



Sample Size Requirements for Detecting the Presence of Disease

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January 18, 2006

Disease Surveillance

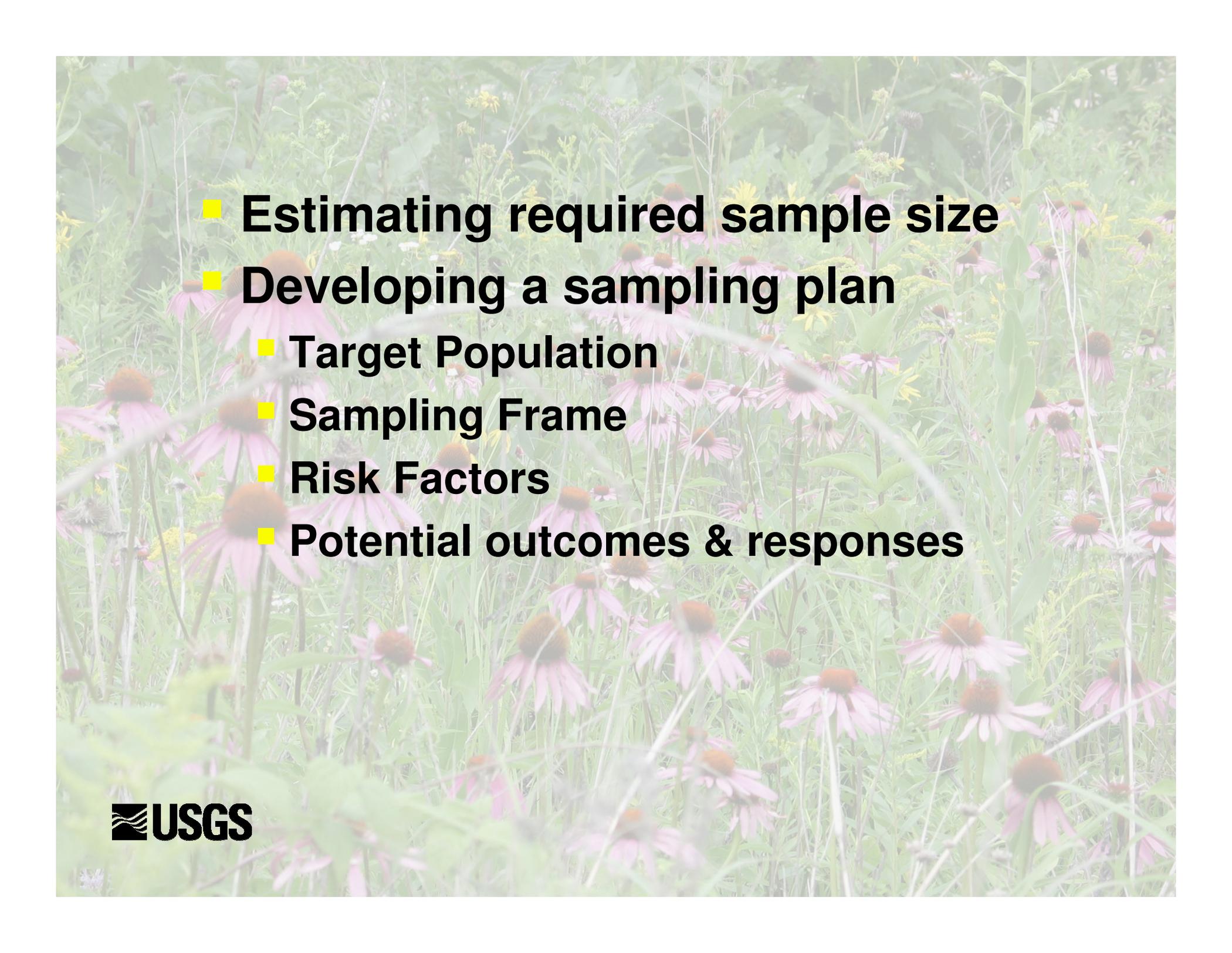
- **Detecting disease in new populations or areas**
- **Assessing prevalence and extent**
- **Monitoring change in prevalence or extent**

Disease Surveillance

- **Detect: Is the disease present?**
- **Assess: How many animals are infected? What is the proportion of animals that are infected? How widespread is the infection?**
- **Monitor: Is the prevalence decreasing in response to management actions?**

