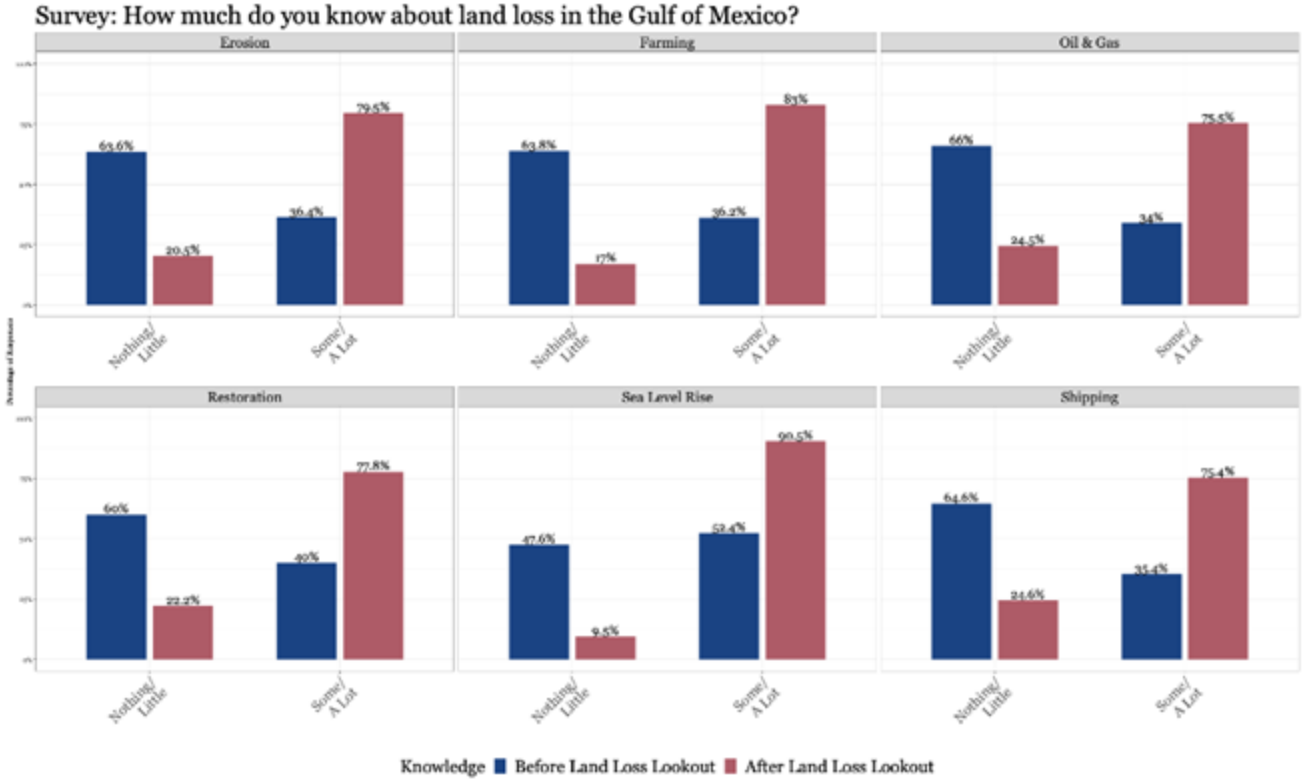
69% of all images contained **at least one** of these two patterns; 77% of the subset of images with either contained **both**.



