

Declining populations of the Javan warty pig *Sus verrucosus*

Gono Semiadi and Erik Meijaard

Abstract We conducted an interview-based survey for the Javan warty pig *Sus verrucosus*, endemic to the islands of Java and Bawean in Indonesia. The species occurs in 10 isolated areas, although some additional, probably very small populations, may remain. Compared to a survey conducted in 1982, 17 of the 32 (53%) populations are extinct or have dropped to levels so low that local hunters have failed to encounter the species in recent years. This indicates a rapid population decline. We hypothesize that this loss is primarily caused by a decline in suitable habitat, especially stands of teak *Tectona grandis* forest or similar forest plantations, and by high

hunting pressure. Competition from and hybridization with the Eurasian wild boar *Sus scrofa* may be further threats to *S. verrucosus*. Rapid action is needed to prevent extinction in the wild. We recommend effective protection of selected *S. verrucosus* populations, lobbying of the Government to give protected status to *S. verrucosus*, conducting ecological research and investigating crop damage issues, and establishment of conservation breeding programmes.

Keywords Ethnobiology, Indonesia, Javan warty pig, Suidae, survey, *Sus verrucosus*, teak.

Introduction

The Javan warty pig *Sus verrucosus* is endemic to the islands of Java and Bawean in Indonesia. Hardjasamita (1987) traced its ancestry to several fossil pig species of Java and this, together with phylogenetic data (Randi *et al.*, 1996), suggests isolation on Java for *c.* 2 million years. *S. verrucosus* occurs alongside the Eurasian wild boar *S. scrofa vittatus*, which arrived in the Late Middle–Late Pleistocene (van den Bergh *et al.*, 2001). *S. scrofa* is widely distributed throughout Asia and Europe (Oliver *et al.*, 1993). Olivier (1925) noted that in West Java both pig species were common and occurred in similar habitats, from coastal to montane forests. More recent studies indicated that the two species avoid each other (Blouch, 1988, 1993).

S. verrucosus was believed extinct in the late 1970s (J. MacKinnon, pers. comm. to W. Oliver), but a small population was found in 1981 on the forested slopes of Mt Penanggungan near Tretes (Whitten *et al.*, 1996; Fig. 1). In 1982 Blouch (1988, 1993) conducted a survey for *S. verrucosus*; this also included Bawean Island but excluded Madura Island, where the species was historically known to occur (Sody, 1941) but was presumed

extinct. Blouch found that *S. verrucosus* occurred in lowland areas below 800 m, although there are several museum specimens of *S. verrucosus* from localities as high as 1,500 m (van Strien, 2001). Its preferred habitat consisted of extensive areas of lowland secondary vegetation, particularly teak *Tectona grandis* plantations in Central Java characterized by a mixture of trees and grasslands with clumps of bush and heavily disturbed forest. Blouch also found that *S. verrucosus* frequented coastal forest. *S. scrofa* on the other hand could be found at all altitudes in most habitats.

The survey by Blouch located 32 populations across Java, and he concluded that the future of *S. verrucosus* was reasonably secure. A few years later Blouch & Groves (1990) pointed out that hybridization between *S. verrucosus* and *S. scrofa* posed an unknown, but potentially serious threat, primarily to the survival of *S. verrucosus*. Two subspecies are recognized: *S. verrucosus verrucosus* on Java and *S. verrucosus blouchi* on Bawean Island. Both subspecies are categorized on the IUCN Red list as Endangered, based on an inferred population decline, fragmentation of habitat, and the levels of exploitation (IUCN, 2004). An Action Plan (Oliver, 1993) accorded the species high conservation priority, and stressed the urgency of implementing relevant conservation measures, including the survey described here. Despite the recommendations of the Action Plan, *S. verrucosus* remains unprotected under Indonesian law. Considering the Red List status of *S. verrucosus* and the much-reported decline of Java's teak forests (Chicago Tribune, 8 July 2001; Jakarta Post, 15, 22, & 27 August 2001) we considered it likely that the conservation needs

