CWA Compensatory Mitigation Scaling Incorporating Uncertainty

Bruce Peacock
National Park Service
Environmental Quality Division

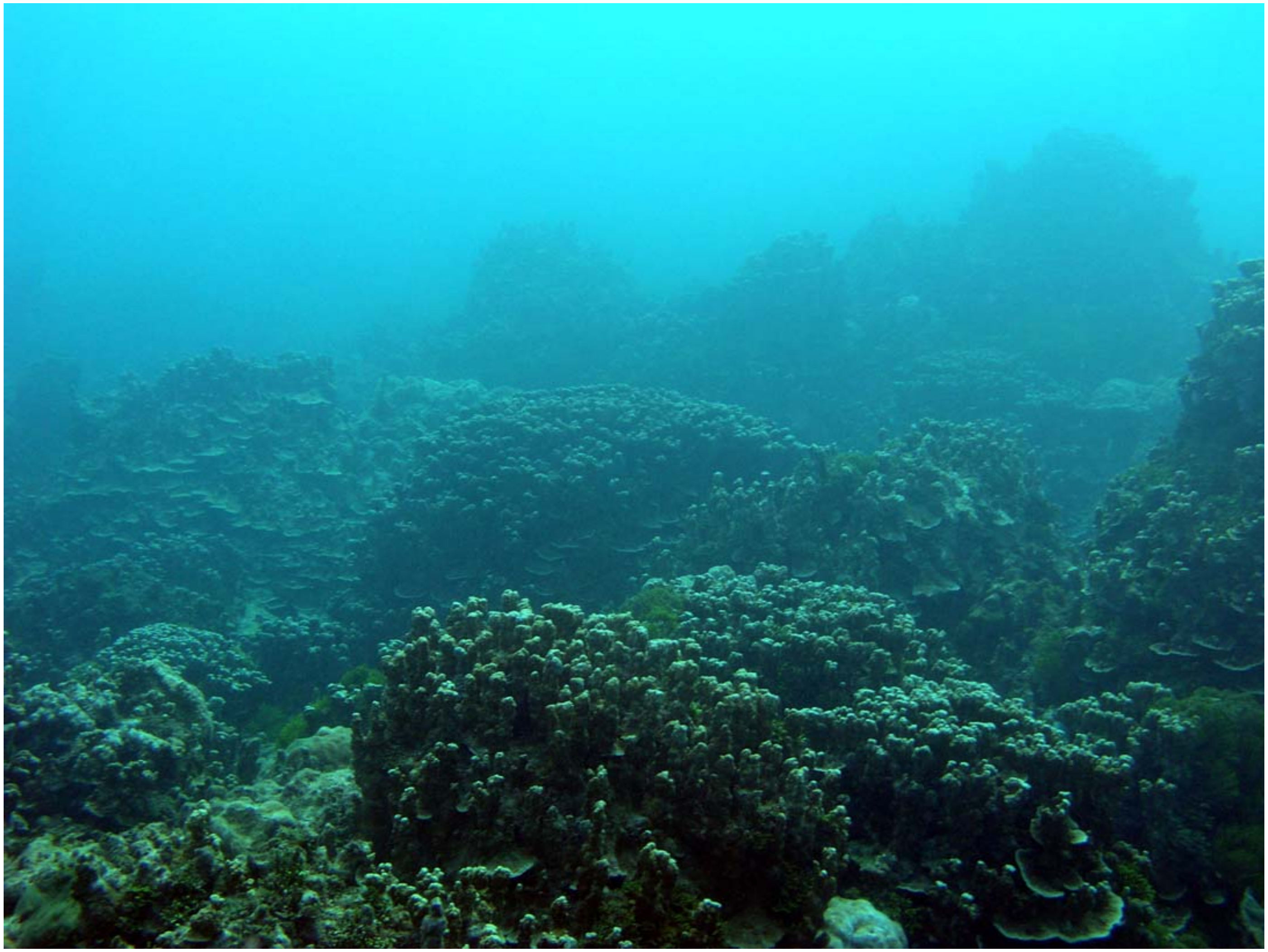
Overview

- Scaling Compensatory Mitigation
- Incorporating Mitigation Uncertainty
- Incorporating Impact Uncertainty

