HABITS, RELATIONSHIPS, AND CONSERVATION OF THE OKINAWA WOODPECKER

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THE Okinawa Woodpecker (*Sapheopipo noguchii*) or Noguchigera as it is known in Okinawa and Japan, has long interested me because of problems concerning its relationships (Yamashina, 1941; Hachisuka and Udagawa, 1953; Goodwin, 1968; Short, 1969), and because it has been considered rare for several decades (Yamashina, op. cit.). It is little known, and some reported information (e.g., the view that the woodpecker may be crepuscular, Hachisuka and Udagawa, 1953: 212) is misleading or erroneous. I made a brief visit to Okinawa from 3 to 9 February 1972. Proceeding to the inland wooded hills in the northern part of the island, I spent five days seeking the Okinawa Woodpecker. Despite almost constant rain the visit proved fruitful, for I observed the Okinawa Woodpecker, assessed the availability of its habitat, and noted (Short, In press) other woodland birds. These observations offer limited information, but are supplemented by information from local inhabitants, from locally produced movies depicting nesting and other habits, and from abundant evidence of foraging activity by the woodpeckers (see below).

Okinawa, situated at 128° E, 26° 30′ N, marks the southern end of the continuous chain of northern and middle Ryukyu Islands, all within 80 km or less of one another, extending northward the 540 km to Japan (Kyushu, the southernmost main island). Okinawa extends 100 km from southwest to northeast, and averages only 11 km (3 to 29 km) wide. Its 1175 km^2 area is about equally divided between the relatively flat, densely populated southern section, and, connected by a narrow "waist," the hilly, sparsely inhabited northern section. Virtually all the remaining forests on the island are found in the north, inland from the coast except at the extreme north end, near Hedo (where Mount Hedo, 248 m, is situated). The extant undisturbed (Fig. 1) forest probably amounts to no more than 1500 ha, distributed on five mountains (Yonaha, 498 m; Ibu, 354 m; Iyu, 449 m; Nichime, 420 m; and Hedo), and in tiny patches interspersed, often on steep slopes, in second-growth forests and cleared areas in the hills connecting these mountains. The Okinawa Woodpecker is confined to the discontinuous undisturbed forest patches.

This report is offered in the hope that it will contribute to the preservation of this distinctive woodpecker, the total population of which I estimate to be 20 to an unlikely maximum of 60 pairs. Some of the comparative information concerning other genera of woodpeckers is drawn from results

FIG. 1. Forest habitat of Okinawa Woodpecker on upper slopes of Yonaha Mountain, elevation 440 m. Except for sporadic wood-cutting and wood-gathering, the forest is natural, and comprises part of the small Yonaha Mountain Preserve. Picture taken 8 February 1972.

of field studies of species representing all but two genera (West Indian *Xiphidiopicus*, *Nesoctites*) of the Picidae. Published information is cited below, but results of my 1972 Asian woodpecker studies are in the preliminary stage of preparation for publication.

LIFE HISTORY

About 23 cm in length, the Okinawa Woodpecker in the field appears dark brown with a pale yellow bill which is conspicuous even in the dense, dark understory of the forest it inhabits. At close range under favorable light conditions an observer notices several small white marks (bars) in the outer primaries, and its dull reddish back (and crown of the male; females have a brown crown). Its calls, described below, and its habit of wing-flicking when calling attract attention to it. The Okinawa Woodpeckers that I saw reminded me of a dark, pale-billed Gray-headed Woodpecker (*Picus canus*). At least five and possibly as many as eight individuals were observed, one in the area southwest of Mount Ibu on 5 February, and the others on the slopes of Yonaha Mountain on 6 to 8 February.

FIG. 2. Workings of Okinawa Woodpecker. A well-hacked limb of a live tree in which a male had been foraging.

Foraging Sites.—The Okinawa Woodpecker forages mainly near the ground in various dead or live trees and bamboos, in stubs, and on moss-draped fallen logs and debris littering the forest floor. It does not feed on the ground in the manner of the ant-foraging flickers (*Colaptes* spp.) or Green Woodpecker (*Picus viridis*), but frequents the bases of trees and stubs, and hops about on fallen logs, and debris amid dense low bushes. Occasionally it perches on the ground, or hops across a small area of open ground near logs, to gain a more favorable position for feeding. In areas occupied by the Okinawa Woodpecker numerous dead stubs are encountered, bearing deep, pitted excavations as large as 3 to 4 cm long and 1 to 4 cm wide (Fig. 2). Over 90 percent of these workings are within 5 m of the ground. The tiny Japanese Pygmy Woodpecker (*Picoides kizuki*), which I did not observe on Okinawa, is the only other picid on the island, and it could not be responsible for such large excavations (see Foraging Modes). The foraging sites of *Sapheopipo noguchii* clearly indicate its dependence upon the diminishing, undisturbed natural forest of Okinawa, that is, moist forest (Fig. 1) with large trees (some dying, providing foraging and nesting sites), accumulated fallen trees, branches and other debris, and undergrowth.

