Marine Mammal Stock Assessments & Abundance Estimates

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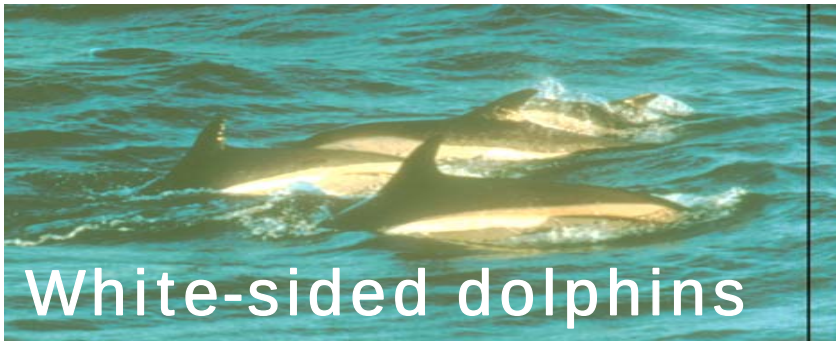
PBR and bycatch estimate (CV)
average for 2000 - 2004

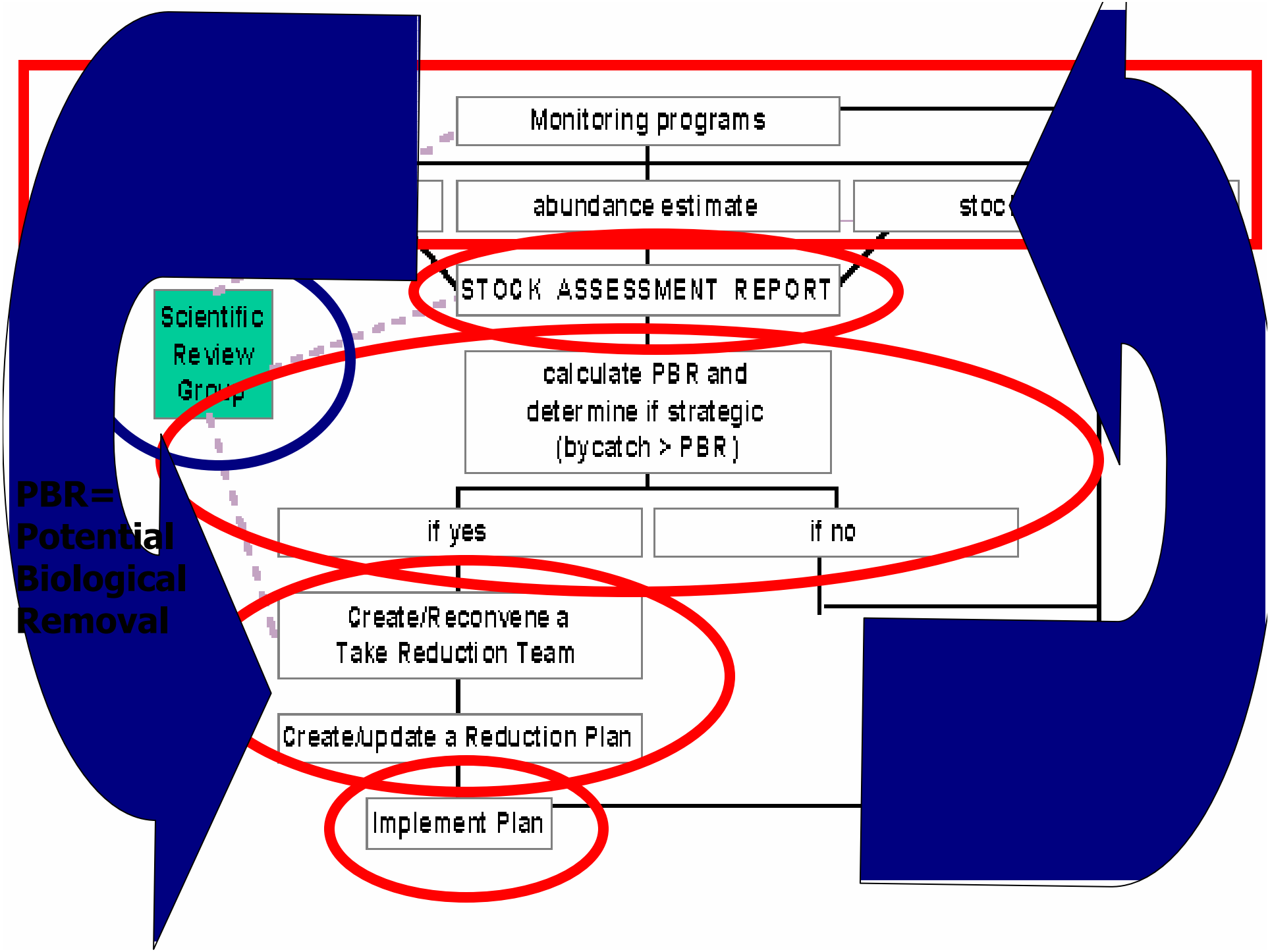
Species	Strategic ?	PBR	Total Bycatch	NE Bottom	NE Midwat	MidAtl Bottom	MidAtl Midwat	JV and TALFF
Common D.	No	1000	101 (0.12)	33 (0.19)	0	68 (0.15)	0	0
Pilot W. spp	No	249	113 (0.24)	10 (0.23)	9.4 (0.55)	12 (0.22)	0.8 (0.74)	11
White-sided D.	No	379	197 (0.09)	130 (0.09)	1.1 (0.58)	25 (0.10)	15 (0.38)	2
Harbor P.	No	747	473 (0.17)	0	0	0	0	0
Minke W.	?	31	2.8+	1+	0	0	0	0

Overview



- **What information is required in a Stock Assessment Report (SAR)?**
- **How to calculate the Potential Biological Removal (PBR) level?**
- **How we estimate abundance?**

Stock Assessment Reports (SAR)?


Monitoring programs
abundance estimate
STOCK ASSESSMENT REPORT
Scientific Review Group
calculate PBR and determine if strategic (bycatch > PBR)
if yes
if no
Create/Reconvene a Take Reduction Team
Create/update a Reduction Plan
Implement Plan
PBR= Potential Biological Removal

Information required in a SAR

- **Abundance**
  - **Geographic range**
  - **Minimum population estimate**
  - **Current population trends**
- **Biology**
  - **Stock structure**
  - **Current and maximum net productivity rates (population growth rates)**

Information required in a SAR ...Continued

- **Mortality**
  - **Annual human-caused mortalities and serious injuries estimated by source**
  - **Other factors that may be impeding recovery**
  - **Describe each commercial fisheries that interacts**
    - **Classification of fishery (Category I, II, and III)**
    - **Approximate number of vessels**
    - **Estimated level of take**
    - **Seasonal and areal differences**

Information required in a SAR … Continued

- **Summary**
  - **Estimate of the Potential Biological Removal (PBR) level**
  - **Categorize the status of the stock**
    - **Strategic (Mortalities > PBR)**
    - **Non-strategic (Mortalities < PBR)**

How to calculate 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}
Common D.	120,743	0.23	99,975
Pilot W. spp	31,139	0.27	24,866
White-sided D.	51,640	0.38	37,904
Harbor P.	89,700	0.22	74,695
Minke W.	3,618	0.18	3,113

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) ≤ 0.3 F_R=0.5
  - if 0.3 < CV(B) ≤ 0.6 F_R=0.48
  - if 0.6 < CV(B) ≤ 0.8 F_R=0.45
  - if CV(B) ≥ 0.8 F_R=0.40

