



Habitat trees and salamanders: Conservation and management implications in temperate forests



Riccardo Piraccini^{a,b,1}, Mario Cammarano^{a,1}, Andrea Costa^a, Marco Basile^{a,c}, Mario Posillico^{a,d}, Luigi Boitani^b, Marco Bascietto^e, Giorgio Matteucci^{a,f}, Bruno De Cinti^a, Antonio Romano^{a,*}

^a Consiglio Nazionale delle Ricerche, Istituto di Biologia Agroambientale e Forestale, Monterotondo Scalo, RM, Italy

^b Department of Biology and Biotechnologies "Charles Darwin", Sapienza University of Rome, Rome 00185, Italy

^c Chair of Wildlife Ecology and Management, University of Freiburg, Tennenbacher Str. 4, D – 79106 Freiburg, Germany

^d Corpo Forestale dello Stato, Ufficio Territoriale Biodiversità di Castel di Sangro-Centro Ricerche Ambienti Montani, Castel di Sangro, AQ, Italy

^e Consiglio per la Ricerca in Agricoltura e l'Analisi dell'Economia Agraria, Unità di Ricerca per l'Ingegneria Agraria, Monterotondo (Roma), Italy

^f Consiglio Nazionale delle Ricerche, Istituto per i Sistemi Agricoli e Forestali del Mediterraneo, Via Patacca, 84 I-80056 Ercolano (NA), Italy

ARTICLE INFO

Article history:

Received 16 July 2016

Received in revised form 12 October 2016

Accepted 19 October 2016

Keywords:

Amphibians

Forest salamanders

Salamandrina

Tree shelters

Buttresses

Biodiversity conservation

ABSTRACT

Among vertebrates the concept of “habitat tree” in temperate forests, involving tree size and microhabitat occurrence, has been investigated mainly for birds and mammals. However, trees are also used by many amphibian species or sometimes by whole amphibian families that have evolved adaptations for living on trees. While there is a self-evident link between arboreal amphibians, which occur mainly in tropical forests, and trees, the relationship between trees and forest ground-dwelling amphibians is less widely studied and more difficult to understand. As a consequence, the effect of forestry practices on amphibian communities are commonly considered at the landscape scale, identifying habitat alteration and loss as major threats. We provide the first evidence that the combination of forestry practices and species conservation strategies may act at a smaller scale than those traditionally adopted: the single-tree scale. Our study focused on the Italian endemic spectacled salamander (*Salamandrina perspicillata*). In a hectare forest stand in central Italy we marked nearly 400 trees individually and for each we measured the DBH, the number of buttresses in the stump (BUT) and the number of cavities between soil and stump (HOL). Salamanders were sampled and individually marked at each tree in eleven sampling occasions, during 2013 and 2014. We discovered that the concept of “habitat tree” may also hold for salamanders, and that DBH and HOL are the best predictors of tree suitability for salamanders. Moreover, using the number of captures for the same individuals on the same tree, occurring in different years, we were able to distinguish between trees that act as permanent or temporary shelters for salamanders. Permanent shelters were not only used by the same individuals in different years, but also hosted a larger number of salamanders, and were characterized by a larger number of HOL. Our findings may be considered of importance for drawing up forest management plans and achieving conservation objectives. During forest harvest operations, for the purpose of salamander conservation we suggest retaining trees with a larger DBH (>30 cm) and a high number of HOL. Finally, since BUT is highly correlated with HOL but is less sensitive to variations during time, we suggest this parameter be used as a proxy of HOL.

© 2016 Elsevier B.V. All rights reserved.

1. Introduction

Though forests are essential for life, they are traditionally valued for their timber, conventionally considered their main commercial resource. Although forest ecosystems currently cover only 6% of the earth, they provide habitats for about two thirds of the planet's species and host 80–90% of the world's terrestrial

biodiversity. In addition, almost half of the terrestrial carbon is stored in forests (FAO, 2006; World Bank, 2008).

Even if a forest is no mere collection of trees, these vertical structures characterize a forest at the macroscopic level. Trees provide shelter and food to a large number of vertebrates including amphibians that are the most endangered class at a global level, even in forest ecosystems (Stuart et al., 2004; Wells, 2007). Trees in forest environments are used by many amphibian species or sometimes by whole amphibian families that have evolved adaptations for living on trees (Wells, 2007 and references

* Corresponding author.

E-mail address: antonioromano71@gmail.com (A. Romano).

¹ Co-primary author: these authors contributed equally to this work.

therein). These arboreal amphibians have unusual morphological characteristics for climbing and clinging to vegetation and have evolved unique breeding strategies and feeding behaviors (Wells, 2007 and references therein).

However, while the existing link among arboreal amphibians and trees is almost self-evident, the relationship between trees and forest ground-dwelling amphibians is much more tenuous and little studied. Arboreal amphibians occur mainly in tropical forests (e.g. Inger and Stuebing, 1997; Wells, 2007, but see Spickler et al., 2006) while in temperate ecosystems no species may be considered exclusively arboreal, even though trees are still a key resource for many. Among amphibians living in temperate regions, only tree frogs (family: Hylidae) may be considered as species typically associated to trees as they use trees as preferred places to call (Wells, 2007). Indeed, although both American and European anurans and salamanders have been observed climbing into trees (e.g. Neill and Grubb, 1971; Gosà, 2003; Casali et al., 2005), such information about arboreal activities were regarded as unusual behaviors of a given population or individual rather than a characteristic trait of the species.

