www.TorreyaGuardians.org/barlow-2010.pdf

The Torreya taxifolia USF&WS Recovery Plan Process

An Opportunity to Shift to a Deep-Time Perspective of Native Habitat

comments/suggestions by **Connie Barlow**
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ABSTRACT: This contribution is intended to advocate for recovery team members to familiarize themselves with the **deep-time perspective** now entering professional discussions among conservation biologists. The 2002 book by noted palynologist and paleoecologist Hazel Delcourt, ***Forests in Peril: Tracking Deciduous Trees from Ice-Age Refuges into the Greenhouse World,*** is recommended as essential background reading for the group members and leaders. If one agrees with the widely held premise that **the habitat along the Apalachicola River in northern Florida and southern Georgia served as a premier "pocket refuge"** for many temperate-zone species during the peak glacial episodes of the past several million years (a premise which Delcourt's 30 years of paleoecological work supports), then one is moved to revamp formal ecological definitions of "native habitat" and "native range" in ways that comport with a perspective that **geographic range for temperate zone species of the eastern United States has always and must continue to shift in tandem with climate change.** With respect to *Torreya taxifolia*, the premise is that **this species is endangered today because it is a "glacial relict."** For one reason or another (likely, local extirpation of squirrels by Indians living along the Apalachicola River during the current interglacial episode, and not in previous interglacial episodes), *Torreya taxifolia* was unable to make the journey northward in tandem with the retreating ice. The conclusion is that the "native range" for this species during this stage of an interglacial (and increasingly so as climate continues to warm) is not to be confused with "historic" native range. **Torreya taxifolia is no more native to the Apalachicola region during this peak stage of an interglacial episode than the Arctic Tern is native to the Arctic in January** (the tern migrates annually from pole to pole). Assisted migration for this endangered conifer tree is an ecologically responsible action, in that the window of opportunity has closed for the species to make that 400 mile migration on its own (that is, with the help of squirrels).

More broadly, **I propose that the USF&WS use this particular endangered species management plan revision as an opportunity to rethink how the word "native" can most responsibly and scientifically be defined and interpreted in accordance with the Endangered Species Act** for compliance with the Act's mandate in this time of rapid climate change, and especially for slow-moving (non-wind-dispersed) species, with long generational times, and whose northward migratory corridors have been prohibitively altered by logging, agriculture, fire, urban development, or the drowning of riverine forest habitats by dams.

CONNIE BARLOW is the founder of Torreya Guardians and is the author of 4 science books in evolutionary biology or evolutionary ecology: *The Ghosts of Evolution: Nonsensical Fruit, Missing Partners, and Other Ecological Anachronisms* (2001, Basic Books); *Green Space Green Time: The Way of Science* (1997, Copernicus Books); *Evolution Extended: Biological Debates on the Meaning of Life* (1994, MIT Press); *From Gaia to Selfish Genes: Selected Writings in the Life Sciences* (1991, MIT Press). Online links to her papers and articles at: http://thegreatstory.org/CB-writings.html

Note: Barlow speaks only for herself, as Torreya Guardians has no organizational structure.

1. The Apalachicola was a PEAK GLACIAL REFUGE.

http://www.torreyaguardians.org/rewilding.html#glacial-refuge

The above url will bring you to this paragraph (and more) on the www.TorreyaGuardians.org website. "Palynologist HAZEL DELCOURT, botanist Rob Nicholson, and others have each independently concluded that the Apalachicola habitat in

which Torreya taxifolia is found is **one of a small group of 'pocket refuges' along the Gulf (and southern Atlantic) coasts** in which **the vast majority of warm and cool temperate plant species found crucial refuge** when the Pleistocene continental glaciers achieved their peak advances during the past 2 million years. Without these refuges, it is likely that North America would have lost not only *Torreya taxifolia* but also its tuliptrees, sweet gum trees, bald cypress, hemlocks, and a host of shrubs and forbs (such as mayapple). How do we know this? Because Europe lost these species, presumably owing to unfortunate geography: southward migration blocked by the Mediterranean, Black Sea, Carpathian Mountains, etc. Indeed, the species name of Franklinia, *Franklinia alatamaha* derives from the only place this lovely tree was found — the Altamaha River of southeastern Georgia — before it vanished from the wild. The Altamaha River thus joins the Apalachicola (and the Tunica Hills of Louisiana) as a peak-glacial pocket refuge for plants of eastern North America."

2. Paleoecologist HAZEL DELCOURT has shifted ecological thinking that underlies conservation planning for biodiversity preservation.