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

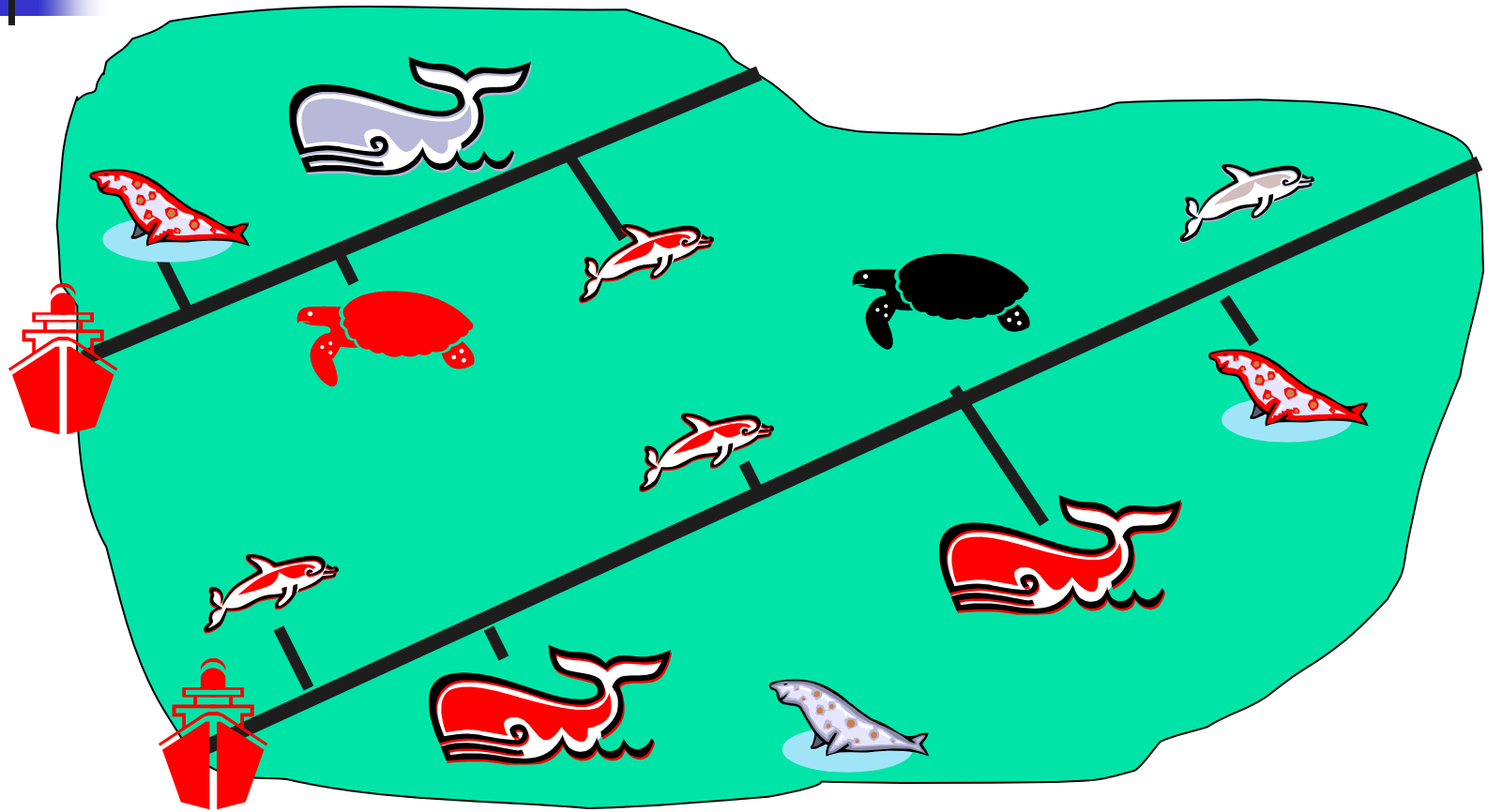
Species	N_{min}	R_{max}	F_r	PBR
Common D.	99,975	0.04	0.5	1000
Pilot W. spp	24,866	0.04	0.5	249
White-sided D.	37,904	0.04	0.5	379
Harbor P.	74,695	0.04	0.5	747
Minke W.	3,113	0.04	0.5	31

How we estimate abundance?

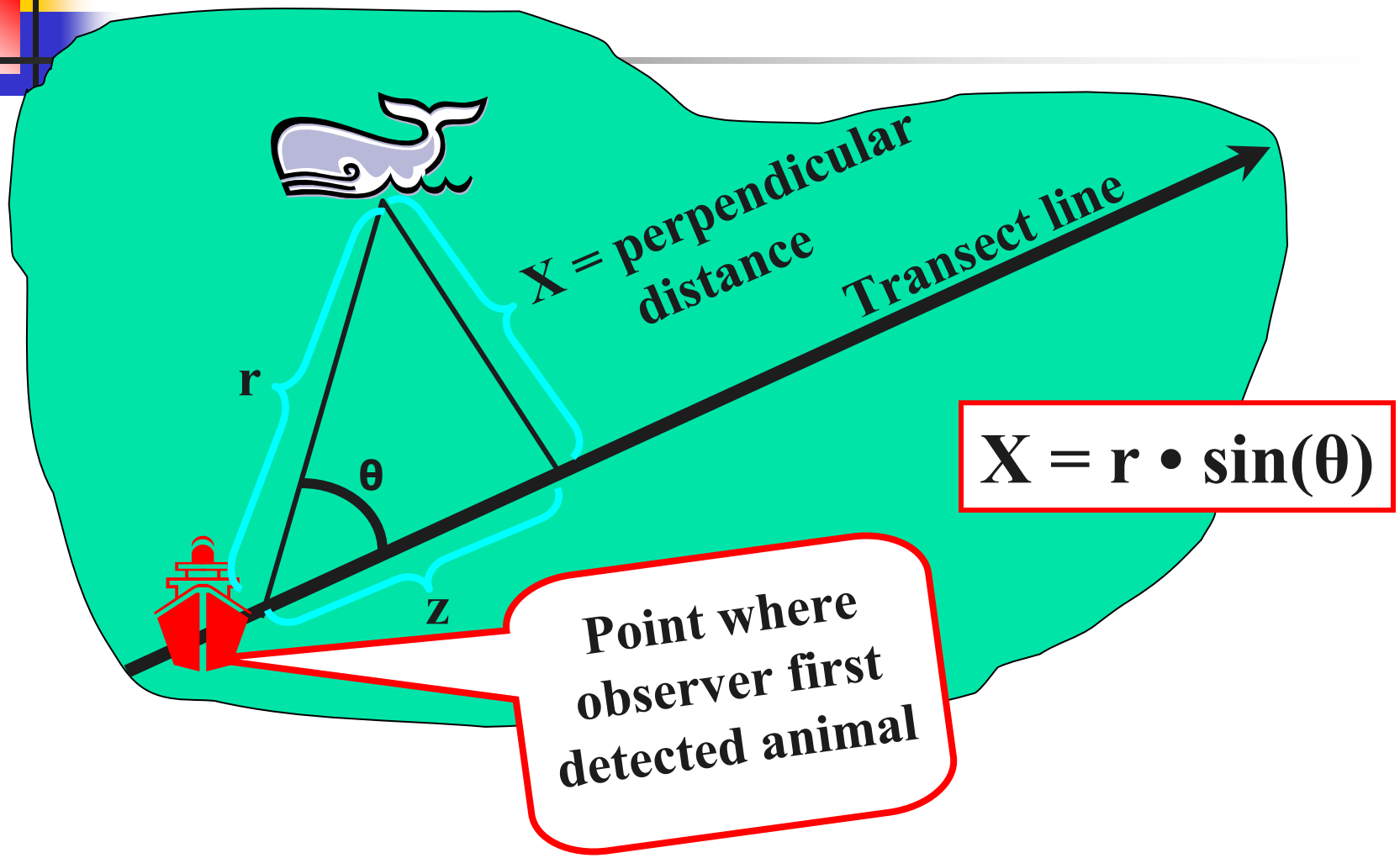
Methods used to estimate abundance

- Census using photo-ids
  - Right whales, blue whales
- Capture-Recapture: photos and genetic tags
  - Humpback whales
- Line transect
  - Whales: humpback, fin/sei, minke, sperm, beaked, dwarf sperm, pygmy sperm and pilot,
  - Dolphins: white-sided, common, Risso's, spotted, striped, rough toothed, and bottlenose
  - Porpoises: harbor

