# TAXONOMIC STATUS OF ROUGH-SKINNED NEWTS (*TARICHA GRANULOSA*) IN IDAHO BASED ON GENETIC AND MORPHOLOGICAL CHARACTERISTICS

**NICHOLAS A. SMEENK and LUKE J. HARMON**

## I. Hypotheses

**Main Hypothesis.** The Idaho population of rough skinned newts (*Taricha granulosa*) is morphologically distinct from populations in the coastal range.

**Alternative Hypothesis.** The Idaho population of rough-skinned newts is morphologically identical to the source population.

## II. Introduction

The rough-skinned newt (*Taricha granulosa*) has a largely contiguous distribution along the pacific coast of North America, including areas in Alaska, British Columbia, Washington, Oregon and California. East of the Cascades, there are populations in Idaho and possibly Montana (Nussbaum and Brodie 1971). The Idaho population is of particular interest because it is disjunct and separated by large tracts of agriculture and unsuitable habitat, perhaps preventing migration and the subsequent gene flow with coastal populations.

Previous studies have compared morphological measurements between newt populations west of the Cascades and the Idaho population. Reimer (1958) defined the currently accepted classification of rough-skinned newts across their range, stating that newts in Idaho show some difference from coastal populations. He did, however, recognize that his sample size was too small so no significant results could be obtained. Nussbaum and Brodie (1971) measured newts across their range and determined that most characters in the Idaho population are similar to populations found near Corvallis, Oregon, but that some characters resemble individuals in the southern portion of their range in California. Due to these similarities, they concluded that newts were introduced to Idaho, probably during the late 1930's when Civilian Conservation Corps workers were constructing Pond Nine on Moscow Mountain. A second introduction may have occurred in 1955 in Stephen's Pond. Close inspection of morphological data from both studies suggests that the Idaho populations may be distinct from any population in the coastal part of the species' range.

Further study conducted by Kutchta and Tan (2004) compared mitochondrial DNA (mtDNA) from 32 populations across their range, including Idaho. Comparisons between populations showed that the Idaho population is fixed for a unique haplotype. This haplotype differs by one base pair from a haplotype widely distributed across Oregon and Washington. When paired with morphological data, it can is conceivable that Idaho populations are native. However, the possibility exists that Idaho populations are anthropogenic introductions from Oregon or Washington.

Thus, morphological data suggest that the newts are similar to California and Oregon populations (Nussbaum and Brodie 1971), while genetic data suggest they are most similar to newts from

Washington and Oregon. Due to discrepancies in conclusions based on similar data, the taxonomic classification of rough-skinned newts in Idaho merits further study.

I propose combining morphometric and genetic data to determine the taxonomic status of rough-skinned newts in Idaho. Through this proposed study, I hope to determine whether newts are morphologically distinct, and, if so, to which coastal population they are most similar (i.e California, Washington, or Oregon).

**III. Methods**

**A. Trapping.** Using minnow traps baited with glow sticks, newts will be trapped from locations north of Moscow, Idaho (Pond Nine and Phillip's Farm County Park), as well as sites west of the Cascades in Oregon (Benton, OR), Washington (Kittitas, WA and the San Juan Islands), and Canada (Southern Gulf Island, BC). The goal of trapping will be to get a sample that is representative of each population. This will be done by setting traps in the evening evenly spaced along the bank in water approximately .25 - .5 m deep. Based on pilot trapping sessions, efforts will be most intense in areas where emergent vegetation is present. No trap will be left longer than one day to prevent overcrowding and mortality.

Preliminary trapping sessions commenced in September 2007 but trapping was stopped due to cold temperatures, which decrease the probability of success. Fieldwork will continue in the spring when rough-skinned newts are active. Voucher specimens will be taken from each site and preserved to allow for future study and comparison.

**B. Museum Specimens.** I am currently in the process of contacting museums with herpetological collections in order to obtain rough-skinned newt specimens from across their range. This will allow me to increase the sample size and thus increase the strength of the analysis and subsequent conclusions. We have located and obtained permission to receive specimens throughout the range of the species, including single populations in Alaska and British Columbia, Pierce Co. in Washington, Clatsop Co., Lane Co., Douglas Co., Klamath Co., Tillamook Co., and Curry Co. in Oregon, and Siskiyou Co., Humboldt Co., Shasta Co., Tehama Co., Sonoma Co., Mendocino Co., and San Mateo Co. in California.

**C. Measurements.** I will measure all rough-skinned newts trapped using calipers, ruler, and spring scale. Measurements will be taken for body length (snout-vent length and inter- limb length), mass, tail (length and width), head (length, width and depth), and limb length. All measurements will be taken in a similar manner for all newts, comparable to those from Nussbaum and Brodie (1971) to allow comparison between previous and current studies. Results will be combined with those from previous studies to provide a larger, more complete sample of rough-skinned newt populations from across their range.

