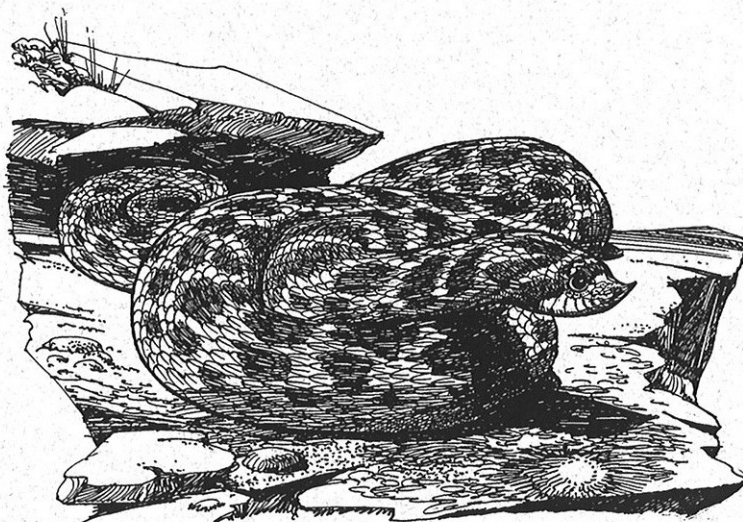


**Fisheries &
Wildlife
Management
Division**

**RESOURCE STATUS AND
ASSESSMENT BRANCH**

**Status of the
Plains Hognose Snake
(Heterodon nasicus nasicus)
in Alberta**

**Jonathan Wright
Andrew Didiuk**



Alberta Wildlife Status Report No. 15



Alberta
ENVIRONMENTAL PROTECTION



**Alberta Conservation
Association**

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PREFACE

Every five years, the Fisheries and Wildlife Management Division of Alberta Natural Resources Service reviews the status of wildlife species in Alberta. These overviews, which have been conducted in 1991 and 1996, assign individual species to 'colour' lists that reflect the perceived level of risk to populations that occur in the province. Such designations are determined from extensive consultations with professional and amateur biologists, and from a variety of readily available sources of population data. A primary objective of these reviews is to identify species that may be considered for more detailed status determinations.

The Alberta Wildlife Status Report Series is an extension of the 1996 *Status of Alberta Wildlife* review process, and provides comprehensive current summaries of the biological status of selected wildlife species in Alberta. Priority is given to species that are potentially at risk in the province (Red or Blue Listed), that are of uncertain status (Status Undetermined), or which are considered to be at risk at a national level by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC).

Reports in this series are published and distributed by the Alberta Conservation Association and the Fisheries and Wildlife Management Division of Alberta Environmental Protection, and are intended to provide detailed and up-to-date information which will be useful to resource professionals for managing populations of species and their habitats in the province. The reports are also designed to provide current information which will assist the Alberta Endangered Species Conservation Committee to identify species that may be formally designated as endangered or threatened under the Alberta Wildlife Act. To achieve these goals, the reports have been authored and/or reviewed by individuals with unique local expertise in the biology and management of each species.

EXECUTIVE SUMMARY

The Western Hognose Snake is currently on Alberta's 'Blue List' of species that may be risk of declining to non-viable population levels in the province. The Plains Hognose Snake (Heterodon nasicus nasicus) is the subspecies of Western Hognose Snake that occurs in Alberta. This report reviews information on the Plains Hognose Snake in Alberta, as a step in updating the status of the species in the province.

Recent findings suggest that the Plains Hognose Snake is relatively liberal in its choice of habitats within the Grassland Natural Region of Alberta. It is found on open plains, rangeland, sandhills, and gravelly glacial till plains, about sloughs, and in riparian habitat. It probably reaches its highest densities in areas of sandy soil, but is not limited to this soil type. It likely avoids heavily cultivated regions within its range, but may occur in roadside right-of-ways in these regions.

The Western Hognose Snake has never been considered abundant throughout most of its range. In Alberta, the range of the Plains Hognose Snake is poorly understood and lack of data makes it difficult to recognize changes in distribution or population levels. Factors that may be limiting to Plains Hognose Snake populations in Alberta include agricultural activities, roads, and the availability of suitable habitat, however, there is little understanding of the exact impacts these factors may have. Recent findings have suggested that the Plains Hognose Snake population in Alberta may, in fact, be stable and perceptions of rarity may be the result of the species' secretive nature and lack of search effort. Nevertheless, research and population monitoring are essential before status can be assessed with any confidence.

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INTRODUCTION

Three subspecies of the Western Hognose Snake (Heterodon nasicus) are currently described (Conant and Collins 1991). The nominate race, the Plains Hognose Snake (H. n. nasicus) is the subspecies found in Alberta, where its range enters into the extreme southeastern corner of the province. It is also the subspecies found in Saskatchewan and Manitoba.

In 1996, the Western Hognose Snake was placed on Alberta's 'Blue List'* of species thought to be at risk of declining to non-viable population levels in the province (Alberta Wildlife Management Division 1996). The species had been ranked as a 'Red List' species in 1991 (Alberta Fish and Wildlife 1991) but was updated in 1996 due to recent increases in new Alberta records (Alberta Wildlife Management Division 1996). Nevertheless, the lack of information on Plains Hognose Snakes makes it difficult to assess current population trends.

This report has been prepared as a review of current information relevant to determining the status of the Plains Hognose Snake in Alberta.

HABITAT

The habitat of the Plains Hognose Snake in Alberta and Saskatchewan falls within the Grassland Natural Region of the High Plains, the latter being the third tier of the Interior Plains of Canada. The High Plains include Alberta's entire prairie region, as well as that of

Saskatchewan, west of the Missouri Coteau. This area has been described as either short or mixed-grass prairie (Coupland 1961) or a combination of the two. This semi-arid region is subject to moderately long, hot but variable summers, and moderately long, and at times extremely cold, winters. In Manitoba, where the only Canadian population of Plains Hognose Snakes occurs outside of the High Plains, the habitat has been described as mixed-savannah, mixed-prairie, and mixed forest (Leavesley 1987).

Outside of Canada, habitat of the Plains Hognose Snake is found in the short, mixed, and tallgrass prairie regions, but the range appears to be most continuous on the higher, more arid shortgrass plains (Platt 1969). On the eastern tallgrass, or 'low' prairie, this species prefers areas of sandy soils, which results in disjunct pockets of hognose snake populations where the habitat is suitable. In Minnesota, for example, at the northeastern edge of its range, the Plains Hognose Snake is found exclusively in pockets of sand-prairie (J. Meltzer, pers. comm.).

Records from Alberta suggest that Plains Hognose Snakes prefer predominantly or completely sandy locations within the grasslands region (Pendlebury 1976, Smith and Wershler 1989), although Moore (1953) reported the species from both sandy locations and damp lowlands, without further definition of the latter. Two records, the first from the Milk River south of Comrey (Lewin 1963), and the second from the Comrey breaks (G. L. Powell, pers. comm.), place this snake on the coulee rim, grassland/badlands ecotone,

* See Appendix 1 for definitions of selected status designations

where clay soil and/or gravel, scattered rocks, jumbled boulders and ground juniper are the prominent features.

In Alberta, the apparent preference of Plains Hognose Snakes for sandy soils results in these habitats being most frequently searched by biologists. Recent records, however, show that the Plains Hognose Snake occurs in more diverse habitat than was formerly believed. The records include captures on, and adjacent to, Canadian Forces Base (CFB) Suffield (1994 to 1997; n=32), where the species was trapped without any habitat bias, and two recent (1997) road-kills from the area immediately northeast of Medicine Hat. Specimens from CFB Suffield were collected on open prairie with sandy substrate, on open prairie with heavy sod, on open prairie near sloughs, on gravelly rolling glacial till plain, on open dune sandhill country, and on a riparian sageflat with densely packed soil conditions (J. Wright, unpubl. data). Of the two recent road-kills mentioned above, one was on a gravel road bordered for many kilometers by overgrazed rangeland with heavy sod, and the other was on a major highway bordered on either side by canola fields with a grassy, 20 m right-of-way (J. Wright, unpubl. data).

