**Rift Valley Fever Workshop**
**An Integrated Approach to Controlling Rift Valley Fever in Africa and the Middle East**
**27-29 January 2009**
**Dokki, Giza, Cairo, Egypt**

# Reintroduction of RVF into previously affected areas

## Rift Valley Fever Outbreak in Yemen Sep 2000/March 2001 and Veterinary Surveillance Follow up

Presented by

Dr. Mansoor Alqadasi

General Director of Animal Health & Vet. Quarantine. MAI

Head of Research Team, Yemen

# Animal population and distribution

- **The animal resources account for about 30% of the agricultural production, which represents 20% of the total income.**

**Livestock population:**

| **Species** | |
|---|---|
| **Cattle** | **1.4 million** |
| **Sheep** | **8.2 million** |
| **Goat's** | **8.0 million** |
| **Camels** | **359,000** |

# Animal distribution

- **Yemen has five agro-climatic zones for agriculture purposes. The climatic conditions vary greatly across the country with rainfall varying from 50 mm in the coastal lowlands to 1200 mm in the southern upland. According to the five agro-climate zones in Yemen the animal population are distributed as following:**
- **Eastern zone 33.75% of the total livestock population and 3.7% of the cattle population.**
- **Coastal lowland 15.4% of the total livestock population and 25.1% of the cattle population.**
- **Central highland 10% of the total livestock population and 12.4% of the cattle population.**
- **Northern highlands 24% of the total livestock population and 25.4% of the cattle population.**
- **Southern uplands 17% of the total livestock population and 33.4% of the cattle population**

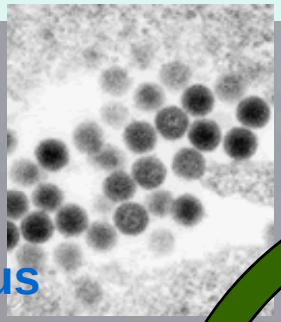
- **Approximately 3 millions animals are kept in the outbreak area (population at risk) and must be considered to be at risk of becoming infected with RVF.**

# Introduction

(Aedes spp. and Culex spp.)

Vectors

Virus



- RNA
- Phlebovirus

Transmission to animal following blood feeding

Environment

Human beings

- Often unapparent infection or flu syndrome rarely fatal

Direct contact with infected material

Animal

- Affects principally small ruminants, cattle and camelids
- Direct (mortality, abortion) and indirect economical impact (commercial ban)

# RFV in Yemen
# 2000 / 2001

# The ecological condition of the Tihamah

- **Wadi networks emerged from the mountains into the Tihamah.**
- **Simple irrigation channels leading from the wadi bed into patterns of fields which could be fed with water from the channel.**
- **The fields often had vegetation of *Panicum* and *Cyperus* grasses. These were found to be associated with the 8 major Wadi zones from the Saudi Arabian border to Wadi Mawzaa in the south of the peninsula.**
- **Tihamah has been the focus of extensive agricultural development over the last 20-30 years as greater use is made of the available water resource for cultivation.**
- **The changes in the wadi systems, which have been made to ensure more effective use of the available water, are also those which favour the development of more extensive breeding sites for the mosquito species which are believed to be of greatest importance in amplifying and transmitting RVF virus.**

# Major Wadi of Tihamah

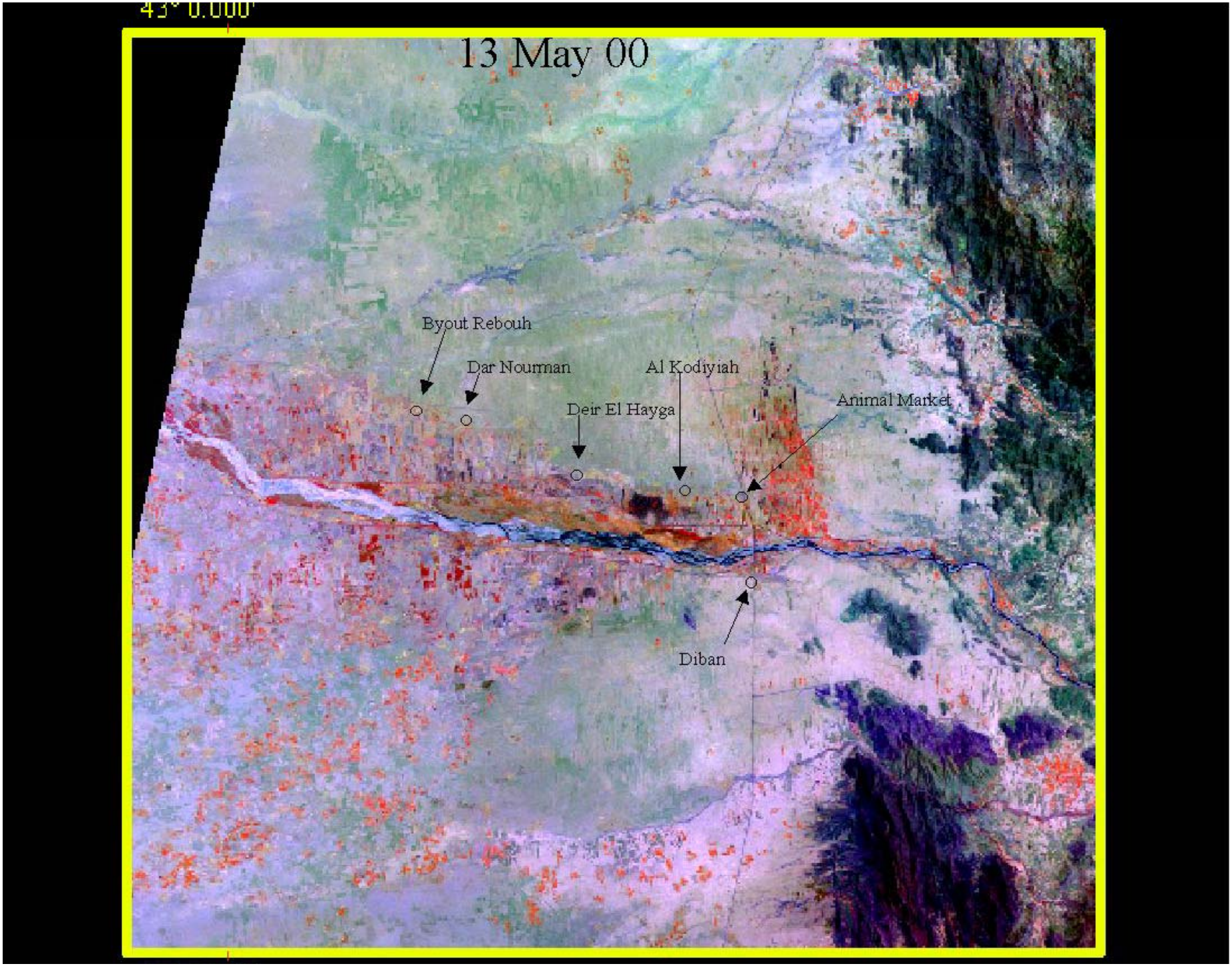
| Wadi | Length/km | rainfall | Catchment's area |
|---|---|---|---|
| Harad | 310 | 490 | 910 km² |
| Hayran | 22 | 560 | |
| Abs | 19 | 490 | |
| Mowr | 310 | 430 | 8000 km² |
| Siham | 187 | 430 | 4900 |
| Surdud | 107 | 550 | |
| Zabid | 152 | 530 | 4560 |
| Rasiyan | 75 | 500 | 1990 |
| Rima’ | 123 | 580 | 2670 |
| Mawzaa | 65 | 500 | |

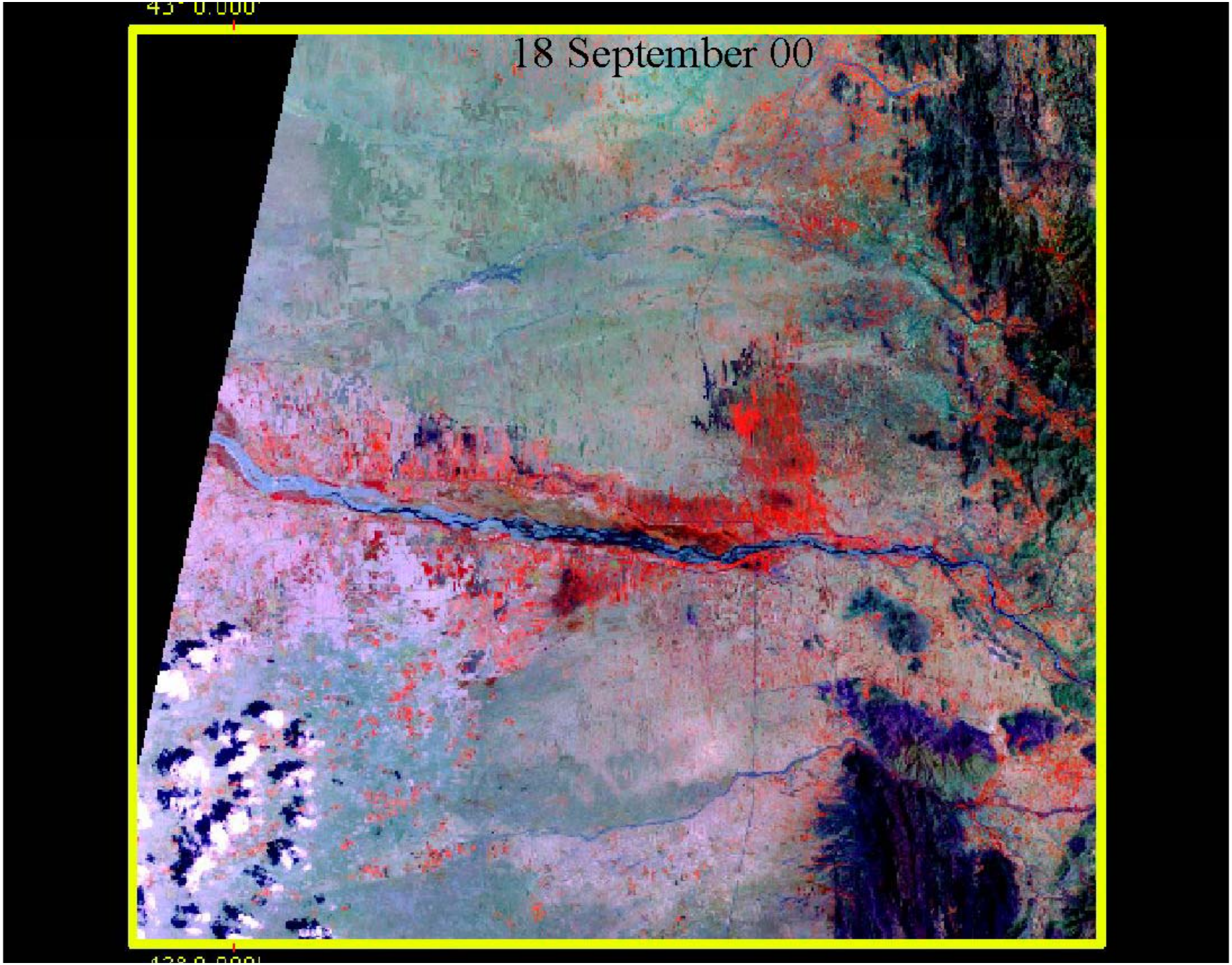
# The ecological condition of the Tihamah

- **Rainfall in Aug - Sep 2000 was higher 4x than the last 10 years**

- **The largest, Wadi Mowr for example covers some 18,000 hectares watered by the canal systems. The run of from the catchments area is equivalent to 237 mm rainfall, and the mean annual rainfall at 2 stations is 145 (Al Zohrah) and 268 ( Kudmatt Malaria) mm.**

- **All these conditions played an important role for the increase mosquitoes breeding and spread of the RVFV.**


43° 0.000'
13 May 00
Byout Rebouh
Dar Nourman
Deir El Hayga
Al Kodiyiah
Animal Market
Diban


18 September 00

# Review of the RVF outbreak Sept 2000/March 2001

# First Foci In Wadi Mowr

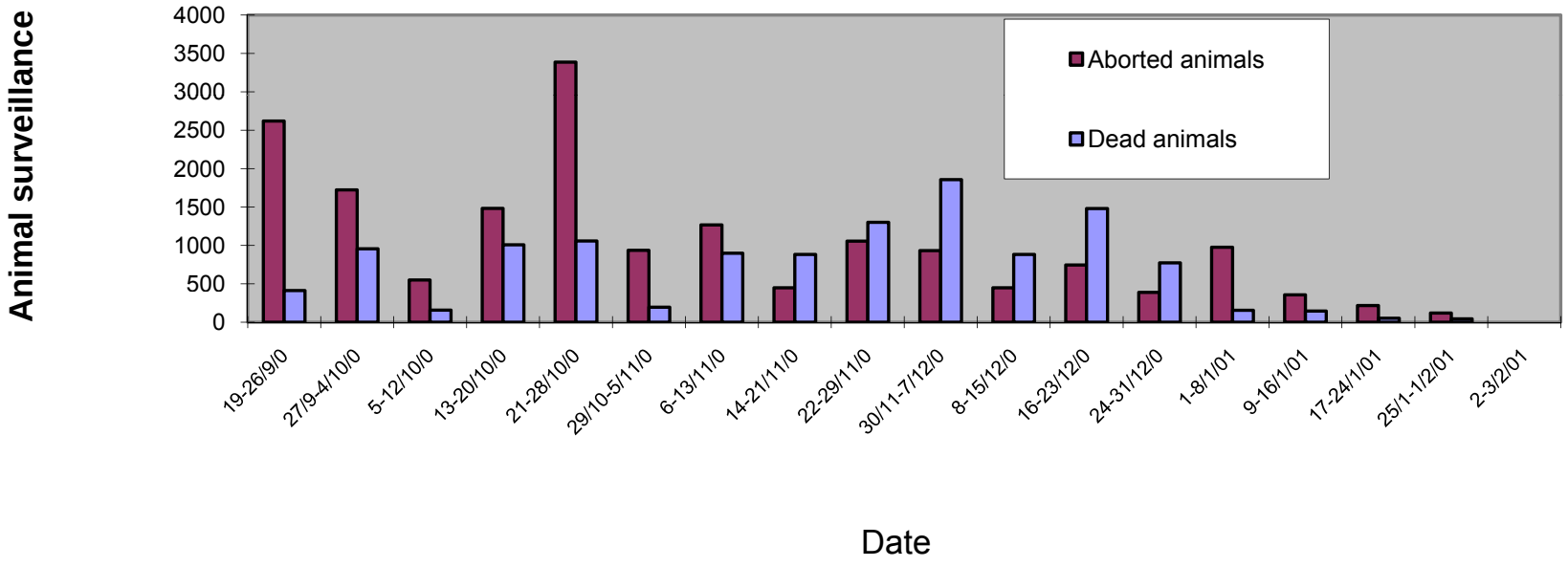
# Action taken following the declaration of RVF

- An operation room was established for controlling the RVF disease with cooperation with Ministry of Health and all related ministries and authorities were represented.
- Stop animal movement from and into infected areas, and between none infected Districts/Governorates.
- Ban slaughtering in the infected area.
- Stop importing live animals.
- Spraying the infected areas by insecticide.
- Active surveillance in the whole country with clear case definition (death, Abortion)
- Four Field operation Centers: Al- Hodeidah, Al-Zuhrah, Abs and Zabid.

# Action taken Count.

- Coordination of activities between MOA and MOH
- Mobile Surveillance teams
  - standardized form
  - serologic testing
  - treatment/referral of ill patient
- Health education/public awareness, disease recognition, vector control, and risk factor reduction.
- Donor support:
  - NUMRU-3
  - FAO
  - WHO
- Human disease
  - confirmed in 16 districts
  - most cases occurred along coastal plain
  - communities adjacent to major wadis
- Animal disease
  - cross sectional surveys reveal evidence of RVF transmission

# RVF data by week (9/9/2000 up to 3/2/2001)

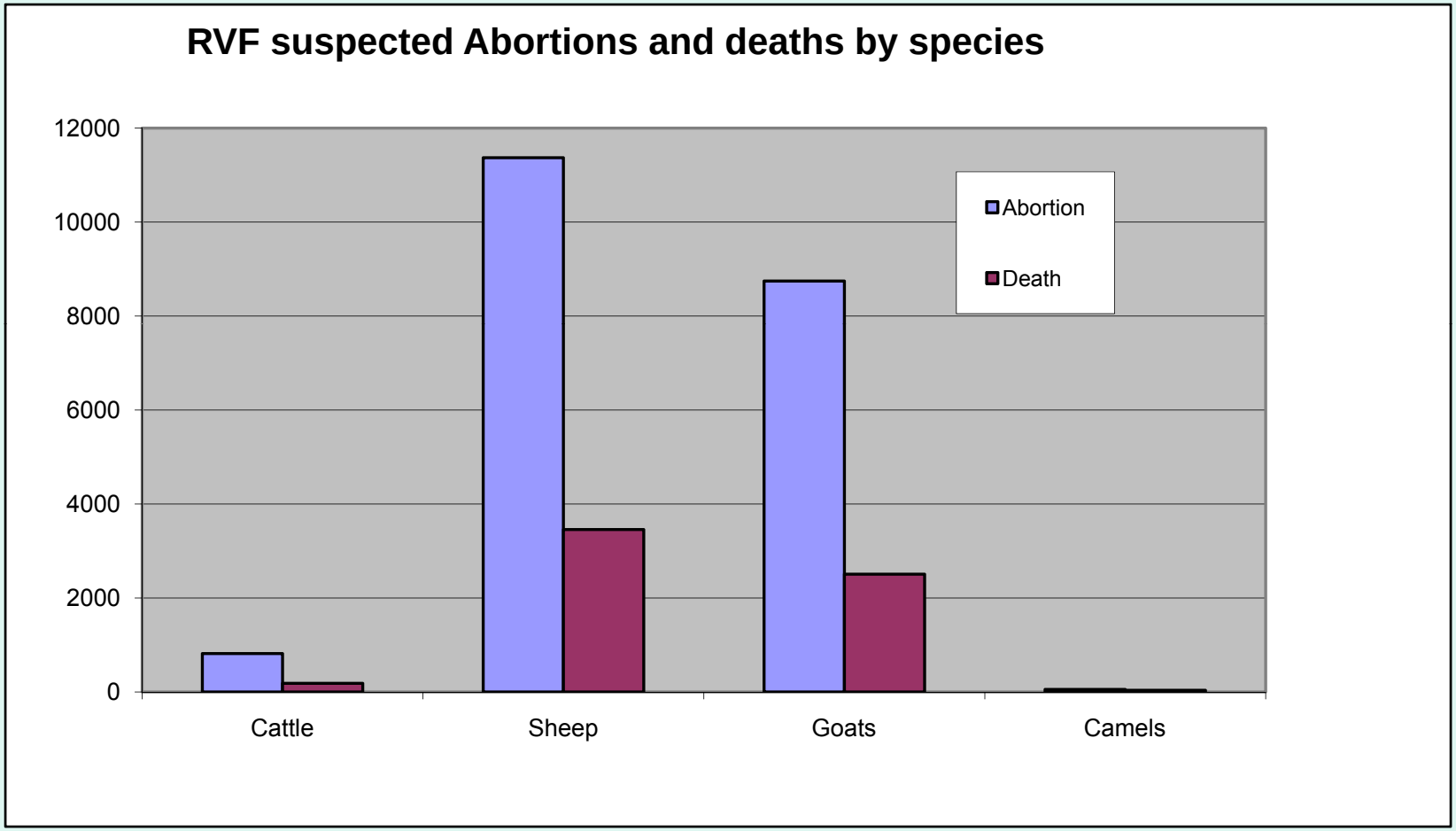


# Survey in Major Wadis of Tihamah

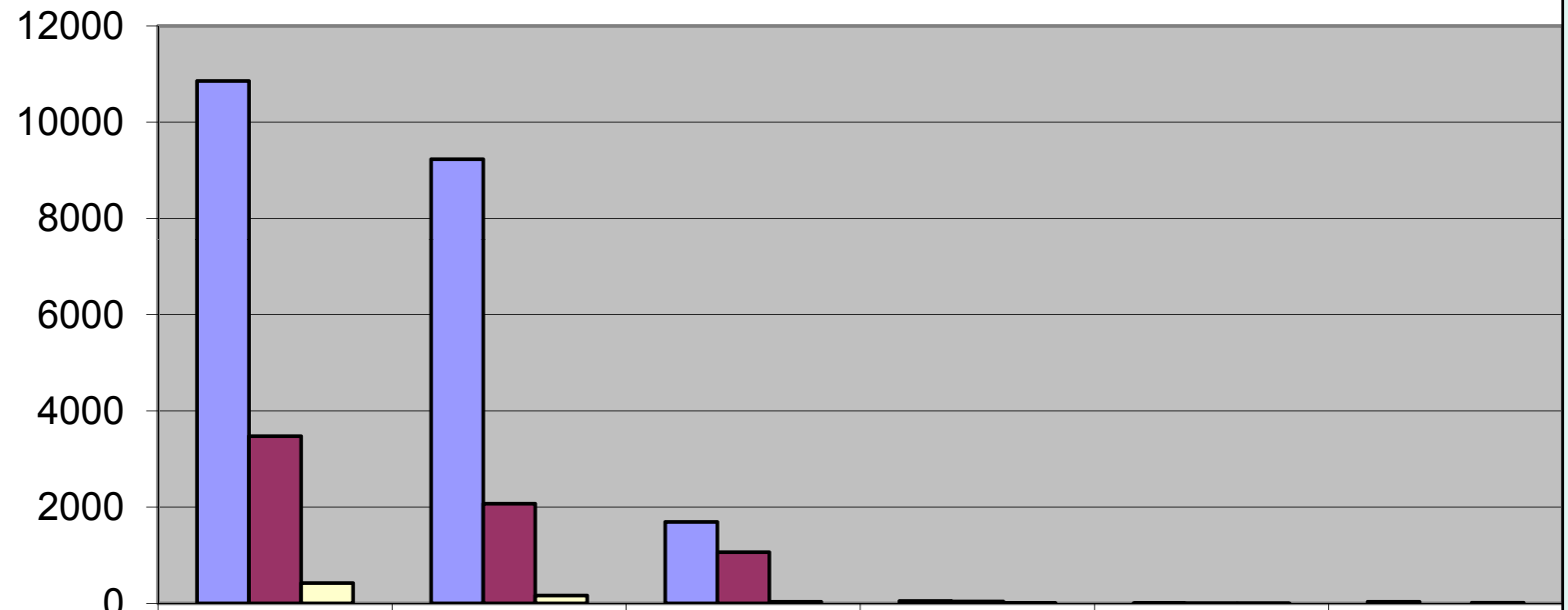
| Wadi | Animal Abortion | RVF IgM | Human Diseases. |
|---|---|---|---|
| Harad | Yes | Yes | Mild |
| Hayran | Yes | Yes | Mild |
| Abs | Yes | Yes | Mild |
| Mowr | Yes | Yes | severe |
| Siham | Yes | Yes | Mild |
| Surdud | Yes | Yes | Mild |
| Zabid | Yes | No | No |
| Rasiyan | No | No | No |
| Rima’ | No | Yes | No |
| Mawzaa | No | No | No |

