V-NETTING WITH PLAYBACK: AN ACTIVE COST-EFFECTIVE METHOD FOR TRAPPING SMALL RAILS

V-NETTING WITH PLAYBACK: UN EFECTIVO MÉTODO ACTIVO PARA ATRAPAR RÁLIDOS PEQUEÑOS

Emiliano A. DEPINO¹ * and Juan I. ARETA¹

SUMMARY.—Small rails remain poorly known due to their secretive habits and the lack of adequate methods for their study. Here we describe and test a novel method for trapping small rails. The V-netting arrangement comprises two 12m mist-nets placed at ground level, forming a V along previously cleared trails. The bottom of the mist-net is positioned on the ground facing the V inwards and staked to prevent birds from escaping. Birds are lured inside the V using playback and driven into the mist-nets by two people that monitor bird responses and react accordingly. We tested this method across the Neotropical region with six species of Laterallus crakes, capturing 20 individuals in 20 attempts, comprising three Grey-breasted Crakes L. exilis, three Black-banded Crakes L. fasciatus (= Porzana fasciata), five Red-and-white Crakes L. leucopyrrhus, three Rufous-sided Crakes L. melanophaius, four Ruddy Crakes L. ruber and two Rufous-faced Crakes L. xenopterus. Although variation was large, mean capture success resulted in one capture per setup. Our method for capturing small rails in tall and dense habitats provides a new, efficient and safe alternative that is focused, actively monitored and dynamic. It may be profitably used to trap other territorial land birds of dense and tall habitats.—Depino, E.A. & Areta, J.I. (2020). V-netting with playback: an active cost-effective method for trapping small rails. Ardeola, 67: 101-112.

Key words: bird capture technique, bird trap, crake, Laterallus, mist-netting, playback, Rallidae.

RESUMEN.—Como consecuencia de sus hábitos reservados y la falta de métodos adecuados para su estudio, los rálidos pequeños siguen siendo poco conocidos. Aquí describimos y ponemos a prueba un método novedoso para atrapar rálidos pequeños. Nuestro método consiste en la disposición de dos redes de niebla de 12 m a nivel del suelo formando una V en senderos previamente demarcados. La parte inferior de la red es colocada sobre el suelo hacia adentro de la V y clavada con estacas para evitar que las aves escapen. Las aves son atraídas hacia dentro de la V mediante la reproducción de sus vocalizaciones y arreadas hacia las redes mediante la acción de dos personas que monitorean y se ajustan dinámicamente a la respuesta de las aves. Pusimos a prueba este método a lo largo de la región Neotropical.

Palabras clave: burritos, Laterallus, playback, Rallidae, técnica de captura de aves, trampa para aves, uso de redes de niebla.

Typically, passive methods have proved less effective than active ones (Zembal & Massey, 1983; Perkins et al., 2010; Mills et al., 2011).

Capture methods need to be designed considering the natural history and behaviour of animals (Bub, 1991). Most methods for capturing rails are more appropriate for species found either in more open habitats such as rice-fields and shallow freshwater marshes (Girard et al., 2010; Perkins et al., 2010; Krementz et al., 2016; Hall & Beissinger, 2017; Hall et al., 2018) or in dense habitats with short vegetation such as Spartina salt marshes (Zembal & Massey, 1983; Perkins et al., 2010; Hall & Beissinger, 2017). Capturing small diurnal rails that seldom fly and occupy habitats where the vegetation is both dense and tall remains challenging.

Laterallus crakes are small (25-100g) cursorial birds in the family Rallidae found in dense wetland habitats with tall grass or marsh vegetation. The genus has traditionally been separated in two groups, coloured Laterallus (subgenus Laterallus) with a Neotropic distribution, and black Laterallus (subgenus Cresciscus) with a Pan-American distribution (Livezey, 1998). Preliminary phylogenetic data suggests that, despite their behavioural and vocal similarities, these groups are not monophyletic (Depino et al., unpubl. data). Coloured Laterallus are secretive, seldom fly and live in pairs that defend year-round territories using their long duet-trill songs (Depino & Areta, 2017). Capturing coloured Laterallus is challenging and
most captures have occurred passively or by accident, either in mammal traps (Erickson & Mumford, 1976; Sick, 1979; Myers & Hansen, 1980; Storer, 1981; de Vasconcelos et al., 2008; Lopes et al., 2013) or mist-nets (Russel, 1966; Lowen et al., 1996; Brace et al., 1997). Two Grey-breasted Crakes \( L. \) exilis were captured by flushing them into mist-nets (Stiles & Levey, 1988). In contrast, black Laterallus have been successfully trapped through the use of dip nets (Tsao et al., 2009), drift fences and drop-door traps (Hsu, 2009), and mist-netting and playback (Girard et al., 2010). However, capture methods of black and coloured Laterallus are not comparable. Although all are currently regarded to belong to the genus Laterallus, the two groups show clear behavioral differences (Depino and Areta, in prep.).

