

Vietnamese crocodile lizard, Shinisaurus crocodilurus



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1. STATUS REVIEW

1.1 Taxonomy:

Class: Reptiles Order: Squamata Family: Sauria Genus: Shinisauridae Species: *Shinisaurus crocodilurus* Type locality: "Kwangsi" Subspecies: *Shinisaurus crocodilurus vietnamensis* Schingen, Le, Ngo, Pham, Ha, Nguyen & Ziegler 2016 Type locality: at an elevation of 407 m in Son Dong District, Bac Giang Province, Vietnam Common name: Thằn lần cá sấu

Local name: Thần lần cá sấu, cá sấu khe, cá sấu nước, kỳ nhông nước, cu ta bu gòn or toong tóong (Dao ethnic).

1.2 Distribution and population status:

The crocodile lizard is confirmed present at eight localities in Guangxi and Guangdong provinces in southern China (Huang et al. 2008). In northern Vietnam, the species has been reported from the contiguous nature reserves Tay Yen Tu in Bac Giang Province, Yen Tu and Hai Ha district in Quang Ninh Province (Nguyen et al. 2014, van Schingen et al. 2015, 2016). During the course pf the EDGE project we discovered two new populations, including one population in Tay Yen Tu NR in Bac Giang Province and another population in Quang Lam Commune, Dam Ha District, Quang Ninh Province (Fig. 1).



Fig. 1. Map of the current distribution of Shinisaurus crocodilurus in Vietnam.





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The crocodile lizard has been assessed as Endangered by the IUCN Red List, included in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). In Vietnam, this species is protected under Decree 64/2019/ND-CP, where it is listed in Group IB, the highest level for wild fauna.

1.2.1 Global distribution:

Country	Population estimate	Distribution	Population trend (plus references)	Notes
China	estimate (plus references) 950 individuals (Huang et al. 2008)	 Jinxiu, Guangxi Dacaichong, Guangxi Chishuichong, Hexou, Guangxi Deshengchong, Hezhou, Guangxi Yusanchong, Hezhou, Guangxi Guiping, Guangxi 	(plus references) According to Huang et al. 2008, the population of this species in China has dramatically decreased compared with previous surveys	Huang, C. M., Yu, H., Wu, Z. J., Li, Y. B., Wei, F. W. & Gong, M. H., 2008. Population and conservation strategies for the Chinese crocodile lizard
		 Miaobei chong, Luokeng, Guangdong Chishuikeng, Luokeng, Guangdong Dabeitou, Luokeng, Guangdong Shenkeng, Luokeng, Guangdong Linzhoding NR., Maoming, Guangdong Luhuding NR Maoming, Guangdong 	(Zeng, 2003)	(<i>Shinisaurus</i> <i>crocodilurus</i>) in China. Animal Biodiversity and Conservation, 31.2: 63–70.
Vietnam	Less than 100 individuals (van Schingen et al. 2016)	 Tay Yen Tu Nature Reserve, Bac Giang Province Yen Tu NRs, Quang Ninh Province Dong Son – Ky Thuong NRs, Quang Ninh Province Dam Ha District, Quang Ninh Province (new population) 	The Vietnamese subpopulations have declined (IUCN SSC, 2021)	The Vietnamese subpopulations have also dramatically declined. According to field surveys, we encountered a total 18 different individuals of <i>S.</i> <i>Crocodilurus</i> (Table 1).

Table 1. Comparison of observed S.	crocodilurus in Vietnam between	our study and van	Schingen et al.
2015.		-	-

Variable	Tay Yen Tu		Yen Tu	Dong Son – Ky Thuong		Hai Ha	New site in Dam Ha	
	Site 1	Site 2 (new stream)		Site 1	Site 2	Site 3		
2020 Total (observed)	0	1	9	0	0	6	0	2
2015 Total (observed)	27	0	20	0	4	5	12	0