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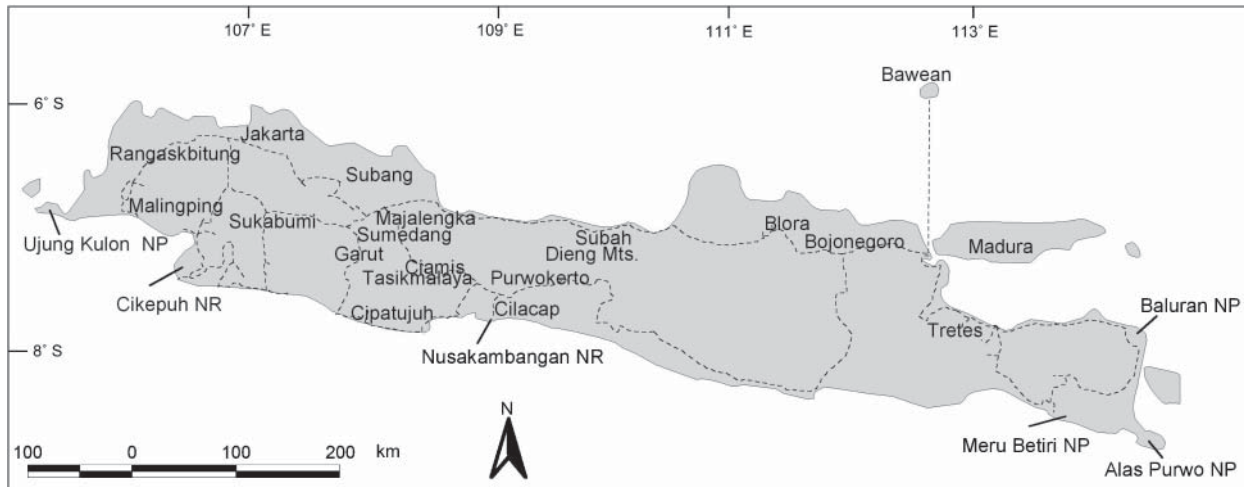


Fig. 1 Java and Bawean Islands, with names of towns and protected areas mentioned in the text; survey routes are indicated by dotted lines (NR, Nature Reserve; NP, National Park).

of the species had increased since the 1982 survey and that active conservation management may be required to ensure its survival.

Our survey is a first step towards assessing the status of *S. verrucosus*. We revisited all populations that were recorded by Blouch. We report our findings by comparing the current distribution with that in 1982, and also use distribution records from c. 1840 to 1950 for an historic perspective. Based on the observed population trends we provide recommendations for improved conservation management.

Methods

Surveys

We conducted a social survey on Java and the island of Bawean, c. 125 km north of Java (see Fig. 1 for survey routes). Presence and absence data for *S. verrucosus* were primarily gathered by GS and local field assistants, who interviewed local informants and conducted field inspections. There are drawbacks to interview-based survey techniques as it is difficult to assess the accuracy of information collected. Nevertheless, ethnobiological surveys constitute an important means of rapidly accumulating presence/absence data and identifying human-induced threats. We ensured that our questions were phrased objectively and took care not to elicit strategic answers by obscuring the purpose of our interviews. Because pig hunting is common and never punished we are confident that interviewees replied honestly. Our first step was to select the most appropriate interviewees, namely those who hunted, trapped or poisoned pigs. We selected people identified by village headmen, who were mostly

older than 35 years and thus most likely to have witnessed longer-term population trends. We also talked to the heads of the regional offices of the Indonesian hunting association (PERBAKIN), to policemen who accompanied or participated actively in hunting excursions, and to farmers who had experienced problems with pigs foraging in their fields and gardens.

We conducted our interviews in a structured manner, noting the interviewee's name, age and occupation, followed by questions relating to crop damage, hunting and poisoning, pig population trends, group sizes and breeding cycles. We also enquired whether different pig species occurred in the area, or in which year they had been last seen, and we asked about their physical appearance, relative abundance and differences in habitat preferences. We showed six photographs (three of each species) to verify the interviewees' acuity and ability to identify the two species. *Sus verrucosus* males have pronounced facial warts, which are absent in *S. scrofa*, and there are also colour and size differences. Females of both species are similar, making field identification difficult. All interviews were conducted in the appropriate local language (Indonesian, Sundanese or Javanese). If the accuracy of information was in doubt, attempts were made to corroborate reports in separate interviews with informants in nearby villages. In addition to the field surveys, GS also visited all Javan zoos maintaining *S. verrucosus* to gather data about the health, breeding success, sex, age, and other particulars of captive animals.

