

OVERVIEW OF CUMULATIVE EFFECTS ASSESSMENT



What is Cumulative Effects Assessment?

Definition:

The process of systematically identifying and analyzing cumulative environmental change as a result of policies, plans, programs and projects

What is Cumulative Effects Assessment? (Cont'd)

Purpose:

to ensure that incremental effects resulting from the combined influences of various actions are properly assessed

What is Cumulative Effects Assessment? (Cont'd)

“Cumulative EIA is environmental assessment as it should have always been, an EIA done well.”

(Duinker, 1994)

Objectives of EIA

- Ensure that potential environmental effects are considered before decisions are made
- Promote sustainable development
- Prevent adverse environmental effects outside of jurisdictions where proposed projects and developments are to be located
- Provide opportunity for public participation in decision-making processes

Limitations of Project-Level EIA in Practice

The practice of EIA has generally been limited to evaluating impacts from specific projects and has often excluded the evaluation of cumulative impacts

Limitations of Project-Level EIA in Practice (Cont'd)

- Ignores additive effects of repeated developments in the same ecological system
- Inadequately addresses precedent-setting developments that stimulate other activities, which may not be desirable
- Often ineffective at addressing large-scale and transboundary impacts

What are Cumulative Environmental Impacts?

Definition:

The additive and interactive effects of human activities on an ecosystem over space and time

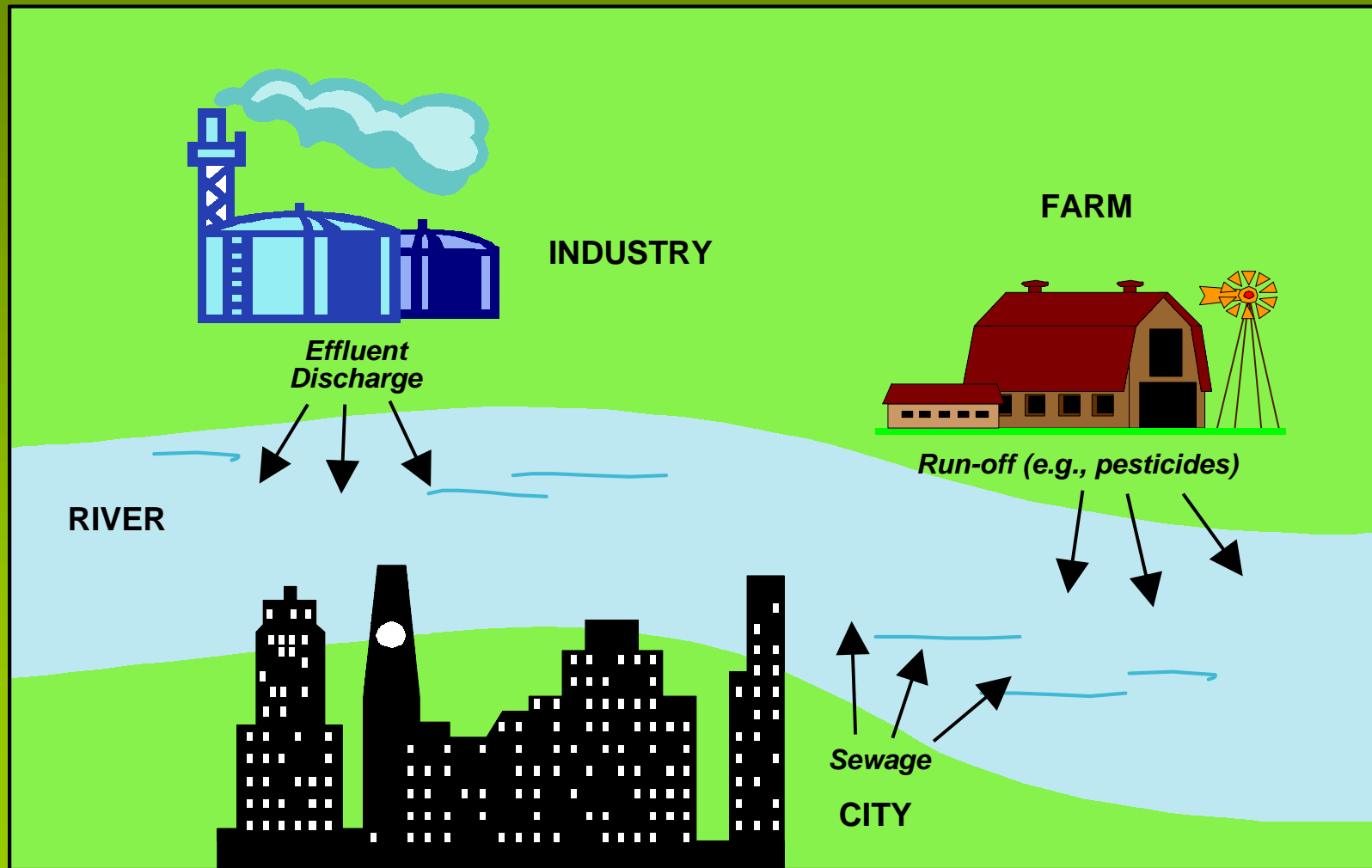
What are Cumulative Environmental Impacts? (Cont'd)