Among vertebrates, the concept of “habitat tree” in temperate forests, which considers tree age, size and microhabitat occurrence, has been researched mainly for birds and mammals, in particular bats and rodents such as squirrels and voles, as well as marsupials (Gillesberg and Carey, 1991; Lindenmayer et al., 1997; Taulman, 1999; Gibbons and Lindenmayer, 2002; Gustafsson et al., 2012; Bütler et al., 2013). As a consequence, the effect of forestry practices on amphibian communities is commonly considered at the landscape and/or forest stand scale, suggesting that major threats are connected with habitat fragmentation and loss, because amphibians exhibit low vagility (low ability to move about freely and migrate) and suffer high mortality rates when crossing inhospitable patches (Cushman, 2006). While many studies have focused on the effects of clearcuts, fewer have tackled the question of multiple forest treatments and structural diversity (see Costa et al., 2016 for a brief review).

Here we provide evidence that the combination of forestry practices and species conservation strategies may act at a smaller scale than those traditionally adopted (i.e. landscape and/or forest stand). We performed our study in a central Italian forest, using the endemic Northern spectacled salamander (*Salamandrina perspicillata*, Savi 1821) as target species. The aim of this study was four-fold. First, we tested whether the concept of “habitat tree” may hold for salamanders, that is whether salamanders use trees as shelters. Second, we investigated whether the morphological characteristics of trees make them suitable shelters for salamanders. These two objectives are meant to corroborate or disprove the results presented by Basile et al. (in press) using a completely different approach. Third, we evaluated the quality of “habitat trees”, investigating whether there are, among suitable “shelter trees”, different quality classes related to salamander ecology, that is, whether there are temporary and permanent “shelter trees”. Our aim here was not only to distinguish between suitable and unsuitable habitat trees (tree diameter is thought to be the main discriminating factor, Basile et al., in press), but also to explore whether suitable trees that are permanently used for shelter by salamanders show features that distinguish them from temporary shelter trees. Our final aim was to provide guidelines for forest management of amphibians, consistent with our research findings.

2. Materials and methods

2.1. Study area

The study was carried out in the Collemeluccio-Montedimezzo UNESCO Biosphere Reserve (Molise, Central Italy; 41.76232°N,

14.21856°E), a mixed deciduous forest dominated by beech (*Fagus sylvatica*), with sporadic oak (*Quercus cerris*), fir (*Abies alba*), maple (*Acer campestre*) and European hornbeam (*Carpinus betulus*). A square study plot of about one hectare on a northeast-facing slope was selected. A first order Apennine stream, located at the north-east edge of the plot, was the breeding sites of three amphibian species, the Common Toad, *Bufo bufo* (Linnaeus, 1758), and two Italian endemics, *Salamandrina perspicillata* and the Apennine frog *Rana italica* (Dubois, 1987). The *Salamandrina* is very abundant in the study plot, from hundreds to about 1500 animals/ha (Costa et al., 2015a).

2.2. Tree morphology

A former pilot study showed that salamanders were not associated to trees with diameter at breast height (DBH) < 10 cm, accordingly we labeled and georeferenced every tree with a DBH ≥ 10 cm. For each tree, three morphometric variables were recorded: DBH, number of buttresses in the stump (BUT), and number of holes between soil and stump (HOL). Buttresses are tree roots that extend above ground as a plate-like outgrowth of the trunk supporting the tree and holes are cavities in the soil at the base of the trunk and between buttresses (see Figs. S1 and S2). DBH was obtained by averaging two perpendicular measurements of the stem, each taken with a calliper at ca. 1.3 m above ground level. BUT and HOL were measured simply by counting buttresses and cavities. Field-Map technology (<http://www.fieldmap.cz>) was used to obtain a distribution map for the selected trees with a centimeter (cm) accuracy.

2.3. Study species and sampling protocol

Salamandrina perspicillata is a forest dwelling salamander with a biphasic life cycle, and only females enter the water during spawning (spring) (Angelini et al., 2007). Information on the terrestrial ecology of this species is very limited, concerning mainly intraspecific behavior and food habits (Utzeri et al., 2004; Bruni and Romano, 2011; Salvidio et al., 2012; Costa et al., 2015b). Knowledge of its relationships with forest ecosystems and forest habitats is lacking (see Angelini et al., 2007), although one recent paper examines this topic (Basile et al., in press).

Salamanders were sampled by a team of 4–7 researchers during eleven sessions conducted over two years (3 in 2013 and 8 in 2014). The exact dates were October 10–28–29 in 2013; October 2–3–4–23–24–25 and November 6–7 in 2014. All samplings were performed in comparable weather conditions (slight rain, no wind and temperature above 8 °C) and at the same time of the day, about 8.00–15.00. Samplings were carried out during autumnal season to minimize variations in the activity of animals and to exclude any effect on the distribution of individuals caused by reproductive behavior. Salamanders were actively sought within a radius of about 1.5 m around each tree, which was checked once per sampling occasion, gently pushing aside the litter and then repositioning it below the buttresses and lighting the holes with a torch. Total counts of salamanders (Y) recorded among all sampling sessions were then calculated for each tree.

Salamanders were also individually marked using digital pictures of the ventral pattern, which is unique and persistent for each individual in this species (Vanni et al., 1997). Photo-matching was performed using the software APHIS, already tested for the Image Template Matching approach on *Salamandrina perspicillata* (Moya et al., 2015). During each sampling session we were able to associate every salamander to the tree in which it was found. As a result, we obtained a sampling history of salamanders and trees that was used to identify “permanent shelter trees” (PERM), “seasonal shelter trees” (SEAS), “temporary shelter trees” (TEMP) and “occasional

Download English Version:

<https://daneshyari.com/en/article/4759605>

Download Persian Version:

<https://daneshyari.com/article/4759605>

[Daneshyari.com](https://daneshyari.com)