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Electronic Supplementary Material

This supplementary material has not been peer reviewed.

Perceptions of Risk in Communities near Parks in an African Biodiversity Hotspot

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Supporting Information

SI Text 1

Risk Assessment Protocol: Life, Livelihood & Lifestyle. To understand risk for households located near protected areas in Sub-Saharan Africa, a risk assessment protocol loosely based on Maslow's Hierarchy of Needs (1943) was developed (Figure S1). Maslow's pyramid of needs starts with physiological and safety needs, and therefore risks that threaten human life would endanger these needs. Within the context of rural communities near protected areas in Sub-Saharan Africa, these risks manifest as physical violence, food insecurity, health problems, natural disasters and attacks by wildlife. The next level in Maslow's pyramid identifies secure access to resources, employment, family, morality, property, and health care. These factors closely align with the capital assets outlined in the livelihoods framework (DFID 1999): human, natural, financial, physical and social capitals; risks to livelihoods were considered the next level of risk within the risk protocol. Risks that endanger livelihoods for primarily subsistence African communities near protected areas include, but are not limited to: crop raiding, livestock predation, animal and crop disease, climate change, restricted access to resources, poor land tenure security, and economic and governmental stability. The upper tiers of Maslow's pyramid identify needs that speak to belonging, self-esteem, and self-actualization, which for the purposes of the risk protocol were classified as endangerment of lifestyle. For households near protected areas in rural Africa lifestyle is most often compromised by the lack of infrastructure, poor education, corruption in leadership, availability of governmental support programs, and variability in the cost of living.

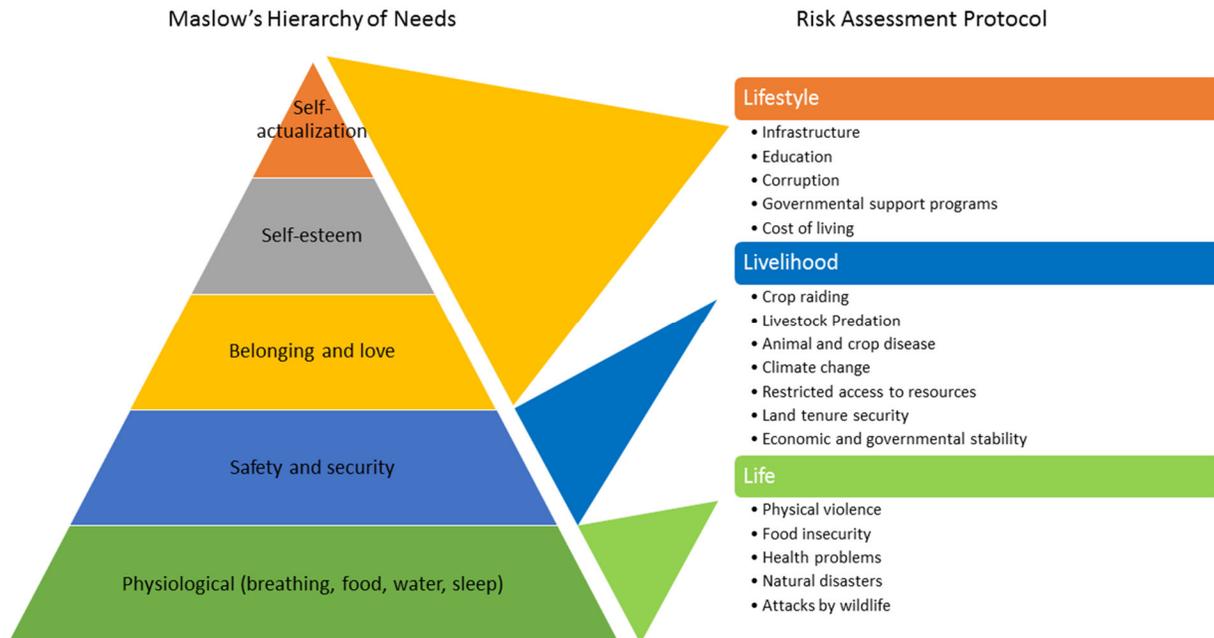


Figure S1. The relationship between Maslow's hierarchy of needs and the risk assessment protocol for rural communities near protected areas in Sub-Saharan Africa.

