















coordination with other land managers and governmental agencies (e.g., voluntary land exchanges and conservation easements) will be more practical than acquisition. Coordination, like acquisition, can both reduce an external challenge generated by a particular land or water use and increase the effective conservation footprint through cooperative habitat management. On conservation matters external to the NWRS boundary, partnership and incentive programs that could be emphasized include the Partners for Fish and Wildlife Program, Refuge Partnership Programs, Safe Harbor agreements, Habitat Conservation Plans, Candidate Conservation Agreements, various Joint Ventures, Conservation Reserve Enhancement Program, and the Natural Resources Conservation Service. Increased partnerships of refuges with other Fish and Wildlife Service programs—the Endangered Species programs, in particular—could result in cost savings and increased achievement of the USFWS' s goals that they could not achieve acting individually.

#### Communication and Education

Initiating coordinated and focused multi-scale communication, education, and training programs by all NWRS partners (management, research, and other public and private land managers) will enable more effective responses to climate change. National wildlife refuges, especially those near urban centers, can increase public awareness of climate change and the challenges facing wildlife by developing educational kiosks that provide information on the causes and effects of climate change, the effects of habitat loss and fragmentation on refuge species, and potential means to prevent and mitigate these challenges.

A clearly elucidated and formal vision of the desired state of the NWRS on the 150th anniversary of the system in 2053 would enhance adaptation. This vision needs to explicitly incorporate the expected challenges of climate change and define the management philosophy necessary to meet this challenge. The complexity of expected climate effects and necessary management responses offers an opportunity to re-energize a focus on the interconnection of spatially separated units of the NWRS and to foster an integrated refuge-to-NWRS vision. Refuges must be reintegrated into the American mindset and the American landscape in the context of climate change.

#### Conclusions

1. Climate change may be the largest challenge ever faced by the NWRS. It adds a known forcing trend in temperature to all other stressors and likely creates

complex non-linear challenges that will be exceptionally difficult to understand, predict, and respond to.

2. Reducing uncertainty in expected climate change effects is essential to successful adaptation. Rigorous models of possible futures are required to develop a suite of appropriate adaptation responses.
3. Adaptation will be required at multiple scales (i.e., system, region, refuge). The scale of response must meet the scale of the challenge in order to meet the legal mandate of maintaining biological integrity, diversity, and environmental health of the NWRS.
4. NWRS must establish a clear vision of conservation targets (e.g., species, guilds, and habitats) necessary to fulfill the system mission. This vision should be expressed in terms of representation, redundancy, and number and size of units required under various potential climate futures. This will require exceptional leadership and discipline.
5. NWRS must conduct a gap analysis of the adequacy of existing units to meet the conservation target vision. This assessment should include the holdings of conservation partners and be repeated as uncertainty regarding possible climate futures is reduced.
6. NWRS must strategically fill gaps in the vision while reducing non-climate stressors. This activity should capitalize on enhanced communication and collaborations with its conservation partners.
7. The greatest latitude for NWRS to adapt to climate change will be provided by strategic growth and an emphasis on the contribution of surrounding, non-refuge lands to the NWRS mission. The concept of refuges as isolated conservation fortresses managed to resist change will not fulfill the promise (US Fish and Wildlife Service 1999) of the NWRSIA, nor will it meet the needs of American wildlife.

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