1.2.2 Local distribution:

Country	Region / province	Site	Level of Protection	Population size	Reference(s)
Vietnam	Uong Bi City, Quang Ninh Province	Yen Tu NRs	This population is in Natural Reserve area and this area is subject to the highest level of site protection in Vietnam.	34 individuals	Van Schingen et al. 2016
Vietnam	Hoanh Bo District, Quang Ninh Province	Dong Son – Ky Thuong NRs	This population is inside Natural Reserve area and this is a second level of site protection in Vietnam	21 individuals	Van Schingen et al. 2016
Vietnam	Hai Ha District, Quang Ninh Province	Quang Son Commune	This population is outside protected area. Based on our surveys, numerous local villagers are hunting the lizards for sale to traders.	28 individuals	Van Schingen et al. 2016
Vietnam	Dam Ha District, Quang Ninh PRovince	Quang Lam Commune	This population is outside protected area. Based on our surveys, numerous local villagers are hunting the lizards for sale to traders.	Unknown (new population during this project)	
Vietnam	Tay Yen Tu NR, Bac Giang Province	Tay Yen Tu NR	This population is inside a protected area. However, this forest has been opened throughout the nature reserve in order to build road and facilitate coal mining.	61 individuals	Van Schingen et al. 2016







1.3 Protection status:

- In Tay Yen Tu NRAII the populations of *S. crocodilurus* in Tay Yen Tu NR are inside of the protected area. However, this forest has been legally opened for road construction and coal mining. The mining area has been extensive and already filled part of a stream habitat of *S. crocodilurus*. Roads also affect another stream (Fig. 2).



Fig. 2: Coal-mining exploration in Tay Yen Tu NR

- In Dong Son – Ky Thuong NR: all the populations in Dong Son – Ky Thuong NR are inside the protected area. However, the construction of the main road in 2017 took over its habitat and formed dispersal barriers to one population of *S. crocodilurus*. The legal road construction involved the dumping of sediment and rock to fill part of this stream which has resulted in habitat fragmentation. Moreover, based on our interviews with local people showed that several persons indeed collect the animals to sale for trader.

- In Hai Ha and Dam Ha District, Quang Ninh Province: the population is situated outside of the protected area. Hunting has posed a severe threat to this species in this area, as our interviews with local people showed that they indeed collect the animals to supply markets in China.

- In Yen Tu NP: all the populations are inside the protected area.

1.4 Ecology, behaviour and habitat requirements:

In China, the crocodile lizard usually is found along slow running rocky streams in montane subtropical evergreen broadleaf forest, limestone mountains (Chan et al. 2002; Zhang, 1991; Zhu et al. 2003). This species also occurs in bamboo plantation forest but avoids coniferous forest, shrubs and grasslands (Wu et al. 2007). In Vietnam, the crocodile lizard is found in shallow and narrow streams. These stream habitats are densely vegetated, mainly by mainly by broad-leafed trees and scattered bamboo, and macro-algae are mostly absent within the streams (van Schingen et al. 2015). The streams inhabited by this species in both countries have a slow to medium flow, are largely shallow (5-73 cm) and narrow (1-8 m) (van Schingen et al. 2015; Ning et al. 2006). The riverbed is composed of sand, gravel, and some boulders which from numerous riffle zones. There are often big truncated tree branches residing in the water. Furthermore, many streams contain small waterfalls followed by backwater pools. The altitudinal range of this species was reported from 400 and 800m a.s.l in Vietnam and 200 a.s.l to 1500 a.s.l in China (Huang et al. 2008; Le & Ziegler, 2003; Zhao et al. 1999). The microhabitat preferences of the crocodile lizard are as follows: length (1-2m) and middle width (1-2m) of backwater pool, slow water velocity, far away from human disturbance (distance > 500 m), broadleaf coverage > 60% (Ning et al. 2006).

According to van Schingen et al. (2015), this species is found in streams with the following ecological factors: pH values of 4.50-5.00 (Yen Tu NR); 5.43-5.58 (Tay Yen Tu NR), and 6.70-







7.40 (Dong Son - Ky Thuong NR); the temperature are approximately 11-23°C (van Schingen et al. 2015, Ngo et al. (unpublished paper)).

