Acoustic Environment and Soundscape Resource Summary
Crater Lake National Park

National Park Service
U.S. Department of the Interior

Natural Resource Stewardship and Science
Natural Sounds & Night Skies Division

The acoustic environment is a resource with intrinsic value. It is important as a natural resource, a cultural resource, or both. It is a critical component of wilderness character and plays an important role in wildlife communication, behavior, and other ecological processes. Results from multiple surveys indicate that hearing the sounds of nature is an important reason for visiting national parks. Therefore, the value of acoustic environments and soundscapes is related to an array of park resources and has broad implications for park management.

The quality of the acoustic environment is relevant in nearly every unit in the NPS System. When developing the foundation document, park staff should consider the acoustic environment as a resource with inherent value that may be recognized, when appropriate, in the Fundamental Resource and Value, Other Important Resource and Value, or other section of the document. The topics in Attachment 1 discuss the importance of the soundscape and the acoustic environment in relation to park resources and values. Please see Attachment 2 for an example of how Bryce Canyon National Park incorporated soundscapes into various sections of the foundation document.

Sound levels in national parks can vary greatly, depending on location, topography, vegetation, biological activity, weather conditions and other factors. For example, the din of a typical suburban area fluctuates between 50 and 60 decibels (dBA), while the crater of Haleakala National Park is intensely quiet, with levels around 10 dBA. Below are some examples of sound pressure levels measured in national parks.

Decibel level (dBA)	Sound Source	Decibel level (dBA)	Sound Source
10	Volcano crater (Haleakala NP)	80	Snowcoach at 30 m (Yellowstone NP)
20	Leaves rustling (Canyonlands NP)	100	Thunder (Arches NP)
40	Crickets at 5 m (Zion NP)	120	Military jet, 100m above ground level (Yukon-Charley Rivers NP)
60	Conversational speech at 5 m (Whitman Mission NHS)	126	Cannon fire at 150m (Vicksburg NMP)

Quality of the Resource at Crater Lake National Park

Continental Geospatial Model

A single parameter that is useful for assessing a park's acoustic environment is the impact of man-made sound sources in relation to natural acoustic conditions. The Natural Sounds and Night Skies Division (NSNSD) estimates the impacts using predictions from a geospatial sound model. The model predicts how much man-made noise raises natural ambient sound levels. Sound pressure levels for the continental United States were predicted using actual acoustical measurements combined with a multitude of explanatory variables such as location, climate, landcover, hydrology, wind speed, and proximity to noise sources (roads, railroads, and airports). The model predicts daytime impacts during midsummer. The impacts are determined by the difference between the modeled *natural* ambient sounds levels and the predicted *existing* sound levels.

To better express the variation of impact across parks, a park-specific impact map was generated from the geospatial sound model for each park. The park map for Crater Lake NP is shown in Figure 1 below. The map was generated using 270 meter resolution, meaning that each pixel represents 270 square meters. At Crater Lake NP, the mean impact is predicted to be 0.6 decibels (dBA). That is, the existing sound level (with the influence of man-made sounds) is predicted to be less than one decibel above the natural ambient sounds level. Compared to parks throughout the national park system, this is a low number and shows a prominence of

natural sounds at Crater Lake that should be preserved and protected.

One decibel change is not readily perceivable by the human hear, but any addition to this difference could begin to impact listening ability. An increase of 0.6 dBA would reduce listening area for wildlife and visitors by 13%. For example, if a predator can hear a potential prey animal in an area of 100 square feet in a setting with natural ambient sounds, that animal's ability to hear would be reduced to 87 square feet if the sound levels were increased by 0.6 dBA. Similar reduction would occur for visitors and their ability to hear natural sounds or interpretive programs.

The park-specific map is a subset of Figure 2, L_{50} dBA impact sound pressure levels for the continental United States. An inset map is included in each park-specific map to provide a better sense of context, and major roads and highways are labeled for reference. For reference, Figures 3 and 4 show natural and existing sound pressure levels for Crater Lake NP, respectively.

