Putative audio recordings of the Ivory-billed Woodpecker (*Campephilus principalis*)

Michael D. Collins[a)]
P.O. Box 1975, Pearl River, Louisiana 70452

(Received 2 August 2010; revised 2 December 2010; accepted 16 December 2010)

Putative audio recordings of the Ivory-billed Woodpecker (*Campephilus principalis*) are presented along with discussions of the videos from which they were extracted and the observations that were made when these data were obtained. On two occasions, high-pitched calls were heard coming from the direction of a bird that was identified in the field as an Ivory-billed Woodpecker. These calls seem to match the description of an alarm call that was reported in the 1930s. One of the videos captured a series of the high-pitched calls, which sound similar to the Blue Jay (*Cyanocitta cristata*) bell call but do not match published sonograms of that call. A putative double knock, which is characteristic of the Ivory-billed Woodpecker, was captured in another video a little over a minute before a large bird with characteristics consistent with an Ivory-billed Woodpecker flew into view. Since it is extremely difficult to observe this critically endangered species, information on audio clues could have an impact on its conservation. © *2011 Acoustical Society of America*.
[DOI: 10.1121/1.3544370]

PACS number(s): 43.80.Ka [WWA] Pages: 1626–1630

I. INTRODUCTION

The Ivory-billed Woodpecker (*Campephilus principalis*) has been feared extinct and then rediscovered several times during the past hundred years.[1] Following one of the rediscoveries, Tanner conducted a study at the last known nest sites in the Singer Tract in Louisiana.[2] The species seemed to vanish again after that area was logged in the 1940s, but there were many unconfirmed reports (almost always of wary birds that were extremely difficult to observe in remote swamp habitats) during the next several decades.[1] The most recent rediscovery claim, by a group of ornithologists in Arkansas,[3] is controversial[4,5] despite a subsequent report of sightings in Florida by an independent group of ornithologists.[6]

This paper presents putative audio recordings of the Ivory-billed Woodpecker that were obtained in the Pearl River basin in Louisiana, where there is a history of unconfirmed reports.[7] Although these recordings come from videos that have received stronger assessments from independent experts than any other evidence that has been obtained in recent decades, the purpose of the paper is not to resolve the controversy but rather to present additional evidence that this species persists and putative new facts about this species. One of the recordings is of a high-pitched call that seems to be consistent with the description of a call that is given when an Ivory-billed Woodpecker is disturbed.[2] This call was never recorded and does not seem to be mentioned elsewhere in the literature. The other recording is of a putative double knock, which is characteristic of the Ivory-billed Woodpecker and other members of the same genus. Putative double knocks have recently been recorded in Florida,[6] but no undisputed recording of the double knock of this species exists. Audio and movie files and other supplemental material can be viewed by opening the html document at the URL provided in Ref. 8.

II. THE 2006 VIDEO

While kayaking along a short stretch of a small bayou during a 5-day period in 2006, the author had five sightings (two of exceptional quality) of birds that were identified in the field as Ivory-billed Woodpeckers and twice heard the characteristic "kent" calls of this species (once coming simultaneously from two directions). The first sighting was on February 16, when a large black bird with large white patches on the trailing edges of the dorsal surfaces of the wings flushed from close range on the bank and flew into the woods. The wingbeats were unusually rapid for such a large bird, but this is consistent with the Ivory-billed Woodpecker in terms of historical accounts of rapid wingbeats during takeoffs.[2,9] Later that day, three kents heard at the same location were immediately followed by territorial calls of a Pileated Woodpecker (*Dryocopus pileatus*) that seemed to be an aggressive response. On February 17, the author had three sightings in the same area, including one of a bird that glided low across the bayou directly in front of the kayak, providing a clear view across the dorsal surfaces of the wings, which had large white patches on the trailing edges.

