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Lessons Learned from Training Students to Conduct Primate Surveys

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Abstract: Habitat destruction is increasingly threatening the remaining primate habitat on the island of Java and populations of primates are declining as a result. Field surveys are commonly used to document the status of species such as primates and often serve as a preliminary step to long-term studies of primate populations. We trained university students on field methods for surveying primates at two sites in Java—Gunung Halimun Salak National Park (GHSNP) in 2017 and Gunung Simpang Nature Reserve (GSNR) in 2019. The purpose was to train students in standardised repeatable methods for surveying primates in the wild. The training courses were intended to provide knowledge on how a primate survey is planned and designed and to teach the methods used to carry them out. We assessed how students used two survey methods, line transects and point counts, and evaluated the differences between the two, and subsequently evaluated the student's response to the program. We delivered in-class and field training on three topics: basic survey techniques; navigation and the use of field equipment; and primate survey methodology. Our results suggested that the students tended to detect primate species better using the line-transect method. A training protocol is critical to make sure that all materials given in the class and in the field are standardized, including the evaluation mechanism. Reliable primate surveys will guarantee that the data collected is scientifically appropriate to support management for primate conservation.

Key words: Primate survey training, line transect, point count, field survey, Javan primates

Introduction

About 516 primate species are recognized worldwide. With 64 species currently described, Indonesia has the third most diverse primate fauna, after Brazil (130 species) and Madagascar (108 species). Indonesia's primates are from five families and 11 genera. At least thirty-eight species are endemic (Mittermeier *et al.* 2013). They are spread across the country from northern Kalimantan to the southern coast of Java, and from the western parts of Sumatra, east, and introduced to Bacan, and East Timor (Heinsohn 2001). Indonesia has every type of primate, from primitive species such as tarsiers to the modern apes, both the small apes and great apes (Supriatna 2019).

Java is the natural southeastern limit of primate distributions in Asia. Some of the primates still surviving on Sumatra and in Kalimantan have become extinct on Java; pig-tailed macaques and orangutans are examples, Java has four endemic primates, all classified as endangered: the Javan gibbon (*Hylobates moloch*), the grizzled leaf monkey (*Presbytis comata*), the West Javan langur (*Trachypithecus mauritius*), and the Javan slow loris (*Nycticebus javanicus*) (Roos *et al.* 2014). There are two others: the Javan langur (*Trachypithecus auratus*), which is found from East Java to the islands of Bali and Lombok, and the long-tailed macaque (*Macaca fascicularis*), which is distributed widely in Sundaland and has been introduced to several islands in the Nusa Tenggara archipelago (Heinsohn 2001; Roos *et al.* 2014; Supriatna 2019).

Primates use forest as habitat and most of the forest that still remains on Java is in rugged mountainous areas or in national parks and other protected areas. There is now less