Line transect surveys



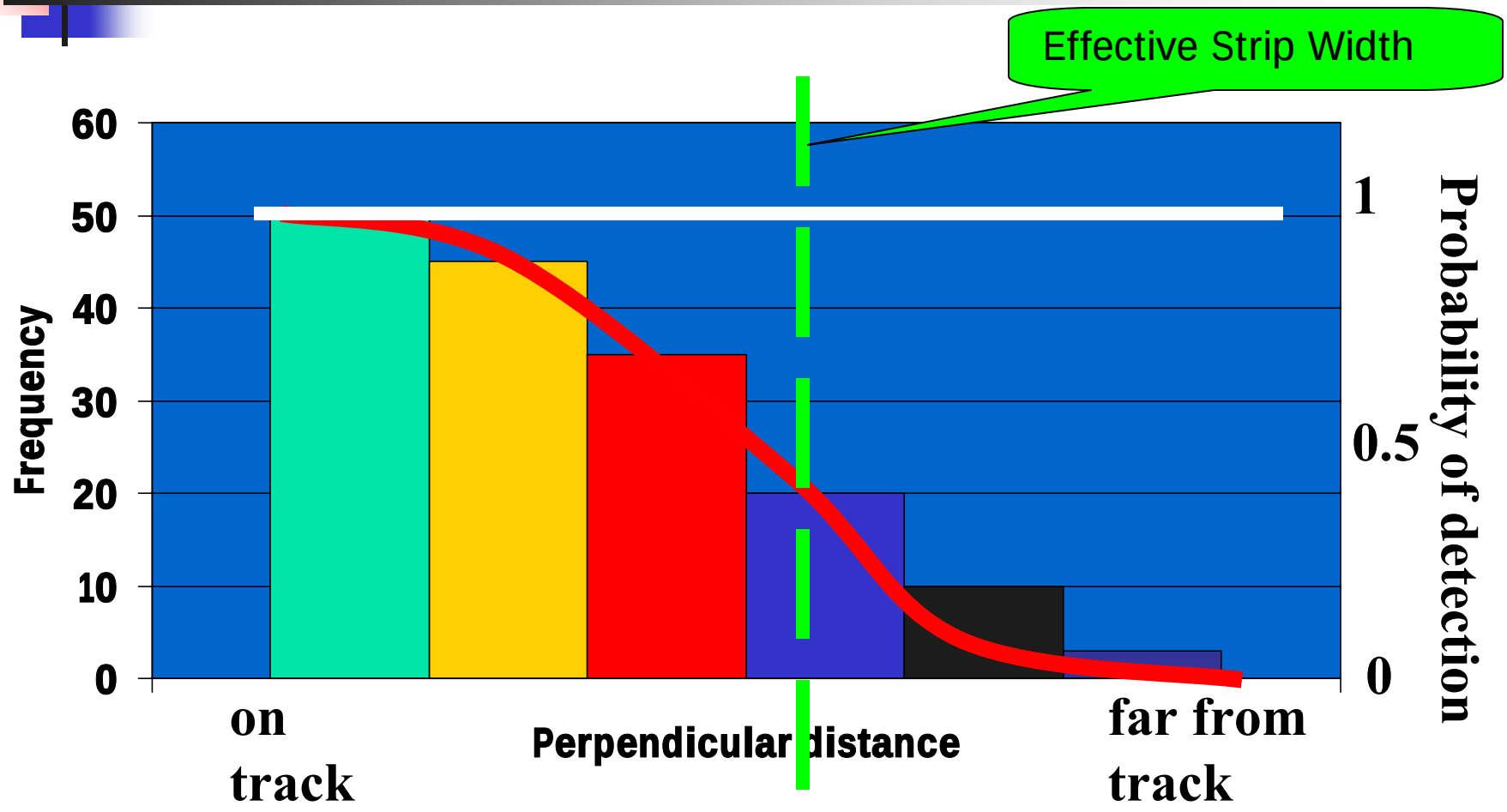
Line transect surveys



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

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,

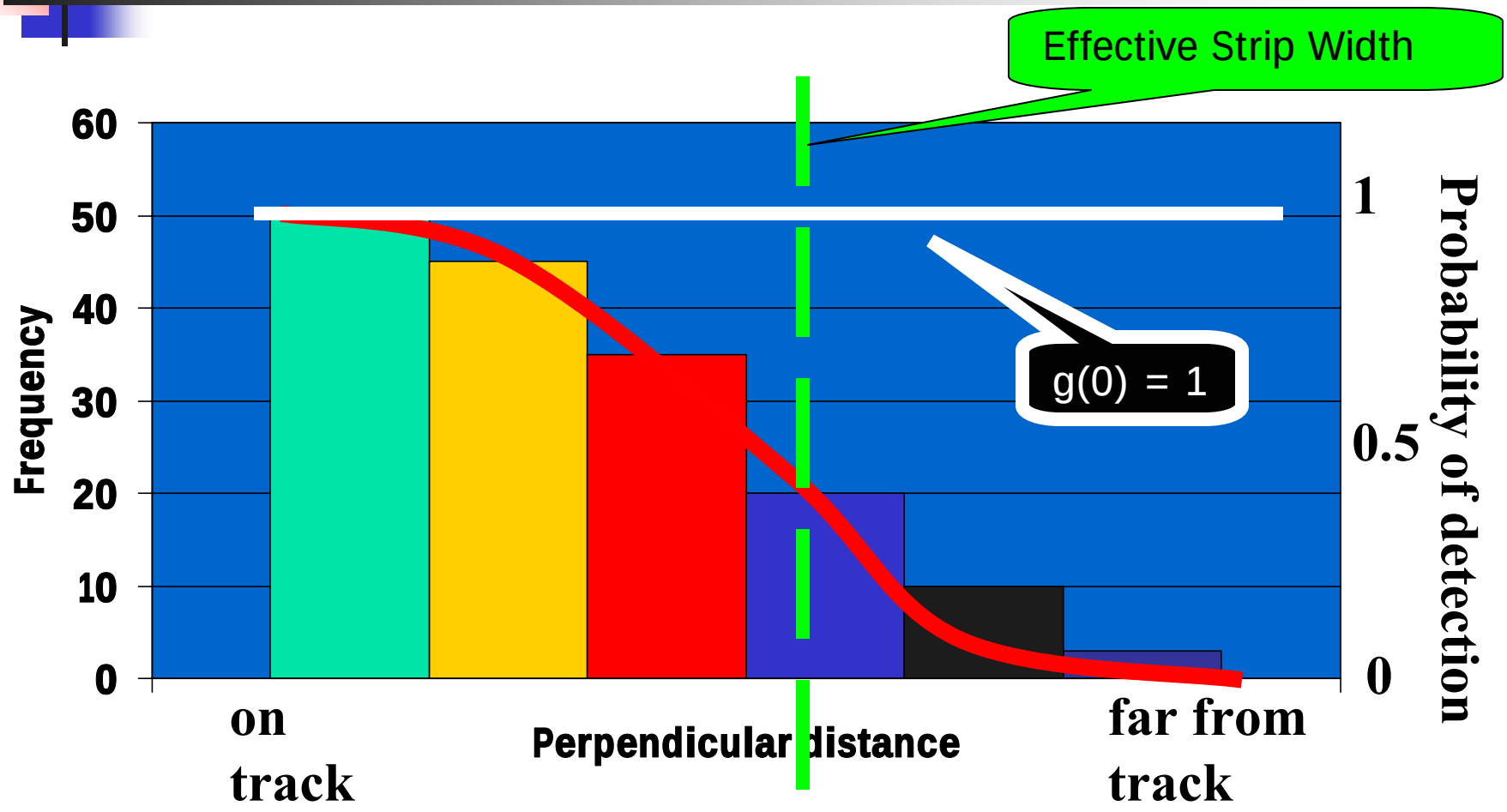
ESW_j = effective strip half-width for team j
= 1/sighting probability density at zero perpendicular distance for team j,

