Abundance and Population Information

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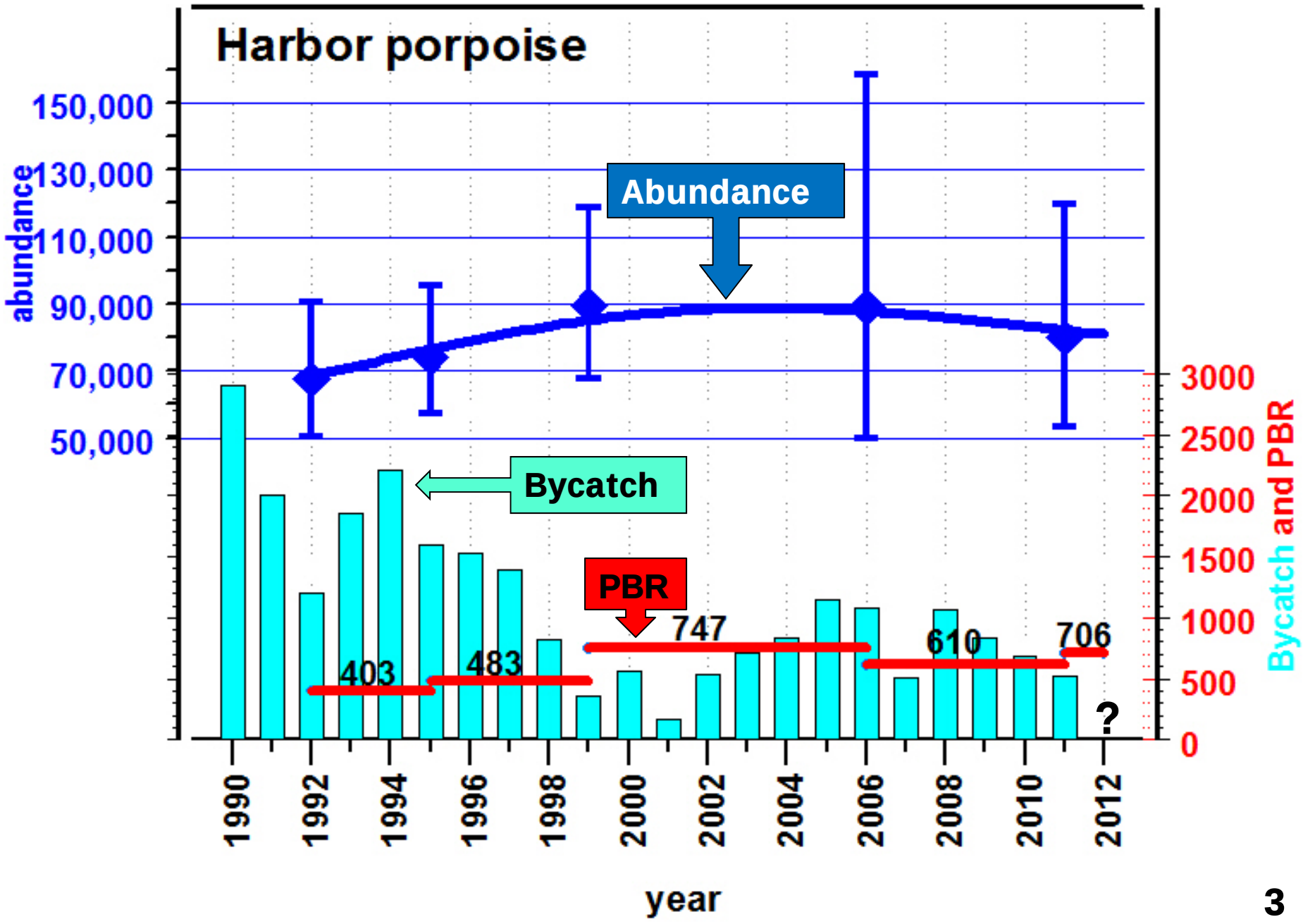
This information is distributed solely to inform discussions of Harbor Porpoise Take Reduction Team, and is subject to future review and revision. It has not been formally disseminated by NOAA. It does not represent any final agency determination or policy.

Overview

- What is the definition of PBR?
- Recent population estimates and how they are calculated
- PBR for harbor porpoises


Harbor porpoise
abundance
150,000
130,000
110,000
90,000
70,000
50,000
Abundance
Bycatch
PBR
403
483
747
610
706
?
3000
2500
2000
1500
1000
500
0
Bycatch and PBR
1990
1992
1994
1996
1998
2000
2002
2004
2006
2008
2010
2012
year

PBR = Potential Biological Removal level

$$PBR = N_{min} * 1/2\ R_{max} * F_R$$

N_{min} = minimum population estimate

$1/2\ R_{max}$ = one-half the maximum theoretical or estimated net productivity rate of the stock at a small population

F_R = a recovery factor between 0.1 and 1

Minimum Population Size

$$N_{\min} = \frac{N_{best}}{\exp\left(z \bullet \sqrt{\ln\left[1 + CV(N_{best})^2\right]} \right)}$$

= population size that provides a reasonable assurance that the true stock size is equal to or greater than N_{min} (MMPA)

= 20th percentile of a log-normal distribution of the population abundance estimate (Wade 1998)

May use weighted average of a series of abundance estimates that are less than 8 years old, if no trend

$$N_{\min} = \frac{N_{best}}{\exp\left(z \bullet \sqrt{\ln\left[1 + CV(N_{best})^2\right]} \right)}$$

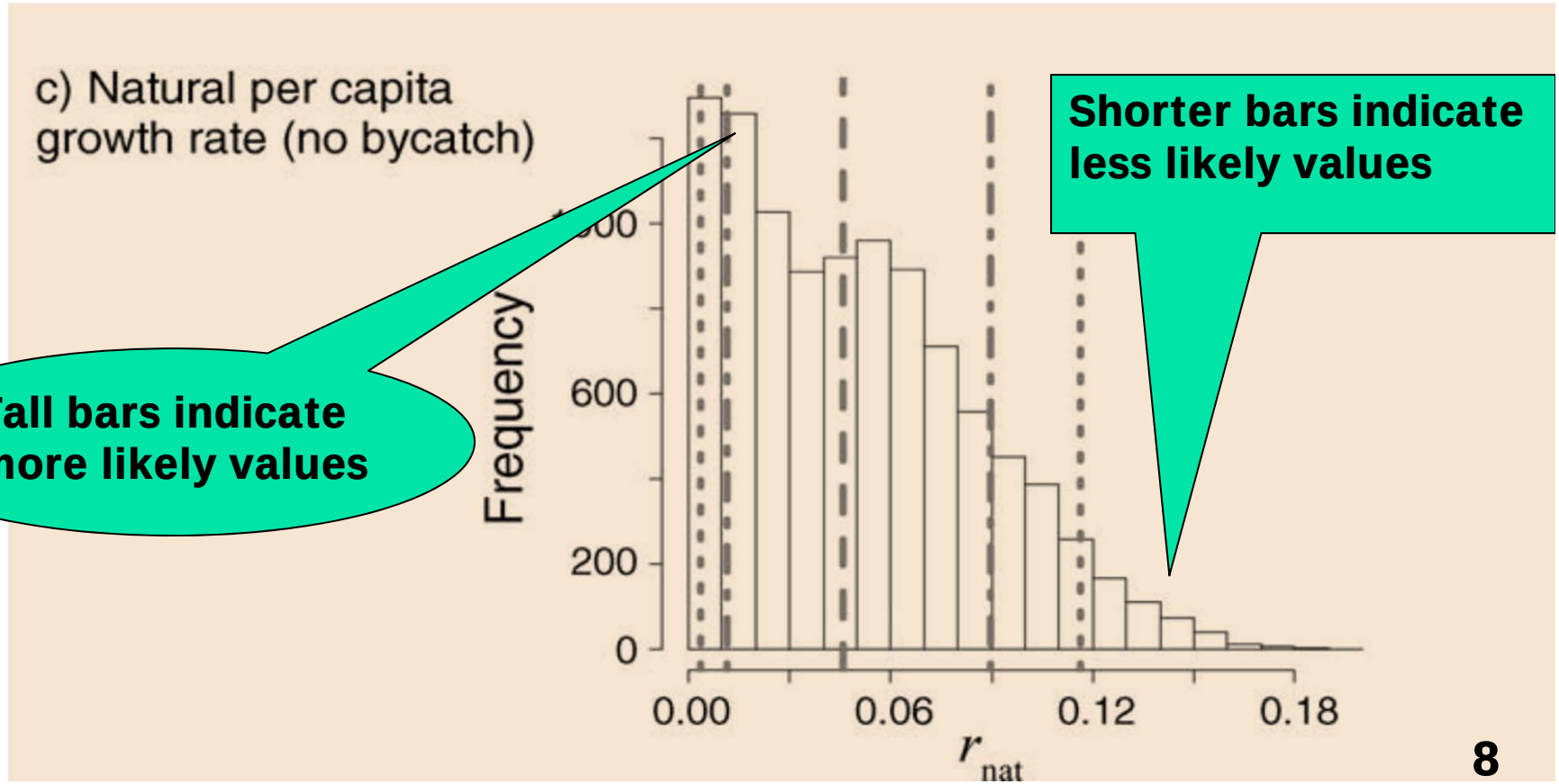
Species	N_{best}	$CV(N_{best})$	N_{min}
Harbor Porpoise	79,883	0.32	61,415

