

# Aquatic Animal Disease Surveillance

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AusVet Animal Health Services

# Overview

- Introduction
- Characteristics of surveillance systems
- Approaches to surveillance
- Risk-based surveillance
- Evidence of freedom
- Output-based regulation

# Introduction

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# White Spot Virus Detection Kit

Detection by Single Tube  
Nested DNA Amplification

For 100 Detections

Expiration Date:

**For Research Use Only**

**Storage: -20°C**

 **Aquatic Animal Health Unit** 

Faculty of Veterinary Medicine  
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FreeCalc Version 2

## Freedom from Disease Survey Toolbox

Sample Size | Analyse Results | Tables | Options

Iteration	n	Cutpoint	Probability
1	50	0	0.6298
2	100	0	0.3878
3	200	0	0.1362
4	400	0	0.0112
5	300	0	0.0423
6	250	0	0.0772
7	275	0	0.0574
8	288	0	0.0496
9	282	0	0.0528
10	285	0	0.0509
11	286	0	0.0503
12	287	0	0.0497

Help

### Sample Size: Estimate Percentage #1

**Sample Size** | Absolute Error

**Input of DATA:**

Population Size:

Expected prevalence (%):

Accepted error (%):

Level of Confidence (%):

% Expected Prevalence	% Level of Confidence				
	90	95	97.5	99	99.5
0	1	1	1	1	1
10	379	464	531	599	640
20	520	606	668	727	760
30	587	669	726	777	806
40	619	698	751	800	826
50	629	706	759	806	832

**RESULTS:**

Sampling fraction (%):

Sample size: n

Adjusted sample size

Use v

### Untitled - EpiCalc 2000

File Edit View Format Help

Sample - Precision - Single proportion

3:44:48 PM, 16/08/2009

Proportion : 20.00%

Precision : 2.00%

Confidence level : 95%

Sample size : 1536

- **Diagnostics**
  - More than having the right reagents
  
- **Surveillance**
  - More than knowing the right sample size



## EpiTools epidemiological calculators

This site has been developed by [AusVet Animal Health Services](#), with funding from the [Australian Biosecurity Cooperative Research Centre](#). The site is intended for use by CRC members and other epidemiologists and researchers involved in estimating disease prevalence or demonstrating freedom from disease through structured surveys, or in other epidemiological applications.

### Site Contents

- [Survey Toolbox for livestock diseases and freedom in finite populations](#)
- [HerdPlus module for herd-sensitivity and freedom in finite populations](#)
- [Detection of disease or demonstration of freedom](#)
- [2-Stage surveys for demonstrating disease freedom](#)
- [Application or evaluation of diagnostic tests](#)
- [Sample size calculations](#)
- [Summarise categorical or continuous data](#)
- [Estimating true prevalence](#)
- [Pooled prevalence calculator](#)
- [Statistical significance testing](#)
- [Probability distributions](#)

**Suggested citation:** Sergeant, ESG, 2009. EpiTools epidemiological calculators. AusVet Animal Health Services and Australian Biosecurity Cooperative Research Centre for Emerging Infectious Disease. Available at: <http://epitools.ausvet.com.au>.

If you cite EpiTools in your publications, please email the details or a copy of your paper to [Evan Sergeant](#) for inclusion in the reference list.

# Surveillance and Biosecurity

- **Biosecurity**
  - Requires many decisions
- **Epidemiology**
  - Tools for decision-making in the presence of uncertainty
- **Surveillance**
  - Branch of epidemiology
  - Gather the right information to help make the right decisions
  - Information is never perfect
  - Aim is to make the right decisions most of the time

# Examples

- What is the best source of seed stock (to avoid introduction of infection)?
  - Status of sources
- What is the risk of introduction of different diseases?
  - Prevalence and distribution
- How do I know if a new disease has appeared and poses a new threat?
  - Early warning

# Characteristics of surveillance systems

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# Characteristics of surveillance

- I want to buy a car
- Which one should I get?



# Characteristics

- Current status with respect to the disease
- Purpose of the surveillance
- Origin of the information
- Disease focus
- Population coverage
- Representativeness
- Type of data collected
- Quality
- Others
- Surveillance approach

# Current status

- Present
- Absent

# Purpose of the surveillance

- **Present**
  - **Measuring the occurrence or distribution of disease**
    - Baseline studies
    - Priority setting
    - Risk analysis
  - **Monitoring progress of control programs over time**
    - Confirm effectiveness
    - Early intervention if not working
- **Absent**
  - **Demonstrate freedom**
    - Support safe movement at lot, farm, zone or national level
  - **Early warning**
    - Exotic or emerging diseases

# Origin of the data

- **Active**
  - **Primary purpose of data collection is surveillance**
    - Group running the surveillance has control over design and data
    - Data meets the needs of surveillance
    - Expensive
- **Passive**
  - **Surveillance is a secondary use of data collected for different primary purpose**
    - Disease reports – seeking assistance to resolve problem
    - Drug sales – accounting
    - Production records – farm management

# Disease focus

- Targeted
  - Focused on a specific disease
- General
  - Able to detect any disease
    - including previously unknown diseases
- Normally determined by the type of test used
  - Targeted
    - Agent-specific tests (eg PCR)
  - General
    - Clinical examination, post-mortem, histology
    - Syndromic, indirect, anomaly detection

# Population coverage

- Census
  - All animals
- Sample
  - Proportion of the population
    - Small or large proportion
    - Distribution of sample

