

FINAL BOOLEAN SEARCH STRING FOR THE WEB OF SCIENCE

The Web of Science was one of four academic, bibliographic search databases that we queried. We used the same search terms as the list below for each of these databases, with modifications for each database's particular syntax. The string below shows that we conducted a Topic Search. This searches titles, abstracts, and Web of Science's proprietary/unavailable list of keywords (called Keywords Plus) for each of the terms below. Note, the general construct of the string is (vegetation terms) AND (bird terms). For search engines like Web of Science we used a small number of NOT terms that we discovered, via comparison searches, eliminated a large number of ineligible papers without eliminating eligible papers, from our search results. For search engines that did not allow the use of NOT operators, we had to exclude many papers related to poultry science and/or laboratory experiments using quail (a common laboratory species for birds). Since we did not summarize papers on Northern Bobwhites or any other native North American quail species, we could use this as NOT term to eliminate many ineligible references. NOT terms should be applied judiciously. We used similar search strings to the one listed below for the EBSCO Host and Proquest Search Engines.

Many of our sources allowed only a small number of characters for searches (e.g., Google Scholar allowed only 260 characters at the time of our search). Consequently, we developed shorter lists of search terms to meet the constraints of these types of search engines. Please see the three examples provided below our full search string below.

(TS=(forest OR savanna OR woodland OR shrubland OR shrub-land OR shrub OR scrub* OR hardwood OR deciduous OR broadlea* OR broad-leaf* OR boreal OR mixed-wood OR mixedwood OR succession* OR oak OR aspen OR willow OR maple OR beech OR basswood OR birch OR alder OR poplar OR spruce OR fir OR pine OR hemlock OR red-cedar OR ash OR elm OR hickory OR "old-field" OR cedar OR populus OR salix OR larch OR tamarack OR pocosin OR hazel* OR holly* OR laurel OR black-gum OR blackgum OR sweet-gum OR sweetgum OR knotweed OR knot-weed OR honeysuckle OR honey-suckle OR currant OR rhododendron OR dogwood OR forestry OR "tree species" OR "importance value" OR "vegetation classification" OR "physiognomy" OR "growth form" OR floristic OR "dominant species" OR "species dominance" OR habitat OR niche OR vegetation OR "plant species" OR "habitat heterogeneity" OR "habitat diversity" OR "habitat complexity" OR "vegetation biomass" OR "structural complexity" OR "structural diversity" OR "structural heterogeneity" OR "biological legac*" OR "spatial heterogeneity" OR "foliage height diversity" OR "foliage diversity" OR "vegetation complexity" OR "vegetation heterogeneity" OR "vegetation structure" OR "foliage height" OR "structural elements" OR "structural attributes" OR "canopy cover" OR "canopy complexity" OR "canopy structure" OR "shrub-stem density" OR "shrub density" OR "foliage arrangement" OR "understory vegetation" OR "understory vegetation" OR "leaf area index" OR "basal area" OR "stand inventory" OR "forest inventory" OR "growing stock" OR "tree spacing" OR "site index" OR "stem diameter" OR "canopy height" OR "key structures" OR "stand attributes" OR "canopy

