

## **SCOPE OF WORK**

### **SALAMANDER POWER ANALYSIS AND SPATIAL ANALYSIS**

**Product A: Power analysis to detect changes in the abundance of juvenile and adult Farallon arboreal salamanders under cover boards**

**Principle Investigators:** Russ Bradley, Ryan Berger, Nadav Nur, Jaime Jahncke

**Contact:** Russell Bradley (rbradley@pointblue.org)

#### **Objectives:**

- To determine whether current monitoring of juvenile and adult salamanders provides sufficient statistical power to demonstrate change in abundance in 5 year increments over 20 years.
- To determine if the addition of small cover boards increased our power to detect changes in juvenile salamander abundance, to inform assessments in the event of mouse eradication.
- To determine the number of years required to detect an ecologically significant change in the abundance of juvenile and adult salamanders.

#### **Background/Justification for study:**

A study on the Farallon arboreal salamander (*Aneides lugubris farallonensis*) population was initiated in 2006 to determine seasonal activity, relative abundance, population status and trends and reproductive behavior. This information was important to establish a baseline to measure potential impacts of the planned mouse eradication. Results from a power analysis conducted in 2012 using data from 2006-2011 indicated that pre-eradication data provided sufficient statistical power to detect a 40% increase in juvenile salamanders within two to three years of data collection post-eradication. Information drawn from the original study is unfortunately limited to a small portion of Southeast Farallon Island and was not representative of the island-wide population size or density, and relied on data that may be skewed towards larger individuals.

In order to gain a more complete understanding of abundance and distribution of this species, a series of extensive island-wide surveys were conducted from the Fall of 2012 to the Spring of 2015. In addition, this new study included “small” cover boards paired with the “large” cover boards in an attempt to increase our ability to detect juvenile salamanders. To meet our objectives listed above we plan on combining data collected in the initial study with that of the new study (8 years of data) and conduct a power analysis to examine differences in detection prior vs post implementation of the “small” boards. Based on simple analysis of the current data we believe that the small boards are increasing our detection of juvenile salamanders and that performing another power analysis with our current data will provide more robust results to aid in management decisions related to the proposed mouse eradication project.

In addition to conducting power analyses on juvenile Farallon arboreal salamanders, we will employ similar methods for adult salamander population. With that information, we can determine whether the current study design is adequate to detect changes in salamander population over the long-term. This measure is important because it reflects more on the overall salamander population, including long-term production and survivorship.

**Budget:** \$12,200

**Due dates:** Draft report will be due March 31, 2016. FWS staff will be given 30 working days to review the draft report. Final report will be due on June 15, 2016.

**Other requirements:** Recipient will meet with the Farallon Refuge Manager and FWS Inventory and Monitoring staff prior to beginning work to discuss and mutually agree on details of the analyses and final product.

**Product 2: Using habitat modeling to assess the distribution and abundance of the Farallon arboreal salamanders on Southeast Farallon Island**

**Principle Investigators:** Russ Bradley, Ryan Berger, Julie Howar, Nadav Nur, Jaime Jahncke

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**Objectives:**

- To identify physical and biological drivers of distribution and abundance of salamanders on the Southeast Farallon Island.
- To predict salamander habitat based on robust statistical models including the main physical and biological drivers of salamander abundance.
- To estimate salamander abundance in high use areas based on predicted densities.

**Background/Justification for study:**

A study on the Farallon arboreal salamander (*Aneides lugubris farallonensis*) population was initiated in 2006 to determine seasonal activity, relative abundance, population status and trends and reproductive behavior. This information was important to establish a baseline to measure potential impacts of the planned mouse eradication. Information drawn from this study is unfortunately limited to a small portion of Southeast Farallon Island and was not representative of the island-wide population size or density. In order to gain a more complete understanding of abundance and distribution of this species, a series of extensive island-wide surveys were conducted from the Fall of 2012 to the Spring of 2015. Current methods of reporting salamander distribution involve reporting the number of salamanders by area based on the cover boards sampled in particular transects around the island. We will use a combination of GIS and rapid assessments to characterize potential physical drivers including slope, aspect, substrate and distance to cover areas. In addition, we have detailed information on biological drivers including type and abundance of vegetation in areas where salamanders have been sampled. Vegetation may be a form of cover for salamanders and the prey they depend on. We will use this information to identify physical and biological drivers of distribution and abundance of salamanders on the Southeast Farallon Island. Specifically, we plan to use Generalized Linear Modeling (GLM), particularly Negative Binomial Regression, to develop predictive models of salamander counts based on the main physical and biological drivers controlling for inter-annual differences in environmental conditions that may have affected our sampling scheme. Having more insight into salamander distribution and abundances around the island will allow estimating minimum and maximum ( $\pm$  confidence interval) population sizes on Southeast Farallon Island.

**Budget:** \$25,000

**Due dates:** Draft report will be due on June 30, 2016. FWS staff will be given 45 working days to review the draft report. Final report will be due on September 30, 2016.

**Other requirements:** Recipient will meet with the Farallon Refuge Manager and FWS Inventory and Monitoring staff prior to beginning work to discuss and mutually agree on details of the analyses and final product.