At CFB Suffield, the area in Alberta from which the greatest number of recent Plains Hognose Snake records have originated, the species was most frequently captured on or near sandy areas (A. Didiuk, unpubl. data). Another prime area was near a wetland, where several live specimens, including an adult male and a gravid female in the spring of 1995, and two newly hatched

young in the fall of 1997, were captured on or near a township road (J. Wright, pers. obs.). The recent findings from CFB Suffield and the Medicine Hat area are not unusual in the sense that they conform to the trend in habitat records from the United States. These U.S. records report Plains Hognose Snakes from the various prairie habitat types, including short and mixed grass plains, as well as badlands and river drainages, but, again, with a heavy emphasis on sandy or gravelly locations (Platt 1969). The record from CFB Suffield of a live snake caught in a drift fence on a riparian sage-flat is an exception as little or no mention of the use of this specific habitat type occurs in the literature.

A summary of captures of Plains Hognose Snakes at CFB Suffield suggests the following listing of habitats, in approximate order of declining relative densities of snakes found: i) open, sandy plains, where grazing pressure is light, resulting in a heavy cover of mixed grasses; ii) open plains with light to moderate grazing pressure near wetlands; iii) sandhill country; iv) short or mixed-grass plains with a heavy sod layer and moderate to heavy grazing pressure and gravelly, glacial till-plains; v) riparian areas (A. Didiuk, unpubl. data).

A live specimen from the Rolling Hills area south of Brooks is unusual among Alberta records in that it was observed on the north bank of the Bow River in close proximity to the water (H. Armbruster, pers. comm.). It is interesting to note that considerable areas of sandy soil occur in the Rolling Hills area (Pendlebury 1976). One other Alberta record was of a Plains Hognose

Snake swimming across the South Saskatchewan River at CFB Suffield (S. Brechtel, pers. comm.).

Plains Hognose Snakes have been frequently captured in Alberta in sandy areas where Northern Pocket Gophers (Thomomys talpoides) are abundant (J. Wright, unpubl. data). It is possible that the winter burrows of this rodent, which extend below the line of frost-penetration, provide suitable hibernacula for the essentially non-migratory Plains Hognose Snake, allowing this reptile to remain year-round on its summer range.

CONSERVATION BIOLOGY

1. Description. - The Plains Hognose Snake is a small to medium sized, heavy-bodied snake. It derives its name from a sharply upturned rostral scale. It has no facial pits, the scales are keeled, and the body colour is brown to gray with three to five rows of darker brown blotches down its dorsal and lateral surfaces (Russell and Bauer 1993). The pattern and colouration resembles that of some specimens of the Prairie Rattlesnake (Crotalus viridis viridis). The underside is completely black, or black checkered with yellow or white. At maturity, the females are larger than the males, and the males have relatively longer tails in comparison to their bodies (Russell and Bauer 1993). The fangs are at the rear of the mouth and the venom is not normally considered dangerous to humans (Russell and Bauer 1993). Plains Hognose Snakes are not aggressive towards humans, and can rarely be induced to bite (J. Wright, pers. obs.).

2. Daily and Seasonal Activity Periods. - In Alberta, the Plains Hognose Snake emerges from hibernation in late April or early May. Pendlebury (1976) gives an early season record of 10 May and the earliest record at Suffield is 22 April (A. Didiuk, unpubl. data). It enters hibernation in the fall in late September, and likely into early October. Pendlebury (1976) gives a late record of 20 September, and the latest record from CFB Suffield is 25 September (R. Lauzon, pers. comm., J. Wright, unpubl. data). On this date, in 1997, two hatchlings were captured, one with the dried umbilicus still attached, indicating that the snake had hatched during the preceding few days.

In the U.S., Wright and Wright (1957) list an early record of 15 May and a late record of 10 October, but fail to mention from which state(s) these records originate. In Kansas, Platt (1969) lists an early record of late April and a late record for the end of October. Trapping of snakes at CFB Suffield did not continue into October, although it is likely that some hognose snakes are active in Alberta at least until the middle of this month, when conditions are favourable.

Plains Hognose Snakes in Kansas are diurnal, with peak activity periods occurring in the mornings and evenings (Platt 1969). On the sand prairie of Minnesota, at the northeast limit of the species' range, this snake is diurnal and shows a dislike for hot temperatures. Observations from that area suggest that the snakes are above ground for an activity period of approximately one hour per day, primarily on sunny days before the air temperature climbs above

20° C (J. Meltzer, pers. comm.). Limited information suggests that such activity patterns are true of Alberta populations as well (A. Didiuk, unpubl. data).

In Alberta, Plains Hognose Snakes are diurnal, and appear to be most active on sunny days, when air temperatures are between 10 and 20° C, and are rarely seen when temperatures exceed 20° C (J. Wright, pers. obs.). This period may occur earlier or later in the morning, depending on the conditions of the day. Such a shift in daily activity period as a function of temperature was noted in Kansas, although the snakes there seem to have a higher preferred temperature range (Platt 1969). In Alberta, as elsewhere, snakes may again be active in the evenings when the temperature falls to within the preferred range.

Captures at CFB Suffield of snakes active on the surface took place primarily on sunny mornings on gravel roads between 0900 and 1100, although a number of snakes were captured between 1500 and 1900 (A. Didiuk, unpubl. data). Leavesley (1987) noted a preferred body temperature of Plains Hognose Snakes in Manitoba of 27.5 to 33.0° C. Attainment of this temperature would likely not take long for a small snake such as the hognose, even at relatively low air temperatures, in the harsh, direct sun conditions of the Alberta plains. This may account for the apparently narrow window of surface activity in this species.

3. Reproduction. - The mating season of the Plains Hognose Snake is in the spring, although some mating may also occur in the fall (Platt 1969). For this

reason, increased activity in the form of greater surface distances covered in search of a mate might be expected during these times of the year. However, no changes in seasonal activity levels were noted at CFB Suffield, with the exception of a short lull in captures in late July and early August (A. Didiuk, unpubl. data). This species may breed in alternate years (Platt 1969).

The Plains Hognose Snake lays between 4 and 23 eggs (Russell and Bauer 1993). In Alberta, eggs are deposited from mid-June to the beginning of July, in sandy soils at a depth of approximately 90 mm (Russell and Bauer 1993). The incubation period is approximately 60 days (Russell and Bauer 1993). Little is known of their survivorship. The eggs may suffer heavy mortality to Striped Skunks (Mephitis mephitis), Badgers (Taxidea taxus), and Coyotes (Canis latrans), all of which occur within the Plains Hognose Snake's Alberta range and are known predators of snake eggs. The young may occasionally die of starvation, or fall victim to predators, but, perhaps due to this snake's secretive nature, neither the young nor the adults have figured prominently in the stomach contents of predators that share their habitat in Kansas (Platt 1969). Badgers, Coyotes, and Red-tailed Hawks (Buteo jamaicensis) have all been observed preying upon, or attempting to prey upon, Prairie Rattlesnakes at CFB Suffield (J. Wright, pers. obs.), so it seems likely that they would also prey upon hognose snakes.

