Cheryl George
Steve Harness
Judy Loundegin
Carol-Anne Piehl

A STEP IN SPECIATION

C0NCEPT: Isolation of members of a species in different environments may result in the formation of a number of subspecies.

STUDENT OBJECTIVES: The student will relate the distribution of salamanders to the occurrence of subspecies.

NATURE OF SCIENCE RELATIONSHIPS: collaboration, interpreting data, hypothesis formation, predicting

TIME: 1 period for each pest

TEACHER DOES

1, Provides introductory comments,

2, Distribute color-coded copies of salamanders,

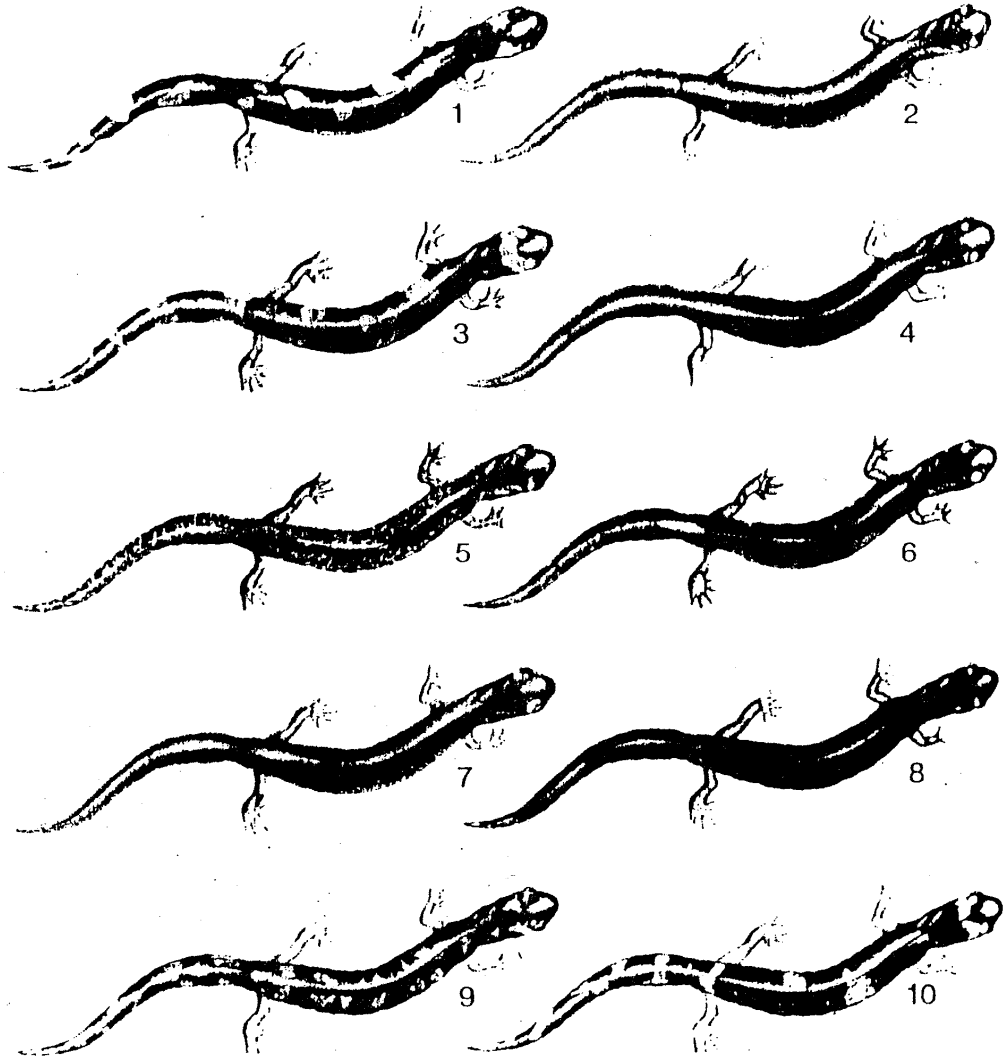
3. Distribute copies of labs.

4. Demonstrate finding coordinates and marking of map,

5. Instruct students to begin and monitor their progress,

6. At teacher discretion, assign Part B

Specimens of the salamander species *Ensatina eschscholtzii*.



