

Ecological Risk Assessment for Non-native Hognose Snake in Oregon

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Executive Summary

Hognose snakes within the genus *Heterodon* have recently become popular in the pet trade. In the genus, there are three species: the eastern hognose (*Heterodon platirhinos*), southern hognose (*Heterodon simus*), and western hognose (*Heterodon nasicus*). Oregon does not currently list *Heterodon* as a non-controlled genus and is therefore automatically classified as prohibited. This ecological risk assessment identifies risks for *Heterodon spp.* based on 'Oregon's Division 56 Importation, Possession, Confinement, Transportation and Sale of Nonnative Wildlife'.

This report concludes a low risk of invasion mainly due to the annual climate of Oregon. It is unlikely that *Heterodon spp.* will survive an Oregon winter. The main concern with *Heterodon spp.* is the ability to prey on native wildlife, primarily amphibians. There have been no recorded cases of any hognose snake species being invasive in other areas nor hybridizing with other species. The hognose snake is unlikely to pass on any novel diseases or parasites to native wildlife, although it can carry the common reptile diseases and parasites. *Heterodon spp.* do share some visual identifications such as colors and patterns with certain native Oregon species. However, the species' defensive behavior and upturned rostral scale make it easy to distinguish from the native species. The southern hognose, *H. simus*, is the only *Heterodon* species considered vulnerable according to the IUCN red list.

Introduction

There are three species in the genus *Heterodon*: eastern hognose (*Heterodon platirhinos*), southern hognose (*Heterodon simus*), and western hognose (*Heterodon nasicus*). Western hognose snakes have three subspecies: *H. n. nasicus*, *H. n. gloydi*, and *H. n. kennerlyi* (Kroll, 1973). We focused on eastern and western hognose snakes for this risk assessment.

The eastern hognose snake is a thick-bodied snake that averages around 30 inches long (Image 1). Although its upturned nose makes it easy to identify, its colors can be variable. Their base colors range from yellow, brown, black, or gray. In general, the underside of the eastern hognose snake is lighter than the dorsal color. When threatened, the eastern hognose will inhale air, flatten its body, and strike with a closed mouth. If this defense fails, it will imitate death by rolling onto its back and sticking out its tongue, often secreting foul-smelling musk from the cloaca. Eastern hognose snakes are currently only protected in Georgia (Tarter, University of Georgia).



Image 1. Photographs of two color morphs of the eastern hognose snake. The melanistic (black) individual displays the “cobra” defensive behavior. Photos courtesy of Aaron Crank.

The western hognose snake is a stout-bodied snake that can reach 35 inches long (Image 2). Its base colors are typically tan or gray, and the dark stripe extending from its eyes to the corner of its mouth is a characteristic feature of this species. The belly is mainly black with yellow blotches. Like the eastern hognose snake, it has a sharply upturned rostral scale and similar defense mechanisms (VanDeWalle 2010).



Image 2. Photograph of a captive western hognose snake. Photo courtesy of Amy McClung.

The populations of eastern and western hognose snakes have similar ecological niches. These include their habitat, diet, shelter, and seasonal activity. However, there is a lack of interspecies competition due to differences in habitat and seasonal activity levels. Eastern hognose snakes live in open forest areas, pine forests, deciduous forests, forest edges, and disturbed sandy habitats close to water. Western hognose snakes reside in sandy or disturbed areas and mixed grass prairies. The eastern hognose snake's diet consists primarily of amphibians and reptiles. Western hognose snakes consume similar prey but are not as selective and will consume small mammals, small reptiles, and bird and reptile eggs (Kroll 1973).

Species' natural ranges

H. platirhinos have a natural range in eastern North America. They reside in Eastern New England (Michener & Lasell 1989) but, more specifically, are known to inhabit New Hampshire, Rhode Island, Massachusetts, and down to southern Florida (Buchanan et al. 2017, University of Georgia). *H. platirhinos* are also known to inhabit Georgia, South Carolina, and the Great Lakes region (University of Georgia). They also have a natural range in southern Ontario, Canada (Goulet et al. 2015). *H. simus* have a natural range from the Mississippi Coastal Plain to North Carolina and down into Florida (Beane et al. 2014). *H. nasicus* have a native range in Alberta, Saskatchewan, Manitoba, Canada, and the Great Plains in the United States, Arizona, and central Mexico. They have also been known to inhabit a few isolated parts of Illinois and Missouri (Kelley 2011).