- Single effects almost never occur in isolation, but occur together with many other influences
- Long-term changes may occur not only as a result of a single action but the combined effects or impacts of each successive action on the environment

What are Cumulative Environmental Impacts? (Cont'd)

- Individually minor actions that are insignificant on their own can collectively result in significant impacts over a period of time
- **Cumulative impacts** result from the accumulation of human-induced changes across space and over time

Example of Cumulative Effects at a Local Scale



Examples of Cumulative Effects at the Regional Scale

Air: combined SO₂ emissions within a regional airshed from three natural gas processing plants

Water: combined reductions in flow volumes within a river resulting from irrigation, municipal and industrial water withdrawals

Resource use: continual removal of timber from a management area

Cumulative Global Impacts of Concern

Global impacts of concern:

- » Global warming due to increased concentrations of greenhouse gases
- » Ozone depletion due to increased concentrations of CFCs
- » Acidification of water bodies due to acid rain
- » Decline in biodiversity due to alteration and loss of habitat, pollution, overharvesting, etc.

How Do Cumulative Effects Occur?

Cumulative impacts arise from **spatial and temporal crowding** - too much is happening in an area and/or it is happening too frequently

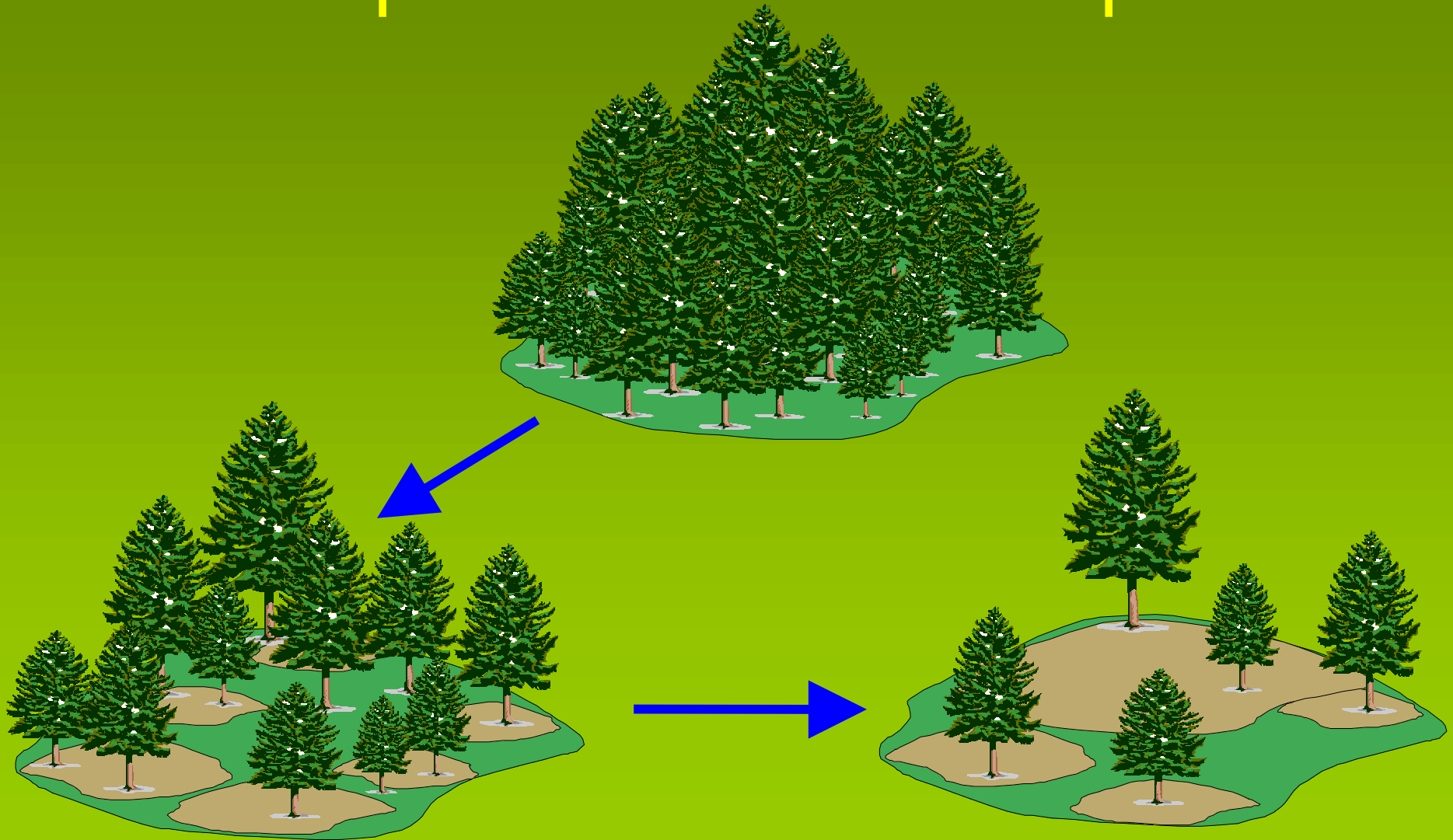
How Do Cumulative Effects Occur? (Cont'd)

- The same kind of activity recurs too frequently through time (e.g., harvesting trees or fish above natural regeneration rates)
- The same kind of activities recur too densely through space (e.g., urbanization)
- Different kinds of activities impose similar consequences on a valued resource (e.g., fishing, loss of habitat, and pollution all combine to result in diminished fish stocks)

Types of Cumulative Impacts

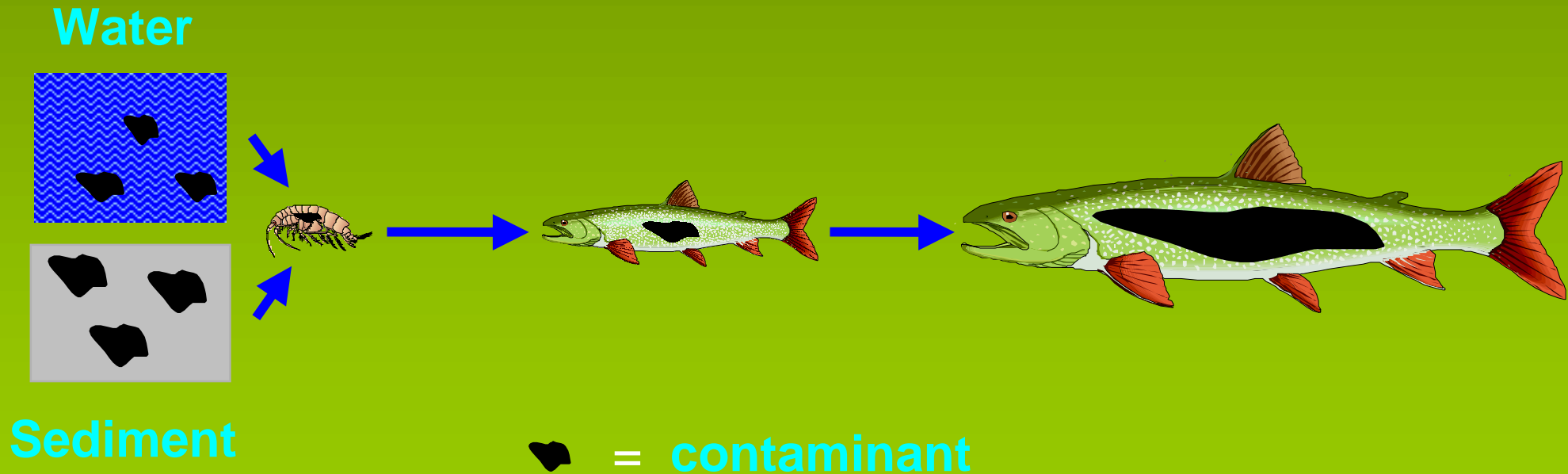
- **Additive:** equal to the sum of individual effects
- **Interactive:** greater than the sum of individual effects
 - » Magnification
 - » Synergistic

