Oral Testimony Presented at the ENRA Hearing on 7 December 2021 with Written Extensions and References

J. William Stubblefield, PhD
346 Farley Road
Wendell, MA 01370-9721
bill@stubblefield.org

Good afternoon. I am Bill Stubblefield from Wendell, and I hold a doctorate in biology from Harvard University. I rise in support of House bills 912, 1002, and 1003. The first two address the critical need for forest protection and the third ensures public accountability of the agencies managing our public lands. All three are much needed.

We face a planetary emergency of unprecedented scale involving the dual threats of Catastrophic Climate Change and Biodiversity Collapse. Forests capture and store vast amounts of carbon, but I want to focus on their equally important role in maintaining the complex web of life upon which human survival depends.[1]

There have been five mass extinction events in the geological past, and a sixth is now underway. Species are vanishing at increasingly rapid rates that far exceed the background rate of eons past. The UN recently estimated that a million species face immanent extinction. The full extent of the devastation is profound but difficult to assess. Countless species await discovery, and we barely understand the interactions among those we already know.[2]

This situation requires a full-scale response. The single most important thing we can do is greatly increase the lands and waters set aside in perpetual protection. House bills 912 and 1002 are modest steps in this direction.[3]

H.1002 requires DFW to set aside 30% of its land as reserves. Ignoring extensive early-successional habitat elsewhere, DFW pursues ongoing logging to create more "young forest."[6] But it is older forests, where the web of ecological interactions has time to fully develop, that are genuinely rare and most in need of protection.[4]

The most intensive logging on state land is conducted by DCR on lands that provide drinking water for some 3 million residents. Although watershed foresters claim their logging enhances resistance and resilience to natural disturbances, scientists at the Harvard Forest have shown that such logging delivers neither resistance nor resilience

and that simply leaving forests alone both speeds their recovery and better protects ecosystem services.[5]

Logging on public land is unnecessary, ill advised, and costly in terms of money, ecological integrity, and the public good.[6]

Please move H.912, H.1002, and H.1003 out of committee with a favorable report. Thank you.

Endnotes

1. Importance of forest biodiversity: Forests are the terrestrial equivalent of coral reefs in terms of the biodiversity they support. It is often suggested that some 80% of terrestrial species are dependent on forests for their ongoing survival. There is no doubt that a great percentage of terrestrial species depend on forests, although the 80% figure suggests a measure of accuracy that exceeds current knowledge. A few examples are sufficient to show the critical importance of forests as bastions of biodiversity. Some 5000 amphibian species (80% of all known species), 7500 bird species (75%), and 3700 mammal species (68%) all depend on forest habitat around the globe (Vié, Hilton-Taylor, and Stuart 2009). Similar estimates could be cited for organisms spanning the tree of life from single cells to the most complex: if they live on land, they probably live in a forest. A comprehensive assessment of the biodiversity in New England forests is much needed but has yet to be compiled. Unfortunately, we cannot afford to wait and must act now to preserve what is still here.

2. The sixth extinction: Anthropogenic extinction is a planetary crisis with impacts on human well-being at least equal to, and likely worse than, the threat of climate disruption (see Rockström *et al.* 2009; Steffen *et al.* 2015). For an accessible introduction to the sixth extinction, see the books by Leakey and Lewin (1995) and Kolbert (2014). An overview of the paleontological record and the threat of mass extinction in the Anthropocene is provided by Hannah (2020). It has been estimated that current extinction rates are some 1000 times the background rate and increasing (Pimm *et al.* 2014). Barnosky *et al.* (2011) pointed out serious difficulties with comparing current extinction rates with those in the geological past; nonetheless, they concluded (p. 56) that “there are clear indications that losing species now in the ‘critically endangered’ category would propel the world to a state of mass extinction that has previously been seen only five times in about 540 million years.” The UN panel on biodiversity and ecosystem services, IPBES (2019), estimated that one million species are already on the brink of extinction.