Species habitat: *Heterodon platirhinos*

For a habitat to support adult populations of *H. platirhinos*, it must have an abundance of toads to prey on. The habitat must also supply small amphibians to sustain hatchlings and young snakes. Due to these needs, *H. platirhinos* tend to colonize peninsular habitats and wetlands, which contain loose, well-draining soils suitable for burrowing and their dietary needs (Michener & Lasell 1989). They are prevalent in barren pine ecosystems and sandy lands dominated by white pine. They may also occupy suburbs, deciduous forests, forest edges, and heath and dune habitats (Michener & Lasell 1989, Buchanan et al. 2017, Kroll 1973).

H. platirhinos tend to prefer humidity between 50-60% (Healey 2022). An additional influence of habitat selection is the thermal environment, as *H. platirhinos* seek to maintain body temperatures of 29-32°C (Goulet et al. 2015). This factor as a determinant of habitat selection has led to populations living in spaces containing small-scale canopy openings, which allow light to reach the ground surface, where the snakes can bask to increase their body temperature. The preferred thermal environment also influences habitat selection to contain sufficient shelter in shrubbery, leaves, and rocks, as this shelter allows the snakes to prevent overheating or predation (Goulet et al. 2015).

Species habitat: *Heterodon nasicus*

Heterodon nasicus is usually found in sandy or gravel soil areas, such as river floodplains, prairies, scrub and grasslands, farmlands, open woodlands, and other semi-arid regions. They prefer dryer conditions of 30-50% humidity (Healey 2022). They have been known to reside in areas of elevations up to 2,500 meters (Baird & Girard 1852, University of Adelaide 2018, Golberg 2004). Optimal environment temperatures for *H. nasicus* range from 30-36°C (Kroll 1973). During the peak of summer, *H. nasicus* invade woodland habitats to seek cooler temperatures, and then leave when temperatures decrease in the fall (Kroll 1973). Unfortunately, fragmentation and habitat loss have threatened some *H. nasicus* populations (Kelley 2011).

Characterization of Exposure

There are no native species of *Heterodon* found within the state of Oregon. The most common hognose species kept in captivity is the western hognose, but the eastern hognose has been slowly gaining popularity.



Image 3. Wild female Eastern hognose discovered underneath a large rock in Ohio after laying eggs. Photo courtesy of Mike Wilhelm.

Eastern Hognose

The eastern hognose, *H. platirhinos*, is found along the east coast of North America, from Florida to Southern Ontario, and as far west as central Texas north to Minnesota. They share a similar range as the Eastern Rat snake, *Pantherophis alleghaniensis*, and other *Pantherophis* species endemic to the eastern United States. They prefer well-draining sandy soils in dry open forests or forest edges and seldom prefer moist or heavily forested areas (Buchanan et al. 2016; Plummer & Mills 2000). This diurnal species enters hibernation in November, emerges in March, and is most active when temperatures are between 31 C and 34 C during spring and fall. They will hibernate in self-constructed burrows or abandoned ones created by other animals. They are not as active during the peak of summer (Kroll 1973). The preferred humidity range is 50-60%, ignoring natural spikes due to precipitation. Due to the extreme differences in natural ranges, population localities will exhibit tolerance to cooler or warmer temperatures and different activity levels throughout the year. Captive individuals in the pet trade are adapted to temperatures not dropping below 21 C and not exceeding 32 C (Healey 2022). Wild individuals

mate in spring, and females lay in late June to July. They will search for burrows in sandy soil or create their own up to 14 cm beneath the surface to lay their eggs (Image 3). Incubation temperatures falling below 22 C greatly reduce hatching success (Cunnington et al. 2005). With captive individuals, breeding consists of gradually cooling temperatures in the fall to 7 C - 10 C and remaining there for 2-3 months for artificial brumation. After successful breeding and nesting similar to their wild counterparts, eggs are collected and placed in a temperature-controlled incubator set between 27 C and 30 C with minimal humidity using dampened vermiculite (Spinner 2015).