SI Text 2

Supplementary Description of Participatory Risk Mapping. During the interview, respondents were asked to free-list risks. Then, they were asked to rank each of those named risks from most important risk to least important risk, and to provide mitigation strategies they employ for each risk. Risks for each respondent were ordered numerically 1 to n , from the most import (highest perceived risk) until all of the risks listed were included. For all risks named by all respondents, we calculated the incidence index for each of the individual risks by dividing the number of respondents which identified that particular risk by the total number of respondents in the survey. This incidence score increases from 0 (not ranked by any respondent) to 1 (ranked by all respondents).

Similar to Baird et al. (2009), we followed a revised methodology for creating a scaled severity index. In this case, risk increases between 0 (not listed) and 1 (highest risk) in equal intervals. This altered version is outlined in Smith et al. (2001). The formula for the severity score is:

$$R_{ij} = 1 - \frac{r_{ij}-1}{n_i} \quad [Equation 1]$$

Where R_{ij} is the individual severity index value for risk j of rank r within the total amount of risks, n , reported by respondent i . This equation will set the most serious reported risk per respondent to $R_{ij}=1$, while the least serious risk will be set to one interval above 0. All of the risks reported by a respondent will be in equal intervals between 0 and 1, increasing with severity. Thus, any risk that was not reported by the respondent will be given a value of 0.

Each individual risk subsequently has a sample severity index calculated following the calculation of the individual severity index. This equation is as follows:

$$S_j = \frac{\sum_{i=1}^{N_j} R_{ij}}{N_j} \quad [Equation 2]$$

where the summation of all the individual severity index scores for a particular risk are divided by N_j , the total number of times that particular risk was listed. The result of this formula is a number showing increasing severity from 0 and 1, and allows for comparison between the severity scores among all of the risks. The severity index and the incidence scores was then plotted for each of the three national parks.

Table S1. Categories and sub-categories of risks identified by respondents. Abbreviations for risks used in Figure 2 are shown in parentheses.

Risk to life
<ol style="list-style-type: none"> 1. The threat of or fear of physical violence (PV): Murder, rape, being near the Congo, fear of rebels, being killed by UWA rangers, living near the army, and a general fear of conflict. 2. Risks to health (Health) and ability to treat these risks: Poor wells and lack of water, human sickness, waterborne diseases, and the lack of health clinics, bed nets, hospitals, health care and drugs. 3. Hunger and food insecurity (Hunger). 4. Fear of attacks by wildlife (Wildlife): wild animal attacks and snakes. 5. Risk of natural disaster (ND): flooding. 6. Risk of technology (Tech): hydroelectric power lines
Risk to livelihoods
<ol style="list-style-type: none"> 1. Risks caused by the existence of the protected area (PA): crop raiding, livestock predation, UWA arrests, UWA rangers, fear UWA will take land, park conflict, fear of reprisal when burning, and UWA arresting cattle that stray into the protected area. 2. The threat to livelihoods from agricultural or pastoral risk (Ag): animal disease, poor soil, declining food prices, poor yields, weeding, cost of irrigation, toxic plants, crop disease, bush burning, the lack of agricultural knowledge and crop pests including red ants. 3. Risk caused by climate change (Climate): weather changes, too much sun, drought, too much rain, too much wind, and flood. 4. Risk of economic stability and financial insecurity (EI and FI): income stability, lack of market for produce, increasing prices for fish, lack of jobs, lack of capital, and poverty. 5. Risk of poor land tenure security (LTS): land security and lack of land. 6. Threat of resource scarcity (RS): lack of firewood, population pressure and resource scarcity. 7. The threats to household security (HS): thieves, government instability, and a general lack of security.
Risk to lifestyle
<ol style="list-style-type: none"> 1. Lower standards of living caused by poor or distant infrastructure (PDI): lack of building materials, bridges, roads, schools, health clinics, poor housing, transportation, and electric power 2. Lack of support from government (Corrup/GS): Corrupt leaders, lack of government assistance programs, revenue sharing, lack of development projects, lack of NAADS program, and lack of access to education. 3. The cost of living (COL): school fees, cost of land, and UWA fines. 4. Fear of outsiders (FOO): oil workers, rebels buying land, tribalism and jealousy.