Foraging Modes.—Foraging of the Okinawa Woodpecker during early

February, 1972, was by excavating, tapping, probing, and flicking aside of rotten wood (see Short, 1970, for terminology). Rotting stubs, logs, and even rotten sticks 2 or 3 cm in diameter lying on the ground are used, and if the wood is well rotted it literally is hacked apart leaving (on logs or the ground) a mound of loose wood particles. The gouges in rotten stubs mentioned above are obvious signs of the Okinawa Woodpecker's excavating habits, but it chisels smaller circular or rectangular holes in live trees and bamboos. Observations at other times of the year are needed, but the numerous workings observed indicate that the foraging modes described here are those generally used throughout the year. An excavating bird directs its bill toward the bark, moderately spreads and appresses its rectrices, and with great force delivers blows with the bill straight downward or laterally at an angle. The noise thus produced is less than might be expected, probably because the rotten wood is moist (rain fell during all but two periods of observation) and soft. At times several taps or even a single peck yielded an item of food (only cicadas have been cited as its food by Yamashina, 1941, but various boring insects probably comprise most of its diet), but extensive excavating often was necessary. Occasionally the woodpeckers probed the bill into rotting wood or crevices in the bark of trees. Bursts of bill movements effectively like digging were noted when a bird foraged on very rotten logs; already broken wood is scattered about by lateral or backward swipes of the bill. This method also is employed in piles of mosses and debris at the bases of vines and bushes, where I observed individuals foraging for up to 45 minutes, probing, excavating, and "digging." One male flushed from the undergrowth then flew to a stub and foraged by probing and excavating for one-half hour there and at two nearby stubs, all between 2 and 4 m above the ground. I watched several birds carve deep, pitted excavations in less rotten wood below such stubs. The preference of the Okinawa Woodpecker for rotten wood suggests that the health of live trees and stage of disintegration of dead trees are of greater significance to foraging woodpeckers than is the species of tree represented. I did note, however, that they shunned coniferous trees, although most conifers accessible to the Okinawa Woodpecker in the area visited were exotic, plantation trees. The foraging modes and sites, and the general deportment of the Okinawa Woodpecker while foraging are very like those of the Southeast Asian *Blythipicus rubiginosus*, although the latter forages much less frequently on small logs or debris actually on the ground (pers. obs.).

Long Call.—I was fortunate to hear ten distant Long Calls (see Short, 1970) of this woodpecker. Only one call was tape-recorded and that too poorly to illustrate herein. The individual notes are clear, whistled *pee* notes closely resembling those in the comparable call of *Picus viridis*, *P. canus*,

Blythipicus rubiginosus, and *B. pyrrhotis* (pers. obs.). The call is characterized by an irregular delivery of notes, which were rendered at rates of 5 to 12 notes per sec, varying even within the same call. One call continued with pauses for 6 sec. Notes are from 2.8 to 3.2 kHz in frequency with little variation within an individual call. The comparable call of *Picus viridis* is of lower frequency (1.5 to 2.2 kHz), and the irregularly delivered notes are rendered in short series. The similar-sounding but longer notes of the Long Call of *Blythipicus rubiginosus* descend progressively (as do those of *B. pyrrhotis*) from about 3.2 to 2.8 kHz within an individual call, and the series are not as long as those of *Sapheopipo noguchii*. The Long Call presumably is the territorial "song" of the species, and at the time of my visit (prior to the breeding season) it was heard much less than was drumming, which may overlap functionally with Long Calls.