R_{max} = Maximum net productivity rate

- Is, essentially, the maximum percentage the population can annually grow after natural mortalities take place
- Default R_{max}=0.04 for all cetaceans
- Default based on theoretical calculations that show dolphin populations can not grow at rates much greater than 4% given constraints of their reproductive life history (Reilly and Barlow 1986)

R_{Max} = 0.046 for harbor porpoises

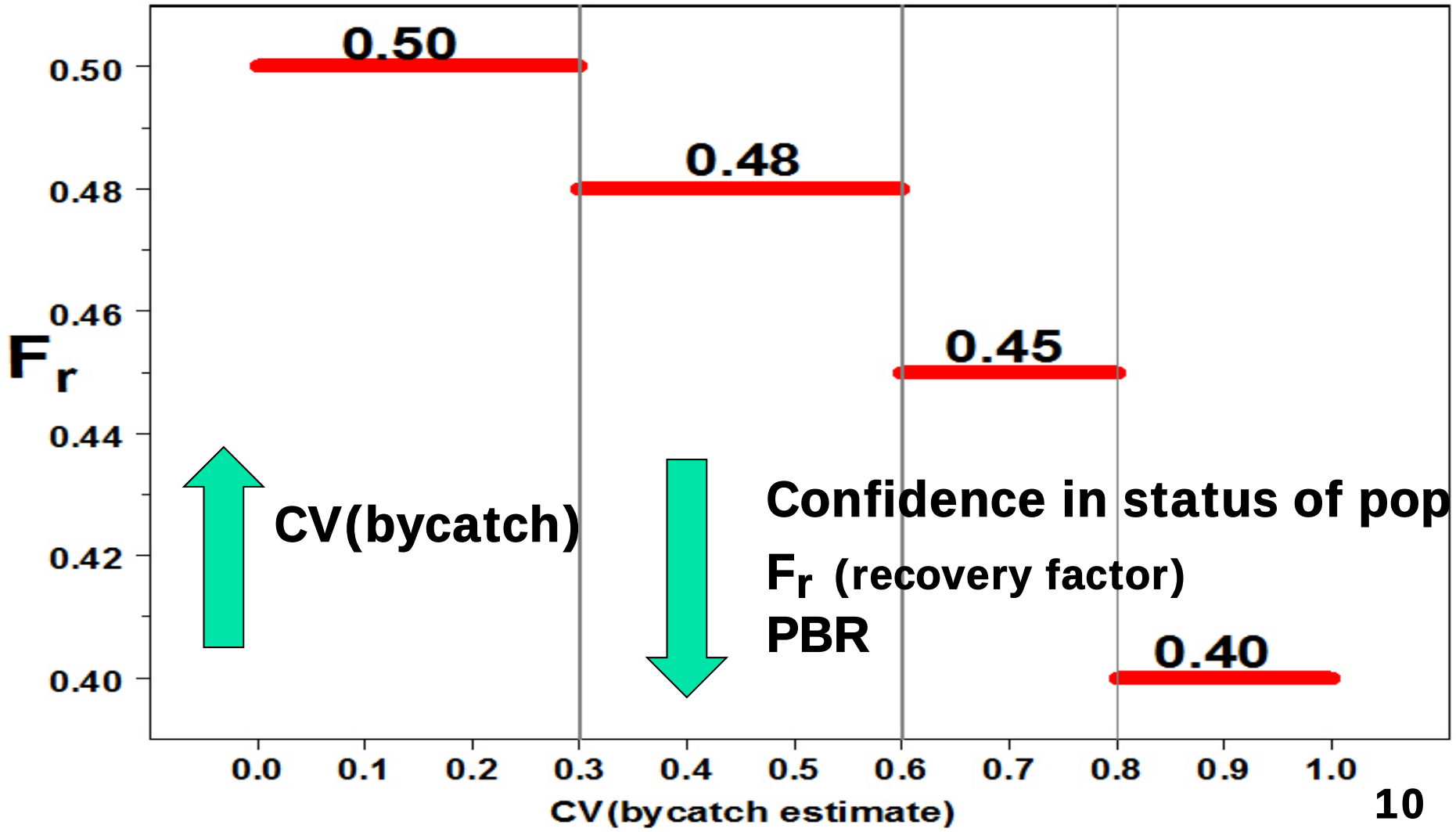
- **Moore and Read (2008) using a Bayesian population modeling analysis to estimate the potential population growth of harbor porpoise in the absence of bycatch mortality**



F_R = Recovery Factor

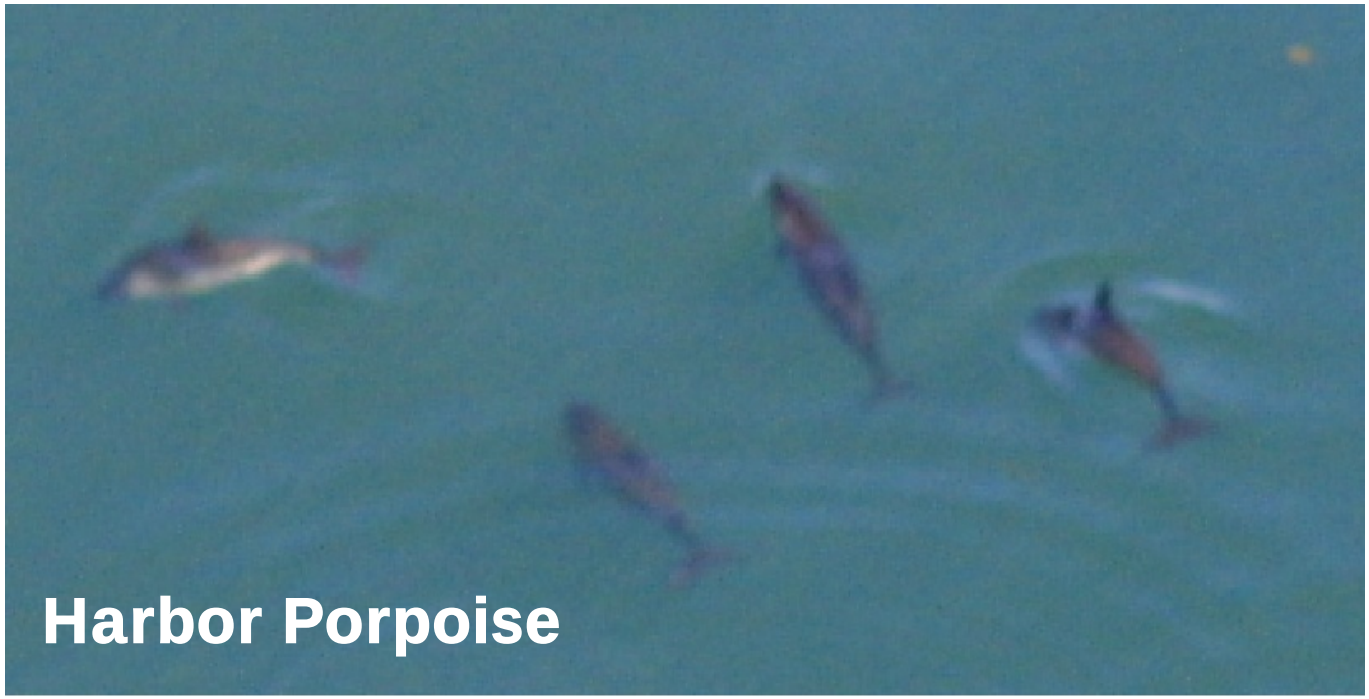
- Factor to ensure the recovery of depleted population
- Factor to account for additional uncertainties other than the precision of the abundance estimate
- Defaults
  - 0.1 for endangered stocks
  - 0.5 for depleted and threatened stocks and stocks of unknown status

