Whales Whales Whales

Miles Grant, Sara Fatimah, and Alex McDonald

Source: The Independent

Motivation

Source: John Calambokidis, Cascadia Research

Vessel Strike: A collision between any type of boat and a marine animal in the ocean. All sizes and types of vessels—from large ships to jet skis—have the potential to collide with nearly any marine species.

BREAKING

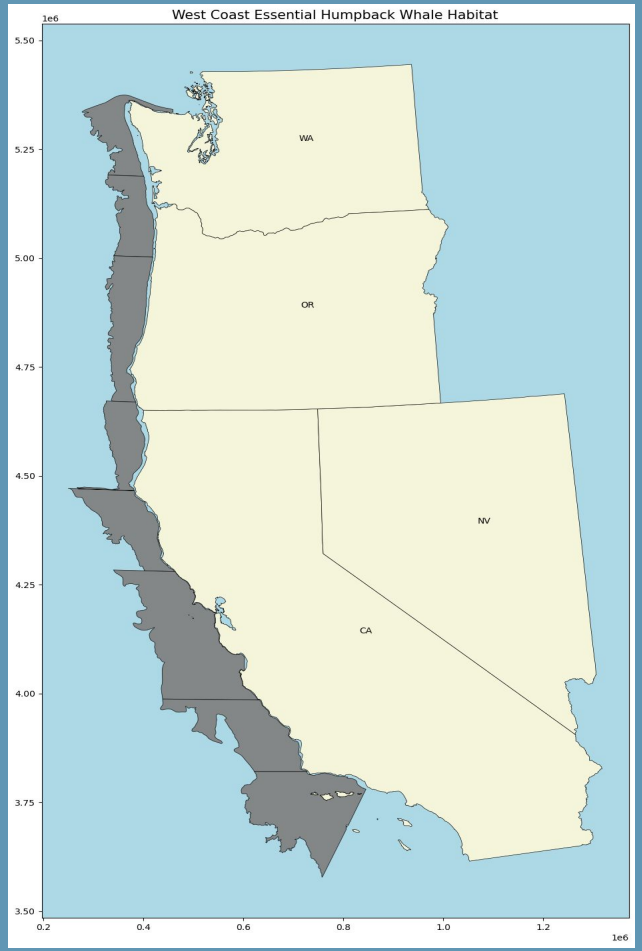
Huge Humpback Whale —And California Celebrity—Killed In Ship Strike Amid Concern Over Collisions

Source: Forbes, Aug 31, 2022

Study Areas

Humpback Whale Mexico Population

- Breeds along the Pacific coast of Mexico and the Revillagigedo Islands
- Feeds across a broad range from California to the Aleutian Islands, Alaska.



Source: NOAA

Humpback Whale Migration and Abundance Records

Year	Peak Month
2009	October
2010	September
2011	July
2012	June
2013	September
2014	July

Based primarily on: Ingman, et al., 2021

Humpback Whale Migration and Abundance Records

Population Estimates	2009	2010	2011	2012	2013	2014
Washington-British Columbia	590	265	360	500	716	526
California-Oregon	1473	1367	1148	1493	1776	1399

