

Visual and Acoustic Survey of Humpback & Sperm Whales in the Eastern Caribbean

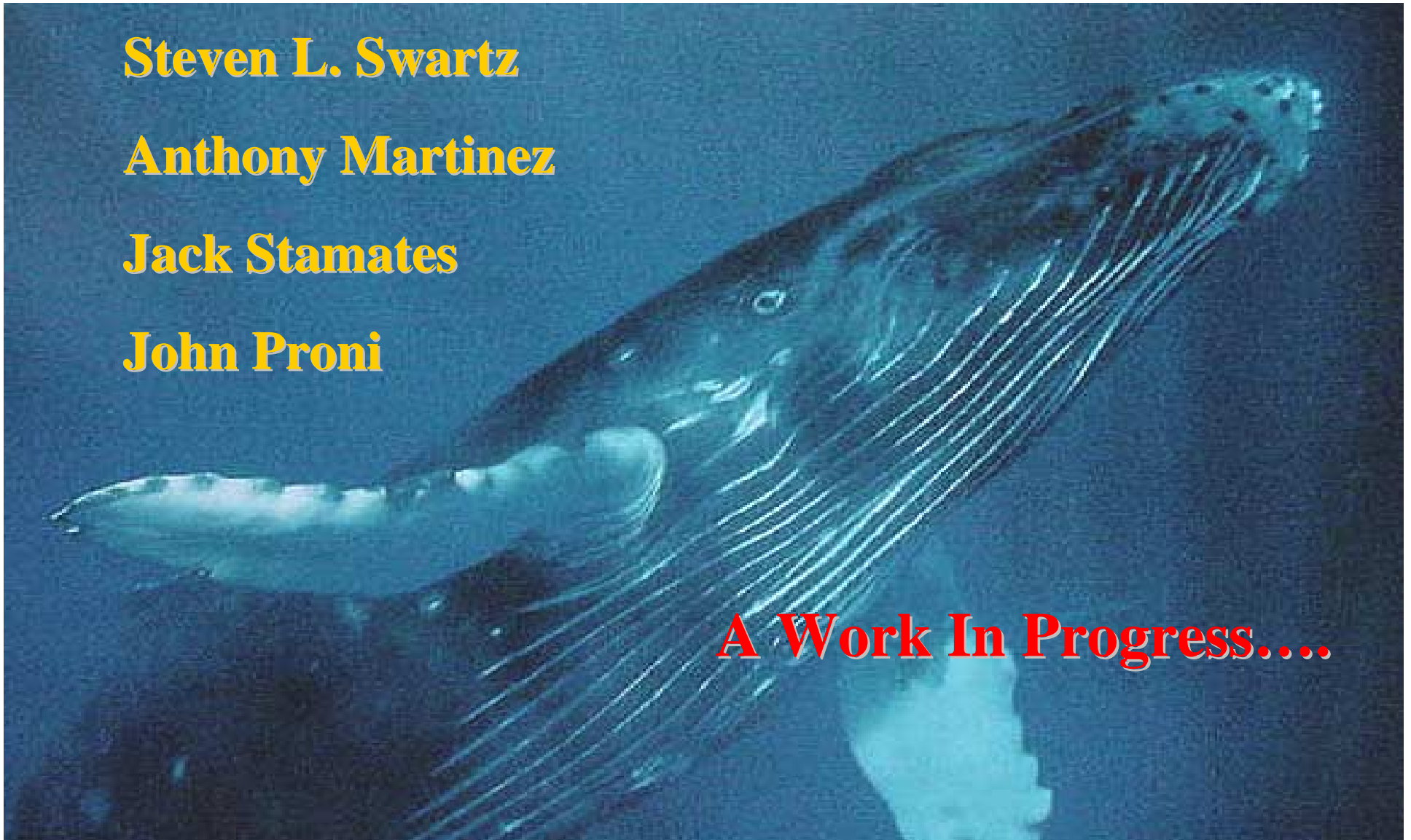
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Anthony Martinez

Jack Stamates

John Proni

A Work In Progress....



Or...

What you see isn't necessarily what
you get...





Thanks to Our Colleagues and Cooperating Scientists

Including:

M. McDonald, J. Hildebrand, E. Oleson, T. Cole, P. Clapham, J. Barlow, C. Clark, W. Watkins, A. , F. Stone, R. Gisiner, D. Melinger, A. Thode, J. Gordon, C. Greene, A. Mignucci-Giannoni D. Gillespie, and all cooperating observers in 2000 and 2001

Supported by: NOAA's SEFSC and AOML
Chief of Naval Operations (Code N45)



Thanks to:

