The Moluccan Woodcock *Scolopax rochussenii* on Obi Island, North Moluccas, Indonesia: a 'lost' species is less endangered than expected

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The Moluccan Woodcock *Scolopax rochussenii* is an enigmatic forest wader endemic to the North Moluccas, Indonesia. Until recently, the species was known from fewer than ten confirmed records and it is currently considered to be endangered under the criteria of the International Union for the Conservation of Nature (IUCN). In July–August 2012, field surveys were conducted at 20 sites and semi-structured interviews held in seven villages to assess the status of the Moluccan Woodcock on Obi Island, Maluku Utara province. Field surveys resulted in 51 records of minimum 13 individuals, and the findings suggest that this species is widespread on Obi, occurring from 15–1,150+ m. Contrary to the existing assumption that the Moluccan Woodcock is a montane species, the data indicate that it is primarily a lowland species, and that population densities decline with altitude. The species tolerates minor habitat disturbance, such as selective logging and small-scale agriculture, and does not appear to be hunted or frequently trapped by local people. A Maxent species distribution model indicates that Moluccan Woodcock distribution correlates strongly with the presence of rivers and streams and predicts 9,530 woodcock territories on Obi. The primary threats to the species are severe habitat disturbance from mining and logging, and better environmental mining regulations need to be enforced to safeguard habitat on Obi. It is recommended that the Moluccan Woodcock be reassessed as vulnerable following IUCN criteria, and that surveys following the same protocol should be conducted on Bacan to clarify the status of the species on that island.

INTRODUCTION

The woodcock (genus: *Scolopax*) consist of eight extant species; two migratory species with large ranges in North America (American Woodcock *S. minor*) and Eurasia (Eurasian Woodcock *S. rusticola*), and six inhabiting islands in tropical East Asia and New Guinea (Olson 1979, Piersma 1996). Of these, the Ryukyu Woodcock *S. mira* is confined to a handful of small islands in the Ryukyu archipelago, Japan, and another four species (Bukidnon Woodcock *S. bukidnonensis*, New Guinea Woodcock *S. rosenbergii*, Javan Woodcock *S. saturata*, Sulawesi Woodcock *S. celebensis*) are restricted to montane forest on large islands in the Philippines, Indonesia and New Guinea (Piersma 1996, Kennedy *et al.* 2001). The final species, the Moluccan Woodcock *S. rochussenii*, is known from two small islands in the North Moluccas, Indonesia, and is the largest and least known member of the genus (Hayman *et al.* 1991, Coates & Bishop 1997).

The Moluccan Woodcock was first collected by Heinrich Bernstein, who obtained a single male specimen from Obi in 1862, but did not live to see the species named (Jansen 2008). Bernstein died of illness in New Guinea in 1865 and '*Scolopax rochussenii*' was not described until 1866 (Schlegel) when his specimen arrived back at the Museum of Natural History in Leiden, the Netherlands. Over the next 150 years, only seven additional individuals were recorded, six from Obi and a single individual from Bacan in 1902, and following two birds collected in 1982, the species disappeared for nearly 30 years. Ornithologists visiting Obi in 1989, 1992 and 2010 (Lambert 1992, Linsley 1994, Bashari 2011) failed to record the bird and a targeted search for the species on Bacan in 2010 also produced no records (Lagerveld 2010). In this same year, however, the species was 'rediscovered' at two localities on Obi by M. Thibault *et al.* (2013) and its vocalisations were recorded for the first time.

Given this paucity of records, virtually nothing is known of the distribution, breeding behaviour or feeding habits of the species. Most information regarding its ecology has been based on assumed similarities to other *Scolopax* species, in particular those on neighbouring islands in Indonesia and New Guinea. Despite the collection of at least one Moluccan Woodcock in lowland habitats (BirdLife International 2001), the species has been assumed to be a montane species restricted to high elevation forest, a distribution that would seemingly explain why it has been recorded so infrequently (White & Bruce 1986, Coates & Bishop 1997, BirdLife International 2013). As a result of the few known records and the relatively small area of montane habitat on Obi and Bacan, the Moluccan Woodcock is currently considered Endangered (BirdLife International 2013).