Table S2. Parameters used¹ in unbiased conditional inference trees in Random Forest, and permuted mean decrease in accuracy importance measure for each response variable. Rank order 1-12 of each parameter relative to other parameters is provided in parentheses for each risk.

Variable	Description	PA²	Climate³	Health⁴
Sex	1 = male	.000 (12)	-.003 (12)	-.002 (12)
Distance to park	Straight-line distance to park boundary in kilometers	.059 (1)	.009 (5)	.007 (7)
Age	Age of respondent	.003 (9)	-.000 (11)	.002 (10)
Elevation	Elevation at household derived from NASA SRTM 30m Digital Elevation Model	.041 (4)	.096 (1)	.030 (1)
Residence	Years in residence in area	.002 (10)	.003 (7)	.002 (11)
Education	Level of education: 0 = some primary, 1 = finished primary, 2 = finished secondary, 3 = more than secondary	.001 (11)	.001 (10)	.003 (8)
Park	Class designating the neighboring park where interviews were conducted	.028 (7)	.011 (4)	.026 (2)
Deforestation	Deforestation (2000-2013) within 1km of household	.029 (6)	.019 (3)	.014 (4)
Population Change	Mean population change 2005 to 2010 within 1km of a household	.056 (2)	.008 (6)	.020 (3)
Poverty	Proportion of residents who live on less than \$1.25 per day in 2011 within 1km of household.	.038 (5)	.027 (2)	.013 (5)
Change in Births	Change in the number of live births between 2000 and 2012 within 1km of a household.	.047 (3)	.002 (08)	.011 (6)
Acres of Land	Amount of land, in acres, the respondent's household holds	.004 (8)	.001 (9)	.003 (9)

¹ Remaining 12 of 20 variables following removal via iterative VIF multicollinearity test. Out of Bag Error Rates: ²19.52%, ³32.62%, ⁴33.88%