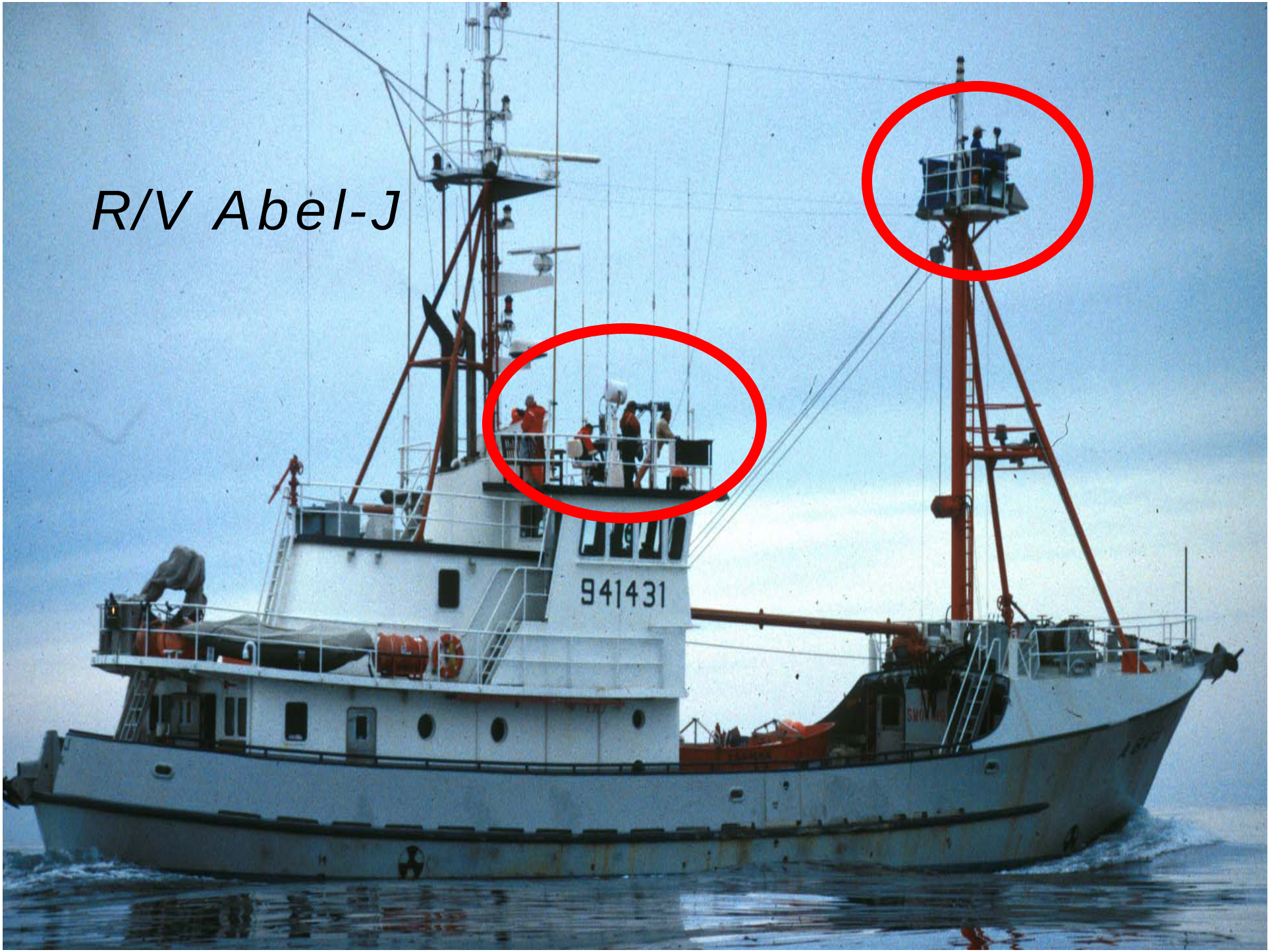
L_i = length of transect line in stratum i.

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

Detection Function

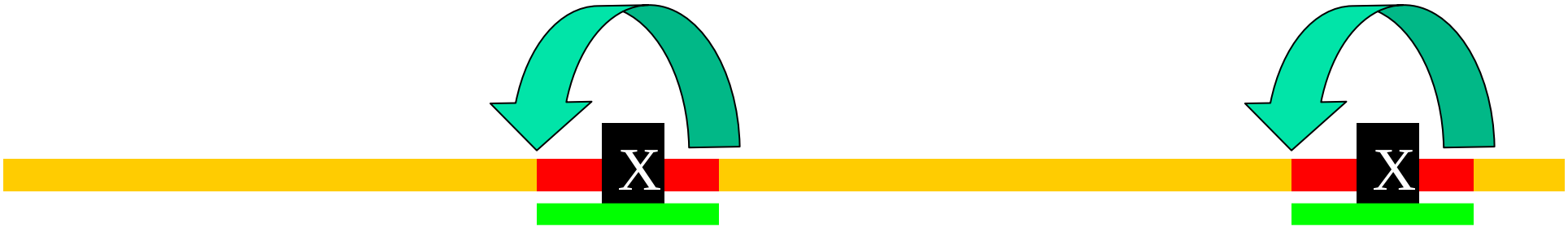
g(y) = the probability of detecting an animal group, given that it is at perpendicular distance y from the track line




R/V Abel-J
941431

- **Standard line transect estimate using only the single plane and leading legs**

