AQUATIC DISEASE SURVEILLANCE

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Epidemiology & Risk Assessment for
Aquatic Animal Diseases (Americas)

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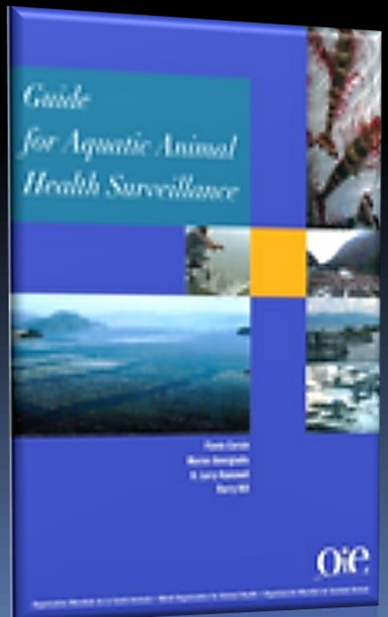
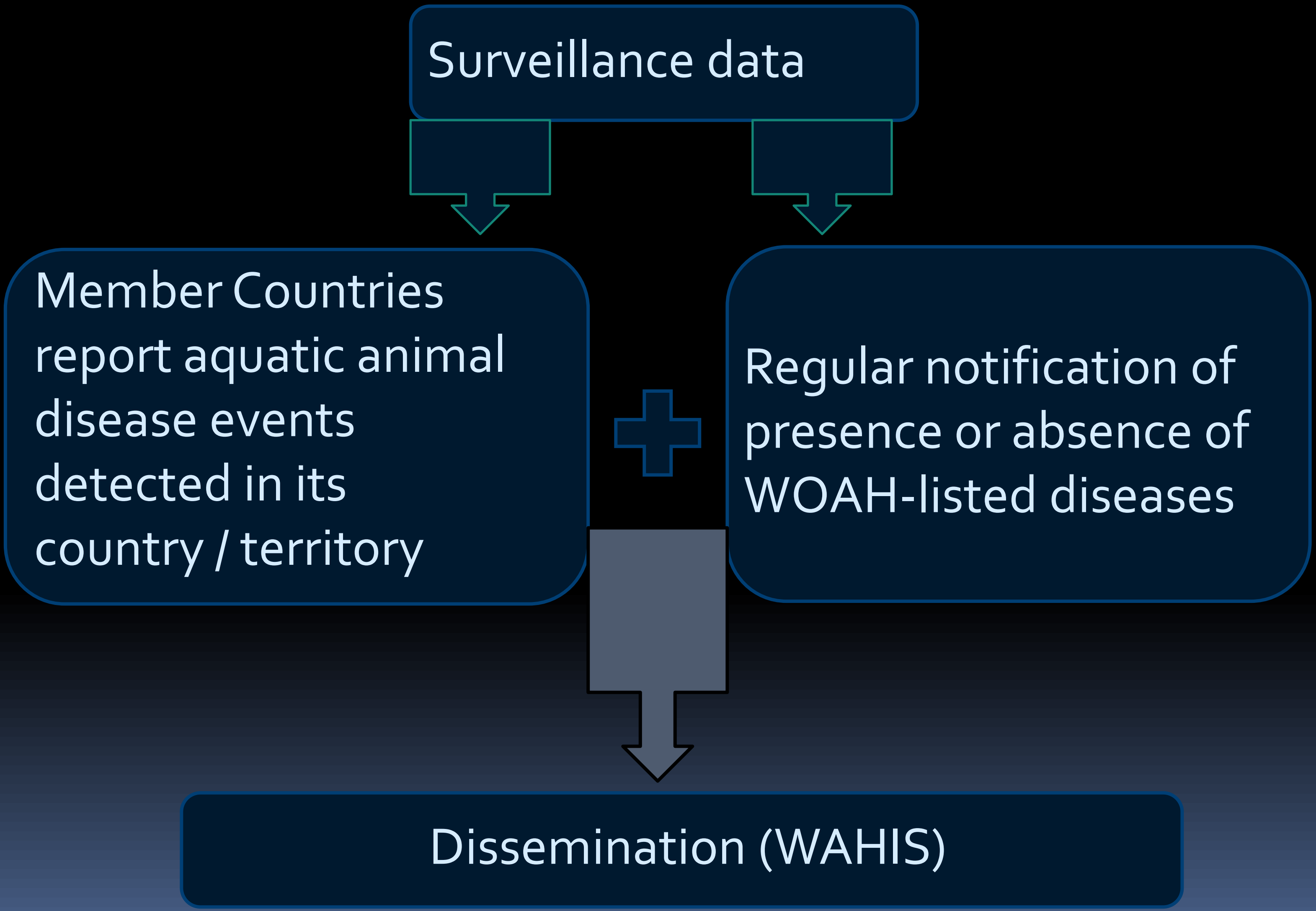
WOAH Perspectives on Surveillance

