Assisted Migration or Assisted Colonization: What's In a Name?

Chronological History of the Debate on Terminology

Compiled by Connie Barlow, founder of Torreya Guardians (2004)
Webpage created in 2008; significantly updated in 2021

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Part 1. Brief History of Terms: Five Synonyms

TABLE 13.1

The changing face of assisted migration.

1992	Primack and Miao	Suggested moving plants in response to global climate change
2000	Barlow	Predicted intentional movement of plants as a future conservation tactic
2002	(Keel, personal communication)	Keel first coined the term *assisted migration*
2005	Keel	Defined assisted migration as a concept
2007	Keel	Constructed theoretical framework of assisted migration
2007	Hunter	Introduced the term *assisted colonization* to avoid confusion with the term *migration*
2008	Hoegh-Guldberg et al.	Presented a decision-making framework for undertaking assisted colonization
2008	Managed Relocation Working Group	Introduced the term *managed relocation* to better capture conservation actions
2009a	Ricciardi and Simberloff	Proposed arguments against using assisted colonization
2009	Schlaepfer et al.	Proposed counterarguments to Ricciardi and Simberloff
2009	Richardson et al.	Presented a multidimensional decision-making framework for undertaking assisted colonization that incorporates socioeconomic axes
2010	Minteer and Collins	Proposed addressing ethical issues associated with managed relocation and shifting attention to developing criteria for managed relocation
2010	Seddon	Suggested thinking beyond moving single species to moving and constructing new communities
2011	Shirey and Lamberti	Called for more regulation of plant sales, restricting purchases of endangered species hybrids, and controlled pilot managed relocation by the US Fish and Wildlife Service

ABOVE: **"Managed Relocation: Panacea or Pandemonium"**, by Kristin E. Haskins and Brian G. Keel. Chapter 13 in *Plant Reintroduction in a Changing Climate*, pp. 229-241, J. Maschinski et al.,

eds.

Between 2004 and 2009, FIVE terms were launched and employed for what ***Oxford Dictionary of Ecology*** in 2010 defined as "assisted migration" (p. 31). The dictionary definition begins:

"ASSISTED MIGRATION is the intentional establishment of populations or meta-populations beyond the boundary of a species' historic range for the purpose of tracking suitable habitats through a period of changing climate...."

The FIVE TERMS, with **dates of earliest publications using each term, along with the names of lead authors** are directly below.

To access the full titles and links, advance to the chronological and annotated **List of Foundational Papers** section of this webpage.

1. ASSISTED MIGRATION - **2002 & 2004** (Brian Keel); **2004** (Connie Barlow & Paul S. Martin); **2006** (Mark W. Schwartz, Louis R. Iverson, Anantha M. Prasad, Stephen N. Matthews, and Raymond J. O'Connor); **2007** (Jason S. McLachlan, Jessica J. Hellmann, and Mark W. Schwartz); **2008** (Jillian M. Mueller and Jessica J. Hellmann); **2009** (Dan McKenney, John Pedlar, and Greg O'Neill); **2009** (Julie Lurman Joly and Nell Fuller); **2010** (Alejandro Camacho); **2010** (Pati Vitt). Journals entail *Wild Earth* 2004; *Conservation Biology* 2007, 2008; *Forestry Chronicle* 2009; *Environmental Law* 2009; *Yale Journal on Regulation* 2010; *Biological Conservation* 2010. The term **"human-assisted migration"** appeared in a **2001** paper by Cathy Whitlock and Sarah H. Millspaugh in the journal *Western North American Naturalist*, but it was not cited until 2014, in a review article by Maria H. Hallfors in *PLOS One*.

2. ASSISTED COLONIZATION - **2007** (Malcolm L. Hunter); **2008** (Hoegh-Guldberg, Hughes, McIntyre, Lindenmayer, Parmesan, Possingham, and Thomas); **2009** (Anthony Ricciardi and Daniel Simberloff); **2009** (Stephen Willis et al.); **2010** (Patrick Shirey and Gary Lamberti); **2010** (Philp J. Seddon); **2010** (Ronald Sandler). Journals entail *Conservation Biology* 2007, 2010; *Science* 2008; *Trends in Ecology and Evolution* 2009; *Conservation Letters* 2009; *Restoration Ecology* 2010. UPDATE: An **April 2021 issue of *Science* journal** propelled this term into dominance once again in the field of conservation biology (Jedediah Brodie et al. 2021).

3. FACILITATED MIGRATION - **2008** (Sally N. Aitken et al.). This paper was published in *Evolutionary Applications*, and it was the first contribution by **forestry academics** (as distinct from conservation biologists, who originated the terms "assisted migration" and "assisted colonization"). In 2017 a paper by Linda M. Nagel et al. and published in *Journal of Forestry* also argued that **"facilitated migration"** was the best term for use in forestry. However, almost all other papers published by **academic foresters (especially in lengthy review articles) selected "assisted migration"** as the term of choice. Such review papers were published in *Forestry Chronicle* (2011 Catherine Ste-Marie et al. and 2011 Richard Winder et al.); *BioScience* (Pedlar, McKenney, Aubin, Beardmore, Beaulieu, Iverson, O'Neil, Winder, Ste-Marie 2012 — all but Iverson are Canadian foresters); *Journal of Forestry* (Mary I. Williams and R. Kasten Dumroese 2013); *New Forests* (Dumroese et al. 2015).

4. MANAGED RELOCATION - **2009 & 2012**. Both the 2009 and 2012 papers that included "managed relocation" in their titles emerged from the work of a **"Managed Relocation Working Group"**, which formed at the 2008 meeting of Ecological Society of America. The 2009 paper, **"Multidimensional evaluation of managed relocation"**, was published in *Proceedings of the National Academy of Sciences*. It was written by 22 co-authors (including prominent conservation biologists), with David M. Richardson as lead author. The 2012 paper, **"Managed Relocation: Integrating the Scientific, Regulatory, and Ethical Challenges"**, was published in *BioScience*.

It entailed 32 coauthors (many the same as the 2009 paper), with Mark W. Schwartz as lead author. Owing to the multi-authorship and working group origin of this pair of conservation biology papers, the formal debate within the field of conservation biology as to when, whether, and how to help species move poleward as climate changed was largely finished in the abstract. Also, two chapters included "managed relocation" in their titles, within a 2012 edited volume, ***Plant Reintroduction in a Changing Climate***.

5. HELPING FORESTS WALK - **2008/2009**. Unlike the previous 4 terms offered and debated, this fifth term has not yet (as of 2021) been presented in a published paper. The first appearance of "helping forests walk" online is p. 49 of the **"2008/2009 Annual Report of the Department of Environmental and Forest Biology" SUNY-ESF** in Syracuse, New York, in the context of **Traditional Ecological Knowledge (TEK)**. There, **Prof. Robin Wall Kimmerer**, founder and director of the university's new **Center for Native Peoples and the Environment**, writes, "The validity of using TEK as a partner to ecological science in education and research is gaining traction through our efforts. The successful development of the Center has created a platform from which grant proposals such as the recent NSFIGERT **"Helping Forests Walk"** have developed." While awareness of TEK is growing among academic conservation biologists and foresters, the concept and name "helping forests walk" is still unfamiliar in any field of scientific ecological knowledge (SEK). The compiler of this webpage, Connie Barlow, did not encounter this fifth term herself until autumn 2020, when she began researching the probable Holocene practice by indigenous peoples of undertaking assisted migration of fruiting native pawpaw, *Asimina triloba*, in the eastern USA. **Indigenous leaders currently listed as directors of the Helping Forests Walk Project** are Robin Kimmerer (Director, Center for Native Peoples and the Environment, State University of New York Syracuse); Henry Lickers (Scientific Chair, Haudenosaunee Environmental Task Force); David Arquette (Chair, Haudenosaunee Environmental Task Force). As of 2021, the project can be found on the SUNY webpage titled **"Collaborative Projects with Indigenous and Tribal Partners"**. Marla Emery of the U.S. Forest Service is also a director. The Forest Service lists projects and partnerships for its **"Tribes and Climate Change Research"** collaborations; ongoing USFS research includes, **"Helping Forests Walk**, assessing opportunities for **assisted migration** of culturally important species in the Haudenosaunee (Iroquois) Confederacy." Advance directly to the **Decolonizing Scientific Language** section of this webpage for papers and arguments on this theme. Two 2021 quotations on "helping forests walk" by Robin Wall Kimmerer is included there, too.

• **SUMMARY 2021 Overall:** The original term, **assisted migration**, is associated with conservation biology, restoration ecology, forestry, and indigenous publications or projects. In contrast, **facilitated migration** has been used only by forestry professionals, while **assisted colonization** and **managed relocation** are exclusively associated with conservation biology and restoration ecology. **Helping forests walk** is utilized only within indigenous North American contexts. Indeed, given the current push in North America to "decolonize" the hegemony of scientific ecological knowledge (SEK), one could surmise that the terms "colonization" and "relocation" would not only be deemed inferior but also offensive. See the fourth section of this webpage, **"Decolonizing Scientific Language"**, as it features **two Australian papers presenting "assisted colonization" as offensive**. Because the Australian authors deem **"managed relocation"** as the preferred term, Barlow contributes linked examples of why in the USA the term **"relocation"** is also offensive. **The only term left standing given all these contexts is thus "assisted migration."** However, a major setback in this regard occurred in the 30 April 2021 issue of the world's leading scientific journal, *Science*. The term **assisted colonization** appeared in the title and throughout a "Policy Forum" advocacy piece by 7 coauthors: **"Global policy for assisted colonization of species"**, which was highlighted in a AAAS staff news article, **"International Policy Guidance for Assisted Colonization of Species Needed"**. Because staff decided upon Florida Torreya as the featured photograph, Connie Barlow was contacted several weeks before publication. She, along with Chris Swanston of the US Forest Service Northern Institute of Applied Climate Science, notified staff of the importance of **decolonizing this conservation terminology**, but the paper and news article were published with the name intact.

• **SUMMARY 2021 Conservation biology & restoration ecology:** There are very few examples of climate-driven translocation ("species rescue") projects underway for plants or animals within conservation or restoration contexts. Thus it is difficult to discern current naming preferences

among conservation biologists and restoration ecologists. **All 3 terms — assisted migration, assisted colonization, and managed relocation — are still in use.** Indeed, terminology is no longer a focus of debate. Rather, authors and practitioners select their preferred term and point to an early source as a citation. The core language arguments were made in the early papers and **now the focus is on relevance and possible uses (and risks) of the tool itself, by whatever name**. Nevertheless, in-print attention to potential species-by-species management applications have rarely reached a stage that can garner academic or news media publication. Owing to grave concerns about potential species "invasiveness" in recipient ecosystems, and the difficulties of navigating social as well as scientific disagreements, **applications of any form of climate-responsive translocation of plants or animals for the purpose of species conservation are still (as of 2021) very rare**. The example pioneered by **Torreya Guardians** in conducting assisted migration for the endangered Florida Torreya tree is still the most referenced case, with poleward establishment of a population of Australia's **Swamp Tortoise** a later example. As mentioned above, "assisted colonization" moved once again into the lead because it was used in the title and throughout an advocacy piece in the 30 April 2021 issue of the world's leading scientific journal, *Science*: **"Global policy for assisted colonization of species"**. An accompanying AAAS staff news article confirmed the term's dominance: **"International Policy Guidance for Assisted Colonization of Species Needed"**.

• **SUMMARY 2021 Forestry:** The response in forestry is remarkably different from that in conservation and restoration. Forestry academics and managers have published papers and reports on this topic at an accelerating pace and almost exclusively utilizing the term **assisted migration**. See or sample **the vast range of forestry papers and reports**. Notably, the U.S. Forest Service uses "assisted migration" as its term of choice within its **Climate Change Resource Center**. Indeed, the distinction between forestry and conservation biology is so strong that on 28 February 2021, a **wikipedia contributor created an altogether new page titled, "Assisted migration of forests in North America"**, thereby distinguishing forestry A.M. from that of conservation biology. The latter is represented in **wikipedia as "assisted colonization"**, following a 2013 redirect from the **original wikipedia entry "assisted migration."** Finally, as already mentioned, the **U.S. Forest Service** includes on its **"Tribes and Climate Change Research webpage: "Helping Forests Walk**, assessing opportunities for assisted migration of culturally important species in the Haudenosaunee (Iroquois) Confederacy."

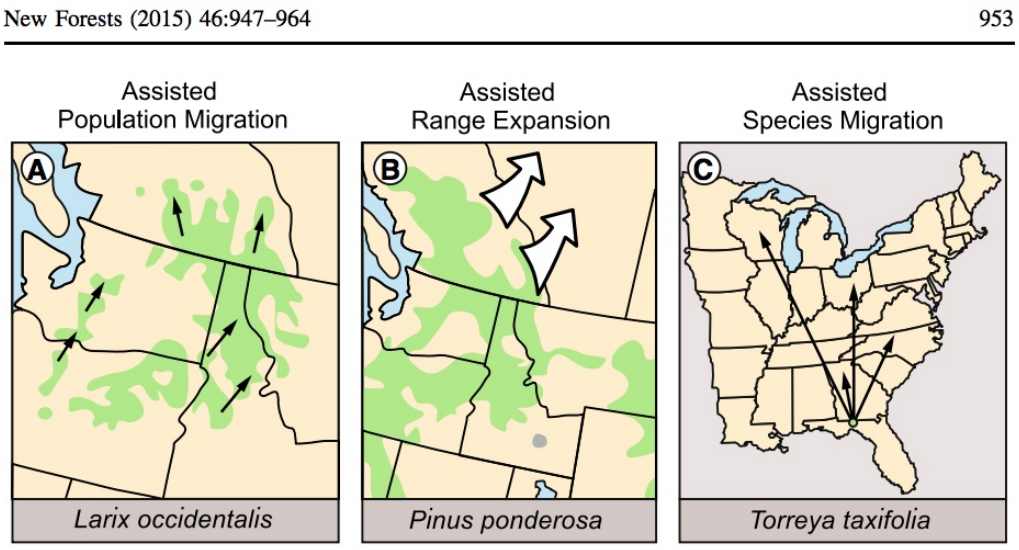
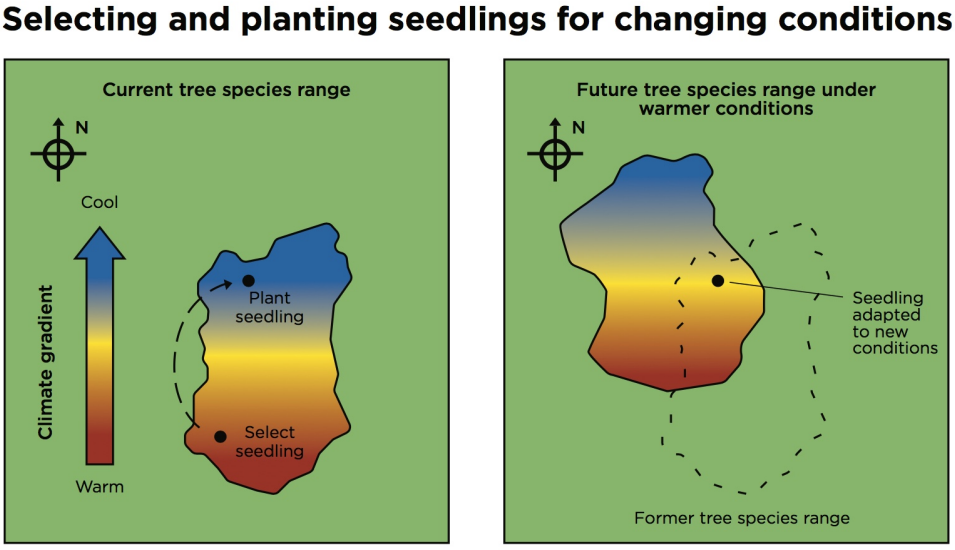


Fig. 3 Seed migration can occur as assisted population migration in which seed sources are moved climatically or geographically within their current ranges (*shaded*), even across seed transfer zones; e.g., moving *Larix occidentalis* 200 km north within its current range (**a**). Seed sources can also be moved climatically or geographically from current ranges to suitable areas just outside the range to assist range expansion, such as moving seed sources of *Pinus ponderosa* from British Columbia into Alberta, Canada (**b**). For assisted species migration, species could be moved far outside current ranges to prevent extinction, such as planting *Torreya taxifolia* in states north of Florida where it naturally occurs (**c**). (Terms from Ste-Marie et al. 2011; Winder et al. 2011; Williams and Dumroese 2013; maps adapted from Petrides and Petrides 1998; Torreya Guardians 2015)

ABOVE: This chart, published in 2015, presents nuanced terminology then in use by foresters. Notice that each term is illustrated with an example of species-specific tree translocation already underway.

SOURCE: **"Considerations for restoring temperate forests of tomorrow: forest restoration, assisted migration, and bioengineering"**, 2015, by R. Kasten Dumroese, Mary I. Williams, John A. Stanturf, J. Bradley St. Clair, in *New Forests*.

Recently, "Assisted Species Migration" is sometimes referred to as: "Assisted Long-Distance Migration" or "Species Rescue". **Practicing foresters use even more moderate terms**: "adaptive management," while revising standards for "seed selection" and "species selection" to include southerly sources.



With a rapidly changing climate, local populations of trees may not be able to adapt quickly enough to remain healthy. Forest managers can help by strategically selecting the seedlings from one part of a tree species' range and planting them where they will be better adapted to new environmental conditions.

The State of Canada's Forests: Annual Report 2020, Natural Resources Canada.

EDITOR'S NOTE - **Canadian foresters present the importance of helping forests move poleward without ever using the standard terms in use by conservation biologists pondering whether and when to move threatened species.** In the entire 88 pages, the term "assisted migration" appears only twice — and that entirely within the titles of papers in the citations section. "Assisted colonization, facilitated migration, and managed relocation" do not appear at all. One can surmise that not only is this a practical way to defuse debate, but because the emphasis is on retaining healthy forest canopy — irrespective of species identities — there is no reason to choose a term created in the context of concern about species-specific tree wellbeing.

• *WHY HAVE FORESTERS stepped out ahead of conservation biologists in putting assisted migration into practice?*

> **Foresters cannot ignore** the imperative to consider poleward tree plantings as prudent methods of climate adaptation for this simple reason: Outside of wilderness areas and parks, **forestry professionals are responsible for managing and re-seeding not only logging sites but also sites that are increasingly suffering from climate-induced tree deaths and devastating canopy burns. Therefore, the question of which seeds to choose for planting cannot be avoided.**
>
> Additionally, **the slow natural migration and slow maturation of trees** require foresters to take ongoing climate change seriously. Selecting seeds from populations or species of trees southward of the planting site is becoming the norm. The big difficulty for foresters is establishing which of the climate scenarios put forth by

climate scientists should guide their decisions — and, just as importantly, how the global scenario will manifest in temperature, precipitation, and seasonality in their specific region. (See excerpts of the review paper by **Hallfors et al. 2014** below.)

- *URBAN LANDSCAPERS are least inhibited in planting more southerly species now.*

  Given that there are no "wild" expectations for patches of urban forests (especially street trees) to fulfill, it has been rather **uncontroversial for city tree planters to revise their list of recommended species** — even ahead of forestry professionals (as in Vancouver, Philadelphia, and Chicago). It is rare, however, for any of the five synonyms to be named, as the quest is not for helping tree species adapt but for maintaining the vital role that street trees and other landscaping play in **mitigating the heat island effect** of concrete and for serving **city dwellers' vital needs** for some measure of access to nature. For articles, papers, and links on this topic: **"Urban Ecology Assisted Migration"**.

- *WHAT LIES AHEAD?*

  As mentioned earlier, **the indigenous term offered, helping forests walk, has not yet appeared in publications**, and is therefore unlikely to even be known by non-indigenous conservation biologists and foresters. Given the recent upturn in academic attention to **"decolonization" of the ecological sciences via "Traditional Ecological Knowledge"**, it is imperative to take another look at the **root metaphors** of terms in use. This is crucial for conservation and restoration fields because **"colonization" has strongly negative connotations** for indigenous peoples suffering the lasting consequences of European invasions of their lands culminating in "colonization." And for tribal peoples in America, **"relocation" is also a repugnant term**. Forced marches hundreds of miles westward into Oklahoma constituted a horrific form of "relocation" for peoples of eastern Turtle Island. These memories carry forward, as in **"Trail of Tears"** inflicted upon the Cherokee, Muscogee, Seminole, Chickasaw, and Choctaw peoples. **"Trail of Death"** is how the Potawatomi refer to their forced removal from the Great Lakes region to Kansas (and then onward to Oklahoma). Even in the 20th Century, "relocation" is a term associated with attempts to force indigenous assimilation into dominant culture within the USA, culminating in the national **Indian Relocation Act of 1956**. (Advance to the final section of this webpage, **"Decolonizing Scientific Terminology"**, for more on this topic.)

Part 2. Visual Compilations of Naming Distinctions

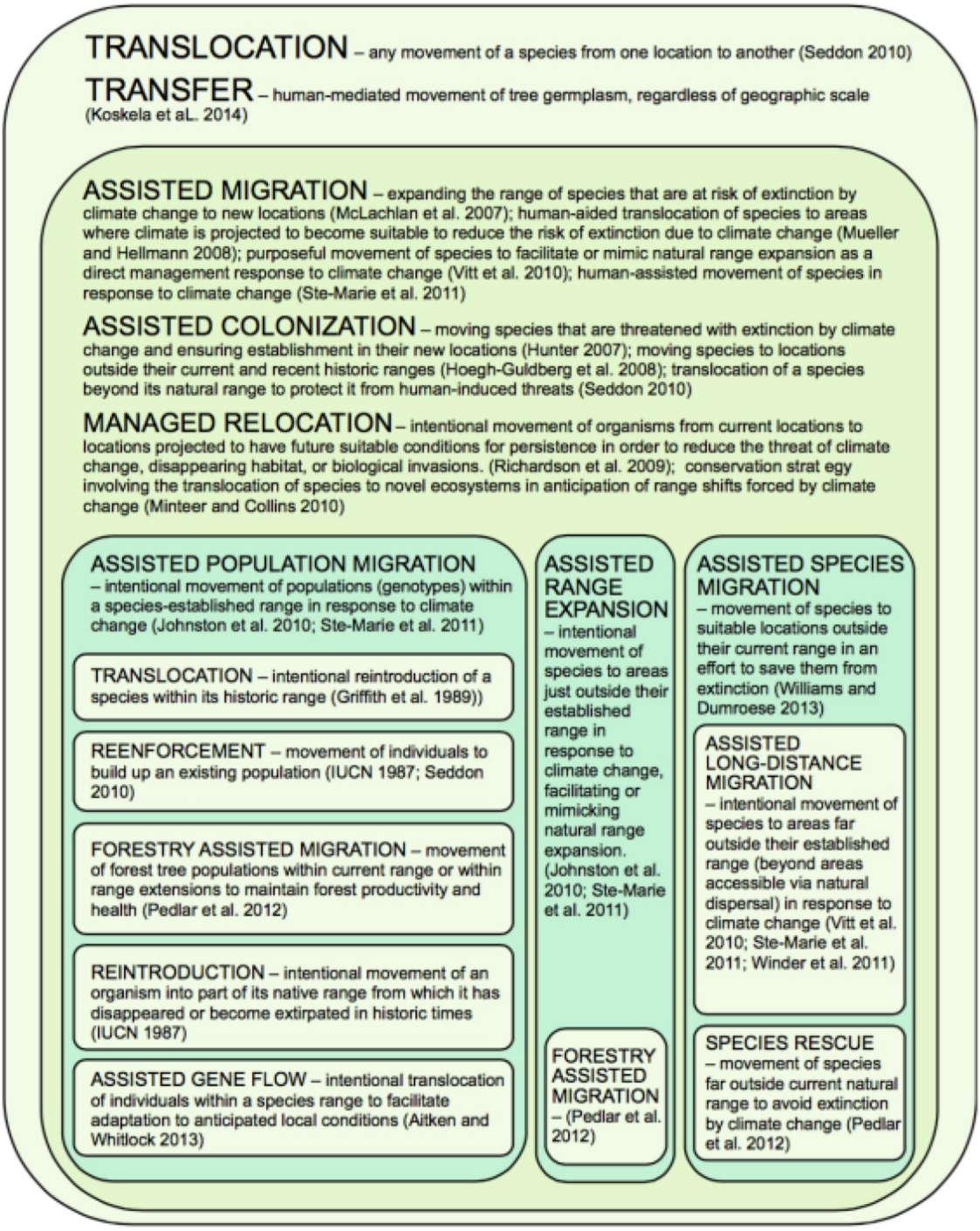


Fig. 2 The movement of plants has been defined many ways depending on context, from very broad to very narrow applications. The terms "transfer" and "translocation" may be the broadest terms. "Assisted migration," "assisted colonization," and "managed relocation" all essentially describe human movement of plants in response to climate change. These three terms can be further subdivided into three additional categories defined by the scale of movement: within the current range (i.e., assisted population migration and similar terms), proximate the current range (i.e., assisted range expansion), and long-distance (i.e., assisted species migration and similar terms)

ABOVE: **"Considerations for restoring temperate forests of tomorrow: forest restoration, assisted migration, and bioengineering"**, by Dumroese et al. 2015, *New Forests*.