4. Movements. - In Kansas, Platt (1969) calculated mean distances traveled by Plains Hognose Snakes from point of

capture as an indicator of home-range size. The longest mean distance traveled was 200 m for snakes recaptured after 31 to 50 days, and the shortest recorded mean distance traveled was 89 m for snakes recaptured after more than 200 days. Although such data have not been collected for the Alberta populations, it appears that Plains Hognose Snakes have smaller home ranges than the Prairie Rattlesnakes and Bullsnares (Pituophis melanoleucus sayi) that share their provincial range (A. Didiuk, unpubl. data). Both of these species, in spite of their much larger apparent ranges, are still moderately common to common in suitable habitat in Alberta. Therefore, given what appear to be similar habitat requirements, it may be that more than sufficient habitat remains in Alberta to support healthy populations of Plains Hognose Snakes.

A Plains Hognose Snake may undergo movements in order to shift its home range to better meet its requirements, or, if it is a male, to seek a mate (Platt 1969). Some hognose snakes may also become 'wanderers' at any given time, for unknown reasons. One such snake is known to have traveled approximately 250 m per day for two days, after which its movements became more moderate (Platt 1969). Such numbers indicate that even 'wanderer' snakes have relatively moderate range requirements when compared to other snake species.

Evidence in Minnesota suggests that Plains Hognose Snakes travel very little in the course of the active season, as the same tagged snakes were repeatedly found outside the same burrows (those dug by either Northern Pocket Gophers

or Thirteen-Lined Ground Squirrels, Spermophilus tridecemlineatus; J. Meltzer, pers. comm.). Snakes were found persisting in this same study area on a 12 m wide right-of-way, five years after the original habitat was converted to a housing subdivision (J. Meltzer, pers. comm.).

5. Food. - Plains Hognose Snakes feed on many organisms in the wild. It is generally agreed upon, however, that they exhibit, like all the Heterodon, a preference for toads of all kinds (Wright and Wright 1957, Platt 1969, Pendlebury 1976, Cottonwood Consultants 1986) and have evolved a number of adaptations for bufophagy (Platt 1969). These adaptations include highly mobile maxillae, and enlarged rear maxillary teeth for handling of large prey, a large gape, a thick body, and a physiological resistance to toad venom which can kill other creatures (Platt 1969). Other prey items include frogs, salamanders, turtle eggs, lizards, small birds, rodents, and other snakes (especially garter snakes; Platt 1969, Pendlebury 1976, Russell and Bauer 1993). Pendlebury (1976) observed a captive Plains Hognose Snake from Alberta attempt to subdue a Western Plains Garter Snake (Thamnophis radix haydeni) when both were placed in the same cage. A captive specimen from Montana, from an area adjacent to the Alberta border, was reported to exhibit a taste for hatchling Bullsnares, whereas captives from South Dakota and Minnesota refused the same food (B. Bruno, pers. comm.).

At CFB Suffield, the shells of June beetles appeared in the feces of Plains Hognose Snakes (J. Wright, pers. obs.).

It seems likely that these remains were inside toads eaten by the snakes, as snakes in general do not show fondness for hard-shelled insects (Pendlebury 1976, J. Wright, pers. obs.). Hatchling Plains Hognose Snakes, as well as Bullsnares, have been observed with grasshoppers in their stomachs (J. Meltzer, pers. comm.).

The fact that hognose snakes frequently feed on rodents, combined with the frequency with which they are found among Pocket Gopher colonies, suggests that they may include newborn examples of this rodent in their diets, as well as, perhaps, the young of the Thirteen-Lined Ground Squirrels. Short-term captives from CFB Suffield fed readily on live and dead newborn mice, small nestling birds, several frog species, and newly metamorphosed Great Plains Toads (Bufo cognatus; A. Didiuk, unpubl. data).

6. Choice of Hibernacula. - Plains Hognose Snakes either dig their own burrows, or use existing rodent burrows as hibernacula (Platt 1969, J. Meltzer, pers. comm.). Platt's (1969) suggestion that these snakes likely do not migrate to and from communal denning sites has been substantiated by Alberta findings (A. Didiuk, unpubl. data). However, what appeared to be a denning congregation of Plains Hognose Snakes was observed in Minnesota (J. Meltzer, pers. comm.). Thirty specimens were found together in the fall, congregating in a sand-prairie ditch over an area of no more than 6 m². The site was characterized by an abundance of rodent burrows (J. Meltzer, pers. comm.).

The Plains Hognose Snake has occasionally been observed denning in communal hibernacula of other snake species. For example, Cottonwood Consultants (1987) report hognose snakes at a 'handful' of communal denning sites in the province. Two records from the south side of the Red Deer River in the Buffalo area relate the occurrence of Plains Hognose Snakes in two separate, communal Prairie Rattlesnake/ Bullsnares/ gartersnake hibernacula (S. Brechtel, pers. comm.). One source documents Plains Hognose Snakes as having occurred with the same species at a den near Drowning Ford, on CFB Suffield, at an estimated density of "300 rattlesnakes for every hognose snake" (S. Brechtel, pers. comm.).

Plains Hognose Snakes are rarely recorded in communal hibernacula from other areas. A newly hatched young Plains Hognose Snake was noted "at or near" a Prairie Rattlesnake hibernacula within the proposed boundaries of Grasslands National Park in southern Saskatchewan, along with Eastern Yellow-bellied Racers (Coluber constrictor flaviventris), Western Plains Garter Snakes, and Bullsnares (Kissner et al. 1996). Two Plains Hognose Snakes were observed at a Prairie Rattlesnake den in Tripp County, South Dakota, along with 6 Bullsnares, 2 Eastern Yellow-bellied Racers, and 1 Red Milk Snake (Lampropeltis triangulum sypila; Wright and Wright 1957).

Nevertheless, recent surveys at CFB Suffield, resulted in no Plains Hognose Snake reports from hibernacula shared by Prairie Rattlesnakes, Bullsnares and

Plains (Thamnophis radix radix) and Wandering (T. elegans vagrans) Garter Snakes (A. Didiuk, unpubl. data). These hibernacula were thoroughly surveyed, and occurred near areas of prime hognose snake habitat. This and other evidence (see 'Movements' section, above) suggests that Plains Hognose Snakes are essentially sedentary and likely den most often within their summer range (A. Didiuk, unpubl. data). They probably hibernate by burrowing down into sandy substrate, or in the burrows of fossorial mammals. At CFB Suffield, the majority of Plains Hognose Snakes were captured far enough (>5 km) from the South Saskatchewan River, where rattlesnake hibernacula are located, to suggest that the river valley does not play a role in the overwintering of this fairly sedentary snake. The fact that they were never captured at any of the several hibernacula surveyed at CFB Suffield supports this view (A. Didiuk, unpubl. data).

DISTRIBUTION

1. Alberta. - The Plains Hognose Snake reaches the northern limit of its range in Alberta (Figure 1). The species' occurrence in the province is loosely associated with the major river drainages of the extreme south-east corner of the province, as these were no doubt used as post-glacial dispersal corridors into the north. Historically, most records have fallen east of a line drawn connecting Orion and Medicine Hat, and south of the Red Deer River (Russell and Bauer 1993). Current records extend this known range to the west, perhaps as far as Rolling Hills (Figure 2), according to a recently

discovered record from the early 1970s (H. Armbruster, pers. comm.). It is important to note that this record does not likely constitute a range expansion for the Plains Hognose Snake, but rather reflects the lack of comprehensive historical data on this species (a direct result of the difficulty in conducting work on such an elusive creature). There are unconfirmed records of Plains Hognose Snakes from the Dinosaur Provincial Park area and from the Fort Macloed area which, if credible, extend the known limits of this species range in Alberta even further west (Figure 2). The Fort Macloed record, however, given its distance from the known range, may represent a case of species misidentification.

