Ultra High Resolution Aerial Remote Sensing Changing the Way We Collect Offshore Wildlife Data

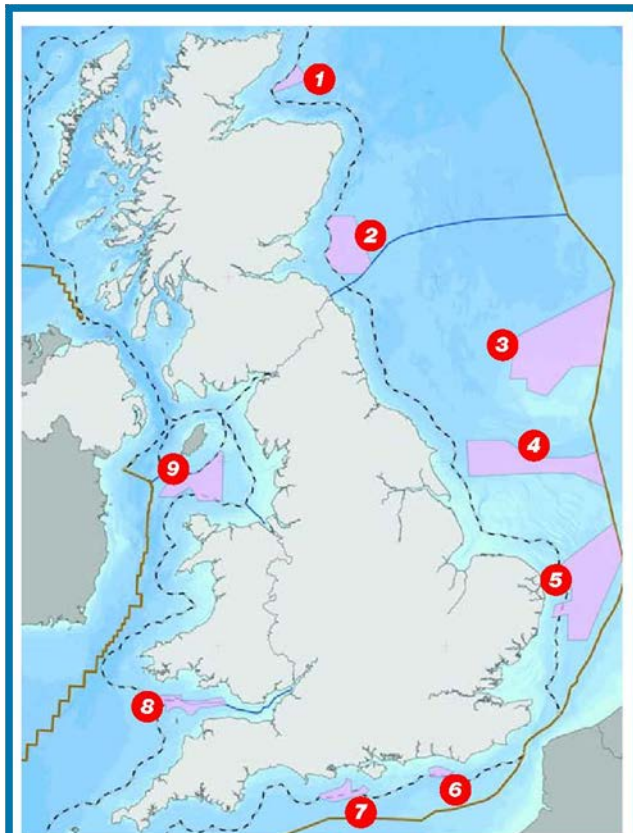## California Offshore Renewable Energy Conference

November 2, 2016

Christian Newman

Why Digital?

- **Operational benefits**
  - Health & Safety; survey altitude
  - Fast to mobilize with fewer weather constraints
  - Survey design consistent; no change post-construction
- **Biological benefits**
  - No disturbance to animals under survey
- **Statistical benefits**
  - No attraction / repulsion from platform
  - Allows randomized designs
  - Less temporal variation in data
  - Quantifiable sample area
- **Confidence**
  - Fully auditable permanent record
  - Fully objective; human error reduced

Offshore Wind – Digital methods established

Wind farm licences: who got what

1. The Moray Firth zone
EDP Renováveis and
SeaEnergy Renewables.
Potential yield: 1.3GW

2. Firth of Forth zone
SSE Renewables and
Fluor. Potential yield:
3.5GW

3. Dogger Bank zone
SSE Renewables, RWE
npower renewables, Statoil
and Statkraft.
Potential yield: 9GW

4. Hornsea zone
Mainstream Renewable
Power and Siemens
Project Ventures, and also
involving Hochtief
Construction.
Potential yield: 4GW

5. Norfolk Bank zone
ScottishPower Renewables
and Vattenfall. Potential
yield: 7.2GW

6. Hastings zone
E.ON Climate and

Renewables UK.
Potential yield: 0.6GW

7. Isle of Wight zone
Eneco New Energy.
Potential yield: 0.9GW

8. Bristol Channel zone
RWE npower renewables.
Potential yield: 1.5GW

9. Irish Sea zone
Centrica Energy.
Potential yield: 4.2GW

United Kingdom
- All UK Round 3 Offshore Wind Farm projects surveyed fully or in part by aerial digital methods
- >30GW of renewable projects have been surveyed since 2009 (wind, wave, tidal)
- East Anglia ONE first project granted consent using aerial data as the primary data source
- Acceptance by UK Statutory Nature Conservation Agencies and Regulators
- Used for strategic and project impact assessments

Germany
- StUK+ standard environmental investigation programme of BSH requires aerial digital survey

USA
- DOE
- BOEM

New technologies…new camera systems

Range of Camera Systems

- 40 – 400+ megapixels

- **Multispectral** (RGB and NIR bands) and thermal

- Includes **in-house** developed system

- **Adaptable**: can be used with a number of sensor heads – digital stills, video, thermal and infrared

- **Transportable** – packs into two boxes

- **Flexible mounting** system for deployment in any aircraft with a standard 19" camera hatch

APEM
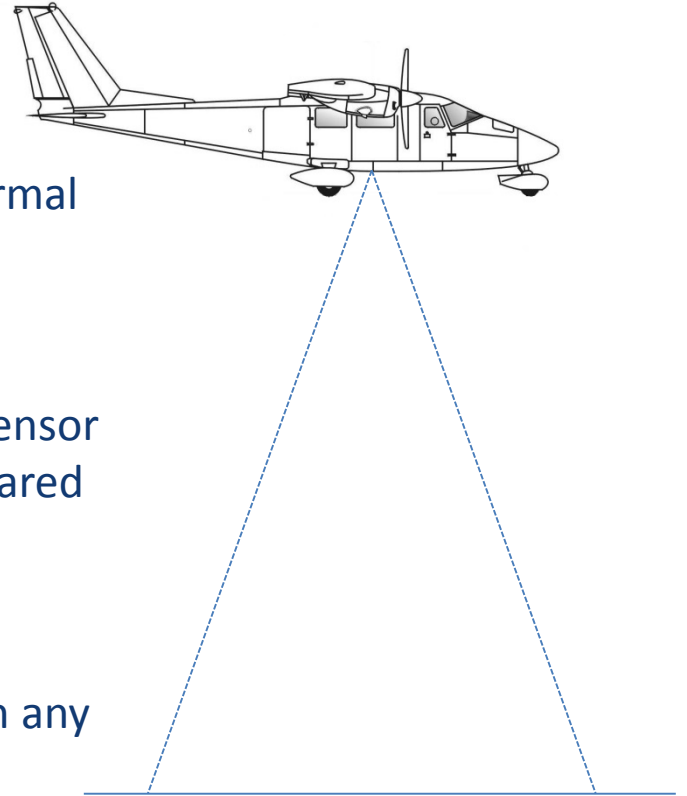
Resolution and Spatial Accuracy

Ground Resolution Distance (GSD)