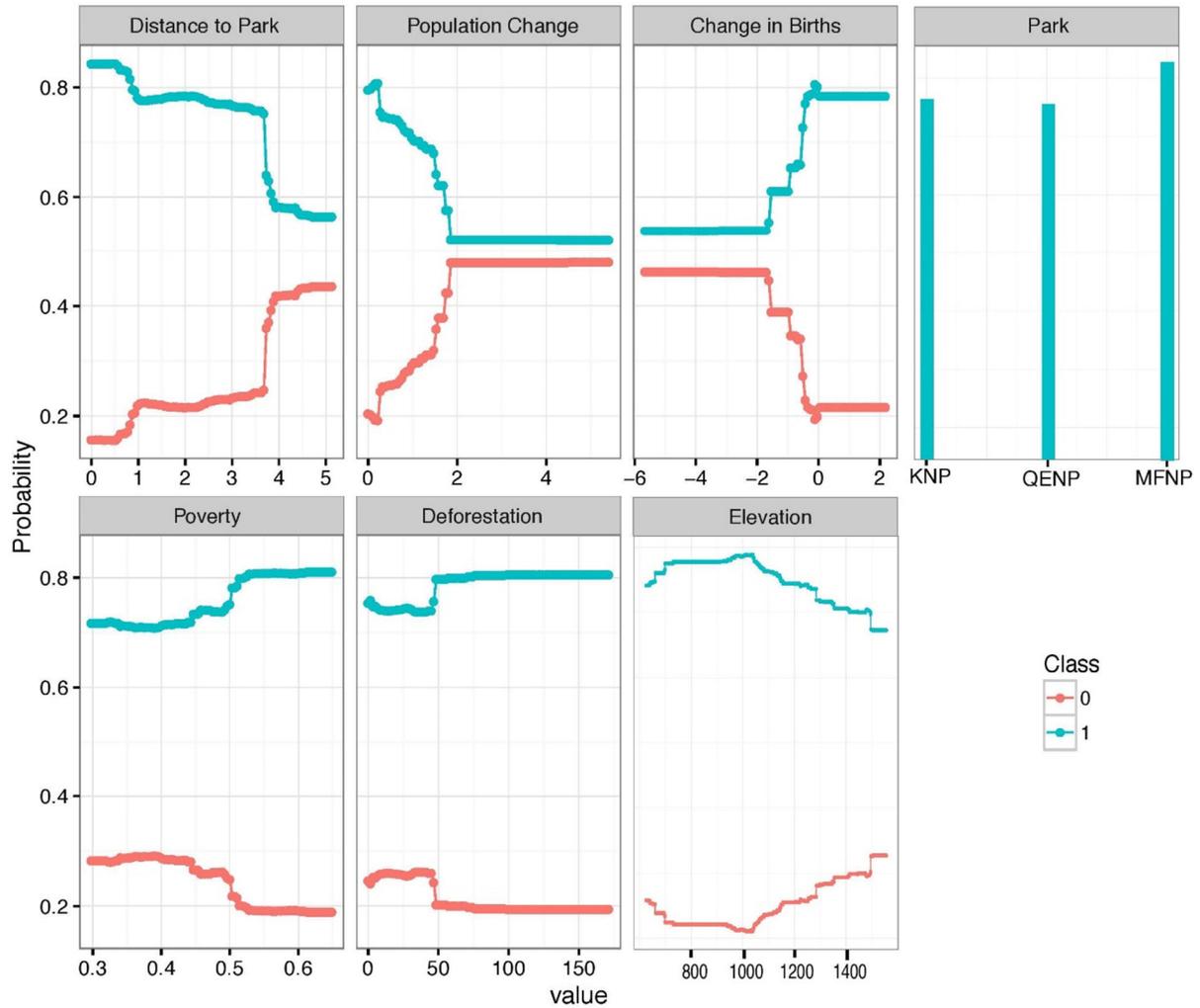


Figure S2. Partial Dependence Plots for Protected Area predictors with highest importance values in the model, depicting the marginal effect of a variable on classification probability (1=high risk; 0=low/no risk) over the 5000 unbiased conditional inference trees in the random forest. The x-axis represents the original values of a variable in the model: distance to park boundary (km), population change (%), change in births (%), poverty (proportion), deforestation (10%), elevation (m).