# Representativeness

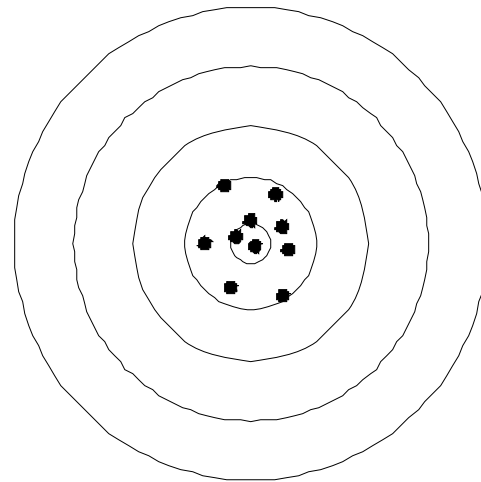
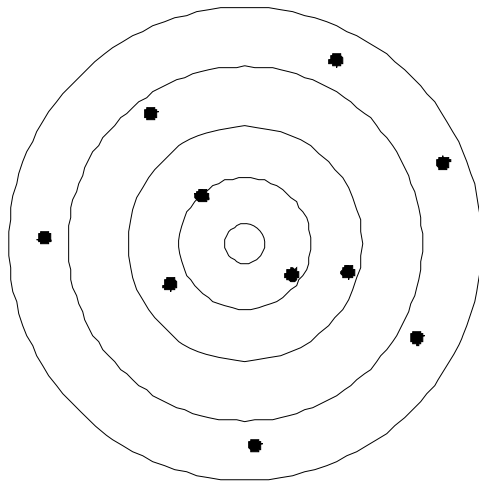
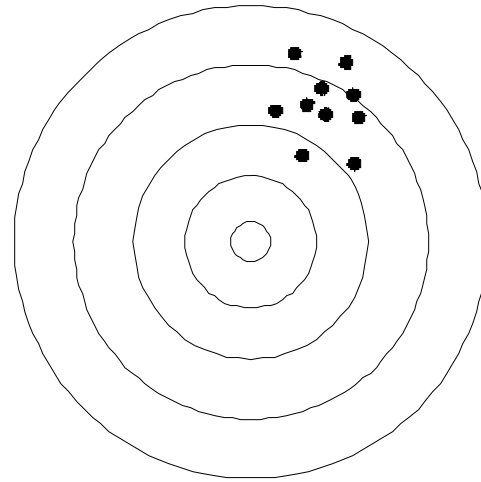
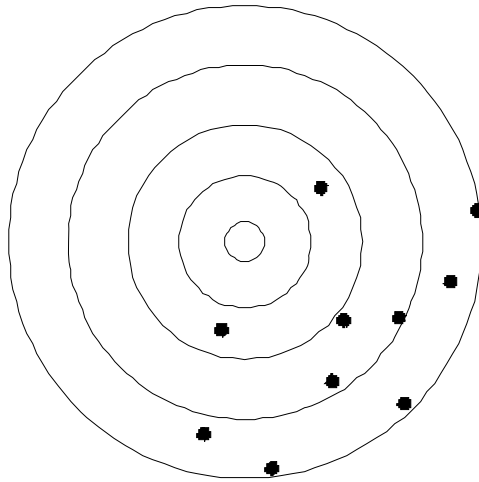
- Representative
  - Characteristics in the sample are similar to those in the population
  - Normally achieved by random sampling
- Non-representative
  - Characteristics are systematically different to the population
    - Bias
    - Risk-based surveillance
- Both may be useful for different purposes

# Type of data collected

- Diagnoses
  - Investigations
- Classifications
  - Screening test results
    - Disease state
    - Immune or risk status
- Syndromes, signs
  - Morts, swimmers
- Indirect indicators of disease
  - Feed consumption
- Negative reports
- Risk factors
  - Algal monitoring programs

# Quality

- Diseases that are present
  - Main result: prevalence (and others)
  - Quality measures: Precision and accuracy
  - Systematic and random error



# Quality (2)

- Diseases that are absent
  - Main result: yes / no
  - Quality measure: Sensitivity
    - Probability that the surveillance system would detect at least one positive animal / farm if the disease is present at a specified level (the design prevalence)

# Other characteristics

- Form of data collected
- Recording and communication systems
- Cost / efficiency
- Practicality
- Timeliness
- Fitness for purpose

# Approaches to surveillance

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# Surveillance approaches

- Passive disease reporting system
- Structured surveys
- Sentinel surveillance
- Proxy surveillance
- Risk-factor surveillance
- Indirect surveillance
- Syndromic surveillance
- Participatory disease surveillance
- Post-harvest processing



# Example - measuring change

2. The risk-based animal health surveillance scheme referred to in paragraph 1 shall aim at the detection of:

(a) any **increased mortality** in all farms and mollusc farming areas as appropriate for the type of production;