**Abortions and Deaths during the RVF Outbreak (September 2000 to March 2001**

| Species | Abortions | Deaths |
|---|---|---|
| Sheep | 11125 | 3602 |
| Goats | 8660 | 2754 |
| Cattle | 1688 | 196 |
| Camel | 389 | 101 |
| Total | 21862 | 6653 |


RVF suspected Abortions and deaths by species
12000
10000
8000
6000
4000
2000
0
Abortion
Death
Cattle
Sheep
Goats
Camels

# RVF infection in Outbreak Area




| | Al-Hodiedah | Hajjah | Sada'a | Al-Mahwit | Dhamar | Sana'a Gov. |
|---|---|---|---|---|---|---|
| Abortions | 10855 | 9229 | 1692 | 49 | 3 | 34 |
| Deaths | 3474 | 2072 | 1064 | 42 | 1 | 0 |
| Lab. Conf. | 422 | 164 | 34 | 11 | 1 | 13 |

# Summary results of Cross-sectional Survey within Wadi Mowr by NAMRU- 3

| Animal species | Total sample tested | RVF IgG positive | RVF IgM positive |
|---|---|---|---|
| Sheep | 1226 | 269 (22%) | 124 (10.1%) |
| Goat | 545 | 121 (22.2%) | 30 (5.5%) |
| Cattle | 469 | 129 (26%) | 46 (9.8%) |
| Total | 2267 | 519 (22.8%) | 200 (8.8%) |

# Vector Surveillance

**Collection studies identified relatively few mosquitoes in the outbreak area.**

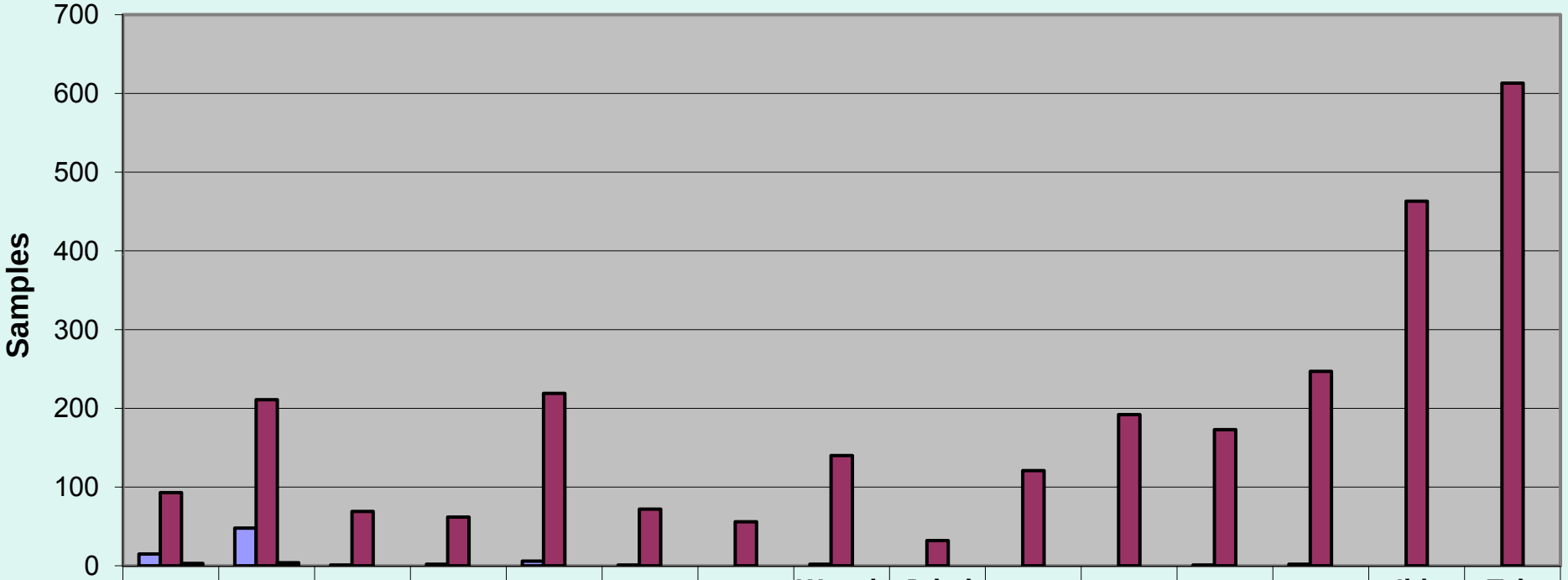
**Mosquitoes collected included 9 species:**

**1) *Aedes species. Ae Arabiensis, Ae. Aegypti, Ae. Vittatus*;**
**2) *Culex* species *Cx. tritaeniorhynchus, Cx. univittatus, Cx. bitaeniorhynchus, Cx. salisburiensis*;**
**3) *Anopheles* species, *An arabiensis (An. Gambia,* type b), *An stephensi.***

# Cross-sectional survey out side Wadi Mowar

- **North and South of Wadi Mowr and wadi Rima at Three 10 km Steps.**
- **Edges of wadis Harad and Mawza into the mountains away from Tihamah at Five 10 km steps.**
- **Highlands in Taiz, Ibb and Dhamar at 500 meters, 1000 meters, 1500 meters, and 2000 meters.**
- **Salt scrub/sand zones of Tihamah.**
- **About 2800 sera were collected.**
- **Results revealed that the spread of the disease was from the north towards the south of the country**

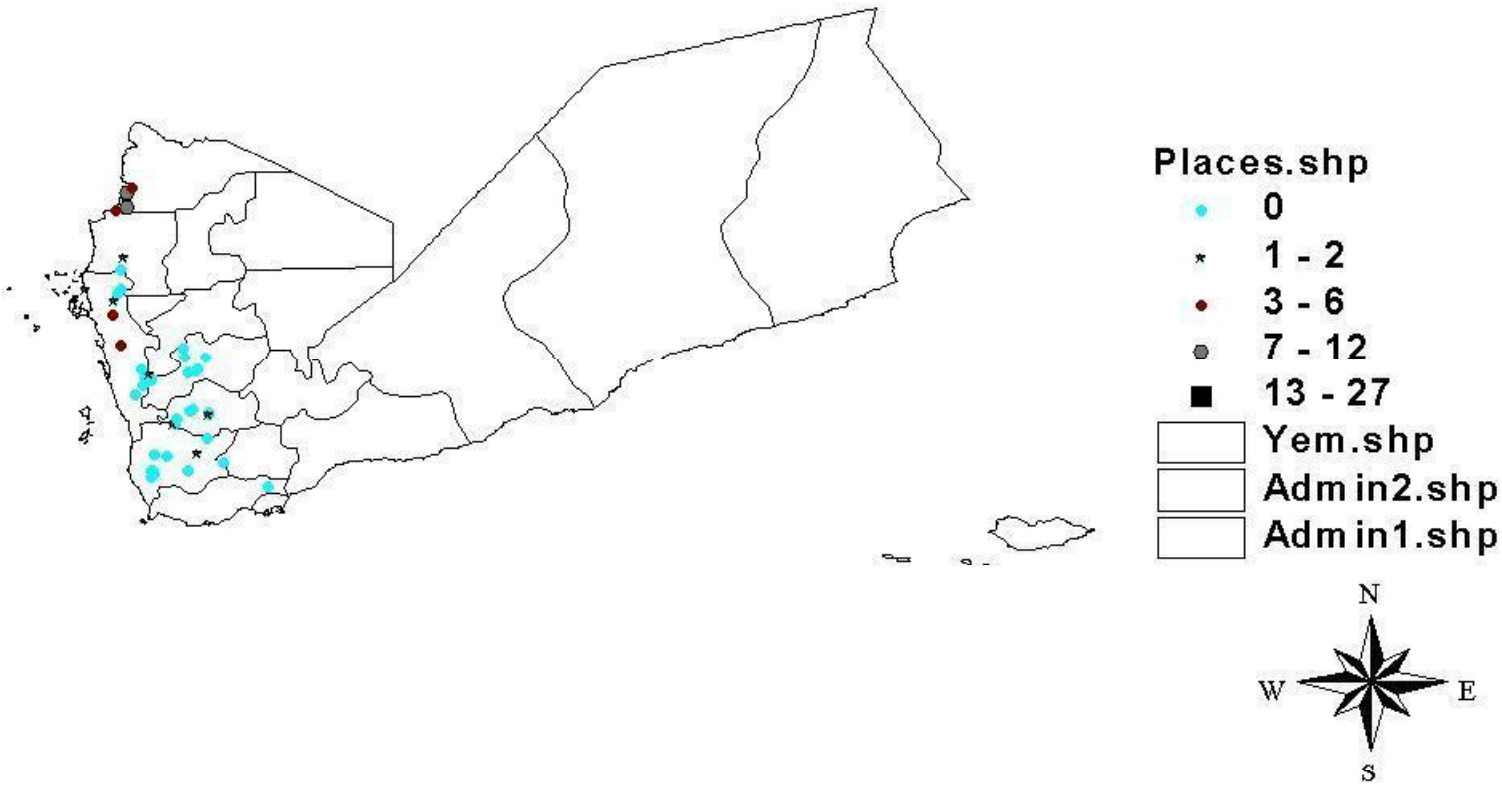
# Survey Results for RVF (Outside Wadi Mowr)




| | Aldda'er | North Harad | Abs | Alluhyah | Azuhran | Alzaidyah | Alqanawis | Wosab Asafel | Jabal Asharq | Dhoran Anis | Utmah | Bait Alfaqi | Zabeed | Ibb (Highlands) | Taiz (Highlands) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| IgM Pos. | 15 | 48 | 1 | 2 | 6 | 1 | 0 | 2 | 0 | 0 | 0 | 1 | 2 | 0 | 0 |
| IgM Neg. | 93 | 211 | 69 | 62 | 219 | 72 | 56 | 140 | 32 | 121 | 192 | 173 | 247 | 463 | 613 |
| IgM Sus. | 3 | 4 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

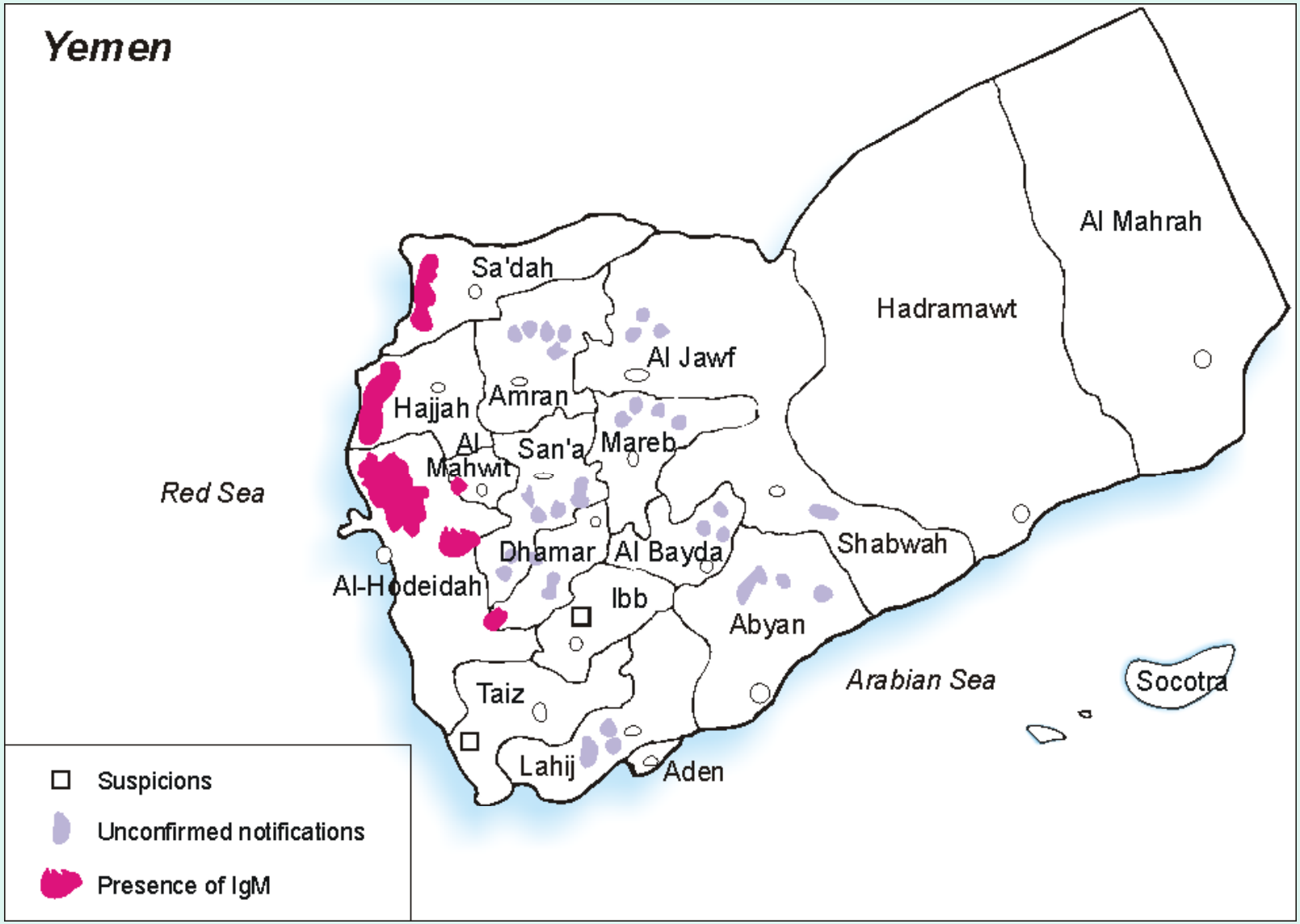
Districts

Survey to define the extent of the RVF virus in Yemen During the outbreak (Nov. 2000)



# Outbreak Area

## 43:62 East-West and 16:45 North-South



# Laboratory testing

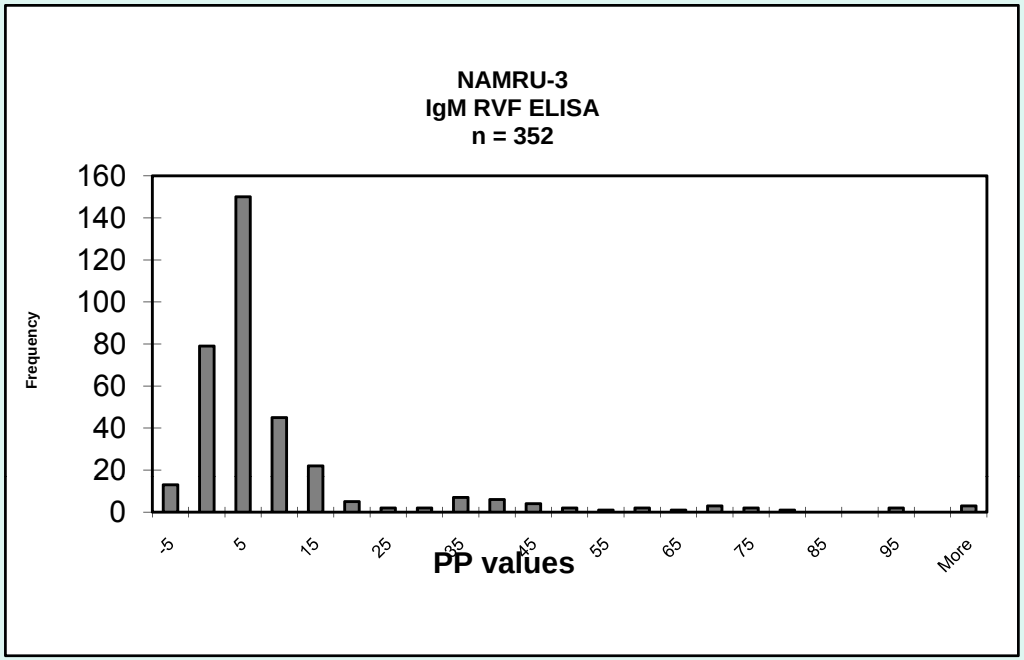
## ELISA techniques used

- **NUMRU-3 ELISA**:
  - **This is an IgM capture assay that is used to detect virus specific IgM (μ chain) antibody.**
- **South Africa ELISA Kit:**
  - **this ELISAs was provided through the National Institute of Virology, Special pathogens Unit, Johannesburg, South Africa. Recently the protocol of the test was modified and the recommended cut off was changed from using OD value to using the PP value. The differences are in the layout of the plate, where in new kit control strong positive serum and week positive serum was used in addition to the negative control as in the old kit**

# Lab testing Cont.

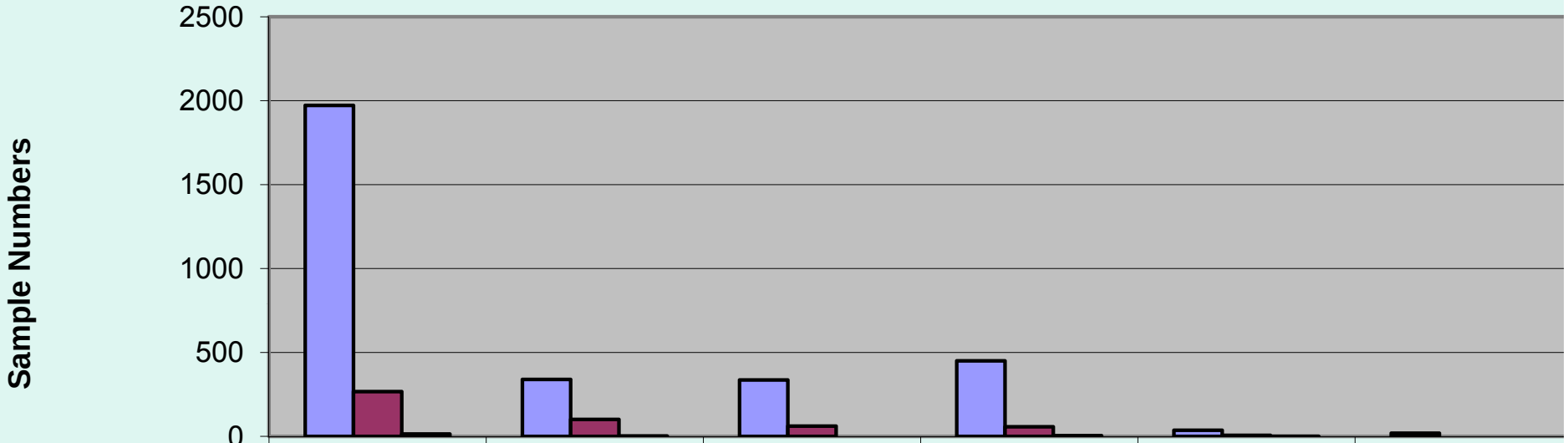
- **Calculations used for interpreting the results :**
- **All the OD values were corrected ($OD_{Corrected\ (Cor)}$ )**
- **$OD_{Corrected\ (Cor)} = OD_{Antigen} – OD_{Control\ Antigen}$**
- **Percentage positivity values (PP values) were calculated as follows relative to the average strong positive control ($OD_{Cor\ Pos}$), which was included in duplicates on each plate.**
- **$OD_{Cor\ Pos} = (OD_{Cor\ of\ positive\ control\ 1} + OD_{Cor\ of\ positive\ control\ 2})/2$**
- **$PP_{Cor\ test\ serum} = (OD_{Cor\ test\ serum} / OD_{Cor\ Pos}) * 100$**
- **Microsoft Excel was used for further data analysis**