This paper preferences "assisted migration" throughout the text. But in this figure it sorts through **the plethora of terms in conservation biology, forestry, and restoration ecology that refer to new management tools for climate adaptation**.

Notice that the 3 columns of bright green at the bottom of the chart offer nuances for the 3-category scheme depicted in the image directly above.

Table 1. Definition of the concept of assisted migration from the scientific literature

Term	Definition
Assisted migration	Human-aided translocation of species to areas where climate is projected to become suitable to reduce the risk of extinction due to climate change. (Mueller and Hellmann 2008)
	The purposeful movement of species to facilitate or mimic natural range expansion as a direct management response to climate change. (Vitt *et al.* 2010)
Assisted colonization	The translocation of species to favourable habitat beyond their native range to protect them from human-induced threats such as climate change. (Ricciardi and Simberloff 2009)
	Translocation of a species beyond its natural range to protect it from human-induced threats. (Seddon 2010)
Managed relocation	An intervention technique aimed at reducing negative effects of climate change on defined biological units such as populations, species or ecosystems. It involves the intentional movement of biological units from current areas of occupancy to locations where the probability of future persistence is predicted to be higher. The underlying motivation is to reduce the threat of diminished ecosystem services or extinction from climate change. (Richardson *et al.* 2009)
	A conservation strategy involving the translocation of species to novel ecosystems in anticipation of range shifts forced by climate change. (Minteer and Collins 2010)

ABOVE: **"Assisted migration: Introduction to a multifaceted concept"**, by Catherine Ste-Marie et al., 2011, in *The Forestry Chronicle*

In **Table 1**, definitions are provided from scientific publications, demonstrating that despite the use of different terms to describe assisted migration, the concepts are complementary and overlap substantially. The term "assisted migration" is the most commonly used term, and it combines the concepts of "assisted" (human intervention) with "migration" (movement of biological units).

Table 1. Several terms that describe the movement of species from one location to another for a directed purpose.

Term	Definition	Example	Source
Managed relocation	The intentional act of moving species, populations, or genotypes to a location outside a known historical distribution for the purpose of maintaining biological diversity or ecosystem functions as an adaptation strategy for climate change	Introducing a butterfly species to a region that is predicted to be and to remain suitable habitat under the conditions that the species' former locations are likely to become unsuitable with climate change	Richardson et al. 2009
Assisted migration	Introducing a species into a new location by bringing propagules or individuals and releasing them	Introducing *Torreya taxifolia* to North Carolina from its native distribution in Florida	McLachlan et al. 2007
Assisted colonization	Assisted migration with the introduction managed to ensure successful establishment	See *assisted migration*	Hunter 2007
Introduction, accidental	Accidental movement of a species, due to human activity, from an area in which it is native to a region outside that range	The accidental introduction of zebra mussels to water bodies by boats	Richardson and Pyšek 2006
Introduction, intentional	Intentional movement of a species, due to human activity, from an area in which it is native to a region outside that range	The intentional introduction of nonnative birds to the Hawaiian Islands	Richardson and Pyšek 2006
Reintroduction (or *reenforcement*)	An attempt to establish an extirpated species within its historical native range or to rebuild native populations within that range	The reintroduction of wolves in the Rocky Mountain West	Seddon 2010
Rewilding	Introduction of an analog species to replace an extinct species in order to maintain ecosystem functioning or to prevent extinction	Introducing elephants to North America as an analog of extinct mammoths or to reduce the extinction risk to elephants	Donlan et al. 2006
Translocation	Any movement of a species from one location to another	Moving a sport fish into previously fishless lakes, reintroducing wolves to Yellowstone National Park	Seddon 2010

SOURCE: **"Managed Relocation: Integrating the Scientific, Regulatory, and Ethical Challenges"**, by Mark W. Schwartz and 31 co-authors, 2012, *BioScience*

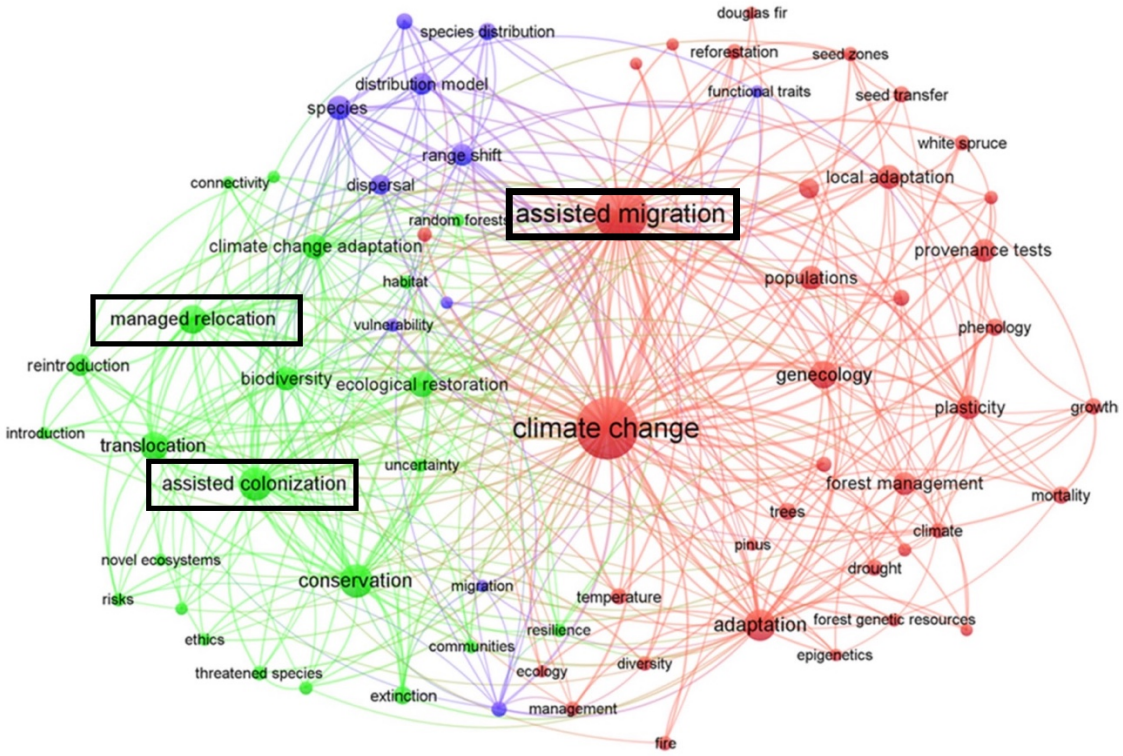


Fig. 7 The network map of author keywords co-occurrence of assisted migration research. Each cluster is represented by a color. The size of the node is proportional to the number of occurrences of a keyword. The distance between nodes is proportional to the frequency of keywords co-occurrence

SOURCE: **"Bibliometric Analysis of the Structure and Evolution of Research on Assisted Migration"**, by Lahcen Benomar et al., June 2022, *Current Forestry Reports*

Part 3. Annotated List of Foundational Papers

with excerpts centering on the rationale for chosen terms

• 2002/2004 - **"Assisted migration"** (Brian Keel, attributed p. 31 of *Oxford Dictionary of Ecology*). Later (March 2011), Brian G. Keel et al. published in the journal *Castanea*, **"Seed Germination of *Habenaria repens* (Orchidaceae) in situ Beyond its Range, and its Potential for Assisted Migration Imposed by Climate Change"**.

• Winter 2004/2005 - **"Assisted Migration of an Endangered Tree"**, Forum section of *Wild Earth* entailing two papers: **"Bring *Torreya taxifolia* North — Now"** (by Connie Barlow and Paul S. Martin), and **"Conservationists Should Not Move *Torreya taxifolia*"** (by Mark Schwartz). The term "assisted migration" appears 7X in the Barlow and Martin paper and 13X in the paper by Schwartz. Definitions derived from context:

> BARLOW & MARTIN: "Many botanists and climate specialists agree that at some point in the future, human-induced global warming will push many plants to the edge of viability; at that time, '**assisted migration**' (a term coined by Brian Keel, 2004) may be the only stay against extinction.... Let us undertake **assisted migration** for *Torreya taxifolia* today, in part, as a trial run for the decades to come. With Florida torreya we can explore the ecological and social dimensions of what seems likely to be a radically new era for plant conservation."
>
> SCHWARTZ: "Thus, the reasoning goes, if we **assist migration** northward, the species is likely to thrive, thereby assuring the persistence of one of this continent's most distinctive conifers. Based on my reading, research, and personal experience, I find some merit in this argument; *Torreya taxifolia* is a glacial relict, quite likely on the edge of its climatic tolerance, and might do well in a cooler climate.... Nevertheless, **assisted migration** sets a risky precedent. Will control assurances and monitoring of problems be followed for future species that are deemed to be in need of **assisted migration**? I fear not. Thus, it is critical that we take a hard look at what criteria are to be used to justify **assisted migration** and develop guidelines for appropriate **assisted migration** in order to preserve biological diversity."
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> > Note: The *Boston Globe* published an article by Chris Berdik, 12 October 2008, **"Driving Mr. Lynx"**, with the tagline, "As the climate changes, proponents of '**assisted migration**' say it's time to help animals and plants move." EXCERPT: "... This theme was picked up in **the first public discussion of assisted migration, a pair of dueling articles published in 2004 by the environmentalist journal *Wild Earth* about the wisdom of moving the endangered Torreya pines north.** Writing in favor was **Connie Barlow**, a science writer, amateur horticulturalist, and the founder of the **Torreya Guardians**, along with **Paul Martin**, a zoologist and researcher of fossilized pollen, seeds, and spores. They argued that the Torreya is not truly native to northern Florida but was pushed south, along with many species, by the last ice age and then was unable to move north again when the glaciers retreated. Thus, they concluded, moving Torreya to North Carolina would actually be a sort of homecoming for the tree. Opposing them was **Mark Schwartz**, a plant ecologist at the University of California who has studied Torreya for 20 years and argued that traditional, less risky conservation measures should be given a chance to succeed. **As the Torreya Guardians proved this summer, the reality of assisted migration could be as simple as a group of concerned citizens bringing a species north in their cars.**"

• July 2006 - **"Predicting Extinctions As a Result of Climate Change"**, Mark W. Schwartz, Louis R. Iverson, Anantha M. Prasad, Stephen N. Matthews, and Raymond J. O'Connor, *Ecology*.

> Conservation management has already shifted its emphasis away from narrowly endemic small populations (Schwartz 1999) based, in part, on ecological theory suggesting that these species may be unsustainable. **If one asserts that narrowly endemic species are doomed to extinction by climate change, then logic dictates that we either begin programs of assisted migration or divert conservation resources away from these 'doomed' species.** Divesting of in situ conservation efforts on behalf of narrow endemics as a consequence of warming must be regarded as premature without specific evidence of climatic sensitivity.

• April 2007 - **"A Framework for Debate of Assisted Migration in an Era of Climate Change"**, by Jason S. McLachlan, Jessica J. Hellmann, and Mark W. Schwartz, *Conservation*

Biology.

> Ecologists likely vary in their perception of the risks associated with imposing or rejecting a policy of **assisted migration**. Conservation biologists studying rare endemics may be more willing to embrace **assisted migration** than ecologists studying invasive species, for example. In either case opinions about the appropriate scope and magnitude of **assisted migration** will also depend on confidence in our understanding of ecological dynamics.

> Note: This paper stimulated the *New York Times* to publish an article by Carl Zimmer, 23 January 2007, **"A Radical Step to Preserve a Species: Assisted Migration"**. EXCERPT: "Dr. Hellmann and her colleagues do not endorse or condemn assisted migration in their new paper. Instead, they call for other conservation biologists to join in a debate. They hope to organize a meeting this summer to have experts share their ideas. 'There really needs to be a clear conversation about this, so that we can lay all the chips on the table,' Dr. Schwartz said."

• September 2007 - **"Climate Change and Moving Species: Furthering the Debate on Assisted Colonization"**, by Malcolm L. Hunter, *Conservation Biology*. Here **"assisted colonization"** was introduced and offered as the preferred term for conservation biologists for this reason:

> I have used the term **assisted colonization** in contrast to assisted migration used by McLachlan et al. because many animal ecologists reserve the word migration for the seasonal, round-trip movements of animals (Wilcove 2007) and because **the real goal of translocation goes beyond assisting dispersal to assuring successful colonization**, a step that will often require extended husbandry.

• February 2008 - **"Adaptation, migration or extirpation: climate change outcomes for tree populations"**, by Sally N. Aitken et al., *Evolutionary Applications*. Here **"facilitated migration"** was introduced and offered as the preferred term by forestry academics. In a section titled "Constraints on migration," the authors wrote:

> Estimates of past rates of species migration from paleobotanical and genetic evidence are frequently used in order to inform predictions of contemporary migration potential. Studies of range shifts over the last 25,000 years show that species ranges have migrated in close correlation with global climatic cycles.... Rare long-distance seed dispersal events have likely played a crucial role in increasing effective migration rates relative to the effects of average seed dispersal distances, but such events are hard to quantify or model.... This suggests it may be worthwhile to initiate new populations through **facilitated migration** as new habitat becomes available (McLachlan et al. 2007), and that these populations do not necessarily need to be large."

• June 2008 - **"An Assessment of Invasion Risk from Assisted Migration"**, by Jillian M. Mueller and Jessica J. Hellmann, Special Section paper in *Conservation Biology*.

> The unprecedented rate of climate change, human-made barriers to natural migration, and disrupted species interactions will only compound the challenges for species to adapt and shift their ranges in step with their climatic requirements (Schwartz 1992; Hulme 2005; Parmesan 2006; Williams et al. 2007). Under such bleak projections, some ecologists and resource managers propose human-aided translocations, or **assisted migration (AM)**, as a proactive measure to combat biodiversity loss from climate change (Hulme 2005; McLachlan et al. 2007). Under AM, species are intentionally moved to climatically favorable areas outside their 20th century geographic range.

• July 2008 - **"Assisted Colonization and Rapid Climate Change"**, by O. Hoegh-Guldberg, L. Hughes, S. McIntyre, D.B. Lindenmayer, C. Parmesan, H.P. Possingham, C.D. Thomas, in Policy Forum section of *Science*. It is behind a paywall, so no quotation is excerpted here. The journal is highly respected, so this paper generated media attention. Immediately, Connie Barlow (founder of Torreya Guardians) engaged in email dialogue to **learn the seriousness of author allegiance to "colonization" and to put forth her own reasons against it becoming the dominant term.** This unpublished correspondence was posted in 2008 on this website, and it has been carried

forward here as the final section: **"Archive of Original Correspondence on Terminology"**.

• August 2008 - While not a published paper, a **"Managed Relocation Working Group"** formed at the August 2008 meeting of the **Ecological Society of America**. As of April 2021, the original website is still online. **Thirty-four participants (with their institutional affiliations) are listed**, along with names of the four group leaders: Jessica Hellmann, Jason McLachlan, Dov Sax, and Mark Schwartz.

> INFO ABOUT MR: **"Managed relocation" (also called "assisted migration" or "assisted colonization") is the purposeful translocation of species adversely affected by global change, particularly climate change.** Goals of managed relocation include, but are not limited to, the reduction of extinction risk, the enhancement of evolutionary potential, and the enhancement of ecosystem services.
>
> **The terms "assisted migration" and "assisted colonization" are terms that have been used to refer to the same basic strategy as "managed translocation." In Aug., 2008, this working group suggested a more comprehensive term, "managed relocation." We prefer "managed relocation" because it captures the concept of persistent intervention (if necessary) and emphasizes the geographical movement of organisms, a conservation or management concept particularly distinctive to the modern era of climate change.** In several locations on this website, however, you will see use of **"assisted migration" because it captures the essence of managed relocation in the sense of geographic movements that actors pursue in a helpful or beneficial sense**.
>
> Since the Industrial Revolution, human emissions of greenhouse gases are altering the climate and are shifting where species can live, just as glaciation did thousands of years ago. Unlike historical climate change, however, modern biodiversity lives in a world that is modified by humans, and this human-modified landscape can stand in the way of natural migration that enables species' ranges to shift.
>
> **Managed relocation** is a potential tool to reduce the negative effects of climate change (and other global changes) to biodiversity, but it could have serious costs in the form of collateral effects. **This working group aims to understand the degree to which managed relocation could achieve its objectives, the risks that it could incur, and the strategies that could be used to implement it. Much remains to be learned about this controversial idea.**

• February 2009 - **"Assisted colonization in a changing climate: a test-study using two U.K. butterflies"**, by Stephen G. Willis et al., in *Conservation Letters*.

> EXCERPT: ... The successful establishment and spread of the populations of M. galathea in Durham and of T. sylvestris in Northumberland suggest that the climate in the two places has been suitable in the period since introduction, and that the distributions of these species were lagging behind current climate warming.... Our findings suggest that **assisted colonization has the potential to be a useful conservation tool** to help limit the impacts of climatic change on species of conservation concern with poor mobility, or whose preferred habitat is discontinuously distributed in a landscape.... In this case, the butterflies were released into communities that contain species with which they already co-exist elsewhere, so negative consequences of the translocations for other species were extremely unlikely. One other major potential issue is whether this approach can ever be cost-effective, which is clearly a major consideration for the **assisted colonization** of large vertebrates, when an intermediate captive-breeding program is required. In our study, we estimate the total effort (of modeling, release, monitoring, and follow-on analysis) to be in the order of 8 person-months per species, about half of which could reasonably have been carried out by amateurs; other expenses were <5,000 pounds. Although this expenditure might not be justifiable for these widespread species, other than as an experimental study, for threatened species — for which creating habitat and restoring connectivity could be a major challenge — **assisted migration** may be at least as cost-effective as other adaptation strategies to climatic change."

• March 2009 - **"Assisted colonization is not a viable conservation strategy"**, by Anthony Ricciardi and Daniel Simberloff, in the "Opinion" section of *Trends in Ecology and Evolution*. Note: This was the first paper strongly critical of this novel conservation tool, by whatever name, and for years it was the primary (sometimes only) citation appearing in papers for referencing an

oppositional paper. **Simberloff's faculty page** lists "biological invasions" as first in his list of four "research interests," and his **wikipedia page** refers to him as "Editor-in-chief of the journal *Biological Invasions*".

> We believe that much of the literature on **assisted colonization** pays little attention to the importance of evolutionary context in conservation biology and places too much faith in risk assessment. Here we explain why the current predictive understanding of invasions is inadequate to forecast and prevent negative, potentially disastrous, consequences associated with species translocations.

• April 2009 - **"Climate change and forest seed zones: Past trends, future prospects and challenges to ponder"**, by Dan McKenney, John Pedlar, and Greg O'Neill, in *Forestry Chronicle*

> "... Changes in forest composition can also be anticipated. McKenney et al. (2007) examined the effect of climate change on the geographic distribution of the climate habitat of 130 North American tree species. They reported an average northward shift in suitable climate of 700 km by the end of this century.... One major area of uncertainty is the degree to which species will track climate shifts. This will depend on **natural tree migration rates**, which are generally thought to be much slower than the predicted rate of climatic shift (i.e., 10–50 km/century; McLachlan and Clark 2004), and the extent to which **humans assist with the migration process** by establishing species in new locales (Hunter 2007, McLachlan et al. 2007).
>
> To ensure that plantations being established today will be adapted to future climates, it is first necessary to ensure that systems of seed transfer controls (also called seed procurement or seed transfer guidelines) are in place throughout Canada. Effective implementation of **assisted migration of seedlots** (see next section) can occur only if a system of seed transfer control is in place. Further, incorporation of **assisted migration** will be most prudent and effective in those seed transfer systems that are based on climate.... Methods have been developed to incorporate **assisted migration** into seed transfer systems (e.g., Parker et al. 2006) or to identify appropriate climate transfer distances to account for future climate change (Wang et al. 2006, Beaulieu and Rainville 2005). SeedWhere addresses **assisted migration** by replacing grids of current climate with grids of future climate of the user's choice to identify sites for seed procurement and deployment. The issue of **assisted migration** has been carried a step further in British Columbia, where seed transfer guidelines were recently modified to account not just for climate change in the near future, but also for climate change that has taken place over the last 100 years (O'Neill et al. 2008).
>
> To this point we have discussed **assisted migration of seed sources** as a key strategy to help maintain healthy and productive forests in the face of climate change. However, there is good evidence that species migration will also lag behind climate migration (Aitken et al. 2008). Consequently, **assisting the migration of species** (also called **assisted colonization**) has also been proposed as an important climate change adaptation strategy. Several modeling approaches have been developed to predict the migration of species' climate niches (Iverson and Prasad 2002, Hamann and Wang 2006, Rehfeldt et al. 2006, McKenney et al. 2007). As with **assisted migration of populations**, the climate distance species are moved will have to be small enough to allow for good survival at establishment, but large enough to ensure good adaptation toward the end of the rotation when mean annual increment is (ideally) near its maximum."

• May 2009 - **"Advising Noah: A Legal Analysis of Assisted Migration**, by Julie Lurman Joly and Nell Fuller, in *Environmental Law*.

> EXCERPTS: "Climate change will likely lead to dramatic transformations of habitats critical to many species. One proposed solution to this problem is **assisted migration**. No federal agency has yet developed any rules specifically regarding assisted migration in response to climate change. However, the existing laws, regulations, and policies do provide guidance that would affect any federally sponsored or permitted assisted migration program. This Article examines those laws, regulations, and policies currently in place that may challenge or facilitate assisted migration programs. Given this legal structure, we find that assisted migration is a legal option on most federal lands under certain circumstances.... As the climate changes, the ecological niches on which many species depend may disappear or shift in location. Many species, however, will not be able to shift with them for a variety of reasons, and **one proposed solution to this**

problem may be assisted migration, also referred to as assisted colonization. This analysis will focus on those laws, regulations, and policies currently in place that may impede or challenge the legality of deliberately introducing species to areas in which they are not native, as well as those laws that would encourage or facilitate such endeavors....

