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Source: Rhodora, 116(968):428-493.
Published By: The New England Botanical Club, Inc.
DOI: http://dx.doi.org/10.3119/13-21
URL: http://www.bioone.org/doi/full/10.3119/13-21

RHODORA, Vol. 116, No. 968, pp. 428–493, 2014

DOI: 10.3119/13-21; first published on-line December 22, 2014.

FIFTEEN YEARS OF CHANGE: WHAT A COMPARISON OF THE TWO FLORA CONSERVANDA LISTS CAN TELL US ABOUT RARE PLANT SPECIES IN THE NEW ENGLAND LANDSCAPE

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ABSTRACT. Flora Conservanda is a list of native plant taxa considered to be most rare in New England. Originally published in 1996, the list was updated in 2012. The updated list includes 593 taxa in five divisions: 62 in Division 1 (Globally Rare), 325 in Divisions 2 and 2(a) (Regionally Rare), 57 in Division 3 (Locally Rare), 96 in Division 4 (Regionally Historic), and 53 in Division IND. (Presumed Rare, but confirmation required). Since the first publication of the list, substantial changes have occurred both in the landscape and in our understanding of the taxa. Here, we compare the 2012 update to the original list, noting changes in the species assigned to each division and recording the reported number of extant populations (Element Occurences) in each state. We assessed trends in rarity during the intervening 15 years among 676 taxa in one or both lists, and identified further data collection that would be beneficial. One hundred and thirty-seven taxa were new to the list in 2012. The numbers of reported extant occurrences increased for 118 taxa and declined for 40 taxa since the 1996 publication; 10 taxa declined in one or more states and increased in others. Little net change in occurrence numbers was seen for 213 taxa, and trend data were insufficient to assess population trends for 295 taxa. Massachusetts (55 or 18.4% of MA listed taxa), Connecticut (55 or 18.4%), and Maine (46 or 16.9%) had the most taxa with increased numbers of occurrences, and Massachusetts (22 or 7.7%), Maine (20 or 8.3%), and New Hampshire (17 or 8.4%) had the most taxa with decreased occurrence numbers. Increased occurrence numbers were more common among those taxa characteristic of shores and banks, wetlands, and forests, whereas higher proportions of declining species were characteristic of coastal, alpine, and exposed rocky areas. A significantly higher proportion of entomophilous species showed occurrence declines than increases. Overall, the magnitude and distribution of noted changes may be due to the success of concerted efforts to seek out previously overlooked populations, range expansions of certain taxa, or validation of older records. Trends apparent in the Flora Conservanda data can be used to prioritize regional conservation actions and data collection.

Key Words: Rare plants, conservation, New England, functional groups, pollination, biogeography, habitat, range shifts

From 1993 to 1996, data on the status of rare plants in the six New England states were compiled to formulate Flora Conservanda, a list of higher tracheophyte plant taxa to be prioritized for regional conservation (Brumback and Mehrhoff et al. 1996). Flora Conservanda: New England 2012 (Brumback and Gerke 2013; hereafter, Flora Conservanda 2012) was compiled to account for nomenclatural and taxonomic changes since 1996 and to suggest updated priorities for protection at both the species and population levels. The aim of the project was to aid: 1) New England Plant Conservation Program (NEPCoP) State Task Forces—a collaboration of professional botanists, state agencies, and conservation organizations in each New England state—in selecting species for conservation; 2) scientists, in focusing research efforts on critical species; 3) federal, state, and local government agencies and private land conservation organizations, in identifying the most important taxa to protect and manage within the region; and 4) the public, in supporting conservation efforts.

Flora Conservanda 2012 was developed by the New England Flora Committee, which consisted of representatives of each of the six New England state's Natural Heritage Programs, or their equivalents, and other botanists familiar with the regional flora. Determination for listing was based on the Global rank (per NatureServe 2013) of the species and the number of Element Occurrences (EOs *sensu* NatureServe 2013; see below) known in New England. All data included in the update were current as of June 2012. By applying strict definitions for the inclusion of a taxon within one of the five divisions of Flora Conservanda 2012, the Committee identified 593 taxa of high regional concern out of a total of approximately 2300 species indigenous to New England.

