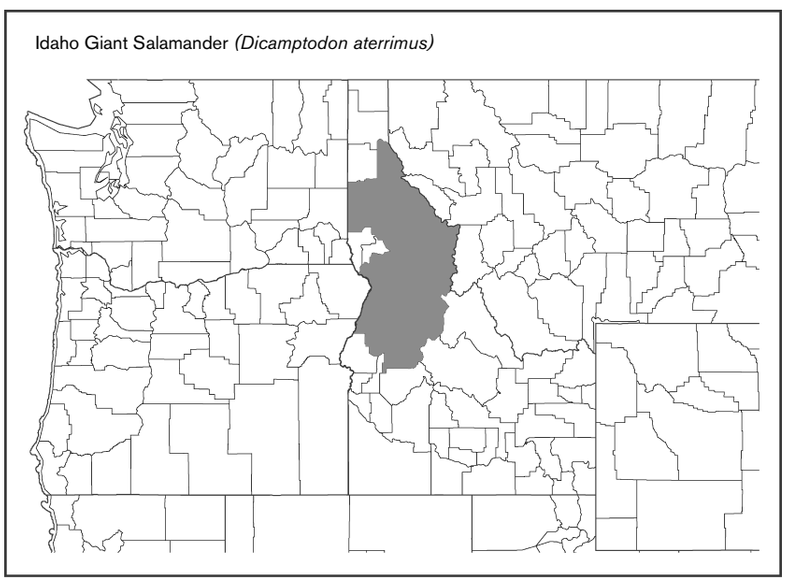
with human occupation and development along the river. Rigorous historical abundance data exist for other streams (see "Historical versus Current Abundance" above) and these areas should be targeted for resurvey.

Family Dicamptodontidae

Dicamptodon aterrimus Cope, 1867
IDAHO GIANT SALAMANDER

Kirk Lohman, R. Bruce Bury

1. Historical versus Current Distribution. Idaho giant salamanders *(Dicamptodon aterrimus)* are found in forested watersheds in north-central Idaho from the Coeur d'Alene River south to the Salmon River (Maughan et al., 1976; Nussbaum et al., 1983) and from two locations in Mineral County in extreme western Montana (Reichel and Flath, 1995). Formerly considered California giant salamanders *(D. ensatus)*, Idaho giant salamanders are now regarded as genetically distinct from other species in the genus (Daugherty et al., 1983; Good, 1989). Although the general outline of their range has not changed in recent years, the distribution of Idaho giant salamanders has likely been much reduced within heavily logged watersheds (Fisher, 1989; Hamilton et al., 1998; Hossack, 1998).



2. Historical versus Current Abundance. Locally abundant in headwater streams in coniferous forest watersheds. Knowledge of historical abundance is scarce, but numbers have likely been reduced in areas of intense timber harvest where larvae may be adversely affected by sedimentation and increases in water temperature (Corn and Bury, 1989a; Bury et al., 1991).

3. Life History Features.

A. Breeding. Reproduction is aquatic.

i. Breeding migrations. The reproductive biology of Idaho giant salamanders is presumed to be similar in most respects to that described for other members of the genus, although breeding behavior of all dicamptodontids is poorly understood. There is circumstantial evidence from population structure that breeding occurs during both spring and fall (Nussbaum, 1969; Nussbaum and Clothier, 1973). Because neoteny is common, asynchronous breeding may also be characteristic of many populations with a high proportion of neotenes (Nussbaum and Clothier, 1973).

ii. Breeding habitat. Courtship likely takes places in hidden nest chambers beneath logs, stones, and crevices in small streams (Nussbaum et al., 1983).

B. Eggs.

i. Egg deposition sites. Nussbaum (1969a) discovered a gravid female buried 60 cm (2 ft) deep in a rock pile at the base of a small waterfall that he believed to be a nest site. Eggs are attached singly on the undersides of rocks within the nest chamber (Nussbaum, 1969a; Nussbaum et al., 1983).

ii. Clutch size. Females lay 135–200 eggs (Nussbaum, 1969a; Nussbaum et al., 1983). Clutch frequency is presumed to be biennial (Nussbaum et al., 1983; Blaustein et al., 1995). Females remain with the eggs throughout development, apparently guarding them from predators (Nussbaum, 1969a). An incubation period of nearly 9 mo was reported by Henry and Twitty (1940).