- Various resolutions possible, down to 0.5 cm

- Trade-off between resolution (species ID rates) and costs

- When comparing different survey methods focus should be on the how <u>clear / sharp</u> a pixel is rather its size (resolution)

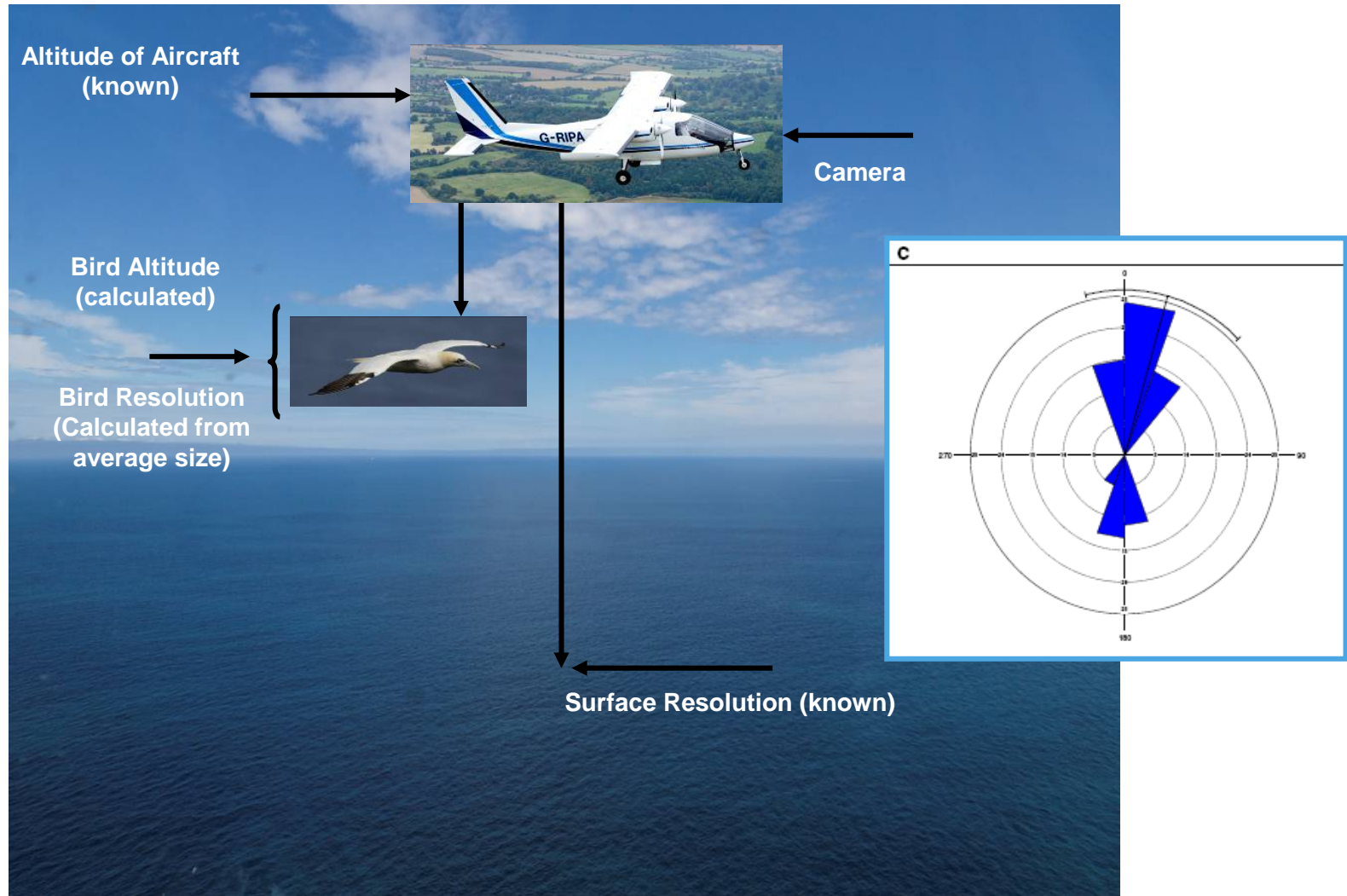- Difference between still versus video

Spatial Accuracy

- GPS/GNSS

- IMU

- Automated Object Recognition

- Wildlife width and body length

- Wildlife direction of movement

- Bird flight height

Altitude of Aircraft (known)

Camera

Bird Altitude (calculated)

Bird Resolution (Calculated from average size)

Surface Resolution (known)

C

Birds and mammal ID rates achieved in UK/Europe

Species Group / Species	% ID (3 cm)	% ID (2 cm)
Large Gulls	100%	100%
Great Black-backed Gull *(Larus marinus)*	>90%	>99%
Lesser Black-backed Gull *(Larus fuscus)*	>90%	>99%
Herring Gull *(Larus argentatus)*	>90%	>99%
Small Gulls	100%	100%
Black-legged Kittiwake *(Rissa tridactyla)*	>90%	>99%
Black-headed Gull *(Chroicocephalus ridibundus)*	>80%	>99%
Common Gull *(Larus canus)*	>80%	>95%
Little Gull *(Larus minutus)*	>80%	>95%
Divers	100%	100%
Red-throated diver *(Gavia stellata)*	>90%	>95%
Black-throated diver *(Gavia arctica)*	>70%	>85%
Great Northern diver *(Gavia immer)*	>90%	>95%
Grebes	<50%	>50%
Seaducks	>85%	>95%
Common Eider *(Somateria mollissima)*	>90%	>99%
Scoter sp *(Melanitta sp.)*	>95%	>99%
Long-tailed Duck *(Clangula hyemalis)*	>85%	>95%
Red-breasted Merganser *(Mergus serrator)*	>75%	>90%
Scaup *(Aythya marila)*	>50%	>85%
Goldeneye *(Bucephala clangula)*	>50%	>85%