The original Flora Conservanda raised as many questions about rare plants as it answered, and several programs and projects have attempted to fill these gaps in our collective knowledge. The two-year Herbarium Recovery Project, funded by the Stratford Foundation and the Ellis L. Phillips Foundation, examined and verified the accuracy of $>$ 18,000 herbarium specimens of 532 species of global and regional conservation concern, as well as poorly known native species, at 42 herbaria throughout New England. Building upon this monumental effort, *Flora Novae Angliae* was completed (Haines 2011), condensing into one volume our understanding of all native and naturalized taxa that comprise the New England flora. Additionally, 111 taxa were selected as the

subjects of peer-reviewed NEPCoP Conservation and Research Plans, the aims of which were to recommend actions that would lead to the conservation of Flora Conservanda species. Along with the diligent efforts of state Natural Heritage programs, botanical professionals, and hundreds of volunteers, these projects have begun to answer some of the questions raised by the first Flora Conservanda publication.

A comparison of the 1996 Flora Conservanda publication to the 2012 update allows us to analyze changes in the status of rare New England taxa over the past 15 years. Specifically, we have sought to discern trends in the numbers of extant populations between 1996 and 2012 among taxa for which sufficient data were available for analysis. The term "population" as used here refers to Element Occurences, *sensu* Nature Serve (2013): "An Element Occurrence (EO) is an area of land and/or water in which a species or natural community is, or was, present. For species Elements, the EO often corresponds with the local population, but when appropriate may be a portion of a population or a group of nearby populations (e.g., metapopulation)."

Overall, we expected that few rare taxa throughout New England would have increased in numbers of EOs. Several recent floristic studies of large sites or towns in New England have provided temporal comparisons of the numbers of species present, and most have noted net declines in native species richness (e.g., Bertin and Rawinski 2012; Jenkins et al. 2008; Lovejoy 2008; Searcy 2012; Standley 2003; but see Hamlin et al. 2012). These studies identified certain plant families that appeared to be particularly vulnerable to decline, such as Orchidaceae, Saxifragaceae, and Ophioglossaceae. They also identified species of particular habitats, particularly early-successional grasslands, rocky balds, and other habitats dominated by herbaceous species, which have experienced disproportionate declines due to succession to woodlands and forests in the absence of fire and other disturbances that maintain open habitats. Likewise, a New England-wide analysis of 71 rare plant taxa showed that functional groups of plants with particular life histories, such as obligate entomophily, localized seed dispersal, and affinities with upland (versus wetland) habitats, showed significant declines relative to other rare taxa with contrasting life histories (Farnsworth and Ogurcak 2008). A similar comparative study of rare and related common plant taxa of New England grasslands revealed that declining species showed tighter habitat

specialization, larger seed size, smaller plant height, less reliance on vegetative (colonial) reproduction, and a tendency toward annual or biennial life history (Farnsworth 2007). Several global comparative studies have found similar patterns (Kunin and Gaston 1997; Kunin and Schmida 1997). Another comparative study found a weak association between the presence of invasive species (in concert with anthropogenic disturbance) and declines in population sizes of rare plants in New England (Farnsworth 2004). We asked if taxa with affinities to particular habitats were undergoing changes in population numbers. We predicted that taxa associated with particular habitats that are more vulnerable to climatic change or sea-level rise (such as coastal or alpine habitats) or to successional change in the absence of disturbance (such as rocky balds and fields) would more frequently exhibit declining population numbers.

We also asked whether taxa native to particular New England states showed declines or increases in numbers of EOs. We hypothesized that a higher proportion of declining taxa would be associated with southern New England states than northern states because the negative influences of land use change are generally stronger in the more populous, highly urbanized region of southern New England (Farnsworth and Ogurcak 2006).

METHODS

Flora Conservanda 2012 focused on taxa that were globally and regionally rare [Divisions 1 and 2, respectively (*sensu* Brumback and Gerke 2013)]. Division 1 taxa were assigned global conservation status ranks (GRank) of G1 through G3 for species, or T1 through T3 for infraspecific taxa. The ranks are: critically imperiled (rank = 1), imperiled (rank = 2), or vulnerable (rank = 3), per NatureServe (2013). Division 2 taxa are defined as having 20 or fewer current EOs observed within New England within the last 20–25 y. A taxon with slightly more than 20 EOs in New England might also be included in Division 2 if it was considered vulnerable to extirpation due to other important factors (population size and trends, area of occupancy, viability of EOs, geographic distribution, habitat rarity and integrity, and/or degree of protection); these taxa were denoted as 2(a). Also identified were taxa that were declining throughout a significant portion of the region or that had EOs with high biological, ecological, or (potential) genetic significance, inferred from a disjunct distribution of EOs (Division 3). Flora

Conservanda 2012 further identified taxa that were considered historic in the region (Division 4), as well as those that may be rare throughout New England, but for which taxonomic or distributional information was insufficient to determine status (Division IND.).