Here we describe \( V \)-netting with playback, a novel method we developed and implemented to capture individuals of six species of the coloured Laterallus group. We compare this technique to existing trapping methods and discuss its benefits and costs.

**METHODS**

To obtain blood samples for a molecular phylogeny of Laterallus crakes (Depino et al., unpubl. data), we developed and implemented a capture method involving the use of mist-nets (Figure 1). We tested this method with six species of coloured Laterallus crakes at five locations in four different countries (Table 1; Figure 2). We made 20 trapping attempts from September 2015 to June 2018, including the breeding and non-breeding seasons of the different species (Table 1). Each species was sampled in its species-specific habitat (Table 1; Figure 2), Ruddy Crakes \( L. \) ruber in Typha domingensis and Cladium jamaicense marsh patches in Cozumel, Mexico (~2-2.5m vegetation height); Black-banded Crakes \( L. \) fasciatus along forest edges with Carludovica palmata, Heliconia sp., and Crox lacrima-jobi in Wawasumaco, Ecuador (~2-4m vegetation height); Rufous-faced Crakes \( L. \) xenopterus in Campo limpo areas of humus tussocky grass in Aguara-Ñu, Paraguay (~0.6-0.8m vegetation height); Grey-breasted Crakes in Panicum sp. grassland (~2m in height) in Isla del Cerrito, Argentina, and Aguara-Ñu, Paraguay; Rufous-sided Crakes \( L. \) melanophaïius in Ludwigia bonariensis and Schoenoplectus californicus coastal scrub (annual mean vegetation height = 1.7 ± 0.4m; Depino & Areta, 2017) in Reserva Natural Punta Lara, Argentina, and Red-and-white Crakes \( L. \) leucopyrrhus in Scirpus giganteus bulrush (annual mean vegetation height 1.5 ± 0.3m; Depino & Areta, 2017) in Reserva Natural Punta Lara, Argentina (Table 1; Figure 2). Our method involves four steps that combine the use of mist-nets and playback and requires active engagement (Figure 1).

**Locating a territory**

Because coloured Laterallus crakes are elusive and difficult to detect, we searched for crakes using playback of conspecific calls in apparently suitable habitats. Coloured Laterallus crakes are territorial and defend relatively small territories generally around 20 × 25-m (Maurício & Dias, 1996; EAD & JIA, pers. obs.). Black-banded Crakes hold larger territories, approximately 50 × 50-m (EAD, pers. obs.). All Laterallus respond well to playback of conspecific calls, with both sexes of a pair uttering duet trills and approaching the sound source (Stiles & Levey, 1988; Depino & Areta, 2017). For all sampled species we used playback of territorial duet trills that we recorded previously. At each apparently suitable point, we played four to eight duet trills, and waited for five to ten minutes for a response. Calls were played using an Apple iPod 5 and an Omaker Nature
Coloured *Laterallus* crakes captured using the V-netting with playback method. We report the total number of individuals captured per species, number of capturing setups per species, trapping record for each species [number of individuals captured at each attempt], mean number ± standard deviation of individuals captured per setup, habitat and location of captures (location numbers in brackets match those in Figure 2), sampling dates and season (B, Breeding; NB, Non-breeding; ?, uncertain). Semi-colons in the Grey-breasted Crake (*L. exilis*) row, separate data from different localities.

