Abundance and Population Information

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Overview

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

What is the definition of PBR?

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 P.	89,054	0.47	60,970
White-sided D.	63,368	0.27	50,883
Common D.	120,743	0.23	99,975

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
- 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)

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

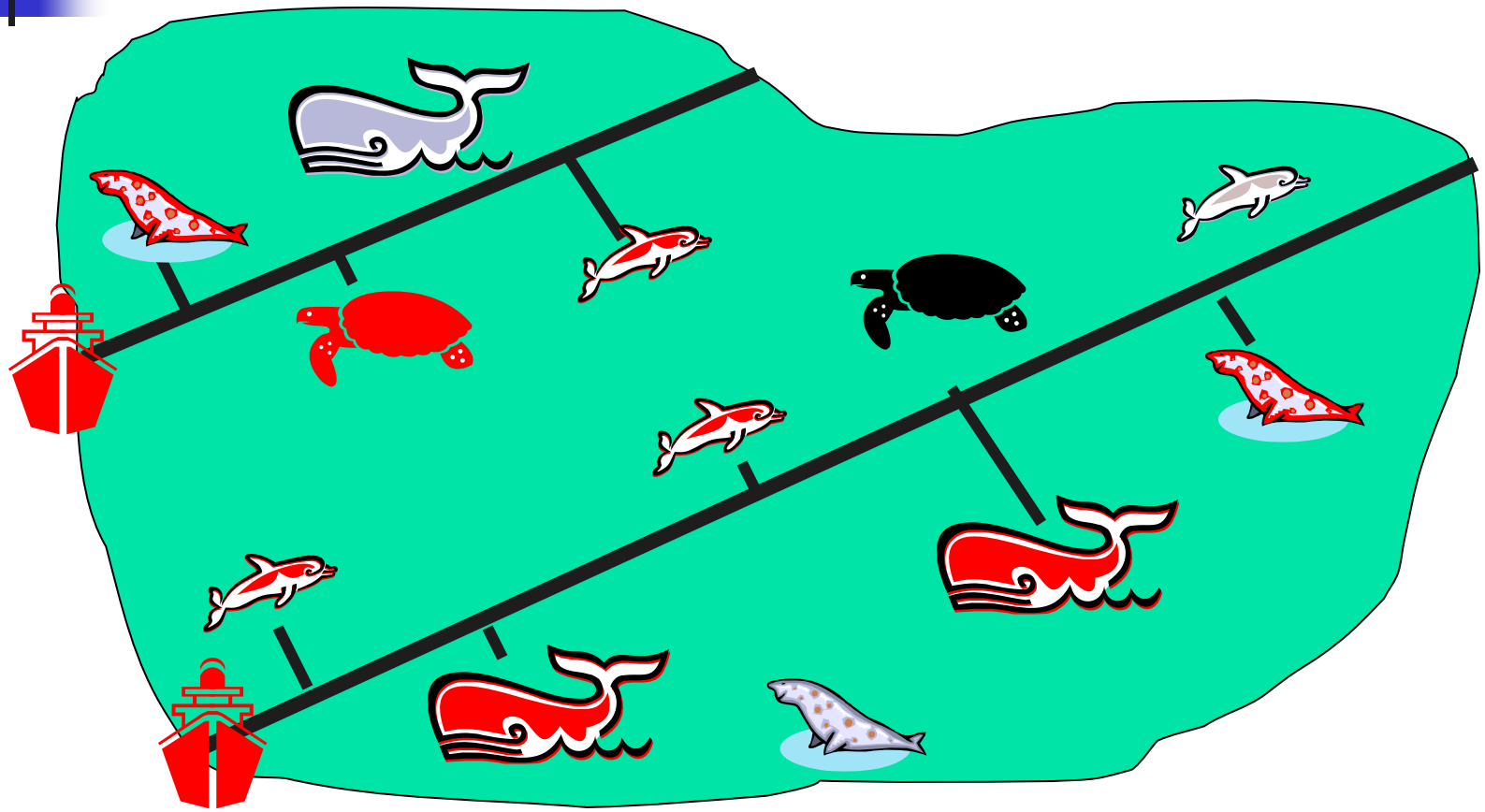
- Coefficient of variation of average by-catch = CV(B)
  - if CV(B) $\leq$ 0.3 F_R=0.5
  - if 0.3 $<$ CV(B) $\leq$ 0.6 F_R=0.48
  - if 0.6 $<$ CV(B) $\leq$ 0.8 F_R=0.45
  - if CV(B) $\geq$ 0.8 F_R=0.40