The listing criteria in 2012 remained the same for all divisions in the 1996 publication, except that hybrid taxa were removed from the list. A great many rare hybrid taxa were identified in Haines (2011), and the Committee decided that because of the many complicating factors involved with describing hybrids and establishing accurate lists of extant EOs, these taxa would be better considered in a separate list.

Division 3 criteria were also changed slightly between 1996 and 2012. Brumback and Mehrhoff et al. (1996) had defined disjunct EOs as those separated from other EOs by at least 50 miles (80 km). Although range-disjunct EOs were still included in Division 3(b) of Flora Conservanda 2012, the strict criterion of a 50-mile separation among EOs was removed and disjunct ranges were considered on a species-specific basis to evaluate the likelihood of gene flow between occurrences. A 50-mile separation was still used as an initial guideline, but disjunction was also defined by the likelihood of genetic isolation based on propagule dispersal distances and pollination mechanisms. Data on species' ranges and occurrence declines were added as criteria for inclusion of a taxon in Division 3 for the 2012 list. Taxa in Division 3(a) were considered still too common in New England to fall under Division 2 or 2(a), and were not globally rare but had been observed to be declining in a substantial portion of their New England range. Occurrences of these taxa were disappearing or decreasing in size in most of their New England ranges and, in any New England states where decline was not observed, occurrences were primarily stable rather than increasing in size.

To compare the 1996 and 2012 versions of the list, the taxa present on the 1996 list were entered into a spreadsheet, along with the divisions assigned to the taxa at that time. A spreadsheet of the 2012 taxa and divisions was then compared to the 1996 list. A cross-reference of taxonomic changes was made by correcting for synonymy using Haines (2011). Misapplied synonyms used on the 1996 list were cross-referenced to the correct taxon in consultation with Arthur Haines (Research Botanist, New England Wild Flower Society, pers. comm.).

We first noted if a name change and/or a division change had occurred. Next, we classified the division changes in the following categories: 1) no division change; 2) taxa new to the list in 2012; 3) taxa more rare than before due to reasons such as confirmed extirpation or being officially declared historic; 4) taxa with changes in global rank; 5) new taxa resulting from taxonomic splitting; 6) taxa appearing less rare due to reasons such as changes in global rank and taxonomic lumping; and 7) taxa that had been removed from the list because of changes in global rank, taxonomic lumping, hybridity, records based on misidentifications, or changes in the nativity status of the taxon in New England.

The initial classification was then used to group taxa based on similar characteristics. For all taxa that changed divisions, including those new to the list, we recorded the specific reason for each change based on committee meeting notes, Flora Conservanda list evaluations, rare plant updates compiled by committee members, research notes in Haines (2011), state rare plant species lists, comparisons of occurrence details between the 1996 and 2012 lists, and EO records from state Natural Heritage programs.

It was also instructive to compare, per state, the changes in numbers of extant EOs for each taxon between 1996 and 2012. Data were available for 378 taxa listed in the first publication, and enough information existed to allow a temporal comparison of an additional three taxa new to the updated list. Taxa in Divisions 3 and IND. were largely excluded from this analysis because they are not tracked closely in most New England states and insufficient information was available to determine changes in numbers of EOs. Changes in the number of extant occurrences fell into four categories: 1) no change; 2) increased numbers of occurrences in New England; 3) decreased numbers of occurrences; and 4) a few taxa that increased in some states and decreased in others. We tended to exclude taxa for which botanical sampling appeared to be sparse, or spatially or temporally biased—cases in which the Flora Conservanda data clearly indicated that more information was needed. In a few cases, we lumped several small populations into a single larger one as we gained better knowledge of a taxon's geographic distribution, and we eliminated such spurious cases prior to our analysis. We also excluded taxa that showed a shift of only one or two occurrences throughout their ranges in New England, except in cases for which a loss of occurrences resulted in