Terrestrial vertebrates comprise but a few twigs on the tree of life, but they are especially well-studied and provide a clear indication of the extinction crisis we face (Ceballos *et al*. 2015, Ceballos, Ehrlich, and Dirzo 2017, Ceballos, Ehrlich, Raven 2020). Extinction rates of terrestrial vertebrates are appallingly high, and patterns of invertebrate extinction are "equally dire" (Dirzo *et al.* 2014). Declines in abundance typically precede extinction, and it is therefore concerning that Rosenberg *et al.* (2019) reported a net loss of nearly 3 billion birds in North America since 1970, a 29% decline. Just think about that: 3 billion canaries in our coal mine. How many does it take? It is sobering to note that the total global biomass of humans and their livestock now dwarfs that of all other terrestrial vertebrates combined (Bar-On, Phillips, and Milo 2018).

Insects comprise a large fraction of terrestrial biodiversity and play essential roles in the ecosystems they inhabit. It is therefore noteworthy that long-term sampling of insect populations often reveal dramatic declines, especially in agricultural areas, so much so that we hear of an Insect Apocalypse (for an accessible summary see Goulson 2021). Although many insect species are thriving and some actually benefit from climate change, the overall trends are downward and alarming (Wagner 2020; Wagner *et al*. 2021).

There is little appreciation of just how little we know about the living world. A widely cited attempt to estimate the number of species on Earth came up with a total of 8.7 (±1.3) million species, of which 2.2 (±0.2) are marine (Mora *et al.* 2011 and commentary by May 2011). These authors estimated that about 1.2 million species have been described, suggesting that some 86% of existing species on Earth still await description. Striking as this is, assigning names is only the barest beginning of what we need to know in order to understand the ecological interactions among the millions of species with which we share the Earth. As a biologist, it is deeply disturbing that such profound ignorance of fundamental ecological components and processes provides the context for human interventions in the biosphere now taking place on a planetary scale, of which commercial logging is an important part. Hubris reigns where humility would be more appropriate.

3. Reserves are essential: The esteemed biologist Prof. E.O. Wilson of Harvard has argued that half the area of Earth should be set aside as conservation reserves in order to give living diversity a fighting chance to survive the onslaught of industrial civilization (Wilson 2016). This proposal has spawned the Nature Needs Half initiative that is gaining worldwide support (see Crist *et al.* 2021). There is ample evidence that protected reserves actually work to protect forest biodiversity (*e.g.* see Miller *et al.* 2018 and Di Marco *et al.* 2019). Consequently, everyone who has seriously considered how

to protect forest biodiversity agrees that reserves where no logging occurs are part of the solution. The debate is about how large and how well-protected these reserves need to be. The lasting legal protection provided by H.912 and H.1002 combined amounts to only slightly more than 9% of the total area of Massachusetts. These are clearly very modest proposals, especially in the context of the multiple planetary crises we now face.

4. Logging for wildlife: The Division of Fisheries and Wildlife (DFW) conducts extensive logging on 167,000 acres of publicly-owned Wildlife Management Areas. Most of this logging is designed to create early-successional or "young forest" habitat, since it is claimed that there is a shortage of such habitat. According to their website, 25 years ago DFW established statewide habitat goals for their lands that include 1-2% as grassland, 8-9% as shrubland, and 10-15% as young forest. That is 11-26% in habitats requiring active management to maintain. These goals also call for 10-15% to be kept as forest reserves, while all of the remainder is in some intermediate state following previous logging.

Although these percentages are said to be based on "information from scientific literature, from biological monitoring, and from private conservation organizations," no argument is presented that these figures are actually based on sound scientific evidence. In fact, there is considerable reason to think that they greatly over-emphasize early-successional habitat. Thompson *et al.* (2013), for example, in their examination of four centuries of land-use change in northeastern forests concluded that "One important pattern throughout was the reduction of late successional species in favor of early successional species." The DFW habitat goals call for 10-15% of their land in reserves. H.1002 increases this to 30% under secure legal protection rather than an administrative status subject to change with a stroke of the pen. In view of the general ignorance of the complement of species dependent on older forests, it seems only prudent to protect at least this much. There is a clear need to undertake extensive biological inventories of our older forests to better determine how to protect the full spectrum of forest-dependent species.