(a) Species extant today have been **massively on the move throughout the Pleistocene and Holocene**.

b) Species **do not move as integrated communities**, but individually and opportunistically.

c) The corridors used by American species in past millennia to transit hundreds of miles north-south have been highly degraded in modern times and thus **can no longer function as migration corridors**.

http://www.torreyaguardians.org/hazel-delcourt.html

The above url will take you to a book review I wrote on Delcourt's 2002 book, ***Forests in Peril: Tracking Deciduous Trees from Ice-Age Refuges into the Greenhouse World.*** The review was published in the Winter 2004 issue of *Wild Earth* journal. Here is the last half of that review:

> . . . In her accessible and worldview-shifting book, **Delcourt illuminates the dramatic changes in how scientists have understood the origin and dynamics of eastern North America's deciduous forest types — perspectives changed in part because of three decades of her own paleoecological sleuthing.** As the title suggests, plant species on the move in response to climate warming or cooling (alternations of which have happened perhaps 20 times during the past two million years) may depend utterly on corridors or archipelagoes of suitable habitats for their survival.
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> *Forests in Peril* thus brings a crucial **deep-time perspective** to one of the central concepts in conservation biology today: corridors. Throughout the Pleistocene, rich soils and moist microclimates traversing sandy, dry landscapes would have hosted mesophytic forest species in transit. These species, moreover, **migrated not as integrated communities but opportunistically**, species by species, hopscotching from one safe site to the next. The corridor that Hazel Delcourt has mapped out between the Tunica Hills of Louisiana and the Cumberland Plateau of Tennessee is rather narrow: dependent on a thinning wedge of glacial loess blown from the Mississippi shoals onto its eastward bluffs and hills. Sadly, **many of the ravines that**

facilitated plant movement in the last 15,000 years have been turned into reservoirs or recreational lakes, no longer able to function as safe sites for plant migrations.

The conservation implications of this deep-time awareness are profound, given the probability of impending climate warming. **We may be rather sure of *what* is native, but precisely *where* becomes problematic.** For example, a small population of cool-temperate American beech still thrives in the rich soils along the Apalachicola River west of Tallahassee. As climate continues to warm, those southernmost remnant beech trees may be endangered. Their brethren, however, may still be vibrant far to the north, provided that their gene pool remains robust and climate change does not exceed their tolerances. What, however, of other **species that are "stranded" in the south in isolated pockets with no stepping stones to accommodate their northward-moving** phalanx? How do we, as conservationists, relate to these truly imperiled plants? For example, should we attempt to save one of the world's most endangered conifers, ***Torreya taxifolia***, by helping it "get back" to places like the Smokies, where we suspect it thrived during previous interglacials and for millions of years of prior Cenozoic warmth?

Delcourt suggests that **anthropogenic fires set by prehistoric Native Americans for purposes of game management may have disrupted the continuity of habitats** that otherwise would have been corridors for northward movement of plants during the current interglacial. If so, human interference with plant migration has not been confined to the modern agrarian and industrial age. Even a pre-Columbian standard for management may thus be a prescription for extinction, especially if our fossil-fuels addiction nudges the current interglacial into a "super-interglacial."

The closing chapter of *Forests in Peril* is a stunning synthesis. Delcourt lays out patterns and predictions, while posing questions of great consequence for those committed to biological conservation. I was at once exilharated as Delcourt's breadth of understanding became my own-and horrified by the conservation challenges that suddenly lurched into view. **"My personal and professional odyssey as a historian of deciduous trees," she writes, "has brought me to the realization that the future of the eastern deciduous forest is now at risk.** (p. 97) We can provide corridors to allow for species to migrate successfully in the face of climate change. We may also need to be prepared to **transplant endangered species to new locations** where climate will be favorable." (p. 207)

Self-enabled migrations facilitated by effective seed dispersers and served by generous corridors are, unquestionably, the ideal. But when the ideal fails for one species or another, we may need to step in to their rescue, not only with good science, but with a strong dose of intuition, humility, and heart.