Distribution range mapping

Using 1:500,000 vegetation maps (Peta Lingkungan Laut Nasional, BAKOSURTANAL, 1992), and for some areas

1:50,000 maps (Peta Perjalanan, Indo Prima Sarana, 2000), we estimated the extent of local distribution ranges of *S. verrucosus* by drawing minimum convex polygons around localities of reported pig sightings and mapping apparently suitable habitats (forest plantations and secondary forests) in each location where the species was reputed to occur. For this we used the vegetation and topography maps of MacKinnon (1997) and the geographical information system ArcView 3.2 (ESRI, Redmond, USA).

Assessment of distribution trends

To investigate whether there has been a decline in *S. verrucosus* populations we assessed the historic distribution range of *S. verrucosus* by plotting the localities of museum specimens and sightings or kills recorded in the literature (Olivier, 1925, 1928; Franck, 1936; Bartels, 1937, 1942; Sody, 1941). We also digitized the distribution range as reported by Blouch (1983, 1988), visually interpreting the location of *S. verrucosus* populations on Blouch's maps.

Results

Present distribution

During our field surveys we conducted interviews in 85 locations, of which four were zoos. Six interviews did not result in useful data as the interviewees had no knowledge of pigs. Information from 26 of the 75 field interviews strongly suggested that *S. verrucosus* was locally present; 13 interviewees suggested that *S. verrucosus* no longer occurred in the area, and 26 were only

familiar with *S. scrofa*. In the remaining 10 interviews it was unclear whether *S. verrucosus* still existed (e.g. last reported sightings 10 or more years previously; for details see Semiadi & Meijaard, 2004). Our survey indicated that, between 1982 and 2003, 17 of the 32 (53%) *S. verrucosus* populations identified by Blouch (1983) had been extirpated or dropped to levels so low that local hunters had failed to encounter the species in recent years. In three cases we found that *S. verrucosus* was probably present in locations where Blouch had not reported them. Our data suggest that there are c. 10 areas on Java and Bawean where *S. verrucosus* populations survive (Fig. 2, see Semiadi & Meijaard 2004 for details), although very small groups may exist elsewhere. We did not visit the island of Madura but one of our interviewees, who was familiar with the pigs of Madura, alleged that *S. scrofa* still occurred but that there were no recent sightings of *S. verrucosus*.

We found no evidence or indications of extant *S. verrucosus* populations in any of the national parks in which we collected information. In 1982 Blouch (1988) reported that *S. verrucosus* still occurred in the Ujung Kulon National Park (Fig. 1), but a camera-trapping survey during 1999–2003 did not record *S. verrucosus* among 115 photographs of pigs (GS, pers. obs.). In Baluran National Park (Fig. 1), where *S. verrucosus* still occurred in the 1970s (Blouch, 1983), there were no *S. verrucosus* among 200 dead pigs found between 1992 and 1999, strongly indicating the absence of this species (S. Hedges, pers. comm.). Extensive mammal surveys and skull studies between 1994 and 1999 in the Alas Purwo National Park (Fig. 1) also strongly suggested that *S. verrucosus* is absent (S. Hedges, pers. comm.). A