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

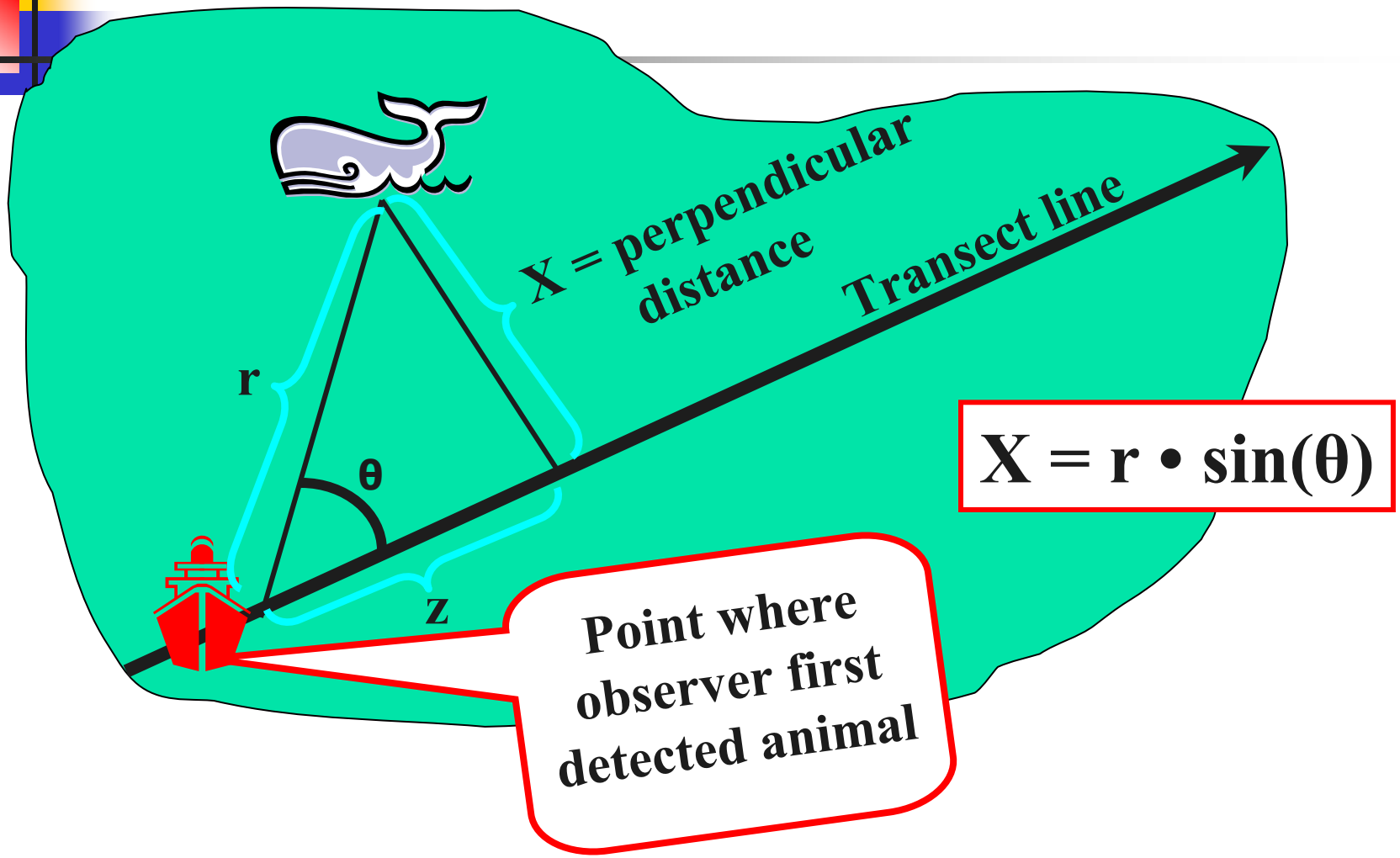
Species	N_{min}	R_{max}	F_r	PBR
Harbor P.	60,970	0.04	0.5	610
White-sided D.	50,883	0.04	0.5	509
Common D.	99,975	0.04	0.5	1000

How we estimate abundance?

