Technical Comments on the U.S. Fish & Wildlife Service's Ivory-billed Woodpecker Draft Recovery Plan

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Executive Summary. Here I review technical elements of the first recovery plan ever drafted by the U.S. Fish & Wildlife Service for the Ivory-billed Woodpecker (*Campephilus principalis*), currently listed as endangered under the Endangered Species Act. Two features uniquely distinguish challenges to (and the suitability of) a Draft Recovery Plan for this species: 1) the woodpecker's inherent and exceptional *rarity*, and 2) *lack of biological information*. Strengths of the current Draft Recovery Plan include a range-wide description of the bird's usage of variable habitats and a state-by-state breakdown of the species' historical occurrences. In its current form, however, and based on considerations supported with references and clarified in greater detail in the narrative of this review, I conclude that this Draft Recovery Plan does not offer a sufficiently rigorous and credible blueprint for conserving the woodpecker. Accordingly, I recommend *at least* the following revisions be made to the plan before it could be deemed acceptable: 1) formulate a chain-of-custody evidentiary protocol, 2) design rapid-response procedures for emergency protection of den trees and other sensitive sites when they are discovered, 3) prioritize and then streamline all habitat-centered recovery management objectives under one over-arching Recovery Action, 4) enhance expertise on the recovery team with individuals knowledgeable about certain peculiar woodpecker management and avian population viability issues, 5) add a minor research component aimed at assessing den tree availability, and 6) craft a sampling protocol for the bird's distribution and abundance that reliably distinguishes absence of evidence from evidence of absence during all field surveys conducted for this extraordinarily cryptic species.

Background and Purpose of the Recovery Plan Review

Astonishingly, and despite its listing status as endangered under the Endangered Species Act since 1967, no recovery plan was ever prepared by the U.S. Fish & Wildlife Service (USFWS) for the Ivory-billed Woodpecker (*Campephilus principalis*) prior to release of this draft on August 22, 2007. Recovery plans have as their purpose specification of those reasonable actions believed to be necessary in order to recover and/or protect listed species. Usually prepared by a recovery team, sometimes with the assistance of parties outside the USFWS, plans are released for review by the public and also submitted for outside peer review before being finally adopted. Thus, this Draft Recovery Plan will not represent the official position of the USFWS until signed by the Regional Director as approved. External review is part of the solicitation of this public comment prior to final approval and adoption. Given the already-listed status for the Ivory-billed Woodpecker (often hereafter: IBWP), and despite essentially retrofitting the listing criteria through hindsight, the rationale for listing itself was not questioned. Rather, my analyses and comments are aimed solely at the suitability of this Draft Recovery Plan and its proposed Recovery Actions for addressing the known current or likely future conservation needs of the IBWP.

Approach to this Review

A variety of sources and methods were used in preparation of my review. Obviously, the recovery plan itself was the principal focus. However, I also consulted published literature relevant to the woodpecker's status, proposed Recovery Criteria, or proposed Recovery Actions. Notably, even some recent literature important to the IBWP *was not* included or cited in this Draft Recovery Plan. This oversight was apparently because the document wended its way up and through various bureaucratic channels over approximately one year prior to public release by the Department of Interior (which was itself a surprise that was not coordinated with the recovery team).

In addition, I spoke on several occasions with the recovery team leader, Jon Andrew, Assistant Regional Director-Refuges, Region 4, USFWS, to gain his perspective on the content, process, and timing of the recovery plan. Finally, and to give proper weight to diverse viewpoints, I spoke with a variety of academic, NGO, and federal biologists who were intimately familiar with the recent search and/or recovery planning efforts surrounding the woodpecker.

For sake of context, I should reveal my general outlook regarding the putative status of the Ivory-billed Woodpecker as a still-extant species. Like others, I have been frustrated with the indefinite quality of much of the evidence presented. I commend, however, the deliberate and even guarded tone evident in the release of most of this evidence from both the Arkansas and Florida search teams. That much of it has been subject to rigorous peer review is laudable. Although none of the individual bits of evidence are (to me) authoritative or conclusive, in the aggregate the *cumulative* weight of evidence is (for me) nearly impossible to refute as either chance or mass delusional thinking. Thus, I would characterize my sense for the species' continued existence conservatively at around 90%, but it is likely higher.