# Advantages of PP as cut off




| PP cut off 22 | | OD cut off 0.3 | | |
|---|---|---|---|---|
| | | Positive | Negative | Total |
| | Positive | 9 | 20 | 29 |
| | Negative | 14 | 309 | 323 |
| | Total | 23 | 329 | 352 |

# Laboratory RVF Data Sep/2000 to March/2001



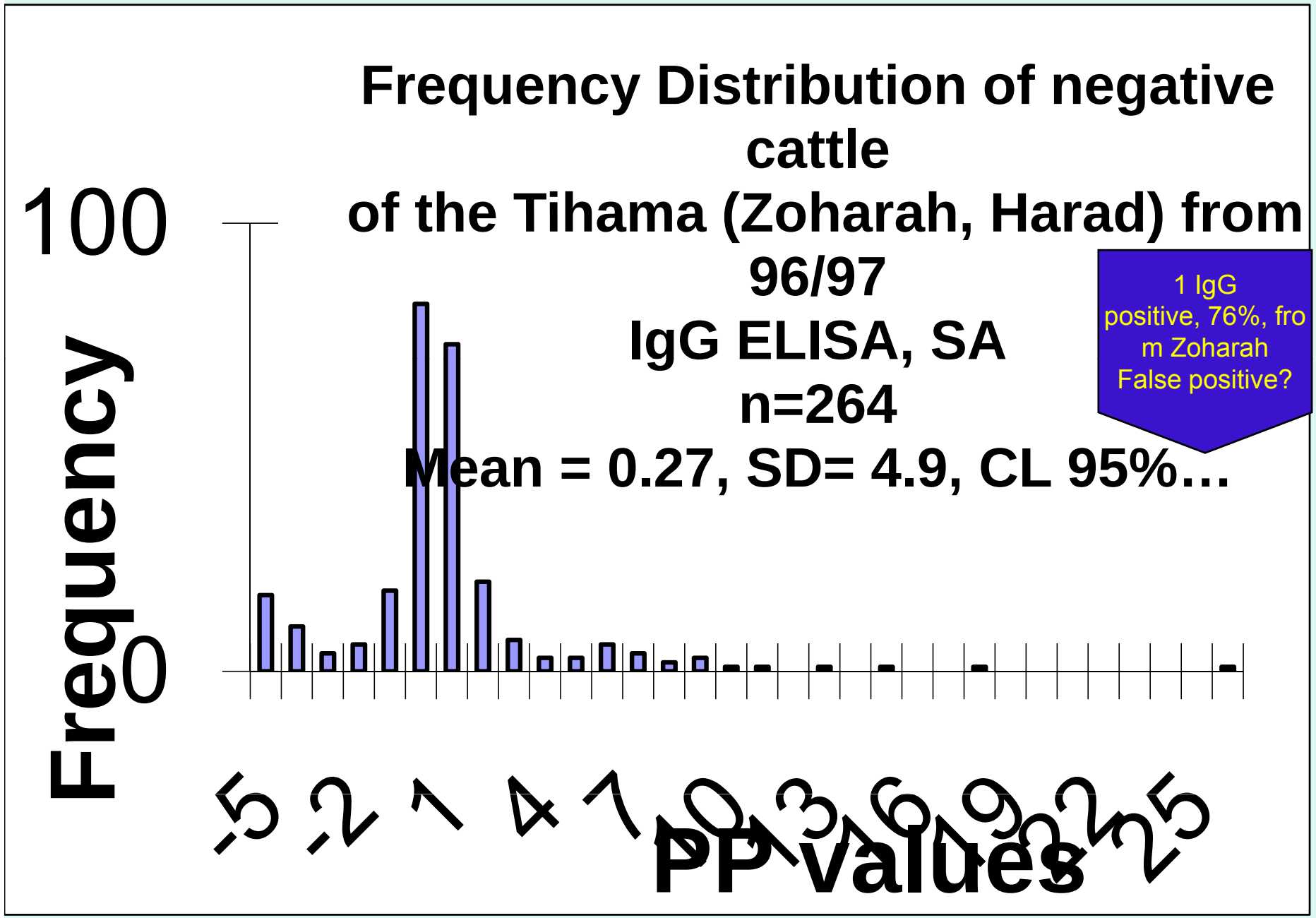

| | Sep/Oct | November | December | January | February | March |
|---|---|---|---|---|---|---|
| No.Tested | 1972 | 339 | 336 | 450 | 37 | 19 |
| No. Pos. | 267 | 101 | 61 | 57 | 6 | 0 |
| Susp. | 14 | 2 | 0 | 5 | 1 | 0 |

How did the disease get to the country and when?

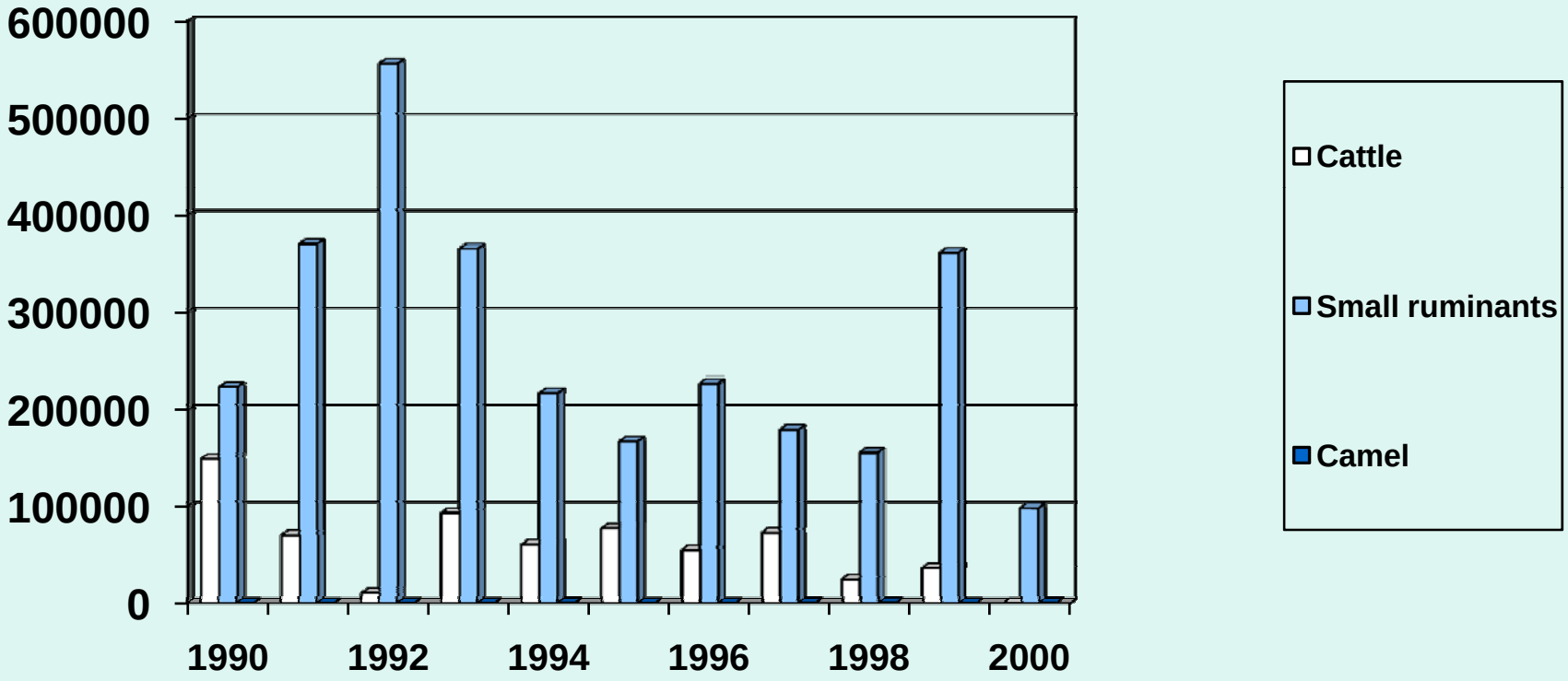
## Working-out the Cut off using PP Value
**(with help of R. Geiger IAEA expert)**

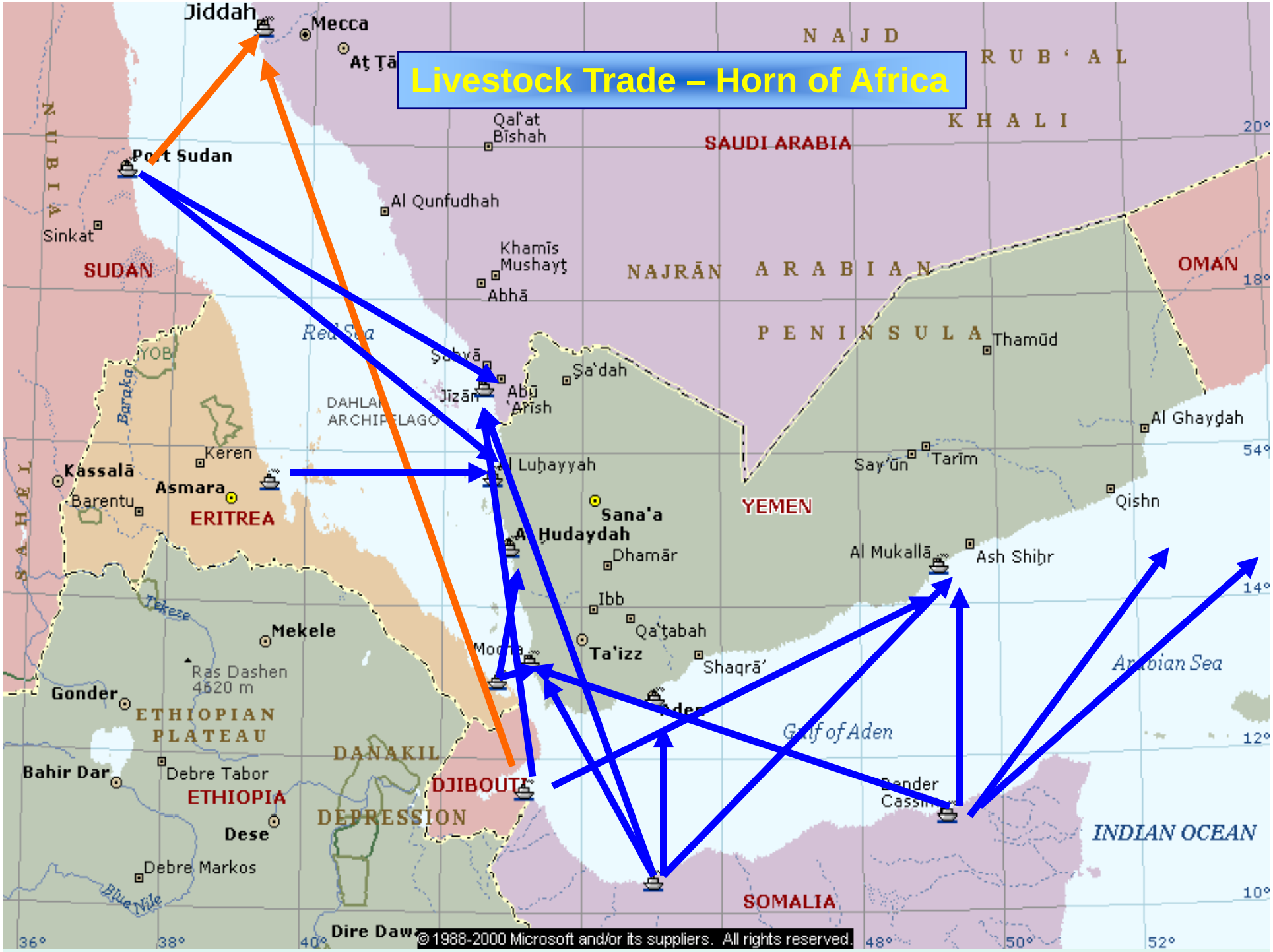
- NAMRU-3 ELISA: Cut off ≥ 0.3
- South Africa ELISA : Cut off ≥ 0.4

- 264 samples from serum bank 1996/97 were tested as a negative population


Frequency Distribution of negative cattle
of the Tihama (Zoharah, Harad) from 96/97
IgG ELISA, SA
n=264
Mean = 0.27, SD= 4.9, CL 95%…
1 IgG positive, 76%, from Zoharah
False positive?
100
0
Frequency
PP values

# Official Livestock imports through Mocha




Livestock Trade – Horn of Africa
Jiddah
Mecca
Aṭ Ṭā
Qal'at Bīshah
Port Sudan
Al Qunfudhah
Sinkat
SUDAN
Khamīs Mushayṭ
Abhā
NAJRĀN
SAUDI ARABIA
NAJD
RUB' AL KHALI
ARABIAN PENINSULA
OMAN
Red Sea
Ṣabyā
Jīzān
Abū 'Arīsh
Ṣa'dah
Thamūd
Al Ghayḍah
Say'ūn
Tarīm
Qishn
Al Luḥayyah
Sana'a
YEMEN
Al Ḥudaydah
Dhamār
Al Mukallā
Ash Shiḥr
Ibb
Qa'ṭabah
Ta'izz
Shaqrā'
Mocha
Aden
Gulf of Aden
Arabian Sea
INDIAN OCEAN
SOMALIA
Bender Cassim
DJIBOUTI
DANAKIL DEPRESSION
ETHIOPIAN PLATEAU
ETHIOPIA
Keren
Kassalā
Asmara
Barentu
ERITREA
Barka
Tekeze
Blue Nile
Mekele
Ras Dashen 4620 m
Gonder
Bahir Dar
Debre Tabor
Dese
Debre Markos
Dire Daw
SAHEL
NUBIA
20°
18°
54°
14°
12°
10°
36°
38°
40°
48°
50°
52°
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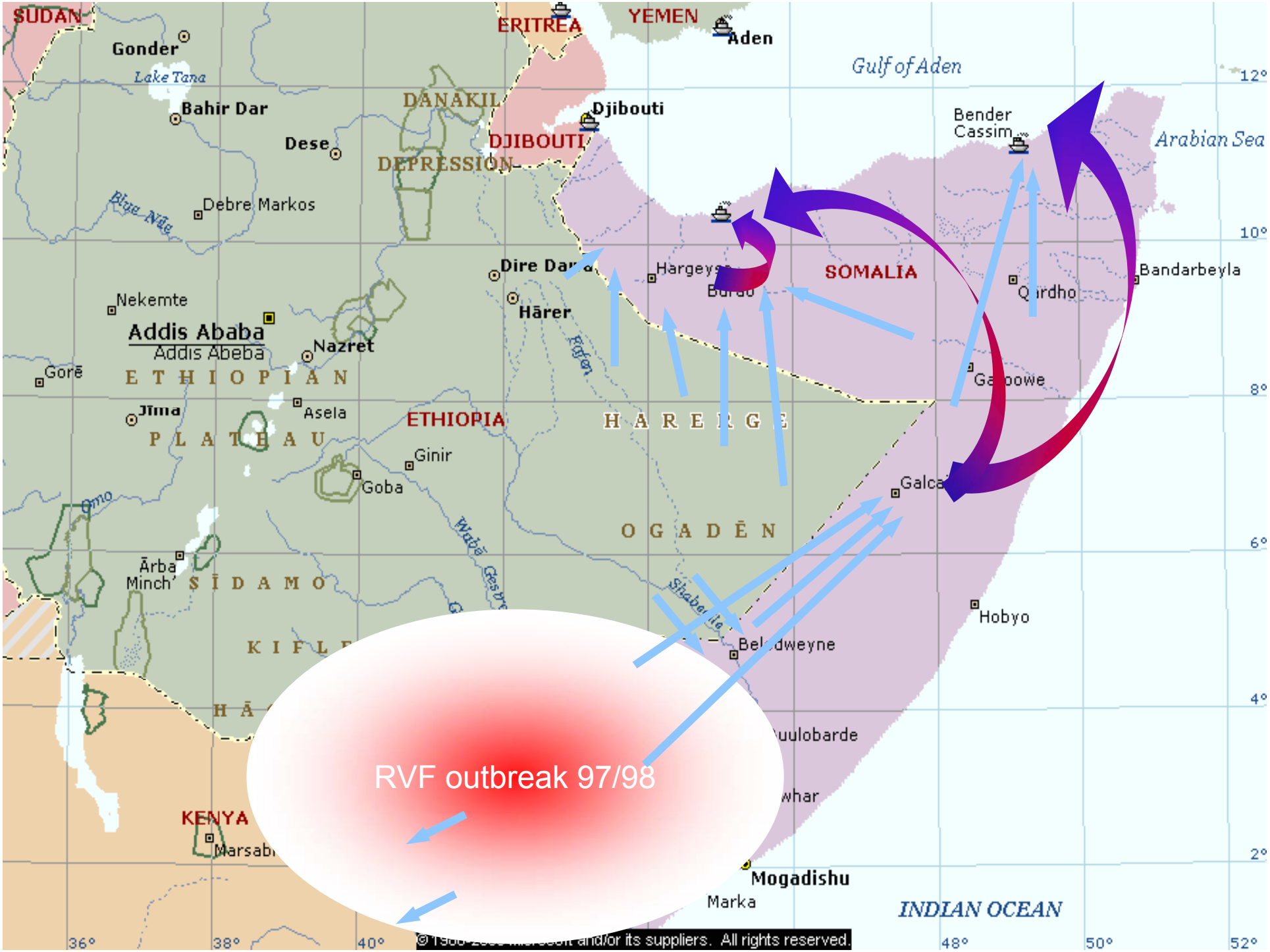
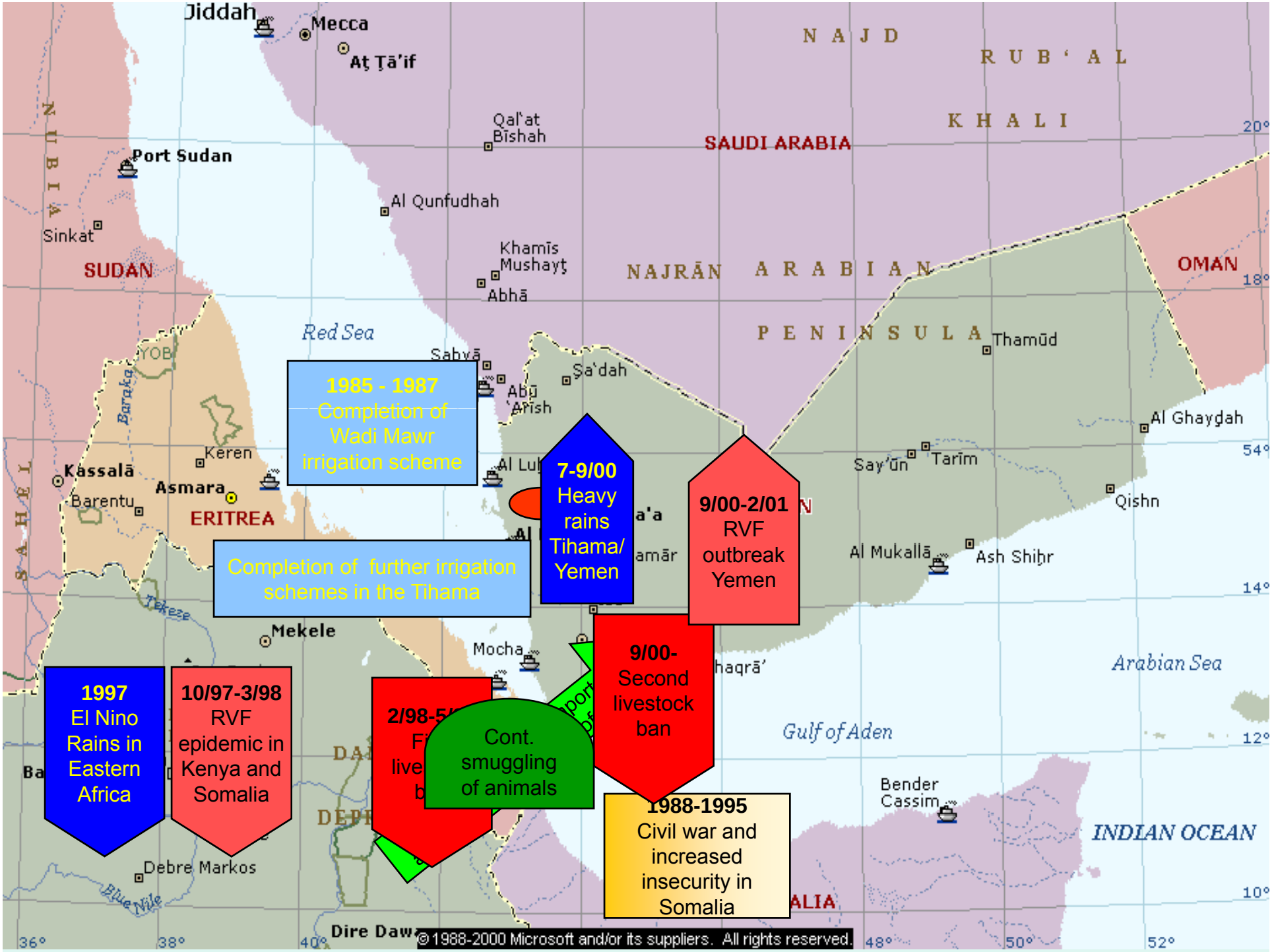
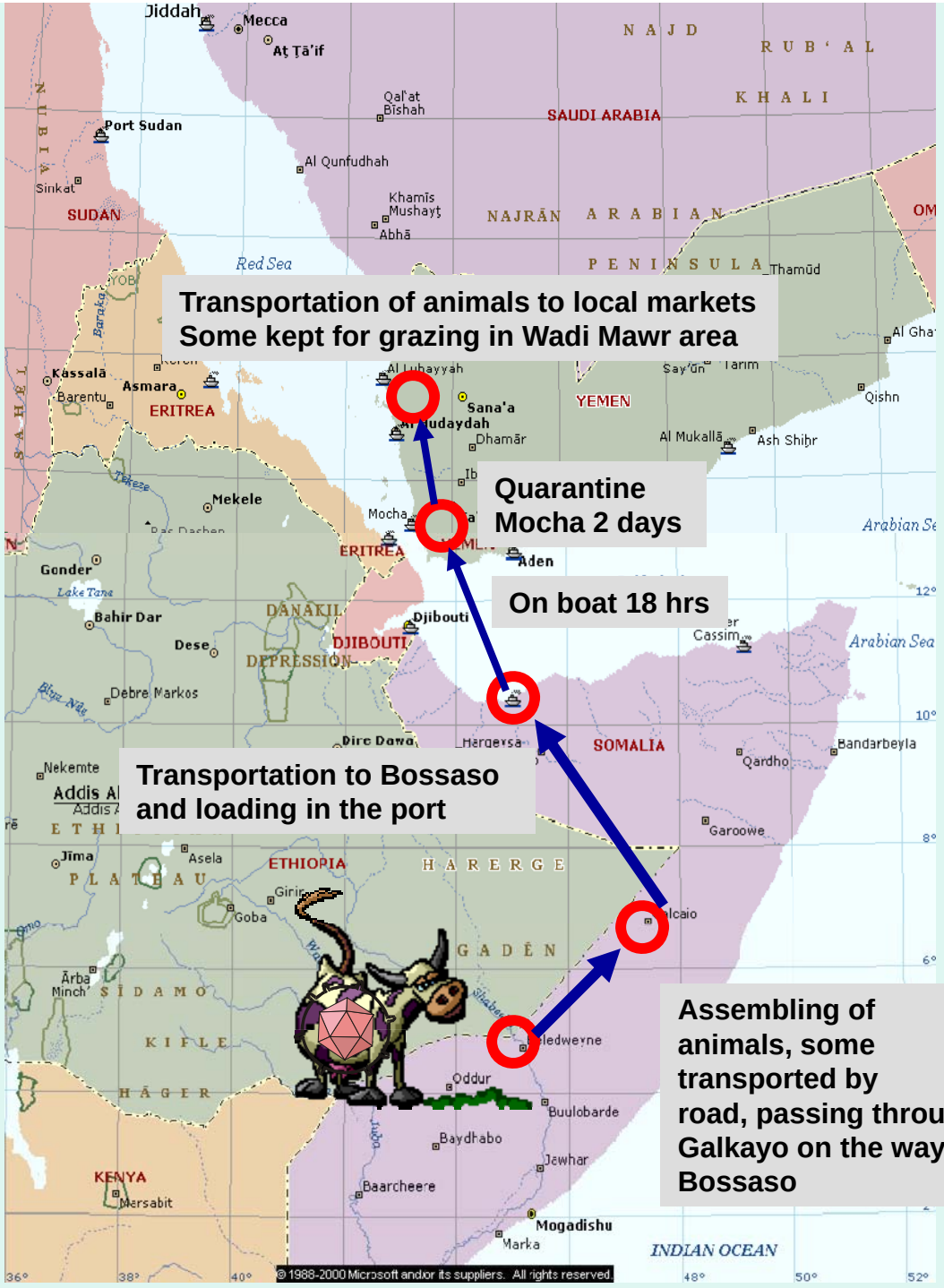







