Plant Risk Evaluator -- PRE™
Evaluation Report

Ilex aquifolium -- Texas

2017 Farm Bill PRE Project

PRE Score: 18 -- Reject (high risk of invasiveness)
Confidence: 84 / 100
Questions answered: 20 of 20 -- Valid (80% or more questions answered)

Privacy: Public
Status: Completed

Evaluation Date: March 16, 2017

This PDF was created on July 06, 2018

Plant Evaluated

Ilex aquifolium

Image by H. Zell

Evaluation Overview

A PRE™ screener conducted a literature review for this plant (*Ilex aquifolium*) in an effort to understand the invasive history, reproductive strategies, and the impact, if any, on the region's native plants and animals. This research reflects the data available at the time this evaluation was conducted.

General Information

Status: Completed
Screener: Kim Taylor
Evaluation Date: March 16, 2017

Plant Information

Plant: *Ilex aquifolium*

Regional Information

Region Name: Texas

Climate Matching Map

To answer four of the PRE questions for a regional evaluation, a climate map with three climate data layers (Precipitation, UN EcoZones, and Plant Hardiness) is needed. These maps were built using a toolkit created in collaboration with GreenInfo Network, USDA, PlantRight, California-Invasive Plant Council, and The Information Center for the Environment at UC Davis.

Click here to see the generated climate matching map for this region. This climate match database is hosted by GreenInfo Network and publicly accessible.

Evaluation Questions

These questions are based in an original article published at the University of California, Davis, and can be found on the PLOS One website, here: https://doi.org/10.1371/journal.pone.0121053

Invasive History and Climate Matching (Questions 1 - 6)

1. Has the species (or cultivar or variety, if applicable; applies to subsequent "species" questions) become naturalized where it is not native?

- Answer: **Yes**, which contributes **1** points to the total PRE score.
- The *screener* has a **Very High** confidence in this answer based on the available literature.

Answer / Justification:

Naturalized in Australia, New Zealand, United States (Hawaii, California, Washington, Oregon, Alabama, Virginia, Maryland), and British Columbia

Reference(s):

- Zika, P. F. (2010). INVASIVE HOLLIES (ILEX, AQUIFOLIACEAE) AND THEIR DISPERSERS IN THE PACIFIC NORTHWEST. Madroño. 57, 1–10.
- Kew Royal Botanical Gardens (0). Ilex aquifolium L. - Plants of the World Online - Kew Science.
- U.S. National Plant Germplasm Network (0). Taxonomy - GRIN-Global Web v 1.9.8.2.
- United States Department of Agriculture (2014). USDA-NRCS Plants Database.
- Kartesz, J. T. (2015). The Biota of North America Program (BONAP).

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2. Is the species (or cultivar or variety) noted as being naturalized in the US or world in a similar climate?

- Answer: **Yes**, which contributes **2** points to the total PRE score.
- The *screener* has a **Very High** confidence in this answer based on the available literature.

Answer / Justification:

Naturalized areas with similar climate include Australia, New Zealand, and US (Alabama in particular)

Reference(s):

- Kartesz, J. T. (2015). The Biota of North America Program (BONAP).
- U.S. National Plant Germplasm Network (0). Taxonomy - GRIN-Global Web v 1.9.8.2.

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3. Is the species (or cultivar or variety) noted as being invasive in the U.S. or world?

- Answer: **Yes**, which contributes **2** points to the total PRE score.
- The *screener* has a **Very High** confidence in this answer based on the available literature.

Answer / Justification:

"It is widely distributed as an ornamental tree and has become invasive in New Zealand, Australia, and northwestern United States" recently noted as invasive in Pacific NW, US and classified as a "Weed of Concern" in King County, Washington and is most abundant non-native tree in Seatttle parks. Also on list of Exotic Plants that Threaten Wildlands in California with an "Alert" status. Noted as invasive by the Pacific Islands Ecosystems at Risk in Chile, Hawaii, Nauru, Australia, New Zealand, and US

Reference(s):

- Jones, C. C., Acker S. A., & Halpern C. B. (2010). Combining local- and large-scale models to predict the distributions of invasive plant species. Ecological Applications. 20, 311–326.
- Stokes, D. L., Church E. D., Cronkright D. M., & Lopez S. (2014). Pictures of an Invasion: English Holly (Ilex aquifolium) in a Semi-Natural Pacific Northwest Forest. Northwest Science. 88(2),
- Pacific Island Ecosystems at Risk (PIER) (0). Ilex aquifolium (PIER species info).