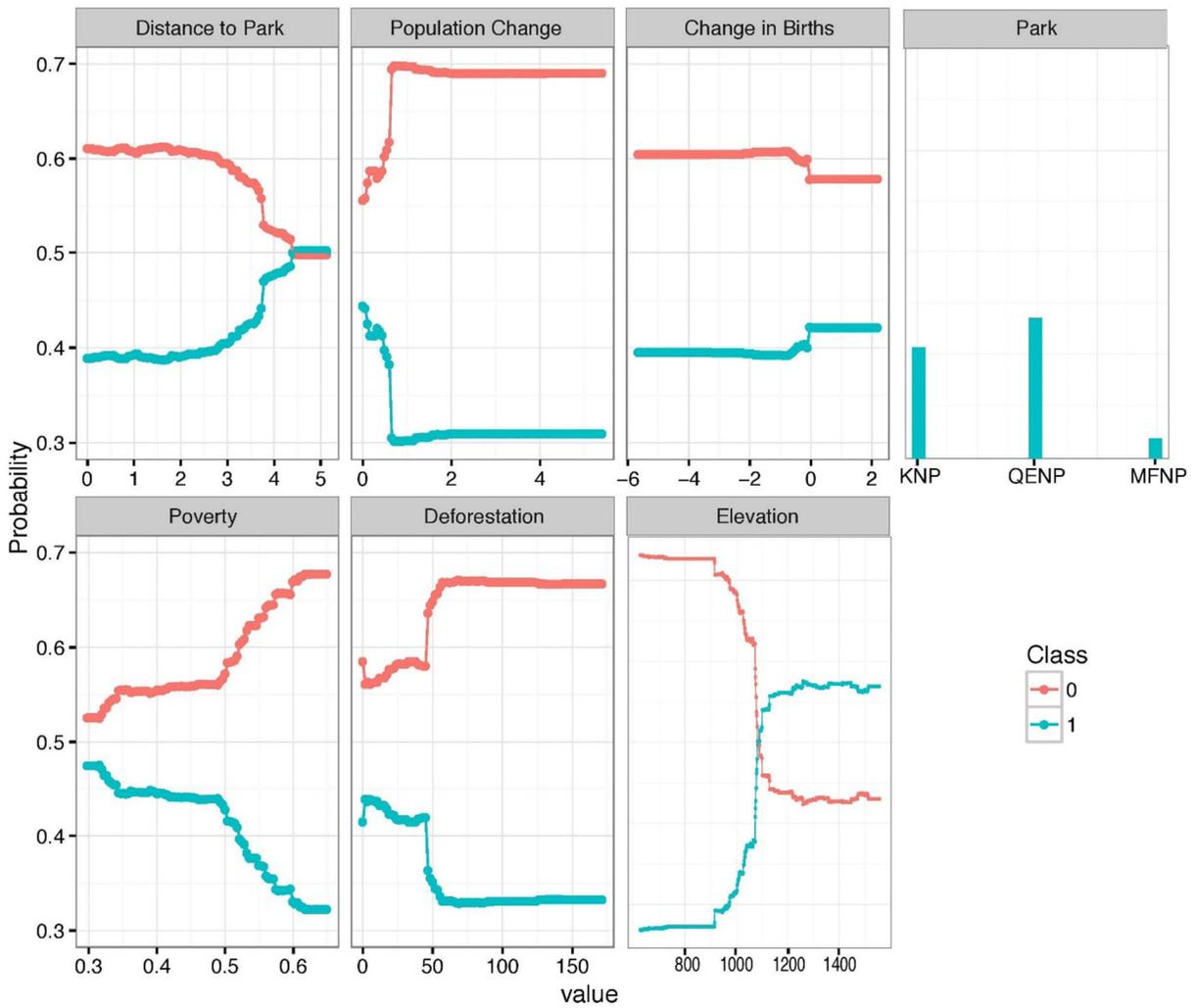


Figure S3. Partial Dependence Plots for Climate predictors with highest importance values in the model, depicting the marginal effect of a variable on classification probability (1=high risk; 0=low/no risk) over the 5000 unbiased conditional inference trees in the random forest. The x-axis represents the original values of a variable in the model: distance to park boundary (km), population change (%), change in births (%), poverty (proportion), deforestation (10%), elevation (m).

