

## THE POTENTIAL DEMISE OF A POPULATION OF ADDERS (*VIPERA BERUS*) IN SMYGEHUK, SWEDEN

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**Abstract.**—In 1999 and 2004, we published reports on how the introduction of 20 males into a severely inbred and isolated population of Adders (*Vipera berus*) halted its decline towards extinction. The introduction significantly enhanced the population's genetic variability, which resulted in a dramatic increase in offspring viability and a rapid increase in numbers. Unfortunately, recently a new and unprecedented development is threatening the population's future survival. In 2004 permission was granted by the Swedish Nature Conservation Agency of the County Administrative Board to build a house and an adjacent 1 m tall brick wall, right across the habitat occupied by the Adders. The construction of the house and brick wall in 2006 has prevented the majority of the snakes from undertaking their annual migration within the study area, resulting in an extirpation > 75% of the Adders. This reduction seriously impedes the future survival of this unique population.

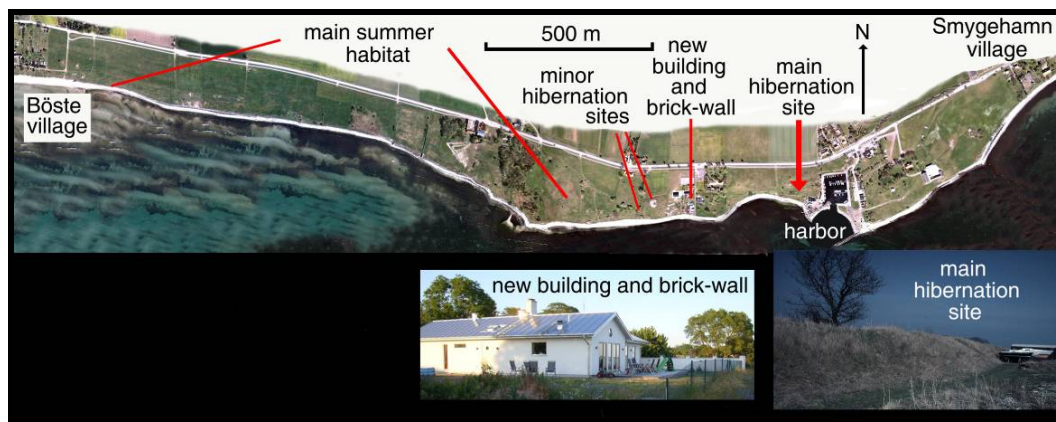
**Key Words.**—Adder; habitat destruction; population dynamic; snake; *Vipera berus*.

