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California Giant Salamander, *Dicamptodon ensatus* (Eschscholtz, 1833), movement distances in an Oak Savanna-dominated riparian habitat

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The California Giant Salamander, *Dicamptodon ensatus* (Eschscholtz, 1833), is a stream-adapted biphasic amphibian (Wilbur, 1980) that ranges from Mendocino to Santa Cruz County in California, USA (Stebbins, 1951; Good, 1989; Lavin et al., 2021). One of the largest terrestrial salamanders in North America, this iconic salamander is typically found in mixed conifer forests, redwoods, and oak woodlands near perennial and intermittent streams (Stebbins, 1951). Within terrestrial environments, *D. ensatus* can be found under various cover items, on creek banks, in rodent burrows or out in the open when moving on rainy nights (Stebbins, 1951; Hansen and Shedd, 2025). Individuals can be found throughout the year (Hansen and Shedd, 2025), but the exact drivers of movements and surface activity remain unclear due to their cryptic behaviour (Fellers et al., 2010). As a result, very few studies have been conducted on their natural history (Kessel and Kessel, 1943; Fellers et al., 2010; Lavin et al., 2021; Miller et al., 2024). Further confounding the lack of natural history information on *D. ensatus,* early research was often based on its congener, the Coastal Giant Salamander (*D. tenebrosus*), which was speciated in 1989 (Good, 1989), however, a paucity of research currently exists for *D. tenebrosus* as well.

Dicamptodon ensatus is designated as a California Species of Special Concern, partly due to being categorised as a low-dispersal species found in relatively localised sub-populations, resulting in little gene flow (Good, 1989; Thomson et al., 2015; Lavin et al., 2021). Thus, management programs that promote connectivity within and among watersheds may benefit this species. Those management actions would be best informed by how individual *D. ensatus* move on the landscape, yet no research has explored their terrestrial movement patterns. This is primarily due to the difficulty in consistently locating individuals, and a distinct lack of success in using traditional survey techniques, such as pitfall traps (Johnston and Frid, 2002; Fellers et al., 2010).

While no studies have looked at movement in *D. ensatus*, two researchers have reported on *D. tenebrosus* movement. Johnston and Frid (2002) surgically implanted telemetry radios into 35 adult *D. tenebrosus*, captured in a stream and the adjacent forest habitat in northern Washington State, to determine if their home range size varied in response to forest clear cuts. They noted that the largest movements away from the aquatic habitat into the terrestrial upland environment was just over 66 m, but that most movements were approximately 20 m from the stream (Johnston and Frid, 2002). Similarly, Fessler (2012), working in a combined perennial and ephemeral stream system in central Washington, employed similar telemetry methods on 16 adult *D. tenebrosus* and monitored their movement behaviour using remote time lapse camera traps. At this location, salamander movements were never more than 50 m from an aquatic resource, and the longest recorded movement was 271 m, traversed in just three days. These studies suggested that the majority of *D. tenebrosus* movements were likely within 50 m of aquatic habitat, but that individuals will make long distance movements along these areas.

Informed by our own 8-year amphibian demographics project in Sonoma County, California, we became aware of a seemingly robust population of *D. ensatus* at our site. As a result, we initiated a capture-mark-recapture program marking individual *D. ensatus* adults

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with Passive Integrative Transponder (PIT; Biomark Mini HPT8) tags in December of 2022. Our goal was to investigate movements of *D. ensatus* and determine whether they differed from those of *D. tenebrosus*. Here we report three distinct observations of movements by adult *D. ensatus* that far exceed those reported for *D. tenebrosus* by Johnston and Frid (2002) and Fessler (2012).

The Mitsui Ranch Preserve is a 632-acre property located in Sonoma County, California, composed of native and non-native annual grasslands and oak savanna habitat. This site contains a riparian corridor that primarily consists of mixed Oaks (*Quercus* spp.) and California Bay Laurel (*Umbellularia californica*) that border Copeland Creek, which bisects the northern half of the property. This section of Copeland Creek is a 2nd order ephemeral stream system (stream designated following Strahler, 1957) that supports *D. ensatus*, and other common and special-status species (Alvarez and Wilcox, 2021, 2022; Erway, 2022).