One basic difficulty with the DFW goals for the land they manage is that they fail to account for the sizable amounts of early-successional habitat elsewhere on the landscape. For example, there are 9,000 miles of high-voltage transmission lines in New England (ISO New England 2021) with easements maintained as early-successional habitat. Moreover, there is and will remain significant amounts of logging on private lands as well as on the remaining 70% of DFW lands still available for logging.

One of the stated reasons for so much young forest is the claim that Native Americans made extensive use of fire to create openings in the forest. However, detailed studies of

pollen and charcoal in pond and lake sediments do not show a correlation between evidence of fire and native population levels as inferred from the archaeological record (Ostwald *et al.* 2020).

Any pattern of land use benefits some species and harms others, and DFW's emphasis on young forest is no exception. The continual creation of new patches of early-successional habitat tends to favor species with high rates of reproduction and dispersal, enabling them to reach new patches of suitable habitat when local conditions deteriorate and grow rapidly when they get there. Habitat patches created by local disturbance such as logging are typically transient and favor effective dispersal, but this is much less so in more permanent habitats, such as mature forests, where even species with low rates of reproduction and dispersal may survive and prosper. Such forests once dominated the landscape as a well-connected covering of persistent vegetation. Forest fragmentation tends to be a more severe problem for species that specialize on late- rather than early-successional habitats. This places a premium on large contiguous areas of mature forest that are allowed to persist for very long periods of time. Many forest species are unable to cross extensive areas of different habitat to reach forest on the other side and others require large areas of contiguous habitat in order to ensure adequate population sizes.

5. Logging for water: Our local trees are remarkably resilient in their ability to bounce back from major disturbances whether natural or human induced (Canham 2020). Indeed, here in Massachusetts, diligent and ongoing work is required to prevent forests from growing back. Nonetheless, foresters with DCR's Division of Water Supply Protection carry on some of the most intensive logging in southern New England (Kittredge *et al.* 2003; McDonald *et al.* 2006) under the "working hypothesis" that their logging of watershed forests greatly improves their resistance to pests and pathogens and their resilience to natural disturbances, such as massive storms. This logging for resistance and resilience is said to create and maintain an "optimal" Watershed Protection Forest (DWSP STAC 2012; DCR DWSP 2013; DCR DWSP 2007-2017; DCR DWSP 2017).

Although DWSP cites evidence that modest amounts of logging do not affect water quality, nowhere do they show that their ongoing logging is actually better than passive management, much less that it is in any way optimal. Neither do they acknowledge the scientific criticism that logging for resistance and resilience has received.

The most salient critique was provided by Foster and Orwig (2006) in their review of preemptive logging in the face of spreading pests or pathogens and salvage logging following natural disturbances such as wind storms or hurricanes. Although such disturbances may cause "dramatic physical changes in forest structure," Foster and

Orwig showed that “little disruption of biogeochemical processes or other ecosystem functions typically follow,” from them and that “Indeed, the physical and organic structures produced by these disturbances are important natural features providing habitat and landscape heterogeneity that are often missing due to centuries of land use.” They also directly addressed the notion of “Watershed Protection Forests,” concluding that “A conservative alternative hypothesis for the long-term management of watershed lands might be proposed: the elimination of harvesting and its associated impacts (e.g. soil compaction, road development and improvement) will yield forest and landscape conditions that maintain and improve water quality in the face of ongoing disturbances and stresses.” It should be noted that DWSP could have tested these alternative management strategies in the decades they have devoted to their “working hypothesis.”

A further impact associated with logging is the spread of invasive plants by allowing more light to reach the ground and thereby creating habitats preferred by many invasives. Intact forests with dense canopies are largely immune to such alien plant invasions. DWSP lands have a serious invasive problem as detailed in their own document (DCR DWSP 2011), which prescribes the use of herbicides in some cases – certainly a questionable practice on watershed lands.