- **Ignore trailing legs, assume g(0)=1**



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

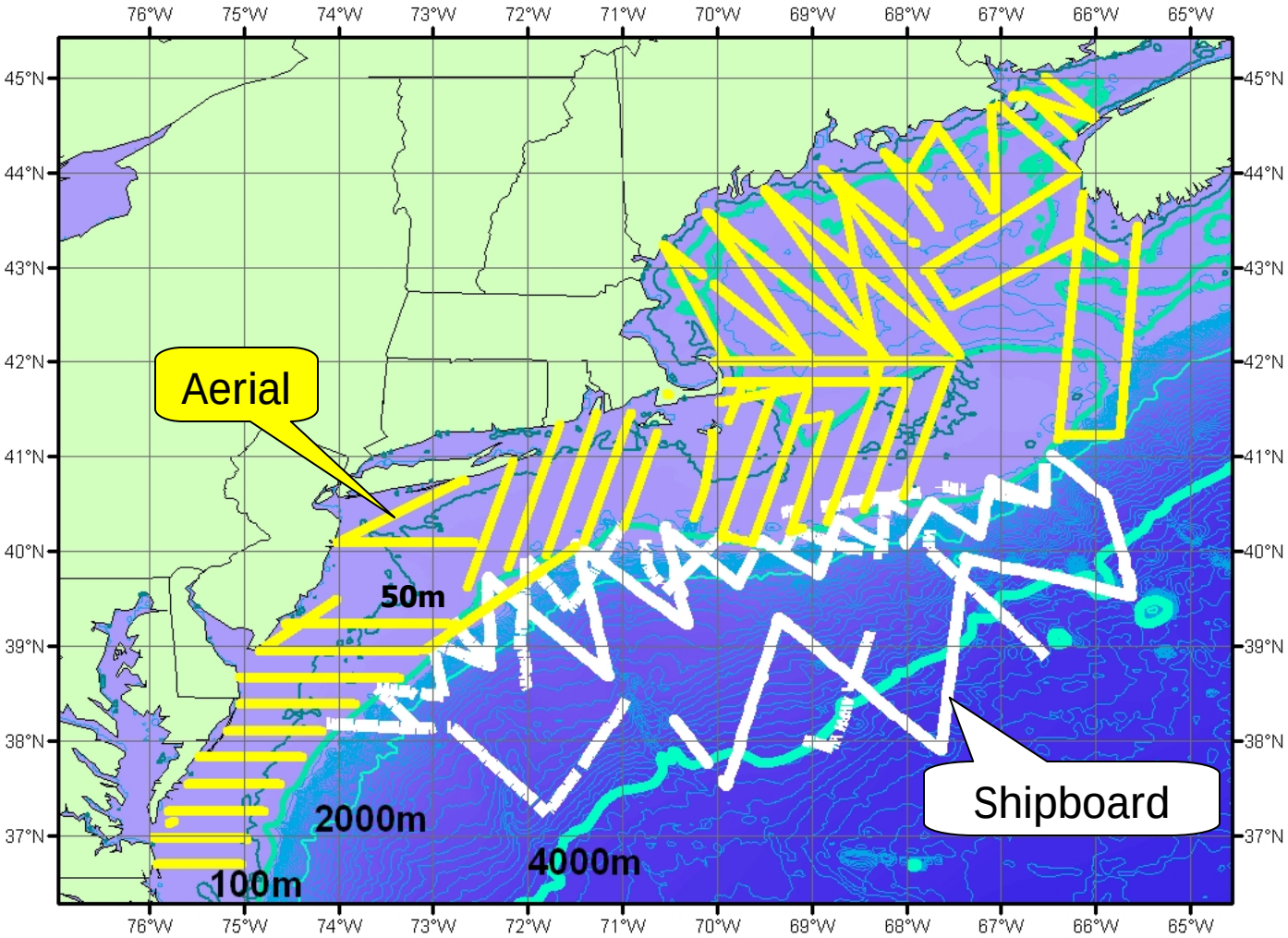
R/V Endeavor

2004

Common D.

Pilot W. spp.

Shipboard and aerial tracklines
June 11 – August 4, 2004



1999

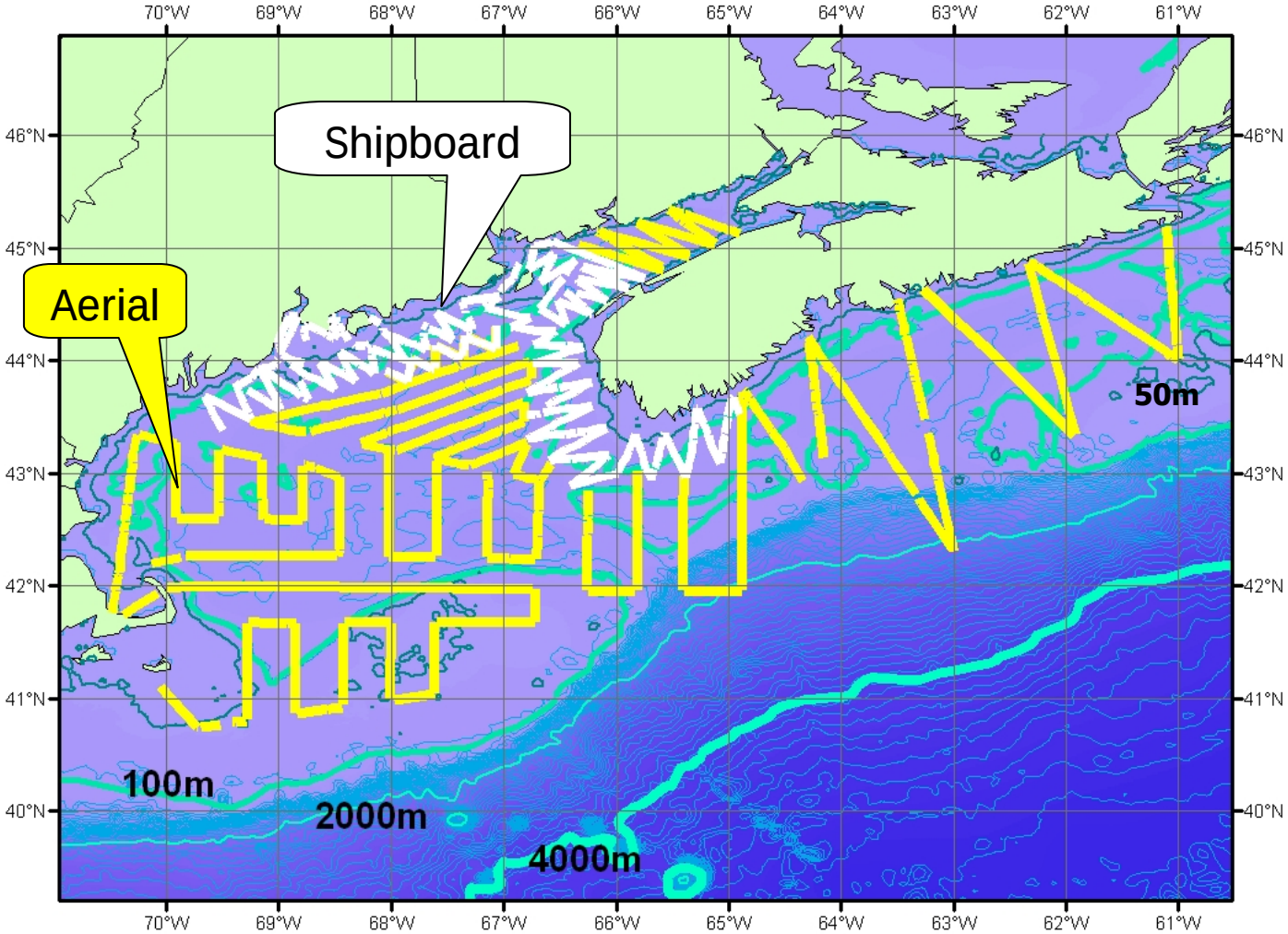
White-sided D.

Minke W.

Harbor P.