The purpose here is only to analyze how assisted migration may fit into our existing legal framework. This Article does not attempt to evaluate the ecological or ethical virtues of assisted migration, nor does it consider agency management priorities or budgetary constraints. As of this writing, no federal agency has explicitly developed any rules specifically regarding assisted migration in response to climate change. However, there are many existing laws, regulations, and policies that do guide agencies, and would affect any attempted assisted migration that was either carried out by a federal agency, or that utilized federally managed lands or funds. Our hope is that biologists, land managers, and others who are currently debating the ethics, utility, and feasibility of assisted migration can use this legal analysis as part of that dialogue.... **Assisted migration is simply the action of picking up and moving certain individuals or populations of species** that either cannot or will not be able to migrate on their own in response to the rapidly changing climatic conditions expected over the next several decades.... **Assisted migration efforts may also include the less invasive method of creating new migratory corridors through which species could migrate independently.**

RE FEDERALLY LISTED "ENDANGERED" SPECIES: ... While **assisted migration of listed species is fraught with legal complications, their status renders them uniquely poised to be assisted migration beneficiaries.** Due to existing mandates, federal land managers will likely focus assisted migration on listed species. To some extent, flexibility has been built into the process through critical habitat exemptions, such as INRMPs on military installations, and the ESA Sec.10(j) relaxed reintroduction regulations. While assisting the migration of listed species will pose legal challenges, they may not be insurmountable." ... As many scientists have already suggested, assisted migration could potentially lead to a host of problems. No one knows when a threatened species will become a noxious invader upon being relocated. Species could become invasive and overwhelm the ecosystem into which they are introduced. A good example of this phenomenon is the black locust tree, which is native to the Appalachian Mountain region. "[The tree] handily escaped groves that were planted on farmland further north. From New York to Wisconsin, colonies of black locust are pushing aside native plants — in some cases, rare endemic communities. Worse yet, this is happening right where you'd want to move the tree — several hundred kilometers north of its current distribution, where climate models predict it will thrive in 100 years." It is therefore a very real possibility that **assisted migration efforts could lead to relocated species becoming invasive and outcompeting native plant or animal communities. It is also possible, however, that relocated species will pose no threat to the ecosystem into which they are introduced.** We have been faced with the problem of exotic invasive species for over 100 years and have developed a large network of laws and policies to avoid problems. **These laws may make relocating species as part of an assisted migration program much more complicated.... Nevertheless, this rule could be used to thwart efforts at assisted migration if proof of non-invasiveness is ever required before a federal agency is able to fund relocation.**... 7 If an **assisted migration** program intends to bring foreign species into the United States, or intends to transfer U.S. specimens to foreign soil, the participants must ensure that all of the CITES permit and certification requirements are satisfied....

CONCLUSION: Scientists, policymakers, and land managers may have to come to a new understanding in the coming years of what is a native versus non-native species. Already the term **"neo-native"** is coming into use to define a species that was not historically part of an ecosystem but, because of shifting climate patterns, may now be considered native.... Given this legal structure, as we have defined and interpreted it, we find that **assisted migration is a legal option on most federal lands under certain circumstances. All federal agencies have legal obstacles in place that could hinder assisted migration efforts, but no agency has an outright prohibition.** The NPS is the most conservative regarding the possibility of assisted migration, due to its focus on natural focus and native species. The other agencies seem to have greater legal flexibilities to attempt assisted migration efforts. While assisted migration may be possible on FWS refuge lands, it appears to present greater legal challenges than would be the case on USFS or BLM lands. The greatest flexibility may be on military installations with INRMPs. Finally, all agencies appear to be able to use whatever legal flexibilities exist to pursue

species-specific goals, especially where those species are threatened or endangered. Therefore, while future legal and policy changes are likely to further facilitate assisted migration, it is a tool that is currently legally available to all federal agencies. Understanding the legal realities will enhance the possibility of assisted migration efforts actually being implemented and effecting on-the-ground species conservation."

NOTE: The above paper dealt strictly with U.S. federal agencies on federal lands and the international CITES treaty. For private individuals assisting the migration of unregulated species and federally "endangered" plants, see: **"Regulate Trade in Rare Plants"**, by Patrick Shirey and Gary Lamberti, 2011, *Nature*. Also **"Commercial trade of federally listed threatened and endangered plants in the United States"**, by Patrick Shirey et al., 2013, *Conservation Letters*. Both papers by Shirey use **assisted colonization** consistently as their preferred term of reference.

• June 2009 - **"Multidimensional evaluation of managed relocation"**, by David M. Richardson and 21 co-authors (including Mark W. Schwartz, Jessica Hellmann, Jason McLachlan, Dov Sax, who are authors and co-authors of other papers on this same topic). This paper was published in *Proceedings of the National Academy of Sciences*. The National Science Foundation published a press release for this paper here: **"Racing the Clock: Rapid Climate Change Forces Scientists to Evaluate Extreme Conservation Strategies"**.

EXCERPT: **Managed relocation (MR)** has rapidly emerged as a potential intervention strategy in the toolbox of biodiversity management under climate change. Previous authors have suggested that MR (also referred to as **assisted colonization, assisted migration, or assisted translocation**) could be a last-alternative option after interrogating a linear decision tree. We argue that numerous interacting and value-laden considerations demand a more inclusive strategy for evaluating MR. The pace of modern climate change demands decision making with imperfect information, and tools that elucidate this uncertainty and integrate scientific information and social values are urgently needed. We present a heuristic tool that incorporates both ecological and social criteria ina multidimensional decision-making framework.

• January 2010 - **"Assisted migration: Part of an integrated conservation strategy"**, by Pati Vitt, Kayri Havens, and Ove Hoegh-Guldberg, in *Biological Conservation*.

Many of the most alarming examples cited by Ricciardi and Simberloff involve the movement of freshwater organisms between lakes. Natural migration of fish and other species between lakes would have been very rare historically; the ecological impacts of artificially increasing migration rates, especially over long distances, are demonstrably severe. By contrast, many of us who are considering **assisted migration** as a conservation strategy work in once geographically continuous ecosystems where there were historically few dispersal limitations. These ecosystems, such as the tallgrass prairie, are now highly fragmented, and dispersal limitation under these circumstances can affect both species richness and ecosystem productivity [3]. We also disagree with the assertion that species considered for **assisted migration** lack a documented invasion history. Many species that are likely to be considered have already had populations restored within their native range or have been grown in botanic gardens and other cultivated settings both in and outside of their native range [4].

Note: The *New York Times* published an article in advance of this paper's publication. The article is by Anne Raver, 9 November 2009: **"A Hunt for Seeds to Save Species, Perhaps by Helping Them Move"**.

• February 2010 - **"Assisted colonization under the U.S. Endangered Species Act"**, by Patrick D. Shirey and Gary A.Lamberti, in *Conservation Letters*.

EXCERPT: Previous policy papers have described management options for deciding when to move a species to mitigate for climate change. We build on this previous work by examining management options and policy solutions for **assisted colonization** under the U.S. Endangered Species Act (ESA). On its surface, the ESA statutory language appears to provide the legal framework for allowing assisted colonization, as the U.S. Congress gave the U.S. Fish and Wildlife Service (USFWS) broad discretion to manage populations of endangered species. However, **current USFWS regulations are an impediment to assisted colonization for many**

endangered animal species, whereas regulations do not necessarily restrict assisted colonization of endangered plants. Because of this discrepancy, we recommend a review of the regulatory language governing movements of endangered species.

EDITOR'S NOTE: Of all the papers included on this webpage, this document is by far the best source for the **history of Endangered Species Act amendments and regulation changes**. A section titled "When assisted colonization is not restricted" reports the specifics of **three officially endangered species that were nonetheless given "assisted colonization": Florida Torreya, Tennessee coneflower, Virginia round-leaf birch**. Special cases of the **Guam Rail** and **Rio Grande silvery minnow** are also presented. **"Assisted colonization contains risks, but it seems ironic that the species meant to be protected by the ESA could be harmed by its restrictions, whereas species that are not listed or are privately owned (e.g., plants) can often be moved freely with few exceptions."**

• April 2010 - **"The Value of Species and the Ethical Foundations of Assisted Colonization"**, by Ronald Sandler, in *Conservation Biology*.

"... Many species are imperiled by the accelerated rate ofclimate change, often in combination with other anthropogenic stressors, and frequently anthropogenic barriers (e.g., urban and agricultural) prevent them from coping by shifting their geographical ranges (e.g., Hulme 2005; Parmesan 2006; Williams et al. 2007). Advocates of **assisted colonization (or assisted migration)** argue that helping species over these barriers is justified because it keeps them from going extinct, thereby preserving their value (e.g., Barlow & Martin 2004/2005; McLachlan et al. 2007; Hoegh-Guldberg et al. 2008). Therefore, the case for assisted colonization depends fundamentally on claims, both explicit and implicit, about the value of species. A complete discussion of assisted colonization needs to include assessment of these claims.... The paradigmatic cases of and candidates for **assisted colonization** discussed in the professional and popular literatures indicate. These cases include relocating the Quino checkerspot butterfly (*Euphydryas editha quino*) to higher elevations (e.g., Zimmer 2007; Hoegh-Guldberg et al. 2008; Marris 2008), the Florida torreya (*Torreya taxifolia*) to North Carolina (e.g., Barlow & Martin 2004/2005; Schwartz 2004/2005; Fox 2007), and the narrow-faced kangaroo rat (*Dipodomys venustus*) north of San Francisco (Berdik 2008). In each case, the aim is to prevent the species from going extinct, not to improve the ecological conditions of the recipient system. The ecological value of the species is not the basis for, and does not justify, the **assisted colonization**."

• September 2010 - **"Home, Home Outside the Range?"**, by Richard Stone, News Focus in *Science*.

NOTE: **"Assisted colonization" appears 8 times** in this news article. EXCERPTS: ... In light of shifting climates and relentless development, scientists here are contemplating a controversial intervention: **assisted colonization (AC)**.... One camp insists that desperate times call for desperate measures. Habitat fragmentation caused by human activity has made it difficult or impossible for many species to migrate on their own to more suitable environments. Thus, **a growing number of researchers argue that AC, also called managed relocation, is a vital conservation tool**. "The future for many species and ecosystems is so bleak that **assisted colonization** might be their best chance," Ove Hoegh-Guldberg, director of the Global Change Institute at the University of Queensland in St. Lucia, Australia, and colleagues wrote in a clarion call for moving species in *Science* 2 years ago (18 July 2008, p. 345). "This is something that conservation organizations should and will start to do," says Chris Thomas, a conservation biologist at the University of York, U.K.... The scientists have been tracking the butterflies ever since. After a rough couple of summers in 2008 and 2009, when England was unseasonably chilly, the butterflies have bounced back this year. "They are behaving very much like natural populations," says [Stephen] Willis. In the February 2009 issue of *Conservation Letters*, his team concluded that "**assisted colonization** has the potential to be a useful conservation tool" to soften the blow of climate change for species with poor mobility or whose habitat is fragmented. The study "makes a strong case that **managed relocation** is feasible," says [Dov] Sax.

• October 2010 - **"Move it or lose it? The ecological ethics of relocating species under**

climate change", by Ben A. Minteer and James P. Collins, *Ecological Applications*.

> ABSTRACT: **Managed relocation (also known as assisted colonization, assisted migration)** is one of the more controversial proposals to emerge in the ecological community in recent years. A conservation strategy involving the **translocation** of species to novel ecosystems in anticipation of range shifts forced by climate change, **managed relocation (MR)** has divided many ecologists and conservationists, mostly because of concerns about the potential invasion risk of the relocated species in their new environments. While this is indeed an important consideration in any evaluation of MR, moving species across the landscape in response to predicted climate shifts also raises a number of larger and important ethical and policy challenges that need to be addressed. These include evaluating the implications of a more aggressive approach to species conservation, assessing MR as a broader ecological policy and philosophy that departs from longstanding scientific and management goals focused on preserving ecological integrity, and considering MR within a more comprehensive ethical and policy response to climate change. Given the complexity and novelty of many of the issues at stake in the MR debate, a more dynamic and pragmatic approach to ethical analysis and debate is needed to help ecologists, conservationists, and environmental decision makers come to grips with MR and the emerging ethical challenges of ecological policy and management under global environmental change.

• November 2010 - **"From Reintroduction to Assisted Colonization: Moving along the Conservation Translocation Spectrum"**, by Philip J. Seddon, and opinion article in *Restoration Ecology*.

> The concept of **assisted colonization** has stimulated recent debate and has also spawned **some confusing terminology, e.g. assisted migration** (McLachlan et al. 2007) and managed relocation (Richardson et al. 2009). The term migration more commonly refers to seasonal round trip movements (Hunter 2007) and does not capture the critical feature of moving organisms outside their range, whereas relocation is simply a synonym for translocation. **I prefer the term assisted colonization, as it captures the key feature that species are deliberately being moved to areas outside their known historic ranges in order to establish new population for conservation targets**. Recent interest in this form of conservation introduction has been driven by the predicted impacts on species distributions due to rapid climate change. The relative newness of this specific threat has given the impression that this type of translocation is something new — this is not the case. The **best definition of assisted colonization is that of Ricciardi and Simberloff (2009a): 'translocation of a species to favorable habitat beyond their native range to protect them from human-induced threats, such as climate change'** (Table 1).

• Month 2010 - **"Assisted Migration: Redefining Nature and Natural Resource Law Under Climate Change"**, by Alejandro E. Camacho, in *Yale Journal on Regulation*, 84 pages

> SUMMARY: "To avoid extinctions and other harms to ecological health from escalating climatic change, scientists, resource managers, and activists are considering and even engaging in **"assisted migration"** — the intentional movement of an organism to an area in which its species has never existed. This Article explores the profound implications of climate change for American natural resource management through the lens of this controversial adaptation strategy. It details arguments regarding the scientific viability and legality of assisted migration under the thicket of laws that govern natural resources in the United States. The Article asserts, however, that the fundamental tensions raised by this strategy are ethical: to protect endangered species or conserve native biota; to manage ecological systems actively or leave nature wild and uncontrolled; and to preserve resources or manage them to promote their fitness under future conditions.
>
> The Article explains why **contemporary natural resource law's fidelity to historic baselines, protecting preexisting biota, and shielding nature from human activity is increasingly untenable, particularly in light of climate change**. Active, anticipatory strategies such as **assisted migration** may not only be permissible but even necessary to avert substantial irreversible harm to ecological systems. Scientists and resource managers should focus on developing scientific data to aid analyses of the risks and benefits of assisted migration in

particular circumstances. To help develop such data while minimizing ecological harm, the Article proposes provisionally limiting **experimental translocations** to situations where translocation is technically and economically feasible, and where the species is endangered, ecologically valuable, and compatible with the proposed site.

More broadly, **assisted migration** illustrates how the institutions and goals of natural resource law must be changed to better reflect a dynamic, integrated world. Climate change forces a radical reconsideration of the aims, foci, and standards of natural resource management. Accordingly, the crucial project of natural resource law must be improving governance by cultivating agency accountability and learning to better manage uncertainty, promoting opportunities for interjurisdictional collaboration, and fostering public information and deliberation over the tradeoffs of strategies like **assisted migration** and the resource values that matter."

• January 2011 - **"Assisted colonization: Integrating conservation strategies in the face of climate change"**, by Scott Loss, Lauren Terwilliger, and Anna Peterson, in *Biological Conservation*

ABSTRACT: "Global climate change poses an immense challenge forconservation biologists seeking to mitigate impacts to species and ecosystems. Species persistence will depend on geographic range shifts or adaptation in response to warming patterns as novel climates and community assemblages arise. **Assisted colonization** has been proposed as a method for addressing these challenges. This technique, which consists of transporting species to a new range that is predicted to be favorable for persistence under future climate scenarios, has become the subject of controversy and discussion in the conservation community due to its highly manipulative nature, questions about widespread feasibility, and uncertainty associated with the likelihood of translocated species becoming invasive. We reviewed the discussion and criticism associated with **assisted colonization** and sought to identify other conservation techniques that also display potential to promote the colonization and adaptation of species in response to climate change...."

EXCERPT: **Assisted colonization — also referred to as assisted migration, assisted translocation, and managed relocation (hereafter, assisted colonization)** — is a conservation strategy that has been proposed to mitigate the effects of climate change on biodiversity (Hoegh-Guldberg et al., 2008a; McLachlan et al., 2007). **Assisted colonization** refers to the physical relocation of a species to a location outside its existing or historical range that is predicted to be favorable for persistence under future climate projections. While much uncertainty exists about **assisted colonization**, the strategy is thought to be most applicable for species characterized by small populations, restricted dispersal ability and adaptive potential (Ozinga et al., 2009; Petit et al., 2008; Primack and Mao, 1992), and inhabiting low-connectivity landscapes (Trakhtenbrot et al., 2005).

• March 2011 - **Assisted Colonization: A Question of Focal Units and Recipient Localities**, by Juergen Kreyling et al., in *Restoration Ecology* distinguishes the 3 key terms:

We define assisted colonization as 'the intentional movement of focal units (ecotypes, species, taxa, functional types, life forms) to recipient localities, where these focal units are currently absent, and where they cannot be expected to colonize by natural means within a short time frame (i.e. years or decades).' **We agree with Hunter (2007) that assisted colonization is a more appropriate term than assisted migration**, because the final goal of this approach is not only to assist dispersal but rather the successful establishment of individuals and the subsequent development of self-sustaining populations, which is much more demanding. **'Managed relocation' or 'managed translocation'** are further used as synonyms for this approach. However, these terms are not necessarily confined to the context of adaptation against climate change (Ricciardi & Simberloff 2009).

• May 2011 - **"Translocation of species, climate change, and the end of trying to recreate past ecological communities"**, by Chris D. Thomas, in *Trends in Ecology and Evolution*.

Translocating species (i.e. **assisted colonisation** or **assisted migration**) beyond their recorded native ranges is an option when traditional strategies are insufficient. However, the fear is that translocated species could become 'invasive' in their new ranges, making it essential to identify

the circumstances under which the benefits of translocation outweigh the potential costs. The question is whether such judgements are too difficult and the risks too high; I argue here that the associated risks are predictably low in some specific situations.

• July 2011 - **"Assisted migration to address climate change: Recommendations for Aspen Reforestation in Western Canada"**, by Laura K Gray et al., in *Ecological Applications*

> **We find it useful to differentiate the movement of species far outside their range for conservation purposes (assisted colonization), and population movement within a species range or somewhat beyond the leading edge (assisted migration).** Under this definition, **assisted migration** would usually apply to common and wide-spread species for the purpose of maintaining ecosystem health and productivity, whereas **assisted colonization** aims at conserving endemic or range-restricted species. Although there are exceptions, this definition largely reflects previous usage of terminology in conservation biology (e.g., Hunter 2007, Hoegh-Guldberg et al. 2008, Ricciardi and Simberloff 2009) and forest resource management (e.g., Millar et al. 2007, O'Neill et al. 2008b, McKenney et al. 2009).

• November 2011 - **Review: Taking Stock of the Assisted Migration Debate**, by N. Hewitt et al., in *Biological Conservation*

> **Assisted migration is the intentional translocation or movement of species outside of their historic ranges in order to mitigate actual or anticipated biodiversity losses caused by anthropogenic climatic change. Equivalent terms include facilitated migration, assisted colonization** (Hoegh-Guldberg et al., 2008a; Hunter, 2007), managed relocation (Richardson et al., 2009), **assisted range expansion** (Hayward, 2009) and **species translocation** (Heller and Zavaleta, 2009). Since it was first proposed (Peters and Darling, 1985), AM has become a major topic of debate in the search for solutions to mitigate the impacts of climate change on biodiversity (McLachlan et al., 2007). **Assisted migration** is controversial because it conflicts with established conservation paradigms that favor maintaining the status quo of species ranges, and in situ management (Hagerman et al., 2010; Hayward, 2009), and because of the complex scientific, policy and ethical questions that it raises....**This is the first comprehensive review of the scholarly literature pertaining to AM.**

• Nov/Dec 2011 - **Why we disagree about assisted migration: Ethical implications of a key debate regarding the future of Canada's forests**, by I. Aubin, C.M. Garbe, S. Colombo, C.R. Drever, D.W. McKenney, C. Messier, J. Pedlar, M.A. Saner, L. Venier, A.M. Wellstead, R. Winder, E. Witten and C. Ste-Marie, in *The Forestry Chronicle*.

> The deliberate movement of species to locations that could better suit them climatically in the future has been proposed as a tool to reduce the threats posed to species and ecosystems by climate change. This tool, called **assisted migration, assisted colonization, or managed relocation** (Ricciardi and Simberloff 2009a, Schwartz et al. 2009, Vitt et al. 2010), encompasses a large variety of actions at different scales, from moving genotypes of timber tree species a few kilometres away to the intercontinental translocation of megafauna. In recent years, **assisted migration** has generated considerable interest and vigorous debate in the scientific community (Fazey and Fischer 2009, Sax et al. 2009, Schlaepfer et al. 2009, Schwartz et al. 2009, Vitt et al. 2010).... How does **assisted migration** differ from historic human-mediated species introductions? At least two important distinctions can be made. First, modern-day species movements are carried out under increased scrutiny and regulation; interested parties are often highly attuned to the potentially devastating impacts of introduced invasive species on natural ecosystems. Second, **assisted migration** is being proposed to reduce the impacts of human-induced climate change, an unprecedented situation in human history that brings with it entirely new environmental, societal and ethical challenges.... As with many issues surrounding climate change, **assisted migration** is a complex topic that encompasses scientific, social, policy and economic viewpoints, for which different stakeholders have their own complex and multi-dimensional objectives, metrics and definitions.... The current scientific debate on **assisted migration** appears stalled between proponents who feel compelled to override natural processes and help nature adapt to human-induced change, and detractors who feel that nature should be left alone and all efforts directed towards reducing human impacts. Therefore, the debate has moved beyond a strict scientific discussion into the arena of beliefs, values, visions of the

future, and subjective perceptions of risk and desirable outcomes. These elements underpin our individual moral judgments about what nature is and where we fit within it and thus are a critical dimension in any position regarding **assisted migration**.

This paper outlines some of the major ethical considerations regarding assisted migration and its implications for Canada's forests. It reflects the perspectives of the authors, who represent a range of disciplines (community ecologists, foresters, conservationists and social scientists), backgrounds (academia, government agencies and non-governmental organizations), and experience. First, **we identify several types of assisted migration**, each with a unique set of motivations, risks and benefits; we then outline consequences of action and non-action and **several moral perspectives associated with assisted migration**. We argue that the general debate and decision processes are strongly influenced by personal values, beliefs and perceptions of underlying objectives. Finally, **we contrast the attitudes toward assisted migration in the fields of conservation and forestry**. Our intent is not to advocate for or against a particular perspective on assisted migration, but by clarifying certain key issues, to assist readers in developing their own views on this important topic.

... We list **the three main objectives of assisted migration** as found in the literature and discuss the different types of movements associated with each: **(1) Preventing the extinction of species, (2) Enabling or conserving market-based goods (e.g., timber), (3) Enabling or conserving ecosystem processes and services**.

Preventing the extinction of species ... is the prevailing objective found in the literature, whereby species of conservation concern are moved to locations expected to be climatically suitable based on projections of future climate (e.g., Carroll et al. 2009, McLane and Aitken 2011). In most cases, this involves moving individuals of a given species beyond its historical range limits (i.e., **assisted long-distance migration**; Ste-Marie et al. 2011). If, however, the motivation is to conserve a target species by maintaining or improving its genetic diversity, a selected population may be moved inside the species' range (i.e., **assisted population migration**; Ste-Marie et al. 2011).

One's view of the relationship between humans and the natural world, the sense of duty to intervene, and beliefs about nature's sensitivity to anthropogenic change are all determining factors that influence perceptions of **assisted migration** and one's willingness to act on it.

• November 2011 - **"Assisted migration: Introduction to a multifaceted concept"**, by Catherine Ste-Marie, Elizabeth A. Nelson, Anna Dabros, and Marie-Eve Bonneau, in *Forestry Chronicle*.

