WhaleMap

A tool to collate and display whale survey results in near real-time

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North Atlantic right whales

- *Eubalaena glacialis*
- Up to 55ft (17 m) long
- Up to 70 US tons (~60 mt)
- East coast US / Canada
  - Southern calving (winter)
  - Northern feeding grounds

Image credit: whaleopedia.org

Right whale sightings
2018-present

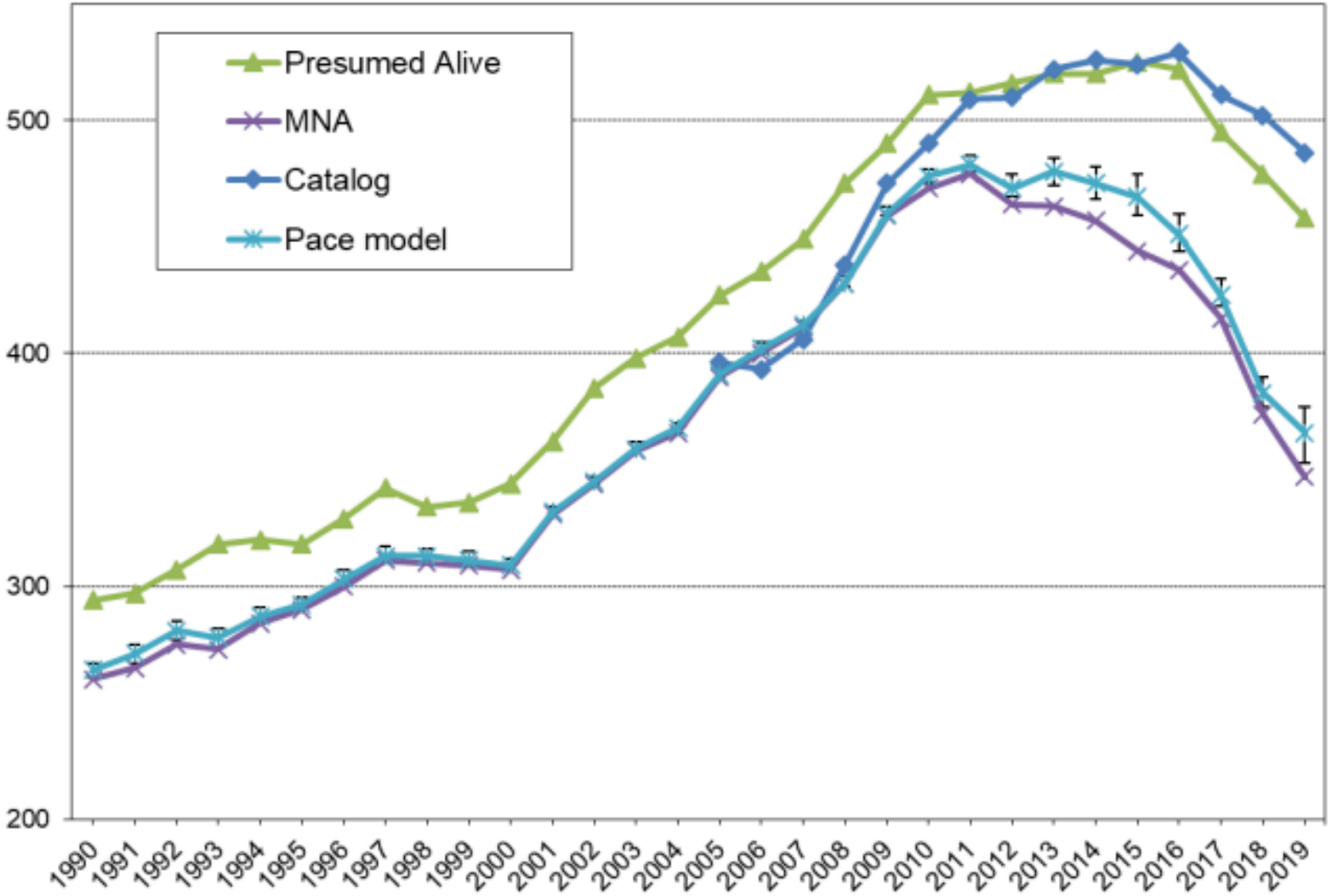
Feeding (mostly summer)

Calving (winter)

whalemap.org

North Atlantic right whales

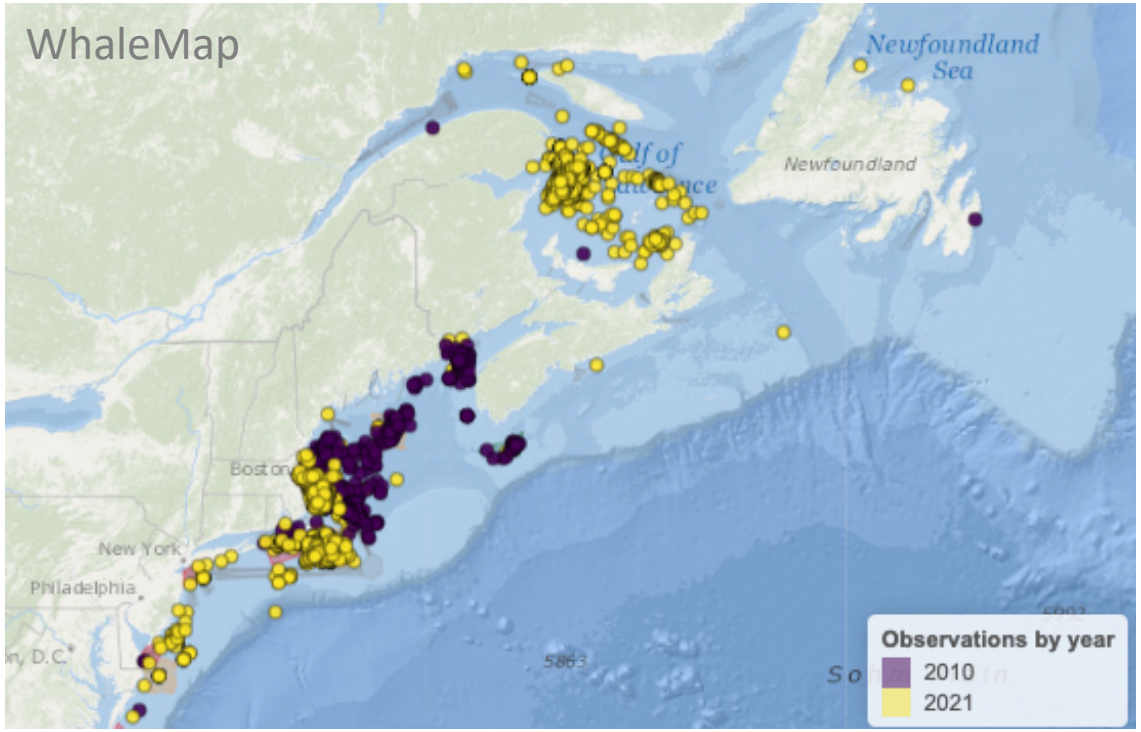
- The ‘right’ whale to hunt
- Endangered (IUCN)
  - Latest population estimate: **336** (NARWC 2021)
  - Under 100 breeding females