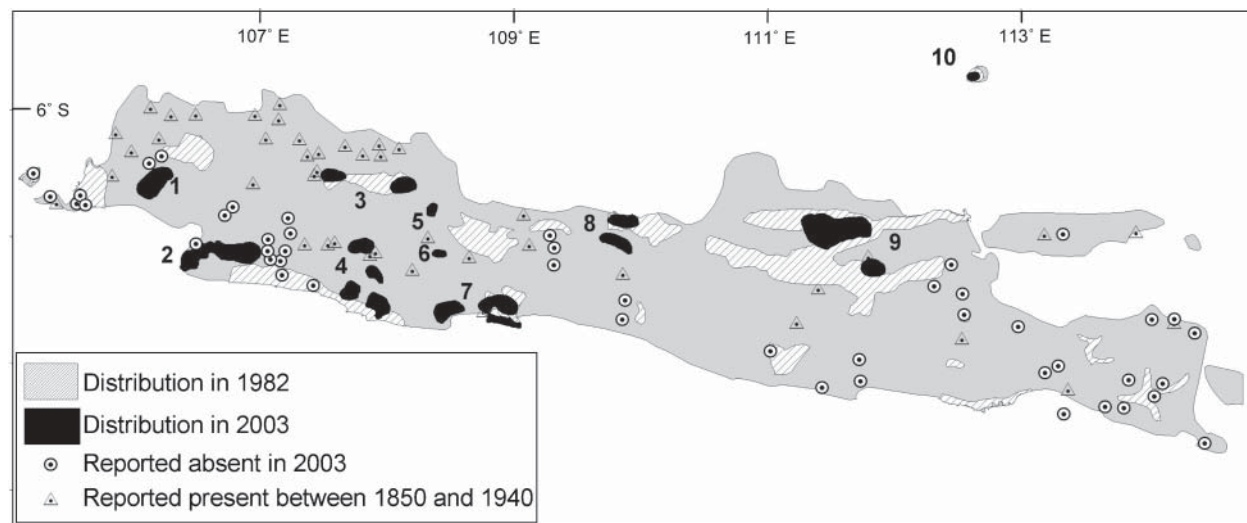


Fig. 2 Presence and absence of *S. verrucosus* as determined by the present survey, Blouch's surveys in the 1980s, and localities of museum specimens collected between 1850 and 1940. Numbers 1–10 indicate the 10 extant populations.

camera-trapping programme conducted between 1999 and 2001 in Meru Betiri National Park (Fig. 1) and reports from several interviewees again suggested the presence of only *S. scrofa*. Some nature reserves, however, may still support *S. verrucosus*, including Cikepuh Nature Reserve and the adjacent Cibanteng Nature Reserve, and Nusakambangan Nature Reserve (Fig. 1). A population of *S. verrucosus* has also been reported in the proposed protected area in the Dieng Mountains (Fig. 1; Nijman, 2001), but we did not visit this area.

Historic distribution

We found 46 identifiable localities in the literature and from museum specimens, and we mapped these to indicate the distribution range of *S. verrucosus* between c. 1850 and 1940 (Fig. 2). This shows that the majority of historic records originated from western Java, with only nine collecting localities (including Bawean and Madura Islands) east of 110°E. A comparison with historic records of *S. scrofa* showed that this species was much more evenly distributed over Java. The data also indicate that *S. verrucosus* used to be common in the north-west of Java, where they are now extinct.

Threats

Twenty-eight of the 49 interviewees (57%) who reported the occurrence of *S. verrucosus* also reported a noticeable decline, which in >50% of the cases had led to the species' local extinction. High hunting pressure, logging of tree plantations, and dispersal of pigs to other regions were considered the most important causes. Twenty-one interviewees specifically mentioned that pigs were major agricultural pests. Pigs are either hunted by village groups or hunting groups from PERBAKIN. An important reason for hunting was to control pig populations and thus damage to croplands. However, pigs are also hunted for commercial purposes in various areas across the island (e.g. Sukabumi, Rangkasbitung, Pemalang, Blora and Cilacap). Wild pork meat is consumed in only a few areas in Java, although there is probably a demand from Christian communities. In the area between Sumedang, Majalengka and Ciamis, pigs were captured alive for organized fights between dogs and pigs. *S. verrucosus* males are sought after because of their large size, aggression and stamina in such fights.

Zoo populations

We visited three zoos holding *S. verrucosus* to explore opportunities for developing a conservation breeding programme. Surabaya Zoo is the only facility to have

bred this species, although it appeared that some individuals have hybridized with *S. scrofa*. This was indicated by the presence of warts, which suggest a genetic contribution from *S. verrucosus*, but the animals were much smaller (20–45 kg) compared to the presumed genetically pure *S. verrucosus* in the Jakarta and Yogyakarta Zoos. The greyish skin colour of the Surabaya *S. verrucosus* also suggested a genetic contribution from *S. scrofa* to the *S. verrucosus* population. K. Leus (pers. comm., 10 June 2004) also raised the possibility that the Surabaya population had been crossed with the *blouchi* subspecies from Bawean Island. The animals in the Yogyakarta and Jakarta Zoos had not bred even after 8 and 10 years of captivity respectively. These animals appeared to be of pure stock; the breeding problem appeared to be that the animals are overfed and overweight, diminishing their capacity to mate or conceive.

Discussion

Methodological considerations

One of the problems in surveying Javan pigs is that it is hard to discriminate between the two species from field signs. In addition, only adult male *S. verrucosus* are easily distinguishable during sightings because of their larger size and facial warts, whereas *S. verrucosus* females and subadults are almost indistinguishable from male and female *S. scrofa*. Hunters were our best source of information, because most had closely observed and handled specimens of each species, and were most likely to recognize any diagnostic differences between them in all age and sex classes. Nevertheless, many hunters fail to distinguish between the females of the two species and some hunters regarded the males with warts as being the oldest and most powerful male pigs of a single species, thus not recognizing that there are two species. Approximately 90% of the reported killings of *S. verrucosus* were of males. This raises the possibility that the species is under reported and that the distribution range as discussed here could be more extensive. However, as males and females are expected to co-occur, the under reporting of females should not lead to a major bias in presence/absence patterns of the species.