gap" OR "branch characteristics" OR "foliage volume" OR "shrub heterogeneity" OR "vertical foliage diversity" OR "structural components" OR "dbh diversity" OR "overstorey species richness" OR "understorey species richness" OR "overstorey species richness" OR "understorey species richness" OR "shrub species richness" OR "standard deviation of dbh" OR "number of strata" OR "tree size diversity" OR "diameter distribution" OR "number of large trees" OR "standard deviation of tree height" OR "height class richness" OR "shrub height" OR "shrub cover" OR "understorey richness" OR "understorey richness" OR "stems per hectare" OR "stems per acres" OR "vertical arrangement of foliage" OR "foliage arrangement" OR "mean dbh" OR "stand structure" OR "large trees" OR "tree size diversity" OR "structural richness" OR "dead tree volume" OR "decay classes" OR "standing dead trees" OR "snags" OR "herbaceous cover" OR "canopy closure" OR "woody vegetation" OR "understorey tree dispersion" OR "woody stem density" OR "down* wood" OR "leaf litter" OR "shrub layer" OR "shrub strata" OR "number of seedlings" OR "number of saplings" OR "tree cavities" OR "legacy trees" OR "sub-canopy" OR "bark" OR silvicultur* OR clearcut* OR clear-cut* OR clearfell* OR even-aged OR "even aged" OR "uneven aged" OR uneven-aged OR timber OR harvest OR "seed-tree" OR coppic* OR highgrad* OR high-grad* OR "green-tree retention" OR "retention forestry" OR "habitat elements" OR "stand elements" OR "residual tree" OR "partial cut*" OR "gap cut*" OR "gap fell*" OR "gap manag*" OR "gap select*" OR "select* cut*" OR "select* logging*" OR "select* silvicultur*" OR "single tree*" OR "single-tree" OR "snag remov*" OR "salvage logging" OR "salvage harvest" OR "salvage cut*" OR "salvage fell*" OR "continu* cover*" OR "regenerat* harvest" OR "regenerat* cut" OR "diameter limit*" OR "diameter-limit" OR "variable retention" OR "partial retention harvest" OR "forestry plantations" OR "forest plantations" OR "plantation forest*" OR "retention forestry" OR "group selection cut" OR "group selection harvest" OR "regeneration forestry" OR "regenerat* clearcut*" OR "regenerat* clear-cut*" OR "managed forest*" OR "shelterwood" OR "precommercial thinning" OR "green tree retention" OR "legacy tree" OR "forest management") AND TS=(bird OR avian OR songbird OR warbler OR woodpecker OR wood-pecker OR thrush OR passerine OR avifauna OR avifaunal OR creeper OR ovenbird OR cowbird OR vireo OR cuckoo OR woodcock OR crossbill OR goshawk OR flycatcher OR fly-catcher OR hawk OR nuthatch OR sapsucker OR wren OR kestrel OR tanager OR merlin OR landbird OR siskin OR titmouse OR "gray jay" OR "Canada jay" OR "blue jay" OR bluebird OR goldfinch OR kinglet OR veery OR catbird OR waxwing OR towhee OR "peregrine falcon" OR chuck-wills-widow OR whip-poor-will OR waterthrush OR water-thrush OR yellowthroat OR parula OR "purple finch" OR "chimney swift" OR "Ruby-throated Hummingbird" OR "Mississippi Kite" OR "Eastern Screech-Owl" OR "Great Horned Owl" OR "Northern Hawk Owl" OR "Barred Owl" OR "Great Gray Owl" OR "Long-eared Owl" OR "Boreal Owl" OR "Northern Saw-whet Owl" OR "Northern Flicker" OR "Eastern Kingbird" OR "Eastern Wood-Pewee" OR "Eastern Phoebe" OR "Blue Jay" OR "Carolina Chickadee" OR "Black-capped Chickadee" OR "Boreal Chickadee" OR "Gray-headed Chickadee" OR "House Wren" OR "Winter Wren" OR "Carolina Wren" OR "Blue-gray Gnatcatcher" OR "Brown Thrasher" OR "Evening Grosbeak" OR "Pine Grosbeak" OR "House Finch" OR "Purple Finch" OR "Chipping Sparrow" OR "Field Sparrow" OR "Fox Sparrow" OR

"Song Sparrow" OR "Lincoln's Sparrow" OR "White-throated Sparrow" OR "White-crowned Sparrow" OR "Dark-eyed Junco" OR "Yellow-breasted Chat" OR "Orchard Oriole" OR "Baltimore Oriole" OR "Rusty Blackbird" OR "American Redstart" OR "Northern Cardinal" OR "Rose-breasted Grosbeak" OR "Blue Grosbeak" OR "Indigo Bunting" OR "Painted Bunting") NOT TS=(dinosaur* OR poultry OR chicken OR broiler OR chimpanzee OR monkey OR primate OR quail))

Searches strings for tools that limit the number of characters

Many non-academic search engines limit the number of terms that can be typed into a search interface at any one time. We show three examples of how we dealt with this problem below. Exact search strings for each information source will be listed in the final systematic review report publication that is in preparation for Environmental Evidence.

