Biology of the Commercially-Harvested Rat Snake (*Ptyas mucosus*) and Cobra (*Naja sputatrix*) in Central Java

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Abstract

We measured and dissected 80 spitting cobras (*Naja sputatrix*) and 174 rat snakes (*Ptyas mucosus*) captured by commercial snake-collectors in Central Java to document basic ecological attributes of these two abundant but poorly-known snake species. The two species differed in several respects (*e.g.*, males grow larger than females in rat snakes, but the reverse is true in cobras) but were similar in others (*e.g.*, in both species, males have larger heads, longer tails and greater body masses than females of the same body length). Almost all the female cobras were non-reproductive when collected, but about half of the female rat snakes were reproductive. Clutch size in rat snakes averaged 13.0 (range = 7-25). Rat snakes fed mainly on frogs, and cobras mainly on mammals. These species do well in disturbed habitats, and can support a significant commercial offtake. However, further studies will be needed before we can confidently assess sustainable levels of harvesting.

Abstrak

BIOLOGI ULAR JALI (*PTYAS MUCOSUS*) DAN ULAR KOBRA (*NAJA SPUTATRIX*) YANG DITANGKAP SECARA KOMERSIAL DI JAWA TENGAH

Telah diukur dan dibedah 80 ekor ular kobra (*Naja sputatrix*) dan 174 ekor ular jali (*Ptyas mucosus*), yang ditangkap oleh pemburu ular komersial di Jawa Tengah, untuk mendokumentasikan sifat-sifat ekologi dasar kedua spesies ular yang jumlahnya banyak tetapi kurang dikenal itu. Kedua spesies ular itu berbeda dalam beberapa hal (mis., ular jali jantan lebih besar dari betinanya, tetapi sebaliknya dengan ular kobra), sedangkan aspek-aspek lainnya mirip (mis., pada kedua spesies, jantannya berkepala lebih besar, ekornya lebih panjang, dan badannya lebih besar dibandingkan dengan betinanya). Hampir semua ular kobra betina pada waktu ditangkap sedang non reproduktif, tetapi setengah dari ular jali betina sedang reproduktif. Besar kelompok telur ular jali rata-rata 13,0 (kisaran: 7 - 25). Ular jali terutama memangsa kodok, sedangkan ular kobra memangsa binatang menyusui. Kedua spesies ular itu hidup dengan baik di habitat terganggu dan mampu mendukung upaya komersial secara nyata. Walau demikian, penelitian lebih lanjut masih diperlukan sebelum kita dapat menilai dengan yakin tingkat-tingkat penangkapan secara lestari.

Zusammenfassung

Wir untersuchten 80 Speikobras (*Naja sputatrix*) und 174 Rattennattern (*Ptyas mucosus*), die in Zentraljava für den Handel gefangen worden waren. Damit sollten wichtige morphologische und ökologische Daten von diesen beiden häufigen aber nur unzureichend bekannten Arten erhoben werden. Beide Arten unterschieden sich in mehrfacher Weise. Bei den Rattennattern sind die Männchen größer, bei den Kobras die Weibchen. Bei beiden Arten haben die männlichen Tiere größere Köpfe, längere Schwänze und ein höheres Körpergewicht als gleichgroße Weibchen. Fast alle weiblichen Kobras waren nicht reproduktiv aktiv als sie von uns gesammelt wurden, bei den Rattennattern traf dies nur für die Hälfte der Weibchen zu. Die Gelegegröße betrug bei den Rattennattern durchschnittlich 13 Eier (Wertbebereich 7-25). *Ptyas mucosus* ernährt sich vorwiegend von Fröschen, *Naja sputatrix* von Säugern. Beide Arten sind in anthropogen überformten Habitaten häufig und

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sind anscheinend auch bei starker Dezimierung durch den kommerziellen Fang nicht in ihrem Bestand gefährdet. Es sind jedoch weitere Untersuchungen erforderlich, um sichere Aussagen darüber machen zu können, ob die derzeitigen Fangzahlen als nachhaltig anzusehen sind.

INTRODUCTION

Discussions on the sustainable levels of harvesting of Indonesian reptiles have been hampered by a lack of reliable information on the basic biology of the species that are being used, or the kinds (sexes, sizes, etc.) of reptiles that are taken by the collectors. In recent years, this problem has been addressed by a series of studies that have taken advantage of the commercial trade to obtain access to large numbers of freshly-killed specimens. This paper reports a study on two Indonesian snake species that are harvested in large numbers from Central Java, the rat snake *(Ptyas mucosus)* and the spitting cobra *(Naja sputatrix)*.