Call Notes.—I heard two distinct one-note calls, which probably vary in function (localization call, alarm call, other agonistic function?). Neither was tape-recorded in the field, but I was able to copy on tape some examples of both calls from the soundtrack of a motion picture, through the kindness of Mr. Katsu Moriguchi. The movie depicted an adult Okinawa Woodpecker feeding young at a nest in 1971 (the forest at the nest site has since been cleared!). One call note is a sharp, whistled *whit* (Fig. 3), rendered when the bird appears disturbed by the close approach of an observer. The Whit Call is a high-peaked, mechanical note, appearing on a sonagram as an inverted U, but with a carry-over beyond the U. Its main frequency range is between 2 and 4 kHz, but a faint component peaks above 8 kHz. The note is 0.15 to 0.20 sec in duration. These calls resemble closely the Pit Call of *Blythipicus rubiginosus*, and *Picus canus* also has a similar call (pers. obs.). The second call, heard more commonly than the Whit Call in February, is a variable Kup Call, rendered *Kyu-kyu*; *Kup, kup, kup*; and *Kyu-kyu-kup* in my notes. A call sounding like this was copied on tape from the film soundtrack, and analysis shows it to consist of a single note, or a series of notes individually appearing on a sonagram much like a Whit Call note but without an extension beyond the inverted U. These notes also are loudest at a higher frequency (3 to 4 kHz) than the Whit notes. The Kup Call closely resembles, and may be a ritualized development of the nestling Pip Call (see below). Compared with a Pip Call note, a Kup note is louder, more intense overall but especially at a higher frequency (3 to 4 kHz versus 2.5 kHz in Pip notes), and the notes are delivered irregularly in short series or singly, rather than regularly in long series as are the Pip notes of nestling Okinawa Woodpeckers. *Gecinulus viridis* and *Blythipicus pyrrhotis* give series of notes similar to Kup notes, but the intensity of the notes is great in higher

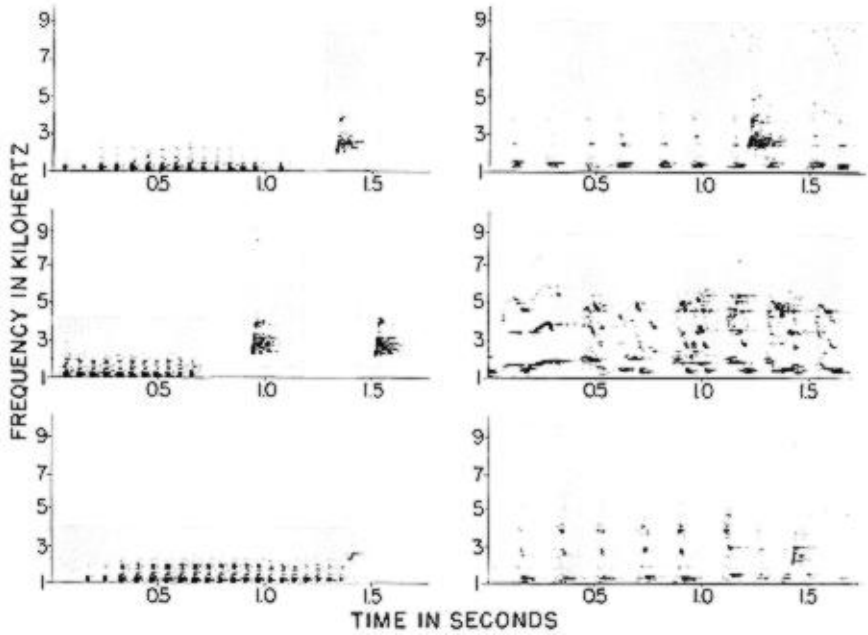

FIG. 3. Sonagrams of some vocalizations and instrumental signals of the Okinawa Woodpecker. Upper left: the shortest of the long or usual drumming bursts (note temporal variation of initial and terminal elements), followed by a Whit Call note. Center left: a short drumming burst, followed by two Whit Call notes. Lower left: a typical long drumming burst. Upper right: weak nestling Pip Call with adult Whit Call appearing (taller note) toward the end. Center right: nestling Kyaa Call (see the paired tendency of the elements, and variation from note to note). Lower right: Kup Call series with low Whit Call (last tall note); the next to last tall note is somewhat intermediate between a Kup and a Whit note (compare Kup Call with nestling Pip Call, upper right). All right sonagrams made from vocalizations in soundtrack of movie by K. Moriguchi. Sonagrams were made using narrow band filter on Kay Electric Sound Spectrograph machine. Please note that drummings are at 0.5 kHz less than shown in the figure.

pitched harmonics rather than in the fundamental tone which is emphasized in the Kup Call of *Sapheopipo noguchii.*