Line transect surveys



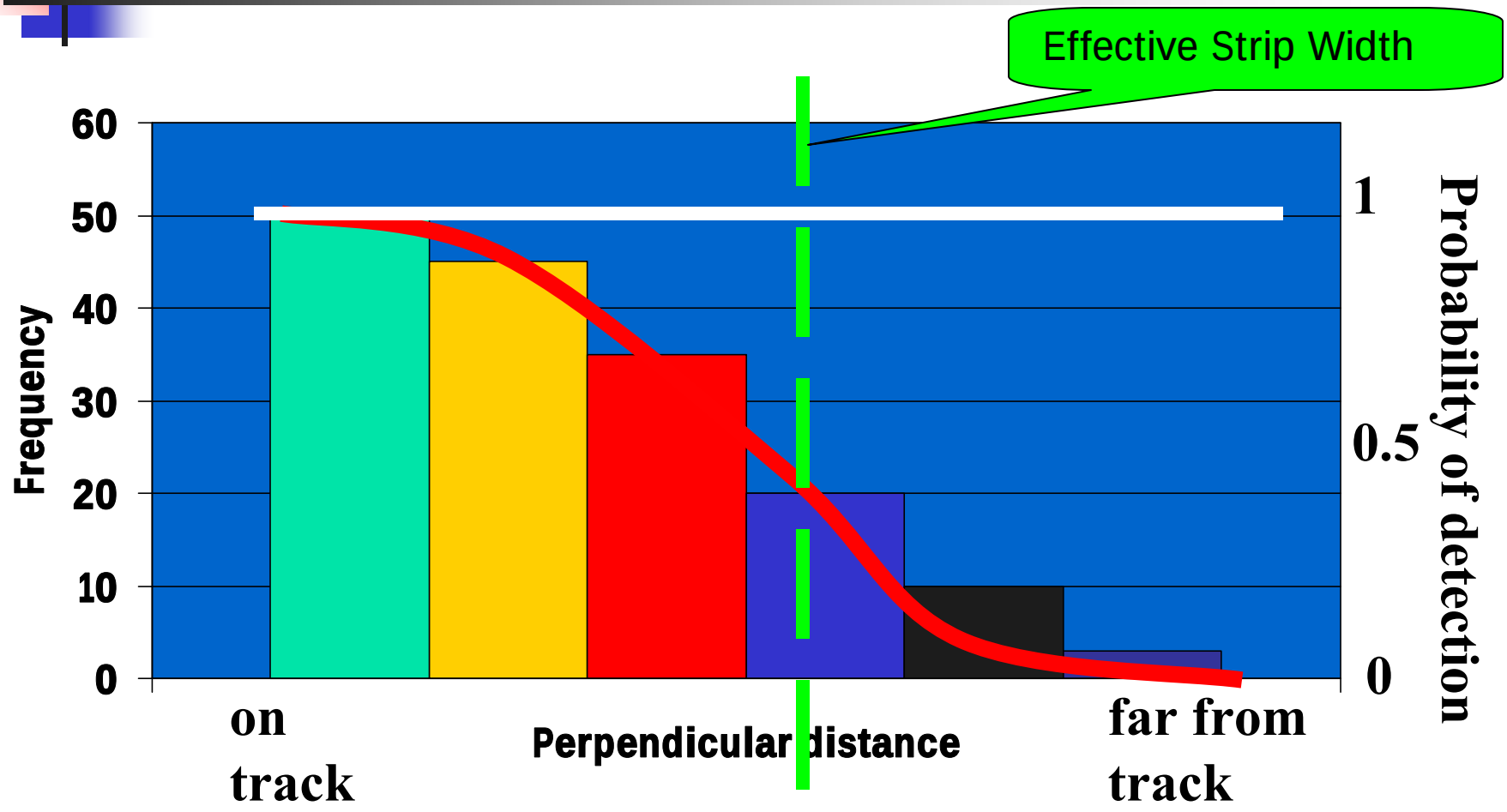
Line transect surveys



$$X = r \bullet \sin(\theta)$$

Detection Function

g(y) = the probability of detecting an animal group, given that it is at perpendicular distance y from the track line



Line Transect Methodology

(Buckland et al. 1993)

$$D_{ij} = \frac{n_{ij} \cdot s_{ij}}{2\, L_i \cdot ESW_j}$$

where

n_{ij} = number of groups detected in stratum i by team j,

s_{ij} = expected group size in stratum i estimated by team j,

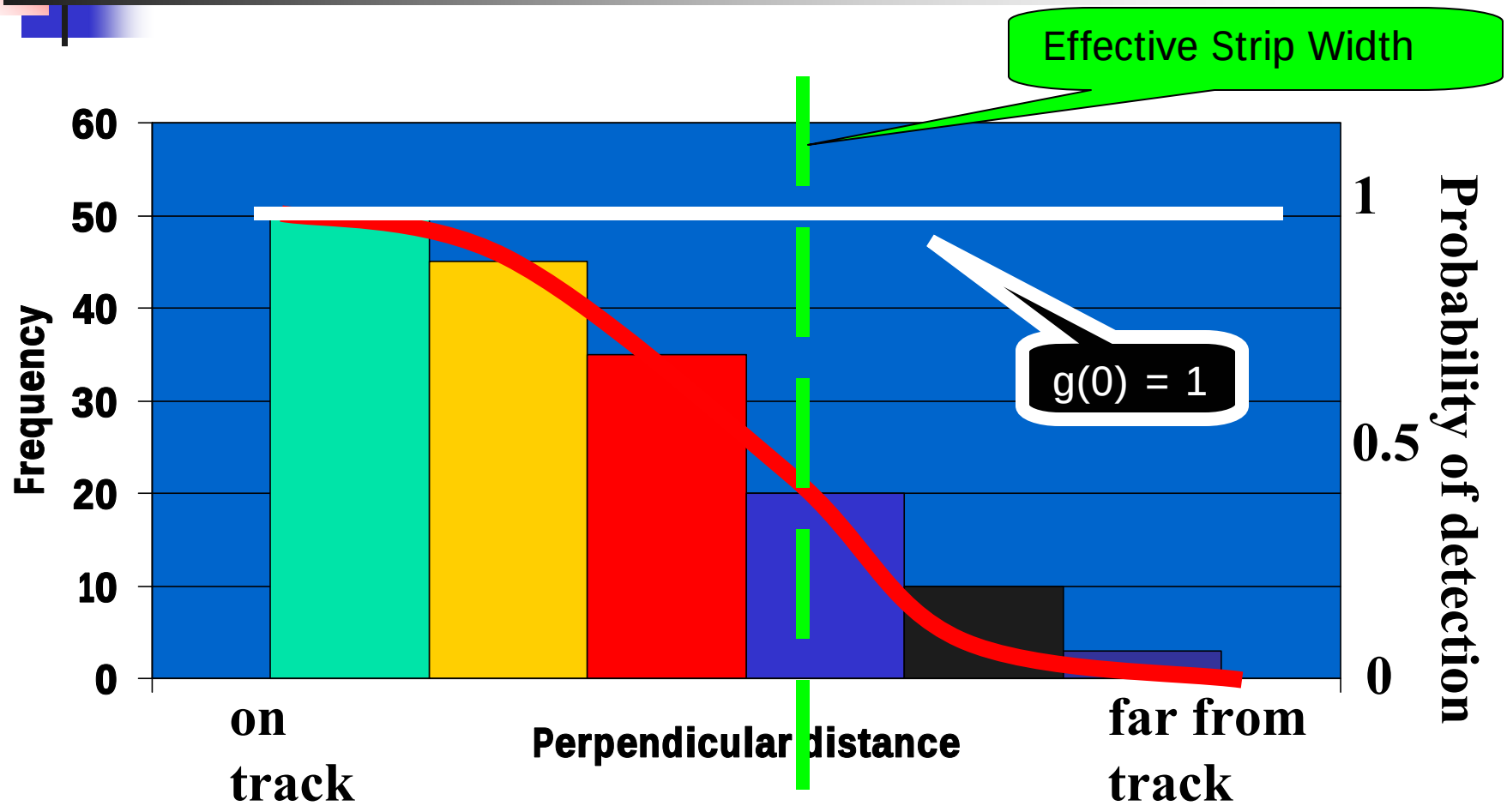
ESW_j = effective strip half-width for team j
= 1/sighting probability density at zero perpendicular distance for team j,