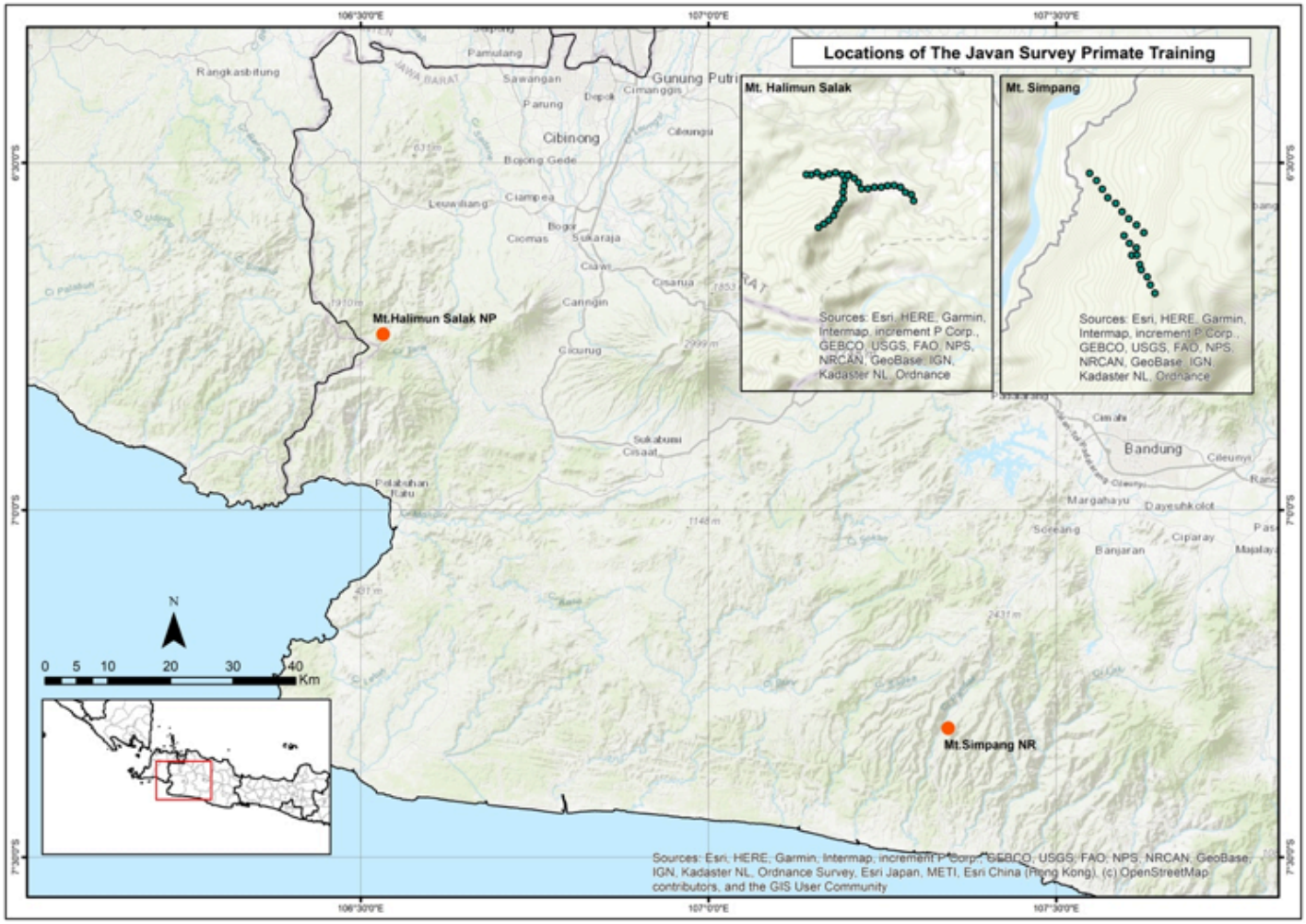

Figure 1. Locations of the primate survey training sites in West Java with positions of survey transects/ at two locations, GHSNP and GSNR (inset).

than 6% of the original forest left on the island (Supriatna *et al.* 1994; Miettinen *et al.* 2011). Forest habitat has been converted into settlements and agricultural land, and primates such as gibbons, leaf monkeys, and the slow loris are hunted for pets. These threats together may drive Javan primates to the brink of extinction. Effective conservation measures are, therefore, urgently needed. There is a need to understand how habitat change contributes to primate declines so that conservation practitioners can guide land-use practices and conservation interventions, and also to reduce the rate of habitat change itself (Gaveau *et al.* 2009).

The Indonesian primate scientists and observers association, Perhimpunan Ahli dan Pemerhati Primata Indonesia (PERHAPPI) has only 176 members (<https://www.voaindonesia.com/a/pakar-khawatirkan-nasib-primata-terdampak-karhutla/5096219.html>), and there are few published studies on primate populations and their distribution in Java (Kappeler 1981; Ruhiyat 1983; Kool 1992; Gurmaya *et al.* 1994; Nijman and Sozer 1995; Nijman 1997; Nijman and van Balen 1997; Nijman and Supriatna 2008; Kool 1992; Setiawan *et al.* 2012; Nijman 2013; Supriatna *et al.* 2010; Supriatna and Ario 2015). Accurate knowledge of the distribution patterns of primates is a necessary foundation for any conservation measures. Surveys are commonly conducted to document the status of species in the wild and often serve as a preliminary step in long-term studies of primate population dynamics. Peres (1999) argued, however, that the lack of consistency in many studies calls for standardizing techniques to ensure the comparability of primate surveys between sites. Training and education on primate surveys are needed therefore, to cover planning, implementation, and evaluation (Jacobson 2010). To address this issue, we conducted courses on field methodology for university students at two mountain sites in Java, Gunung Halimun Salak National Park (GHSNP) in 2017 and Gunung Simpang Nature Reserve (GSNR) in 2019 (Fig. 1). The aim of the training was to teach students how to plan and design primate surveys and to explain the methods used to survey primates. We focused on how students used two different survey methods and evaluated the differences between the two methods. We also then evaluated the student's responses to the program.