Western Hognose

The western hognose, *H. nasicus*, is found in North America from south central Canada through the Great Plains to north central Mexico. They share a similar range as the Western rat snake *Pantherophis obsoletus*, and various bull and gopher snakes of the *Pituophis* genus. They prefer loose sandy soils in grassy prairies, scrublands, semi-arid regions, and deciduous forests during the peak heat of summer; some localized populations overlap with the eastern hognoses' ranges but do not seem to have competitive behaviors regarding habitats and food sources (Kroll 1973). This diurnal species is lightly documented entering hibernation in mid-October and exiting mid to late Spring. They tend to be most active during summer in June and July when air temperatures are between 30 C and 36 C but have been documented to be active as early as March and as late as October (Kroll 1973). The preferred humidity range is between 30-50%, ignoring natural spikes due to precipitation. Due to the differences in natural ranges, population localities will exhibit tolerance to cooler or warmer temperatures as well as differing activity levels throughout the year. Captive individuals in the pet trade are adapted to temperatures not dropping below 16 C and not exceeding 35 C (Reptifiles). Wild individuals start to mate in spring and females start to lay during summer, as late as August (Kroll 1973, Goldberg 2004). Within captivity, to induce breeding, a brumation period must take place which consists of slowly dropping temperatures to 10 C – 16 C for a period of two to three months, then gradually increasing temperatures. After successful breeding and laying, eggs are collected and placed in a temperature-controlled incubator set between 25 C and 28 C with minimal humidity by using dampened vermiculite (Clayton 2012).

Climate Variations

Oregon's temperatures and humidity levels range annually and regionally. The average temperature in Oregon for July is 23.5 C, with the lowest average in January at -3.6 C (National Weather Service). With the species' nesting from June to July, temperatures in Oregon may still be too cold for a complete and successful incubation. Oregon humidity levels average between 75% to 92% during winter, and for the summer, the range is 77%-87% west of the Cascades and 25-30% east of the Cascades (Western Regional Climate Center). Prolonged increased humidity can cause illness in both species. However, the western side of Oregon may have a more

tolerable humidity during the drier summer season (if temperatures are also in the ideal range). From our understanding of the research, long-term captive or captive-bred individuals would be unable to adapt efficiently to the natural climate variations of Oregon. Both species have been bred to survive in captive parameters and can become ill in incorrect care, such as too cold/hot or too humid (Healey, 2022). Tables 1 and 2 briefly summarize this conclusion.

Commercial Propagation

The western hognose is a commonly bred and kept pet snake in the hobby, and the eastern hognose is slowly gaining popularity as well. There are currently more than 60 morphs (selectively bred patterns and colors) of just the western hognose available for public purchase. Both species of hognose snake can be found for sale on websites that sell reptiles such as lllreptile.com, snakesatsunset.com, xyzreptiles.com, and backwaterreptiles.com, although these companies do commonly sell wild caught individuals. Websites such as morphmarket.com and faunaclassifieds.com allow any global breeder to create a personal profile to be able to sell and ship their animals worldwide (abiding by laws and proper documentation if necessary). The western hognose can be found locally in the Pacific Northwest at reptile conventions, such as the Northwest Reptile Expos and the Pacific Northwest Reptile and Exotic Animal Show (PACNWRS), and at privately owned reptile stores.

Species	Hibernation	Average Oregon temperatures during start/emergence of hibernation
Heterodon platirhinos	November - March	November: 5.8 °C March: 2.6 °C
Heterodon nasicus	October - April/May	October: 12.5°C May: 16.2°C

Table 1. Hibernation cycles for *Heterodon platirhinos* and *Heterodon nasicus* and average temperatures during those periods.

	Temperature	Humidity
Heterodon platirhinos	31-34°C may not tolerate lower than 16°C	50-60%
Heterodon nasicus	30-36°C may not tolerate lower than 16°C	30-50%
Oregon - July	23.5°C	77-87% 25-30% east of the Cascades
Oregon - January	-3.6°C	75-92%

Table 2. Temperature and humidity preferences for *Heterodon platirhinos* and *Heteron nasicus*, and Oregon temperature and humidity averages during July and January.

Characterization of Ecological Effects

Potential to Prey Upon Native Wildlife

The eastern hognose has a preferred diet of small amphibians and reptiles, but has been found to consume small mammals and invertebrates as well (FMNH 2021). The western hognose has a more diverse diet and will consume amphibians, small mammals, and ground-dwelling reptile or bird eggs (quail sized). Within Oregon, the diet of either snake would cause great harm to the numerous local wildlife such as frogs, toads, and salamanders, especially to the ones listed as Oregon Conservation Strategy Species.

The native salamander species in Oregon that Hognose snakes may prey on: the mole salamanders (Family: Ambystomatidae, Genera: *Amystoma* and *Dicampyodon*) the newt (Family: Salamandridae, Genus: *Taricha*), torrent salamanders (Family: Rhyacotritonidae, Genus: *Rhyacotriton*), and plethodontids which are the most diverse type of salamander in Oregon (Family: Plethodontidae, Genera: *Plethodon*, *Ensatina*, *Aneides*, and *Batrachoseps*)(Oregon Department of Fish & Wildlife).