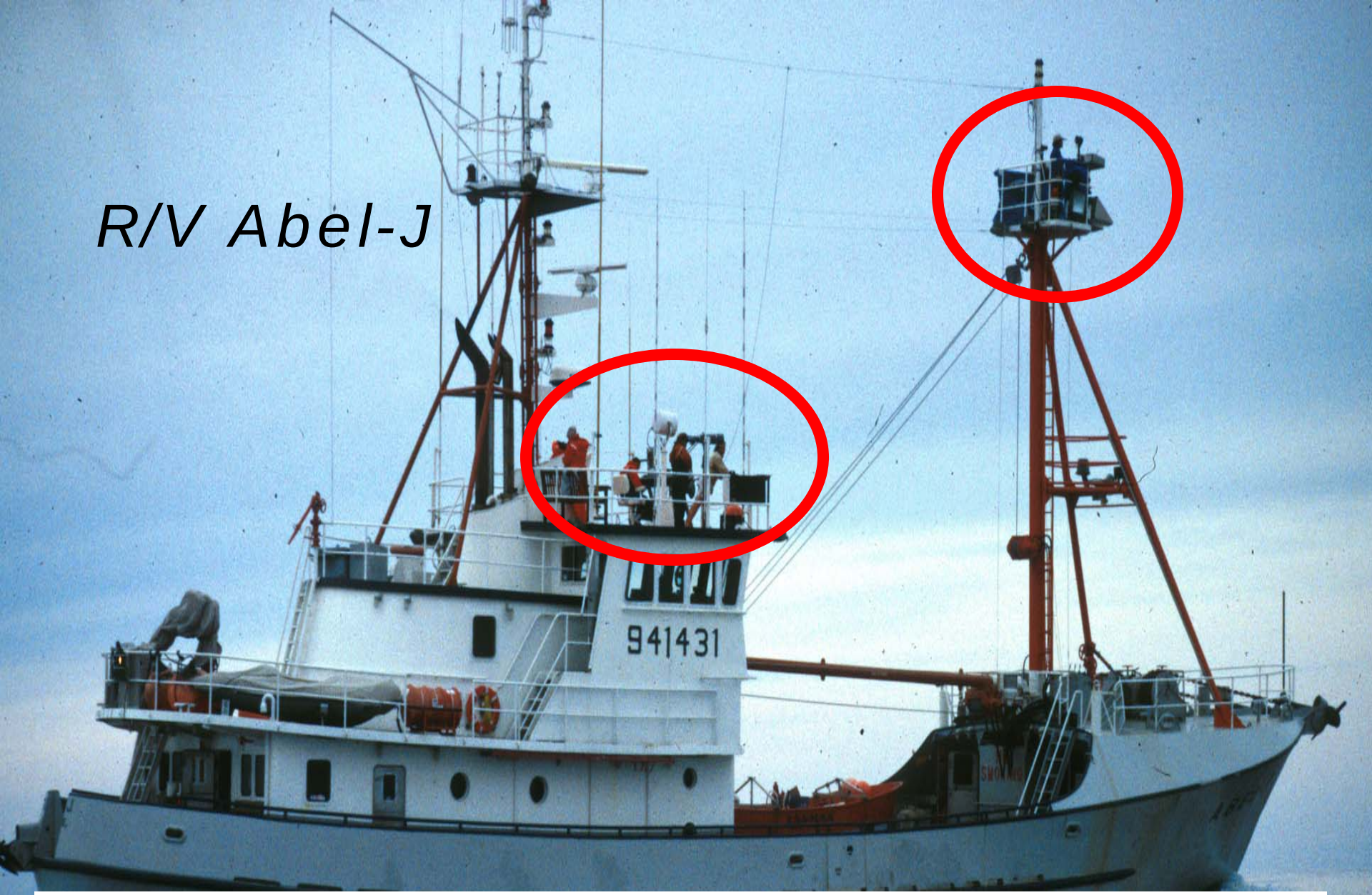
L_i = length of transect line in stratum i.

j = team: *plane*=single team on the plane, *upper*=upper team on ship, and *lower*=lower team on ship.