Voucher specimens collected and museum specimens will be measured using techniques outlined by Harmon et al. (2005). I will take measurements for various skeletal characteristics from radiographs. Head shape will be measured by generating three-dimensional landmark coordinates for landmarks on the head of all voucher and museum specimens using a Microscribe G2 digitizer.

**D. Analysis.** Measurements will be compared among populations using ANOVA and multiple regression. ANOVA will allow me to determine which factors are most important for comparison between populations. It will also help in the determination of which population Idaho rough-skinned newts are most similar to, and from which population they were most likely introduced, if in fact they are non-native.

Multiple regression analysis will further our understanding of correlations between morphometric measurements and snout-vent length. Comparing correlations between snout-vent length and other characteristics among populations will help in determining unique characters in the Idaho population of rough-skinned newts.

Finally, we will directly compare morphological and genetic distance among populations, controlling for geographic distance, using a multiple Mantel test. This will tell us if the morphological and genetic data are concordant or, alternatively, if there is strong conflict between the two data sets.

**IV. Expected Results.**
There are two possible outcomes for the data, both of which can have major management implications.

**A. Distinct.** The disjunct population of Idaho rough-skinned newts may be distinct in terms of morphology and genetics. Kutchta and Tan (2004) described newts from genetic data, finding that Idaho newts are a distinct haplotype from populations west of the Cascades. If both morphometric and genetic data support the hypothesis that rough-skinned newts in Idaho are native, this means that they may be a subspecies and worth preserving because populations are not widespread.

Across the range of rough-skinned newts, populations in Oregon and Washington are genetically similar, with Idaho populations varying by two base pairs (Kutchta and Tan 2004; J. Sullivan, pers. comm.). This could mean that newts were introduced and then evolved, or it could show that the population from which Idaho newts were introduced has yet to be sampled. Rapid evolution of Idaho populations in an estimated 70 years is entirely plausible. In anoles, adaptive changes have been observed in a matter of months when environmental pressures force individuals to adapt or die (Losos 2007). Rapid adaptation of newts can provide interesting ecological studies as well as having important management implications.

**B. Identical.** The disjunct population of Idaho rough-skinned newts could also be found to be identical to coastal populations. If this populations is the same one identified by genetic analysis, this would provide further evidence for the hypothesis that newts were introduced to Idaho and help identify the source populations.

**V. Anticipated Difficulties.**
**A. Trapping troubles.** As with any wild animals, newts do not always cooperate and do what you wish for them to do. Therefore, trapping may be difficult and frustrating at times. The best solution to this problem is to be persistent with trapping efforts, and to set as many traps as possible. I will employ any means necessary to increase trapping success including, but not

limited to, placing a female newt in a trap or baiting traps with orange glow sticks. Hopefully through intensive trapping efforts I may also identify the best method for trapping rough-skinned newts. If such a method is identified, this could lead to further publications outside of the intended research.

Preliminary trapping sessions have proven to be successful. Trapping at Phillip's Farm County Park yielded 20 newts from two traps. Initial trapping sessions also supported the idea that glow sticks work as bait and indicated that trapping near emergent vegetation may be more successful than open water.

**B. Obtaining previous data.** Obtaining data from previous studies has proven to be the most difficult aspect of this study. Because the last morphological study was conducted nearly 40 years ago, this data has been catalogued and is now difficult to locate. Nussbaum and Brodie have both been contacted to try to obtain morphological data, and we are in the process of obtaining previously collected genetic data from collaborators here at the University of Idaho. I have also contacted universities with amphibian collections, and preserved specimens with location data will be arriving by the end of the year. We have already found about 4000 specimens of *T. granulosa* in museums throughout the US. Being persistent and patient will prove to be most effective in dealing with these issues.

**VI. Bibliography.**

Brodie Jr., E.D., B.J. Ridenhour, and E.D. Brodie III. 2002. The evolutionary response of predators to dangerous prey: Hotspots and coldspots in the geographic mosaic of coevolution between garter snakes and newts. *Evolution* 56: 2067-2082

Harmon, L.J., J.J. Kolbe, J.M. Cheverud, and J.B. Losos. 2005. Convergence and the multidimensional niche. *Evolution* 59: 409-421.

Kutchta, S.R. and A.M. Tan. 2005. Isolation by distance and post-glacial range expansion in the rough-skinned newt, *Taricha granulosa*. *Molecular Ecology* 14: 225-244.

Losos, J.B. 2007. Detective Work in the West Indies: Integrating historical and experimental approaches to study island lizard evolution. *BioScience* 57: 585-597.

Nussbaum, R.A. and E.D. Brodie, Jr. The taxonomic status of the rough-skinned newt, *Taricha granulosa* (Skilton), in the Rocky Mountains. *Herpetologica* 27: 260 – 270.

Riemer, W.J. 1958. Variation and systematic relationships within the salamander genus *Taricha*. *University of California Publications in Zoology* 56: 310-390.