Birds and mammal ID rates achieved in UK/Europe

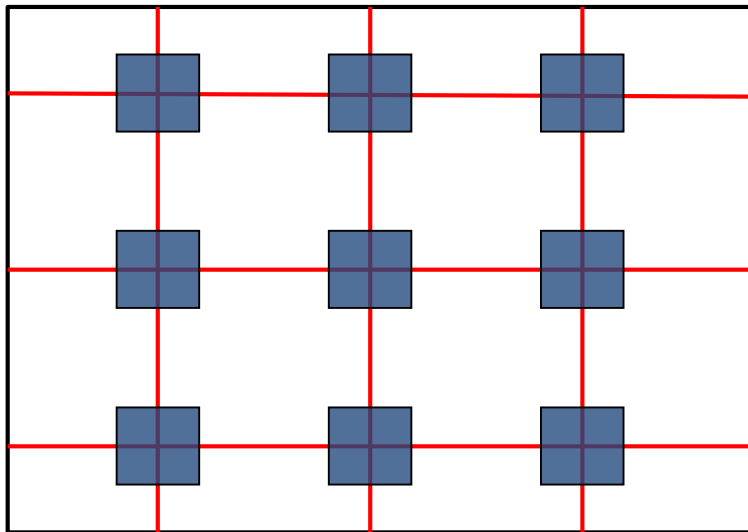| Species Group / Species	% ID (3cm)	% ID (2cm)
Seal species	100%	100%
Grey Seal (*Halichoerus grypus*)	<50%	>50%
Harbour Seal (*Phoca vitulina*)	<50%	>50%
Harbour porpoise (*Phocoena phocoena*)	>80%	>90%
Dolphin species	>75%	>95%
Common dolphin (*Delphinus delphis*)	>75%	>90%
Common bottlenose dolphin (*Tursiops truncatus*)	>75%	>90%
White-beaked dolphin (*Lagenorhynchus albirostri*)	>75%	>85%
Whale species	100%	100%
Minke whale (*Balaenoptera acutorostrata*)	>85%	>99%
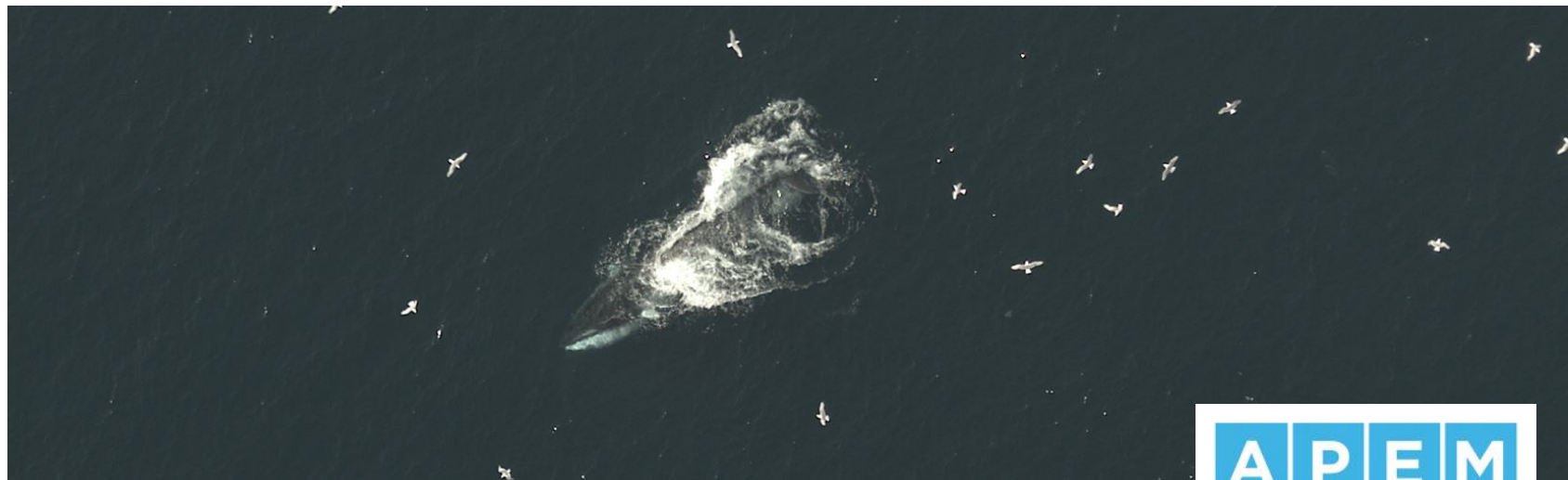
QA/QC

- **Divide images with birds / mammals or blanks**

  - **QA by APEM (10% blanks & 100% bird / mammal images go for QA, 90% agreement needed to PASS)**

