Review of proposed rule (3 October 2013) to list western distinct population segment of yellow-billed cuckoo (*Coccyzus americanus*) as a threatened species

Reviewer: Janice M. Hughes, Ph.D
Professor, Department of Biology
Curator, Lakehead University Museum of Zoology
Lakehead University
Thunder Bay, ON, Canada

Date: 22 November 2013

This review is the form of answers to the supplied questions as follows:

1. Are the Service's descriptions, analyses, biological findings, and conclusions accurate, logical, and supported by the data and information in the proposed rule; especially in regards to the species' biology, habitat use, range and status (current and historical), distribution, population size and trends, and configuration of the DPS boundary?

In the proposed rule, the authors have provided detailed and accurate descriptions of the physical appearance, reproductive biology, habitat preferences and use, seasonal movements, range and status, population size and trends, distribution, and configuration of the DPS boundary of the western yellow-billed cuckoo. In addition, they offer a thorough overview of the history of the species taxonomy regarding its separation into two subspecies: the eastern yellow-billed cuckoo (*Coccyzus americanus americanus*) and the western yellow billed-cuckoo (*C. a. occidentalis*), and offer numerous compelling arguments that favor the recognition of the western yellow-billed cuckoo as a distinct population segment (DPS). Their analyses and conclusions are logical and well-considered, and are strongly supported by robust scientific research, extensive population surveys, and other exhaustive studies in the field that span many decades.

I will discuss many of these topics in more detail as I address subsequent questions in this review; however, I wish to comment extensively here regarding the authors' well-founded proposal to recognize the western yellow-billed cuckoo as a distinct population segment.

As a requirement of the Endangered Species Act, it is the responsibility of the Service to demonstrate that the western segment of the yellow-billed cuckoo is a distinct population segment (DPS). Policy requires that a DPS be both discrete (i.e., markedly separated from other populations of the same taxon) and biologically or ecologically significant to the larger taxon to which it belongs: in this case, the yellow-billed cuckoo (*C. americanus*) species.

To this end, the authors have provided a thorough and convincing description of the DPS boundary that clearly shows eastern and western yellow-billed cuckoo populations separated across most of the distribution by the Continental Divide. This boundary has been delimited using both recent and past field studies, bird counts and nest surveys, and historical records dating back to the early 20th

century. Furthermore, the authors explain that cuckoos are rarely found above elevations of 6,000 ft; and breeding is virtually absent above 7,000 ft. This demonstrates quite conclusively that high-elevation mountains of the North American Cordillera form a significant barrier to gene flow between eastern and western populations from the Pacific Northwest south to western Texas. In western Texas and northern Mexico, where the mountains are lower, populations are separated geographically by as little as 50 miles (80 km). Nevertheless, the authors provide robust evidence that populations maintain separation in this region due to lack of suitable nesting and foraging habitat between the boundary areas. Further evidence for the separation of the two populations at the southern part of the species distribution was put forward by Hughes (2000) who concluded that body size differences between eastern and western yellow-billed cuckoos in west Texas and southern New Mexico were not gradual east to west, and that the size differences were too abrupt to reflect a clinal trend that might indicate gene flow between the populations. This supports the authors' conclusions that western yellow-billed cuckoos can be considered discrete with respect to geographic distribution.

The authors also successfully demonstrate discreteness in behavioral differences observed between eastern and western yellow-billed cuckoos. Their most compelling argument describes a significant difference in timing of migration, with western yellow-billed cuckoos arriving on the breeding grounds 4 to 8 weeks later than eastern individuals occurring at the same latitude. Timing of migration in birds is intricately connected to their endogenous annual cycle that includes breeding, feather molt, and fat deposition, all of which are under genetic control. More specifically, differences in timing of migration between populations of an avian species have been shown experimentally to have a genetic basis and, therefore, timing of migration is a heritable trait that is subject to natural selection (Pulido et al. 2001). Clearly, this difference in migration phenology between eastern and western yellow-billed cuckoos was established early in the species' evolution and is reflective of underlying genetic differences between the two populations.

The Service has also demonstrated conclusively that the western yellow-billed cuckoo is a biologically and ecologically significant population segment of the species as a whole on the basis of two criteria: (a) evidence that loss of the discrete population would result in a significant gap in the range of the taxon, and (b) evidence that the discrete population segment differs markedly from the remainder of the species in its genetic characteristics.