Based primarily on: Calambokidis, et al, 2017

Vessel Data

MarineCadastre.gov

Vessel Traffic Data

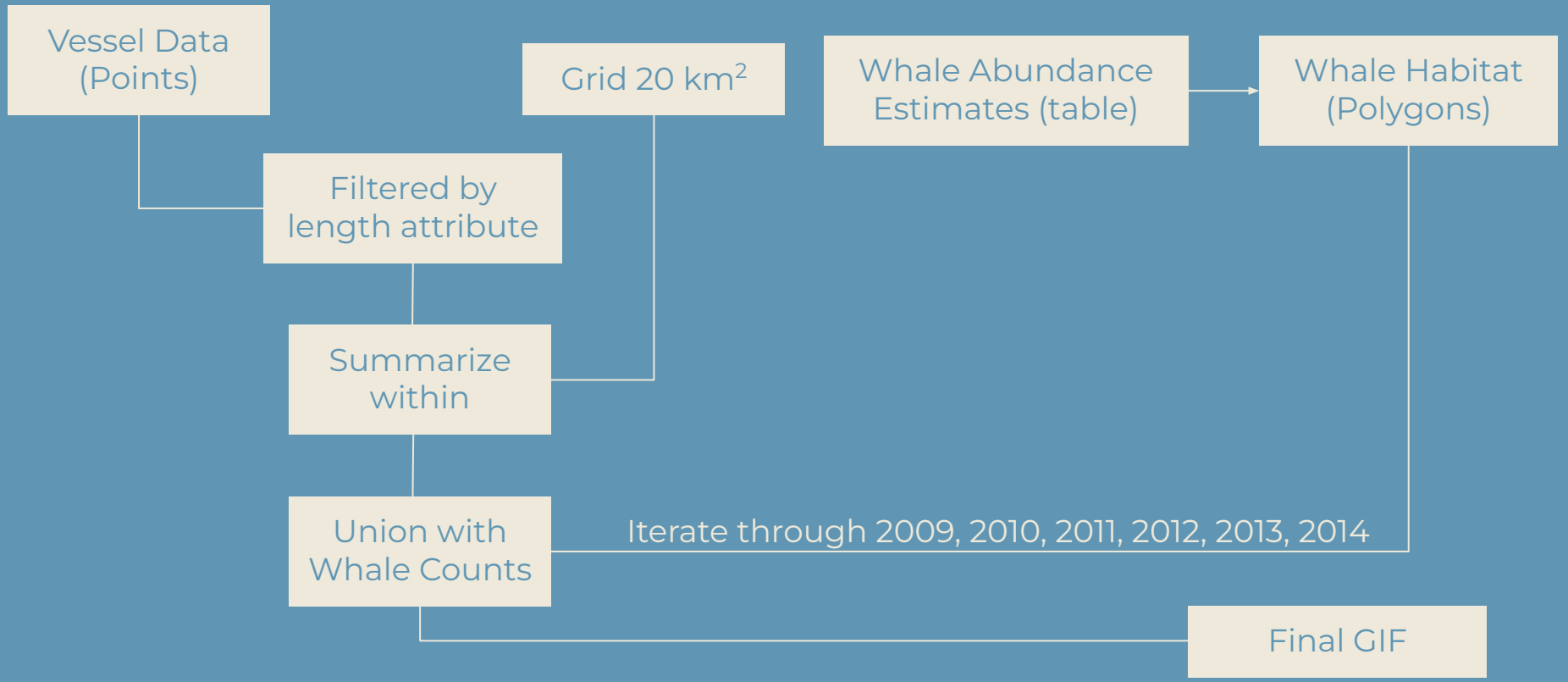
	geometry	SOG	COG	Heading	ROT	\
0	POINT (-175.41912 52.17695)	1.4	149.399994	142.0	0.0	
1	POINT (-175.41874 52.17665)	1.8	140.699997	151.0	0.0	
2	POINT (-175.41859 52.17627)	1.4	193.800003	174.0	0.0	
3	POINT (-175.41833 52.17588)	1.3	128.399994	129.0	0.0	
4	POINT (-175.41788 52.17563)	1.5	144.500000	147.0	127.0	
...	...	...	...	...	...	
117831	POINT (-174.29942 52.92772)	12.4	71.000000	72.0	0.0	
117832	POINT (-174.22092 52.94348)	12.4	70.000000	71.0	0.0	
117833	POINT (-174.16170 52.95570)	12.5	71.000000	71.0	0.0	
117834	POINT (-174.12772 52.96288)	12.3	69.000000	71.0	0.0	
117835	POINT (-174.06707 52.97533)	12.4	69.000000	71.0	0.0	

	BaseDateTime	Status	VoyageID	MMSI	ReceiverType	\
0	2013-10-01T00:00:45+00:00	7	1	367805068	r	
1	2013-10-01T00:01:45+00:00	7	1	367805068	r	
2	2013-10-01T00:02:45+00:00	7	1	367805068	r	
3	2013-10-01T00:03:54+00:00	7	1	367805068	r	
4	2013-10-01T00:04:56+00:00	7	1	367805068	r	
...	...	...	...	...	...	
117831	2013-10-31T22:22:55+00:00	0	510	538752002	r	
117832	2013-10-31T22:37:25+00:00	0	510	538752002	r	
117833	2013-10-31T22:48:25+00:00	0	510	538752002	r	
117834	2013-10-31T22:54:45+00:00	0	510	538752002	r	
117835	2013-10-31T23:05:55+00:00	0	510	538752002	r	

```
...
117834        167,23,16,16
117835        167,23,16,16
```

Source: marinecadastre.gov

Workflow


Vessel Data (Points)
Grid 20 km²
Whale Abundance Estimates (table)
Whale Habitat (Polygons)
Filtered by length attribute
Summarize within
Union with Whale Counts
Iterate through 2009, 2010, 2011, 2012, 2013, 2014
Final GIF