2020 NARWC Report Card

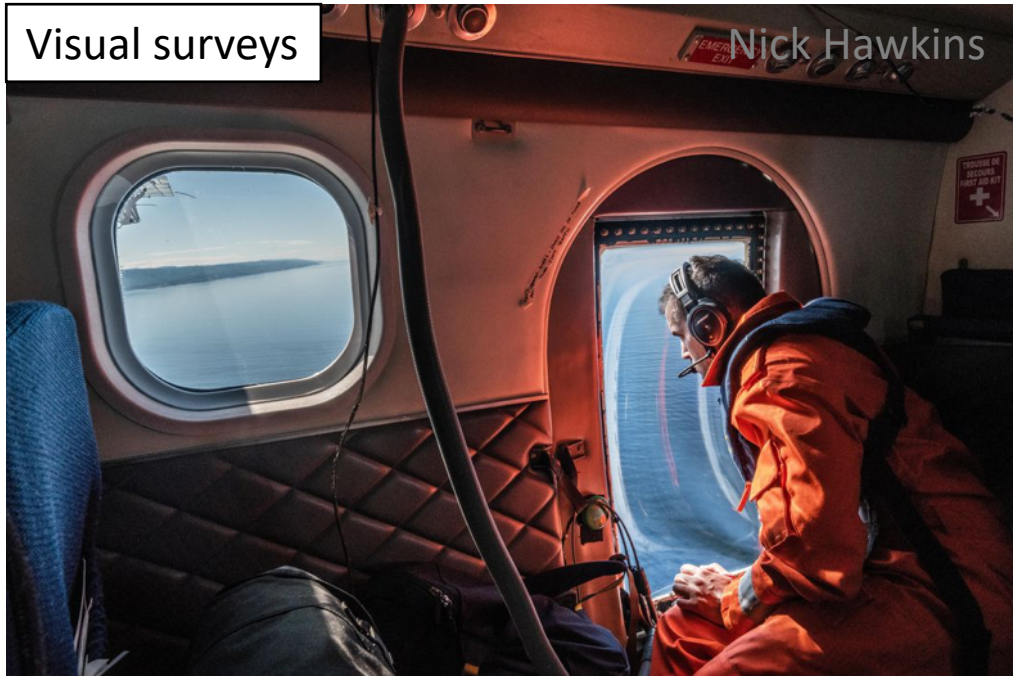
Barriers to recovery

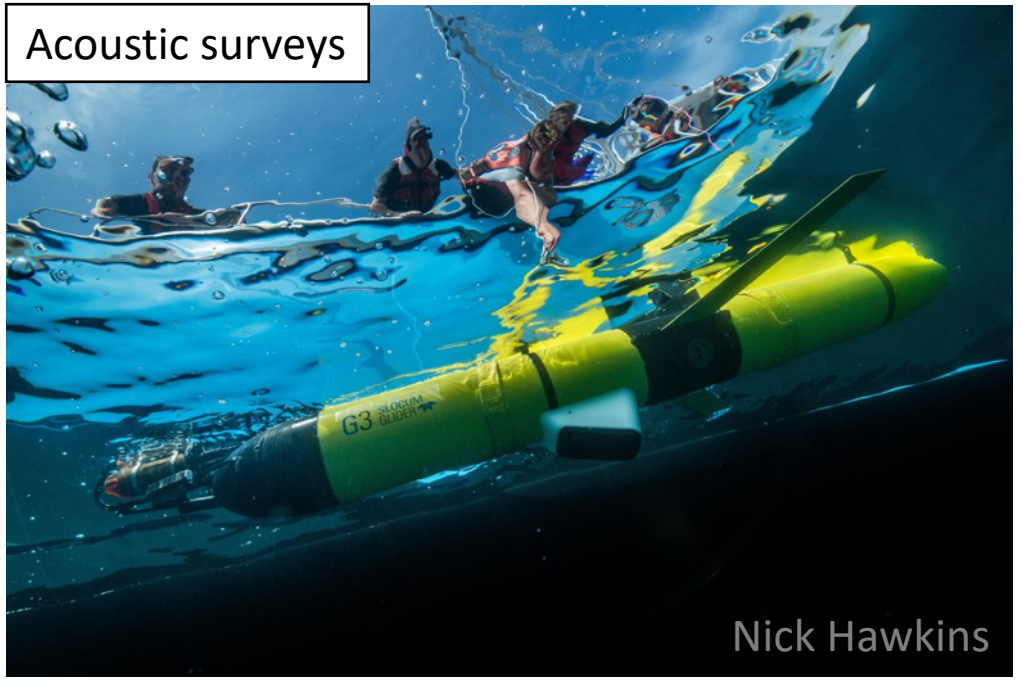
- Climate-induced shifts in prey
- Human-caused stress and mortality
  - Entanglement
  - Vessel strikes
  - Unusual Mortality Event: 34 dead since 2017