C. Larvae/Metamorphosis.

i. Length of larval stage. Metamorphosis occurs during or after the third year (Nussbaum and Clothier, 1973).

ii. Larval requirements.

a. Food. Primarily benthic invertebrates and tailed frog tadpoles (Metter, 1963). Some predation on juvenile fishes by other *Dicamptodon* sp. has been reported (Antonelli et al., 1972; Parker, 1993a).

b. Cover. Stones and submerged logs (Nussbaum et al., 1983).

iii. Larval polymorphisms. None.

iv. Features of metamorphosis. Transforming individuals are 92–166 mm TL (Nussbaum and Clothier, 1973). Larvae (145–150 mm TL) observed in process of metamorphosis during August in northern Idaho (K.L., personal observations). Complete metamorphosis of Idaho giant salamander larvae required from 11 d to 6 mo in aquaria (Kessel and Kessel, 1944). Mixed populations of neotenic and terrestrial adults are common (Nussbaum, 1976).

v. Post-metamorphic migrations. Move from streams to moist coniferous forest floors (Nussbaum et al., 1983).

vi. Neoteny. Common.

D. Juvenile Habitat. Same as adults.

E. Adult Habitat. Under logs and bark in coniferous forests (Nussbaum et al., 1983). Adults are rarely encountered and knowledge of their habits is scarce.

F. Home Range Size. Unknown.

G. Territories. Large larvae and adults are aggressive toward conspecifics, but whether larvae or adults defend territories is unknown.

H. Aestivation/Avoiding Desiccation. These behaviors have not been reported.

I. Seasonal Migrations. Unknown.

J. Torpor (Hibernation). Unknown.

K. Interspecific Associations/Exclusions. Often occur in the same streams as tailed frogs *(Ascaphus truei)*. Tailed frog tadpoles are an important prey item for larval Idaho giant salamanders.

L. Age/Size at Reproductive Maturity. Sexual maturity in both larval and terrestrial forms usually occurs at sizes greater than 115 mm SVL (Nussbaum et al., 1983).

M. Longevity. Unknown. Based on a 3-yr larval period and a maximum size of 250–300 mm, a lifespan of at least 6–10 yr would not be an unreasonable estimate.

N. Feeding Behavior. Larvae are sit-and-wait predators (Parker, 1994). Adult *Dicamptodon* feed on a wide variety of prey, including terrestrial invertebrates, small snakes, shrews, and mice (Nussbaum et al., 1983).

O. Predators. Predators include fishes, garter snakes, weasels, and water shrews (Sorex palustris) (Nussbaum et al., 1983; Blaustein et al., 1995).

P. Anti-Predator Mechanisms. Toxic skin secretions, warning postures, and biting (Nussbaum et al., 1983). Adults are also known to growl or squawk (Nussbaum et al., 1983).

Q. Diseases. Unknown.

R. Parasites. Unknown.

4. Conservation.
The general outline of the range of Idaho giant salamanders has not changed in recent years, and they can be locally abundant in headwater streams in coniferous forest watersheds. However, numbers have likely been reduced in areas of heavily logged watersheds where larvae may be adversely affected by sedimentation and increases in water temperature (Corn and Bury, 1989a; Fisher, 1989; Bury et al., 1991; Hamilton et al., 1998; Hossack, 1998).

Dicamptodon copei Nussbaum, 1970
COPE'S GIANT SALAMANDER

Lawrence L.C. Jones, R. Bruce Bury

1. Historical versus Current Distribution.
Cope's giant salamanders *(Dicamptodon copei)* are known from western Washington and extreme northwestern Oregon (Nussbaum, 1970, 1976, 1983; Jones and Aubry, 1984; McAllister, 1995; Leonard et al., 1998). In Washington, they are known from the Cascades (south of Mt. Rainier), Willapa Hills, and Olympic Peninsula (except for most of the northeast portion; R.B.B., unpublished data). In Oregon, Cope's giant salamanders are confined to the vicinity of the Columbia River Gorge (Cascades and Coast Range). They can be locally abundant and are widely distributed through much of their range, but tend to have a more spotty distribution where they are sympatric with Pacific giant salamanders *(D. tenebrosus)*. Although it is likely that development and deforestation may have resulted in reduction in some populations, there has been no apparent reduction in range.

