



**Garry Oak
Ecosystems
Recovery Team**

STEWARDSHIP ACCOUNT FOR

**Carolina Foxtail
(*Alopecurus carolinianus* Walt.)**

March 2003

**Prepared by
Andrew MacDougall
For the Garry Oak Ecosystems Recovery Team**

**Funding Supplied by the Habitat Stewardship Program of the Government of Canada
and the Nature Conservancy of Canada**

Canada
The Habitat Stewardship Program
of the Government of Canada

**NATURE
CONSERVANCY**
CANADA

**CONSERVATION
OF NATURE**
CANADA

STEWARDSHIP ACCOUNT FOR *ALOPECURUS CAROLINIANUS*
(CAROLINA FOXTAIL)

1. Species information

- a) Names: *Alopecurus carolinianus* Walt.
- b) Synonyms: *Alopecurus ramosus* Poirot, *A. geniculatus* var. *ramosus* (Poirot) H. St. John, *A. pedalis* Bosc ex P. Beauv., *A. gracilis* Willd. ex Trin., *A. macounii* Vasey (NOTE: from specimen collected by J.M. Macoun “on dry rocks” at Oak Bay on 30 May 1887), *A. geniculatus* var. *caespitosus* Scribner (NOTE: from specimen collected by J.M. Macoun at Yale on 17 May 1889).
- c) English name(s): **Carolina foxtail, annual foxtail, common foxtail, tufted meadow foxtail.**
- d) Family name (Latin and English): **Poaceae (Grass Family)**

- e) Classification: include any taxonomic changes or problems: none
- f) Similar species: Latin and English: **Three other *Alopecurus* species occur in south-western British Columbia: (1) *A. geniculatus* L. (water foxtail), (2) *A. aequalis* Scobol. (little meadow foxtail), and (3) *A. pratensis* L. (common meadow foxtail). Like *A. carolinianus*, all possess the dense and cylindrical panicle that characterizes this genus. They also all occur in moist-to wet soils, and have known associations with Garry Oak ecosystems (Fuchs 2001). However, these three species are perennial, are more widespread, and grow much larger and taller than *A. carolinianus*. As well, longer awns of the glumes of *A. carolinianus* distinguish it from *A. aequalis*, while shorter spikelets distinguish it from *A. pratensis*.**
- g) Range and Known Distribution
- h) Global range: **Continental North America, including parts of western Canada and northern Mexico. Occurs throughout the United States except Nevada (and possibly Maine, Vermont, and New Hampshire).**
- i) Canadian range: **south-western British Columbia east to southern Saskatchewan.**
- j) British Columbia range: **south-eastern Vancouver Island (Victoria to Campbell River), the Gulf Islands including Trial Island off Victoria, and the south-central mainland (Yale, Princeton).**
- range changes during last ten generations or 10 years: **regional range changes in the past decade are unknown. The recent discovery of this species in Princeton could conceivably be the result of human-caused seed introductions (R. Hebda, personal communication), and thus represent a range expansion. However, this is strictly speculative. In areas where this species is definitely native (e.g., Vancouver Island), there is no evidence of range expansion.**
 - longer-term trends: **Although regionally stable, there appears to have been several local extirpations in the Victoria area (Cattle Point [last record 1966], Uplands Park [last record 1961], Oak Bay [last record 1968]). Element occurrences Yale and Mitlenatch Island have not been observed since the late 1970s or earlier. It is unknown whether these sites have been visited recently. Determination of this species' longer-term status will require more field work to 1) ascertain the status of old records, 2) to clarify whether populations in south-central B.C. are recent introductions (e.g., associated with agricultural activity or seeding of roadside banks?), and whether it occurs or has established in other areas of southern B.C., and 3) to determine if this species occurs in other parts of Vancouver Island and the southern Gulf Islands that possess vernal habitat.**
 - range of species: **restricted**
 - general localities of Canadian populations and number of specific locations of occurrence within each population: **BRITISH COLUMBIA: (1)**

