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Spatial Ecology of the Introduced Chinese Water Dragon *Physignathus cocincinus* in Hong Kong

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Abstract: Basic ecological understanding is important for effective management of introduced species. If the species is rare or threatened in its native ranges, ecological knowledge gained from its introduced ranges may offer useful information for conservation. We radio-tracked 12 adult *Physignathus cocincinus* in Hong Kong, where it is introduced, to investigate their home range, movements, and habitat use. The home range of all *P. cocincinus* covered the stream, but 66% of relocations occur >5 m away from the stream. Movements did not differ between sexes and seasons. Females stayed at a longer distance from the stream than males. Lizards preferred woodland and concrete structures over orchards. For microhabitats, they preferred wider streams, greater height, and denser canopy cover. This infers the high association of this species with streams and riparian forests, which may be crucial for the establishment of introduced populations. To effectively manage the introduced populations through eradication efforts, areas away from streams (5–100 m) needs to be covered.

Key words: Habitat use; Home range; Invasive species; Movement; Radio-tracking

Introduction

Invasive species are one of the greatest threats to biodiversity worldwide (Wilcove et al., 1998; Clavero and Garcıa-Berthou, 2005). In many cases, if timely and effective erradication is not implemented, the spread of introduced species becomes uncontrollable and can harm local ecosystems (Wiles et al., 2003; Phillips et al., 2006). Basic ecological knowledge can guide effective management of introduced species. For example, applying knowledge on spatial use to evaluate plans for eradication and to predict the likelihood of further establishment of populations (Klug et al., 2015).

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The Chinese water dragon, *Physignathus cocincinus*, is a semi-aquatic lizard that is native to southern China, Thailand, Myanmar, Vietnam, Laos, and Cambodia (Uetz et al., 2017). It is a popular species in the pet trade and has been introduced to Taiwan and Malaysia (Grismer, 2011). In Hong Kong, it was first recorded in 2005, which may be attributed to religious release or abandoned pets (To, 2005). It has been recorded in over 10 localities in Hong Kong (Y.-H. Sung, personal observations). Some populations appear to be robust and studies on the impacts of these introduced populations on the local ecosystem are overdue.

While some populations of *P. cocincinus* are robust in Hong Kong, a recent study found that native populations in Vietnam are severely threatened by harvesting for the local food market and the international pet market (Nguyen et al., 2018). Detailed studies on their basic ecology, either in its native or introduced ranges, are lacking, which may hinder effective conservation measures.

In this study, we sought to gather ecological information of the introduced populations of *P. cocincinus* in Hong Kong. Specifically, we (1) determine the home range size; (2) examine movement patterns; and (3) investigate habitat use and identify potential habitat parameters that influence use. The results may provide useful information for the management of introduced populations and the conservation of native populations.

Materials and Methods

Study area

We conducted this study in Tsing Yi Road West Park (22°21.170' N, 114°05.985' E), an urban park in the Hong Kong Special Administrative Region, China. Although this study was conducted in an urban park, the stream and riparian vegetation are similar to locations within protected areas where *P. cocincinus* has established in Hong Kong. Hong Kong has a subtropical climate, which is characterized by two distinctive seasons, a wet and hot summer (May to August), and a dry and cold winter (November to February) (Dudgeon and Corlett, 2004). The study stream section is approximately 200 m long, and the average stream width is 3.6 m. Both sides of the stream are dominated by dense riparian trees, including *Sterculia lanceolate* and *Ficus variegate*, and orchards that are actively managed, where *Musa paradisiaca*, *Dimocarpus longan*, *Litchi chinensis*, *Artocarpus heterophyllus*, *Citrofortunella mitis*, and *Citrus maxima* are planted.

Radio-tracking

Between August and November 2015, we searched along the stream at night and captured adult *P. cocincinus* by hand or using a noose and fishing rod. Upon capture, lizards were kept temporarily and transferred to Ocean Park, Hong Kong within 24 hours for transmitter implantation. We anesthetized the lizards using vaporized Isoflurane and surgically implanted a transmitter with coiled antenna (Model: BD-2H, expected battery life=3 months, Holohil System Ltd, Carp, Ontario, Canada) into the coelomic cavity. The weight of the transmitters was <5% of the weight of all radio-tracked lizards. We released lizards at the locations of capture within 48 hours after attachment. We collected relocation data one week after release using a flexible three-element Yagi antenna (Model: F172-3FB 02145, Wildlife Materials Inc., Illinois, USA) and a receiver (Model: IC-R20, ICOM Inc., Tokyo, Japan). We located each lizard twice a week during daytime hours (7:00–18:00). To account for nocturnal habitat use, we located each lizard once per two weeks during nighttime hours (19:00–23:00). We located each lizard by triangulation except for the lizards that were visually observed. We tracked all individuals until we could not detect the signal from the transmitters.