2. Historical versus Current Abundance.
Little is known about the effects of timber harvest on Cope's giant salamanders. Ruggiero et al. (1991) state that this species is associated with old-growth forests and/or stands with similar structural attributes. However, Bury et al. (1991) found densities somewhat lower in old forests than in young, naturally regenerated forest streams in the Washington Cascades. Unfortunately, results of investigations on this species may be obscured by combining Cope's giant salamander and Pacific giant salamander data sets, as these species are phenotypically similar when young (e.g., Antonelli et al., 1972; Wilkins and Peterson, 2000). Ongoing investigations in the Olympic Peninsula and elsewhere will help clarify habitat relationships.

3. Life History Features.

A. Breeding.

i. Breeding migrations. Unknown.

ii. Breeding habitat. Likely to be the same as egg deposition sites, which include hidden chambers under rocks and logs and in cutbanks (Nussbaum et al., 1983; Steele et al., 2003).

B. Eggs.

i. Egg deposition sites. Nussbaum et al. (1983) reported on nine nests found in nature. Eggs are deposited in spring–fall. Females placed their eggs in hidden chambers under rocks and logs and in cutbanks. Steele et al. (2003) recently reported on two clutches.

ii. Clutch size. Clutches range from 25–115 eggs, averaging about 50. Females guard the eggs, and conspecifics are often found with bite marks, which suggests nest defense. The two nests discovered by Steele et al. (2003) contained 23 and 28 eggs.

C. Larvae/Metamorphosis.

i. Length of larval stage. In general, the species is larviform throughout its life and growth rates are unknown.

ii. Larval requirements.

a. Food. Antonelli et al. (1972) studied food habits of Cope's giant salamanders and Pacific giant salamanders, but did not distinguish between the two species or age classes, except transformed individuals were not included. They considered Cope's giant salamanders to be opportunistic, feeding primarily on invertebrate stream benthos.

b. Cover. Bury et al. (1991) found that Cope's giant salamanders (paedomorphic animals and larvae combined) primarily inhabited pools in mountain streams, using large stones for cover.

au: is breeding aquafic or terrestrial? (see other accounts)

iii. Larval polymorphisms. None.

iv. Features of metamorphosis. Metamorphosis in Cope's giant salamanders is extremely rare. To date, six naturally metamorphosed individuals have been reported in the literature (Nussbaum, 1983; Jones and Corn, 1989; Loafman and Jones, 1996). All were from the Olympic Peninsula, except one from the Washington Cascades. All are extremely similar in coloration and external morphology (see color photograph in Jones and Corn, 1989), although we did not examine the Cascades specimen. This species has little proclivity for metamorphosis, as demonstrated by intensive thyroxin treatment to induce transformation (Nussbaum, 1976).

v. Post-metamorphic migrations. Unknown, but transformed individuals were usually found near streams.

vi. Neoteny. This species appears to be a near-obligate paedomorphic species.

D. Juvenile Habitat. Not applicable.

E. Adult Habitat. Unknown for metamorphosed individuals and little studied for larviform adults. Paedomorphic adults and larvae are usually associated with pools in small to moderately sized rocky mountain streams and, occasionally, montane lakes (Nussbaum et al., 1983; Bury et al., 1991).

F. Home Range Size. Unknown.

G. Territories. Unknown, but individuals often have scars inflicted by conspecifics (Nussbaum et al., 1983), which may be due to nest protection, territoriality, or both.

H. Aestivation/Avoiding Desiccation. Surface activity is normally high during the summer (Antonelli et al., 1972), but individuals probably seek refuge during desiccating conditions.

I. Seasonal Migrations. Unknown.

J. Torpor (Hibernation). Surface activity is absent or reduced in the winter, at least in areas where temperatures are near freezing (Antonelli et al., 1972).