- Risk-based approach

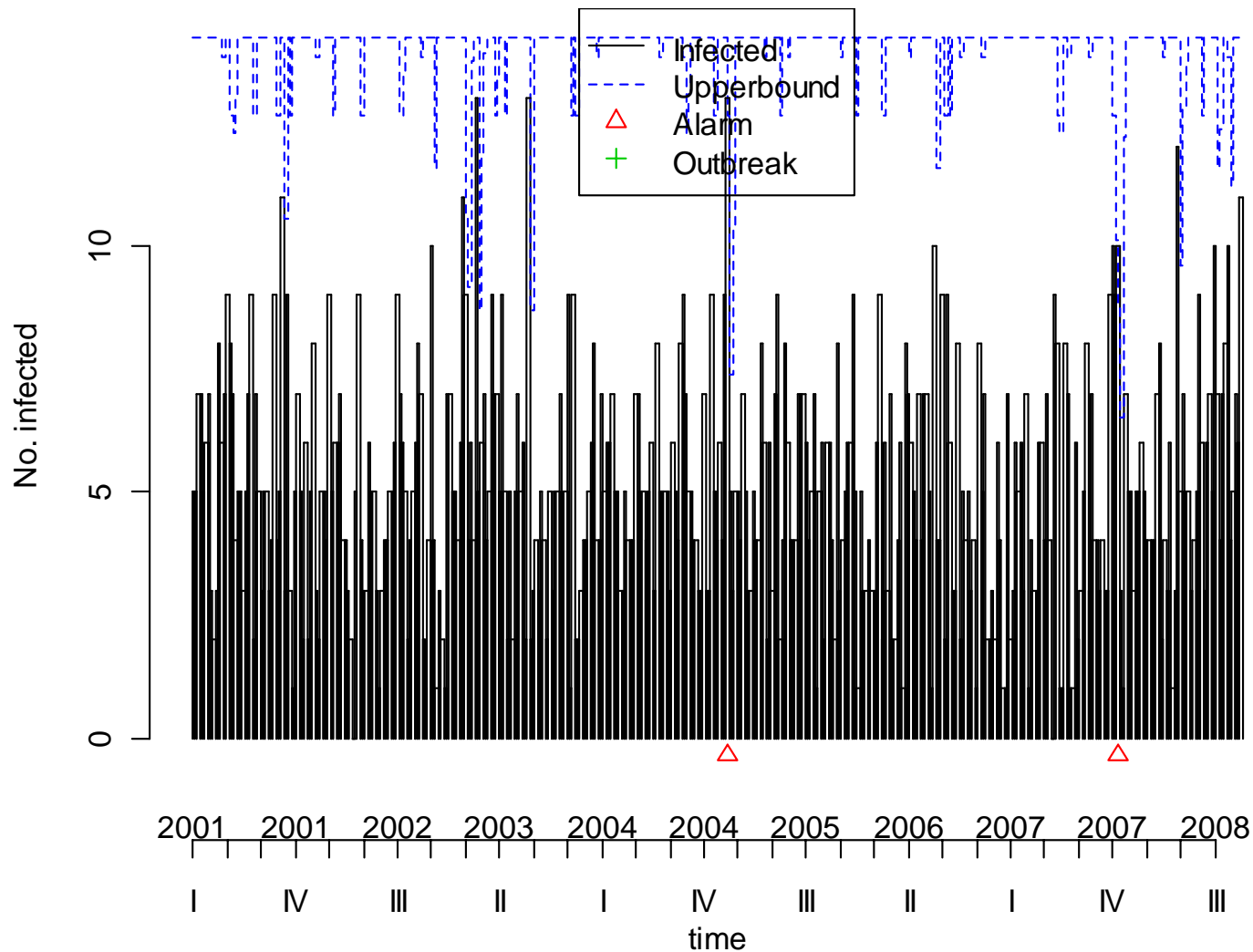
- Relative risk: 8
- High risk: 10% of animals, 80% prevalence
- Low risk: 90% of animals, 10% prevalence
- True prevalence: 17%
- Apparent prevalence: 80%

# Early warning, new diseases

- General surveillance
- High coverage
- Timely
- Surveillance options?
  - Passive farmer reporting
  - Indirect surveillance
    - Feed consumption
  - Syndromic surveillance
    - Morts
  - Incentives?



## Analysis of disProgObj using cusum: anscombe



# Risk-based surveillance

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## Article 10

### **Animal health surveillance scheme**

1. Member States shall ensure that a risk-based animal health surveillance scheme is applied in all farms and mollusc farming areas, as appropriate for the type of production.
  
2. The risk-based animal health surveillance scheme referred to in paragraph 1 shall aim at the detection of:
  - (a) any increased mortality in all farms and mollusc farming areas as appropriate for the type of production;

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  - (b) the diseases listed in Part II of Annex IV, in farms and mollusc farming areas where species susceptible to those diseases are present.

# Risk-based surveillance (1)

- Theory – easy
  - Look for disease where it is most likely to be
  - Cheaper, more efficient
  - Small sample, same sensitivity
- Practice – a bit more complicated
  - What does risk mean?
  - When do we apply it?
  - How do we quantify the sample size?
  - Other sampling issues

# Definitions of “risk”

1. Likelihood of an adverse event
  - The risk of being killed in a plane crash is less than the risk of being killed in a car accident
  - Relative risk
2. Likelihood and consequences
  - Risk analysis definition
3. Risk-based surveillance
  - Does it include consequence or not?

# Risk-based surveillance (2)

- Surveillance in fish, single risk factor
  - Example of risk factors
    - Water temperature, age (influence disease)
    - Moribund, lesions (caused by disease)
- To quantify benefit of risk-based sampling, need
  - What is the difference in risk?
    - Describe with relative risk
  - How has the higher risk population been targeted
    - Proportion in the population
    - Proportion in the sample

