Salty Salamander: Occurrence of a *Dicamptodon tenebrosus* in a Tidal Stream

Author(s): Gareth R Hopkins and Zoë M Hopkins
Source: Northwestern Naturalist, 96(2):147-149.
Published By: Society for Northwestern Vertebrate Biology
DOI: http://dx.doi.org/10.1898/nwnt-96-02-147-149.1
URL: http://www.bioone.org/doi/full/10.1898/nwnt-96-02-147-149.1

NORTHWESTERN NATURALIST 96:147–149 AUTUMN 2015

SALTY SALAMANDER: OCCURRENCE OF A *DICAMPTODON TENEBROSUS* IN A TIDAL STREAM

GARETH R HOPKINS AND ZOË M HOPKINS

Key words: Coastal Giant Salamander, *Dicamptodon tenebrosus*, habitat, salinity, tidal

Amphibians, due to their highly permeable skin and egg membranes, are generally considered osmotically challenged animals and, thus, highly sensitive to brackish and saline environments (Shoemaker and Nagy 1977; Duellman and Trueb 1994). Due to their intolerance of salt water, amphibians have long been mostly discounted from occurring in areas directly influenced by the ocean (Darwin 1872), and notes of salamanders in these habitats are rare (Neill 1958).

On 14 May 2012, we observed a larval *Dicamptodon tenebrosus* (Coastal Giant Salamander) in the tidal area of Hunter Creek, Curry County, Oregon (UTM Zone 10, 382898.3E, 4693923.4N, WGS84), 177 m from the Pacific Ocean. The animal was active, appeared in good body condition, and had a snout-vent length of 5.5 cm and a total length of 9.7 cm (Fig 1A). We found the salamander in a shallow sand and rock pool on the edge of the stream (<30 cm deep), with a salinity of 1.0 ppt. Freshwater is generally <0.5 ppt; brackish water is 0.5 to 20 ppt; sea-water typically averages 35 ppt (Boaden and Seed 1985). We measured salinities of up to 1.4 ppt in this area on other days, and these concentrations have been found to be detrimental to caudate amphibian embryonic and larval survival and development (Hopkins and others 2013a, 2013b, 2014). The water temperature at the time of our observation was 14.2°C. This area of the stream is devoid of riparian and aquatic vegetation, except for some algae growing on the rocks, and is essentially on a sandy and rocky beach (Fig. 1B, 1C).

Affected dramatically by the tides, the water level of this habitat changes by almost 1.0 m between high and low tides (Fig. 1B, 1C). A dead sea-star (Forcipulatida, *Pisaster* spp.) was located a few meters away from the salamander. This habitat is also affected by coastal storm events, which sometimes lead to sea-water washing through this area (Fig. 1D). As we only found 1 individual *D. tenebrosus* in the tidal area of this stream, it is possible that these storm events may prevent a larger population from inhabiting this habitat due to temporarily increased salinity beyond this species' tolerance level, or simply because the lack of vegetation and cover in this habitat renders it unsuitable. It is also possible that this individual may have been washed downstream due to spring flooding, and may be sensitive to increased salinity levels, as was found for *Ambystoma gracile* (Northwestern Salamander) in British Columbia, where larvae were found dead or dying in a tidal area with presumably increased salinity (Carl 1949). The *D. tenebrosus* that we found in the tidal area did not, however, appear to be dead or dying, and may have been more salt-tolerant than the individuals observed by Carl (1949). Ferguson (1956) also found 1 larval *D. tenebrosus* approximately 20 m from the edge of the high tide area of a coastal stream in Lincoln County, Oregon, but salinity was not measured. To the best of our knowledge, salinity tolerance in *D. tenebrosus* has not yet been experimentally determined, and more work clearly needs to be done to determine tidal habitat utilization and salt tolerance in this species.

Although reports of salamanders in tidal habitats in the Pacific Northwest are rare, Ferguson (1956) found *Taricha granulosa* (Rough-skinned Newts) in the tidal area of a stream in southern Oregon, and we also found a large breeding group (over 60 individuals) of this species in the same tidal area as the *Dicamptodon* we observed (Hopkins and Hopkins, pers. obs.). *Batrachoseps relictus* (Relictual Slender Salamanders) were reported on a beach in California (Moss Landing, Monterey County) under driftwood near the tide line (Licht and others 1975; B Bury, pers. comm.), as was *B. pacificus* (Channel Islands Slender Salamander) in the Channel Islands (Hansen and others 2005). *Batrachoseps relictus* was experimentally determined to be physiologically adapted to the increased salinity in this habitat (Licht and others 1975).