Uncertainty in bycatch estimate affects F_r and PBR



$PBR = N_{min} * 1/2\ R_{max} * F_R$

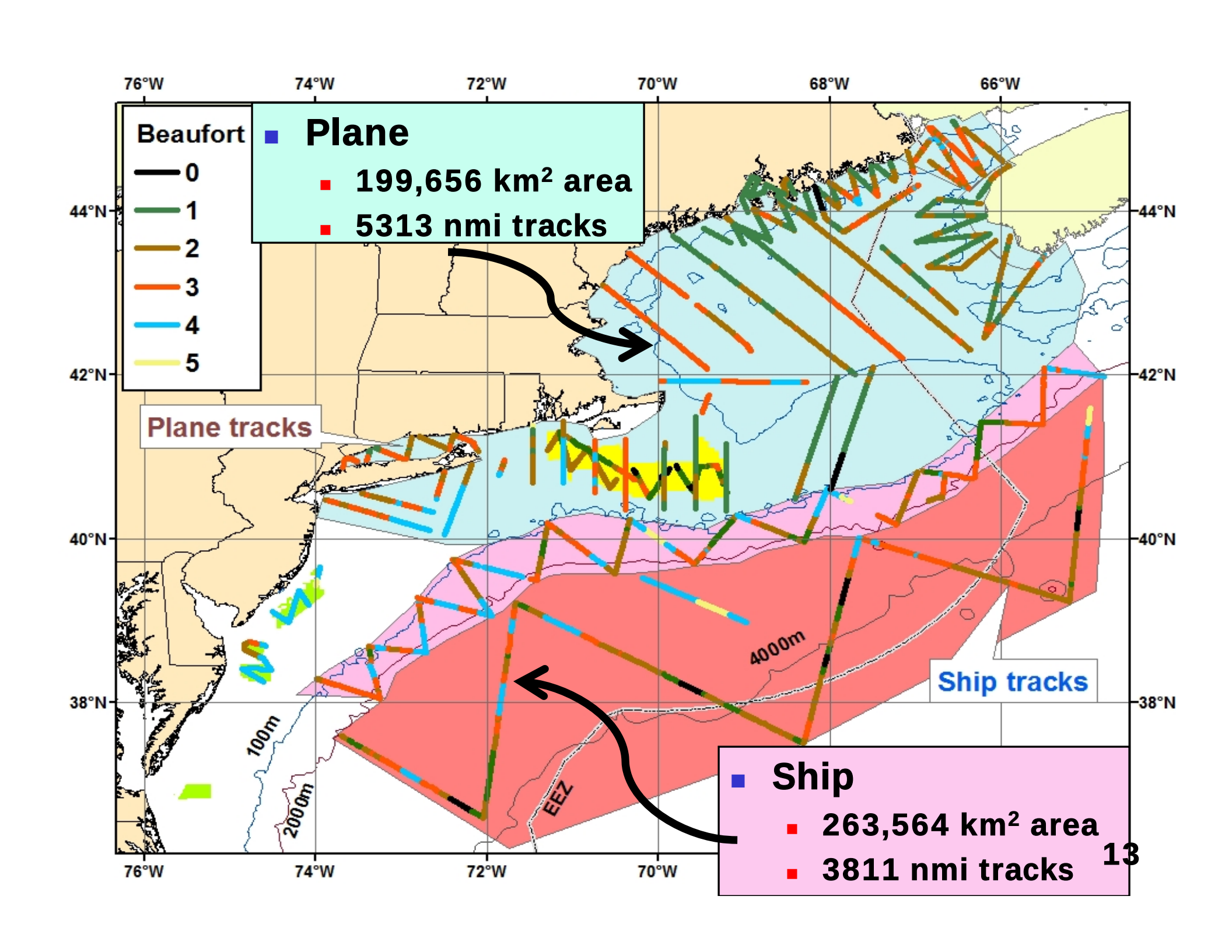
Species	N_{min}	R_{max}	F_r	PBR
Harbor Porpoise	61,415	0.046	0.5	706

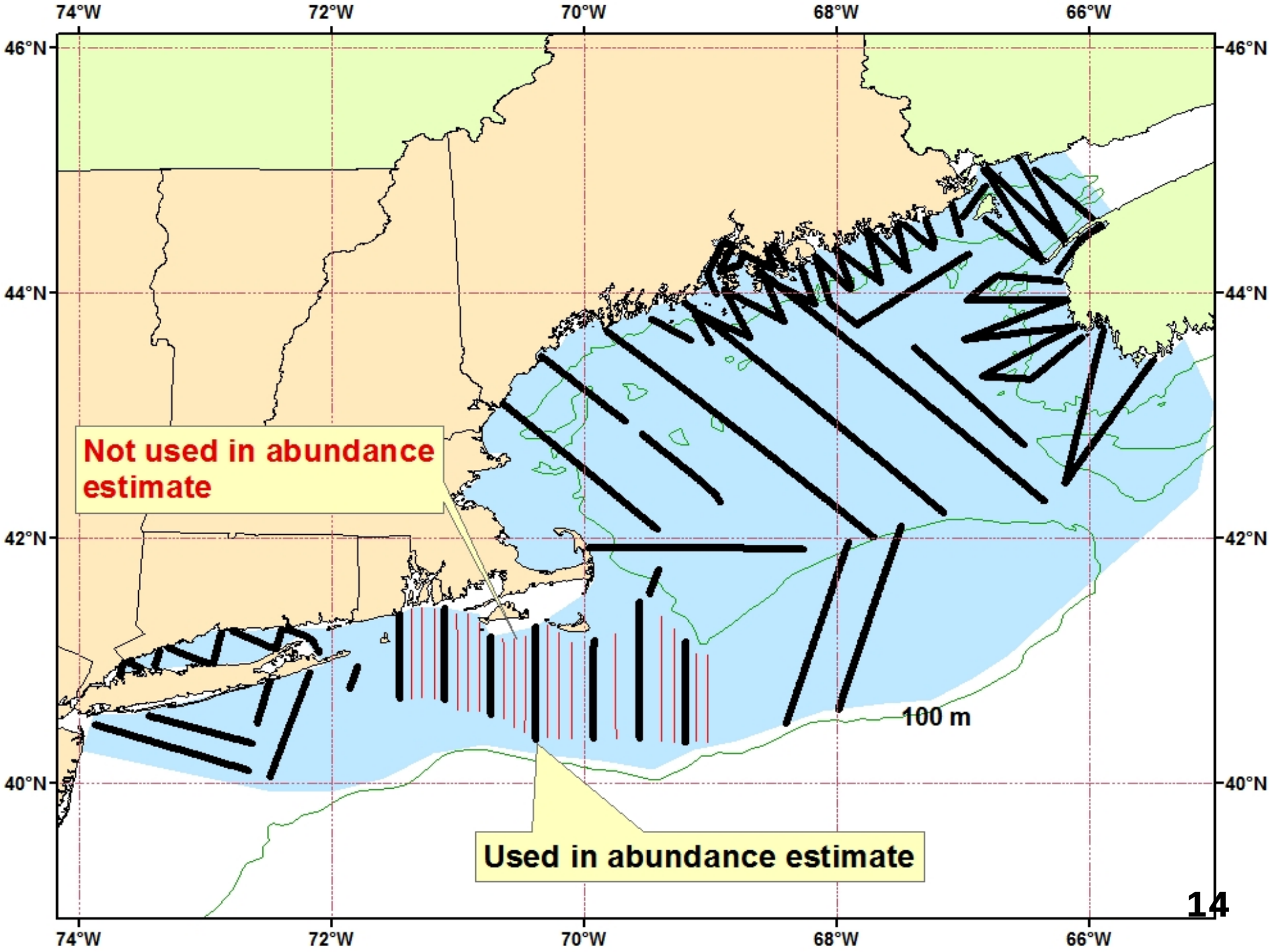


How we estimated abundance for the 2011 survey

NOAA Twin Otter

NOAA ship Henry B. Bigelow


Beaufort
0
1
2
3
4
5
Plane
199,656 km² area
5313 nmi tracks
Plane tracks
Ship tracks
Ship
263,564 km² area
3811 nmi tracks
4000m
2000m
100m
EEZ
76°W
74°W
72°W
70°W
68°W
66°W
44°N
42°N
40°N
38°N


74°W
72°W
70°W
68°W
66°W
46°N
44°N
42°N
40°N
Not used in abundance estimate
100 m
Used in abundance estimate