The native frog and toad species in Oregon that Hognose snakes may prey on: coastal tailed frog, rocky mountain tailed frog, great basin spadefoot, western toad, woodhouse's toad, pacific treefrog, northern red-legged frog, cascades frog, Oregon spotted frog, columbia spotted frog, foothill yellow-legged frog, american bullfrog, and northern leopard frog (Oregon Department of Fish & Wildlife).

Competition for Food, Water, Shelter, or Space with Native Wildlife

If the hognose snake were to be introduced it would likely present competition for its diet with the local garter snake. Both snakes feed upon amphibians, including frogs and toads. There would not likely be an issue with water resources, as most of the places where the snake might be able to survive would have abundant water sources. There likely would not be much competition for shelter as hognose snake burrow in herbaceous layers often not used by other species. They sometimes shelter in abandoned burrows created by mammals, which would not lead to any competition for space. Overall, if hognose were able to survive in Oregon's environment the main competition they would be creating would be for food resources. This presents a medium risk for native species and has been assigned with medium certainty.

Hybridization Potential

There was only one mention of the hybridization of hognose snakes found in the literature. The literature identified species of the Mexican hognose snake, *H. kenneryli*, as having hybridized within the same genus. It is seen as unlikely that the hognose snake would hybridize with native snakes if released. Due to the fact that there was minimal literature surrounding the subject of hybridization, it is categorized as low risk with high certainty.

Disease and Parasites

There were no notable diseases or parasites identified through the literature that could be passed on via the snakes to native wildlife. The only diseases and parasites found were common ones that would be expected of snake species. Examples of these include fly larvae entering an open wound or the common snake mites found in captive collections (DiClaro, 2011)

Another expected ailment would be parasites which are common with an amphibian diet (Edgren, 1952). The primary food source for hognose snakes is amphibians, so parasites would be expected. The same literature also notes that trematodes, which are a type of flatworm, flukes, are common in various types of snakes, are found in the lungs, and have no ill effects to their hosts (Edgren, 1952). One study of eastern hognose snakes found 1 in 4 snakes were infected with oocysts of the parasite *C. lampropeltis* (McAllister, 2015). For captive western hognose snakes, *Eimeria coccidia*, a parasite, has been found to be detrimental to stressed hosts (Daszak, 2011).

Human Health Risk and Zoonotic Virus Risk,

A handful of zoonotic diseases have the potential for transmission from snakes to humans. These diseases include salmonella, mycobacterium, aeromonas, escherichia coli, klebsiella, campylobacter, serratia, and flavobacterium meningosepticum (Zoonoses associated with Reptiles & Amphibians, n.d.). Any of these could cause serious human ailments and are of serious concern. Whether the animals are in the wild or captivity, this risk is present. Due to the range of potential diseases, this issue is assigned with medium risk and medium certainty, as there may be other diseases with potential transmission between snakes and humans.

Cost If Not Controlled

Without species control, a decline of hognose prey (such as at-risk amphibians like the Northern red-legged frog) may result in costly but necessary measures. An accidental or intentional release of the hognose snake with successful integration will present problems for native amphibians whose populations are threatened. A decrease in amphibian populations would be detrimental to amphibians and species that rely upon them for food.

Identifying *Heterodon* Compared to Other Species

Due to outer coat similarities, *Heterodon* snakes might be mistaken for night snakes or gopher snakes (*Snakes*: Oregon Department of Fish & Wildlife, 2022). They may also be mistaken for prohibited species, such as look-alike rattlesnakes, with similar outer coat markings.

Risk Characterization

Table 3 below shows the twelve criteria used to determine categorized risk levels of Hognose snakes in Oregon. We used the Oregon division 56: Noncontrolled Classification of the Oregon Department of Fish & Wildlife for criteria, including our researched decision of risk level (low, medium, or high) per criteria and the reasonings for conclusions.