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4. Is the species (or cultivar or variety) noted as being invasive in the US or world in a similar climate?

- Answer: **Yes**, which contributes **3** points to the total PRE score.
- The *screener* has a **High** confidence in this answer based on the available literature.

Answer / Justification:

has become invasive in New Zealand, Australia, and northwestern United States but Climate only matches in New Zealand. There is a small climate overlap in Eastern Australia, but specimens from Australia were not present from this region. Flora of Australia online showed very few specimens from Australia so I question if it is really invasive there.

Reference(s):

- Jones, C. C., Acker S. A., & Halpern C. B. (2010). Combining local- and large-scale models to predict the distributions of invasive plant species. Ecological Applications. 20, 311–326.
- Australian Government - Department of Environment and Energy (0). ABRS Flora of Australia Online.
- Pacific Island Ecosystems at Risk (PIER) (0). Ilex aquifolium (PIER species info).

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5. Are other species of the same genus (or closely related genera) invasive in a similar climate?

- Answer: **Yes**, which contributes **1** points to the total PRE score.
- The *screener* has a **High** confidence in this answer based on the available literature.

Answer / Justification:

Ilex cornuta and I. crenata are naturalized in the Southeastern US and listed by the Georgia Exotic Pest Plant Council as category 4 plants. Ilex crenata is also listed by the Tennessee and Mid-Atlantic Exotic Pest Plant Councils.

Reference(s):

- Kartesz, J. T. (2015). The Biota of North America Program (BONAP).
- Georgia Exotic Pest Plant Council (0). List of Non-Native Invasive Plants in Georgia - Georgia Exotic Pest Plant Council.
- Swearingen, J., & Bargeron C. (0). Japanese holly: Ilex crenata (Celastrales: Aquifoliaceae): Invasive Plant Atlas of the United States.

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6. Is the species (or cultivar or variety) found predominately in a climate matching the region of concern?

- Answer: **No**, which contributes **0** points to the total PRE score.
- The *screener* has a **High** confidence in this answer based on the available literature.

Answer / Justification:

less than half of the areas where the plant is found match the climate.

Reference(s):

- GBIF (0). Ilex aquifolium L..

Impact on Native Plants and Animals (Questions 7 - 10)

7. Does this plant displace native plants and dominate (overtop or smother) the plant community in areas where it has established?

- Answer: **Yes**, which contributes **1** points to the total PRE score.
- The *screener* has a **Very High** confidence in this answer based on the available literature.

Answer / Justification:

Because it is evergreen, it casts persistent shade, which may reduce plant regeneration beneath its canopy "Plant density was highest in some urban greenbelts, with young stands of Pseudotsuga and an understory dominated by naturalized Ilex aquifolium rather than native shrubs". May suppress native species through shading (as demonstrated in its native range) or nutrient competition. Noted as often becoming a dominant forest plant that could alter native forest structure. one of few invasives that can colonize closed-canopy Pacific NW forests. Stokes notes that 79% of the area under a Holly thicket was devoid of native evergreen or woody vegetation, compared to just 36% in adjacent areas. Holly is often the only ground cover, especially under large trees or clumps.

Reference(s):

- Jones, C. C., Acker S. A., & Halpern C. B. (2010). Combining local- and large-scale models to predict the distributions of invasive plant species. Ecological Applications. 20, 311–326.
- Zika, P. F. (2010). INVASIVE HOLLIES (ILEX, AQUIFOLIACEAE) AND THEIR DISPERSERS IN THE PACIFIC NORTHWEST. Madroño. 57, 1–10.
- Stokes, D. L., Church E. D., Cronkright D. M., & Lopez S. (2014). Pictures of an Invasion: English Holly (Ilex aquifolium) in a Semi-Natural Pacific Northwest Forest. Northwest Science. 88(2),

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8. Is the plant noted as promoting fire and/or changing fire regimes?