Disease Surveillance

- **Detect:** Finding at least one infected animal
- **Assess:** Estimating mean and characterizing spatial distribution
- **Monitor:** Estimating changes before and after management action

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- **Estimating required sample size**
 - **Developing a sampling plan**
 - **Target Population**
 - **Sampling Frame**
 - **Risk Factors**
 - **Potential outcomes & responses**

Estimating Required Sample Size

- **Detection defined as finding at least one infected animal in the sample**
- **Infected animal = shedding virus**
- **Use hypothesis testing framework to translate biological questions into statistical context**

Estimating Required Sample Size

- $H_0: p = 0$
- $H_a: p \geq \text{threshold of concern (TC)}$
- Decision rule is reject H_0 if find 1 or more infected bird in sample
- Type I error – reject H_0 when true
- Type I error = 0 in this case
- Type II error – accept H_0 when false
- Power = 1 – type II error

Estimating Required Sample Size

- How large of a sample size do we need to reject H_0 (i.e., find one infected bird in the sample) when H_a is true (i.e., $p \geq TC$)?
- Power = $\Pr(\text{reject } H_0 \mid p \geq TC)$
- Power = $1 - (1 - p)^n$
- more math
- $n = \log(1 - \text{Power}) / \log(1 - p)$
- Set Power = .95 and TC = 1.5%
- $n = \log(1 - .95) / \log(1 - 0.015) = 200$

Estimating Required Sample Size

- Choice of power is arbitrary
- Threshold of concern
 - Assumed prevalence
 - Biological meaningful value
 - Action level
- Adjust for finite populations

Handout

Developing a Sampling Plan

Other Considerations

- Risk factors
- Target population
- Sampling frame & sampling units
- Potential outcomes & responses

Risk Factors

- **Defined in report from CWD Workshop**
- **Discussed 2 types**
 - **Related to exposure – the introduction of the disease into a new area or population**
 - **Related to amplification – the spread of the disease through the population or region**

Risk Factors – Chronic Wasting Disease

- **Exposure risk factors**
 - **Areas adjacent to CWD-positive wildlife**
 - **Areas with CWD-positive farmed or captive herds**
 - **Areas with concentration of farmed or captive elk or deer**
 - **Areas that have received translocated deer or elk from CWD-affected regions**
- **Amplification risk factors**
 - **Areas with high elk or deer density**
 - **Areas with a history of CWD animals or CWD contaminated environments**
 - **Areas with low abundance of large predators**

Risk Factors – Avian Influenza

- **Exposure risk factors**
 - Migrate directly between NA/AK and SE Asia
 - Contact with MB species found in outbreak areas
 - Contact outbreak areas
 - Mixing with poultry or domestic birds in SE Asia
 - Mixing with poultry or domestic birds in US (if found in poultry first)
 - Speed of migration
- **Amplification risk factors**
 - Gregarious
 - Intermingle with other species at staging areas

Target Population

- **Migratory bird populations are dynamic**
- **For detection, use risk factors to identify target population**
- **For assessment & monitoring, may use risk factors differently**
- **Define before begin surveillance**

Sampling Frame & Sampling Units

- **Sampling wildlife populations presents many challenges**
- **Consider differences between the target population and the ‘sampled’ population**
- **Define sampling biases**
- **Incorporate ways to evaluate their impact**
- **For detection, capitalize on attributes of infected animals**

Potential Outcomes and Responses

No Infected Birds Detected

- Evaluate power of survey to detect prevalence rates of interest.
 - $\text{Power} = 1 - (1 - \text{TC})^n$
 - $\text{TC} = 1 - (1 - \text{Power})^{1/n}$
- Evaluate what you learned about the disease
- Improve your sampling design
- Identify what you still need to know

Potential Outcomes and Responses

At Least One Infected Bird Detected

- **Move to assessment or monitoring**
- **Other management responses?**
 - **Objective of surveillance is to provide managers with information**
 - **Consider potential outcomes now as well as response to those outcomes**
- **How do sampling strategies change if HPAI is first detected in poultry or domestic fowl?**

Closing Comments

- Use what you know when developing a sampling plan
- Do it in a way that you can evaluate your assumptions and sampling biases
- Learn from what you do
- Apply what you learned to improve your sampling plans

A photograph of a field of wildflowers, primarily purple coneflowers (Echinacea) with brown centers, and some yellow wildflowers. The flowers are in various stages of bloom and are surrounded by green foliage. The image has a slightly faded or semi-transparent appearance.

Questions?