Nestling Calls.—I was not present on Okinawa during the nesting season, but copies were made of vocalizations on the soundtrack of Mr. Moriguchi's movies of nesting Okinawa Woodpeckers (see above). These included a great number of nestling calls, permitting analysis of these vocalizations, which generally resemble those of nestling *Picus* sp., and are less complex than are the calls of nestling flickers (*Colaptes*, Short, 1972). Two distinct nestling calls (Fig. 3) recorded are the Kyaa Call and the Pip Call. The latter call seemingly is rendered at intervals, especially when the nestlings

are agitated or sense the presence of an adult nearby. The Kyaa Call replaces the Pip Call when adults are in close proximity to the nestlings, and especially is uttered by the young as an adult approaches to feed them. The Pip Call consists of very uniform notes delivered in long series, and are uttered from very softly to very loudly. There is a distinct tendency, evident in most calls, for a pairing of notes within series, and the call may be called more accurately a Pip-pip Call. Each note with its harmonics covers a great frequency range (0 to 7 or more kHz), but the intensity is great only at about 2.5 kHz, and to a lesser extent at 1.2 kHz. Above 3 kHz the components are weak, and above 5 kHz they are extremely weak. The notes are rendered at from 6.8 to 7.6 per sec. Each note appears on a sonagram as a simple inverted U approximately 0.07 sec in duration. The Kyaa Call bears some resemblance to the Pip Call in that the notes basically have an inverted U shape, and they are repeated regularly in series, which may be short or long. However, the notes are usually paired, a pair effectively comprising a single component note of a series, and they are variably long notes. Even a component element of a double *Kyaa* note is twice the duration of a *Pip* note, and full double notes are as much as five times (0.35 sec) the duration of a *Pip* note. The fundamental at 1.2 to 2.0 kHz, and the first two harmonics are intense, and higher frequency harmonics are weaker. Some notes peak sharply over 1 kHz, with a slight drop between the elements of the double-notes; other, longer notes are more horizontal, showing a gradual rise to the highest frequency, but not a sharp peak. A few double notes have very sharp peaks, and it is the elements of these which, except for their higher frequency, most resemble *Pip* notes. Longer, horizontal *Kyaa* notes resemble notes of the Long Call of *Blythipicus* sp., and *Pip* notes resemble single note calls of *Picus canus*, and notes occurring in series of *Blythipicus pyrrhotis*, *B. rubiginosus*, and *Gecinulus viridis*.

Drumming.—This instrumental signal was heard intermittently, mainly between 07:00 and 09:00. Up to three bursts per minute, continued for five minutes were heard on the mornings of 7 and 8 February. Such drumming bouts followed periods of 10 to 30 minutes without drumming. Drumming consisted of short bursts of 7 to 14 individual taps, and long bursts of 15 to 21 notes. Seven recorded short bursts (Fig. 3) of drumming lasted 0.40 to 0.87 sec, averaging 0.629 sec. With an average of 10.43 taps per instance of drumming the short drumming bouts were delivered at a rate of 14.5 to 18 notes per sec, varying from bout to bout but being quite regular within a bout. Long drumming episodes (Fig. 3) proved more regular from instance to instance (16 recorded long drumming bouts lasted 1.00 to 1.22 sec, averaging 1.11 sec, and they averaged 17.6 notes per bout delivered at a rate of 15.45 to 17.21 taps per sec). However, within a long burst of drumming

the first two to six notes usually were delivered at a slower rate than those notes following them. Occasionally there was a similar slowdown in the last two or three notes, and, in two cases there was a break of 0.08 to 0.1 sec in the middle of a bout. Short bursts of drumming tended to initiate, or to terminate a series of long drumming episodes. Consecutive long drumming bouts generally resemble one another closely. For example, in one series of five bouts the consecutive bouts lasted 1.05, 1.04, 1.05, 1.06, and 1.05 sec. The first four of them each contained 17 notes, whereas the last, and terminal bout of this particular series, contained but 15 notes. Compared with the drumming of *Picus canus* (recorded in Austria, Summer 1970), that of *S. noguchii* consists of generally shorter bursts rendered at a slower rate (*P. canus*—19 to 21 notes per sec), and the drumming is less regular.

Nesting.—The Okinawa Woodpecker nests in April and May (Yamashina, 1941; Hachisuka and Udagawa, 1953; H. Arakaki, pers. comm.). Several old nests of this species were known to Messrs. Arakaki and Moriguchi, and I saw other holes undoubtedly excavated by *Sapheopipo noguchii.* These were 3 to 9 m above the ground in large trees or stubs (diameter 25 cm or more). A woodcutter working on the slopes of Yonaha Mountain at my direction cut down a stub in which an old nesting cavity was located. The stub was in a cleared area, and the nest had been active about seven years prior to my visit, when the forest was more extensive. The stub was 38 cm in diameter and 10 m high. The nest entrance was the shape of a hen's egg, wider at the top and narrower at the bottom. It measured 58 mm wide and 50 mm (inside) to 76 mm (outside) deep, thus being considerably smaller than the 10 cm diameter reported by Hachisuka and Udagawa (1953: 212). At the end of the 55 mm entrance tunnel was a chamber measuring about 24 cm in diameter and 38 cm in depth, with the greatest diameter opposite the nest entrance (18 cm diameter at bottom).