- **APEM images assessed by trained full-time observers**

  - **Number of birds / marine mammals**

  - **Grouping / species of bird**

  - **Position of bird (GIS based)**

- **External independent QA**

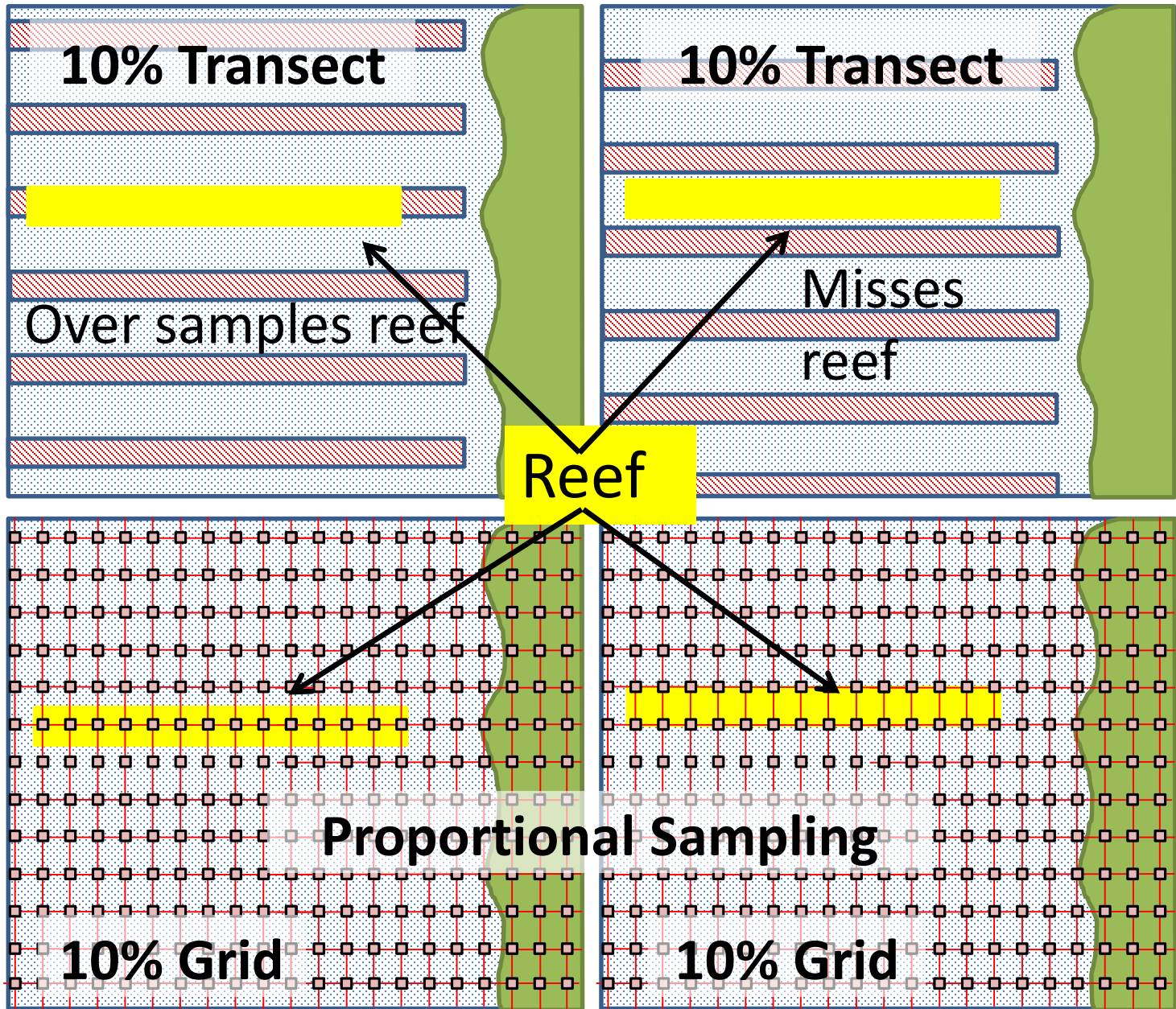 - **BTO (birds) and SMRU (mammals) (10% QA of data, 90% agreement required to PASS)**
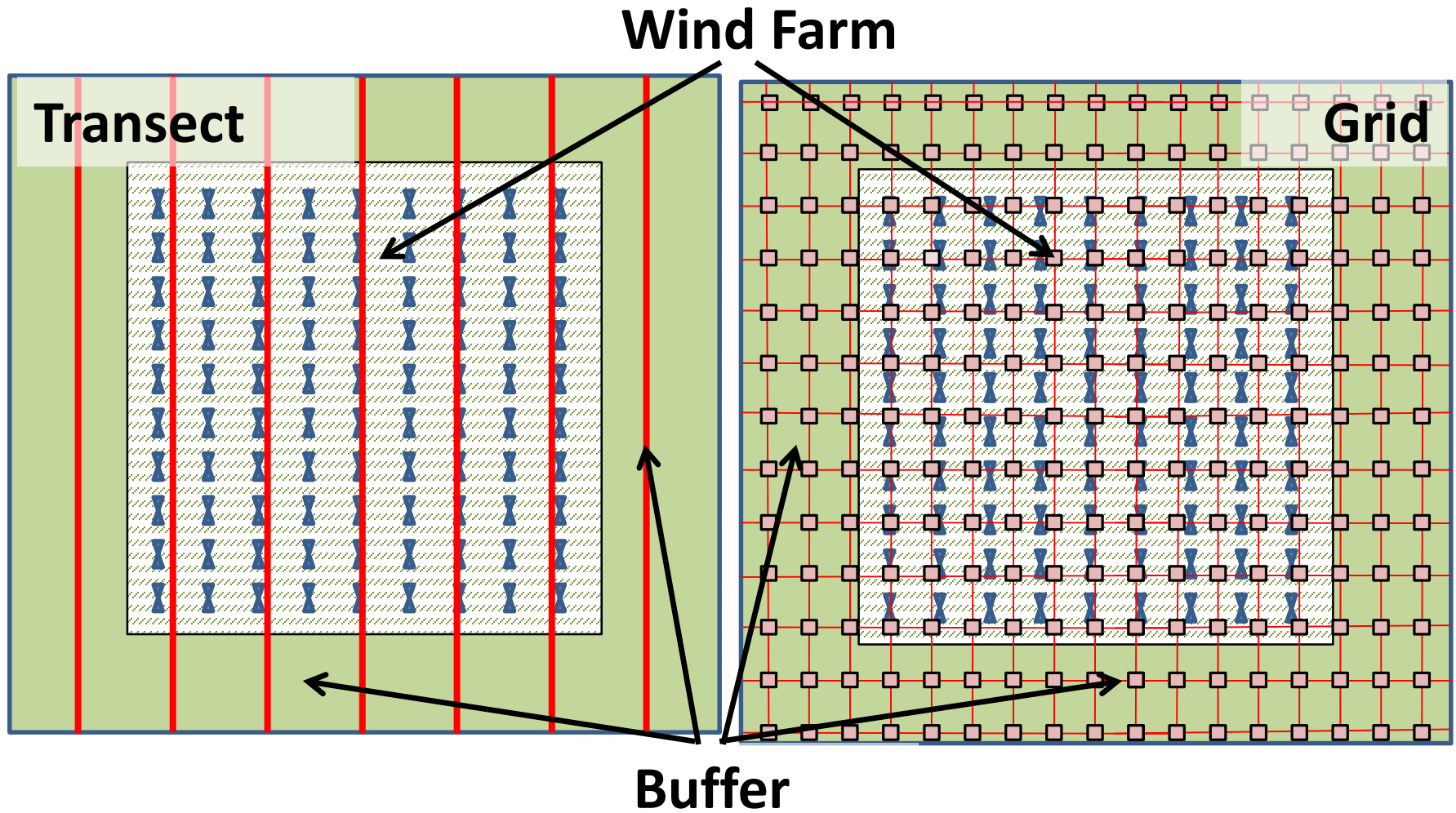
Survey design

