

Best Management Practices *Enhancing Forage*

Available research at three sites indicates that desert tortoises are highly selective in their foraging (Avery and Neibergs 1997, Oftedal et al. 2002, Jennings and Berry 2015). Desert tortoises preferred certain native annual forbs in those studies, such as desert dandelion (*Malacothrix glabrata*), desert plantain (*Plantago ovata*), Mojave lupine (*Lupinus odoratus*), and lacy phacelia (*Phacelia tanacetifolia*). At the Desert Tortoise Research Natural Area, for example, certain native annual forbs were not consumed while others were more preferred among 80 species (Jennings and Berry 2015). Foraging preferences appear species-specific and particular genera and families (e.g., Fabaceae, Malvaceae, Onagraceae) may be favored. Certain herbaceous perennial forbs (e.g., desert wishbone-bush, *Mirabilis laevis*) may be preferred even when annuals are available. Limited evidence indicates that forbs are more easily digested and have more of the required nutrients than grasses, and that juveniles will lose weight on grasses (e.g., Hazard et al. 2009). For the purposes of this fact sheet, the focus will be on annual forage plants. Please see the “Restoring Perennial Plants” fact sheet for perennials.

Best-management practices for enhancing annual plant forage available to desert tortoises include:

- **Maintain a diverse “menu” of native annual plants.** Diets of desert tortoises vary seasonally within a year during the progression of plant growth and phenology. Different sizes of tortoises can access different species and sizes of annual plants (Fig. 1). A diverse annual plant community is most likely to provide access to diverse nutrition.

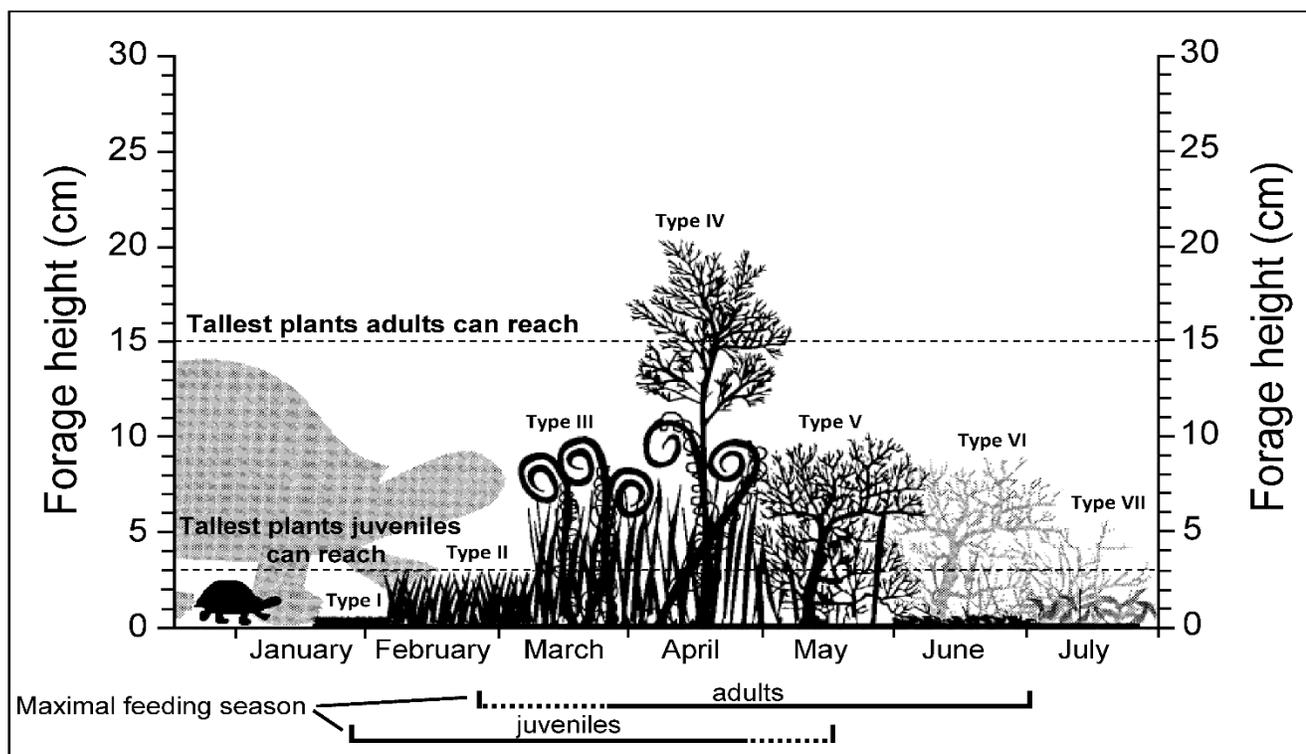


Fig. 1. Different types of annual plant forage based on size of plant and timing of growth in relation to juvenile and adult desert tortoises. Adapted from Morafka and Berry (2002).