From 5 July to 27 August 2012 the first field study of the Moluccan Woodcock on Obi Island was conducted and the species was observed on 51 occasions. Here the distribution, display behaviour and population size of this enigmatic species are reported and the impact of these findings on its conservation status are discussed.

METHODS

Field surveys

Field surveys were conducted at 20 sites around Obi. Localities included all major habitat types on the island, and covered an elevational range from sea level to 1,550 m (Mittermeier *et al.* 2013). At each site, dawn and dusk survey points (n=60) were coupled with daily field observations (total 630 hours). Surveys were designed to maximise the possibility of encountering a Moluccan Woodcock and, when possible, dawn and dusk surveys were carried out along ridgelines or in open areas (such as river beds or forest clearings) where observers could scan for displaying birds. Morning observations began about 10 minutes before first light and continued until about 10 minutes after sunrise (05h30–06h10); evening observations were from about 20 minutes before sunset to about 10 minutes after dark (18h40–19h15).

At each location, the number of individuals, detection method, and observation times were recorded along with habitat information including elevation, level of disturbance and the presence of nearby streams or swamps. Displaying woodcock were almost always detected by their call, and therefore the field of view at survey points could not be controlled. At three locations where it was possible to track a Moluccan Woodcock over the course of its entire display, the GPS points at the territory boundaries were

marked in order to estimate the size of the territory (see Discussion). Sites with swamps, streams with a width of greater than 3 m, or swamp forest located within 100 m of the point count were classified as wetlands. Level of disturbance was qualitatively assessed with primary forest defined as 'undisturbed', areas with small agricultural clearings and light logging defined as 'minor disturbance' and areas with mining, extensive cultivation or extensive and recent logging (within the last 5 years) defined as 'major disturbance'. A generalised linear model with a log-link function and a Poisson error structure was used to identify any significant relationships between these variables and the number of Moluccan Woodcock recorded at the survey sites.

Distribution and population assessment

Field data were used to construct a model predicting the distribution of the Moluccan Woodcock on Obi and Bacan. The data for the model was downloaded as raster layers: 19 climatic variables relating to temperature and rainfall (Worldclim, 30 arc second resolution, WGS84 projection; Hijmans *et al.* 2005), altitudinal data (Worldclim, 30 arc second resolution, WGS84 projection; Hijmans *et al.* 2005), land cover data (Globcover, 300 m × 300 m resolution, WGS84 projection; Globcover 2009), world geopolitical boundaries (Digital Chart of the World, 1 km^2 resolution, WGS84 projection; Danko 1992), and hydrological information (Hydro1K, 1 km^2 resolution, WGS84 projection; Verdin *et al.* 2011). All input layers were resampled to 300 m × 300 m cell size using linear interpolation (resample, R package raster; Hijmans & van Etten 2012) to maintain the resolution of the finest scale data (Globcover), and cropped with a bounding box of latitude 0–2°S and longitude 127–129°E (crop, R package raster; Hijmans & van Etten 2012). Rather than using raw values for two of the Hydro1K data layers, the distance of each grid cell to either a river (flow accumulation) or wet area (compound topographic index) was calculated (distance, R package raster; Hijmans & van Etten 2012).

Species distribution models were estimated using Maxent (Phillips *et al.* 2004) with presence-absence points taken directly from the field data. All the 19 Worldclim, Hydro1k and land cover data layers were entered as predictor variables; a total of 21 variables. A total of 100 Maxent runs were done, each time using a random subset of the data as either training (4/5) or testing sets (1/5), and then a mean probability surface was calculated across those 100 runs. The ability of each of the 100 training datasets to predict the locations of the corresponding test datasets was measured using the 'area under operating curve' approach. This gives a value between 1, where the locations of testing sets are perfectly predicted by the niche model that was created using the training set, and 0 where the probability of occurrence of the niche surface is random with respect to the testing set.

Given that the approximate area of each territory estimated in the field was close to 10 ha, the probability of occurrence grid output from Maxent was used to create a rough estimate of population size. The assumption was made that every thousand grid cells covering land was a potential range site and that the probability of occurrence taken from Maxent was the chance that this site was occupied by a single individual. Based on these assumptions, therefore, the summed probability from the model equated to an estimate of minimum population on the island. Although ranges will not, in reality, be shaped or arranged in such a uniform manner, given that occupancy will in many cases be greater than a single individual, this approach remains a conservative estimate of population size and means that errors resulting from the assumptions will be unlikely to cause an overestimation of the number of woodcock on the island.