The idea that humans can assist nature by purposely moving species to suitable habitats to fill the gap between their migration capability and the expected rate of climate change is being increasingly contemplated and debated as an adaptive management option. The interest in **assisted migration**, both in the scientific community and society at large, is growing rapidly and is starting to be translated into action in Canada. However, **the concept is in its infancy; clear terminology has not yet been established and assisted migration still encompasses a broad range of practices**. This introductory paper for the special issue of *The Forestry Chronicle* on the subject of **assisted migration** describes increasing interest in the subject and its complexity. It also provides **an overview of the potential scale of assisted migration, proposes a terminology**, and briefly introduces the following papers. Overall, the five papers aim to present a comprehensive state of the scientific and operational knowledge and **the debate on assisted migration in the context of Canada's forests**.... Despite the growing body of literature addressing the issue, **assisted migration still does not have an established definition**; instead, it has multiple interpretations and therefore can be applied to a broad range of practices. In Table 1, definitions are provided from scientific publications, demonstrating that despite the use of different terms to describe assisted migration, the concepts are complementary and overlap substantially. The term **'assisted migration' is the most commonly used term**, and it combines the concepts of 'assisted' (human intervention) with'migration' (movement of biological units)....**Our proposed terminology**, developed following a review of the literature, and selected for its effective communication, is outlined in Table 2.

Table 2. Proposed terminology for assisted migration modes

Term	Definition
Assisted migration	The human-assisted movement of species in response to climate change.
Assisted population migration	The human-assisted movement of populations (genotypes) within a species-established range in response to climate change.
Assisted range expansion	The human-assisted movement of species to areas just outside their established range in response to climate change, facilitating or mimicking natural range expansion.
Assisted long-distance migration	The human-assisted movement of species to areas far outside their established range (beyond areas accessible via natural dispersal) in response to climate change.

• November 2011 - **"The implementation of assisted migration in Canadian forests"**, by John H. Pedlar et al., in *Forestry Chronicle*.

> ABSTRACT: We outline the major steps involved in implementing **assisted migration (AM)** and assess, in a general way, the capacity to carry out each step in Canadian forests. Our findings highlight the fact that capacity to implement AM differs between forest species; in particular, the existence of established provenance trials, seed transfer guidelines, seed procurement systems, and plantation establishment protocols **makes AM considerably more feasible for most commercial tree species than for most species of conservation concern**. We report on several **AM** efforts involving commercial tree species that are already underway in Canada and identify a number of initiatives that could be undertaken to help build **AM** capacity. This paper is not intended as an endorsement of the **AM** approach; however, we feel there is considerable value in discussing implementation issues at this point in the **AM** debate.

• December 2011 - **"Ecological implications for assisted migration in Canadian forests"**, by Richard Winder, Elizabeth A. Nelson, and Tannis Beardmore, in *Forestry Chronicle*.

> ABSTRACT: Forest ecosystems are already being impacted by climate change as natural migration rates are outpaced by rapidly changing climate conditions. **Human-assisted migration** has been proposed as a potential management option to maintain optimal health and productivity of Canada's forests; however, a better understanding of the ecological implications is needed to inform decision-making on **assisted migration (AM)**. This paper examines the ecological constraints and consequences of AM, and discusses options for their mitigation at three scales: translocation over long distances (**assisted long-distance migration**), translocation just beyond the range limit (**assisted range expansion**), and translocation of genotypes within the existing range (**assisted population migration**). From an ecological perspective, we find that AM is a feasible management option for tree species and that constraints and consequences can be minimized through careful application of available knowledge and tools.

• _____ 2011 - **"Assisted Migration: Adapting forest management to a changing climate"**, by Susan March Leech, Pedro Lara Almuedo, and Greg O'Neil, in *BC Journal of Ecosystems and Management*

> In this paper, we discuss one forest management option — **assisted migration** — as a climate change adaptation strategy. We begin by providing context: an explanation of how rapidly our climate is predicted to change, how rapid climate change may impact ecosystems, and the body of evidence suggesting that it will be difficult for trees to keep up with predicted changes in climate over the coming decades. We then discuss **assisted migration** as one forest management option for dealing with climate change, describe perceived risks and benefits of different forms of **assisted migration**, and identify knowledge gaps, current research, and policy changes needed to implement **assisted migration** in British Columbia. Finally, we provide links to resources and additional information on this important topic.

• July 2012 - **"Assisted migration: Uncertainty, risk and opportunity"**, by Andrew Park and

Carolyn Talbot, in *Forestry Chronicle*.

> INTRODUCTION: **Assisted migration** (also called **managed relocation** or **assisted colonization** Ste-Marie et al. 2011) refers to the intentional movement of organisms (be they trees, animals or crops) to areas outside their historic range. A restricted form of **assisted migration (AM)** is made possible by the seed transfer guidelines that are used in several provinces (O'Neill et al. 2008) to optimize the matching of seed sources to sites in forestry. More extensive AM of provenances and species is being contemplated as an adaptive response to anthropogenic global warming (AGW). **Assisted migration** was originally contemplated as a conservation measure to address the possibility that existing tree populations may become maladapted to their local conditions as the climate shifts around them. More recently, it has been argued that AM could be used to pre-emptively adapt forests to the effects of AGW....

• August 2012 - **"Managed Relocation: Integrating the Scientific, Regulatory, and Ethical Challenges"**, by Mark W. Schwartz and 31 co-authors: Jessica J. Hellmann, Jason M. McLachlan, Dov F. Sax, Justin O. Borevitz, Jean Brennan, Alejandro E. Camacho, Gerardo Ceballos, Jamie R. Clark, Holly Doremus, Regan Early, Julie R. Etterson, Dwight Fielder, Jacquelyn L. Gill, Patrick Gonzalez, Nancy Green, Lee Hannah, Dale W. Jamieson, Debra Javeline, Ben A. Minteer, Jay Odenbaugh, Stephen Polasky, David M. Richardson, Terry L. Root, Hugh D. Safford, Osvaldo Sala, Stephen H. Schneider, Andrew R. Thompson, John W. Williams, Mark Vellend, Pati Vitt, and Sandra Zellme, in *BioScience*.

> **DEFINING MANAGED RELOCATION**: Managed relocation has been used synonymously in the literature with several terms, including **assisted migration, assisted colonization, and managed translocation** (Hunter 2007, McLachlan et al. 2007, Hoegh-Guldberg et al. 2008, Olden et al. 2011). **We define managed relocation as the intentional act of moving species, populations, or genotypes (the target) to a location outside a target's known historical distribution for the purpose of maintaining biological diversity or ecosystem functioning as an adaptation strategy for climate change** (Richardson et al. 2009). **Managed relocation is distinct from other types of conservation-motivated translocations**, including biological control of invasions, restoration of populations within a native range, and rewilding, because it entails moving a target outside its historical distribution in response to climate change for the benefit of natural resources management (table 1). As such, **managed relocation is a specific case of the more general translocation**, a term that can refer to any species intentionally moved by people for any purpose. **Managed relocation** may be motivated by a desire to (a) maintain genetic diversity, (b) protect species from extinction, (c) mimic dispersal interrupted by human habitat barriers, (d) maintain ecosystem functionality, or (e) maintain a population used in natural resource extraction.... 2007a). **We prefer managed relocation to alternative terms because it is value neutral and emphasizes all of the steps that one might take in adaptation**, including source extractions; establishment; performance and affect monitoring; and, possibly, the control of established populations. Because **managed relocation is the intentional introduction and maintenance of populations for a specific conservation focused outcome, it includes ethical, social, and policy concerns** (Camacho et al. 2010, Minteer and Collins 2010, Sandler 2010). Although many technical issues are central to **managed relocation**, ethical, legal, and social components pose equally challenging questions about the appropriate use of **managed relocation**.

> NOTE: **Connie Barlow posted a detailed critique of this 2012 paper** in a separate webpage accessible on the Torreya Guardians site. Her critique is in four sections: (1) Definitions of Terminology; (2) Ecological History as a Benchmark; (3) Acknowledging that We Already Know a Lot about Species-Specific Risk; and (4) Recommendation for Further Work by the Managed Relocation Working Group.

• September 2012 - **"Placing Forestry in the Assisted Migration Debate"**, by **9 forestry professionals (8 Canadians and 1 USA)**: John H. Pedlar, Daniel W. McKenney, Isabelle Aubin, Tannis Beardmore, Jean Beaulieu, Louis Iverson, Gregory A. O'Neill, Richard S. Winder, Catherine Ste-Marie, in *BioScience*.

> ABSTRACT: **Assisted migration (AM)** is often presented as a strategy to save species that are imminently threatened by rapid climate change. This conception of AM, which has generated

considerable controversy, typically proposes the movement of narrowly distributed, threatened species to suitable sites beyond their current range limits. However, **existing North American forestry operations present an opportunity to practice AM on a larger scale**, across millions of hectares, with a focus on moving populations of widely distributed, nonthreatened tree species within their current range limits. Despite these differences (and many others detailed herein), **these two conceptions of AM have not been clearly distinguished in the literature, which has added confusion to recent dialogue and debate. Here, we aim to facilitate clearer communication on this topic by detailing this distinction and encouraging a more nuanced view of AM.**

• 2012 - BOOK: *Plant Reintroduction in a Changing Climate*, Part III: "Managed Relocation" entails two chapters: **"Managed Relocation: Panacea or Pandemonium?"** (by Kristin E. Haskins and Brian G. Keel) and **"Is Managed Relocation of Rare Plants Another Pathway for Biological Invasions?"** (by Sarah Reichard, Hong Liu, and Chad Husby).

EXCERPT of historical review of concept in chapter 13: "Managed Relocation: Panacea or Pandemonium?": ... Since 2007, numerous scientific journal articles, media articles, letters to the editor, and articles in popular magazines for and against the intentional movement of plants have surfaced. **Debates over terminology ensued, leading to many synonyms.** Because migration is often associated with animal movement, Hunter (2007) suggested **assisted colonization**, and Hellman and colleagues (2008) proposed **managed relocation**. It is important to remember that no matter which term is being used, they all refer to human- assisted movement of plants outside the species' historic range in response to population decline due to climate change.

In the following discussion of some key literature **we have used these terms interchangeably to maintain the original author's intentions**. McLachlan and colleagues (2007) highlighted the lack of scientifically based policy on **assisted migration** and suggested that the conservation community needed to consider it.... Hoegh-Guldberg and colleagues (2008) presented a decision assessment framework for evaluating the feasibility of **assisted colonization**.... Mueller and Hellman (2008) predicted that cases of detrimental invasion would be less likely for intracontinental movements of species than for intercontinental movements. They indicated that plants, as opposed to taxonomic groups such as fish, are at low risk as intracontinental invaders, and given the dispersal constraints of plants, **assisted migration** might be useful for this life form.

As with any controversial practice, the **opponents of assisted migration** have also emerged and argued their position. Ricciardi and Simberloff (2009a) made the case against **assisted colonization** as a viable conservation strategy. Their argument stems primarily from the invasive species literature, which includes many animal examples. The authors envision **assisted migration** being practiced as "large-scale transfers of species outside their natural ranges — in other words, planned invasions" (Ricciardi and Simberloff 2009a, p. 248). Schlaepfer and colleagues (2009), Sax and colleagues (2009), Schwartz and colleagues (2009), and Vitt and colleagues (2009) presented counterarguments. Among the counterarguments given are the need to weigh the risks of **MR** against the risk of extinction (Schlaepfer et al. 2009; Schwartz et al. 2009), the doubt that endangered species pose much risk of invasive behavior, the lack of evidence indicating that relocated species will cause extinctions (Sax et al. 2009), and the recognition that stake-holders may hold different values of outcomes (Schlaepfer et al. 2009). Vitt and colleagues (2009) implored practitioners to begin planning for the possibility of **MR** by making wise, genetically diverse ex situ collections now. Seddon and colleagues (2009) warned against conservation practitioners prematurely embracing **assisted colonization**.

... Richardson and colleagues (2009) were the first to incorporate social aspects in their multidimensional decision-making framework for MR. **Managed relocation** should not be a last resort approach, they argued. Instead, MR should be an intervention strategy and part of a portfolio of options built around both ecological and social considerations (Richardson et al. 2009).... Considering MR as a conservation tool is now expanding beyond whether or not it is a practical tool to whether or not it is an ethical tool. Minteer and Collins (2010) presented ethical and policy questions focused on candidate species, institutional context, authorization and oversight, motive, and environmental responsibility that are designed to make practitioners think about whether they should rather than could practice **MR**.... Unregulated, haphazard movement of plants in the commercial trade is also a rising concern (Shirey and Lamberti 2011).

• July 2013 - **"Preparing for Climate Change: Forestry and Assisted Migration"**, REVIEW ARTICLE by foresters Mary I. Williams and R. Kasten Dumroese, in the Society of American Foresters *Journal of Forestry*.

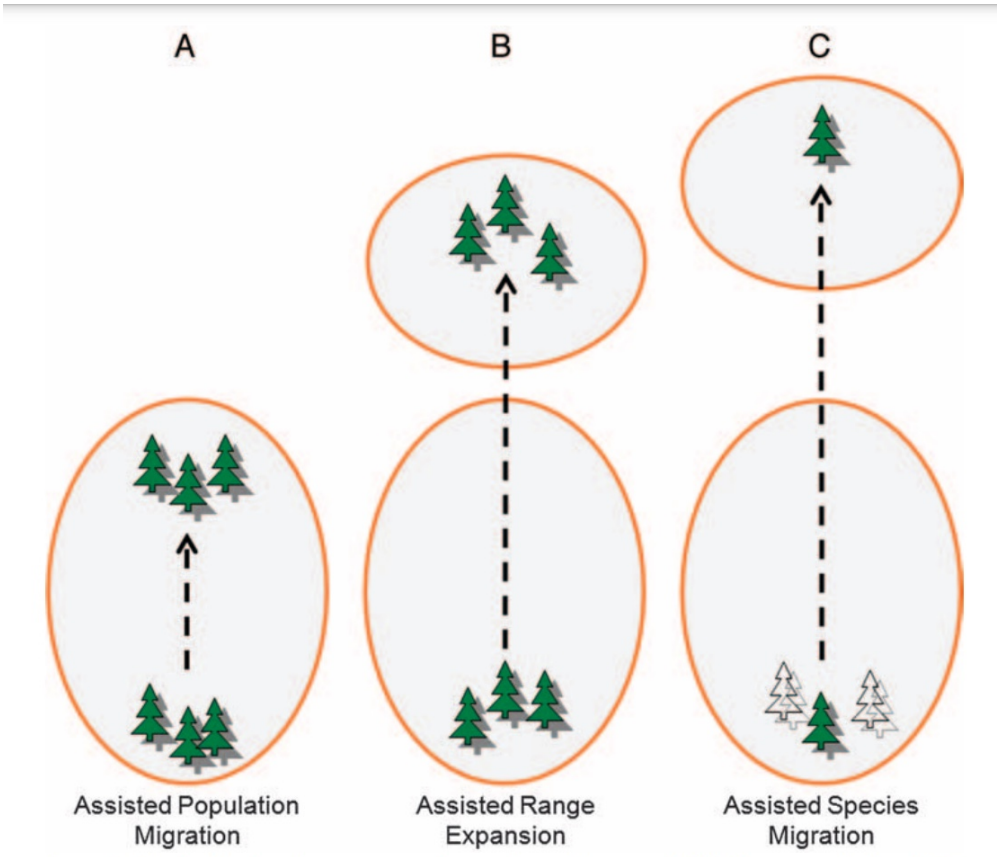


Figure 1. Assisted migration can occur in a variety of forms to fulfill diverse goals (Ste-Marie et al. 2011, Winder et al. 2011). To avoid economic loss in the timber industry, seed sources and populations (e.g., genotypes) of commercial trees could be moved within their current range (A) or from their current range to suitable areas just outside (B) to keep pace with changing conditions (e.g., warmer climates). Movement to locations far outside current ranges is an option to prevent species extinction (C). Risks can vary widely across the forms of assisted migration but would probably increase with migration distance (Mueller and Hellmann 2008, Vitt et al. 2010, Pedlar et al. 2012). For example, assisted migration to areas far outside its current range (e.g., C) would carry greater financial responsibilities and ecological risks (Winder et al. 2011).

EXCERPT: During the past 30 years, climate change adaptation strategies have been proposed. One strategy is **assisted migration** (Peters and Darling 1985), defined as the movement of species and populations to facilitate natural range expansion in direct management response to climate change (Vitt et al. 2010). Drawing from conventional reforestation practices and proposed adaptation strategies, **we review the current thinking on assisted migration of forest tree species** and provide information for nursery managers, land managers, and restorationists to consider in management planning. Unlike recent reviews covering **assisted migration**, we expand implementation and provide options, resources, and tools to move forward. **Our primary focus is on forest tree species and populations, but the information we provide is relevant to other native plant species**.

... Given its long tradition of research, development, and application of moving genetic resources through silvicultural operations, **the forestry profession is well suited to evaluate, test, and use an assisted migration strategy**.

• August 2013 - **"Will plant movements keep up with climate change?"**, by Richard T. Corlett and David A. Westcott, *Trends in Ecology and Evolution*.

EXCERPTS: ... Most plant populations studied have tracked recent warming partly or not at all, with more complete tracking upslope than latitudinally [2,5–8,65] and by better-dispersed

species [66]. It is not clear if these lags reflect a lack of need for movement, after only a small increase in temperature, or a lack of ability. A time lag in the response to warming is another possibility, although the paleoecological record suggests that this must be less than 50 to 100 years [67]. The lack of response to warming could also reflect the influence of other climate variables, such as water availability, with divergent movement vectors [12,68]. Whichever explanation for recent migration lags is correct, the evidence presented above suggests that many plant species will be unable to keep up with the higher velocities of climate change expected for the remainder of the 21st century.

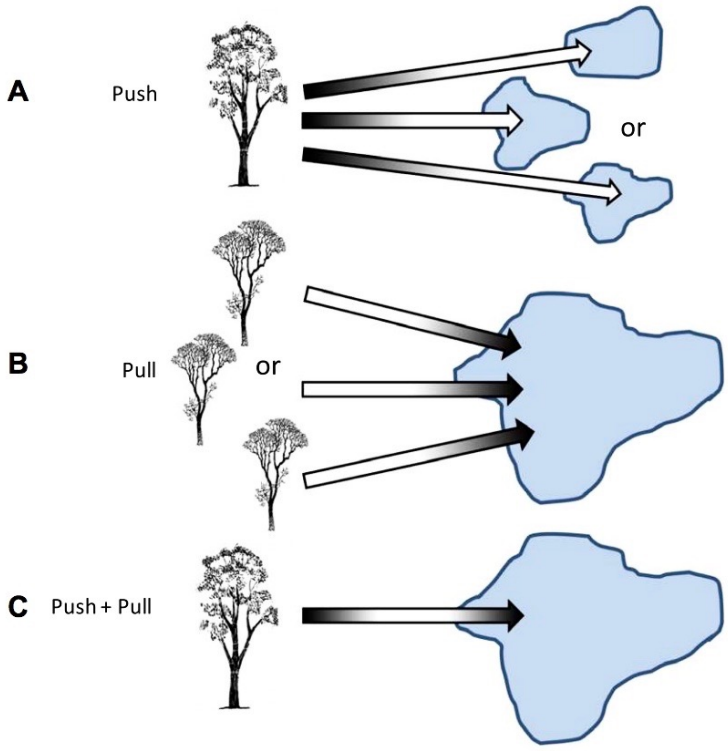
... No plant extinctions have so far been attributed to recent climate change and only one species, the previously widespread *Picea critchfieldii*, is known to have become globally extinct during the Late Pleistocene from natural climate change [2,73].

... Only in steep topography is habitat continuity across climatic gradients likely to benefit most plant species.... In less steep topography, **managed translocation** (Box 3) will probably be needed for many species.

BOX 3: **Managed translocation (also called assisted migration or assisted colonization)** is the deliberate establishment of populations outside their natural range for conservation purposes: in this case, to reduce the risks of extinction from climate change [90]. It is a controversial idea that not only pits two widely accepted 'conservation rules' against each other (the duty to prevent extinction against the prohibition on introducing non-native species), but also reflects two opposing views of local communities, as coevolved assemblages or the result of 'ecological fitting' of species that are locally available, irrespective of their evolutionary history. The choices are not really as stark as this, however, because managed translocations of plants will normally be into similar communities near the edge of their natural ranges, reducing the risk of unpredictable impacts. Moreover, the traits that make a species likely to require translocation (e.g., poor dispersal, long life-cycle, or low competitive ability) are the opposite of those commonly associated with invasiveness [90], although invasion biology is a field where predictability is still low. Less controversial than translocation outside the current range would be moving plants within their range, from the core to the expanding margin, to increase gene flow [41,79]. By contrast, the proposed use of managed translocation to restore ecological processes in the recipient ecosystem, rather than simply to reduce the risk of extinction for the translocated species, is more controversial, because the aim in this case would be to have a substantial impact [91]....

- **"Using assisted colonisation to conserve biodiversity and restore ecosystem function under climate change"** by Ian D. Lunt et al, *Biological Conservation*, Vol 157, 2013

I.D. Lunt et al./Biological Conservation 157 (2013) 172–177



EXCERPT: "To date, the **assisted colonisation** literature has focused primarily on a single rationale: to enhance the survival prospects of the taxon being moved, or small numbers of interdependent taxa, such as butterflies and host plants (Hellmann, 2002). However, here we suggest that **assisted colonisation could also be undertaken to achieve a very different conservation goal — to maintain declining ecosystem processes**. Adopting the terminology of Seddon (2010), this type of assisted colonisation would be classified as ecological replacement — the release of "a species outside its historic range in order to fill an ecological niche left vacant by the extirpation of a native species", and is akin to the "anticipatory restoration" activities proposed by Manning et al. (2009). **This goal may become prominent in future climate change adaptation programs as the impacts of climate change become more severe**, but the juxtaposition of goals has not been considered in the assisted colonisation literature and demands benefit–risk evaluation.

"For simplicity, **we characterize these two contrasting rationales for assisted colonisation as 'push' and 'pull' strategies**. Push strategies that focus on conserving individual taxa or small groups of inter-dependent taxa are already widely discussed in the assisted colonisation literature. In these cases, issues such as rarity and threat guide the selection of target taxa, and populations are 'pushed' into one or more localities where it is expected that they will maintain viable populations for an extended period under climate change (e.g. Willis et al., 2009). Risk assessments are required to ensure that informed decisions are made to relocate taxa such that there is minimal impact on other species where they are introduced (Burbidge et al., 2011). **In contrast, assisted colonisation that is also motivated by a desire to restore ecosystem function should expect to have an appreciable impact at the recipient site. In such 'pull' scenarios, desired ecosystem functions and potential recipient sites would first be identified, and appropriate candidate species would then be 'pulled' into recipient sites to maintain or restore the specified function.** Relocation of taxa may be undertaken to deliver ecological functions that are directly affected by climate change, or where climate change exacerbates other causes of decline."

CONCLUSIONS: We emphasise that we are not promoting the adoption of any particular assisted colonisation strategy, and we advocate that all assisted colonisation activities must be subject to comprehensive risk assessments and ongoing monitoring and management. However, **we encourage ecologists and managers to consider how assisted colonisation could be**

adopted to achieve broader goals than the persistence of a single, or just a few, threatened species.