3. Delcourt's 2002 book was the impetus for TORREYA GUARDIANS to form and to use assisted migration as a key conservation action.

http://www.amazon.com/Forests-Peril-Tracking-Deciduous-Greenhouse/dp/0939923890/ref=sr_1_3?ie=UTF8&s=books&qid=1273666585&sr=8-3

The above url will take you to the Amazon.com page for Hazel Delcourt's book, *Forests in Peril: Tracking Deciduous Trees from Ice-Age Refuges into the Greenhouse World.* There you will find just two reviews, both by Torreya Guardians. The most recent is by Russ Regnery (who in 2008 planted Torreya taxifolia seedlings on his rural land at 4,000 feet elevation in western North Carolina). The older review by me (posted under my husband, Michael Dowd's, Amazon account name) is titled: "**A Deep-Time Perspective on Global Warming**." Here it is in full:

This is the book that launched our citizen naturalists group on the internet: Torreya Guardians. In reading Hazel's book, I was struck by how important the "pocket reserves" were to

> the preservation of rich forest species during the peak of the last glacial episode some 18,000 years ago (as well as all the previous glacial episodes). One of those pocket reserves runs along the edge of the Apalachicola River in the Florida Panhandle. And it is here that the most endangered conifer tree in the world, *Torreya taxifolia*, is gravely imperiled.
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> *Torreya taxifolia* was just one of many species that hunkered down in this furthest south patch of rich soil, while cold-adapted spruces dominated the landscape in Georgia and points north. But as the glacial subsided and warming ensued, it was time for Torreya and its companions to begin their migration north, back into the Appalachian Mountains and beyond. For one reason or another, however, Torreya taxifolia was left behind. It did not disperse back to the north; it just lingered in the little Florida reserve. Thus, even without post-1960s increases in atmospheric CO2, Torreya taxifolia would have been doomed without human assistance. For in the 1960s was when it stopped producing seeds. But **because ecologists are not trained with a deep-time perspective, "native range" for this beleaguered tree is still considered to be only where it was historically found -- not where it likely was found pre-historically, during previous interglacial episodes.**
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> *Forests in Peril* was thus a wake-up call for myself and others who joined to discuss and take actions to save this tree in ways that mainstream ecology and the Endangered Species Act still do not allow: by engaging in "assisted migration" ("assisted colonization") for this beautiful relative of the yew. We formed www.torreyaguardians.org, and in July 2008 we purchased from a plant nursery 31 seedlings of Torreya taxifolia and planted them ("rewilded" them) into forested landscapes of two private properties in the mountains of North Carolina. Welcome home, Torreya taxifolia! And thank you, Hazel Delcourt, for your magnificent and worldview-shifting book.
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> (review written by) Connie Barlow (spouse of Amazon.com member Michael Dowd)
> Founder of Torreya Guardians, author of "The Ghosts of Evolution"

NOTE: I visited Hazel Delcourt at her office at the University of Tennessee Knoxville, just before she retired and spoke with her in depth about her deep-time perspective and how conservation efforts must henceforth include that perspective.

4. It is time to revisit the implicit assumptions of what constitutes "native habitat."

USF&WS is directed, under the Endangered Species Act, to work to restore the viability of officially "endangered" plants in their "native" habitats — but **the law itself may not limit precisely *how* ecologists define what is meant by the term "native habitat."**

As climate change is now undeniable for this century and beyond, **it is time to bring a deep-time perspective to our understanding of "native" in order to fulfill both the letter and the underlying intention of the Endangered Species Act.** Here I shall describe a key published document (gray literature) in which a deep-time perspective was used to evaluate best management practices for *Torreya taxifolia.*

Paleoecologist **Paul S. Martin** and I published our "Bring Torreya taxifolia North—Now" in the Fall/Winter 2004-2005 issue (final issue) of *Wild Earth* journal. (Mark Schwartz published an oppositional view in that same issue.) It is here that **we argue for regarding the "native range" of *Torreya taxifolia* as centering on the southern Appalachians during times of peak interglacial** (which we are in right now and which will continue to intensify). Here are key excerpts from our paper:

> . . . Thus far, the arguments we have made in favor of assisted migration for *Torreya taxifolia* are grounded entirely in an ethic of biodiversity preservation: T. tax is in deep trouble in its historic

native range, so let's give it a chance to establish in cooler realms. Biodiversity preservation is not, however, the only environmental ethic that should guide conservation choices. Increasingly, "rewilding" (Soulé and Noss 1998, Barlow 1999, Foreman 2004) is a powerful motivator. According to this standard, a network of "potted orchards" of T. tax tended in northern botanical gardens, though a good hedge against outright extinction, falls far short of the mark—**potted is the botanical equivalent of caged**.