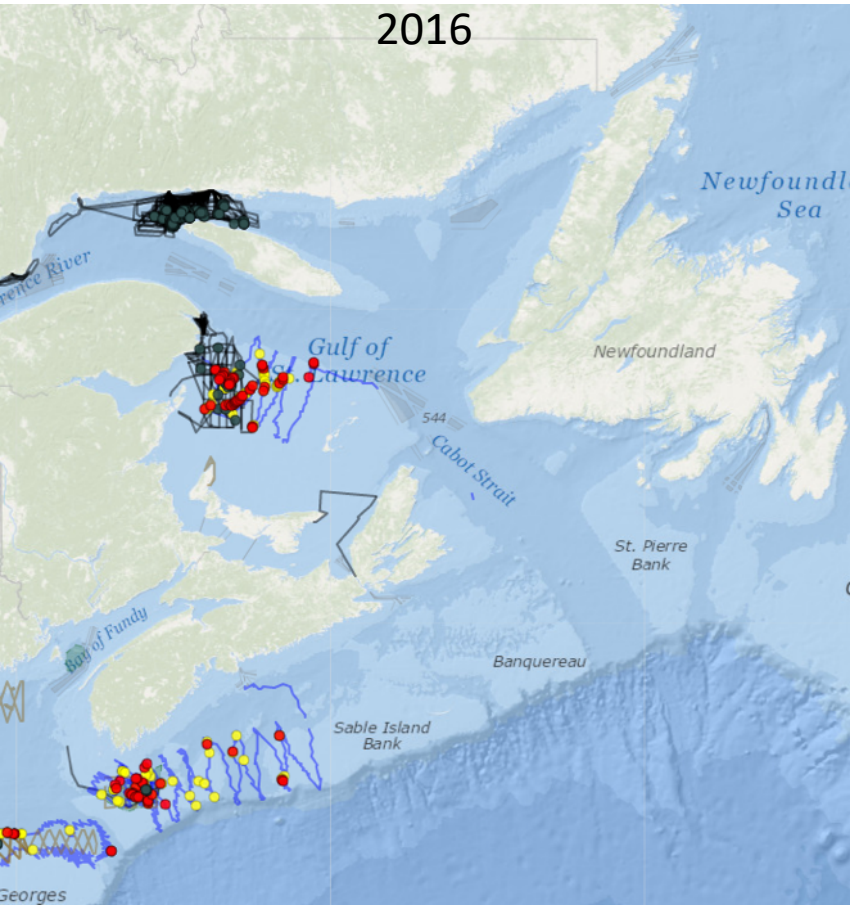
Risk mitigation

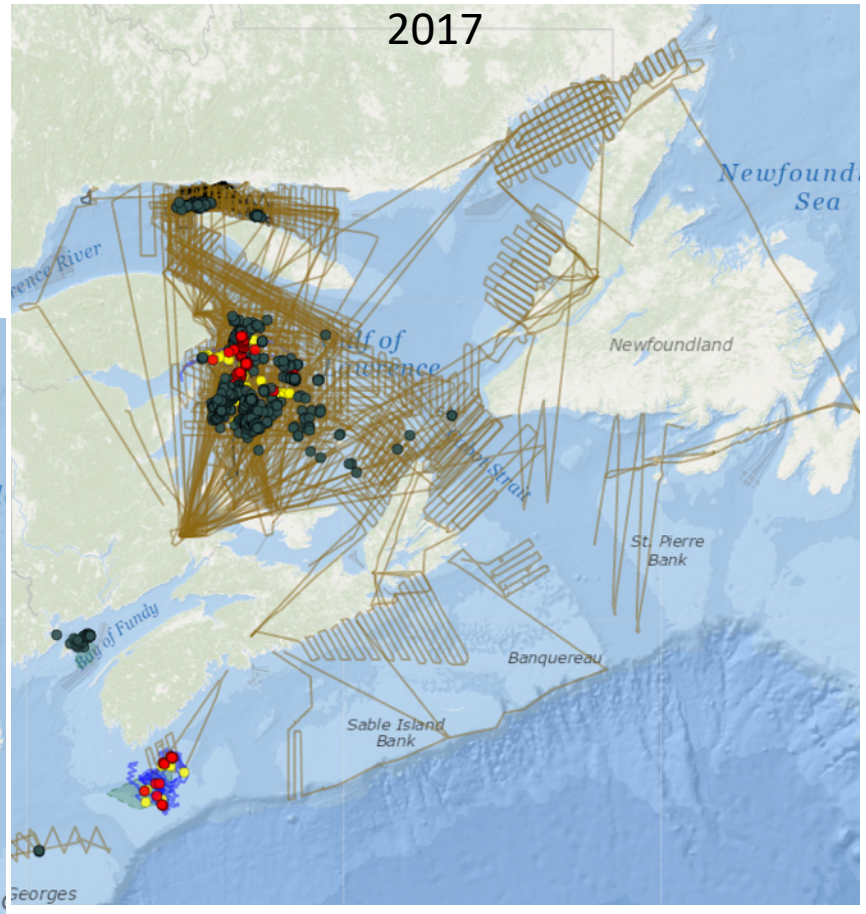
- Entanglement: ropeless gear, closures
- Vessel strike: speed restrictions, closures
- Static or **dynamic**
- Rely heavily on near knowledge of whale distribution
  - Visual surveys
  - Acoustic surveys