First, the historical range of the western yellow-billed cuckoo comprises 1,350,000 sq mi, about 40% of the area of the lower 48 states, and includes the entire Pacific migration flyway and about one half of the Central flyway. Moreover, approximately 35% of the overall historical breeding range of yellow-billed cuckoos is represented by the distribution west of the Continental Divide. As such, the loss of western yellow-billed cuckoos would represent a huge gap in the North American distribution of the species, including all of seven states and parts of five more states in the United States, and six additional states in Mexico. In addition, there is some evidence that western yellow-billed cuckoos may follow different routes during migration than eastern birds, and may winter in a more westerly part of South America (Hughes 1999). This being the case, a loss of the western breeding population would also constitute a loss or contraction in the

geographic distribution of transient populations through Mexico and Central America during migration, and on wintering grounds in South America. Consequently, the extinction of the western yellow-billed cuckoo would result in a significant gap in the distribution of the species in its entirety across both the Nearctic and Neotropical ecozones.

In addition, the authors successfully demonstrate that western yellow-billed cuckoos differ markedly from the eastern populations in both morphological and physiological traits that are genetically determined. They cite the works of numerous researchers who have completed extensive analyses on body size, body mass, bill size and shape, egg size, and eggshell thickness; and examined differences in bill coloration in both adult and juvenile cuckoos. As these phenotypic traits have a genetic basis with differences observed between them evolving over time in response to different environmental regimes, the authors rightfully conclude that there is a genetic difference between the eastern and western populations. It is important to note that the 12-month petition finding published in the 25 July 2001 Federal Register (66 FR 38611) concluded that the western population of the yellow-billed cuckoo was, indeed, a valid DPS. Among the evidence provided was the physical separation of eastern and western populations by the Continental Divide and significant differences between them in migration and nesting phenology, egg sizes, bill color and size, and body mass and size. Indeed, these criteria have not changed since the 2001 petition and, thus, are still valid to justify separation between eastern and western populations in the present proposed rule.

Since 2001, most scientific contributions to the taxonomy of the yellow-billed cuckoo have employed molecular genetics. In the proposed rule, the Service notes three molecular studies that have addressed this question: Pruett et al. 2001, Fleischer 2001, and Farrell 2006. The Service concludes that inconsistencies inherent between these three studies suggest that they do not provide sufficient evidence to separate western and eastern yellow-billed cuckoo populations at the level of subspecies at this time; although, recognition of the western yellow-billed cuckoo as a distinct population segment is certainly warranted by these data. Moreover, it is my opinion that closer examination of these studies infers a deeper genetic divergence between western and eastern populations, and with some further analysis would likely support a division of yellow-billed cuckoos into two subspecies. My explanation is as follows:

Two of the molecular studies used cytochome-*b* in their analysis; this slowly-evolving mitochondrial gene codes for a cellular respiration protein and is most commonly used in avian phylogenetic studies at the level of family, not species or subspecies. By quantifying the rate of base-pair substitution, it has been estimated that this gene evolves at approximately 0.5-1.0% change per million years (Hughes in revision, Ho et al. 2005). The fact that both Pruett et al. and Farrell identified some variation in this slowly-evolving gene within a species is remarkable; indeed, Farrell identified 20 different haplotypes among her samples that demonstrated some rudimentary structuring within and between eastern and western cuckoo populations. The third study by Fleischer concluded that two more rapidly-evolving mitochondrial genes (control region and ATPase 8) revealed no genetic structure to separate eastern and western yellow-billed cuckoos. However, it must be noted that many facets of Fleischer's analysis are decidedly flawed; perhaps,

most importantly, the use of ancient DNA extracted from toe pads of museum specimens (which are fraught with inaccuracies due to contamination and DNA degradation); and questionable tree-building algorithms; short DNA sequences; and suboptimal outgroup selection. Outgroup selection is very important in phylogenetic analyses (Luo et al. 2010): both Pruett et al. and Farrell used the appropriate pearly-breasted cuckoo (*Coccyzus julieni*), sister species to the yellow-billed cuckoo, as their outgroup. Fleischer, on the other hand, used the black-billed cuckoo (C. *erythropthalmus*), a more distantly-related species (Hughes 2006) as outgroup.