Detection Function

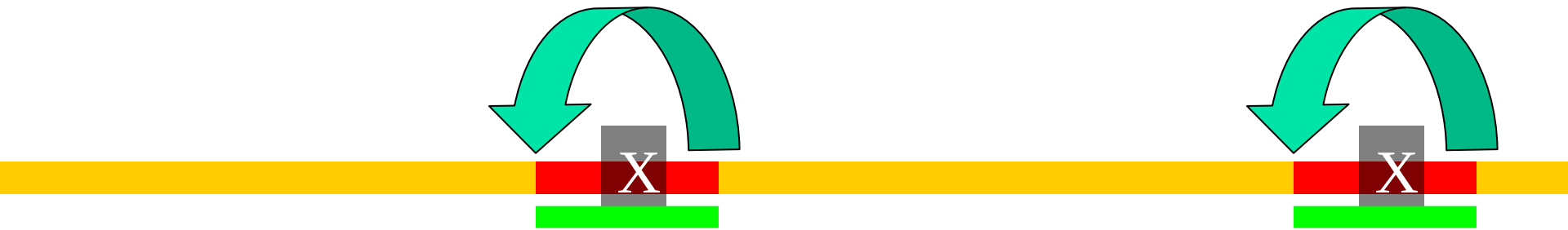
g(y) = the probability of detecting an animal group, given that it is at perpendicular distance y from the track line





To estimate g(0), two independent teams of observers search for animals

- **AERIAL SURVEYS**
- **Use Circle-back method to estimate g(0)**
- **Standard line transect estimate using only the single plane and leading legs**
- **Use trailing legs to estimate g(0)**