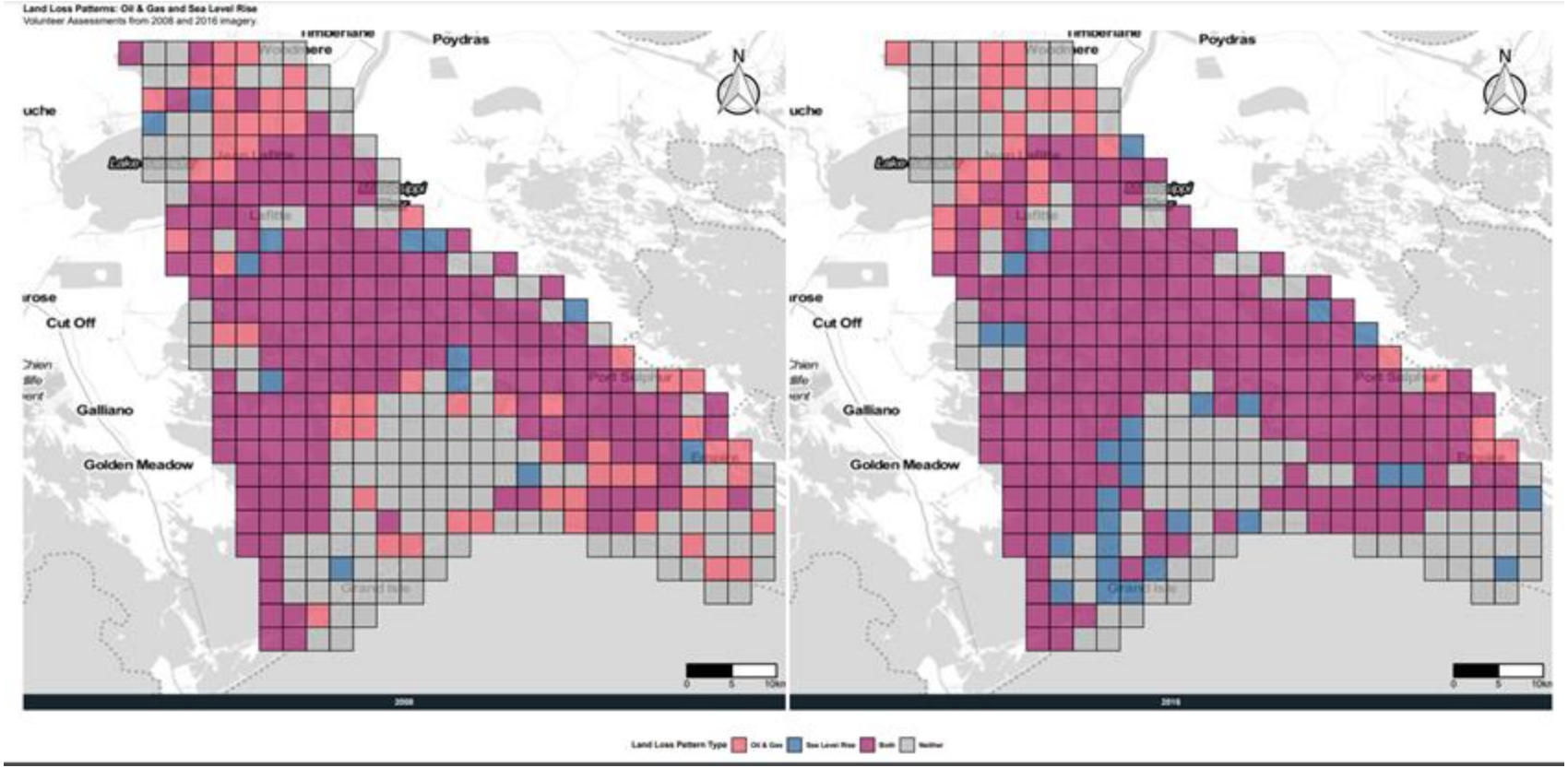
Participants self-reported increased knowledge of wetland loss after participating in the project

"Some" & "A Lot" responses **increased by 104%**.

"Nothing" & "Little" responses **decreased by 67%**.



Next Steps



Compare 2008 data to 2016

Pushing for Revegetation of Oil and Gas Canals

Revegetation: Oil companies are legally responsible for revegetating canals after closing off wells.

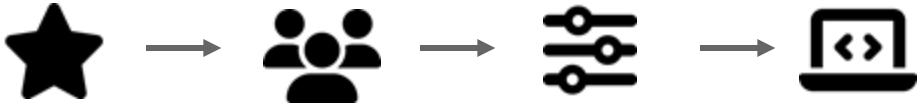
However many corporations don't revegetate and don't report closing of canals or wells.