• 2013 - **"Translocation of Imperiled Species Under Changing Climates"**, by Mark W. Schwartz and Tara G. Martin, *Annals of the New York Academy of Sciences*

> EXCERPT: ... Our purpose is to review the recent literature on conservation translocations and decision making in conservation to synthesize translocation recommendations and to focus future scientific study. **Managed relocation, the conservation translocation of species outside historic distributions in anticipation of changing future climates, generates significant scientific and public concern and requires a formal decision process to evaluate the potential benefits and risks.** We are just beginning to experience the ecological impacts of **anthropogenic climate change**, with the severest projected impacts on natural ecosystems yet to come. Thus, there is time to plan — to develop adaptation strategies and protocols to help conserve biodiversity under climate change. With significant uncertainty about how climate will change, as well as how ecosystems will respond to the myriad other drivers of future environmental change, **action comes with a large risk of making management mistakes. Likewise, failing to act, or to act in a timely manner ultimately risks species extinction. Risk generates conflict and controversy over the appropriate steps on behalf of conservation....**

• April 2014 - **"Agreed but not preferred: expert views on taboo options for biodiversity conservation, given climate change"**, by Shannon M. Hagermann and Terre Satterfield, *Ecological Applications*.

> ABSTRACT: Recent research indicates increasing openness among conservation experts toward a set of previously controversial proposals for biodiversity protection. These include actions such as **assisted migration**, and the application of climate-change-informed triage principles for decision-making (e.g., forgoing attention to target species deemed no longer viable). Little is known however, about the levels of expert agreement across different conservation adaptation actions, or the preferences that may come to shape policy recommendations....

• June 2014 - **"Assisted colonization as a climate change adaptation tool"**, by Rachael Gallagher et al., *Austral Ecology*.

> EXCERPTS: **Assisted colonization** is a type of conservation **translocation**; a form of introduction, where organisms are intentionally moved outside their indigenous range to avoid extinction of populations of the focal species (IUCN/SSC 2013). The movement of organisms beyond their indigenous range is also commonly referred to as **'managed relocation', 'assisted migration' and 'benign introduction'** (Richardson et al. 2009; Seddon 2010; Lunt et al. 2013).... Despite the uncertainties and risks associated with **assisted colonization**, this practice may be the only option for many species faced with extinction as a result of climate change. For this reason, it is imperative that researchers, policy-makers and practitioners work collaboratively to ensure this conservation strategy delivers results for those species they seek to protect.

• July 2014 - **"Coming to Terms with the Concept of Moving Species Threatened by Climate Change – A Systematic Review of the Terminology and Definitions"**, by Maria Hallfors et al., *PLOS ONE*. *Editor's note by Connie Barlow in 2021:* This widely cited paper demonstrates that the term **"assisted migration"** had become the lead term as of 2014. Abundant usage of "assisted migration" in forestry journals began in 2011, swamping diminishing theoretycal engagement with this topic in conservation biology. By 2018, however, **practicing foresters often used more moderate terms** for the same concept, hence: "adaptive management" and revised standards for "seed selection" and "species selection", thereby drawing upon seeds and tree species from more southerly realms.

> ABSTRACT: Intentional moving of species threatened by climate change is actively being discussed as a conservation approach. **The debate, empirical studies, and policy development, however, are impeded by an inconsistent articulation of the idea.** The discrepancy is demonstrated by the varying use of terms, such as assisted migration, assisted colonisation, or managed relocation, and their multiple definitions. Since this conservation approach is novel, and may for instance lead to legislative changes, it is **important to aim for terminological**

consistency. The objective of this study is to analyse the suitability of terms and definitions used when discussing the moving of organisms as a response to climate change. An extensive literature search and review of the material (868 scientific publications; FIGURE BELOW) was conducted for finding hitherto used terms (N=40) and definitions (N=75), and these were analysed for their suitability.

Based on the findings, it is argued that an appropriate term for a conservation approach relating to aiding the movement of organisms harmed by climate change is assisted migration defined as follows: ***Assisted migration means safeguarding biological diversity through the translocation of representatives of a species or population harmed by climate change to an area outside the indigenous range of that unit where it would be predicted to move as climate changes, were it not for anthropogenic dispersal barriers or lack of time.***

The differences between assisted migration and other conservation translocations are also discussed. A wide adoption of the clear and distinctive term and definition provided would allow more focused research on the topic and enable consistent implementation as practitioners could have the same understanding of the concept.

Term	Times mentioned
Assisted migration	563
Assisted colonization	121
Managed relocation	94
Facilitated migration	26
Translocation	25
Human assisted migration	22
Assisted dispersal	14
Assisted translocation	8
Artificial translocation	8
Bening introduction	8
Assisted relocation	7
Managed translocation	7
Facilitated dispersal	5
Human assisted dispersal	5
Conservation introduction	4
Human assisted translocation	4
Transformative restoration	3

... We noticed a discrepancy in the definition of the measure between the fields of conservation and forestry. Most of the forestry-related definitions emphasised a silvicultural viewpoint, which is not included in the original idea of assisted migration, which has to do with safeguarding biodiversity. Pedlar et al. [65] place forestry in the assisted migration debate by introducing the concepts **forestry assisted migration** and **species rescue assisted migration**.

*EDITOR'S NOTE: To access the full range of social science papers on this topic, go directly to the **"Society, Values, and Communications"** section of the lengthy **"Assisted Migration Scholarly Links"** webpage maintained on this Torreya Guardians website.*

• September 2014 - **"Time for Trees to Pack Their Trunks?"**, by Greg Breining, *Ensia Magazine*.

EXCERPTS: ... When it comes to **assisted migration** to adapt to climate change, caution has generally trumped action. "Most places in the world are doing research but they're very reluctant to move into practice," says Sally Aitken. "We sold people so well on the 'local is best' that it's a big change to all of a sudden say, 'Well you might want to get your seed from somewhere else.'"... "The crux of it is that species are at risk because of climate change," says Dov Sax, deputy director with the Institute for the Study of Environment and Society at Brown University and member of a scientific group that studied **assisted migration**

In some cases, the aim is to save a species with nowhere to go, stranded by elevation or

manmade obstacles. In other cases, the concern is less for individual species than for the overall well-being of ecosystems. In northeastern Minnesota, for example, white spruce, paper birch and balsam fir may all but disappear in a warming climate. They will surely exist in profusion farther north. But can other tree species expand northward quickly enough to take their place? ... It may sound like a can't-lose. But in reality, assisted migration of trees is controversial — risky, some scientists say. For example, TNC offered to plant Michigan white pine on state and federal land in northeastern Minnesota, but both the U.S. Forest Service and state Department of Natural Resources declined, so the trees were planted on county land instead. "They are still, and rightly so, taking a conservative approach to moving things around," says Meredith Cornett.

... Some scientists and conservationists warn that mixing species will degrade "ecosystem integrity." But as Dov Sax points out, perhaps a fifth of the plant species in North America already hail from somewhere else. And the notion of a "balanced" ecosystem doesn't have much support in scientific evidence. "What we think of as ecosystems are transient — very few of the associations of species that we see now that make up an ecosystem would have been together at most points in time in the past," says Sax. "What we get is that maybe communities will be together for a few thousand years." Novel ecosystems — a hodgepodge of natives and exotics — can function, but how much worse or how much better than native assemblages is still a puzzle. "That's the kind of thing we don't have a handle on," Sax says.

...When it comes to **assisted migration** to adapt to climate change, caution has generally trumped action. "Most places in the world are doing research but they're very reluctant to move into practice," says Aitken. "We sold people so well on the 'local is best' that it's a big change to all of a sudden say, 'Well you might want to get your seed from somewhere else.'"

In Europe "most conservationists are quite conservative (what's in a name?) when it comes to introducing or translocating species," Sebastiaan Van der Veken, director of the natural area Regionaal Landschap Kleine en Grote Nete in Belgium, wrote in an email. "Even reintroduction of recently disappeared species or short-distance translocation is highly discussed. Most scientists in Europe think (or hope) creating robust networks and corridors will make it possible for species to migrate themselves. They even fear that putting **assisted migration** on the agenda will restrain policy makers from investing in these ecological networks 'because we can simply move species around when necessary.'"

Meanwhile, as scientists debate, there's evidence that ambitious gardeners and commercial nurseries are stealing the march. Commercial plant nurseries are raising, selling and introducing hundreds of native forest plants far beyond their natural ranges — in effect pushing the northern limits of these trees, shrubs and wildflowers on average more than 600 miles, according to a study by Van der Veken. Not surprisingly, however, there is a bias toward pretty, popular and economically valuable species. "So it would be wrong to rely on these nurseries and gardeners alone to solve the biodiversity problem induced by climate change," Van der Veken wrote. "**Scientists have an important role in making a framework for assisted migration, including screening of endangered species**, translocation risk analysis and post-migration monitoring." Other scientists concur that the willy-nilly experimentation in the garden or backyard is unsuited to remaking something as long-lived and self-sustaining as a native forest.

• August 2015 - **"Considerations for restoring temperate forests of tomorrow: forest restoration, assisted migration, and bioengineering"**, 2015, by R. Kasten Dumroese, Mary I. Williams, John A. Stanturf, J. Bradley St. Clair, in *New Forests*.

EXCERPTS: **Assisted migration**, the intentional movement of species or populations in response to observed or anticipated climate change (Ste-Marie et al. 2011), might be a valuable tool for rare, long-lived, and locally adapted species and populations, especially those threatened by fragmentation and pathogens and with limited adaptation and migration capacities (St. Clair and Howe 2011; Erickson et al. 2012). As discussed earlier, native populations adapted to sites under current climate may become maladapted as changes in climate occur. **Assisted migration** may be used to ensure adapted populations by countering two limitations of tree migration: long generation cycles and reduced dispersal ability (Potter and Hargrove 2012).

Assisted migration can be applied at different scales, including moving populations within a species' current range, beyond a species' range proximate a current distribution, or long distances outside its current range (SteMarie et al. 2011; Winder et al. 2011; Williams and Dumroese 2013). In addition, movements can be geographic (e.g., distance along an elevation

gradient), climatic (e.g., change in number of frost-free days along an elevation gradient), and/or temporal (e.g., date when the current climate of the migrated population equals the future climate of the outplanting site).

... **Assisted migration terminology**, like that of restoration (see Stanturf et al. 2014a), becomes unwieldy because universalism in definitions is trumped by historical use within various disciplines and creation of context base descriptions (Fig. 2). Although no explicit solution exists for this, remaining mindful to discuss **assisted migration** within the context of the restoration goal should support better communication among scientists and among scientists, land managers, and the public.

• August 2016 - Review paper: **"Assisted Migration in Normative and Scientific Context"**, by D.S. Maier and D. Simberloff, in *Journal of Agricultural and Environmental Ethics*.

EXCERPTS: **Assisted migration (AM)**, an ecosystem engineering technology, is receiving increasing attention and significant support as a means to save biodiversity in a changing climate. Few substantive, or not obviously deficient, reasons have been offered for why pursuing this conservation goal via these means might be good. Some proponents of AM, including those who identify themselves as 'pragmatists,' even suggest there is little need for such argument. We survey the principal reasons offered for AM, as well as reasons offered for not offering reasons.... **Papers discussing assisted migration (hereafter, 'AM') have proliferated — from virtually nil before 2007 to hundreds per year recently** (Hallfors et al. 2014, p. 5, Fig. 2). **Also known as 'assisted colonization,' 'managed relocation,' 'species translocation,' and other names**, this type of project was initially proposed in a conservation context by Peters and Darling (1985, p. 715), who suggested that such projects might avoid extinction of populations or entire species facing climate change. This change, they observed, may outpace the ability of some species to sufficiently adapt in situ to new conditions — even if intensively modified for their benefit — or to migrate sufficiently far to suitable new sites.

• August 2016 - News report: **"Relocating Australian tortoise sets controversial precedent"**, by Dyani Lewis, *Science*.

... The trial will be a contentious test case in conservation circles. Introducing nonnative species into new ecosystems has an ignominious history, not least in Australia, where the deliberately introduced European red fox and domestic cat have wreaked havoc on native wildlife. But the idea of **assisted colonization** has gained some favor over the past decade as conservationists grapple with the impacts of rapidly changing climate on habitat suitability for numerous flora and fauna.... "Any conservation action you take is in itself questionable and should be questioned," says Gerald Kuchling from the Western Australian Department of Parks and Wildlife in Perth, who has headed the swamp tortoise recovery efforts for the past 28 years. "But at some stage, you have to do a trial to actually find out what it means to **assist them in colonizing** completely new areas."... **Assisted colonization has already been used for plant species, such as *Torreya taxifolia***, an endangered conifer native to the Florida panhandle. Conservationists in New Zealand are also weighing the strategy to save the endangered hihi, or stitchbird (*Notiomystis cincta*), which faces an uncertain future if not moved to cooler climates farther south. But Possingham doubts the floodgates will open any time soon. "It's not open slather," he says, and scientists will judge each proposed colonization on its merits. For Possingham, who thinks **assisted colonization** will become a 'pragmatic' conservation tool to prevent extinctions, results of the trial can't come soon enough. "Unless we try these things, we'll never learn how to do them, so the sooner the better."

• August 2016 - **"How Climate Change Will Transform the National Parks' Iconic Animals and Plants"**, by Ker Than, *Smithsonian Magazine*.

EXCERPTS: ... There was a time when the notion of letting prized native species die out seemed heretical. Now the agency is bracing for the possibility that some of the species under its care simply won't make it. It is also openly discussing the possibility of **"assisted migration"**: manually relocating some animals and plants if it turns out they can't survive within the park's changing landscapes. These kinds of last-resort actions are controversial even amongst conservationists, but the NPS believes it is time to consider implementing them one day. **"We don't rule out managed relocation in the future," says Patrick Gonzalez, the agency's**

principle climate change scientist. "But there are a lot less costly and less risky things we can try first."

Faced with the possibility of losing one of its most iconic symbols, the park service must now consider what lengths it is willing to go to save the giant sequoias. One of its options is **assisted migration, also known as managed relocation or climate translocation**. Last year, NPS scientists used this technique to move bull trout in Montana's Glacier National Park. The researchers transferred trout from a lake where their numbers were dwindling—as a result of warming conditions and predation from another invasive trout species—to a higher-elevation lake that was cooler and free of predators.

... Christy Brigham, chief of resources management and science at Sequoia and Kings National Park, says the NPS's plans for **assisted migration** of giant sequoias are still purely speculative. "I would say we are at least five to ten years away from having to decide whether we need to take that step," Brigham says.

• January 2017 - **"Quantifying the need and potential of assisted migration"**, by M.H. Hallfors, S. Aikio, and L.E. Schulman, *Biological Conservation*.

EXCERPTS: Here we present a conceptual framework for identifying and quantifying situations in which predictions indicate that a species could benefit from **assisted migration**. We translate predicted changes in suitable area into separate metrics for **migration need and migration potential** on the basis of the amount of lost, remnant, and new area. These metrics can be used as part of decision-making frameworks in determining the most suitable conservation method for a specific species. They also hold potential for coarser screening of multiple species to estimate the proportion of species that could benefit from **assisted migration** within a given time frame and climate change scenario. Furthermore, the approach can be used to highlight time frames during which **assisted migration** or, alternatively, other conservation actions are the most beneficial for a certain species.

A concern that traditional conservation methods may not be enough to safeguard species from decline has led to proposals of new proactive methods, such as actively moving species to new areas in pace with the changing climate. **Although rarely implemented to date, this approach has been extensively discussed. It has variously been called assisted migration, assisted colonization, and managed relocation**, among others, and also defined in different ways. In the strict sense, however, it is a type of conservation translocation (sensu IUCN, 2012) in which species are moved from their indigenous range to areas where they would be predicted to move as climate changes, were it not for **anthropogenic dispersal barriers or lack of time** (see Hallfors et al., 2014 for a thorough discussion); here we refer to the method in this sense and call it **assisted migration** (AM).

To begin with, it should be noted that **wide consensus on the acceptability of AM has not been reached** (Hewitt et al., 2011; Maier and Simberloff, 2016; Siipi and Ahteensuu, 2016). Nevertheless, **AM has already been conducted for the conifer *Torreya taxifolia*** in the USA (Barlow and Martin, 2004; Marris, 2008) and for two butterfly species in the UK (Willis et al., 2009), and is being considered, e.g., for the butterfly *Euphydryas editha quino* (Marris, 2008). Hence, it is important to develop best-practice guidelines for the possible future implementation of the method even if their application, in the end, may not turn into mainstream conservation practice. Indeed, several frameworks have been presented for guiding decisions on whether and when a species needs AM, for risk evaluation, and for planning the process if deemed feasible (Hoegh-Guldberg et al., 2008; Richardson et al., 2009; McDonald-Madden et al., 2011; Pérez et al., 2012; Schwartz & Martin, 2013).

• February 2017 - **"Merging paleobiology with conservation biology to guide the future of terrestrial ecosystems"**, by Anthony D. Barnosky et al. (40 coauthors), ***Science***.

EXCERPTS: ... In the future, the choices will be starker, likely involving decisions such as which species are candidates for **managed relocation** and to which areas, and whether certain areas should be off limits for intensive management, even if it means losing some species that now live there. Developing the capacity to make those choices will require conservation in both historical and novel ecosystems and effective collaboration of scientists, governmental officials, nongovernmental organizations, the legal community, and other stakeholders.... In **managed relocation experiments**, how will the transferred species affect trophic structure and ecological networks of the target ecosystems?... Such paleontologically enhanced species

distribution models can also be helpful in informing efforts to relocate species into suitable environments, ranging from **managed relocation** experiments that aim to save threatened species to choosing which trees to plant in urban and suburban landscaping in order to jump-start dispersal in anticipation of future climatic conditions.

• March 2017 - **"Seeking International Agreement on What it Means To be 'Native'"**, by James J. Gilroy, Julian D. Avery, and Jule L. Lockwood, *Conservation Letters*.

Section Head: **"Nativeness and 'Assisted Migration'"**. Many species may lack the capacity to shift their ranges in response to environmental change, either due to dispersal limitation or low productivity within their native ranges (Menéndez et al. 2006). This has prompted calls for conservationists to perform "**assisted migration**," actively establishing new populations in areas where conditions are predicted to become increasingly suitable (Hoegh-Guldberg et al. 2008). There has been much debate on the practicalities and ethics of this approach (e.g., Mueller & Hellmann 2008; McLachlan et al. 2009), but little explicit consideration of how **assisted migration** fits alongside existing policies related to nonnative species (Schwartz et al. 2012).

Assisted migration can be targeted towards areas that lie within the former native range of a species, but where populations are extirpated (i.e., "reintroduction"). For example, the translocation of Florida torreya (*Torreya taxifolia*) to areas 500km north of its current range has been described as a "reintroduction," although it was only present in that area approx. 65 million years ago (McLachlan et al. 2007). In many cases, however, translocation may only be feasible to areas outside the native range of the species. **Under our framework, this would result in the establishment of a "nonnative" population, potentially resulting in a conflict with invasive species legislation.** On one hand, this could be beneficial in reducing the likelihood of ad hoc and poorly planned independent translocation attempts (McLachlan et al. 2009). On the other hand, if invasive species legislation impedes efforts for **assisted migration**, this could increase the risk of extinction among severely climate-threatened taxa (Hoegh-Guldberg et al. 2008; McLachlan et al. 2009). This suggests that some legislative flexibility may be necessary in order to deal with particularly acute conservation challenges, although any plans for **assisted migration** should always be carefully vetted for potential impacts in the new range (Richardson et al. 2009).

• June 2017 - Featured Review: **"Climate Change, Managed Relocation, and the Risk of Intra-Continental Plant Invasions: A Theoretical and Empirical Exploration Relative to the Flora of New England"**, by Jesse Bellemare, Bryan Connolly, and Dov F. Sax, in *Rhodora*.

EXCERPT: ... Given the pivotal role that dispersal and colonization of new regions is likely to play in allowing species to avoid climate change-driven extinction, some researchers and conservationists have proposed that humans should directly intervene to "assist" poorly-dispersing species in tracking their habitat as it shifts poleward (Barlow and Martin 2004; Bellemare and Moeller 2014; Thomas 2011). **This new conservation strategy has variously been termed "assisted migration," "assisted colonization," and "managed relocation" (Barlow and Martin 2004; McLachlan et al. 2007; Richardson et al. 2009)**. Most strikingly, the approach would involve moving climate-threatened species beyond their native ranges into new geographic regions where they have not occurred historically, but where they are predicted to survive in the future as climate changes (McLachlan et al. 2007).

... Is unplanned managed relocation already happening and what might be the genetic consequences? Even as ecologists, conservation biologists, and land managers are debating the merits and risks of **managed relocation** (Ricciardi and Simberloff 2009; Richardson et al. 2009; Sax et al. 2009; Schwartz et al. 2012; Thomas 2011), it appears that some **unplanned, accidental managed relocation** might already be taking place via the horticultural trade (Bellemare and Deeg 2015; Van der Veken et al. 2008). For example, many plant species from the southeastern US are already present in the horticultural trade across the eastern US as commonly used landscape plants [e.g., Aesculus parviflora Walter, Fothergilla gardenii L., Hamamelis vernalis Sarg., Hydrangea quercifolia W. Bartram, Isotrema macrophyllum (Lam.) C.F. Reed, Rhododendron vaseyi Gray] or as specialty items from native plant nurseries (e.g., Diphylleia cymosa, Shortia galacifolia Torr. & Gray, various endemic Trillium spp.)].

Furthermore, there are records of numerous southern plant species occasionally escaping from horticulture and naturalizing beyond their native ranges in the north (Gleason and Cronquist 1991; Haines 2011). For example, a recent investigation by Bellemare and Deeg (2015)

> found Magnolia tripetala (L.) L., an understory tree species from the southeastern and mid-Atlantic US escaping from horticultural settings and naturalizing at multiple sites across Massachusetts, nearly 400 km beyond its native range edge in southern Pennsylvania. Similar observations have been reported for Catalpa speciosa (Warder) Warder ex Engelm., Isotrema macrophylla, and I. tomentosa (Sims) Huber, among others (Burk and Lauermann 1977; Burk 1984; Burk and Zebryck 2001). As such, it appears that a subset of native plants, particularly those with ornamental value, might already have had opportunities to shift their ranges northward via **inadvertent human assistance** (Bellemare and Deeg 2015; Van der Veken et al. 2008).

• February 2018 - Review paper: **"Managing consequences of climate-driven species redistribution requires integration of ecology, conservation and social science"**, by Timothy C. Bonebrake et al. (42 coauthors; 22 pages), *Biological Reviews*. Note: **Managed relocation** is the term of choice, appearing 10 times in the text of this paper. **"Assisted"** appears twice: **"assisted evolution"** and **"assisted colonisation"** — the latter as the term used in IUCN guidelines. Excerpts appear in the **"Decolonizing Scientific Language"** below, as Australian aboriginal connotations of the term "colonisation" prompt the authors to opt for "relocation" instead.

• April 2018 - Review paper: **"Information Underload: Ecological Complexity, Incomplete Knowledge, and Data Deficits Create Challenges for the Assisted Migration of Forest Trees"**, by Andrew Park and Carolyn Talbot, *BioScience*. Note: **Assisted migration** is the term of choice in the title and throughout this document.

> … One such tool, proposed by conservationists and resource managers, is **assisted migration. Assisted migration (AM)** refers to the translocation of species or genotypes from their current ranges to facilitate range expansion in response to climate change (Williams MI and Dumroese 2013). In recent years, AM has been discussed as a tool for conserving endangered species (Hoegh-Guldberg et al. 2009), increasing climate resilience of commercial forests (i.e., forestry AM; Pedlar et al. 2011, Williams MI and Dumroese 2013), and enhancing resilience in restoration projects (Dumroese et al. 2015). **Whereas conservation AM emphasizes species rescue, forestry AM is proposed as a tool to ensure that adapted seed varieties continue to contribute to productive and healthy commercial forests** (Pedlar et al. 2012, Williams MI and Dumrose 2013). Three scales of forestry AM are defined on the basis of short- to long-distance movements of genetic material: **assisted population migration** (APM) of seed sources within the current species range, **assisted range expansion** (ARE) to areas just beyond current range limits, and **assisted species migration** (ASM) far beyond current range boundaries (Williams and Dumroese 2013, Messinger et al. 2015, SilviFuture 2017).