Working in teams of 2–6 people, we used hand-held flashlights and head lamps to visually scan for salamanders within the 700 m section of the creek and along the bordering riparian zone. Surveys were conducted approximately once a week year-round. Each hand-captured *D. ensatus* had an 8 mm PIT tag inserted subcutaneously at the base of the tail along the dorsal surface, adjacent to the cloaca, using a hollow-tipped needle with an attached plunger. Morphometric data was collected including weight using a Pesola (Pesola, Chur, Switzerland) spring scale in grams, and snout-to-vent length (SVL), tail length, and gape using hand-held rulers. We measured SVL as the length between the tip of the snout and the posterior end of the cloaca. The SVL and tail lengths were added together to determine total length (TL). Location data was collected as points of latitude and longitude, using a handheld Garmin GPSmap 60CSx (Garmin, Olathe, KS, USA) device and habitat descriptions were recorded at the point of each capture.

On 27 January 2026, we PIT-tagged an individual found on the south bank of Copeland Creek in a cluster of roots (PIT number 4A1E6C5; Table 1). At the time of capture, salamander 4A1E6C5 was 217 mm TL and weighed 63 g. We recaptured this individual 21 days later moving upstream on the south bank within another cluster of tree roots, approximately 125 m from the original location (Fig. 1).

On 14 March 2023, we PIT-tagged another *D. ensatus* (PIT number 3C7D73D), after capturing it on the north creek bank within a cluster of tree roots (Table 1). This salamander was 258 mm TL and 90 g. We recaptured 3C7D73D 49 days later, adjacent to a grassland walking on top of the bank in an area with no canopy cover away from the riparian vegetation. This location was also upstream from the original capture location by approximately 260 m (Fig. 1).

A third adult *D. ensatus* was captured on top of the creek bank on 19 January 2023 and was PIT-tagged with number 849B18F (Table 1; Fig. 2). This salamander was 241 mm TL and 105 g. Over the next 180 days we recaptured 849B18F two additional times, moving to different microhabitats within the riparian area approximately 20 m from the original capture site (Table 1). However, nearly two years since its last capture (i.e., 6 June 2023) we recaptured 849B18F on 2 October 2025 approximately 560 m upstream from the last known location on the creek bank (Fig. 1), tucked into a root crevice, in what we believe was a "sit and wait" position facing outward toward the creek channel (Fig. 2).

Our observations indicate that *D. ensatus* can traverse at least 560 m. These movements are presumably along or within the stream and terrestrial riparian zone and are some of the first observations to shed light on the movement capabilities of *D. ensatus*. These observations are similar to the findings of Fessler (2012), who found *D. tenebrosus* moved a maximum terrestrial movement distance of 184 m and a maximum along-stream

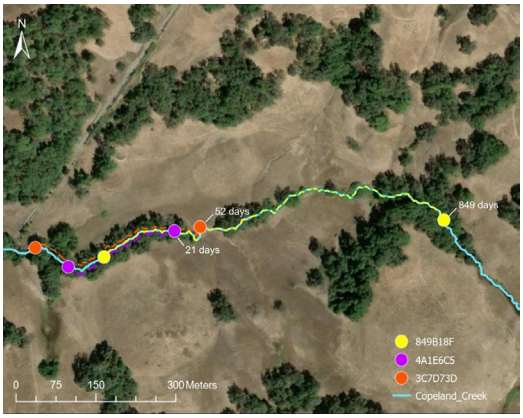


Figure 1. Map depicting the paths of the three individual California Giant Salamanders (*Dicamptodon ensatus*) movements within Copeland Creek. All movements started downstream and moved upstream. The number of days between movements is indicated at the end point for each individual and denotes the direction of travel.

Table 1. Capture data for each California Giant Salamander (*Dicamptodon ensatus*) reported at Mitsui Ranch Preserve, Petaluma, California, USA. Information for each salamander captured is reported including the distances moved (m), days between captures, descriptions of the habitat for each observation, total body length (mm), and weight (g). All habitat descriptions are along the creek, under canopy, unless otherwise stated.

PIT tag	Date	Days between captures	Habitat	Distance moved (m)	Total length (mm)	Weight (g)
4A1E6C5	27 January 2026	—	Creek bank, in tree roots	—	217	63
4A1E6C5	17 February 2026	21	Creek bank, in tree roots	125	217	66
3C7D73D	14 March 2023	—	Creek bank, in tree roots	—	258	90
3C7D73D	5 May 2023	52	Top of bank, no canopy	260	258	93
849B18F	19 January 2023	—	Top of bank, full canopy	—	241	105
849B18F	30 May 2023	131	Top of bank, in log	~20	241	84
849B18F	6 June 2023	7	Top of bank, rodent burrow	~20	241	88
849B18F	2 October 2025	849	Top of bank, at base of tree	560	242	95

distance moved of 271 m over just three days. The latter distance was a similar length moved by 3C7D73D over approximately 49 days (260 m), and 849B18F moved an additional 300 m further (560 m) over a two-year period. While we cannot say whether the movements we observed were made through terrestrial, aquatic habitat, or both, each salamander capture location was within the riparian terrestrial environment and not in the creek channel itself or surrounding uplands.