the taxon being moved into Division 4 (Historic; i.e., no longer present in a given state or the entire region). Also excluded were taxa that changed rank due to taxonomic restructuring. Two of us (J.G. and E.J.F.) independently scored all taxa as increasing in numbers of occurrences, decreasing (losing occurrences), showing no change, increasing/decreasing in part of the New England range, or having insufficient information. Our classifications initially differed for only 8 taxa, for which we then developed a consensus rating. We also invited comments on our classifications from independent Natural Heritage botanists who were knowledgeable about the species in question; their comments corroborated our classifications. Using these criteria, we were able to classify trends for 168 taxa, representing 24.9% of the 676 New England native, non-hybrid taxa included in either the first Flora Conservanda publication or the update. Two-hundred-thirteen taxa (of which 38 were still historic and an additional six were listed as historic in 2012) had little or no reported change. Determinations could not be made for 295 taxa; as stated above, most of these were in Divisions 3 (Locally Rare taxa) or IND. (Presumed rare, but confirmation required), or had been newly added to the list, with no 1996 data available.

The taxa were then matched with their habitat type, as listed in Haines (2011), to determine if taxa with affinities to certain habitat types were more vulnerable to declines. The habitat types were categorized into nine broad groups by very general defining characteristics: alpine and subalpine zones; aquatic (submerged in water); banks (riverbanks, pondshores, and floodplains); coastal (saltmarshes, beaches, and dunes); forests (and woodlands); open (fields, turf, meadows, and shrublands); rocky (balds, cliffs, and talus slopes); wetlands (marshes and swamps); and anthropogenic habitats (e.g., roadsides, ditches, and power lines). These categories are analogous to those used by Bertin (2014) to classify the Worcester County (MA) flora, but more broadly reflect the full range of habitat types in New England. Classification was complicated by the fact that certain taxa can span several habitat types or may occupy specialized habitats within a general category (such as woodland edges of forests, or peaty shores versus ice-scoured river banks). Therefore, taxa were classified into each broad habitat group that applied to their habitat description. For example, *Gentianella quinquefolia* (L.) Small var. *quinquefolia* occurs in fields, pastures, roadsides, banks, and pond shores,

commonly in regions of high-pH bedrock (Haines 2011), and was classified as both ''open field'' and ''banks or shores.'' Also, taxa were classified regardless of whether or not an EO was currently extant in that habitat type in New England. Of 168 taxa classified, 57 (34%) belonged to one habitat type and 111 (66%) to two or more.

Taxa with notable changes in numbers of EOs were also scored for their general geographic range relative to New England. Although it can be said that all species reach a range edge at the Atlantic coast, it was possible to categorize the heart of each species' range by visual inspection of maps published online by NatureServe (2013). ''Northern'' species were those, such as *Barbarea orthoceras*, that reached the southern edge of their range in New England, with the majority of occupied states or provinces falling north of the region (i.e., predominantly in Canada and northern latitudes of the U.S.). ''Southern'' species, such as *Orontium aquaticum*, primarily occupied states south of New England, reaching a northern range edge in the southern sectors of the region. ''Western'' species, such as *Amaranthus tuberculatus*, predominated west of New England, reaching an eastern range edge, whereas ''central'' species had New England in the heart of their ranges or were effectively endemic to the region. Taxa were also scored for pollination mechanism (insect, wind, or unknown), based on floral morphology and existing literature, especially references therein for taxa covered by NEPCoP Conservation and Research Plans (see http://www.newenglandwild.org/conserve/conservation-research-plans). Data on probable mode of pollination were gleaned from floral morphology and floras (Flora of North America Editorial Committee 1993+; Haines 2011).

We then used Chi-square tests on percentages of all declining and increasing taxa in each category, using the methods of Preacher (2001), and reported the Fisher's exact test statistic for the one case in which expected values were <3 (i.e., ''unknown'' pollination mechanism). We tested the null hypothesis that the distributions of habitat types, pollination mechanisms, and ranges would not differ significantly between groups of species with declining numbers of EOs and those showing increasing numbers of EOs.

We also acknowledged that apparent increases in EOs might be attributable simply to increased search efforts ensuing since 1996 and, thus, did not necessarily indicate that a taxon was becoming more common in the region. To test the robustness of our

comparisons, we derived a new, more conservative category of species that included both the apparently increasing taxa and those that showed no change; we then compared this category to the declining taxa using the statistical methods described above.