Hachisuka and Udagawa (loc. cit.) reported a nest found on 30 April containing young about 10 days old. They state that the clutch is "apparently two." They also indicate that nests are used year after year, but Okinawans familiar with the bird told me that nest sites change yearly. The only information that I can add concerning its nesting (see also section on vocalizations) is that food brought to young in the nest includes large grubs (3 cm long or more) and other large arthropods, perhaps including centipedes (large heads seen in bills of adults in brief film made in 1971 by K. Moriguchi).

Other Behavior.—Stretching movements of both the one wing and a leg type (first on one side, then the other), and the double wing type were glimpsed in the field, and seen in Mr. Moriguchi's movie. The only display noted is Wing Flicking, mentioned above (see call notes). Birds moderately

alarmed, but not so alarmed as to flee, gave Kup Calls intermittently, and flicked the wings slightly to moderately every few seconds (both while calling and between calls). At close range the Wing Flicking appears to emphasize the white markings on the outer primaries.

TAXONOMIC RELATIONSHIPS

Yamashina (1941) considered *Sapheopipo noguchii* to have no close relatives, but mentioned *Picus*, *Picoides* (*Dendrocopos* or *Dryobates* of Yamashina; for merger of *Dendrocopos* into *Picoides* see Short, 1971) and *Blythipicus* as comparatively closely related to *Sapheopipo*. Unfortunately he did not consider *Blythipicus* further, but he mentioned (1941: 327) resemblance of *Sapheopipo* to *Picoides* in "structure of bill, feet, and wings," "while *Picus* resemble (*sic*) *Sapheopipo* in the colour of the plumage and their habits." Peters (1948) placed *Sapheopipo* between *Picoides* (*sensu stricto*) and *Xiphidiopicus*. Hachisuka and Udagawa (1953: 212) referred to both Peters' placement of *Sapheopipo*, and to Yamashina's (1941) "interesting discussion" relating *Sapheopipo* to *Picus*. Goodwin (1968) suggested that *Sapheopipo* is a derivative of *Picoides*, evolved perhaps from the line that gave rise to the melanic *Picoides leucotos owstoni*, endemic to Amami-Oshima in the northern Ryukyu Islands. I failed (Short, 1969) to detect the traces of an *owstoni*-like pattern in *Sapheopipo noguchii* alluded to by Goodwin, and after recent examination of the British Museum (Natural History) specimens available to Goodwin I still cannot make them out.

Sapheopipo is characterized by the strong feet of a specialized woodpecking picid, and especially by the combination of a strong bill, broad across the nostrils, and bearing a distinct chisel-tip and an unspecialized (broad-vaned feathers, rather soft) tail. I consider that woodpeckers, being an arboreally specialized group, pose great problems of subtile morphological convergence and divergence. Hence, the lack of detailed, especially functional, anatomical study involving many character complexes of *Sapheopipo* and its possible relatives permits only a tentative consideration of the relationships of *Sapheopipo* based upon its external morphology and habits. Nevertheless, the preponderance of evidence at hand inclines me to regard *Sapheopipo* as a specialized, relict offshoot of a picid line that gave rise to modern species of *Picus* and the related *Gecinulus-Blythipicus* line.

The possible affinity of the Okinawa Woodpecker with *Picoides* seems to have little basis except for general bill-foot similarities; on this basis many other, although zoogeographically less satisfactory, relationships could be proposed. *Sapheopipo* in no way resembles *Picoides* in coloration. Its appearance in the field is like that of *Picus canus*; this resemblance is not merely a matter of coloration, but involves size, proportions and attitudes

(*Sapheopipo* "leans" considerably outward from tree trunks). Painted to resemble say *P. leucotos*, it would appear as a behaviorally bizarre woodpecker of that genus. The soft, broad rectrices of *Sapheopipo* are not like those of *Picoides*. No species of the latter genus regularly forages on fallen branches and branchlets, actually moving about on the ground to get at these branches, in the manner of *S. noguchii*. Finally, the vocalizations of the Okinawa Woodpecker are dissimilar to those of *Picoides*; it has no Kix, Peek, or Rattle (Blume, 1968; Short, 1971) call, or other calls found in *Picoides*.

