Minnesota Noxious Weed Risk Assessment

Developed by the Minnesota Noxious Weed Advisory Committee

Assessment information

Common name: Yellow starthistle

Scientific name: *Centaurea solstitialis* L.

Family name: Asteraceae – daisy

Current reviewer name and organizational affiliation: Christina Basch – Minnesota Department of Transportation
Date of current review: 6/23/2022

Species description

Photos

Photo caption: Yellow starthistle flowers with spiny bracts. Photo credit – Monika Chandler, Minnesota Department of Agriculture

Photo caption: Field of dead yellow starthistle. Photo credit – Monika Chandler, Minnesota Department of Agriculture

Why the plant is being assessed

- Yellow starthistle was listed as a Prohibited-Eradicate Noxious Weed in 2012 before the formal risk assessment process was finalized.
- It outcompetes native and desirable vegetation in the western United States.
- It creates dense thickets causing irritation for animals grazing or moving through area.
- It can cause chewing disease in horses.

Identification, biology, and life cycle

- Winter annual that germinates after seed dispersal and forms a rosette in fall (Minnesota Department of Agriculture 2022).
- Plants bolt in the spring and summer and send up multiple flowering stalks. The stems are winged and branched. Stem leaves are alternate, narrow, have few or no lobes, and are approximately ½- 1 inches long. The grayish-green stems and leaves are covered with wooly hair (Minnesota Department of Agriculture 2022).
- Flower heads are golden yellow and approximately 5/8 inches in diameter. A pointed yellowish spine is formed at the end of each bract. Together they look like a ring of spikes just below the flowers. The flowers are pollinated primarily by bees (Minnesota Department of Agriculture, 2022).
- Two types of seed are produced. Seeds in the center of the seedhead have white pappi (fluffy hairs) that aid seed movement by wind and animals. Seeds near the seedhead edge do not have pappi (Minnesota Department of Agriculture 2022).

- Documented hybridizing with meadow knapweed (Roche and Susanna 2010). And may be capable of hybridizing with other *Centaurea spp.*

Current distribution

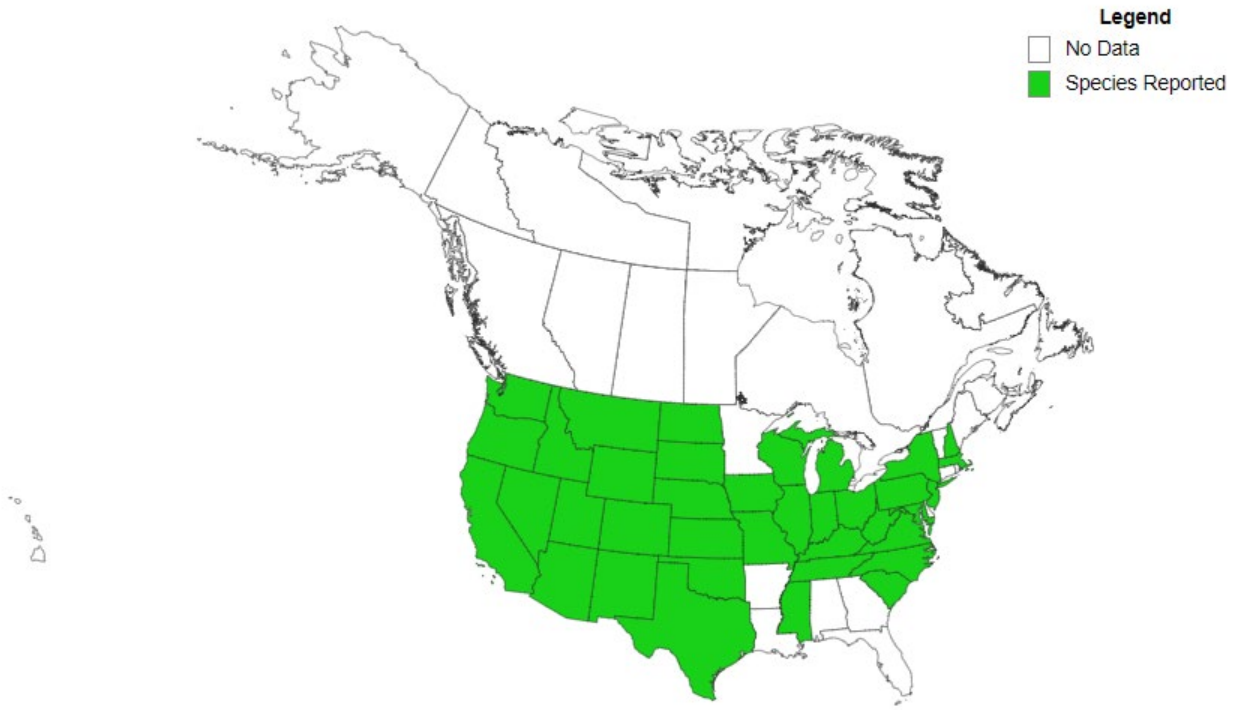


Photo caption: National level map from EDDMapS. Accessed 12/30/2021.
Most of the continental United States have reports of yellow starthistle with a concentration of observations in the western United States.