The range of the Plains Hognose Snake in Alberta appears to be discontinuous west from the Cypress Hills area (Figure 2), resulting in what has been historically portrayed as separate populations of this snake in the province (Pendlebury 1976). The 'south population' occurs in the Milk River Canyon/ Wild Horse/ Manyberries region and is likely contiguous with a Montana population (Pendlebury 1976, Reichel and Flath 1995). Meanwhile, the 'north population' is centered along the South Saskatchewan River from the area of Medicine Hat in the south to the area of Empress in the north (Pendlebury 1976). Evidence to support the hypothesis that these two populations have perhaps been isolated from each other for some time is illustrated by Pendlebury (1976). He points out that specimens from the 'northern population' tend to have their black venters broken up into a checkerboard pattern by yellowish squares, while specimens from the



Figure 1. Distribution of the Western Hognose Snake in North America (adapted from Stebbins 1985).

‘south population’ have predominantly black venters. In 1995, however, a specimen was captured at a drift fence at Suffield (in the ‘northern population’ region) with a solid black venter (J. Wright, pers. obs.).

These two populations may be the divided remnants of what was once (and may still be) a continuous population in Alberta, following the snake’s northward post-glacial dispersal route around the west side of the Cypress Hills. If this is the case, it is not unreasonable to suggest, especially in light of the record from Rolling Hills and a record from the southwest border of CFB Suffield, that undiscovered populations of this snake may still exist west of the Cypress Hills in suitable habitat along the species’ dispersal routes. Conversely, the ‘north population’ of this species in Alberta may be the result of a separate migration of snakes northward through Saskatchewan, and around the east end of the Cypress Hills. Whichever the case, this snake should be looked for in suitable habitat along all of southeast Alberta’s post-glacial spillway drainages, especially the Etzikom, the Chin, and the Forty-Mile Coulees.

At CFB Suffield, hognose snakes were captured with the greatest frequency in areas where Northern Pocket Gopher activity was high (J. Wright, pers. obs.). The Northern Pocket Gopher is absent from a large portion of southern Alberta (Smith 1993). It is interesting to note that the bulk of the records for the Plains Hognose Snake in this province fall within the eastern boundary of the range of the Northern Pocket Gopher. The fact that the ranges of these two

species closely overlap in the southeast corner of the province may suggest a close association between these two animals in Alberta. The Richardson’s Ground Squirrel (Spermophilus richardsonii) in comparison, was largely absent on the study area at Suffield, so it was not possible to determine whether the snakes also favour the colonies of this rodent where their populations overlap.

The paucity of records points out that the actual range of the Plains Hognose Snake in Alberta has yet to be accurately defined. It is therefore impossible, at present, to determine whether this species has a stable, expanding (unlikely) or contracting (more likely) range in the province. The sympatric Prairie Rattlesnake, for instance, is believed to have experienced range contraction in some areas of Alberta in recent years, probably as a result of modern land-use practices (Watson and Russell 1997). It seems reasonable to suggest that the Plains Hognose Snake would be affected similarly by these same pressures.

The Plains Hognose Snake may be expected to occur over an area adjacent to and south of the Red Deer River, and at least as far west as the longitude of Bassano, as suitable habitat would appear to be available for this snake in pockets throughout this block. In attempting to determine the true limits of the hognose snake’s range in Alberta, initial priority should be placed on habitat that supports healthy (not overgrazed) native grassland on sandy surficial deposits. The areas near seasonal or permanent wetlands, especially where Northern Pocket

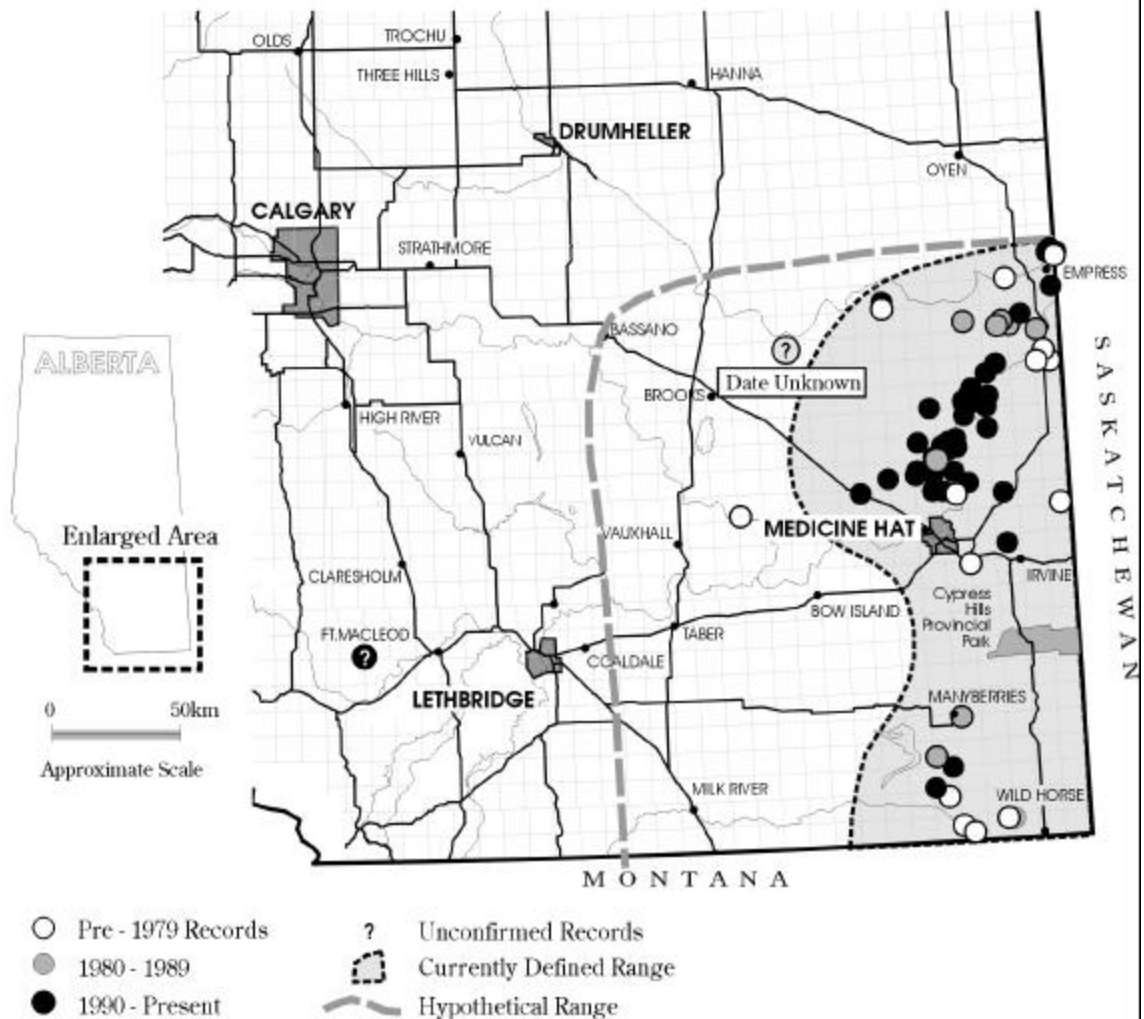


Figure 2. Currently defined and hypothetical range of the Plains Hognose Snake in Alberta. See 'Distribution' section, above, for explanation of the hypothetical range. Detailed descriptions of records are found in Appendix 2.

Gophers occur, should be considered habitat on which to focus efforts. An example of a potential area to search, which has yet to yield any records of this snake, lies northwest of the town of Brooks, south of, and adjacent to, the Red Deer River. Highway 36 bisects an extensive region of low, shrubby dune country in this area, which has the outward appearance of being prime hognose snake habitat. The Rolling Hills area near Brooks is another region in which efforts to find this snake might be concentrated, as is the Grassy Lake area west of Taber. It remains to be seen whether the fact that these areas lie outside of the known range limits for the Northern Pocket Gopher (Smith 1993) is relevant.