# Risk-based surveillance - Example (1)

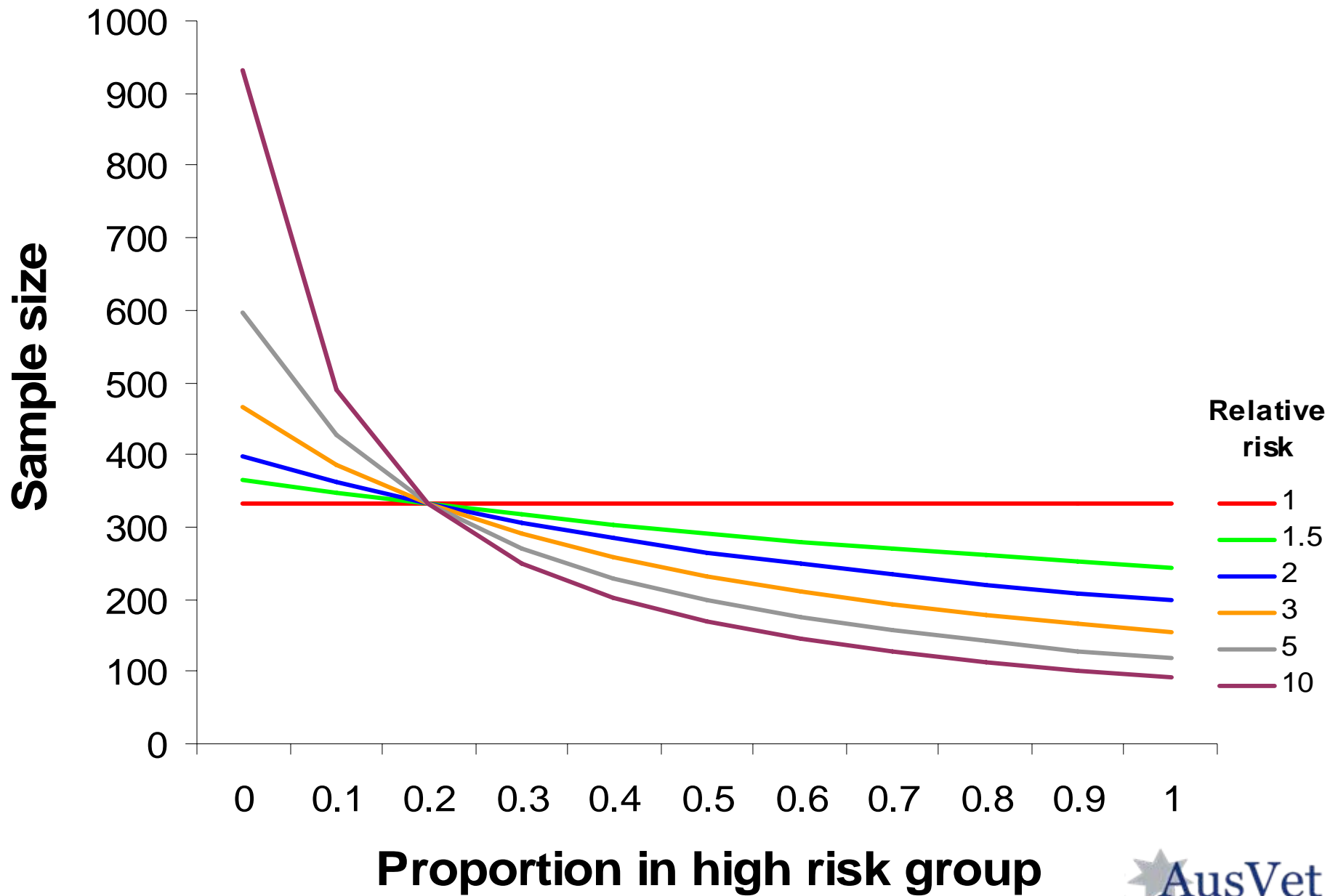
- High risk group
  - Relative risk: 3
  - Proportion of population: 20%
- Other parameters
  - Design prevalence: 1%
  - Test sensitivity: 90%
  - Target surveillance sensitivity: 95%

# Example: relative risk = 3

Scheme	High risk	Low risk	Sample size (% saving)
Representative	20	80	331 (0)
Risk based	50	50	231 (30)
Risk based	90	10	165 (50)
Biased	10	90	387 (-17)

# Example: relative risk = 1.5

Scheme	High risk	Low risk	Sample size (% saving)
Representative	20	80	331 (0)
Risk based	50	50	291 (12)
Risk based	90	10	251 (24)
Biased	10	90	347 (-5)