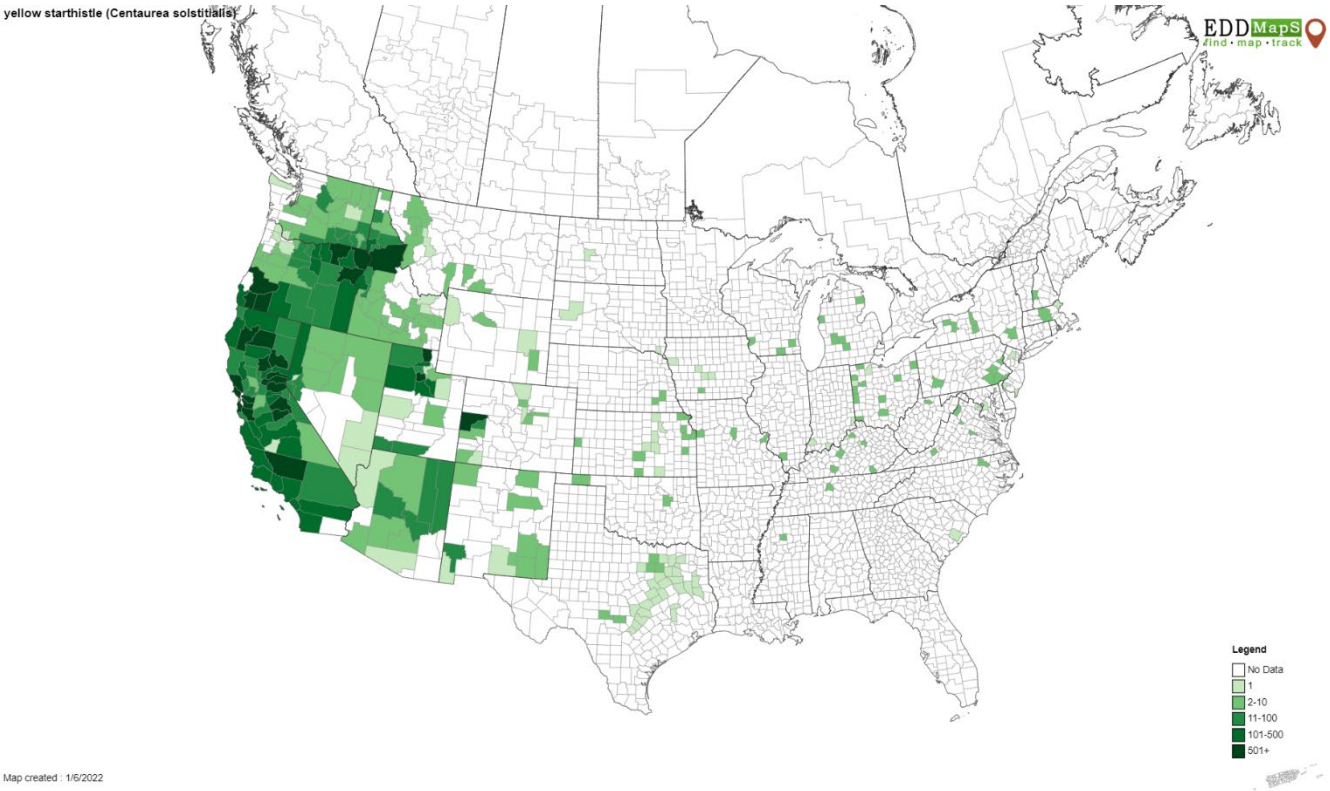
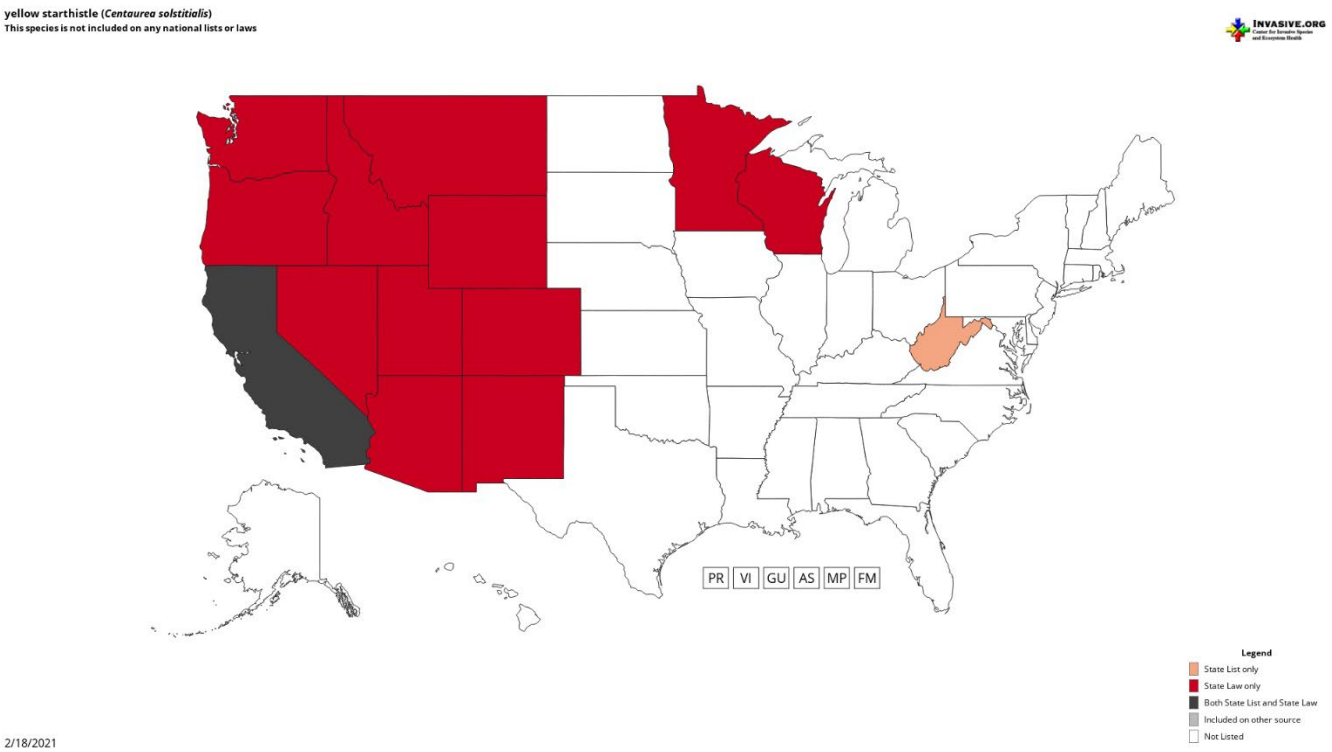