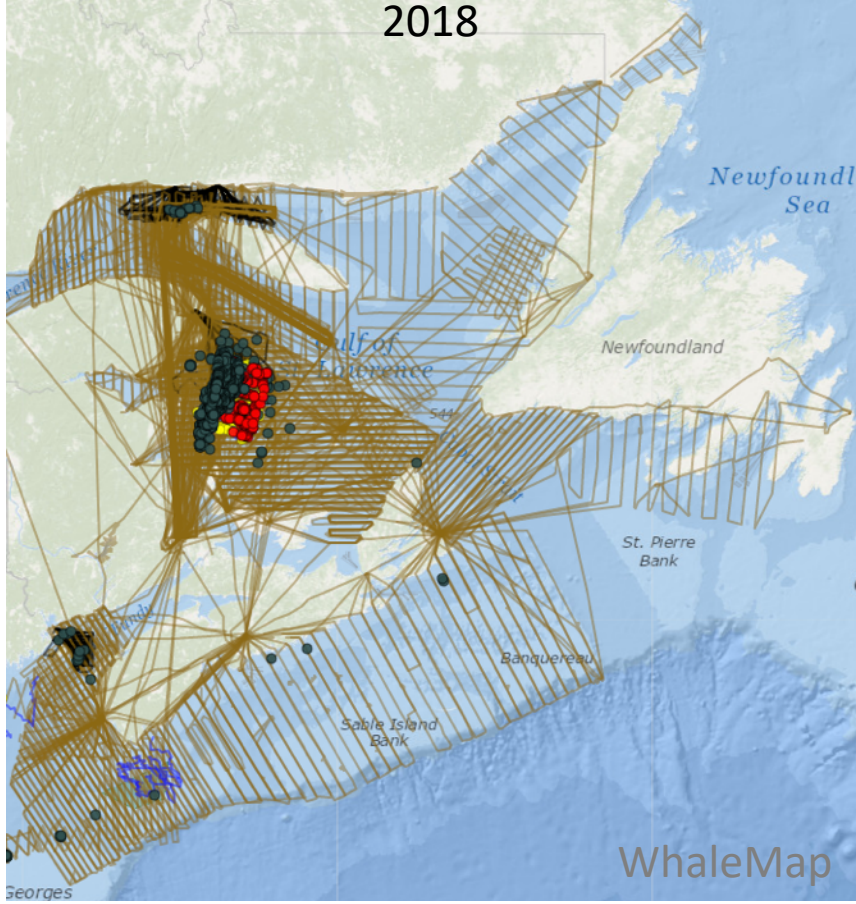


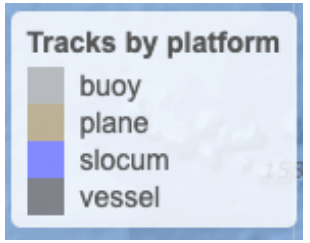


Survey effort in Canada









Need an **efficient** way to combine **survey results** to inform **management**

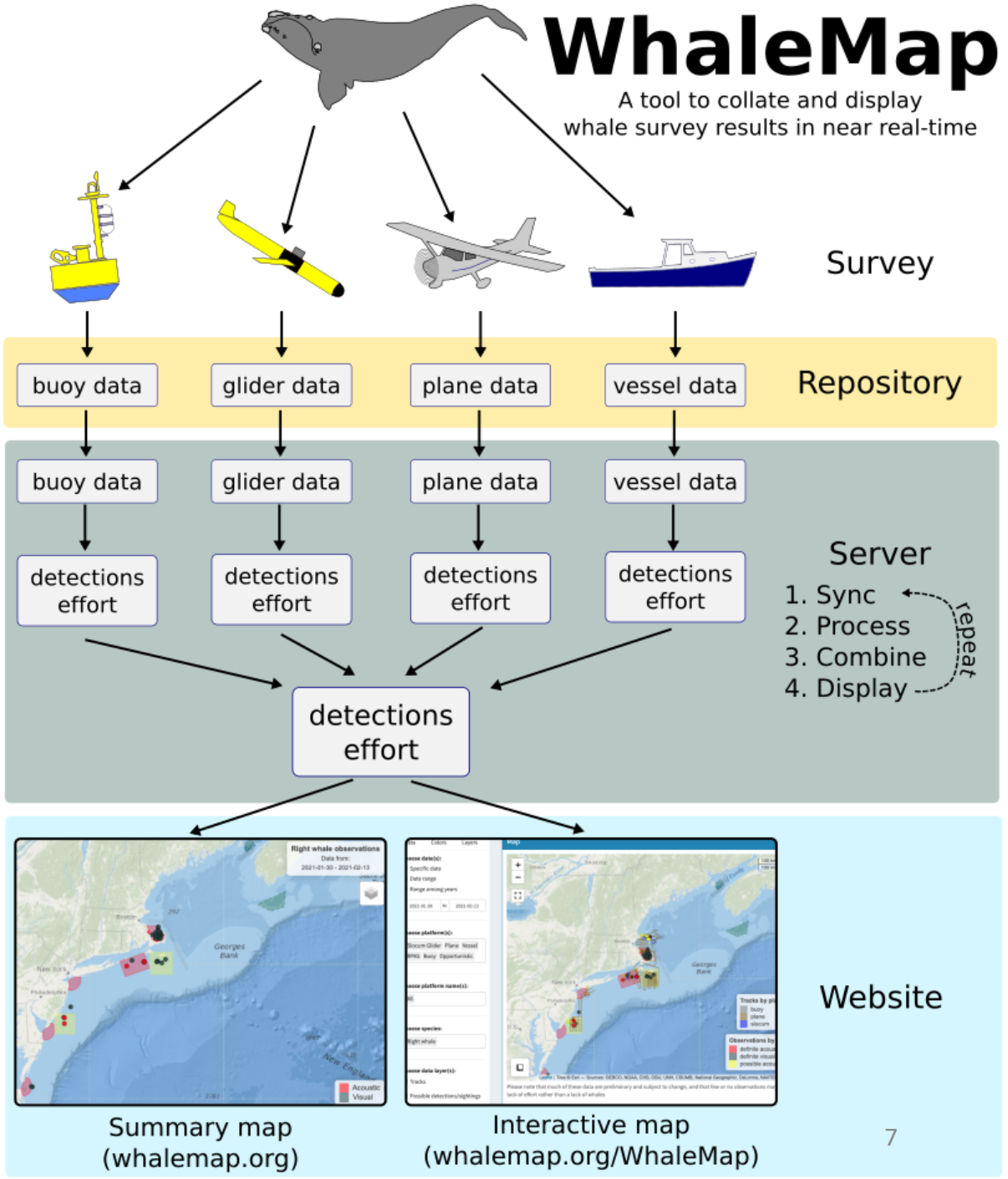
Introducing WhaleMap

WhaleMap was designed to:

- Incorporate whale detection and survey effort from all survey methods
- Allow teams to easily contribute and retain complete control over their data
- Provide the latest data in an accurate and publicly accessible format
- Operate transparently using open-source tools and with limited supervision

How it works

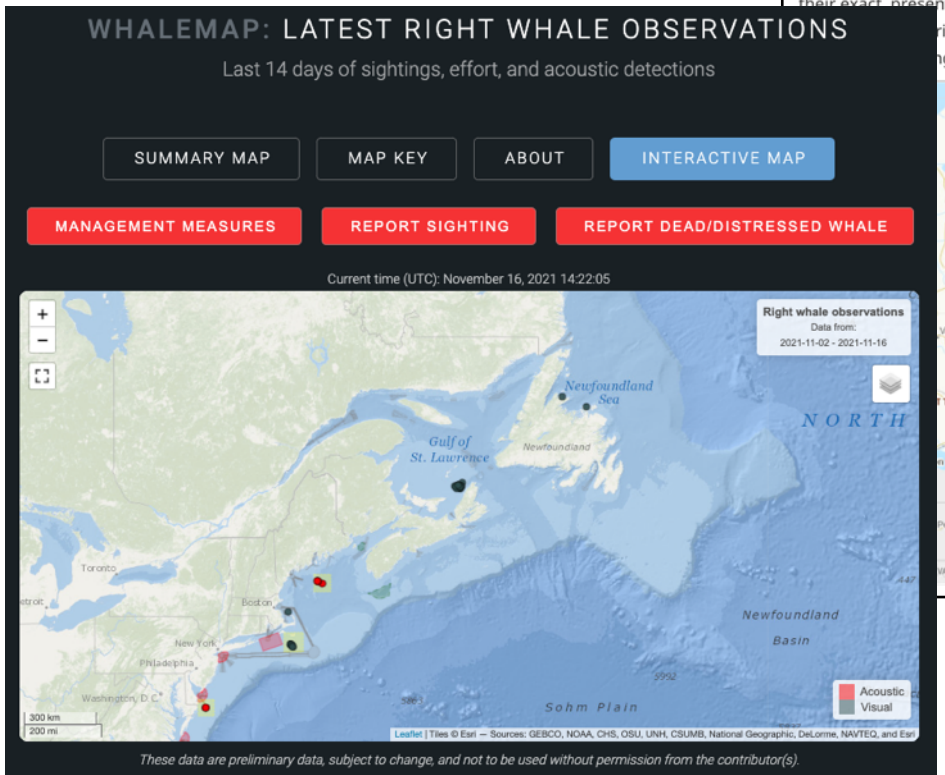
1. Raw survey data are uploaded to a remote repository (e.g., Google Drive) shared with WhaleMap
2. Data are copied to the WhaleMap server
3. Custom code extracts detections and effort from each survey
4. Data are combined and displayed on summary and interactive maps



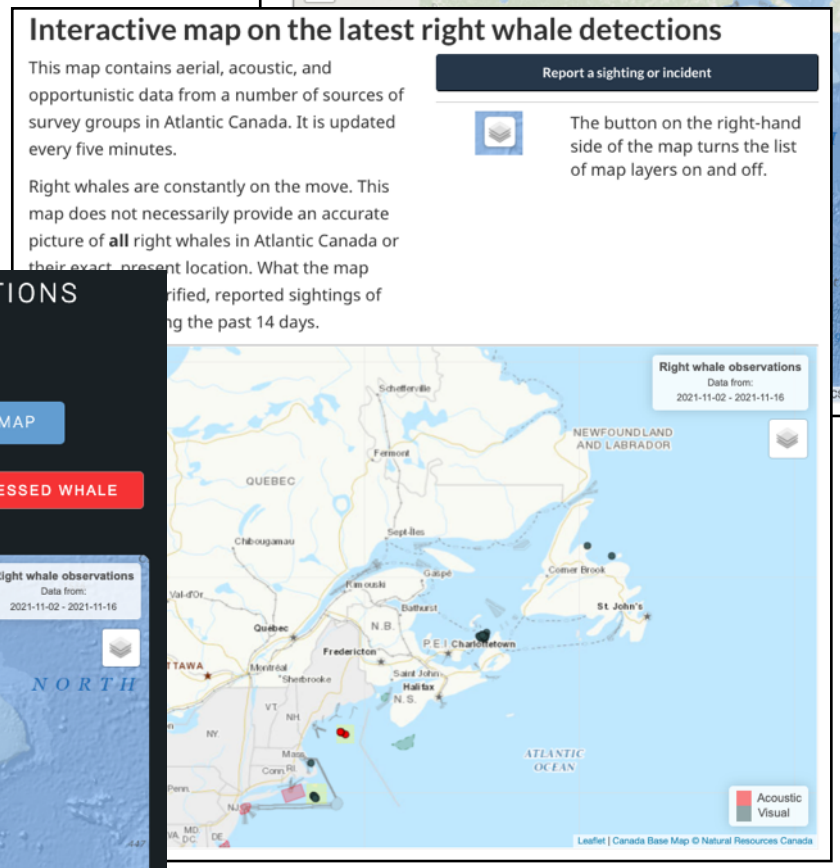
Johnson et al (2021)