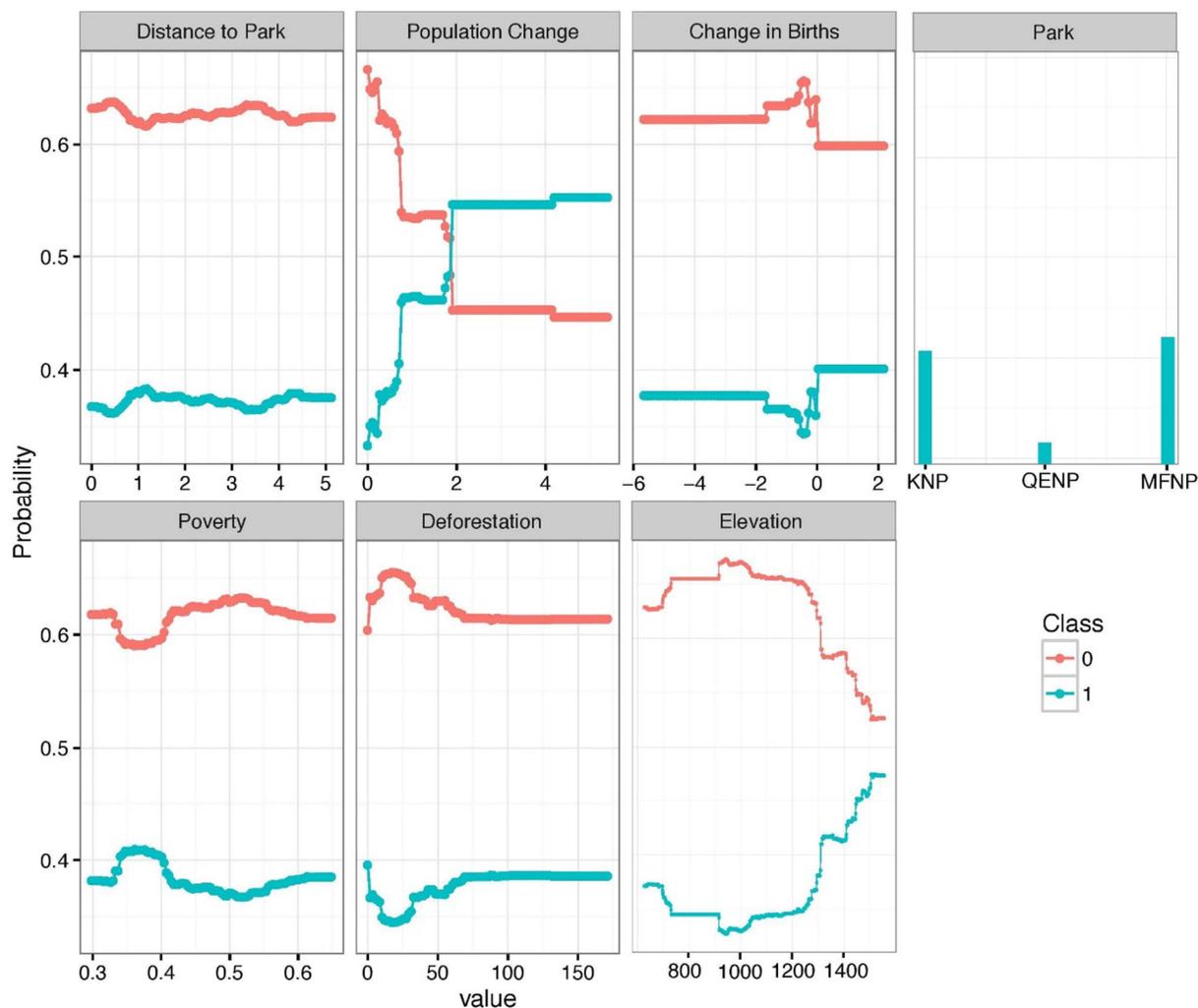


Figure S4. Partial Dependence Plots for Health predictors with highest importance values in the model, depicting the marginal effect of a variable on classification probability (1=high risk; 0=low/no risk) over the 5000 unbiased conditional inference trees in the random forest. The x-axis represents the original values of a variable in the model: distance to park boundary (km), population change (%), change in births (%), poverty (proportion), deforestation (10%), elevation (m).