My review is presented in the following sequence. First, I describe the very idiosyncratic challenges to crafting a recovery plan for this taxon, especially given a much greater degree of uncertainty than is customarily the case when preparing recovery plans for even the most imperiled of species. Then, I describe two separate sets of criticisms I perceived in the plan. One category scrutinizes errors of commission I perceived in the Draft Recovery Plan. The second category relates to perceived errors of omission in the Draft Recovery Plan. Then, I make a list of miscellaneous observations helpful for putting the Draft Recovery Plan into a fuller context. After these I compile a list of minor technical errors and edits that might be helpful for clarifying the narrative text in future drafts of the Recovery Plan, and a list of references used to amplify or question this Draft Recovery Plan. Finally, I present a set of conclusions and recommendations for improving the Draft Recovery Plan.

Unique Challenges to a Recovery Plan for this Species

To its great credit, the Draft Recovery Plan for IBWP honestly admits (p. 41), "…the *rarity* of the species and our *lack of biological information* are therefore the greater constraints facing recovery" (italics supplied). These two features, then, are crucial for evaluating the suitability of the draft plan itself. Adequate resolution of both issues also becomes essential for charting a set of constructive solutions that truly address the woodpecker's conservation needs in a final recovery plan.

So far, the bird's *rarity* has made it extraordinarily difficult to secure evidence of high enough quality to convince critics, skeptics, and detractors of the woodpecker's very existence. On the grounds of parsimony, I find some of these criticisms, including those levied by Sibley et al. (2006), to be more contorted and dubious than the original affirmative evidence. Also, some of this criticism was levied by those who, despite searching many years for the woodpecker and generally recognized as experts (Jackson 2006), were not part of the Arkansas discovery team. Candidly, in these and in other instances, one cannot entirely discount envy, turf-guarding, or other inherent human motivations as contributing to some of the criticism. At times, I've been hard-pressed to imagine any definitive evidence that might ever convince some of the critics, even film, digital image, video image, fresh feathers, or a DNA tissue sample of the IBWP.

On the other hand, the claim that one has seen or otherwise encountered putative evidence of IBWP has historically been so damaging to professional reputations that only the bravest or most reckless of ornithologists are courageous enough to venture forth with the information at all. In my opinion, John Fitzpatrick, Ken Rosenberg, and Geoff Hill (among others) are not reckless. In other words, there is a substantial asymmetry in the motivation between those who are offering what evidence is available *versus* those who routinely question any and all new information about IBWP.

Observations presented above may appear odd in a review of this sort, but the lingering disputes over the evidence need to be recognized as a potential impediment to recovery. In order to find an eventual solution, we need to go beyond a fruitless exercise in dart-throwing between believers and non-believers. Data, not personalities, are what should ultimately matter. And because any reluctance to come forth with new putative evidence could have utterly chilling effects for charting an effective recovery process, the species' *rarity* has huge practical consequences. Thus, there is a profound need for equally rigorous documentation of woodpecker presence *and* absence, a topic that I treat in further detail in the section on Recommendations.

The woodpecker's *rarity* has another profound import for evaluating merits of the recovery plan – it demands that a robust sampling protocol be adequately sensitive, accurate, and precise so as to withstand intense peer scrutiny and gain professional acceptance if and as more evidence of the woodpecker is acquired. The more-or-less proprietary sampling methodology of Cornell Laboratory of Ornithology (at least during the first couple of field seasons) are ineffective means to secure wide acceptance from professional peers for the soundness of a sampling design used in such sensitive field work and that carry such huge consequences to conservation. And of course, conspiracy theorists, not unknown in the orbit of the Ivory-billed Woodpecker, will never accept some narrowly-selected or poorly-vetted sampling plan.

Lack of biological information leads to yet a different set of challenges in this draft recovery plan. Because the decline of the Ivory-billed Woodpecker mostly predated the modern era of quantitative ornithology, precious little reliable information and hard data were ever documented for the species across its original distribution, range of habitats, environmental settings, disturbance regimes, and so on. Thus, there has been a tempting but also deceptive over-reliance upon the study by Tanner (1942) to fill in all the unknowns. This is entirely

unjustified because there is absolutely no affirmative evidence that the Tensas study site in northeastern Louisiana where Tanner conducted his study was at all representative of the woodpecker's preferred habitat and other life history needs.

In fact, there is enough other literature and evidence presented here in the Draft Recovery Plan itself to confirm that the woodpecker's habitat usage was much broader than often supposed. The Draft Recovery Plan repeatedly over-reaches and –interprets the Tanner (1942) study, often with reckless abandon, especially with respect to diet, forest stand characteristics, tree species usage, and landscape hydrology. This overly-narrow selection of the few facts that *are* known, more than any other feature, makes this Draft Recovery Plan untenable in its current form.