Photo caption: National level map by county of where yellow starthistle is found from EDDMapS. A majority of the reports are on the west coast, west of the Rocky Mountains. Accessed 1/6/2022.

Current regulation

Prohibited – Eradicate noxious weed in Minnesota.



Map of states where yellow starthistle is regulated. (EDDMapS 2022)

State	Species	Regulation
Arizona	Yellow starthistle	Class B noxious weed
California	Yellow starthistle	Noxious weed
Colorado	Yellow starthistle	List A noxious weed
Idaho	Yellow starthistle	Statewide containment list
Minnesota	Yellow starthistle	Prohibited – Eradicate noxious weed
Montana	Yellow starthistle	Priority 1A noxious weed
Nevada	Yellow starthistle	Noxious weed
New Mexico	Yellow starthistle	Class A noxious weed
Oregon	Yellow starthistle	List B noxious weed
Washington	Yellow starthistle	Class B noxious weed
Wisconsin	Yellow starthistle	Prohibited noxious weed
Wyoming	Yellow starthistle	Designated noxious weed

Risk assessment

Box 1:

Is the plant species or genotype non-native?

Answer: Yes

Outcome: Go to Box 3

Yellow starthistle is native to the Mediterranean Basin in southern Europe and the Middle East (USDA- Forest Service, 2014).

Box 2:

Does the species pose significant human or livestock concerns or have the potential to significantly harm agricultural production?

Question 2A: Does the plant have toxic qualities that pose a significant risk to livestock, wildlife, or people?

Outcome: Decision tree does not direct to this question.

Question 2B: Does the plant cause significant financial losses associated with decreased yields, reduced quality, or increased production costs?

Outcome: Decision tree does not direct to this question.

Box 3:

Is the species, or a related species, documented as being a problem elsewhere?

Answer: Yes

Outcome: Go to Box 6

In the United States, the primary range of yellow starthistle is the western-most states, from Washington and Oregon south throughout California and eastward into Idaho, Nevada, Utah, and Arizona. It has been reported in up to 41 states (USDA- Forest Service 2014).

Box 4:

Are the species' life history and growth requirements understood?

Outcome: Decision tree does not direct to this question.

Box 5:

Gather and evaluate further information

Outcome: Decision tree does not direct to this question.

Box 6:

Does the species have the capacity to establish and survive in Minnesota?

Question 6A: Is the plant, or a close relative, currently established in Minnesota?

Answer: Yes

Outcome: Go to Box 7

Other *Centaurea* species have established in Minnesota including meadow knapweed, brown knapweed, spotted knapweed and diffuse knapweed (EDDMapS 2022). Yellow starthistle is not known to be in Minnesota as of 2022.

Question 6B: Has the plant become established in areas having a climate and growing conditions similar to those found in Minnesota?

Outcome: Decision tree does not direct to this question.