Might it be possible for T. tax to take its place once again as a thriving member of some subset of Appalachian forest communities? We say *again* because **we believe that northern Florida is more properly viewed not as native range for T. tax but as peak-glacial range.** Helping T. tax establish in the southern Appalachians is thus not so much relocation for a plant struggling with global warming as **repatriation of a once-native. It is a form of rewilding that uses a deep-time baseline for determining appropriate range.**

Torreya is a member of the ancient gymnosperm family Taxaceae, whose ancestors were evolutionarily distinct from other conifers by the **Jurassic**, some 200 million years ago. Because ***Torreya* pollen is indistinguishable from the pollen of yews (*Taxus*), bald cypress (*Taxodium*), and cypress (*Cupressus*)**, known fossil occurrences of this genus are limited to macrofossils (seeds, leaves, and secondary wood), and these are sparse. There are no known Cenozoic fossils of *Torreya* in eastern North America. **The most recent macrofossils identified as the genus *Torreya* in eastern North America are upper Cretaceous, and these were unearthed in North Carolina and Georgia**—hence, our suggestion that assisting T. tax to rewild in North Carolina would be assisting **the return of a deep-time native**. Because worldwide climate during the Cretaceous was much warmer and far less seasonal than that of today, it is not surprising that *Torreya* macrofossils of Cretaceous age have also turned up along the Yukon River of Alaska. In western North America, there is Cenozoic fossil evidence of genus *Torreya* in the John Day region of Oregon (lower Eocene) and variously in California (Oligocene and late Pleistocene). **Today, the genus is highly disjunct**. *Torreya californica* survives as a rare tree, locally abundant in a score of isolated populations within the coastal mountains of central and northern California and on the west slope of the Sierras. It favors moist canyons and mid-slope streamsides, growing beneath a canopy of taller conifers and deciduous trees. *Torreya nucifera* is found in mountain habitats of Japan and Korea, and four other species of genus *Torreya* inhabit mountainous regions of China. We would not be surprised if one day a remnant grove of *Torreya* were discovered in the mountains of northeastern Mexico, in patches of mesic forest that still support sweet gum, beech, and yew (Martin 1957). *Torreya taxifolia* is the only one of the six known species that is highly imperiled, and we believe we know why.

www.TorreyaGuardians.org/barlow-2010.pdf

> ***Torreya taxifolia* is a glacial relict, left behind in its pocket reserve** of rich soils and cool, moist microclimates afforded by ravines along the east shore of the Apalachicola River. The current richness of North America's deciduous forests is, in large part, thanks to this and other glacial refuges—including the Tunica Hills of Louisiana and the Altamaha River of southeastern Georgia (Delcourt 2002). For some of the repatriated plants, relict populations still remain in one or more of these refugia, while the bulk of the range is disjunct much farther north—beech is a notable example. We infer that T. tax was unable to follow the other plant refugees north when the ice retreated, beginning some 15,000 years ago.
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> http://www.torreyaguardians.org/barlow-martin.pdf

I suggest that **the definitions of "Current range", "Historic range", "Near-time range", "Deep-time range", and "Target range" that were posted online in 2004**, and which resulted from exchanges with high-level ecologists and botanists who participated in email discussions about the *Torreya taxifolia* issue, be considered by the recovery team in its update of the management plan for this species. Online access to those first-published standards is:

http://www.torreyaguardians.org/standards.pdf

Overall, I suggest that **deciding whether *Torreya taxifolia* (a.ka. Florida Torreya) is native to northern Florida or to the southern Appalachians makes no more sense than deciding if the Arctic tern is native to the arctic or to the antarctic.** (This bird species breeds in the Arctic and "winters" along Antarctic seas.)

A deep-time ecological perspective leads inevitably to this: **Genus *Torreya* has a species in eastern North America that is native to northern Florida during peak glacial times and that is (most likely) native to the southern Appalachians during peak interglacial times.** In between those "seasons" it is in transit (slowly, owing to its large seed that depends on squirrels to disperse). Note: The other five species of genus *Torreya* in the world have less disjunct glacial and interglacial ranges, as their habitat is mountainous even in today's interglacial, and thus they can adapt more quickly by moving up and down slope elevationally and by dispersing between north- and south-facing aspects.

Only a deep-time perspective can help professional ecologists perceive the dangers of maintaining the short-sighted, established assumptions about what "native" range entails. Any ecologist who accepts that climate change is underway (the degree to which such change is anthropogenic has no bearing on this point) and that such change will affect habitat suitability in decades to come can, in my view, **no longer ignore the need to revisit how "native range" and "native habitat" are professionally understood**.