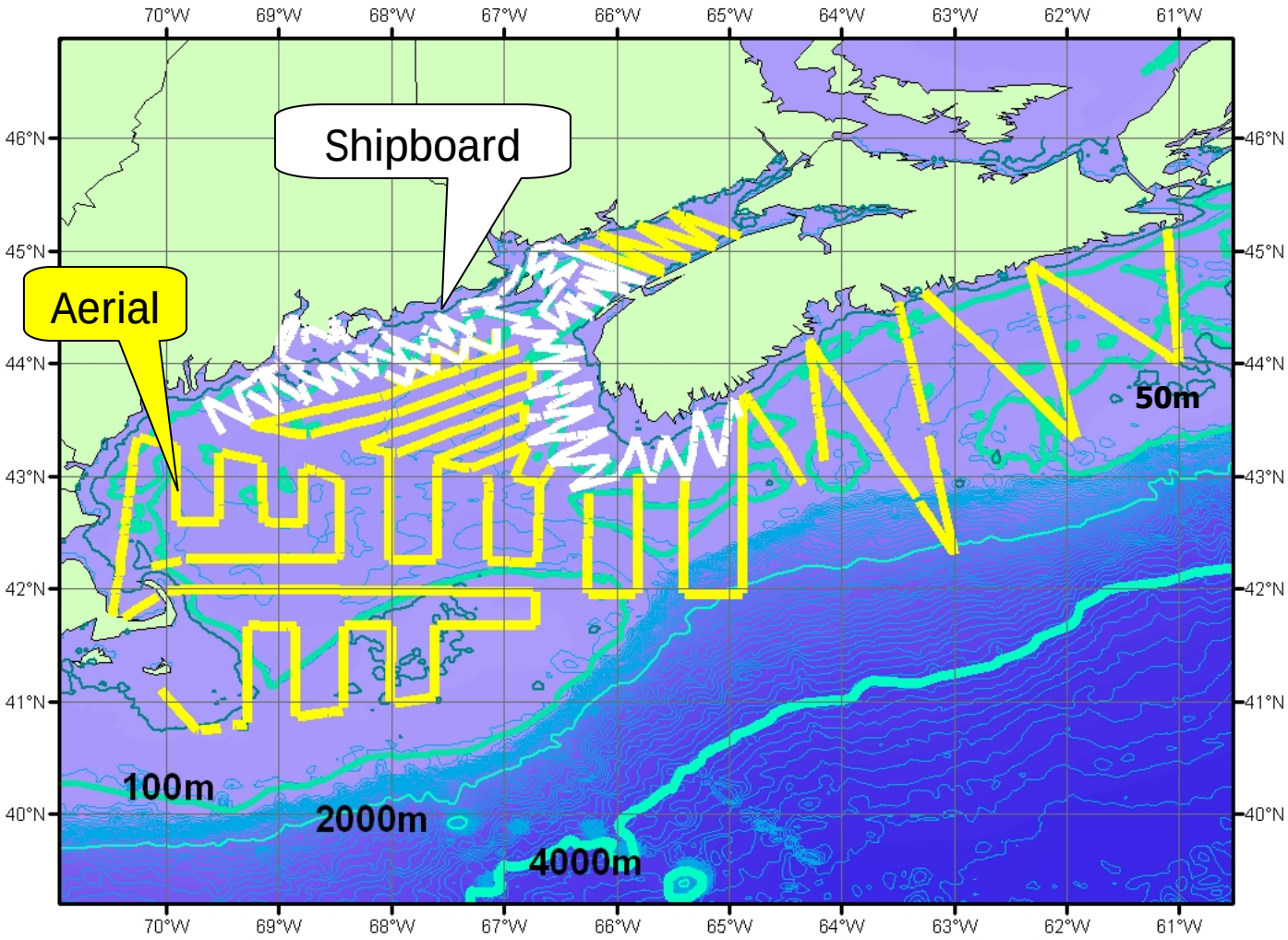


Single + leading legs	**=**	**6,688 km**
Trailing legs	**=**	**219 km**

R/V Abel-J
941431
1991 - 1995

1999

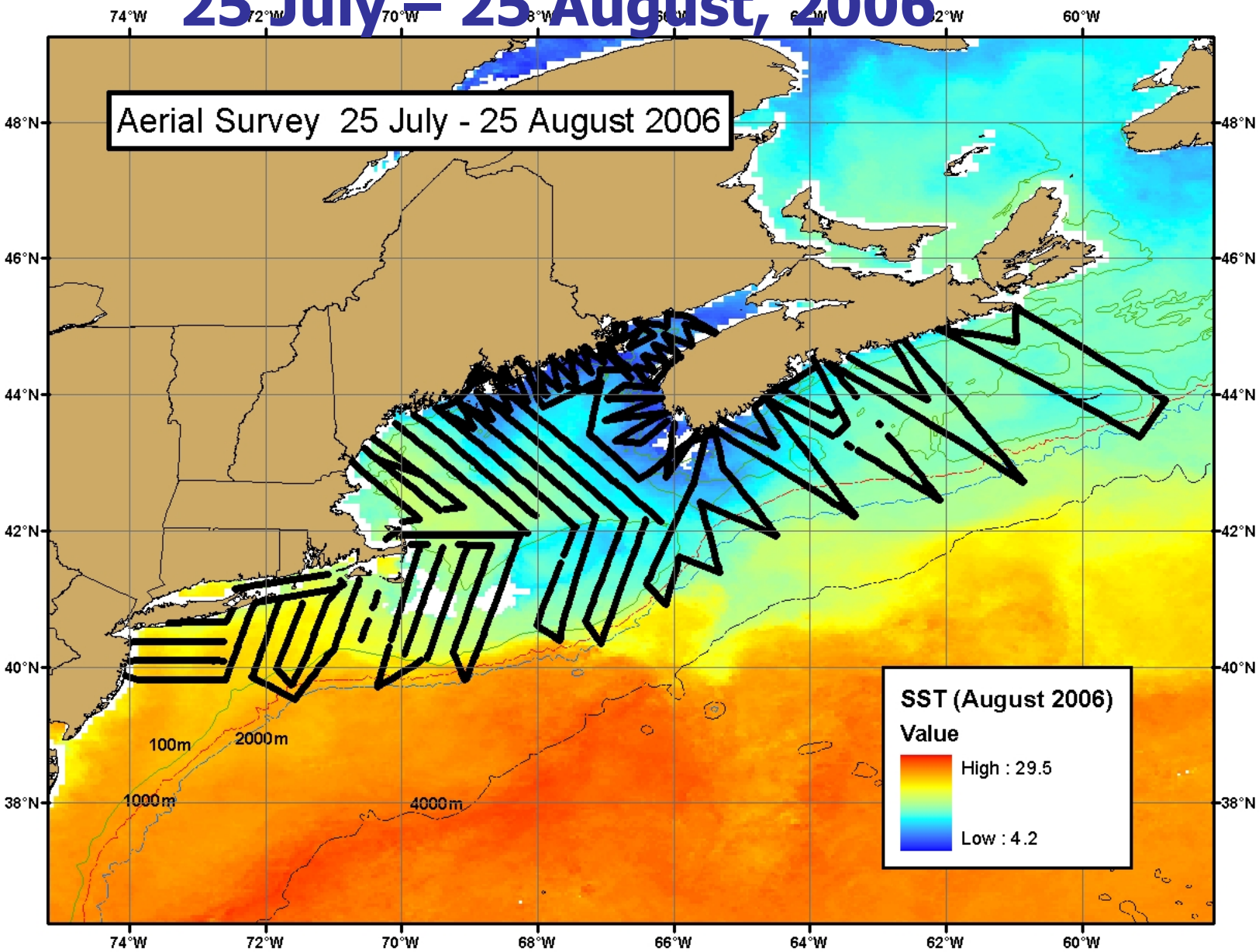
Shipboard and aerial tracklines July 28 – August 31, 1999