NOAA NMFS & AOML

Gordon Gunter Officers and Crew

IOCARIBE

International Whaling Commission

Bahamas, Turks and Caicos

Dominican Republic, British VI

St. Kitts and Nevis

Guadelopue-Marie Galante

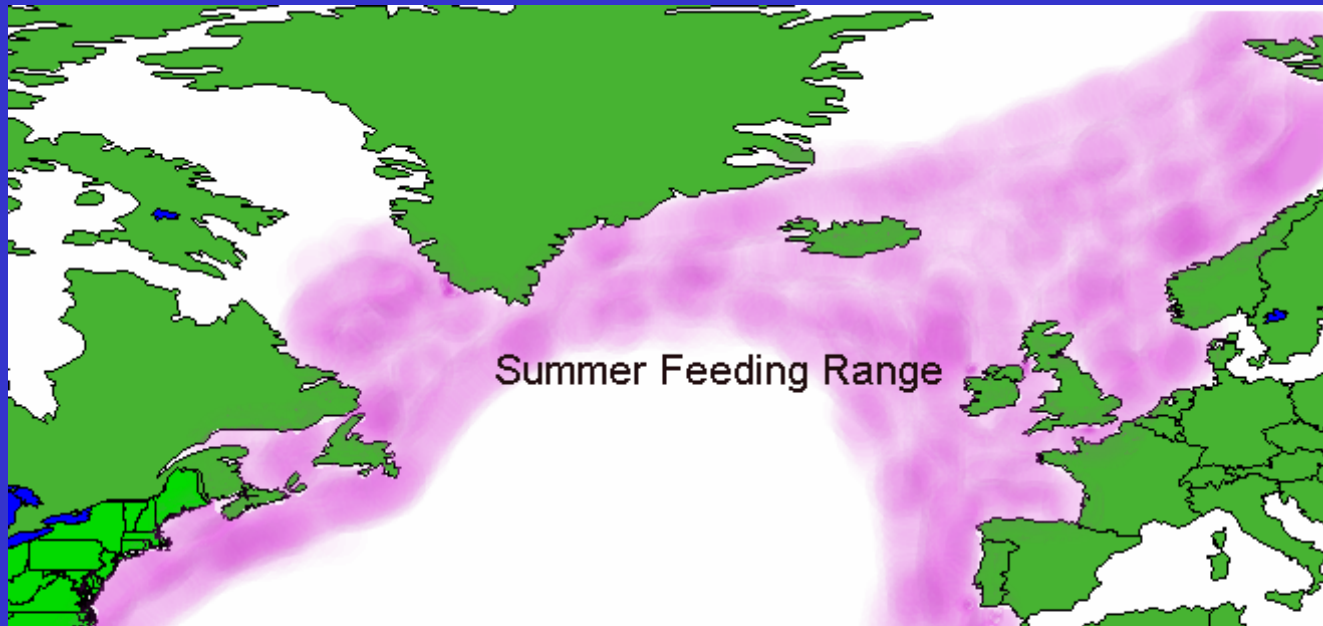
Martinique, St. Lucia, Barbados

Trinidad and Tobago

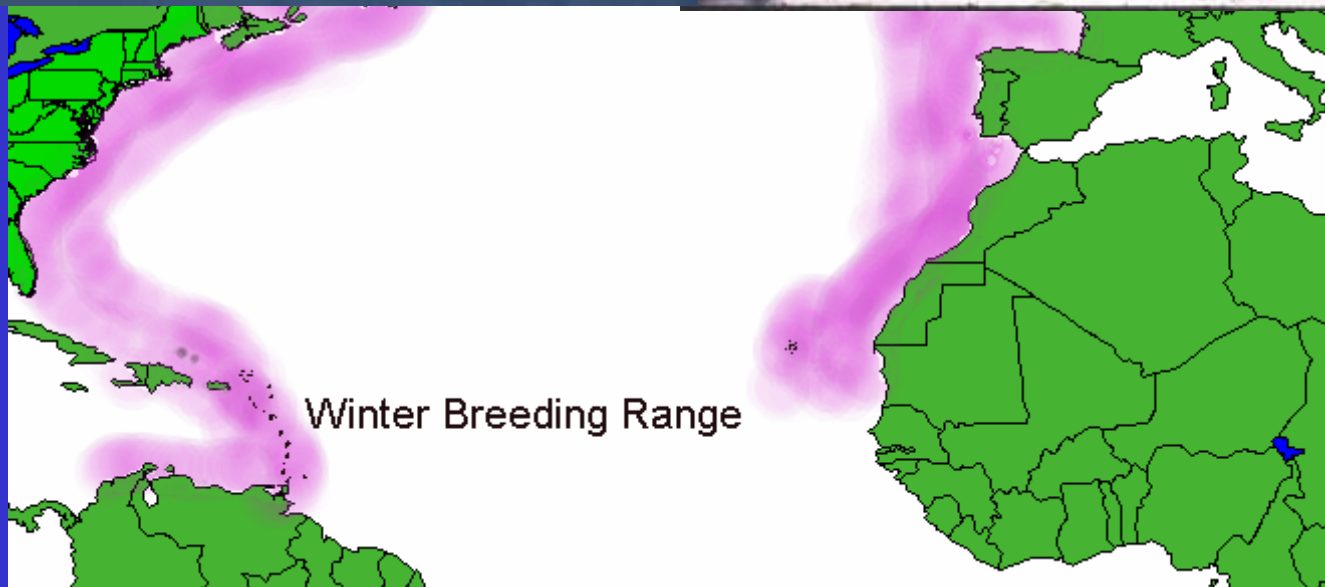
Grenada

Venezuela

Summer Feeding In Northern Latitudes



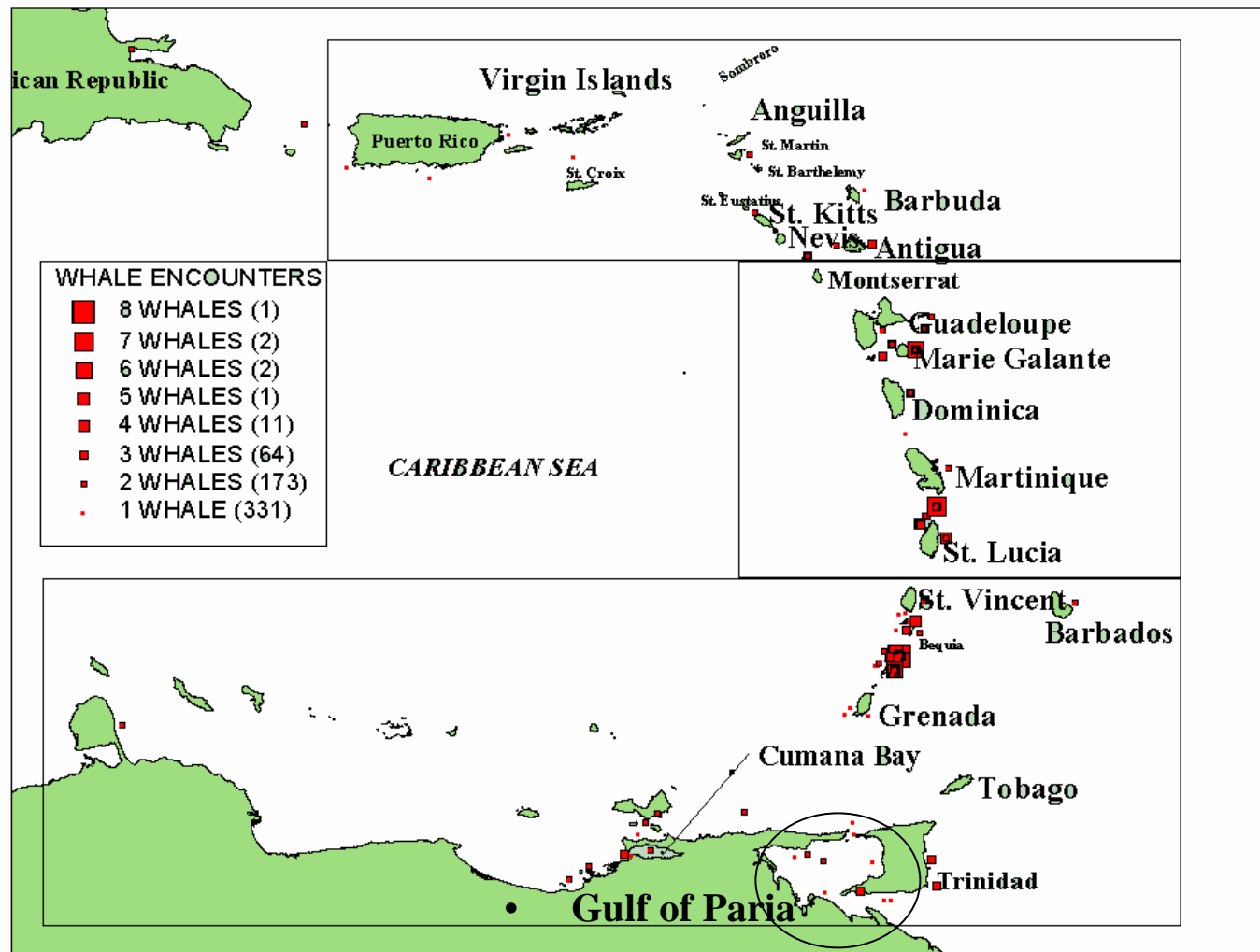
Winter Breeding in the Tropics



Historical Whaling: 1820s-1880s



Historical Distribution: Reeves *et al.* 2001 reviewed whaler's logbooks



Modern day distribution: centered in northern areas, *e.g.*:
Silver Bank, Navidad Bank, Samana Bay, Virgin Bank
and Northern Leeward Islands

Winn et al. 1975

Winn and Winn 1978

Levenson and Leaply 1978

Whitehead and Moore 1982

Mattila and Clapham 1989

Mattila et al. 1994

Mignucci-Giannoni 1998

And others...

Project Objectives:

- Compare Current Distribution with Historical Distribution
- Test Passive Acoustic Detection Methods
- Compare Visual and Acoustic Detection Rates
- Explore Estimating Abundance from Acoustic Data
- Identify Individuals from Fluke Photos, Genetics, and Song characteristics for stock structure analysis

Visual Surveys Hampered by Sea State and Wind



Challenges:

- Whales at the surface for only brief periods of time
- Windy conditions are common and visibility is poor
- Use passive acoustics to find whales
- Confirm with visual observations

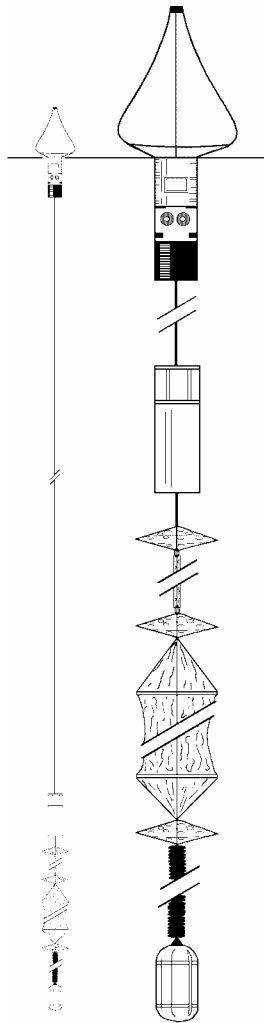
NOAA ship Gordon Gunter



Visual Survey



DIFAR Sonobuoys

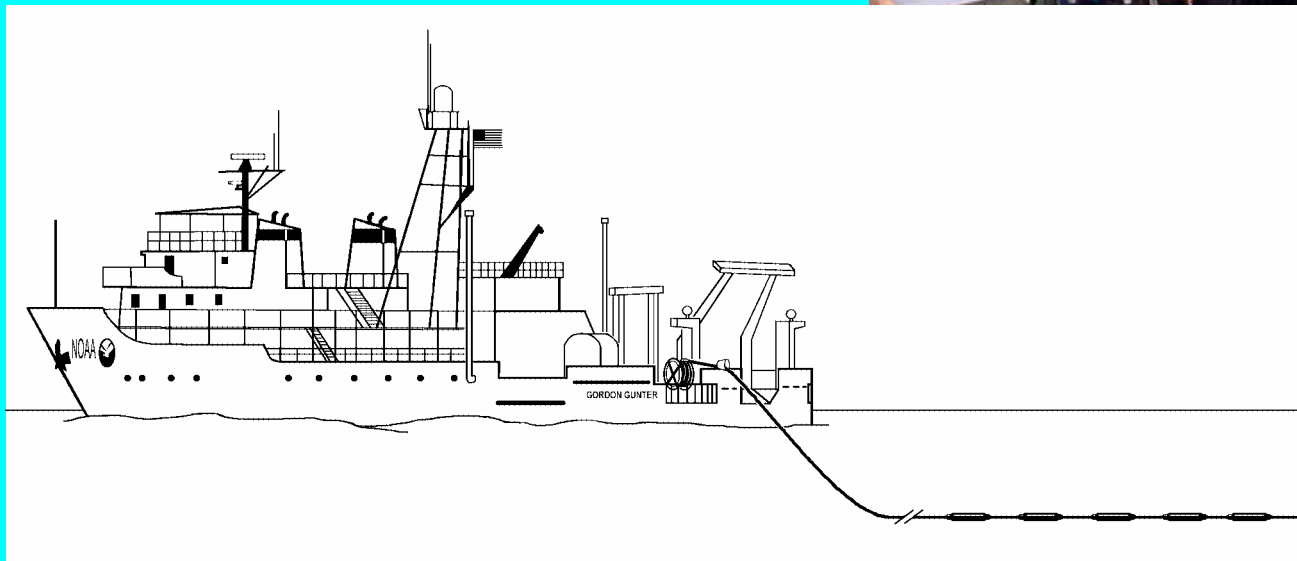


Towed Hydrophone Array

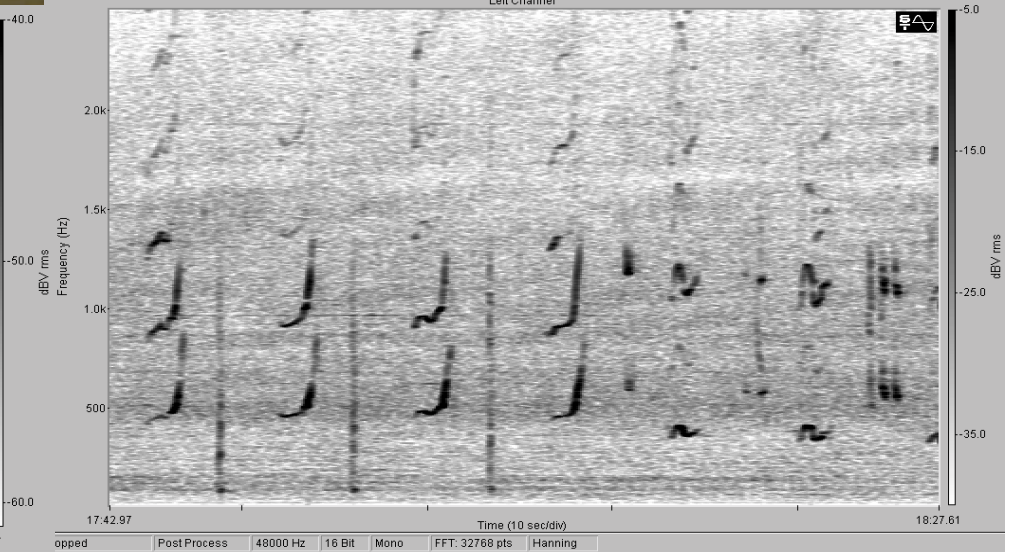
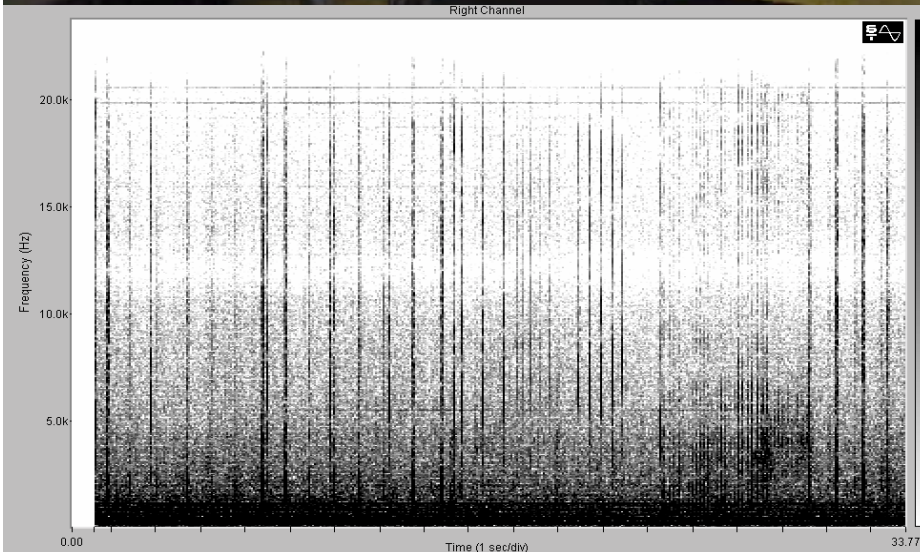
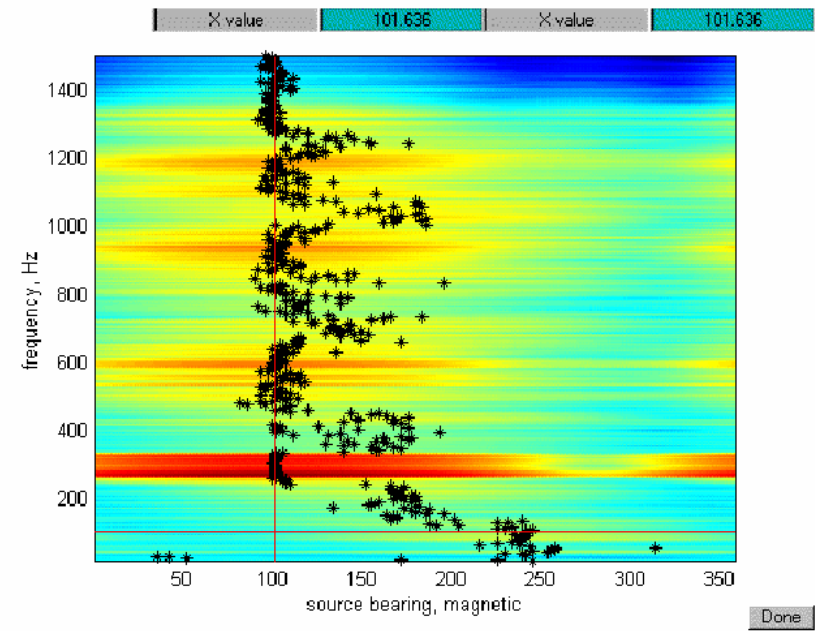
5 - Elements (Hydrophones)