A key question, then, is given these two serious constraints, *rarity* and *lack of biological information*, is this draft version of the recovery plan suitable as presented? I make a case that it is not. Moreover, it is my judgment that *errors of both commission and omission in this draft recovery plan are serious enough to require the USFWS to craft a wholly rewritten and refocused alternative draft*. It is also my judgment that the recovery team itself would be hugely improved if more "outside" peer attention were levied at improving the plan. Greater objectivity is sorely needed to make any of several improvements needed for implementing successfully the necessary Recovery Criteria and the follow-up Recovery Actions.

Criticisms related to perceived errors of *commission*:

1. *Misdirected, superfluous, and exaggerated emphasis on "destruction of their food resource" to explain the species' disappearance.* Like an earlier Draft Recovery Outline prepared in late 2005 that I also examined, this version of the recovery plan still retains an inappropriate emphasis on food supplies as a factor contributing to the species' imperilment (p. iv, line 2). Not only are other, more likely co-factors besides habitat destruction (e.g., poaching, scientific collecting) better able to explain the IBWP's extreme imperilment, there are no or extremely few instances of other vertebrates becoming imperiled due to limited access to food supply *per se* (i.e., independent of habitat loss; see below).

   Nowhere is a justification given on why the wood-boring beetle larvae portion of the bird's diet was emphasized in the recovery plan when the known diet also included fruits, soft, and hard mast, including grapes, persimmons, hackberries, poison ivy, acorns, *Magnolia* fruit, hickories, and pecans (Bent 1939). Moreover, besides cerambycid beetle larvae, other insects, including grubs and engraver beetles (Scoltidae) were also documented in the diet. This led Bent to forthrightly state (p. 9): "The Ivorybills are, therefore, apparently somewhat adaptable in their food and feeding habits…"

   This narrow dietary emphasis in the Draft Recovery Plan is inappropriate, as it has led and can lead to an entirely misdirected effort on individual tree mortality as an overly-narrow management prescription for purposes of recovery. Thus, the heavy emphasis on energetic aspects of IBWP foraging on bark beetles (Task 3.1 in the recovery actions, p. 44) is dumbfounding, frankly. Moreover, I believe it is not at all justified based on past experiences with the ecology, conservation biology, and management needs of any endangered bird species of equal or greater dietary specialization. My reasons for this judgment are detailed below:

A. Past experiences have not provided us evidence that feeding energetics *per se* are especially informative (never mind necessary) to elucidate the causative reasons for, and the corrections to, bird imperilment. For example, in what is arguably the most specialized endangered U.S. bird having narrow feeding requirements, the snail kite (*Rostrhamus sociabilis*), little or no effort was ever expended at directly boosting its food supply, the apple snail (*Pomacea*). Rather, conservation attention for snail kites was devoted correctly to such issues as impoundments, wetland hydrology, climate-driven water flow, area requirements, and other habitat-scale manipulations.

Even for conservation-reliant species where access to food is a management issue (e.g., the scavenging California Condor *Gymnogyps californianus*), it is not food type *per se* but rather a broad community/ecosystem-level deficit in top predators that created the management challenge of a food shortage. Thus, an autoecological emphasis on IBWP energetics is a striking departure from successful track records in past management responses established for other highly-endangered birds.

B. A majority of imperiled bird species have mixed diets, like the IBWP, so emphasis on conservation management need not focus on a single dietary component. Even for other woodpeckers having quite specialized diets (e.g., the bark beetle-foraging Black-backed [*Picoides arcticus*] and Three-toed Woodpeckers [*Picoides tridactylus*]), the conservation emphasis is typically placed on the management challenge of insuring that sufficient areas of mature forest, abundant and large snags, all provide for the senescent forest conditions that predispose production of beetles *en masse*. Thus, the management focus is on stand condition across a shifting landscape mosaic – not manipulations of beetle density *per se*, something that in the long run and over large areas would never, ever be logistically practicable for IBWP.

C. The known diet of IBWP encompasses such non-insect components as nuts, berries, and so on. This dietary breadth further contradicts the emphasis on bark beetle production. Importantly, any putative benefits from boosting beetle abundance could be entirely offset by creating younger trees which are known to produce no hard or soft mass below certain minimum ages (e.g., compare the life-history tables for mast production as a function of tree age as listed in the Loehle (1988) appendix cross-referenced to the relevant tree species listed in the draft recovery plan, p. 169).

For example, some of these trees within the range of IBWP produce little or no mast until reaching 20-50 years of age. Shortages of older, mast-producing trees have been implicated as elevating conservation risks in reasonably widespread bird species (Benkman 1993), and contributing substantially to outright extinction in the worst instances (Buchner 1992).