All three studies concluded that the molecular markers that they utilized evolved too slowly to reveal substantial genetic structure within the species, and that markers more appropriate for subspecies analyses, such as microsatellites, would be more informative in this regard. Nonetheless, the Act recognizes both subspecies and distinct populations in order to conserve genetic diversity in a species overall. It is clear that western yellow-billed cuckoos represent unique genetic haplotypes that are not present in eastern populations. At some level, these are expressed in the significant phenotypic divergence that can be observed in bill color and configuration, morphometrics and body mass, egg size, and behavioral divergences in the timing or migration and breeding. Thus, there is no question that the western yellow-billed cuckoo represents a distinct population segment as specified by the Act.

2. Have we accurately described the biological or ecological requirements of the species and ongoing conservation measures for the species and their habitat? Is the scientific foundation of the proposed rule fundamentally sound? Can the scientific foundation be strengthened, and if so, how?

The Service has accurately explained the biological and ecological requirements of the western yellow-billed cuckoo and has provided substantial evidence to support their descriptions. These data are based on decades of extensive field research comprising point surveys; quantification of prey use and abundance; monitoring of active nest sites; quantifying microclimate; comparison of occupied versus unoccupied habitat; extensive analyses of vegetation types and density; and radio telemetry to determine home range size and breeding densities. One such study on the South Fork Kern River in California was conducted for 17 years, thus, providing remarkable insight into the biological and ecological requirements of nesting and foraging western yellow-billed cuckoos. Field studies of this magnitude and longevity are rare in the scientific literature.

The authors conclude that protection and restoration of critical preferred habitat be the focus of ongoing and future conservation measures. To support their conclusion, they describe recent habitat restoration projects along the Colorado River in California that successfully increased local cuckoo populations by providing resources that encouraged continued colonization by breeding pairs. As such, they offer sound scientific evidence that active habitat restoration can be a successful conservation measure. Additional conservation measures involving relocation of livestock grazing within critical riparian habitat have also increased abundance of nesting cuckoos. Thus, the authors demonstrate that, in many cases, even severely degraded riparian habitat can recover from damage due to grazing after livestock are removed.

3. Are there instances in the proposed rule where a different, yet equally reasonable and scientifically-sound conclusion might be drawn? If any instances are found where this is the case, please provide specifics.

The proposed rule clearly describes the historical population and distributional status of the western yellow-billed cuckoo and compares these measures to its present state. Perhaps, the most compelling statements of the current condition of western yellow-billed cuckoos are the detailed region-by-region estimates of breeding pair abundance (pages 61634-61642), which distinctly show markedly-small remaining fragment populations that continue to dwindle steadily. Several states within the historical range of western yellow-billed cuckoos, such as Washington, Wyoming, Colorado, and Nevada have only a few remaining breeding pairs. Even California, once a stronghold of western yellow-billed cuckoo abundance, probably has less than 50 pairs. Moreover, about one half of the remaining western yellow-billed cuckoos breed in Mexico, where any state or federal protection offered the DPS will not be effected; thus, it is imperative that remaining western yellow-billed cuckoos within the United States be safeguarded.

The authors base their population and distributional estimates on numerous robust surveys comprising many thousands of hours over decades of study; there is no doubt that their conclusions regarding the continuing precipitous decline in western billed-cuckoo abundance are valid. In addition, there is strong evidence that western yellow-billed cuckoos are declining due to loss and degradation of the riparian habitat that is essential for nesting and foraging (see pages 61643-61655). Currently any state protection, where it exists, and the Migratory Bird Treaty Act, only prohibit damage, destruction, and harassment to the bird itself, and its eggs and nest; they do not provide protection for critical habitat. Clearly, western yellow-billed cuckoos are not declining due to physical tampering of their nests, nor from hunting or other such individual losses. Therefore, the authors' conclusions that the western yellow-billed cuckoo must be offered protection under the Endangered Species Act, which includes provisions to safeguard critical breeding and foraging habitat, is both logical and scientifically sound.