- Unique to each survey depending on site, species & questions
- Specialist software plots flight lines & nodes
- Camera only fires when target location reached
- Choose the best resolution 5 cm, 3 cm or 2 cm normally…0.5 cm
- Choose grid or transect

10% Transect

10% Transect

Over samples reef

Misses reef

Reef

Proportional Sampling
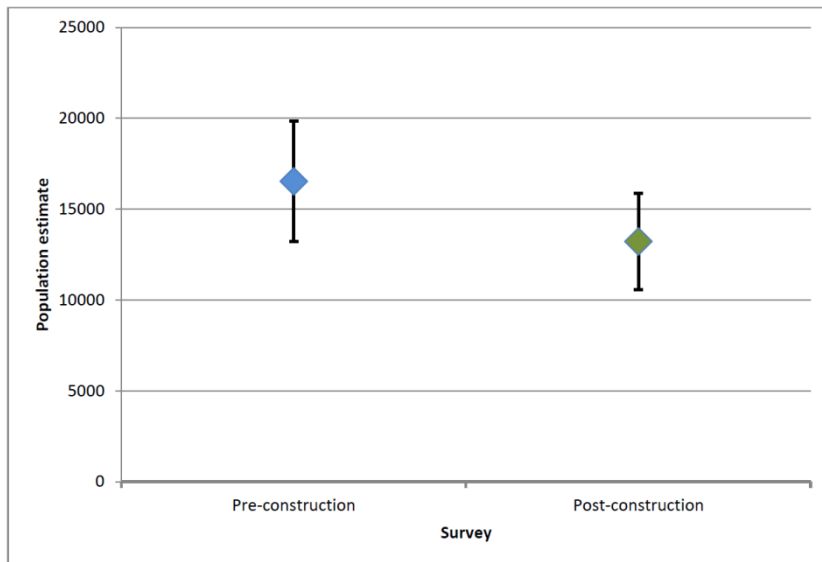
10% Grid
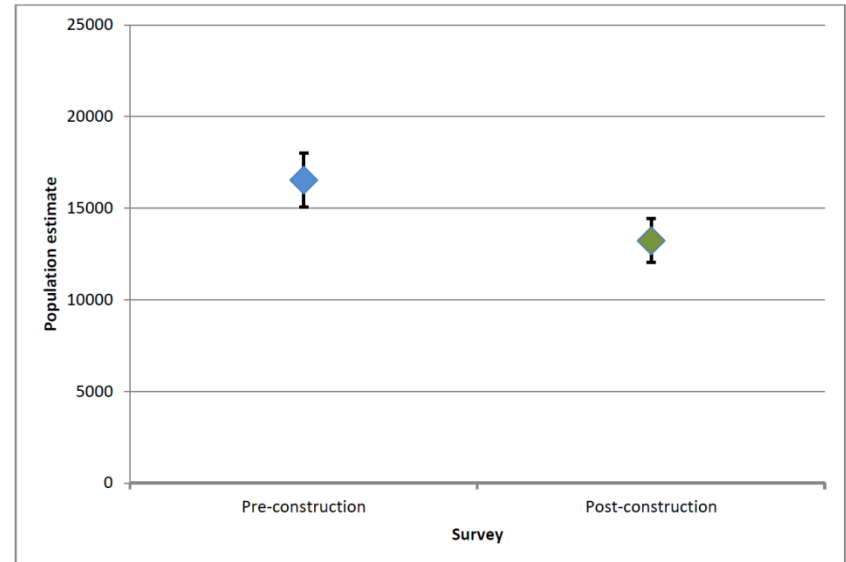
10% Grid