# Evidence for freedom

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# Evidence of freedom



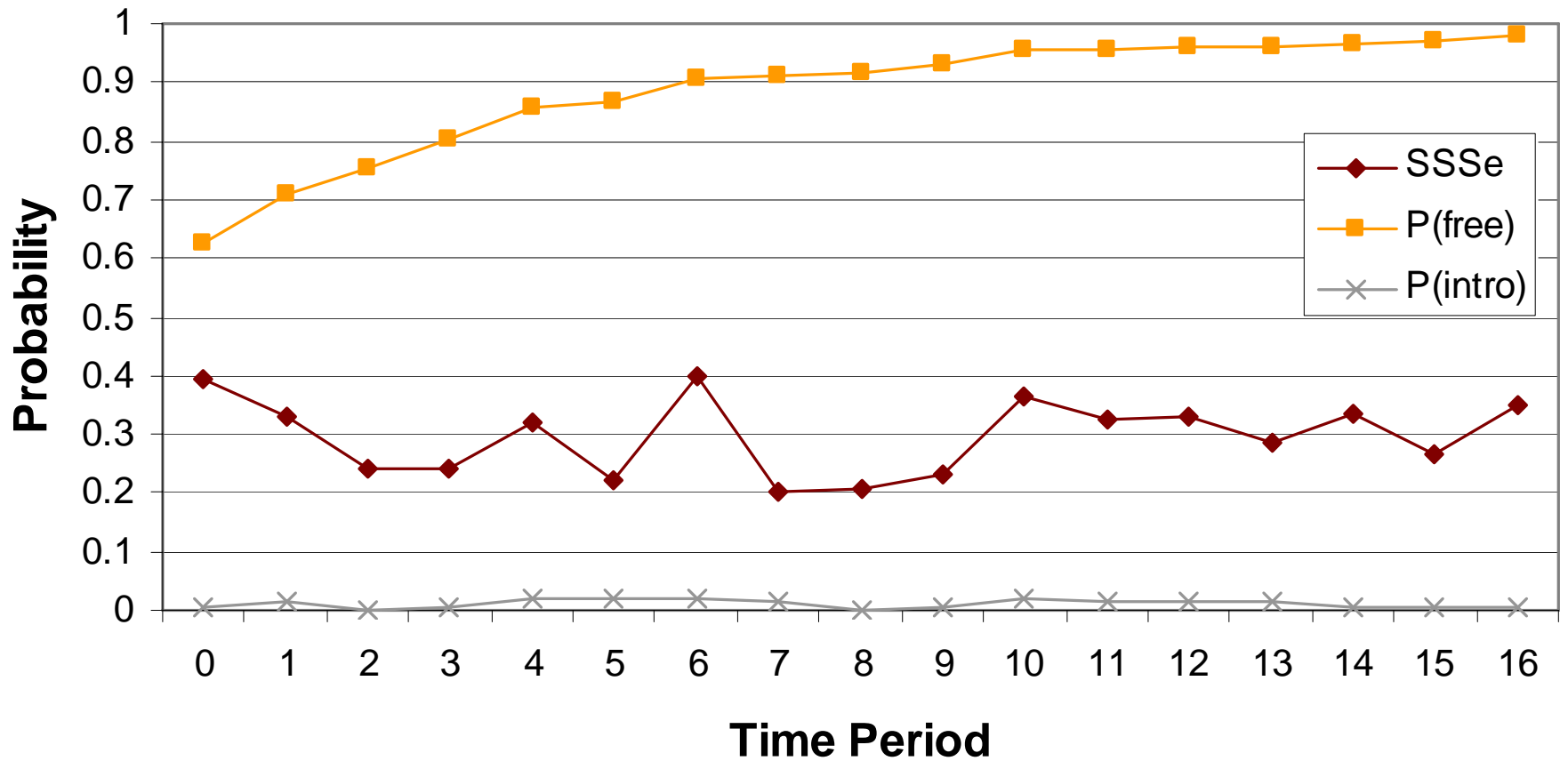
# Introduction of infection





Biosecurity Measures





# Output-based regulations

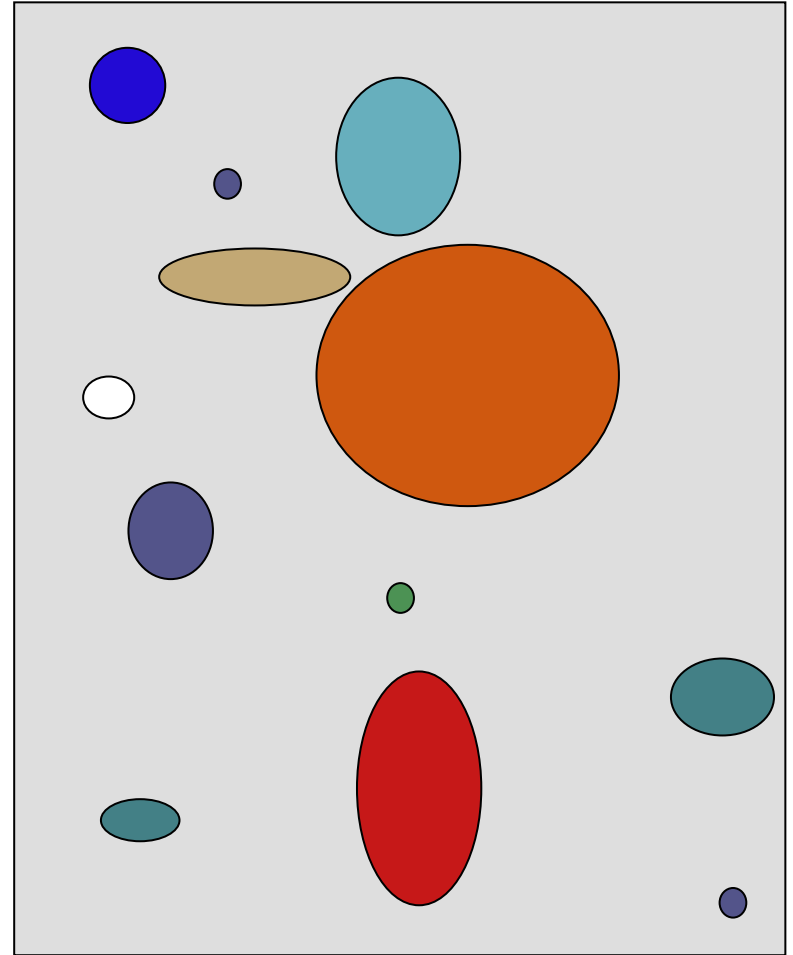
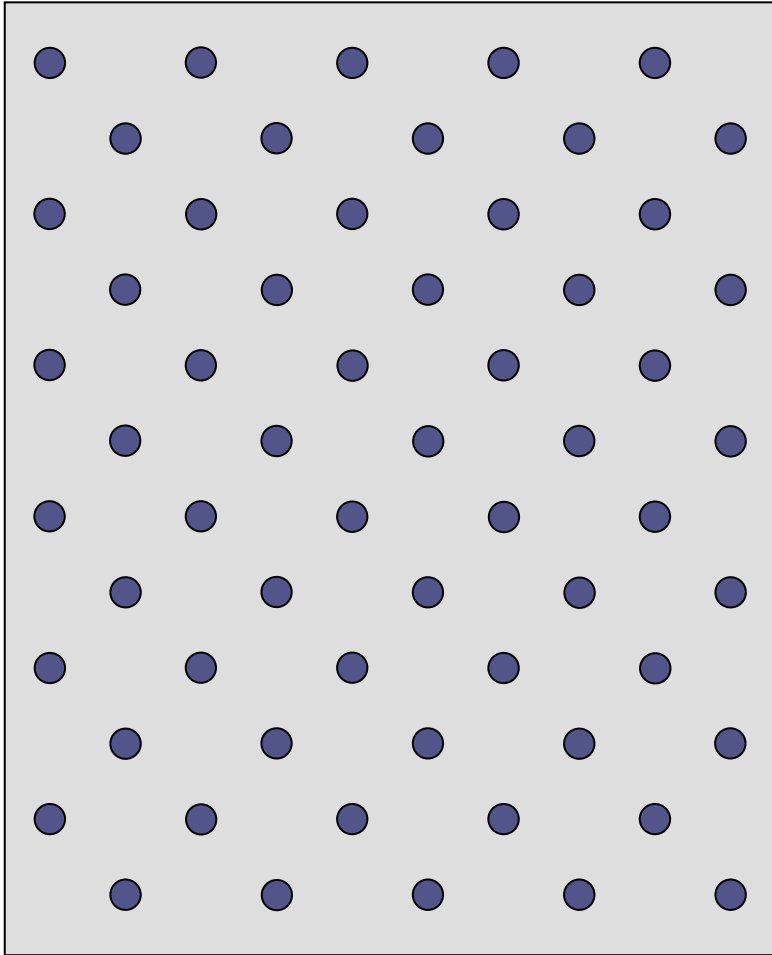
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**Inspection and sampling scheme for zones and for farms in non-approved zones for the two-year control period which precedes achievement of approved status for VHS and/or IHN**

*(in accordance with Directive 91/67/EEC, Annexes B and C and the provisions set out in Part I of this Annex)*