• September 2018 **Amplifying plant disease risk through assisted migration** - by Allison B. Simler, Matthew A. Williamson, Mark W. Schwartz, and David M. Rizzo, *Conservation Letters*.

> ABSTRACT EXCERPT: Translocation of species, populations, or genotypes beyond their historic ranges (i.e., **assisted migration, AM) is an oft-debated climate adaptation strategy**. Well-intentioned **AM actions** could alter disease dynamics for target species and recipient sites, resulting in unanticipated detrimental economic and ecological impacts. Although disease risks are occasionally mentioned in **AM debates**, current regulations or best practices that reduce or mitigate these complex risks are generally lacking in North America. We use the "Disease Triangle", a foundational framework in pathology, to illustrate pathways through which AM may impact disease emergence, to identify knowledge gaps, and to suggest best practices to reduce disease risks.

• October 2020 - **"Saving the Florida torreya: One goal, two schools of thought on preserving the rare, endangered tree"** - by Dan Chapman, public affairs specialist, U.S. Fish & Wildlife Service. (This article is a governmental publication offered to media for reprinting.) Note: Although not a peer-reviewed publication, this article shows that **"assisted migration"** is still the term of choice by public, botanical garden, and governmental spokespeople involved in this initial case of a climate-driven translocation underway.

> EXCERPTS: Connie Barlow doubts torreya will survive in Florida in a warming climate. She's the founder of Torreya Guardians dedicated to saving the tree by planting its seeds in the wild,

particularly in cooler northern climes where torreya supposedly once thrived. "It is still limited to a spot where it would've survived during the coldest time, 15,000-18,000 years ago, but it hasn't found a way to move back north," said Barlow, a science writer who founded the activist group 15 years ago. "If you put the seeds back in Torreya State Park they'll just produce little saplings and die."

Vivian Negron-Ortiz, a Fish and Wildlife botanist, says the Service has no official policy on the **assisted migration of endangered species**. "We have to look at all alternatives to have the species in situ [in its original habitat] conserved and protected," said Negron-Ortiz. "**Assisted migration** could be an alternative given climate change and if there are no other options. But we have to have a plan in place first. It will probably take a lot of resources and a suite of partners to save the torreya."

... Connie Barlow says she has a cure for torreya — move them far enough north to escape Fusarium and a steadily warming climate. The torreya "is in deep trouble in its historic native range, so lets give it a chance to establish in cooler realms," Barlow wrote 15 years ago. Her thinking hasn't changed. "'**Assisted migration' may be the only stay against extinction.**"

• October 2020 - **"Importance of species translocations under rapid climate change"** - by Nathalie Butt et al., in *Conservation Biology*.

ABSTRACT: Species that cannot adapt or keep pace with a changing climate are likely to need human intervention to shift to more suitable climates. **While hundreds of articles mention using translocation as a climate-change adaptation tool, in practice, assisted migration as a conservation action remains rare, especially for animals.** This is likely due to concern over introducing species to places where they may become invasive. However, there are other barriers to consider, such as time-frame mismatch, sociopolitical, knowledge and uncertainty barriers to conservationists adopting **assisted migration** as a go-to strategy. We recommend the following to advance **assisted migration** as a conservation tool: attempt **assisted migrations** at small scales, translocate species with little invasion risk, adopt robust monitoring protocols that trigger an active response, and promote political and public support.

EXCERPTS: We examined barriers to the use of **assisted migration** as a species conservation tool for adapting to climate change and how these barriers could be overcome to ensure that assisted migration is used more widely. **We focused on 3 primary barriers that are seldom explored: sociopolitical, knowledge and uncertainty, and time-frame mismatch**, although we acknowledge the existence of others, such as legal and ethical constraints. Our aim was to help chart a way forward to facilitate the use of assisted migration and contribute to slowing the global extinction rate.

... **Assisted migration (also called assisted colonization or managed relocation [Hallfors et al. 2014]) has been considered part of the translocation toolkit, officially since 2013, and has been discussed in the scientific literature for more than a decade.** A search of a subset of the conservation literature (*Conservation Biology*, *Conservation Letters*, *Biological Conservation*, and *Biodiversity and Conservation* journals) revealed over 350 articles mentioning climate-assisted migration and over 550 mentioning climate-change translocation since 2010. Yet, even though climate change will make the current habitat of many species unsuitable (e.g., Chauvenet et al. 2013; Verges et al. 2014; Gallagher et al. 2019) translocation continues to be primarily concerned with reintroducing species to areas from where they have been extirpated (Soorae et al. 2010, 2011, 2013, 2016, 2018) or moving individuals between populations to reduce the likelihood of local extinction from a range of threats (Hedrick & Fredrickson 2010) (Fig. 1).

... **Moving species to new areas outside their current or previous ranges has not been implemented widely (Heikkinen et al. 2015), and examples are few.** In Western Australia, one of the rarest reptile species in the world, the Western swamp turtle (*Pseudemydura umbrina*), threatened by drying climate conditions, has been translocated to areas south of its current range that are projected to be hydrologically suitable in the future (Dade et al. 2014; Lewis 2016; Mitchell et al. 2016). In the Scottish Highlands, an alpine lichen (*Flavocetraria nivalis*) underwent experimental translocation to higher elevations to inform modeling of habitat suitability under climate change (Brooker et al. 2017), and two butterfly species were introduced to sites outside their native range in northern England (Willis et al. 2009). In all of these examples, the current ranges of the species are projected to become unsuitable due to increasing temperatures. **The Florida torreya (*Torreya taxifolia*), however, is an example of a**

species whose existing range had already become unsuitable and so was translocated 600 km north to a more suitable area (Barlow & Martin 2004).

Assisted migration has been recommended as a climate-change conservation action due to its necessity in the conservation of species that are not able to disperse unaided to climatically suitable locations (e.g., Heller & Zavaleta 2009; Chauvenet et al. 2013; Reside et al. 2018). Conservation scientists have already constructed decision frameworks (e.g., McLachlan et al. 2007; Richardson et al. 2009; Rout et al. 2013) designed integrated strategies for selecting sites and species (e.g., Chauvenet et al. 2012; Harris et al. 2013; Gallagher et al. 2015), begun to test adaptive versus acclimatization effects in translocated species (Morikawa & Palumbi 2019), and provided recommendations about the best time to carry out assisted migration (McDonald-Madden et al. 2011). **However, given the pervasiveness of the climate crisis and impending extinctions of species (IPBES 2019) and ecosystems (Bland et al. 2017), surprisingly few cases of climate-change translocations exist.**

There has been much written about the **ethics of assisted migration**. Researchers have examined whether a species' instrumental, ecological, or intrinsic value justify the risk and expense of moving them (Sandler 2010), make calls for pragmatic ethical analysis (Minteer & Collins 2010) that incorporates risk (Ahteensuu & Lehvävirta 2014), and acknowledge that solutions to the philosophical, political, and practical challenges around translocation are complex and multifaceted (Hewitt et al. 2011; Schwartz et al. 2012). The legal aspects of assisted migration are also important to consider, and regulatory policy should support ethical considerations by facilitating thorough appraisals of species' conservation plans (Camacho et al. 2010; Schwartz et al. 2012). Conservation scientists and practitioners themselves are of course also subject to ethical concerns and considerations. **We argue that despite several barriers to adopting assisted migration, it is urgent that it be added to the standard conservation toolkit because climate change is (or soon will become) the primary threat for many species. It is therefore critical to be open about these barriers to identify pathways to overcome them.**

• November 2020 - **"Widespread underfilling of the potential ranges of North American trees"** - by Benjamin J. Seliger, Brian J. MGill, Jens-Christian Svenning, and Jacquelyn L. Gill, *Journal of Biogeography*

Results: **The potential ranges of North American trees and shrubs are broadly underfilled (mean = 48%).** Furthermore, range filling is positively correlated with geographic range size. Large-ranged species have higher range filling than the null model, and shape ratios indicative of climatic restrictions. **Small-ranged species showed a stronger influence of dispersal limitation.**

Main conclusions: **Climate explains only about half of tree species' ranges**, and the signal of climatic equilibrium increases with range size. Small-range species show high levels of climatic disequilibrium, which is likely be driven by combinations of **dispersal lags, and undetected environmental factors or biotic interactions**. These results highlight the importance of conserving small-ranged species and the difficulty of forecasting how their distributions will shift in the coming centuries.... As such, we may need to embrace emerging conservation efforts such as **managed relocation** or **horticultural naturalizations** to ensure reliable persistence for our most vulnerable tree species.

NOTE: A popular account of this paper was published by journalist Zach St. George in ***Sierra Magazine***, using the term "assisted migration":

> ... The question of what is constraining species' ranges is at the heart of the debate over whether people should move species to suitable places, a conservation method known as "**assisted migration**." Since the 1980s, botanists have worried that many plants would be unable to keep pace with the rate of modern climate change. For small, isolated species, this could mean extinction. While people have often moved species from one part of the world to another for more mundane reasons, the idea of doing so as a conservation method has proven controversial. Skeptics worry about inadvertently creating new invasive species, and about disrupting the existing ecosystems that would receive the assisted migrants.
>
> But there is also the question of whether species actually need the help. As ecologist **Mark Schwartz wrote in a 2004 paper arguing against assisted**

migration, "the arguments about range and climate rely on very important assumptions that are not well justified. We usually do not have empirical data from which to judge whether narrowly distributed species are, as assumed, limited by climate and not by other environmental factors.... As a consequence, I believe that we should exercise caution."

On the one hand, the Biogeography study, which shows species widely in disequilibrium with climate, seems to reinforce Schwartz's point. "People advocating that we need to assist movement should think twice," says Carsten Rahbek, a macroecologist who was not involved in the *Journal of Biogeography* study. "It looks like these small-ranged species are not determined by contemporary climate, and that kind of undermines the necessity of people to go in and help them."

Svenning draws a different conclusion. Tree species, he says, have had more than 10,000 years of relatively stable climatic conditions since the end of the last ice age and still haven't reached equilibrium with the climate. "We're now expecting strong climate change in the next decades and centuries," he says. "It's super unrealistic to expect many species to track this. They couldn't do it across these 10,000 years. They can't do it in this short time frame."

Seliger says that, in an odd way, both perspectives can be true. The current distributions of many tree species might have little to do with the current climate, and, for many of those species, climate change could be the biggest threat in the future. "Unfortunately," he says, "the debate is going to go on."

Whether people take the possibility that many species are out of sync with the current climate as evidence for or against **assisted migration**, Svenning says he hopes it will lead them to consider a slightly broader view of whether species are "native" to a particular place. The places we find species today, he says, represent only where they've managed to reach.

It seems to be true, at least, of Kentucky yellowwood. For decades, people have planted it in yards and along streets across eastern North America. Today, the species inhabits an area far greater than it ever managed to reach on its own.

• March 2021 - **"Ecological risk assessment of managed relocation as a climate change adaptation strategy"** - by Aviv Karasov-Olson et al., report to and published by U.S. National Park Service, 113 pp. *Note:* Two co-authors are also authors of principle papers on this issue in the early years: Mark W. Schwartz and Jessica J Hellmann. The report includes 4 case studies: Bull Trout, Karner Blue Butterfly, Giant Sequoia, and Pitcher's Thistle.

FIRST PARA OF EXECUTIVE SUMMARY: "Changing climate and introduced species are placing an increasing number of species at risk of extinction. Increasing extinction risk is increasing calls to protect species by relocating, or translocating, them to locations with more favorable biotic or climatic conditions. **Managed relocation, or assisted migration**, of species entails risks to both the conservation target organisms being moved as well as the recipient ecosystems into which they are moved."

EXCERPT OF DEFINITIONS SECTION:

Assisted migration. The intentional movement of a conservation target outside its historical range, often in response to climate change. Can be used to avoid extirpation of the target or to replace a declining function in the recipient ecosystem. [synonyms: assisted dispersal, assisted colonization, managed relocation] (p. 59)

Managed relocation. The intentional movement of a species beyond its historical range. We treat managed relocation to be equivalent to assisted migration or assisted colonization and a subset of the broader set of actions that may be considered conservation translocations. (p. 60)

• 22 April 2021 - **"Earth Day 2021: Why reforestation is a crucial part of saving the**

environment" - by Julia Jacobo, ***ABC NEWS***.

> EXCERPTS: Climate change may be the focus of the environmental movement, but restoring the Earth, the theme of this year's Earth Day, will play a crucial role in keeping global temperatures down.... Reforestation is the top nature-based climate solution in the U.S., Brian Kittler told ABC News. Solomon Dobrowski, professor of landscape ecology at the University of Montana, believes that forests play a "pivotal role" in finding solutions for biodiversity and climate change.... Building brand new forests provides scientists with an opportunity to approach the replanting strategically, Burney said, describing the process as "climate-smart reforestation." Researchers have taken the idea of **assisted migration** — for example, planting a species of tree that is native to the area but sourcing the seed from a little farther south — to ensure that the forest will endure....

• 30 April 2021 - **POLICY FORUM, CONSERVATION: "Global policy for assisted colonization of species"** - by Jedediah F. Brodie and six coauthors (Lieberman, Moehrenschlager, Redford, Rodriguez, Schwartz, Seddon, and Watson), ***Science***.

> EXCERPTS: ... To keep pace with changing conditions, many organisms that cannot adapt will either **need to move poleward in latitude**, upward in elevation, downward in water depth, or to refugial areas that might lie outside their current or historical indigenous ranges. For many species, these movements are stymied by human infrastructure and disturbance. **Assisted colonization — the translocation and establishment, for conservation purposes, of populations of organisms outside their historical range — could facilitate species conservation** by moving individuals of species that cannot disperse around these barriers, allowing them to escape from shrinking climate refugia and to establish populations in new locations that have the conditions needed for population persistence. **But despite having been discussed by conservation scientists for decades, assisted colonization has been deployed for climate adaptation only rarely** and often remains precluded by contradictory global policies. **Private citizens in several countries, however, have been acting on their own to implement assisted colonization without guidance, oversight, or reporting**. There is therefore a need for processes by which potential assisted-colonization projects could be planned, evaluated, implemented, regulated, and monitored within the framework of international treaties, intergovernmental organizations, and statutory bodies. The Convention on Biological Diversity has an opportunity to set global standards that countries can create policy on, implement, and report back on. **We recommend that the Convention on Biological Diversity empower a technical committee toward creation of an assisted-colonization protocol that all countries could implement based on structured benefit-risk assessment.**

• May 2021 - ***Action Plan for Australia's Imperilled Plants - 2021***, by J Silcock et al, NESP Threatened Species Recovery Hub, Brisbane, 342 pages. EDITOR'S NOTE: This report focused on plants confirms that **"assisted migration" is the only term used** related to climate change. However, the term appears on only 3 of the 342 pages. In contrast, the traditional term **translocation** appears on 141 pages.

• June 2021 - **"Exploring the potential for plant translocations to adapt to a warming world"** - by Sarah E. Dalrymple, Richard Winder, and Elizabeth M. Campbell, in *Journal of Ecology*.

> EXCERPTS: The term **translocation** has typically been used in the context of reintroduction whereby a population of a threatened species is created within the indigenous range to address population loss in that region (IUCN/SSC, 2013). However, climate change is rendering portions (or the entirety) of species' indigenous ranges, unsuitable thereby constraining the use of reintroductions.... Recognising the challenges posed by climate change, conservationists are now cautiously exploring the use of plant translocations in management interventions, using terms such as **'assisted colonisation', 'assisted migration' or 'managed relocation'**. Generally speaking, these all involve the intentional movement of individuals, populations or species to areas outside their indigenous range (IUCN/SSC, 2013), as a strategy for adapting conservation management to a changing climate. In this context, it is recognised that movement outside a species range entails risks where plants could become vulnerable to other factors (e.g. disease). **In forestry, 'assisted migration' is viewed more favourably as a practice capable of matching planted tree populations to future climates.**... Climate change has also altered

forestry practice. Under the rubric of **'assisted gene flow'**, **forestry translocations are more advanced in their application than in the conservation sector**.

- June 2022 - **"Bibliometric Analysis of the Structure and Evolution of Research on Assisted Migration"**, by Lahcen Benomar et al., June 2022, *Current Forestry Reports*.

> ABSTRACT (excerpts): Purpose of Review - **Assisted migration** is increasingly proposed as a proactive management strategy to mitigate the consequences of maladaptation predicted under climate change. Exploring the social and academic structure of the field, its research gaps, and future research directions can help further the understanding and facilitate the implementation of assisted migration strategies. Here we used bibliometric analysis to examine the intellectual, social, and conceptual structures of assisted migration research to identify gaps and opportunities for future research....
>
> EXCERPTS: Among the various strategies that have been proposed to manage species under climate change, **assisted migration (AM)** is a proactive conservation and restoration strategy that aims to limit species' maladaptation by facilitating gene flow and transfer of genetic material that may be adapted to the climate of the recipient environment. **AM, also called "assisted colonization," "managed relocation," and "assisted gene flow" is defined as the intentional movement of species or populations to regions predicted to be suitable under future climate conditions.**... This study showed that much of the research on assisted migration has been carried out in North America, where Canada and the USA have established strong collaborative networks. Canada-USA collaborations have emphasized research related to **assisted migration** of populations for forest trees, compared to other research categories ... Overall, this bibliometric analysis points towards the need to establish new, long-term experiments that expand international collaborations and foster development of interdisciplinary toolkits to fill existing and evolving knowledge gaps that are important to **assisted migration** and its application to conservation and restoration.

- October 2022 - **Operationalizing forest-assisted migration in the context of climate change adaptation: Examples from the eastern USA**, Brian J. Palik, Peter W. Clark, Anthony W. D'Amato, Chris Swanston, Linda Nagel, October 2022, *Ecosphere*

> EXCERPTS: ... While **forest-assisted migration (FAM)** has been discussed conceptually and examined experimentally for almost a decade, operationalizing FAM (i.e., routine use in forest conservation and management projects) lags behind the acceptance of the need for climate adaptation. As the vulnerability of forest ecosystems in climate change increases, FAM may need to become an integral management tool to reduce long-term risks to ecosystem function, despite real and perceived barriers for its implementation. **Here we discuss the concept of operational-scale FAM and why it remains a controversial, not yet widely adopted component of climate adaptation.** We present **three case studies of operational-scale FAM** to illustrate how the practice can be approached pragmatically within an adaptation framework despite the barriers to acceptance. Finally, **we discuss a path toward advancing the wide use of operational-scale FAM**.
>
> ... The case studies presented are examples of successfully overcoming barriers of experience, risk, and practice employed within an ecosystem context to actualize FAM at operational scales.... We have outlined approaches to minimize risk of failure through an adaptation framework, which contain a range of adaptation strategies that incorporate FAM to varying degrees. These include (1) a resistance strategy, which largely defers consideration of regeneration and compositional shifts, including FAM, to a future date, (2) a resilience strategy, which may include an assisted population expansion, and (3) a transition strategy, which may incorporate multiple forms of FAM, including **assisted range expansion** and occasionally **assisted species migration**. Although the latter presents considerable challenges to conservation theory, value perceptions, and barriers under policy, we have shown its application under limited circumstances to be warranted....

Part 4. Decolonizing Scientific Language

by Connie Barlow (background report and advocacy)

AUTHOR'S NOTE: *In this final section, I continue to report and summarize front-line documents, but this is also my opportunity for advocacy.* ***I personally opt for only two of the five synonyms.*** *In all professional contexts I use the original term: "**assisted migration**." However, in popular and citizen-science contexts where I advocate for poleward movement of Florida Torreya, Coast Redwood, and other trees native to temperate zones of North America, I am increasingly inclined to use the only term of Indigenous origin: "**helping forests walk**."*

• *REVIEW OF TERMINOLOGY, pertaining to Indigenous concerns*: As mentioned earlier, **the Indigenous term offered, helping forests walk, has not yet appeared in publications**, and is therefore unlikely to even be known by non-Indigenous conservation biologists and foresters. But here is a relevant quote by Robin Wall Kimmerer, as part of Michigan Tech U's **Justice in Transition** speaker webinar series (2021):

> 1:07:50 Q: "Do you have a personal land ethic, and if so, what does it entail and how has it changed over the years for you?"
>
> 1:07:06 A: "Yes, I certainly do have **a personal land ethic, which is tied to expressions of gratitude and reciprocity for land**. And I try to always think about all the gifts that we're given. And we have to think about what are the gifts that we have to give back and **in return for the privilege of being here**. So that's my land ethic: **returning the gift**.
>
> And how has it changed over the years? In a very pragmatic way, I've been thinking so much about resilience and adaptation in the face of climate change. So the things that I have to give are, *How can I help in a small way forests and plants to adapt?* I live on a little piece of land that I care for, and I've been planting (I call it jokingly) my climate change forest. Because what I'm trying to do is to **introduce trees to this little piece of land that would have a hard time getting here — that have to walk here through times of climate change**.
>
> So I am trying to **take plants from just a horticultural zone to the south and bring them, so that they can get to know their neighbors and be here in place when that time comes** — which for me is the great tension between climate change mitigation (trying to do everything we can to slow climate change) but at the same time recognizing that it is already upon us, and how do we adapt and build in resilience. So I'm trying to do that through the trees.

In a June 2021 **interview with a U.K. newspaper**, *The Guardian*, **Robin Wall Kimmerer** spoke of "helping forests walk" in this context:

> EXCERPT: ... Even as she notices the alarming fact that bloom times are arriving ever earlier, she is also increasingly aware of the natural movement of plants: "We've fragmented the planet in such a way that their natural migration routes are broken up. So **it's our responsibility now to assist that migration, to essentially help forests to 'walk'. We have to help them get to where they need to go.**" Will we be here to witness a new world, the one that she believes will be regenerated for us by the plants? She hesitates. "I have less faith in that."

*Note: In a June 2021 email exchange initiated by Connie Barlow, Kimmerer clarified how the metaphor, "helping forests walk," came to be: "**Those words actually came to us from a respected Haudenosaunee elder, Henry Lickers**. As we worked together on a climate change education project, he gave us that term for the project."*

Prof. Kimmerer, author of the acclaimed 2013 book ***Braiding Sweetgrass***, is founder and director of **Center for Native Peoples and the Environment**, hosted by SUNY Syracuse, where she writes,

> "The validity of using TEK as a partner to ecological science in education and research is gaining traction through our efforts. The successful development of the Center has created a platform from which grant proposals such as the recent NSFIGERT **"Helping Forests Walk"** have developed."

While awareness of TEK is growing among academic conservation biologists and foresters, the concept and name **"helping forests walk"** is still unfamiliar in any field of scientific ecological knowledge (SEK). The compiler of this webpage, Connie Barlow, did not encounter this term until autumn 2020, when she began researching the probable Holocene practice by indigenous peoples

of undertaking assisted migration of fruiting native pawpaw, ***Asimina triloba***, in the eastern USA.