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Methods

The courses involved both classes and field surveys. In 2017, we invited 10 students from several universities in Jakarta, West Java and Central Java. For the course in 2019, there were 14 participants, ten undergraduates and four graduate students studying primatology and community ecology in the Department of Biology, University of Indonesia (Table 1).

Training sites

In 2017, the students were taken to Gunung Halimun Salak National Park (GHSNP), which is about 90 km south of Jakarta, and in 2019, to Gunung Simpang Nature Reserve (GSNR), about 250 km south-east of Jakarta. We chose these sites because we knew them well. We expected to encounter primates in GHSNP as they are often seen there. We hoped to encounter primates in GSNR but there have been few reports of sightings in recent years so we wanted to assess the populations ourselves.

We conducted the first field course in GHSNP from the 12−15 August 2017. We chose the Citalahab – Cikaniki area for our training site because it has an ecotourism center inside the tropical rainforest, and primates are known to occur there, e.g., Javan langur (*Presbytis comata*), Javan Gibbon (*Hylobates moloch*), the East Javan langur (*Trachypithecus auratus*) and the long-tailed macaque (*Macaca fascicularis*) (Supriatna 2014). The second training course was conducted in GSNR, West Java. At 15,000 ha, GSNR is one of the largest protected areas in West Java. We conducted the course from 4−5 May 2019. This nature reserve is suitable habitat for the same species as in GHSNP. (BBKSDA Jabar 2016). This course took place in the Citengkor Area.

In both locations, transects were prepared prior to the courses and were made as straight as possible.

Survey training

Students were given in-class training on basic primate survey theory, the use of survey equipment (compass, GPS) and the two Distance Sampling methods, line transects and point counts (Buckland *et al.* 1993, 2001) (Table 2). The students practised distance estimation prior to the actual surveys. The line-transect method is used to estimate relative density of primate populations. In this method, observers walk along a straight line and record all encounters with primates (Marshall *et al.* 2008). We also conducted point-count surveys to compare the effectiveness of this method with the line-transect method as part of the training exercises. Point count can also be used to estimate relative density and to census primates. In the point count method, observers stay at a point and record all encounters for 15 minutes. Either visual or call signals can be estimated using point count by estimating the distance from the observer to the primate or its call (Plumptre *et al.* 2013). Our expectation was that students would learn to use both methods in the field, become competent in the detection and identification of Javan primate species and that they would understand the assumptions inherent in distance sampling methods, i.e., animals on the transect line or point must be detected; animals are detected at their initial location, species are identified correctly, and that distances are measured accurately (Buckland *et al*. 1993, 2001).

Table 1. Training course profiles.

	Course I – 2017 Gunung Halimun Salak National Park (GHSNP)	**Course II – 2019 Gunung Simpang Nature Reserve (GSNR)**
Participants		
Number of participants	10	14
Background of participants	Different universities in Jakarta, West and Central Java	Universitas Indonesia (primatology and community ecology class)
Tutors		
Senior scientists	3	3
Junior scientists	3	2

Table 2. Classes given during training.