To determine habitat use, we recorded the habitat type (woodland, shrubland, orchard, concrete structure, and stream), substrate type (concrete/rock, woody debris/tree branch, and leaf litter/soil), height above ground, distance to stream, and percentage of canopy cover for each sighting. We measured the height above ground using a laser distance measurer (Model: DISTO D2, Leica Geosystems Inc., Heerbrugg, Switzerland). The distance to the stream was measured using a range finder or calculated using GIS program with the locations recorded using a GPS unit (Model: GPSMAP 64s, Garmin, Olathe, Kansas, USA). For lizards that were found in or within five meters from the stream, we also recorded the in-stream microhabitat type (pool, run, and riffle), stream width, and proportion of different types of substrate in the stream (boulder [>25.6 cm], cobble [6.4–25.6 cm], pebble [2.0–6.4 cm], and gravel [<2.0 cm]). For every relocation point, a random point was selected where habitat type and habitat parameters were recorded to indicate habitat availability. The random points were selected by picking two numbers randomly, one between 1 and 20 and the other between 1 and 360, representing distance (in meters) and bearing, respectively.

Data analysis

We used ArcMap 10.1 (ESRI, Redlands, California, USA) to estimate the home range of each lizard by calculating 100% minimum convex polygon (MCP) as MCP is recognized as a better method than kernel density estimation in estimating home range of reptiles (Row and Blouin-Demers, 2006). We calculated mean daily displacement by dividing the distances moved between relocations by the time interval (in days) between successive relocations. As *P. cocincinus* are active during the day, we excluded tracking data collected at night in movement calculation. We included the lizards that were tracked for more than four weeks in a season in the analysis, nine and eight lizards were tracked in the wet (August to October) and dry (November to January) season, respectively (Appendix 1). We compared the home range sizes, mean daily displacements, and distance to stream between sexes and seasons using Generalized Linear Mixed Models (GLMM) (Bolker et al., 2009) in software R (R Core Team, 2004). Sex and season were set as fixed effects while the lizard ID was considered as a random effect to account for individual variations. We used linear regression to examine correlations between home range size, daily displacements, and distance to stream with body size.

We calculated log ratios of used and available habitat types and in-stream microhabitat types in wet and dry seasons for compositional analysis and tested for non-random use of habitats using *t*-test (Aebischer et al., 1993). For compositional analysis of habitat types, we arbitrarily chose stream as the reference habitat against other habitat types. For the proportion of habitat types, we replaced 0 values with 0.0001 following Aebischer et al. (1993). For compositional analysis of in-stream microhabitat types, we arbitrarily chose riffle as the reference microhabitat against other microhabitats.

We used GLMM with binomial distribution to test which terrestrial and stream habitat variables were related to the occurrence of lizards, puting presence or absence of lizards as the response variable (Zuur et al., 2009). Prior to model building, we tested for multicollinearity by calculating variance inflation factors (VIF) for each habitat variable, and removed factors with VIF >4 (Fox, 1997). Proportion of gravels correlates with proportion of pebbles, boulders, and cobbles, and thus was removed from the analysis. For terrestrial habitat variables, we included relocations that were >5 m away from the stream. We set height above ground, substrate type, distance to stream, and canopy cover as fixed factors. For stream habitat variables, we included relocations that were in or ≤5 m away from the stream. We set height above ground, distance to stream, canopy cover, stream width, proportion of cobble, proportion of pebble, and proportion of boulder as fixed factors. For all models for terrestrial and stream habitat variables, we set lizard ID and season as random effects to account for individual and seasonal variations. We tested

