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**Title:** Estimating Critical Nitrogen Loads for a California Grassland

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**Abstract:**

Rigorously established critical nitrogen loads to protect biodiversity can be effective policy tools for addressing the insidious impacts of atmospheric N-deposition on ecosystems. This presentation describes methods for determining critical N-loads to a California grassland ecosystem by careful examination of the continuum from emissions, transport, atmospheric chemistry, deposition, ecosystem response, and impacts on biodiversity. Nutrient-poor soils derived from serpentinite bedrock support diverse native grasslands with dazzling wildflower displays and numerous threatened and endangered species, including the Bay checkerspot butterfly. Under moderate atmospheric N-deposition, these sites are rapidly invaded by introduced nitrophilous annual grasses in the absence of appropriate grazing or other management. Critical loads to this ecosystem have been approached by measurements of atmospheric concentrations of reactive N gases using Ogawa passive samplers and seasonally averaged deposition velocities. A regional-scale pollution gradient was complemented by a very local-scale pollution gradient extending a few hundred meters downwind of a heavily traveled road in a relatively unpolluted area. The local gradient suggests a critical load of 5 kg-N ha<sup>-1</sup> a<sup>-1</sup> or less. The passive monitor calculations largely agree with deposition calculated with the CMAQ model at 4 km scale. Emissions of NH<sub>3</sub> from catalytic converters are the dominant N-source at the roadway site, and are a function of traffic volume and speed. Plant tissue N-content and <sup>15</sup>N gradients support the existence of N-deposition gradients. The complexities of more detailed calculations and measurements specific to this ecosystem include seasonal changes in LAI, temporal coincidence of traffic emissions and stomatal conductance, surface moisture, changes in oxidized versus reduced N sources, and annual weather variation. The concept of a "critical cumulative load" may be appropriate over decadal time scales in this ecosystem and other semi-arid systems where N-export is minimal.