S. crocodilurus is ovoviviparous and hibernates from October until April (Zhao et al., 1999). Hibernation is initiated by cool temperatures of 9-11°C (Hu et al., 1984; Zhao et al., 1999; Wu pers. comm.). It is reported to feed on invertebrates including worms, cockroaches, the yellow rice borer, small lizards, caterpillars, locusts, seeds, aquatic and terrestrial insects, spiders and crustaceans, but also on small fish, tadpoles and frogs (Brever et al., 2005; Huang et al., 2008; Zhao et al., 1999; Ziegler et al., 2008). At night, this species rests on perches above the stream. Once disturbed, animals abruptly jump into the water, where they move by smooth paddling and are capable to remain up to 15-20 minutes under water (Zhao et al., 1999).

1.5 Threat analysis:

Threat	Description of how this threat impacts the species	Intensity of threat (low, medium, high,	IUCN threat category
Habitat loss and habitat alterations	In Tay Yen Tu NR, the species' habitat was lost or seriously disturbed. This forest has been opened legally in order to build roads and facilitate coal mining. The mining area has been rapidly expanding and has already impacted the crocodile lizard as one stream habitat known to contain a population of <i>S.</i> <i>crocodilurus</i> has been filled. Dams and the extraction of water also affect another stream. In Dong Son – Ky Thuong NR, the construction of main roads in 2017 occupy land resources and form barriers between individuals in a population of <i>S.</i> <i>crocodilurus</i> . It also contributes both coarse sediment and rock to a stream and is filling a part of this stream	High	1. Residential & Commercial Development > 1.1. Housing & Urban areas and 1.2. Commercial & Industrial Areas
Hunting posed	Our interviews with local villagers revealed that crocodile lizards had been very abundant throughout the whole region until ten years ago. The population underwent rapid decline due to poaching for illegal trade. Numerous local villagers are allegedly hunting the lizards for sale to traders from China and three or four years ago was the peak period.	High	5. Biological Resource Use > 5.1. Hunting & Collecting Terrestrial animals
Knowledge	Local people have little knowledge of the laws protecting this species and this is of concern, as it has potential to affect the levels of hunting and exploitation of the species	Medium	12. Other options > 12.1. Other threats
Diseases	Disease may threaten wild populations, but the extent of this is not yet known. Bacteria and viruses have caused the direct loss of many threatened species, such as <i>Mycoplasma</i> infections can cause significant morbidity and mortality in captive and wild turtles or herpesvirus can be lethal to some individual turtles and to lizards as well or adenovirus, iridovirus, paramyxovirus and reovirus can be respiratory disease to several individual lizards. Understanding the diseases of wild <i>S. crocodilurus</i> is very important for successful conservation species. Therefore, I propose to screen wild <i>S. crocodilurus</i> for pathogens to collect base line	Unknown	8. Invasive & Other Problematic Species, Genes & Diseases > 8.1. Invasive Non- Native/Alien Species/Diseases







data for this species in Vietnam. Moreover, there is evidence that the captive environment can have negative impacts on different aspects of skin microbiota, which could potentially affect the wild population via reintroduction program. To minimize the potential risk of disease introduction to the wild population, I therefore propose screening for disease of captive individuals for reintroduction in the near	
future.	

1.6 Stakeholder analysis:

Country	Stakeholder	Stakeholder's interest in the species' conservation	Current activities	Impact (positive, negative or both)	Intensity of impact (low, medium, high or critical)
Vietnam	Assoc. Prof. Minh D. Le - Researcher and teacher in VNU University of Science, Vietnam National University - Researcher in American Museum of Natural History	High interest	He is assistant in project design and development of an eDNA protocol for surveying <i>Shinisaurus</i> <i>crocodilurus</i> <i>vietnamensis</i> . He also helped ensure that project outcomes were widely disseminated to the relevant stakeholders. He also supports the writing of manuscripts and reports resulting from the project.	Positive	High
Vietnam	Prof. Dr. Truong Q. Nguyen, researcher in the Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology	High interest	He assisted in project design and, in carrying out all field surveys. He helps ensure that project outcomes are widely disseminated to the relevant stakeholders.	Positive	High
Germany	Thomas Ziegler, Curator Aquarium & Coordinator, Biodiversity and Nature Conservation Professor at the Zoological Institute, University of Cologne	High interest	He assisted in project design and, in carrying out all field surveys. He helps ensure that project outcomes are widely disseminated to the relevant stakeholders both in Vietnam and at the international scale.	Positive	High