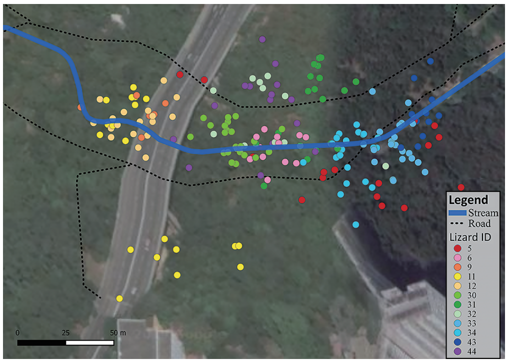

FIG. 1. Relocation points of 5 female and 7 male *Physignathus cocincinus* in the wet and dry season in Tsing Yi, Hong Kong between August 2015 and January 2016.

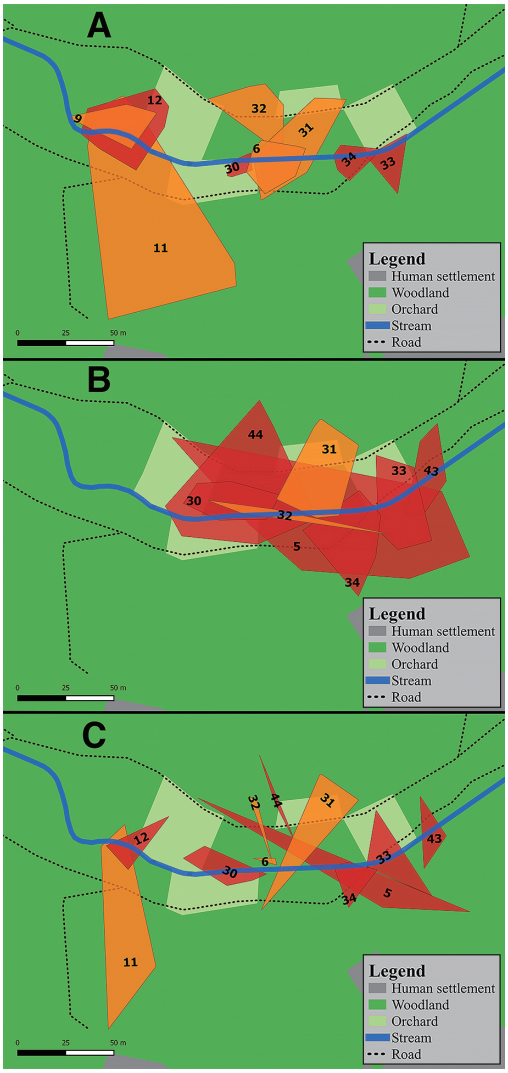

FIG. 2. Home ranges (100% minimum convex polygon) of 12 radio-tracked *Physignathus cocincinus* in Tsing Yi, Hong Kong in the (A) wet season, (B) dry season, and (C) at night between August 2015 and January 2016. Numbers indicate lizard ID and red and orange polygons indicate ranges of males and females, respectively.

multicollinearity using package car (Fox et al., 2012) in software R before model building. We used package lme4 for model building (Bates, 2010), and function dredge of package MuMIn (Barton, 2011) in software R to select the best models based on the corrected form of Akaike's Information Criterion for small sample sizes (AICc) (Burnham and Anderson, 2002; Barton, 2011). Models that best explained the difference between used and available habitats were selected based on the comparison of AICc values between the most parsimonious ("best") model (minimum AICc value) and other models. Models with AICc values within two of the best model were regarded as having similar support as the best model (Burnham and Anderson, 2002). We averaged the variables from models with similar support to obtain final estimates and standard errors for predictor variables.

RESULTS

We attached radio transmitters to 12 lizards (5 females and 7 males; Fig. 1). All lizards were tracked for over one month (mean 74±27 days, range 37–113 days; Appendix 1). Among the 229 relocations made, we observed the lizards directly in 121 occasions (52.8%) while estimations of locations were made according to the signals in the remaining 108 occasions (47.2%). Lizards were found >5 m away from streams in 148 relocations (64.6%) while being found ≤5 m from the streams in 81 occasions (35.4%). Mean (±SD; range) 100% MCP of all tracked lizards was 1793 m^2 (±1604; 469–5159). In