W. Mawr- Grazing-Markets

Feeding of competent vectors

Quarantine

Viraemia 3-9 days

Mocha

Bossaso

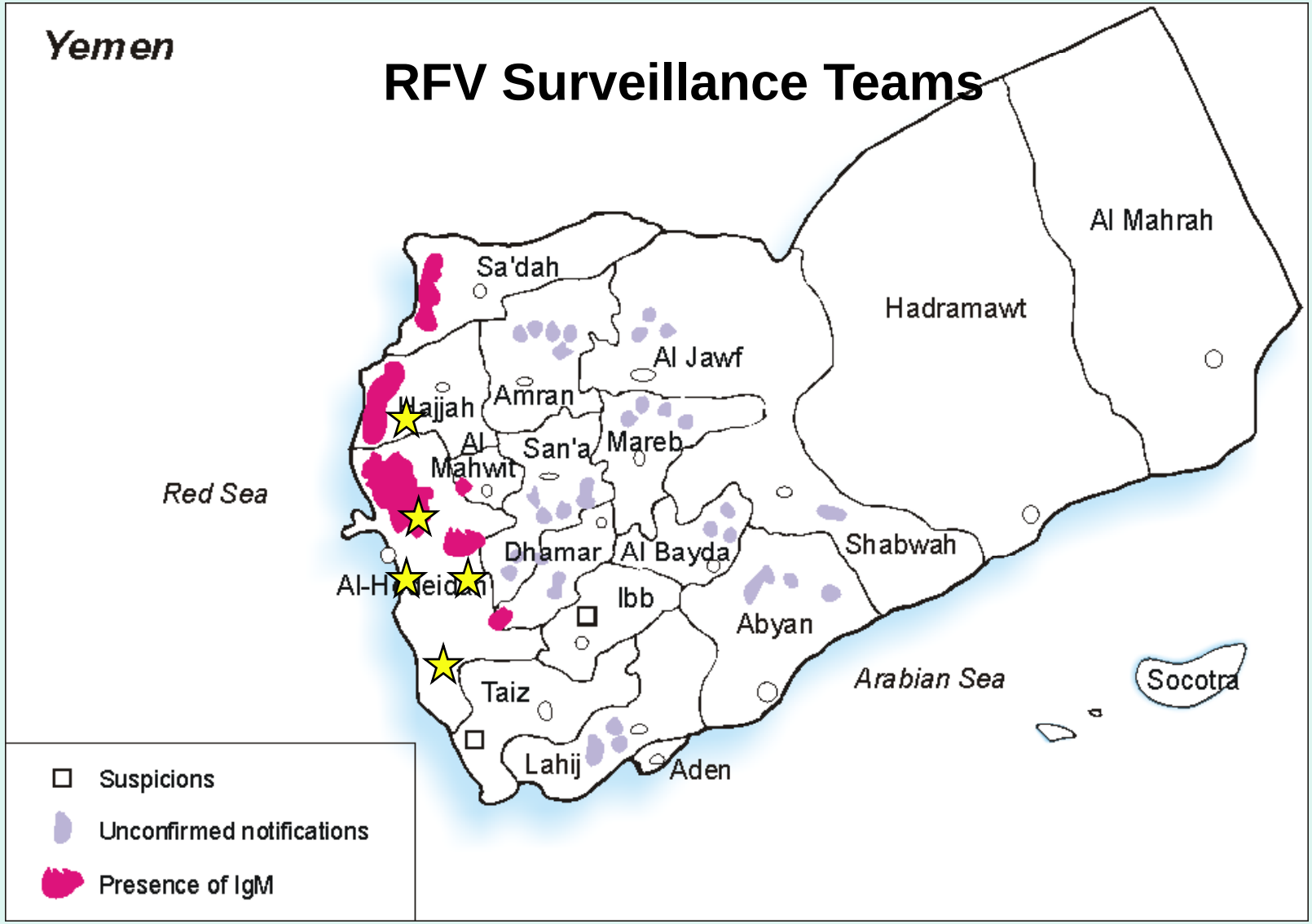
Inc. 3-8 days

Beletwein-Galkayo

Incubation Period, OIE code, 30 days

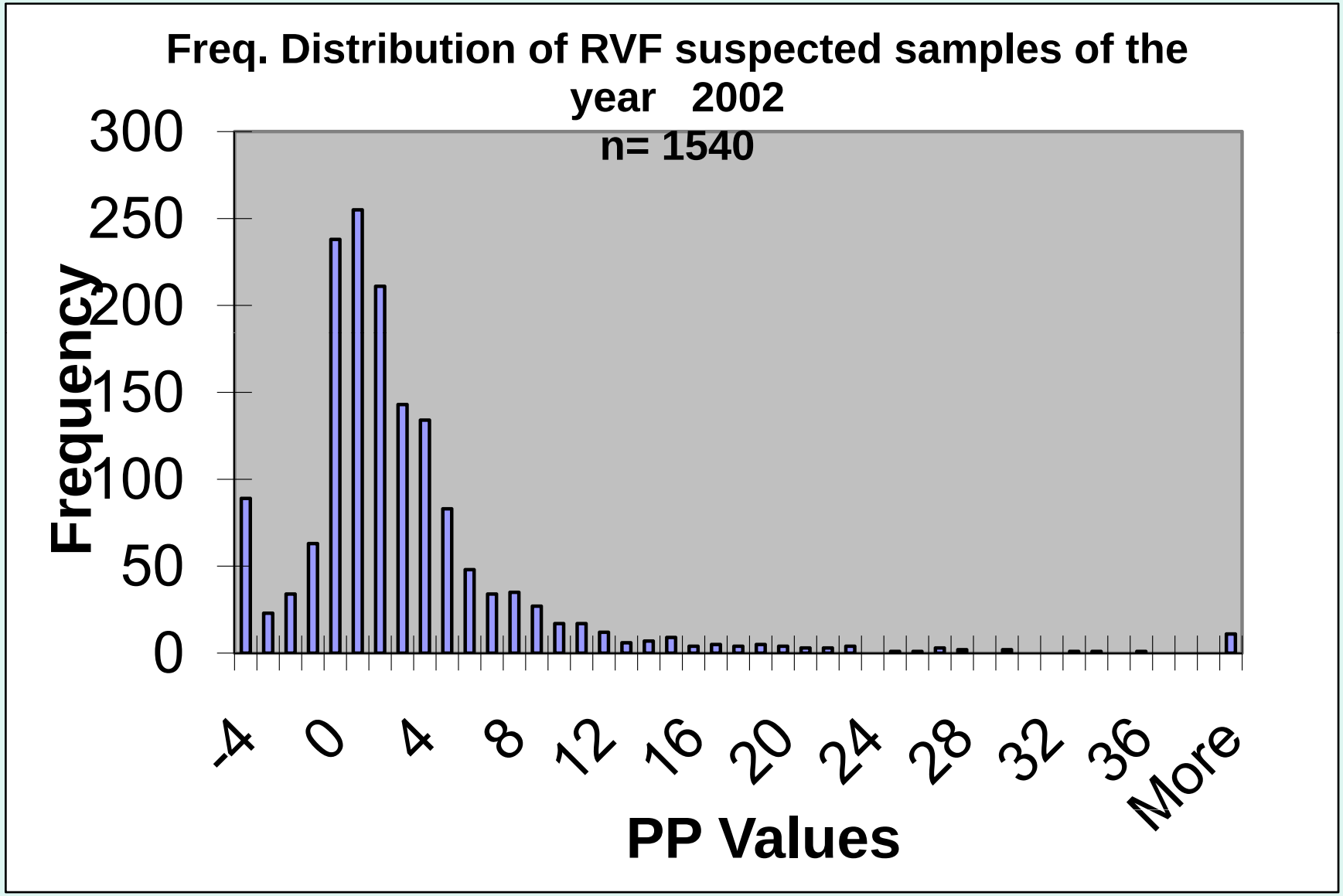
Infection

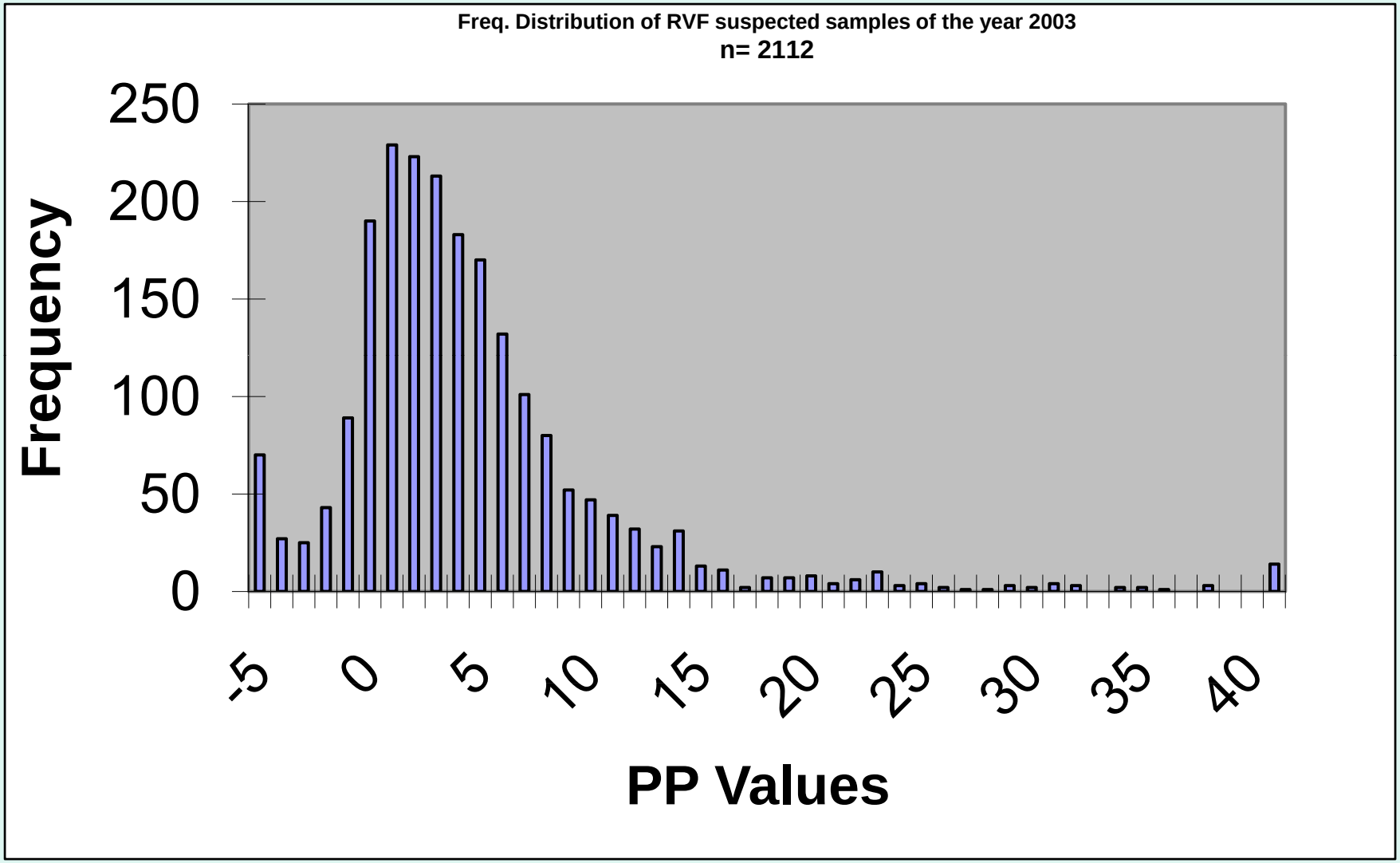
# Surveillance Follow up


Yemen
RFV Surveillance Teams
Red Sea
Arabian Sea
Sa'dah
Hajjah
Amran
Al Jawf
Al Mahrah
Hadramawt
Al Mahwit
San'a
Mareb
Dhamar
Al Bayda
Shabwah
Ibb
Abyan
Taiz
Lahij
Aden
Socotra
Suspicions
Unconfirmed notifications
Presence of IgM

# Samples collection:

- **The Surveillance teams covered all villages and reacted with any single aborted animal.**
- **The samples were collected and sent to the Laboratory for testing.**
- **All details were recorded on the RADISCON epidemiological disease investigation forms.**
- **Thereafter the sera were collected as a part of National RVF Surveillance Programme in all areas of the outbreak zone of the Tihamah.**
- **4372 blood samples were collected during the years 2002 and 2003**


Freq. Distribution of RVF suspected samples of the year 2002
n= 1540
Frequency
300
250
200
150
100
50
0
-4
0
4
8
12
16
20
24
28
32
36
More
PP Values


Freq. Distribution of RVF suspected samples of the year 2003
n= 2112
Frequency
250
200
150
100
50
0
-5
0
5
10
15
20
25
30
35
40
PP Values

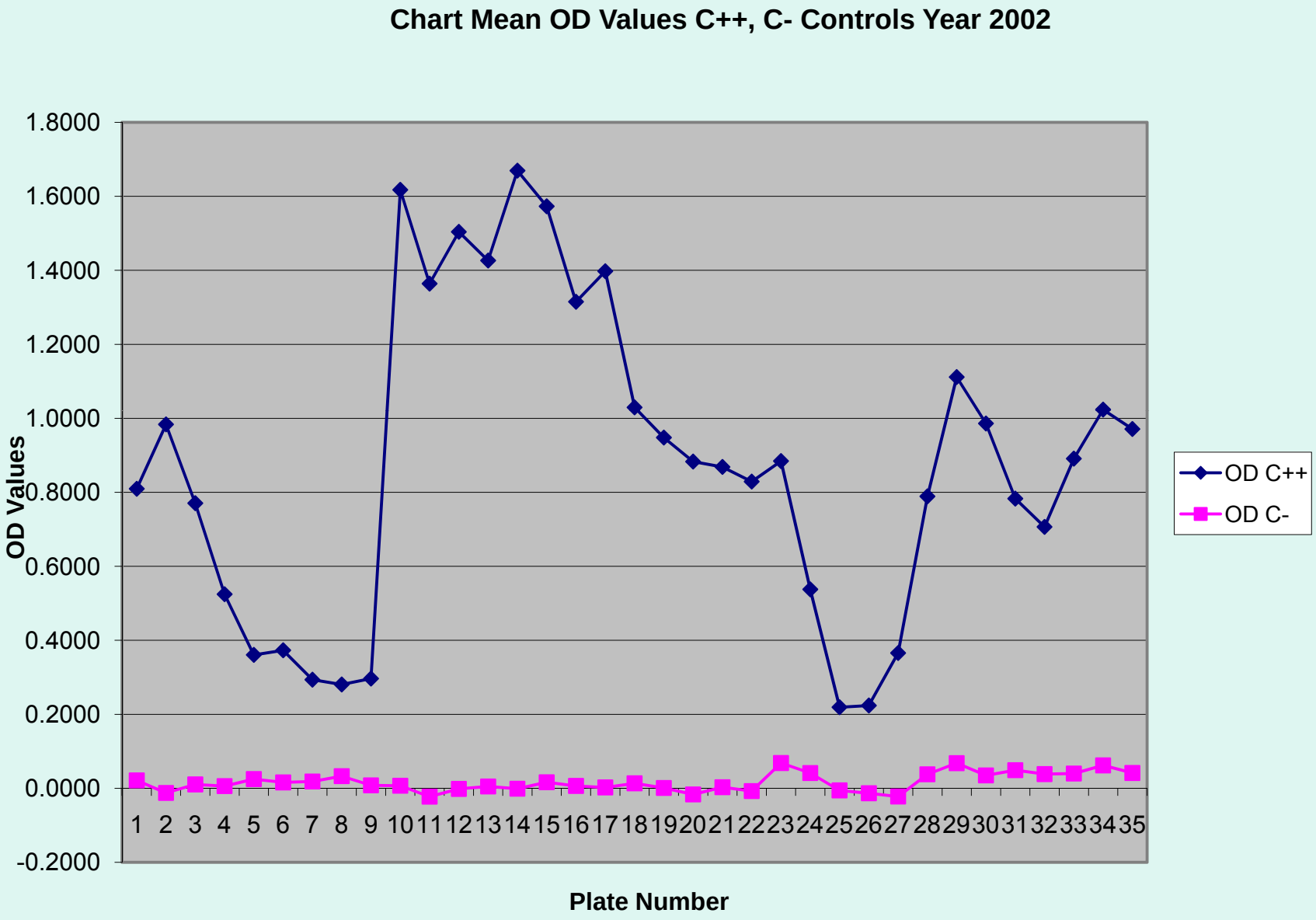


Chart Mean OD Values C++, C- Controls Year 2002
OD Values
1.8000
1.6000
1.4000
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
-0.2000
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35
Plate Number
OD C++
OD C-