MATERIALS AND METHODS

In order to obtain reliable information on the basic biology of Indonesian snakes that have traditionally been harvested for commercial and domestic purposes in Central Java, scientists from LIPI carried out two surveys. The first survey was carried out from 19 December 1994 to 2 January 1995 in the East Javan districts Banyuwangi, Jember, Surabaya, Krian, Bojonegoro, and the Central Javan districts Purwodadi, Sragen, and Magelang. The second survey was carried out from 25 October 1996 to 7 November 1996 in the West Javan districts Cheribon and Ciamis, and the Central Javan districts Ajibarang, Wonosari, Yogya, Imogiri, Wonogiri, Karanganyar, Klaten, Sragen, Boyolali, Purwodadi, and Demak. The first of these surveys concentrated exclusively on rat snakes (*Ptyas mucosus*), whereas the second survey involved studies on spitting cobras (*Naja sputatrix*) as well as rat snakes. These two are the major species harvested in Java, and it was hoped to obtain information that would be relevant to the evaluation of sustainable levels of harvesting for both of these taxa.

The methods used are similar to those developed by SHINE and his co-workers for their work on pythons, acrochordids and varanids (SHINE et al., this volume), and so will not be explained in detail here. Briefly, they consist of measuring and weighing snakes that are brought in to be killed and skinned, and then examining the carcasses after skinning to obtain data on reproductive condition and food habits.

RESULTS

MORPHOLOGY AND SEXUAL DIMORPHISM

Most of the snakes collected were adults, although it was not possible to be certain in the case of female cobras since virtually all of these animals were nonreproductive at the time they were collected (see below). Analysis shows that the rat snakes grow considerably larger than the cobras (Tab. 1).

Slightly more males than females were collected for each species, but with a different pattern of sexual dimorphism in the two species. Male rat snakes attain much larger sizes than females, and have significantly larger average head sizes

and body masses (Tab. 1). In contrast, female cobras tend to be larger than males, although the sexes are similar in average head sizes and body masses (Tab. 1).

	Adult males	Adult females	unpaired t test df	t	*P*
Spitting cobras (*Naja sputatrix*)					
N	45	35			
Mean SVL	957.6 (90.8)	1013.0 (82.8)	78	2.81	0.007
Mean head length	36.3 (4.0)	35.4 (3.8)	78	0.95	0.34
Mean tail length	156.7 (19.6)	147.7 (15.7)	72	2.14	0.04
Body mass	498.0 (145.6)	442.1 (154.7)	78	1.66	0.10
Rat snakes (*Ptyas mucosus*)					
N	102	72			
Mean SVL	1415.4 (175.4)	1329.0 (98.4)	172	3.78	0.0002
Mean head length	41.3 (4.2)	38.8 (2.7)	172	4.39	0.0001
Mean tail length	481.3 (86.3)	465.2 (42.7)	172	1.46	0.15
Body mass	884.9 (345.8)	657.5 (157.0)	172	5.21	0.0001

Tab. 1. Sample sizes, body sizes and sexual size dimorphism of spitting cobras *(Naja sputatrix)* and rat snakes *(Ptyas mucosus)* from East and Central Java, based on examination and dissection of specimens collected for the commercial trade. Table gives mean values, with standard deviation in parentheses. SVL = snout-vent length; all measurements are in mm. Last three columns show results from statistical tests for the presence of significant sexual dimorphism.

To determine whether these sex differences were simply due to body-size differences, analyses of covariance with sex as the factor, snout-vent length as the covariate, and the other body dimensions as dependent variables were carried out. These analyses showed significant differences in body proportions between the sexes, in both species studied. Males had longer tails than females of the same snout-vent length (for rat snakes, slopes $F_{1,172} = 3.96$, $P < 0.05$; for cobras, slopes $F_{1,74} = 0.0002$, $P = 0.99$, but intercepts $F_{1,75} = 18.00$, $P < 0.0001$). In both species, males also had larger heads than females of the same body length (for rat snakes, slopes $F_{1,172} = 0.17$, $P = 0.68$, but intercepts $F_{1,173} = 5.86$, $P < 0.02$; for cobras, slopes $F_{1,74} = 0.64$, $P = 0.43$, but intercepts $F_{1,75} = 18.57$, $P < 0.0001$). Lastly, males were heavier than females of the same body length (for rat snakes, slopes $F_{1,172} = 0.61$, $P = 0.81$, but intercepts $F_{1,173} = 7.31$, $P < 0.008$; for cobras, slopes $F_{1,80} = 0.75$, $P = 0.39$, but intercepts $F_{1,81} = 25.42$, $P < 0.0001$). Particularly in the case of the cobra, these sex differences in body proportions were quite considerable (Fig. 1).