4. Does the proposed rule provide accurate and balanced reviews and analyses of the threats to the species (at the time of listing and in future) in the five listing factors? Are the Service's findings regarding threats biologically sound and supportable based on the information and data presented in the proposed rule?

The proposed rule identifies two of a possible five factors that are primarily responsible for the decline of western yellow-billed cuckoos that are deemed to be current and future threats to the DPS: Factor A, the present or threatened destruction, modification, or curtailment of its habitat or range; and Factor E, other natural or manmade factors affecting its continued existence. The authors have provided substantial data to justify their identification of these factors, and their findings are scientifically sound and supportable based on the information and data presented in the proposed rule.

Western yellow-billed cuckoos require extensive blocks of riparian vegetation containing trees of varying ages suitable for both nesting and foraging. The authors provide a particularly compelling case for the multi-faceting causes of destruction and degradation of critical riparian habitat throughout the range of the western yellow-billed cuckoo. Among the described threats are alteration of hydrology due to dams, water diversions, management of riverflow, channelization, bank stabilization projects, conversion of floodplains for agricultural purposes, conversion of native habitats to unsuitable non-native vegetation, long-term drought, and climate change. They also offer substantial evidence to demonstrate conclusively that these factors are affecting yellow-billed cuckoos through time. For example, many of these threats are currently ongoing and are projected to occur in future; in addition, many past impacts are predicted to have continued negative implications (see question 5 below). One notable example explained in the proposed rule describes how riparian vegetation once lost is often unable to regenerate naturally following the original perturbation – even in its absence – without intervention and rectification through appropriate habitat restoration projects.

Addressed under Factor E are three additional threats: habitat fragmentation; effects of agriculture on riparian habitat; and pesticide use, which negatively impacts prey insect populations. Again, the Service provides detailed, well-supported evidence to demonstrate and describe the causal factor and to quantify its effects on cuckoo populations. In addition, they provide a compelling case for the synergistic effects of these perturbations. For example, small fragments of preferred riparian habitat ultimately become unsuitable for nesting and foraging cuckoos because increased edge area relative to patch core area allows for higher nest loss due to increased intrusion by predators, which leads to abandonment of the patch by breeding pairs. Increased nest predation in patches was particularly notable in areas where riparian habitat edges were adjacent to open agricultural land. These patches were also prone to overspray of pesticides from nearby crop fields, which has shown to reduce substantially prey populations to untenable levels; pairs will forgo breeding on sites with poor food supplies. Pesticides have also shown to have both direct and indirect effects on cuckoos and their young by causing death, sublethal poisoning and concomitant behavioral anomalies, and eggshell thinning (Hughes 1999, 2001). In addition, the Service explains how small, widely-spaced patches, which may be separated by hundreds of miles of inhospitable habitat, often remain unoccupied due to low colonization and reoccupation rates by dispersing juveniles and returning breeding adults. The authors cite numerous locations where patches of suitable habitat are bereft of breeding cuckoos because of perturbations occurring either singularly, or in combination. Given the degree of general loss of suitable riparian habitat, it seems logical that reparations be made to habitat that still remains so that it will be usable by breeding cuckoos.

5. Are there additional current or planned activities in the area occupied by the species and what are the possible impacts of these activities on this species?

Without conservation intervention, loss, degradation, and fragmentation of critical riparian habitat will undoubtedly continue as it has for more than a century. Moreover, the authors indicate ongoing and future alterations of natural hydrological patterns as being a primary concern. For example, they describe long-term effects of many river damming projects throughout the western

yellow-billed cuckoo range. In the short term, these projects cause direct modification and loss of riparian habitat through inundation upstream of the dam as well as changes to riverbank conditions downstream. In addition, the authors provide supportable evidence of the negative long-term effects of damming, such as reduced prey populations, changes to vegetation communities, and alterations to riverbed sediments as a consequence of fluctuating water levels through normal continued dam operation. Given the typically rapid cycle of these fluctuations, there is insufficient time for remaining riparian habitat and its amenities to recover to serviceable levels. Furthermore, they cite proposals for future dams on the Sacramento River, and note the exclusion of western yellow-billed cuckoo habitat requirements in environmental assessments associated with dam construction. The Service also discussed future impacts of climate change on both water resources and existing riparian habitat within the distribution of the yellow-billed cuckoo. They concluded that loss, degradation, and fragmentation of riparian habitat will no doubt be exacerbated by factors such as increased drought, reduced snow levels in the watershed, changes in timing of snow melt and peak water flows. These factors will result in both direct effects to riparian habitat and indirect effects generated by greater demand and control of water resources for human use.