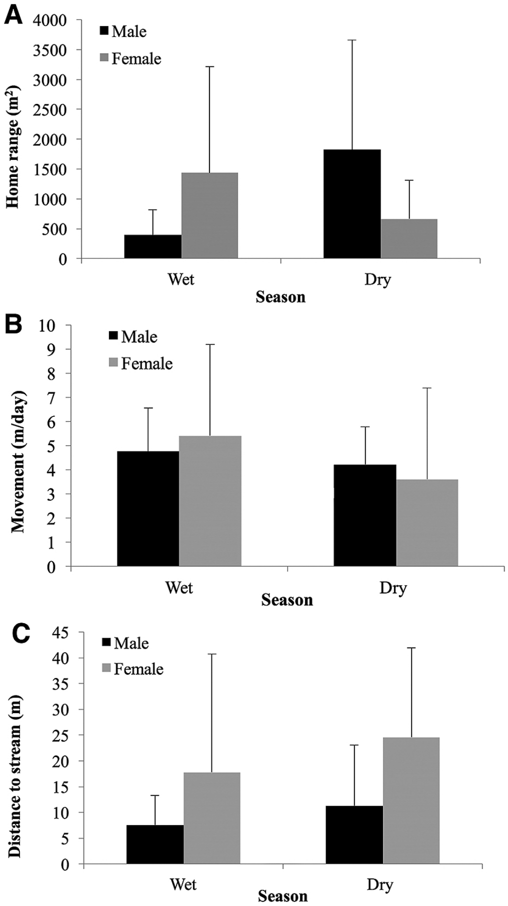

FIG. 3. (A) Home ranges (100% minimum convex polygon), (B) mean daily displacement, and (C) mean distance to stream of 5 female and 7 male *Physignathus cocincinus* in wet and dry seasons in Tsing Yi, Hong Kong between August 2015 and January 2016.

the wet season, mean 100% MCP of males and females were 397 m^2 (±423; 85–1020) and 1436 m^2 (±1776; 469–4586), respectively (Fig. 2A). In the dry season, mean 100% MCP of males and females were 1825 m^2 (±1835; 489–5159; Fig. 2B) and 663 m^2 (±650; 203–1123), respectively. Home range (MCP) sizes did not differ significantly between seasons (Z=–1.31, P=0.21; Fig. 3A) and sexes (Z=–0.62, P=0.55).

Mean daily displacements in the wet season and the dry season were 5.13 m (±3.68; 3.45–7.20 and 4.11 m (±4.88; 2.96–5.89), respectively (Appendix 2). Mean daily displacements of females and males were 3.77 m (±4.31; 3.77–7.30) and 4.34 m (±4.59; 3.30–6.01), respectively. Mean daily displacements did not differ significantly between seasons (Z=0.18, P=0.86) and sexes (Z=–1.61, P=0.13) (Fig. 3B).

Mean distance to stream of males and females were 10.18 m (±10.40; 4.13–20.25) and 19.77 m (±21.55; 3.22–31.20), respectively (Appendix 2). Mean distance to stream in wet season and dry season were 13.16 m (±18.04; 2.42–31.21) and 13.67 m (±13.81; 3.49–28.8), respectively. Mean distances to the stream differed significantly between seasons (Z=–2.153, P=0.032; Fig. 3C) and sexes (Z=2.412, P=0.017). Body size of lizards (snout-vent length) was not correlated with home range size (P=1.00), daily displacement (P=0.90), or distance to the stream (P=0.27).

In the wet season, lizards showed non-random selection of habitat types with preferences for woodlands (t=2.853, P=0.03) and concrete structures (t=–2.573, P=0.04) over orchards (Table 1). However, in the dry season, lizards exhibited random selection of habitats (P>0.1 in all comparisons). For stream microhabitat types, we found random selection in both seasons (P>0.15 in all comparisons) (Table 1).

For terrestrial habitat variables, the best models included canopy cover and height above ground (Appendix 3). The probability of occurrence increased with canopy cover and height above ground (Table 2 and 3). For stream habitat variables, the best models included canopy cover, stream width, and proportion of boulders (Appendix 3). The probability of occurrence increased with canopy cover and stream width for lizards that were relocated ≤5 m away from the stream (Table 3).

DISCUSSION

The introduced populations of *P. cocinci-*

TABLE 1. Mean percentage (SD) of habitats and in-stream microhabitats used by 12 *Physignathus cocincinus* and available within home ranges in wet and dry season in Tsing Yi, Hong Kong between 2015 and 2016.