The telemetry research conducted by both Johnston and Frid (2002) and Fessler (2012) typically found individuals within 20–30 m from aquatic habitat, with one *D. tenebrosus* tracked 66 m away from a stream (Johnston and Frid, 2002). However, the longest upland movement explicitly reported to our knowledge was by McComb et al. (1993), who captured a *D. tenebrosus* in a pitfall trap 400 m from a stream, in a mixed conifer forest. While we did not extensively search the upland habitat for *D. ensatus* at our site, our observations of their movement capabilities along the creek are similar to *D. tenebrosus* and suggest that upland movement patterns warrant further research.

The use of radiotelemetry better facilitates detection of movements (i.e., direction and habitat use) and

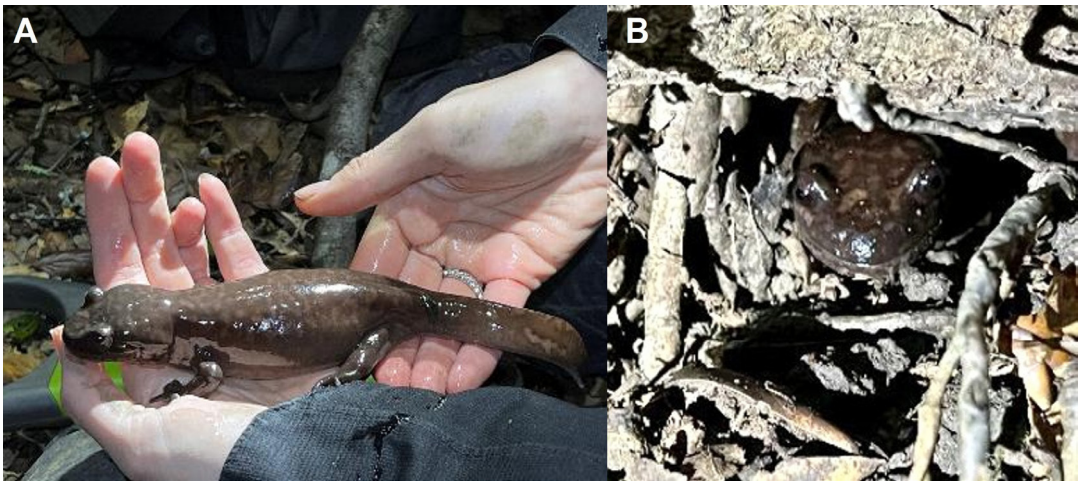


Figure 2. California Giant Salamander (*Dicamptodon ensatus*) (PIT 849B18F) captured on 19 January 2023, in hand (A), and the same individual observed *in situ* on 6 June 2023 perched in sit-and-wait position in a vertical section of creek bank in a rodent burrow (B). Photos by Victoria Brunal-Byrd (A) and Jeffery T. Wilcox (B).

estimation of travel rates because locating an animal is an ostensible outcome of each search since each radio is emitting a constant, detectable signal. Using PIT tags in capture-mark-recapture studies rely on the discovery and recapture of unique individuals and depends on the success of visual survey detections. Thus, the travel rates are likely underestimated if salamanders arrived at the destination quickly but avoided detection due to their cryptic behaviour. Conversely, these salamanders may have traversed distances slowly over time or incrementally. Because Fessler (2012) found one radioed *D. tenebrosus* moved 271 m over three days, *D. ensatus* are likely capable of this movement rate as well, but without radiotelemetry, travel rates are only estimates.

While our movement observations are gross estimates based on mark recapture data, these movements of 125 m, 260 m and 560 m are the first published along-stream movements of individual *D. ensatus* to our knowledge. The possible drivers of these long-distance movements are likely varied, but could be related to seasonal breeding movements, competition, or resource acquisition (Wilbur, 1980). These observations highlight the importance of considering the movement capabilities of this species on a larger scale. Our preliminary results using PIT tags alone, in addition to the rates of travel revealed by Fessler (2012), indicate that the assumption of *D. ensatus* being a low-dispersal species may reflect a lack of information collected for this understudied species. Future research on *D. ensatus* employing radiotelemetry would better address this information gap.

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