Our mission: Leverage Crowdsourcing and Machine Learning to identify open canals adjacent to closed wells

Not Vegetated

Vegetated

Process:



Expert labeling examples → **Crowdsourcing** → **Corrective Feedback** → **Machine Learning Model**

Tile-o-Scope AR

- Image labeling with a physical component.
- Variety of games and activities using the same image matching mechanics.
- Goal: **Community building**

cartosco.pe/ar

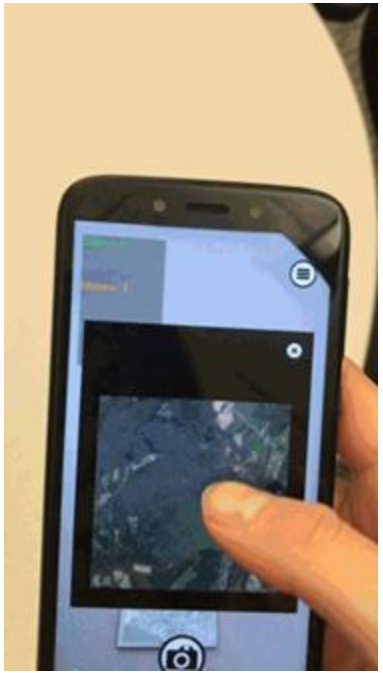
TILE-O-SCOPE AR

TILE-O-SCOPE AR

cartosco.pe/ar

How it works

1. Hover over tiles to make images appear.
2. Select ones you believe belong to the same category to collect them.



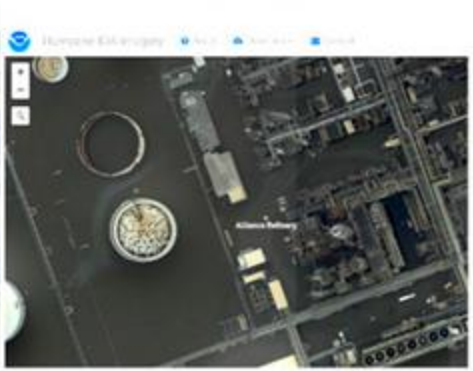
- Gandhi, Kutub, et al. "A Comparison of Augmented Reality and Browser Versions of a Citizen Science Game." The 16th International Conference on the Foundations of Digital Games (FDG) 2021. 2021.
- Spatharioti, Sofia Eleni, et al. "Tile-o-Scope AR: an augmented reality tabletop image labeling game toolkit." International Conference on the Foundations of Digital Games. 2020.

IDA DAMAGE LOOKOUT

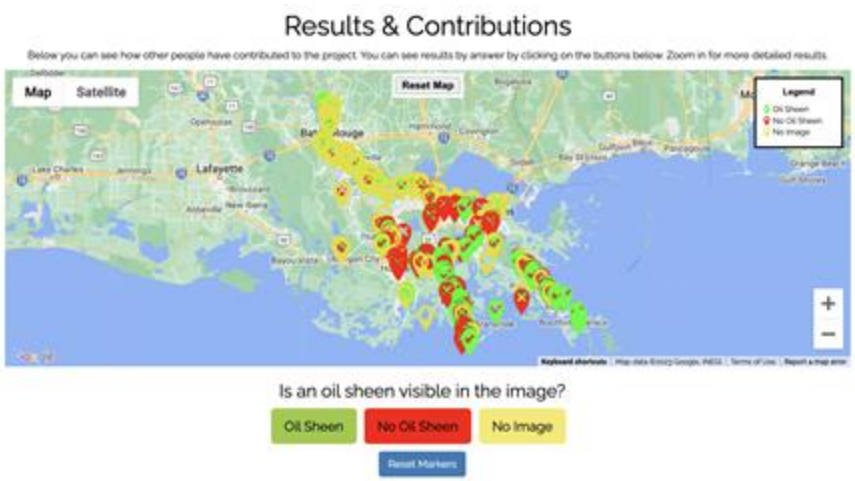
Crowdsourced image analysis of NGS data: 102 oil spills, with a high level of confidence.