ATGTRT meeting 19 Sep 2006

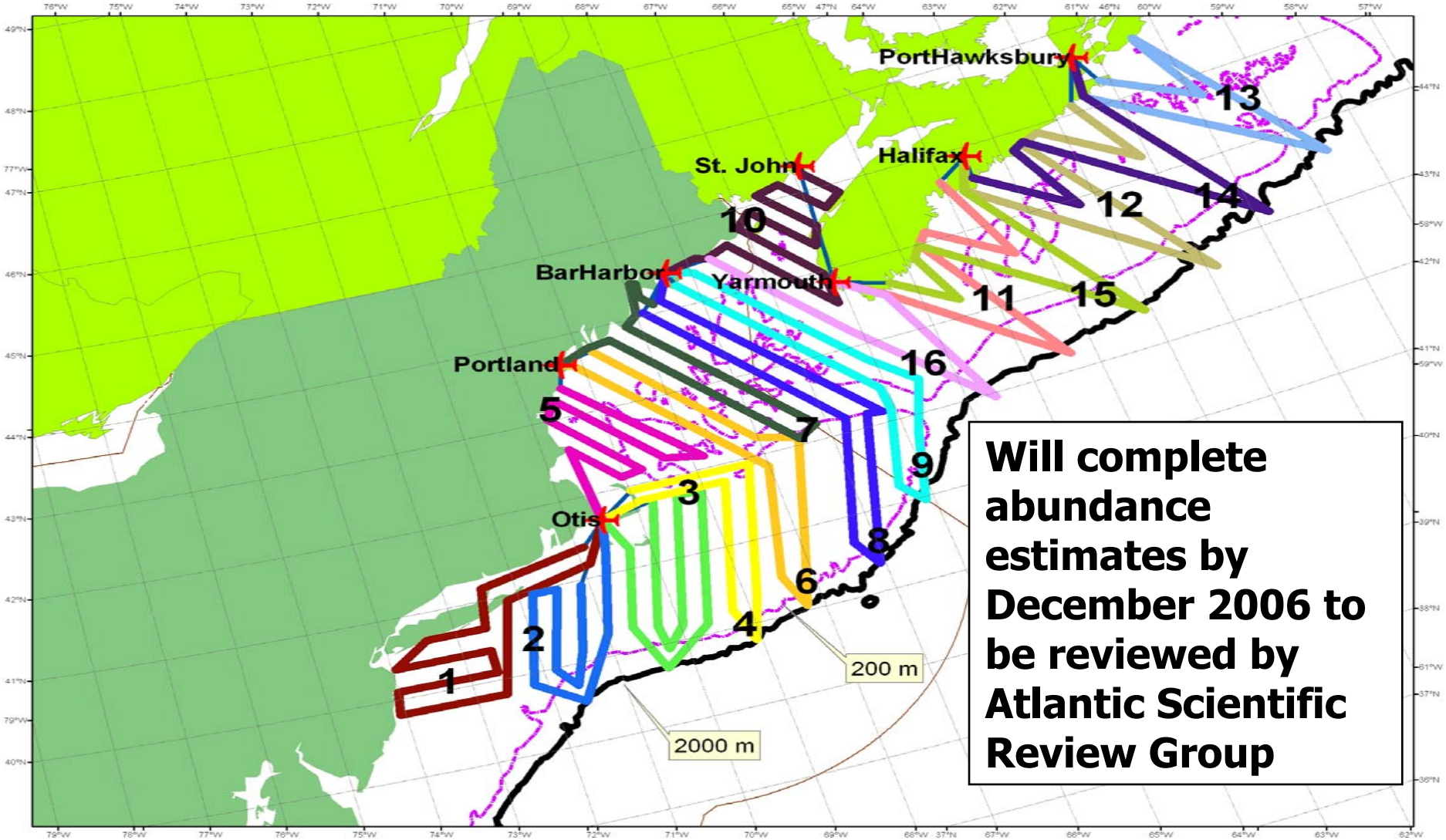
Shipboard and aerial tracklines
July 28 – August 31, 1999



NOAA Twin Otter

Aerial survey

25 July – 25 August, 2006

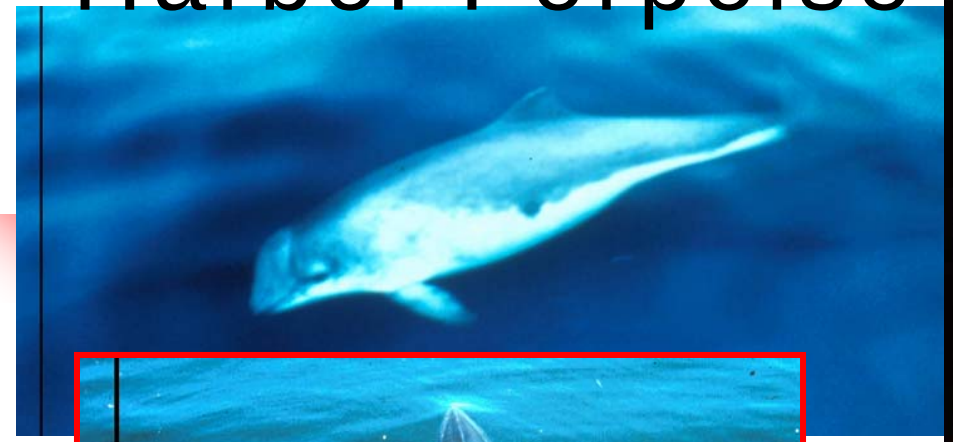


Will complete abundance estimates by December 2006 to be reviewed by Atlantic Scientific Review Group

On ship surveyed by Naked eye and "Big-eyes"

On plane surveyed by naked eye thru bubble windows

Harbor Porpoise



Loggerhead Turtle

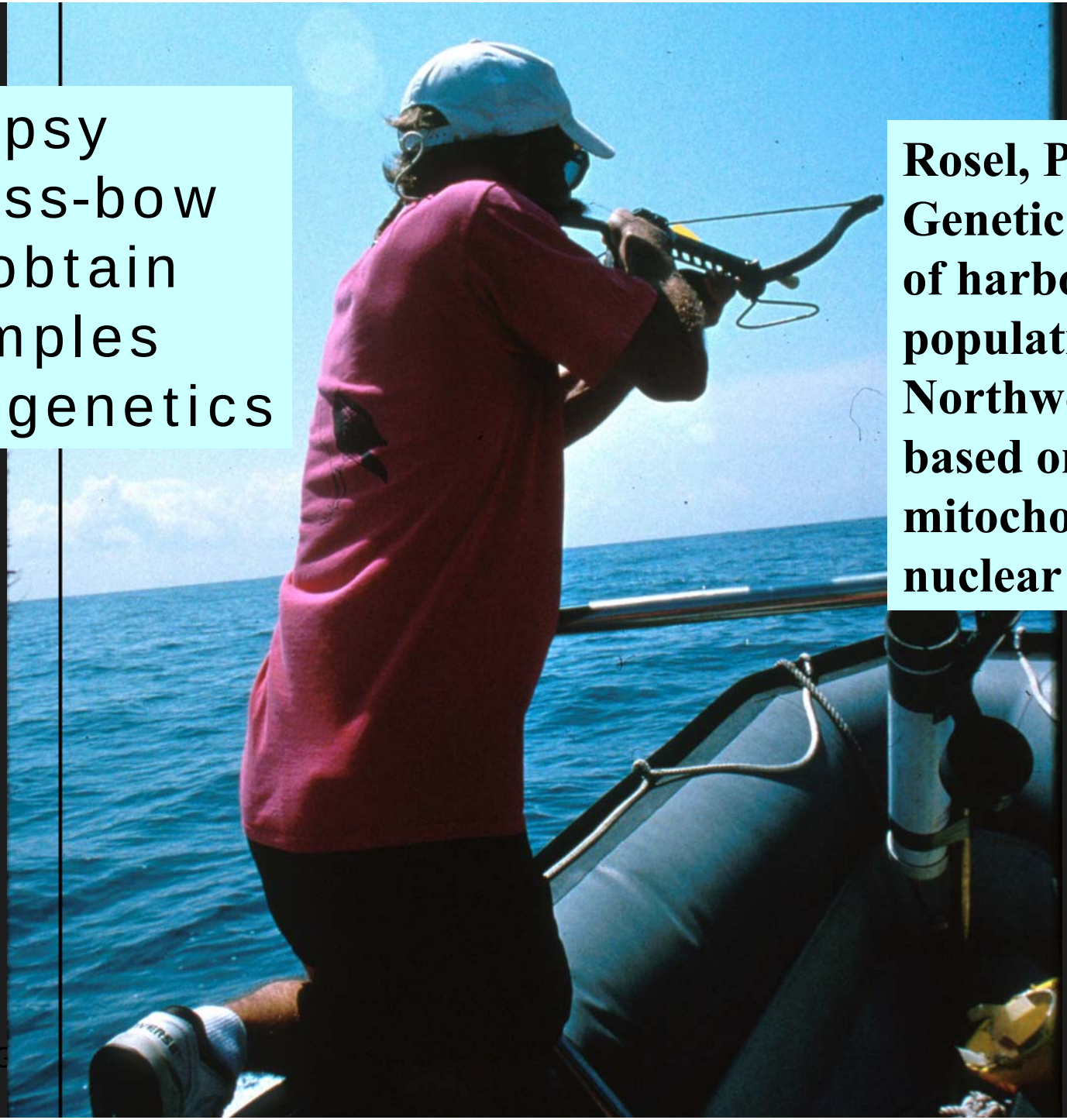
Minke whales

Common dolphins

Pilot whales

Also collect other types of data

For improved abundance estimates, understanding the animal's habitat and stock structure