Habitat Fragmentation: An Example of Additive Impacts

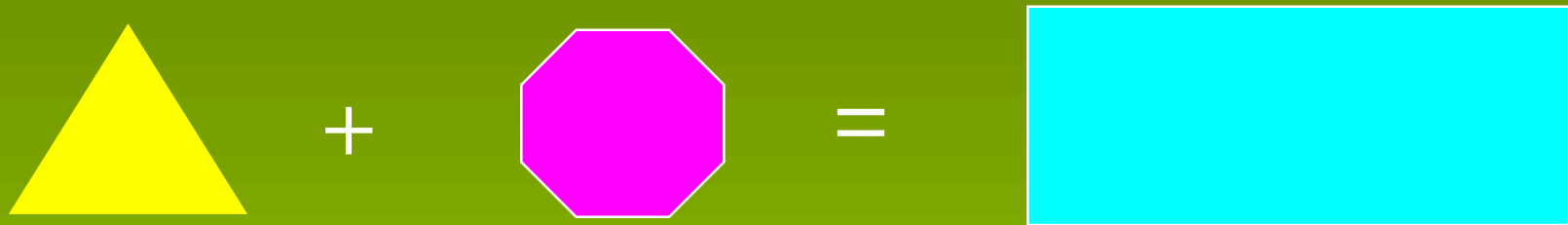


Biomagnification: An Example of Interactive Impacts

A process whereby the concentration of a contaminant in the tissues increases as it passes through one or more trophic levels



Contaminant Synergism: An Example of Interactive Effects



For example: the toxicity of a mixture of chemicals could be greater than would be expected from simply adding the toxicity of the individual chemicals

Major Cumulative Impact Situations

Repeat Offences:

- repeated occurrences of the same small-scale events at the same place (e.g., fishing, salinization of soil from repeated irrigation)

Nibbling:

- similar small-scale events happening simultaneously (e.g., loss of forest habitat during settlement and establishment of agriculture)

(Duinker, 1994)

Major Cumulative Impact Situations (Cont'd)

Multiple Effects:

- several different responses of an ecosystem to one single action

(e.g., forest harvesting results in loss of habitat for birds and wildlife, soil erosion, increased sedimentation to rivers)

(Duinker, 1994)

Major Cumulative Impact Situations (Cont'd)