This information is supplemental and is not part of the flow chart pathway for this risk assessment. Yellow starthistle is stated to grow in USDA hardiness zones 5-9 (Plants for a Future 2022). Three counties in Wisconsin

have reports with herbarium samples from 1958, 1971, and 1992. Two of the three records state that just a single plant was found (Online Virtual Flora of Wisconsin, 2022). All of those locations are in USDA zone 5.

There is a single report in from the US Army Corps in North Dakota with an observation date of 1 January 2008. This is in Mercer County, North Dakota which is in USDA zone 4. The point was bulk verified and says the infestation is 30,000 acres in the middle of Garrison Dam (EDDMapS, 2022). Accuracy of the report is unknown.

Question 6C: Has the plant become established in areas having a climate and growing conditions similar to those projected to be present in Minnesota under future climate projections?

Outcome: Decision tree does not direct to this question.

This information is supplemental and is not part of the flow chart pathway for this risk assessment.

Future suitability and certainty modeling show Minnesota is not a suitable location for yellow starthistle (EDDMapS 2022). Cook County is the only location in Minnesota with one out of 13 models showing range suitability. The INHABIT model shows that all of Minnesota is environmentally dissimilar for yellow starthistle establishment (USGS 2022).

Box 7:

Does the species have the potential to reproduce and spread in Minnesota?

Question 7A: Are there cultivars of the plant that are known to differ in reproductive properties from the species?

Answer: No

Outcome: Go to Question 7B

Not a species used in the nursery industry.

Question 7B: Does the plant reproduce by asexual/vegetative means?

Answer: No

Outcome: Go to Question 7D

Reproduces exclusively by seed (Innes and Zouhar 2021).

Question 7C: Are the asexual propagules - vegetative parts having the capacity to develop into new plants - effectively dispersed to new areas?

Outcome: Decision tree does not direct to this question.

Question 7D: Does the plant produce large amounts of viable, cold hardy seeds? For woody species, document the average age the species produces viable seed.

Answer: Unknown

Outcome: Go to Question 7E

Research has shown a single plant producing anywhere from 120 seed sup to 10,000 seeds. Each flowerhead produces 30-80 seeds, and the number of flower heads per plant is highly variable. Seed can mature in as little as 8 days after pollination. Most seeds germinate soon after seed dispersal, and some seeds have conditional dormancy. (Innes and Zouhar 2021).

High seed production and germination rates can result in extremely dense yellow starthistle seedling populations, especially in disturbed areas. However, seedling mortality can be high, and only a small portion of seedlings typically survive to maturity (Innes and Zouhar 2021).

Question 7E: For species that produce low numbers of viable seeds, do they have a high level of seed/seedling vigor or remain viable for an extended period (seed bank)?

Answer: No

Outcome: Go to Question 7F

Yellow starthistle is adapted to drought conditions and does not do well with flooding. Seedlings are somewhat frost tolerant, but bolting plants are highly susceptible to frost events. Seed life reported up to 10 years with a majority of seeds germinating in the first two years. Seed production varies greatly by site conditions. Research has shown a single plant producing anywhere from 120 seed up to 10,000 seeds. Each flowerhead produces 30-80 seeds, and the number of flower heads per plant is highly variable. Seed can mature in as little as 8 days after pollination. Most seeds germinate soon after seed dispersal, and some seeds have conditional dormancy. (Innes and Zouhar 2021). It is unknown If seeds dispersed in September, or seedlings germinating in fall could survive a Minnesota winter.

Question 7F: Is the plant self-fertile?

Answer: No

Outcome: Go to Question 7H

Yellow starthistle is monoecious (plant has both male and female parts), pollinator-dependent, and facultatively xenogamous (requires cross-pollination) (Innes and Zouhar 2021).

Question 7G: Are sexual propagules – viable seeds – effectively dispersed to new areas? List and consider all vectors.

Outcome: Decision tree does not direct to this question.

This information is supplemental and is not part of the flow chart pathway for this risk assessment. Yellow starthistle has two types of seed. Plumed seeds disperse via wind soon after flowering ends, while plumeless seeds fall near the parent plant after senescence (Innes and Zouhar 2021). Seed easily attaches to fur, hair, or clothing; and it can be transported over far distances by adhering to tires and undercarriages of road vehicles and equipment. Yellow starthistle seed may also be introduced into new areas through transported hay that is not certified to be weed free (USDA - Forest Service 2014).

Question 7H: Can the species hybridize with native species (or other introduced species) and produce viable seed and fertile offspring in the absence of human intervention?

Answer: Yes

Outcome: Go to Question 7I

Centaurea x kleinii (*C. moncktonii* x *C. solstitialis*) has naturally hybridized in the Western United States with intermittent characteristics observed. Hybrids may have a larger suitable range. Though the observed plants were sterile, the plant could possibly become an invasive weed through clonal reproduction or create fertile seed through further mutations (Roche and Susanna 2010).

