CALIFORNIA DEPARTMENT OF FOOD & AGRICULTURE

California Pest Rating Proposal

Amynthas agrestis (Goto & Hatai): Jumping worm

Haplotaxida: Megascolecidae

Current Rating: A

Proposed Rating: B

Comment Period: 08/01/2023 – 09/15/2023

Initiating Event:

Amynthas agrestis has been found in the environment in Sonoma County and is established in the state. A pest rating proposal is needed.

History & Status:

Background:

The majority of this proposal was prepared by Dr. John Chitambar and posted (with an A-rating) in 2017. Minor changes were later made by Dr. Heather Scheck. For the sake of efficiency, it has been retained for the most part but modified to reflect the finds in the environment of California.

Amynthas agrestis, commonly known as jumping worm, crazy worm, wood eel, jumpers, wigglers, snake worm, and Alabama jumper, is an invasive earthworm that is native to East Asia (Japan and Korean Peninsula). These earthworms are extremely active, aggressive, and have voracious appetites. True to their name, they jump (known to jump off the ground or out of a bait can) and thrash immediately when handled, behaving more like a threatened snake than a worm, sometimes even breaking and shedding their tail when caught (Williams, 2014). Jumping worms are considered aggressive as they out-compete common European earthworms (Tiddens, 2015). These

worms are up to eight inches in length and are characteristically marked by a light (milky white to gray) band (clitellum) around a dark body. They breed en masse and constantly produce cocoons at the soil surface (Barncard, 2014; Williams, 2014; Tennesen, 2009). Hatchlings have been observed after air temperatures reached above 10 °C and die when air temperatures reach below 5 °C. Adults develop in approximately 60 days (or in lab studies, 77-93 days at 1000 °C growing degree days accumulated from time of hatching). They can reproduce without mating or asexually (parthenogenetic). Cocoons can survive at soil temperatures below -20 °C (Görres et al., 2016).

Amynthas agrestis has been found in deciduous and mixed deciduous-coniferous forests, hardwood forests, compost, mulched beds, ornamental beds amended with municipal leaf litter waste, plant containers, and gardens (Görres, 2014).

Amynthas agrestis lives at the soil surface and constructs shallow, temporary burrows in upper topsoil layers. They voraciously consume leaf litter and associated microorganisms and produce large quantities of casting material that changes the physical, chemical, and biotic properties of the topsoil. They are usually very successful colonizers and competitively dominate newly invaded environments, negatively impacting other earthworm species (Burtelow et al, 1998; Redmond et al., 2014).

Earthworms are generally considered beneficial due to their ability to loosen and aerate soil. However, *A*. *agrestis* poses a significant threat to forest health because of its impacts to soil characteristics (Barncard, 2014). It reportedly causes damage to hardwood forests, especially those consisting of maple, basswood, red oak, poplar or birch species that rely on thick layers of leaf litter that serve as rooting medium. It is a voracious feeder and can deplete a thick organic mat in 2-5 years (Tennesen, 2009). Consequently, these earthworms disrupt the natural decomposition of leaf litter on forest floors turning the soil into grainy, dry worm castings that cannot support understory forest plants and alter forest soils from a fungal to a bacterial-dominated system, which speeds up the conversion of leaf debris to mineral compounds, thereby robbing plants of organic nutrients. Also, by clearing the forest floors of understory plants and leaf debris, the worms encourage erosion

and provide more accessible avenues for infection by other invasive species of organisms. Some northern hardwood forests that once had a lush understory are reported to now have only a single species of native herb and virtually no tree seedlings. This worm can also cause harm to ornamental plantings and turf. Impacts to lawns due to abundant castings of this earthworm have been reported in Connecticut. Once established in environment, jumping worms are impossible to eradicate. Jumping worms have been found in abundance in nursery field and container stock, as well as in mulch and compost that may then be transported to residential and commercial gardens and parks thereby threatening production and resulting in significant losses in horticultural crop production (Görres, 2014; Tennesen, 2009).

Amynthas agrestis is not regulated by the State's Fish and Game Code or the California Code of Regulations. Bait regulations (section 4) would allow *A*. *agrestis* as bait: "Legally acquired and possessed invertebrates…may be used for bait". Subsections a-f of section 4 provide exceptions to this, none of which apply to *A*. *agrestis* (Personal communications: Martha Volkoff, Environmental Program Manager, Invasive Species Program, California Department of Fish and Wildlife).

Worldwide Distribution: These jumping worms were originally found in Japan and the Korean peninsula and are believed to have been introduced to the United States and Canada through landscape plants imported from those native Asian regions (Barncard, 2014). They have been reported in Alabama, California, Connecticut, Florida, Georgia, Kentucky, Louisiana, Maine, Maryland, Massachusetts, Missouri, New Hampshire, New Jersey, New York, North Carolina, Ohio, Oklahoma, Pennsylvania, South Carolina, Tennessee, Texas, Vermont, Virginia, West Virginia, and Wisconsin (Loria, 2014; Tiddens, 2015; Görres, 2014; Görres et al., 2016; CABI ISC, 2020).