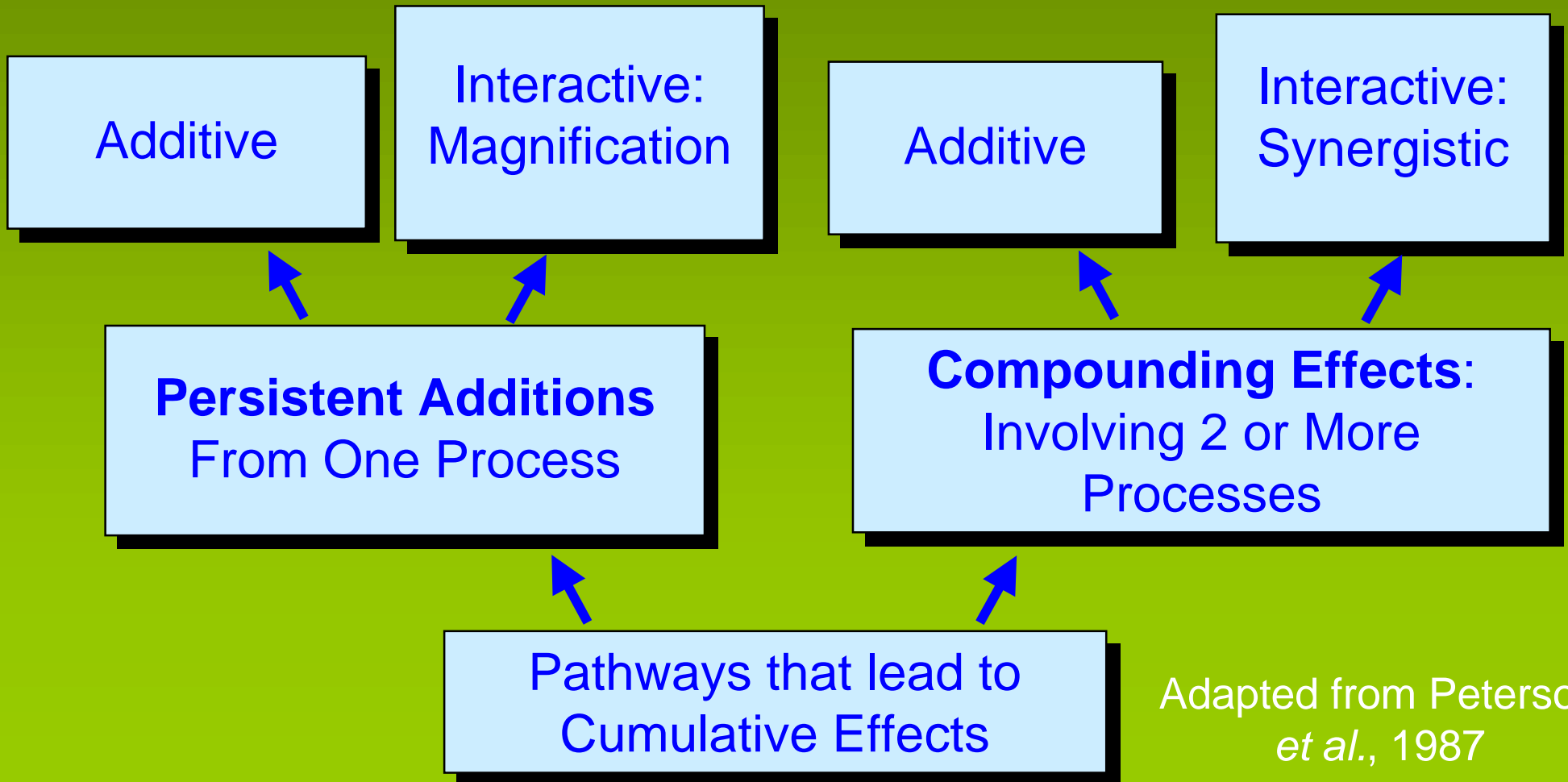
Multiple Causes:

- several agents of change occurring on an ecosystem or VEC

(e.g., multiple industrial discharges or decrease in fish population as a result of multiple stresses such as of fishing, hydroelectric development and industrial discharges)

(Duinker, 1994)

Functional Pathways that Contribute to Cumulative Effects from Multiple Causes



Adapted from Peterson
et al., 1987

Why do Cumulative Impact Become Difficult Problems?

INCREASE IN SPACE AND TIME

*Additive
Effects*

*Multiplying
Effects*

*Discontinuous
Effects*

*Long-term
System Change*

DECREASE IN PREDICTABILITY

Why is CEA Important?