Type	Wet season		Dry season	
	Used	Available	Used	Available
Habitat				
Woodland	68.6 (36.3)	62.9 (31.5)	76.3 (15.5)	73.5 (21.6)
Orchard	7.1 (18.9)	21.4 (18.6)	6.9 (5.7)	11.6 (8.3)
Shrubland	0 (0)	2.9 (7.6)	0 (0)	0 (0)
Concrete	10.0 (19.2)	3.6 (9.5)	0 (0)	1.4 (2.6)
Stream	14.3 (22.3)	9.3 (11.7)	16.9 (18.3)	13.6 (19.1)
In-stream microhabitat				
Pool	69.5 (37.9)	65.7 (41.3)	66.7 (40.8)	68.1 (35.1)
Run	23.3 (25.2)	19.4 (22.7)	19.1 (24.6)	20.8 (23.4)
Riffle	7.1 (18.9)	14.9 (21.0)	14.3 (35.0)	11.1 (20.2)

TABLE 2. Terrestrial and stream habitat parameters (mean and SD in parentheses) in habitats used by 12 *Physignathus cocincinus* and available within home ranges in wet and dry season in Tsing Yi, Hong Kong between 2015 and 2016.

Parameters	Wet season		Dry season	
	Used	Available	Used	Available
Terrestrial habitat variables				
Height above ground (m)	2.8 (1.7)	2.2 (0.8)	3.9 (1.9)	2.2 (1.0)
Distance to stream (m)	17.2 (14.4)	16.9 (14.0)	17.3 (10.2)	16.1 (9.4)
Canopy cover (%)	93.0 (9.5)	78.9 (13.7)	97.1 (3.9)	88.2 (9.6)
Substrate				
Concrete/rock (%)	4.4 (8.8)	3.7 (11.1)	0 (0)	4.0 (8.8)
Woody (%)	92.1 (9.5)	81.1 (17.8)	1 (0)	83.6 (13.1)
Leaf litter/soil (%)	3.4 (6.9)	15.2 (17.9)	0 (0)	12.4 (13.9)
Stream habitat variables				
Height above ground (m)	1.8 (1.6)	2.4 (0.8)	3.1 (2.0)	2.7 (1.0)
Distance to stream (m)	1.5 (0.7)	1.6 (0.4)	2.2 (1.4)	1.8 (1.0)
Canopy cover (%)	94.2 (12.1)	68.3 (13.2)	91.0 (8.9)	80.6 (14.8)
Stream width (m)	3.6 (1.1)	3.6 (1.1)	3.8 (0.7)	3.4 (1.0)
Substrate				
Boulder (%)	54.6 (31.3)	43.2 (32.1)	50.3 (31.8)	50.4 (30.2)
Cobble (%)	8.7 (2.5)	10.5 (4.9)	9.3 (6.2)	11.2 (9.0)
Pebble (%)	7.8 (4.5)	11.7 (9.8)	9.8 (6.5)	8.4 (6.1)
Gravel (%)	28.9 (26.5)	34.6 (24.0)	30.7 (19.8)	30.1 (23.2)

TABLE 3. Terrestrial and stream habitat variables that best explained (GLMM) probability of occurrence of 12 *Physignathus cocincinus* in Tsing Yi, Hong Kong between 2015 and 2016. Bold indicates significant variables.

Variables	Estimate	SE	*Z*	*P*
Terrestrial habitat variables				
Canopy cover	**3.60**	**1.04**	**3.45**	**<0.001**
Height	**0.48**	**0.10**	**4.91**	**<0.001**
Stream habitat variables				
Canopy cover	**3.22**	**0.93**	**3.43**	**<0.001**
Stream width	**0.38**	**0.19**	**2.01**	**0.04**
Boulder	0.69	0.91	0.76	0.45

nus established in Hong Kong provide an opportunity for filling knowledge gaps of their basic ecology. We found that *P. cocincinus* prefers woodland, and taller microhabitats with denser canopy cover. More mature forests with tall trees and dense canopy cover provide more shelters and food for arboreal lizards (Ober and Hayes, 2008; Perry et al., 2009). In Hong Kong, *P. cocincinus* has been recorded in over ten locations, all of which include streams with riparian forests, suggesting that riparian forests and streams are crucial for the establishment of introduced populations.