500 m tow cable

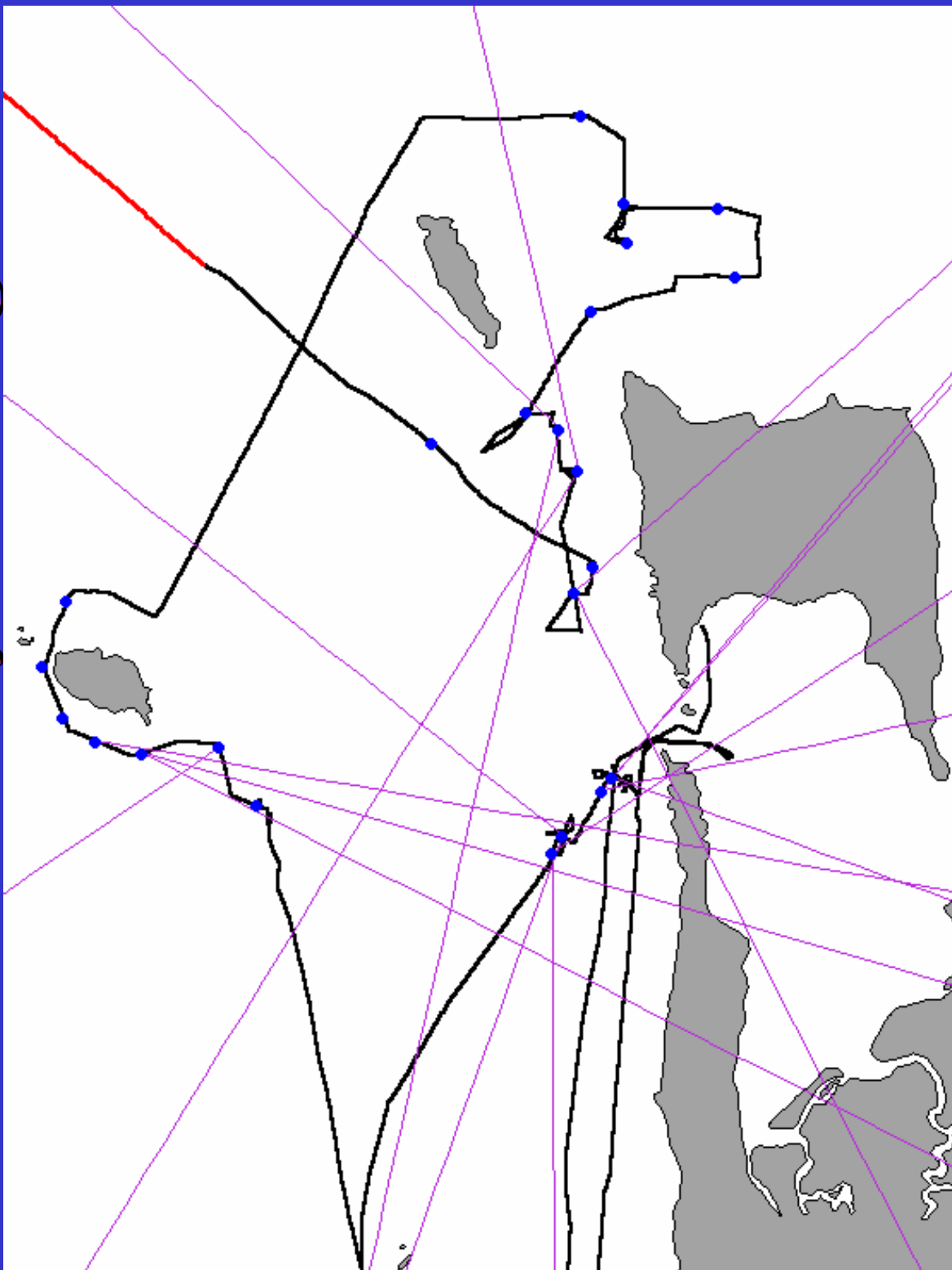
750 m overall length



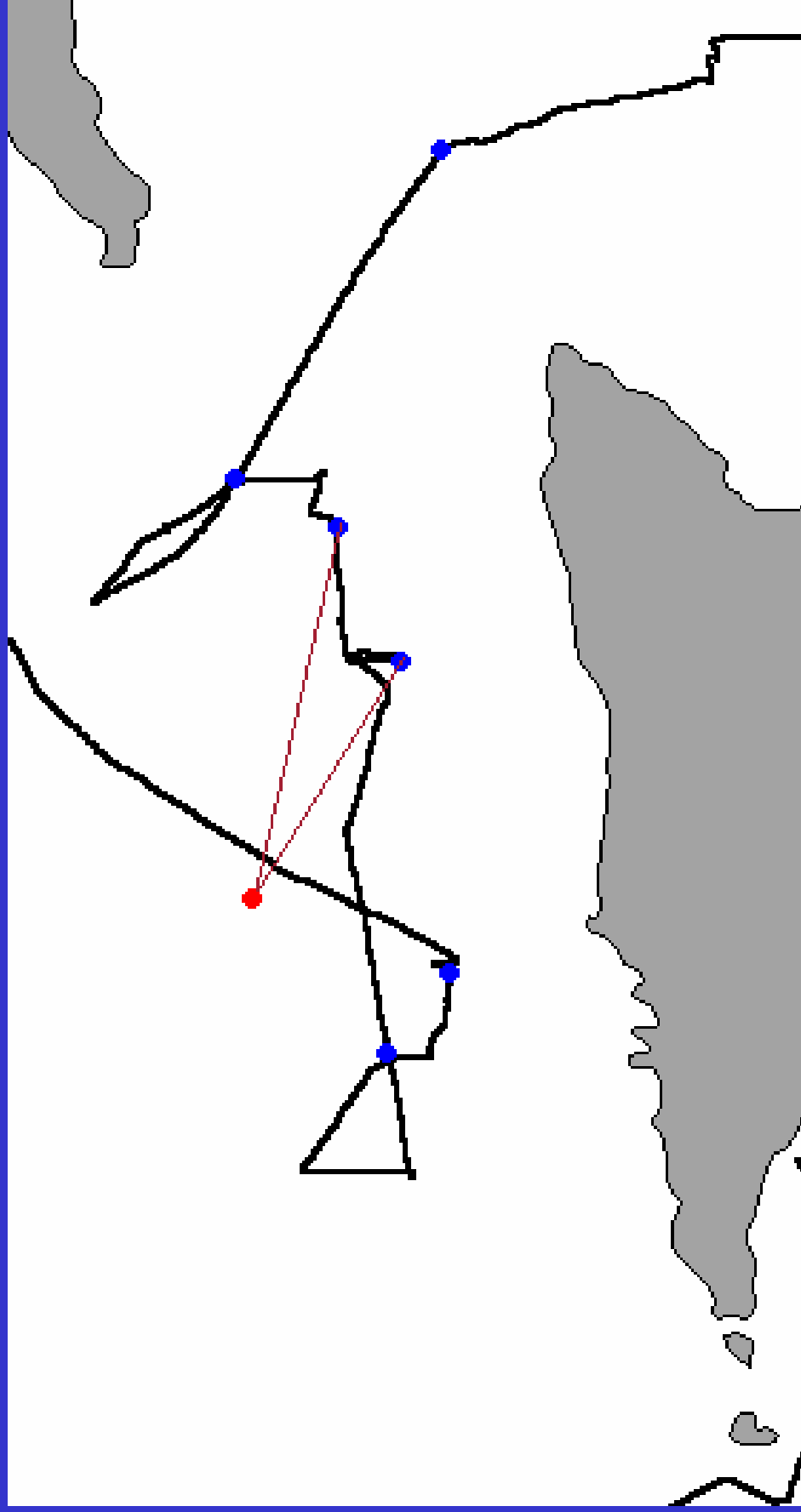
Real-Time Signal Monitoring



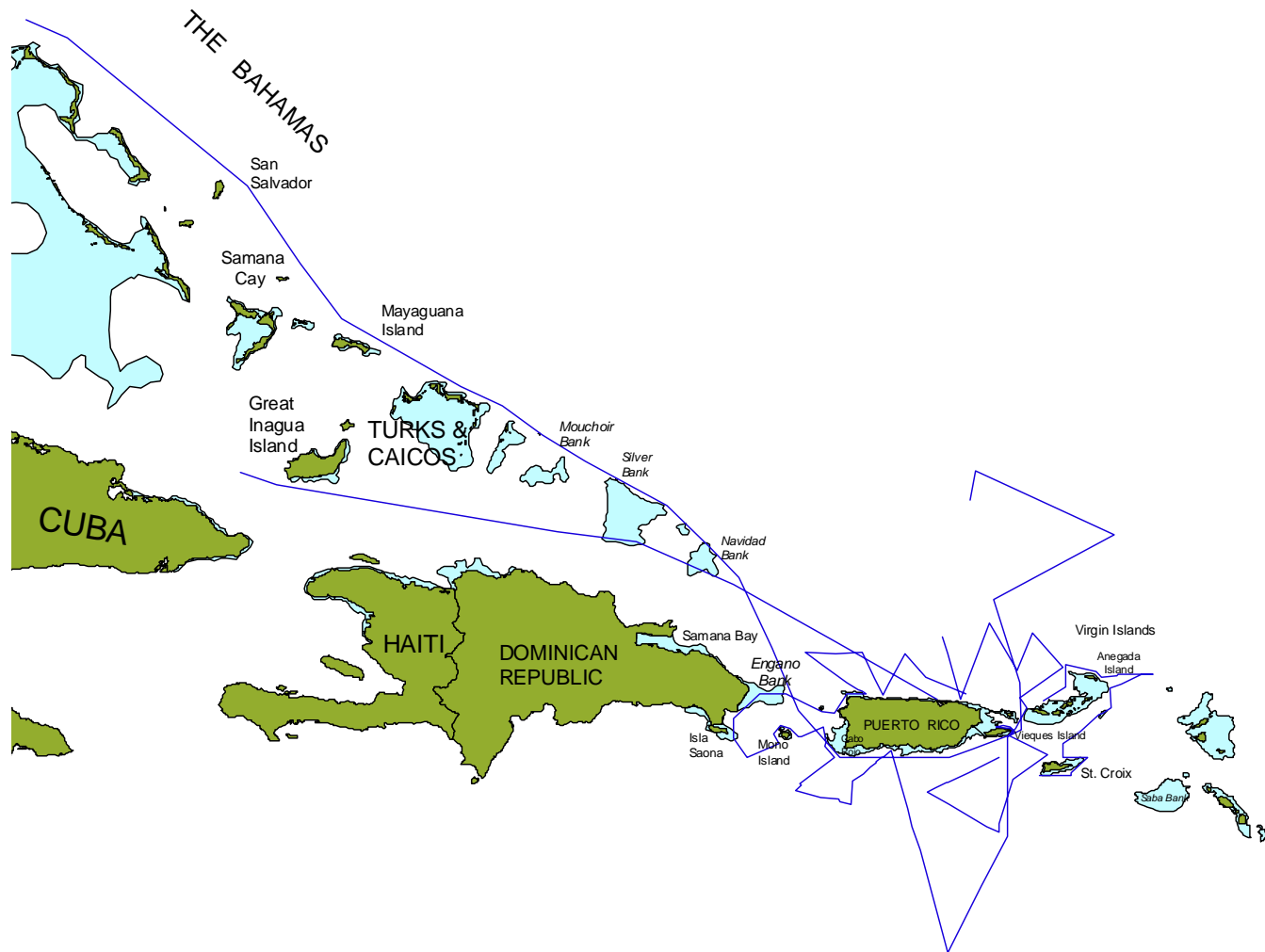
Sonobuoy Bearings:



Locations by Crossing Bearings:

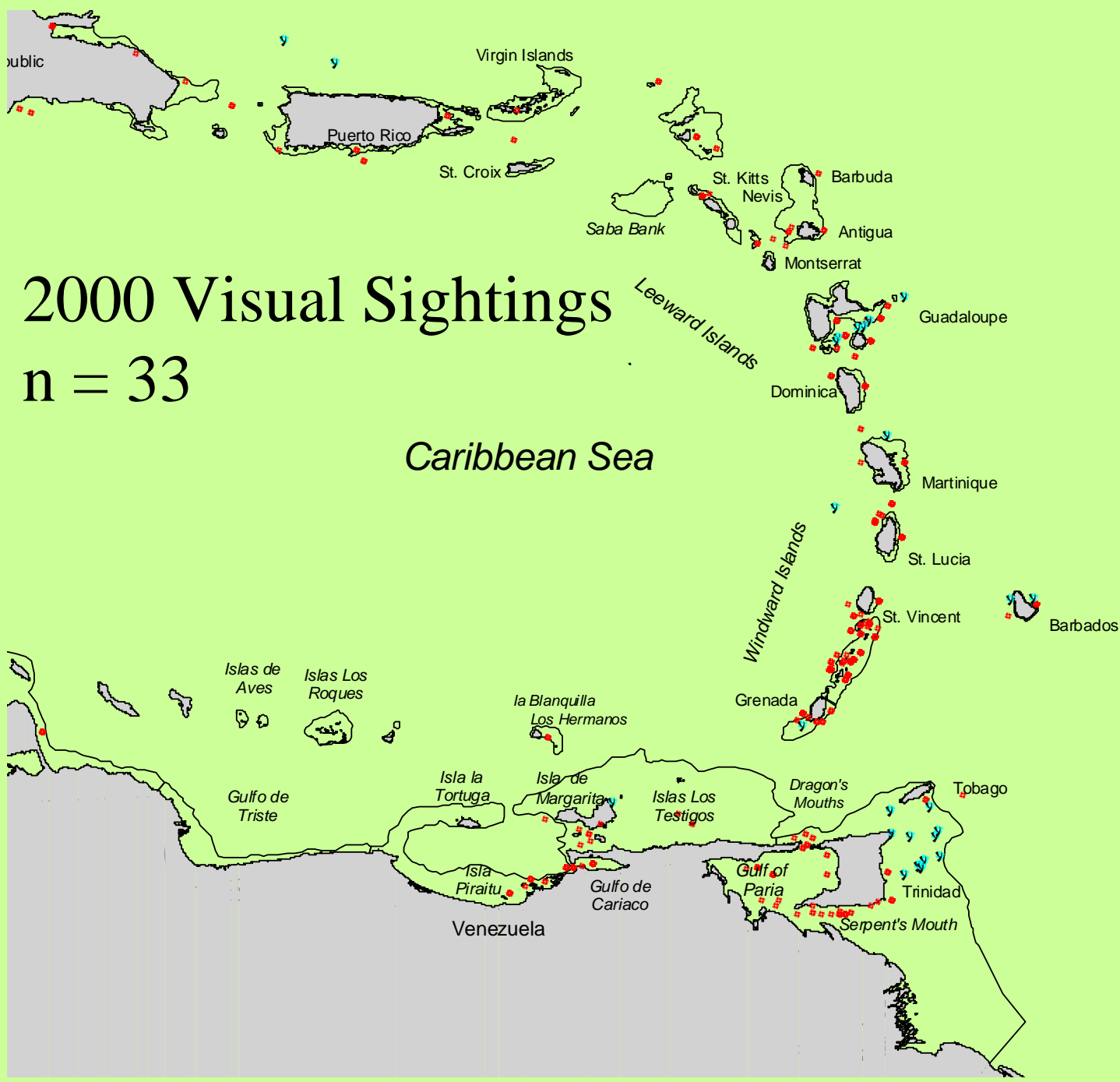


2001 Survey Trackline



Visual Sightings



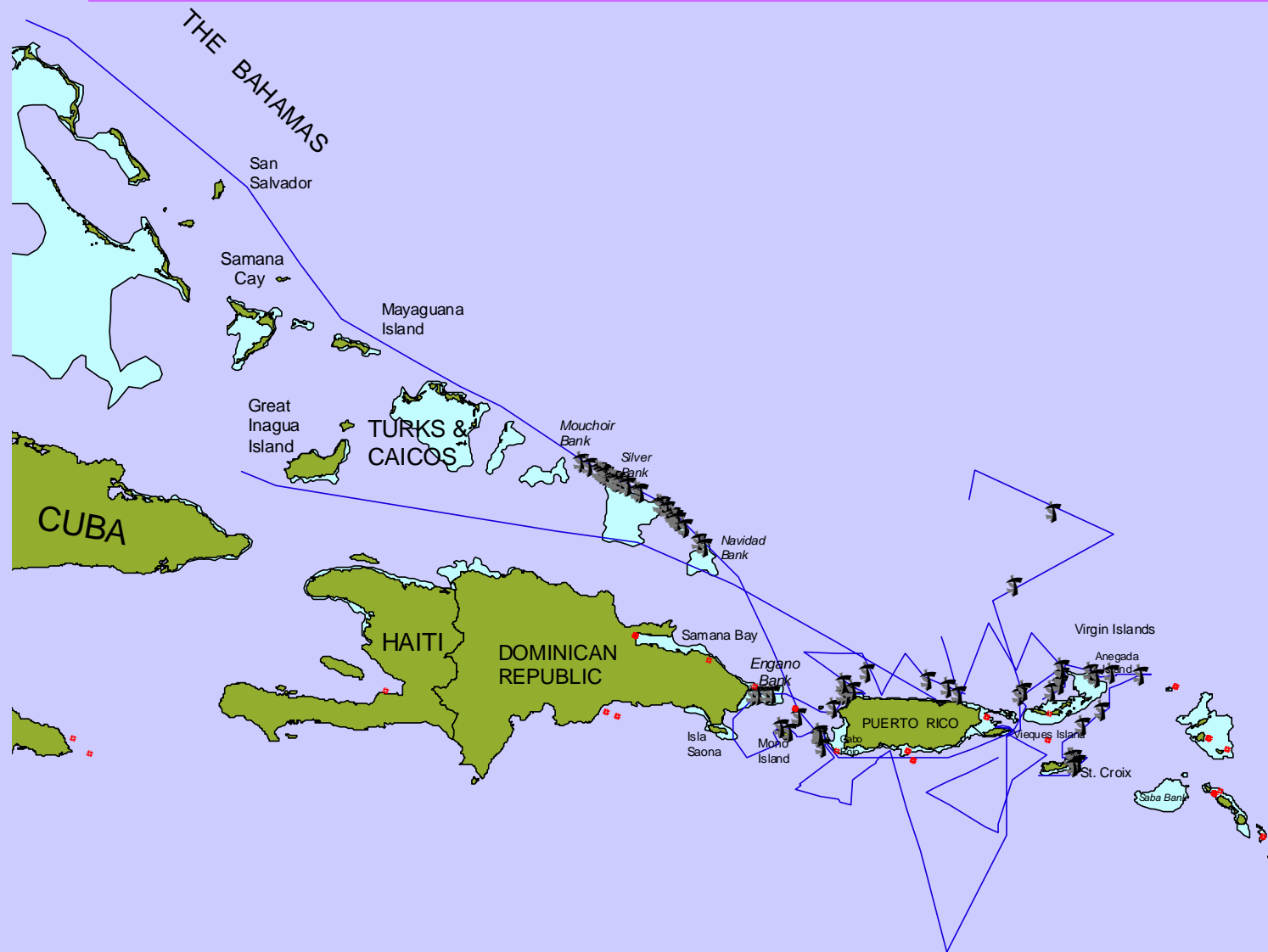


2000 Visual Sightings

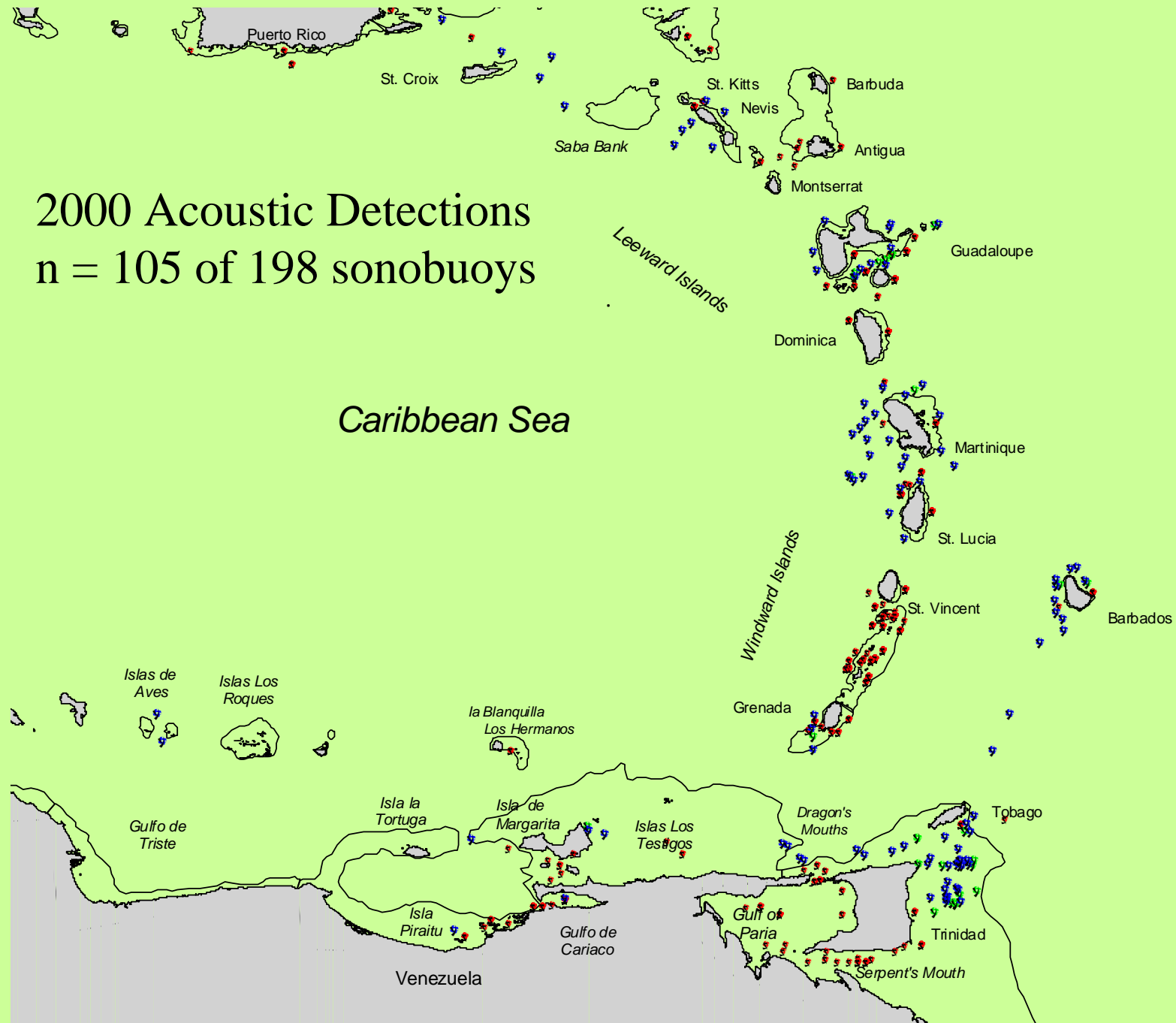