- There is increasing evidence that the most **devastating environmental effects** may not be from the direct effects of a particular action, but from the **combination of individual minor effects** of multiple actions over time
- Consideration of the potential for new projects to exacerbate these problems has not been effectively integrated into project-level EIAs

Advantages of CEA

- Provides an estimate of the incremental impact of a proposed project or activity and of the total impact to the environment after addition of the increment
- Assesses not just single projects but concurrent or similar projects occurring sequentially in an area

Advantages of CEA (Cont'd)

- Evaluates environmental impacts of policy, program and plans in addition to projects
- Assesses effects over larger areas and can address transboundary concerns
- Assesses effects during longer time periods, into the past and future
- Evaluates significant effects taking into account cumulative, regional and global effects

Advantages of CEA (Cont'd)

Considered best practice
in environmental impact
assessments



Scales of Analysis for Addressing Cumulative Impacts

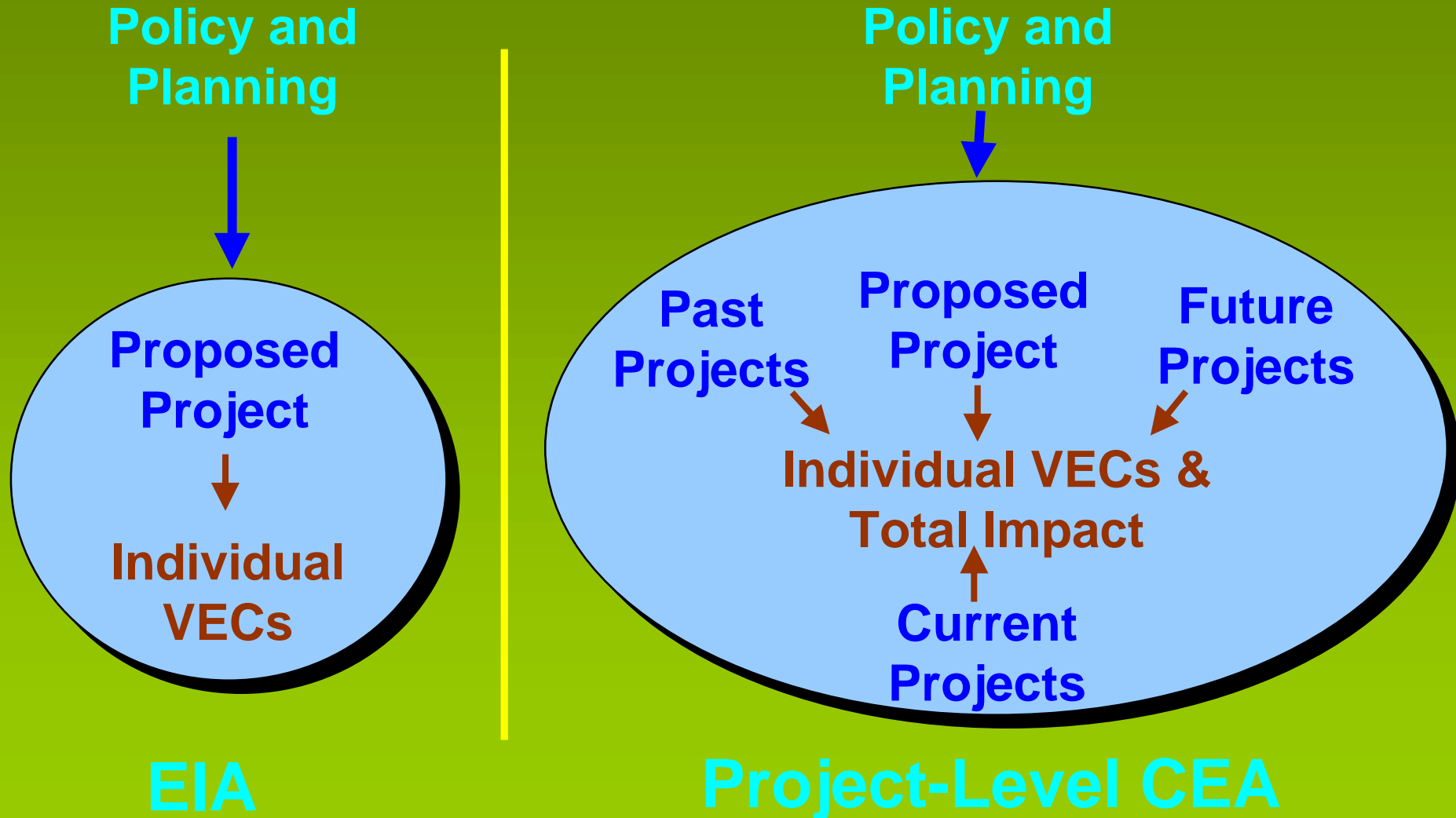
Project-level CEA: evaluates the interaction from all potential impacts associated with a project and with effects from other projects (i.e., past, present and foreseeable future)