- Primary reasons:
  - Evidence for self-declaration of disease freedom,
  - Early detection of first case to enact contingency plans
  - Describe pathogen distribution (for control and movement restrictions)



Transparency in global aquatic animal disease status



Disease surveillance

- Disease detection
  - A) FIRST cases in previously negative area
  - B) new cases in endemic area
- Involves
  - disease sampling / testing intensity decisions
  - Disease control actions
  - Movement restrictions

Passive versus Active Surveillance

Passive: disease information generated for another purpose but informs status

- Vet visits, urgent calls from producers, etc
- Requires method that info will enter regulatory system "knowledge"
- High probability that delayed reporting and responses (hampering investigations)

Active: sampling for disease purposefully designed to describe infection distribution or declare absence

Important Consideration

- Registration / permitting process for live animal movements
  - identify farms / animals when designing sampling strategy
  - ensure unexplained mortality events will be documented and investigated
  - Without this, passive surveillance is much less effective

AQUATIC (Active) Surveillance Issues to consider

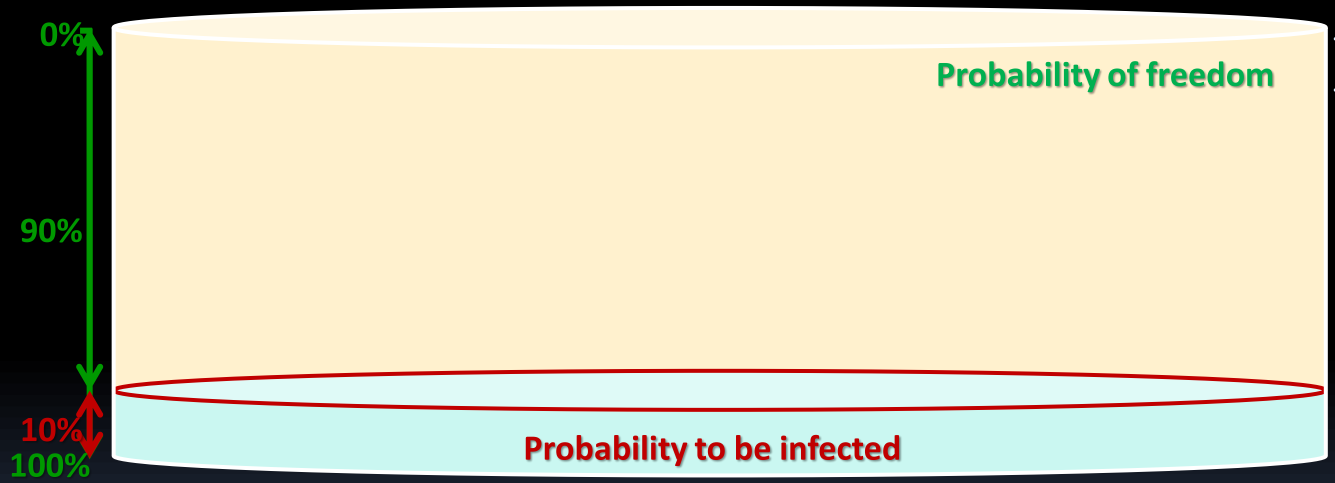
- Population is difficult to visualize and quantify
- Large population sizes and value (at group level)
- Limited access to individuals representative of the general population
- Wild-farmed interactions can be intense
- Large number of species and growing environments