Historical note: The reason that Connie Barlow and Paul S. Martin co-authored the paper "Bring Torreya taxifolia North—Now" is that **the informal group discussing by email in 2003 and 2004 the conservation possibilities of a deep-time perspective for *Torreya taxifolia*** (the discussion was initiated by Connie Barlow) could not reach a consensus. **Barlow and Martin were unwilling to accommodate the oppositional or neutral perspectives of the other discussants.** So we wrote our paper and submitted it for publication. The editor of the journal then recruited Mark Schwartz to

submit his own views, resulting in a "Forum" pair of papers for the journal. Schwartz' paper, "Conservationists Should Not Move *Torreya taxifolia*" is accessible here:

http://www.torreyaguardians.org/schwartz.pdf

Individuals who participated to varying degrees in those email exchanges of 2003 and 2004 were: Connie Barlow, Paul S. Martin, Hazel Delcourt, David Jarzen, Lee Barnes, Bill Alexander, Peter White, Rob Nicholson, Peter Wharton, Mark Schwartz, Leigh Brooks, Anathea Brooks, Brian Keel, Paul Spitzer, Josh Brown, Sharon Hermann, John Johnson. (Connie Barlow has retained an archival paper record of these exchanges.)

5. Torreya taxifolia translocation into the southern Appalachians poses no serious risk to the resident species.

Once one accepts that "native range" for *Torreya taxifolia* would have differed greatly prehistorically between peak-glacial and peak-interglacial times, and that *Torreya* is in trouble today, at least in part, because it is a "glacial relict" in northern Florida, there are **only two reasonable arguments against formally introducing into the management plan one or more pilot tests of assisted migration** (translocation), aimed at attempting to identify "preferred range" (and the preferred microhabitats within that range) directly to the north for this species now and in the decades to come.

One argument against translocation is **limited financial resources**. That is, adding translocation as a management option would necessarily diminish monies available to continue vigorous work on in-situ (in-Florida) restoration efforts. From what I heard at the recovery group meeting on May11, 2010, a revamping of budget priorities could be a serious professional blow to team members who have been receiving money for in-situ work and the associated pathological studies. I sense that of the team members present at that meeting, only the **Atlanta Botanical Garden** staff would have an assured and significant role to play in an expansion of the management plan to include assisted migration — indeed, there would finally be a vast and scientifically important outlet for use of their huge supply of propagated, potted seedlings. New scientists and institutions in North Carolina and environs would need to be recruited to the effort of **scientifically studying habitat and micro-climate preferences of existing genotypes moved into its hypothesized pre-historic range.** Costs could be mitigated by accessing volunteer citizens, under the guidance of professional scientists, to do much of the fieldwork. Torreya Guardians would be able to assist in recruitment of volunteers and the posting of text and image results of the work.

The second argument is the most serious: Irrespective of whether translocation northward would be undertaken purely as a safety back-up in case in-situ restoration fails, or whether it is undertaken with an updated understanding of "native range," based on paleoecological studies, **the threat this species would pose to resident taxa** must be taken into account. Would resident species be threatened by Torreya becoming an invasive or by it carrying with it pathogens that are not already resident in those locations?

In the "Standards for Assisted Migration" posted in 2004 on the Torreya Gurardians website, this concern is addressed in Standard No. 4: "Low Risk for Recipient Ecosystems." The url for that document is:

http://www.torreyaguardians.org/standards.pdf

I have yet to hear any professional ecologist, horticulturalist, botanist, or similar professional who is familiar with *Torreya taxifolia* and/or with southern Appalachian forest ecologies express any real concern for this possibility. One need only look at the existing translocations of this species in which seed production has been occurring for decades (the Biltmore Estate, Clinton NC, Highlands NC) to conclude that **this large-seeded plant can't disperse any farther in a generation (roughly 20-30 years in the wild) than the distance a squirrel is inclined to bury seed from the parent plant.** More, if it were to become invasive, all specimens could easily be removed by hand, especially since they do not spread by root runners. This contention is supported, in the abstract, by a 2007 paper that concluded that north-south translocations of terrestrial (nonaquatic) species in eastern North America pose little threat of invasiveness: Jillian M. Mueller and Jessica J. Hellmann, "An Assessment of Invasion Risk from Assisted Migration" *Conservation Biology*, 28 June 2007.

The concern about **spreading pathogens** is more pronounced. But if professionals are not willing to more carefully monitor pathogens spread by homeowners purchasing exotic species for their landscaping from private nurseries, I don't see why this should be a credible argument against assisted migration experiments undertaken in small, private preserves. Indeed, **scientists currently performing pathogen studies under the management plan might beneficially turn to assessing the degree to which pathogens plaguing the Florida specimens are actually present already in potential destination habitats to the north — and whether northward translocation might strengthen the plant's resistance to such unavoidable pathogens.**

CONNIE BARLOW can be contacted at cbtanager@bigplanet.com
Phone: 850-420-8002. Her cv and links to online papers:
http://thegreatstory.org/CB-writings.html