NOAA Twin Otter

Aerial survey

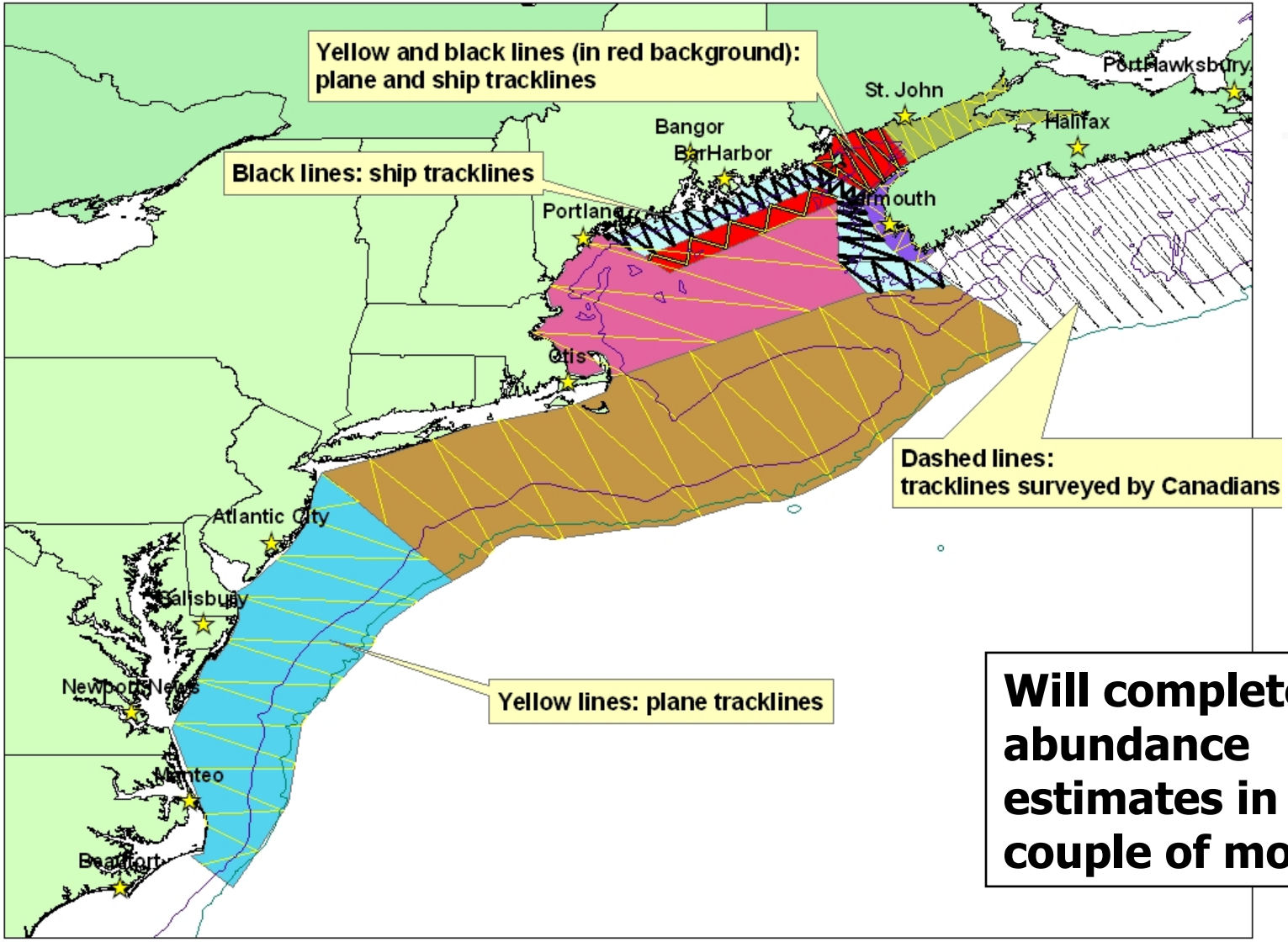
25 July – 25 August, 2006



2007

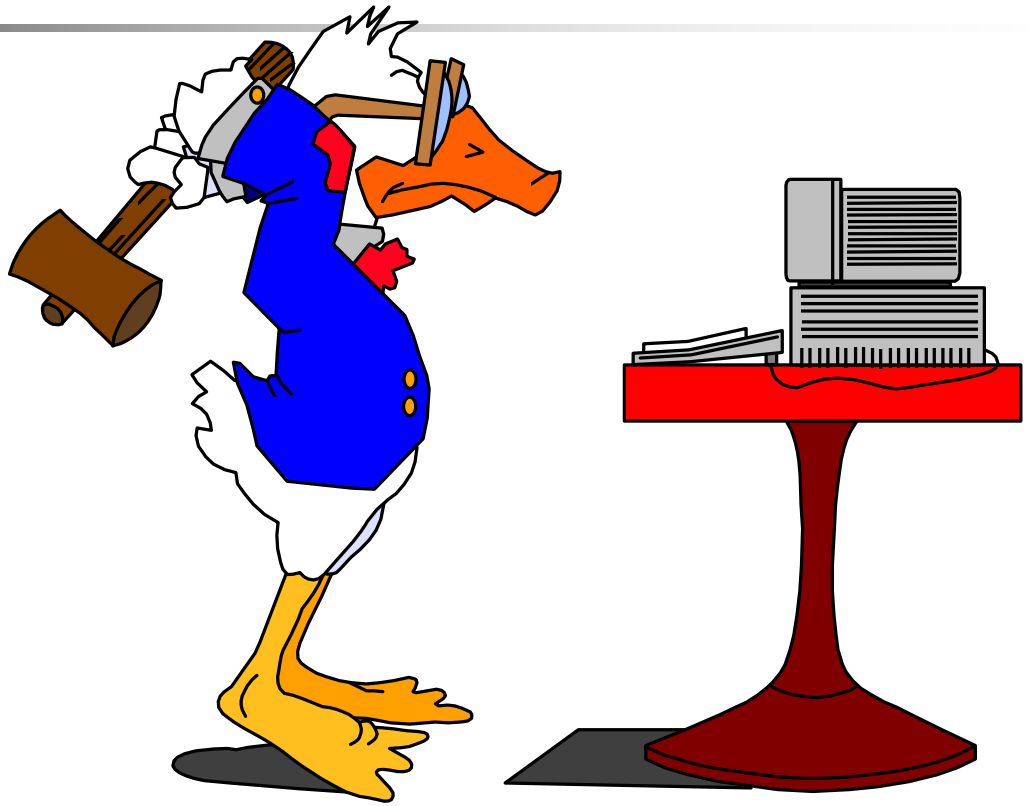
Aerial and shipboard survey

30 July – 30 August, 2007