Google Scholar

Google Scholar limits searches to 260 characters. This includes the specification of "all in title", which limited searches to document titles, since full text searches yielded many millions of results. Google Scholar does not facilitate title-abstract searches. Google Scholar provides limited support for Boolean searches (AND and OR operators), but does not support NOT operators. The | operator in the string below is equivalent to OR in Google Scholar. Google Scholar does not allow users to extract citation information in batches (e.g., >1 reference at a time). In order to extract results of Google Scholar searches to our bibliographic databases, we used the software Publish or Perish, which created citations from Google Scholar results lists as long as they had less than 1,000 results. For this reason, we applied the same search string multiple time to unique ranges of years to stay below the 1,000 result limit (see below). The string below includes 25 terms (compared to the hundreds of search terms included in our full search string): 18 terms related to vegetation and 7 terms related to birds. After some experimentation, this was the limited term string that worked best for us to search tools with character limits.

allintitle: (forest | woodland | shrubland | hardwood | deciduous | boreal | mixedwood | deciduous | oak | aspen | willow | beech | spruce | fir | pine | forestry | maple | birch) AND (bird | avian | songbird | warbler | woodpecker | thrush | vireo)

Range of years for title only searches in Google Scholar and number of results

1900-1997 = 928

1998-2008 = 998

2009-2019 = 889

Elsevier Science Direct

The search engine for Elsevier Science Direct, at the time of our search, allowed for title-abstract searches and the ability to output search results to bibliographic software in batches. However, it also had character limits for searches. To cover the same subset of 25 terms in the Elsevier Science Direct search tool required the following 9 searches...

(forest OR woodland) AND (bird OR avian OR songbird OR warbler OR woodpecker OR thrush OR vireo) 2099

(shrubland OR hardwood) AND (bird OR avian OR songbird OR warbler OR woodpecker OR thrush OR vireo) 171

(deciduous OR boreal) AND (bird OR avian OR songbird OR warbler OR woodpecker OR thrush OR vireo) 295

(mixedwood OR oak) AND (bird OR avian OR songbird OR warbler OR woodpecker OR thrush OR vireo)
158

(aspen OR beech) AND (bird OR avian OR songbird OR warbler OR woodpecker OR thrush OR vireo) 72

(spruce OR fir) AND (bird OR avian OR songbird OR warbler OR woodpecker OR thrush OR vireo)
103

(pine OR forestry) AND (bird OR avian OR songbird OR warbler OR woodpecker OR thrush OR vireo) 368

(willow OR maple) AND (bird OR avian OR songbird OR warbler OR woodpecker OR thrush OR vireo) 110

(birch) AND (bird OR avian OR songbird OR warbler OR woodpecker OR thrush OR vireo)

[TreeSearch](#)

At the time of our search, the USFS Tree Search website limited searches to 128 characters. Covering the same 25 search terms that we used for Google Scholar required the following 4 search stings...

(forest OR woodland OR shrubland OR hardwood) AND (bird OR avian OR songbird OR warbler OR woodpecker OR thrush OR vireo)

(willow OR deciduous OR boreal OR mixedwood OR oak) AND (bird OR avian OR songbird OR warbler OR woodpecker OR thrush OR vireo)

(aspen OR beech OR spruce OR fir OR pine OR birch) AND (bird OR avian OR songbird OR warbler OR woodpecker OR thrush OR vireo)

(forestry OR maple OR silviculture) AND (bird OR avian OR songbird OR warbler OR woodpecker OR thrush OR vireo)