- **Reducing non-native grasses is likely to improve forage quality and quantity.** Desert tortoises appear to avoid eating the non-native annual Mediterranean grass (*Schismus* spp.). The non-native red brome (*Bromus rubens*) may also be sub-optimal forage. When non-native grasses are reduced, native annuals have increased.
- **Properly timed herbicide applications have reduced non-native grasses while minimizing non-target impacts to native plants.** Non-native grasses typically display accelerated phenology (earlier germination in winter) compared to native winter annuals. Exploiting this, by timing pre- or post-emergent herbicides early in the growing season (with specific timings varying with weather among years), can potentially enhance forage composition. Early treatments may also correspond with periods of inactivity of desert tortoises still inside winter burrows. Conducting herbicide trials within desert tortoise habitat is a research priority to evaluate benefits and tradeoffs, as compared to unabated non-native grass invasion.
- **Reducing or eliminating non-native animals has enhanced native plant community condition.** Fencing and removal of feral animals (horses, burros) and livestock (cattle, sheep) has increased native perennial grasses and annual plant forage quality (Fig. 2). Diets of desert tortoises and non-native animals overlap. For example, desert plantain was the most abundant species in feral burro diets in the Mojave Desert. Desert plantain also is preferred by tortoises. Alleviating any potential competition for forage between non-native animals and desert tortoises is consistent with recovery strategies for desert tortoises.

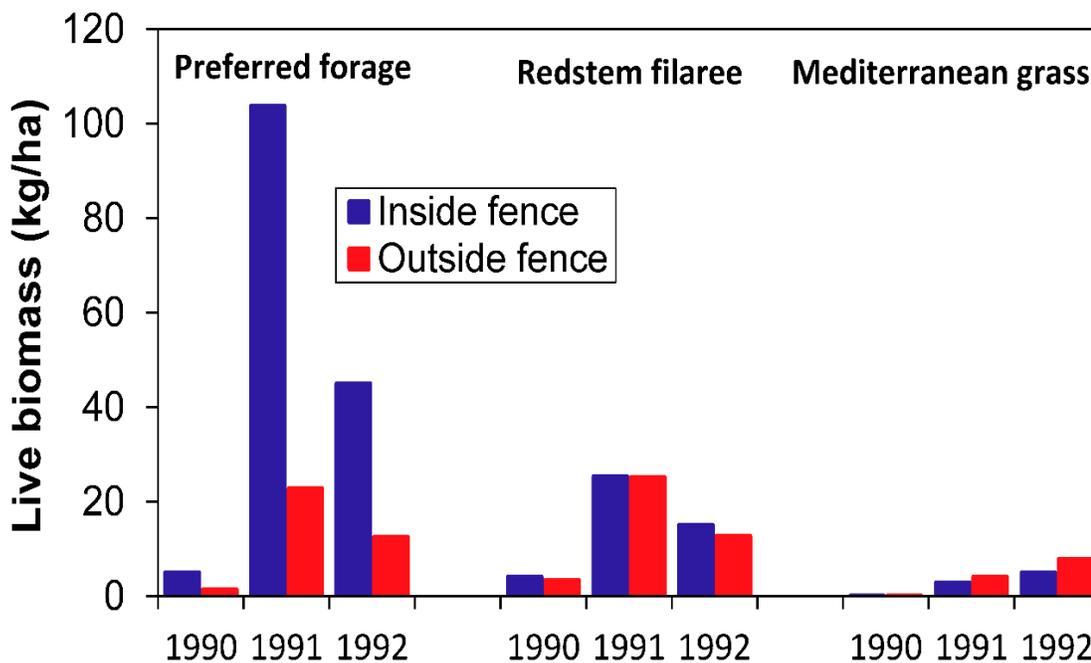


Fig. 2. Biomass of preferred forage plants and non-native redstem filaree (generally better forage than non-native grasses but less preferred by tortoises than some native forbs) and non-preferred Mediterranean grass (a non-native annual) inside and outside fencing at the Desert Tortoise Natural Area. Data, from Brooks (1995), are shown for three years varying in rainfall.

- **Maintaining or enhancing perennial plant communities may be important for enhancing annual plant forage.** Perennial plants provide areas of ameliorated microclimate and nutrient-enriched soil important to annual plant recruitment. Different perennial plant species “cultivate” different annual plant communities. Please see the “Restoring Perennial Plants” fact sheet for techniques for establishing perennials.
- **Severely disturbed or compacted soils (e.g., backcountry dirt roads) generally support low abundance of annual plants.** Ameliorating these conditions, such as through techniques in the “Restoration of Severe Disturbances” fact sheet, may enhance annual plant communities.

- **Augmenting annual plant forage through seeding is expensive and prone to failure but can succeed under some conditions.** At the Large-Scale Translocation Site for desert tortoises near Jean, Nevada, seeding pelletized (with a protective coating) seed of locally collected desert plantain in fenced areas increased forage for at least two years.
- **Conducting additional desert tortoise forage preference studies is a priority for understanding variability in forage plants tortoises prefer among years and soil types.** We need additional research to evaluate generalizations such as tortoises favoring plant species low in potassium or with high potassium excretion potential, or other plant species with particular characteristics.



Fig. 3. Desert tortoises foraging. Left photo by K. Powell; right by M.W. Tuma.

Example References and Further Reading

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