Vietnam	- Quyen H. Do and Thanh P. T. Bui, student in VNU University of Science, Vietnam National University; researcher in the Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology - Tien Q. Phan, researcher in the Institute of Ecology and Biological Resources, Vietnam Academy of Science and Technology	High interest	They are assistants in the field surveys and all other project activities	Positive	High
Vietnam	Local community in Quang Son Commune, Hai Ha District, Quang Ninh Province; local community in Quang Lam Commune, Dam Ha District, Quang Ninh Province; local community in Huc Dong Commune, Binh Lieu District, Quang Ninh Province; local community in Dong Son – Ky Thuong District, Quang Ninh Province.	Medium interest	They help to assess the threats to the species and some local people participate as field assistants	Positive and negative	High
Vietnam	Traders in Quang	Low interest	Collecting the crocodile	Negative	High
Vietnam	Tay Yen Tu National Forest Management, Yen Tu Forest Management, Hai Ha Forest Protection Department, People's Committee of Dam Ha District	High interest	They are assistants in field surveys and they help conduct field surveys. They will also provide any new information of this species in the future	Positive	High
Vietnam	Rangers in Quang Ninh and Bac Giang Province	Medium interest	They help conduct field surveys and participate as field assistants.	Positive and negative	Medium









1.7 Context and background information that will affect the success of any conservation action for this species:

	Description	Barriers to conservation	Opportunities for conservation
Socio-cultural effects	The main ethnic group living around the crocodile	Hundreds of people rely on forests to	Building livelihood development
and cultural attitudes	Ha and Dam Ha District are the Dao people		programmes
Economic implications	- Yen Tu NR includes a huge pagoda in northern Vietnam and tourism activity is developed in this area, therefore, local people don't need to go to forests to earn their living.	- Sewage treatment system, trash pollution can cause habitat degradation.	Local people don't usually go to the forest
	 Trade in bushmeat and wildlife products contribute significantly to local household income and access to food. As our interview with local people showed that they could earned 2 million VND/per night with 10 individuals of <i>S.</i> <i>crocodilurus.</i> Coal mining has already filled part of a stream habitat of <i>S. crocodilurus</i> 	 Decreasing the population size. Loss habitat, decreasing the population size or population fragmentation 	
Existing conservation measures	A breeding program for crocodile lizards in Me Linh Station for Biodiversity, Vietnam Academy of Science and Technology has been developed for re-introduction in the future.	Extent of suitable habitat for translocation, mitigation of known threats, reintroduction program in a good protected area might help restore this species populations	Increasing the population in the wild through the breeding programme and the population could be recovered
Administrative/ political set-up	Tay Yen Tu NR, is a protected area. However, it is also inside the military area and this area has rapidly expanded and already impacted one of the to a streams crocodile lizard inhabit. All populations in Tay Yen Tu NR are inside the military area.	The population of this species in Tay Yen Tu NR is located inside the military area. Therefore, all populations are quite difficult to access. It is very difficult to do any conservation action in this area.	It is very difficult to do any conservation action in this area as it is not permitted to build or doing something in the military area.









Local expertise and interest	Local communities have helped to assess the threats to the species and some local people assisted in the filed surveys. Some local people are very nice and are willing to help us.	Local communities live in the park' zone, therefore, they are easy to access the population. Moreover, perching behaviour above the tree of this species make local people to hunting easily.	Our interview surveys indicates that local people hunt the lizard frequently to sell them for money. A price of 5 individuals in 2020 equals more than three month's average wage for one person in these remote mountain areas. Therefore, building livelihood development programmes may provide local communities with alternative sources of income and potentially reduce the need to collect wild crocodile lizards for the illegal trade.
Resources	Funders, EDGE staff members, EDGE Fellow, ZSL staffs, Nat Geo, IEBR members, CRES members, Cologne Zoo works together to protect and restore species and their habitats.	Sustainable funding?	Increasing the population in the wild and protecting the population in their natural habitat.