### INTRODUCTION

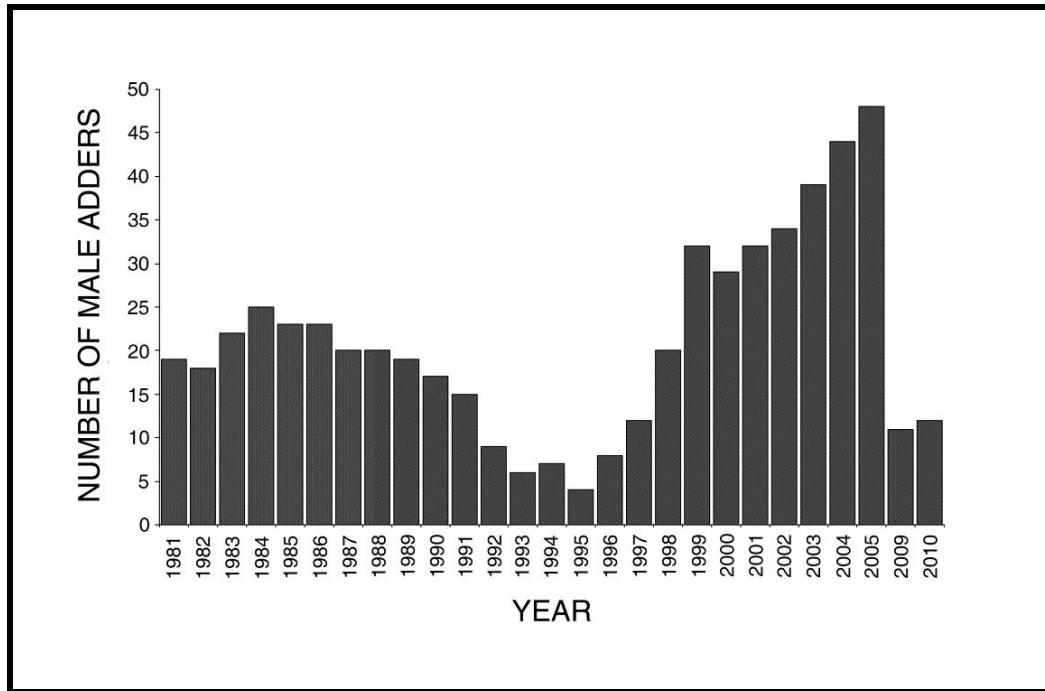
Since 1981 we have been studying the demography of an isolated population of Adders (*Vipera berus*) living along the seashore at Smygehuk in the southernmost part of Sweden. The range of the Adder covers a huge area; it occurs throughout most of central and northern Europe and across Asia to the Sakhalin Island (Arnold and Burton 1978). It is a fairly small venomous snake; female Adders typically reach a snout-vent length of 55–65 cm and males 50–55 cm. From 1981 to 2005, approximately 75% of the Adders in this population have hibernated in a steep south-facing slope situated in the eastern part of our study area ('major hibernation site'; Fig.1). Every spring, after emerging from this hibernation site, the

Adders have migrated to their summer habitats 1–2 km west of this site (Fig.1; Madsen, pers. obs.).

The life history of this Adder population has attracted broad interest from the scientific community, and provided the first evidence for offspring-viability benefits for multiple mating by females (Madsen et al. 1992) and for the feasibility of genetic supplementation to rebuild a declining inbred population (Madsen et al. 1999, 2004). Since 1975, Swedish nature conservation regulations have prevented building houses within 100 m of any shoreline (Swedish law: Chapter 4, 6§). However, in 2004, permission was granted to the Nature Conservation Agency by the County Administrative Board to build a house within 20 m of the shoreline in Smygehuk, and an adjacent 1 m tall brick wall



**FIGURE 1.** Map of study area of an isolated population of Adders (*Vipera berus*) living along the seashore at Smygehuk in the southernmost part of Sweden. (Aerial photograph taken from GoogleEarth 2010. Other photographs by Thomas Madsen).



**FIGURE 2.** Numbers of adult male Adders (*Vipera berus*) captured from 1981 to 2010 along the seashore at an isolated population just west of Smygehuk Village in southern Sweden. (No censuses occurred 2006–2008).

between the summer habitat occupied by the Adders and their major winter hibernacula (Fig. 1). The permission was granted despite the Adders having been protected by law at this site since the mid-1980s (the first Adder population ever granted such protection in Sweden). Unfortunately, the permission was given without consulting research biologists or the county ecologist (whose duties include the evaluation of new constructions that may harm protected populations and/or species). The house and the brick wall act as a barrier, severely obstructing the annual spring migration route for the Adders hibernating at the major hibernation site (Fig. 1). The aim of the present study was to investigate how this new development has affected the population demography of the Smygehuk Adders.

#### MATERIALS AND METHODS

We conducted our study at Smygehuk, situated in the southernmost part of Sweden, where the Adder population is confined to a narrow strip of grassy meadow along the south coast (width 50–200 m, length 2 km; Fig. 1). The area is bordered to the south by the Baltic Sea, to the north by arable land, to the west by a village, and to the east by a harbor. The nearest known Adder population is situated to the north, across 20 km of agricultural fields. Our long-term mark-recapture and radio-telemetric studies have revealed no cases of immigration or emigration between these populations (Madsen et al. 1992, 1996,

1999, 2004). Thus, the Smygehuk population is totally isolated from other Adder populations.

