Persistence of velvet worms (Onychophora; Peripatopsidae): effects of fire and climate in forests of south-west Western Australia

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Climate effects
Long-term mean monthly maximum temperature and rainfall data were obtained for Dwellingup and Pemberton from the Bureau of Meteorology (BOM) web site in 2012. Collection frequencies for each month of O. gilesii and Kumbadjena sp. and were plotted along with mean monthly temperature and mean monthly rainfall for Dwellingup and Pemberton, locations central to the range of these taxa (Figures above right). Mean annual point potential evapotranspiration and mean annual rainfall for the period 1961-1990 were interpolated from grid cell surfaces obtained from the BOM for localities listed in Reid (2002), and FORESTCHECK collection and fine grain fire mosaics collection localities (Figure right). All O. gilesii and Kumbadjena sp. collection sites except the montane sites of the Porongurup and Stirling Ranges experienced mean annual rainfall greater than or equal to 473 mm in the period 1961 and 1990. Kumbadjena sp. and O. gilesii collection sites were segregated by mean annual point potential evapotranspiration with a maximum value for O. gilesii of 1983 mm and a maximum value for Kumbadjena sp. of 1644 mm. There are almost no mechanisms for physiological regulation of water loss in onychophorans. However, closely related species, and males and females of the same species, can differ in their rates of respiratory water loss under the same conditions (Weldon et al. 2013). Differences in seasonal climate and the apparent difference in climatic tolerances of O. gilesii and Kumbadjena sp. suggest that differences in respiratory water loss, and for life cycle traits may play a part in the distribution limits of Western Australian onychophorans.

Acknowledgements
We thank DFES district staff and the many students and volunteers who have assisted in specimen collection and sorting for the FORESTCHECK and Walpole small grain fire mosaic projects. The above image of aftermath of wildfire was provided courtesy of Ted Maddison.

References
Farr J.D., Wills A.J., Van Heurck P.F., Mellican A.E., Williams M.R. (2011) Mean months rainfall for Dwellingup and Pemberton, locations central to the ranges of these taxa (Figures above right). Mean annual point potential evapotranspiration and mean annual rainfall for the period 1961-1990 were interpolated from grid cell surfaces obtained from the BOM for localities listed in Reid (2002), and FORESTCHECK collection and fine grain fire mosaics collection localities (Figure right). All O. gilesii and Kumbadjena sp. collection sites except the montane sites of the Porongurup and Stirling Ranges experienced mean annual rainfall greater than or equal to 473 mm in the period 1961 and 1990. Kumbadjena sp. and O. gilesii collection sites were segregated by mean annual point potential evapotranspiration with a maximum value for O. gilesii of 1983 mm and a maximum value for Kumbadjena sp. of 1644 mm. There are almost no mechanisms for physiological regulation of water loss in onychophorans. However, closely related species, and males and females of the same species, can differ in their rates of respiratory water loss under the same conditions (Weldon et al. 2013). Differences in seasonal climate and the apparent difference in climatic tolerances of O. gilesii and Kumbadjena sp. suggest that differences in respiratory water loss, and for life cycle traits may play a part in the distribution limits of Western Australian onychophorans.

Time since fire and collection frequency
Litter is an important though insecure habitat for onychophorans in Western Australia. Three quarters of the specimens collected in the FORESTCHECK and fine grain fire mosaics projects were collected from litter, or from fallen logs in litter beds. The remaining specimens were collected from moveable woody debris. Lags were not dissected. Much of the fine fuels that constitute the litter habitat used by onychophorans in jarrah forest is likely to be consumed in fires of the low intensities, encompassed by the fine grain fire mosaics. Fine fuel consumption in jarrah forest fires, with fire intensities < 700 kWm^-1 (Hollis et al. 2010)). This highlights the ephemeral nature of litter habitat and the importance of fire durable fallen logs for onychophorans. Collection sites were subjected to a variety of the intensities of fire described species K. occidentalis, K. shannonensis, K. sp. (Van Der Lande 1978, Reid 2002) and from a more extensive distribution in jarrah (Eucalyptus marginata) forest of the eastern part of the Swan Coastal Plain (SCP) and the Darling Plateau from the Mount Helena area south to about Collie (Reid 2002, data this paper). Kumbadjena sp. have a southern distribution an arc from the SCP near Busselton, the jarrah forest north of Collie (data this paper) and from the Leeuwin-Naturalist Ridge to an eastern inland outlier in the Stirling Range north of Albany. Reid (2002) noted the importance of karri (Eucalyptus diversicolor) forest as a provider of habitat for Kumbadjena sp. though the genus is also known from jarrah forest and allochtonous dominated patches within jarrah forest. Observations and specimens of O. gilesii and Kumbadjena sp. collected during the FORESTCHECK jarrah forest biodiversity monitoring project (Farr et al. 2011, McCaw et al. 2011) and an investigation of effects of fine grain mosaics burning on biodiversity near Walpole Western Australia are reported here.

Forestcheck and Fire
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Kumbadjena sp.

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