	Number of clinical inspections per year (two years)	Number of laboratory examinations per year (two years)	Laboratory examination for presence of virus <sup>(1)</sup>	
			Number of growing fish (Organ material)	Number of broodstock fish (Ovarian fluid)
Continental zones and farms				
(a) Farms with broodstock	2	2	1 20 (first inspection) <sup>(2)</sup> 1 50 (second inspection)	30 (first inspection) <sup>(3)</sup> 0 (second inspection)
(b) Farms with broodstock only	2	1	0	1 50 (first or second inspection) <sup>(3)</sup>
(c) Farms without broodstock	2	2	1 50 (first and second inspections)	0



# Output-based standards

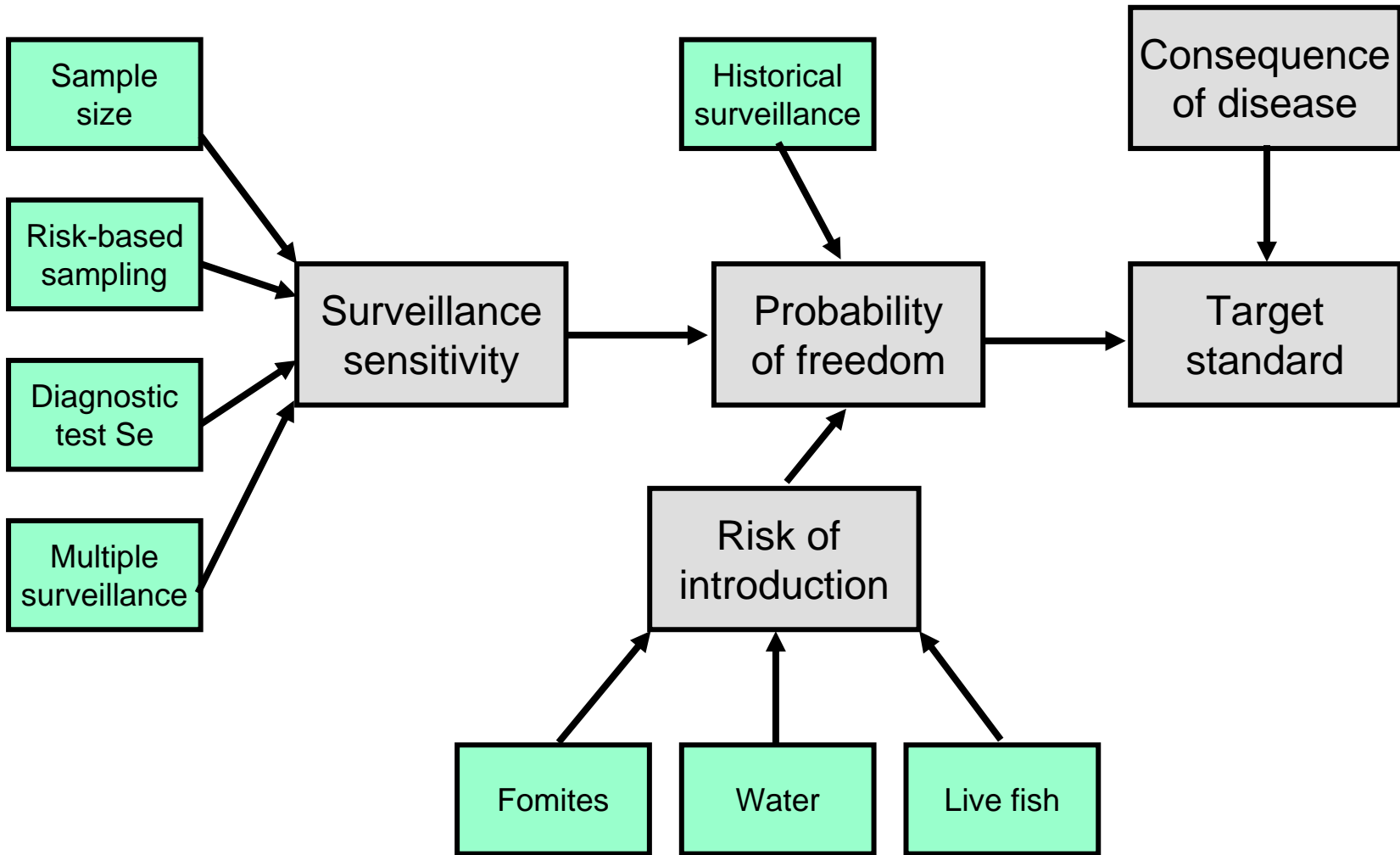
## Examination, sampling, testing and diagnosis of aquaculture animals