- Answer: **No**, which contributes **0** points to the total PRE score.
- The *screener* has a **Medium** confidence in this answer based on the available literature.

Answer / Justification:

No evidence that it promotes fire or changes fire regimes. PIER states it is not a fire hazard.

Reference(s):

- Pacific Island Ecosystems at Risk (PIER) (0). Ilex aquifolium (PIER species info).

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9. Is the plant a health risk to humans or animals/fish? Has the species been noted as impacting grazing systems?

- Answer: **Yes**, which contributes **1** points to the total PRE score.
- The *screener* has a **High** confidence in this answer based on the available literature.

Answer / Justification:

listed as poisonous to mammals. "Contains saponins. The fruits and leaves contain ilicin, ilexanthin and ilicic acid and a tannin plus cyanogenic glycosides. The berries are poisonous but a small dose has been used as a purgative. A large dose, of the order of 30 or so berries, can cause nausea, vomiting, diarrhoea and abdominal pain"

Reference(s):

- Robertson, J. (0). Ilex aquifolium, holly - THE POISON GARDEN website.
- U.S. National Plant Germplasm Network (0). Taxonomy - GRIN-Global Web v 1.9.8.2.

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10. Does the plant produce impenetrable thickets, blocking or slowing movement of animals, livestock, or humans?

- Answer: **Yes**, which contributes **1** points to the total PRE score.
- The *screener* has a **Very High** confidence in this answer based on the available literature.

Answer / Justification:

"a vigorous growth habitat and the ability to thrive in sun or shade allow English holly to form dense thickets in the forest understory to the detriment of native plants". Forms persistent thicket-like evergreen sub-canopy tree layer, which is noted as being a structural element with no analogue in the Pacific NW native forest

Reference(s):

- Stokes, D. L., Church E. D., Cronkright D. M., & Lopez S. (2014). Pictures of an Invasion: English Holly (Ilex aquifolium) in a Semi-Natural Pacific Northwest Forest. Northwest Science. 88(2),
- Watts, A. (0). Pacific Horticulture Society - English Holly.

Reproductive Strategies (Questions 11 - 17)

11. Does this species (or cultivar or variety) reproduce and spread vegetatively?

- Answer: **Yes**, which contributes **1** points to the total PRE score.
- The *screener* has a **Very High** confidence in this answer based on the available literature.

Answer / Justification:

Suckering from roots, or, more rarely, layering from branches often gives rise to clumps. Reproductin mostly by seed, but "adventitious rooting from attached and detached twigs, or root suckering may assume importance locally" 78% of trees in a study in the Pacific NW were found to have originated vegetatively, from holly roots or branches, and 22% from seed.

Reference(s):

- Peterken, G.. F., & Lloyd P.. S. (1967). Ilex Aquifolium L.. Journal of Ecology. 55, 841–858.
- Stokes, D. L., Church E. D., Cronkright D. M., & Lopez S. (2014). Pictures of an Invasion: English Holly (Ilex aquifolium) in a Semi-Natural Pacific Northwest Forest. Northwest Science. 88(2),

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12. If naturally detached fragments from this plant are capable of producing new plants, is this a common method of reproduction for the plant?

- Answer: **Yes**, which contributes **1** points to the total PRE score.
- The *screener* has a **Medium** confidence in this answer based on the available literature.

Answer / Justification:

"adventitious rooting from attached and detached twigs, or root suckering may assume importance locally". I found little discussion of its ability to resprout from detached twigs.

Reference(s):

- Peterken, G.. F., & Lloyd P.. S. (1967). Ilex Aquifolium L.. Journal of Ecology. 55, 841–858.

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13. Does the species (or cultivar or variety) commonly produce viable seed?

- Answer: **Yes**, which contributes **1** points to the total PRE score.
- The *screener* has a **Very High** confidence in this answer based on the available literature.

Answer / Justification:

reproduces mainly by seeds. New clumps are established by seed

Reference(s):

- Jones, C. C., Acker S. A., & Halpern C. B. (2010). Combining local- and large-scale models to predict the distributions of invasive plant species. Ecological Applications. 20, 311–326.