On February 18, the author heard a long series of kent calls while drifting down the bayou. The bird was hidden from view but continued to call from behind a fallen tree as the author quietly maneuvered the front end of the kayak against the bank and within perhaps 5 m of the bird. An American Robin (*Turdus migratorius*) was scolding from just above the source of the kent calls. The calls continued for more than a minute, and then kent calls started coming simultaneously from a second bird on the opposite side of the bayou and nearly directly behind the kayak. The second

a)Author to whom correspondence should be addressed. Electronic mail: mike@fishcrow.com

 0001-4966/2011/129(3)/1626/5/$30.00

bird started making harsh scolding calls after it apparently noticed the author near the first bird, which then went silent. High-pitched calls then started coming from the direction of the second bird.

The author had the fifth sighting on February 20, which was his second day in the field with a video camera. The bird was observed briefly perched on the side of a dead tree near the bank. The same high-pitched calls that were heard 2 days earlier started as the bird flew into the woods in the downstream direction and came from the direction of the bird. The author turned on the video camera and began recording the high-pitched calls while drifting down the bayou. After the initial series of calls stopped, the author backed the kayak into an observation position against the opposite bank, but then four more calls came from deeper in the woods. Just over 10 min into the video, movement was detected in a tree near where the last calls originated. While unsuccessfully trying to spot the bird in binoculars, the author kept the camera aimed in the direction of the movement and obtained footage of a large woodpecker in the fork of a tree 128 m distant (determined with a laser rangefinder). An artist (who has a "long interest in" the Ivory-billed Woodpecker according to the 2006 edition of Ref. 1) provided the following assessment of the 2006 video:

> I like the head/neck/crest and especially bill to head proportions. They do not suggest Pileated Woodpecker to me—too massive, especially the large, long bill. The rared-back pose, long but fluffy and squared-off crest, and extremely long, erect head and neck suggest Ivory-billed Woodpecker. The flapping leap the bird takes to the right, across the two trunks, is very unusual, and unlike anything I've seen a Pileated Woodpecker do. The flight appears ponderous and heavy, and the wings altogether too long and thin for a Pileated Woodpecker. The bird overall just looks very large and heavy.
>
> *Julie Zickefoose, March 2006*

Although Zickefoose is not a scientist, her paintings of Ivory-billed Woodpeckers have appeared on the covers of a leading ornithology journal and the leading contemporary text on this species.[1] The impressions of bird artists should be taken seriously, and in fact Sibley[4] is a bird artist. Appearing in Fig. 1 is an image from the video that shows the large bill and rared-back posture. Movie S1 shows the rared-back posture, large bill, and unusual movements while perched. Movie S2 shows the unusual flapping leap across the fork. Movie S3 shows the takeoff with ponderous and heavy flaps.

The high-pitched calls were recorded at 1, 6, 15, 45, 52, 56, 67, 82, 85, 86, 90, 92, 100, 104, 110, and 120 s into the video. These calls can be heard in Audio S1, along with the calls of two American Crows (*Corvus brachyrhynchos*) that appeared to be harassing the bird. Four more high-pitched calls were recorded between 337 and 363 s. The high-pitched calls sound similar to the bell call[10] of the Blue Jay (*Cyanocitta cristata*), but this species (which was not observed) is conspicuous and usually betrays its presence with "jay" calls; there are no such calls in the recording, which runs for nearly 38 min (from the beginning of the encounter) and also

FIG. 1. A large woodpecker is perched on the left branch of a large fork in the upper left part of the image. The bird later hopped across to the right branch of the fork and then took off into level flight to the left. The part of the fork that appears in the image was collected after the tree blew down in the summer of 2008 and was used to determine that the distance between the points marked by arrows is 1.41 m.

lacks any calls of the Pileated Woodpecker. Sonograms of the high-pitched calls and three putative kent calls from Ref. 6 are compared in Fig. 2. Both calls are composed of simultaneously excited harmonics, which are at 2.35 and 4.70 kHz for the high-pitched calls. This simple structure is characteristic of all known and putative recordings of Ivory-billed Woodpecker vocalizations. Appearing in Fig. 3 are sonograms of bell calls from Ref. 10, which do not have the harmonic structure of the calls in Fig. 2, and a bell call recorded by the author in the Pearl River, which matches the frequencies and structure of one of the bell calls of Ref. 10.