There is considerable and growing evidence that lands fully protected as reserves increase both species and structural diversity in eastern forests (Miller *et al.* 2016, Miller *et al.* 2018). Similarly, Thom *et al.* (2019) reported that older northern mixed (hardwood and conifer) forests support more diversity and are better able to withstand expected changes due to climate change, at least over the near- to mid-term. Failure to avoid runaway climate change, of course, would entail dramatic disruption of any existing forests.

6. Logging is unnecessary and costly: The many ways that intact forests benefit public welfare have been well explored by Moomaw *et al.* (2019), who introduced the term “proforestation” for the practice of allowing forests to continue growing with only minimal human intervention. My remarks have emphasized the benefits of intact forests in terms of biodiversity protection with some mention of their great importance for large-scale carbon accumulation, but, of course, there are many other benefits as well, including water filtration, flood mitigation, evaporative cooling, outdoor recreation, nature study, tourism, physical and mental health, and spiritual replenishment. All of these benefits are enhanced by forest protection at the cost of a somewhat smaller timber and wood products industry.

Logging on public lands is unnecessary and costly in terms of ecosystem services and public welfare more generally. It is also costly in terms of the public purse. A review of

logging contracts by DCR's Bureau of Fire Control and Forestry indicates that their logging program loses substantial amounts of money every year. A chronic lack of transparency (which H.1003 would help to remedy) makes it difficult to fully analyze the budgetary implications of logging on public lands. Oversight authorities are strongly encouraged to look into this matter across all three agencies involved.

Life on Earth has proven itself remarkably resilient, having survived multiple mass extinction events over the last 3.5 billion years, while profoundly altering the planet in the process. There is little reason to think that it wouldn't do so again, pretty much however we respond, or fail to respond, to the planetary emergencies we now face. Matters are quite different, however, when it comes to human civilization as now practiced in our interconnected global economy. Having already transgressed multiple planetary boundaries, the future of civilization is now in grave doubt. It is therefore altogether appropriate to focus on the instrumental benefits to people and other organisms that intact forests provide, but it is also important to recognize that living forests are of enormous intrinsic value in their own right.

Billions of years of trial-and-error evolution have produced a diaphanous film of life that envelops the entire planet. On closer inspection, we find millions of interacting species that jointly weave a resplendent living gown of such incomparable richness, grandeur, and majesty as to dwarf anything produced by humankind. As far as I can see, there is no more precious thing in all the known universe. Surely, the Commonwealth of Massachusetts can take a few modest steps to protect some little portion of this greatest of all gifts.

References

Barnosky, A.D. *et al.* 2011. Has the Earth's sixth mass extinction already arrived? *Nature* 471: 52-57. https://doi.org/10.1038/nature09678

Bar-On, Y.M., Phillips, R., and Milo, R. 2018. The biomass distribution on Earth. *Proc. Natl. Acad. Sci. USA* 115: 6506-6511. https://doi.org/10.1073/pnas.1711842115

Canham, C.D. 2020. *Forests Adrift: Currents Shaping the Future of Northeastern Trees.* Yale University Press, New Haven. 222 pp.

Ceballos, G., Ehrlich, P.R., Barnosky, A.D., Garcia, A., Pringle, R.M, Palmer, T.M. 2015. Accelerated modern human-induced species losses: Entering the sixth

mass extinction. *Science Advances* 1:e1400253. https://www.science.org/doi/epdf/10.1126/sciadv.1400253

Ceballos, G., Ehrlich, P.R., Dirzo, R. 2017. Biological annihilation via the ongoing sixth extinction signaled by vertebrate population losses and declines. *Proc. Natl. Acad. Sci. USA* 114: E6089-E6096. https://doi.org/10.1073/pnas.1704949114

Ceballos, G., Ehrlich, P.R., Raven, P.H. 2020. Vertebrates on the brink as indicators of biological annihilation and the sixth mass extinction. *Proc. Natl. Acad. Sci. USA* 117 (24): 13596-13602; https://doi.org/10.1073/pnas.1922686117