Official Control: Wisconsin Natural Resources Law Rule NR 40 lists *Amynthas agrestis* as a prohibited species (Görres, 2014).

California Distribution: *Amynthas agrestis* was found at two residences in Sonoma County in June 2022 (Sonoma) and June 2023 (Santa Rosa).

California Interceptions: There was one detection associated with containerized plants at a nursery in Napa County in July 2021.

The risk *Amynthas agrestis* poses to California is evaluated below.

Consequences of Introduction:

1) **Climate/Host Interaction:** It is likely that *Amynthas agrestis* will be able to establish a widespread distribution through California's forest habitat and ornamental production sites, particularly in residential and commercial environments. Therefore, *A. agrestis* receives a **High (3)** in this category.

   – Low (1) Not likely to establish in California; or likely to establish in very limited areas.

   – Medium (2) may be able to establish in a larger but limited part of California.

   – High (3) likely to establish a widespread distribution in California.

2) **Known Pest Host Range:** *Amynthas agrestis* is not known to feed on living plants. However, it has been found in deciduous and mixed deciduous-coniferous forests, hardwood forests, compost, mulch, ornamental beds amended with municipal leaf litter waste, nursery field and container stock, and horticultural gardens. Because of its association with a large range of living plants and non-living plant growth-influencing media, the "host range" category is evaluated as high. Therefore, it receives a **High (3)** in this category.

   – Low (1) has a very limited host range.

   – Medium (2) has a moderate host range.

   – High (3) has a wide host range.

3) **Pest Reproductive and Dispersal Potential:** All earthworms are hermaphrodites and many, including *A*. *agrestis*, have developed parthenogenesis. Unlike many earthworms, *A*. *agrestis* has an annual life cycle. On their own, they can move 12 meters in a year. Possible means of spread to non-infested sites are, therefore, passive and through contaminated soil and leaf debris adhering to off-road vehicles, municipal leaf litter waste, bait used by anglers, logging equipment, nursery field and container stock, compost, and mulch (Görres, 2014; Tennesen, 2009). Earthworms purported to be *A*. *agrestis* can also be ordered online (Ziemba et al., 2016). Therefore, it receives a **Medium (2)** in this category.

   – Low (1) does not have high reproductive or dispersal potential.

   – Medium (2) has either high reproductive or dispersal potential.

   – High (3) has both high reproduction and dispersal potential.

4) **Economic Impact**. *Amynthas agrestis* poses a serious threat primarily to California's forests (see below). However, they may also be detrimental to residential and public gardens and to crop production through alteration of soil structure. Similar effects may occur in residential and commercial plant production sites. Once established, eradication of an earthworm is unlikely. Therefore, it receives a **High (3)** in this category.

   Economic Impact: A, B, C, D

   A. The pest could lower crop yield.

   B. The pest could lower crop value (includes increasing crop production costs).

   C. The pest could trigger the loss of markets (includes quarantines).

   D. The pest could negatively change normal cultural practices.

   E. The pest can vector, or is vectored, by another pestiferous organism.

   F. The organism is injurious or poisonous to agriculturally important animals.

   G. The organism can interfere with the delivery or supply of water for agricultural uses.

Economic Impact Score: High

– Low (1) causes 0 or 1 of these impacts.

– Medium (2) causes 2 of these impacts.

– High (3) causes 3 or more of these impacts.

5) **Environmental Impact**. *Amynthas agrestis* can deplete thick layers of leaf litter that serve as rooting media, thereby disrupting the natural decomposition of leaf litter on forest floors and turning the soil into grainy, dry worm castings that cannot support understory forest plants. Forest soils can be altered from a fungal to a bacterial-dominated system, which speeds up the conversion of leaf debris to mineral compounds, thereby robbing plants of organic nutrients. The destruction of forest habitats could have significant environmental impact by lowering biodiversity, threatening natural communities and endangered and threatened species. This worm may significantly impact ornamental plantings in home and urban gardens. Therefore, *A. agrestis* receives a **High (3)** in this category.

Environmental Impact: A, B, C, E

A. The pest could have a significant environmental impact such as lowering biodiversity, disrupting natural communities, or changing ecosystem processes.

B. The pest could directly affect threatened or endangered species.

C. The pest could impact threatened or endangered species by disrupting critical habitats.

D. The pest could trigger additional official or private treatment programs.

E. The pest significantly impacts cultural practices, home/urban gardening or ornamental plantings.

Environmental Impact Score: High (3)

– Low (1) causes none of the above to occur.

– Medium (2) causes one of the above to occur.

– High (3) causes two or more of the above to occur.

Consequences of Introduction to California for *Amynthas agrestis*: High (14)

Add up the total score and include it here.

–Low = 5-8 points

–Medium = 9-12 points

–High = 13-15 points

6) **Post Entry Distribution and Survey Information:** *Amynthas agrestis* is established in Sonoma County. It receives a **Low (-1)** in this category.

–Not established (0) Pest never detected in California, or known only from incursions.