2. ACTION PROGRAMME

Vision (30-50 years)					
A long-term viable population of Vietnamese crocodile lizard is sustained in natural habitats					
Goal(s) (5-10 years)					
Enhancing in-situ conservation measures for the Vietnamese Crocodile Lizard					
Objectives	Prioritisation				
	(low, medium,				
	high or critical)				
Objective 1. Identifying priority sites for re-introduction of the Vietnamese crocodile lizard	Medium				
Objective 2. Capacity building for patrolling monitoring with a focus on the Vietnamese crocodile lizard	High				
Objective 3. Assessing the hunting and trafficking activities over the distribution range of the species and on-site markets	High				
Objective 4. Raise awareness of law protection of the crocodile lizard for local people within or near its distribution range	High				
and for traders	-				
Objective 5. Developing pathogen screening protocol for the crocodile lizard and undertaking disease risk analyses	High				
Objective 6. Establish whether the Vietnamese population should be considered a separate species using molecular	High				
analyses	_				









Activities	Country / region	Priority (low,	Associate d costs	Time scale	Responsible stakeholders	Indicators	Risks	Activity type	IUCN Conservation
		mediu	(currency						action
		m, nign or)						
		critical)							
Objective 1: I	dentifying p	oriority sit	es for re-inti	oduction	of the Vietnamese crocod	lile lizards			1
Activity 1.1. Assessment of human activities inside the forest within the range of the crocodile lizard	Quang Ninh and Bac Giang Province	Medium	\$2000	2 months	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team	Final report	Vietnam was forced to lockdown for several times due to Covid-19 and caused travel interruptions within the country. The situation is getting better, but it is possible that the country will be shut down again in the future. This could delay the fieldwork and progress of the project.		2. Land/Water Management > 2.1. Site/area management
Activity 1.2. Assessment the access into protected area of local people	Quang Ninh and Bac Giang Province	Medium	\$2000	2 months	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team	Final report	Vietnam was forced to lockdown for several times due to Covid-19 and caused travel interruptions within the country. The situation is getting better, but it is possible that the country will be shut down again in the future. This could delay the fieldwork and progress of the project.		2. Land/Water Management > 2.1. Site/area management
Activity 1.3. Recruit local people to do	Quang Ninh and	Medium	\$2000	2 months	VNU-Central Institute for natural resources and environmental studies	Final report	Vietnam was forced to lockdown for several times due to Covid-19 and caused travel		6. Livelihood, Economic & Other Incentives > 6.4







conservation work	Bac Giang Province	ilding for	potrolling m	opitoring	team, Institute of Ecological Resources team	measurand	interruptions within the country. The situation is getting better, but it is possible that the country will be shut down again in the future. This could delay the fieldwork and progress of the project.		Conservation payments
Objective 2: 0	Dong Son	iung ior	pau oning M	unitoring					
Activity 2.1. Identifying 02 rangers in each site and recruit them for patrolling monitoring	Jong Son Ky Thuong NR and Yen Tu NR, Quang Ninh Province, Vietnam	High	\$9000	24 months	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team, Dong Son – Ky Thuong and Yen Tu NR management team and rangers	2 rangers in each site will be recruited. Exploitation of crocodile lizards deceases.	People not available Delay in training the rangers	Improving knowledge/ patrolling technique	2. Land/Water Management > 2.1. Site/area management
Activity 2.2. Training of local rangers on species identification and patrolling techniques	Dong Son Ky Thuong NR and Yen Tu NR, Quang Ninh Province, Vietnam	High	\$4000	24 months	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team	2 rangers in each site will be trained. Exploitation of crocodile lizards deceases.	People not available Delay in training the ranger	Improving knowledge/ patrolling technique	2. Land/Water Management > 2.1. Site/area management
Activity 2.3. Patrolling monitoring reports written	Dong Son Ky Thuong NR and Yen Tu NR,	High	\$0	24 months	Rangers in Dong Son – Ky Thuong and Yen Tu NR	2 rangers in each site will be sent the report in every	People not available Delay in training the ranger	Improving knowledge/ patrolling technique	2. Land/Water Management > 2.1. Site/area management







