

Four species of bats which roost in the crevices of raised Shinkansen railway in Japan

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Introduction

Recently, there have been more and more reports of bats roosting in man-made structures across Japan as well as other countries (8). These structures have become crucial to bats. The Shinkansen is the high-speed railway connecting major cities across Japan. For most lines, trains run on elevated tracks. There are some crevices between 1.5cm and 6cm wide. These crevices have a variety of depth, and can be found between the concrete blocks which comprise the railway. The railway is elevated between 5-20m from ground level at various points. Some bat species utilize these crevices as maternity sites and as hibernacula (1, 4, 5, 6, 9, 10, 11, 12, 13, 14, 15, 17, 18, 19). We have compiled the data that we have collected on these bats since 2011 in conjunction with other references.

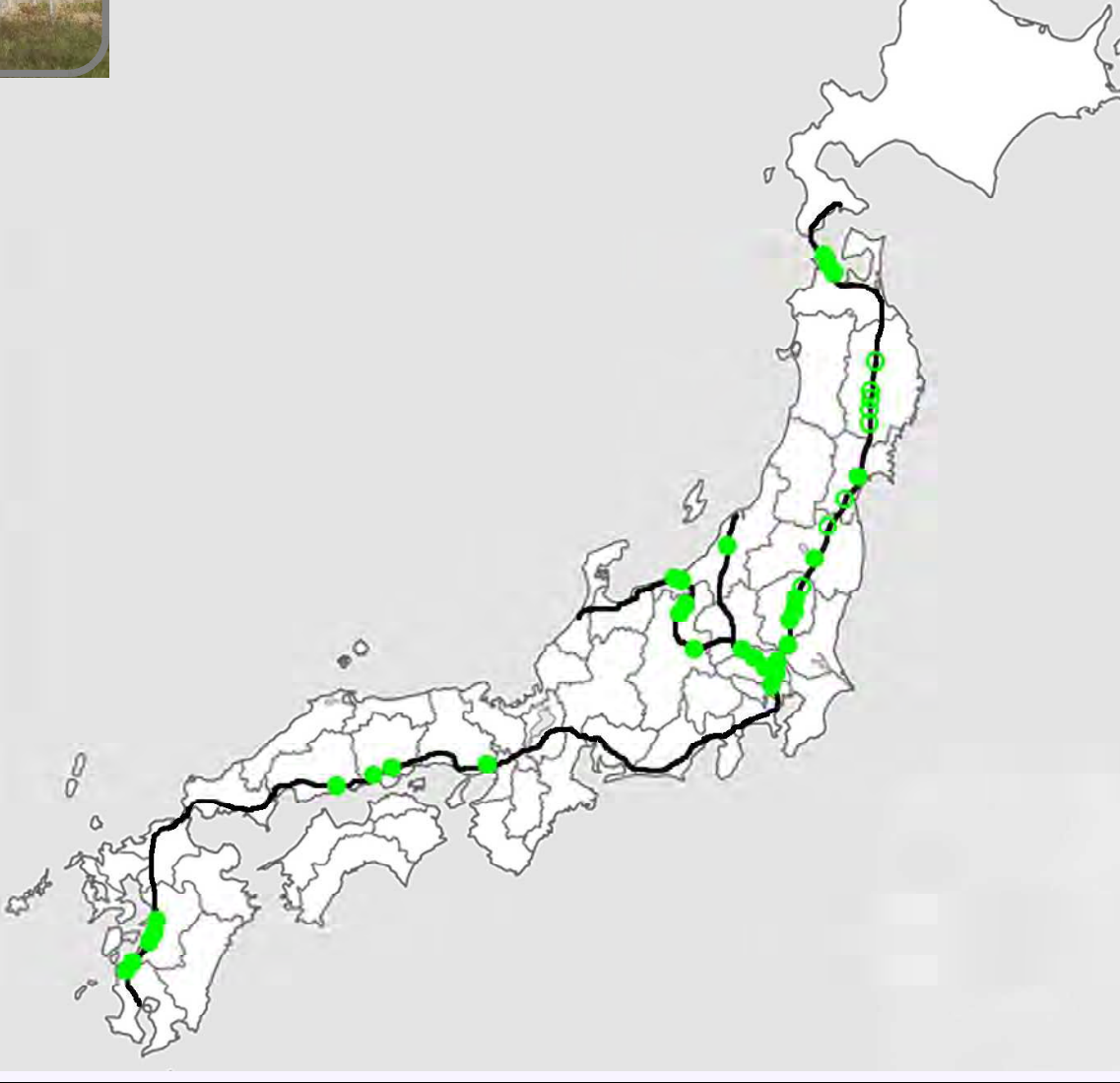
Study Sites

Fig. 1. Photo of the Joetsu Shinkansen railway.



Fig. 3. Location of study sites. Solid circles represent where the authors surveyed. Open circles represent where the surveys from the references were conducted.

Fig. 2. Photo of the Joetsu Shinkansen railway showing the crevices.