Criteria	Risk Level	Reasoning
a) Species' natural range and habitat similarity to Oregon	Medium	<i>Heterodon platirhinos</i> excel in high toad/amphibian habitats, wetlands, & sandy lands. <i>Heterodon nasicus</i> excel in sandy/gravelly soil areas. However, both are associated with low moisture. Optimum environment temperatures range from 31-34°C.
b) Species invasive history	Low	No articles found on invasive history. We make educated reasoning that it has not been an issue in need of studying.
c) Species possibility of survival in Oregon	Low	Temperatures too low for likely survival past summertime, temperatures too low to spawn, humidity is too high past summertime.
d) Species' potential to prey upon native wildlife	High	Diet highly depends on small amphibians and reptiles.
e) Species potential to degrade the habitat of native wildlife	Low	Do not consume ecosystem engineers.

f) Species potential to pass disease or parasites to native wildlife	Low	See the following section.
g) Species-specific potential diseases or parasites that can be passed to native wildlife	Low	No notable diseases or parasites found.
h) Species' potential for competition of food, water, shelter, or space with native wildlife	Medium	Has the potential to compete with native garter snakes due to a similar diet. May also compete with burrowing mammals for their shelter.
i) Species potential to hybridize with native wildlife	Low	No known documentation on hybridizing with any other species.
j) Will species be distinguishable from other species	Medium	Similarities in scale, color, and pattern to native night snakes, gopher snakes, and rattlesnakes.
k) Species categorization	Low	<i>Heterodon platirhinos</i> and <i>Heterodon nasicus</i> listed as least concern in The IUCN Red List of Threatened Species
l) Species likelihood to be commercially propagated	Low	Currently commercially bred and distributed in the North American pet trade in addition to other countries.

Table 3. Hognose snake risk levels (low, medium, high) based on criteria a-l Oregon division 56: Noncontrolled Classification of the Oregon Department of Fish & Wildlife.

Non-Controlled Classification Criteria

(a) Whether the species' natural range and habitat is similar to Oregon's climate and habitat

Species' natural range:

Heterodon platirhinos

- Natural range in eastern North America
- Eastern New England, New Hampshire, Rhode Island, Massachusetts, Florida, Georgia, South Carolina, Great Lakes region, and southern Ontario (Goulet et al. 2015, Buchanan et al. 2017, University of Georgia)

Heterodon simus

- Natural range from the Mississippi Coastal Plain to North Carolina and down into Florida (Beane et al. 2014)

Heterodon nasicus

- Native range in Alberta, Saskatchewan, Manitoba, Canada, and the Great Plains in the United States, Arizona, central Mexico, & few isolated parts of Illinois and Missouri (Kelley 2011)

Species habitat:

Heterodon platirhinos

- Habitat must have an abundance of toads to prey upon & small amphibians to sustain hatchlings and young snakes (Michener & Lasell 1989)
- Peninsular habitats and wetlands, which contain loose, well-draining soils suitable for burrowing and dietary needs (Michener & Lasell 1989)
- Prevalent in pine barren ecosystems and sandy lands dominated by white pine, also in suburbs, deciduous forests, forest edges, and heath and dune habitats (Michener & Lasell 1989, Buchanan et al. 2017, Kroll 1973)
- Associated with dry, low moisture and open lands
- Thermal environment- seek to maintain body temperatures of 29-32°C (Goulet et al. 2015), and optimum environment temperatures range from 31-34°C (Kroll 1973).
- Spaces with small-scale canopy openings, which allow light to reach the ground surface, where snakes can bask (Goulet et al. 2015)
- Sufficient shelter in shrubbery, leaves, and rocks- prevents overheating or predation (Goulet et al. 2015)

Heterodon nasicus

- Usually found in sandy or gravelly soil areas, such as river floodplains, prairies, scrub and grasslands, farmlands, open woodlands, and semi-arid regions
- Have been known to reach elevations of up to 2,500 meters (Baird & Girard 1852, University of Adelaide 2018, Golberg 2004)
- Optimum environment temperatures range from 31-34°C (Kroll 1973)
- During summertime, they invade woodland habitats- move back to grasslands in the fall (Kroll 1973)

Medium risk
High certainty

(b) Whether the species has an invasive history

- Did not find peer-reviewed or non-peer-reviewed articles about Hognose snake invasive history

Low risk
Medium certainty

(c) Whether the species can survive in Oregon

- Oregon has a wide variety of temperatures, terrains, and species
- The species' needs are appropriate temperatures, humidity, and access to food

Temperature

- The average temperature in July for all of Oregon is 23.5°C, and the coldest month of the year, January, has an average of -3.6°C (National Weather Service)
- Species' ranges in temperature from 30-36°C (Kroll 1973) and may not tolerate temperatures lower than 16°C (Healey 2022)
- Some Oregon areas meet these criteria during warmer months, such as Bend or Portland