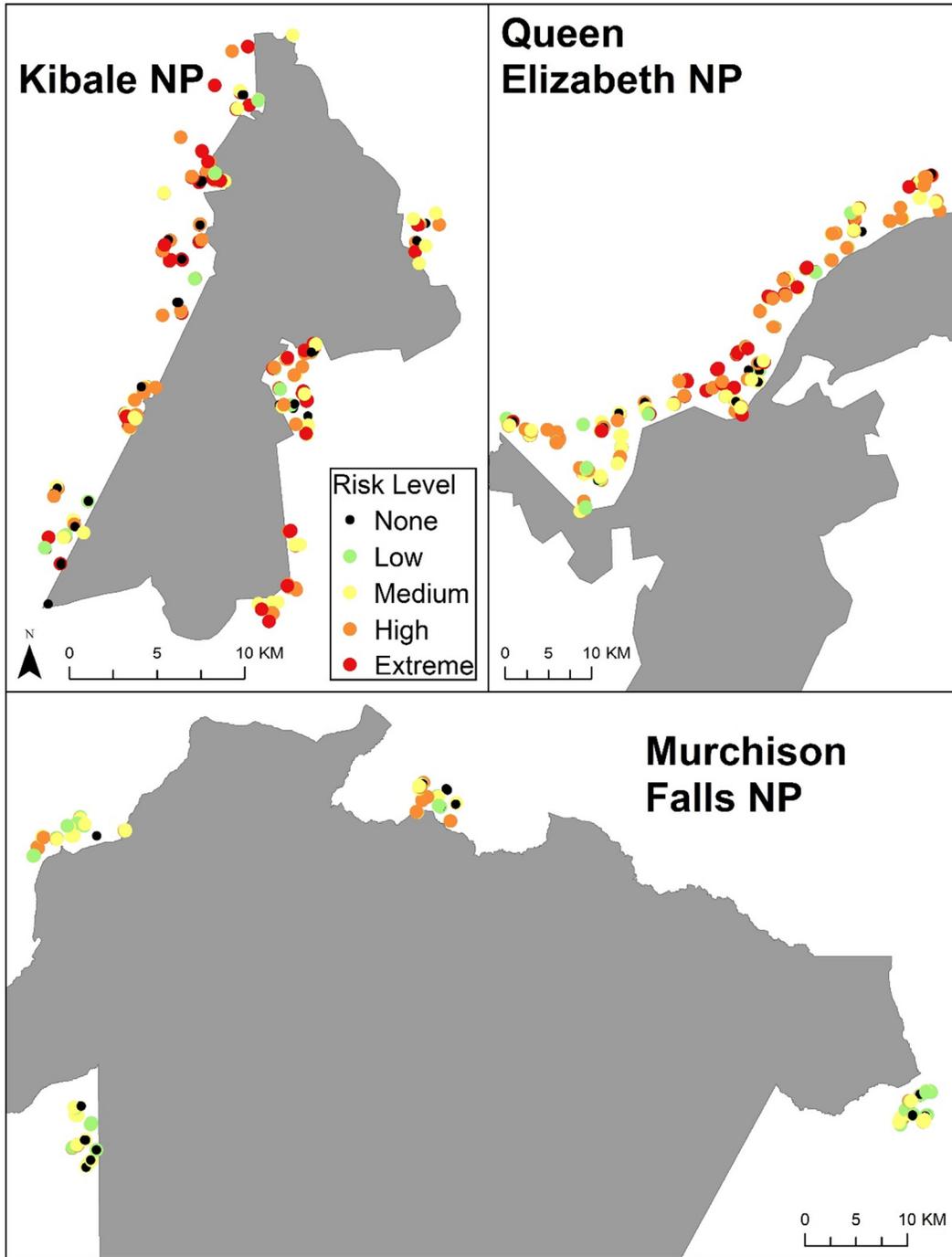


Figure S5. Geographic risk map of “climate” risk perceived by households near national parks. No risk = household that was interviewed, but that particular risk was not named by the respondent. Low risk had a severity score ranging from 0.1-0.3; medium risk 0.31-0.6; high risk 0.61-0.9; and extreme risk from 0.91-1.0.