The home range of all tracked *P. cocincinus* encompassed the stream (Fig. 1 and 2), however, over 60% of relocations were made at >5 m away from the stream, supporting extensive use of nearby habitats away from streams. In addition, one female lizard (lizard ID 11) stayed away from the stream (maximum distance=85 m) for more than 35 days before the signal from the transmitter was lost. This provides an implication for the management of introduced populations: terrestrial forests away from streams (5–100 m) may need to be included for eradication or control of this species.

Lizards may choose microhabitats to obtain thermal benefits, and reduce disturbance and risk of predation. On land, despite the association of *P. cocincinus* with trees, they preferred rock and concrete structures over orchard. Rock and concrete structures retain heat, allowing effective thermoregulation (Webb and Whiting, 2005; Croak et al., 2008). Crevices in rocks and concrete structures provide shelters to *P. cocincinus* for escaping from predators (Campbell, 2015), whereas the sparse vegetation in orchards may not provide secure shelters. Frequent visitation by people to the orchards may also deter usage by the lizards.

Territoriality is probably pronounced in *P. cocincinus*, concordant to the studies on the closely related species, Australian water dragons *Intellagama* (formerly *Physignathus*) *lesueurii* (Baird et al., 2012). The home range at night of most males, except two individuals, did not overlap (Fig. 2C). In the field, we seldom observed males in close proximity to each other at any time, further supporting the existence of male-male territoriality. Between sexes, we found that males, the larger sex, stayed closer to the stream than females did. Males were often observed staying on trees above streams, where they could dive into the water when disturbed. Dominant males may defend deeper and larger pools, which are better refuges to escape from predators. This also explains their preference for wider streams.

It was surprising that we observed similar home range sizes and movements between the wet and dry season, given that seasonal differences in movements have been shown in many reptile species which become inactive during the dry season (Huey and Pianka, 1977). The dry season covered in the present study (November 2015 to January 2016) was exceptionally hot and wet: the highest average temperature in November and the highest monthly rainfall in January were recorded (Hong Kong Observatory 2018). Therefore, in this study, movements may be abnormal in this dry season and further study is needed to investigate the impacts of climatic condition on movement patterns.

We supplement an example that studying introduced populations can benefit the conservation of native populations (Gibson and Yong, 2017). The population density in the study site (114.3 individuals/100 m along the stream [Y.-H. Sung, unpublished data]) is considerably higher than that of the native populations in Vietnam (1.98–2.64 individuals/100 m), which has been under harvesting pressure (Nguyen et al., 2018). Little is known about the conservation status of other native populations. The robust population in Hong Kong might be of conservation value, acting as a source for captive breeding or reintroduction in the future (Gibson and Yong, 2017).

Although the sample size (12 individuals were tracked) of this study is relatively small, we found that *P. cocincinus* exhibits extensive use of habitats away from streams, an observation that may assist in targeting habitat for eradication of populations. To conserve native populations of *P. cocincinus*, preservation of riparian forests within 100 m from the stream may be necessary. For the management of introduced populations, the ecological impacts of the introduction of *P. cocincinus* has not been studied in Hong Kong. However, in Taiwan, the introduced *P. cocincinus* preys upon a high diversity of invertebrates, potentially competing with endemic lizard species (Ciao, 2015). For effective control, for example eradication, we suggest including riparian forests approximately 100 m away from streams.

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Appendix 1

Home range sizes of 5 female and 7 male *Physignathus cocincinus* in the wet and dry season in Tsing Yi, Hong Kong between August 2015 and January 2016.