Spawning

- Temperatures below 22°C may be responsible for reducing hatching success (Cunnington & Cebek 2005)
- Likely chance of failure in hatching, as incubation periods range from 49-63 days, during which the temperature would likely drop below 22°C (Cunnington & Cebek 2005)

Humidity

- *Heterodon platirhinos* prefer a humidity of 50-60% (Healey 2022)
- *Heterodon nasicus* prefer a humidity of 30-50% (Healey 2022)
- On average, Oregon shows relative humidity between 82-92% during January 4:30 am readings and ranges between 75-85% in afternoon readings (Western Regional Climate Center)
- Humidity is high for both *H. platirhinos* and *H. nasicus* during winter but may be somewhat tolerable for both during summer

Food

- Abundance of small reptiles, birds, and amphibians to eat

Hibernation - *Heterodon platirhinos*

- Emerge from hibernacula in March and then enter in November (Kroll 1973)
- Maximum activity occurs in spring and autumn (Kroll 1973)

Hibernation - *Heterodon nasicus*

- Emerge from hibernacula in April/May and enter in October (Kroll 1973)

- Maximum activity occurs from late spring to fall (Kroll 1973)

Low risk

High certainty

(d) Whether the species has the potential to prey upon native wildlife

- The Hognose snake's diet consists mainly of frogs, toads, lizards, and salamanders (William Wegner 1958)
- The native salamanders in Oregon that Hognoses could prey on: the mole salamanders (Family: Ambystomatidae, Genera: *Amystoma* and *Dicampyodon*), the newt (Family: Salamandridae, Genus: *Taricha*), torrent salamanders (Family: Rhyacotritonidae, Genus: *Rhyacotriton*), and plethodontids which are the most diverse type of salamander in Oregon (Family: Plethodontidae, Genera: *Plethodon*, *Ensatina*, *Aneides*, and *Batrachoseps*)
- The native frog and toads in Oregon that the Hognose could prey on: coastal tailed frog, rocky mountain tailed frog, great basin spadefoot, western toad, woodhouse's toad, pacific treefrog, northern red-legged frog, cascades frog, oregon spotted frog, columbia spotted frog, foothill yellow-legged frog, american bullfrog, and northern leopard frog (Oregon Department of Fish & Wildlife)

High

High certainty

(e) Whether the species can potentially degrade the habitat of native wildlife

- *Heterodon spp.* are only known to eat amphibians and no ecosystem engineers, therefore would not degrade the habitat (William Wegner 1958)

Low

High certainty

(f) Whether the species has the potential to pass disease or parasites to native wildlife

- *Heterodon* do have the ability to pass some diseases or parasites to native wildlife. The possible diseases and parasites are listed in the following section.

Low risk

High certainty

(g) What types of disease or parasites could be passed on to native wildlife

- No notable diseases or parasites found; what has been documented is not specific to species or genus, e.g. fly larvae entering a wound, common snake mites found in captive collections (Diclaro 2011)
- Due to the amphibian diet, stomach parasites are common (Edgren 1952)
- Trematodes (type of flatworm, flukes) found in lungs will no ill effect to snakes, also common in various snakes (Edgren 1952)

- Eimeria coccidia found in captive *H. nasicus*, host specific, detrimental to host when stressed (Daszak 2011)
- In one study, 1 of 4 *H. platirhinos* snakes was infected with oocysts of *C. lampropeltis*; prior this type of coccidia was only found in species of milk and king snakes (McAllister 2015)

Low risk
High certainty

(h) Whether the species has the potential to compete for food, water, shelter, or space with native wildlife

- Eats amphibians, primarily frogs and toads, which may compete with native garter snakes' diets
- Shelters within underground tunnels created by burrowing mammals- seldom found in dense forest habitats

Medium Risk
Medium certainty

(i) Whether the species has the potential to hybridize with native wildlife

- No known documentation on hybridizing with any other species
 - There have been hybrids of the Mexican Hognose Snake identified (Journal of Kansas Herpetology)
 - No other articles about the hybridization of the western hognose snake or eastern hognose snake

Low risk
High certainty

(j) Whether the species can be readily distinguished from a native species, or a prohibited or controlled species.

Native species

- Shows some similarity in color and pattern to the night snake and gopher snake
 - *Snakes: Oregon department of fish & wildlife*. Snakes | Oregon Department of Fish & Wildlife. (n.d.)