Question 7I: Do natural controls, species native to Minnesota, which have been documented to effectively prevent the spread of the species in question?

Answer: No

Outcome: Go to Box 8

Some biocontrol species have been released in California and Oregon with unknown effectiveness. These biocontrol insects may not be suitable for Minnesota climates (Innes and Zouhar 2021).

Question 7J: Was the answer to Question 7A (Are there cultivars that differ in reproductive properties from the original species) "Yes"?

Outcome: Decision tree does not direct to this question.

Box 8:

Does the species pose significant human or livestock concerns or have the potential to significantly harm agricultural production, native ecosystems, or managed landscapes?

Question 8A: Does the plant have toxic qualities, or other detrimental qualities, that pose a significant risk to livestock, wildlife, or people?

Answer: Yes

Outcome: Go to Box 9

Causes chewing disease in horses. Mortality is due to starvation or dehydration. Spiny bracts reduce the amount of desirable forage for other grazing livestock, and grazing livestock avoid it if possible (USDA- Forest Service 2014).

Question 8B: Does, or could, the plant cause significant financial losses associated with decreased yields, reduced crop quality, or increased production costs?

Outcome: Decision tree does not direct to this question.

This information is supplemental and is not part of the flow chart pathway for this risk assessment. Substantial economic losses are attributed to low forage yield and quality on invaded rangelands and associated treatment costs. (Innes and Zouhar 2021)

Question 8C: Can the plant aggressively displace native species through competition (including allelopathic effects)?

Outcome: Decision tree does not direct to this question.

This information is supplemental and is not part of the flow chart pathway for this risk assessment. It can occur in dense monocultures that displace native plants; decrease native plant and animal diversity; reduce native wildlife habitat and forage; and alter water cycles, soil microbial community composition, and soil nutrient availability. It is most invasive in annual and perennial grasslands, shrub steppes, oak savannas, open woodlands, and openings in forests. It is especially invasive after disturbance, so limiting disturbance may help prevent yellow starthistle invasion. (Innes and Zouhar 2021).

Question 8D: Can the plant hybridize with native species resulting in a modified gene pool and potentially negative impacts on native populations?

Outcome: Decision tree does not direct to this question.

Question 8E: Does the plant have the potential to change native ecosystems (adds a vegetative layer, affects ground or surface water levels, etc.)?

Outcome: Decision tree does not direct to this question.

Question 8F: Does the plant have the potential to introduce or harbor another pest or serve as an alternate host?

Outcome: Decision tree does not direct to this question.

Box 9:

Does the species have clearly defined benefits that outweigh associated negative impacts?

Question 9A: Is the plant currently being used or produced and/or sold in Minnesota or native to Minnesota?

Answer: No
Outcome: Go to Box 10
Currently regulated in Minnesota so no production uses are applicable here (Minnesota Department of Agriculture 2022)

Question 9B: Is the plant an introduced species and can its spread be effectively and easily prevented or controlled, or its negative impacts minimized, through carefully designed and executed management practices?

Outcome: Decision tree does not direct to this question.

Question 9C: Is the plant native to Minnesota?

Outcome: Decision tree does not direct to this question.

Question 9D: Is a non-invasive, alternative plant material or cultivar commercially available that could serve the same purpose as the plant of concern?

Outcome: Decision tree does not direct to this question.

Question 9E: Does the plant benefit Minnesota to a greater extent than the negative impacts identified at Box #8?

Outcome: Decision tree does not direct to this question.

Box 10:

Should the species be regulated as Prohibited/Eradicate, Prohibited/Control, or Restricted Noxious Weed?

Question 10A: Is the plant currently established in Minnesota?

Answer: No
Outcome: Go to Question 10B
EDDMapS distribution as of 5/10/2022 has no current occurrences in Minnesota. USDA has one historical record from the 1970's (USDA-NRCS, 2022). A single yellow starthistle plant was possibly found growing perhaps arriving as a contaminant with hay from the west. The single plant was pulled and never went to seed. No sample was collected. (Chandler 2022)

Maddox et al. (1985) says there were 22 counties in Minnesota with yellow starthistle presence, with results based on a questionnaire and no verification. No yellow starthistle was found in locations reported in the survey (Chandler 2022).

Question 10B: Would prohibiting this species in trade prevent the likelihood of introduction and/or establishment?

Answer: No

Outcome: Go to Question 10D

Yellow starthistle seed is a common contaminate in alfalfa and hay, and there have been multiple accidental introductions. Preventing trade would have minimal impact (Innes and Zouhar 2021).

Question 10C: Does this risk assessment support this species being a top priority for statewide eradication if found in the state?

Outcome: Decision tree does not direct to this question.

Question 10D: Does the plant pose a serious human health threat?

Answer: No

Outcome: Go to 10F

Spines are stiff and can cause irritation when walking through infestations. Chewing disease from ingestion is not observed in other grazing animals (Innes and Zouhar 2021).