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14. Does this plant produce copious viable seeds each year (> 1000)?

- Answer: **Yes**, which contributes **1** points to the total PRE score.
- The *screener* has a **Very High** confidence in this answer based on the available literature.

Answer / Justification:

Fruits have an average of 3.4-3.9 seeds per berry, with an estimates fifty berries per fertile twig. A single tree, standing 15 ft high and 12 ft crown diameter estimated to bear 30,000 berries, or potentially 120,000 seeds.

Reference(s):

- Peterken, G.. F., & Lloyd P.. S. (1967). Ilex Aquifolium L.. Journal of Ecology. 55, 841–858.

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15. Is there significant germination (>25%) of seeds the next growing season, with no requirement of an infrequent environmental condition for seeds to germinate (i.e. fire) or long dormancy period?

- Answer: **No**, which contributes **0** points to the total PRE score.
- The *screener* has a **Very High** confidence in this answer based on the available literature.

Answer / Justification:

"germination is delayed 18-36 mo in Europe". " Regurgitated seeds I gathered and planted January 2004 germinated 29 mo later" "germination normally occurs in the second or third spring after formation of the seed" "seed germination is delayed because embryos are immature and take one year, or more, to mature"

Reference(s):

- Peterken, G.. F., & Lloyd P.. S. (1967). Ilex Aquifolium L.. Journal of Ecology. 55, 841–858.
- Zika, P. F. (2010). INVASIVE HOLLIES (ILEX, AQUIFOLIACEAE) AND THEIR DISPERSERS IN THE PACIFIC NORTHWEST. Madroño. 57, 1–10.
- Majada, J. Pedro, Sánchez-Tamés R., Revilla M. Angeles, & Casares A. (2000). Micropropagation of Ilex aquifolium L.. In Vitro Cellular & Developmental Biology. Plant. 36, 521–526.

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16. Does this plant produce viable seed within the first three years (for an herbaceous species) to five years (for a woody species) after germination?

- Answer: **No**, which contributes **0** points to the total PRE score.
- The *screener* has a **High** confidence in this answer based on the available literature.

Answer / Justification:

"Flowers may rarely be found on individuals less than 5 ft (1.5 m) tall." "In their first 4 years, seedlings may grow at less than 1 cm/year," Average tree age of trees with less than 1 cm basal diameter was 3.62 years. Produces flowers by 10 years

Reference(s):

- Peterken, G.. F., & Lloyd P.. S. (1967). Ilex Aquifolium L.. Journal of Ecology. 55, 841–858.
- Stokes, D. L., Church E. D., Cronkright D. M., & Lopez S. (2014). Pictures of an Invasion: English Holly (Ilex aquifolium) in a Semi-Natural Pacific Northwest Forest. Northwest Science. 88(2),

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17. Does this plant continuously produce seed for >3 months each year or does seed production occur more than once a year?

- Answer: **Yes**, which contributes **1** points to the total PRE score.
- The *screener* has a **Medium** confidence in this answer based on the available literature.

Answer / Justification:

"Mature hollies flower freely in most seasons" Fruits may stay on the plant for long periods of time with fruits produced in November or December and persiting through March. Flowers typically open in May and June but may produce more flowers in September

Reference(s):

- Peterken, G.. F., & Lloyd P.. S. (1967). Ilex Aquifolium L.. Journal of Ecology. 55, 841–858.

Dispersal (Questions 18 - 20)

18. Are the plant's propagules frequently dispersed long distance (>100 m) by mammals or birds or via domestic animals?

- Answer: **Yes**, which contributes **1** points to the total PRE score.
- The *screener* has a **High** confidence in this answer based on the available literature.