DCR DWSP 2011. *Terrestrial Invasive Plants: Problem Statement and Management strategy for properties under the Care and Control of the DCR Division of Water Supply Protection.* https://www.mass.gov/files/documents/2017/10/10/terrestrial.pdf

DCR DWSP 2013. *From Here Forward: Changes to the Department of Conservation & Recration Division of Water Supply Protection Watershed Forest Management Program.* https://www.mass.gov/files/documents/2017/10/02/review-of-mass-dwsp-watershed-forestry-progarm.pdf

DCR DWSP 2017. *Division of Water Supply Protection: 2017 Land Management Plan.* https://www.mass.gov/files/documents/2018/02/05/dcrdwsp2017landmanagementplan.pdf

DCR DWSP 2007-2017. *Quabbin Reservoir Watershed System: Land Management Plan 2007-2017.* *https://www.mass.gov/files/documents/2018/01/22/quabbinlmp2007_0.pdf*

Di Marco, M, Ferrier, S., Harwood, T.D., Hoskins, A.J., & Watson, J.E.M. 2019. Wilderness areas halve the extinction risk of terrestrial biodiversity. *Nature* 573: 582-585, http://doi.org/10.1038/s41586-019-1567-7

Dirzo, R., Young, H.S., Galetti, M., Ceballos, G., Isaac, N.J.B., Collen, B. 2014. Defaunation in the Anthropocene. *Science* 345: 401-406. https://www.science.org/doi/epdf/10.1126/science.1251817

DWSP STAC 2012. *Review of the Massachusetts DWSP Watershed Forestry Program*. Produced by the DWSP Science and Technical Advisory Committee. https://www.mass.gov/files/documents/2017/10/02/review-of-mass-dwsp-watershed-forestry-progarm.pdf

Foster, D.R. & Orwig, D.A. 2006. Preemptive and Salvage Harvesting of New England Forests: When Doing Nothing Is a Viable Alternative. *Conservation Biology* 20: 959-970. https://harvardforest.fas.harvard.edu/sites/default/files/Foster_ConservationBio_2006.pdf

Goulson, Dave. 2021. *Silent Earth: Averting the Insect Apocalypse.* Harper Collins, New York.

Hannah, Michael. 2021. *Extinctions: Living and Dying in the Margin of Error.* Cambridge University Press, Cambridge. 328 pp.

IPBES (2019): Summary for policymakers of the global assessment report on biodiversity and ecosystem services of the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. S. Díaz, J. Settele, E. S. Brondízio, H. T. Ngo, M. Guèze, J. Agard, A. Arneth, P. Balvanera, K. A. Brauman, S. H. M. Butchart, K. M. A. Chan, L. A. Garibaldi, K. Ichii, J. Liu, S. M. Subramanian, G. F. Midgley, P. Miloslavich, Z. Molnár, D. Obura, A. Pfaff, S. Polasky, A. Purvis, J. Razzaque, B. Reyers, R. Roy Chowdhury, Y. J. Shin, I. J. Visseren-Hamakers, K. J. Willis, and C. N. Zayas (eds.). IPBES secretariat, Bonn, Germany. 56 pages. https://doi.org/10.5281/zenodo.3553579

ISO New England 2021: https://www.iso-ne.com/about/key-stats/transmission

Kittredge, D.B., Finley, A.O., and Foster, D.R. 2003. Timber harvesting as ongoing disturbance in a landscape of diverse ownership. *Forest Ecology and Management* 180: 425-442. https://harvardforest1.fas.harvard.edu/sites/harvardforest.fas.harvard.edu/files/publications/pdfs/Kittredge_ForEcol&Man_2003.pdf

Kolbert, Elizabeth. 2014. *The Sixth Extinction: An unnatural history.* Henry Holt and Co., New York.

Leakey, R.E. & Lewin, R. 1995. *The Sixth Extinction: Patterns of Life and the Future of Humankind.* Doubleday, New York. 271 pp.