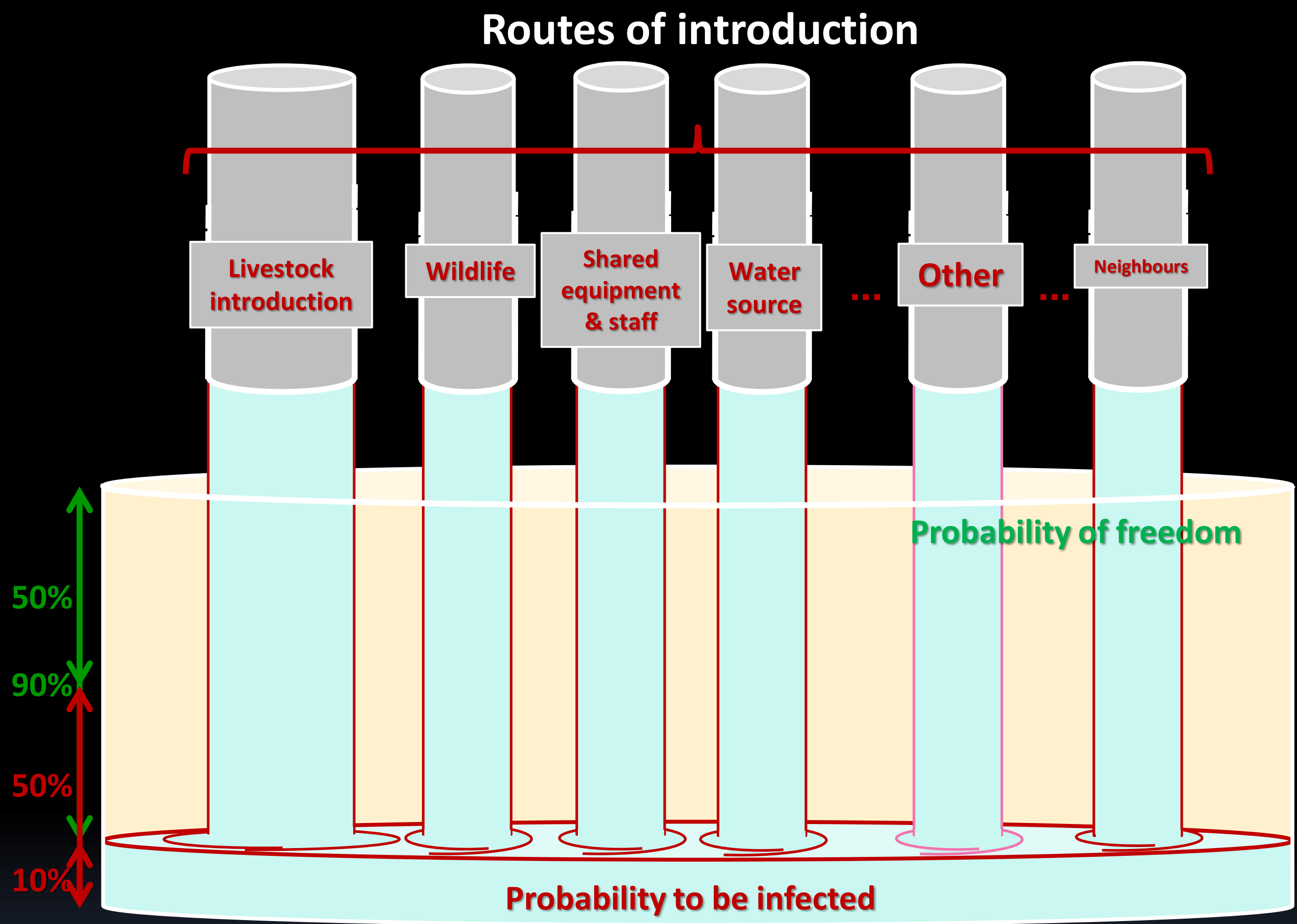
- Need strategies to conserve resources and increase probability of detecting cases in early stage of outbreak