2. *Unwarranted assumptions on the degree of niche specialization*. High levels of uncertainty in the true habitat needs of this woodpecker stem from lack of rigorous documentation prior to its highly imperiled status. Thus, one must be on guard to avoid making the wrong assumptions about the species' real ecological needs. Use of hardwoods vs.

softwoods is one uncertainty that the recovery plan appropriately identifies and even emphasizes (to its credit). But a separate uncertainty that is not sufficiently weighted concerns whether or not the species was truly as dependent on areas with high tree mortality and/or old-growth status as commonly believed. Dig around even a little, and one can uncover claims that this is simply not the case.

I can see no reason, for example, why Ivory-billed Woodpeckers could not use much of the same "niche space" as does the Pileated Woodpecker (*Dryocopus pileatus*). That species too was once condemned, wrongly, to an eventual disappearance due to loss of older forests. If narrowness in either diet or habitat have been over-stated or –interpreted for IBWP, then it is possible that a greater (but still poorly understood) flexibility in this woodpecker's life history needs were what enabled it to survive what could only have been very severe habitat bottleneck(s) in the early- and mid-1900s.

3. *Over-emphasis on tree species affinities of the woodpecker*. On pp. 27-28, there is much discussion about the affinity of the woodpecker for sweet gum and Nuttall oak based on Tanner's study, as well as on specific hydrological regimes that favor particular suites of tree species in this region. However, once again it is dangerous to over-interpret from that study, especially given that the woodpecker was known to use very different forest types across its former occupied range, and the fact that woodpeckers studied by Tanner had contracted back inside the Tensas site after surrounding areas were heavily logged. Again, there is no reason to assume that the Tensas study site was at all representative. Indeed, there is more than a tantalizing suggestion from 19th century Kentucky that the bird may even have used *upland hardwoods* (p. 122)!

4. *Unjustified promotion of narrowly prescribed silviculture as an initial recovery action*. I realize the inherent appeal that manipulative silviculture has for many of us across the natural resource profession (especially Recovery Actions 4.2, 4.3; pp. 46-47) – we want to do something. But I believe that a knee-jerk response of "managementism" here is misplaced and grossly premature, especially given an otherwise cautious stance usually offered elsewhere in the Draft Recovery Plan. For example, the Plan calls for building an adaptive framework to promote recovery goals. A heavy emphasis on artificially increasing beetle abundance comes off as lopsided for a recovery process this much still in its infancy. Moreover, because IBWP is hardly an early-successional species, customary benefits of successional intervention are nowhere evident. Indeed:

    A. Morticulture, i.e., girdling of trees to artificially boost either feeding or nesting substrate for IBWP (Recovery Action 4.3.2; p. 47), cannot be proposed as sustainable over the medium and long-term as a valid management option, so its appearance here smacks of some sort of research boondoggle. The reason for lack of sustainability is that such activities will inevitably lead to a 'successional legacy debt,' a situation whereby progressively fewer and fewer trees are available to achieve senescence (by man or nature) for the species' putative benefit. Our rate capacity to kill trees will always outrun nature's rate to grow them – this is widely perceived to be a factor in bringing about the species' demise in the first place. In effect, one

could or would create one or more artificially-induced, future bottlenecks of shortages in suitable trees, somewhere in the putative recovery area and sometime over the horizon of the recovery period, thereby compromising future recovery goals and interjecting greater uncertainty and a known, preventable risk into what is already an inexact recovery process.

B. Managers too often forget that natural disturbance (e.g., fire, tornadoes, hurricanes, ice storms, thunderstorm downbursts) create stand–replacing and stand–altering scenarios that produce senescent or dying trees anyway. The only plausible improvement to a shortage of suitable trees, if there is a shortage currently, is to: 1) let existing forest stands acquire an older age distribution (and this is exactly how forests behave under natural disturbance regimes [e.g., Frelich and Lorimer 1991, Lorimer and Frelich 1994]), or 2) plant more new stands over broader areas (including currently non-forested areas) such that progressively more trees eventually are brought 'on line' to achieve the appropriate age-class distribution across the recovery area(s) well into the future.

   Any deliberate girdling/killing of trees might coincide unfortunately with a large-scale natural disturbance such that future bottlenecks in either feeding or foraging substrates would be exacerbated. These past few years' we have witnessed remarkable landfalls from three (3) force-5 hurricanes along wide swaths of the Gulf Coast. Such disturbances should be sufficient reminder of nature's profound ability to create ample tree-killing, beetle-foraging opportunities!