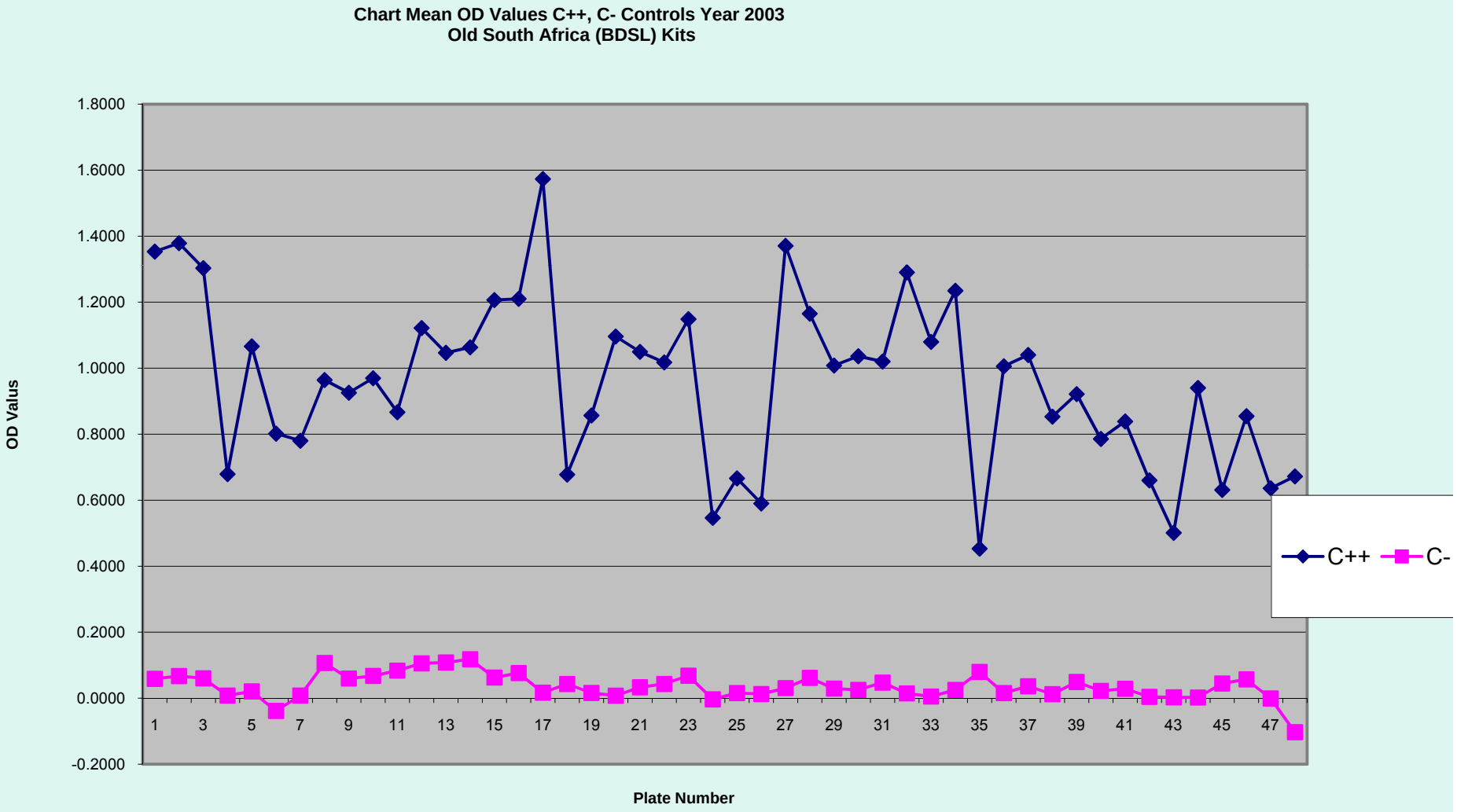
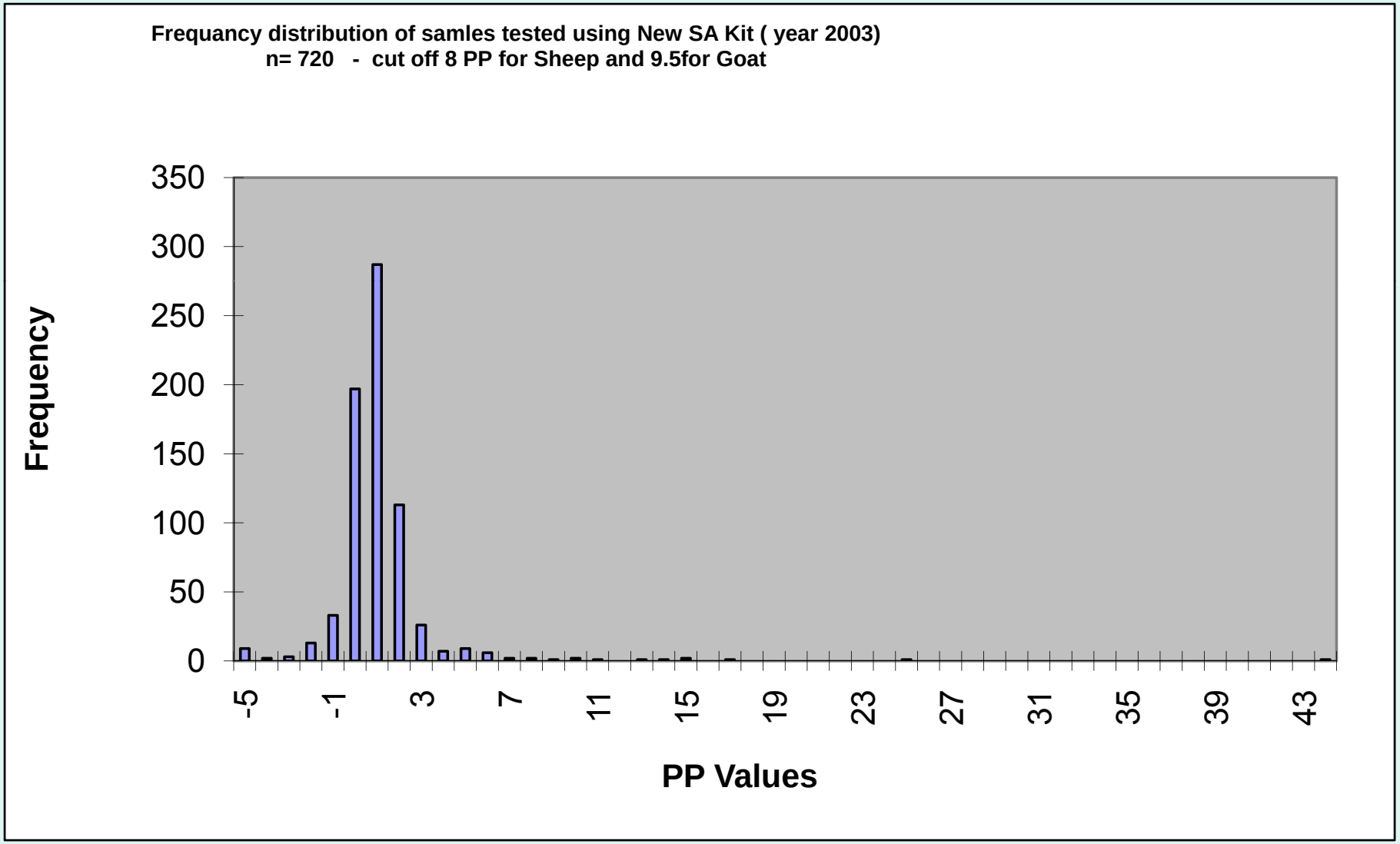
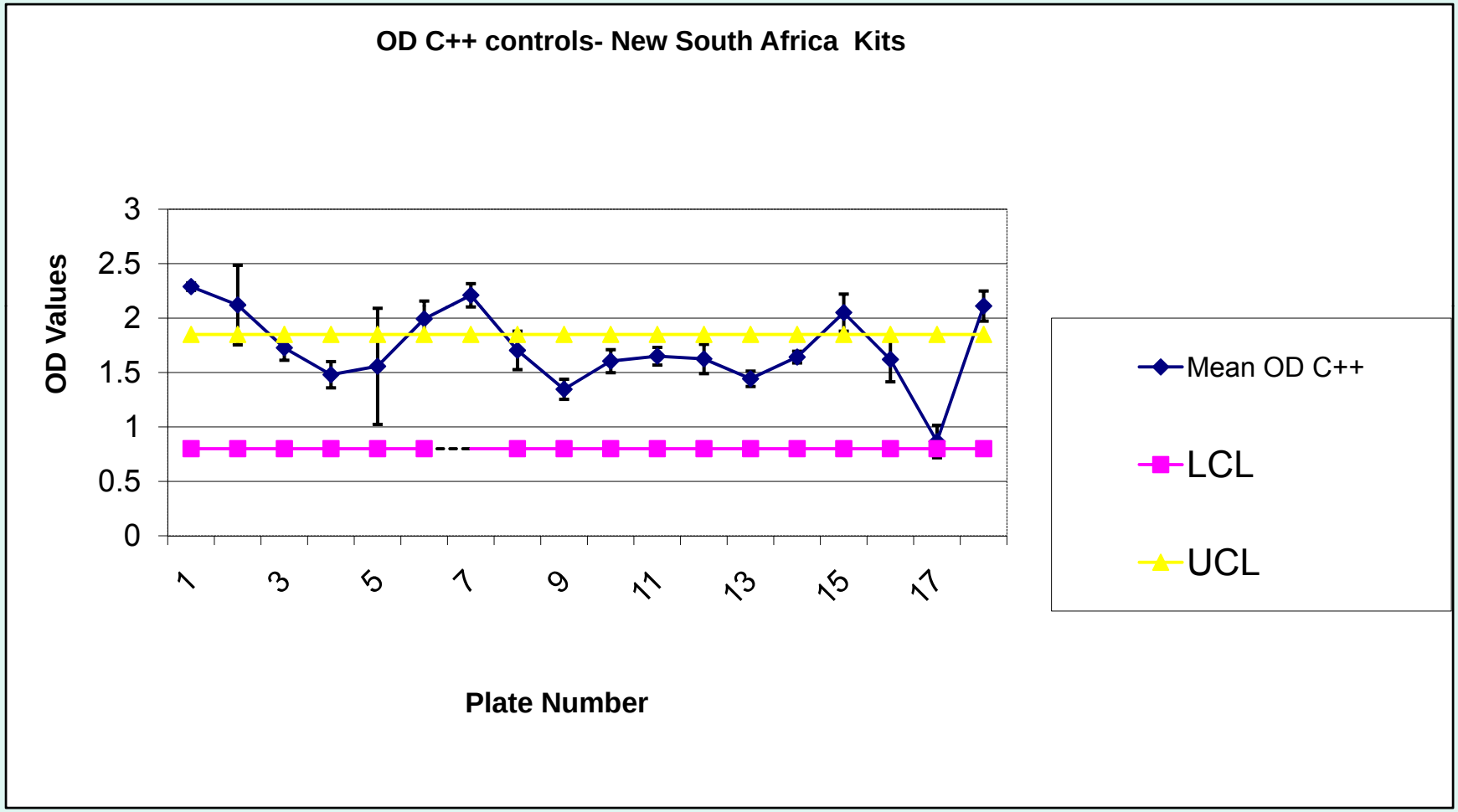
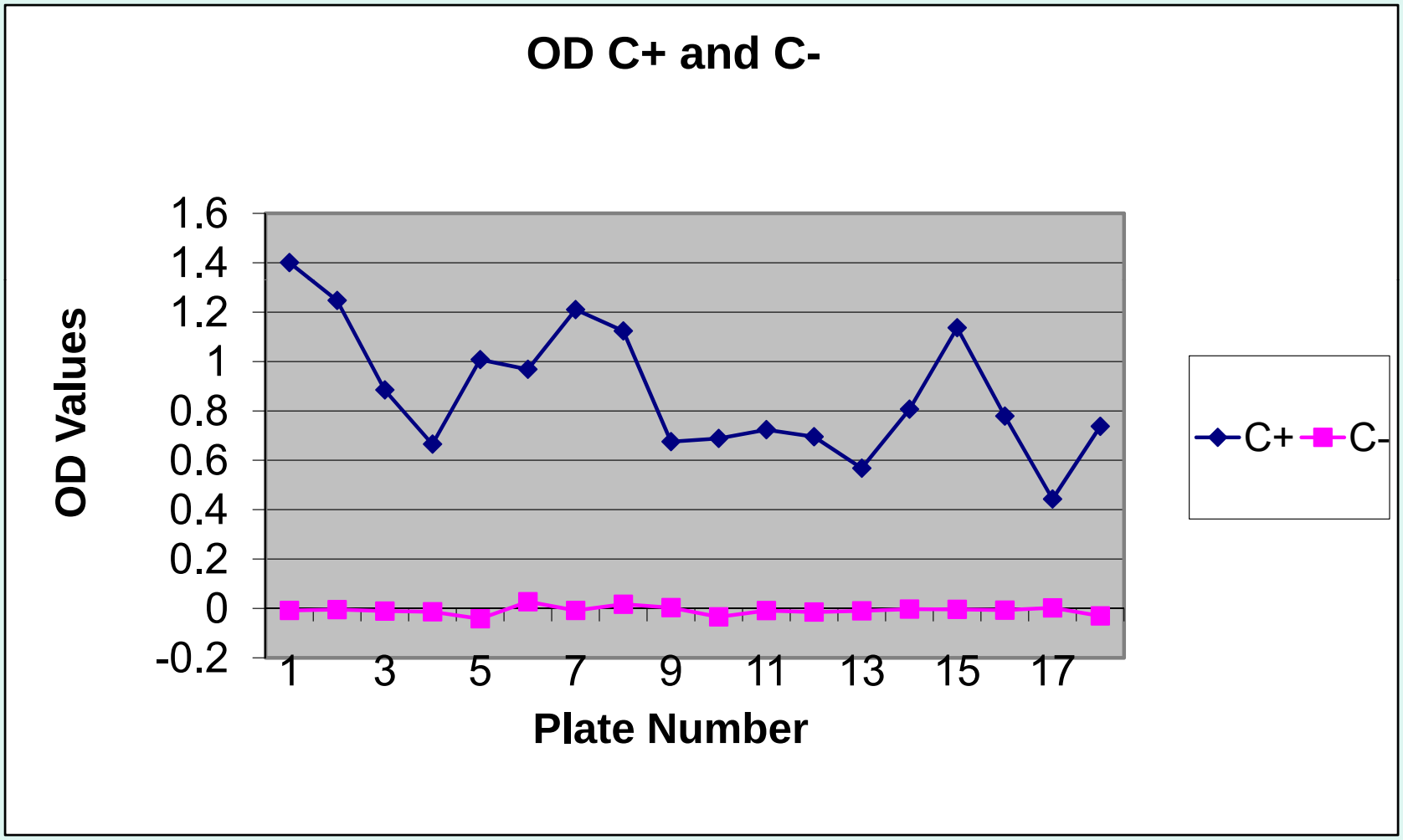


Chart Mean OD Values C++, C- Controls Year 2003
Old South Africa (BDSL) Kits
OD Valus
1.8000
1.6000
1.4000
1.2000
1.0000
0.8000
0.6000
0.4000
0.2000
0.0000
-0.2000
1
3
5
7
9
11
13
15
17
19
21
23
25
27
29
31
33
35
37
39
41
43
45
47
Plate Number
C++
C-


Frequancy distribution of samles tested using New SA Kit ( year 2003)
n= 720 - cut off 8 PP for Sheep and 9.5for Goat
Frequency
350
300
250
200
150
100
50
0
-5
-1
3
7
11
15
19
23
27
31
35
39
43
PP Values

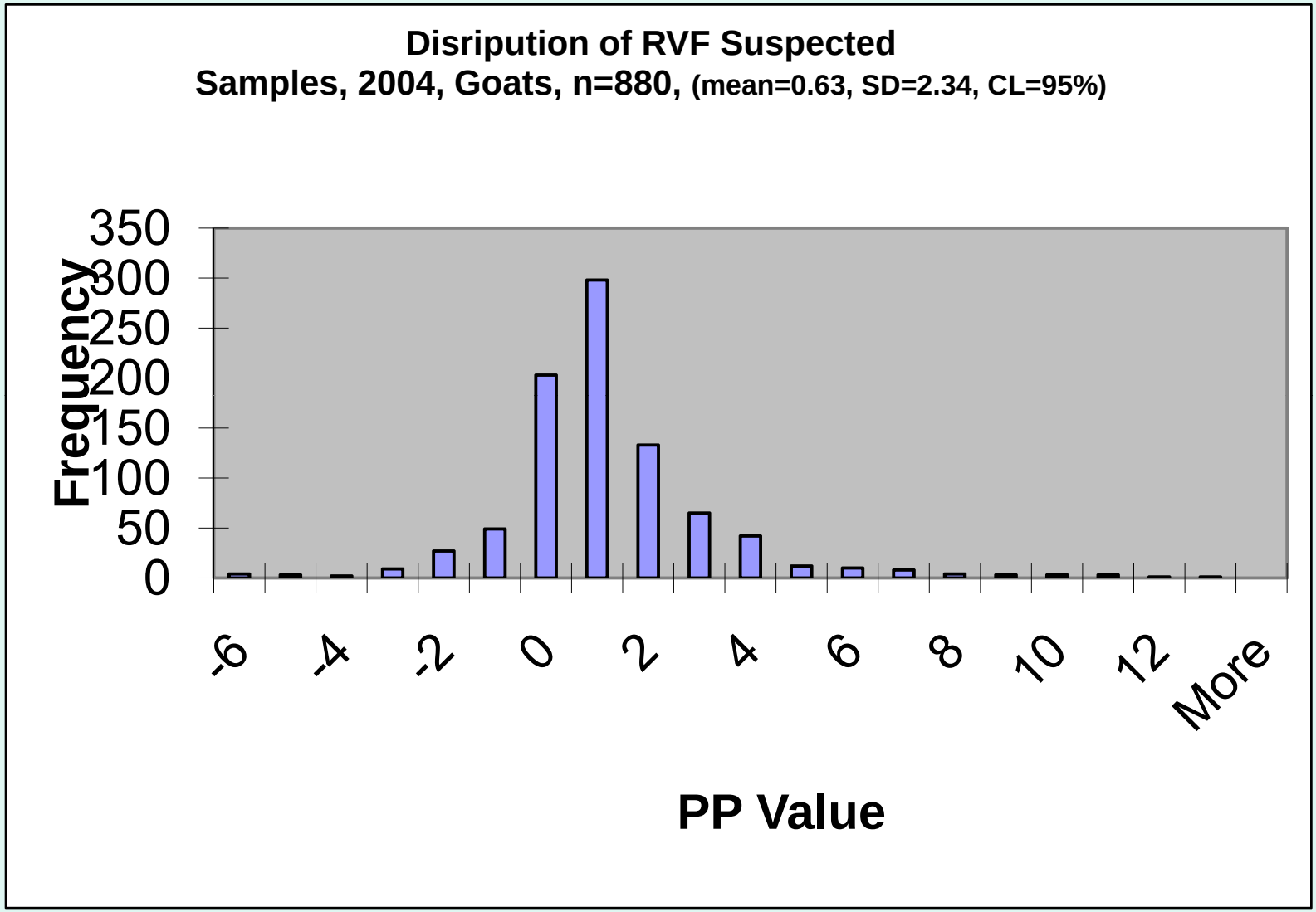

OD C++ controls- New South Africa Kits
OD Values
3
2.5
2
1.5
1
0.5
0
1
3
5
7
9
11
13
15
17
Plate Number
Mean OD C++
LCL
UCL