–Low (-1) Pest has a localized distribution in California, or is established in one suitable climate/host area (region).

–Medium (-2) Pest is widespread in California but not fully established in the endangered area, or pest established in two contiguous suitable climate/host areas.

–High (-3) Pest has fully established in the endangered area, or pest is reported in more than two contiguous or non-contiguous suitable climate/host areas.

Final Score:

7) The final score is the consequences of introduction score minus the post entry distribution and survey information score: 13 (High)

Uncertainty:

Other species of *Amynthas* are established in California and are broadly distributed. These worms are similar in appearance to *A. agrestis* and distinction between the species is difficult. It is likely that *A. agrestis* is more broadly distributed in California.

Conclusion and Rating Justification:

Amynthas agrestis is an earthworm that has potential to impact environment and agriculture in California. However, it is established in Sonoma County and eradication does not appear practical. It is not regulated by the United State Department of Agriculture, there appear to be little if any restrictions on movement of earthworms in the United States. For these reasons, a "B" rating is justified.

References:

Barnard, C. 2014. Hungry, invasive 'crazy worm' makes first appearance in Wisconsin. University of Wisconsin-Madison. Accessed December 7, 2021: http://news.wisc.edu/hungry-invasive-crazy-worm-makes-first-appearance-in-wisconsin/

Burtelow, A. E., Bohlen, P. J. and Groffman, P. M. 1998. Influence of exotic earthworm invasion on soil organic matter, microbial biomass and denitrification potential in forest soils of the northeastern United States. Applied Soil Ecology 9:197-202.

Chang, C.H., Snyder, B.A. and Szlavecz, K. 2016. Asian pheretimoid earthworms in North America north of Mexico: an illustrated key to the genera *Amynthas*, *Metaphire*, *Pithemera*, *and Polypheretima* (Clitellata: Megascolecidae). Zootaxa 4179:495-529.

Görres, J. 2014. Invasive earthworms in the Northeastern USA and the Horticulture Industry. Accessed December 7, 2021: http://www.uvm.edu/~entlab/Greenhouse%20IPM/Workshops/2014/InvasiveEarthworms.pdf

Görres, J.H., Bellitürk, K. and Melnichuk, R.D., 2016. Temperature and moisture variables affecting the earthworms of genus *Amynthas* Kinberg, 1867 (Oligachaeta: Megascolecidae) in a hardwood forest in the Champlain Valley, Vermont, USA. Applied Soil Ecology 104:111-115.

Loria, K. 2014. These 'crazy worms' are poised to wreak havoc on the Midwest. Business Insider, Science, July 16, 2014. Accessed December 7, 2021: http://www.businessinsider.com/crazy-worms-have-invaded-wisconsin-2014-7

Redmond, C. T., Kesheimer, A. and Potter, D. A. 2014. Earthworm community composition, seasonal population structure, and casting activity on Kentucky golf courses. Applied Soil Ecology 75:116-123.

Ridden, T. 2015. Pest Alert: *Amynthas agrestis* (crazy worm or jumping worm). My Chicago Botanic Garden, September 11, 2015. Accessed December 7, 2021: http://my.chicagobotanic.org/horticulture/crazy-worm-or-jumping-worm/

Tennesen, M. 2009. Invasive earthworms denude forests in U. S. Great Lakes Region. Scientific American, March 1, 2009. Accessed December 7, 2021: https://www.scientificamerican.com/article/invasive-earthworms-denude-forests/#

Williams, B. 2014. Crazy worms fact sheet *Amynthas agrestis*. Wisconsin DNR Forest Health. Accessed December 7, 2021: http://host.madison.com/crazy-worms-fact-sheet/pdf_abb51687-cf96-5e27-9f48-956a6ed25884.html

Ziemba, J. L., Hickerson, C. A. M., and Anthony, C. D. 2016. Invasive Asian earthworms negatively impact keystone terrestrial salamanders. PLoS ONE doi:10.1371/journal.pone.0151591

Responsible Party:

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*Comment Period: 08/01/2023 – 09/15/2023

*NOTE:

You must be registered and logged in to post a comment. If you have registered and have not received the registration confirmation, please contact us at permits[@]cdfa.ca.gov.

Comment Format:

- Comments should refer to the appropriate California Pest Rating Proposal Form subsection(s) being commented on, as shown below.

Example Comment:
Consequences of Introduction: 1. Climate/Host Interaction: [Your comment that relates to "Climate/Host Interaction" here.]

- Posted comments will not be able to be viewed immediately.

- Comments may not be posted if they:

Contain inappropriate language which is not germane to the pest rating proposal;

Contains defamatory, false, inaccurate, abusive, obscene, pornographic, sexually oriented, threatening, racially offensive, discriminatory or illegal material;

Violates agency regulations prohibiting sexual harassment or other forms of discrimination;

Violates agency regulations prohibiting workplace violence, including threats.

- Comments may be edited prior to posting to ensure they are entirely germane.
- Posted comments shall be those which have been approved in content and posted to the website to be viewed, not just submitted.

Proposed Pest Rating: B