REPRODUCTION

No useful data were obtained on reproductive output in cobras, because only one female had vitellogenic follicles when collected (26 follicles, 18 × 8 mm, in a female measuring 1010 mm SVL). However, many of the rat snake females were reproductive. Of all female rat snakes collected, 20 of 42 (48 %) were reproductive when collected on the first survey (Dec. 1994 - Jan. 1995) whereas 17 of 32 (53 %)

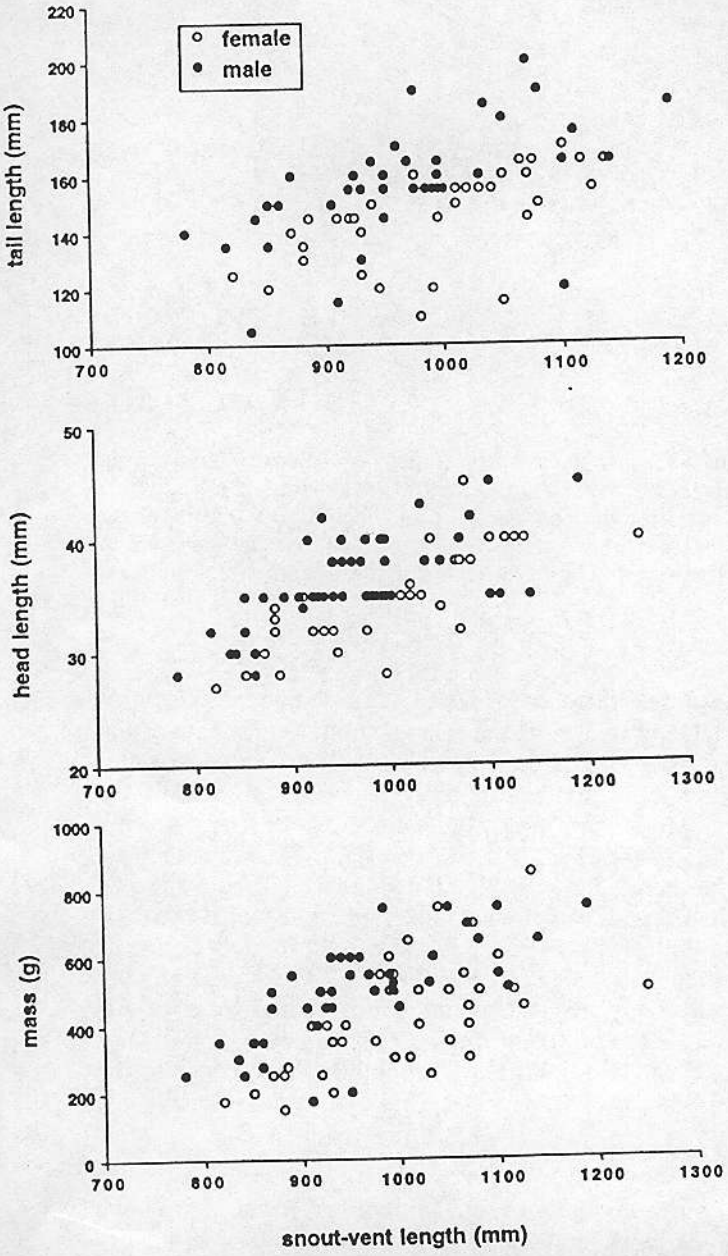

Fig. 1. Sex differences in body proportions in specimens of the spitting cobra, *Naja sputatrix*, from Central Java. Compared to females of the same snout-vent length, male cobras have longer tails (upper graph), larger heads (middle graph) and weigh more (lower graph).