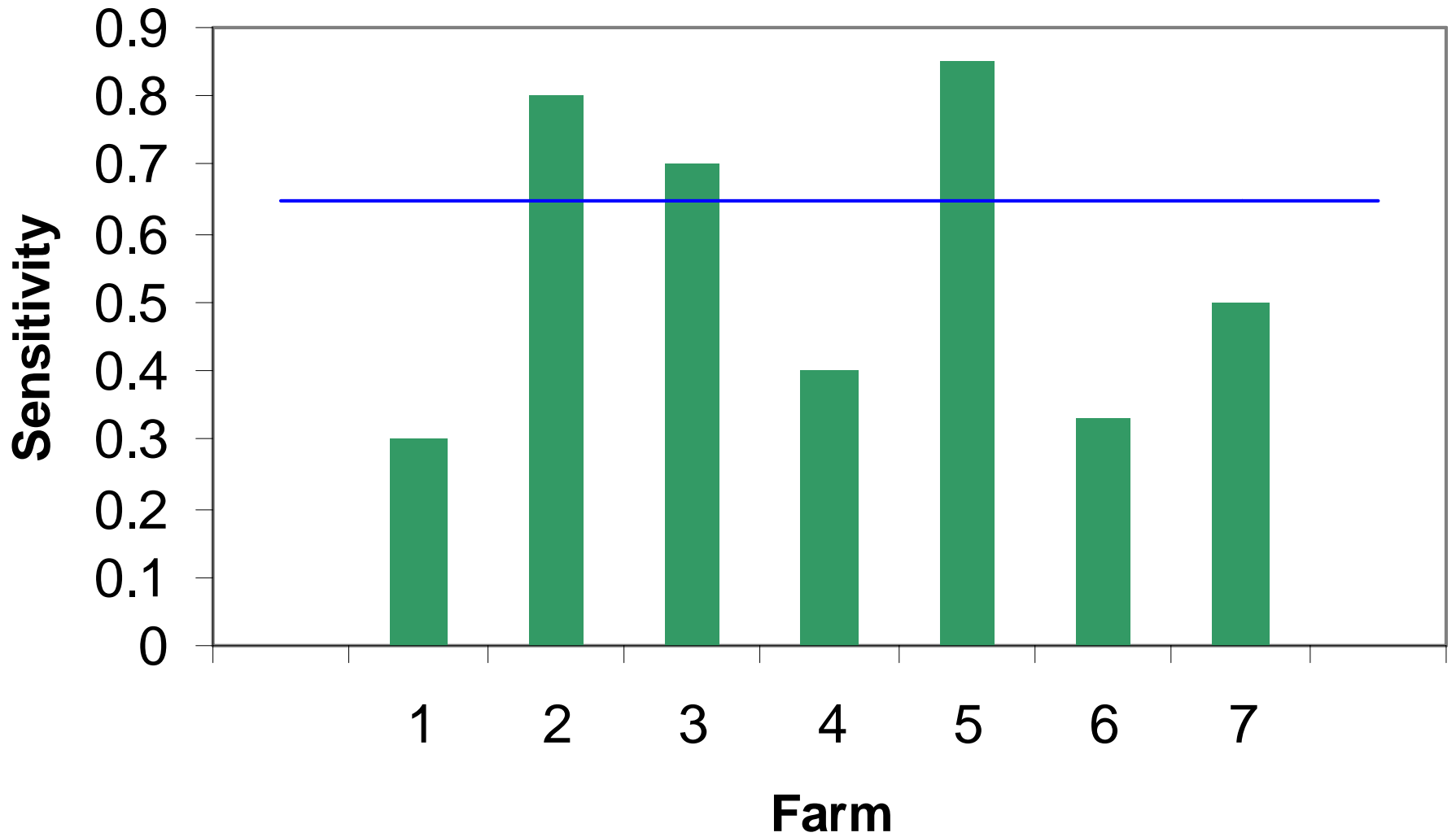
1. The examination, sampling, testing and diagnosis of aquaculture animals shall be carried out ensuring that the environmental conditions conducive to the laboratorial detection of the relevant listed disease(s) are present in the quarantine facility during the whole quarantine period.
2. During quarantine, the following aquaculture animals shall be sampled within 15 days before date of the expiry of the quarantine period:
  - (a) when sentinel aquaculture animals are used, samples from all of them must be taken;
  - (b) when sentinel aquaculture animals are not used, samples must be taken from a relevant number of aquaculture animals ensuring the detection of the relevant listed disease(s) with a 95 % confidence if the design prevalence is 10 % (never less than 10 animals).