Question 10E: Is the health threat posed by the plant serious enough, and is the plant distribution sufficiently small enough to be manageable, and are management tools available and effective enough to justify listing as Prohibited / Eradicate species?

Outcome: Decision tree does not direct to this question.

Question 10F: Is the plant known to cause significant ecological or economic harm and can the plant be reliably <u>eradicated</u> (entire plant) on a statewide basis using existing practices and available resources considering the distribution, reproductive biology and potential for spread?

- *For distribution, note if the distribution is well documented, the number and acreage of known infestations and how widespread they are in the state. Note if there are infestations in border areas.*
- *For reproductive biology, note if there are reproductive biology factor that make the plant easier to control and eradication more likely (for example, long pre-reproductive period, self-incompatible pollination, short-lived seed bank).*
- *For potential for spread and re-invasion of controlled areas, note its potential to spread beyond places where it is being controlled such as deliberate planting by people, wildlife vectors, re-infestation from border states, or other factors that facilitate spread.*
- *For known management tools, note what management tools are available, potential non-target impacts, and the reasonableness of state management or mandating that landowners throughout the state use the management tools to eradicate or control existing plants.*
- *For available resources, consider the capacity of state and local personnel and availability of funding to respond to new and existing infestations.*

Answer: Yes

Outcome: LIST THE PLANT AS A PROHIBITED / ERADICATE NOXIOUS WEED
Since yellow starthistle is not known to be in Minnesota at this time, and the environment may not be suitable for establishment, spread potential is low. Any populations that do arise can be addressed quickly. There are a variety of mechanical and chemical treatments that work with yellow starthistle (DiTomaso et al. 2013).

If yellow starthistle has the chance to hybridize with *other Centaurea spp*., the suitable habitat for those hybrids may differ with intermittent characteristics between both parents (Roche and Susanna 2010).
Yellow starthistle seed is a common contaminate in alfalfa and hay, and there have been multiple accidental introductions (Innes and Zouhar 2021). Regulating yellow starthistle would reduce the chances of introducing the plant as it would be illegal to move alfalfa and hay with yellow starthistle propagating parts into Minnesota. Yellow starthistle seed is currently not regulated in Minnesota (USDA-AMS 2022), and should be assessed by the Seed Program Advisory Committee.

Question 10G: Is the plant known to cause significant ecological or economic harm and can the plant be reliably controlled to limit spread on a statewide basis using existing practices and available resources? Would the economic impacts or other hardships incurred in implementing control measures be reasonable considering any ongoing or potential future increase of ecological or economic harm?

- *Also consider all bullet points listed under 10F when evaluating 10G*

Outcome: Decision tree does not direct to this question.

Question 10H: Would prohibiting this species in trade have any significant or measurable impact to limit or reduce the existing populations or future spread of the species in Minnesota?
Outcome: Decision tree does not direct to this question.

Question 10I: Are there any other measures that could be put in place as Special Regulations which could mitigate the impact of the species within Minnesota?
Outcome: Decision tree does not direct to this question.

Box 11:

The species is being proposed to be designated as a Specially Regulated Plant. What are the specific regulations proposed?

Outcome: Decision tree does not direct to this question.

Final outcomes of risk assessment (2022)

NWAC Listing Subcommittee

Outcome: Yellow starthistle remains a Prohibited Eradicate Noxious Weed. (06/17/2022)
Comments: Common seed contaminant. Recommend a formal risk assessment for yellow starthistle be completed by the Seed Program Advisory Committee (SPAC) for possible noxious weed seed designation.

NWAC Full Committee

Outcome: Yellow starthistle remains a Prohibited Eradicate Noxious Weed. (12/13/2022)
Comments: The vote was 15 in favor, 2 against and 1 abstained.

MDA Commissioner

Outcome: Yellow starthistle remains a Prohibited Eradicate Noxious Weed.
Comments: No comments

Risk Assessment Current Summary (06-22-2022)

- It is unknown if yellow starthistle can establish in Minnesota (EDDMapS 2022).
- Yellow starthistle has the potential to hybridize with other *Centaurea* species which have established in Minnesota (Roche 2010).
- Yellow starthistle can degrade grazing habitats and native plant communities.
- Yellow starthistle should remain as a Prohibited-Eradicate species to prevent its introduction and facilitate quick management if found.