Strategic Environmental Assessment (SEA): evaluates potential direct, indirect and cumulative impacts of alternative actions, and decisions made at the policy and planning level; evaluates potential impacts to a region from all actions (i.e., past, present and foreseeable future)

Distinction between Project-Level EIA, Project-Level CEA and SEA

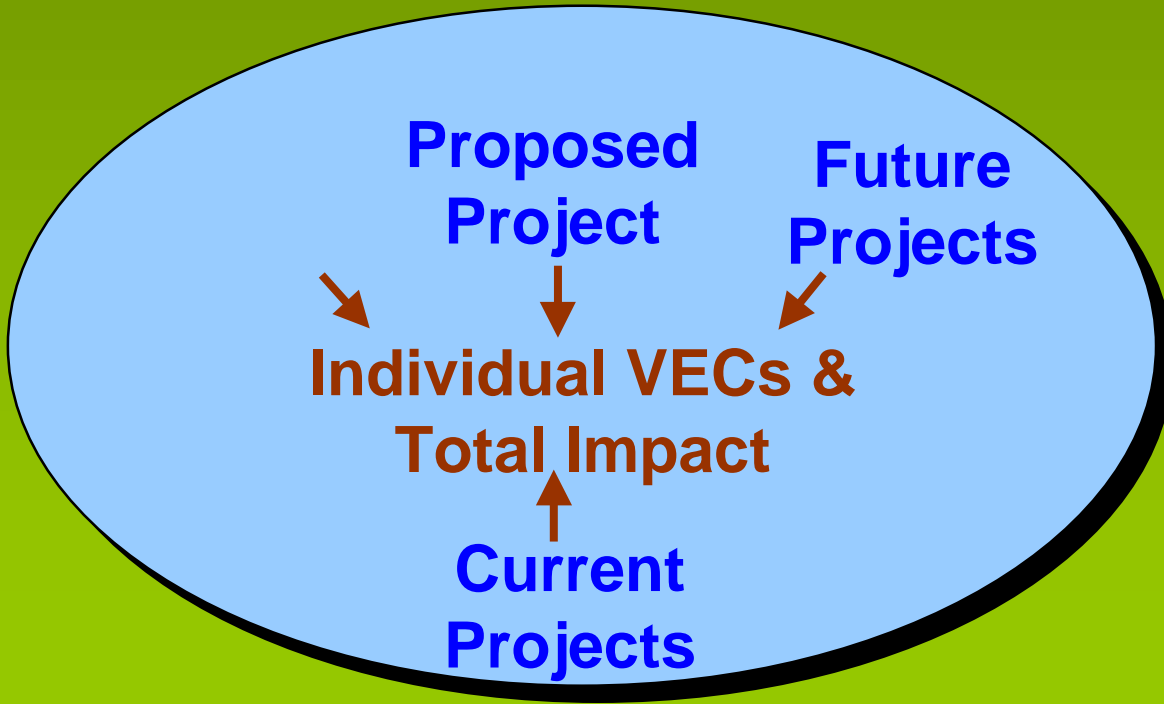
- Project-level EIA addresses specific issues and impacts at specific locations
- Project-level CEA addresses all issues of the EIA but also incorporates assessment of cumulative effects
- SEA is broader in scope and is used to direct human activities (e.g., proactively guide policy and planning development to address cumulative impact concerns)

Comparison of Focus Between EIA and Project-Level CEA



Comparison of Focus Between Project-Level CEA and SEA

Policy and Planning



Project-Level CEA



Proposed Projects

SEA

Scientific Challenges in Evaluating Cumulative Effects

- Limited knowledge and understanding on the relationships and tolerances of ecological systems
- Predictions of what will happen (e.g., human influences and ecosystem responses) are highly uncertain
- Extremely complicated analysis (i.e., must address multiple actions and additive or interactive effects at different time and spatial scales)

Uncertainty

- There will **always** some degree of uncertainty associated with CEA
 - » scientific expertise and techniques may be inadequate
 - » historical background data may not exist
 - » new or unproven technology may be included in the project proposal

Uncertainty (Cont'd)

- Another major source of uncertainty relates to what future projects should be considered in the CEA, and when those projects are scheduled to proceed
- Use a weight-of-evidence approach when evaluating which projects to consider within the context of the current proposal
 - » in other words, how strong are the indicators that the other projects will proceed?