greater Victoria region including Trial Island, Fort Rodd Hill, Christmas Hill, and Rocky Point (10 stations reported from BC CDC, Royal BC Museum Herbarium, UBC Museum) (2) Hornby Island (1 station (Gurney Cape) reported from BC CDC), (3) Mitlenatch Island (1 station (offshore of Campbell River) reported from BC CDC), (4) Princeton (6 stations (Stevenson Lake, Whipsaw Creek) reported from BC CDC), and (5) Yale (1 station reported from the late 1800s by Macoun; this record is not listed in the BC CDC database) ALBERTA: parts of southern Alberta (NOTE: this species is ranked S3 in Alberta, and is on the Alberta CDC “watch list”) SASKATCHEWAN: parts of southern Saskatchewan.

3. Habitat Description

a) General habitat requirements of the species

- general habitat type: **open areas with wet or moist shallow soils.**
- specific habitat type (BC): **most commonly associated with vernal inundated soil pockets on rock outcrops or other open areas with shallow soils. These sites, often supporting numerous small annual native “oak ecosystem” species, are dry by mid-summer. *A. carolinianus* also occurs in moist disturbed areas such as roadsides, ditches, and fields.**
- Specific habitat types (elsewhere in North America): **1) also occurs in vernal “oak ecosystem” habitats in south-western California and western Washington (Thurston County and Orcas Island), 2) in the prairies, it is known to occupy vernal moist buffalo wallows, and 3) given its preference for wet and sometimes disturbed soils, this species is considered an invasive weed in some agricultural areas of the central and eastern United States. It can be problematic in irrigated corn fields and nursery beds, where it is treated with herbicides.**
- specific characteristics: dynamic factors (e.g. erosion, flooding, nutrient deposition): **given its slight physical stature, this species tends to occur in weakly vegetated habitats free from intense competition. This includes areas where moisture is limiting or unavailable for much of the year (i.e., vernal pools) and areas that are disturbed (naturally or by humans).**
- associated native & non-native species: **B.C. herbaria records describe associated native species typical of moist vernal habitats (e.g., *Carex obnupta*, *Isoetes nuttallii*, *Montia fontana*, *Montia howellii*, *Plagiobothrys figuratus*, *Plagiobothrys scouleri*) as well as oak ecosystem species of shallow-soil rock outcrops (e.g., *Allium amplexans*). These records also indicate that some sites are invaded**

by exotic grasses (e.g., *Agrostis spp.*, *Poa compressa*). The effect of invasives on *A. carolinianis* is unknown.

- other species at risk occurring in same habitat: 1) *Lotus unifoliolatus* spp. *unifoliolatus*, and 2) *Plagiobothrys figuratus*.
- b) Habitat availability and net trends in habitat change:
- sufficient habitat protected for long-term survival: **unclear. Several sites receive some level of protection (Trial Island, Fort Rodd Hill, Mitlenatch Island (remote, bird sanctuary), Rocky Point), although not all of these sites are managed to specifically protect rare flora (e.g., Rocky Point). The potential for human disturbance of the Princeton populations is probably low. If populations do still occur at Cattle Point and in Uplands park (requires verification), however, the protection of these sites is offset by the potential for heavy foot traffic (i.e., these sites are protected, but the status of species contained within are not fully secure). Ultimately, long-term survival will depend on whether the limited number of remaining protected populations are sufficient to withstand probable genetic isolation (given the distances that separate many sites) and the occasional disappearance of local populations that naturally affects annual ruderal species with limited distributions. The ability for *A. carolinianus* to naturally re-establish or colonize previously unoccupied protected habitats is probably limited, although the dispersal behaviour of this species is not fully known (e.g., relative proportion of seeds that are dispersed long distance by wind vs. the number that merely fall to the base of the parent plant).**
 - net gain or loss of habitat; recommended critical habitat: **Recommended critical habitat is vernal moist areas, which supports a large number of oak ecosystem species including some that are also at-risk. NOTE: Vernal pool habitat is considered critical habitat for oak ecosystem species throughout areas of western North America (Keeley and Zedler 1998). There has been a net loss of this habitat in the Victoria area in particular due to development. Net habitat changes in other areas (e.g., Hornby Island, Yale) are unknown.**
 - cause of trends: **urban expansion onto rocky outcrops and other areas that formerly supported vernal moist habitat. Trampling by humans may also be an issue in some areas.**
 - threats to habitat: **development, foot traffic.**
 - habitat trends across border: **difficult to determine for Washington, Oregon, and California. This species has slipped “under the radar screen” for these states; it is not listed by any of their Natural Heritage Programs. It could be more widespread, or equally or more at-risk due to habitat loss. It is reported from only two stations in western Washington (Thurston Co. [1939] and Orcas Island [1992]), and the status of these sites is unknown. Seven other records have been reported for the state but all occur east of the Cascade**