References

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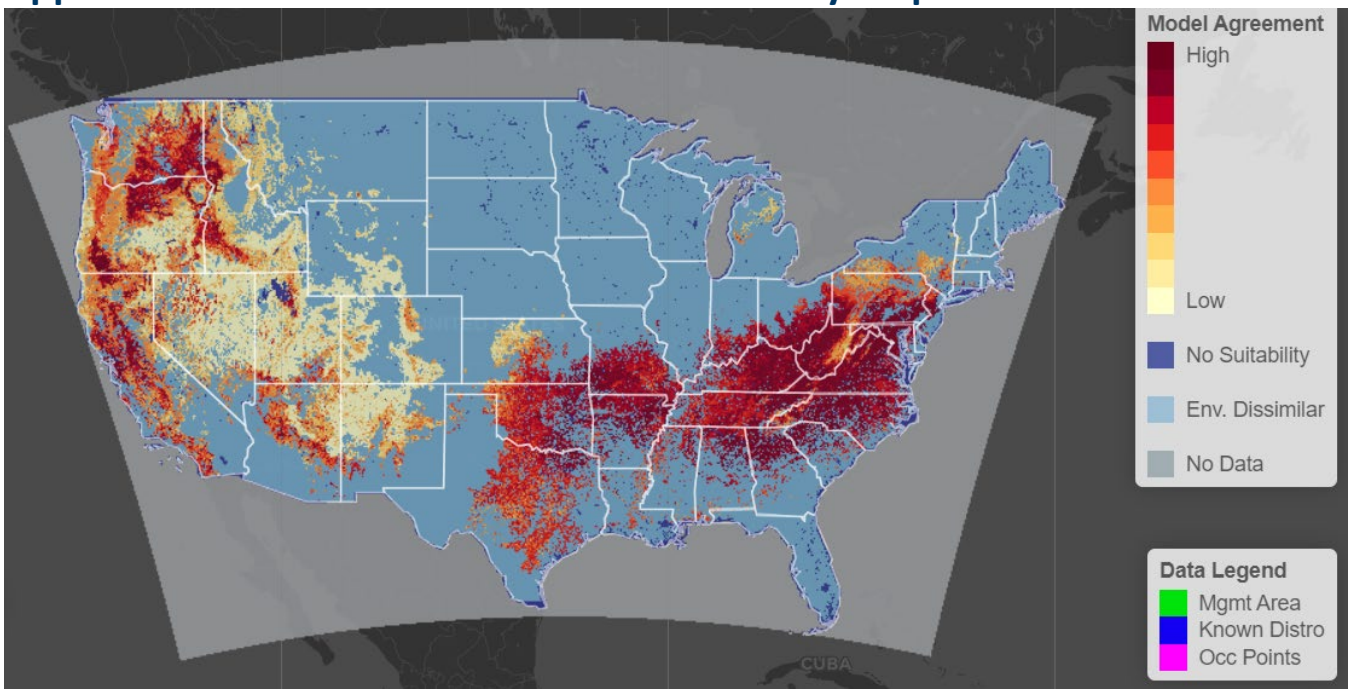
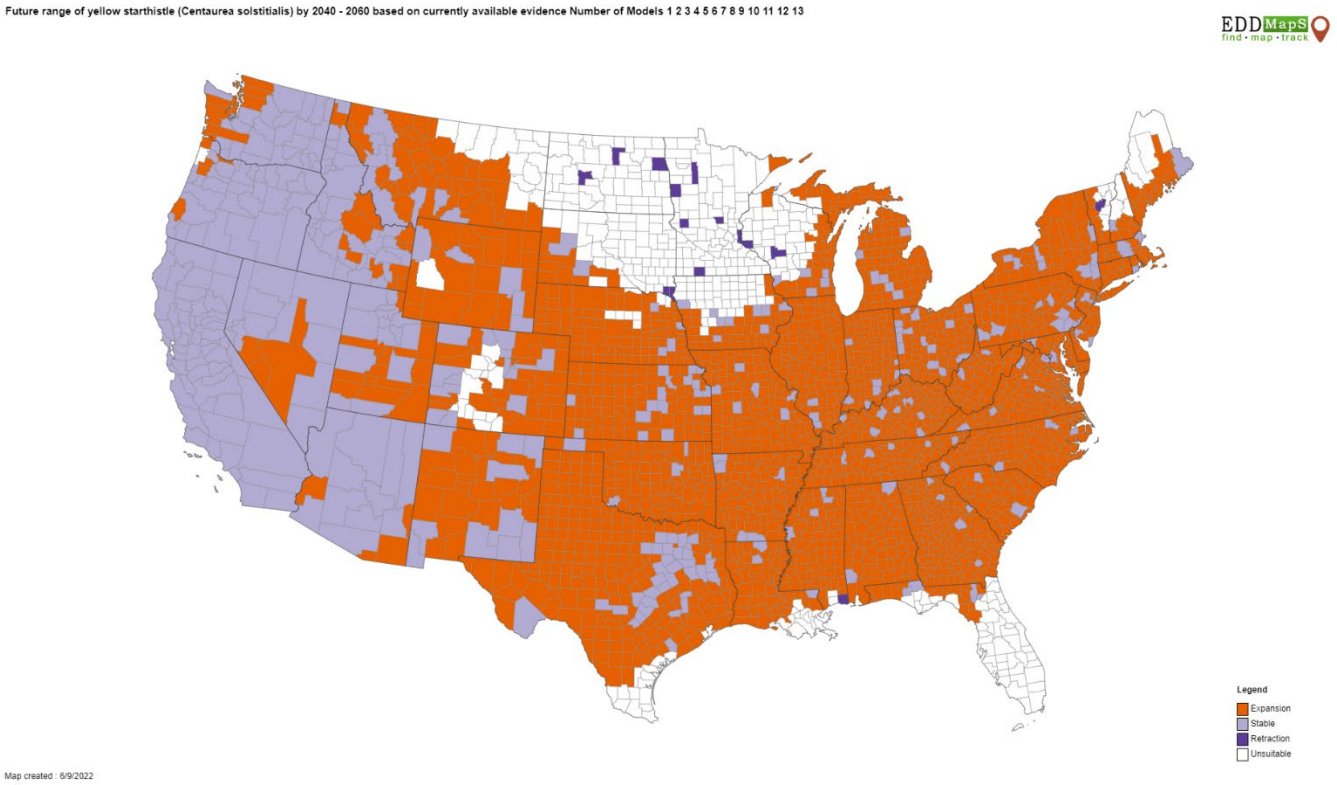
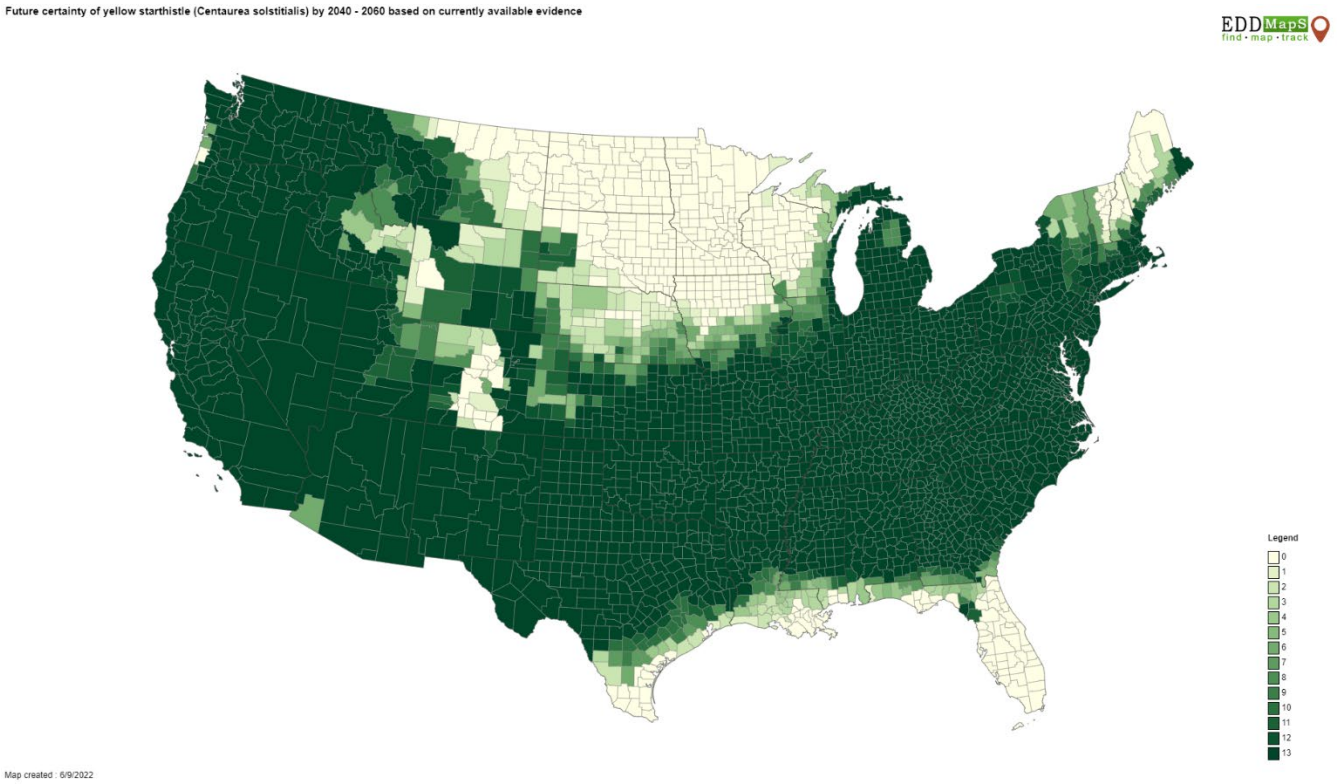
Appendix – Yellow starthistle habitat suitability maps



USGS Inhabit map showing environmental suitability for yellow starthistle under current climatic conditions. Minnesota has a dissimilar environment while the western, southern, and eastern United States have varying levels of suitability (USGS, 2022).



EDDMapS Future range prediction of yellow starthistle. Six Minnesota counties show a retraction in range suitability, while 1 model shows an expansion of range into Cook County (EDDMapS, 2022).



EDDMapS future certainty of yellow starthistle. Models show minimal suitability of Minnesota (EDDMapS, 2022).