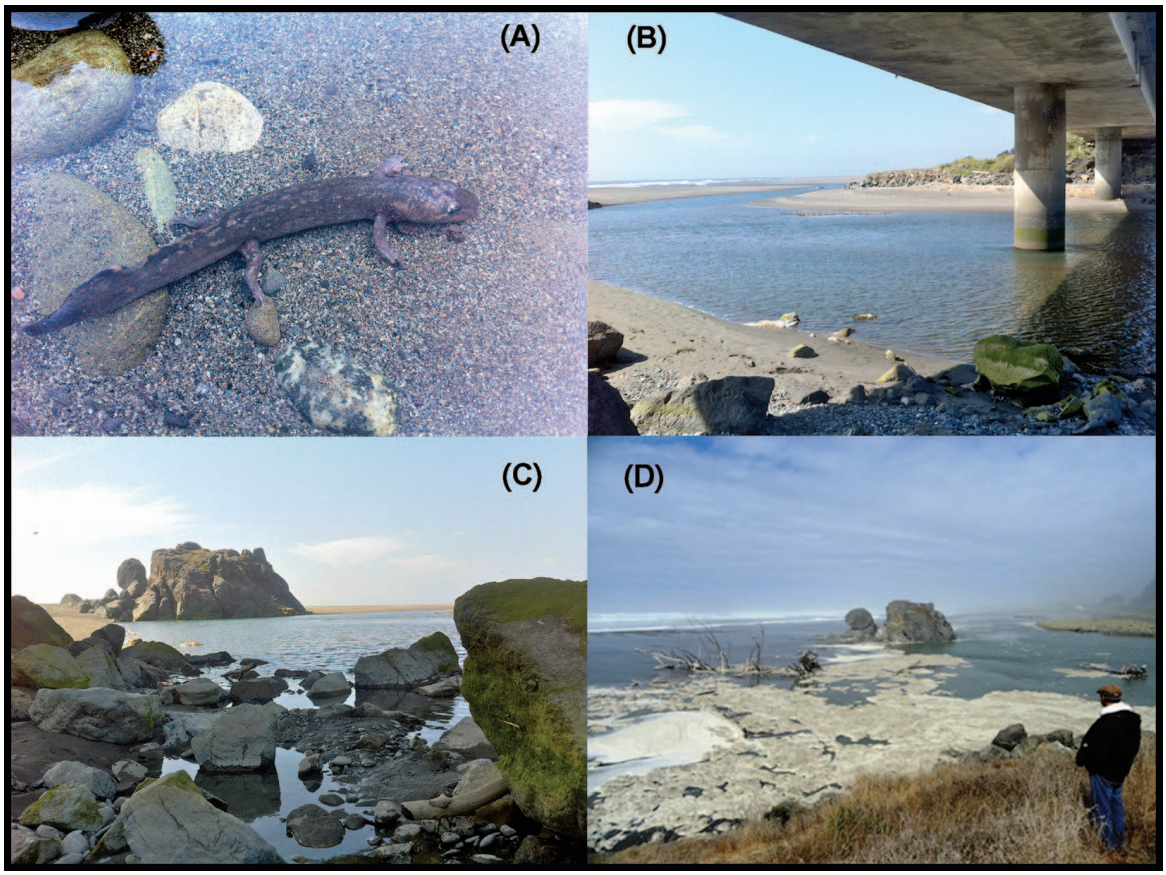

FIGURE 1. Larval *Dicamptodon tenebrosus* (A) and tidal habitat (B, C) where the individual was observed on the southern Oregon coast, 177 m from the Pacific Ocean. Algae visible on rocks and bridge (B, C) show change in water level with tides in this habitat (photos taken at low tide). The distinctive large rock formation approximately 77 m from where the salamander was found (visible in C), photographed immediately after a storm event in September 2011 (D), where sea-water washed up into the habitat where the *Dicamptodon* was found (white oceanic foam visible). Photograph in D was taken by Rose Muenker, used with permission; all other photos by GRH.