Recent findings that place Plains Hognose Snakes in a broader variety of prairie habitats than was formerly expected are heartening. Based on these findings, potentially suitable areas for this snake exist in large tracts from the area north of, but adjacent to, the Red Deer River, west to at least the longitude of Bassano, and south to the U.S. border. In contrast, the amount of what we consider 'pristine' prairie remaining in Alberta is relatively small. If it is shown that the Plains Hognose Snake requires such conditions, then a large portion of the area outlined above would not be suitable habitat, and lightly impacted areas such as CFB Suffield and the Pinhorn Grazing Reserve could be crucial to the survival of this species in Alberta.

2. Other Areas. - The Plains Hognose Snake is found from extreme southeast Alberta, through western Saskatchewan (Secoy and Vincent 1976) west of the

Missouri Coteau, and into the United States, through North Dakota, and as far east as Minnesota (Stebbins 1985; Figure 1). From Minnesota it occurs south to northern Texas, west to west-central New Mexico, and north to Montana (Platt 1969, Conant and Collins 1991). The Rocky Mountains are a barrier at the western range limit of the Plains Hognose Snake in the United States (Platt 1969). There is a relict population in the sandhills of southwest Manitoba (Leavesley 1987). Populations at the eastern edge of the Plains Hognose Snake's range in the United States (Minnesota, Iowa, Illinois, Missouri) tend to be highly fragmented due to the highly fragmented nature of preferred habitat in this region (Platt 1969, Conant and Collins 1991).

There are two subspecies of the Plains Hognose Snake. The Dusty Hognose Snake (*H. n. gloydi*) overlaps the southeastern edge of the nominate snake's range in extreme southern Kansas, through central Oklahoma, and south through south central Texas, with disjunct colonies in eastern Texas, Missouri, and Illinois. It integrates with the Plains Hognose where their ranges overlap. The Mexican Hognose Snake (*H. n. kennerlyi*) is found from extreme southern Texas to southeast Arizona, and south into central Mexico (Conant and Collins 1991; Figure 1).

The limited data available on the Plains Hognose Snake suggests that this species has not undergone any changes in range or distribution, except perhaps on a local basis, where, like the Prairie Rattlesnake, populations may have become extirpated due to alteration of habitat.

POPULATION SIZE AND TRENDS

1. Alberta. - Little is known about the population size of the Plains Hognose Snake in Alberta. Population sizes of reptiles can be very difficult to determine with any degree of reliability under the best of conditions, such as for communally denning species. With a species like the Plains Hognose Snake, which rarely dens communally, any reliable method of determining actual numbers of individuals is difficult to develop and implement. As a generalization, based on current information levels, experts propose that this snake, which was historically believed to be very rare in Alberta, might exist in greater numbers than was once believed (A. Didiuk, unpubl. data).

Similarly, trends in population for this species in Alberta are currently undetermined. The increasing number of records over the past few years almost certainly reflects the trend towards more herpetological research in the province, rather than any actual increase in the number of these snakes. Although the species has been perceived as being very rare and perhaps in decline since it first began receiving scientific attention in the province, the increased frequency with which the snake is found may indicate that the population in Alberta is in fact stable. An attempt at a population estimate for Alberta suggests numbers in the thousands, but not tens of thousands (A. Didiuk, unpubl. data).

2. Other Areas. - No reliable population estimates exist for Manitoba, where some work on this snake has been done. However, the species is perceived to be rare in the province in localized areas of

sandy soils (Leavesley 1987). Even less is known about the species in Saskatchewan, so no comments can be made regarding population size or trend in that province.

High densities of Plains Hognose Snakes have been indicated in Minnesota, where up to 200 different marked individuals have been observed on a single 8 ha field of native sand-prairie (J. Meltzer, pers. comm.). Population estimates established from data from two study sites in Kansas give densities of 2.81 and 5.98 snakes/ha (Platt 1969). It is probable that these densities are higher than those that exist in Alberta (A. Didiuk, unpubl. data).

LIMITING FACTORS

There are a number of natural factors that limit the distribution of the Plains Hognose Snake in Alberta. Whereas the Plains Hognose Snake has demonstrated some adaptability to lightly or moderately impacted prairie habitat types in southeastern Alberta (see 'Habitat' section, above), it is known to be limited on the eastern extremities of its range to areas of sandy substrate. If this snake is found further west on the prairie in Alberta than was formerly believed (a pattern that is beginning to emerge) then perhaps it will be found to be limited to sandy substrates on the extremes of its range in this province as well. This assumption might aid researchers in identifying areas where the species has a high probability of being detected outside of its known range.

The Plains Hognose Snake may also be dependent on the burrows of Northern

Pocket Gophers for hibernacula. Northern Pocket Gophers appear to be important determinants of the distribution of Bullsnares and Prairie Rattlesnakes of southeastern Alberta for a number of reasons, as well (pers. obs.). The presence of available hibernacula may then not be as strong of a limiting factor for the Plains Hognose Snake, which does not rely on major drainages, as it is for the Prairie Rattlesnake which relies on such areas for denning sites.

The availability of habitat may be only a minor limiting factor to Plains Hognose Snakes in Alberta at present, as the known range falls within an area which still contains adequate tracts of near 'natural' grassland to support healthy populations of other prairie snake species. What may be more important to the Plains Hognose Snake is the quality of available habitat. The following sections discuss the effects of factors that may effect breeding and survival of the Plains Hognose Snake with emphasis on impacts resulting from human activities.

1. Agricultural Activities. - The full effects of agricultural activities on hognose snakes are poorly understood. Cultivation of the prairie renders it largely or completely unsuitable for snake habitat (Russell and Bauer 1993). Today, 68% of Alberta's prairie is cultivated (Willms and Dormaar 1995), although the percentage is likely lower in the extreme southeast part of the province. Taking these factors into account, it is likely that cultivation is the single greatest limiting factor for the Plains Hognose Snake in Alberta. Although there is evidence to suggest

that this species, being relatively sedentary, can persist on fairly small parcels of suitable habitat, cultivation likely represents a barrier to dispersal, ultimately affecting genetic integrity. Furthermore, the breaking of new sod by the plow may kill most individuals outright, with further individuals being claimed by machinery at harvest time. It is possible that ditches and right-of-ways are important as dispersal corridors, and may even support populations of hognose snakes if rodents are abundant (J. Meltzer, pers. comm.). However, no work has been done in Alberta to support this theory.

Specimens of Plains Hognose Snakes have been found adjacent to heavily grazed pastures in Alberta. No work has been done to implicate grazing pressure - light, moderate or otherwise - as a limiting factor on this snake, although it is known that grazing by cattle may render habitat unsuitable or suboptimal for some species (Russell and Bauer 1993).

Insecticides may be of concern as a limiting factor for the Plains Hognose Snake. Grasshoppers have been found in the stomachs of hatchlings, so mortality may occur as a result of ingestion of insecticides. Insecticides may also act indirectly as a limiting factor by reducing the available prey-base for hognose snakes. They may also inhibit or prevent successful breeding (Russell and Bauer 1993).

2. Roads. - Roads are likely second in importance as a limiting factor on the Plains Hognose Snake in Alberta. On the otherwise protected Suffield National Wildlife Area, natural gas

exploration and extraction activities create heavy vehicular traffic, and snakes, including the Plains Hognose Snake, are probably the only wildlife species present which suffer appreciable road-kills (pers. obs.). Five of the recent specimens from CFB Suffield were road-killed, and a sixth had been hit by a vehicle and recovered. The two recent specimens from northeast of Medicine Hat, along with the recent specimen from near Manyberries were also road-kills. Plains Hognose Snakes appear especially vulnerable during the morning when they are regularly encountered on heavily-traveled access routes. It is possible, however, that the hognose snake's essentially non-migratory habits, (in contrast to those of the wide-ranging Prairie Rattlesnake), afford protection to populations that occur a suitable distance from any thoroughfare. Therefore, mortalities from vehicles are likely of most significance to populations in close-proximity to roads.