The video camera recorded continuously during the encounter. This footage, which appears in Movie S4, documents the author turning the kayak around just after the bird flushed, drifting back down the bayou, backing the kayak into an observation position, and keeping watch in the direction where the woodpecker appears perched in the video; the field of view was centered on the location of the bird just before the motion was detected and the camera was zoomed. It is clear from this footage that the author was attempting to relocate a bird following a sighting. Skeptics might consider the probability that an experienced bird watcher could mistakenly identify a bird as an Ivory-billed Woodpecker, track the movements of the bird for 10 min, and then obtain video footage of a large woodpecker that has several characteristics consistent with an Ivory-billed Woodpecker. This footage supports the hypothesis that the high-pitched calls were made by an Ivory-billed

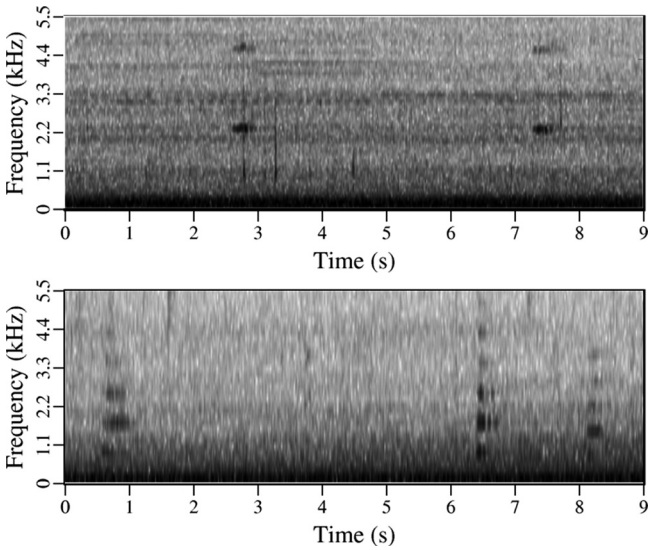

FIG. 2. Sonograms that show two high-pitched calls from the 2006 video (top) and three putative kent calls recorded in Florida (Ref. 6) (bottom). The harmonics in the high-pitched calls are at 2.35 and 4.70 kHz.

Woodpecker if one accepts that this species is too wary and cryptic (as most reports in recent decades suggest) to be tracked without audio clues for more than 10 min and through more than 200 m of dense vegetation.

III. THE 2008 VIDEO

A second video was obtained less than a kilometer up the same bayou on March 29, 2008, from a vantage point 23 m above the water in a tree that was used as a platform for watching for Ivory-billed Woodpeckers flying over the treetops in the distance. A large bird was detected in the distance flying up the bayou and was initially assumed to be a Wood Duck (*Aix sponsa*) based on its size and high flight speed, but

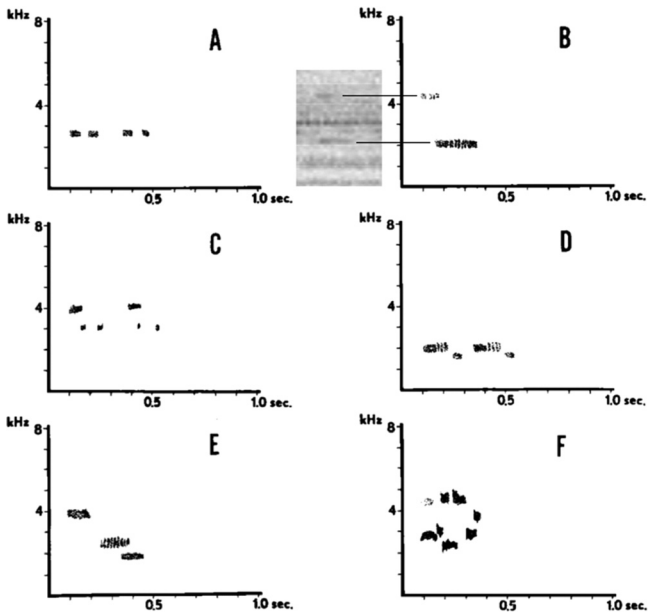

FIG. 3. Sonograms of the Blue Jay bell call from Ref. 10 do not have the simple harmonic structure of the sonograms in Fig. 2 (used with permission from the original publisher). The inset shows a bell call recorded by the author in the Pearl River that approximately matches both the structure and the frequencies of bell call B from Ref. 10.

two white dorsal stripes were observed as the bird passed nearly directly below and white trailing edges were observed on the wings as the bird continued up the bayou beyond the observation tree. A putative double knock was captured in the video a little over a minute before the bird flew into view.