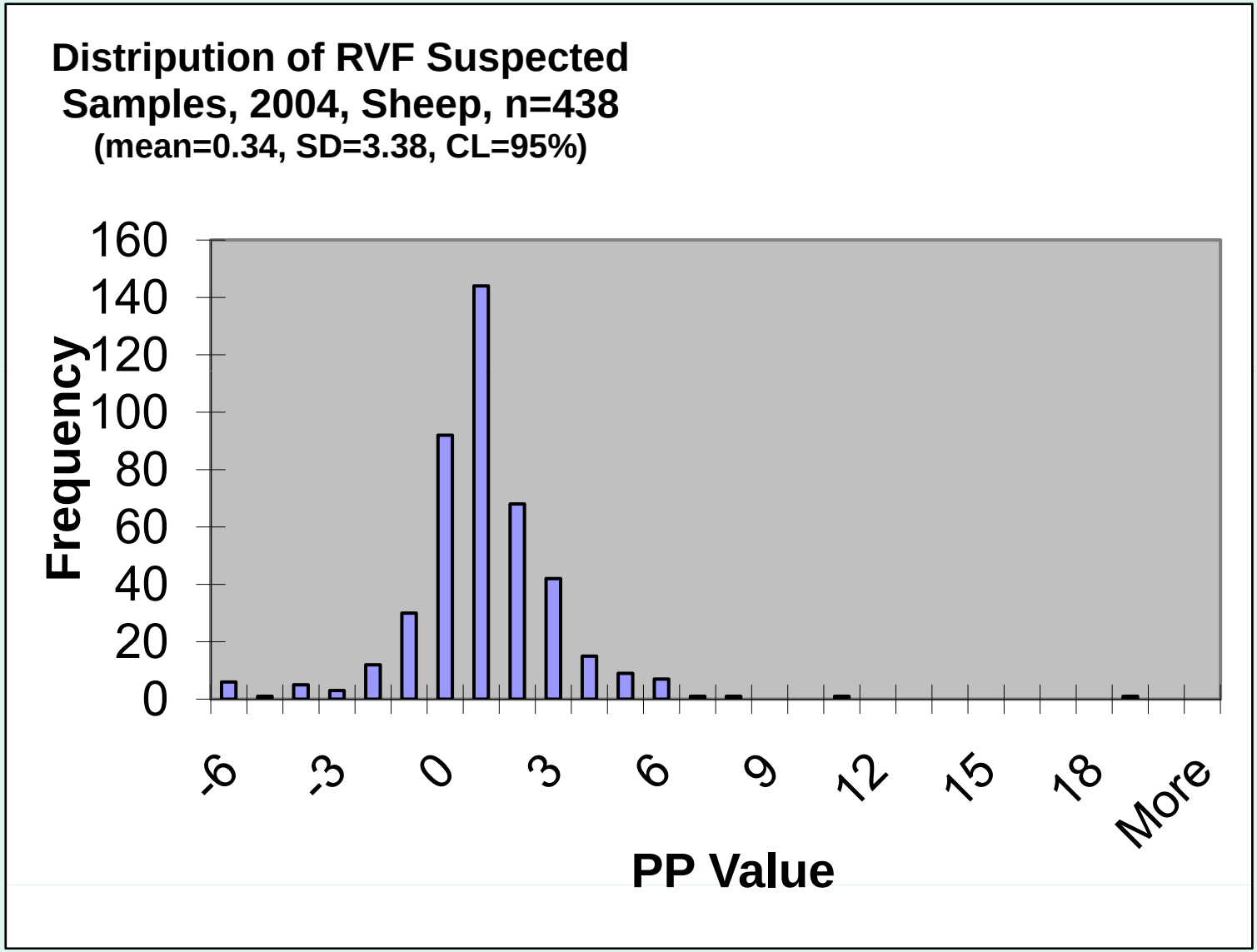

OD C+ and C-
OD Values
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
1
3
5
7
9
11
13
15
17
Plate Number
C+
C-

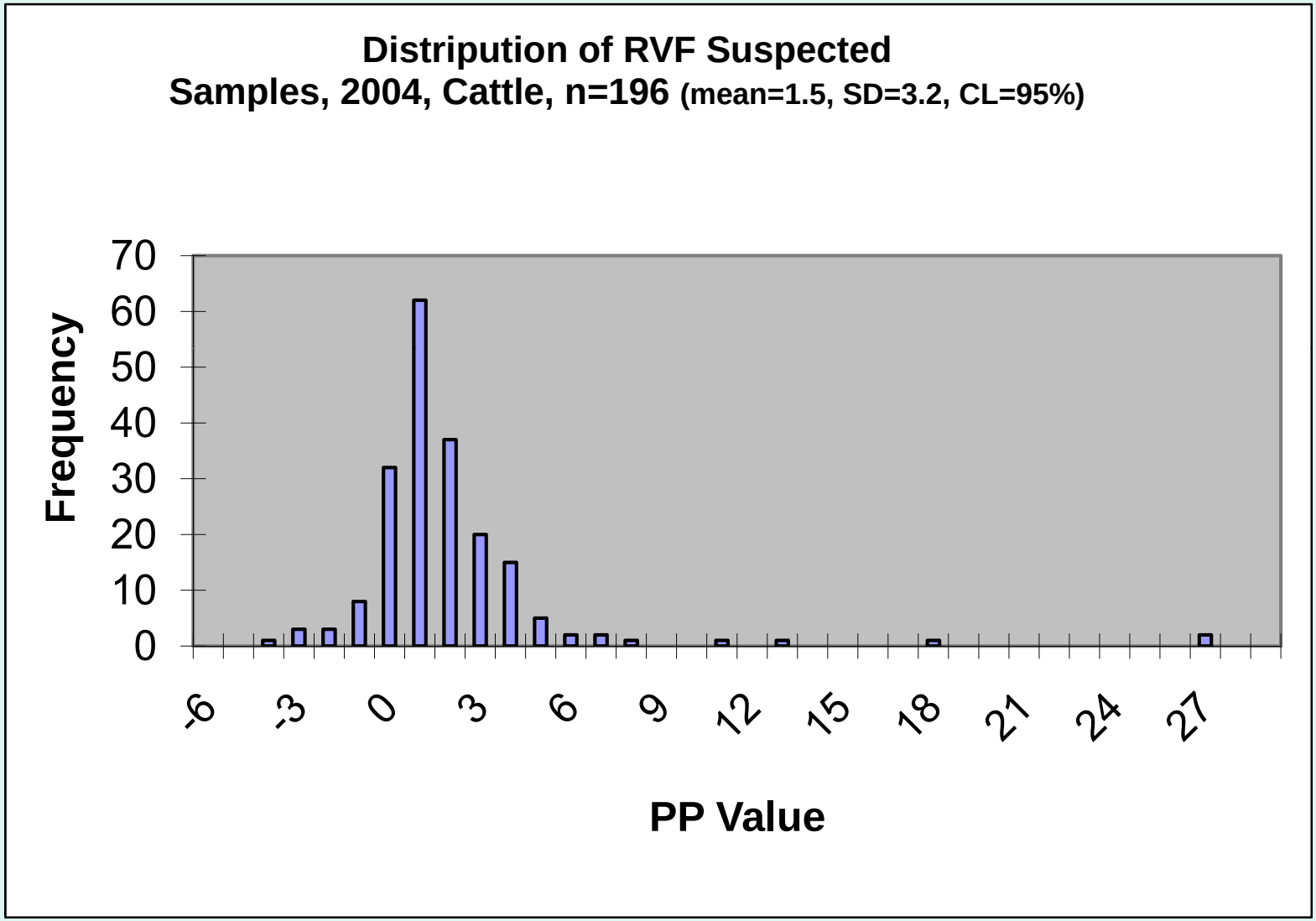
## Samples Al-daher District, Sada'a- Nov. 2003

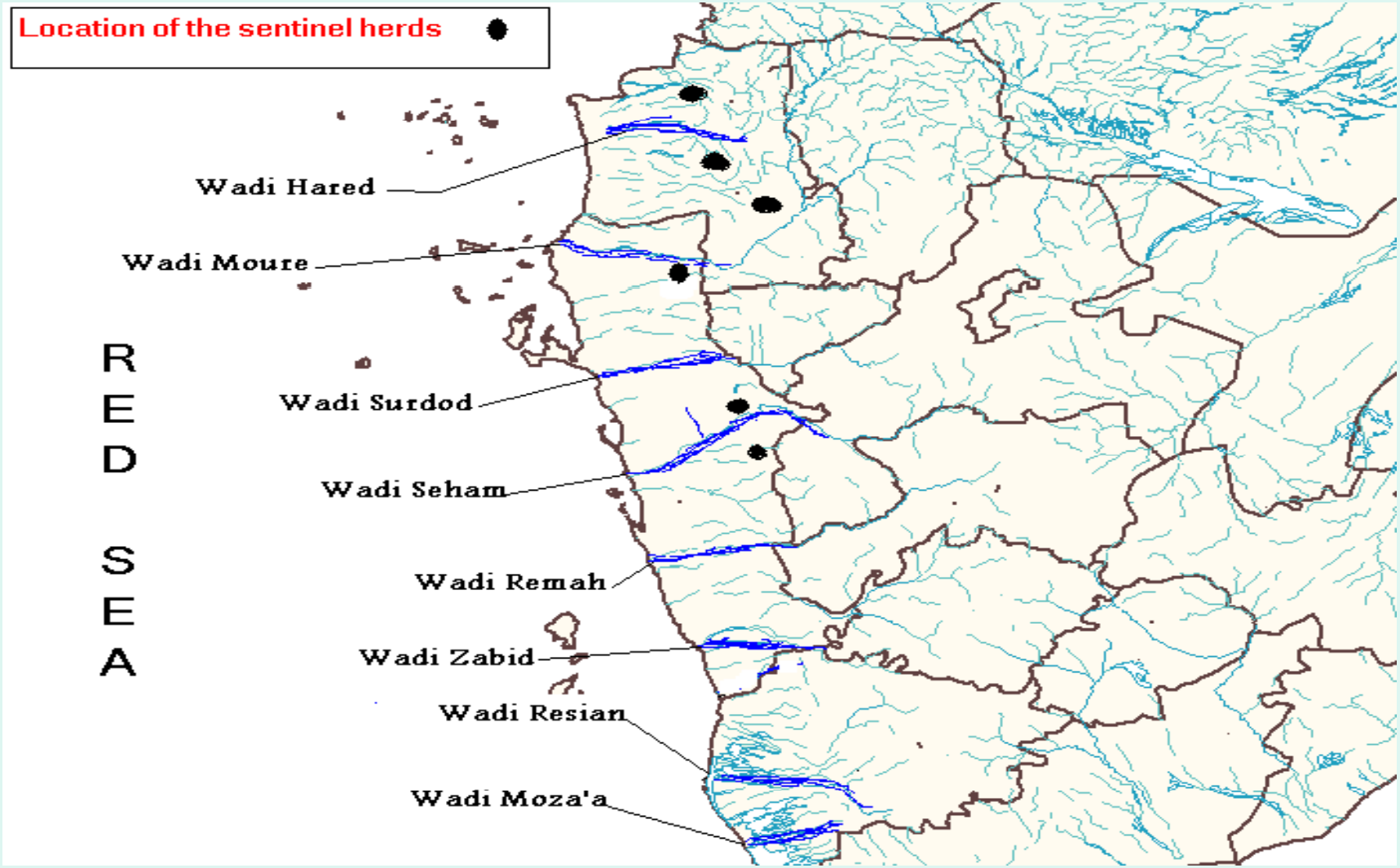
| Age group | No. Tested | IgM results | IgG results |
|---|---|---|---|
| <2 year old | 75 | 0 | 2 |
| 2 years and >2 years old | 171 | 0 | 46 |
| Unknown | 114 | 0 | 4 |
| Total | 360 | 0 | 52 |


'03年 8月28日


Disripution of RVF Suspected
Samples, 2004, Goats, n=880, (mean=0.63, SD=2.34, CL=95%)
Frequency
350
300
250
200
150
100
50
0
-6
-4
-2
0
2
4
6
8
10
12
More
PP Value


Distripution of RVF Suspected Samples, 2004, Sheep, n=438
(mean=0.34, SD=3.38, CL=95%)
Frequency
160
140
120
100
80
60
40
20
0
-6
-3
0
3
6
9
12
15
18
More
PP Value


Distripution of RVF Suspected
Samples, 2004, Cattle, n=196 (mean=1.5, SD=3.2, CL=95%)
Frequency
70
60
50
40
30
20
10
0
-6
-3
0
3
6
9
12
15
18
21
24
27
PP Value


Location of the sentinel herds
Wadi Hared
Wadi Moure
R
E
D
S
E
A
Wadi Surdod
Wadi Seham
Wadi Remah
Wadi Zabid
Wadi Resian
Wadi Moza'a

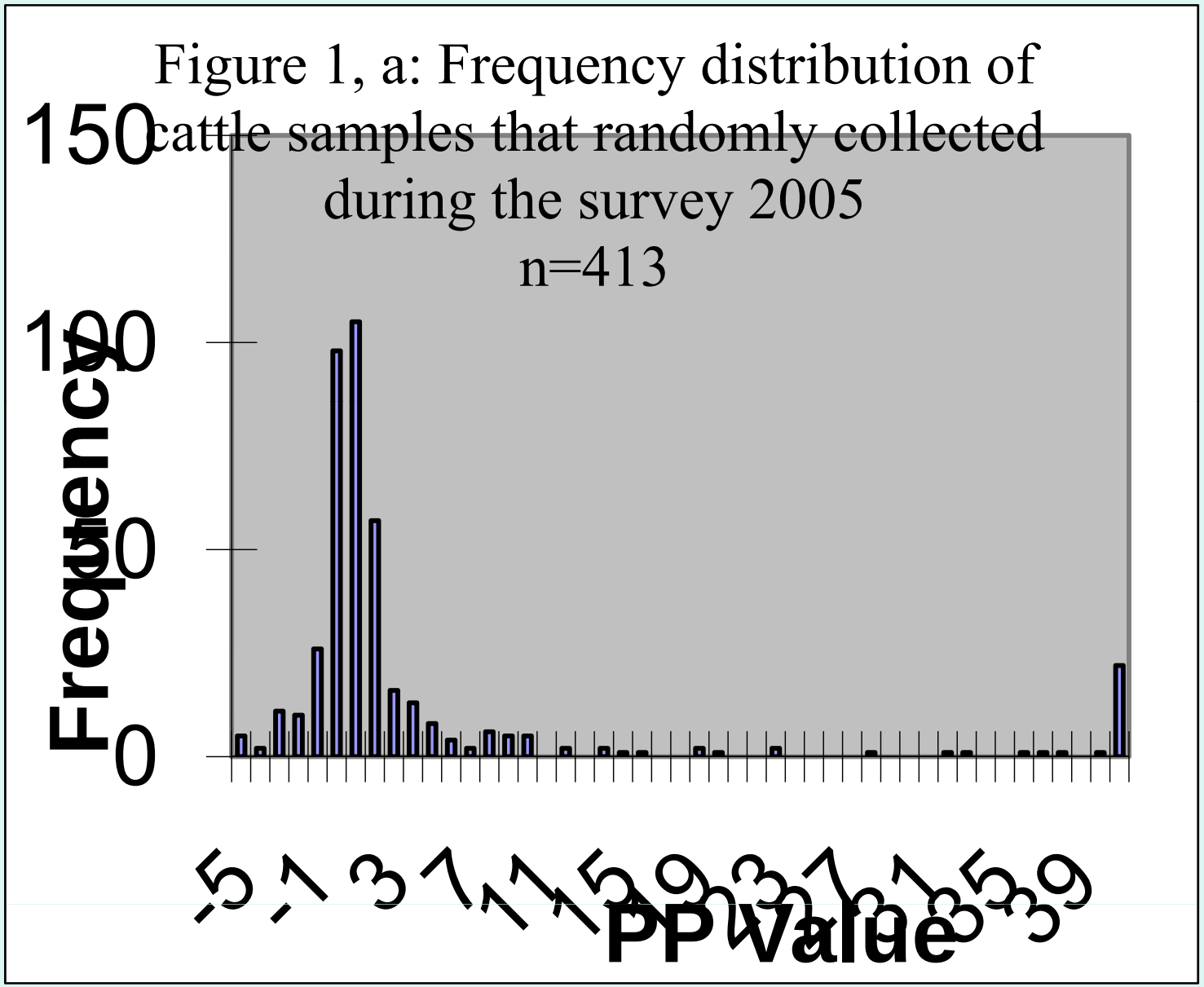


Figure 1, a: Frequency distribution of cattle samples that randomly collected during the survey 2005
n=413
150
100
50
0
Frequency
PP Value

Figure 1, b: Frequency distribution of Goat samples that randomly collected during the survey 2005
n=564

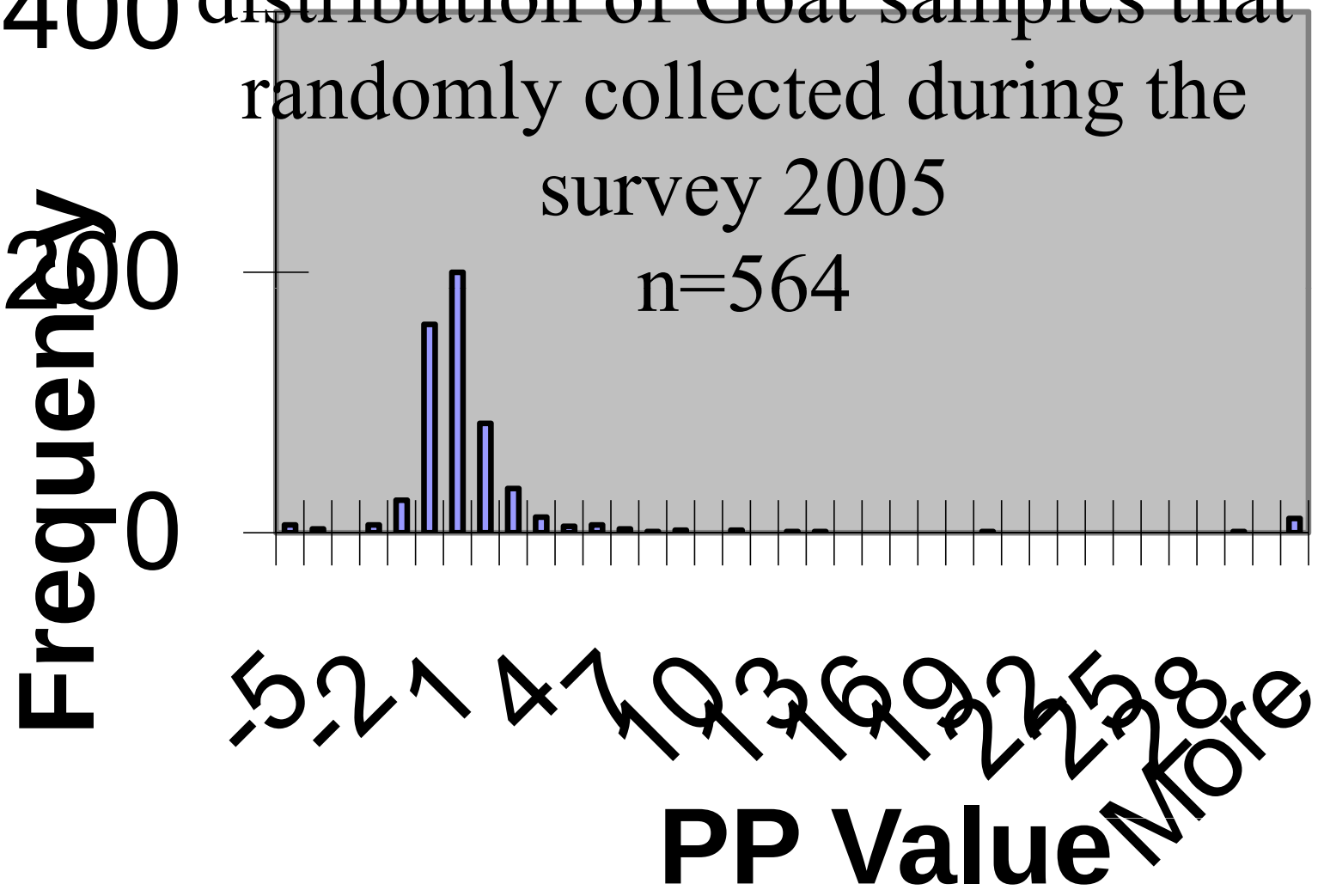
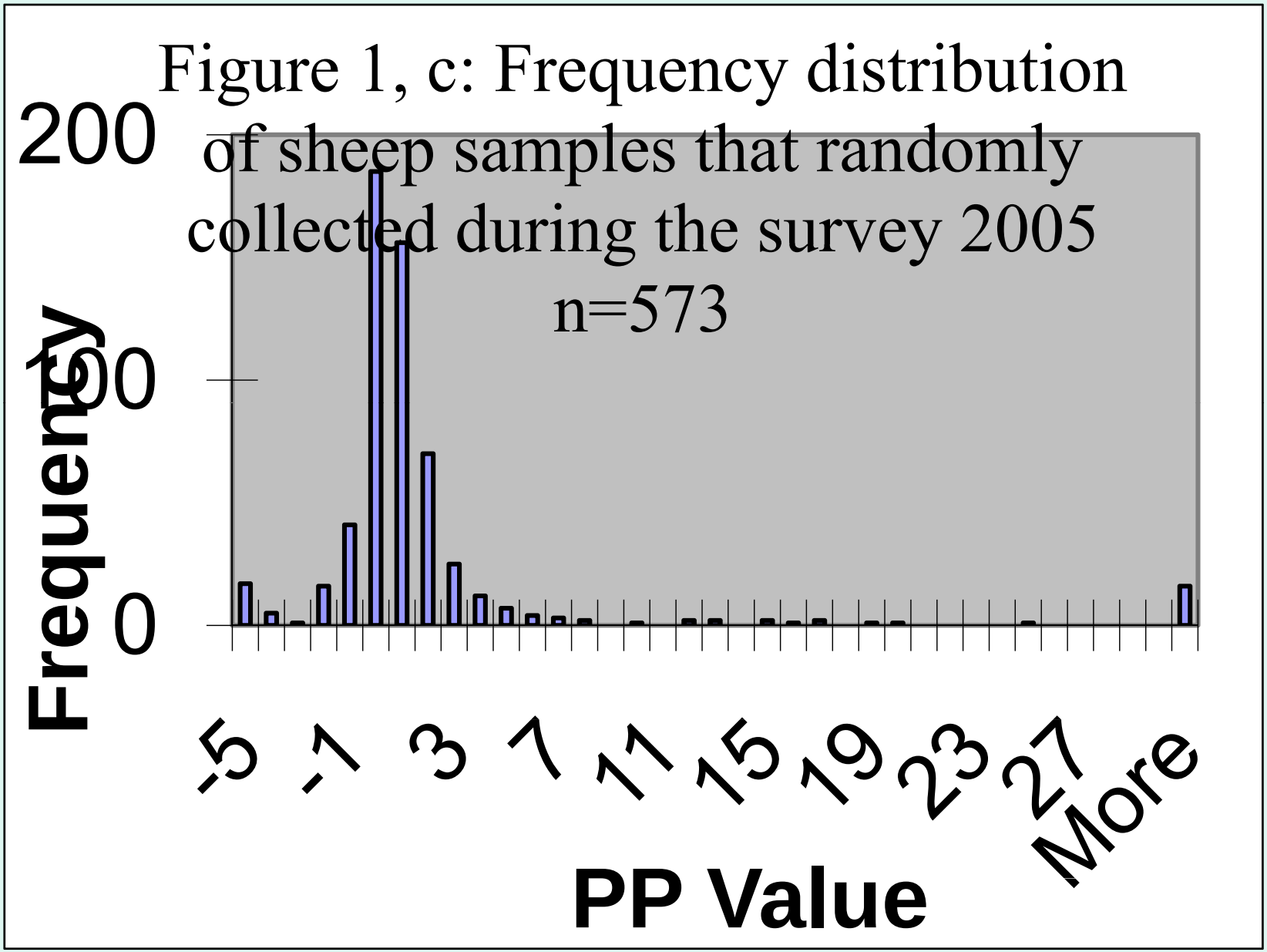