Process: Blocks of Code

Spatial Join

```
ships_cell = gpd.sjoin(ship_points, west_coast_grid, how = "inner", predicate = "intersects")
```

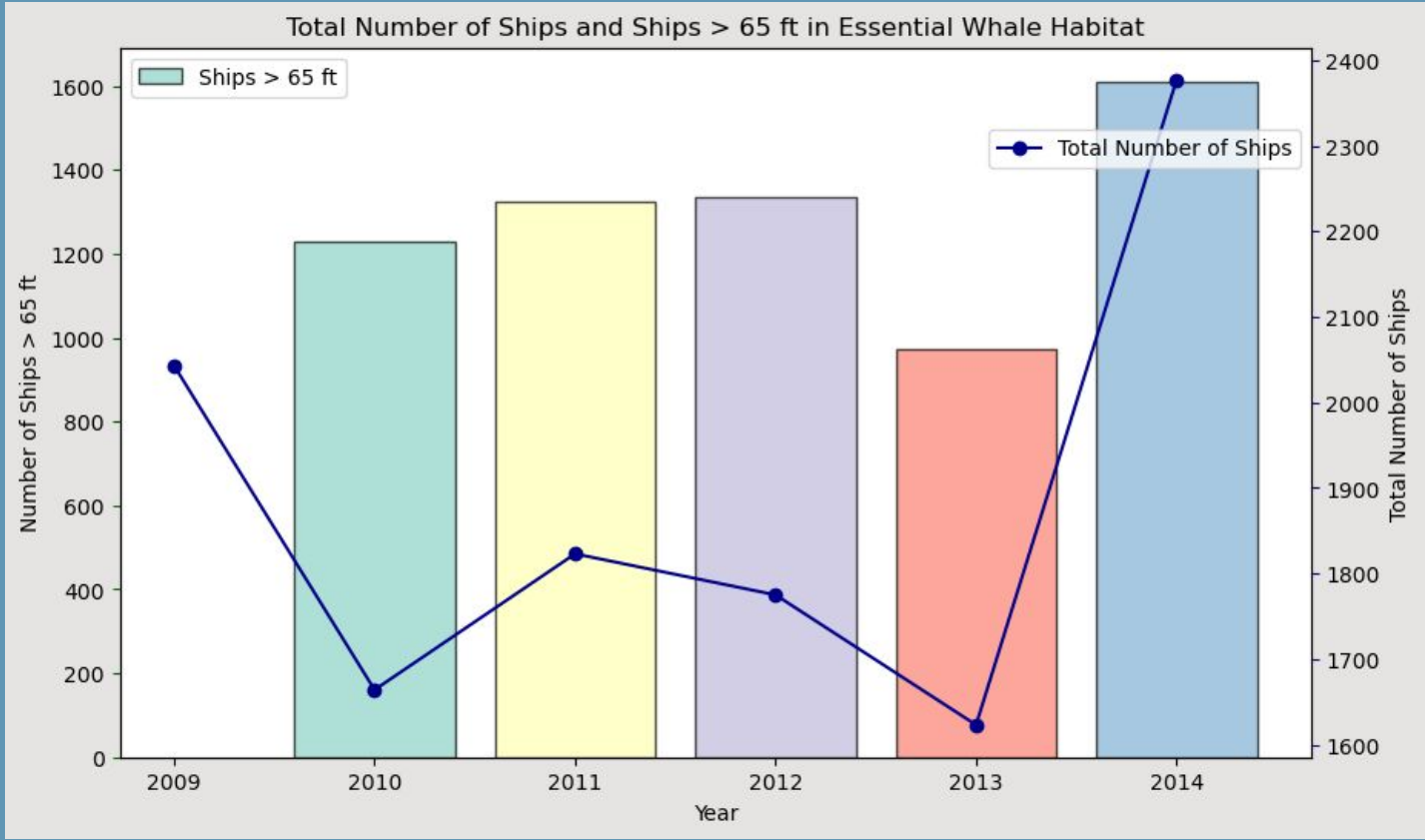
```
ships_cell = ships_cell.drop_duplicates(subset = ['Point_ID']).reset_index(drop = True)
```

```
count_field = "Count"

ships_cell[count_field] = 1

ships_cell = ships_cell.groupby('Grid_ID').agg({count_field:'sum'})
west_coast_grid = west_coast_grid.merge(ships_cell, on = 'Grid_ID', how = "left")

west_coast_grid[count_field] = west_coast_grid[count_field].fillna(0)

west_coast_grid[count_field] = west_coast_grid[count_field].astype(int)
```