Wind Farm

Transect
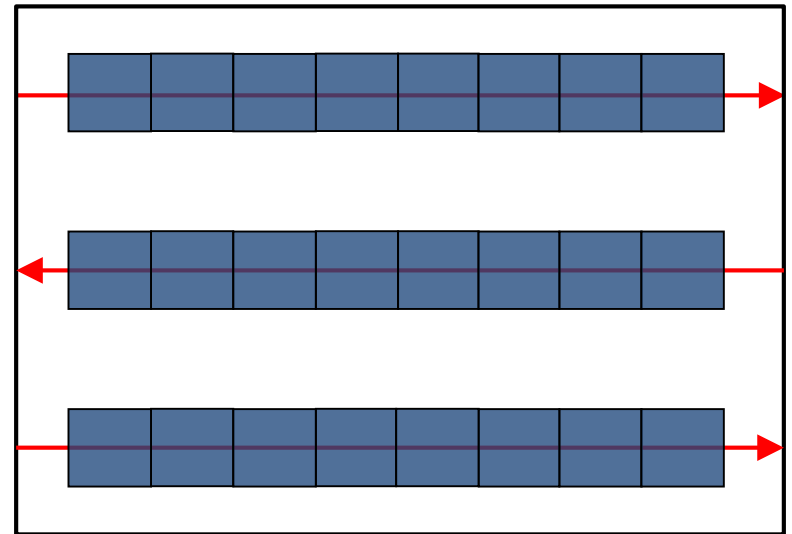
Grid

Buffer

Methods: Confidence in estimates

- **Without small confidence intervals it is impossible to assess if environmental change has had a significant impact on a population**
  - High confidence = small confidence intervals
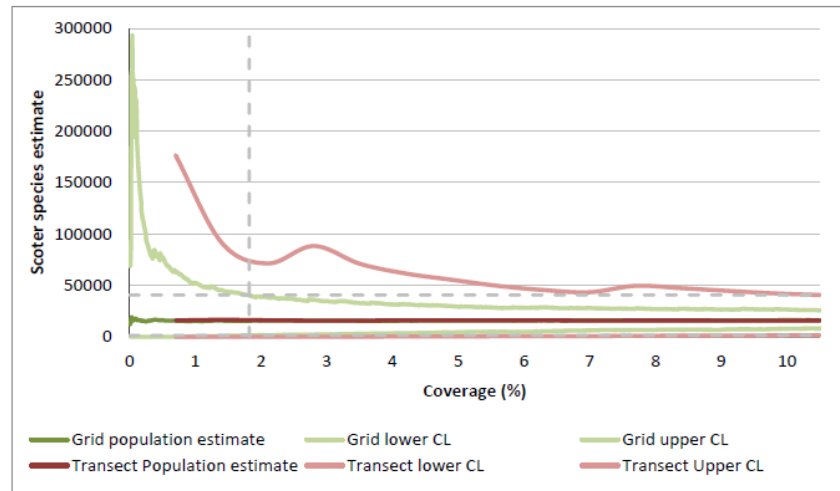 **- Low confidence = large confidence intervals**

Low confidence – overlapping confidence intervals

High confidence – non-overlapping confidence intervals
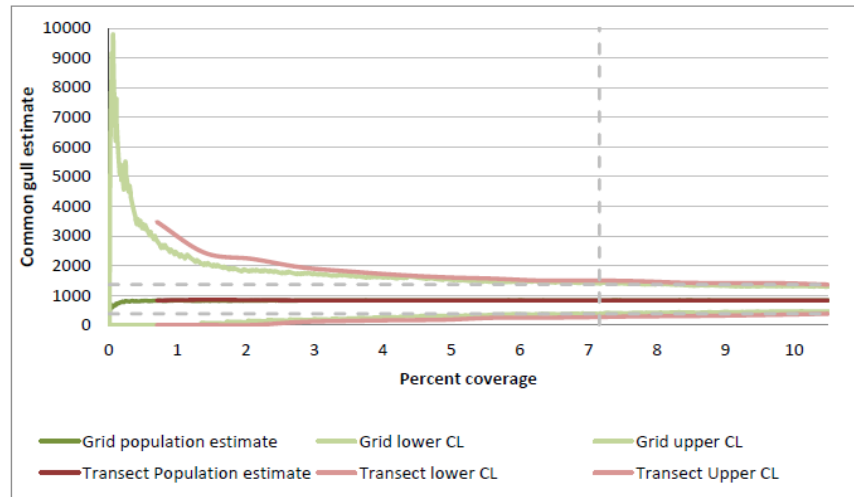
Methods: Scoter species – transect vs grid

Method	Coverage	Estimate	Lower confidence Interval	Upper confidence Interval	Equivalent % coverage to achieve the same for the contrasting survey design
Transect	10.5%	16,187	1,519	41,635	1.8%
Grid	10.5%	16,184	8,090	25,774	61.6%
Grid	**8%**	**16,073**	**6,764**	**26,992**	**49.7%**

Grids achieved the target precision and tighter confidence intervals at a much lower percent coverage than transects

To equal an 8% grid survey a transect survey needs to obtain 49.7% coverage

Methods: Common Gull – transect vs grid

Method	Coverage	Estimate	Lower confidence Interval	Upper confidence Interval	Equivalent % coverage to achieve the same for the contrasting survey design
Transect	10.5%	833	352	1,381	7.19%
Grid	10.5%	829	452	1,282	14.7%
Grid	**8%**	**831**	**413**	**1,387**	**13.3%**

Grids achieved the target precision and tighter confidence intervals at a lower percent coverage than transects

To equal an 8% grid survey a transect survey needs to obtain 13.3% coverage

Project Examples- New York

remote.normandeau.com/public_data.php

mer survey are still being added daily. Data shown are partial results.
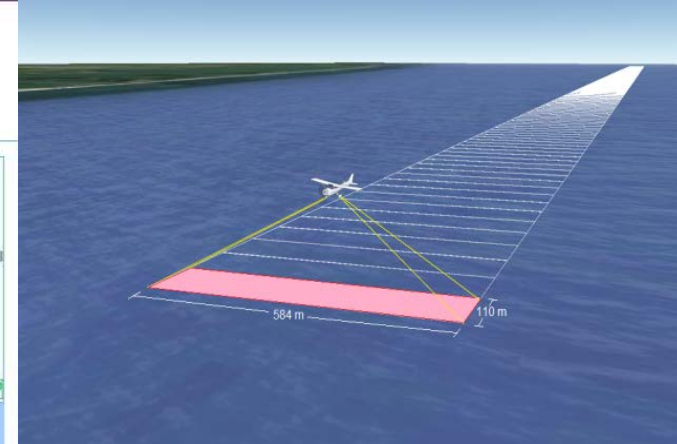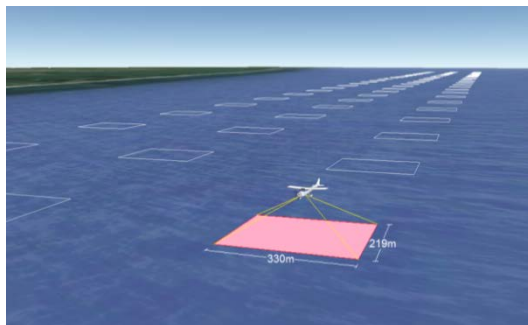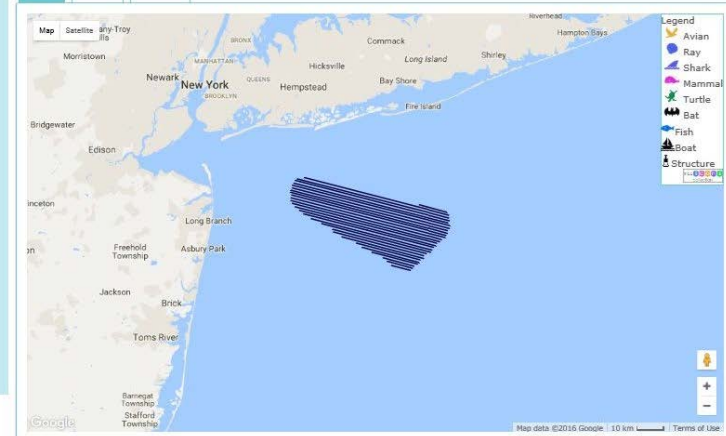een completely reviewed and may contain some inaccuracies.