C. A focus on dead trees as feeding substrate (Recovery Actions 4.2.2 and 4.3.2) is further puzzling to me because a shortage of suitable nest or den trees might be a more plausible conservation concern. According to Tanner's study, as much as 62% of IBWP feeding occurred on trees less than 61 cm dbh. In other words, we know for certain that IBWP require only large trees to roost and nest in; they may or may not require mostly (never mind only) large, old trees to feed on. I'm not actually suggesting there is a shortage of den trees, either, because a pair/family might need access to only a few such suitably large trees in several square miles of territory. My own research on cavity availability for smaller woodpecker species revealed a surplus of such microhabitat relative to woodpecker home range size. Still, at this stage of knowledge our research and management focus would be better placed on a potentially more limiting aspect of tree architecture in the woodpecker's well being. Regardless, I cannot see the benefits of spending ~150K each year for a Recovery Action (4.2.1; p. 59) that focuses on snag formation and decay rates.

D. Though I emphasize primarily the science reasoning (or lack of) behind the morticulture proposal, it is worth emphasizing that there would likely be significant credibility and political impediments to pushing such a notion onto a public likely to be quite skeptical about killing trees to manipulate or create habitat for IBWP. Unsubstantiated advocacy (e.g., Schock 2005) is unlikely to pass any of several conventional 'smell tests.' To be blunt,

"deriving practical management applications from incomplete information" (Schock 2005) is an audacious recipe for producing a conservation disaster. A far better tack, and one that would at least have some scientific validity, would be to establish a minimum threshold in rotation age of 60+ years in all areas subject to federally permitted projects and section 7 consultations across the potential IBWP recovery area. Such a standard, if accompanied by large tree retention under any and all active silvicultural regimes practiced, would likely maintain in perpetuity some trees 60 cm or greater dbh.

Criticisms related to perceived errors of *omission*:

1. *Recovery priority number of 5*. The full consequences of this ranking evaluation, never mind how it was actually computed, are a mystery. There needs to be a discussion in the recovery plan to explain why and how this number was derived, and how it compares with other listed vertebrates, especially birds, that are covered under the Endangered Species Act. And what are the consequences from this ranking for the recovery process?

2. *Recent published, peer-reviewed information on IBWP presence in Florida was not included.* The draft recovery plan needs to at least incorporate the Hill et al. (2006) study, to pp. 8-9 and elsewhere wherever it is relevant. Though apparently left out because of the long bureaucratic process in preparing the Draft Recovery Plan, in my opinion this entirely independent study boosts considerably the overall plausibility for the existence of a true IBWP metapopulation. Also, and recognizing that field efforts in Florida had similar difficulties of relocation as did the Arkansas search, the Hill team in panhandle Florida nevertheless found a modestly substantial amount of IBWP evidence of a diverse nature in a remarkably short period of time.

3. *The Draft Recovery Plan does not describe a sufficiently rigorous sampling protocol for assessing the population size, density, or habitat use and selection of IBWP with adequate statistical reliability.* The solutions to this deficiency can be broken down as follows:

    A. *Probability-based sampling*. I assume the Cornell team has already constructed a standardized protocol for deploying, training, and debriefing field researchers, for verifying sightings and other detection data, and for compiling or archiving that data in peer-accessible format (i.e., Recovery Actions 1.1 – 1.3, p. 44)? However, this methodology still needs to be peer-reviewed, published, or otherwise vetted before widespread adoption.

    But my greater concern here is with something different – whether there is a survey design in place for determining exactly where (and perhaps when) to deploy data-gathering at the outset such that results will have statistical validity for making strong inferences in future management and policy decisions, either within the central Arkansas recovery area, or to and in other potential recovery areas across the southeastern U.S. This bears on issues addressed especially in Recovery Action 1.2, and probably Recovery Action 1.3.

    What is fundamentally necessary is to establish a framework and/or grid relatable to the landscape characterization and assessment work (Recovery

Actions 2.0 – 6.0) such that whatever data is obtained can enable calculation of point estimates and their proper error terms (i.e., confidence limits, intervals) to derive robust numbers for IBWP population size, density, and/or habitat use.

Without prejudging suitability of any exact methodology, I could strongly recommend that stratified adaptive sampling be considered as a logical place to start (e.g., see Thompson and Seber 1996; Steven K. Thompson is quite a knowledgeable expert in this field, see http://www.stat.psu.edu/people/faculty/thompson.html.

It may be, too, that some of the site occupancy modeling work currently underway and conducted by Barry Noon and the CSU lab for this species would alleviate my concerns; however, apparently failing to cite or otherwise incorporate such research weakens my confidence in this Draft Recovery Plan.