Resemblances of *Sapheopipo* to *Picus* are many, and, indeed, the very strong bill of *Sapheopipo* is the main character separating it from *Picus*. One has but to consider the variation in *Picus canus* from typical green-backed races to the dark-plumaged, red-backed *P. c. dedemi* of Sumatra to see how readily the color pattern of *Sapheopipo* could have been derived from patterns found in *Picus*. The malar patch, crown color and sexual dimorphism in color of the crown, the pale throat, white wing markings, structure of the rectrices and the soft feather texture of *Sapheopipo* are shared with species of *Picus*. Even the pale bill color of *Sapheopipo* has somewhat of a parallel in the pale yellow lower bill of *Picus vittatus*, which contrasts with the dark upper bill, and is visible to the field observer and presumably to the birds (pers. obs.). The attitude of the Okinawa Woodpecker as it perches in trees, and its proportions resemble those of *Picus canus*. Its Long Call resembles similar calls of *Picus canus*, *P. viridis*, and *P. vittatus*, and nestling calls and drumming are not dissimilar to those of these species. *Picus* is a widespread Eurasian genus, with its greatest development in Southeast Asia where 10 species are found.

Blythipicus is a small genus consisting of two species, the smaller, lowland, Sundaland *B. rubiginosus*, and the larger, montane, southern Asian (east to mountains of Fukien, opposite Taiwan) *B. pyrrhotis*. Unlike the related *Picus*, these species have specialized "woodpecking" bills, broad between the nostrils, and their tails also are specialized (rectrices narrow and strong). These species resemble *Sapheopipo* in several features, particularly in their bill structure, the pale bill color, vocalizations, wing-flicking simultaneously with call notes, and in foraging habits. Like *Sapheopipo*, species of *Blythipicus* tear apart rotting wood, mainly (entirely in *rubiginosus*) close to the forest floor, and including rotting logs on the ground. Their call notes are punctuated by wing-flicking, and head movements show off the pale bill, just as in *Sapheopipo*. The plumage of *B. rubiginosus* strikingly resembles that of *Sapheopipo*, with subdued red dorsally, red on the crown (rear only), blackish underparts, and a pale yellow bill, and except for its shorter tail and smaller size, it could be mistaken for *Sapheopipo* in the field.

Gecinulus is a genus related to *Blythipicus* and *Picus*, and it also resembles *Sapheopipo* in several ways. The two species, *grantia* and *viridis*, form a superspecies occupying some lowland areas and hill or montane bamboo brakes in southern Asia, extending eastward to the mountains of Fukien. Like *Sapheopipo*, *Gecinulus* combines an unspecialized tail with a strong bill, which is, however, not as broad between the nostrils, nor as long and chisel-tipped as that of *S. noguchii*. *Gecinulus* shows specializations such as loss of a toe, a rather long tail, and proportionately short bill, all perhaps involved in adaptation to existence in bamboo groves. The two species show a green-red color replacement dorsally, as in *Picus*. Both have a pale bill which may serve a species identification function in the darkness of bamboo clusters. Vocalizations of *G. viridis* heard in Malaya and in Thailand are very like the calls of *Blythipicus* and to an extent like *Sapheopipo*. Its foraging habits, involving woodpecking in bamboo shoots, differ from those of *Blythipicus* and *Sapheopipo*.

I do not consider *Sapheopipo noguchii* congeneric with any one of these genera. *Gecinulus*, although specialized for bamboo-foraging, affords an indication of a possible stage in the evolution of *Blythipicus* and of *Sapheopipo* from *Picus*-like ancestors. The widespread occurrence of *Picus*, and the montane distribution of *Blythipicus pyrrhotis* and *Gecinulus grantia* as far east as Fukien, suggest that an ancestor of *Sapheopipo* derived from *Picus*-like ancestors may have invaded Taiwan and the Ryukyu Islands long ago, become isolated there (through competitive exclusion by evolving *Blythipicus* on the mainland?), and finally become extinct on Taiwan and Ryukyu Islands other than Okinawa. A similar derivation from mainland (montane) ancestors can be argued for the distinct jay *Garrulus lidthi* of Amami-Oshima; the closest extant relative of *lidthi* is the Himalayan *G. lanceolatus* (Yamashina, 1941).