<table>
<thead>
<tr>
<th>Species</th>
<th>Individuals captured/Nº of setups/trapping record</th>
<th>Mean ± SD captures per setup</th>
<th>Habitat</th>
<th>Location</th>
<th>Date (Season)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ruddy Crake <em>(Laterallus ruber)</em></td>
<td>4/2 [2, 2]</td>
<td>2.00 ± 0.0</td>
<td>Typha domingensis and <em>Cladium jamaicense</em> marsh patches</td>
<td>(1) Cozumel, Mexico</td>
<td>28 to 29 June 2018 (B)</td>
</tr>
<tr>
<td>Black-banded Crake <em>(L. fasciatus/Porzana fasciata)</em></td>
<td>3/3 [2, 1, 0]</td>
<td>1.0 ± 1.0</td>
<td>Forest edges with <em>Carduodovica palmata</em>, <em>Heliconia</em> sp. and <em>Croix lacrima-jobi</em></td>
<td>(2) Wawasumaco, Ecuador</td>
<td>12 to 13 April 2017 (NB?)</td>
</tr>
<tr>
<td>Rufous-faced Crake <em>(L. xenopterus)</em></td>
<td>2/7 [0, 0, 0, 1, 1, 0, 0]</td>
<td>0.3 ± 0.5</td>
<td>Campo limpo areas of humid tussocky grass</td>
<td>(3) Aguara-Ñu, Paraguay</td>
<td>4 to 6 October 2016 (B)</td>
</tr>
<tr>
<td>Grey-breasted Crake <em>(L. exilis)</em></td>
<td>3/4 [1; 0, 1, 1]</td>
<td>0.8 ± 0.5</td>
<td><em>Panicum</em> sp. tall grassland</td>
<td>(3) Aguara-Ñu, Paraguay; (4) Isla del Cerrito, Argentina</td>
<td>3 October 2016 (B); 15 to 16 October 2015 (B)</td>
</tr>
<tr>
<td>Red-and-white Crake <em>(L. leucopyrrhus)</em></td>
<td>5/2 [1, 4]</td>
<td>2.5 ± 2.1</td>
<td><em>Scirpus giganteus</em> Bulrush</td>
<td>(5) Reserva Natural Punta Lara, Argentina</td>
<td>12 to 14 April 2016 (NB)</td>
</tr>
<tr>
<td>Rufous-sided Crake <em>(L. melanophaius)</em></td>
<td>3/2 [1, 2]</td>
<td>1.5 ± 0.7</td>
<td><em>Ludwigia bonariensis</em> and <em>Schoenoplectus californicus</em> Coastal scrub</td>
<td>(5) Reserva Natural Punta Lara, Argentina</td>
<td>20 April 2016 (NB)</td>
</tr>
</tbody>
</table>

**Total** | 20/20 | 1.0 ± 1.0 |
4 Improved Model bluetooth speaker set at 81 to 85 dB SPL at 1 m from the speaker (measured with Radio Shack 33-099; C-weighting; fast response) to match the natural amplitude of the duet trills of coloured *Laterallus*. After obtaining a response, we assessed vegetation structure from where birds responded to roughly delimit territory boundaries in order to choose the best mist-net set up. Territories were in general in accordance with natural boundaries, such as the limits of vegetation patches, marked changes in vegetation height

![Details of the V-netting setup and stages of a V-netting with playback capture attempt. (A). Arrangement of the two 12 m mist-nets in a V shape into previously cleared trails 0.8-1.0 m wide. (B). Detailed view of the vertex of the netted V showing the intercalated position of the net loops on the central pole, and the disposition of the central mist net or cloth at the vertex. (C). Detail of the disposition of the net onto the ground, with the bottom shelf clamped to the ground and bent inwards at 90° into the V. (D). Relocalisation and attraction of the birds through playback of duet trills. (E). Luring the birds inside the V by playback of calls by the person with the speaker (see arrows for movement trajectories). (F). Cornering and flushing the birds by the flusher when instructed by the person with the speaker.](#)

