# Climate Change and Your National Forest

## Assessing the potential impacts of climate change on El Yunque National Forest

Forestlands across the world are experiencing increased threats from fire, insect and plant invasions, disease, extreme weather, and drought. Scientists project increases in temperature and changes in rainfall patterns that can make these threats occur more often, with more intensity, and/or for longer durations. Natural resource management informed by the best current science enable natural resource professionals to mitigate these impacts and conserve the region's forestlands into the future.

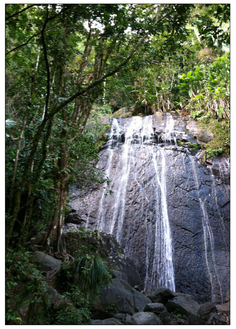
### Climate Trends

- Average temperatures in El Yunque have increased over the past 30 years
- Scientists predict warming will continue at an accelerated pace
- Caribbean precipitation projections suggest drier climate in both wet and dry seasons
- Increasing sea surface temperatures may lift the base altitude of cloud formation, which would further decrease precipitation in El Yunque

### Aquatic Ecosystems

- Shifts in rainfall patterns lead to periods of flooding and drought
- Heavy downpours and more intense hurricanes in the wet season can lead to erosion and sedimentation in waterways
- Altered temperature, precipitation, and run-off will change riparian areas
- Extended droughts in the dry season decrease dissolved oxygen content and lead to habitat squeeze, crowding of species, and a decrease in reproductive output

***Adaptation to climate change as a management goal may provide multiple benefits***



### Biological Diversity

- At risk species must adapt, move, or risk decline
- Species with high genetic variation can more easily adapt
- Higher temperatures force ranges to higher elevations, but the rate of warming and land use changes restrict this option
- Highland species with restricted habitats and at high risk species in montane cloud forests may be pushed beyond their upper elevation limits

### Wildlife

- Altered habitat suitability from warming could prompt population losses, particularly among cool-adapted, range-restricted, high elevation amphibians
- Water loss, disease, and parasites from drought could threaten reptiles and amphibians
- Reduced rainfall could diminish habitat quality for neotropical bird migrants wintering in El Yunque
- Increased major hurricane disturbances could increase habitat competition and nesting predation for cavity-nesting birds

### Extreme Weather

- There is a greater likeliness of heat waves, as well as less frequent but more severe hurricanes in the Caribbean
- Frequency of extreme precipitation events is predicted to increase, leading to potential flooding and landslides
- Longer droughts with decreasing annual rainfall are predicted
- Effects of fire will increase from climate warming and drying, and human activities

### Terrestrial Ecosystems

- El Yunque's tropical montane cloud forests are among the world's most sensitive ecosystems to climate change
- Higher temperatures and changes in precipitation and cloud cover will affect ecosystem processes
- Increasing night-time temperatures may affect tropical tree growth and survival
- Both intensified extreme weather events and drier summers will alter the distribution of tropical forest life-zones
- Moisture stress due to higher temperatures and less cloud cover, affecting growth and flowering of epiphytes
- Plant communities on isolated mountain peaks, unable to move to higher elevations, will be most vulnerable

### Recreation

- The Caribbean region and its year-round warm weather may see increasing competition from other regions as warm seasons expand globally
- Sea level rise will affect coastal resorts, which may affect tourist and recreationist preferences throughout Puerto Rico
- Climate change may affect recreation in El Yunque through ecosystem changes that impact unique scenery and weather patterns disrupting recreation activities
- An increase in extreme weather events may increase damage to facilities and structures, reduce tourist access in some areas, and increase the need for road repairs

### Management Implications

Management activities provide national forests with an opportunity to reduce the susceptibility of their resources to these threats. Adaptation to climate change as a management goal may provide multiple benefits, promoting immediate and long-term forest health. Examples of adaptive strategies include:

- Anticipate changes in visitor behavior and plan to mitigate any seasonal increases in use
- Maintain natural migration corridors between lowland and upland forests to allow species to move upslope into cooler environments as climate warms
- Maintain piles of natural woody debris and promote wetlands and ponds in areas of high amphibian diversity to supplement habitats that retain cool, moist conditions
- Monitor for new invasive species moving into new areas, especially following hurricane events in high-elevation communities
- Mitigate negative effects on sensitive species following hurricane events by promoting the more disturbance-resistant species, such as palms

**Table 1–Climate model projections for changes in precipitation at end of century**

| Source | Spatial Extent | Projection |
|---|---|---|
| Girvetz et al., 2009; Meehl et al., 2007 | Puerto Rico | -10 to -30% annually |
| Campbell et al., 2011 | Caribbean | -25% to -50% annually |
| Biasutti et al., 2012 (IPCC) | Caribbean | -30% in spring and summer |
| Magrin et al., 2007 (IPCC) | Latin America | -40% to +10% annually |

**Table 2–Climate model projections for increases in temperature at end of century**

| Source | Spatial Extent | Projection |
|---|---|---|
| Scatena, 1998 | Puerto Rico | +1.5 to +2.5 °C |
| Girvetz et al., 2009; Meehl et al., 2007 | Puerto Rico | +2.2 to +2.7 °C |
| Campbell et al., 2011 | Caribbean | +2 to +5 °C |
| Christensen et al., 2007 (IPCC) | Central America | +1.8 to +5 °C |
| Magrin et al., 2007 (IPCC) | Latin America | +1 to +7.5 °C |