The Ryukyu Islands are oceanic islands situated at the junction of the Eurasian and Pacific continental plates (Chai, 1972). They are the scene of considerable past tectonic activity, and it is difficult to ascertain the past extent of the island land masses during the Pliocene and Pleistocene, when *Sapheopipo* presumably evolved. Taiwan, also a tectonically active area, is, however, on the continental shelf, and likely was connected with adjacent mainland China (Fukien) at several times during Pleistocene glacial periods when sea level was considerably lower than at present. The depth of the Taiwan Strait is barely greater than 50 m. With Taiwan (and Japan) directly connected to continental Eurasia, various Ryukyu Islands interconnected, and the Eurasian land mass much closer to the west of the Ryukyu Islands during glacial maxima, there presumably was greater opportunity for ancestral

Sapheopipo noguchii to invade these islands from the west and southwest at those times than at present.

The behavioral and morphological similarities between *Sapheopipo* and *Picus-Gecinulus-Blythipicus* suggest that these taxa are related, and their zoogeography lends support to this view. I cannot totally discount the possibility of convergence as a factor responsible for these similarities, but I consider this possibility unlikely. Relationship ought to be assumed as a causal factor for manifold similarities, unless proven otherwise. That is, the burden of proof lies with those who would suggest a more complex factor, in this case convergence, as a causal agent for the similarities observed among these picid genera. Pending anatomical and other investigations of *Sapheopipo* and its possible relatives, this genus should be placed after *Gecinulus* and *Blythipicus* in a classification of woodpeckers (placement of *Picus* is problematical in a linear sequence, because of its other relationships, e.g., with *Celeus*, and with *Dinopium-Chrysocolaptes*, Bock and Short, in prep.).

CONSERVATION

The Okinawa Woodpecker, declared a national monument by the Government of the Ryukyu Islands in 1955, is restricted in its distribution to approximately five square miles of undisturbed forest in northern Okinawa. Small populations are known to exist, or to have existed within the past several years on Yonaha Mountain, Nashime Mountain, Mount Ibu, Mount Hedo and Iyu Mountain. Between these "mountain" peaks, the highest of which reaches an elevation of 498 m, undisturbed forest patches exist, presumably containing very small populations and scattered pairs of woodpeckers. Much of the area in which habitat still occurs is in control of the United States Marines and will remain so for the next several years or more. This control, influenced to some degree by an Okinawan movement to protect the woodpecker, probably has been generally beneficial to the woodpecker, since most of the area is used infrequently by the Marines, and the local population has been deterred to some extent from clearing forest lands. Nevertheless, forest fires during the hot summers, limited clearing in the Marine-controlled region, widespread wood-gathering, and wood-cutting have (Fig. 4) seriously affected much of the remaining forest.

Yonaha Mountain has a small area (perhaps 20 ha) of virtually undisturbed forest around its summit, which includes a 7 ha nature preserve. Within this preserve occur the Okinawa Woodpecker, and the endemic Ryukyu Akahige (*Erithacus komodori*), many other forest birds, and some 378 species of plants, including some alpine types (data from unpubl. conservation survey by Dr. George Ruhle of the United States National Park Service, 1965). The entire Yonaha Mountain region is in the Northern

FIG. 4. View looking north from slopes of Yonaha Mountain, 8 February 1972. Note effects of cutting (foreground) and planting of exotic conifers adjacent to the Yonaha Mountain Preserve, and clearing of distant hills, which lie in the U.S. Marine training area.

Training Area of the United States Marines; military activities have not been undertaken in the area, but clearing, and planting of exotic conifers is occurring in the entire region, and a woodcutter working with a power saw was clearing slopes immediately adjacent to the preserve on its northern boundary in 1972. The preserve forms a critical portion of the territory of at least two and probably three pairs of Okinawa Woodpeckers, which forage to some extent in adjacent second-growth, and along forested, narrow but steep slopes extending downward from the preserve. One nest used in 1966 or 1967 was in a dead stub 100 m north of the forest at the edge of the preserve. Another, probably used in 1970 or 1971, was in a small forested ravine above the woodcutter's house, and just northeast of the preserve. On the slope about this nest I made most of my observations of the Okinawa Woodpecker. The ravine and slope up to the preserve are due to be cleared in 1973. I estimate that about five pairs of *S. noguchii* inhabit the forests of Yonaha Mountain, where I saw at least four individuals (three males, one female).