Movie S5 shows the bird approaching the observation tree from down the bayou. Movie S6 shows the bird continuing up the bayou after passing the observation tree. Movie S7 contains the putative double knock and documents the sequence of events during the encounter; note from this footage that the sky was overcast, the wind was negligible (the surface of the bayou was smooth and strands of moss hung motionless except when the author moved to pan the camera), and the camera panned down the bayou immediately after the putative double knock (suggesting that it came from the same direction as the bird). Audio S2 compares the putative double knock with a putative double knock from Ref. 6; note that the brief time interval between knocks is about the same for both of the putative double knocks.

Definitive field marks of the Ivory-billed Woodpecker were observed in the field, but there seemed to be a contradiction after the video was inspected and found to reveal a flap style that is radically different from what was expected for this species. When something unexpected is discovered, the possibility of an error must be considered, but a clue (that was apparently overlooked for many years) in a historical photo of an Ivory-billed Woodpecker in flight suggests that there had been a misconception about the flap style. Based on historical accounts of a duck-like flight, the flap style of the Ivory-billed Woodpecker was thought to be duck like, with the wings remaining extended throughout the flap cycle. Details about the flap style are absent from most historical accounts, but a description by Eckleberry[11] of a "straight ducklike flight in which there seemed to be very little movement of the inner wing" suggests duck-like flaps. In a painting of woodpeckers in flight by Zickefoose, the Pileated Woodpecker is correctly shown folding its wings against the body in the middle of the upstroke, while the Ivory-billed Woodpecker is shown with the wings remaining extended throughout the flap cycle. Hill *et al.*[6] apparently expected the flap style of the Ivory-billed Woodpecker to differ from that of the Pileated Woodpecker since they reported an Ivory-billed Woodpecker flying with "stiff wingbeats" (which is synonymous with "duck-like flaps") without further comment. As shown in Fig. S1 in the supplemental material, the wings of the bird in the 2008 video are folded against the body during the flap cycle. A historical photo of an Ivory-billed Woodpecker in flight with the wings folded against the body is also shown in Fig. S1. This suggests that the flap style of the Ivory-billed Woodpecker is actually like that of the Pileated Woodpecker. The other images in Fig. S1 show that there are large white patches on the dorsal surfaces of the wings and that the wings appear to be narrower than the wings of a Pileated Woodpecker.

An expert on the flight mechanics of woodpeckers provided the following assessment of the 2008 video:

> I am confident it is a large woodpecker. I base this conclusion on the small upstroke/downstroke span ratio

and the pauses in mid-upstroke during which the bird holds its wings flexed in a 'bound' posture. This style of flight is consistent with Pileated Woodpecker, but I do not think that it rules out the bird being an Ivory-billed Woodpecker. Casual observers of a live bird in the field (e.g., Tanner) would likely miss the brief pauses even if they were present. There are two fields in which there is considerable white (or light gray) visible on the upper surface of the wings. Those patches of light-colored feathers would seem to be consistent with an Ivory-billed Woodpecker.

Bret Tobalske, April 2008

While analyzing the 2008 video, Tobalske obtained the wingtip curves in Fig. 4 using an approach that he previously developed for analyzing videos of woodpeckers in flight.[12] Since the bird was flying nearly directly toward the camera during part of the video, it was possible to obtain both curves simultaneously. Another advantage of the 2008 video is that the reflection of the bird off the still surface of the bayou makes it possible to pin down the position of the bird and estimate size, which cannot always be deduced from videos. Since the video was obtained from a known observation position and the bird flew just to the side of a tree during the approach, it was possible to place a bound on the wingspan. As shown in the supplemental material, the wingspan appears to be greater than 24 in., which is consistent with the author's impression in the field that the bird was similar in size to a duck and Tobalske's impression from the video that the bird is a large woodpecker.