Probability of Freedom

Exporting Party

-Country
-Zone
-Compartment
-Farm





Exporting Party

- -Country
- -Zone
- -Compartment
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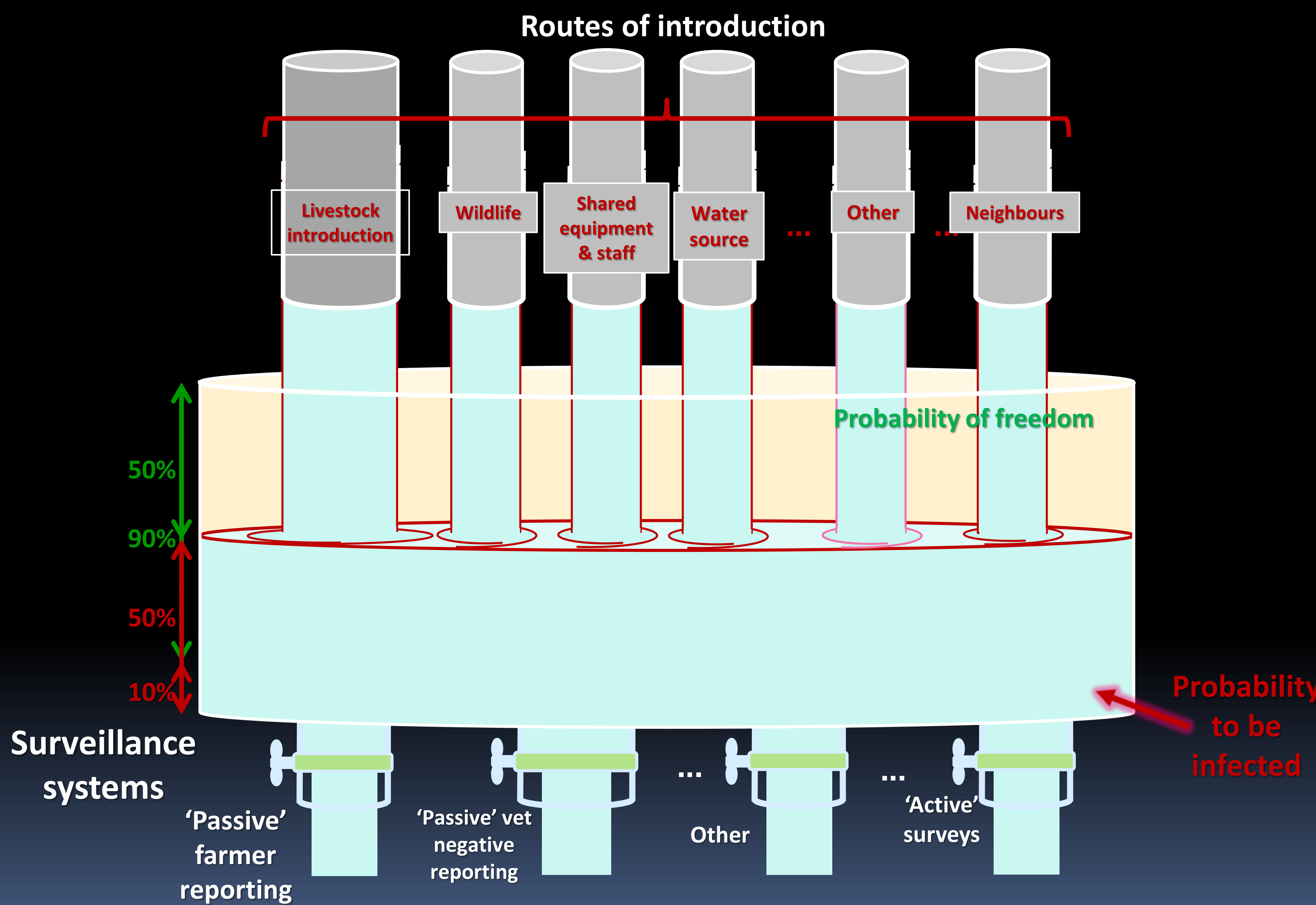
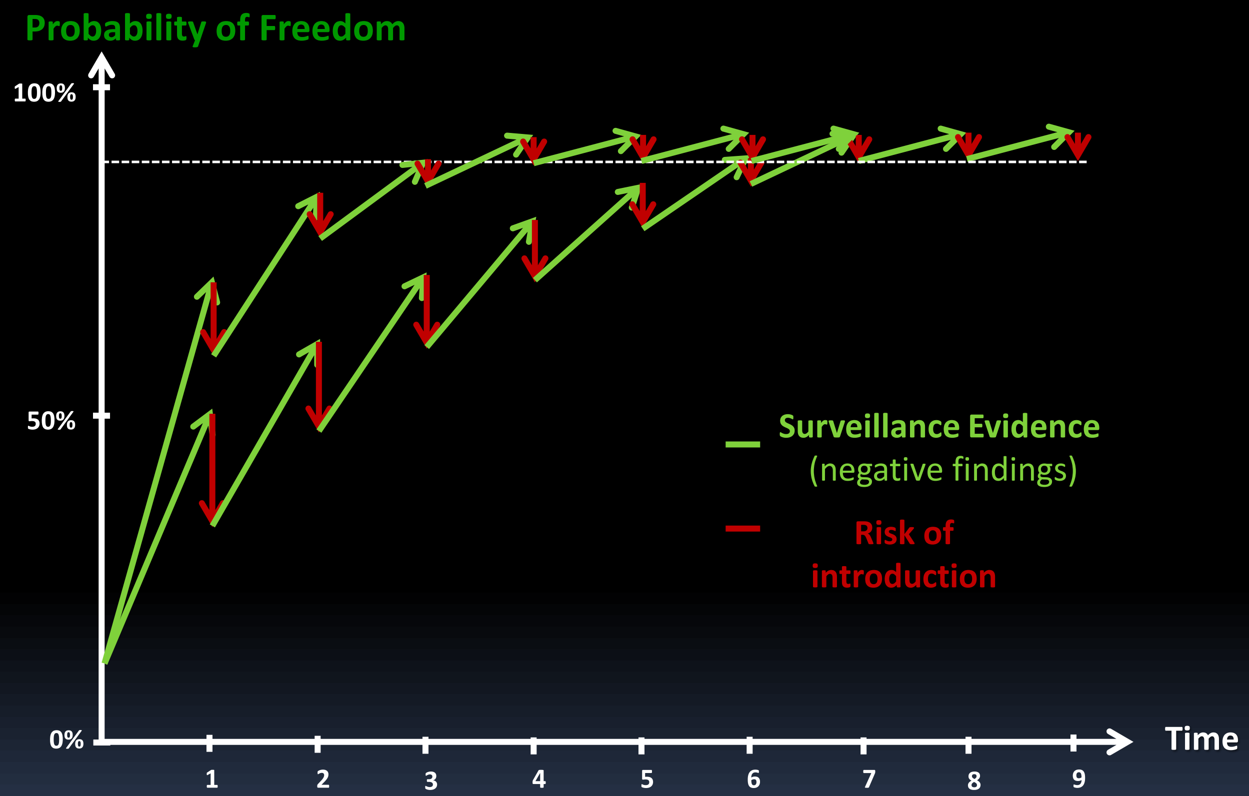
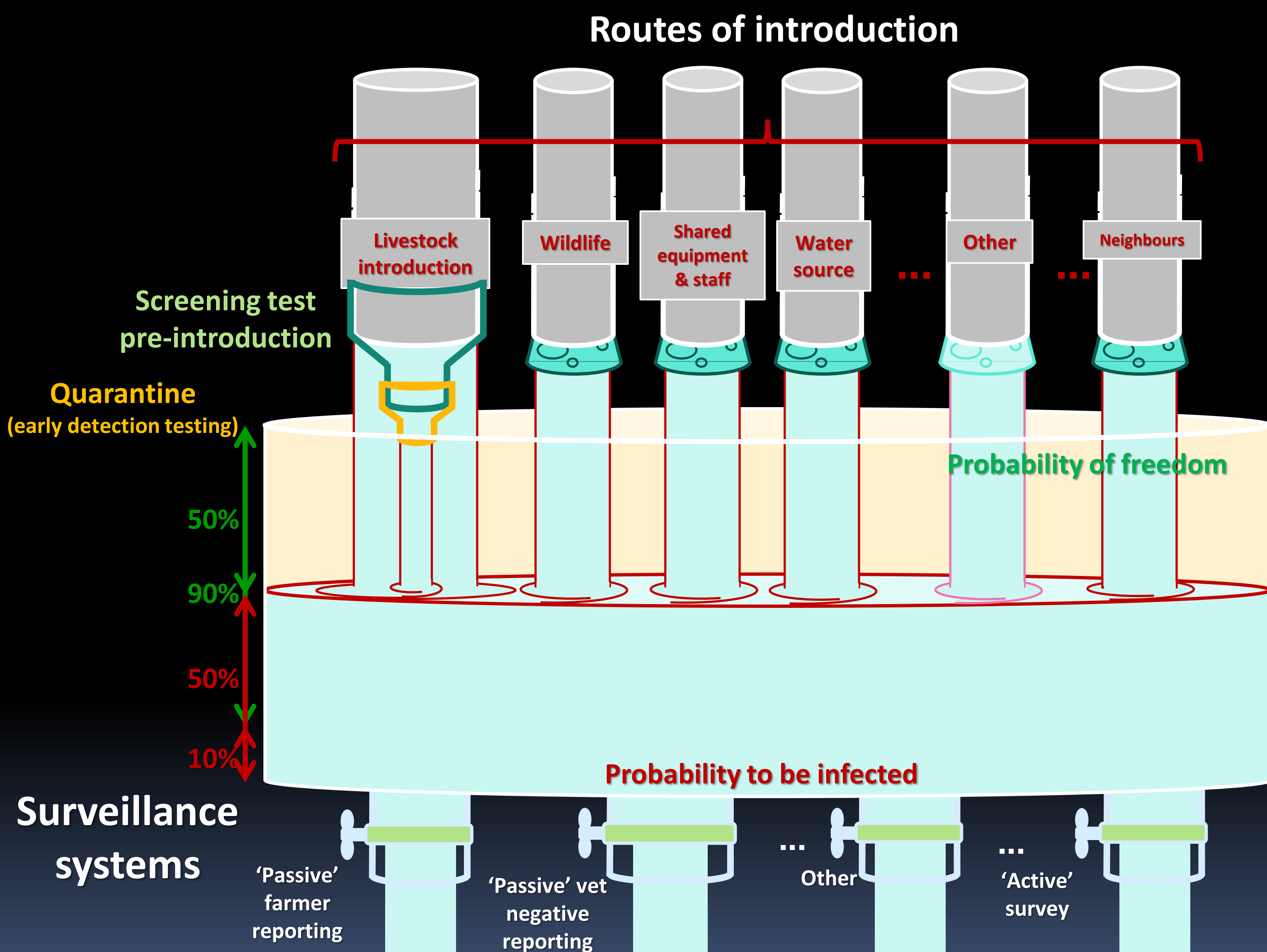