May, R.M. 2011. Why worry about how many species and their loss? *PloS Biology* 9: e1001130. https://doi.org/10.1371/journal.pbio.1001130

McDonald, R.I., Motzkin, G., Bank M.S., Kittredge, D.B., Burk, J., and Foster, D.R. 2006. Forest harvesting and land-use conversion over two decades in Massachusetts. *Forest Ecology and Management* 227: 31-41. https://harvardforest1.fas.harvard.edu/sites/harvardforest.fas.harvard.edu/files/publications/pdfs/McDonald_ForestEcologyManagement_2006.pdf

Miller, K.M. *et al.* 2016. National parks in the eastern United States harbor important older forest structure compared with matrix forests. *Ecosphere* 7: Article e01404. https://doi.org/10.1002/ecs2.1404

Miller, K.M. *et al.* 2018. Eastern national parks protect greater tree species diversity than unprotected matrix forests. *Forest Ecology and Management* 414: 74-84. http://doi.org/10.1016/j.foreco.2018.02.018

Moomaw, W., Masino, S.A., and Faison, E. K. 2019. Intact forests in the United States: proforestation mitigates climate change and serves the greatest good. *Frontiers in Forests and Global Change* 2: Article 2. http://doi.org/10.3389/ffgc.2019.00027

Mora, C., Tittensor, D.P., Adl, S., Simpson, A.G.B., Worm, B. 2011. How many species are there are Earth and in the ocean. *PloS Biology* 9: e1001127. http://doi.org/10.1371/journal.pbio.1001127

Ostwald, W.W., Foster, D.W., Shuman, B.N., Chilton, E.S., Doucette, D.L. and Duranleau, D.L. 2020. Conservation implications of limited Native American impacts in pre-contact New England. *Nature Sustainability* 3: 241-246. http://doi.org/10.1038/s41893-019-0466-0 and https://harvardforest1.fas.harvard.edu/sites/default/files/publications/pdfs/Oswald_NatureSust_2020.pdf

Rosenberg, K.V., Dokter, A.M.. Blancher, P.J., Sauer, J.R., Smith, A.C., Smith, P.A., Stanton, J.C., Panjabi, A., Helft, L., Parr, M., Marra, P.P. 2019. Decline of the North American avifauna. 366: 120-124. https://www.science.org/doi/epdf/10.1126/science.aaw1313

Rockström J. *et al.* 2009. A safe operating space for humanity. *Nature* 461: 472-475. https://doi.org/10.1038/461472a

Steffen, W. *et al.* 2015. Planetary boundaries: Guiding human development on a changing planet. *Science* 347: 736 and full article at: http://dx.doi.org/10.1126/science.1259855

Thom, D., Golivets, M., Edling, L., Meigs, G.W., Gourevitch, J.D., Sonter, L.J., Galford, G.L., Keeton, W.S. 2019. The climate sensitivity of carbon, timber, and species richness covaries with forest age in boreal-temperate North America. *Global Change Biology* 25:2446-2458. https://doi.org/10.1111/gcb.14656

Thompson, J.R., Carpenter, D.N., Cogbill, C.V., Foster, D.R. 2013. Four centuries of change in northeastern United States forests. *PloS One* 8: e72540. https://doi.org/10.1371/journal.pone.0072540

Vié, J.-C., Hilton-Taylor, C., and Stuart, S.N. (eds.) 2009. Wildlife in a Changing World – An Analysis of the 2008 IUCN Red List of Threatened Species. Gland, Switzerland, IUCN 180 pp. https://portals.iucn.org/library/efiles/documents/rl-2009-001.pdf

Wagner. D.L. 2020. Insect declines in the Anthropocene. *Annual Review of Entomology* 65: 457-480. https://doi.org/10.1146/annurev-ento-011019-025151

Wagner. D.L., Grames. E.M., Forister. M.L., Berenbaum. M.R., Stopak, D. 2021. Insect decline in the Anthropocene: Death by a thousand cuts. *Proc. Natl. Acad. Sci. USA* 118: e2023989118. http://doi.org/10.1073/pnas.2023989118

Wilson, E.O. 2016. *Half-Earth: Our Planet's Fight for Life.* W.W. Norton and Co., New York. 259pp.