Interviews

Field surveys were supplemented by 46 semi-structured interviews in seven villages around Obi. Interviews were conducted in Bahasa Indonesia with the help of three students from the University of Indonesia (Christine Endang Purba, Eka Hesdianti and Nova Maulidina Ashuri). Interviewees were selected opportunistically or following recommendations from the local village head. Interviews commenced with several background questions including religious affiliation, age, hometown, activities pursued in the forest, estimated frequency of visits to the forest and the amount of time spent there. Next, interviewees were shown a series of pictures of Indonesian birds and asked whether the species occurred on Obi and if so what the local name was and where it could be found, and whether they hunted or caught it. Pictures were colour photocopies taken from plates in Coates & Bishop (1997) and featured the Moluccan Woodcock, Drummer Rail *Habroptila wallacii*, White Cockatoo *Cacatua alba*, Dusky Megapode *Megapodius freycinet*, Maleo *Macrocephalon maleo* and Common Sandpiper *Actitis hypoleucos*, in no particular order.

Respondents' familiarity with the Moluccan Woodcock illustration was analysed for significance using a chi-squared test, and their ability to correctly identify the Moluccan Woodcock compared to the other illustrated species was analysed using Cochran's Q test. Using a binary logistic regression model, several variables were tested against the ability to correctly identify the Moluccan Woodcock, namely: whether someone had lived their entire life on Obi, how often they visited the forest, how well they identified other species in the interview, whether they hunted or trapped birds, their religion, and their village of origin.

RESULTS

Display behaviour

During display a single bird would fly quickly with shallow wing beats at a height of about 10 m above the canopy, vocalising at regular intervals (Plate 1). Vocalisations consisted of an explosive even trill, lasting 0.1–0.6 seconds in duration and given at intervals of 1.9–3.2 seconds. When two Moluccan Woodcock encountered each other during display flights (believed to be territorial conflicts), interactions included short parallel flights and a descending, twittering call, without overlapping into the adjacent bird's display area (Macaulay Library of Natural Sounds LNS 182223). Display areas followed the course of a river or stream or circled above areas of swampy habitat. In the highlands, displaying birds were observed flying up to the headwaters of a stream before looping back to follow the course of a valley. Displays covered a large area, and flight patterns were either generally circular (in more open environments) or linear (following narrow valleys), but did not appear to follow a consistent pattern. In open areas, displaying birds were recorded passing above an observer on average every 3.8 minutes (n=15 display flights), and disappearing out of sight in the intervening period. In other conditions, birds would double back and fly over more frequently. Displaying Moluccan Woodcock were not disturbed by people, and would occasionally fly directly overhead with heads tilted to look down at observers. While there was a slight variation in timings, morning display flights would typically run from 05h25–06h02 (mean length 21 minutes), and evening display flights would usually take place from 18h47–19h06 (mean length 13 minutes). Ambient recordings of complete dawn and dusk display flights recorded by JCM are available online from the Cornell Lab of Ornithology Macaulay Library of Natural Sounds (http://macaulaylibrary.org).