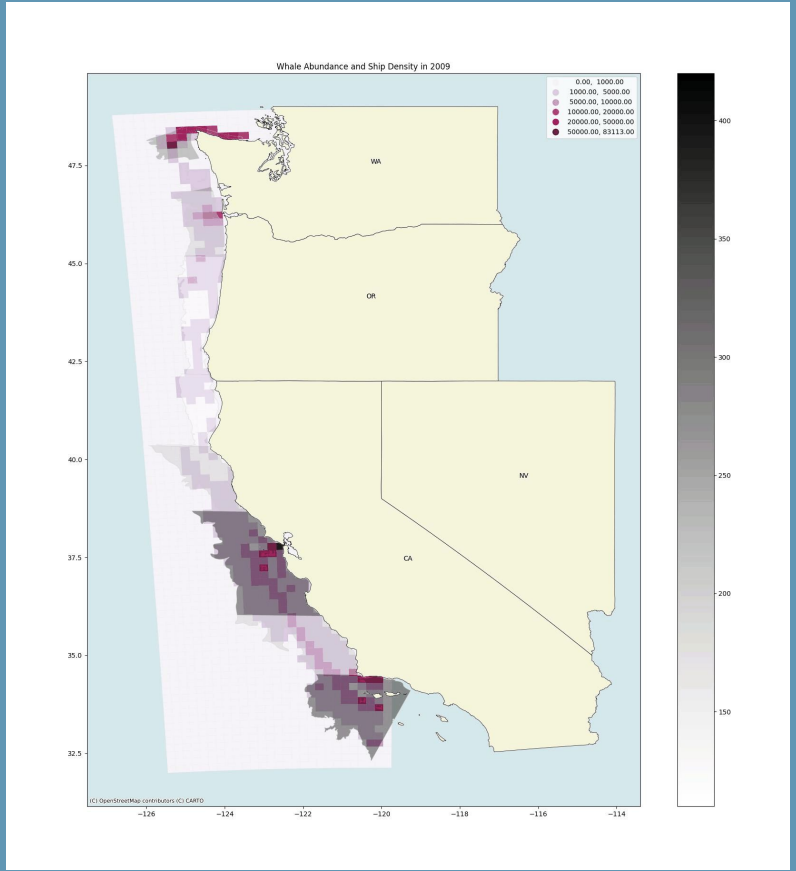
```
west_coast_grid
```

```
#2010 DENSITY

# Create subplots
fig, ax = plt.subplots(1, 1, figsize=(20, 20))

# Plot 2010 ship data
ship_2010_wgs.plot(ax=ax, column="Count", cmap="PuRd", linewidth=0.0, alpha=1, legend=True, scheme='User_Def:

# Plot habitat data
whale_wgs.plot(column='2010', cmap='Greys', linewidth=0.8, alpha=0.4, ax=ax, edgecolor='0.8', legend=True)

westcoast_wgs.plot(ax=ax, marker='o', color='beige', edgecolor='black', linewidth=0.5, markersize=1)
# Add labels
for idx, row in westcoast_wgs.iterrows():
    centroid = row['geometry'].centroid
    name = row['STUSPS']
    ax.annotate(name, xy=(centroid.x, centroid.y), xytext=(10, 10), textcoords='offset points')

ctx.add_basemap(ax, source=ctx.providers.CartoDB.Voyager,zoom = 6, reset_extent = True)
# Set plot title
ax.set_title('Whale Abundance and Ship Density in 2010')

# Save the plot as a JPG file
plt.savefig('result_2010.jpg')

# Display the plot
plt.show()
```

Results


Total Number of Ships and Ships > 65 ft in Essential Whale Habitat
Ships > 65 ft
Total Number of Ships
Number of Ships > 65 ft
Total Number of Ships
Year
0
200
400
600
800
1000
1200
1400
1600
1600
1700
1800
1900
2000
2100
2200
2300
2400
2009
2010
2011
2012
2013
2014

Results



2009-2014

Conclusion, Limitations, Future Directions

- Difficult data for Alaska.
- Vessel speed restrictions
- Education
- Modifications of Shipping Routes
- Marine mammal adaptation

Source: John P Goodridge

NEWS

For the first time, scientists spot humpback whales riding a ship's wake

Behavior might save energy during long migration

11 JUL 2022 · 1:00 PM · BY KATHERINE IRVING

Source: Science.org

References

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