As in previous years of study, we determined population size during the 2009 and 2010 seasons by censusing male Adders during spring (March to early May). The small size and open habitat of the study area allow us to capture all adult males during the spring of each year. Thus, as in our previous publications (e.g. Madsen et al. 1992, 1996, 1999, 2004), our population size estimates in the present study are based on numbers of adult males, which provides a robust indicator of the total adult Adder population number (Madsen et al. 1999, 2004). We marked all Adders captured at our study site individually by ventral scale clipping. In spring we also painted their dorsum with an assigned number using a red leather paint, which enabled us to identify each snake from a distance, thus reducing disturbance during the mating season.

#### RESULTS AND DISCUSSION

We found 11 males and six females in 2009 and 12 males and eight females in 2010 (Fig. 2). However, in spring 2009 and 2010, we did not find any Adders (males or females) at the major hibernation site east of the building/brick wall. All snakes we captured were west of the new building/brick wall at the minor hibernation sites (Fig. 1).

The construction of the building and brick wall were completed in 2006. In 2007 the county ecologist

reported to us that Adders were frequently sighted within the tourist resort east of the harbor and even in Smygehamn village, approximately 1 km east of the major hibernation area (Fig. 1). In August 2008 a two-year old girl was bitten by an Adder in the village (she survived the bite). During our previous 25 years of field work, we have never observed any Adders in this area, most of which consists of a lawn that is mowed at regular intervals during spring and summer. Moreover, we have never heard of any Adders being found in Smygehuk village. The appearance of Adders in these unsuitable habitats strongly suggests that the obstruction of the snake's usual spring migration route by the building and the adjacent brick wall has caused the Adders becoming displaced when trying to find new summer habitats.

The small size of the study area has enabled us to annually capture every adult male Adder between 1981 and 2005; as well as the majority of the adult females (e.g. Madsen et al. 1992, 1996, 1999, 2004). We are therefore convinced, in spite of intensive field work, that the lack of Adders east of the house and the brick wall in 2009 and 2010 was not due to our inability to find the snakes, but that most (if not all) of the Adders hibernating at the major hibernation site had died. The cause of their demise is most likely due to increased predation. We think the Adders hibernating in this area likely were forced to move across unsuitable habitat east of the harbor making them easy prey for predators such as Hooded Crows (*Corvus cornix*) and Magpies (*Pica pica*). It is also possible that when Adders were observed within Smygehuk village, they were killed by humans. The snake that bit the young girl was killed by her parents. Such activities could further have contributed to the dramatic decline in Adder numbers.

In spite of Sweden's high nature conservation profile, the administrative decision by the local council

authorities has thus caused a dramatic decline in Adder numbers that could result in a genetic bottleneck, and hence, increase the risk that the population again will be subjected to the deleterious effects of inbreeding depression. In 2009 the Swedish government changed the law restricting construction of new buildings close to shorelines, facilitating the opening of such areas for future urbanization (Naturvårdsverket 2009). The apparent fate of the Smygehuk Adder population suggests that this change of legislation may adversely affect the flora and fauna living along the hitherto protected Swedish shorelines. Our findings clearly show the importance of ensuring proper habitat protection in order to maintain viable populations.

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**THOMAS MADSEN** is an Honorary Fellow at the University of Wollongong and has studied Adders in Sweden since 1981. He also studies Water Pythons (*Liasis fuscus*), as shown here, captured at Fogg Dam Conservation Reserve in the Northern Territory of Australia. He has been studying Water Pythons at Fogg Dam since 1989. (Photographed by Beata Ujvari).



**BEATA UJVARI** is a Research Associate at the University of Sydney. Besides her work on Adders in southern Sweden, she is also researching the effects of the Cane Toad (*Bufo marinus*) invasion on squamates on the Adelaide River floodplain in the Northern Territory of Australia. The picture depicts Dr. Ujvari sitting beside a large King Brown Snake (*Pseudoechis australis*). (Photographed by Thomas Madsen).