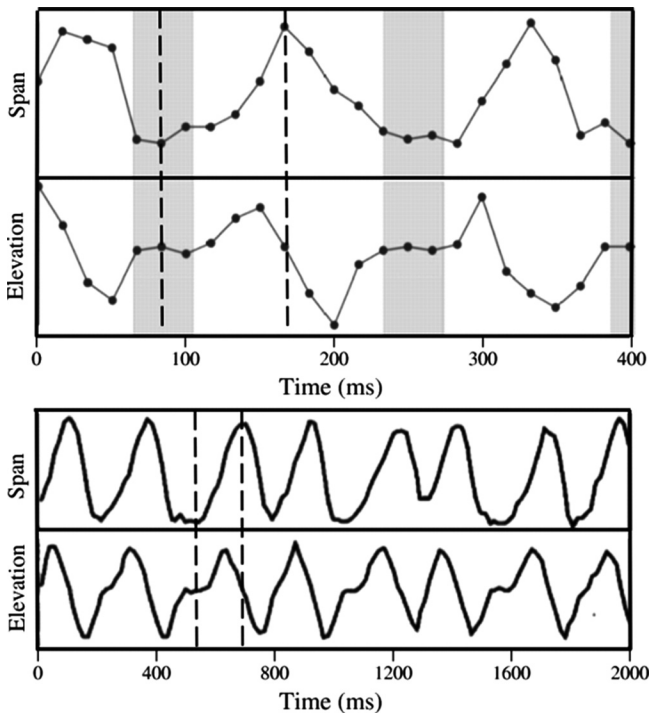

FIG. 4. Wingtip elevation and span curves. The upper curves were digitized from the 2008 video by Bret Tobalske. The lower curves from Ref. 12 correspond to a Pileated Woodpecker (used with permission from the original publisher). As indicated by the dashed lines, the span has a small value in the middle of the upstroke and a large value in the middle of the downstroke. The shaded areas indicate brief intervals during which the wings were held fixed in the middle of the upstroke.

The 2008 video is suitable for estimating flight speed since the bird flew past reference objects, the reflected image makes it possible to determine position, and the wind was negligible. As discussed in the supplemental material, an estimate of the flight speed was obtained by returning to the observation position and using images from the video to position marker stakes at reference points below. The bird flew approximately 66.5 m in 4.38 s. This corresponds to 15.2 m/s, which is significantly greater than the maximum of 11.6 m/s that Tobalske reported for Pileated Woodpecker.[12] The high flight speed is consistent with Ivory-billed Woodpecker in terms of historical accounts.

Two definitions for flap rate are used for woodpeckers, which often hold their wings fixed (folded against the body) for a significant percentage of the time. The raw flap rate is defined to be the number of flaps divided by the elapsed time. The intrinsic flap rate is obtained by subtracting out intervals in which the wings are held fixed. The Pileated Woodpecker has a mean raw flap rate of 3.7 Hz.[12] The raw flap rate of the bird in the video varied between about 6.6 Hz (15 flaps in 2.27 s) during the approach and about 7.5 Hz (4 flaps in 0.53 s) just beyond the observation tree. The period associated with the intrinsic flap rate corresponds to the time that elapses from the end of a pause, through a complete flap, and to the beginning of the next pause. The intrinsic flap rate of the Pileated Woodpecker has a mean of 5.2 Hz and a standard deviation of 0.4 Hz.[12] The intrinsic flap rate of the bird in the video ranges up to about 10 Hz, which is about ten standard deviations above the mean intrinsic flap rate of Pileated Woodpecker. The high flap rate is consistent with Tanner's account of a high flap rate.[2]

IV. DISCUSSION

Audio recordings were captured in two videos that were obtained during encounters with birds that were identified in the field as Ivory-billed Woodpeckers on the basis of key fieldmarks. The high-pitched calls resemble the Blue Jay bell call but do not match published sonograms of that call. They are consistent with an alarm call of the Ivory-billed Woodpecker that was reported by Tanner. During both encounters, the calls began at a moment when the bird was disturbed and came from the direction of the bird. The putative double knock apparently came from the direction from which the bird in the 2008 video appeared just over a minute later. This recording is consistent with a putative double knock recorded in Florida in terms of the time interval between knocks.