n = 33

Caribbean Sea

2001 Humpback Whale Sightings: n = 72

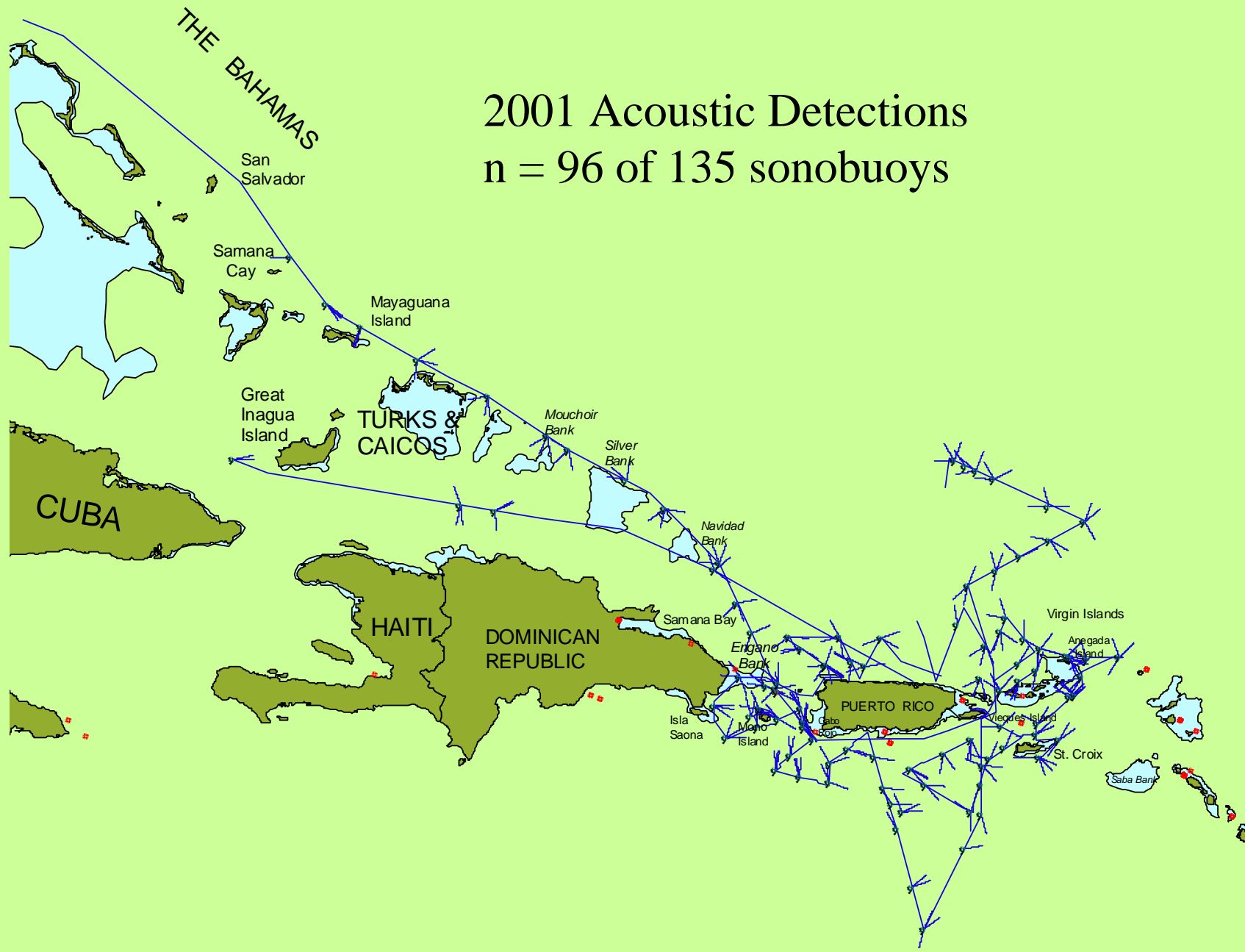


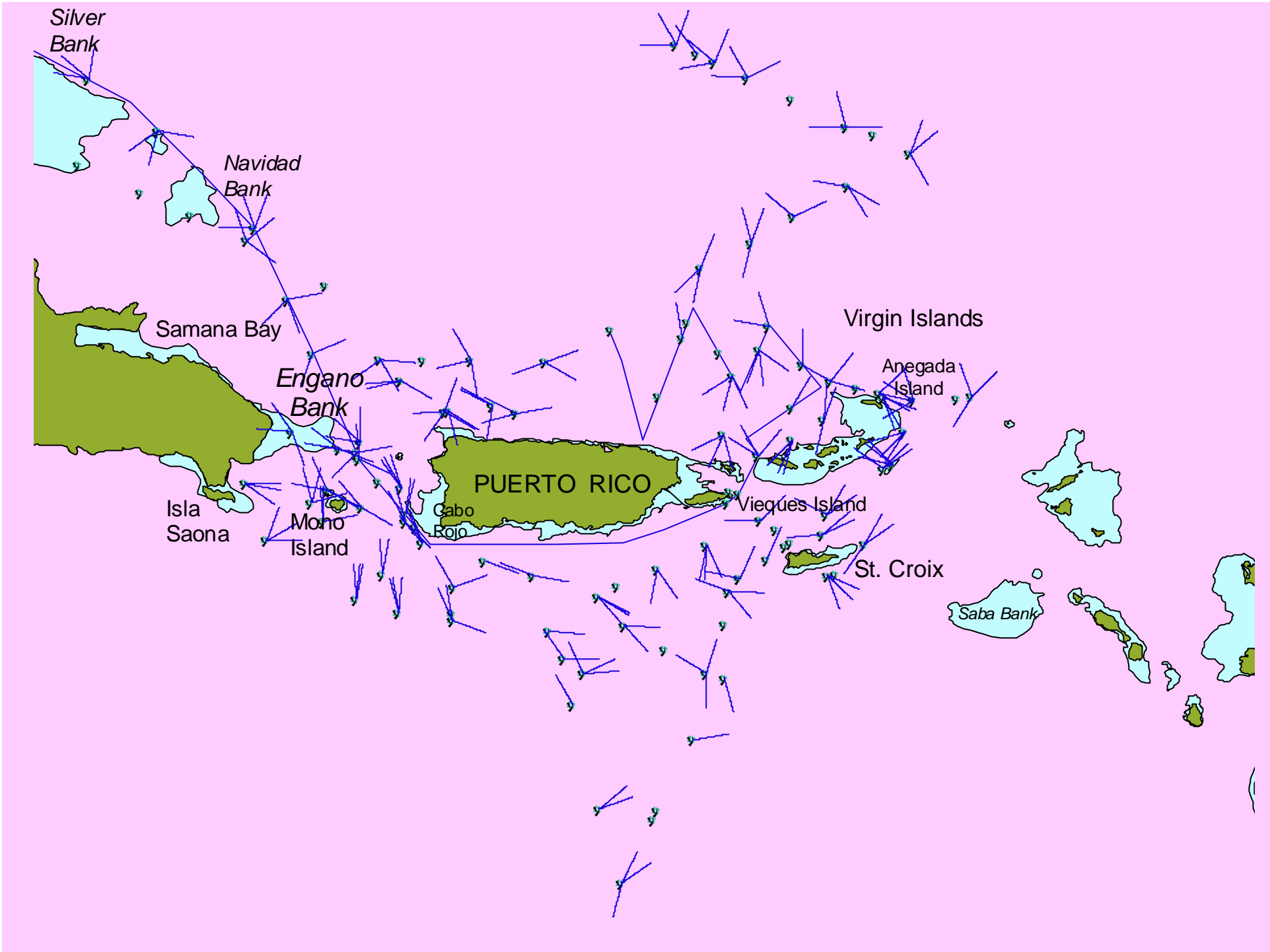
2000 Acoustic Detections n = 105 of 198 sonobuoys