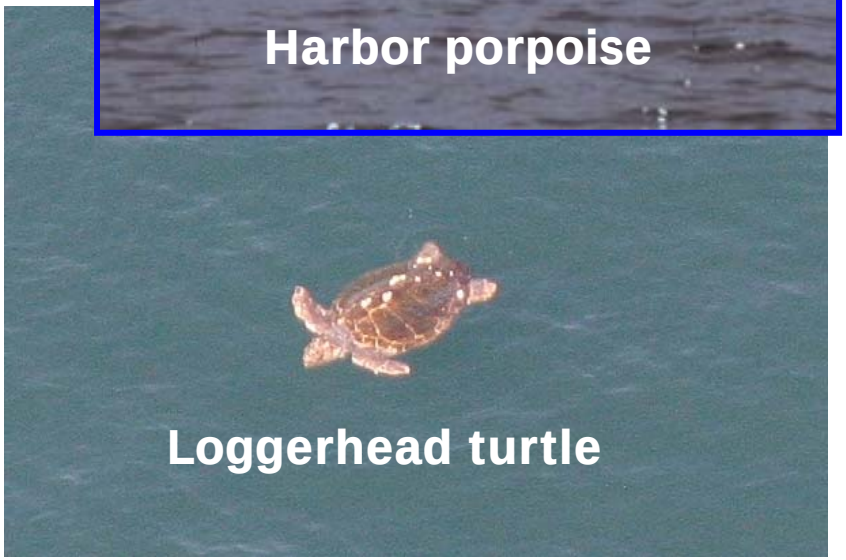
Surveys record many species


Common dolphins


Right whale

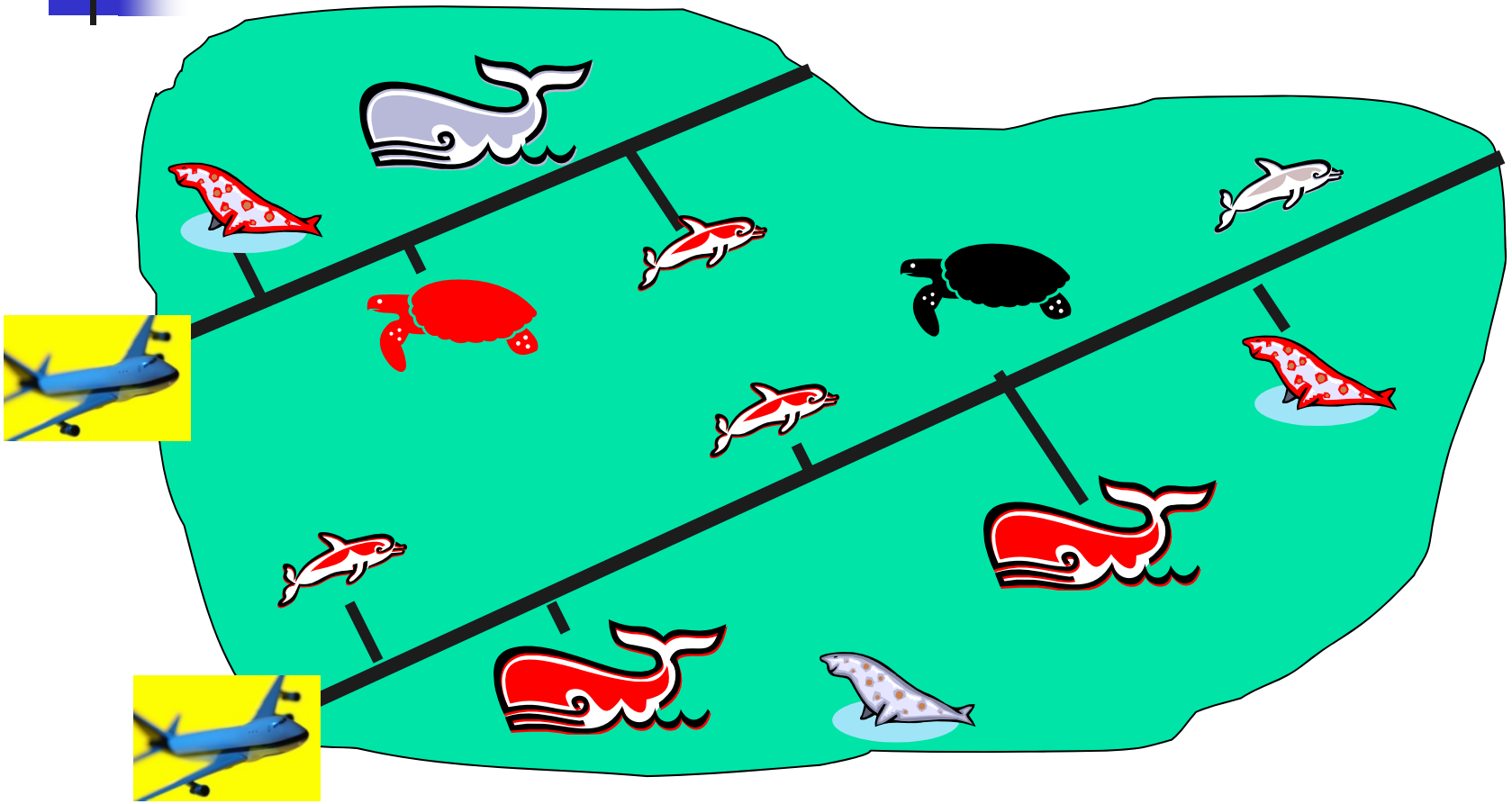

Harbor porpoise


Dead things


Loggerhead turtle

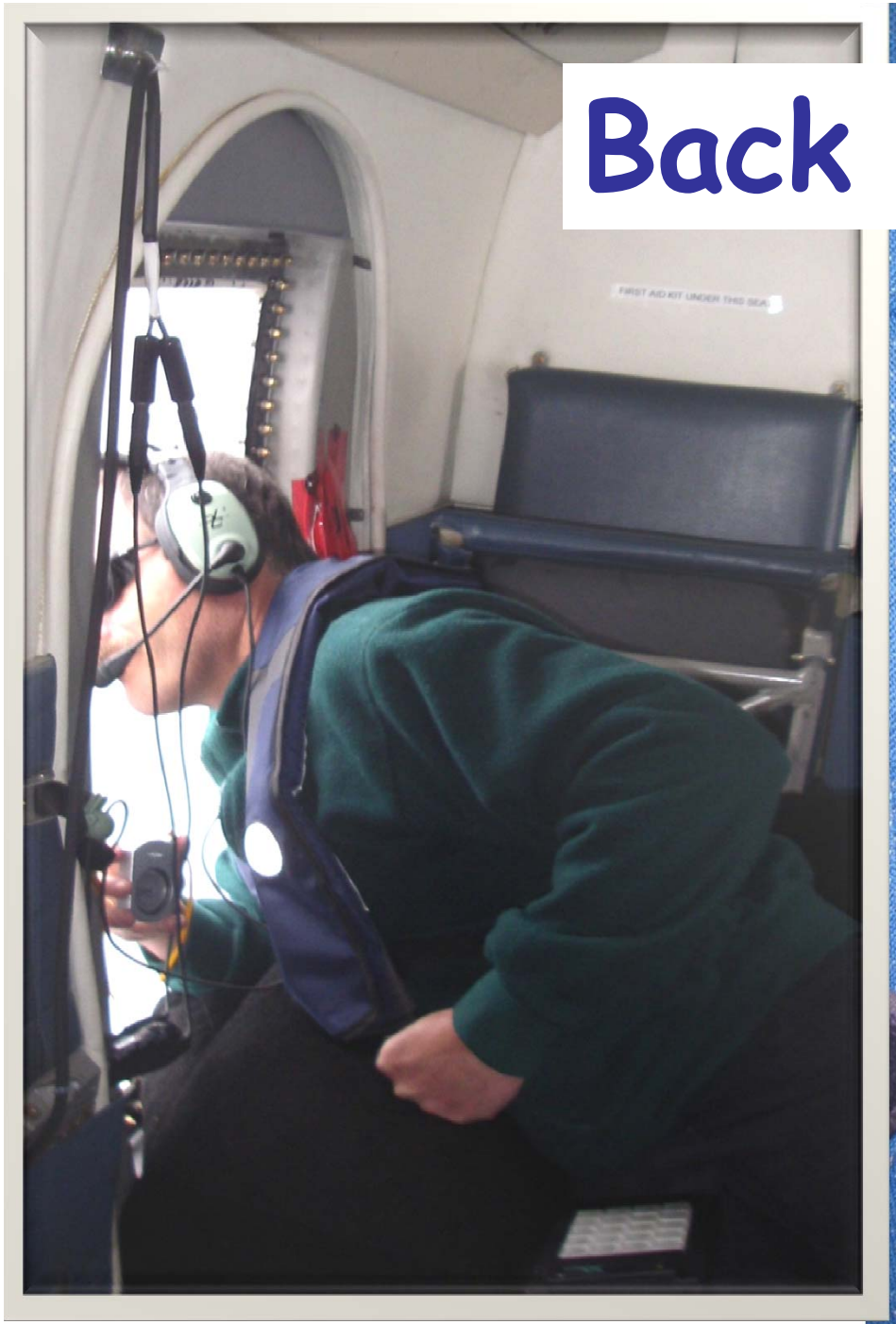

Harbor seal

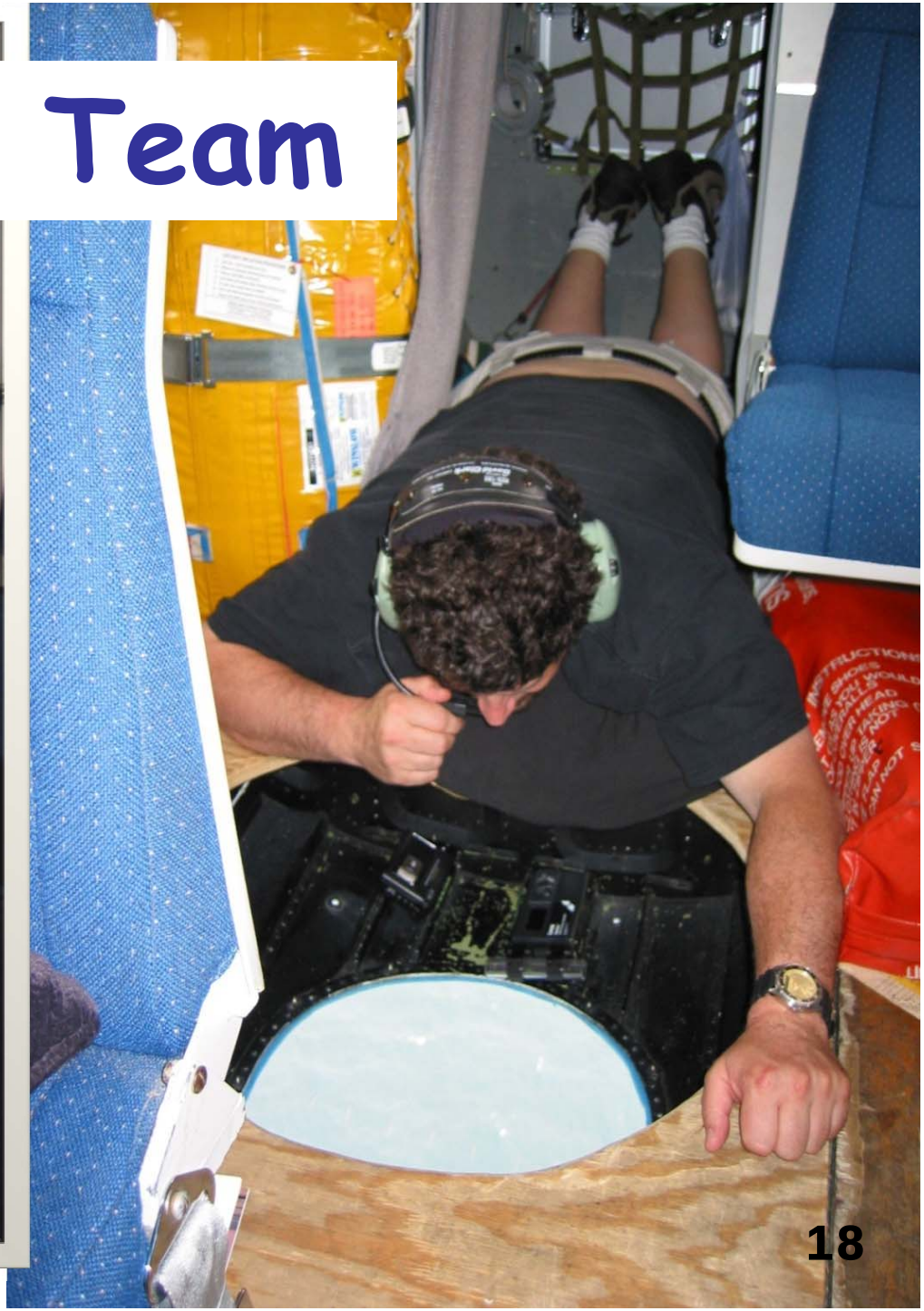
Line transect surveys



Front Team

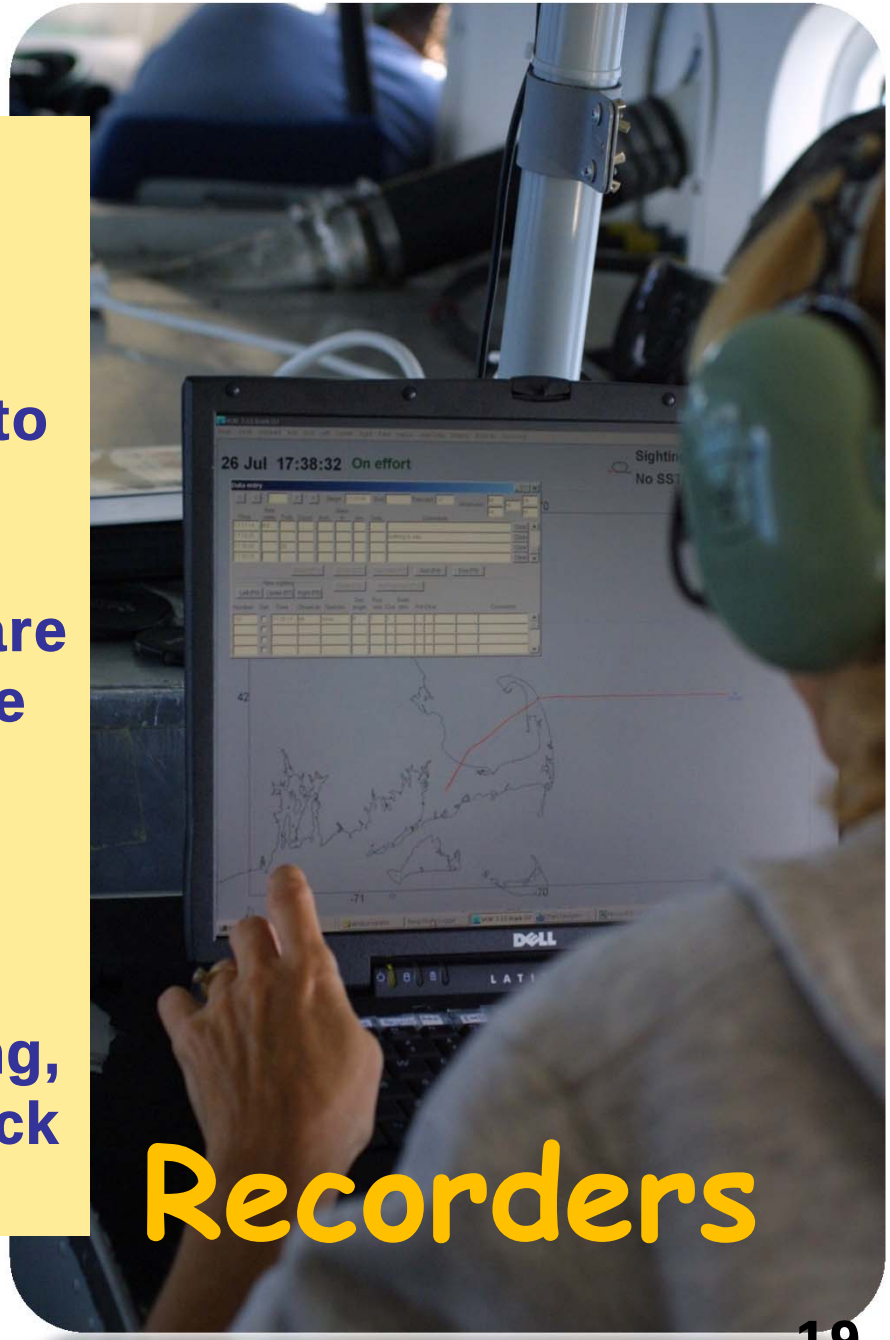
Back Team





Effort variables

* location of observers
* Beaufort sea state (measured to one decimal place)
* percent cloud cover
* location and severity of the glare
* overall subjective quality of the sighting conditions as thought by each observer
* times when start searching, break to id group, resume after a break, end searching, beginning and end of a track line