![Espuemas representando los detalles necesarios para el montaje y pasos básicos del desarrollo dinámico de un intento de captura mediante el V-netting con playback. (A). Disposición de las dos redes de niebla de 12 m en forma de V en senderos previamente demarcados de 0.8 a 1 m de ancho. (B). Vista detallada del vértice de la V conformada por redes mostrando la posición intercalada de los lazos de la red en el poste central, y la disposición de una red o tela en el vértice de la V. (C) Detalle de la disposición de la red sobre el suelo, con el bolsillo inferior clavado con estacas y plegado 90° hacia dentro de la V. (D) Relocalización y atracción de las aves a través de la reproducción de trinos a dueto. (E) Atracción de las aves dentro de la V mediante la reproducción de llamados por parte de la persona que porta el altavoz (véanse flechas para visualizar las trayectorias de los movimientos). (F). La persona dispuesta en el vértice instruye al asistente en la entrada de la V a que proceda para acorralar y espantar las aves.](#)
Fig. 2.—Localities and habitats of coloured *Laterallus* crakes in which the V-netting with playback method was used. Countries of sampled localities are shown in dark grey. Numbers in black circles link localities with habitat photographs and crake species: (1) Cozumel, Mexico, *Typha domingensis* and *Cladium jamaicense* marsh patches; (2) Wawasumaco, Ecuador, forest edges with *Carludovica palmata*, *Heliconia* sp. and *Croix lacrima-jobi*; (3) Aguara-Ñu, Paraguay, campo limpo areas of humid tussocky grass; (4) Isla del Cerrito, Argentina, *Panicum* sp. tall grassland; (5) Reserva Natural Punta Lara, Argentina, (above) *Scirpus giganteus* Bulrush, (below) *Ludwigia bonariensis* and *Schoenoplectus californicus* Coastal scrub. See Table 1 for capture dates and efficiency.

or density, or abrupt changes in water depth or soil humidity. *Laterallus* prefer tall and dense vegetation, with humid soil to shallow water areas. Where territory limits were indistinct, we continued using playback for no more than ten minutes to lead the individuals through the vegetation to identify the approximate limits of their territory. When studying territory boundaries, we moved very carefully among points to avoid trampling the vegetation. Where vegetation was delicate we walked out of the presumed territorial limits, approaching the territory from outside an area larger than its estimated boundary.
Identifying territory cores

Once territory boundaries were roughly delimited, approximate territory cores were identified. We define the territory core as a portion of a territory where crakes tend to spend more time, usually basking, preening and trilling more frequently. Territory cores were quickly and roughly recognised as such by their vegetation structure and by behavioural responses to playback. Structurally, territory cores were small ~4 × 4-m areas including the tallest vegetation of the territory, usually a small tree, bush, or a central zone of taller vegetation. Behaviourally, rails tended to move to their territory core when disturbed with playback and most calling in response to playback occurred inside territory cores.

Erecting mist-nets

After detecting birds and identifying the territory core, we set up two 12m mist-nets in a V shape forming a 45° angle, containing the territory core within the V (Figure 1A). Using a machete, we cleared two narrow (80-100cm) trails in the vegetation to fit the mist-nets, without damaging other vegetation in the territory. Laterallus rails are averse to crossing open spaces (pers. obs.) so excessive trampling of vegetation would impede the normal movement of birds through vegetation, resulting in decreased trapping efficiency. We minimised vegetation trampling to facilitate captures and to avoid territory abandonment after captures. We used three 2m aluminium poles; the trammel loops of both mist-nets were alternated on the pole in the vertex (Figure 1B). Poles were placed vertically on the ground and attached to vegetation by thin ropes (Figure 1A, B, and C). We set the bottom trammel of the nets free from all poles. We placed the bottom shelf of the nets on the ground facing the V inwards, by clamping the bottom trammel to the ground with stakes (rails have been reported to escape by raising the bottom edge of loose mist-nets with their bills; Willard & Krementz, 2011), while leaving the second trammel just a few centimetres (<5cm) above the ground (Figure 1C). As a result, the net bottoms were flexed inwards creating a 90° angle between the first (horizontal) shelf and the second (vertical) shelf. Depending on the irregularities of the ground, we positioned the first shelf vertically to fill any ground depression. We closed the vertex of the V by attaching a third small mist-net or cloth (30cm wide and as tall as the two nets of the V) at the top and bottom of the nets using light aluminium carabiner hooks (Figure 1B). Finally, we checked and eliminated any space between the nets and the ground to prevent the birds from escaping. Setting up the mist-nets took some 45 to 70 minutes, depending on differences in vegetation structure. For example, sharp and dense Scirpus bulrush was more difficult to clear than Panicum grass stands. We set up mist-nets on days with good weather, either from sunrise to noon or from afternoon to sundown when crakes are more active.