Map | **Stats** | **Export**

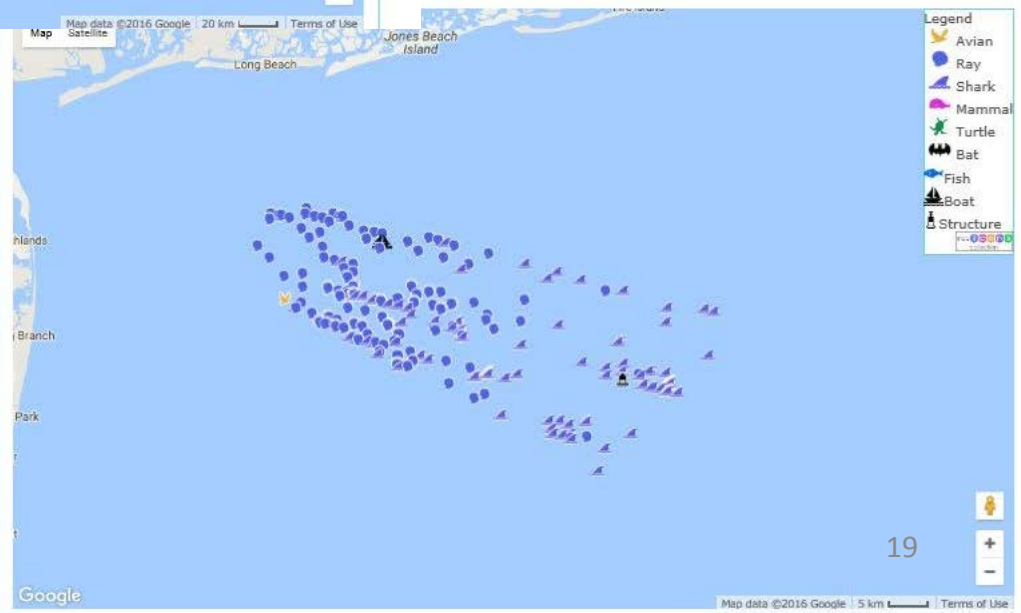|	All		OPA		WEA
Avian	2043		2034		7
Cormorant	6		6		0
Double-crested Cormorant		6		6	0
Gull	126		126		0
Great Black-backed Gull		57		57	0
Herring Gull		32		32	0
Laughing Gull		13		13	0
Ring-billed Gull		9		9	0
species unknown		4		4	0
species unknown - Large		6		6	0
species unknown - Small		5		5	0
Loon	3		3		0
Common Loon		3		3	0
Petrel	12		12		0
Black-capped Petrel		8		8	0
species unknown		4		4	0
Raptor	5		5		0
Bald Eagle		2		2	0
Osprey		3		3	0
Shearwater	744		744		0
Audubon's Shearwater		8		8	0
Cory's Shearwater		473		473	0
Great Shearwater		72		72	0
Sooty Shearwater		2		2	0
species unknown-Large		174		174	0
species unknown-Small		15		15	0
Shorebird	13		13		0
Piping Plover		13		13	0
Storm-petrel	868		868		0
Wilson's Storm-Petrel		868		868	0
Tern	252		250		0
Common/Roseate Tern		189		187	0
Least Tern		43		43	0
Royal Tern		9		9	0
species unknown		11		11	0
Wader	14		7		7
species unknown		14		7	7
Ray	1860		1624		234
Shark	6		6		0
Mammal	282		280		2
Turtle	281		268		13
Fish	426		423		3
Boat	46		45		1
Structure	5		4		1
Unknown/Other	135		131		4

Needs ID:

	All	OPA	WEA
Ray	6547	6547	0
Shark	1093	785	308
Mammal	761	761	0
Turtle	317	317	0
Fish	389	389	0

en completely reviewed and may contain some inaccuracies.

Map | **Stats** | **Export**

	All		OPA		WEA
Avian	2043		2034		7
Ray	1860		1624		234
Bluntnose Stingray		2		1	1
Bullnose Ray		6		6	0
Cownose Ray		134		123	11
Cownose/Bullnose Ray		3		3	0
Giant Manta Ray		149		149	0
species unknown		1566		1342	222
Shark	6		6		0
Great Hammerhead		1		1	0
Oceanic Whitetip Shark		1		1	0
Scalloped Hammerhead		1		1	0
Smooth Hammerhead		1		1	0
Thresher Shark		1		1	0
Tiger Shark		1		1	0
Mammal	282		280		2
Dolphin	266		264		2
Common Bottlenose Dolphin		73		73	0
Harbor Porpoise		2		2	0
Risso's Dolphin		42		42	0
Short-beaked Common Dolphin		33		33	0
species unknown		116		114	2
Whale	16		16		0
Beaked Whale (unid.)		3		3	0
Fin Whale		9		9	0
Humpback Whale		1		1	0
Pilot Whale (unid.)		2		2	0
species unknown		1		1	0
Turtle	281		268		13
Green Turtle		1		1	0
Kemp's ridley turtle		14		13	1
Leatherback		2		2	0
Loggerhead Turtle		175		171	4
species unknown		89		81	8
Fish	426		423		3
Boat	46		45		1
Structure	5		4		1
Unknown/Other	135		131		4