Mountains (Curtis Bjork, personal communication). It is not reported from “oak ecosystem” habitat in Oregon. All four records (all pre-dating the 1950s) come from eastern Oregon and could be human-mediated introductions. In California, this species is listed as uncommon (Hickman 1993), and most records date from 1903-1942 in areas that are now heavily settled (San Diego, Fresno). It is only considered native in the “South Coast” floristic province of California; all other records are classified as “weedy”.

c) Habitat ownership/protection:

- type of ownership and management responsibility: **Exact ownership pattern unknown, though BC occurrences are probably a mix of private, municipal, crown, and Department of National Defence.**
- amount legally protected; future land use: **Exact amount protected unknown, and not all protected areas are managed specifically to maintain rare plant species. Occurrences on Trial and Mitlenatch Islands, and Fort Rodd Hill are probably protected. Rocky Point is protected but not managed to protect its rare flora. The status of the Christmas Hill, Hornby Island, and Princeton populations is uncertain. Future risk depends on whether the remaining areas are managed to protect this species specifically. As has probably occurred in some or all of the Cattle Point and Uplands populations, protection alone is not sufficient if detrimental disturbances continue.**

4. Status of Species

- endemic/relict/indicator or keystone species: **In B.C., this species is an indicator of vernal moist habitat that is known to support numerous oak ecosystem plant species, including some that are also at-risk.**
- species at risk worldwide?: **No (though it also considered a rare species in New Jersey). This species can be very common in parts of central and southern United States. In Weeds of the United States and Canada (1998), it is listed as an invasive weed. NOTE: the invasive status of this species may mean that it has been overlooked as a species-of-interest in some areas where it is 1) native, and 2) rare. Although I could not find direct evidence of this in conversations with Oregon and western Washington botanists, it is possible that past collectors have ignored collecting or recording this species. Raising the profile of *A. carolinianus* as a at-risk species in the Pacific Northwest may potentially lead to increased sightings in habitats where it is now unrecorded (e.g., most oak ecosystem areas of Washington; all oak ecosystem areas of Oregon).**

- Status from nearby jurisdictions: **Washington** (unranked. Known from only two western “oak ecosystem” locations); **Oregon** (unranked. Known from only four locations in state; all are non-oak ecosystem habitats of eastern Oregon); **California** (unranked. Known from only three “oak ecosystem” locations in the western part of the state). **Alberta** (ranked S3 and on the “watch” list by the Alberta CDC).
- global rank; North American (G5) and provincial rank (S2)
- any related forms threatened: **No.**
- special scientific interest: **No.**
- possibility to be confused with another common species (list these): **No.** **Other *Alopecurus* species in British Columbia are much larger and perennial.**
- genetic importance: **Unknown but warrants further investigation given 1) its extremely wide distribution in North America, and 2) its occurrence in mediterranean (where it grows as a winter annual) and non-mediterranean (where it grows as a summer annual) climates. Genetic exchange between populations separated by the Rocky Mountains is probably limited or nil. Populations in the “winter” climates east of the Rocky Mountains flower 2 months (or more) later than our populations. Research on the life history of this species by Baskin et al. (undated) suggests that this species is extremely “plastic” (i.e., it can adjust to regional climatic differences quite easily) rather than showing substantial genetic differentiation based on regional climate differences. They observed that seeds from the same “mother plant” could germinate as a winter or summer annual depending on interactions of imposed temperature and moisture conditions. This research, however, was conducted on populations from the eastern and southern United States only.**
- other uses (e.g. pharmacological, ethnobotanical, horticultural): **none**
- plant & pollinator interactions: **wind-pollinated; unknown if self-pollination occurs and whether self-pollination produces viable seeds.**
- how much of range is in protected areas: **the exact percentage is unknown. The highest priority unprotected locations of this species appear to be Hornby Island, Yale (if it still occurs there), and Princeton.**