Playback

Once mist-nets were set up, we waited quietly for ten minutes. Then, one of us (with the speaker) stayed ~2m from the centre of the entrance of the netted V and played back territorial duet trills. A second person (flusher) waited at the side of the entrance, next to one of the poles (Figure 1D). Crakes could respond to playback from outside the netted V either at the entrance, outside the vertex or at either side. In the latter cases, the person with the speaker herded the birds to the entrance of the V by playing back duet trills from behind the entrance. Once the birds were at the entrance of the V, the person...
with the speaker entered the V walking slowly towards the vertex along one of the two net trails (Figure 1E). Once at the inner angle of the vertex of the V, the person with the speaker tried to lure the rails as close to the vertex as possible by playing back calls at a lower volume. Because tall marsh vegetation is less dense near the soil, the person with the speaker often crouched to see the birds while approaching the vertex of the V. In shallower but dense vegetation, bird trajectories were revealed by vegetation movements. In addition, soft vocalisations by crakes helped the person with the speaker to detect them. Once birds were 1-3m from the person with the speaker (Figure 1E), the flusher was signalled to start shouting and clapping while running into the netted V. This disturbance either flushed birds into one of the mist-nets or towards the vertex where the person with the speaker was located and subsequently into a mist-net (Figure 1F). In two occasions (one successful and one unsuccessful attempt), a third person stayed at the entrance of the V, walking quickly between the poles, clapping and shouting to prevent the birds from escaping. If, at the beginning of the attempt, crakes responded to playback from inside the netted V, everyone involved in the capture flushed them by walking toward the vertex. The time needed for this entire stage was about 20 to 30 minutes.

RESULTS

We captured 20 Laterallus crakes representing all six focal species: three Grey-breasted Crakes, three Black-banded Crakes, five Red-and-white Crakes, three Rufous-sided Crakes, four Ruddy Crakes, and two Rufous-faced Crakes. Mean capture success was one capture per attempt, although variation was large (Table 1). All the captured birds were bled and released. Although we did not mark any individuals, duet trills were heard coming from all 12 territories where we trapped crakes one to five days after captures, showing that our trapping method did not cause territory abandonment.

Red-and-white and Ruddy crakes were captured most often. Despite the dense habitat where Red-and-white Crakes occur (Figure 2), this was possibly the species whose behaviour and vocalisations we knew better, allowing us to predict bird movements and response behaviours, and a family group of four individuals was trapped in one attempt (Table 1). The Ruddy Crake was the last species sampled and we benefited from our previous trapping-experience, its tame behaviour and the sparse habitat where we could sample it, allowed us to see the individuals easily (Figure 2). In contrast, our method was less effective with Rufous-faced Crakes (Table 1). Their secretive habits and the extremely dense vegetation where they occur (Figure 2) hampered our ability to set up mist-nets directly over the soil, resulting in crakes escaping twice through the bottom of mist-nets. Rufous-faced Crakes captured were lone individuals, so there was no possibility to capture more than one in those two attempts.

DISCUSSION

We have presented and described V-netting with playback, a novel active-trapping method designed for and tested on coloured Laterallus crakes. The method was effective for trapping six coloured Laterallus species, including scarce, rare and very shy species.

Most captures of coloured Laterallus crakes reported in the literature have been accidental, unlike those of black Laterallus (see below). Passive mammal traps have provided haphazard captures of coloured Laterallus crakes that resulted in new distributional records (Erickson & Mumford,
1976; Sick, 1979; Myers & Hansen, 1980; Storer, 1981; de Vasconcelos et al., 2008). We tested passive baited bow-net spring traps for Red-and-white Crakes in *Scirpus giganteus* Bulrush at Reserva Natural Punta Lara, Argentina, and trapped only two individuals in two independent attempts after 51h of trapping in 15 attempts and had three unwanted captures. Clearly, baited bow-net spring traps perform poorly in comparison to the capture efficiency of the V-netting with playback method in the same species (see Table 1).

Mist-nets have also resulted in a few accidental captures (Russel, 1966; Lowen et al., 1996; Brace et al., 1997), probably a consequence of the cursorial rather than aerial habits of coloured *Laterallus* crakes that would rarely fall passively into mist nets. Stiles and Levey (1988) actively mist-netted two Grey-Breasted crakes, with five people walking in a semi-circular path in front of a line of mist-nets anchored at the bottom, trampling the grass as thoroughly as possible to eliminate the runways and making much noise to drive the birds toward the net. This technique is somewhat similar to ours. However the vegetation in the territory was probably severely damaged, it requires a large number of people (and possibly nets) and it has not been systematically tested.