Displays: summary map

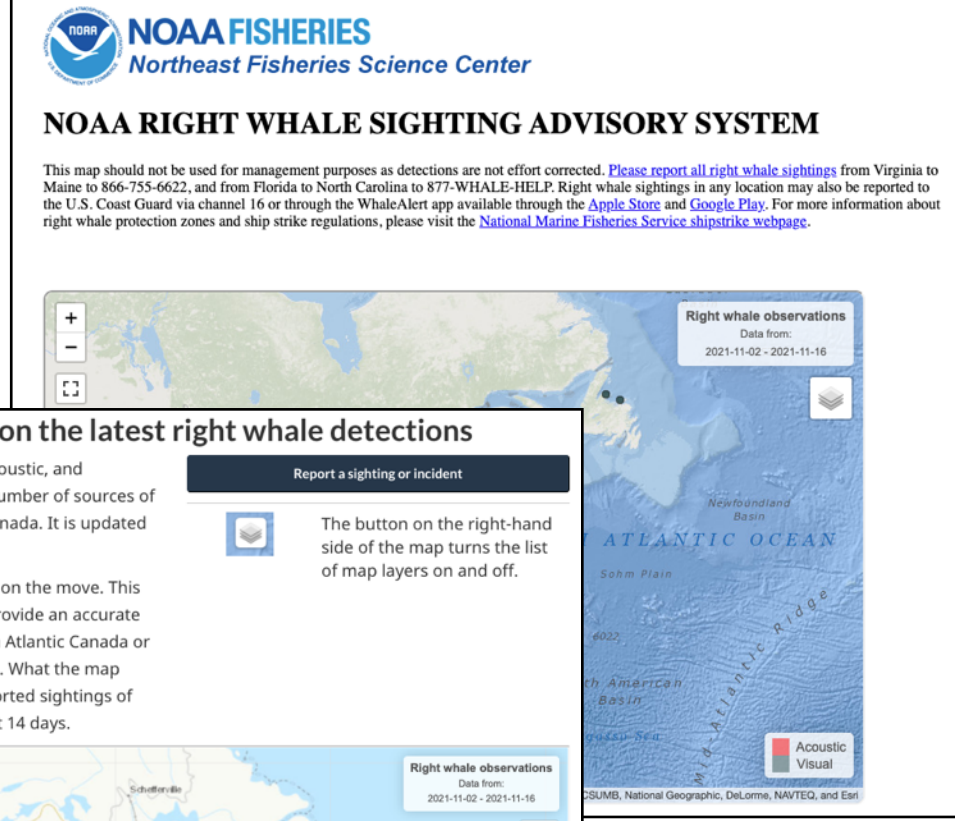
- Provides a snapshot of last 14-days of right whale detections
- Available at the **whalemap.org** homepage and embedded on several other websites
- Easy to interpret, but limited functionality



whalemap.org

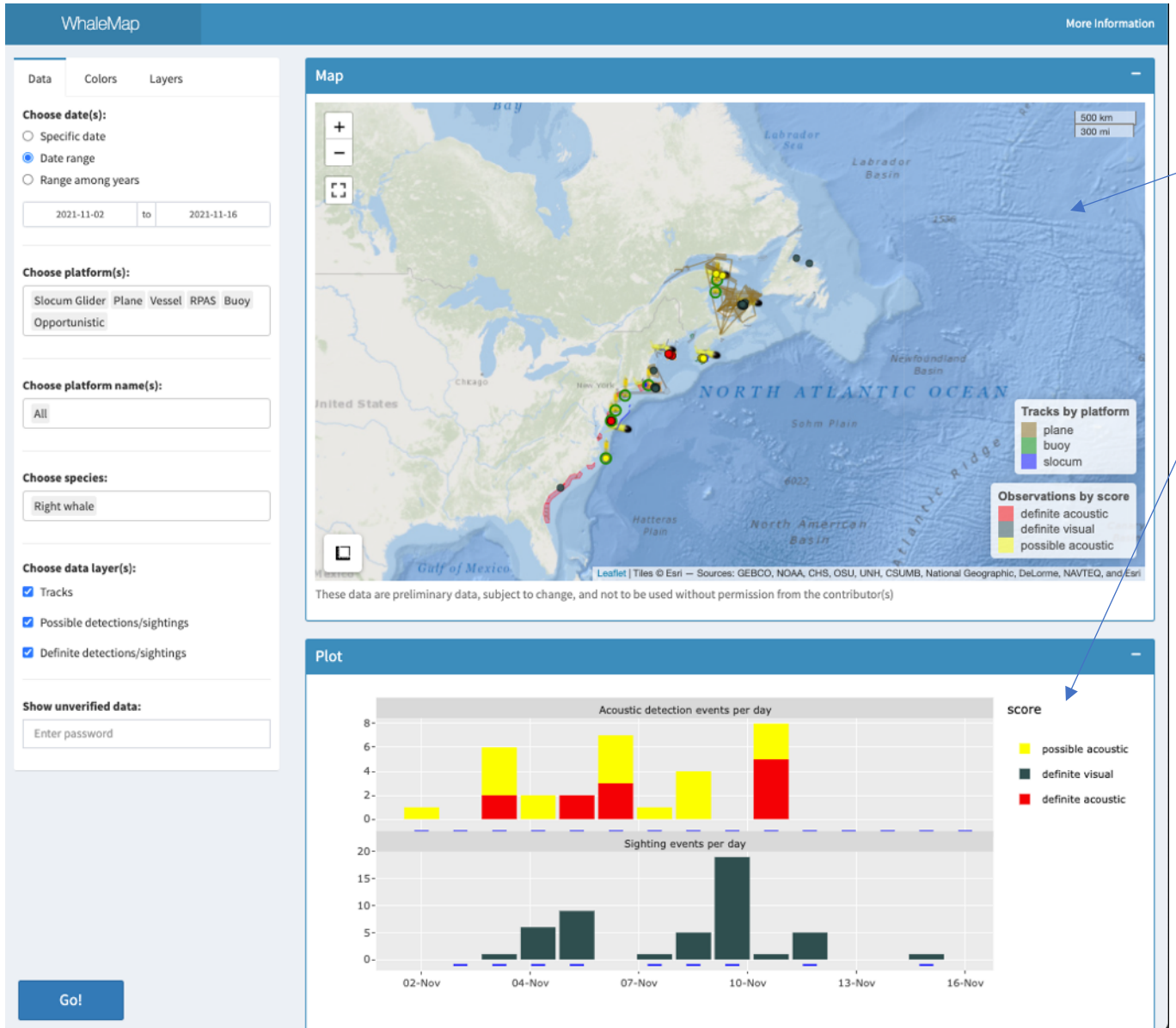


DFO



NOAA

Displays: dashboard



- Available at **whalemap.org/WhaleMap**
- Several data displays
  - Map
  - Timeseries
  - Summary
  - Status