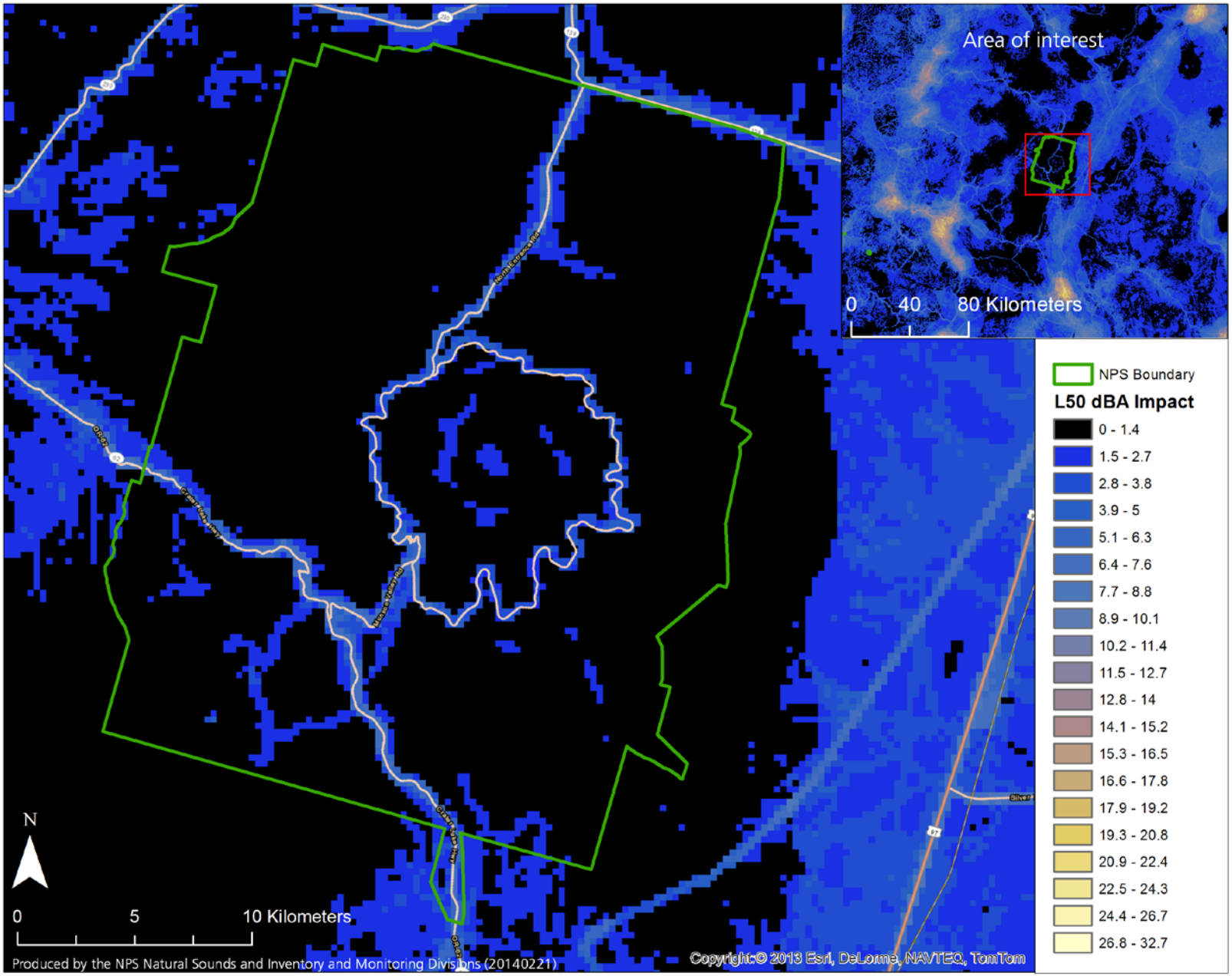


Figure 1. Park-specific impact map for Crater Lake NP. (note: each figure has different scale values)