Figure 1, c: Frequency distribution of sheep samples that randomly collected during the survey 2005 n=573



## Surveillance samples tested for RVF IgM May 2005-June 2006

| Governorate | Tested Samples for RVF IgM | | | |
|---|---|---|---|---|
| | Sheep | Goat | Cattle | **Notes** |
| Hajjah | **81** | **89** | **14** | |
| Al-Hodaidah | **596** | **911** | **89** | **1 positive RVF IgM- 2005 in sheep**<br>**1 positive RVF IgM-2006 in Goat** |
| Raimah | | **6** | | |
| Sa'dah | **80** | **115** | **0** | |
| Al-mokha (Quarantine | **183** | **290** | **458** | |
| Total | **940** | **1411** | **561** | **2 positives (0.07%)** |

# RVF IgM ELISA Results

July 2006 – Dec. 2006

| Governorate | Sheep | | Goat | | Cattle | |
|---|---|---|---|---|---|---|
| | Tested | Pos. | Tested | Pos. | Tested | Pos. |
| Al-Hodaidah | 184 | 0 | 186 | 0 | 18 | 0 |
| Hajjah | 22 | 0 | 0 | 0 | 0 | 0 |
| Sa'dah | 5 | 0 | 21 | 0 | 0 | 0 |
| Taiz (Quarantine) | 16 | 0 | 12 | 0 | 47 | 0 |
| Total | 227 | 0 | 219 | 0 | 65 | 0 |

# RVF IgG ELISA Results

July 2006 – Dec. 2006

| Governorate | Sheep | | Goat | | Cattle | |
|---|---|---|---|---|---|---|
| | Tested | Pos. | Tested | Pos. | Tested | Pos. |
| Al-Hodaidah | 90 | 3 | 88 | 3 | 8 | 0 |
| Taiz (Quarantine) | 16 | 2 | 12 | 0 | 47 | 0 |
| Total | 106 | 5 | 100 | 3 | 55 | 0 |


2006 11 30

**RVF Survey in Tihamah (Al-Hodaidah and Hajjah governorates) 2007.**
**IgG RVF ELISA**

| Age group | Samples tested | Positives RVF IgG |
|---|---|---|
| Less than one year | 42 | 2 |
| 1 – 2 years | 129 | 10 |
| More than 2 – 3 years | 115 | 8 |
| More than 3 – 5 years | 346 | 19 |
| More than 5 years | 430 | 36 |
| Unknown | 237 | 11 |
| Total | 1299 | 86 (6.6%) |

Figure 1.b. : Frequency distribution of Goats samples collected during RVF randomely survey 2007
n= 125

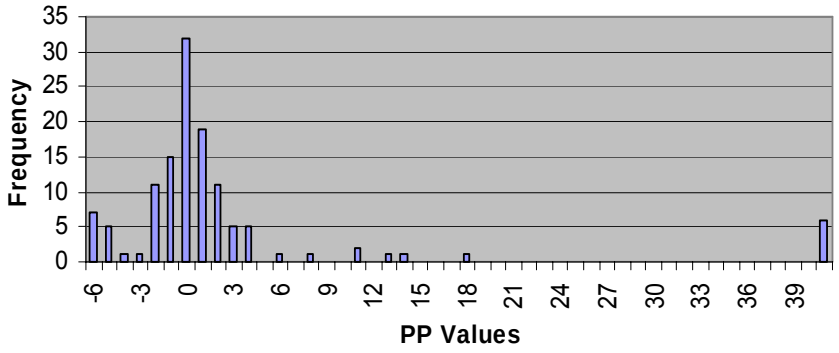



Figure 1.a. : Frequency distribution of cattle samples collected during RVF randomely survey 2007
n=1042

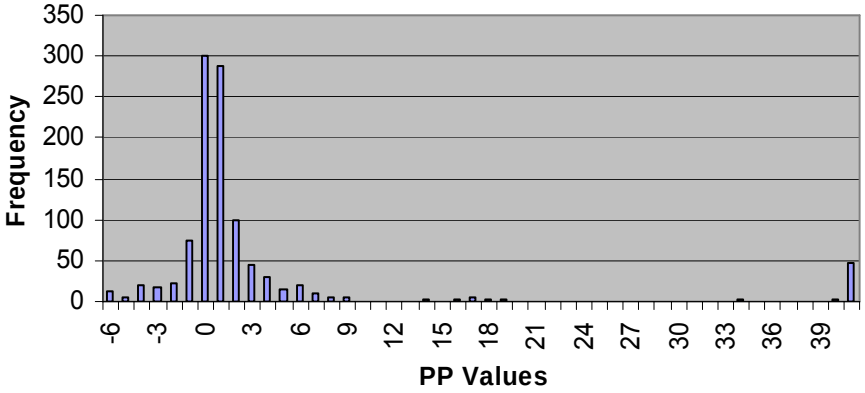
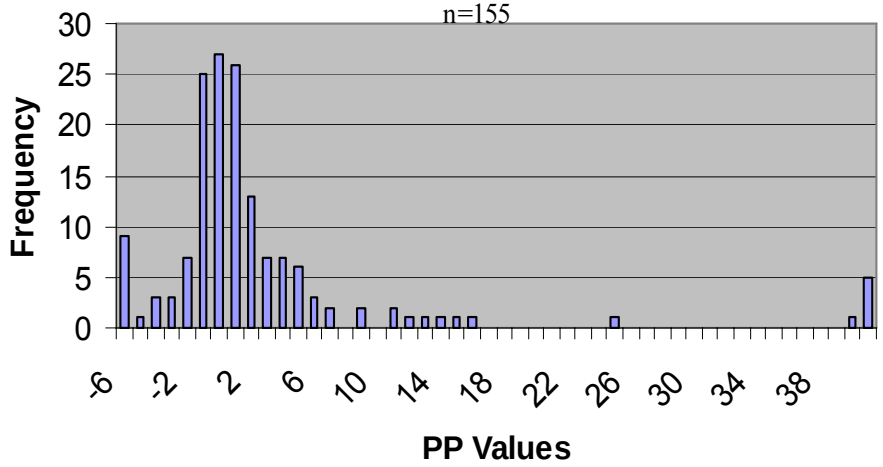



Figure 1.c. : Frequency distribution of cattle samples collected during RVF randomely survey 2007
n=155



# Surveillance samples tested for RVF IgM during 2007

| Governorate | Tested Samples for RVF IgM | Pos. | Notes |
|---|---|---|---|
| Taiz (Almocka Quarantine) | 1622 | 7 | The positives cases found during the RVF outbreak in Kenya and south Somalia |
| Alhodayedah | 1079 | 2 | |
| Hajjah | 62 | 1 | |
| Hadramout | 46 | 0 | |
| **Total** | **2809** | **10** | |


2007 1 22


2007 1 22


2007 1 22


2007 1 22


2007 1 22


2007 2 21


2007 2 21


2007 2 21


2007 2 21


2007 2 21


2007 2 21


2007 2 21


2007 2 21

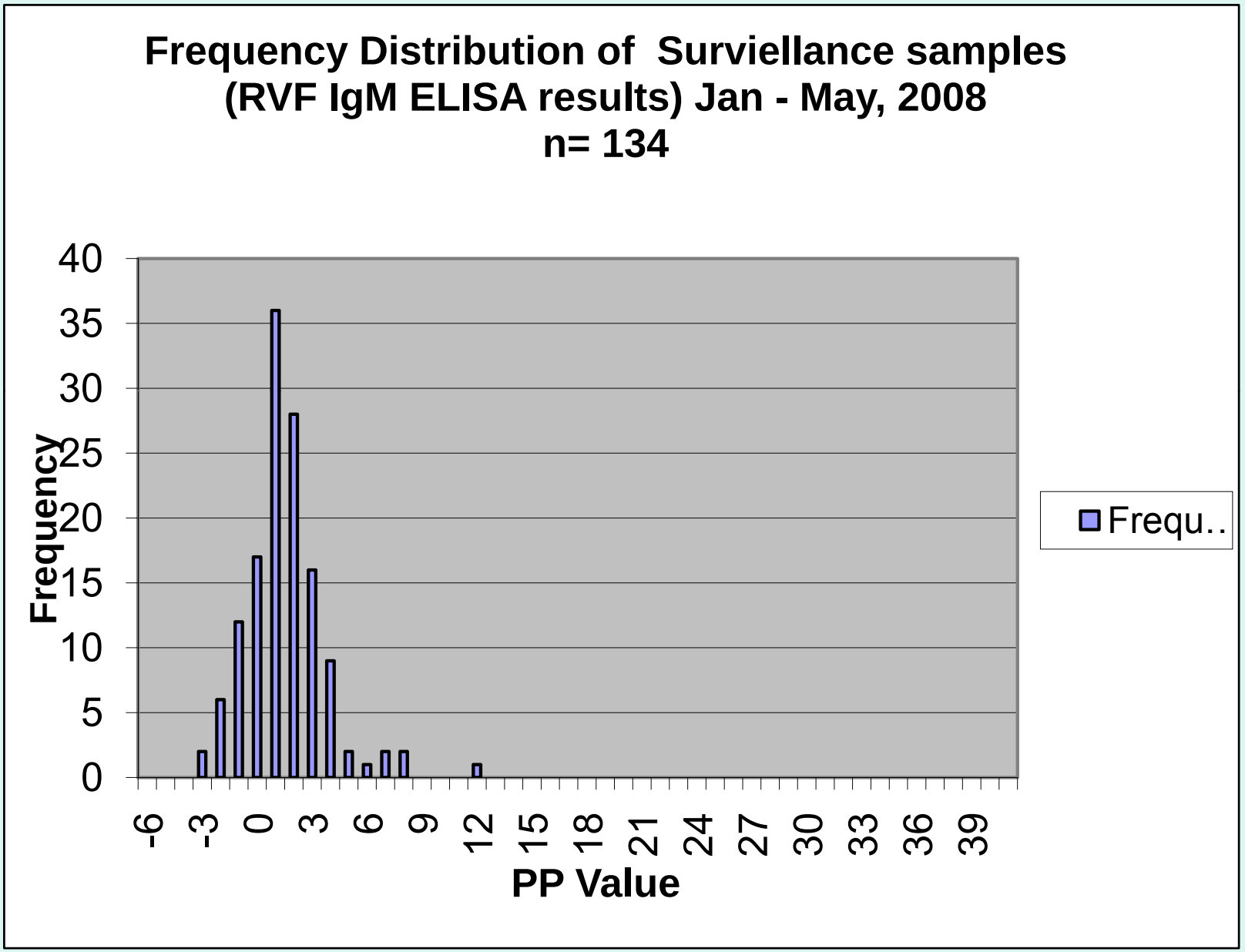

2007 2 21


2007 2 21


2007 2 21

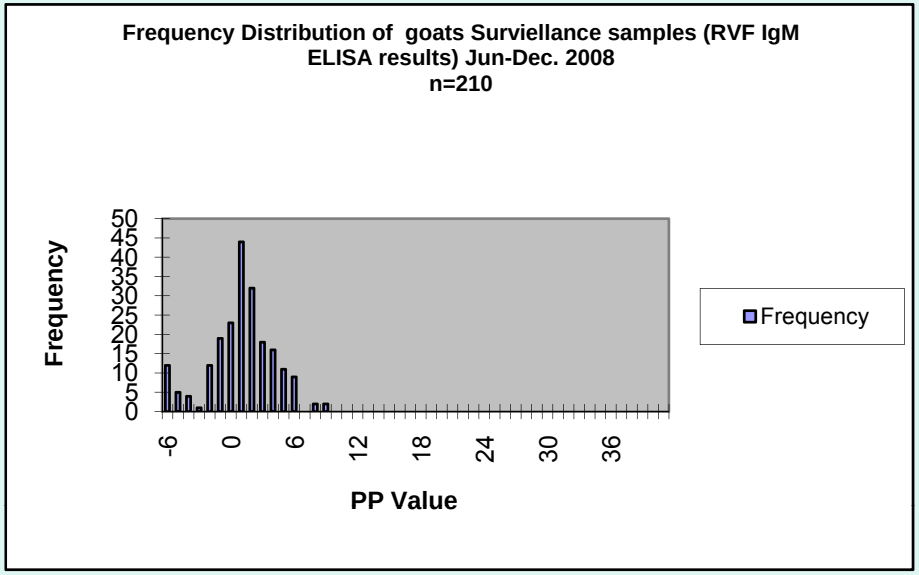

2007 2 21

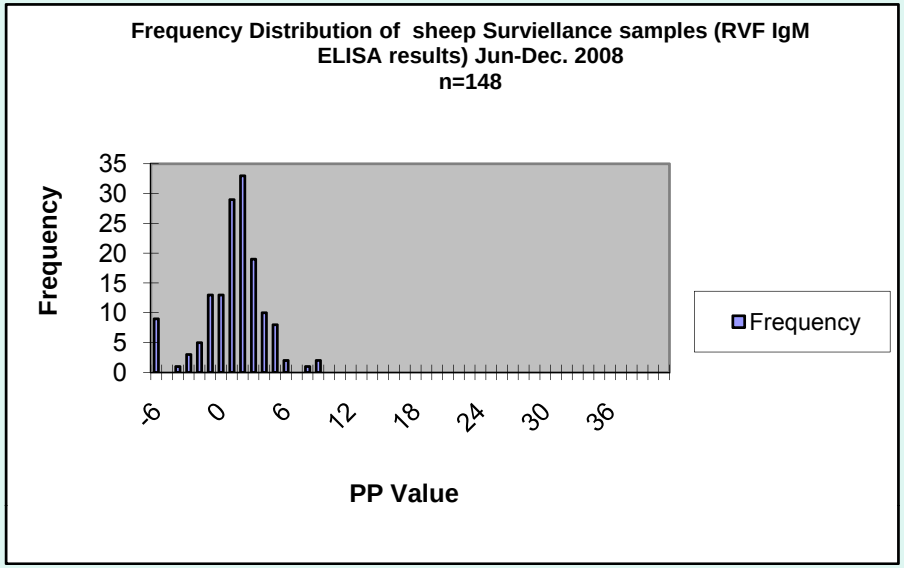

2007 2 21

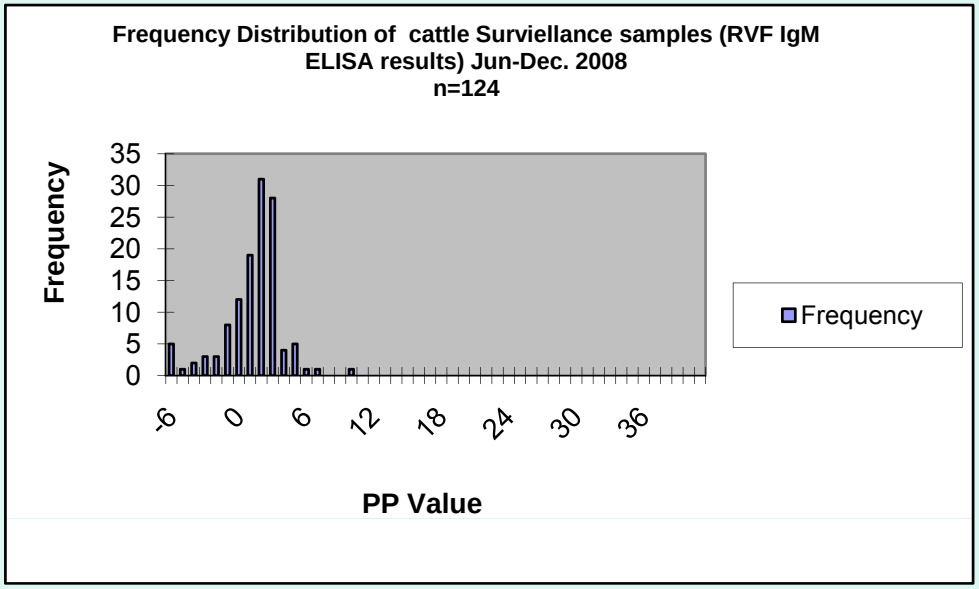

Frequency Distribution of Surviellance samples
(RVF IgM ELISA results) Jan - May, 2008
n= 134
Frequency
40
35
30
25
20
15
10
5
0
-6
-3
0
3
6
9
12
15
18
21
24
27
30
33
36
39
PP Value
Frequ..