Introduction

The small salamanders of the genus *Ensatina* are strictly terrestrial. They even lay their eggs on land. Nevertheless, these salamanders need a rather moist environment and do not thrive in arid regions. In California, *Ensatina eschscholtzii* has been studied by R. S. Stebbins of the University of California, Berkeley. This investigation is based on his work.

Materials (per student) outline map of California colored pencils

Part A Procedure

Imagine that you are working with Stebbins's salamander specimens, some of which are pictured in figure 9.26. In the following list, the parentheses after each subspecies name contain a number and a color. The number is the total of individuals that Stebbins had available in his study. The color is for you to use in designating the subspecies. Following this is a list of collection areas. Each is indicated by a number/letter coordinate on the map of California in figure 9.27. For example, 32/R means that 1 or more *E. e. croceator* specimens were collected at the intersection of line 32 and line R.

1. E. e. croceator (15; brown): 32/R, 32/S, 30/T, 31 /T.

2. E. e. eschscholtzii (203; red): 30/M; 32/0, 34/S, 35/V, 36/W, 35/Z, 38/Y, 40/Z.

3. E. e. klauberi (48; blue): 36/Z, 38/a, 40/a, 39/a.

4. E. e. oregonensis (373; pink): 9/B, 7/E, 6/E, 13/C, 10/C, 7/D, *15/ D.*

5. E. e. picta (230; yellow): 2/B, 2/C, 3/C, 4/C.

6. E. e. platensis (120; green): 8/J, 10/J, 11/M, 13/M, 15/M, 15/0, 17/M, 15/P, 20/Q, 24/S, 21/R, 25/T, 26/U.

7. E. e. xanthoptica (271; orange): 17/G, 17/F, 19/H, 19/0, 20/I, 20/J, 21/I.

Plot each collection area by marking a small X on an outline map that has a grid like the one in the figure. Write with pencils of different colors to indicate the different populations.

Analysis

You now have a distribution map of the subspecies of *TnsatIna esc1scrw(tzii* in California.

1. Describe the distribution of the species throughout California.

2. How is this distribution unique?

3. What environmental conditions are controlling the distribution?

4. Estimate the width and length of the central valley.

5. Which subspecies still have the possibility of interbreeding? How?

Part B Procedure

You may wonder whether there might not be salamanders in some of the areas for which you have no records. You also may wonder whether there might be additional subspecies for which you have no specimens. A biologist faced with these questions would leave the laboratory and go into the field to collect more specimens. Imagine that you do so, too, and return with the following additional data:

- *E. e. eschscholtzii* (16; red): 36/Z, 41/Z, 33/M, 34/W, 34/U
- *E. e. klauberi* (23; blue): 40/b, 40/Z, 36/a
- Unidentified population no. 8 (44; black and green): 4/I, 5/H, 7/H, 7/F, 6/J, 9/F
- Unidentified population no. 9 (13; black and red): 28/T, 27/T, 26/T, 28/S, 29/T
- Unidentified population *no.* 10 (131; black and blue): 23/J, 24/K, 24/I, 29/M, 25/J, 25/I
- Unidentified population no. 11 (31; black and yellow): 6/C, 7/C, 6/B

Mark with an 0 the following places that were searched for *Ensatina* without success:

11/I, 14/I, 17/K, 19/K, 22/N, 26/0, 5/M, 32/U, 32/a, 35/f.

Specimens of nos. 8 and 9 are shown in figure 9.26. There are no illustrations for nos. 11 and 12.

q

Discussion

According to Stebbins, the unidentified populations are not additional subspecies, yet more hybrids between the already identified species.

1. What then, is the probable genetic relationship of populations no. 8, no. 9, and no. 1.0 to the subspecies already plotted on the map?

2. What is the definition of a species?

3. Considering the geographic isolation of many of the subspecies, why is not surprising that the phenotypes are different throughout the state? Why do they not look like the original subspecies that entered from the north?

4. E. xanthoptica has very similar coloration to the rough skinned newt, a very poisonous relative who lives throughout the region. How might this phenotype out compete others?