2001 Acoustic Detections

n = 96 of 135 sonobuoys





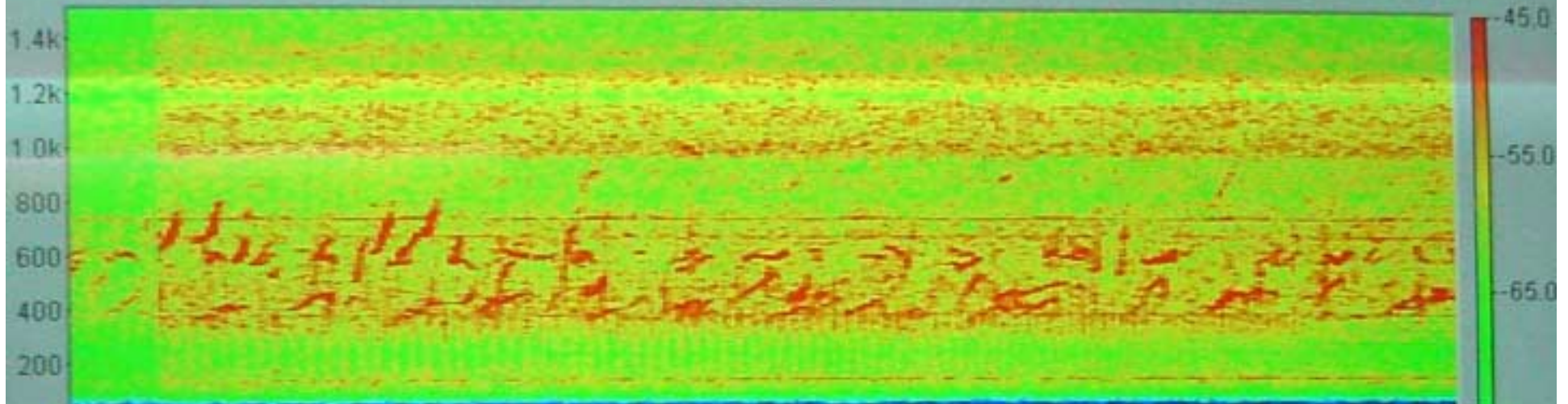
2000 Visual Versus Acoustic Detections

On-effort visual sightings = 9

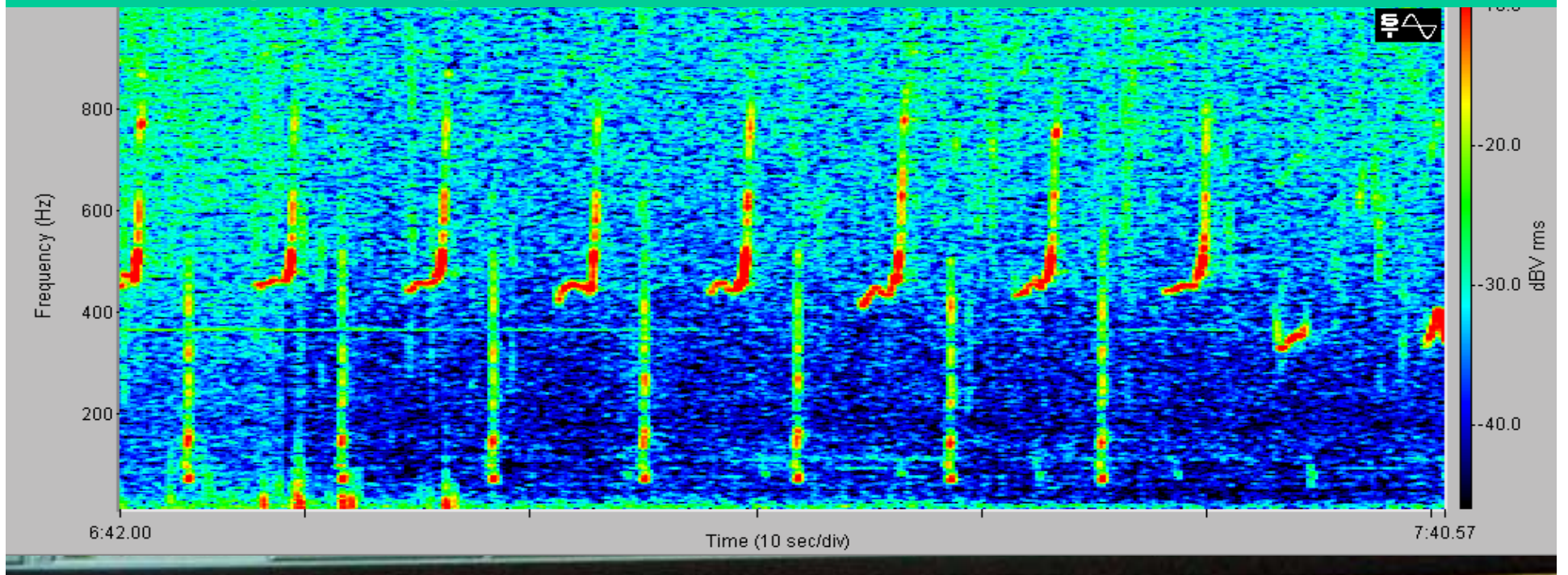
Minimum unique acoustic detections = 74



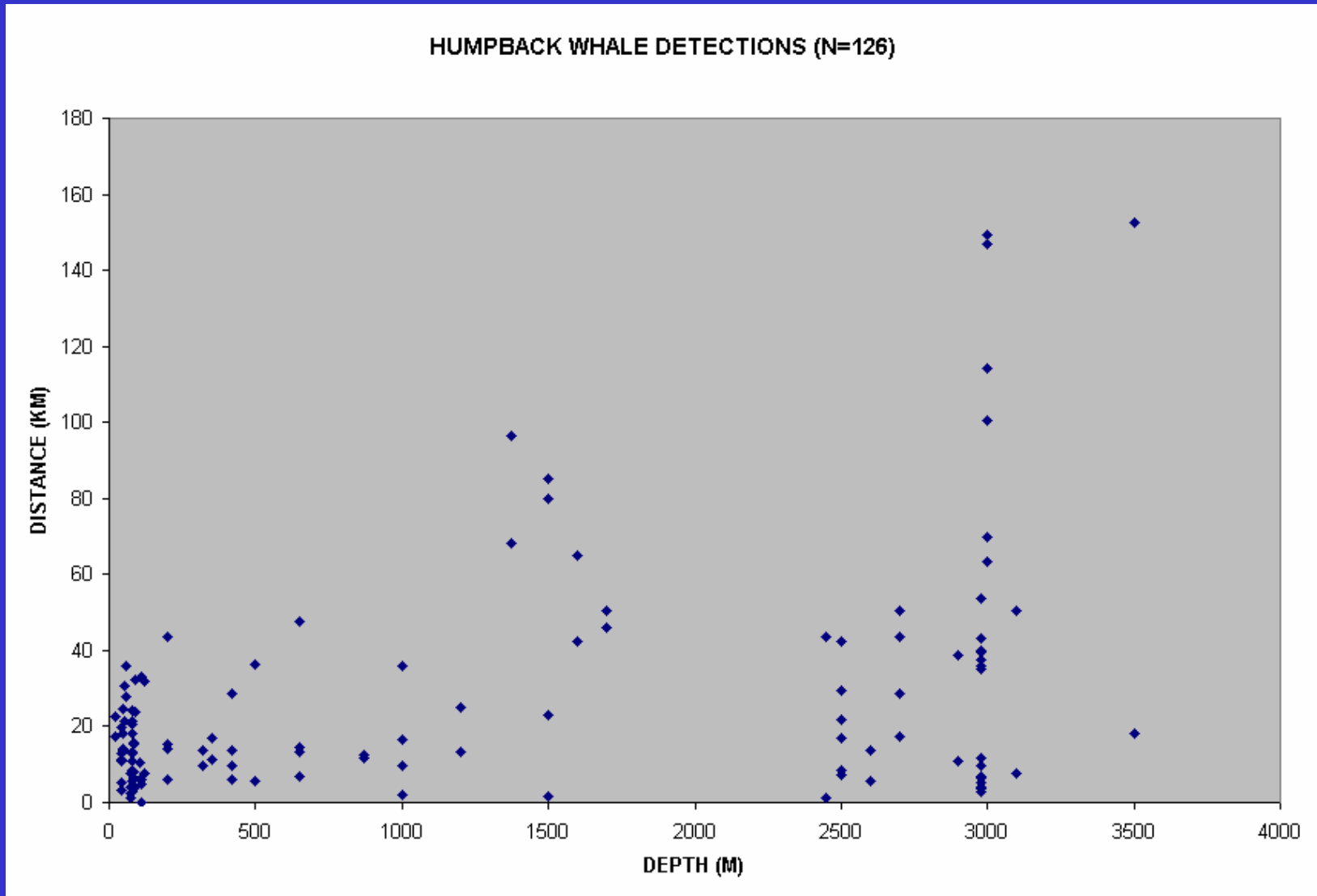
2001 - Multiple Humpback Calls ...



2000 - Single Humpback Calls...

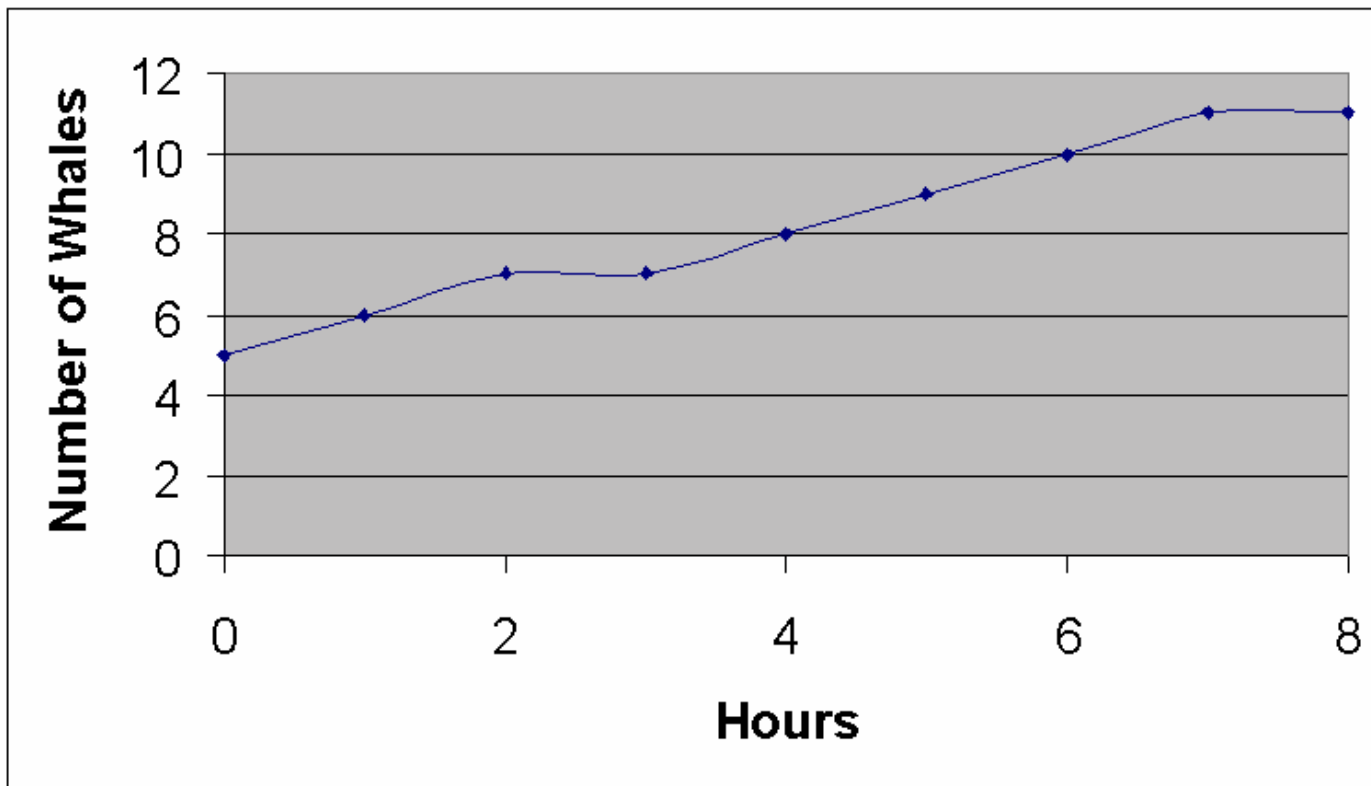


2000 Sonobuoy Detection Distances



Approach to Humpback Abundance Estimation From Acoustic Data: Males = Singers

- No. Singers = Minimum Number of Male Whales
- Singers sing approximately 45% of the time
- Total Males = Singing Males / 0.45



Abundance Estimation: Females

- YoNAH - Silver & Navidad Banks breeding grounds sex ratio favored males
- Female:Male Ratio 35:65
- Total Females = Males * (35/65)
- Total Adults = Males + Females
- Total whales = Total Adults + Juveniles

Assumptions / Biases:

All singers were heard ??