Result

To date, the Japanese pipistrelle (*Pipistrellus abramus*), the Asian parti-colored bat (*Vespertilio sinensis*), the birdlike noctule (*Nyctalus aviator*), and the Oriental free-tailed bat (*Tadarida insignis*) have been confirmed to roost in the Shinkansen railway. At least one of these bat species can be found roosting in each of the 12 prefectures from Iwate at about 39.7 degrees north latitude, to Kagoshima at about 32.1 degrees north latitude. All four species are open space aerial foragers.

***Vespertilio sinensis* roosts in tree cavities, slits under elevated bridges, caves, and rock crevices** (2). Of the four species, it has the highest number in the Shinkansen railway. These days, its maternity roosts are mainly found in the Shinkansen railways. It forms large maternity colonies and emits audible calls in the roost so it is easily spotted. It also uses as a hibernaculum but in winter scatters into small groups and is often difficult to spot (Fig.4).

***Pipistrellus abramus* roosts in narrow spaces of buildings** (7). It utilizes the Shinkansen railway as a maternity roost and a hibernaculum alongside a separate night roost in summer. This is the only species that doesn't usually emit audible sound in the roost of the four species. Therefore, it might often be missed unless the crevices are photographed (Fig.5).

***Nyctalus aviator* roosts mainly in tree cavities** (3). The usage of the Shinkansen has only been reported from limited areas in Kanto and Chubu region mainly as a hibernaculum, but in some places as a maternity roost (Fig.6).

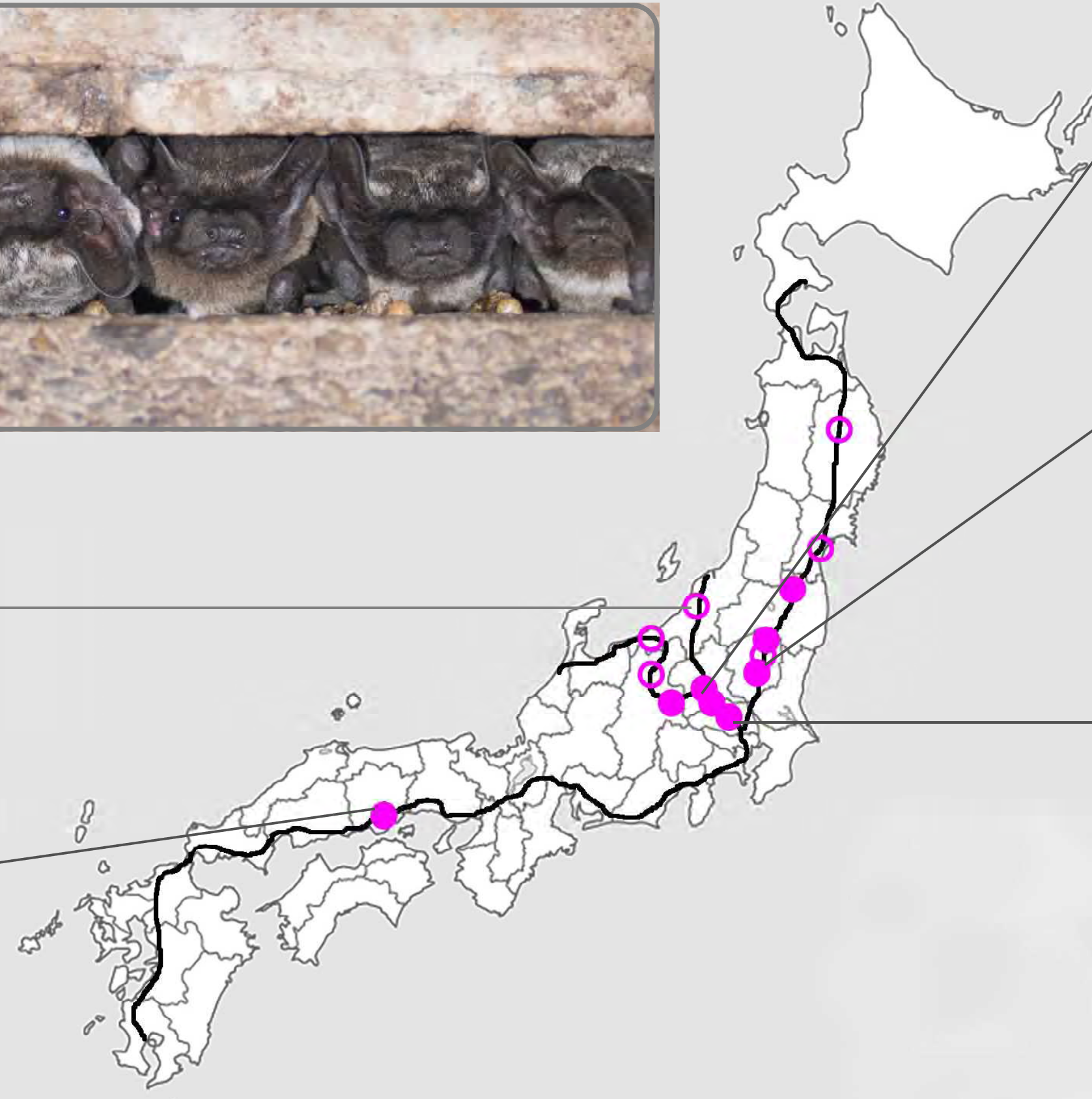
***Tadarida insignis* has been recorded from the crevices of seaside rocks and in the narrow spaces of one schoolhouse across central and south west parts of Japan** (16). At the Shinkansen railway, it is only recorded from Kagoshima and Kumamoto. It roosts year round but breeding has not been confirmed (Fig.7).