5. Life History

- a) General: **One of approximately 25 *Alopecurus* species worldwide, 11 of which are native to North America. Seven species, including *A. carolinianus*, occur in the Pacific Northwest (Cronquist 1984, Douglas et al. 1998, Hitchcock and Cronquist 1998). Taxon is a spring-flowering annual grass,**

growing from 5-25 cm in height. Has erect to decumbent culms. Leaf blades are 1-3 mm wide, and may be finely scabrous above. Ligule is membranous, rounded to elongate, 1-5 mm long. The spike-like panicle is 1-5 cm long and 3-5 mm thick. Glumes are 1.5-2.8 mm long, obtuse-tipped, villous on the keel and lateral nerves. The awn from back of the lemma is exerted 2-4 mm beyond the glumes tips (an especially diagnostic feature of this species compared to other *Alopecurus* species).

- b) Phenology: Germination time variable, either in winter or spring (Hitchcock and Cronquist 1998). Variable germination times are common for annual species to ensure that some individuals successfully establish and set seed each year.
- c) Pollination Biology: **Unknown; probably an unspecialised wind-pollinated species.**
- d) pollinators and pollination mechanisms; structures (e.g. nectaries corolla type); crossing; fl. sequence; blooming period; seed viability; dormancy and germination requirements: **flowering period in BC is April-June; flowering period east of the Rocky Mountains is May-August. Research by Baskin et al. (undated) suggests that seeds of this species may be viable for up to 2-3 years, although the percentage of viable seeds does decline over time. Dormancy appears to be broken by either warm temperatures alone, or the combination of warm temperatures and moisture (NOTE: based on research from the south-eastern United States, May not apply to BC populations but is probably close). As well, seeds that break dormancy but do not germinate appear to be able to re-enter dormancy and germinate in the following year. Apparently, its seed does not require cold stratification.**
- e) Reproductive ecology: longevity; sexual/asexual reproduction; reproductive success; growth rate; seedling ecology; hybridisation: **The potential exists for some level of hybridisation of this species with other *Alopecurus* species, as reported by Curtis Bjork in eastern Washington. He writes:**

“A. carolinianus, A. saccatus, A. aequalis and A. geniculatus appear to hybridize in eastern Washington, or they might be poles of a complex, four-part continuum. For example, typical A. saccatus is common at the west end of the Channeled Scablands, typical A. carolinianus is common at the east end, but in the center of the region, it's the intermediates that are most common, though the intermediates sometimes turn up in the same vernal pools with typical A. saccatus or A. carolinianus, with no integration between typical and nontypical forms. Also adding to the confusion in Washington *Alopecurus*: some characters that distinguish among these four species sometimes vary within the same plant: as with the point of origin of the lemma awn and awn exertion, or in the same population: glume length, inflation of the uppermost sheath, and coloration. Of course, it might be only on the Scablands that you see intermediates (hybrids or whatever they are).”

It is unclear if this is a phenomenon restricted to this location. It may require further investigation given the co-occurrence of some of these species in B.C.