Kimmerer wrote of the TEK and SEK potential for improved relationship in a 2013 book, ***Contemporary Studies in Environmental and Indigenous Pedagogies***. Her chapter is **"The Fortress, the River, and the Garden: A New Metaphor for Cultivating Mutualistic Relationship Between Scientific and Traditional Ecological Knowledge"**. Here is an excerpt:

> "**My scientific experience is as a plant ecologist, trained and working within the highly colonized framework of university science education, and working to create ways to bring indigenous ways of knowing into respectful and productive relationship with ecological science**, through the Center for Native Peoples and the Environment. The mission of the Center is to bring together the wisdom of two great intellectual traditions of indigenous and western scientific knowledge for our shared concerns for Mother Earth.
>
> This essay draws upon decades of experience as a teacher and a scientist, lived experience at the interface between science and traditional culture, traditional teachings, the shared insights of my students, the scholarly literature and the wisdom of plants. Our elders remind us that to truly understand a thing, we must engage all four aspects of our human gifts, mind, body, emotion and the spirit, and this narrative is constructed to honor those teachings.
>
> TERMINOLOGY: The **conventions of academic writing can unfortunately constrain expression and meaning**, so I offer at the outset, a few caveats on terminology. The term "Indigenous Knowledge" is so broad and variously defined that it fails to reflect the great diversity and range of perspectives represented in thousands of unique indigenous cultures (Simpson 2000), although there are broadly shared archetypes and values which transcend cultures. Likewise, the term "Science" refers simultaneously to a body of knowledge, a process of inquiry, along with its associated institutions held by subcultures as different as theoretical physicists and wildlife biologists. **The perceived incompatibility between science and indigenous knowledge is also a product of viewing each as a singular entity, when in fact both have many forms and dimensions** (Maffie 2009). So this discussion is focused on two smaller subsets of "Indigenous Knowledge" and "Science" — i.e. **traditional ecological knowledge (TEK) and scientific ecological knowledge** (SEK), within the realm of relationships among the beings and phenomena of the living world.
>
> I acknowledge, as others have done (Lickers 1997, Procter 2000, McGregor 2008) that **the term "TEK" does not accurately capture the nature of a living, evolving practice of knowledge generation, in which knowledge is more than a body of information, it is a suite of relationships**. However flawed the term, it has become the international academic and policy convention and in the absence of a widely accepted alternative, I will, like my predecessors, use it here. **We await the emergence of a term from indigenous languages that will more richly express the depth and scope of this knowledge.**
>
> This chapter explores three metaphors of what has been called "knowledge integration" between scientific and indigenous ways of knowing. Indeed, the term knowledge integration is itself problematic, when integration is defined as "the process of synthesizing multiple knowledge models into a common model" in which the individual identities of knowledge are inevitably diminished. Here, I will try to use the term creating a "relationship" between knowledge systems in order to **avoid that unintended meaning of knowledge blending**.
>
> GOAL: **Indigenous ways of framing and communicating concepts, through shared narratives and symbols, effectively engage the power of metaphors** (Snively and Williams 2008, Snively and Corsiglia 2001, 2008, Cajete 1994) to encompass both material and spiritual dimensions of a matter. Reflective of that practice, this paper explores **two existing metaphors for relationships between knowledge systems, the Fortress and the River**. I then offer **a new metaphor, the Garden, for relations among knowledge systems**, which is based upon a primary process of knowledge generation among indigenous peoples, i.e. learning from intelligences other than our own, from our oldest teachers, the plants...."

Given the recent upturn in academic attention to **"decolonization" of the ecological sciences via "Traditional Ecological Knowledge"**, it is imperative to take another look at the **root metaphors** of terms in use. This is crucial for conservation and restoration fields because **"colonization" has strongly negative connotations** for Indigenous peoples suffering the

lasting consequences of European invasions of their lands culminating in "colonization." And for tribal peoples in America, **"relocation" is also a repugnant term**. Forced marches hundreds of miles westward into Oklahoma constituted a horrific form of "relocation" for peoples of eastern Turtle Island. These memories carry forward, as in **"Trail of Tears"** inflicted upon the Cherokee, Muscogee, Seminole, Chickasaw, and Choctaw peoples. **"Trail of Death"** is how the Potawatomi refer to their forced removal from the Great Lakes region to Kansas (and then onward to Oklahoma). Even in the 20th Century, "relocation" is a term associated with attempts to force Indigenous assimilation into dominant culture within the USA, culminating in the national **Indian Relocation Act of 1956**.

• **DECOLONIZING FORESTRY: ALREADY UNDERWAY.** Choice of terminology has not been contentious in academic papers of the forestry profession. "Assisted colonization" and "managed relocation" rarely appear. Instead, **"assisted migration" has been and is widely used**, along with a subset of its variants: "**assisted range expansion**," "**assisted population migration**," "**assisted gene flow**", and (at the extreme) "**assisted species rescue**." Moreover, in actual forestry plans for "climate adaptation", **colloquial language predominates**.

The focus in forestry management is not in helping particular species adapt to climate change (via poleward movement, for example). Rather, the focus is on **maintaining forest health during climate change** — and for a variety of purposes. These purposes range from extractive uses, such as timber and pulp, to "ecosystem services" such as watershed health and wildlife habitat, and on to recreational and aesthetic values for humans.

Alpena-Montmorency Conservation District

CLIMATE CHANGE WINNERS AND LOSERS

A version of this article appeared in the Montmorency County Tribune and Alpena News

Dr. Greg Corace

Alpena-Montmorency Conservation District

December 2020

Table 1. Projected climate change "winners" and "losers" based on habitat suitability for a given tree species in neLP. Browsing and other factors that limit reproduction are not considered (from Prasad et al. 2007 and ongoing). Species are listed in decreasing order (i.e., species listed first either are expected to decline or increase more).

Habitat Suitability Decreases	Habitat Suitability Increases
Quaking aspen	White oak
Northern white-cedar	Eastern red-cedar
Balsam fir	Black oak
Sugar maple	American elm
Jack pine	Black cherry
Red pine	Silver maple
Paper birch	Black walnut
Black spruce	Shagbark hickory
Bigtooth aspen	Hackberry
Balsam poplar	Slippery elm

Accordingly, public and private forest managers are offered guidance for forestry health — which usually include **tree species lists** such as shown at LEFT for northern Michigan.

Notice that standard language of "Habitat Suitability Increases or Decreases" may be further translated into "**Climate Change Winners and Losers**."

To fully "decolonize" U.S. Forest Service (and other) climate adaptation assistance with respect to forests on tribal lands, **additional shifts must be made not only in terminology but also in stated and implicit values**.

As of 2021, a leading example is a 2019 a document that had been co-developed by the U.S. Forest service staff in the Great Lakes region associated with the **Northern Institute of Applied Climate Science** (NIACS). The team primarily contributes in *applying* forestry climate science in collaboration with public, private, and tribal forestry managers via the institute's **Climate Change Response Framework**.

The 2019 document co-developed by U.S. Forest Service, Ojibwe, and Menominee contributors is shown below and titled ***A Tribal Climate Adaptation Menu***, pertaining to a portion of the Great Lakes region:



As apparent in the image above, **this document is grounded not only in the expressed values of the tribal participating co-authors, but also in the language itself**. For example, the term "species" rarely appears; "beings" is the usual word of choice. As well, the term "invasive" occurs only once in the text, where it is not only renamed but described in a way expressive of indigenous values:

> "**Bakaan ingoji gaa-ondaadag is an Ojibwe term that describes non-local or invasive beings.** When natural ecosystems are healthy and in balance, bakaan ingoji gaa-ondaadag may not have a large or noticeable effect. As climate change continues to add stress and disturbance, there may be more opportunities for non-local beings to disrupt the normal function and health of an ecosystem. **Climate adaptation may require respectful actions to minimize or prevent the establishment of non-local beings**, particularly if they pose a threat to the health of the local environment."

Crucially, **"assisted colonization" and "managed relocation" never appear in this document**. "Assisted migration" appears only in one paragraph, below:

> **Strategy 11: Encourage community adjustments and transition while maintaining reciprocity and balance.**
>
> Natural communities are expected to change as plant and animal beings adapt to a new climate and transition into new communities. The following approaches describe ways to maintain overall ecosystem balance and health by gradually assisting with these transitions, which may alter or fundamentally change the makeup of beings in the community. This Strategy includes methods to actively promote ecosystem change, including **assisted migration, in which the establishment of beings suited to future climate conditions are encouraged and assisted in their movement — an issue of some disagreement**. Managers should thoroughly investigate potential consequences and knowledge from other sources before introducing new beings to the native ecosystem.

• **DECOLONIZING CONSERVATION BIOLOGY and RESTORATION ECOLOGY: NEEDED.** Here is where the terminological debate has been focused, often intensely, and is still unresolved. Three terms have been at issue since 2009: **assisted migration, assisted colonization, and managed relocation**. The original "assisted migration" was uncontested for only a few years. In 2007, the "migration" component of the term was judged as inferior to a proposed substitute, "colonization" — and for 2 primary reasons: Here is how **Malcolm L. Hunter** argued for the substitute in 2007:

> I have used the term **assisted colonization** in contrast to **assisted migration** used by McLachlan et al. because many **animal ecologists** reserve the word migration for the seasonal, round-trip movements of animals (Wilcove 2007) and because the real goal of translocation goes beyond assisting dispersal to assuring successful colonization, a step that will often

require **extended husbandry**.

- **BARLOW DISAGREES WITH "COLONIZATION" (March 2021 original post of 4 reasons):**

(1) "Migration" is the standard botanical term for plants tracking climate change. Because the first climate-driven assisted migration was undertaken for a **plant, the Florida torreya tree**, the authors debating this action in 2004 (Connie Barlow and Paul S. Martin for A.M. and Mark Schwartz against) did not need to concern themselves with the terminological confusion of animal species that engage in annual migrations. As well, **paleobotanists regularly refer to range shifts by plants as "migrations."** A classic paper by Margaret B. Davis & Ruth G. Shaw (2001) refers to post-glacial range extensions of trees as "migrations": "Range Shifts and Adaptive Responses to Quaternary Climate Change", 2001, *Science* 292: 673-679.

> EXCERPT (p. 673): "Range shifts are the most conspicuous, and best documented, response of woody species to Quaternary climate. As the climate warmed at the end of the last glacial interval, **tree populations** became established at higher latitudes. **These range extensions are called "migrations,"** although individual plants, unlike animals, cannot move to follow changing climate. Rather, occupation of new regions occurs through passive seed dispersal and establishment of seedlings in sites where conditions permit. **The patterns of migration during the past 25,000 years are individualistic**, with the entire range of some tree taxa displaced to new latitudes, e.g. spruce. In contrast, others expanded from glacial refuges, e.g. oak. **Migration rates and the routes of migration** also differed among taxa."

See also, "Predicting Plant Migration Rates in a Changing World: The Role of Long-Distance Dispersal", 1999, *American Naturalist* by Steven I. Higgins and David M Richardson.

> ABSTRACT: Models of **plant migration** based on estimates of biological parameters severely underestimate the rate of spread when compared to empirical estimates of plant migration rates. This is disturbing, since an ability to predict **migration and colonization rates** is needed for predicting how native species will distribute themselves in response to habitat loss and climate change and how rapidly invasive species will spread. Part of the problem is the difficulty of formally including rare long-distance dispersal events in spread models. In this article, we explore the process of **making predictions about plant migration rates**.

See also *Forests in Peril: Tracking Deciduous Trees from Ice Age Refuges into the Greenhouse World*, by Hazel Delcourt, 2002.

> EXCERPT: My personal and professional odyssey as a **historian of deciduous trees** 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) *Note: Delcourt's papers are cited in the 1986 recovery plan for Florida Torreya.*

(2) Rewilding as the goal. While some volunteers serving **Florida Torreya** do offer continuing horticultural assistance for their plantings — notably, mowing around and watering potted seedlings outplanted into full-sun conditions — I have always been focused on "rewilding" this glacial relict tree. The most radical action (also cheapest and least time-consuming) is "free-planting" seeds directly into forest soils beneath unmanaged deciduous canopies (which several of us have been engaged in for a half dozen years). I am unfazed by potential "invasiveness" in moving native trees poleward on their home continents, especially if their seeds are not dispersed by wind or birds. Rather, I challenge, "Who was it that moved the oaks and beeches as climate shifted during the Quaternary? And how well did those birds and squirrels (and, surely, first peoples) do in their wild actions — unsupervised by scientists?" See, for example, my 2014 video, "Becoming Passenger Pigeon".

(3) Failures are essential for learning. How but through a willingness to fail can one **discover current poleward limits of a tree's tolerance**, and thereby target migration assistance that could serve the species during long-term warming? How, too, but through failure — and by taking a **hands-off approach once the seed is delivered to receptive soil** — can one **discover ideal microsites** (slope, aspect, soil chemistry, seral stage, plant associates) within selected "recipient ecosystems"? What, indeed, can be learned if imperiled plants are offered no more opportunities to thrive than "safeguarding" in cramped and managed ex situ reserves and isolated plots in botanical gardens? **Torreya Guardians sets the example in the merits of learning through a willingness to fail**: we are not constrained by a need to produce rapid and positive results for the purposes of securing funding and publishing papers. Torreya Guardians have no funding, yet we have been making progress in planting success and learnings over nearly two decades.

(4) "Assisted Colonization" showcases dominant culture insensitivity; "assisted migration" does not. Two professional papers published in Australian journals clearly establish this language offense. (See directly below.)

• AUSTRALIAN PAPERS OFFER INDIGENOUS PERSPECTIVE ON "COLONIZATION" AS OFFENSIVE:

*Note: The two Australian papers below share authorship by these three individuals of Australian and Tasmanian heritage: **Emma Lee** (Trawlwulwuy woman from Tebrakunna country, northeast Tasmania), **Phillipa McCormack** (Faculty of Law, University of Tasmania), and **Hugh Possingham** (Queensland chief scientist and coauthor of the 2008 paper, "Assisted Colonization and Rapid Climate Change.").*

• May 2016 - **"The language of science: Essential ingredients for indigenous participation"**, by Emma Lee, Phillipa McCormack, Pamela Michael, Shaun W. Molloy, Edith Cowan, Tero Mustonen, and Hugh Possingham, pp.21-23 in *Newsletter of the Convention on Biological Diversity*.

> EXCERPTS: The Sustainable Development Goals identify areas where we have failed to achieve the universal values of human rights, mutual respect and equity of all peoples. These goals provide opportunities to progress towards a more inclusive and respectful global community. **As indigenous, traditional and non-indigenous authors, we wish to highlight the strengths of working together and provide input to agenda Item 8 of the Convention on Biological Diversity**, "Capacity-building, technical and scientific cooperation and technology transfer." We discuss our experience in **Australia as a case study** representing opportunities for progress in other cross-cultural and global communities.
>
> Collaboration between the Government of Australia and **indigenous peoples** on biodiversity conservation is growing and, for example, has contributed immensely to Australia meeting its obligations under the Convention's Aichi Biodiversity Target 11 for protected areas.
>
> … **Indigenous, traditional and mobile peoples are valuable resource knowledge-holders who can draw together the strands of tradition and science**, when presented with opportunities to participate and learn science in culturally safe and respectful conditions. **Indigenous empowerment** can also contribute to strategic sustainable development and ecologically and socially beneficial conservation outcomes. **Indigenous, traditional and mobile peoples not only have legitimacy through traditional knowledges**, but can tailor their participatory, on-country experiences to technological adaptations and improvements that embed research collection and collaboration through cultural practices. Yet despite efforts to develop equitable conditions of fair participation, Australian indigenous peoples' inclusion in environmental science is limited.
>
> LANGUAGE BARRIER: **One of the major barriers to fair participation is the use of language developed by the cultural majority that can exclude or devalue the rich history and ongoing engagement of indigenous, traditional and mobile peoples with the subject matter of science.** While highly-technical or short-hand 'jargon' can be challenging for any non-scientist to engage with, **terms such as 'colonisation', 'assimilation' or 'invasion' can carry connotations informed by an individual's cultural identity**. One practical example of this is recent developments in the **terminology around translocations** of animals and plants — in particular the term **'assisted colonisation' vs 'assisted migration'**.
>
> Key arguments in favour of the term **'assisted colonisation'** include (1) a desire to avoid confusing the intentional translocation of species with natural species migrations (e.g. migratory birds); and (2) to ensure the emphasis of the discussion is on the populations established at the destination, rather than the emphasis of 'migration' on the process of movement. **Arguments against the assisted colonisation terminology include its hegemonic overtones and historical references.**
>
> It is critically important to ensure clarity of terminology for scientific research and decision-making, especially for **controversial adaptation strategies**, but we suggest that without participation and inclusion of a broad range of peoples and perspectives, **technical terminology choices can undermine** the purpose and utility of a concept, and create barriers to engagement.
>
> A paper published in 2012 in *BioScience* by **Schwartz et al** used the term '**managed**

relocation' instead of '**assisted colonization**', on the basis that: "...it is **value neutral** and emphasizes all of the steps that one might take in adaptation, including source extractions; establishment; performance and affect monitoring; and, possibly, the control of established populations... [and] it includes ethical, social, and policy concerns" (p 733).

We applaud the authors for **considering the broader context of the terminology** that is being used, and call for a similar approach to be taken at the international level in the preparation of policy documents like the IUCN's Technical Guidelines.

The changes needed to support these Guidelines include open discussions about the words used to communicate the science and show an appropriate degree of **sensitivity to the impact those words may have on Indigenous, traditional and mobile peoples**. To that end, scientists have an obligation to recognise that indigenous, traditional and mobile peoples may hear their words from within a **paradigm** of lore, history and circumstance that is, often, very different to their own.

Indigenous, traditional and mobile peoples often feel **dominated by western science and conservation paradigms** in two-way learning and hence they struggle to achieve what they perceive as real equity. To counter this, we encourage greater inclusion and participation of Indigenous, traditional and mobile perspectives in science. This would be facilitated by **more thoughtful use of language**.

• February 2018 - Review paper: **"Managing consequences of climate-driven species redistribution requires integration of ecology, conservation and social science"**, by Timothy C. Bonebrake et al. (42 coauthors; 22 pages), *Biological Reviews*

The primary challenge for practicing managed relocation is identifying ways to overcome any social barriers to relocation. Relocating species for conservation can challenge deeply held values and beliefs about human intervention in nature, and what constitutes appropriate and desirable environmental stewardship. Particular challenges may arise for Indigenous peoples, for whom connection to landscapes and historically, culturally and spiritually significant species is of great importance. Formal mechanisms for engaging with local communities and stakeholders, including consideration of the cultural effects and drivers of proactive conservation management under climate change, will be critical. **Issues include cultural nuances, such as the terminology used in management proposals and policy.**

For example **the term 'assisted colonisation'**, adopted in the guidelines of the International Union for Conservation of Nature (IUCN) for species introductions outside of the known range to prevent extinction, has **historical and colonial connotations with the word 'colonisation' that may create barriers to participation**. In this case, an alternative, **culturally considerate phrase to encourage broader inclusion might be 'managed relocation'** (see Schwartz et al., 2012).

The IUCN guidelines for **conservation translocations** (IUCN/SSC, 2013) provide a complete framework to assess the need for **managed relocation**, including the risks associated with translocations for the species of interest and for the ecosystem that receives the new species. **Potential damage to the ecosystem from managed relocation is the worst-case scenario**, and this issue forces decision-makers to ask themselves what they value most. Is the survival of a particular species that is threatened by human actions sometimes worth the risk of profound change to the recipient ecosystem? **If we aim for a species to thrive, when does it become invasive?** These are questions that will need to be answered as managed relocation for conservation becomes more frequent.

... This **paradigm shift** requires partnership approaches with non-Indigenous institutions to respond to the scale and significance of impacts on livelihoods (Huntington, 2011). **Culturally safe and respectful language spoken by scientists, and teaching of science for Indigenous, traditional and mobile peoples are an essential part of this approach.** Otherwise, opportunities to effectively **integrate the often deep and diverse knowledge of these people** into strategies to cope with change will be lost (Lee et al., 2016).

... **Growing recognition of the important role of Indigenous, traditional and mobile peoples in protected area management is one positive change in recent years.** The creation of a fourth type of governance (in addition to government, shared and private governance) in the IUCN's Protected Area Guidelines specifically addresses IPAs and **Indigenous peoples**' and Community-Conserved territories and Areas (ICCAs). In this case, **the nature-culture binary is**

> **being dismantled to incorporate a range of worldviews** that promote sustainable development, governance vitality and management devolution (delegation of power) (Borrini-Feyerabend et al., 2013; Lee, 2016). **Acknowledging the legitimacy of traditional knowledge systems** can be instrumental in understanding species redistribution and provides a mechanism by which local communities can monitor systems can be instrumental in understanding species redistribution and provides a mechanism by which local communities can monitor and manage impacts (Eicken et al., 2014; Tengo et al., 2017).

- **WHY "MANAGED RELOCATION" IS AN OFFENSIVE TERM FOR INDIGENOUS IN USA:**

*Note that the **two Australian papers** excerpted above warn that **"assisted colonization" is a barrier** to dialogue with the Indigenous peoples on that continent. **But they opt for "managed relocation" rather than "assisted migration"** (perhaps because Australia's first translocation project was not for a plant but for an animal: the swamp tortoise). **Barlow objects to "managed"** for the same reasons that she advocates for "rewilding" and "freeplanting" of the USA endangered Florida Torreya tree. More important is this: **"Relocation" has offensive connotations to native peoples in the USA**, as evidenced below.*

- **WIKIPEDIA: Indian Relocation Act of 1956**

> **The Indian Relocation Act** of 1956 (also known as Public Law 959 or the Adult Vocational Training Program) was a United States law intended to encourage American Indians to leave Indian reservations and their traditional lands, and to assimilate into the general population in urban areas. Part of the Indian termination policy of that era, which terminated the tribal status of numerous groups, it played a significant role in increasing the population of urban Indians in succeeding decades.
>
> BACKGROUND: In 1947, Secretary of the Interior, Julius Krug, at the request of President Truman, proposed a ten-year program to provide the Hopi and Navajo tribes with vocational training. In 1950, the Navajo-Hopi Law was passed which funded a program to help **relocate** tribe members to Los Angeles, Salt Lake City, and Denver and help them find jobs. **In 1951 the Bureau of Indian Affairs began expanding the program and assigned relocation workers to Oklahoma, New Mexico, California, Arizona, Utah and Colorado, officially extending the program to all Indians the following year. In 1955, additional BIA relocation offices in Cleveland, Dallas, Minneapolis, Oklahoma City, St. Louis, the San Francisco Bay area, San Jose, Seattle, and Tulsa were added.** Relocation to cities, where more jobs were available, was expected to reduce poverty among Native Americans, who tended to live on isolated, rural reservations.... **Overall, the program had devastating long-term effects. Relocated tribe members became isolated from their communities and faced racial discrimination and segregation.** Many found only low-paying jobs with little advancement potential, and suffered from the lack of community support, and the higher expenses typical for urban areas. They could not return to dissolved reservations.

- 1998 - **"Indigenous Perspectives"**, by Laurie Anne Whitt, Mere Roberts, Waerete Norman, and Vicki Grieves, chapter 1 in *A Companion to Environmental Philosophy* (Dale Jamieson, ed.)

> That knowledge and land are intimately bound to one another is a belief share among indigenous peoples, as is the accompanying belief that the natural world is alive, spiritually replete. Consider Alice Benally, a Diné woman who expresses the incomprehensibility of her **removal** from Big Mountain by commenting that in the proposed **relocation** site the plants and animals would not know here — nor would she know them. She says, "If we are to make our offerings at a new place, the spiritual beings would not know us. We would not know the mountains or the significance of them. We would not know the land and the land would not know us" (in Jenny Manybeads et al. 1989, p.248). Indeed, in some native languages such **relocations** are literally unthinkable. There is no term for them; no concept by which they are known.

- October 2000 - **"Traditional Ecological Knowledge: The Third Alternative**

(Commentary)", by Raymond Pierotti and Daniel Wildcat, in *Ecological Applications*.