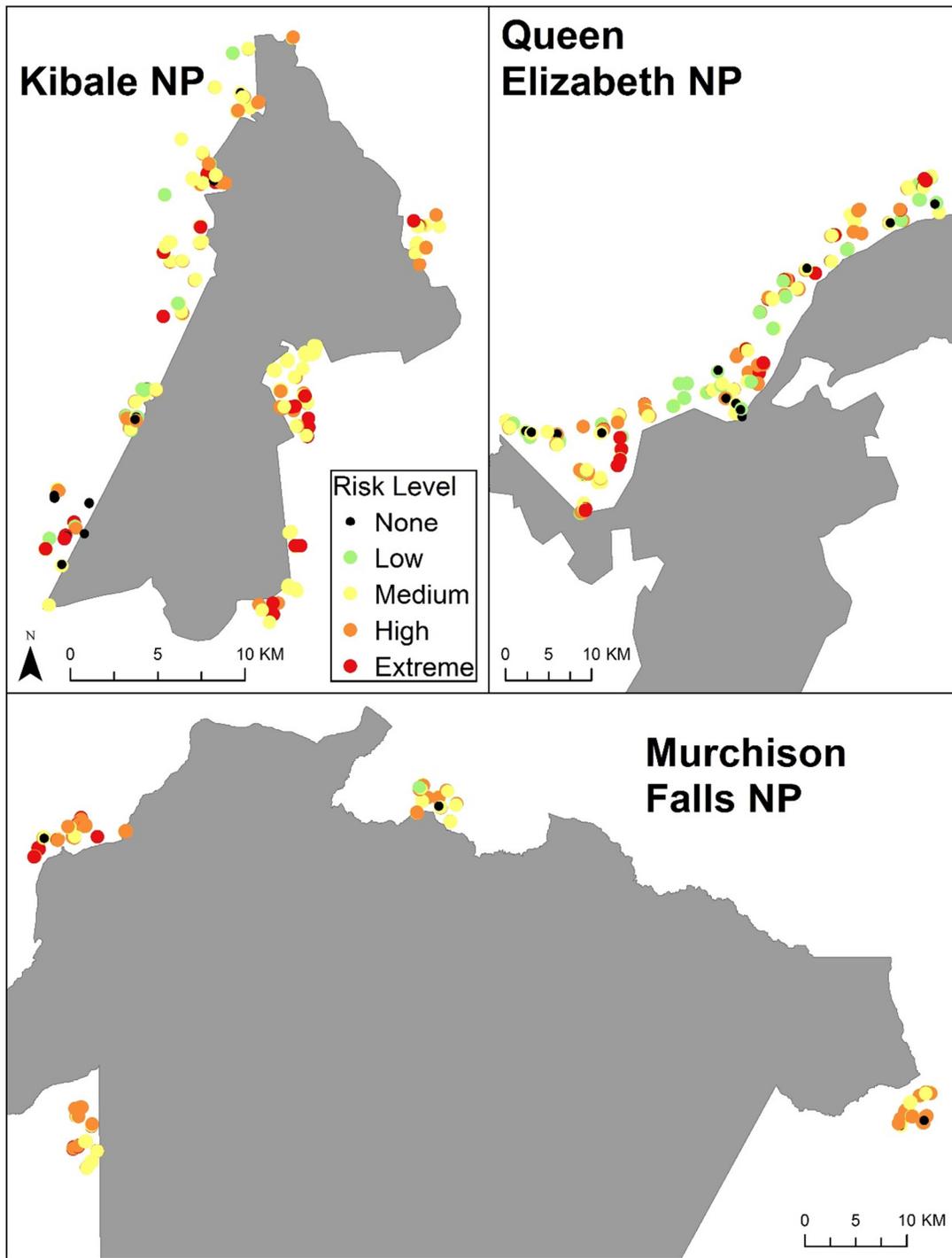


Figure S6. Geographic risk map of “health” risk perceived by households near national parks. No risk = household that was interviewed, but that particular risk was not named by the respondent. Low risk had a severity score ranging from 0.1-0.3; medium risk 0.31-0.6; high risk 0.61-0.9; and extreme risk from 0.91-1.0.