Materials given	**In-class duration**	**In the field duration**	**Expectation**
Basic theory (Introduction on Javan primate, design sampling)	2 hrs	1 hr	• Participants can identify Javan primate species • Participants understand how a survey is designed
Navigation and the use of field equipment (navigation, GPS, compass)	1 hr	1 hr	• Participants can use compass and GPS for survey • Participants understand how to estimate distances
Primate survey methodology (line transect, point counts, habitat survey)	2 hrs	4 hrs	• Participants can identify correctly all the Javan primate species observed during field survey training • Participants can use the line transect and point count methods in the field and can complete the datasheet properly • Participants can collect the habitat structure data

The training surveys were conducted from 06:00 am to 11:00 am. Each transect was separated by 500 m from every other transect. In each transect, one group, composed of 3–4 participants, practiced the line-transect method, while another group with the same number of participants practiced the point-count method. Each group of students was accompanied by two tutors (one scientist and one junior scientist), who had previous experience in primate surveys. During training, participants learned to detect both visual and call signals. Data collected for the line-transect method were time of observation, species name, number of individuals, angle of object to the transect, and estimated distance of object to observer. Data collected for the point-count method included time of observation, species name, number of individuals, and estimated distance of object from the point.

After conducting line transects and point counts the participants collected data for habitat profiles to describe the primate habitat, i.e., canopy closure, understorey density, and number of trees with DBH (Diameter at Breast Height) >10 cm. Habitat variables were quantified within a 20-m radius around the points. This circular plot was then divided into 4 quadrants and within these quadrants, the participants measured understory density and canopy closure. Canopy coverage was measured using a canopy scope made of a transparent CD case which was divided into a 5 × 5 grid. The observer then looked up at the canopy through it and recorded the number of grids covered by the canopy (Brown *et al.* 2000). The understory layer was measured by using a 1 m² white sheet divided into a 4 × 4 grid and counting the number of grid squares covered by understory vegetations. Tree diameter at breast height (DBH) was measured using a DBH tape. After that, the students learned to navigate the track from one point to the other.

Student evaluation

After the surveys, the students were given questionnaires to determine the value of the training from their point of view. There were four indicators: 1) usefulness, to find out if they thought that the courses would likely be useful for their future conservation careers, 2) knowledge increase, to measure the knowledge that the participants gained during the training, 3) appropriateness of course duration, to assess the suitability of the duration for effective training, and 4) quality of the tutors. We measured these parameters from the two fieldwork exercises and scaled each parameter from 0 (least) to 10 (perfect) and also measured the average score (%).

A post fieldwork test was then given to participants. In the first course, the post-test comprised 20 multiple-choice questions, while the second course post-test comprised 10 essay questions. The second post-test was different because we were seeking the best evaluation method to make improvements for future courses. The questions covered three topics, basic theory, navigation and field equipment use, and primate survey methodology. We then compared the average results of both tests.

Results

Training survey results

Three of the four possible primate species were observed by students during the course fieldwork in GHSNP and GSNR as shown in Table 3. In GHSNP, the students observed 34 individuals using line transects and 21 individuals using point counts. Only one gibbon, *H. moloch* was observed using line transects in GSNR and none using point counts, although another individual was heard calling beyond the range of the transects (Table 3). The different results from the two sites might be due to a number of factors, such as for example, habitat profiles and the close proximity of transects to villages. Transects had already been established in GHSNP; they are actively used for primate surveys and the local guides know the primate groups in the area. The GSNR was a new location even for the mentors and there were no local guides trained to do primate surveys.

Table 3. Primate species encountered during training fieldwork in the two protected areas and the records the from two different survey methods.

Species	GHSNP			GSNR		
	Line transect	Point count	Outside transect	Line transect	Point count	Outside transect
Hylobates moloch	10	7	0	1	0	1
Presbytis comata	9	2	0	0	0	0
Trachypithecus auratus	15	12	0	0	0	0
Total	34	21	0	1	0	1

Table 4. Results of student evaluations and post-training test scores.

	Course I	Course II
Participant's Responses		
Usefulness	98.00%	94.29%
Knowledge Increase	73.90%	74.29%
Training Duration	80.00%	48.57%
Tutors	86.00%	85.71%
Post-Test		
Number of questions	20	10
Average score of post test	46.00/100	75.80/100

Table 5. Average scores in the post-test of Training I and II by topic.