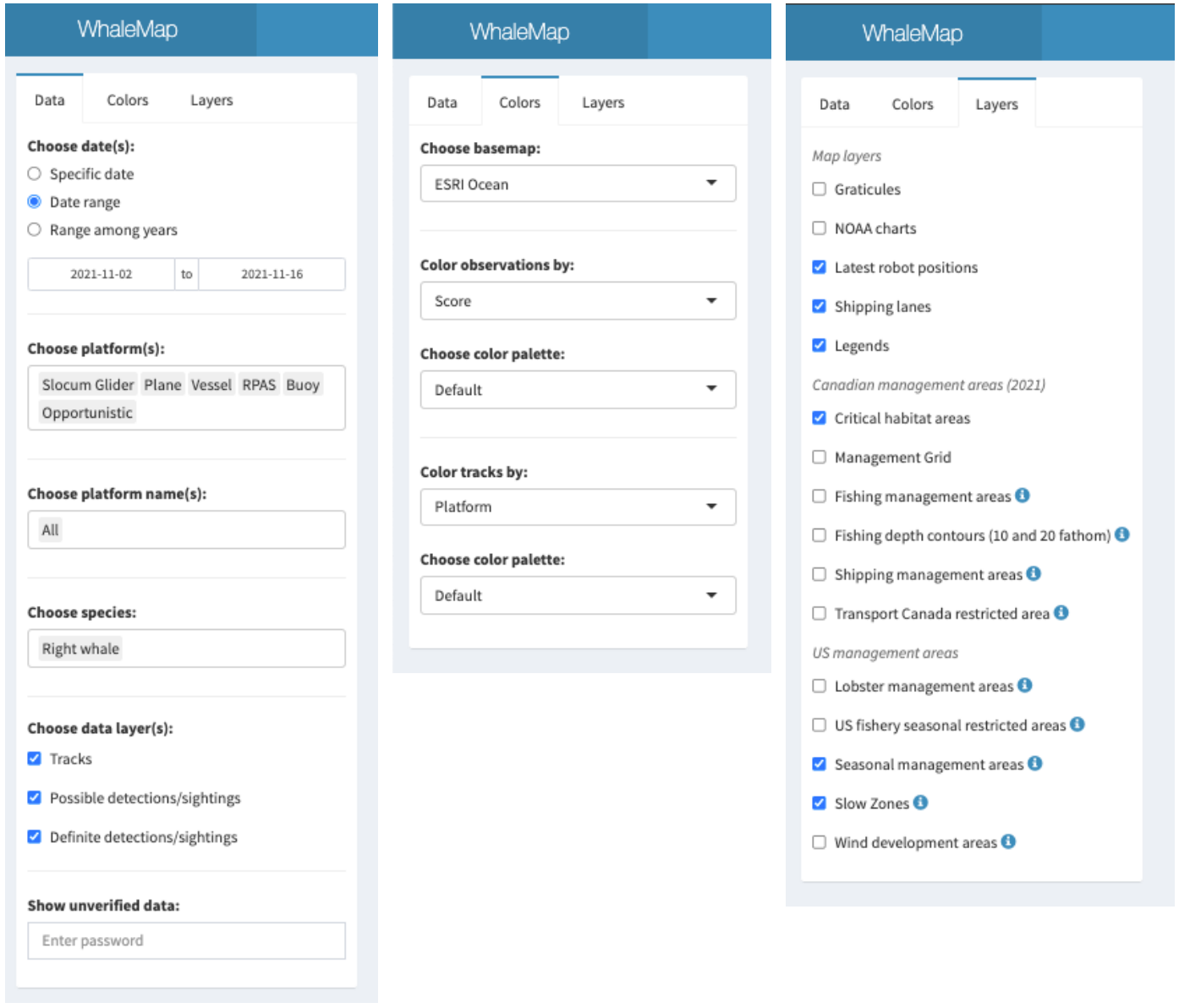
Currently viewing:

Species: right
Number of definite sighting events: 48
Number of whales sighted (includes duplicates): 81
Number of possible sighting events: 0
Number of whales possibly sighted: 0
Number of definite detections: 12
Number of possible detections: 19
Earliest observation: 2021-11-02
Most recent observation: 2021-11-15
Most recent position: 46.9098, -61.3659

Status:

Platform	Last processed [UTC]
Dal/WHOI acoustic detections	2021-11-16 13:30:51
NOAA NEFSC aerial survey sightings/tracks	2021-11-15 18:03:14
DFO Cessna aerial survey sightings (YOB)	2021-11-15 13:34:25
DFO Cessna aerial survey tracks (YOB)	2021-11-15 13:33:25
DFO opportunistic sightings reports	2021-11-11 20:02:43
TC Dash 7 aerial survey sightings	2021-11-11 00:06:30