3. Oil and Gas Activity. - The primary impact of oil and gas activity on Plains Hognose Snakes is likely from vehicular traffic on existing roads and on roads created during well and pipeline construction services. However, trenching during pipeline construction can also cause mortality of snakes. Due to the short duration in which pipeline trenches remain open, and because the Plains Hognose Snake does not appear to be a highly migratory species, mortality from falling into trenches is likely of minor impact on this snake. However, Prairie Rattlesnakes and Bullsnares are regularly found trapped in trenches (J. Wright, pers. obs.), especially in the spring and fall, and

therefore it seems probable that hognose snakes may also become trapped (especially in prime habitat). This occurrence, however, has not been documented. Hatchling Plains Hognose Snakes have been found dead, in the sunken gas-well structures at CFB Suffield on several occasions in recent years (pers. obs.).

4. Intentional Persecution. - Plains Hognose Snakes are of small size, cryptic colouration, reclusive behavior, remote habitat, and do not make themselves especially vulnerable by denning communally. For these reasons, they likely do not often fall victim to intentional persecution. Nevertheless, this species, like the Bullsnares, is probably killed occasionally as a result of being mistaken for the Prairie Rattlesnake, which is often killed on sight due to its venomous nature (Watson and Russell 1997), or as a result of the general prejudice which exists against all snakes. Reports by local residents north of Medicine Hat of 'small, rattle-less rattlesnakes' (J. Wright, pers. obs.), probably refer to this species, and it is conceivable that such specimens may fall victim because of prejudice.

STATUS DESIGNATIONS

1. Alberta. - In 1991, due to the perception of its extreme rarity in the province, the Western Hognose Snake was included on Alberta's 'Red List' of species at risk of declining to non-viable population levels (Alberta Fish and Wildlife 1991). Although little is known about the Plains Hognose Snake in Alberta, where it has been historically considered rare, and even "endangered -

the rarest of all reptiles in Alberta” (Alberta Fish and Wildlife 1984), recent studies have greatly increased our limited knowledge of this snake. Currently, the Plains Hognose Snake is on Alberta’s ‘Blue List’ of species that may be at risk in the province (Alberta Wildlife Management Division 1996). The emerging picture is one of an extremely secretive and elusive creature. The question now is whether the Plains Hognose Snake is truly ‘rare’ in Alberta, or whether it is just rarely seen.

2. *Other Areas.* - The Nature Conservancy (1998) gives a global rank of ‘G5’ to the Plains Hognose Snake meaning the species is widespread, abundant and demonstrably secure. In Saskatchewan, the Plains Hognose Snake is rated as ‘S3’ (‘rare’) under the same ranking system (Saskatchewan Conservation Data Centre 1997). Few records exist in the province but little work has been done (A. Didiuk, pers. obs.). The Plains Hognose Snake is considered threatened in Manitoba and is rated ‘S2’ (‘imperilled’; Duncan 1996). The species may be designated as ‘vulnerable’ in the upcoming report for the Committee on the Status of Endangered Wildlife in Canada (A. Didiuk, in prep.).

This species receives no official protection in the United States. It is considered of ‘special interest’ in Montana (D. Flath, pers. comm) where, it is ranked as ‘S3’ (‘rare’) due to the paucity of records for that state (Platt 1969, Reichel and Flath 1995, Montana Natural Heritage Program 1998). In Minnesota and Iowa the Plains Hognose Snake is listed as ‘endangered’, and in Missouri it is considered ‘rare’ (Iowa

Department of Natural Resources 1997, Minnesota Department of Natural Resources 1997, Missouri Department of Conservation 1998). Few records exist from the Dakotas or northern Wyoming (Platt 1969). It is considered relatively common in prairie regions of Oklahoma and Texas (Platt 1969) where it is ranked as ‘S5’ (‘demonstrably secure’; D. Scott, pers. comm.), one of the more common snakes in the past in New Mexico (Wright and Wright 1957), and relatively common in western Kansas and Nebraska south of the Platte River (Platt 1969).

RECENT MANAGEMENT IN ALBERTA

Attempts to understand, and subsequently manage, populations of the Plains Hognose Snake have been nearly non-existent in Alberta, due to the difficulty in collecting meaningful data on this species. This situation is changing, as a number of recently initiated projects are providing new insights into the natural history of this snake. Such research is necessary for management of the species.

1. *Suffield National Wildlife Area.* - Approximately 458 km² within Canadian Forces Base Suffield has recently (1992) been designated as a National Wildlife Area in a joint agreement between the Department of National Defense and the Canadian Wildlife Service (CWS). An inventory of the herpetofauna of the area was conducted by CWS from 1994 to 1997 as part of an overall wildlife and habitat inventory. The inventory revealed that the area supports an apparently healthy population of Plains Hognose Snakes (A. Didiuk, unpubl.

data; J. Wright, pers. obs.). Snakes were captured regularly in drift-fences and on the area's system of roads. Sixteen Plains Hognose Snakes were captured in 1995 alone as a part of the overall herpetological efforts, and these snakes have provided a comparative wealth of new data on this species in Alberta.

2. Medicine Hat Area. - A study of Prairie Rattlesnakes, initiated by Alberta Fish and Wildlife in conjunction with the University of Calgary in 1997 at a site near Medicine Hat, yielded two new (1997) Plains Hognose Snake specimens.

3. Pilot Project on the Study of the Western Hognose Snake in Alberta. - This project was conducted in 1989 by Sweetgrass Consultants and was funded by Alberta Forestry, Lands and Wildlife and World Wildlife Fund ('Prairies for Tomorrow'). A major focus of the study was to test the effectiveness of live trapping as a way of improving the chance of finding hognose snakes. Traps were set up for a total of 222.5 trap days in the Lost River area south of Cypress Hills Provincial Park and the Empress area (Smith and Wershler 1989). One individual was captured. It is possible that the relatively short length (3.4 m) of drift fencing used for the wings of the traps in this study limited the number of snakes caught (A. Didiuk, pers. obs.).

4. Alberta Fish and Wildlife / WWF Poster Campaign. - Beginning in 1989, and into the early 1990s, a joint poster campaign sponsored by Alberta Fish and Wildlife and the World Wildlife Fund was initiated. Posters featuring a photo

of the Plains Hognose Snake and bearing the inscription, "Have You Seen This Snake?" were distributed throughout the province, urging people to respond with their sightings. While the campaign was intended primarily to increase awareness of the species (S. Brechtel, pers. comm.), numerous new records for Alberta were collected, although many are considered 'unconfirmed'.

5. Alberta Snake Hibernaculum Inventory. - Initiated in 1996 by the Status and Surveys Branch of Alberta Natural Resources Service, this program maintains a central database of information on the location, features, and longevity of hibernacula occupied by all snake species in Alberta. The information, which is obtained from landowners and naturalists, has yet to yield new Plains Hognose Snake records. Given the scarcity of historic records placing this species at communal hibernacula, this is perhaps not surprising. However, the possibility exists that future records may emerge.

SYNTHESIS

In response to recent records suggesting that the Plains Hognose Snake may not be quite as rare and localized in Alberta as previously thought, a renewed interest in accurately determining the status of this species has resulted. It remains to be seen whether this interest leads to more research, but it would appear that enough preliminary data has been collected to suggest substantial data accumulation can be expected in future projects. At present, we have learned only enough to hypothesize that our past assumptions of extreme rarity

may be faulty. More research is needed before any accurate statements can be made about the status of the species in Alberta.

Few in-depth studies have been conducted on this snake to date in Alberta. Such studies are imperative if we wish to accurately determine the status of this species in this province. A study with at least three prime areas of focus is recommended:

1.) Radio-telemetry would enable researchers to follow transmitter-implanted snakes throughout their active season. The recent availability of technology allowing this type study has revolutionized the field of herpetology, providing data on the previously undetermined aspects of snake biology.