Routes of introduction
Livestock introduction
Wildlife
Shared equipment & staff
Water source
…
Other
…
Neighbours
Probability of freedom
50%
90%
50%
10%
Probability to be infected
Surveillance systems
'Passive' farmer reporting
'Passive' vet negative reporting
…
Other
…
'Active' surveys

Historical Surveillance





Routes of introduction
Livestock introduction
Wildlife
Shared equipment & staff
Water source
…
Other
…
Neighbours
Screening test pre-introduction
Quarantine
(early detection testing)
Probability of freedom
50%
90%
50%
10%
Probability to be infected
Surveillance systems
'Passive' farmer reporting
'Passive' vet negative reporting
…
Other
…
'Active' survey

Low cost surv + No cost control

NO cases
Passive Surveillance

Mod cost surv + No cost control

NO cases
Active Surveillance (early detection if occurred)

D

Mod cost surv + Low cost control

NO cases
Active Surveillance with LOW Specificity (early detection of FALSE positive)

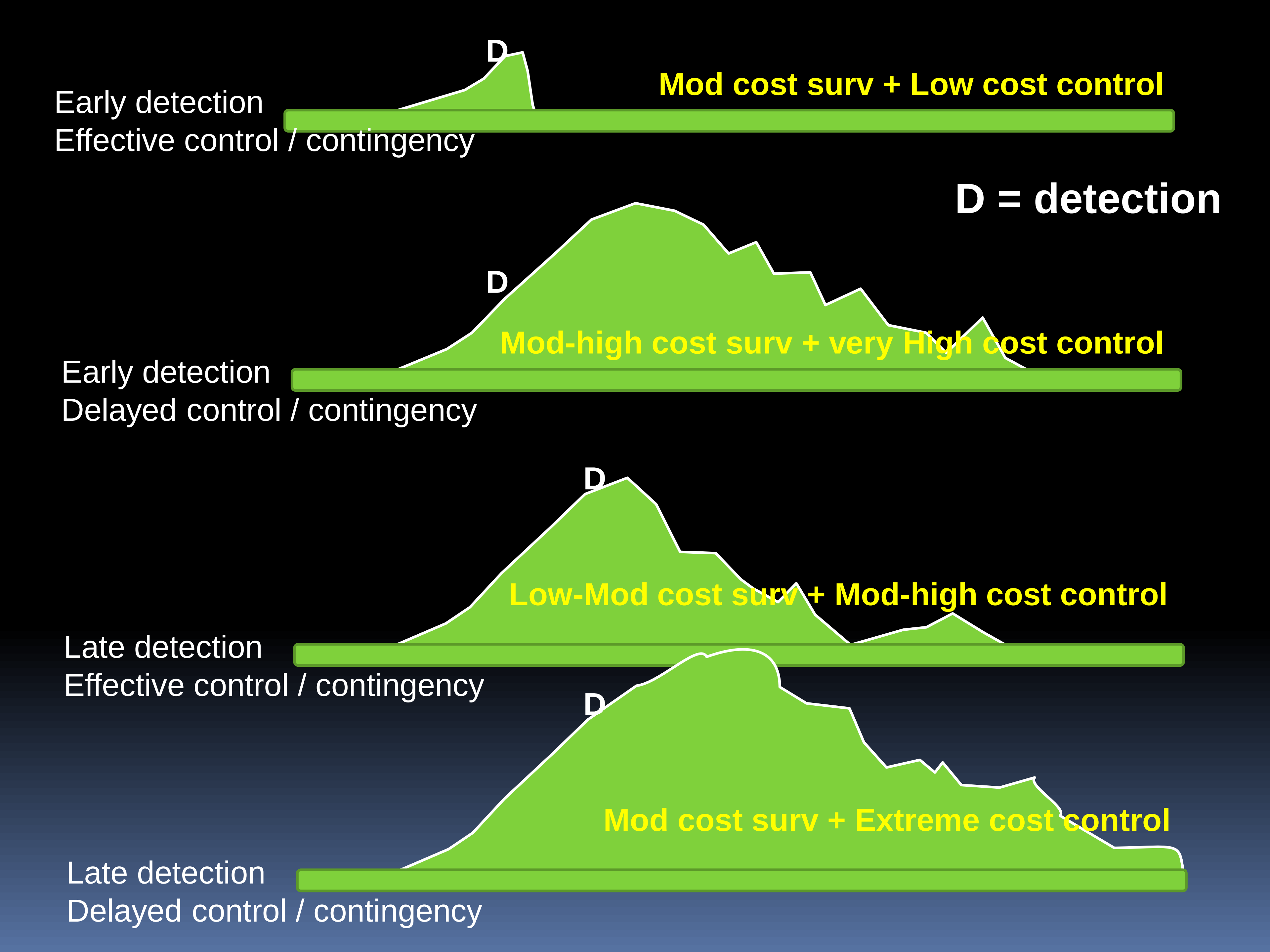
D

Mod cost surv + Mod cost control

Case(s)
Active Surveillance with LOW Sensitivity (delayed detection of true positive)

D = detection

All with effective & rapid control


D
Mod cost surv + Low cost control
Early detection
Effective control / contingency
D = detection
D
Mod-high cost surv + very High cost control
Early detection
Delayed control / contingency
D
Low-Mod cost surv + Mod-high cost control