In any event, whatever final survey design is adopted, it must be suitable for a multi-scale and hierarchical search effort conducted over the long term for population assessment, not just to produce validated photos or sound recordings to convince the few remaining skeptics in the short term (see below).

B. *Survey intensity*. Right now, the proper concern of field work and most investigators is on the risk of "false positives" in IBWP detection, i.e., making sure that woodpecker presence is adequately supported by reliable if not unequivocal evidence (sound, video, still photos; expert and multiple sight verifications, etc.).

However, in the long run it will be just as important (some of us might argue more important) to guard against "false negatives" as well, particularly as the IBWP seems to be extraordinarily cryptic in its behavior. In other words, there seems to be a huge risk of thinking that there are no woodpeckers around when in fact they may be present (but hidden).

Therefore, much can be learned by examining some of the past sampling solutions that were obtained for other vertebrate species displaying highly cryptic lifestyles, e.g., pine marten (Smith et al. 2007). The recovery plan must consult and then use where appropriate experiences of this other research which solved similarly-challenging quantitative problems of detectability.

5. *No formal, retrospective population viability analyses (PVAs) or similar 'bottleneck'-related research has been conducted (or at least yet reported)*. If it is still alive today, the IBWP has managed to squeeze through one or more severe bottlenecks in terms of population size, minimum extent of habitat, or likely both kinds of choke points since at least the middle stretch of the last century. This feature provides an outstanding opportunity for us to gauge what challenges and opportunities may lay before us in recovering this magnificent bird.

It should be possible, then, using data generated in Recovery Action 3.6 and/or other sources, to retroactively examine a range of scenarios (e.g., habitat shortages) likely faced by IBWP in the recent past as it traversed those bottlenecks. This could be accomplished by comparing current to historical records of forest extent, etc. This could prove hugely important in identifying why central-eastern Arkansas and

northwest Florida served apparently as [among the?] last refugia for the species, findings that could ultimately help identify other areas that might be most feasible for implementing recovery in the future.

Various miscellaneous observations:

1. The recovery plan team consisted of 12 members, 6 of whom were USFWS employees, 4 were university-affiliated researchers, and 2 were state wildlife agency employees. Jon Andrew, USFWS, was the recovery team leader. The biological and habitat working groups on the recovery team were larger and somewhat broader in their composition. Still, the recovery plan desperately needs the infusion of independent sets of eyes to scrutinize many of the assumptions, biases, and emphases used throughout this draft.

2. The draft recovery plan usually (but not always) places what I would regard as a correct emphasis on learning more about the species' status instead of habitat management actions *per se* (p. v). Nevertheless, elsewhere in the document there is undue emphasis placed on habitat management, especially morticulture. This is inexplicable given all the other sorts of factors that may impede recovery, including too much disturbance at the wrong time if, for instance, roosting or nest trees were ever discovered and not protected.

3. Recovery objectives and recovery criteria are appropriately broad, if at times vague. This general approach is only appropriate over the short term: 1) given the very limited current knowledge of the woodpecker's true needs, and 2) if it will facilitate appropriate management flexibility if and as new knowledge becomes available. I would strongly suggest that the eventual Recovery Plan be flexible enough to *constantly* adopt and incorporate any new findings.

4. Recovery actions (of which there are 9) tend to be overly prescriptive and too narrow given the limited state of knowledge today. This many total actions also seem excessive under all the uncertainty, and some appear to be redundant (e.g., #3, #4, #5, #6). In the main, and with a couple of exceptions, the recovery strategy does include the most important broad elements: surveys to characterize status, distribution, ecology, and habitat use.

5. Total costs seem reasonable, though this is difficult to judge. In part this stems from the unknown trajectory for the species' status and future management. It may be reasonable to view the total figure as an upper estimate on costs. However, I will argue in the Recommendations section that some tasks can and probably ought to be dropped and others added, so some adjustments in costs may eventually prove be necessary. I find the costs (500K annually) to conduct forest inventories (Recovery Action 2.3.2) to be rather exorbitant, especially if they must come from the recovery budget alone. These would seem to be more appropriate to fund elsewhere, from other sources, especially state or federal land management agencies.

6. The 'right' or at least realistic aim of down listing from endangered to threatened is identified as the primary recovery goal (p. v). Let's hope we have that opportunity!