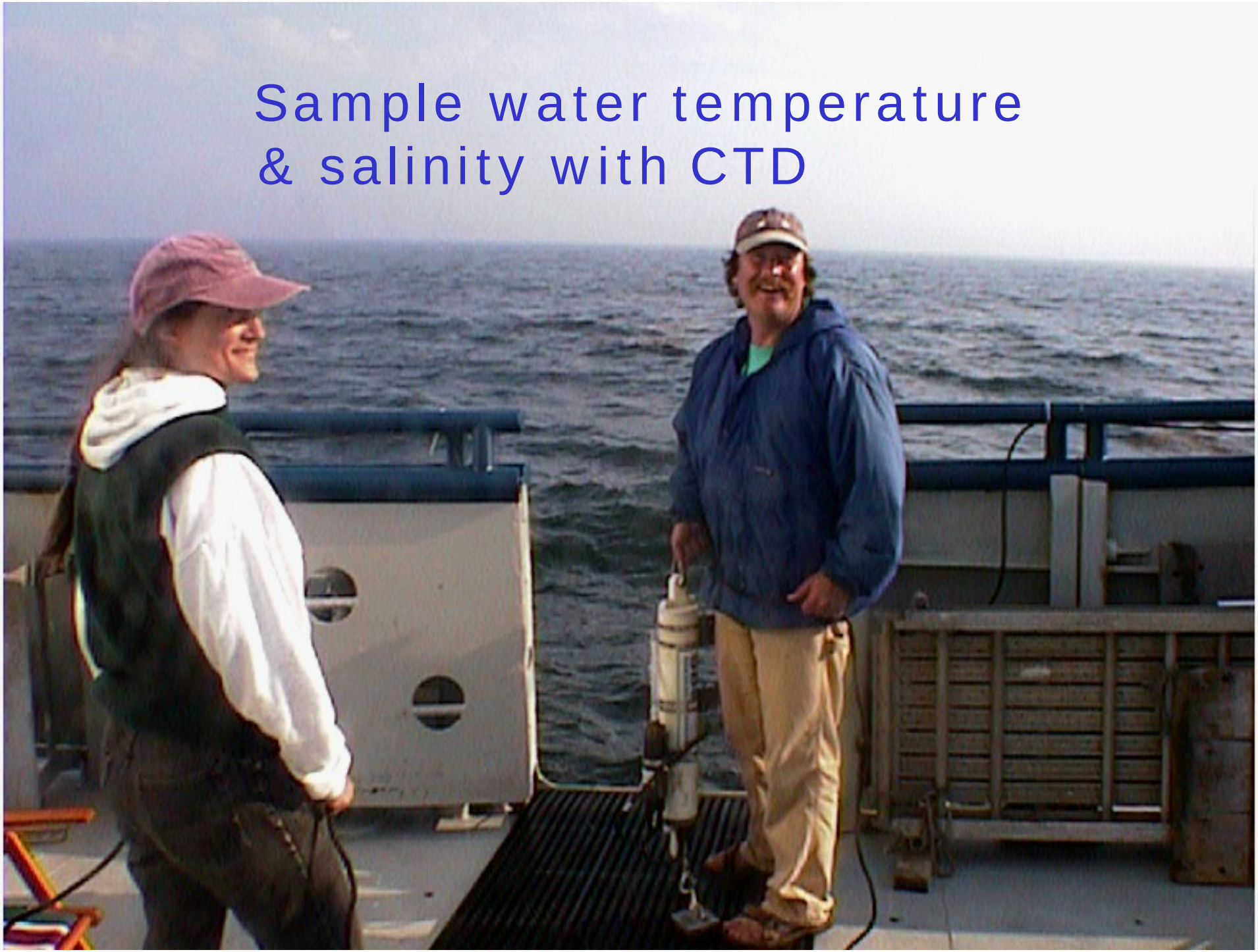


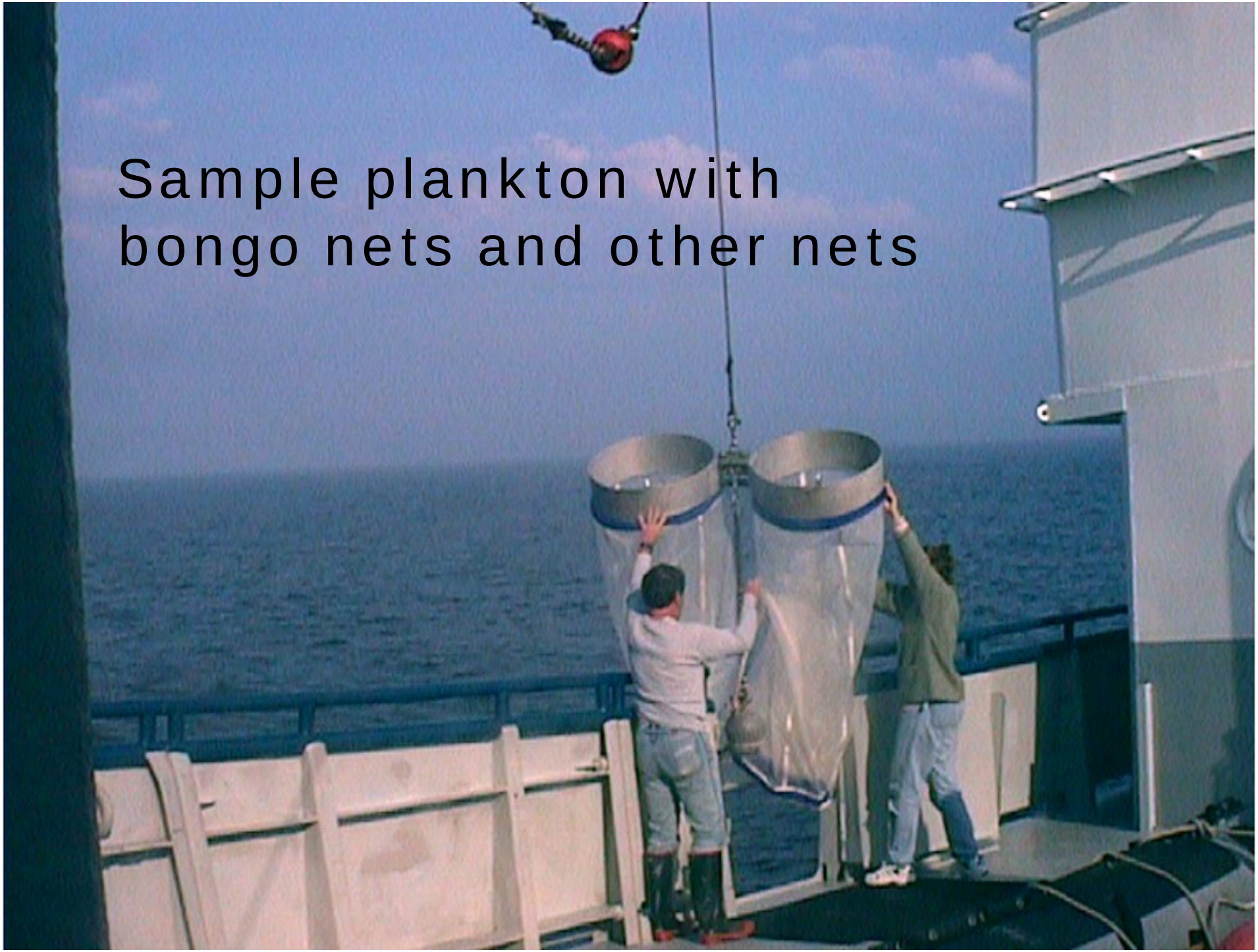
Biopsy cross-bow to obtain samples for genetics