healthygulf.org/IdaReport

Alliance Refinery Before #Hurricaneida



Alliance Refinery After #Hurricaneida



https://scistarter.org/ida-damage-lookout

LAND POLLUTION LOOKOUT: NIGER DELTA

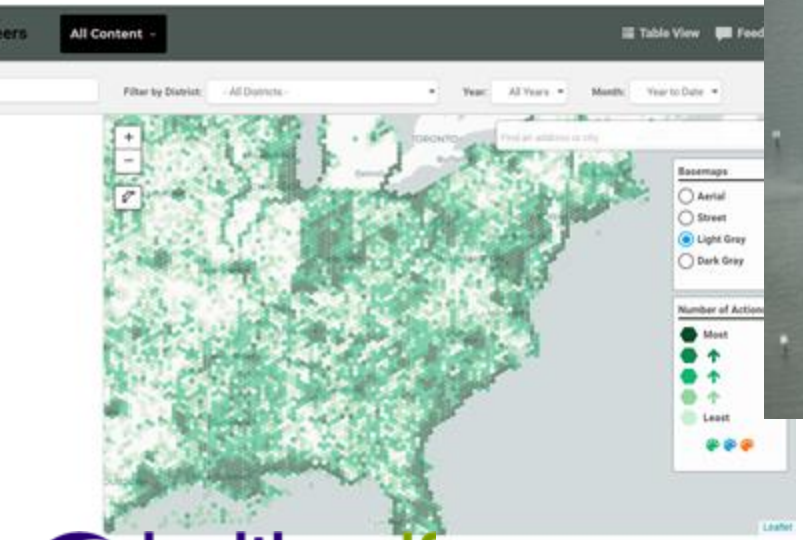
Oil spill restoration site in Ogoniland. Image credit: Baridapsi Unique Mappers Network,Nigeria, February 2022.

78/368 locations:
Oil Spill
&
Damaged
Vegetation

https://cartosco.pe/hub/landpollution

SIGN ON LETTER TO EPA

Sign On: EPA must include wetlands impacts in EJ Screen



ORM Wetlands impacts are a burden on environmental justice communities, but is not considered in EJ Screen or on CEJST

https://bit.ly/WetlandsEJScreen

healthygulf

Scott Eustis
Community Science Director,
Healthy Gulf

Kutub Gandhi
PhD Research Assistant,
NEU

Eliza Boetsch
Research Assistant,
NEU

Seth Cooper
Associate Professor,
Northeastern University

Sophie Spatharioti
Post Doc
Microsoft Research

Matt Rota
Senior Policy Director,
Healthy Gulf

Archana Apte
UX Design
NEU

Sara Wylie
Associate Professor,
Northeastern University

The Land Loss Lookout Team

Thank You!

Contact Info
Cartoscope: contact@cartosco.pe
Healthy Gulf: scott@healthygulf.org

Tutorial: Oil & Gas

1 out of 6

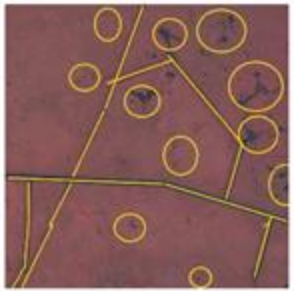
Tutorial for Land Loss Lookout: Identifying Oil & Gas

Correct! This aerial photograph shows a pattern of oil and gas.

Watch for:

- Medium sized canals with several off-shoots (yellow lines).
- Irregular patterns of canals.
- Multiple blotchy or irregular ponds (yellow circles).

The ponds form because oil canals block in surrounding marshes so water can't drain out, and then ponds form where the lowest areas become flooded.



Next

Tutorial: Sea Level Rise

1 out of 7

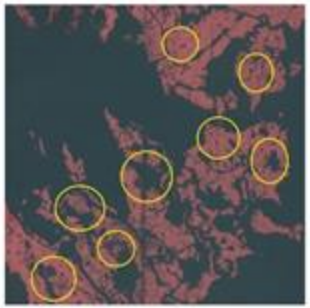
Tutorial for Land Loss Lookout: Identifying Sea Level Rise

Correct! This is an example of a pattern of sea level rise, because we see:

- Land dotted with small holes (yellow circles).