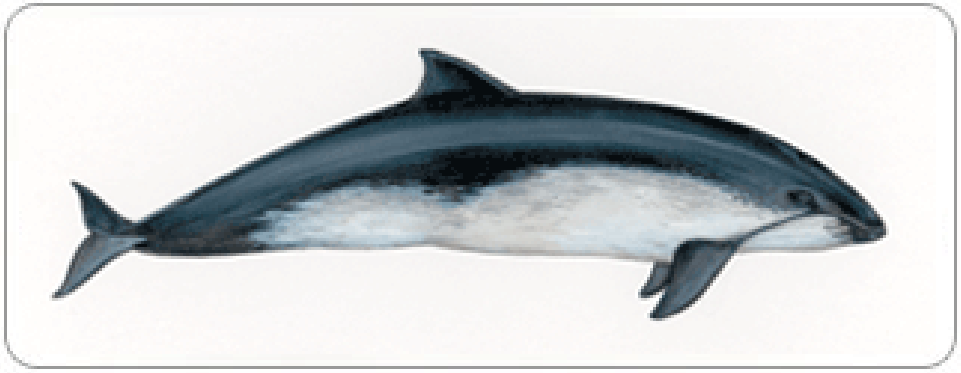


Recorders

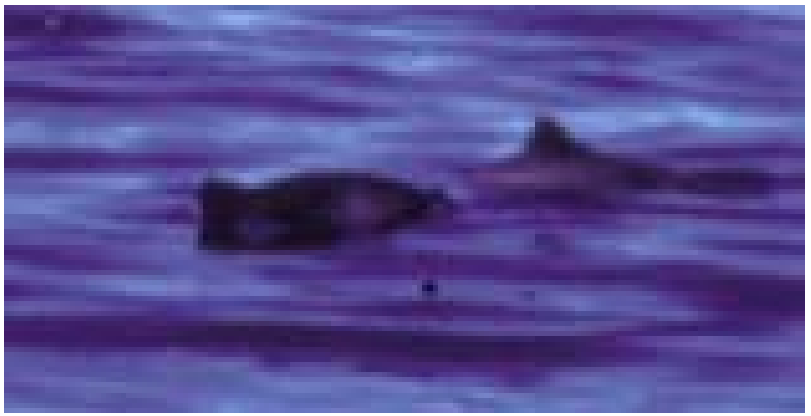
Sighting variables

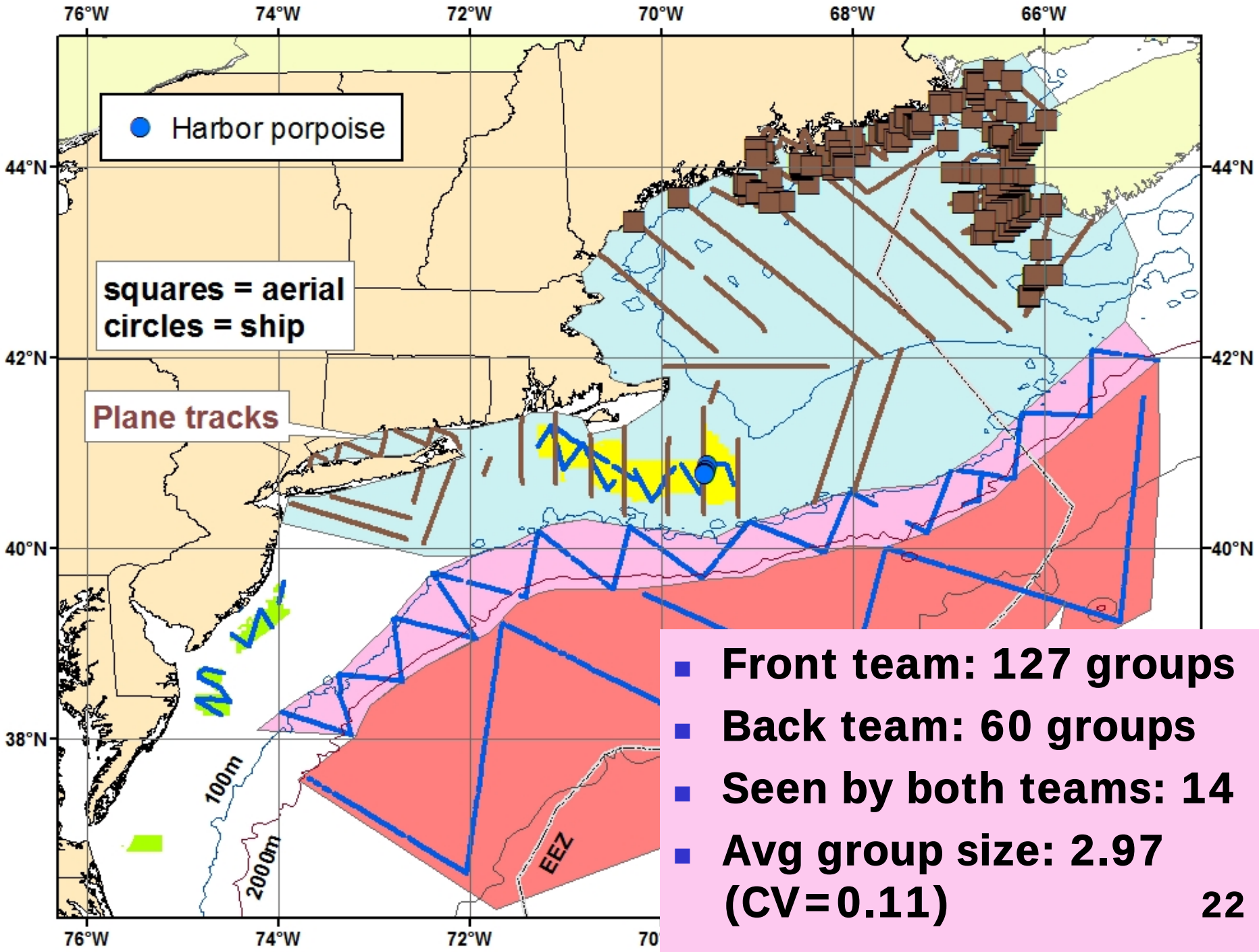
* who made the sighting
* time of the sighting
* species
* declination angle
* group size
* sighting cue
* swim direction
* group behavior

Recorders



Results for harbor porpoises

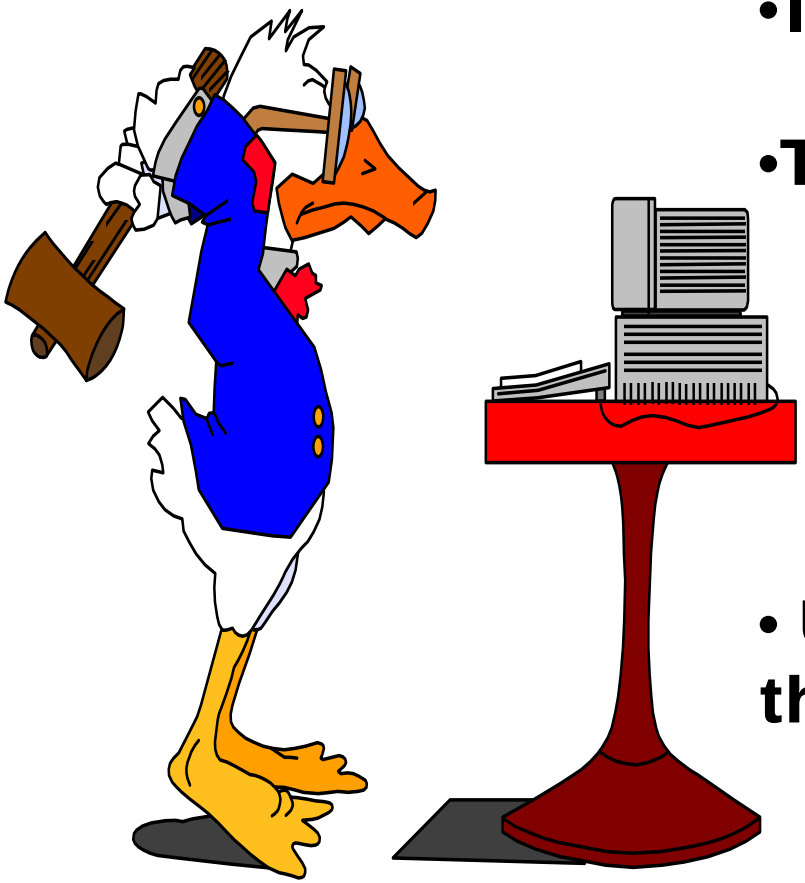




- **Front team: 127 groups**
- **Back team: 60 groups**
- **Seen by both teams: 14**
- **Avg group size: 2.97 (CV=0.11)**

After collect data ...