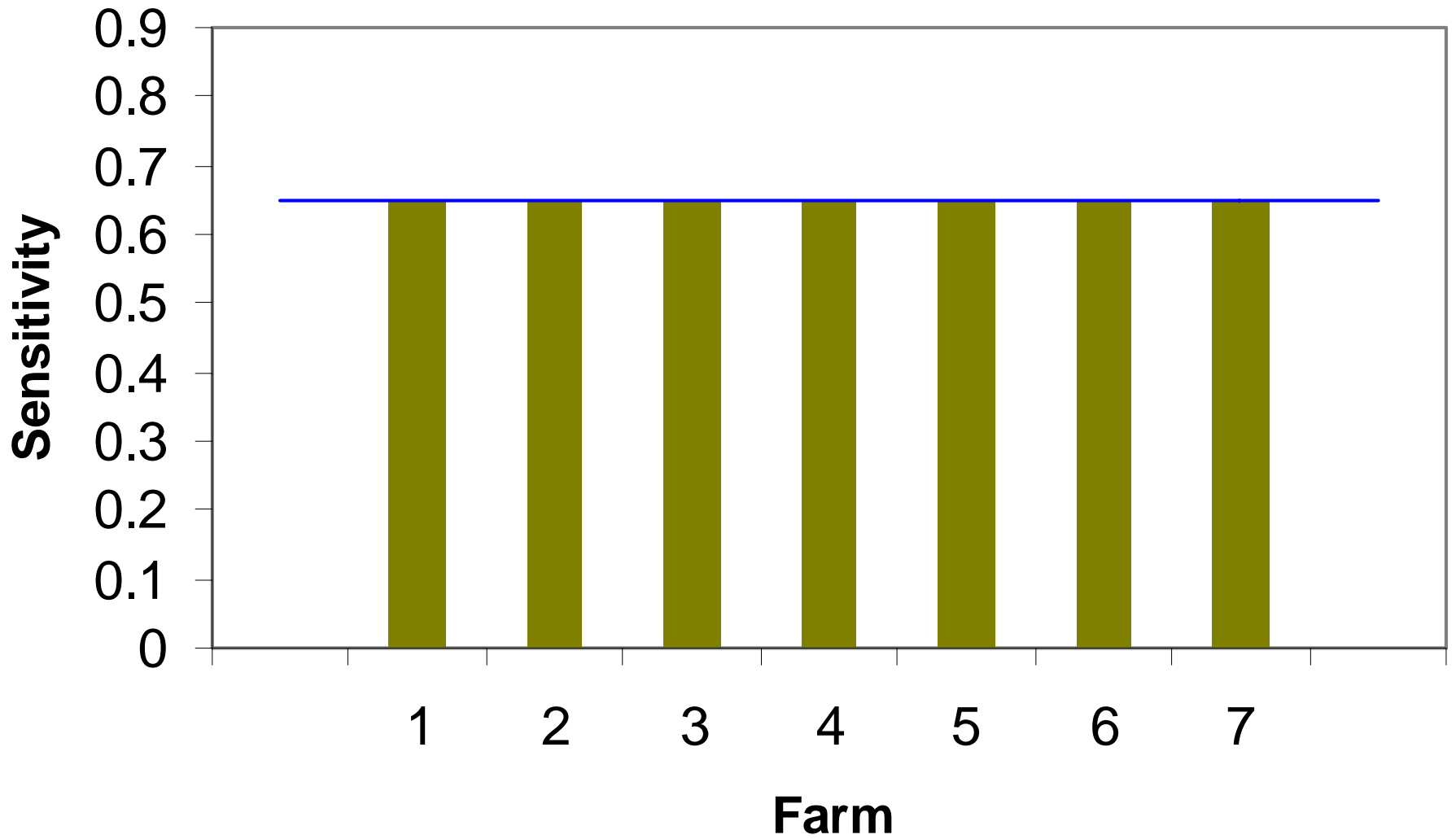
- Doesn't take risk into account

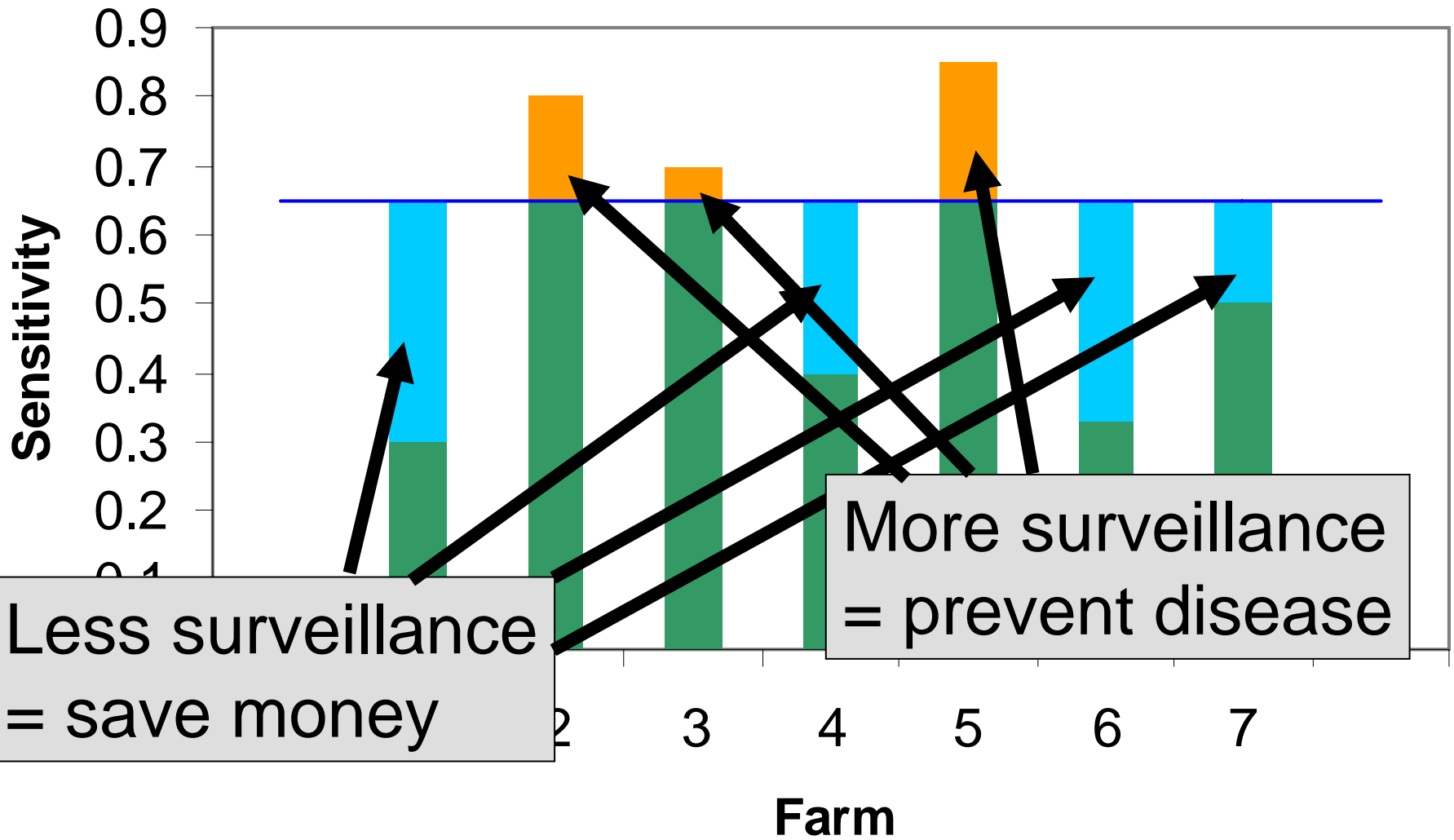
# Preferred output-based standard

- Probability of freedom
  - Flexibility
    - Choice of tests
    - Approach to surveillance
    - Number of animals tested
    - Frequency of testing
  - Accounts for biosecurity
    - Probability of introduction of infection









Less surveillance  
= save money

More surveillance  
= prevent disease

# Conclusions

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# Conclusions – Risk-based surveillance

- Risk-based surveillance
  - Relative risk of infection in sub-groups within a population under surveillance
- Probability of introduction of infection
  - Influences how much surveillance is needed
  - Good biosecurity, less surveillance over time
- Consequences of being infected
  - Influences standard of proof of freedom required
  - High consequences, meet higher standard

# Conclusions

- Greatly improved understanding and much new research in surveillance in last few decades
- An exciting variety of surveillance options
  - Less expensive
  - Better suited to different situations
- New approaches tend to be more complex
  - Easier to make mistakes
  - Need professional guidance to take advantage of new opportunities

# Notices

- Course in analysis of surveillance data
  - Prince Edward Island, Canada, 5<sup>th</sup> to 9<sup>th</sup> October
- Species networking
  - Crustaceans, molluscs