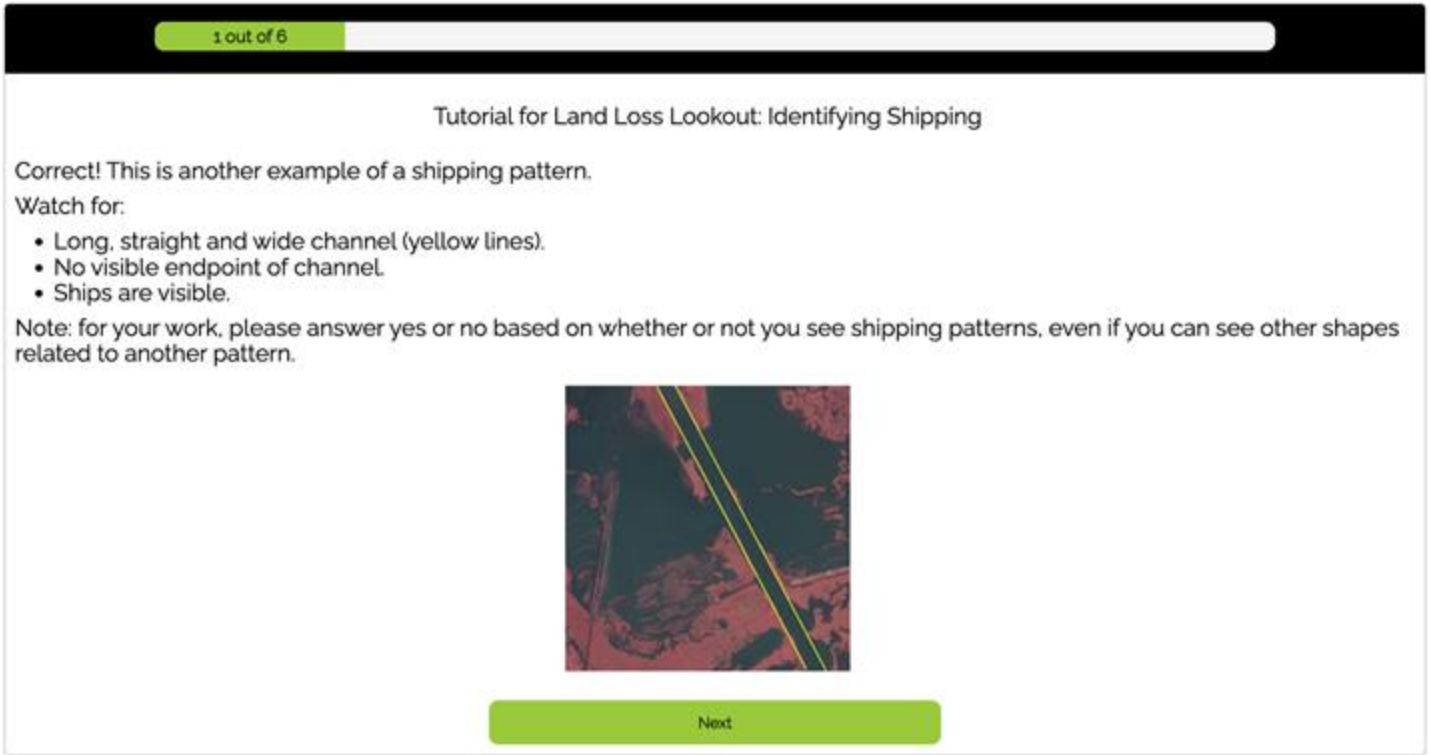
One of the characteristic patterns that suggests sea level rise is land appearing spongy or lacy.

Note: You won't see any lines, circles or arrows on the aerial photographs you'll be working with, so please take note of the shapes in this tutorial.



Next

Tutorial: Shipping



Tutorial: Shoreline Erosion

1 out of 6

Tutorial for Land Loss Lookout: Shoreline Erosion

This is an example of shoreline erosion patterns. Isn't it cool what patterns waves can make on the shore?

Watch for:

- Sharp points (arrows)
- Scooped curves (yellow lines)

Next

Tutorial: Restoration

1 out of 7

Tutorial for Land Loss Lookout: Identifying Restoration

Yes! This is an example of a restoration pattern, because we see:

- Boxy shapes of land, linear boundaries (green lines).
- Open soil, indicated by gray.

Restoration patterns often have boxy boundaries in an aerial photograph. However, boxy boundaries are are similar to farms, so another distinguishing characteristic is the presence of open soil or sand, indicated by gray color next to the red color of land.