ID	Sex	SVL (cm)	Tracking period (duration)	No. of relocations (relocations at night)		100% MCP (m^2)			50% MCP (m^2)		
				Wet	Dry	Total	Wet	Dry	Total	Wet	Dry
6	F	19.5	22/8/2015–28/9/2015 (37 days)	13 (3)		475.7	475.7		121.5	121.5	
9	F	21.0	22/8/2015–28/9/2015 (37 days)	6 (1)		469.3	469.3		14.5	14.5	
11	F	20.0	22/8/2015–30/10/2015 (69 days)	19 (4)		4586.1	4586.1		1816.6	1816.6	
31	F	19.5	10/10/2015–24/1/2016 (106 days)	6 (2)	19 (3)	1786.0	1024.1	1122.5	221.7	76.6	102.5
32	F	20.5	3/10/2015–10/11/2015 (38 days)	7 (2)	4 (1)	1981.2	622.7	203.1	261.9	22.3	
5	M	27.6	5/11/2015–24/1/2016 (80 days)		18 (3)	5159.3		5159.3	1284.0		1284.0
12	M	30.2	22/8/2015–22/10/2015 (61 days)	18 (5)		1020.4	1020.4		182.3	182.3	
30	M	25.5	10/10/2015–24/1/2016 (106 days)	6 (2)	19 (3)	734	84.8	633.5	168.2	15.9	138.9
33	M	28.5	3/10/2015–2/1/2016 (91 days)	7 (2)	16 (2)	955.6	257.9	859.3	222.6	53.4	122.1
34	M	23.2	3/10/2015–24/1/2016 (113 days)	7 (2)	20 (3)	1071.6	222	1019.4	244.3	24.9	272.8
43	M	27.4	5/11/2015 – 24/1/2016 (80 days)		18 (3)	488.9		488.9	88.2		88.2
44	M	27.8	5/11/2015 – 24/1/2016 (80 days)		18 (3)	2787.4		2787.4	457.5		457.5

Appendix 2

Daily displacement and distance to stream of 5 female and 7 male *Physignathus cocincinus* in the wet and dry season in Tsing Yi, Hong Kong between August 2015 and January 2016.

ID	Sex	SVL (cm)	Daily displacement (m)			Distance to stream (m)		
			Total	Wet	Dry	Total	Wet	Dry
6	F	19.5	4.2 (1.8)	4.2 (1.8)		3.2 (2.8)	3.2 (2.8)	
9	F	21.0	4.6 (1.7)	4.6 (1.7)		7.8 (8.9)	7.8 (8.9)	
11	F	20.0	5.5 (4.4)	5.5 (4.4)		31.2 (30.8)	31.2 (30.8)	
31	F	19.5	3.8 (4.7)	7.2 (3.3)	3.0 (4.3)	23.8 (17.6)	10.9 (15.0)	28.8 (16.2)
32	F	20.5	7.3 (5.9)	6.6 (6.1)	9.1 (7.1)	18.1 (13.4)	25.3 (10.7)	5.5 (6.4)
5	M	27.6	4.7 (4.5)		4.7 (4.5)	20.0 (9.3)		20.0 (9.3)
12	M	30.2	6.0 (3.8)	6.0 (3.8)		7.6 (3.4)	7.6 (3.4)	
30	M	25.5	3.5 (4.2)	6.5 (3.3)	3.5 (4.6)	4.1 (3.2)	2.4 (3.4)	4.8 (3.0)
33	M	28.5	4.0 (3.7)	3.4 (1.8)	4.3 (4.3)	12.0 (4.7)	12.0 (7.3)	12.0 (2.8)
34	M	23.2	3.9 (4.2)	4.4 (4.6)	3.8 (4.3)	7.4 (7.5)	7.3 (7.1)	7.4 (7.8)
43	M	27.4	3.3 (5.2)		3.3 (5.2)	3.6 (2.1)		3.5 (2.2)
44	M	27.8	5.9 (6.3)		5.9 (6.3)	20.3 (19.1)		20.6 (19.7)

Appendix 3

The best GLMM models, based on corrected Akaike's Information Criterion (AICc) examining the relationship between terrestrial and stream habitat variables, and probability of occupancy of 12 *Physignathus cocincinus* in Tsing Yi, Hong Kong between 2015 and 2016. Bold indicates models with similar support to the best model (≤2 ΔAICc).

Model	*df*	AICc	ΔAICc	*w*
Terrestrial habitat variable				
Canopy+height	**5**	**294.7**	**0**	**0.88**
Canpy+distance+substrate+height	8	298.7	4.02	0.12
Height	4	311.6	16.91	0.00
Stream habitat variable				
Canopy+width	**5**	**168.5**	**0**	**0.58**
Canopy+width + boulder	**6**	**169.6**	**1.05**	**0.34**
Canopy+cobble+height+width+gravel	8	172.6	4.07	0.08