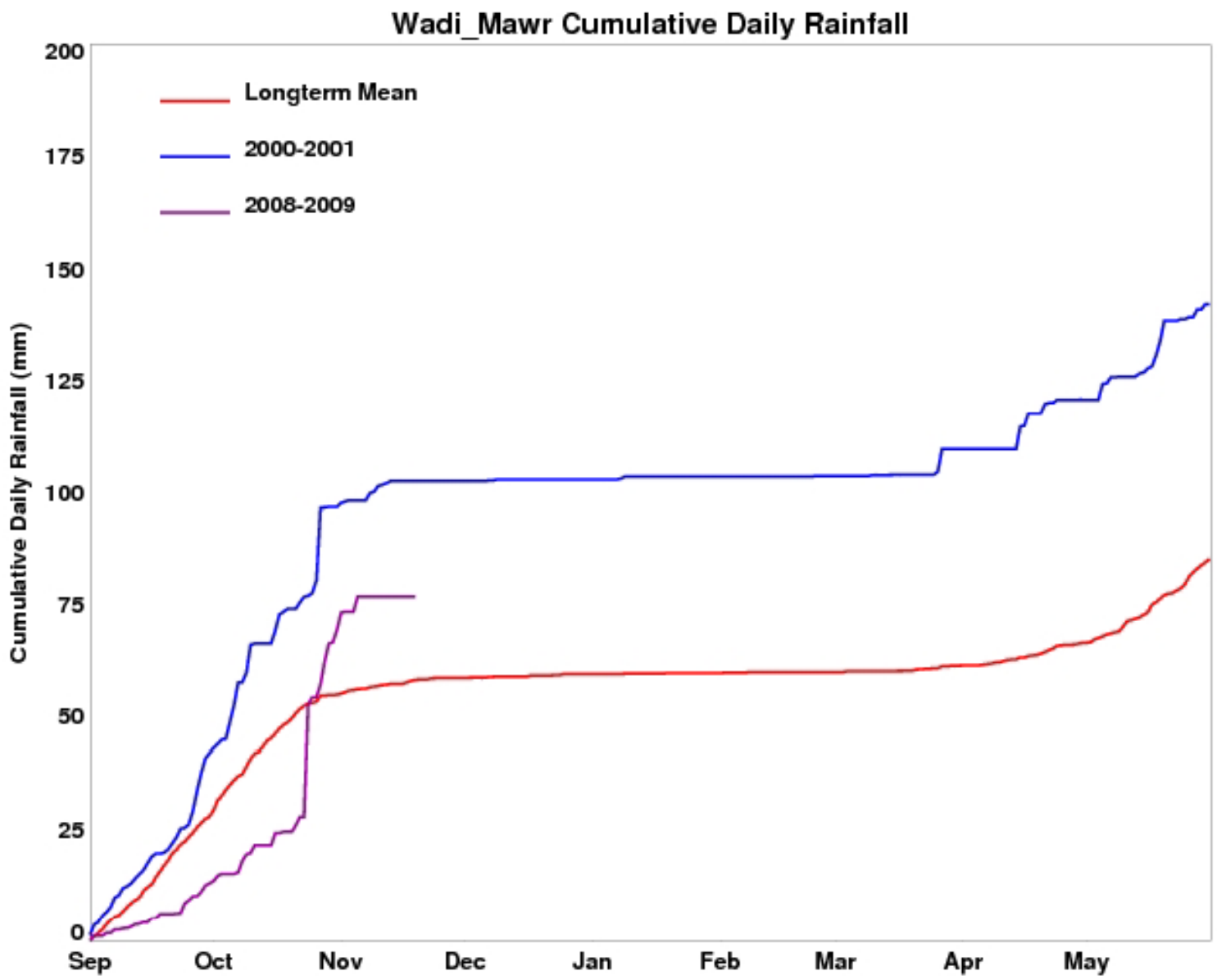
# RVF IgM during July- Dec. 2008 from Tihamah Area and quarantine.

| Governorate | Sheep | | Goat | | Cattle | |
|---|---|---|---|---|---|---|
| | Tested | Pos. | Tested | Pos. | Tested | Pos. |
| AL-Hodaidah | 114 | 0 | 129 | 0 | 4 | 0 |
| Hajjah | 13 | 0 | 0 | 0 | 0 | 0 |
| Sana'a | 0 | 0 | 0 | 0 | 2 | 0 |
| Taiz | 21 | 0 | 81 | 0 | 118 | 0 |
| Overall total | 148 | 0 | 210 | 0 | 124 | 0 |

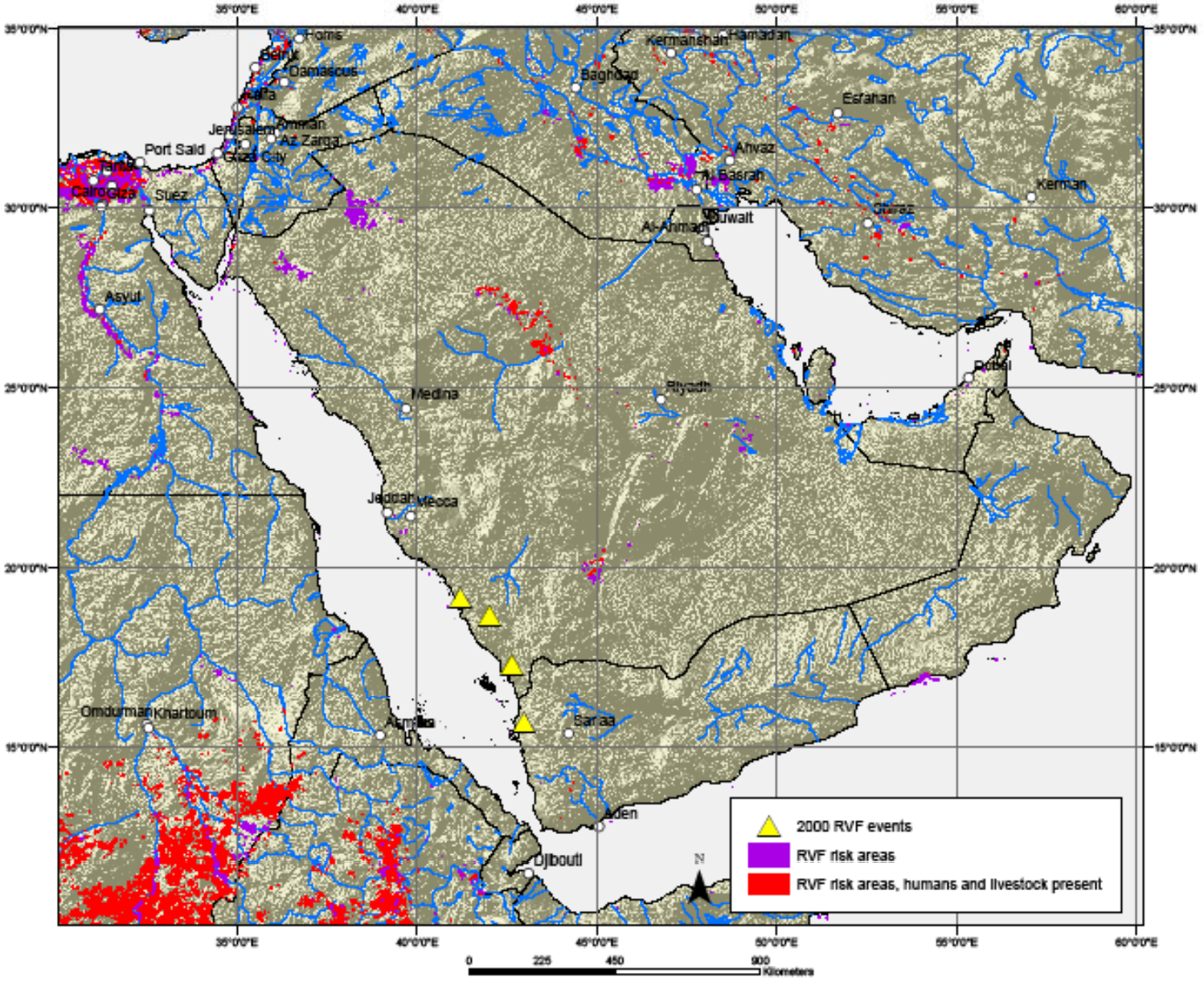

Frequency Distribution of goats Surviellance samples (RVF IgM ELISA results) Jun-Dec. 2008
n=210
Frequency
PP Value
Frequency

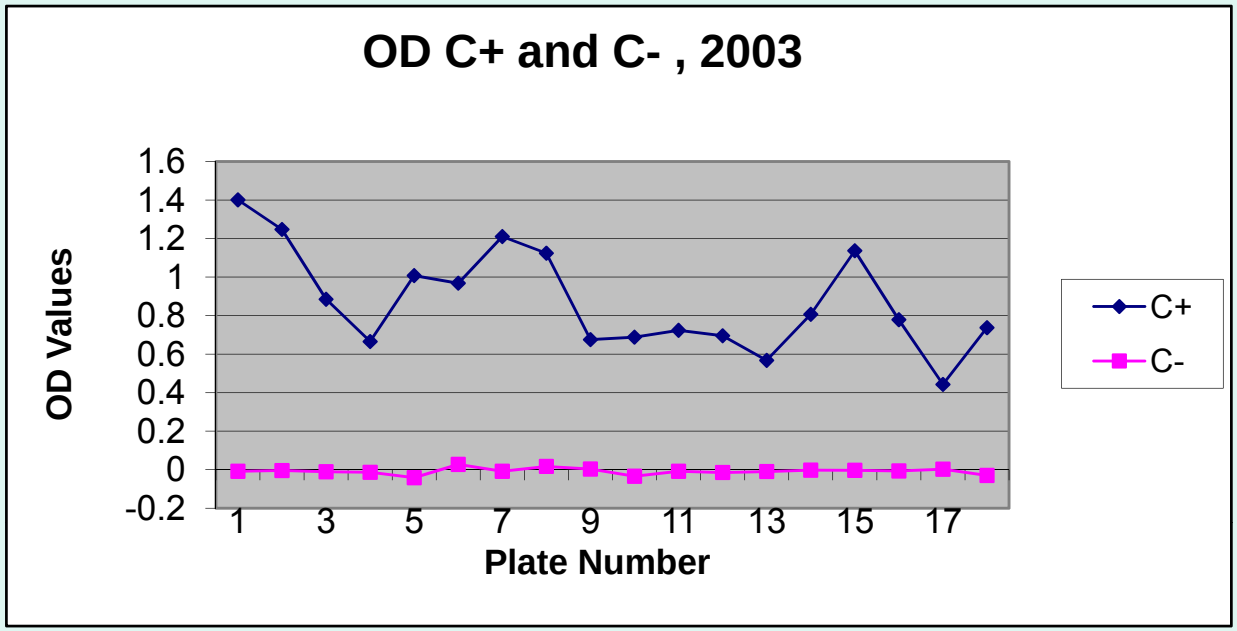

Frequency Distribution of sheep Surviellance samples (RVF IgM ELISA results) Jun-Dec. 2008
n=148
Frequency
PP Value
Frequency


Frequency Distribution of cattle Surviellance samples (RVF IgM ELISA results) Jun-Dec. 2008
n=124
Frequency
PP Value
Frequency


Wadi_Mawr Cumulative Daily Rainfall
Longterm Mean
2000-2001
2008-2009
Cumulative Daily Rainfall (mm)
200
175
150
125
100
75
50
25
0
Sep
Oct
Nov
Dec
Jan
Feb
Mar
Apr
May

# Rift Valley Fever Risk Assessment - October 2008 - Arabian Peninsula




OD C+ and C- , 2003
OD Values
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
1
3
5
7
9
11
13
15
17
Plate Number
C+
C-

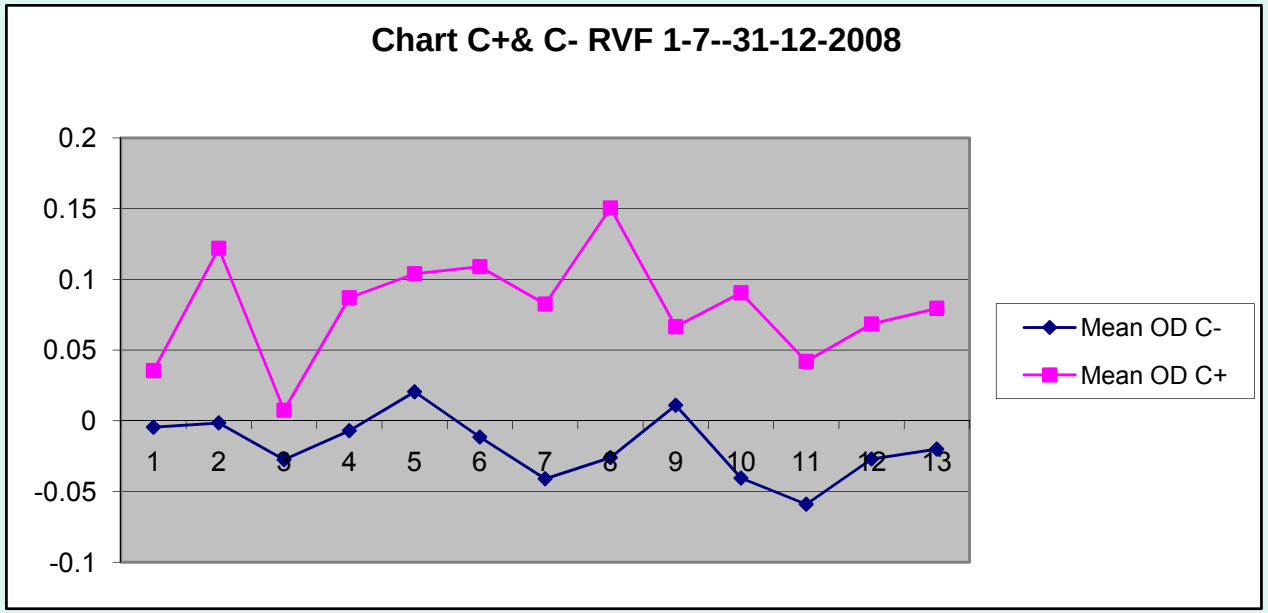
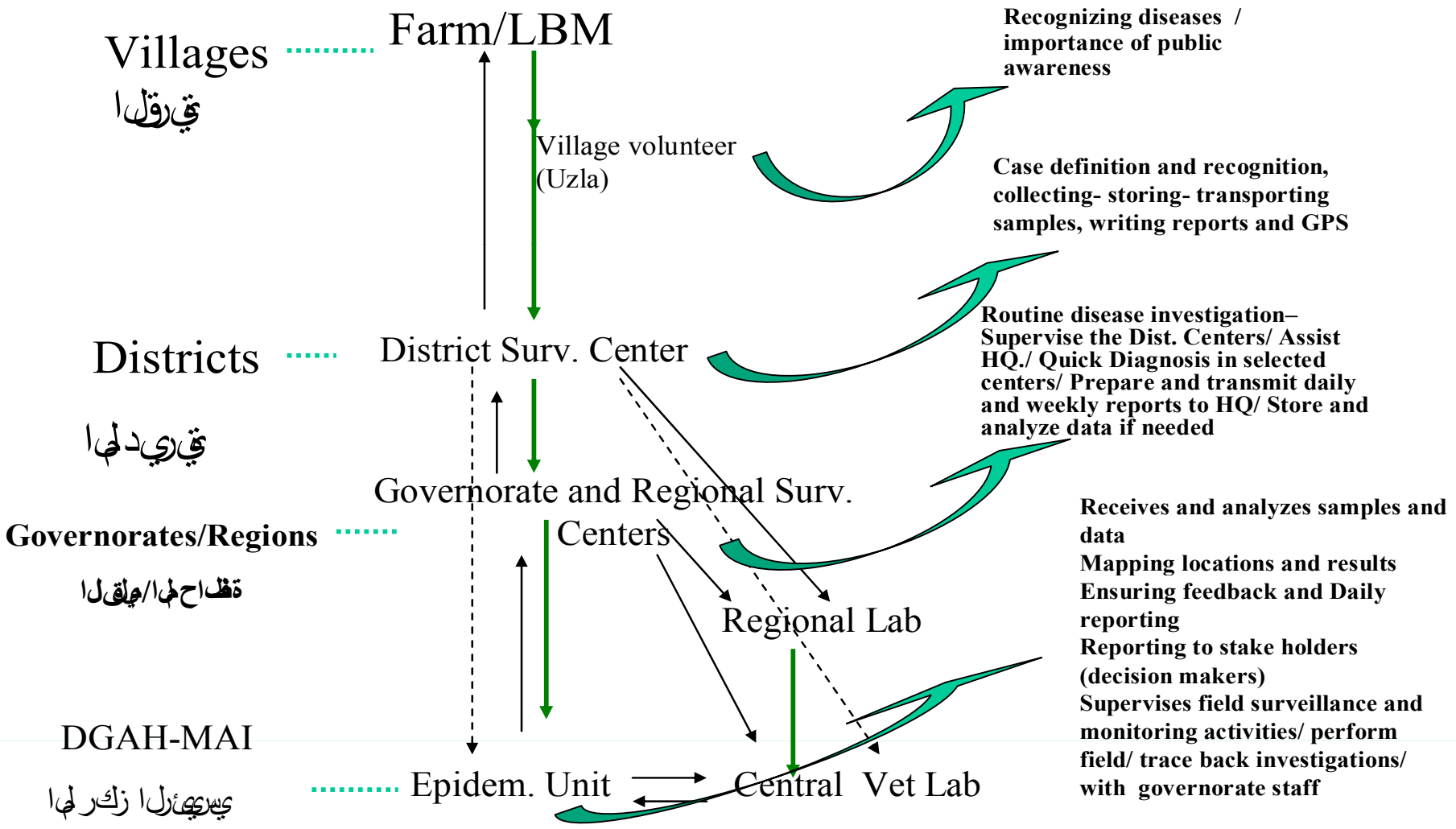


Chart C+& C- RVF 1-7--31-12-2008
0.2
0.15
0.1
0.05
0
-0.05
-0.1
1
2
3
4
5
6
7
8
9
10
11
12
13
Mean OD C-
Mean OD C+

# New Development

- **Development of Disease Active Surveillance Activities**
  - **Strengthen the DGAH Central Strategic Epidemiology Unit capacity to improve analytical capacity and database management.**
  - **Renovate and upgrade regional surveillance centers where necessary in high-risk governorates to undertake effective disease outbreak response**
- **Improvement of Disease Laboratory Diagnostic Capacities**
  - **To renovate, equip and staff the CVL to improve its capacity to diagnose and analyze materials related to TADs and other public and economical disease ; and**
  - **To provide more effective diagnostic capacity at the lower levels in the regional laboratories,**
- **Enhanced Quarantine and Border Security to strengthen overland, Sea and airborne entry points with the objective to reduce the legal and illegal entry of infectious viruses,**
- **Strengthening the Communication and Information unit in DGAH**

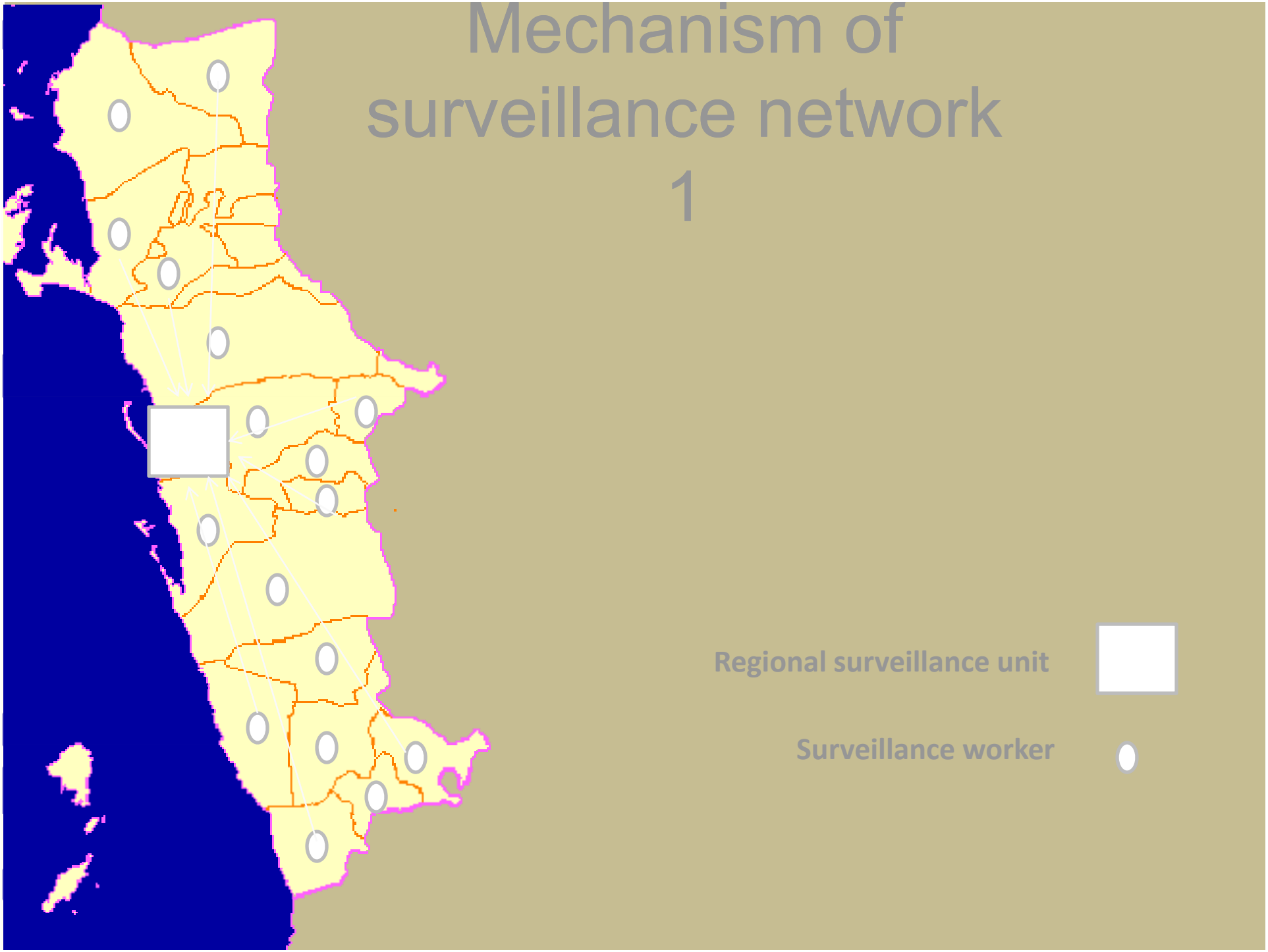
# Flow of Information and Samples



# The Surveillance Programme is active now in some governorate

**Governorates= 6 districts= 106 , surveillance workers= 74**

# Mechanism of surveillance network 1



# Mechanism of surveillance network 2