- f) limiting factors: **limits to occurrence probably a balance between highly competitive habitats and habitats that are too moisture limited to persist.**
- g) Survival – factors affecting species survival; population age structure; recruitment rate; causes of mortality; rate of survival to maturity; potential for growth of population; seedling survival: **Much of this information is unknown. Given that this species is annual, its persistence depends on the ability of the seed bank to re-establish itself each year. Because of fluctuations in annual temperature and rainfall patterns, annual species such as *A. carolinianus* may experience dramatic fluctuations in the number, size, and range of populations locally on a year-to-year basis. There is potential for seeds to not germinate in a given year, but to re-appear the following year when conditions are more appropriate.**
- h) Physiology - range of climatic conditions; physiological adaptations; pH, soil/substrate and moisture requirements; dormancy period: **Moisture requirements unknown but propensity for vernal wet soils suggests an ability to tolerate inundated and potentially anaerobic soils for some time, followed by an ability to tolerate some level of desiccation. Onset of the desiccation period may be the primary trigger for seed set, although this is speculative.**
- i) Dispersal – mechanisms and distance (pollen, spores, seeds). **Most likely gravity and wind.**
- j) Nutrition & Interspecific Interactions – nutritional requirements; obligate or facultative associations; toxic or allelopathic associations: **Unknown. This species is probably restricted to vernal or disturbed wet habitats to escape competitively superior species, rather than requiring specific nutrient or moisture conditions of these habitats.**
- k) Behaviour/Adaptability - specialized species; ability to adapt to changes; disturbance type & tolerance; horticultural varieties; breeding or transplant studies: **Greenhouse experiments suggest that this species can be easily grown from seed (Baskin et al., undated). Germination was found to be triggered by one, or the combination of, warm temperatures and moist conditions. Warm temperature and moist conditions triggered germination in individuals planted during the summer months. Moisture alone triggered germination in individuals planted during the autumn months. The greenhouse study found germination levels were close to 100%, that the seeds maintained some degree of viability for over three years, and that the seeds could re-enter dormancy as described above. These results suggest that this species could be readily established if seed is planted in appropriate habitats during the autumn period.**

6. How the species is at risk

Long-term and recent changes in the species number and range due to limiting factors (biological, environmental, others) and threats (both natural and human):

- description of threat (e.g. loss of habitat, fragmentation or degradation): **loss of habitat, direct disturbance (e.g., trampling).**
- susceptibility to disturbance: **unknown but probably depends on the type, intensity, and frequency of the disturbance(s). Periodic trampling, for example, may not be a problem compared to repeated disturbance.**
- successional factors: **requires sparsely vegetated conditions. Occurrence of this species in perturbed locations may not persist unless the area is periodically re-disturbed.**
- specific notes on threats and limitations on population size or distribution of species or population: **see above**
- dispersal/pollination restrictions: **among remnant oak ecosystem sites, this species is probably highly dispersal limited. Wind dispersal may disperse seeds within some sites, however.**
- competition: **appears to be a poor competitor with other plant species.**
- disease: **rust infection has been reported in some populations, though it is unknown whether this affects or threatens the growth of this species.**
- other (e.g. invasive species such as Scotch broom/orchard grass):

7. Management Recommendations

- current management policies and actions: **none, other than sporadic monitoring. Recommendation: historical sites of occurrence outside of Victoria should be re-surveyed and areas previously un-surveyed but possessing appropriate habitat should be visited. Establishment of new populations in suitable habitat should be considered, and may not be difficult to accomplish. Any such re-introduction should be monitored over time to assess success and the impacts of this species on other native taxa. Given that this species is known to be invasive elsewhere, there may be a risk that other flora may be displaced if establishment is too successful.**
- management prescriptions relative to locations of populations: **make sure that seed comes from local native populations. Seed from unverified sources could be derived from central North America or from recently established human introductions west of the Rocky Mountains.**
- specifics and timing of prescriptions (e.g. mowing, controlled burning, invasive species control/removal): **this annual species flowers in late spring or early summer, and probably germinates throughout the**

wettest months of late winter and early spring. Any intervention into areas of occurrence should be wary of trampling at these times.