Answer / Justification:

Birds primary disperser, including 8 English birds in its native range. Seven birds observed eating Ilex fruits in Washington with native birds primary consumers of fruit. "t the variable feeding behavior of American robin flocks, with the use of different relay trees, make them effective dispersers for Ilex aquifolium" "berries can be dispersed long distances by birds". Tardus iliacus, which prefered Ilex fruits over Yew and Hawthorn, flew greater than 50 m post feeding 41% of the time. Other species flew lesser distances. Bird also had long-distance displacement events (>300 m) but were typically associated with movement among patches

Reference(s):

- Jones, C. C., Acker S. A., & Halpern C. B. (2010). Combining local- and large-scale models to predict the distributions of invasive plant species. Ecological Applications. 20, 311–326.
- MARTÍNEZ, I., GARCÍA D., & OBESO J. Ramón (2008). Differential seed dispersal patterns generated by a common assemblage of vertebrate frugivores in three fleshy-fruited trees. Écoscience. 15, 189–199.
- Peterken, G.. F., & Lloyd P.. S. (1967). Ilex Aquifolium L.. Journal of Ecology. 55, 841–858.
- Zika, P. F. (2010). INVASIVE HOLLIES (ILEX, AQUIFOLIACEAE) AND THEIR DISPERSERS IN THE PACIFIC NORTHWEST. Madroño. 57, 1–10.

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19. Are the plant's propagules frequently dispersed long distance (>100 m) by wind or water?

- Answer: **No**, which contributes **0** points to the total PRE score.
- The *screener* has a **Medium** confidence in this answer based on the available literature.

Answer / Justification:

No mention of this was found, though it could be possible for berries to fall into the water or for seeds to move downstream after being regurgitated by birds.

Reference(s):

- [Anonymous] .

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20. Are the plant's propagules frequently dispersed via contaminated seed (agriculture or wildflower packets), equipment, vehicles, boats or clothing/shoes?

- Answer: **No**, which contributes **0** points to the total PRE score.
- The *screener* has a **Medium** confidence in this answer based on the available literature.

Answer / Justification:

No evidence of this was found.

Reference(s):

- [Anonymous] .

Total PRE Score

PRE Score: 18 -- Reject (high risk of invasiveness)
Confidence: 84 / 100
Questions answered: 20 of 20 -- Valid (80% or more questions answered)

PRE Score Legend

The PRE Score is calculated by adding the point totals for each (answered) question.
< 13 : accept (low risk of invasiveness)
13 - 15 : evaluate further
> 15 : reject (high risk of invasiveness)

Questions Answered Legend

It is important to answer at least 16 questions to consider a PRE Score as "valid".
>= 16 : valid (80% or more questions answered)
<= 15 : invalid (not enough questions answered)

Organization Ownership and Content Privacy

Organization: 2017 Farm Bill PRE Project
Content Privacy: Public

Evaluation Reviewers

The PRE approach is to base decisions on science and make decisions by consensus of diverse horticultural stakeholders. The literature review and process of answering PRE's questions are based on science; the decisions of which plants to prioritize are based on consensus. To ensure this process is in place and that PRE is collaborative, volunteer stakeholders are recruited from each region to review evaluations. The following experts in their profession (plant science, conservation, or horticultural trade) have participated as volunteer PRE reviewers for this evaluation:

• Hans Landel	December 18, 2017
• Steve Moore	August 30, 2017

This evaluation has a total of 2 reviewer(s).

Evaluation Issues

The following section lists all public issues for this evaluation. Issues provide a way for stakeholder reviewers to communicate any concerns or suggestions they might have with the plant or evaluation. Please email PlantRight@suscon.org if additional action is required to resolve open issues.

There are currently no issues associated with this evaluation.

About PRE and this Plant Evaluation Report

The PlantRight Plant Risk Evaluator -- PRE is an online database and platform enabling those involved in non-native, terrestrial plant production to know before they grow if a plant poses a regional invasive risk. This tool offers many benefits, and we encourage you to visit the PRE website (https://pre.ice.ucdavis.edu) for more information.

If you are a nursery trade association, or involved in the research, development or distribution of horticultural plants we invite you to join the PRE community. If you are a plant scientist, affiliated with a horticultural college or botanic garden, and would like to learn more about becoming a PRE Screener, please drop us an email, PlantRight@suscon.org, requesting a PRE Account.

PRE beta funding is provided by Sustainable Conservation (http://www.suscon.org/) and a USDA Farm Bill grant.