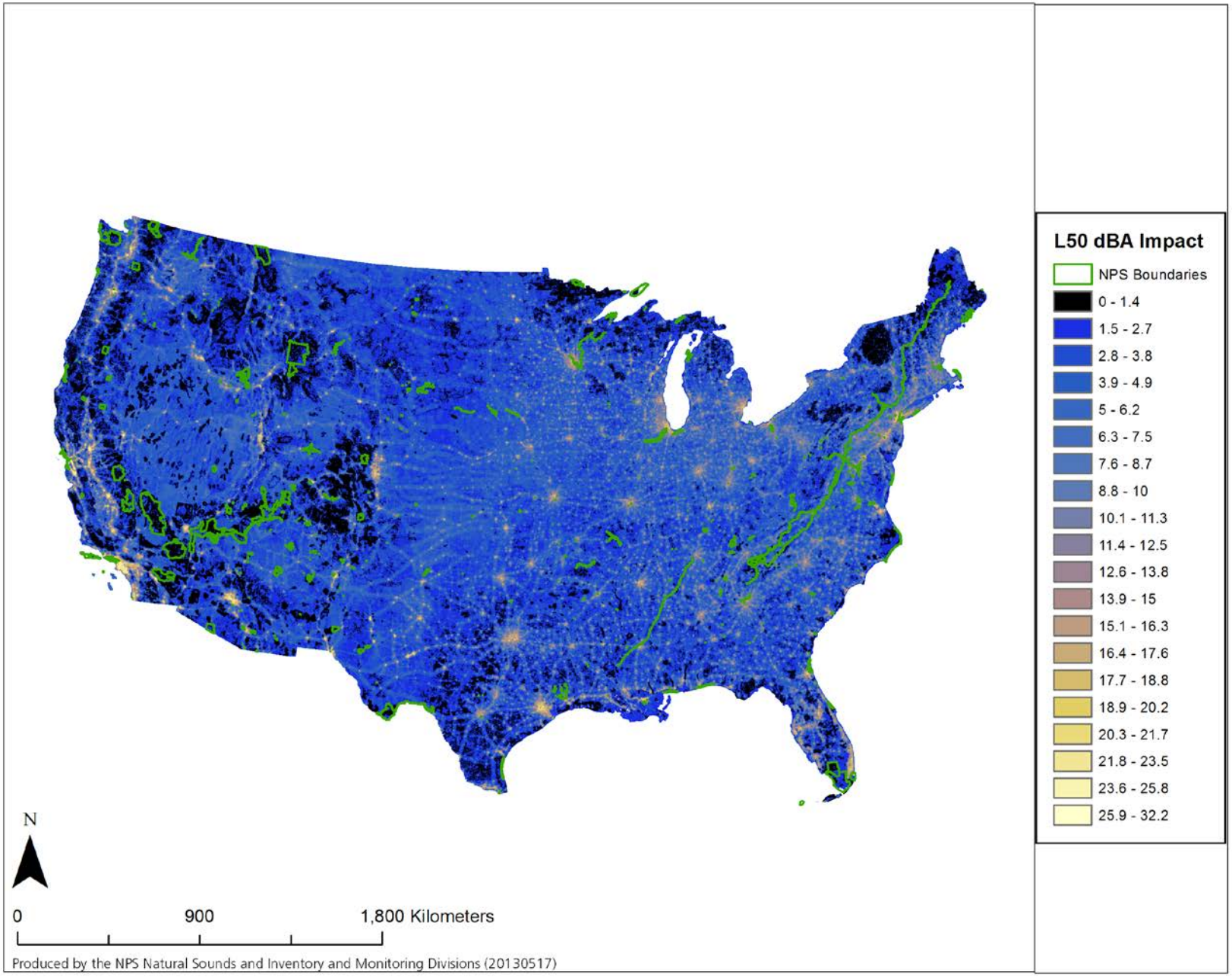


Figure 2. L_{50} dBA impact sound pressure levels for the continental United States. (note: each figure has different scale values)