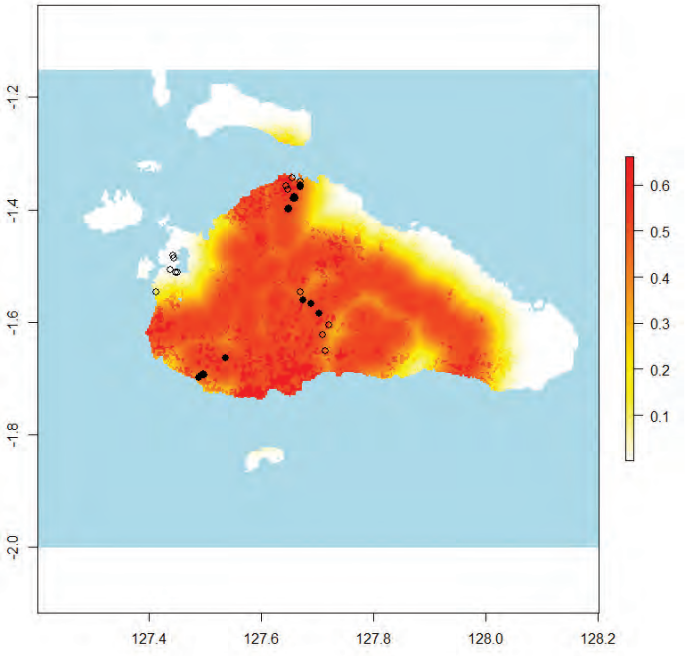
Distribution and population

The Moluccan Woodcock was recorded on 51 occasions at 11 sites (Figure 1). They were recorded almost exclusively during their dawn and dusk display flights, during which they were both consistent and conspicuous. At seven sites where several survey days

Plate 1. Moluccan Woodcock photographed during display flights over the Cabang River, south of Kampon Buton, Obi, 26 August 2012.

were spent near a displaying bird, it was recorded every day at both dawn and dusk regardless of weather conditions. Non-displaying birds, on the other hand, were extremely inconspicuous and difficult to locate. During 630 hours of field surveys, only one non-displaying individual was observed. This bird was flushed by JCM from an area of mossy boulders and pools along the edge of a stream, in primary montane forest at 930 m on 3 August (Plate 2).

Figure 1. A species distribution model for the Moluccan Woodcock on Obi Island. Darker colours indicate areas of more suitable habitat, and circles identify field survey sites where woodcock were present (closed circles) and not recorded (open circles).



The Moluccan Woodcock was recorded at sites between 15 and 1,150 m elevation in a range of habitats including primary lowland forest, selectively logged secondary forest, swamp forest, secondary forest with small agricultural clearings and montane forest. A generalised linear regression model found no significant difference in Moluccan Woodcock densities in areas with minor disturbance relative to undisturbed habitats (Table 1); indeed the birds were frequently present in selectively logged forest and areas with small-scale agriculture and agroforestry. Moluccan Woodcock were not, however, recorded in areas with major disturbance (e.g. extensive agriculture and mining). While the model found no significant relationship with altitude, raw point count data illustrate that the Moluccan Woodcock was more frequently recorded in the lowlands than the highlands (Figure 2). The strongest correlation identified by the generalised linear model was with the presence of streams and rivers (Table 1).

The Maxent models created using the training data showed a good ability to predict the testing data, with a mean receiver operating characteristic (ROC) value of 0.833 with a standard deviation of 0.11 over 100 replicates. The influence of waterways was also reflected in this distribution model (Figure 1) where 'distance to major river' explained more than 80% of the variation using both the Hydro1K data set and the Digital Chart of the World. The remaining variation in the model was explained by land cover type (~20%), and in a few models, by mean diurnal temperature range (~5%). The variable 'Distance to rivers' was consistently the highest loading variable (with an average of 95%), with habitat type (2%) and daily temperature range (2.5%) also being consistently important.

Based on data from individual displaying birds at three sites, the mean territory size for a Moluccan Woodcock was estimated to be 10.67 ha (SE = 2.3, range=7.6–13). By applying this territory size to the modelled distribution, a mean estimate of 9,530

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Plate 2. Two habitats where Moluccan Woodcock were found on Obi: a) a fast-flowing mountain stream in primary forest at 930 m and b) logged forest bordering the Cabang River at 35 m, July 2012.

Figure 2. The mean number of Moluccan Woodcock recorded at survey sites in lowland and highland elevations.

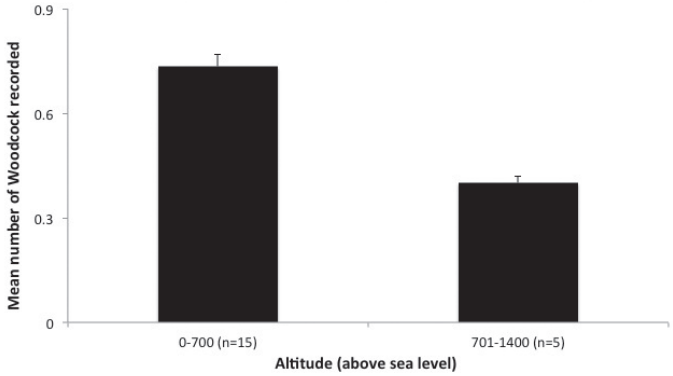

Table 1. Generalised linear regression model results for Moluccan Woodcock habitat associations.