Fig. 4. *Vespertilio sinensis*



Before the discovery of about 2000 bats in 2011, there had been only four accounts describing this species of single individuals in **Niigata**.

Before the discovery of the maternity roosts of about 1000 bats in 2008, there had been only 2 records of single individuals in **Okayama**. This is the first record of the colony and also the first record of breeding of this species in **Okayama**.



7258 bats were counted in the summer of 2011 in **Gunma**. This is one of the largest breeding colonies of this species in **Japan**.

A summer roost in **Tochigi** has been confirmed since 2011 and in 2012 breeding was confirmed. Prior to these, this species had been recorded in summer only from mountain districts and no breeding site had been confirmed in **Tochigi**.

Before the discovery of the maternity roosts of 3680 bats in 2012, there had been no breeding record of this species in **Saitama**. In the winter of 2012, 604 individuals were recorded over a wide range of the Joetsu Shinkansen, although this species had previously been recorded in small numbers in winter only from four other places in **Saitama**.

Prefectures where the bats were confirmed breeding in the Shinkansen railways are indicated by a solid circle. Prefectures where the bats were present but their breeding has not yet been confirmed are indicated by an open circle. Circles don't indicate exact locations of the bat colonies.

Fig. 5. *Pipistrellus abramus*



Fig. 6. *Nyctalus aviator*



The breeding of this species in **Saitama** in the summer of 2012 is the first case of this species breeding in man-made structures in **Japan**.



Before the discovery of 337 bats across four cities in the Shinkansen railway in the winter of 2012, there had been only one reliable wintering record of this species in **Saitama**. This is the first case of this species' colony wintering in concrete structures in **Japan**.

Fig. 7. *Tadarida insignis*



The first recorded sighting of *T. insignis* in **Kagoshima** was in 2015 roosting in the Shinkansen railway.



Fig. 8. *P. abramus* uses the Shinkansen railway as a night roost.

Sometimes two or three species share the same crevice.

Fig. 9. Picture of *N. aviator*, *P. abramus*, and *V. sinensis* sharing the same crevice. *T. insignis* also shares the crevice with *P. abramus*(5).



Discussion

Numerous additional discoveries to the local record of these bats (Fig.4, Fig.5, Fig.6, Fig.7) prove that the Shinkansen railway is an important roost site for these bat species. Considering these four species are relatively difficult to catch with mist nets and harp traps while foraging and difficult to survey in the roosts without disturbance, many more findings can be obtained by surveying the Shinkansen railway across Japan.

Unless the areas under the elevated railways are used by humans such as for parking lots, people seem to be indifferent about bats. In some places, Japan Railways (JR) which operates Shinkansen networks took measures to prevent bats roosting in response to complaints about falling feces and annoying audible calls. In Okayama, at first JR tried to remove *V. sinensis* but eager conservationists appealed to JR and in the end JR put up some signs to promote conservation of these bats (6,17, Fig.10). As for Saitama prefecture, we informed JR of our research results in 2013 only to get a tepid response saying "We will report it to those who are in charge." In the US, during the nationwide surveys of bats in bridges, no structural damage attributable to bats was observed, nor were any reports of such damage received (8). This suggests bats have no negative impact on concrete structures. So we should take the bats in the Shinkansen railway as a good chance to raise awareness for the general public about understanding and conservation of bats. Informational sign boards and bat watching events might work to promote public awareness. We will also reach out to JR for better understanding.

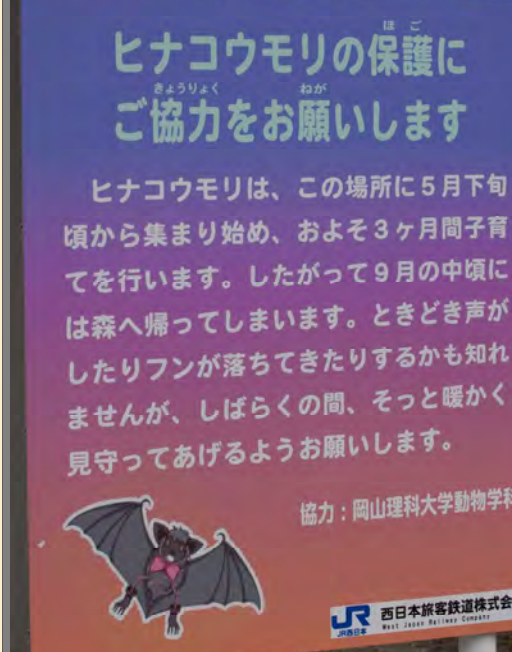


Fig. 10. A bat information and caution sign board under the Sanyo Shinkansen railway.