Our observation appears to be the first indication of possible salt tolerance and tidal habitat utilization in the genus *Dicamptodon*. Other amphibians found in tidal and brackish coastal areas in the Pacific Northwest include *Pseudacris regilla* (Pacific Tree-frog; Murray 1955; Roberts 1970; Weick 1980; Smith and Reis 1997), and *Rana draytonii* (California Red-legged Frog; Smith and Reis 1997). *Anaxyrus boreas* (Western Toad) were also found frequenting beaches in Benicia, California (Solano County) and even jumping into the sea (Storer 1925). All of these observations indicate that salt tolerance in amphibians may not be as rare as has been previously assumed, and the presence of these animals in tidal and estuarine habitats should not be discounted. We urge more attention to elucidate possible salt tolerance and local adaptation to these habitats in *D. tenebrosus* and other species in the Pacific Northwest.

Acknowledgments.—We thank ED Brodie, Jr and SS French for support and feedback. Field research was funded by a student scholarship to GRH from the Society for Northwestern Vertebrate Biology, Utah State University Department of Biology and Ecology Center, and the Natural Sciences and Engineering Research Council of Canada (NSERC). We thank Rose Muenker for permission to use her photograph in Figure 1D, and B Bury, R Hoffman, and an anonymous reviewer for their helpful suggestions to improve the manuscript. Field work was completed under Oregon Department of Fish and Wildlife permit #062-12.

Literature Cited

BOADEN PJS, SEED R. 1985. An introduction to coastal ecology. New York, NY: Chapman and Hall.

CARL GC. 1949. Extensions of known ranges of some amphibians in British Columbia. Herpetologica 5: 139–140.

DARWIN C. 1872. On the origin of species by means of natural selection, or the preservation of favoured races in the struggle for life. London, UK: Murray.

DUELLMAN WE, TRUEB L. 1994. Biology of amphibians. Baltimore, MD: John Hopkins University Press. 670 p.

FERGUSON DE. 1956. Notes on the occurrence of some Oregon salamanders close to the ocean. Copeia 1956:120.

HANSEN RW, WAKE DB, FELLERS GM. 2005. *Batrachoseps pacificus* (Cope, 1985) - species account. In: Lannoo M, editor. Amphibian declines: The conservation status of United States species. Berkeley and Los Angeles, CA: University of California Press. p 685–686.

HOPKINS GR, FRENCH SS, BRODIE JR ED. 2013a. Increased frequency and severity of developmental deformities in Rough-skinned Newt (*Taricha granulosa*) embryos exposed to road deicing salts (NaCl & $MgCl_2$). Environmental Pollution 173:264–269.

HOPKINS GR, FRENCH SS, BRODIE JR ED. 2013b. Potential for local adaptation in response to an anthropogenic agent of selection: Effects of road deicing salts on amphibian embryonic survival and development. Evolutionary Applications 6: 384–392.

HOPKINS GR, BRODIE JR ED, FRENCH SS. 2014. Developmental and evolutionary history affect survival in stressful environments. PLoS One 9:e95174.

LICHT P, FEDER ME, BLEDSOE S. 1975. Salinity tolerance and osmoregulation in the salamander *Batrachoseps*. Journal of Comparative Physiology 102: 123–134.

MURRAY KF. 1955. Herpetological collections from Baja California. Herpetologica 11:33–48.

NEILL WT. 1958. The occurrence of amphibians and reptiles in saltwater areas, and a bibliography. Bulletin of Marine Science of the Gulf and Caribbean 8:1–97.

ROBERTS JO. 1970. Variations in salinity tolerance in the Pacific Treefrog, *Hyla regilla*, in Oregon [dissertation]. Corvallis, OR: Oregon State University.

SHOEMAKER VH, NAGY KA. 1977. Osmoregulation in amphibians and reptiles. Annual Reviews of Physiology 39:449–471.

SMITH JJ, REIS DK. 1997. Pescadero Marsh Natural Preserve salinity, Tidewater Goby and Red-legged Frog monitoring for 1995–1996. California Department of Parks and Recreation Publication 3790-301-722(7).

STORER TI. 1925. A synopsis of the Amphibia of California. Berkeley, CA: University of California Press.

WEICK DL. 1980. Osmotic regulation and salinity tolerance in the Pacific Treefrog *Hyla regilla* [thesis]. Fullerton, CA: California State University.

Department of Biology and the Ecology Center, Utah State University, 5305 Old Main Hill, Logan, UT 84321 USA (GRH, ZMH); *gareth.r.hopkins@gmail.com.* *Submitted 20 August 2014, accepted 23 November 2014. Corresponding Editor: Robert Hoffman.*