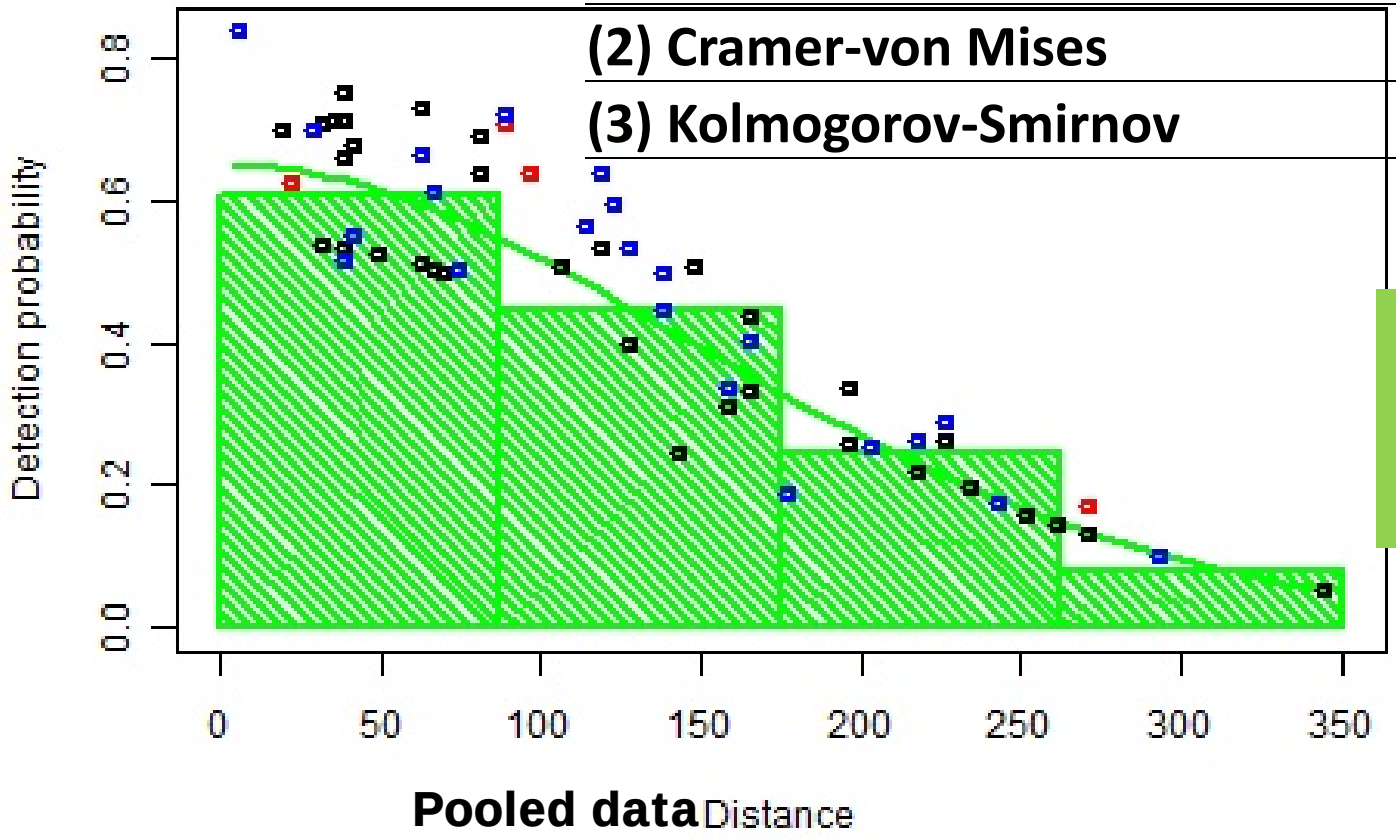
Used mark-recapture distance sampling



- Implicitly includes estimate of g(0)
- Two sub-model components
  - Detection function
  - Probability one team detected a group, when the other team has detected it
- Use covariates to better describe these sub-models

Models fit data

TEST	Test statistic	p-value
(1) Chi-squared test		
Distance Sampling	0.49	0.48
Mark-recapture	1.53	0.68
TOTAL CHI-SQUARE	2.02	0.73
(2) Cramer-von Mises	0.054	0.85
(3) Kolmogorov-Smirnov	0.042	0.92