Prohibited species

- Some rattlesnakes look similar in color and pattern

Medium risk
High certainty

(k) How is the species categorized in “The IUCN Red List of Threatened Species?”

- The western hognose snake, *heterodon nasicus*, and eastern hognose snake, *heterodon platirhinos*, are listed as least concern (Hammerson 2007)

Low risk

High certainty

(I) Is the species commercially propagated? Unknown, rarely, moderate, common

- Hognose snakes are present in the North American pet trade (Stallins & Kelley 2013, Kelley 2011)
- The western hognose is a commonly bred and kept pet snake in the hobby

Low risk

High certainty

Summary & Recommendations

With potential risks of introduction and possible establishment, it is recommended to classify the genus *Heterodon* as a noncontrolled species. Due to Oregon's annual climate, it is unlikely that *Heterodon* would survive Oregon winters. *Heterodon* does pose a threat to native salamanders, frogs, toads, and other amphibians, although considering the unlikelihood of *Heterodon* surviving annually, this should not be a major concern.

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References

- Amphibians: Oregon Department of Fish & Wildlife. Amphibians | Oregon Department of Fish & Wildlife. (n.d.). <https://myodfw.com/wildlife-viewing/species/amphibians>
- Arizona-Sonora Desert Museum. (2022). *Western hognose snake (heterodon nasicus)*. Retrieved November 22, 2022. https://www.desertmuseum.org/books/nhsd_hognose_snake.php
- Beane, Jeffrey C., Sean P. Graham, Thomas J. Thorp, and L. Todd Pusser. (2014). "Natural History of the Southern Hognose Snake (*Heterodon Simus*) in North Carolina, USA." *Copeia* 2014, no. 1: 168–75. doi:10.1643/CH-13-044
- Buchanan, S. W., Timm, B. C., Cook, R. P., Couse, R., & Hazard, L. C. (2016). Surface Activity and Body Temperature of Eastern Hognose Snakes (*Heterodon platirhinos*) at Cape Cod National Seashore, Massachusetts USA. *Journal of Herpetology*, 50(1), 17–25. <https://doi.org/10.1670/13-212>
- Buchanan, S. W., Timm, B. C., Cook, R. P., Couse, R., & Hazard, L. C. (2017). Spatial ecology and habitat selection of eastern hognose snakes: Movements and Habitat Selection of Hognose Snakes. *The Journal of Wildlife Management*, 81(3), 509–520. <https://doi.org/10.1002/jwmg.21218>
- Clayton, Jeff. (2012). Care And Breeding The Western Hog-nosed Snake. *Reptiles Magazine*. <https://reptilesmagazine.com/care-and-breeding-the-western-hog-nosed-snake/>
- Cunnington, Glenn M., and Joseph E. Cebek. (2005). Mating and Nesting Behavior of the Eastern Hognose Snake (*Heterodon platirhinos*) in the Northern Portion of its Range. *The American Midland Naturalist*, 154(2), 474–478. [https://doi.org/10.1674/0003-0031\(2005\)154\[0474:MANBOT\]2.0.CO;2](https://doi.org/10.1674/0003-0031(2005)154[0474:MANBOT]2.0.CO;2)
- Daszak, Peter, et al. (2011). A New Species of *Eimeria* (Apicomplexa: Eimeriidae) From the Western Hognose Snake, *Heterodon Nasicus* (Serpentes: Xenodontidae), From Texas." *The Journal of Parasitology*, vol. 97, no. 3, pp. 463–65, doi:10.1645/GE-2698.1.
- Diclaro, J. W., et al. (2011). A Case Study of *Megaselia Scalaris* (Diptera: Phoridae) Causing Ocular Myiasis in a Western Hognose Snake. *Journal of Medical Entomology*, vol. 48, no. 4, pp. 934–36, doi:10.1603/ME11006.
- Durso, A. M., & Mullin, S. J. (2017). Ontogenetic shifts in the diet of plains hog-nosed snakes (*Heterodon nasicus*) revealed by stable isotope analysis. *Zoology*, 120, 83-91.
- Edgren, Richard Arthur. (1952). Biogeographical and Behavioral Considerations of the Snakes of the Genus *Heterodon*. *ProQuest Dissertations Publishing*.