The birds in the videos have various characteristics consistent with Ivory-billed Woodpecker. The flap style is the only characteristic that is not consistent with what was expected for this species, but evidence in a historical photo suggests that this was a misconception. Among the large species of birds native to Louisiana, only the two large woodpeckers have a flap style in which the wings are folded closed against the body, but several characteristics of the bird in the 2008 video are inconsistent with Pileated Woodpecker. This footage provides the first putative data on the flap rate and flight speed of the Ivory-billed Woodpecker in cruising flight.

ACKNOWLEDGMENTS

The author thanks Bret Tobalske for extracting wingtip curves from the 2008 video; Julie Zickefoose and Bret Tobalske for assessing the videos; Steve Sillett, Jim C. Spickler, and Michael Taylor for donating expertise, time, and equipment to the tree climbing approach that made the 2008 video possible; Amity Bass, Dave Coke, Gretchen Dawson, Susan Epps, Tommy Tuma, and Wayne Higginbotham for assisting with the wingspan and flight speed estimates; and Dalcio Dacol for discovering a clue about the flap style in a Tanner photo.

[1]J. A. Jackson, *In Search of the Ivory-billed Woodpecker* (Smithsonian, Washington, D.C., 2004), 322 p.
[2]J. T. Tanner, *The Ivory-Billed Woodpecker* (National Audubon Society, New York, 1942), 111 p.
[3]J. W. Fitzpatrick, M. Lammertink, M. D. Luneau, T. W. Gallagher, B. R. Harrison, G. M. Sparling, K. V. Rosenberg, R. W. Rohrbaugh, E. C. H. Swarthout, P. H. Wredge, S. B. Swarthout, M. S. Dantzker, R. A. Charif, T. R. Barksdale, J. V. Remsen, S. D. Simon, and D. Zollner, "Ivory-billed Woodpecker (*Campephilus principalis*) persists in continental North America," Science **308**, 1460–1462 (2005).
[4]D. A. Sibley, L. R. Bevier, M. A. Patten, and C. S. Elphick, "Comment on Ivory-billed Woodpecker (*Campephilus principalis*) persists in Continental North America," Science **311**, 1555 (2006).
[5]J. A. Jackson, "Ivory-billed Woodpecker (*Campephilus principalis*): Hope and the interfaces of science, conservation, and politics," Auk **123**, 1–15 (2006).
[6]G. E. Hill, D. J. Mennill, B. W. Rolek, T. L. Hicks, and K. A. Swiston, "Evidence suggesting that Ivory-billed Woodpeckers (*Campephilus principalis*) exist in Florida," Avian Conserv. Ecol. **1**, online (2006).
[7]M. K. Steinberg, *Stalking the Ghost Bird* (Louisiana State University Press, Baton Rouge, LA, 2008), 173 p.
[8]See supplemental material at http://dx.doi.org/10.1121/1.3544370 Document No. E-JASMAN–129–024103 for audio files, movie files, and images from the videos and other images that were used for comparisons and for estimating wingspan and flight speed. For more information see http://www.aip.org/pubservs/epaps.html
[9]B. Christy, "The vanishing ivorybill," Audubon **46**, 99–102 (1943).
[10]H. G. Kramer and N. S. Thompson, "Geographic variation in the bell calls of the Blue Jay (*Cyanocitta cristata*)," Auk **96**, 423–425 (1979).
[11]D. R. Eckleberry, in *Discovery: Great Moments in the Lives of Outstanding Naturalists*, edited by J. K. Terres, Search for the Rare IvoryBill. (Lippincott, New York, 1961), pp. 195–207.
[12]B. W. Tobalske, "Scaling of muscle composition, wing morphology, and intermittent flight behavior in woodpeckers," Auk **113**, 151–177 (1996).