Topics	Course I	Course II
Basic theory	2.81	5.64
Navigation and field equipment use	1.50	7.32
Primate survey methodology	2.42	9.40

Learning from two sites

The value of the training from the student's point of view is shown in (Table 4). In both training exercises, the students were satisfied that their knowledge of how to conduct primate surveys had been enhanced (74%). Participants in both training exercises believed that the courses would benefit their future conservation careers (98% and 94%). The duration of sampling was different at the two field sites. The first survey was for four days and the second only two. This may partly explain the differences in the students observations between the two. The students thought that the second survey was too short. Participants from both training exercises found that the tutors were good at delivering and demonstrating the lessons and the survey methods (86%). Based on the post-fieldwork test (Table 5), knowledge of how to conduct primate surveys improved from 46% in the first training exercise to 76% in the second. The difference is likely due to the fact that the second group of participants were all students of primatology and community ecology from one university, while the first group were drawn from a range of courses related to conservation in different universities. Although the differences between multiple choice for the first group and essay questions for the second, may also have had an impact on test scores (Table 5).

Discussion

Course Survey Results

Fewer primates were found at GSNR than at GHSNP. In GSNR, the participants only found only one Javan gibbon (Fig. 2) but did not find any other gibbons or primates. One of the reasons may be that transects were close to cliffs and human settlements. Primates generally occur in areas that have little human activity (Basalamah *et al.* 2010). The transects were chosen based on accessibility. GSNR has many cliffs and ravines, which makes locating suitable transects difficult. In addition, the training survey was conducted during the rainy season, which makes paths more slippery and dangerous, which in turn makes participants focus more on walking and less on detecting primates. This can be a problem for beginners such as students who have never been involved in longer-term field work. In addition, there were no local guides trained to do primate surveys in GSNR, who can help participants to detect and identify the primates.

Figure 2. Javan gibbon, *Hylobates moloch*, on Mount Simpang.

We also suspected that primates were rarely found because transect locations were close to villages. The line-transect method seems to be more effective than the point-count method for students, although our sample size was really too small to be confident about this. Students could easily see and understand the difference between the two once they implemented them in the field. On the questionnaire and competency test, most of the participants already knew the line-transect method. Most of the participants mentioned that the line-transect method is a method where the observer walks in a straight line while making observations and recording data from the object of observation, which is correct (Navarro & Diaz-Gamboa 2015). The line transect-method is also the most common method used in diurnal primate surveys.

Most of the participants also knew the basics of the point count method. Participants knew that for the point-count method observers stay at a point for a pre-determined length of time and record what they see and hear during that time. Although rarely used, the point-count method is appropriate

when existing transects are not easy to implement such as in areas of steep local relief.

Learning from the implementation of primate survey training

Navigation tools are necessary components of field surveys. There were mixed results for competency with navigation tools. Standard repeatable surveys require the same high level of competency with navigation tools so the learning from this exercise is that more training is needed for some students to bring them up to a consistent level.

The most important lessons to learn from the actual primate surveys are how to detect individual primates and how to estimate the distance they are from the observer. When walking in a large group, sometimes it is difficult to focus on detecting the animals. Observers need to walk slowly and should not make any noise. There are assumptions for line transects and point counts that need to be met: (1) animals on the transect line or point must be detected; (2) animals are detected at their initial location, prior to any movement in response to the observer; (3) distances from the transect or point are measured accurately (Buckland *et al.* 1993, 2001). Peres (1999) suggested that a single observer is recommended when conducting surveys for primates, which during training was impossible because in one group there was at least four observers including the trainer (Fig. 3). This number was even larger during the second training exercise due to the larger number of participants.

Most participants considered that the training provided was important for their future conservation careers. This is because all the participants had some background and interest in biology and conservation. Based on these results, the majority of participants expressed their wish to work in the field of conservation, especially in primate conservation.

In the first training exercise, the participants argued that four days was an optimal duration, while in the second, that two days of training was insufficient. An important consideration when designing field surveys is the trade-off that has to be made between how long to spend at each site versus how many sites can be visited. Resources (funds, people) available are usually limited. With only one observation in the GSNR, two days is clearly not long enough. Perhaps four to seven days would have enabled the participants to understand the area better and detect more primates. The longer duration of the first course also allowed participants to change from one transect to another enabling participants to gain more practice. However, the exact duration will vary depending on the precise objective of the survey and a decision will need to be made for each survey. It is relatively easy to standardize methods but duration raises significant issues. It can take a long time to get to inaccessible sites and if the terrain is rugged, it can take longer to complete the same length of transect than if the terrain is flat. There is no simple answer but in seeking to standardise methods these issues must be addressed. Although fieldwork training is usually limited in time, it remains necessary in order to accurately confirm the presence or absence of primates in an area (Geissmann *et al*. 2009) and to estimate population densities.