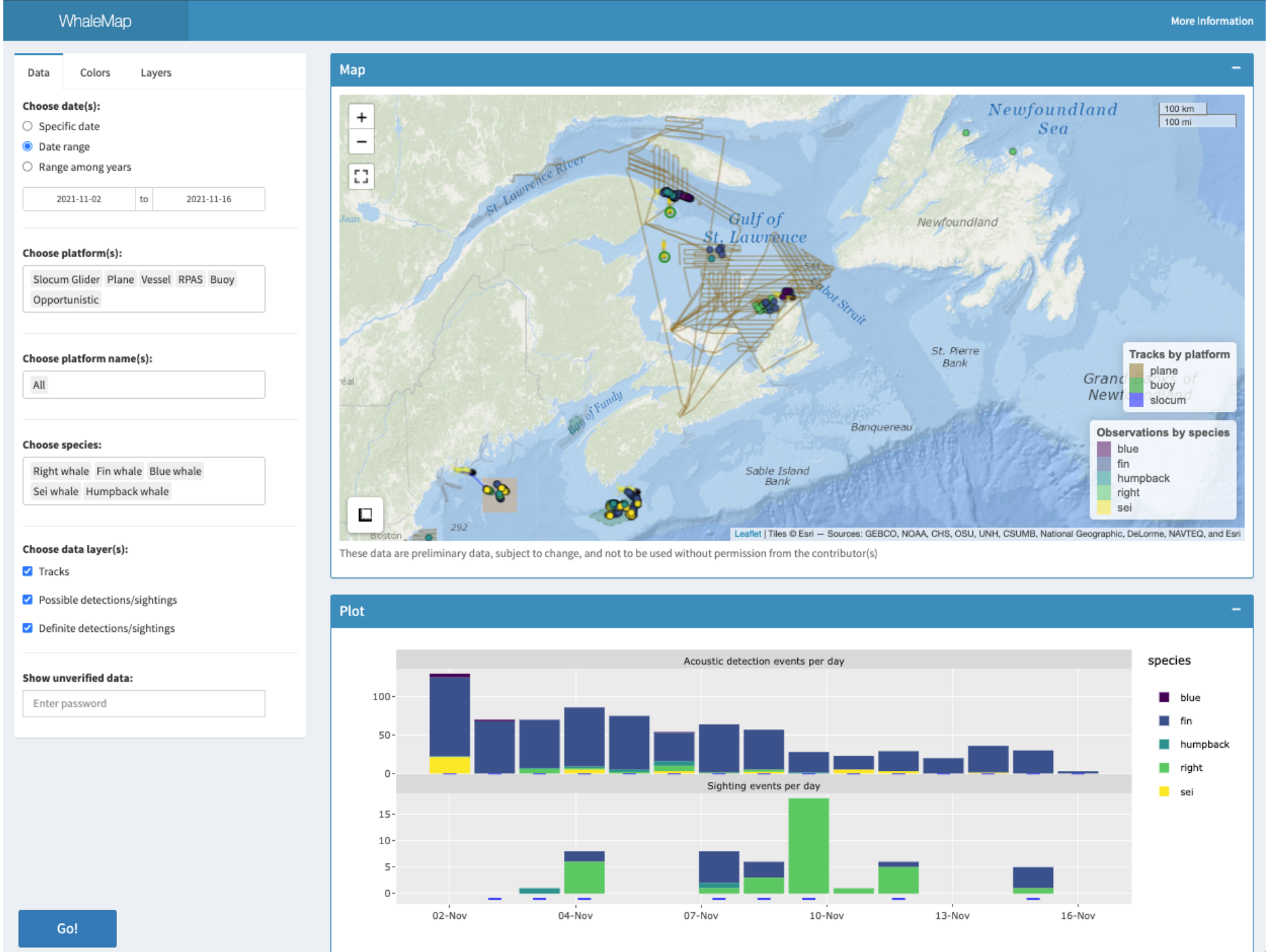
Displays: dashboard



- Available at **whalemap.org/WhaleMap**
- Several data filters and layers
  - Time range, platform type/name, species
  - Basemap, plot colors
  - Management layers