Next

Tutorial: Farming

1 out of 6

Tutorial for Land Loss Lookout: Identifying Farming

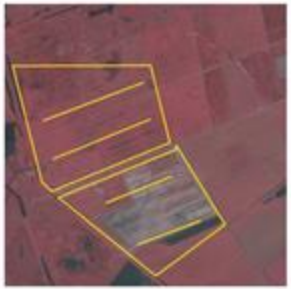
Correct! This aerial photograph shows a pattern of a field used for farming.

Remember to look for:

- Parallel straight lines in a field (yellow lines).
- Blocky shapes of land with angular borders (yellow blocks).

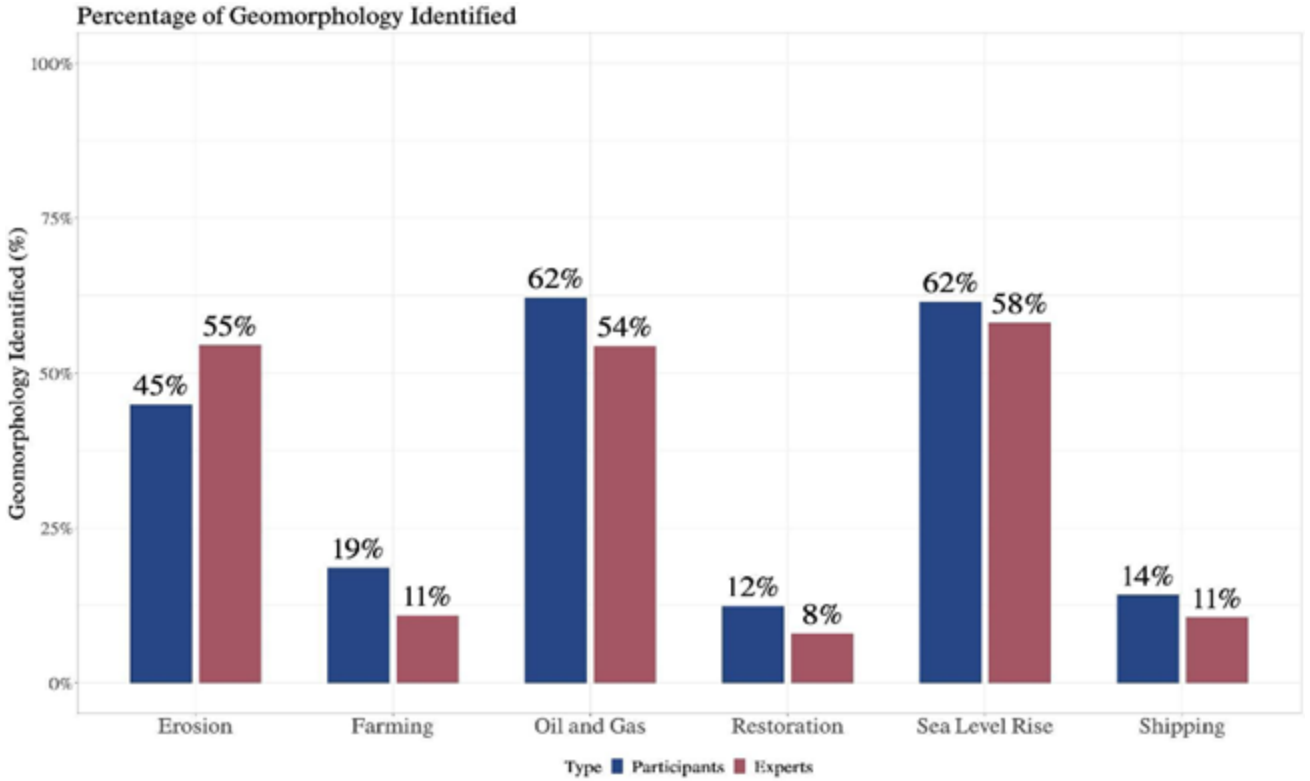
Parallel lines are the plowing patterns.

Note: You won't see any lines or arrows on the aerial photographs you'll be working with, so please take note of the shapes in this tutorial.



Next

Findings: Participants vs Experts



Ida Damage Lookout