Some black *Laterallus* crakes have been systematically trapped. However, differences in the natural history and behavior of coloured and black *Laterallus* groups demand specific capture methods for each. For example, Flores & Eddleman (1995) used passive drift fences combined with drop-door traps and captured 36 Black Rails *L. jamaicensis*, while Hsu (2009) captured 13 individuals, but no details were published about trapping efficiencies. Nonetheless, most coloured *Laterallus* crakes have small year-round territories (e.g., 20×25m in *Laterallus leucopyrrhus*; Mauricio & Dias, 1996) and it seems unlikely that several individuals will move for the long distances required to passively run into drift fences, as occurs in rails with large home-ranges or migrant species (Kearns et al., 1998; Fuertes et al., 2002). Active trapping methods have also been used to capture black *Laterallus* crakes. Chicken wire box traps were used for Galapagos Rail *Laterallus spilonotus* (Franklin et al., 1979), resulting in ten captures in ten days (two adults and six juveniles; presumably two re-traps?). Black Rails have also been captured using spotlights and dip nets at night (Tsao et al., 2009; Girard et al., 2010), and single line-shaped mist-nets coupled with playback and drag-ropes (Girard et al., 2010; Hall & Beissinger, 2017; Hall et al., 2018). Whilst the nocturnal habits of black *Laterallus* crakes facilitate spotlight-dazzling of birds, and the shorter vegetation that they inhabit permits the use of ropes to force the birds towards mist nets, these trapping methods are unsuitable for the diurnal coloured *Laterallus* that live in tall and dense habitats. Although neither setup details nor trapping efficiencies have been reported, S.R. Beissinger (in litt., 2019) indicates that those trapping techniques resemble our method, except for the lack of the delimitation of a territory core, the use of a single mist-net with the bottom trammel (not the second one) pegged to the ground, and the frequent use of drag-ropes.

Advantages of the V-netting with playback method

We recognise several advantages of our capturing method over others available. First, the key of this method is its focus: it is based on the detection of the individuals to be captured and in predicting their behaviour in their territories. Detecting the birds to be captured allows active interaction with them, permitting their responses to be evaluated and enabling immediate adjustments and learning what trap setting details to change.
in subsequent attempts. Second, the birds captured are completely safe, unlike passive methods such as riddle claptraps, drop-door traps, or fish-nets that may result in injured or predated birds (e.g., de Kroon, 1979; Zembal & Massey, 1983; Fuertes et al., 2002). Third, the V-shape setup confines the rails to a narrow corridor from which they cannot escape, unlike mist-nets arranged in a straight line (Stiles & Levey, 1988; Girard et al., 2010; Hall & Beissinger, 2017; Hall et al., 2018). The V-shape arrangement has been successfully used to mist-net radio-harnessed individuals of large rails (Zembal & Massey, 1983), to lure birds into mist-nets with the use of decoys and playback (Willard & Krementz, 2011; Krementz et al., 2016), and as an arrangement of drift-fences and drop-door traps (Pickens & King, 2013). Fourth, economic and logistical investments are insignificant in comparison to passive methods using traps and equivalent to other mist-netting methods that are not suitable for these rails. The equipment is light, uncomplicated and can easily be set up by two persons, even in dense habitats in remote areas. Fifth, although our main goal was to obtain blood samples from a few individuals of each species for phylogenetic analysis, this method has been effective for trapping 60 Galapagos Rails for phylogeographic studies (J. Chaves in litt., 2019). Thus, although our method can be used to trap black Laterallus, some methods traditionally used to trap them, including dazzling-lights and drag-ropes cannot be applied in the tall and dense habitats used by the diurnal coloured Laterallus. Finally, our method worked well during both the breeding and non-breeding seasons, without the need of drag-ropes that could destroy nests.

In conclusion, the V-netting with playback method comprises a focused, actively monitored and dynamic procedure that effectively captures crakes without injury. Future applications of this trapping method should further our knowledge and aid in the conservation and management of poorly known rail species and other territorial and cursorial bird species found in dense and tall habitats.

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