The participants from both courses had the same reactions to the tutors. That is likely because the teaching staff were the same. Most participants said that the competencies of teaching staff were high. The presence of competent tutors is important for training and conservation awareness (Supriatna *et. al.* 2014). In addition, tutors must also understand the concerns, the abilities, and the knowledge of the participants regarding the materials discussed during training (Jacobson 2010).

The post-fieldwork tests from the two exercises were not comparable because the test methods were different. From our results, we argue that the multiple-choice tests used in the first exercise are the best method to measure participant competencies, both pre- and post-training. Multiple choice tests provide straight scores for each question and are free from ambiguity, so can precisely measure the participants' capability (Warren 1979). In the essay test used in the second exercise, it was hard to measure the participants' capability from the complex questions and the scoring depended on the knowledge of the assessor. Each question had a different maximum score according to its complexity.

The participants of the first course achieved an average score of 46 in the post training tests. In the second course,

Figure 3. Survey training activities in Gunung Halimun-Salak National Park (left) and Gunung Simpang Nature Reserve (right).

Table 6. Best practices for primate survey training.

Items	Current practices	Best practices
Materials taught	Basic Theory, Navigation and equipment use, Primate survey methodology	No change
Tutors	Number of senior scientists = 3 Number of junior scientists = 2–3	Number of senior scientists = 3 Number of junior scientists depends on number of participants (at least 1 junior scientist for 3 participants)
Locations	GHSNP with existing transects, GSNR with no existing transects	Areas with existing transects should be used, where available, for training.
Duration	GHSNP 4 days GSNR 2 days	At least 4–7 days
Evaluation system	Yes, but not standardized	Apply standardized evaluation system for both theory and practice
Training Protocol	Not available	Apply standardized training protocol

the participants achieved an average score of 75.8 in the post-training tests. We assume that participants in the second exercise achieved higher scores than those in the first was because most participants were students in their final undergraduate semester or were masters program students, while most participants in the first exercise were undergraduate students in early to middle semesters. Participants in the second course had also taken primatology courses prior to training. Improvement of knowledge is correlated with the duration of training. The longer the training is carried out, the more knowledge will be gained. A course protocol is probably necessary during fieldwork training to ensure that standardized material is given (Peres 1999).

Future recommendations

In the future, this training needs to be amplified and continued to raise awareness among the next generation of primatologists that will influence Indonesia's primate conservation efforts. In addition, we need to engage communities surrounding the forests to ensure the best possible outcomes for primate conservation. People who are interested in primate conservation need to be given education and training so that they can contribute and communicate with the public better (Marshall and Wich 2016).

Table 6 lists what we conclude are best practices for primate survey training. While materials given were the same in both courses, training should employ more tutors, particularly junior scientists to lead the field survey with at least one tutor for every three participants. This is to ensure that the participants can break up into smaller groups. We also suggest that field training should be in areas where existing transects are available. Many field research stations already have existing transects, which are usually set out in flat areas. This is important to ensure that participants can focus on detecting animals, not be preoccupied with where they are walking in rough terrain. A longer period of training would enable participants to spend more time in the field. At least 4–7 days is recommended. A standardized evaluation system should also be applied to both theory and practice. Field training practice was more difficult to test as it depends on mentors and was not straightforward in scoring. However, standard evaluation methods should be developed for future training programs as field surveys promote a hands-on understanding of what is really required for successful primate surveys. Overall, a standardized training protocol should be prepared prior to training and all mentors should read and understand the protocol. If these recommendations were to be applied, we believe that primate conservation in Indonesia would have a sound future.

In summary, our training exercises suggested that students tended to detect primate species better using line-transect methods than using point-count methods. Our training periods were too short to ensure that students understood fully the concept of primate surveys; why they are needed, what information they should provide and how they should be designed. The fact that our training exercises were carried out at different times, in different areas, with different participants, reinforced the need for a standard training protocol. It is critical to ensure that all materials taught in the class and in the field are standardized, including the evaluation mechanism.