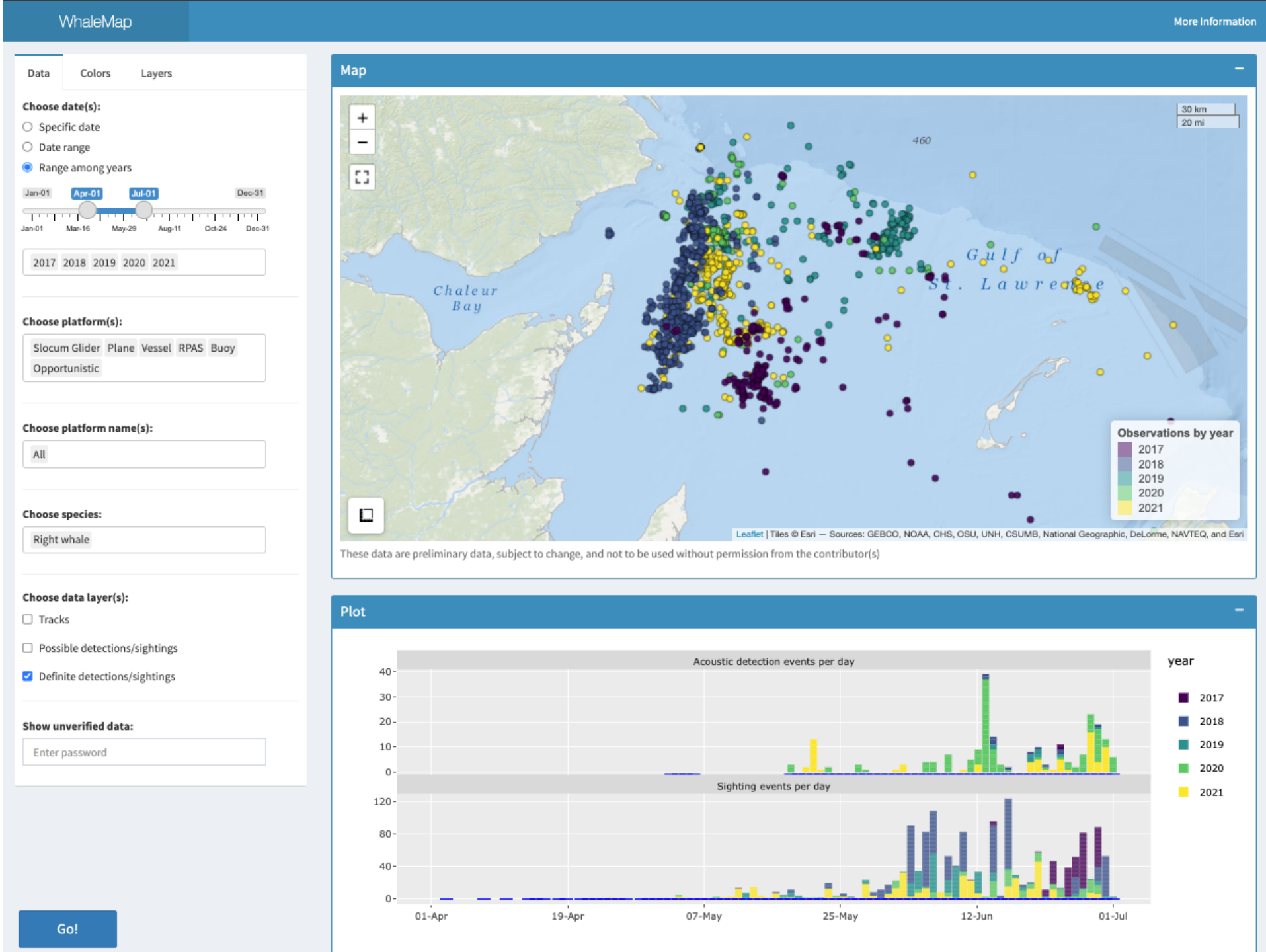
Examples

Last two weeks of survey effort and observations of all baleen whale species



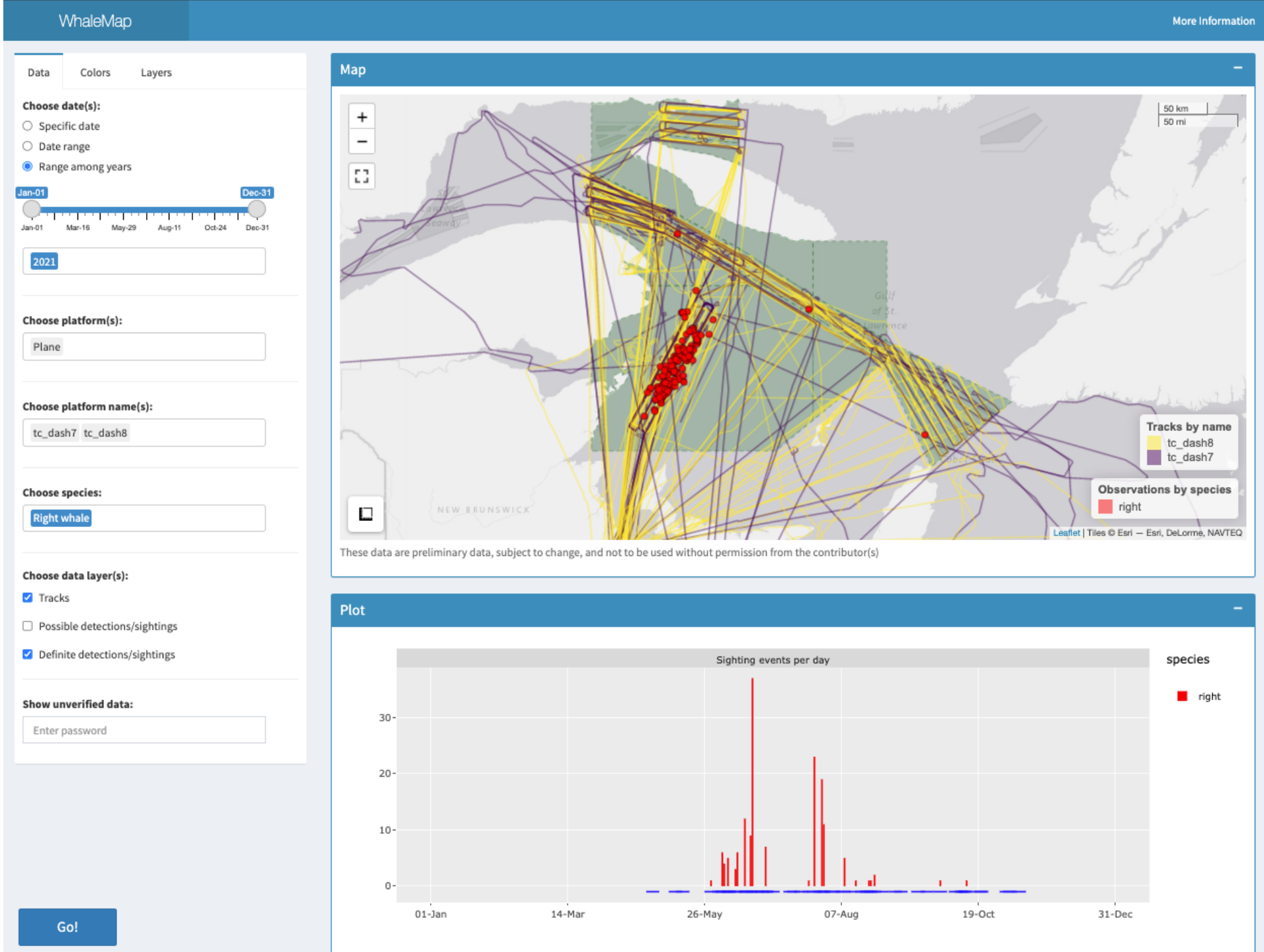
Examples

Annual variation in right whale distribution in the southern Gulf of St Lawrence during the snow crab fishery from 2017-2021



Examples

Distribution of aerial survey effort and right whale detections by Transport Canada planes in 2021



Available data

- **Species**: right, fin, sei, humpback, and blue whales
- **Region**: East coast of US and Canada
- **Years**: 2010 – present
  - Limited effort data before 2017
- **Sources**:
  - Direct contributions from >20 organizations
  - NOAA Right Whale Sightings Advisory System (RWSAS)
  - North Atlantic Right Whale Consortium (NARWC)

Data on WhaleMap are subject to numerous caveats. They are often not quality controlled or comprehensive and should be interpreted with care.

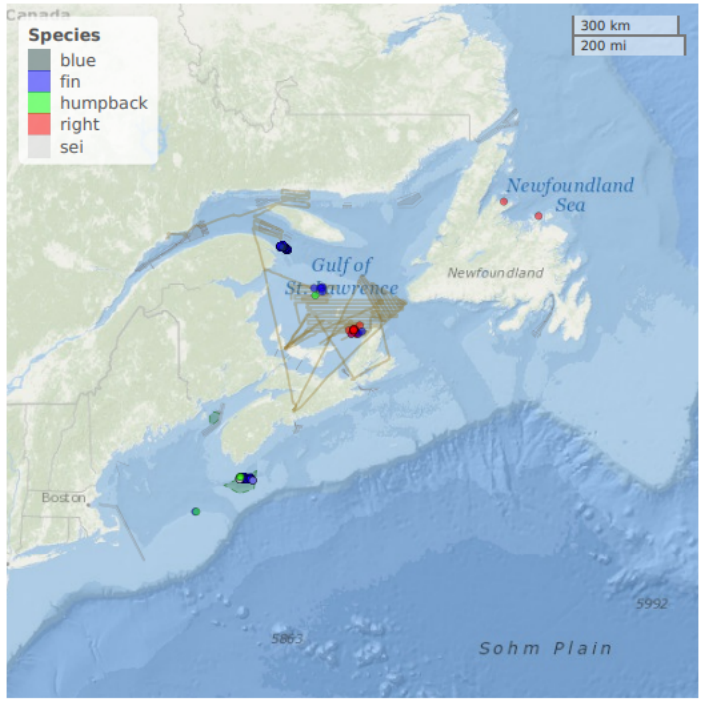
Summary reports

- Data and summary reports sent to DFO and TC every day
- Used directly to inform dynamic management
  - Vessel slowdowns
  - Fisheries closures

WhaleMap Summary Report
2021-11-05 to 2021-11-11

Report generated on: 2021-11-12 11:50:59
Produced by Dalhousie MEOPAR-WHaLE project and DFO Science - Maritimes Region

Figure 1: Locations of large whale observations



For interactive map, go to: https://whalemap.org/WhaleMap/

Table 1: Number of large whale observations

species	visual_counts	acoustic_detections
blue	0	1
fin	14	269
humpback	2	2
right	43	0
sei	0	4

Visual counts only include sightings where numbers of whales were recorded, and may include duplicates

Table 2. Platforms with recorded survey effort

name	platform
tc_dash7	plane
noaa_twin_otter	plane
dfo_viking_PMZA-VAS	buoy
dfo_cessna_yob	plane
cabot	slocum
qala1	slocum

Table 3: North Atlantic right whale sightings

date	time	lat	lon	number	calves	platform	name
2021-11-05				1	NA	plane	noaa_twin_otter
2021-11-05				1	NA	plane	noaa_twin_otter
2021-11-05				1	NA	plane	noaa_twin_otter
2021-11-05				2	NA	plane	noaa_twin_otter
2021-11-05				2	1	plane	noaa_twin_otter
2021-11-05				1	NA	plane	noaa_twin_otter
2021-11-08				2	0	opportunistic	Opportunistic
2021-11-09				1	NA	plane	noaa_twin_otter
2021-11-09				4	NA	plane	noaa_twin_otter
2021-11-09				3	NA	plane	noaa_twin_otter
2021-11-10				1	NA	plane	noaa_twin_otter
2021-11-10				2	NA	plane	noaa_twin_otter
2021-11-10				2	NA	plane	noaa_twin_otter
2021-11-10				1	NA	plane	noaa_twin_otter
2021-11-10				1	NA	plane	noaa_twin_otter
2021-11-10				1	NA	plane	noaa_twin_otter
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2021-11-10				1	NA	plane	noaa_twin_otter
2021-11-10				2	NA	plane	noaa_twin_otter
2021-11-10				1	NA	plane	noaa_twin_otter
2021-11-10				1	NA	plane	noaa_twin_otter
2021-11-10				1	NA	plane	noaa_twin_otter
2021-11-10				2	1	plane	noaa_twin_otter
2021-11-10				1	NA	plane	noaa_twin_otter

Conclusions

- WhaleMap has improved conservation outcomes for endangered whales
- Currently taking steps to ensure it is maintained in perpetuity
- Open source development allows it to be adapted to others facing similar data or conservation challenges

For more information

- Visit the WhaleMap homepage at https://whalemap.org
- Read the (short) manuscript at https://joss.theoj.org/papers/10.21105/joss.03094
- Review the WhaleMap source code at https://github.com/hansenjohnson/WhaleMap
- Email me (hansen.johnson@dal.ca)

Thank you!

Acknowledgements

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- Helpful input from many researchers, including Chris Taggart (Dal), Stephanie Ratelle (DFO), Pam Emery (DFO), Tim Cole (NOAA)
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