Determining the Significance of Cumulative Impacts

- The significance of potential cumulative impacts can be evaluated against an ecosystem's threshold disturbance level
 - » threshold refers to the point at which added disturbances within the ecosystem or region will result in major system deterioration or collapse
 - » can be qualitative or quantitative (i.e., such as a numerical standard)
 - » thresholds are related to an ecosystem's carrying capacity

Significance of Cumulative Impacts (Cont'd)

- Carrying capacity within the context of CEA can be thought of as the ability of a natural system to absorb the effects of development or human population growth without significant degradation or breakdown
- Determining an ecosystem's threshold level of disturbance can be very difficult, due to the inherent complexity of natural systems

Significance of Cumulative Impacts (Cont'd)

Finally, societies need to determine the limits of acceptable change in environmental components resulting from natural resource extraction and development



Management Requirements for Addressing Cumulative Impacts

- Interdisciplinary approaches
- Incorporate public input
- Develop adaptive and flexible policies (e.g., policies must be learning-based, not control-based)
- Use of various methods and tools to identify and evaluate system changes over different spatial and temporal scales (e.g., annual sampling is insufficient)

Management Requirements for Addressing Cumulative Impacts (Cont'd)

- Effective institutions
 - » Coordination and participation across government agencies
 - » Consensus-based decision making
 - » Enhance legal protection at the ecosystem level
 - » Adopt a systems perspective
 - » Be adaptive and responsive
 - » Ensure adequate funding

Lack of Guidelines

- Few regulations or guidelines have been developed for planning and conducting CEA
- In the absence of specific guidelines, it is often easy to not address cumulative impacts at all
 - » in instances where cumulative impacts are addressed, they may not be considered until quite late in the EIA process

CEA Guidelines

- The development of effective criteria and guidelines for CEA is one of the best ways to overcome the barriers to CEA
- The Canadian Cumulative Effects Assessment Working Group has developed some guidelines
 - » these could be adapted for use in the Lower Mekong Basin

CEA Guidelines

1. The study area is large enough to allow the assessment of VECs that may be affected by the project. This may result in an area that is considerably larger than the project's 'footprint'. Each VEC may have a different study area.

CEA Guidelines (Cont'd)

2. Other actions that have occurred, exist, or may yet occur which may also affect those same VECs are identified. Future actions that are approved within the study area must be considered if they may affect those VECs and there is enough information about them to assess their effects. Some of these actions may be outside the study area if their influence extends for considerable distances and length of time.

CEA Guidelines (Cont'd)

3. The incremental additive effects of the proposed project on the VECs are assessed. If the nature of the effect's interaction is more complex (e.g., may be synergistic), then assess the effect on that basis, or explain why that is not reasonable or possible.
4. The total effect of the proposed project and other actions on the VECs is assessed.

CEA Guidelines (Cont'd)

5. These total effects are compared to thresholds or policies, if available, and the implications to the VECs are assessed.
6. The analysis of these effects use quantitative techniques, if available, based on best available data. This should be enhanced by qualitative discussion based on best professional judgment.

CEA Guidelines (Cont'd)

7. Mitigation, monitoring and effects management should be recommended (i.e., perhaps as part of an Environmental Protection Plan). These measures may be required at a regional scale (possibly with other stakeholders) to address broader concerns of effects on VECs.
8. The significance of residual effects are clearly stated and defended.

Concluding Thoughts

Important points to remember are:

- Cumulative impacts are the additive and interactive effects of various projects and activities on an ecosystem over space and time
- Limited knowledge and understanding of ecosystems represents a major challenge in predicting and mitigating cumulative impacts
- In the absence of specific CEA requirements and guidelines, cumulative impacts are rarely addressed in a comprehensive and timely manner