Scaling Compensatory Mitigation

- Example: Kilo Wharf in Apra Harbor, Guam
  - Approximately 19 acres of coral habitat impacted
    - Anchor
    - Dredge
    - Fill
    - Sedimentation
  - Recommended mitigation: Coral recovery through water quality improvements in Cetti Bay
    - Controlling upland sources of sediment deposition
    - Natural coral recruitment and re-establishment

Scaling Compensatory Mitigation



Scaling Compensatory Mitigation

- How much mitigation is enough?
  - New ACOE and EPA regulations for CWA § 404 permitting (2008)
    - Amount must be sufficient to replace lost aquatic resource functions
      - Method of compensatory mitigation
      - ***Likelihood of mitigation success (uncertainty)***
      - Differences between the lost and replacement functions
      - Temporal loss of functions
      - Difficulty of restoring functions
      - Distance between the project and mitigation sites

Scaling Compensatory Mitigation

- Used an ***equivalency*** approach for Kilo Wharf
  - Habitat Equivalency Analysis (HEA)
  - Balances lost ecosystem services with replacement services
  - Originally developed for CWA § 404 mitigation scaling
    - King and Adler 1991
  - Subsequently used in Natural Resource Damage Assessments
  - Flexible enough to accommodate uncertainty

Scaling Compensatory Mitigation

- Loss parameters
  - Severity of impacts: 5 – 100 percent
  - Period of impacts: 2 – 95 years, and into perpetuity
  - Present value of loss: 102 acre-years of coral services
- Replacement parameters
  - Cetti Bay sedimentation control
  - Replacement rate: 3.9 – 36.8 acre-years of coral services per acre of mitigation ***given complete certainty of success***
  - Range of success considered: 50 – 100 percent

Incorporating Mitigation Uncertainty

- Scaling criterion used

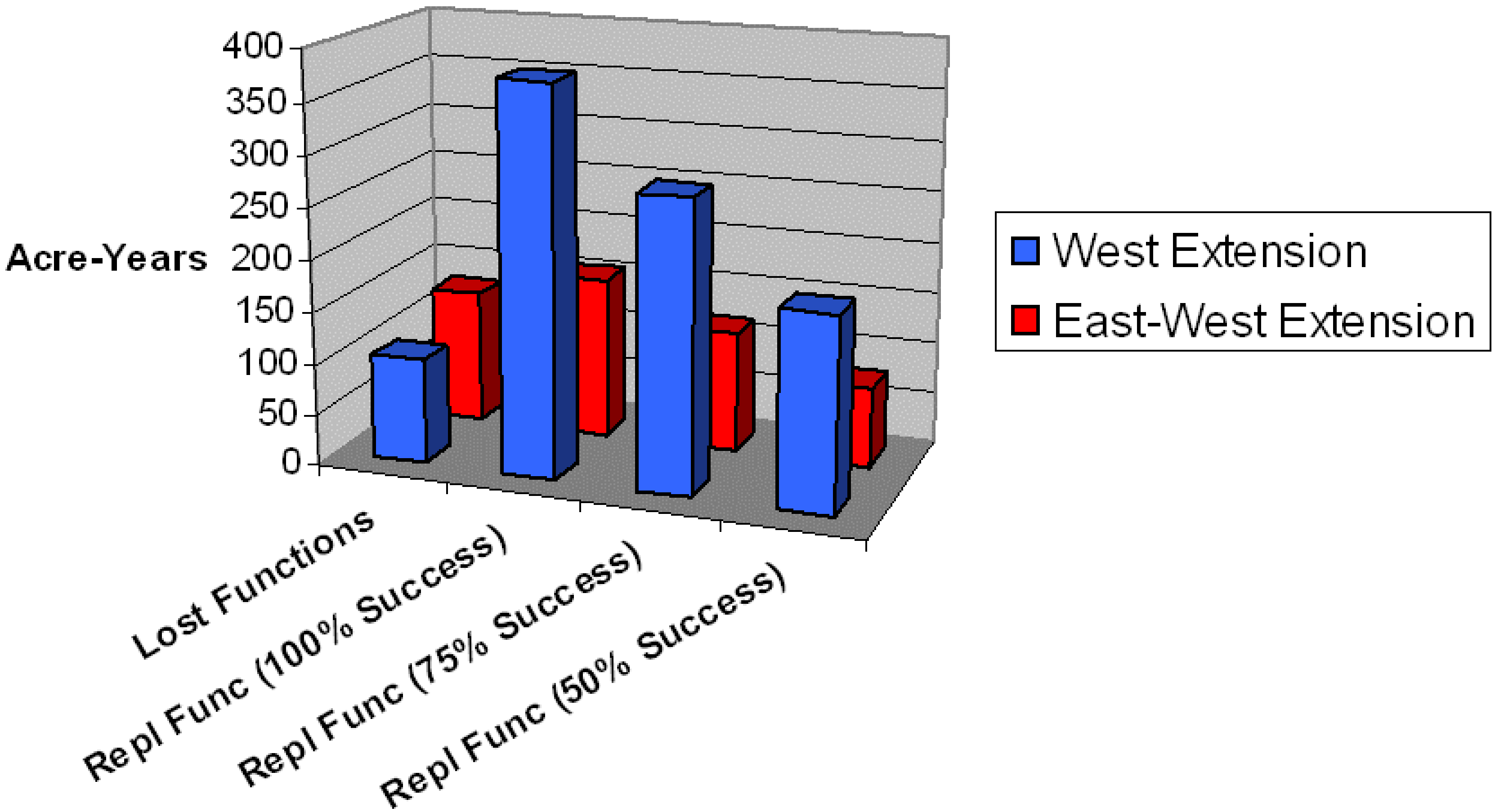
$$\sum_{t=t_0}^{t_1} L_t (1+i)^{(P-t)} = a \sum_{s=s_0}^{s_1} R_s (1+i)^{(P-s)}$$