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Literature Cited

Balai Besar Konservasi Sumber Daya Alam Jawa Barat (BBKSDA Jabar). 2016. *Informasi kawasan konservasi lingkup BBKSDA Jabar.* BBKSDA, Bandung, Jawa Barat.

Basalamah, F., A. Zulfa, D. Suprobowati, D. Asriana, A. Anggraeni and R. Nurul. 2010. Status Populasi Satwa Primata di Taman Nasional Gunung Gede Pangrango dan Taman Nasional Halimun Salak, Jawa Barat. *Jurnal Primatologi Indonesia* 7(2): 55–59.

Brown, N., S. Jennings, P. Wheeler and J. Nabe-Nielsen. 2000. An improved method for the rapid assessment of forest understorey light environments. *J. Appl. Ecol*. 37(6): 1044–1053.

Buckland, S. T., D. R. Anderson, K. P. Burnham and J. L. Laake. 1993. *Distance Sampling: Estimating Abundance of Biological Populations*. Chapman & Hall, London.

Buckland, S. T., D. R. Anderson, K. P. Burnham, J. L. Laake, D. L. Borchers and L. Thomas. 2001. *Introduction to Distance Sampling: Estimating Abundance of Biological Populations*. Oxford University Press, Oxford.

Gaveau, D. L., J. Epting, O. Lyne, M. Linkie, I. Kumara, M. Kanninen and N. Leader-Williams. 2009. Evaluating whether protected areas reduce tropical deforestation in Sumatra. *J. Biogeogr*. 36(11): 2165–2175.

Geissmann, T., M. Grindley, F. Momberg, N. Lwin and S. Moses. 2009. Hoolock gibbon and biodiversity survey and training in Southern Rakhine Yoma, Myanmar. *Gibbon J.* 5: 7–27.

Gurmaya, K. J., I. M. W. Adiputra, A. B. Sayatiman, S. N. Danardono and T. H. Sibuea. 1994. A preliminary study on ecology and conservation of the Java primates in Ujung Kulon National Park, West Java. In: *Current Primatology. Volume 1: Ecology and Evolution*, B. Thierry, J. R. Anderson, J. J. Roeder and N. Herrenschmidt (eds.), pp.87–92. Université Louis Pasteur, Strasbourg.

Heinsohn, T. E. 2001. Human influences on vertebrate zoogeography: animal translocation and biological invasions across and to the east of Wallace's Line. In: *Faunal and Floral Migrations and Evolution in SE Asia–Australasia*, I. Metcalfe, J. M. Smith, M. Morwood and I. Davidson (eds.), pp.153–170. CRC Press, Darwin.

Jacobson, S. 2010. Effective primate conservation education: gaps and opportunities. *Am. J. Primatol.* 72: 414–419.

Kappeler, M. 1981. The Javan Silvery Gibbon (*Hylobates lar moloch*): Habitat, Distribution and Number. PhD thesis, University of Basel, Basel.

Kool, K. M. 1992. The status of endangered primates in Gunung Halimun Reserve, Indonesia. *Oryx* 26: 29–33.

Marshall, A. J. and S. A. Wich. 2016. Some future directions for primate conservation research. In: *An Introduction to Primate Conservation*, S. A. Wich and A. J. Marshall (eds.), pp.287–296. Oxford University Press, Oxford.

Marshall, A. R., J. C. Lovett and P. C. L. White. 2008. Selection of line-transect methods for estimating the density of group-living animals: lessons from the primates. *Am. J. Primatol.* 70: 452–462.

Miettinen, J., C. Shi and S. C. Liew. 2011. Deforestation rates in insular Southeast Asia between 2000 and 2010. *Global Change Biol.* 17: 2261–2270.

Mittermeier, R. A., A. B. Rylands and D. E. Wilson (eds.). 2013. *Handbook of the Mammals of the World. Volume 3. Primates*. Lynx Edicions, Barcelona.