Parameter	*B* (SE)	p-value
Intercept	0.71 (0.79)	0.37
Altitude	–0.001 (0.0)	0.17
Water absence	–28.9 (–)	–
Light disturbance	0.03 (0.8)	0.97
Severe disturbance	–2.22 (1.26)	0.08

Deviance=0.83, Pearson Chi-square$_{(14)}$=10.17, p=0.73

(standard deviation=282, n=100) woodcock territories on Obi was obtained.

Interviews

Interview results indicate that the majority of Obi residents are unfamiliar with the Moluccan Woodcock. With the exception of Maleo, which does not occur on Obi, all species in the survey were identified significantly more often than the woodcock (Figure 3). This even included Drummer Rail, a notoriously secretive species that until this study was unknown on Obi (Mittermeier *et al.* 2013). Almost 83% of respondents did not identify the Moluccan Woodcock, while nearly 11% identified it as a coastal shorebird found on the beach or in open areas along waterways ($X^2_{(1)}$=34.78, p<0.005). The lack of respondents accurately identifying the species constrained the ability of the model to select predictors, and none of the explanatory variables was significant. In total, only three people stated that they were familiar with the woodcock and that it was found in the forest on Obi. Of these, one reported that he had caught a bird in a snare and then released it because it did not look good to eat, and a second said that he saw it frequently flying at dawn and dusk near his rice fields, but that he believed it ate fruit in the treetops and that he had never seen it on the ground. The third, a parrot trapper and a very astute observer, noted that he occasionally saw the species eating worms in muddy areas along the margins of rivers and that he called the woodcock *wapichu* (transcribed phonetically). No interviewees reported hunting or eating this species.

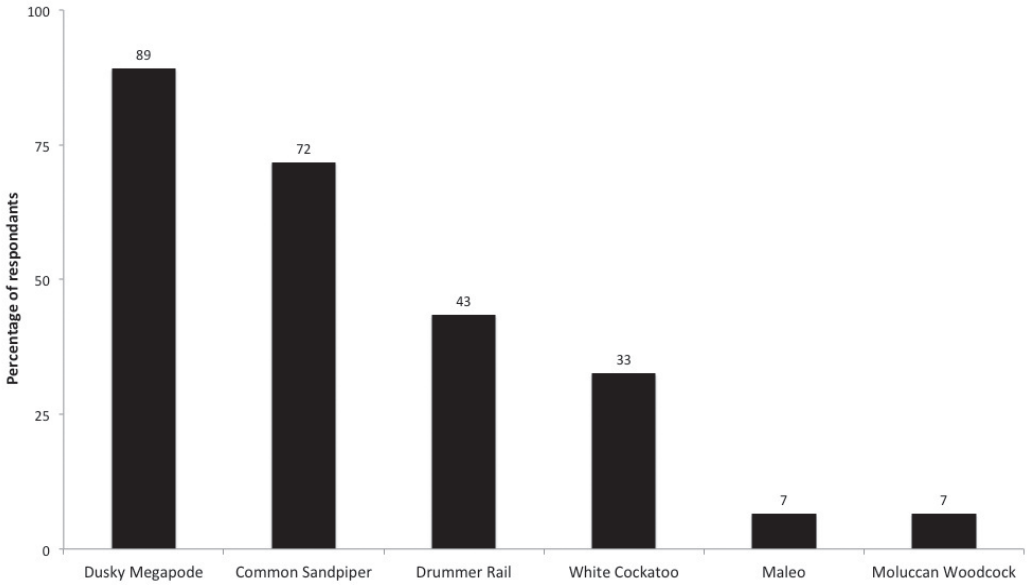

Figure 3. The percentage of interviewees (n=46) who correctly identified Indonesian birds using picture prompts taken from plates in Coates & Bishop (1997).