- potential to stabilize or reverse any decline: **unclear. Occurrences of this species in BC may fluctuate naturally (i.e., some populations may blink out naturally, others may establish elsewhere) due to life history (annual), and habitat (size and location of vernal pools may vary year-to-year). Best bet may be to protect areas of known occurrence, and explore planting seeds in suitable habitat to increase germination/establishment success elsewhere.**

8. References/Literature Cited and General Bibliography

Baskin, CI, Chester EW, and Baskin JM (undated) The annual dormancy cycle in buried seeds of the native winter annual grass *Alopecurus carolinianus*. Available at www.apsu.edu/biol_page/symhome/seeds.html .

Cronquist A (1984) Poaceae. In: Vascular Plants of the Pacific Northwest. University of Washington Press, Seattle, Washington.

Douglas GW, Meidinger D, Pojar J (2001) Illustrated Flora of British Columbia. Volume 7. Province of British Columbia, Victoria, British Columbia.

Douglas GW, Straley GB, Meidinger DV (1998) Rare Native Vascular Plants of British Columbia. Province of British Columbia, Victoria, British Columbia.

Fuchs, M (2001) Towards a recovery strategy for Garry Oak and associated ecosystems in Canada: ecological assessment and literature review. GOERT, Victoria, B.C.

Hickman, JC (1993). The Jepson Manual: the higher plants of California. University of California Press, Berkeley, California.

Hitchcock CL, Cronquist A (1998). Flora of the Pacific Northwest. University of Washington Press, Seattle, Washington.

Keely, JE and Zedler PH (1998) Characterization and global distribution of vernal pools. Pages 1-14 in: Ecology, conservation, and management of vernal pool ecosystems (eds. CW Witham, ET Bauder, D Belk, WR Ferren, and R Ornduff). Proceedings from the 1996 Conference of the California Native Plant Society, Sacramento, CA.

Southern Weed Society (1998) Weeds of the United States and Canada. Southern Weed Society, Champaign, Illinois.

9. Authorities Consulted

an *Alopecurus* specialist could not be identified from North America

10. Personal communications and Consulted Websites

(a) Marta Donovan

BC CDC

e-mail: Marta.Donovan@gems4.gov.bc.ca

Dates of Contact: February 10, 2003

Received: extant and extirpated occurrence records for British Columbia.

(b) Richard Hebda

Royal British Columbia Museum

Dates of Contact: February 26, 2003

Received: discussions on its potential origins (human or native) in BC

(c) Chris Chappell

Vegetation Ecologist

Washington Natural Heritage Program

Olympia, WA

360-902-1671

Dates of Contact: February 24, 2003

Received: Discussions on status in Washington State, and the likelihood of its origins being native or human-introduced. NOTE: was not aware of this species, or its status in the state.

(d) Florence Caplow

Rare Plant Ecologist

Washington Natural Heritage Program

Olympia, WA

360-902-1789

Dates of Contact: early February 2003. Received information on March 11, 2003;

Received: Detailed information on the status of this species in Washington, including county records and discussion of its life history within Washington.

(e) Curtis R. Bjork

Washington State University

cbjork@mail.wsu.edu

Date of Contact: early February, 2003. Received information on March 11, 2003.

Received: Detailed information on the location of this species in eastern Washington, including evidence of possible hybridisation with other *Alopecurus* species in the area.

(f) Sue Vrilakas

Rare Plant Botanist

Oregon Natural Heritage Program

503-731-3070

Dates of Contact: February 24, 2003

Received: Discussions on status in Oregon, and the likelihood of its origins being native or human-introduced. NOTE: was not aware of this species, or its status in the state.

(g) Robert Meinke

Program Leader

State Endangered Plant Program

Oregon Dept. of Agriculture, Oregon State University

541-737-2317.

Dates of Contact: February 24, 2003

Received: Discussions on status in Oregon, and the likelihood of its origins being native or human-introduced. NOTE: was not aware of this species, or its status in the state.