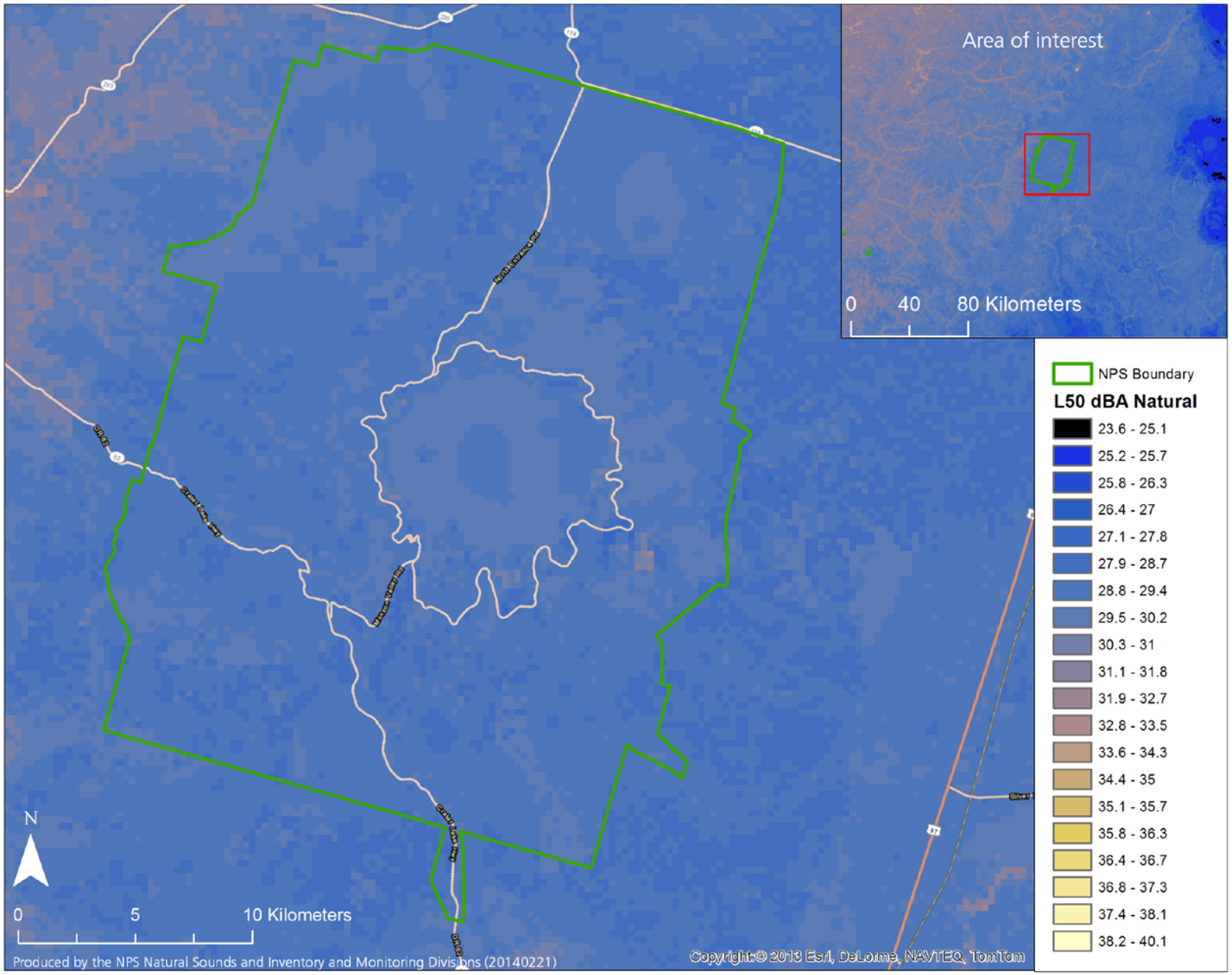


Figure 3. L_{50} dBA natural sound pressure levels for Crater Lake NP. (note: each figure has different scale values)