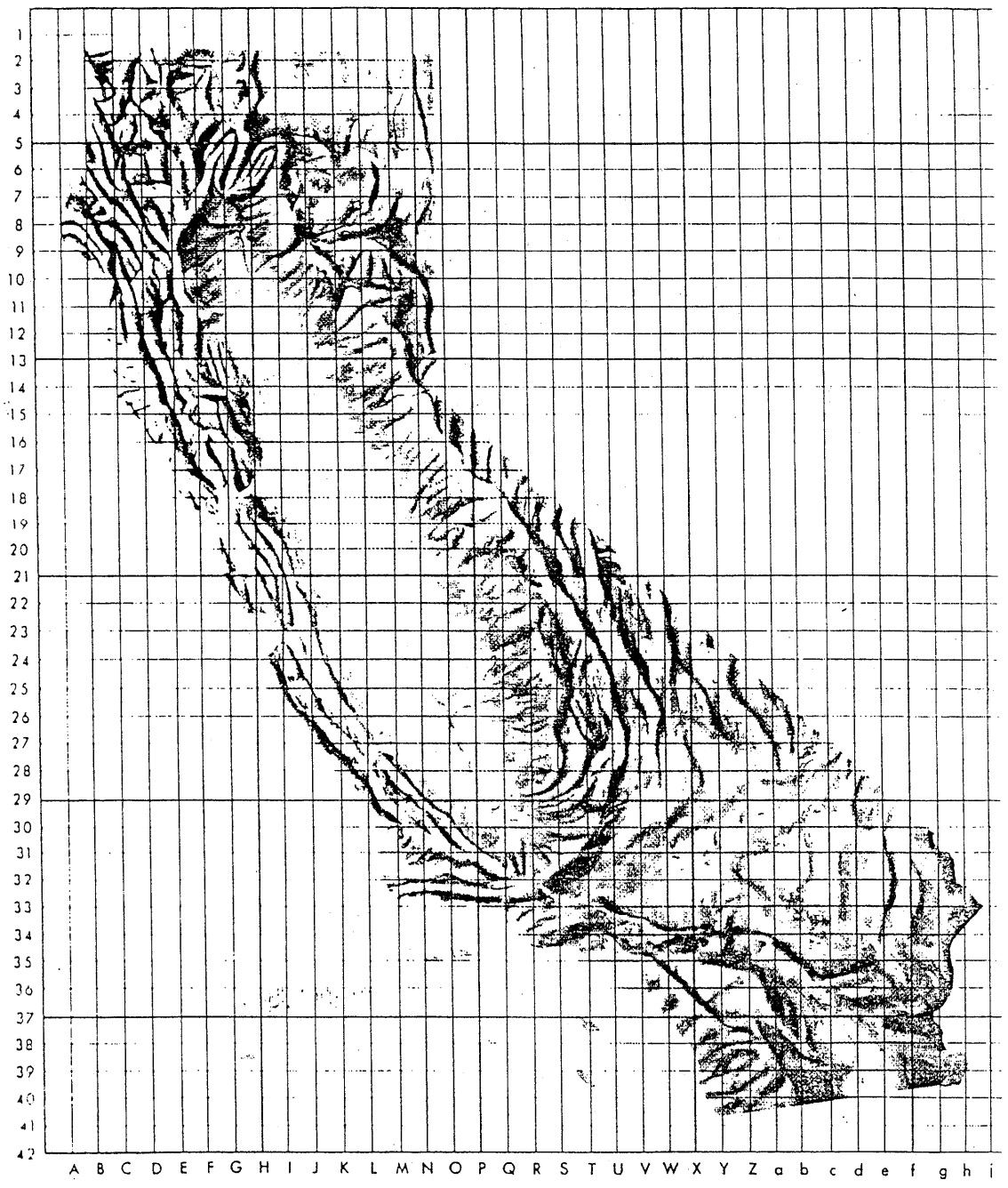
5. If a very successful mutation occurred in a northern subspecies (say, faster leg speed), could that gene reach a southern species?

6. Over time, what do you predict will happen to these salamanders? How might a new species of salamanders arise?

7. In paragraph form, explain why Stebbins has had a lot of difficulty determining if there is more than one species of *EnsatIna* in California.

FURTHER INVESTIGATION:

Problem: What accounts for the I record of E. e. xanthoptica in the Sierra, whereas the rest of the subspecies occurs along the coast.


1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42
A B C D E F G H I J K L M N O P Q R S T U V W X Y Z a b c d e f g h i