Population trends

Comparison of our results with the 1982 survey of Blouch (1983, 1988; Fig. 2) is striking. It is unclear to what extent these differences can be explained by dispersal of *S. verrucosus*, local population decline, or methodological differences between the two surveys. Our interview data indicate a general decline of *S. verrucosus*, with many interviewees remembering the species from several years or a decade ago, but not having encountered it in recent

times. Interview data of relative kill rates provided further evidence of such declines; i.e. with average numbers of animals reported killed having dropped from 3–10 pigs per hunting excursion *c.* 15 years ago to 0–2 pigs in 2001. A comparison with the species' pre-1940 distribution indicates that it has also been extirpated from large parts of north-west Java and possibly from Madura, although for this island there is still no convincing evidence.

Differing methodologies may also have resulted in different estimates of the extent of the species' distribution range. Blouch (1988) also placed heavy reliance on hunter interview surveys, but stated that 'probable limits of distribution for each population were determined using land use maps accompanied by field checking'. *S. verrucosus* occurs in a wide range of vegetation and land use types making it hard to assert how far from reported localities the species ranges. We were probably more conservative than Blouch in drawing distribution ranges and primarily used minimum convex polygons around all localities where the species has recently been reported. To a lesser extent we relied on the extent of vegetation types such as lowland secondary forest and forestry plantations to determine where the species could occur, because we expected that much of the key vegetation types in which *S. verrucosus* occurs had decreased since the vegetation maps were made. This methodological difference may be another reason why the ranges indicate by Blouch (1983, 1988) were much larger than ours.

Interaction between *S. verrucosus* and *S. scrofa*

Another disparity between the 1982 survey (Blouch, 1983, 1988) and our data was that Blouch identified several areas where only *S. verrucosus* occurred and no *S. scrofa*; e.g. the region around Subang and Majalengka (Fig. 1). Our data suggested that *S. scrofa* is now the dominant species in that area. Similarly, Blouch (1983, 1988) reported good numbers of *S. verrucosus* on the southern coastal plain of western Java, especially in the western half of this region, where he thought *S. scrofa* absent. Our data suggest that *S. verrucosus* is now rare or locally absent in this region, whereas *S. scrofa* is apparently common throughout the area. In the extensive teak forests between Semarang and Surabaya, Blouch (1983, 1988) recorded *S. verrucosus* as the only species present, whereas our survey suggests *S. scrofa* is more abundant than *S. verrucosus*, which is still in this region but in much reduced numbers.

These data indicate that *S. verrucosus* has declined in many areas and that there have been corresponding increases in the numbers of *S. scrofa*, which has even replaced *S. verrucosus* in some places. Too little is known

about the ecology of *S. verrucosus* to infer competitive exclusion as a mechanism for the changing ratios between *verrucosus* and *scrofa*, although the few available data suggest this may be the case. This view was also shared by Blouch (1983).

Our data suggest increased deforestation and high hunting pressure to be the main causes of the decline of *S. verrucosus*, although direct evidence for this is lacking. Comparison of our survey with that of 1982 (Blouch, 1983, 1988) suggests that *S. scrofa* is able to withstand these pressures better than *S. verrucosus*, probably because of ecological differences between the species. The absence of any *S. verrucosus* remains in Holocene cave deposits in two locations in Central Java where *S. scrofa* remains are abundant (Dammerman 1934; van den Brink 1982) not only suggest these species did not always coexist in the same areas, but that without significant human pressure the species may have occupied different ecological niches. Clearly more ecological research on *S. verrucosus* is needed to establish its ecological requirements and to determine if and how *S. scrofa* has a competitive advantage.

Habitat loss

Since the political upheaval in Indonesia in the late 1990s the teak forests of Java, which both our survey and that of Blouch (1983, 1988) indicate as prime *S. verrucosus* habitat, have come under increasing threat from illegal logging. Teak theft has been reported from all over Java (Chicago Tribune, 8 July 2001; Jakarta Post, 15 August 2001, 11 October 2003, 5 July 2004), especially since the fall of president Suharto and the resulting power vacuum. The state-owned forest company PT Perhutani claimed to have lost USD 49 million worth of teak trees in 2000 alone because of theft from its forestry concessions in Java (Jakarta Post, 9 June 2001), and that it lost 243,158 m³ of teak from its plantations over 1997–2002 (*Paras Indonesia*, 29 November 2002). We were unable to obtain reliable data on trends in forest and plantation area in Java, and we have therefore primarily relied on interviewees and newspaper articles to suggest that a decline in forest habitat is one of the reasons for the decline of *S. verrucosus*.