> We cannot and do not attempt to offer a definitive treatment of all North American indigenous worldviews. The influence of local places upon cultures, and the corresponding diversity of peoples attached to those places, guarantees the existence of variation in the ceremonial and symbolic expressions of native worldviews. Our experience and research suggest, however, that there may exist a shared way of thinking and concept of community common to native peoples of North America, which we define as TEK (see also Anderson 1996). Despite both **forced and voluntary relocations**, native people have taken their TEK with them, which has allowed them to survive these experiences, and establish sacred places in their new homes (Owens 1998:164). This way of thought includes: (1) respect for nonhuman entities as individuals, (2) the existence of bonds between humans and nonhumans, including incorporation of nonhumans into ethical codes of behavior, (3) the importance of local places, and (4) the recognition of humans as part of the ecological system, rather than as separate from and defining the existence of that system.

Part 5. Archive of Original Correspondence (2008) on Terminology

WEBPAGE ORIGIN & EVOLUTION: This "What's in a Name?" webpage was created in July 2008 by Connie Barlow in order to **encourage and document informal discussion** of the recent **turn by conservation biologists from the original "assisted migration" to the new "assisted colonization" name** for this climate adaptation tool. The shift began with Malcolm Hunter's proposal in September 2007 that "assisted colonization" was a better term for professional use. In July 2008 a multi-author paper used the term "assisted colonization" and was published in America's top journal, *Science*, prompting a news article in *Scientific American*: **"Deporting Plants and Animals to Protect Them from Climate Change"**. The paper is:

- July 2008 - **"Assisted Colonization and Rapid Climate Change"**, by O. Hoegh-Guldberg, L. Hughes, S. McIntyre, D.B. Lindenmayer, C. Parmesan, H.P. Possingham, C.D. Thomas, in Policy Forum section of *Science*.

EARLY HISTORY OF THE CONCEPT AND TERMINOLOGICAL DEBATE: From its beginning in 2004, the very loose-knit organization **Torreya Guardians** was formed (by Connie Barlow, Paul S. Martin, and Lee Barnes) to move ahead with "assisted migration" poleward for one highly endangered species, *Torreya taxifolia*. The organization has its roots in a **paper published in the Fall 2004 issue of *Wild Earth***, titled **"Bring Torreya taxifolia North — Now"** by Connie Barlow and Paul S. Martin. (See links immediately below.) This article was published about a year after Torreya discussion via email had been underway **among a dozen naturalists, botanists, and ecologists** — among them Barlow, Martin, Hazel Delcourt, Bill Alexander, Peter White, Mark Schwartz. Barlow and Martin decided that the group could not reach common ground and thus split off to **publicly propose the radical end: assisted migration**. Their published article established the rationale for such assistance not only in the plant's neediness, but also from a **deep-time perspective** that portrayed this subcanopy tree as simply being given some now-necessary assistance in moving back to what would have been its native habitat in warm climate episodes during the past tens of millions of years. **Terminology was not controversial at that early time, as only "assisted migration"** was in use. As tallied below, both pro and con contributions in the *Wild Earth* forum used this term:

[WILD EARTH FORUM]

Assisted Migration for an Endangered Tree

Bring *Torreya taxifolia* North—Now

by Connie Barlow and Paul S. Martin

Conservationists Should Not Move *Torreya taxifolia*

by Mark Schwartz

- **"Forum"** (both articles in a single pdf, *Wild Earth* Fall/Winter 2004/2005)
- **"Bring *Torreya taxifolia* North — Now"**, by Connie Barlow and Paul S. Martin ("assisted migration" used 7 times)
- **"Conservationists Should Not Move *Torreya taxifolia*"**, by Mark Schwartz ("assisted migration" used 13 times)

• In April 2007, a much-cited classic paper continued to use the term "assisted migration": **"A Framework for Debate of Assisted Migration in an Era of Climate Change"** by Jason S. McLachlan, Jessica J. Hellmann, and Mark W. Schwartz, ***Conservation Biology***. The term and advocacy is attributed to Torreya Guardians in this paper's "Introduction":

> … **The focus of the Torreya Guardians is an "assisted migration" program** that would introduce seedlings to forests across the Southern Appalachians and Cumberland Plateau (http://www.TorreyaGuardians.org). Their intent is to avert extinction by deliberately expanding the range of this endangered plant over 500 km northward. Because planting endangered plants in new environments is relatively simple as long as seeds are legally acquired and planted with landowner permission, the Torreya Guardians believe their efforts are justified. Introducing this species to regions where it has not existed for 65 million years is "[e]asy, legal, and cheap" (Barlow & Martin 2004).
>
> If circumventing climate-driven extinction is a conservation priority, then **assisted migration** must be considered a management option. Compelling evidence suggests that climate change will be a significant driver of extinction (McCarthy et al. 2001; McLaughlin et al. 2002; Root et al. 2003; Thomas et al. 2004). Researchers typically conclude that mitigating climate change and providing reserve networks that foster connectivity and movement should be a priority (e.g., Hannah et al. 2002). Ecologists must recognize, however, that even optimistic estimates of natural movement may be insufficient for species to keep pace with climate change.
>
> **Assisted migration is a contentious issue** that places different conservation objectives at odds with one another. This element of debate, together with the growing risk of biodiversity loss under climate change, means that now is the time for the conservation community to consider **assisted migration**. Our intent here is to highlight the problem caused by a lack of a scientifically based policy on **assisted migration**, suggest a spectrum of policy options, and **outline a framework for moving toward a consensus** on this emerging conservation dilemma.

• In **"Climate Change and Moving Species: Furthering the Debate on Assisted Colonization"**, by Malcolm L. Hunter Jr. (*Conservation Biology* Vol 20(5), September 2007), the term **assisted colonization** was proposed as a replacement for the original term **assisted migration** (the latter likely to have been first used by ecologist Brian J. Keel). Hunter wrote:

> **I have used the term assisted colonization in contrast to assisted migration** used by McLachlan et al. because many animal ecologists reserve the word migration for the seasonal, round-trip movements of animals (Wilcove 2007) and because the real goal of translocation goes beyond assisting dispersal to assuring successful colonization, a step that will often require extended husbandry.

• 18 July 2008, marked a Policy Forum posting that furthered the term **"assisted colonization"**: **POLICY FORUM: ECOLOGY: "Assisted Colonization and Rapid Climate Change"** by O. Hoegh-Guldberg, L. Hughes, S. McIntyre, D. B. Lindenmayer, C. Parmesan, H. P. Possingham, and C. D. Thomas, in *Science* 18 July 2008: 345-346.

ORIGINAL CORRESPONDENCE (July 2008)

• July 19, 2008 / by Connie Barlow / Barlow writes to authors of Assisted Colonization article in *Science* and other leaders

On Jul 19 2008, Connie Barlow wrote:

To: authors of the *Science* paper on "assisted colonization"

Fr: Connie Barlow, of Torreya Guardians, the citizen's group advocating assisted migration of Torreya taxifolia from Florida to the Appalachians

Re: **Concerns about the shift in terminology from "assisted migration" to "assisted colonization"**

Hello all.

I am the founder and webmaster of the citizen's group that is actually undertaking assisted migration of a highly endangered conifer, *Torreya taxifolia*. I applaud your paper in *Science* journal in not only advocating this bold new move in conservation but in offering a decision tree to help conservation managers in moving forward in ways that can be regarded more broadly as objective and rational.

I have two suggestions for future discussion:

1. **Paul S. Martin and I, when we published our original paper on this topic in *Wild Earth* (2004), stressed the deep-time perspective in perceiving not only the need for but naturalness of climate-induced migration.** Thus, for our focal species, the endangered conifer *Torreya taxifolia*, we stress that the proposed translocation from northern Florida (actually, the "pocket glacial reserve") to the southern Appalachian Mountains is mimicking what would almost certainly have been the tree's natural migratory movements during previous episodes of interglacial warming. **I think it would help conservationists and others "warm" to the idea of assisted migration if the populace became better educated about the massive movements species have made during previous episodes of massive climate change.** See, for example, Hazel Delcourt's excellent book, *Forests in Peril*, which stimulated the initial debate that led to the formation of TorreyaGuardians.org.

2. **I would urge you to reconsider adopting the term "assisted colonization" as a replacement for the term we and others have been accustomed to using, "assisted migration."** I have created a new page on the www.TorreyaGuardians.org website in which **I post 4 reasons why "assisted migration" is preferable as the term of choice** [2021: directly below]. **I also invite further comments, and will post those on the web page too, so that discussion can spread.** Click here to visit that webpage....

Overall, my experience has been that "Assisted Migration" is a very controversial topic. My sense is that "Assisted Colonization" **unnecessarily evokes additional wariness**, and that a return to the term "assisted migration" would be very helpful for moving the **paradigm shift** beyond academia and into institutional conservation actions and advocacy.

In addition, please make sure you are aware of the initial articles that began this debate, both occurring in a "Forum" in the Fall 2004/Winter 2005 issue of *Wild Earth*. You can access them by visiting a webpage I have created that lists all the significant online papers and reports on the "assisted migration" and related "rewilding" issues: Assisted Migration Links.

On that page, do click on the first link, too. This article on assisted migration features the work of Torreya Guardians. Although it is not academic, it is beautifully written (for Orion magazine) and highlights the human/subjective sides of the debate.

Evolutionarily yours,
Connie Barlow

BTW: You will note that I cannot directly link to the July 18 multi-author paper in *Science* because it is available only by purchase. I personally have a pdf of the 2-page forum piece and would love to be able to either post it directly on my website or hotlink to somewhere where it is posted. I know that not uncommonly, authors of such papers have them posted in pdf on their own academic websites. If any of you know how I can hotlink to the pdf, or know who I can talk to at Science journal to get permission to post it on mine, please let me know.

P.S. **I am the author of the 2001 book, "The Ghosts of Evolution", in which one section proposed translocation of Torreya taxifolia**, upon the assumption that human extinction or

extirpation of its seed disperser was at the root of its inability to head north from its pocket refuge in northern Florida.

• July 19, 2008 / by Connie Barlow / FIRST POST: Pro "Assisted Migration" as the term of reference

Here are the reasons that I advocate for retention of the original term, "assisted migration":

1. Unfortunately, for many of us, the term "colonization" has **hegemonic overtones** harking back to European "colonization" of the world. In contrast, "migration" has an immediate natural and organic cast to it.

2. "Migration" has its emphasis on the movement itself — thus feeling **less interventionist** than a word that places emphasis on a desired end result, "colonization." Indeed, "assisted migration" evokes subsequent discussion of **how much to assist the species** in its success, once the act of migration itself is completed. For example, Torreya Guardians are now discussing whether or not to assist its rewilded T. taxifolia seedlings with soil supplementation/liming at the time of forest plantings (scheduled for July 30, 2008 in Waynesville NC). In contrast, the term "colonization" implies that the effort is incomplete unless management interventions continue after the transfer, toward the goal of ensuring successful establishment and eventual reproduction. (Note: If one provides soil supplementation or other assistance as a norm upon arrival, then there is less opportunity to "read" the response of the species itself as to whether the landing site actually meets all its needs, or whether, in fact, a better migration target might be attempted with a subsequent batch of immigrants.)

3. "Migration" inclines one to think that either something has gone catastrophically wrong with the native home, or that the movement is **part of recurring cyclic phenomena** — seasonal in the case of Monarch butterflies, or in the case of genus *Torreya* (and presumably many other nonendangered plants), cyclic movement of plants upslope/downslope or north/south in sync with the pulses of glacial warming and cooling at the scale of geologic time. In contrast, "colonization" may indicate movement of an expansionist (opportunistic or hegemonic) cast, even while the home range is still quite viable for the species in question.

4. "Migration" is suggestive of **more localized and contiguous movements**, whereas "colonization" often refers to human-led actions that can spot-move from and to anywhere on the globe — indeed, even interplanetary, as in "colonization of Mars" or establishment of a human "colony" on the moon.

POSTED RESPONSES

• July 20, 2008 / by Chris Thomas (co-author of the July 2008 key paper on "assisted colonization" in *Science* journal / Pro "Assisted Colonization" as the term of reference

NOTE: Chris Thomas (Dept. Biology, University of York, UK) sent this statement by email reply to Torreya Guardians in response to Connie Barlow's request for elaboration. It is printed with permission of the author.

I was personally particularly keen that this issue be described as "assisted colonisation" rather than the more commonly used "assisted migration". This is my personal view, and other authors of our paper might possibly wish to add something.

In common usage (outside pure science), **"migration"** is most commonly used in two major contexts.

The first, and most common, is to describe **the seasonal return migration of birds and other groups of animals**. This is quite clearly NOT what is being discussed. There are already policy reports and published scientific papers on the potential consequences of climate change for these "true" migrants, so I believe that it will be **very confusing to use "assisted migration" as the general term** to describe the type of endeavour we are discussing.

The second common useage relates to **human migration**, meaning the net flow of people from one region to another. The connection with this is also **undesirable** because (a) this already has a negative image in many people's minds, and (b) it usually represents the flow of individuals from one region to another, already populated, region, rather than establishment in an area without human populations.

In a scientific context, the term migration is also sometimes used in ecology to describe the unidirectional movement of individuals from one location to another. However, migration in this context normally means the act of movement itself, and not the establishment of new populations in the locations where individuals arrive (although this may be the consequence). **Assisted colonisation does not stop at moving individuals; it may also require preparation (and protection) of sites to receive the immigrants, and subsequent management of the establishing population until such time as a self-sustaining population has been achieved.**

My personal belief is that "assisted colonisation" avoids confusion with other types of migration, and identifies that establishing populations at the destination is the key goal (not simply moving individuals).

• July 20, 2008 / by Hugh Possingham (co-author of the July 2008 "Assisted Colonization and Rapid Climate Change" policy forum article in *Science* journal / Pro "Assisted Colonization" as the term of reference

NOTE: Hugh Possingham (Centre for Applied Environmental Decision Analysis, University of Queensland, Australia) sent this statement by email reply to Chris Thomas, and cc-d Torreya Guardians. It is printed with permission of the author.

I agree completely, and in one of my interviews I clarified this point also, although not as clearly as you have, Chris.

• July 21, 2008 / by Malcolm L. Hunter (author of the June 2007 paper in *Conservation Biology* that proposed the terminology change / Pro "Assisted Colonization" as the term of reference

NOTE: Malcolm Hunter (Dept. Wildlife Ecology, University of Maine, USA) sent this statement by email reply to Torreya Guardians in response to Connie Barlow's request for elaboration and Chris Thomas's reply to her. It is printed with permission of the author.

Dear Connie et al:

I understand that **I am the person responsible for the proposed switch to "assisted colonization"**, and having read the four reasons you support continued use of "assisted migration" I have to **stand by my original argument and agree with Chris' elaboration**. "Colonization" is a perfectly acceptable word among ecologists, and your concerns about its "hegemonic overtones" **will not worry most scientists who are primarily concerned with evaluating this management option in clear language** rather than advocating it with the public.

mac hunter

• July 21, 2008 / by Jessica Hellmann (co-convenor of the August 2008 Working Group meeting on Assisted Colonization prior to annual meeting of the Ecological Society of America) / Agrees with need to address the naming issue at the ESA pre-meeting

NOTE: Jessica Hellmann (Dept. Biological Sciences, University of Notre Dame, USA) sent this statement by email reply to Torreya Guardians in response to Connie Barlow's request for elaboration. It is printed with permission of the author.

Dear Connie,
Thank you for your email. I am sympathetic to your concerns, and **we will discuss it at the ESA meeting**. I also understand the authors' worry that "migration" tends to refer to seasonal

movements, e.g., migratory birds. But I also think that the term "migration" is also well defined in the paleo literature with the definition that we intend in this modern context.

My own concern about "assisted colonization" is the same that Chris Thomas raises in his email about "assisted migration." So, clearly, this needs more discussion. I tend to think of "colonization" in the way that it is defined by the invasion pathway — as the first step in population establishment. Instead, we might envision more conservation action than just establishment. But then, Thomas says the same about "assisted migration" and doesn't feel that "assisted colonization" has that problem. Again, I'll do my best to raise your concerns at the meeting.

Just previous to the ESA meeting, **we're gathering a group of conservation biologists, invasion biologists, lawyers, ethicists, and economists to form a working group that we think will have something meaningful to contribute to this issue**. (The working group is being convened by myself, Mark Schwartz, Jason McLachlan, and Dov Sax.) We'll talk about the naming issue with that group as well, and I'll let you know what they had to think.

I've seen your site, and I've enjoyed watching it grow. Thanks very much for your efforts on this important issue — you guys started it all!
Best wishes,
Jessica

• July 31, 2008 / by Connie Barlow (Torreya Guardian) / Acceptance of either terminology; advocacy of "rewilding" as a correlative term

After reading all 4 comments (above), I now feel less squeamish about the terminology for this effort shifting from the original "assisted migration" to "assisted colonization". From my deep-time perspective (see my 2001 book, ***The Ghosts of Evolution***), and having been inspired to begin the discussion that eventuated in Torreya Guardians after I read ***Forests in Peril: Tracking Deciduous Trees from Ice-Age Refuges into the Greenhouse World*** (2002, by palynologist and deep-time ecologist Hazel Delcourt), **I still regard "migration" as the preferred term.** This is because I regard our assistance today as mimicking actual migration patterns that likely played out as climate warmed during previous peak-interglacial periods — that is, episodes of climate change in which human interference in the natural world had not yet disrupted the continuity of natural corridors for long-term migratory movement, and when humanity had not yet undermined natural dispersal by extincting or extirpating seed dispersers of plants (such as tortoises and squirrels as dispersers of *Torreya taxifolia*).

One other term I'd like to toss into the mix for discussion: **rewilding**. Rewilding was introduced professionally in the following two papers: (1) "Rewilding North America" by Josh Donlan and 11 other authors, ***Nature***, 18 August 2005 (2 pages), and (2) "Pleistocene Rewilding: An Optimistic Agenda for the 21st Century" by Josh Donlan and 11 other authors, *American Naturalist*, November 2006, vol 168: pp 660-681. Yesterday, a group of Torreya Guardians, colleagues, and a writer and photographer recording the event for *Audubon* magazine undertook what we regard as **the first rewilding of the highly endangered "Florida" conifer, *Torreya taxifolia***. Others have already intentionally or unintentionally planted this species northward into the Appalachian Mountains in ways that constitute "assisted migration" or perhaps even "assisted colonization", **but such plantings in home gardens and institutional botanical gardens are not in wild, forested habitats** — nor in great enough numbers to ensure long-term population survival and pollination in this dioecious species (male and female reproductive organs occurring on separate plants).

Yesterday, we planted 10 seedlings on one property and 21 on a second property in the vicinity of Waynesville, NC. Elevations were 2600 and 3400 feet, respectively. We chose natural forested landscapes with fully deciduous canopy, on somewhat steep slopes. Deciduous canopy will allow this subcanopy evergreen conifer to have access to nearly full sun in the early spring and late fall (as well as winter). Significantly, at both sites where our potted seedlings of *Torreya taxifolia* were planted, dying hemlocks were evident. Perhaps **this "deep-**

time native" of the Appalachians will be able to ecologically serve its forest community in ways similar to that of the beleaguered eastern hemlock.

• October 23, 2008 / by Brian Keel / Posting of chapters from my "Assisted Migration" PhD thesis

I have noticed the term assisted colonization showing up in several sources. I feel that assisted colonization and assisted migration are two similar but separate concepts. The attached document is part of chapter one of my dissertation that may help clarify the difference. [Editor's Note: Click for "Defining Migration" chapter or "Assisted Migration" chapter within Keel's 2007 thesis titled, "Assisted Migration as a Conservation Strategy for Rapid Climate Change: Investigating Extended Photoperiod and Mycobiont Distributions for *Habenaria repens* Nuttall (Orchidaceae) as a Case Study."]

• December 18, 2008 / by Connie Barlow / The working group website leans toward "Managed Relocation"

I just learned about the url posted by the group of conservation biologists, lawyers, and ethicists that met just prior to the **Ecological Society of America meeting in August 2008**, and whose goal is to produce a document to guide others in these fields and governmental and private conservation managers on how to deal with this issue. Notably, the website is called "Managed relocation". However, right under the home page title appears this list:

Working group on managed relocation
Working group on assisted migration
Working group on assisted colonization

Here is a clip from the Info about MR page within that site:

> **"Managed relocation" (also called "assisted migration" or "assisted colonization")** is the purposeful translocation of species adversely affected by global change, particularly climate change. Goals of managed relocation include, but are not limited to, the reduction of extinction risk, the enhancement of evolutionary potential, and the enhancement of ecosystem services.
>
> The terms "assisted migration" and "assisted colonization" are terms that have been used to refer to the same basic strategy as "managed translocation." **In Aug., 2008, this working group suggested a more comprehensive term, "managed relocation." We prefer "managed relocation" because it captures the concept of persistent intervention (if necessary) and emphasizes the geographical movement of organisms, a conservation or management concept particularly distinctive to the modern era of climate change.** In several locations on this website, however, you will see use of "assisted migration" because it captures the essence of managed relocation in the sense of geographic movements that actors pursue in a helpful or beneficial sense.

Connie Barlow speaking here, with Torreya Guardians, I find I prefer "managed translocation" to "managed relocation" for the same reason that I preferred "assisted migration" to "assisted colonization", as the former implies (to me) more of a boost to a species, giving it a chance, rather than a highly interventionist goal to have that boost succeed. For example, Torreya Guardians planted seedlings of *Torreya taxifolia* into a natural forest situation on private lands in the mountains of North Carolina in July 2008. If those seedlings do not survive and grow pretty much on their own here, then that will be an indication that (a) the troubles the species has in northern Florida is not just climate-induced, or (b) maybe we ought to try a north-facing slope, a higher elevation, or a more northerly latitude.

Of interest, I have been receiving "Google alerts" for the terms "assisted migration", "assisted coloniz/sation" and the results are fascinating. About a quarter refer to precisely the issue we are dealing with, but check out some of these other usages of the term:

1/12/08: "Rush University Medical Center will also be using the Acuo DICOM Assisted Migration (ADAM) to move data from the existing proprietary archive."

12/14/08: "Slow-moving cranesWeather has not cooperated with this year's ultralight-assisted migration of whooping cranes."

12/08/08: "Displaced Darfuris response to joint Arab-African peace initiative for Darfur: SLM Nur's rebels in Darfur's Kalma Camp dismiss peace talks and demand more UN security or assisted migration out of Sudan."

12/05/08: "Called the Assisted Migration Adaptation Trial, the long-term research project aims to better understand the climatic tolerance of all of B.C.'s tree species, then take that information to better refine the province's reforestation strategies as it relates to climate change."

• January 30, 2011 / by Connie Barlow / "Assisted Migration (Not Colonization) of Endangered Torreya"

Following the **Shirey and Lamberti 2011 commentary in *Nature***, Torreya Guardian founder Connie Barlow posted her strongest advocacy yet for choosing "assisted migration" as the term of reference: **"Assisted Migration (Not Assisted Colonization) for Endangered Torreya"**.

EXCERPT: ... When you realize that the particular plant species we have been helping has actually been around for tens of millions of years, and that it has repeatedly had to move vast distances south and north as the continental glaciers waxed and waned, then you realize that what we **Torreya Guardians** are up to is assisting an ancient and lovely tree do what it has always done whenever things warm up: head north. We're just helping the tree get around habitat obstacles that we humans have put in its way. And we're helping Torreya do that a whole lot faster than its natural seed dispersers, mainly squirrels and possibly land tortoises, could otherwise do the job. **Overall, whenever Earth heats up, Florida Torreya has got to become Appalachian Torreya. Remember that in previous warm periods much of Florida has been underwater — as it soon may be again.**.

END OF ARCHIVE SECTION (original postings)

Return to Beginning

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Contact Connie Barlow **OR** **Contact Fred Bess**

Return to HOME PAGE

Annotated List of Papers/Reports Online re Assisted Migration