2.) The effects of rural land-use practices on this species need to be determined. Research should be conducted in an area that is already known to support a healthy population of Plains Hognose Snakes, and which offers a variety of range conditions, i.e. light, moderate, and heavily-grazed pasture. Ideally, some of the area studied should be adjacent to cultivated

areas. Drift fences could be erected on closely adjacent parcels of land representative of each of the above levels of usage, and the occurrence of the snakes along with relative population densities could be determined. Care should be taken to include edge habitat such as ditches and right-of-ways next to cultivated areas.

3.) The extent of the Plains Hognose Snake's range in Alberta needs to be accurately determined. The erection of drift fences in pre-determined areas of prime habitat may help in determining occurrences beyond the presently known range of the species in Alberta. The fences should be in place by mid-April, and monitored regularly until the end of September. Effort should be concentrated on areas with anecdotal records, and perhaps from areas west of the Cypress Hills along potential historic dispersal routes (see 'Distribution' section, above). A survey of landowners should be part of this component. Drift fence and trap designs developed at CFB Suffield have proven to be effective, and should be used.

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APPENDIX 1. Definitions of selected legal and protective designations.

A. Status of Alberta Wildlife colour lists (after Alberta Wildlife Management Division 1996)

| | |
|--------------|--|
| Red | Current knowledge suggests that these species <u>are</u> at risk. These species have declined, or are in immediate danger of declining, to nonviable population size |
| Blue | Current knowledge suggests that these species <u>may be</u> at risk. These species have undergone non-cyclical declines in population or habitat, or reductions in provincial distribution |
| Yellow | Species that are not currently at risk, but may require special management to address concerns related to naturally low populations, limited provincial distributions, or demographic/life history features that make them vulnerable to <u>human-related</u> changes in the environment |
| Green | Species not considered to be at risk. Populations are stable and key habitats are generally secure |
| Undetermined | Species not known to be at risk, but insufficient information is available to determine status |

B. Alberta Wildlife Act

Species designated as 'endangered' under the Alberta Wildlife Act include those defined as 'endangered' or 'threatened' by *A Policy for the Management of Threatened Wildlife in Alberta* (Alberta Fish and Wildlife 1985):

| | |
|------------|---|
| Endangered | A species whose present existence in Alberta is in danger of extinction within the next decade |
| Threatened | A species that is likely to become endangered if the factors causing its vulnerability are not reversed |

C. Committee on the Status of Endangered Wildlife in Canada (after COSEWIC 1998)

| | |
|---------------|---|
| Extirpated | A species no longer existing in the wild in Canada, but occurring elsewhere |
| Endangered | A species facing imminent extirpation or extinction |
| Threatened | A species likely to become endangered if limiting factors are not reversed |
| Vulnerable | A species of special concern because of characteristics that make it particularly sensitive to human activities or natural events |
| Not at Risk | A species that has been evaluated and found to be not at risk |
| Indeterminate | A species for which there is insufficient scientific information to support status designation |

D. United States Endangered Species Act (after National Research Council 1995)

| | |
|------------|--|
| Endangered | Any species which is in danger of extinction throughout all or a significant portion of its range |
| Threatened | Any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range |

E. Natural Heritage Element Rarity Ranks (after The Nature Conservancy 1998)

Global or G-rank: Based on the range-wide status of a species.

Sub-national or S-rank: Based on the status of a species in an individual state or province. S-ranks may differ between states or provinces based on the relative abundance of a species in each state or province.

| Rank | Definition |
|-------------|---|
| G1 S1 | Critically imperilled globally because of extreme rarity (5 or fewer occurrences, or very few remaining individuals), or because of some factor of its biology making it especially vulnerable to extinction. |
| G2 S2 | Imperilled globally because of rarity (6 to 20 occurrences), or because of other factors demonstrably making it very vulnerable to extinction throughout its range. |
| G3 S3 | Either very rare or local throughout its range, or found locally in a restricted range (21 to 100 occurrences). |
| G4 S4 | Apparently secure globally, though it might be quite rare in parts of its range, especially at the periphery. |
| G5 S5 | Demonstrably secure globally, though it may be quite rare in parts of its range, especially at the periphery. |

Appendix 2. Locations where Plains Hognose Snakes have been reported in Alberta. Records correspond to sites mapped on Figure 2.

| Description (1) | Year | Location (2) | Source (3) |
|--|---------|-----------------------------|---|
| Manyberries * | no date | 49°23' 47" N, 110°41' 40" W | UAMZ |
| Dunmore | 1927 | 49°59' 00" N, 110°34' 45" W | NMC, H. Seamans |
| Comrey | 1938 | 49°07' 00" N, 110°44' 20" W | UAMZ, E. Logier and J. Brown |
| None given | 1940 | W30-Tp17-Rge4-W4 | Cottonwood Consultants 1987 |
| Craigmyle (South and west 89, state location probably incorrect) * | 1949 | 51°37' 00" N, 112°15' 00" W | J. Moore |
| Empress | 1951 | 50°57' 00"N, 110°00' 40' W | UAMZ, R. Lister and J. Moore |
| 13 mi. W and 5.5 mi. N of Wildhorse | 1961 | 49°04' 49" N, 110°30' 15" W | UAMZ, E. Stribney |
| 20 mi. W and 2.5 mi. N of Wildhorse | 1962 | 49°02' 00" N, 110°39' 30" W | UAMZ, J. Ryder |
| S14-Tp19-Rge2 | 1969 | 50°36'00" N, 110°10'00" W | PMA |
| Tp 13, Rge 1, Many Island Lake (Prairie Trail 2.4 km west of lake) | 1969 | 50°08'00" N, 110°04'16" W | PMA, M. Hampson |
| Hilda | 1971 | 50°37'07" N, 110°05'40" W | UAMZ |
| 23 mi. S and 4 mi. W of Empress | 1971 | 50°37' 07" N, 110°05' 40" W | UAMZ, N. Panter |
| S14-Tp19-Rge2 | 1971 | 50°37'00" N, 110°11'00" W | PMA |
| Tp19-Rge 2, Hilda | 1972 | 50°28'39" N, 110°02'00" W | B. Shantz in Cottonwood Consultants 1986 |
| None given | 1973 | 50°11' 00" N, 110°42' 38" W | G. Pendlebury in Cottonwood Consultants 1986 |
| Bindloss | 1975 | Tp21-Rge3-W4 | J. Picotte in Cottonwood Consultants 1986 |
| Atlee | 1976 | 50°50'31" N, 110°54'25" W | C. Wallis, C. Wershler |
| Comrey Breaks | 1979 | 49°04'30" N, 110°41'28" W | L. Powell |
| N22-Tp22-Rge3-W4, Bindloss | 1980 | 50°53'24" N, 110°19'12" W | C. Wallis, C. Wershler in Cottonwood Consultants 1986 |
| Pakowki Lake; 14 mi. S, 1 mi. W of Orion | 1980 | 49°15'07" N, 110°49'30" W | UAMZ, J. Acorn |
| South of Onefour, north of Lost River Canyon | 1980 | 49°04'04" N, 110°30'18" W | L. Powell |
| Cavendish | 1987 | 50°46'26" N, 110°27'14" W | B. Picotte |
| CFB Suffield | 1987 | 50°18'03" N, 110°41'09" W | C. Wallis, R. Wershler |
| Sandy Point Bridge | 1987 | 50°44'24" N, 110°03'07" W | C. Wershler |
| Remount Ranch | 1987 | 50°45'36" N, 110°21'03" W | J. Picotte |
| Cavendish | 1989 | 50°45'36" N, 110°22'51" W | B. Worfell per W. Smith |
| Remount Ranch | 1989 | 50°45'36" N, 110°20'24" W | W. Smith, C. Wershler |