7. Estimation of population densities, p. 4. I like these sorts of exercises and was modestly surprised that they were not used more extensively in the Draft Recovery Plan (or elsewhere) to make a plausible argument for the species continued existence independent of all the other evidence. To whit: the total acreage of bottomland forest already protected in the eastern Arkansas Big Woods area alone could theoretically support ~20-30 pairs! I understand that J. Michael Scott, USGS, may be doing something along these lines of scenario modeling; it would help the Draft Recovery Plan immensely to fold in the results, if they are yet available.

8. Greatest activity of woodpecker 2-3 years post-disturbance. This hypothesis could prove to be significant, and it is worth pointing out that this scenario follows those of certain other woodpeckers, e.g., Black-backed and Three-toed woodpeckers, both of which are known to closely track large-scale disturbance regimes. Populations of both boreal woodpeckers essentially occur in two states: 1) a low-level, endemic status consisting of dispersed individuals, and 2) aggregated clusters or even colonies of individuals during brief successional windows (3-5 years) in recently-dead forest stands.

   Given the greater rates of disturbance from storms and other causes expected under various climate change scenarios, however, a shortage of disturbance-driven tree die-offs can probably be factored out as a significant conservation risk. The plan could use, however, some simulations on how future climate scenarios would or would not provide for stand-altering disturbances that might provide the sorts of senescence helpful to the woodpecker. Such simulations would need to be spatially-explicit for the various environments across the southeastern U.S. where the woodpecker may still survive.

9. Proxy or surrogate species studies (Recovery Action 4.5; p. 60). There is probably some merit in using a more widespread *Campephilus* woodpecker to work out experimentally any hitches to the capture, transport, breeding, etc., of the IBWP. Still, it hard to see this as a particularly high priority, and it would be difficult in practice to implement politically for the IBWP.

10. Appendix 1. Metrics collected at woodpecker locations. These are, in general, quite comprehensive and useful. A question I would pose to the recovery team, and ask that they answer: *Can some or enough of these metrics be cross-referenced to FIA and other forest inventory data typically collected in landscape assessments so as to be really useful for typifying woodpecker habitat?*

11. Appendix F. Habitat conditions across Historic Range. It is far from clear that the private forest products industry could or needs to be "brought to bear upon issues surrounding recovery of the Ivory-billed Woodpecker"(p. 152).

- Firstly, public timberland contains more of the predominantly large-diameter trees that the recovery plan states are important to the woodpecker (p. 151, lines 22-24).
- Secondly, a growing proportion of the forest products industry purchases wood from non-industrial private land owners via distinctive business arrangements that include NIPFLOs, REITs, TIMOs, etc., thereby making *private industry increasingly less (not more) nimble than public lands for responding to woodpecker habitat needs* (if these were sufficiently understood).
- Thirdly, even if private industry had the capability to help (p. 153), it is far from evident that they would have sufficient motive or incentive (financial or otherwise) to do so,
- The sole exception to this weighting is if future research indicated that the woodpecker has a greater or equal preference for softwoods than hardwoods, the former being much better represented on private lands throughout the southeastern U.S. However, absent that confirmation, a special or priority emphasis on private land solutions for the woodpeckers is unwarranted.

Errors, corrections, recommended additions, and other minor edits to text:

- p. iii, line 8: recommend usage of the following addition (in underlines): "Evidence indicating the presence of an uncertainly small population…"
- p. 1, line 26: space between "." and "2006"
- p. 3, line 26: recommend usage of "," after word "recordings"
- p. 3, line 29: recommend infinitive verb forms for "promote" and "support" for consistence with rest of sentence
- p. 3, lines 33-34: Lammertink et al. citation not in reference list
- p. 10, line 15: Loftin 1991 citation not in reference list
- p. 12, line 16: McIlhenny 1941 citation not in reference list
- p. 12, line 19: Lowery 1974 citation not in reference list
- p. 13, lines 19-20: Peterson 1948 citation not in reference list
- p. 13, line 22: Pough 1944 citation not in reference list
- p. 13, line 24: Eckelbery 1961 citation not in reference list
- p. 13, line 27: Peterson 1988 citation not in reference list
- p. 13, lines 33-34: the Gauthreaux 1971 and Steward 1971 citations not in reference list
- p. 14, lines 3-4: the Dennis 1979 and Hamilton 1975 citations not in reference list
- p. 14, line 6: the Williams 2001 citation not in reference list
- p. 14, line 35: recommend inserting "of" between "south" and "the"
- p. 19, line 2: place a ")" to close the bracket around the "1937" date
- p. 82, line 13: the Hoose 2004 citation not in reference list for this section
- p. 83, last line: the statement "Without any additional tangible evidence this essentially remains true today outside Arkansas" is not longer operant (e.g., Hill et al. 2006)

- p. 85, line 21: the Hardy 1975 citation not in reference list for this section
- p. 85, line 33: apparent need of word "to" between words "due" an "the"
- pp. 100-102: the Rosenberg et al. 2005 citation not in reference list for this section
- p. 103: the Fitzpatrick et al. 2005 listed under the Literature Cited is not cited in the preceding text narrative
- p. 124, line 28: the Allen and Kellog 1937 citation not in reference list for this section
- p. 167, line 4: presumably "*silvi*culture" rather than "culture" is intended here.
- P. 167, line 22, in paragraph "Large diameter": meaning or purpose for the number "2" behind "diameter trees" is not clear here.