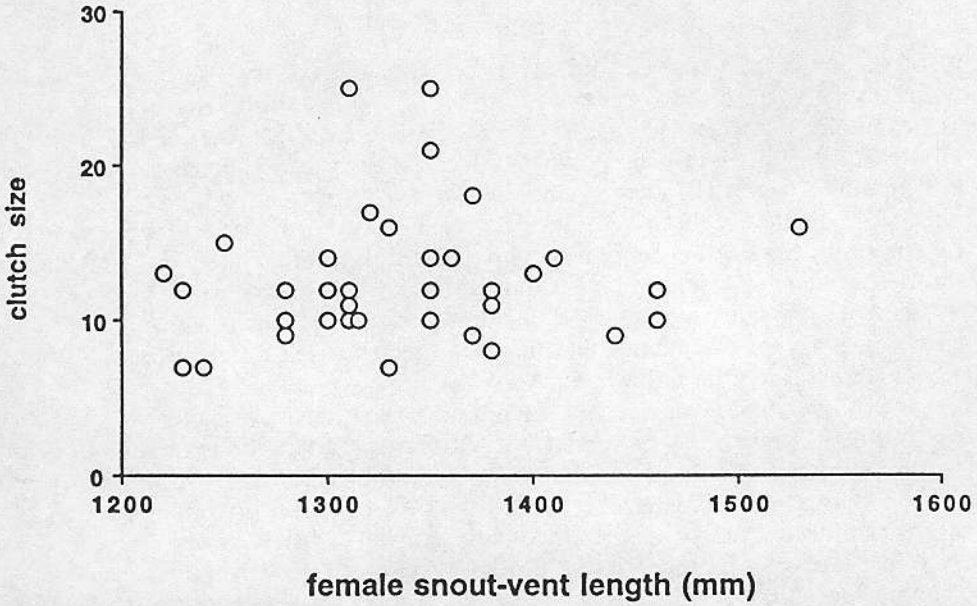

Fig. 2. Clutch sizes relative to female body size in rat snakes, *Ptyas mucosus*. Clutch sizes estimated from vitellogenic ovarian follicles and oviductal eggs.

were reproductive when collected on the second survey (Oct. - Nov. 1996). Nine of the females collected on the first survey contained oviductal eggs, whereas this was true for seven females on the second survey. Based on 37 records of oviductal eggs or vitellogenic ovarian follicles, clutch size averaged 13.0 (SD = 4.0), and ranged from 7 to 25 eggs. Clutch size was not significantly correlated with maternal body length ($r = 0.16$, $P = 0.36$; see Fig. 2).

FOOD HABITS

Of the 85 rat snake guts examined, 65 contained the remains of prey items. Most of these alimentary tracts (71%, N = 65) contained unidentifiable material (colloidal substances and insect fragments), as is typically seen in snakes that have consumed amphibians (SHINE, pers. obs.). Thus, it is presumed that these gut contents represented ingestion of frogs. Another nine rat snake guts (14%) contained mammalian fur, presumably from rats.

A similar proportion of cobras contained prey items when collected (67%, N = 84 guts). Mammalian prey items were recovered from many of these cobras (33, or 59%), with the remainder consisting of unidentified animals (probably mainly frogs).

DISCUSSION

Our data provide the first quantitative information on morphology, sexual dimorphism, reproduction and food habits of the two most important species

harvested for their skins in East and Central Java, the rat snake and the spitting cobra. Some of our results are directly relevant to the long-term sustainability of harvesting. For example, it seems as though both of the harvested species feed extensively on prey types (rats and frogs) that may have increased in abundance due to human agricultural activities such as flooding of paddy fields, growing of grain crops, etc. The relatively high numbers of male snakes collected also suggests that the impact of collecting on natural populations may not be as severe as one might at first imagine. Also, the large clutch size and high proportions of reproductive rat snakes – the latter result suggesting that these snakes may produce more than one clutch per year – indicates that, for this species at least, potential rates of population growth may be quite high.

Clearly, however, more studies are needed to build up a comprehensive picture of the biology of these snakes. In particular, it will be important to gather information on the reproductive biology of the cobra, by carrying out field work during times of the year when cobras are breeding. It is also necessary to gather data on rat snakes at times of the year other than November to January, in order to investigate the seasonality of reproduction in this species as well. However, this task is not so simple as it might seem. Harvesting is highly concentrated at certain times of the year, when the agricultural workers have enough free time to go out and catch snakes. Hence, the snakes are not collected at times of the year when the farmers are busy planting or harvesting their crops.

The current harvest of rat snakes and cobras in Java has probably been going on for a considerable time, and there seems to be no doubt that some level of commercial and domestic exploitation of these natural resources will be sustainable indefinitely. However, we will require further studies – including long-term monitoring of offtake levels from the harvest – before we can confidently assess the impact of collectors on the populations. In the shorter term, it would be useful to investigate patterns of habitat use by the harvested taxa to assess the degree to which they are able to exploit habitats that have been significantly modified by agricultural and other human activities.

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