Needs ID:

	All	OPA	WEA
Ray	6547	6547	0
Shark	1093	785	308
Mammal	761	761	0
Turtle	317	317	0
Fish	389	389	0

20

Brown pelicans, laughing gulls, herring gulls and royal / Caspian tern
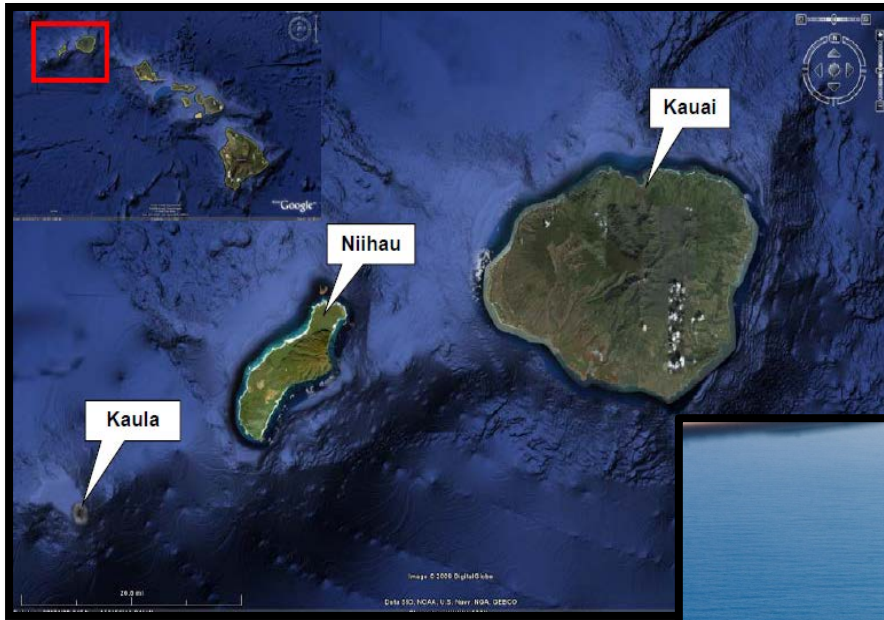
Legend

- Brown Booby
- Brown Noddy
- Great Frigatebird
- Hawaiian Monk Seal
- Masked Booby
- Red-footed Booby
- Red-footed Booby/Masked Booby
- Red-tailed Tropicbird
- Sooty Tern
- White Tern

Client
United States Navy

Project
512908

Title
Ka'ula Bird Survey - July 2015 - All Birds & Mammals

Scale	Drawn	Chk	Auth
1:4,761	ZB	SW	SW

Coordinate System	Date		
UTM 04 N	06/11/2015	06/11/2015	06/11/2015
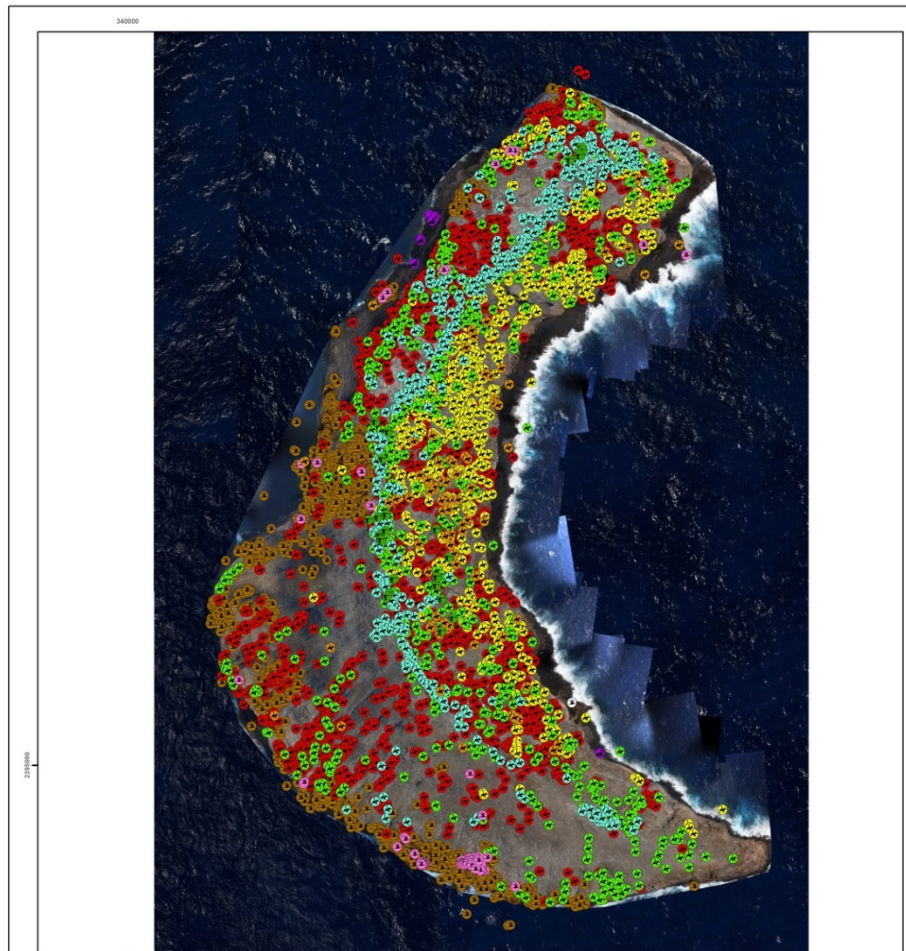
Map Reference
Ka'ula2015BirdSurveys_July_2015.mxd

Laysan Albatross

Flying great frigatebirds

Black-footed albatross

Breeding frigate birds with males displaying gular pouches

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  - Health & Safety; survey altitude
  - Fast to mobilize with fewer weather constraints
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