| | | | |
|---|---------|---------------------------|--------------------------------|
| Manyberries * | no date | 49°23'47" N, 110°41'40" W | USMZ |
| Remount Ranch, SE Quadrant T21 R3 W4 * | no date | T21-R3-W4 | J. Picotte |
| Bindloss Area SW Quadrant T22 R2 W4 * | no date | 50°51'21" N, 110°14'13" W | J. Picotte |
| Junction of highways 562 and 899 | 1990 | 50°58'22" N, 110°02'45" W | S. Brechtel to J. Wright |
| 1.5 mi. W of junction of highways 562 and 899 | 1990 | 50°58'22" N, 110°04'01" W | S. Brechtel to J. Wright |
| SE8-Tp22-Rge7-W4 * | no date | 50°51'21" N, 110°57'50" W | Gina Ofadczuk |
| SW26-Tp23-Rge1-W4 | 1990 | 50 58'58" N, 110 02'09" W | Carol Vokeroth, J. Oliver |
| WMU 148, N of Hwy 1 S and E of Suffield to TWP 18 * | 1990 | | Cory Schmidt |
| North of Many Island Lake | 1991 | 50°13'44" N, 110°48'32" W | Fred Weisgerber |
| Etzikom | 1992 | 49°12'39" N, 110°51'39" W | Norman Finstead |
| S. Sask River at Koomati | 1985 | 50°23'49" N, 110°35'16" W | L. Hildebrandt, R&L Environ |
| N. end of Remount Pasture (use middle of Twp) | 1991 | 50°51'21" N, 110°13'55" W | H. Fieldberg |
| Due N. of Cowley Bridge, Oldman R., W of Peigan Reserve | 1990 | 49°41'38" N, 113°43'44" W | Chantal Pattenden, R&L Environ |
| North bank of Bow River, 2 mi. W of Highway 875 Bridge | 1972 | 50°08'49" N, 110°45'03" W | Harry Armbruster |
| 0.5 km N of junction of Hwy 501 and 502, near Manyberries | 1996 | 49°14'06" N, 110°43'55" W | Danna Schock |
| None given | 1990 | 50°30'25" N, 110°31'51" W | AEC |
| N. of junction of 1st road W of Bindloss and Highway 555 | 1990 | 50°51'43" N, 110°16'44" W | Michael O'Shea |
| N. of junction of 1st road W of Bindloss and Highway 555 | 1990 | 50°51'43" N, 110°16'44" W | Michael O'Shea |
| N. of junction of 1st road W of Bindloss and Highway 555 | 1990 | 50°51'43" N, 110°16'44" W | Michael O'Shea |
| CFB Suffield | 1994 | 50°22'25" N, 110°40'36" W | AEC |
| CFB Suffield | 1994 | 50°13'16" N, 110°50'45" W | H. Reynolds |
| Ellice Ranch - yard of first ranch house | 1994 | 50°13'14" N, 110°37'18" W | G. Ellis |
| CFB Suffield | 1994 | 50°13'47" N, 110°40'39" W | G. Ellis |
| CFB Suffield | 1995 | 50°13'16" N, 110°59'10" W | B. Dale |
| CFB Suffield | 1995 | 50°27'48" N, 110°38'52" W | A. Bezner |

| | | | |
|--|---------|---------------------------|----------------------|
| CFB Suffield | 1995 | 50°16'29" N, 110°43'10" W | B. Dale |
| CFB Suffield | 1995 | 50°19'11" N, 110°43'59" W | A. Didiuk |
| CFB Suffield | 1995 | 50°13'16" N, 110°50'45" W | B. Dale |
| CFB Suffield | 1995 | 50°28'53" N, 110°38'52" W | P. Goossen |
| CFB Suffield | 1995 | 50°19'11" N, 110°43'59" W | A. Didiuk |
| CFB Suffield | 1995 | 50°28'21" N, 110°38'52" W | B. Dale |
| CFB Suffield | 1995 | 50°20'17" N, 110°49'02" W | J. Wright |
| CFB Suffield | 1995 | 50°21'20" N, 110°42'17" W | J. Sifert |
| CFB Suffield | 1995 | 50°30'27" N, 110°27'00" W | A. Didiuk |
| CFB Suffield | 1995 | 50°37'27" N, 110°20'59" W | A. Didiuk |
| CFB Suffield | 1995 | 50°33'44" N, 110°35'26" W | AEC |
| CFB Suffield | 1995 | 50°14'52" N, 110°43'10" W | B. Dale |
| CFB Suffield | 1995 | 50°33'10" N, 110°29'31" W | H. Killian |
| CFB Suffield | 1995 | 50°19'10" N, 110°38'05" W | A. Didiuk |
| CFB Suffield | 1996 | 50°19'11" N, 110°43'59" W | A. Didiuk |
| CFB Suffield | 1996 | 50°19'11" N, 110°43'59" W | A. Didiuk |
| CFB Suffield | 1996 | 50°20'16" N, 110°42'18" W | A. Bezner |
| CFB Suffield | 1996 | 50°28'52" N, 110°33'47" W | B. Dale |
| CFB Suffield | 1996 | 50°30'27" N, 110°27'00" W | A. Didiuk |
| CFB Suffield | 1996 | 50°33'42" N, 110°29'30" W | J. Wright |
| CFB Suffield | 1996 | 50°19'11" N, 110°43'59" W | A. Didiuk |
| CFB Suffield | 1996 | 50°36'56" N, 110°27'46" W | H. Reynolds |
| CFB Suffield | 1996 | 50°22'25" N, 110°41'26" W | A. Didiuk |
| CFB Suffield | 1996 | 50°13'16" N, 110°51'35" W | H. Reynolds |
| CFB Suffield | 1996 | 50°13'15" N, 110°42'20" W | AEC |
| Bowmanton Road | 1997 | 50°10'30" N, 110°28'55" W | L. Powell |
| Highway 41 | 1997 | 50°02'25" N, 110°31'31" W | J. Wright |
| CFB Suffield | 1997 | 50°13'16" N, 110°50'45" W | R. Lauzon, J. Wright |
| CFB Suffield | 1997 | 50°13'48" N, 110°50'45" W | R. Lauzon, J. Wright |
| CFB Suffield * | no date | 50°34'55" N, 110°30'00" W | AEC |
| Tinny's Homestead Den At Sherwood Forest * | no date | 50°27'43" N, 110°32'09" W | Norm Rubelki |
| Majestic Ranch, Red Deer River South Face On South Shore * | no date | 50°51'36" N, 110°47'38" W | M. Schornhofer |

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|--|---------|----------------------------|----------------|
| Cavendish, South Shore Of Red Deer River, South And West Slopes * | no date | 50°53'02" N, 110°24'07" W | Tony Minor |
| Burdett Region * | no date | 49°50'13" N, 110°34'12" W | Larry Nelson |
| N. Of Red Deer Lake * | no date | 50°24'39" N, 110°24, 07" W | Bert Hargrave |
| Wolfer Residence Near Sandy Point On South Sask. River * | no date | 50°43'33" N, 110°03'07" W | Floyd Wolfer |
| In Region of Special Areas Grazing Lease, Dinosaur Prov. Park (Mapped As "Date Unknown" in Figure 1) | no date | 50°45'07 N, 111°30'32" W | John Flyberger |

- (1) Locations denoted by an asterisk (*) are not mapped because specific location or date is unknown
- (2) Given as latitude/longitude or Sec-Twp-Rge; location information should not be used for any purpose without the permission of the authors
- (3) UAMZ=Univ. of Alberta Museum of Zoology; NMC=National Museum of Canada; PMA=Prov. Museum of Alberta; USMZ=University of Saskatchewan Museum

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