Moluccan Woodcock *vs* Dusky Megapode: Cochran's $Q_{(1)}$=38.00*, *vs* Common Sandpiper: Cochran's $Q_{(1)}$=29.00*, *vs* Drummer Rail: Cochran's $Q_{(1)}$=16.00*, *vs* White Cockatoo: Cochran's $Q_{(1)}$=32.00*, *vs* Maleo: Cochran's $Q_{(1)}$=0.20. * p<0.005.

DISCUSSION

Ecology and display

The results indicate that the Moluccan Woodcock occurs throughout Obi. It is found at higher densities in the lowlands and favours areas near water particularly in the vicinity of streams and rivers. This close association with waterways reflects observations of the Sulawesi Woodcock, which has been reported to forage along forest stream banks (Mole & Wangko 2006). The elevational distribution of the Moluccan Woodcock, with the species notably more common in lowland habitats, contrasts with that of related *Scolopax* species on the larger islands of Sulawesi, Java, New Guinea and the Philippines. As the Moluccan Woodcock associates strongly with waterways, it is possible that this distribution reflects the lower density of large rivers at higher elevations. While this lowland distribution overturns existing assumptions, it is not overly surprising; many birds in the Indo-Pacific that are restricted to the highlands on large islands are found in lowland habitats on oceanic islands (Mayr & Diamond 2001).

The display flights of different woodcock species show substantial plasticity. The American Woodcock performs a unique display involving a terrestrial 'peenting' call followed by a vertical display flight (Duke 1966), several male Eurasian Woodcock perform 'roding' display flights over the same area of woodland competing for females polygamously (Hirons 1980, Hoodless *et al.* 2009), and the Ryukyu Woodcock does not seem to perform any display flight at all (BirdLife International 2001). In the absence of any evidence to suggest otherwise, this study indicates that the Moluccan Woodcock performs territorial display flights, and suggests that territories abut without overlapping, similar to the Bukidnon Woodcock (Kennedy *et al.* 2001).

Population

The lack of ecological data on the Moluccan Woodcock and the degree of variation in the breeding behaviour of other woodcock species makes it difficult to establish how many individual woodcock might be present in a single territory. At the most conservative, an estimate of one individual per territory predicts a total population of 9,530 individuals. A more realistic estimate, though still very conservative, would be two individuals per territory for a minimum population of 19,059 individuals. However, the relationship between the number of displaying individuals and the total population is unknown even in well-studied woodcock species (Hoodless *et al.* 2009), and so this population estimate for the Moluccan Woodcock should be regarded as preliminary. Obtaining a more accurate population estimate for the species will require a better understanding of the relationship between the number of displaying birds and the total number of individuals in a given area, the degree of variation in territory size, and clarifying the status of the bird in several areas not surveyed. Neither the eastern side of Obi nor the outlying island of Bisa were visited, as part of eastern Obi had been surveyed by F. Lambert in 1992, and current reports indicated that the rest had been converted into coconut groves. Due to the lack of rivers in these two areas, the distribution model indicates that they are unsuitable for woodcock. Whether this is accurate should be confirmed by future field surveys.

The status of the Moluccan Woodcock on Bacan is also important. Bacan (1,900 km^2) is smaller than Obi (2,500 km^2) and could theoretically hold a similar population of the woodcock. However, the only known record for Bacan is a female collected from an unspecified location in 1902 (BirdLife International 2001). Bacan has been surveyed more often than Obi (White & Bruce 1986), Alfred Russel Wallace spent six months collecting there in 1858-1859 (Wallace 1869) and it is rather surprising that it has not been recorded there again for more than a century. That said the distribution model does identify significant areas of suitable habitat on Bacan, particularly along large rivers in the central part of the island. Surveys on Bacan, and also Halmahera, using the same methodology should be undertaken to ascertain whether the Moluccan Woodcock occurs on other islands in the North Moluccas. If Moluccan Woodcock are not present on these islands, it would be appropriate to revert to the former common name of Obi Woodcock.