Navarro, J. and R. Díaz-Gamboa. 2015. Line transect sampling. In: *Introduction to Ecological Sampling*, B. F. J. Manly and J. N. Alberto (eds.), pp.47–61. CRC Press, Florida.

Nijman, V. 1997. Geographical variation in pelage characteristics in *Presbytis comata* Desmarest, 1822, Mammalia, Primates, Cercopithecidae). *Z. Säugetier.* 62: 257–264.

Nijman, V. 2013. One hundred years of solitude: effects of long-term forest fragmentation on the primate community of Java, Indonesia. In: *Primates in Fragments: Complexity and Resilience*, L. K. Marsh and C. A. Chapman (eds.), pp. 33–45. Springer, New York.

Nijman, V. and S. (Bas) van Ballen. 1998. Faunal survey on the Dieng Mountain, Central Java, Indonesia: distribution and conservation of endemic primate taxa. *Oryx* 32: 145–156.

Nijman, V. and R. Sözer. 1995. Recent observation of the grizzled leaf monkey (*Presbytis comata*) and extension of the range of the Javan gibbon (*Hylobates moloch*) in Central Java. *Trop. Biodiv.* 3(1): 45–48.

Nijman, V. and J. Supriatna. 2008. *Trachypithecus auratus* ssp. *auratus*. The IUCN Red List of Threatened species. 2008: e.T39848A10276744. Downloaded on 15 July 2020.

Peres, C. A. 1999. General guidelines for standardizing line-transect surveys of tropical forest primates. *Neotrop. Primates* 7(1): 11–16.

Plumptre, A. J., E. J. Sterling and S. T. Buckland. 2013. Primate census and survey techniques. In: *Primate Ecology and Conservation: A Handbook of Techniques*, E, J, Sterling, N. Bynum and M. E. Blair (eds.), pp.10–26. Oxford University Press, Oxford.

Roos, C., R. Boonratana, J. Supriatna, J. R. Fellowes, C. P. Groves, S. D. Nash, A. B. Rylands and R. A. Mittermeier. 2014. An updated taxonomy and conservation status review of Asian primates. *Asian Primates J.* 4(1): 2–38.

Ruhiyat, Y. 1983. Socioecological study of *Presbytis aygula* in West Java. *Primates* 24: 344–359.

Setiawan, A., Nugroho, T.S., Wibisono, Y., Ikawati, V. and Sugardjito, J. 2012. Population density and distribution of Javan gibbon (*Hylobates moloch*) in Central Java, Indonesia. *Biodiversitas, J. Biol. Divers.* 13(1): 23–27.

Supriatna, J. 2006. Conservation programs for endangered Javan gibbon (*Hylobates moloch*). *Primate Conserv.* (21): 155–162.

Supriatna, J. 2014. Berwisata alam di taman nasional (Tourism at the National Park). Yayasan Pustaka Obor Indonesia, Jakarta.

Supriatna, J. 2019. *Field Guide to Primates of Indonesia*. Yayasan Pustaka Obor Indonesia, Jakarta.

Supriatna, J. and A. Ario. 2015. Primates as flagships for conserving biodiversity and parks in Indonesia: lessons learned from West Java and North Sumatra. *Primate Conserv.* (29): 123–131.

Supriatna, J., A. Mootnick and N. Andayani. 2010. Javan gibbon (*Hylobates moloch*): population and conservation. In: *Indonesian Primates*, S. Gursky-Doyen and J. Supriatna (eds.), pp.57–72. Springer, New York.

Supriatna, J., E. Perbatakusuma, A. H. Damanik, H. Hasbulah and A. Ario. 2014. Sumatran Orangutan as a flagship for conserving biodiversity and parks: lesson learnt from north Sumatra conservation awareness programmes. *Asian Primates J*. 4(2): 52–59.

Supriatna, J., R. Tilson, K. K. Gurmaya, J. Manansang, W. Wardojo, A. Sriyanto, A. Teare and U. Seal. 1994. *Javan Gibbon and Javan Langur: Population and Habitat Viability Analysis*. IUCN/SSC Conservation Breeding Specialist Group (CBSG), Apple Valley, Minnesota.

Warren, G. 1979. Essay versus multiple choice tests. *J. Res. Sci. Teaching* 16(6): 563–67.

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