(h) Website: USDA Natural Resources Conservation Service

www.plants.usda.gov

Received: general classification and distribution information for North America. Includes description of this species as an invasive weed

(i) Website: CalFlora Occurrence Database

www.calflora.org

Received: County-level occurrences records for California, including date of collection, location, and observer.

(j) Website: NatureServe Conservation Status Reports

www.natureserve.org

Received: Global and state/province level heritage status ranks, derived from Natural Heritage Programs and Conservation Data Centre databases.

(k) Website: Washington State Natural Heritage Program.

www.wa.gov/dnr/htdocs/fr/nhp

Received: No data available on this species.

(l) Website: Oregon State Natural Heritage Program.

www.heritage.tnc.org/nhp/us/or

Received: No data available on this species

(m) Website: Alberta Natural Heritage Information Centre.

<http://www.cd.gov.ab.ca/preserving/parks/anhic/flashindex.asp>

Received: status of species in Alberta.

(n) Website: Saskatchewan Natural Heritage Information Centre.

<http://www.biodiversity.sk.ca/>

Received: No information could be retrieved on this species.

(o) Website: Department of Botany Herbarium, University of British Columbia.

<http://www.botany.ubc.ca/>

Received: Two records.

(p) Website: Royal BC Museum Herbarium

<http://obj.royalbcmuseum.bc.ca/>

Received: Nine records.

(q) Website: Jepson Flora Project- University of California Berkeley

<http://ucjeps.herb.berkeley.edu/>

Received: bioregional distribution data, including range maps, in California. Information on its status as a native and exotic species. Six records listed for California on this database.

(r) Website: Oregon State University Website

<http://oregonstate.edu/dept/botany/herbarium/>

Received: 4 state records, all from eastern Oregon.

(s) Website: University of Washington herbarium website

<http://depts.washington.edu/wtu/home.htm>

Received: 1 state record from Orcas Island

(t) Website: Aquatic and Vascular Plants of the Northern Great Plains

www.greatplains.org

Received: morphological description of species, plus life history and distribution in the northern Great Plains of the United States.

(u) Website: information on *Alopecurus* synonymy

<http://herbarium.usu.edu/synomy/alopecurus.html>

(v) Website: Illinois Plant information network

<http://www.fs.fed.us/ne/delaware/ilpin/ilpin.html>

Received: Descriptions of the morphology and life history of the species, including its status as an invasive species in some areas.

NOTE: Many of the state-level websites on the www.fs.fed.us website were consulted, and contained information on this species within various states.

(w) Website: IT IS reports on North American flora

www.it.is.usda.gov/servlet/SingleRpt?search_topic=TSN&search_value.

Received: nomenclature, geographic information.

(x) OTHER WEBSITES CONTAINING GENERAL INFORMATION ON *A. CAROLINIANUS*:

1. pen-and-ink image : <http://www.csdl.tamu.edu/FLORA/image/k4368000.htm>
2. exotic plant information:
<http://www.usgs.nau.edu/SWEPIC/asp/aprs/location.asp?Symbol=ALCA4>
3. colour PDF photo: http://mccoy.lib.siu.edu/~weeds/capture/Alopecurus_carolinianus.pdf
4. another nice pen-and-ink image:
<http://spuds.agron.ksu.edu/ksgrasskey/images/Alopecuruscarolinianus.htm>
5. lists of Illinois weeds, including *A. carolinianus*:
<http://mccoy.lib.siu.edu/~weeds/capture/index.pdf>
6. Missouri weed list: http://www.psu.missouri.edu/fishel/carolina_foxtail.htm
7. New Jersey rare plant species list: <http://www.natureserve.org/nhp/us/nj/njsale.txt>
8. full list of all Pacific Northwest herbaria consulted in this report: <http://www.fs.fed.us/r6/nr-botany/links.htm#Herbaria>
9. Colour photo from Wisconsin plant database website:
<http://www.botany.wisc.edu/herbarium/wisflora/scripts/detail.asp?SpCode=ALOCAR>