Aberrantly-colored salamanders have been occasionally reported for species in several North American families. Dyrkacz (1981) listed 18 species in four families in his review of albinism. Numerous reports have been published since his review. Variations include albinism (e.g., Brandon and Rutherford, 1967; Houck, 1969; Channell and Valentine, 1972), leucistic phenotypes (Mitchell and Church, 1998; Mitchell and Mazur, 2002; Lamb and Qualls, 2013; Paluh et al., 2013), and various unusual color variants (Pauley et al., 2001; Mitchell, 2004; Williams et al., 2013; Moore and Ouellet, 2014). The unusual piebald pattern has been reported for *Ambystoma mexicanum* (Shaw & Nodder) (Axolotl), (http://www.caudata.org/photoplog/index.php?title=axolotls-ambystoma-mexicanum&c=118&page=20, accessed 15 June 2015), and a wild-caught *Lithobates catesbeianus* (Shaw) (American Bullfrog) (Whipple and Collins, 1990). Here we report on aberrant salamanders in two families (Dicamptodontidae, Plethodontidae) from North America. We also discuss archiving difficult-to-document digital internet images that would be useful to the scientific community.

One of us (MN) discovered an unusually-colored *Plethodon cinereus* (Green) (Eastern Red-backed Salamander) under a moist log on 10 August 2014 on the Rock House Ridge Trail in Grayson Highlands State Park in Grayson County, Virginia (36.61673°N, 81.483609°W) at an elevation of 1,330 m. It had the normal red-backed pattern on head, neck and tail, but in-between the normal color and pattern, the dorsum and left side were milky white with several faint black areas (Fig. 1). The term partial leucistic may apply to this salamander, but the contrast between the black anterior and posterior areas was stark enough for it to also be considered a partial piebald variation. Piebald is a term used originally to describe a black and white horse and is not uncommon in bats, mice, and humans (e.g., Baxter et al., 2004; Treitler et al., 2013). It refers to the absence of pigment or presence of white spots in irregular patches on an animal that otherwise has normal coloration. It is usually caused by developmental anomalies in pigment cells and is not necessarily related...
to genetic mutations (Treitler et al., 2013). Moore and Ouellet (2014) reviewed the geographic and population variation of color morphs throughout the range of *P. cinereus*, identified eight categories of phenotypes, and provided a key. Our *P. cinereus* keyed to the Red-backed Salamander morph with milky white pigment replacing the red on the dorsum and the black on the sides. This is the first report of a partial leucistic or piebald Red-backed Salamander color morph in Virginia. Mitchell et al. (2003) described an orange erythritic *P. cinereus* phenotype from Virginia that is similar to the one in Figure 8 in Moore and Ouellet (2014).

A *P. cinereus* found by D. Fallon under a log in a private garden in Sellersburg, Pennsylvania on 3 October 2010 exhibited the normal red-back phase phenotype, but instead of red it had an irregular pattern of milky white on the dorsum and anterior half of the tail where the stripe occurs. It should be called a silver/gray morph (Fig. 2). This *P. cinereus* keyed to the Red-backed Salamander morph in Moore and Ouellet (2014) with discontinuous areas of silver/gray replacing the red. Our individual most closely matches Figure 5 in Moore and Ouellet (2014), but with considerably more gray. This is the first silver-backed *P. cinereus* from Pennsylvania. Moore and Ouellet (2014) reported the first one from USA.

Two of us (SV and ST) discovered a late-stage larval *Dicamptodon tenebrosus* (Baird and Girard) (Coastal Giant Salamander) under rocks in a small tributary to the Wilson River on 4 September 2011 in the Tillamook State Forest, Oregon (45.5846°N, 123.3809°W) while conducting surveys for a previous study (Twitchell, 2013). The larva had an entirely white anterior right foreleg and white on the inner digit on the left rear foot, but was otherwise normal in color on the body and the other three legs (Fig. 3). It was released back into the stream where it was captured. Previous accounts of abnormally colored *Dicamptodon* have all been larvae. An albino *D. ensatus* larva was found in Skamania County, Washington, in 1983 that was yellowish except for black toe tips (Jones and Bury, 1985). Three partially albinistic *D. ensatus* larvae from Benton County, Oregon, had pigmented eyes and faint dorsal patterns (Nussbaum, 1976). One of these larvae is illustrated in color in Nussbaum et al. (1983).

Photographs of salamanders with unusual colors or patterns and other animals that exhibit variation in color such as frogs and snakes are occasionally posted on the internet in Flickr and Facebook, among other social media sites. Most are not accompanied with information on location, date, or how many aberrant and normally-colored individuals were observed to calculate frequency of occurrence. Some of these photographs show individual variations not previously reported in the scientific literature. How to retrieve these photos so scientists and others who need to know the range of phenotypic variation of a species is problematic. Two examples illustrate the point. Photos of unusually colored *Eurycea lucifuga* (Rafinesque) (Cave Salamanders) have been posted twice recently. This species is usually reddish-orange with scattered, irregular black spotting on the dorsum of the body and tail (Petranka, 1998; Mitchell and Gibbons, 2010). One photograph posted on flickr (https://www.flickr.com/photos/17806334@N05/5802840078/in/album-72157626895066660/, H. Day, 7 April 2011, accessed 12 June 2015) is a partially leucistic adult with milky

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**Fig. 2.** The first silver-backed variant *P. cinereus* (Eastern Red-backed Salamander) from Bucks County, Pennsylvania.

**Fig. 3.** A late-stage larval *Dicamptodon tenebrosus* (Coastal Giant Salamander) in the Tillamook State Forest, Tillamook County, Oregon.
white replacing the brownish orange on the tail. Another (http://fineartamerica.com/featured/2-cave-salamander-dante-fenolio.html, D. Fenolio, 2006, accessed 12 June 2015) is also a partially leucistic adult with complete absence of orange and black pigment on the anterior dorsum, both forelegs and feet, both sides, and portions of both rear legs and feet. These areas are pink and translucent allowing brachial and lateral arteries to be visible through the skin. Repeated attempts to contact both photographers to see if they were interested in co-authorship were unsuccessful.

We suggest that a digital internet repository be established in which photographs such as these can be made available to the scientific community. Moore and Ouellet (2014) created an online gallery of P. cinereus color photographs that can be used for recognition and comparison purposes for this species (http://www.amphibia-nature.org/en/projects/amphibians-reptiles/colorations-plethodon/). Interested citizens can upload their photographs and use the email address to send information on date, location, and details about the observation. Perhaps establishment of a website such as this for all salamanders could be created that has a similar set of criteria. Databases such as inaturalist.org or amphibiwab.org would be ideal for these types of observations, but currently there is no section for unusually-colored individuals. If the administrator of either database would create a section that includes different forms and morphs of salamanders, then this would be most ideal. Recovery of useful scientific information from the vast expanse of the internet is a challenge, but if such a website repository was successful, it could help increase our knowledge of the natural history of salamanders.

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References


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