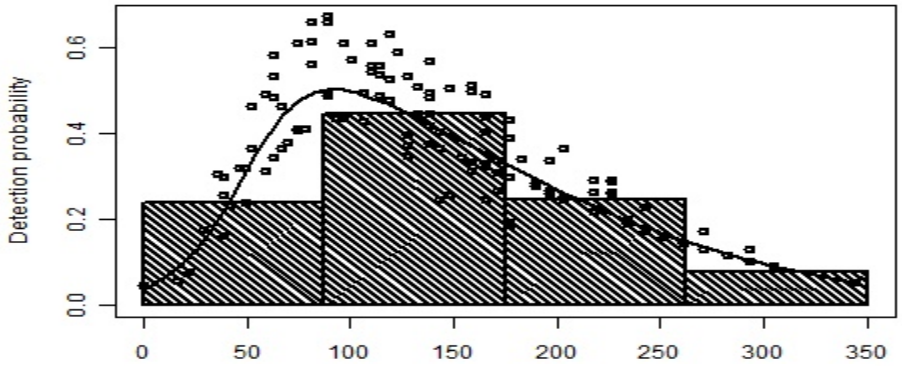
H_o: Model fits data

If $p<0.05$ then model does not fit

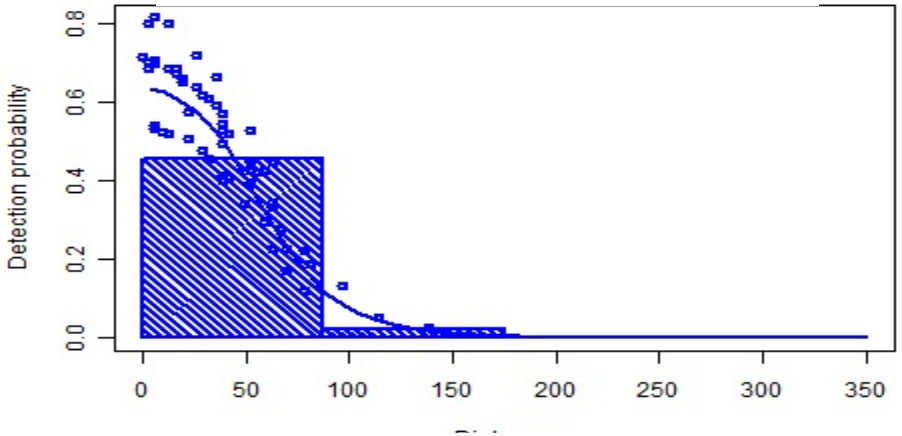
DS model: distance + glare

MR model: distance+team+swim direction+distance:team

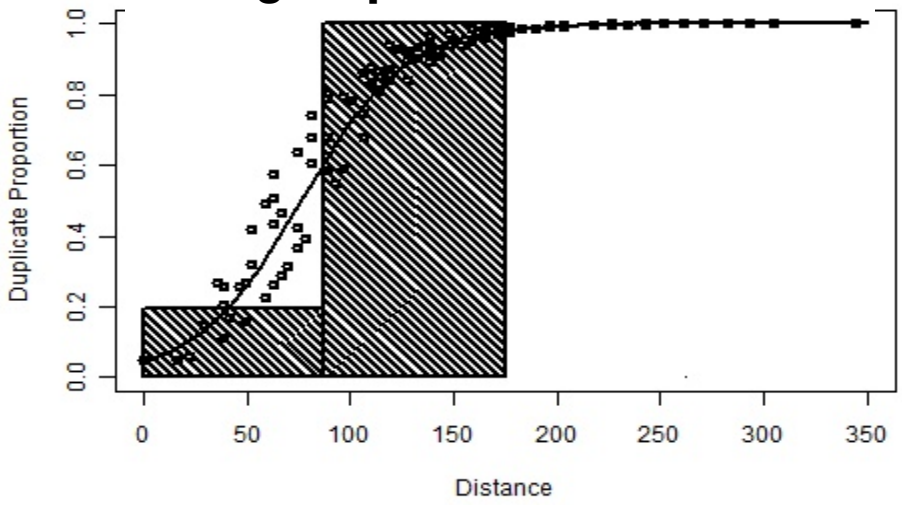
Front team's detections



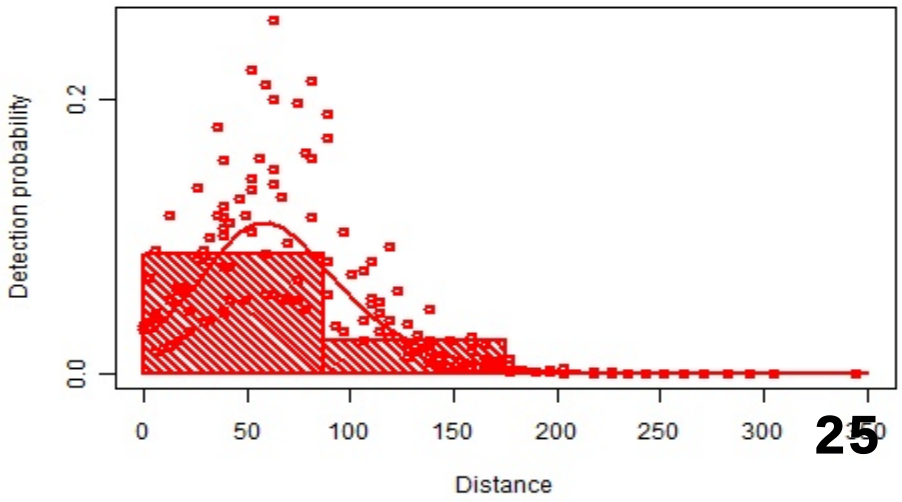
Back team's detections



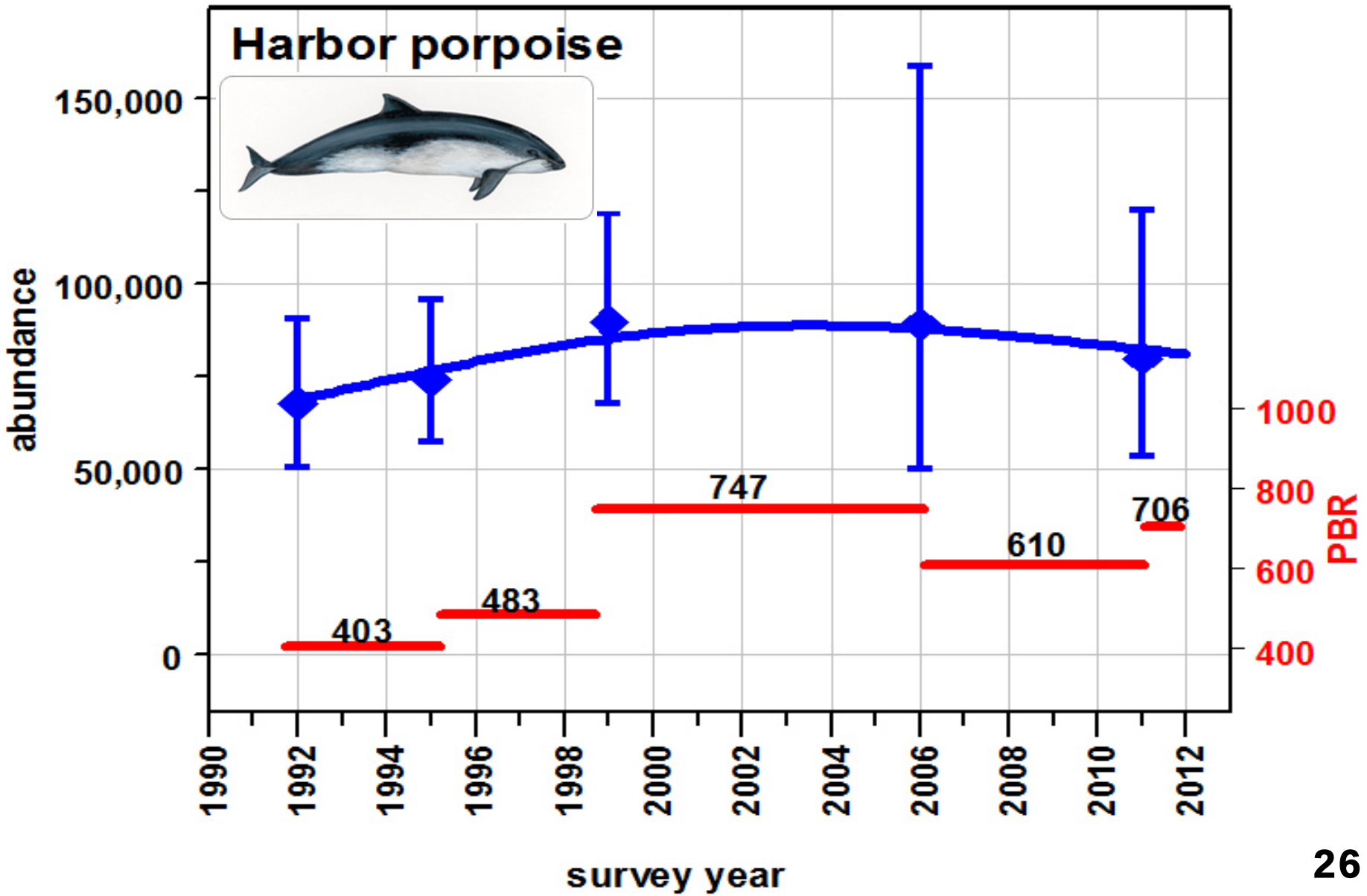
Mark-recapture detections of front team given back team saw group



Duplicate detections



Abundance estimate series



Harbor Porpoise

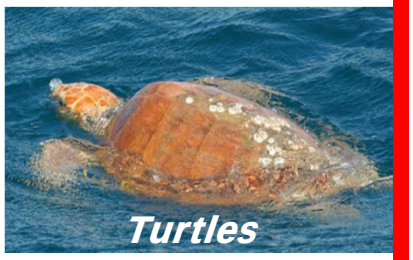
$PBR = N_{min} * 1/2\ R_{max} * F_R$

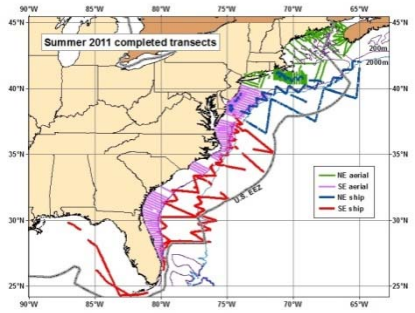
Year	N_{best}	$CV(N_{best})$	N_{min}	PBR
1991	37,500	0.29	--	--
1992	67,500	0.23	40,297*	403
1995	74,000	0.20	48,289**	483
1999	89,700	0.22	74,695	747
2006	89,054	0.47	60,970	610
2011	79,883	0.32	61,415	706

* Average of 1991 and 1992

** Average of 1991, 1992, and 1995

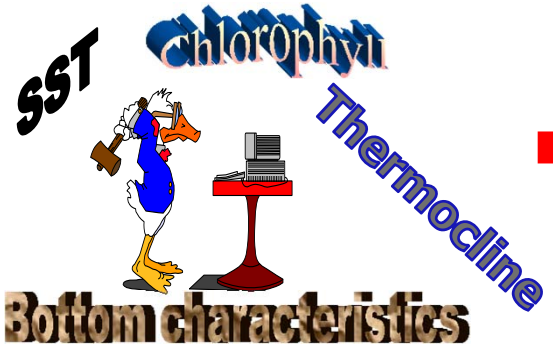
Atlantic Marine Assessment Program for Protected Species (AMAPPS) 2010 – 2014 (+?)

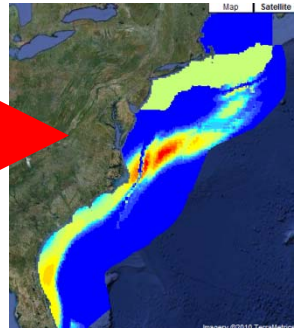




Quarterly collect distribution and abundance data via shipboard and aerial visual and acoustic surveys

Tag turtles, seals and seabirds to correct visual abundance data for animals not seen





Model seasonal, spatially-explicit density estimates incorporating habitat characteristics

NOAA NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION U.S. DEPARTMENT OF COMMERCE

BOEM

NAVY

U.S. FISH & WILDLIFE SERVICE

2010 – summer NMFS & FWS aerial

2011 – winter NMFS & FWS aerial

– summer NMFS & FWS aerial & shipboard

2012 – spring NMFS & FWS aerial

– fall NMFS & FWS aerial

2013 – winter NMFS & FWS aerial

– summer NMFS shipboard

2014 – winter NMFS & FWS aerial

– fall NMFS & FWS aerial

2015 – spring NMFS & FWS aerial

Present & Future

- Surveys in all four seasons
- AMAPPS
  - Use environmental / habitat features to create:
    - Potentially better abundance estimates
    - Spatially explicit density maps
    - Trends analyses