Conclusions and Recommendations for Improving the Draft Recovery Plan

1. *Develop, adopt, and then require that all IBWP evidence conform to an established chain-of-custody arrangement to safeguard credibility*. Bickering over evidence has been distracting, and in the long run only unhelpful to the recovery planning effort. Detractors and critics should be among those solicited to help craft a set of evidentiary standards applied to new data, including how to properly safeguard sensitive findings such as occupied nest cavities, roosting cavities, or breeding territories. But once these are vetted, peer-reviewed, and adopted, these protocols should become the standard against which all new findings are compared. Criticism after that point then becomes moot, if not entirely irrelevant.

2. *Prepare for the worst while expecting the best*. So far, birders and others interested in the IBWP have generally surprised managers in not stampeding to each of the woodpecker discovery sites. Certainly, I would have thought their response to be quite different than it has proven out to be. Nevertheless, the USFWS must have embedded in the Recovery Plan a set of procedures to rapidly deploy technical and law enforcement personnel, if necessary, to protect especially-sensitive IBWP sites. For example, if a breeding pair was detected at a cavity tree, one would need to take strong measures. I know from Jon Andrew that the capacity for this is already there, as much of the manpower was mustered for Arkansas in late spring 2005 when the rediscovery was first announced. The proper location within the Plan for stipulating these procedures would seem to be somewhere under 8.0 Public Use and Access in Occupied Habitat.

3. *Current Recovery Actions #2 through #6 should be collapsed and combined into one comprehensive, habitat-centered Recovery Action.* The overarching emphasis in the recovery plan should be on connecting and enhancing forest patch size across putative IBWP range, and allowing for increased patch age, both of which are occurring and have occurred already since the mid 1900s. Only lots of old forest will have lots of lots of old trees continually reaching states of senescence. Priority by sequence and by cost should go to landscape-level habitat inventories across the entire putative range of IBWP. It should take no more than one or two separate recovery actions (not ~5, i.e., p. vii) to accomplish this goal.

4. *Involve outside experts directly into the recovery process who have experience with other beetle-feeding woodpeckers that display similar affinity for mature forests*. Scientists affiliated with the

USDA Forest Service Research Experimental Stations in the western U.S. would be a good place to start. Dr. Ed Murphy, of the University of Alaska, has also conducted some research in this subject area in the past.

5. *Add a research component focused on den trees*. Make it a priority to conduct analyses, including modeling projections, that link stand dynamics, tree aging and growth rates, and IBWP territory size requirements, to the sustainable production of potential suitable den trees of sufficient size; identify any future bottlenecks in availability for reproductive expansion in the recovering population, and prepare an appropriate management response to such hypothetical shortages, if they exist.

6. *The Recovery Plan needs to have critiqued and then adopt a quantitative methodology appropriate for distinguishing absence of evidence from evidence of absence* (e.g., see Zielinski and Stauffer 1996 for an approach used in another cryptic forest vertebrate). For IBWP, it is important to make sure that the places we sample are searched long and often enough to truly declare them 'woodpecker-free' before any of our estimates of density, home range size, and other measures could be deemed trustworthy. Otherwise, we risk under-counting the woodpeckers, under-assessing their habitat, and thereby actually exaggerating the conservation risks that are faced by this species. Doug Johnson, Ken Burnham, William Zielinski, and the Jim Nichols group at Patuxent are among several of the well-qualified experts who could help meet this need.

7. *Add experts in Population Viability Analysis (PVA) to the recovery team*. Steve Beissinger, Barry Noon, Ron Pulliam are among several prospective candidates. At this stage of the recovery process, and for obvious reasons, I would emphasize analyses devoted to population rather than to genetic bottlenecks. Also, I think it would be highly useful to conduct some PVA retroactively, even if many parameters must be only estimated with unknown error terms. This could be useful in potentially identifying past bottlenecks through which the woodpecker apparently successfully navigated in order to survive up to today.

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