Local knowledge

People on Obi often had a detailed knowledge of the local avifauna, particularly of species that were trapped, such as parrots, and terrestrial birds caught in snares, such as rails and megapodes. For example, several forest workers near Kampon Buton and Wayaloar readily identified 5–6 species of rail. In this context, the limited knowledge of Moluccan Woodcock is somewhat surprising. This may partly be due to the survey method (Diamond & Bishop 1999). The illustration of Moluccan Woodcock in Coates & Bishop (1997) displays the species in daylight on the ground, a context in which it is apparently rarely seen. In the wild, the vast majority of observations are of a silhouetted bird, flying in poor light and giving its distinctive call. It is recommended that any future interviews to determine local knowledge of Moluccan Woodcock use photographs and sound recordings rather than the standard illustrations. An important implication of this result, however, is strong support for the fact that people do not regularly hunt or eat the species and therefore have limited opportunities to see it in the hand. This is critical to the conservation of the species. In other parts of the world, woodcock are frequently hunted and considered a good source of meat. Given the conspicuous nature of the Moluccan Woodcock's display flights, a change in attitudes coupled with an increase in hunting on Obi could lead to a rapid decline in the bird's population.

Conservation

The population and distribution estimates for the Moluccan Woodcock indicate that the number of individuals and area of occupancy for this species are both above the established thresholds for listing as Endangered (IUCN 2012). With an area of occupancy of more than 2,000 km^2 on Obi and the number of territories estimated to be 9,530, this species qualifies to be reassessed as Vulnerable under the IUCN criteria.

Although the species can tolerate minor habitat disturbance, the current spread of mining on the island could represent a significant threat. The ultrabasic rock formations are rich in nickel ore, and nickel mining currently takes place on a large scale in the Kawasi area of western Obi. Moluccan Woodcock was not found in this degraded mining landscape, and the expansion of mining on Obi poses a major threat to the Moluccan Woodcock and other species. Industrial nickel mining was due to expand into the foothills north of Tapaya village, but this has been suspended, possibly due to a recent government quota on the export of unprocessed material; however, it seems likely that it may soon commence. More sophisticated approaches to the regulation of the impact of mining on biodiversity and the restoration of mined areas need to be a priority for conservation on Obi.

A protected area has been proposed in the mountainous centre of Obi, but these results demonstrate that a highland protected area is unlikely to contain a high density of Moluccan Woodcock. Conservation efforts need to consider both montane and lowland habitats (see Mittermeier *et al.* 2013). Fortunately, Moluccan Woodcock appear to tolerate a relatively high degree of habitat degradation including selective logging, agroforestry, and small-scale agriculture, and these habitats should also be considered in devising a conservation plan for the species. In addition the display behaviour of the Moluccan Woodcock makes it potentially

vulnerable to hunting. While no evidence of hunting was observed, high rates of immigration to the island, linked to the expansion of mining, could change this.

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REFERENCES

Bashari, H. (2011) Rediscovery of Carunculated Fruit Dove *Ptilinopus granulifrons* on Obi, North Moluccas. *BirdingASIA* 16: 48–50.

BirdLife International (2001) *Threatened birds of Asia: The BirdLife International Red Data Book*. Cambridge UK: BirdLife International.

BirdLife International (2013) Species factsheet: *Scolopax rochussenii*. Downloaded from www.birdlife.org on 10 February 2013.

Coates, B. J. & Bishop, K. D. (1997) *A guide to the birds of Wallacea*. Alderley: Dove Publications.

Danko, D. M. (1992) The digital chart of the world project. *Photogramm. Eng. Rem. S.* 58:1125–1128.

Diamond, J. M. & Bishop, K. D. (1999) Ethno-ornithology of the Ketengban people, Indonesian New Guinea. Pp.17–46 in D. Medin & S. Atran, eds. *Folkbiology*. Cambridge Mass: MIT Press.

Duke, G. E. (1966) Reliability of censuses of singing male Woodcocks. *J. Wildl. Manage.* 30: 697–707.

Globcover (2009) *GlobCover Land Cover v2 2008 database*. Downloaded from http://ionia1.esrin.esa.int/index.asp on 20 February 2013.

Hayman, P., Marchant, J. & Prater, T. (1991) *Shorebirds: identification guide to the waders of the world.* London: Christopher Helm.