Late detection
Effective control / contingency
D
Mod cost surv + Extreme cost control
Late detection
Delayed control / contingency

Surveillance design

- **Basic knowledge about aquatic population structures often lacking**
  - e.g. total number of animals stocked, movement of equipment and animals between locations, details of their potential for pathogen introduction
- **Active surveillance**
  - When population structure and potential introduction changes are rapid or unpredictable
  - Uncertainty makes most conclusions about disease status unreliable
- **Risk-based surveillance**
  - Mixed age classes and species at the same farm, close proximity to other sites, and lack of biosecurity barriers
- **Passive surveillance** (if susceptible species present) relies on
  - System able to receive and act on alerts
  - Population dynamics uncertainty is likely associated with unreliable passive reporting system

Biased sampling

Convenience samples

- Risk-based samples
  - Moribund with specific external characteristics known to be more common for disease of interest

Risk-based surveillance

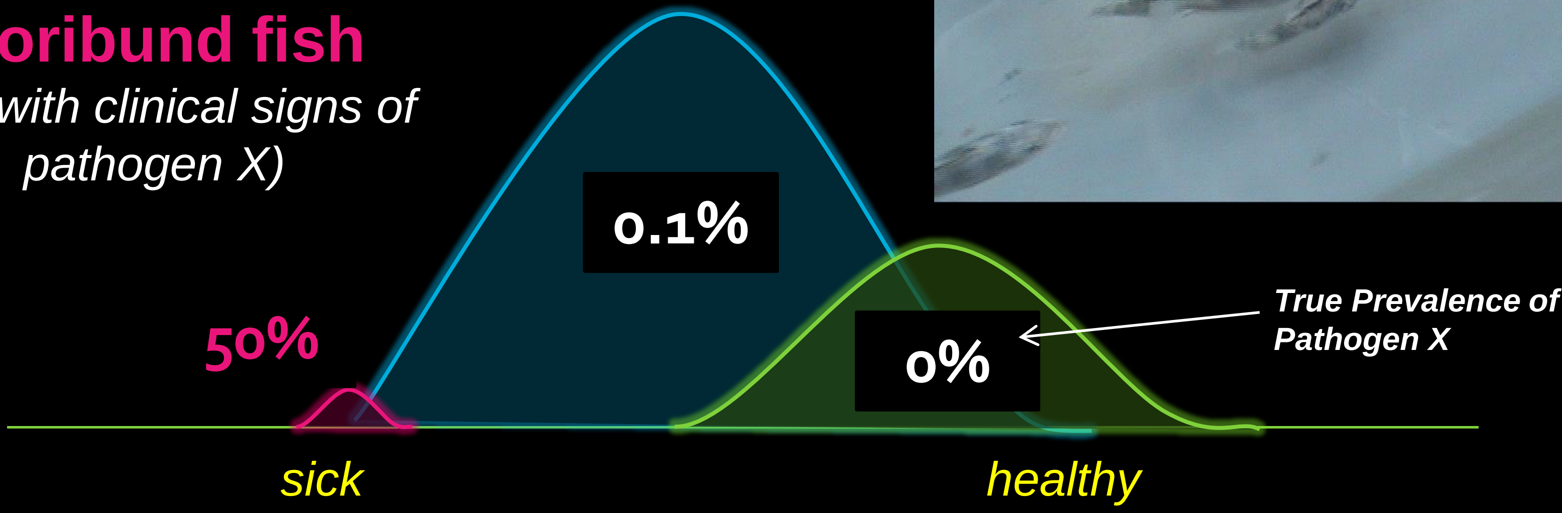
- Goal:
  - Optimize performance of new or existing surveillance systems
- Intentionally use selective sampling of high-risk sub-populations
  - to increase probability of detecting positive individuals within general population