and sent to stakeholders	Quang Ninh Province, Vietnam					month. Exploitation of crocodile lizards deceases.			
Objective 3:	Assessing t	the huntin	ng and traffic	king activ	vities over the distribution	range of the	species and on-site markets		
Activity 3.1. Hunting and trafficking activities assessed over the distribution range of the species and on-site markets	Dong Son Ky Thuong NR and Dam Ha District, Quang Ninh Province	High	\$4000	12 months	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team	4 communes will be assessed in every three months	Vietnam was forced to lockdown for several times and caused travel interruptions within the country. The situation is getting better, but it is possible that the country will be shut down again in the future. This could delay the fieldwork and progress of the project.	Improving knowledge	
Activity 3.2. Trafficking activities investigated in online platforms	Facebook, Zalo	High	\$1500	12 months	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team	Report will be sent to funding organizatio n in every three months		Improving knowledge	
Activity 3.3. Technical reports written and sent to stakeholders	Vietnam	High	\$300	12 months	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team	Report will be done in every 3 months		Improving knowledge	







Objective 4. Raise awareness of law protection of the crocodile lizard for local people within or near its distribution range and for traders									
Activity 4.1. A poster displayed at the local community center	Vietnam	High	\$0	\$0	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team	Poster		Improving knowledge for local people	4. Education & awareness > 4.3 Awareness & Communications
Activity 4.2. A poster displayed on social media	Facebook, Zalo	High	\$0	1 day	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team	Poster			4. Education & awareness > 4.3 Awareness & Communications
Activity 4.3. Evaluation of poster affection	Vietnam	High	\$500	2 weeks	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team	Evaluation report	Vietnam was forced to lockdown for several times due to covid-19 and caused travel interruptions within the country. The situation is getting better, but it is possible that the country will be shut down again in the future. This could delay the fieldwork and progress of the project.		4. Education & awareness > 4.3 Awareness & Communications
Objective 5. I	Developing	pathogen	screening p	rotocol fo	r the crocodile lizard				
Activity 5.1. Develop PCR primers (to detect pathogen DNA/RNA)	Vietnam	High	\$0	1 month	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team				3. Species management > 3.2 Species recovery







Activity 5.2. Collect pathogen samples from captive and wild crocodile lizard	Vietnam	High	\$5000	6 months	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team	Pathogen samples	Vietnam was forced to lockdown for several times due to covid-19 and caused travel interruptions within the country. The situation is getting better, but it is possible that the country will be shut down again in the future. This could delay the fieldwork and progress of the project.	Improving knowledge about disease of the crocodile lizard in Vietnam	3. Species management > 3.2 Species recovery
Activity 5.3. Screen pathogen samples from captive and wild crocodile lizard	Vietnam	High	\$6000	6 months	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team	Screen pathogen protocol	Vietnam was forced to lockdown for several times and caused travel interruptions within the country. The situation is getting better, but it is possible that the country will be shut down again in the future. This could delay the fieldwork and progress of the project.	Improving knowledge about disease of the crocodile lizard in Vietnam	3. Species management > 3.2 Species recovery
Activity 5.4. Molecular analysis of the crocodile lizard pathogen	Vietnam	High	\$0	2 months	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team	Pathogen report	Vietnam was forced to lockdown for several times and caused travel interruptions within the country. The situation is getting better, but it is possible that the country will be shut down again in the future. This could delay the fieldwork and progress of the project.	Improving knowledge about disease of the crocodile lizard in Vietnam	3. Species management > 3.2. Species recovery









Objective 6.	Objective 6. Establish whether the Vietnamese population should be considered a separate species using molecular analyses										
Activity 6.1. Collecting samples from localities in Quang Ninh and Bac Giang Provinces	Vietnam	Low	\$0	0 month	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team	Samples list	NA (DNA samples were collected in previous project which funded by Cologne Zoo, WAZA and NAFOSTED)		3. Species		
Activity 6.2. Extracting DNA samples	Vietnam	Low	\$0	0 month	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team		NA (DNA samples were extracted in previous project which funded by Cologne Zoo, WAZA and NAFOSTED)		management > 3.2. Species recovery		
Activity 6.3. Amplication 10 loci and reading the fragment size	Vietnam	High	\$8000	10 months	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team						
Activity 6.4. Analyzing data	Vietnam	High	\$0	2 months	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team						
Activity 6.5. Writing and submit report	Vietnam	High	\$100	4 months	VNU-Central Institute for natural resources and environmental studies team, Institute of Ecological Resources team	Final report					







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