First report of a possible hybrid between
*Gloydius brevicaudus* Stejneger 1907 and *G. intermedius* Strauch 1868 (Squamata; Viperidae)

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Hybridization occurs not only between closely related but also distantly related species (Schildet al., 2004; LeClere et al., 2012; Koo et al., 2014; Rubtsov, 2015). The genetic transformation and mix due to hybridization are important phenomena for understanding the speciation and evolution of organisms (Mallet et al., 2016). There are examples for species belonging to the family Viperidae that frequently hybridize in contact zones, and various studies have been conducted in Europe focusing on the role of geography and the morphological and genetical effects of hybridization (Martínez-Freiría et al., 2010; Tarroso et al., 2014; Guiller et al., 2017). The three viper species inhabiting the Korean Peninsula differ from each other in morphology, distribution, and ecology (Lee et al., 2011; Do, 2018). A recent study based on species distribution models predicted that interspecific contact could be expected to occur frequently in the Taebaek Mountains (Do et al., 2016). Herein, we report a possible case of hybridization between two *Gloydius* species in South Korea.

Field work was conducted in Sobaeksan National Park which is located across Chungcheongbuk-do and Gyeongsangbuk-do (37.0167°N, 128.5892°E, 750 m a.s.l.). Species living in the park are protected by the government. Sobaeksan is a representative mountain of the Taebaek Mountains in South Korea (Fig. 1). On August 4, 2016, we observed a snake individual with a unique morphology that featured various characteristics that are typically attributed to either *Gloydius brevicaudus* or *G. intermedius* whereas other characters were of an intermediate state between the two species (Fig. 2, Table 1), and we suspect it to be a hybrid between these species. Body length of the snake was approximately 53 cm and the dorsal colour was light brown. The snake had 22 scale rows around mid-body. There were 32 circular patterns with dark brown, typical for *G. brevicaudus* (Fig. 2A, B).

Moreover, it had a longitudinal line along the centre of

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Figure 1. Location of the observation site (red star) of the possible hybrid individual between *Gloydius brevicaudus* and *G. intermedius* in Sobaeksan National Park, South Korea.
the back from the head to the tail, which is an important morphological characteristic of \textit{Gloydius brevicaudus} (Fig. 2A, B). The tail colour was the same as that of the body, and the colour of the tongue was black (Fig. 2B, E). Most of the morphological features of the possible hybrid were similar to \textit{G. intermedius}, while the clear vertical centre line on the body and the shape of the circular patterns were typical characteristics.

\textbf{Table 1.} External body traits of \textit{Gloydius brevicaudus}, \textit{G. intermedius} and the suspected hybrid individual.

<table>
<thead>
<tr>
<th>Traits</th>
<th>\textit{G. brevicaudus}* ((n=10))</th>
<th>Hybrid individual</th>
<th>\textit{G. intermedius}* ((n=10))</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body length (cm)</td>
<td>30–50</td>
<td>53 (approx.)</td>
<td>40–70</td>
</tr>
<tr>
<td>No. of dorsal scale row on mid-body</td>
<td>21 or 23</td>
<td>22</td>
<td>22 or 23</td>
</tr>
<tr>
<td>No. of circular patterns</td>
<td>32</td>
<td>32</td>
<td>stripes</td>
</tr>
<tr>
<td>Keeled scales on dorsal scales</td>
<td>present</td>
<td>present</td>
<td>present</td>
</tr>
<tr>
<td>Body colour</td>
<td>white background with black patterns</td>
<td>light brown with dark brown patterns</td>
<td>light brown with dark brown stripes</td>
</tr>
<tr>
<td>Tail tip colour</td>
<td>yellow</td>
<td>same as body colour</td>
<td>same as body colour</td>
</tr>
<tr>
<td>Tongue colour</td>
<td>black</td>
<td>black</td>
<td>black</td>
</tr>
<tr>
<td>A white line behind eyes</td>
<td>present</td>
<td>absent</td>
<td>absent</td>
</tr>
<tr>
<td>Line on the two mid-dorsal scales from head to tail</td>
<td>present</td>
<td>present</td>
<td>absent</td>
</tr>
</tbody>
</table>

* The data for \textit{G. brevicaudus} and \textit{G. intermedius} were taken from Stejneger (1907), Lee et al. (2011), Koo et al (2017).
of *G. brevicaudus* (Table 1). The genetics of the snake could not be analysed because the collection and sampling of live organisms are prohibited in the Korea National Park. However, the result of analysis on the morphological characteristics of the abnormal snake suggests that the observed anomalies were the results of hybridization between *G. brevicaudus* and *G. intermedius*. Our observation represents the first reported case of a possible hybrid in the genus *Gloydius*. Additional sampling and genetic analyses are required to confirm that the two species hybridize in their natural habitats.

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**References**