- Florida Museum of Natural History. (2021). Florida Snake ID Guide, Eastern Hog-nosed Snake, *Heterodon platirhinos*.
<https://www.floridamuseum.ufl.edu/florida-snake-id/snake/eastern-hog-nosed-snake/#:~:text=Detailed%20Description,with%20slightly%20upturned%2C%20pointed%20snouts.>
- Goldberg, S. R. (2004). Reproduction in the western hognose snake, *Heterodon nasicus* from the southwestern part of its range. *The Texas Journal of Science*, 56(3), 267-273.
- Goulet, Celine, John A. Litvaitis, and Michael N. Marchand. (2015). Habitat Associations of the Eastern Hognose Snake at the Northern Edge of Its Geographic Distribution: Should a Remnant Population Guide Restoration? *Northeastern Naturalist*, 22(3), 530–540.
<https://doi.org/10.1656/045.022.0309>
- Healey, M. (2022). Hognose temperature, lighting & humidity requirements. *Reptifiles*.
<https://reptifiles.com/heterodon-hognose-snake-care/hognose-temperatures-humidity-lighting/>
- Jessee, Renee. (2019). *Heterodon platirhinos*. *Animal Diversity Web*.
https://animaldiversity.org/accounts/Heterodon_platirhinos/
- Kroll, J. C. (1973). Comparative Physiological Ecology of Eastern and Western Hognose Snakes (*Heterodon Platyrhinos* and *Heterodon Nasicus*). *ProQuest Dissertations Publishing*.
- McAllister, Chris T., et al. (2015). A New Host for *Caryospora Lampropeltis* (Apicomplexa: Eimeriidae) from the Eastern Hognose Snake, *Heterodon Platirhinos* (Ophidia: Colubroidea: Dipsadinae), from Arkansas, U.S.A., with a Summary of Hosts of This Coccidian. *Comparative Parasitology*, vol. 82, no. 1,, pp. 151–54, doi:10.1654/4699.1.
- Michener, Martin C., and James D. Lazell. (1989). Distribution and Relative Abundance of the Hognose Snake, *Heterodon Platirhinos*, in Eastern New England. *Journal of Herpetology* 23, 1, 35.
- Plummer, M., & Mills, N. (2000). Spatial Ecology and Survivorship of Resident and Translocated Hognose Snakes (*Heterodon platirhinos*). *Journal of Herpetology*, 34(4), 565–575. <https://doi.org/10.2307/1565272>
- Rule 635-056-0050 prohibited species*. OAR 635-056-0050 - Prohibited Species - Oregon Administrative Rules. (n.d.). https://oregon.public.law/rules/oar_635-056-0050
- Smith, H, Chiszar, D, Eckerman, C, Walley, H. (2003). The Taxonomic Status Of The Mexican Hognose Snake *Heterodon Kennerlyi* Kennicott (1860). *Journal of Kansas Herpetology*. 5, 17-20. http://ksherp.com/wp-content/uploads/2019/02/JKH_5.pdf#page=19

- Snakes: Oregon department of fish & wildlife*. Snakes | Oregon Department of Fish & Wildlife. (n.d.). <https://myodfw.com/wildlife-viewing/species/snakes>
- Spinner, Leo. (2015). The Natural History and Captive Care of the Eastern Hognose Snake. *Reptiles Magazine*.
<https://reptilesmagazine.com/the-natural-history-and-captive-care-of-the-eastern-hognose-snake/>
- Stallins, J. A., & Kelley, L. (2013). The Embeddedness of a North American Snake in the Wildlife Pet Trade and the Production of Assemblage Biogeographies. *Annals of the Association of American Geographers*, 103(3), 417–436.
<https://doi.org/10.1080/00045608.2013.765770>
- University of Adelaide. (2018). *Heterodon nasicus*. WCH clinical toxinology resources.
<http://www.toxinology.com/fusebox.cfm?fuseaction=main.snakes.display&id=SN1531>
- US Department of Commerce, N. O. A. A. (2022). Climate.
<https://www.weather.gov/wrh/Climate?wfo=pqr>
- VanDeWalle, T. (2010). Snakes and lizards in your pocket : A guide to reptiles of the upper midwest. *University of Iowa Press*.
- Washington State University. (2021). *Zoonoses associated with Reptiles & Amphibians*. Institutional Animal Care and Use Committee.
<https://iacuc.wsu.edu/zoonoses-associated-with-reptiles-amphibians/>
- Western Regional Climate Center. (2022). *Climate of Oregon*. WRCC. Retrieved November 8, 2022. https://wrcc.dri.edu/Climate/narrative_or.php
- William Wegner. (1958). Frogs in the Diet of a Hognose Snake. *Herpetologica*, 13(4), 276–276.