Rosel, P. et al. 1999 Genetic structure of harbor porpoise populations in the Northwest Atlantic based on mitochondrial and nuclear markers

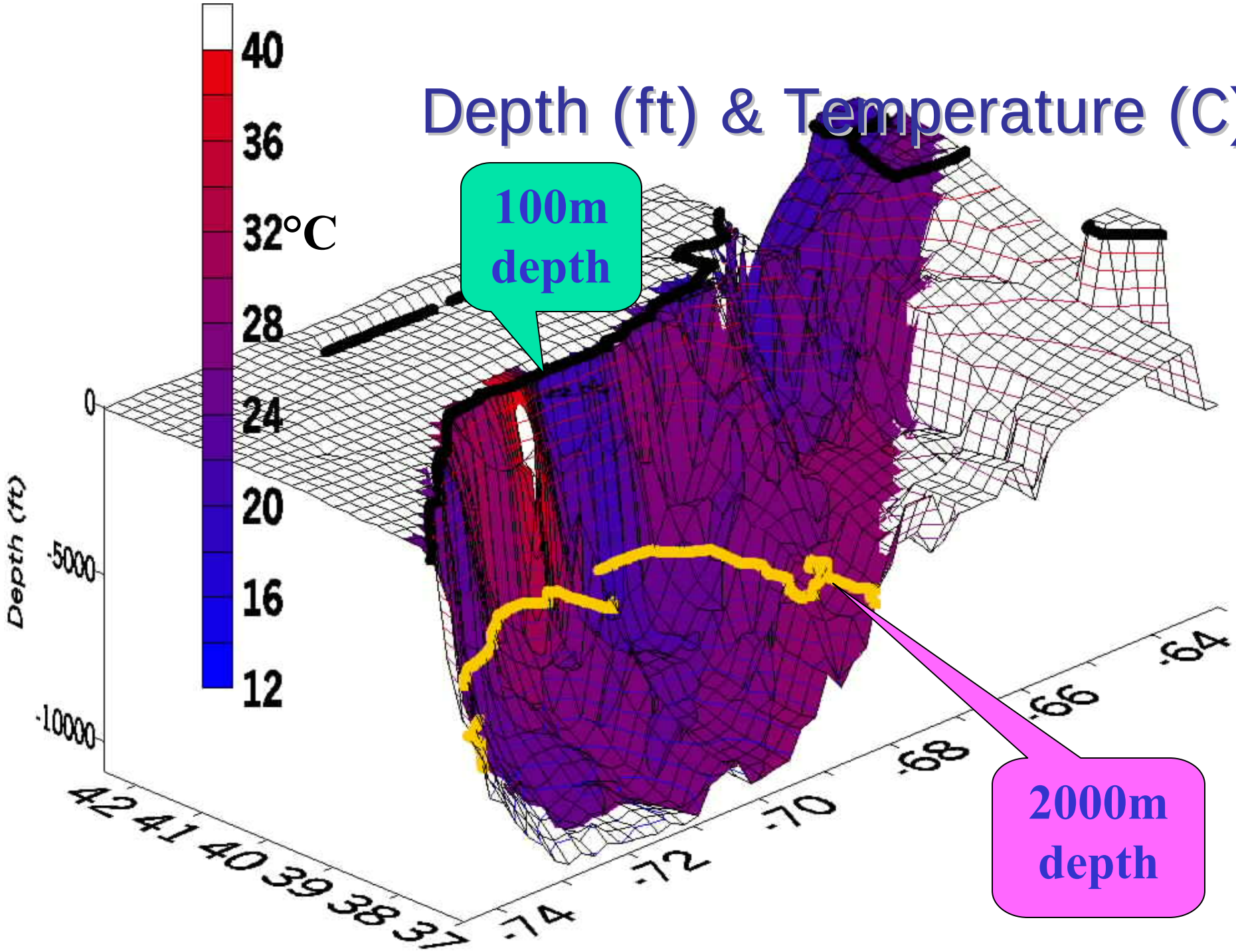
Listen to cetaceans using passive hydrophones to use location of vocalizing cetaceans to improve the abundance estimate

Sample water temperature & salinity with CTD



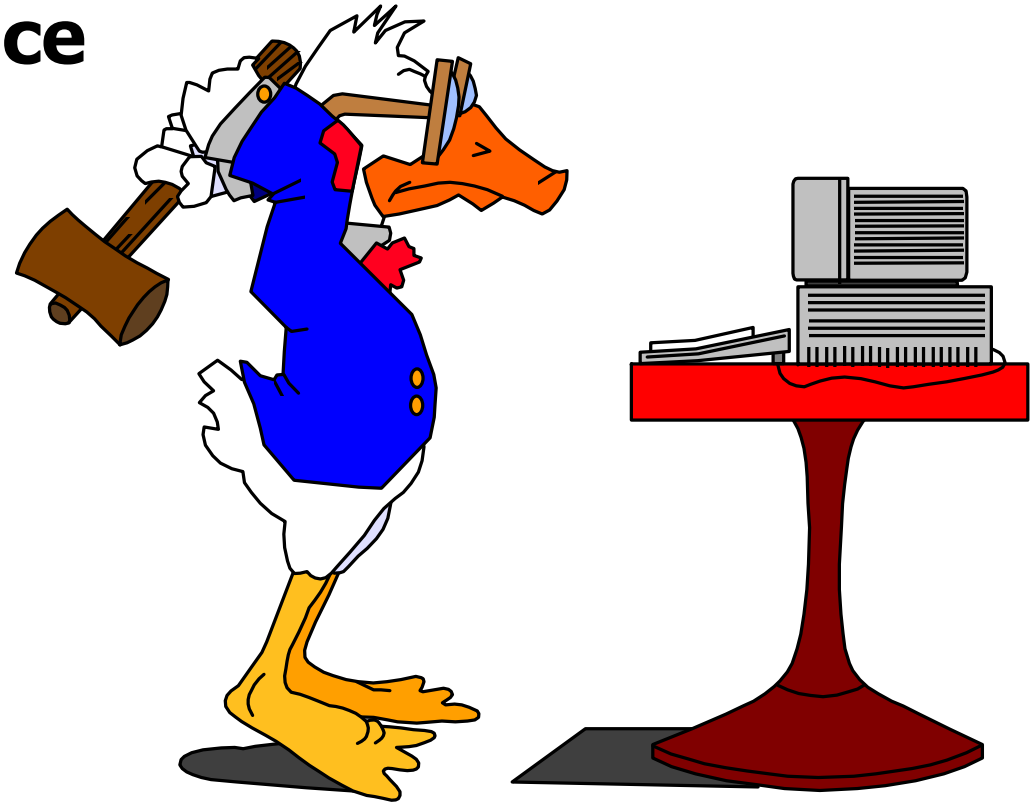

Sample plankton with
bongo nets and other nets

Depth (ft) & Temperature (C)



After collect data ...

use line transect methods to estimate abundance



Abundance estimates

Probability of detecting a group of animals on the track line

Species	Ship g(0)	Abund	CV(Abun)
Common D.	0.84	120,743	0.23
Pilot W. spp	0.55	31,139	0.27
White-sided D.	0.33	51,640	0.38
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PBR and bycatch estimate (CV)
average for 2000 - 2004

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