Risk-based Sampling

- Use BIAS to its advantage
  - But it has limitations
- Is bias “direction” known?
  - Assumptions that bias toward detection if sample sick or slow individuals
  - From population perspective:
    - Sample is from “sick population” (i.e. sick segment of population)
- Dangerous IF make an error in the direction of the bias
  - If bias away from infection, decrease probability of inclusion of infected individual

Moribund fish

(fish with clinical signs of pathogen X)

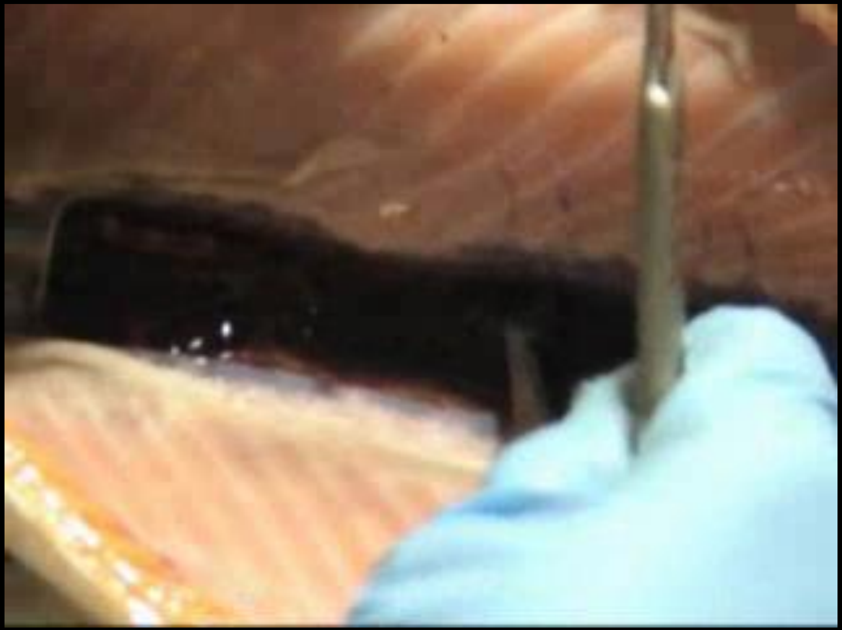


Prevalence in sample of moribund fish DOES NOT estimate prevalence in general population

Prevalence vs detection

- Selection bias toward detection is not used to estimate prevalence
- Detecting ZERO positive in biased (i.e. toward detection) sample is more reliable than ZERO positive in random sample
- Only a few opportunities in production cycle for random sampling
  - Usually handling stresses involved

Disease detection



- Diagnostic tests are imperfect
  - Particularly when attempting to detect asymptomatic individuals
- New cultured species *will* have new pathogens identified

Biasing samples can be good

- We routinely bias our samples toward detection
  - By looking for individuals that have characteristics common in the diseased population
    - Smaller individuals (compared to cohorts)
    - Off-feed or altered swimming behaviour
    - Slow swimmers
    - Fish with lesions
- Can identify higher risk farms or clusters of farms to purposively apply same selection bias

Conclusion

- Optimizing disease control and prevention requires surveillance evidence to support practices
- Sampling and test performance are two important considerations for surveillance programs
  - Affecting decisions and confidence in results
- Contingency plans should be included to address surveillance outcomes