6. Did the Service accurately describe the analyses, studies, and literature that are referenced in the proposed rule, and did the Service use the best available science to support its assumptions, arguments, and biological conclusions? If any instances are found where the best available science was not used, please provide the specifics.

The Service has accurately described the analyses, studies, and literature that are referenced in the proposed rule, and has used the best available science to support its assumptions, arguments, and biological conclusions in all cases.

7. Are there any significant peer-reviewed scientific papers that the proposed rule omits from consideration that would enhance the scientific quality of the document? Please identify any such paper.

There are no significant peer-reviewed scientific papers that have been omitted from the proposed rule.

8. Are there parts of the proposed rule that need additional detail or explanation? Are there parts that are superfluous, or that could be condensed?

The proposed rule succeeds in providing all necessary information in a logical and succinct manner, and requires no further augmentation or abridgment.

9. Are scientific uncertainties clearly identified and characterized, and are potential implications of the uncertainties for the technical conclusions clear?

Perhaps the only scientific uncertainty in this proposed rule surrounds the official taxonomic status of the western yellow-billed cuckoo: is it a subspecies of *Coccyzus americanus*? However,

because the Act does not require a distinct population segment to be recognized as a definitive species or subspecies – but only as a discrete and biologically or ecologically significant portion of the larger taxon to which it belongs – this scientific uncertainty need not be resolved at this time. The authors have made an excellent case for the recognition of the western yellow-billed cuckoo as a distinct population segment as defined by the Act for which their are no scientific or technical uncertainties.

Literature cited in this review:

Farrell, LL. 2006. *Subspecies status of the western yellow-billed cuckoo (*Cuculidae: Coccyzus americanus occidentalis*): using cytochrome B to elucidate the enigma*. Masters Thesis, Lakehead University, Thunder Bay, Ontario Canada.

Fleischer, RC. 2001. *Taxonomic and evolutionary significant unit (ESU) status of western yellow-billed cuckoos (*Coccyzus americanus*)*. Admin. Rept. to USGS and US Fish and Wildlife Service.

Ho, SYW, MJ Phillips, A Cooper, and AJ Drummond. 2005. Time dependency of molecular rate estimates and systematic overestimation of recent divergence times. *Mol. Biol. Evol.* 22: 1561–1568.

Hughes, JM. 1999. Yellow-billed Cuckoo (*Coccyzus americanus*). In *The Birds of North America*, No. 418. (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA. 28 pp.

Hughes, JM. 2000. In litt. Letter from Janice Hughes to Kieran Suckling of the Center for Biodiversity (forwarded to D. Harvey and G. Falxa of the Service) regarding status of yellow-billed cuckoos. 10 March 2000.

Hughes, JM. 2001. Black-billed Cuckoo (*Coccyzus erythropthalmus)*. In *The Birds of North America*, No. 418. (A. Poole and F. Gill, eds.). The Birds of North America, Inc., Philadelphia, PA. 26 pp.

Hughes, JM. 2006. Phylogeny of the genus *Coccyzus* (Aves, Cuculidae): A test of monophyly. S*ystematics and Biodiversity* 4: 483-488.

Hughes, JM. *Calibrating the molecular cuckoo clock: Cretaceous origins or not?* In revision.

Luo, A, Y Zhang, H Qiao, W Shi, RW Murphy, and C Zhu. 2010. Outgroup selection in tree reconstruction: a case study of the family Halictidae (Hymenoptera: Apoidea). *Acta Ento. Sinica* 53: 192-201.

Pruett, CL, DD Gibson, and K Winker. 2001. Molecular “cuckoo clock” suggests listing of the western Yellow-billed Cuckoos may be warranted. *Wilson Bull.* 113: 228-231.

Pulido F, P Berthold, G Mohr, and U Querner. 2001. Heritability of the timing of autumn migration in a natural bird population. *Proc. R. Soc. Lond.* B 268: 953-959.