- Where
  - L_t = Lost services in year t
  - R_s = Replacement services in year s
  - a = Likelihood of mitigation success
  - i = Discount rate

Incorporating Mitigation Uncertainty

- Results for Kilo Wharf
  - Present value of loss: 102 acre-years of coral services
  - Expected present value of replacement at Cetti Bay:
    - 188 – 376 acre-years of coral services
    - 50% – 100% likelihood of mitigation success
  - Cetti Bay project likely to mitigate impacts of Kilo Wharf over a wide range of mitigation success

Incorporating Mitigation Uncertainty



Incorporating Impact Uncertainty

- Scaling criterion used

$$a\sum_{t=t_0}^{t_1} L_t (1+i)^{(P-t)} = \sum_{s=s_0}^{s_1} R_s (1+i)^{(P-s)}$$

- Where
  - ***L_t*** = Lost services in year t
  - ***R_s*** = Replacement services in year s
  - ***a*** = Likelihood of impact
  - ***i*** = Discount rate

Incorporating Impact Uncertainty

- Example: Garrison Diversion in North Dakota
  - Bureau of Reclamation water supply study
  - Study of inter-basin water transfers between Missouri River and Red River basins
    - Crosses the Continental Divide
  - Concern about potential transfers of invasive biota
    - Lake Winnipeg commercial fishery
    - Hudson Bay drainage
    - Ecological Risk Assessment
    - Consequence Analysis

Incorporating Impact Uncertainty

Incorporating Impact Uncertainty

- Results
  - Certain mitigation now to compensate for uncertain impacts in the future
  - Incorporated probability estimates from Ecological Risk Assessment
  - Accounted for a variety of propagation scenarios
  - Estimated a range of mitigation requirements
    - Lake Winnipeg: 2 – 27,750 acres (< 0.5%)
    - Red River: 0 – 2 river-miles (< 0.5%)

Conclusions

- Equivalency approaches such as HEA appear to satisfy the requirements of the new ACOE and EPA regulations for CWA § 404 permitting
- HEA can accommodate mitigation uncertainty
- HEA can accommodate impact uncertainty

Suggested References

- King, D.M., and K.J. Adler. "Scientifically Defensible Compensation Ratios for Wetland Mitigation." Office of Policy, Planning and Evaluation, U.S. Environmental Protection Agency, January 1991.
- Allen, P.D., II, D.J. Chapman, and D. Lane. "Scaling Environmental Restoration to Offset Injury Using Habitat Equivalency Analysis." In Economics and Ecological Risk Assessment, edited by R.J.F. Bruins and M.T. Heberling. CRC Press, 2005.

Suggested References

- Peacock, B. "Habitat Equivalency Analysis of the Kilo Wharf Extension Project in Apra Harbor, Guam." National Park Service, Environmental Quality Division, 2007.
- Linder, G., E. Little, B. Peacock, H. Goeddeke, L. Johnson, and C. Vishy. "Risk and Consequence Analysis Focused on Biota Transfers Potentially Associated with Surface Water Diversions Between the Missouri River and Red River Basins." U.S. Geological Survey, 2005.