**Closed System - no movements in or out
of area ??**

**Singers may cease singing, move and
be double counted ??**

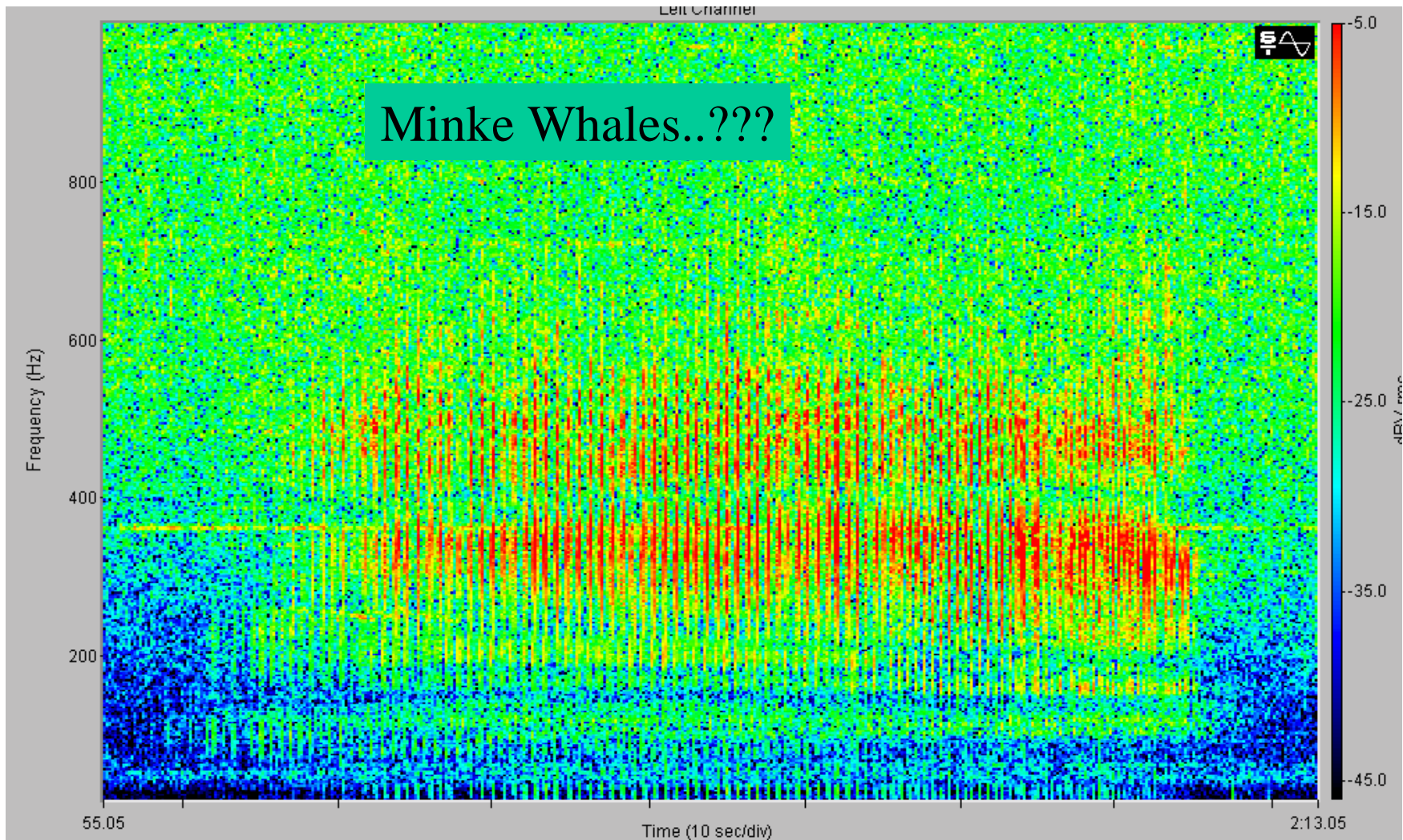
Not all whales sing (e.g., female-calf pairs)

2000 Minimum Abundance Estimates:

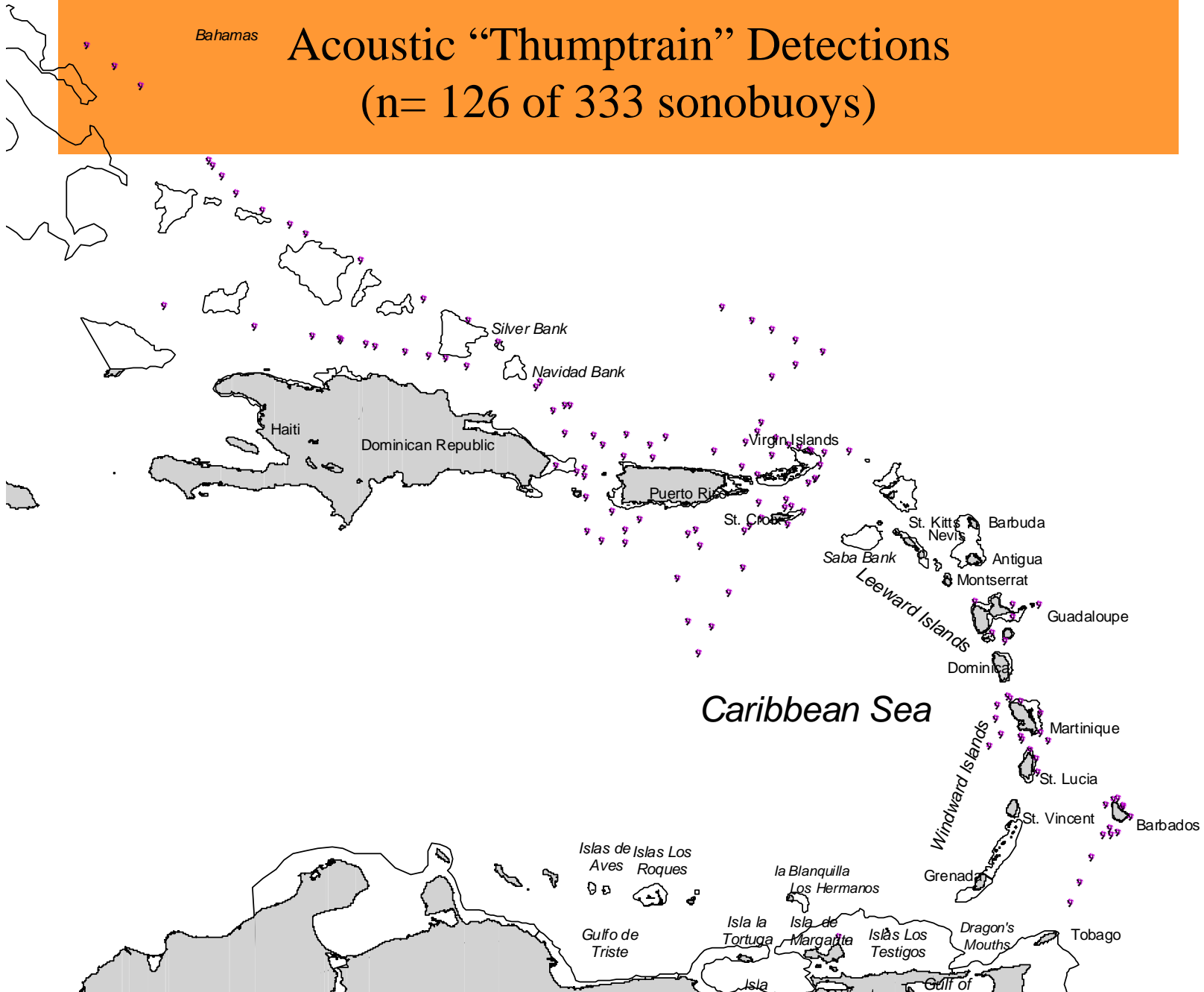
AREA	DATE	ACOUSTIC DETECTIONS (SINGERS = MALES)	ADULT MALES (Nm) = Nsingers/0.55	ADULT FEMALES (Nf) = Nm * (35/65)	TOTALS = (Nm + Nf)	(95% CL)
St. Kitts & Nevis	17-18 Feb	7	13	7	20	(12 - 50)
Antigua - Barbuda	-	no survey				
Montserrat	-	no survey				
Guadeloupe	19-Feb	7	13	7	20	(12 - 50)
Dominica	-	no survey				
Martinique	20-21 Feb	7	13	7	20	(12 - 50)
St. Lucia	22-Feb	2	4	2	6	(4 - 14)
St. Vincent	-	no survey				
Grenada	23-Feb	0	0	1*	1	
Barbados	24-Feb	0	0	0	0	
Tobago & E. Trinidad	27-28 Feb	7	13	7	20	(12 - 50)
LEG 1 SUBTOTALS:		30	55	29	85	(53 - 215)
Grenada	19-Mar	5	9	5	14	(9 - 36)
Tobago & E. Trinidad	20-21 Mar	7	13	7	20	(12 - 50)
St. Vincent	-	no survey				
St. Lucia	-	no survey				
Barbados	22-23 Mar	5	9	5	14	(9 - 36)
Martinique	24-Mar	7	13	7	20	(12 - 50)
Dominica	-	no survey				
Guadeloupe	25-Mar	9	16	9	25	(16 - 64)
Montserrat	-	no survey				
Antigua - Barbuda	-	no survey				
St. Kitts & Nevis	-	no survey				
LEG 2 SUBTOTALS:		33	60	32	92	(57 - 235)
Venezuela	11-18 Mar	11	20	11	31	(19 - 78)

* Note: a cow-calf pair was sighted during the survey effort.