Mr. Hideo Arakaki estimated that 140 ha on Mount Ibu and 50 ha on

Nashime Mountain provide forest habitat in which Okinawa Woodpeckers occur. These sites are under the protection of the Forestry Department of the Ryukyu Government, but they are unfenced, and only occasionally are visited by Forestry Department personnel. Our party found signs (old nesting and roosting cavities, woodpecker work) of Okinawa Woodpeckers and saw one distant individual on the slopes of Mount Ibu. The undisturbed forest there, together with surrounding second growth and forested slopes, may support as many as 10 pairs of Okinawa Woodpeckers. Dr. G. Ruhle observed the Okinawa Woodpecker (number unknown) on Nishime Mountain in September, 1965, and he saw cavities in trees attributed to the activities of these birds. This mountain area may support five or more pairs of *S. noguchii*. Baker (1948) reported two specimens (in U.S. National Museum) of *S. noguchii* collected by military personnel in the Mount Hedo area during 1945, and suitable habitat may remain for a few birds in that region. The Iyu Mountain area is well within the main portion of the Marine training area, and the status of Okinawa Woodpeckers there is unknown. The Kunigami highland area between Mount Ibu and Yonaha Mountain contains much second growth with scattered clearings, old burns, some exotic tree plantations, and much rough terrain bearing forest remnants of small extent. This patchy woodland probably harbors scattered pairs of Okinawa Woodpeckers; a wooded portion of the southeastern part of this area was the nesting site of a pair photographed by Mr. Moriguchi in 1971.

Wood-gatherers and others are at work throughout the area of woodland available to the Okinawa Woodpecker, and not even the nominal preserves are safe from their activities. The greatest danger to the woodpecker, aside from the obvious small extent of remaining undisturbed forests, is the fragmentation of its population into scattered tiny colonies and even isolated pairs. Gestures such as the naming of the species as a national monument, and protecting it from collecting are empty if sufficient habitat is not saved to insure the continued existence of an effective population of Okinawa Woodpeckers. I estimate the population of this species at from 20 possibly to as many as 60 pairs, depending upon the occurrence of pairs scattered about the highlands between the mountain peaks. It is conceivable that fewer than 20 pairs actually exist; it is inconceivable that more than 60 pairs exist, and it is likely that that figure is considerably optimistic. Concerned Okinawans feel that the economic boom engendered by the reversion of Okinawa to Japan (May, 1972) may result in rapid clearing of the remaining forests, enhanced fragmentation and decimation of the woodpecker population, and extinction of the Okinawa Woodpecker within a decade.

A concerted action by the Japanese government, with full support of all international conservation agencies, and indeed of all conservationists, is

needed to establish effectively protected, sufficiently large preserves for this woodpecker. In so doing, a considerable portion of Okinawa's original biota, probably including some rare plants and other animals, also will be preserved. These reserves could then serve as a source for reestablishment of the woodpecker in properly managed, surrounding forests. Too often conservation efforts are expended to save small populations representing subspecies or local populations of species otherwise existing elsewhere in numbers, or representing species similar to other, congeneric species elsewhere. I am in favor of preserving as much of organic diversity as possible, but common sense and limited resources demand that some priorities be established. In any scheme of priorities, the distinctive Okinawa Woodpecker, comprising a monotypic genus, ought to be near the top of the list of species requiring immediate attention. It would be a calamity if this species became extinct directly through the activities of man. I hope that this report will contribute to its preservation.

SUMMARY

The endemic, endangered Okinawa Woodpecker (*Sapheopipo noguchii*), comprising a monotypic genus, inhabits scattered patches of original forest in northern Okinawa, Ryukyu Islands. Brief studies in February 1972 established that it forages by excavating for insects in trees, and particularly in rotting branches, and stubs, and in rotten trees and branches lying on the ground. It is found at low levels in trees and undergrowth, much as is *Blythipicus rubiginosus* in Southeast Asia. Various calls are described, as is drumming. Vocalizations show resemblances to those of *Blythipicus* and *Picus*. What is known of this woodpecker's anatomy, and its behavior strongly suggest that *Sapheopipo noguchii* is related to the *Blythipicus-Gecinulus-Picus* line of woodpeckers, and not to *Picoides* (*Dendrocopos*). Although only five to eight individuals actually were observed, information available from my field observations of its habitat, and from Ryukyu Island forestry officials suggests a population of 20 pairs (possibly as many as 60 pairs) distributed patchily over about 1500 ha of the Okinawan highlands. Wood-gathering, woodcutting, forest clearing and replacement by exotic tree plantations, and fires are reducing the natural forests. Because the woodpecker requires undisturbed forest with plenty of rotting trees for foraging, and with standing trees and stubs 25 cm or more in diameter for nesting, the various human activities just mentioned are fragmenting its remaining small population and threatening it with immediate danger of extinction. Loss of this distinctive species and genus of woodpecker can be prevented only by fast action to establish one or, better, several effectively protected, suitably large preserves containing a few pairs of Okinawa Woodpeckers. Proper management of forests in the surrounding regions may permit reestablishment of the species over a large area, such that it no longer would be in danger.

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