Hijmans R. J. & van Etten, J. (2012) *Raster: Geographic analysis and modeling with raster data. R package version 2.0-12.* Downloaded from http://CRAN.R-project.org/package=raster on 20 February 2013.

Hijmans, R. J., Cameron, S. E., Parra, J. L., Jones, P. G. & Jarvis, A. (2005) Very high resolution interpolated climate surfaces for global land areas. *Int. J. Climatol.* 25: 1965–1978.

Hirons, G. (1980) The significance of roding by Woodcock *Scolopax rusticola*: an alternative explanation based on observations of marked birds. *Ibis* 122: 350–354.

Hoodless, A. N., Lang, D., Aebischer, N. J., Fuller, R. J. & Ewald, J. A. (2009) Densities and breeding estimated of Eurasian Woodcock *Scolopax rusticola* in Britain in 2003. *Bird Study* 56: 15–25.

IUCN (2012) *IUCN Red List categories and criteria: version 3.1*. Gland, Switzerland & Cambridge UK: IUCN.

Jansen, J. (2008) Heinrich Bernstein. *BirdingASIA* 10: 103–107.

Kennedy, R. S., Fisher, T. H., Harrap, S. C. B., Diesmos, A. C. & Manamtam, A. S. (2001) A new species of woodcock (Aves: Scolopacidae) from the Philippines and a re-evaluation of other Asian/Papuan woodcock. *Forktail* 17: 1–12.

Lagerveld, S. (2010) *Op zoek naar de Molukse Houtsnip*. (Looking for the Moluccan Woodcock) Downloaded from http://dutchbirding.nl/news.php?ntype=17&id=712&lang=en on 10 November 2011. (In Dutch).

Lambert, F. R. (1994) Notes on the avifauna of Bacan, Kasiruta, and Obi, Northern Moluccas. *Kukila* 7: 1–9.

Linsley, M. D. (1995) Some bird records from Obi, Maluku. *Kukila* 7: 142–151.

Mayr, E. & Diamond, J. M. (2001) *The birds of northern Melanesia: speciation, dispersal and biogeography*. Oxford: Oxford University Press.

Mittermeier, J. C., Cottee-Jones, H. E. W., Purba, E. C., Ashuri, N. M., Hesdianti, E. & Supriatna, J. (2013) A survey of the avifauna of Obi Island, North Moluccas, Indonesia. *Forktail* 29: 128–137.

Mole, J. & Wangko, M. F. (2006) Habitat of the Sulawesi Woodcock *Scolopax celebensis* in Lore Lindu National Park. *Kukila* 13: 64–66.

Olson, S. L. (1979) Fossil woodcocks: an extinct species from Puerto Rico and an invalid species from Malta (Aves: Scolopacidae: *Scolopax*). *Proc. Biol. Soc. Wash.* 89: 265–274.

Phillips, S. J., Dudik, M. & Schapire, R. E. (2004) A maximum entropy approach to species distribution modeling. Pp: 655–662 in *Proceedings of the 21st International Conference on Machine Learning*. New York: ACM Press.

Piersma, T. (1996) Family Scolopacidae (sandpipers, snipes & phalaropes). Pp.444–533 in J. del Hoyo, A. Elliott & J. Sargatal, eds. *Handbook of the birds of the world*, 3. Barcelona: Lynx Edicions.

Schlegel, H. (1866) Observations zoologiques. *Ned. Tijdschr. Dierk.* 3: 257–258.

Thibault, M., Defos du Rau, P., Pineau, O. & Pangimangen, W. (2013) New and interesting records for the Obi archipelago (north Maluku, Indonesia), including field observations and a first description of the vocalisation of Moluccan Woodcock *Scolopax rochussenii*. *Bull. Brit. Orn. Club* 133: 83–115.

Verdin, K. L. (2011) *ISLSCP II HYDRO1k Elevation-derived Products*. Downloaded from http://daac.ornl.gov/ on 20 February 2013.

Wallace, A. R. (1869) *The Malay Archipelago*. Singapore: Graham Brash.

White, C. M. N. & Bruce, M. D. (1986) *The birds of Wallacea*. Tring: British Ornithologists' Union (Checklist 7).

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