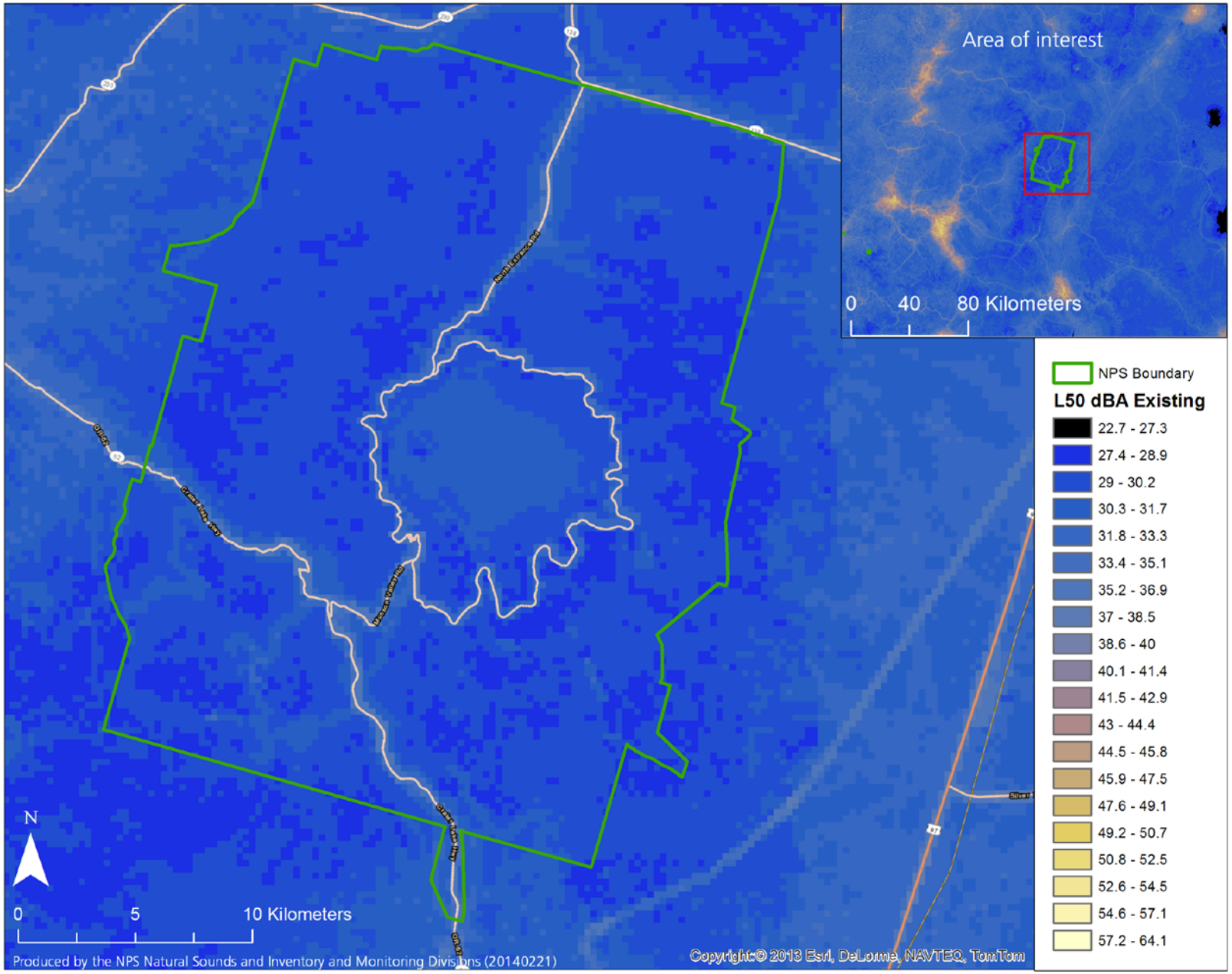
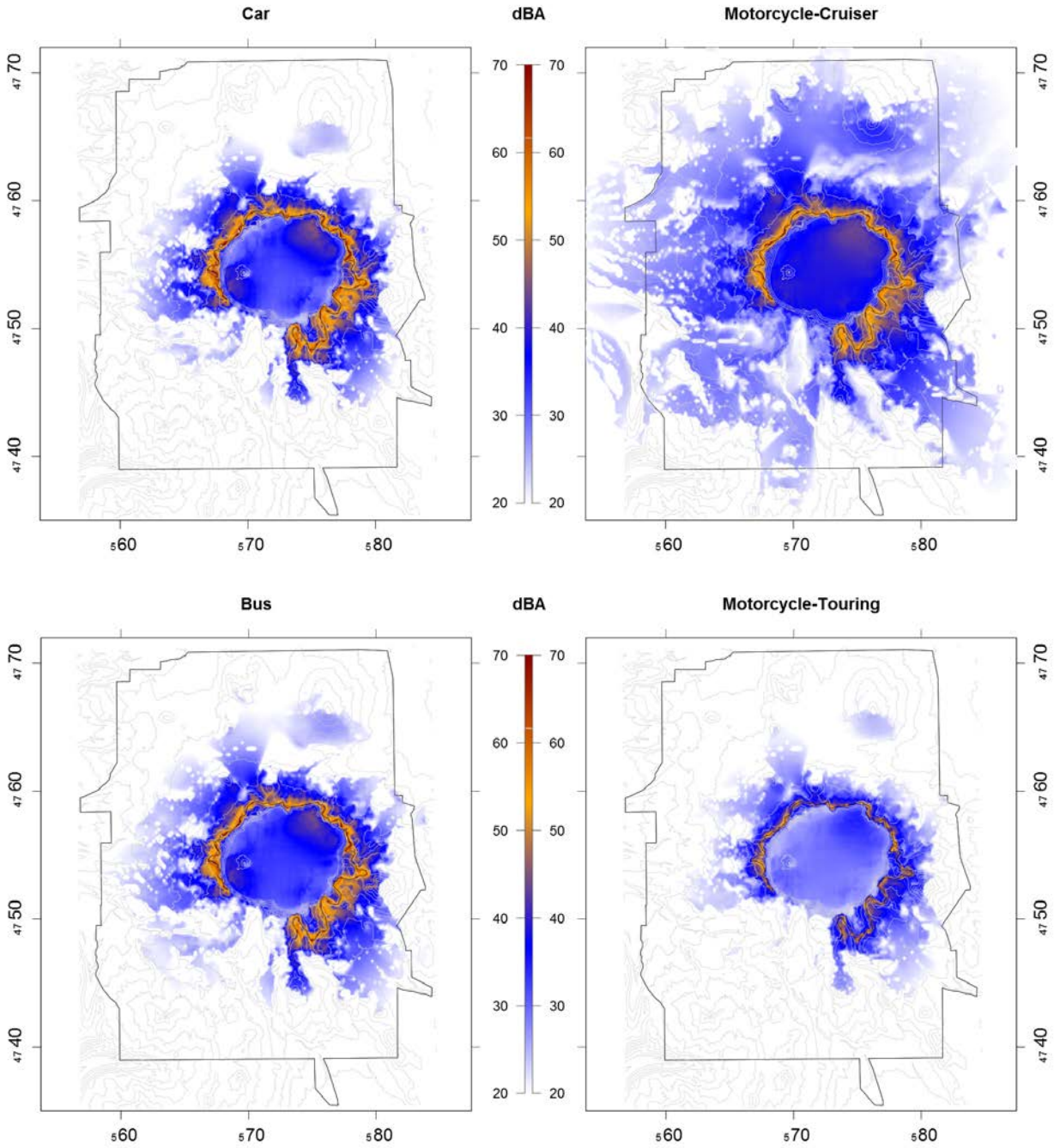


Figure 4. L_{50} dBA existing sound pressure levels for Crater Lake NP. (note: each figure has different scale values)

Acoustic Monitoring

In addition to this national model, acoustical monitoring was conducted for Crater Lake in 2010 and 2011. This research provides a more comprehensive description of the acoustic environment by characterizing existing sound levels, estimating natural ambient sound levels, and identifying audible sound sources. The methods, data and preliminary results of this monitoring effort are provided to the park in an Acoustic Snapshot Report that is attached to this summary.

Vehicle sound modeling

The attenuation of vehicles sounds were mapped in a geospatial sound model of the park. This model shows the noise "footprint" for various vehicle types bases on a known decibel level for the source vehicle and the and park topography. Visual representation of the vehicle noise footprints are displayed below and show different impacts from different vehicles.