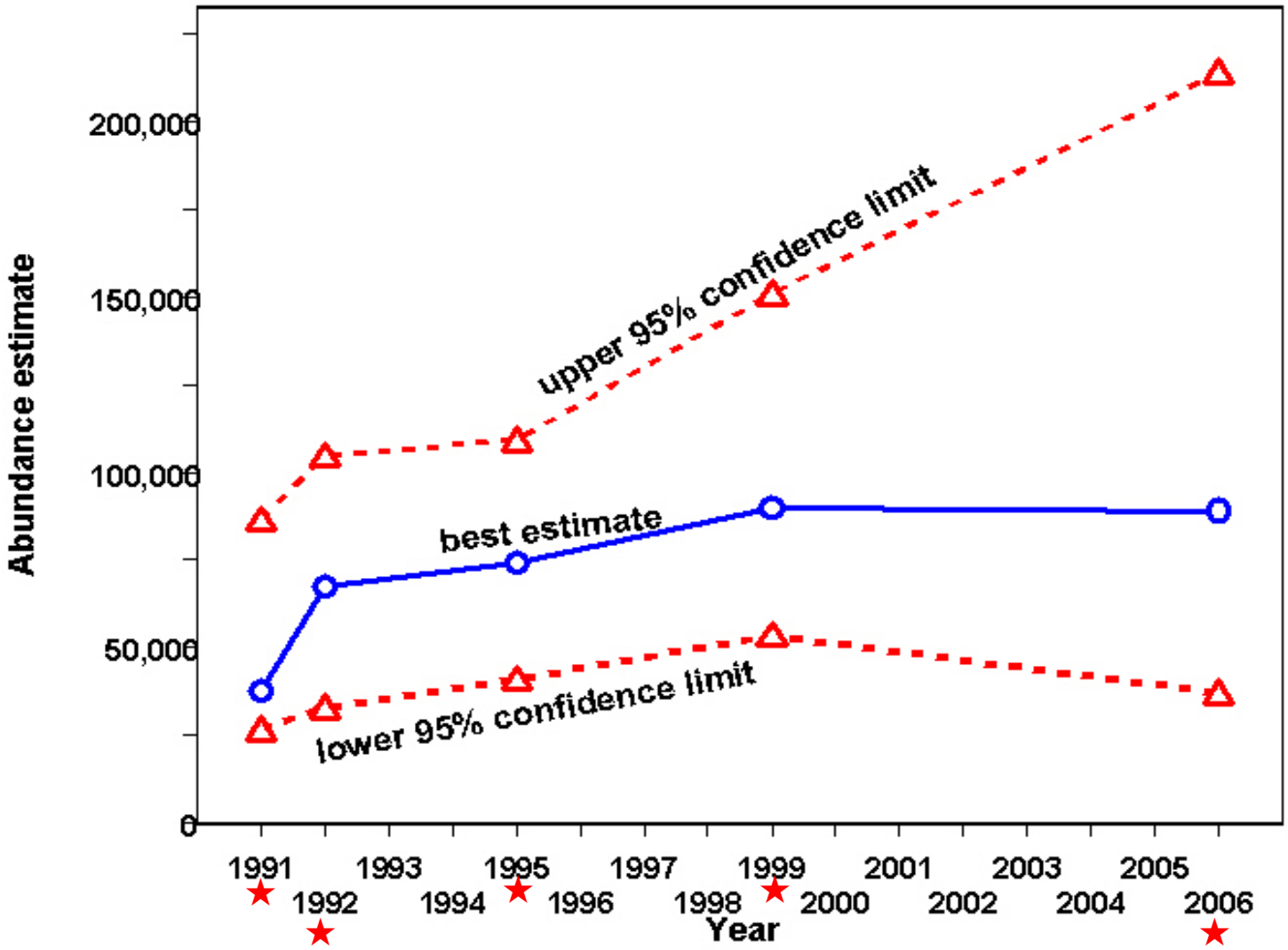


Will complete abundance estimates in next couple of months

After collect data …



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

* Average of 1991 and 1992

** Average of 1991, 1992, and 1995