Hunting

In addition to hunting, poisoning has taken a great toll on wild pigs (Whitten *et al.*, 1996), although this was rarely reported by our interviewees. About 70% of our interviewees reported that pig pests and concomitant hunting increased after 1950. It is possible that this is related to the demise of what was probably the main natural predator of pigs, the Javan tiger *Panthera tigris sondaicus*. By 1950 the once common Javan tiger had

declined to *c.* 25 animals (Boomgaard, 2001), and it became extinct in the 1970s. In many areas where tigers had been exterminated pigs increased in numbers and became local agricultural pests (Boomgaard, 2001).

Captive breeding

The present state of the captive *S. verrucosus* population is insufficient to safeguard or contribute to the survival of the species. The three captive populations on Java are either failing to reproduce (Yogyakarta and Jakarta Zoos) or are of questionable purity (Surabaya Zoo). As far as we know there are no captive populations elsewhere. Considering the increasingly precarious status of both *S. verrucosus* subspecies in the wild, the establishment of one or more well managed captive populations is both desirable and urgent.

Conclusions and recommendations

The balance of evidence suggests that *S. verrucosus* is in decline throughout its range. The main reasons for this appear to be overhunting and probably a decrease in habitat area, although other factors may also be involved. We suggest the following priority activities for the enhanced future conservation management of this species.

- (1) Effectively protect selected *S. verrucosus* populations in the wild. There appear to be no *S. v. verrucosus* populations within Java's National Parks, although some remain in Nature Reserves. Indonesia's reserves are poorly managed (Curran *et al.*, 2004; EM, pers. obs.) and it is not clear to what extent they can presently contribute to safeguarding *S. verrucosus*. Nijman (2003) noted similar concerns for Bawean's pigs because the one reserve on the island, which covers only 7.3 km², is largely unmanaged. Proposals made by Blouch (1983) included the protection of several key areas, but no action has yet been taken. Elsewhere, protection of key habitats, i.e. lowland teak plantations and lowland secondary forest, may be more likely to succeed in areas that are privately owned or actively managed by the State.
- (2) Lobby the Government to give protected status to *S. verrucosus*. The species is not protected in Indonesia, and hunting them is legal. Whitten *et al.* (1996) suggested that this should remain unchanged, and considered that sports hunters were the key to successful conservation of *S. verrucosus* as they have a vested interest in the species' survival. These are issues that need to be discussed with government agencies, PERBAKIN, local farmers groups and other stakeholders. We believe, however, that without any legal status, it will be difficult to set hunting quotas or locally prohibit killing of the species.
- (3) Investigate crop damage by *S. verrucosus*. Crop raiding is the stimulus for hunting pigs but it is not clear which of the two species are involved, which crops they are attracted to and at which time of year, and how pigs can be kept out of crops.
- (4) Develop research projects. Little is known about the biology of *S. verrucosus* and there is a need for both *in situ* and *ex situ* studies, especially of the species' habitat requirements and interactions with *S. scrofa*. Survey methods need to be developed that can reliably establish densities of both pig species; DNA analysis of faecal material may be useful, and camera trapping techniques could also be used. There is also a need to quantify poisoning and hunting.
- (5) Establish conservation breeding programmes. Available pure-bred stocks could be utilized, supplemented with additional founders where necessary. Improving the holding facilities and management practices in Jakarta, Yogyakarta and Surabaya zoos would be the easiest way to achieve this. An additional option would be to set up a semi-captive breeding facility on an island offshore from West Java, which would allow easy reintroduction into nearby national parks.

Seed funding has recently been made available by the Dutch Stichting Dierentuinen to assess the suitability of some islands near Ujung Kulon National Park for a semi-captive breeding programme. In early 2006 a workshop involving scientists, government officials, and representatives from the zoo community will address the various options for effective *in situ* and *ex situ* conservation programmes for *S. verrucosus*. Our aim is to have an active conservation programme for the species by the end of 2006.

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Biographical sketches

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