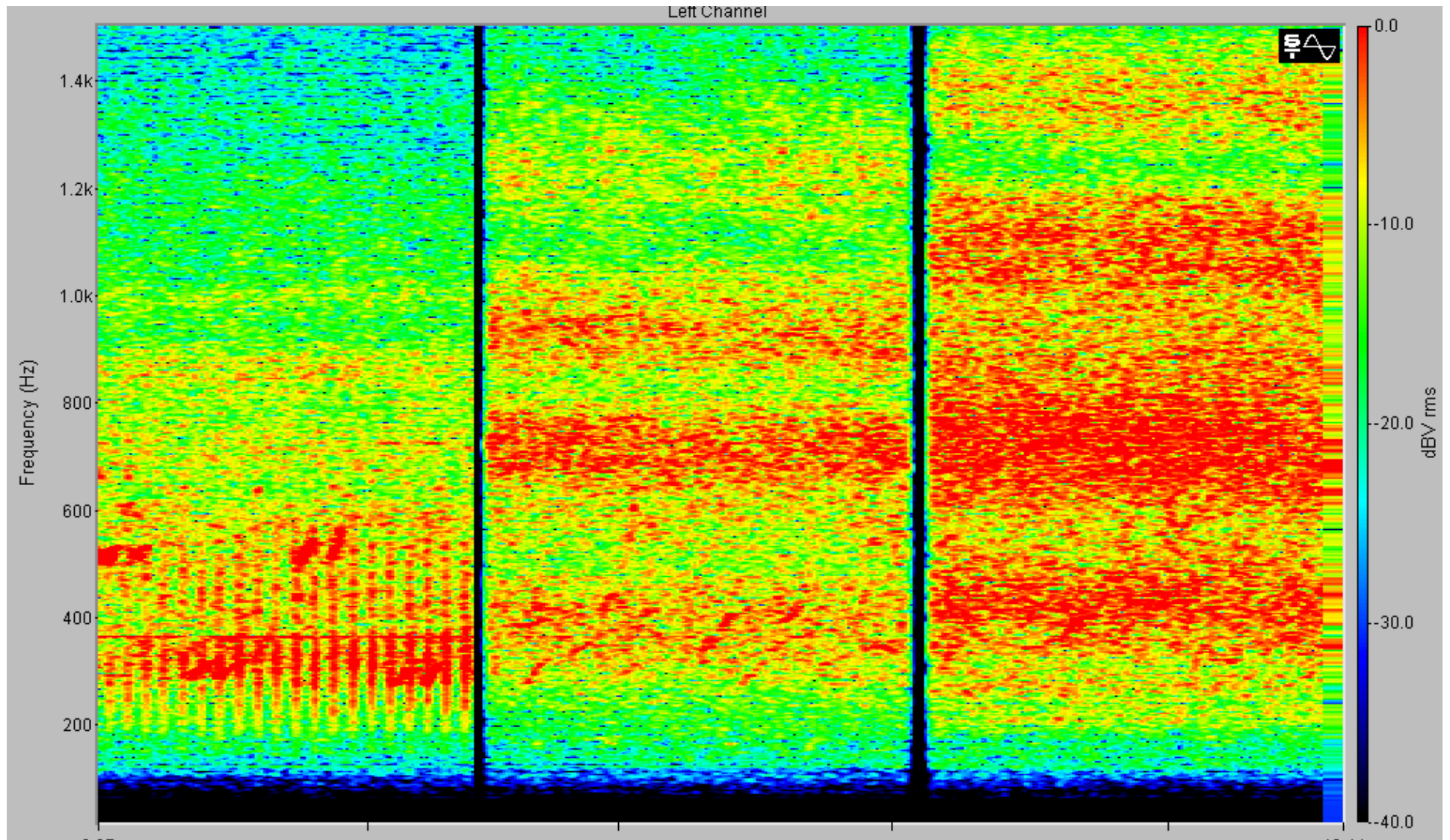
Typical Atlantic “Thumptrain”



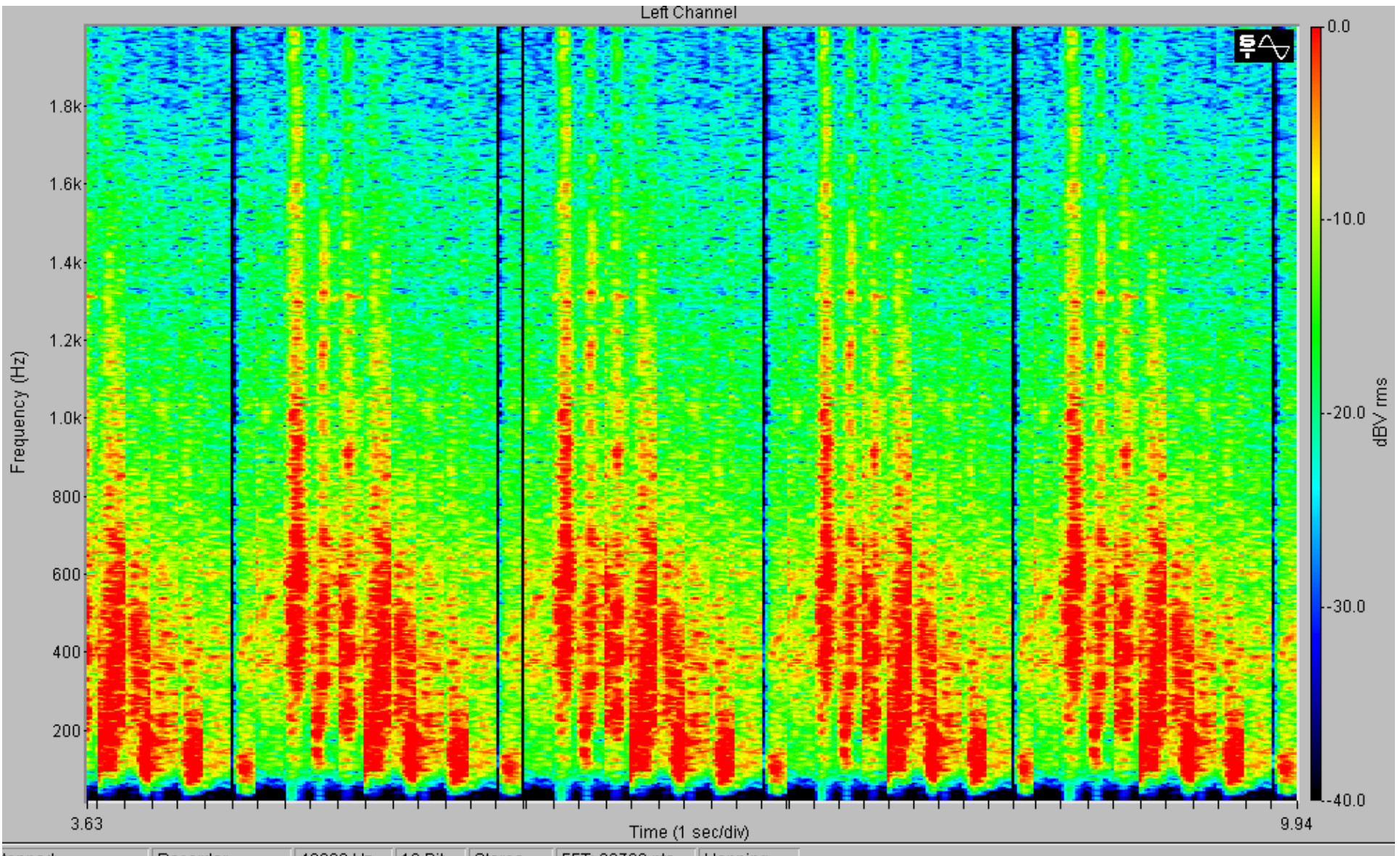
Acoustic “Thumptrain” Detections (n= 126 of 333 sonobuoys)



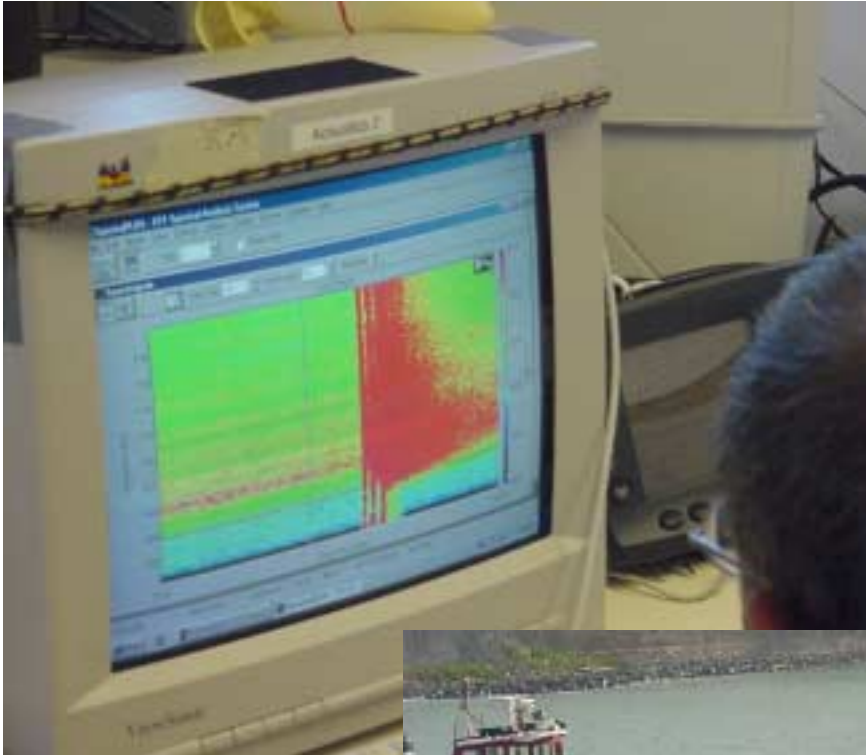
Shipping Noise



Percussive “explosion-like” sounds



Does ambient noise influence which areas
whale select as gathering sites?



For example:

Gulf of Paria - formerly occupied by humpbacks..
Location of significant historical harvests

Today.. None were found in the Gulf of Paria
where industrial noise is significant

In contrast:

Areas like Silver and Navidad Banks host concentrations
of humpbacks today and have relatively low ambient noise

Conclusions and Future Research:

- Humpbacks found throughout their former range Eastern Caribbean in winter
- Southeastern Densities appear less than during historical commercial whaling
- Additional northern concentration areas include: east of the Virgin Islands, St Croix, Saba Bank, Engano Bank, Mono Island, northern shore of Haiti, Caicos Banks, Great Inagua Island, and over some deep water areas

Conclusions and Future Research:

- Passive Acoustics is an effective method for finding singing humpback male whales
- Need to develop and improve statistical methods for abundance estimation
- Integrate whale distribution with habitat features

Ongoing research:

- **Develop detection range estimates to better determine survey effort**
- **Develop group-size estimates based on visual observations**
- **Investigate humpback song characteristics as possible sub-stock indicator**

Ongoing research:

- **Investigate relationship between historical and modern day whale distributions with ambient noise levels present and past ?**
- **Do whales that rely on song for communication and reproduction require some minimum ambient noise levels ?**



They are out there....

Keep on fishing for answers...