RESULTS

Flora Conservanda 2012 included 593 taxa, compared to 576 taxa on the 1996 list. The size, although not the species composition, of Division 1 remained relatively stable, increasing by only five taxa from 1996 to 2012 (Table 1). Divisions 2 and 2(a) together grew by 52 taxa. Division 3 decreased by 19 taxa. Division 4 grew by 41 taxa. Division IND. shrank considerably, by 62 taxa. There was movement of 137 taxa onto the list, whereas 120 taxa moved off and 97 taxa changed divisions within the list (Table 1). There were 359 taxa (60%) that did not change divisions.

Rare taxa. Some EOs previously counted as extant, have not been observed, or are known to have been extirpated, since 1971. Although each state Natural Heritage program typically considers an EO to be historic after 20 to 25 y, definitions vary somewhat among New England states. When Flora Conservanda was first published in 1996, historical EOs were defined as those not observed since about 1971 or 1976 (now about 40 y ago). In the 2012 update, historic populations were defined as those that had not been observed since about 1987 to 1992 (now about 20–25 y ago). Thus, 15 taxa, previously listed as Division 2 or IND. in Flora Conservanda 1996, were placed in Division 4 because there were no EOs known to be extant for these taxa in New England as of 2012. Nine of these taxa had EOs that had been observed on the landscape since 1971, but are now considered to be extirpated. There were also 43 Division 4 taxa that were completely new to the list in 2012 (Table 1). Two of these had populations observed since 1971 but are now known or suspected to be extirpated.

Three additional taxa from the 1996 list were considered more rare in 2012, as indicated by a change in division: *Tanacetum bipinnatum* (L.) Sch.-Bip. subsp. *huronense* (Nutt.) Breitung was moved from Division 2(a) to 2 because there were only 18 EOs reported from Maine in 2012, whereas there had previously been 30. *Triphora trianthophora* (Sw.) Rydb. was moved from Division 2 to 1 due to a change in global rank to G3G4 (despite an increase in the

Table 1. Numbers of taxa occurring in each division (first column on left) of the 1996 *Flora Conservanda* list (second column) and the divisions by which they were classified in 2012 (columns 3–8). For example, of the 57 taxa classified as Division 1 in 1996, 42 remained in Division 1 in 2012, eight were moved to Division 2, one was moved to Division 2(a), and six were not included in the 2012 list. Note that the Division 3 category was split into two categories [3(a), declining in a substantial portion of their range in New England, and 3(b) those with population disjunctions resulting in genetic isolation]. "EO" is Element Occurrence *sensu* NatureServe (2013).

		Number of taxa in each division in 2012 (including taxa listed in both 1996 and 2012). Divisions defined per updated 2012 criteria.						
1996 Division	Total taxa in 1996 division	1	2	2(a)	3(a) and 3(b)	4	IND.	Number of 1996 taxa not included on 2012 list
1: Globally Rare (G1–G3 and/or T1–T3)	57	42	8	1	–	–	–	6
2: Regionally Rare (≤20 EOs)	266	–	212	9	2	7	5	31
2(a): Regionally Rare (21–30 EOs)	7	1	1	2	1	–	–	2
3: Locally Rare (regional decline and/or range disjunction)	76	–	1	–	48	–	1	26
4: Regionally Historic	55	2	12	–	–	38	–	3
IND.: Status undetermined; presumed rare, but more information is needed	115	7	27	2	2	8	17	52
Number of 2012 taxa not included on 1996 list	137	10	48	2	4	43	30	N/A
Total number of taxa on 2012 list	593	62	309	16	57	96	53	120

number of known EOs within New England). And *Cryptogramma stelleri* (S.G. Gmel.) Prantl was moved from Division 3 to 2 because there were only 20 reported EOs in 2012, whereas there had previously been more than 35. One-hundred-and-twenty taxa, now considered more rare, were new to the updated list. Forty-six taxa previously published in Flora Conservanda 1996 were moved from IND. to other divisions because more information regarding the status of each taxon had been amassed over the past 15 y. Although the actual rarity status of all the 169 taxa in these three groups may not have changed over the past 15 y, recent information on extant EO numbers has improved our ability to accurately rank them. An additional 17 taxa were added to the list following taxonomic revision that segregated them from larger taxa (Table 2). When these were considered to be distinct taxa, it became clear that they were rare in New England.

Field verifications, taxonomic changes, and misapplications. Field work since 1996 has verified the existence of EOs formerly thought to be extirpated, and has led to the discovery of new populations. Fourteen taxa, previously listed as Division 4, were verified in the last 15 y as extant in New England (Table 3). In 2012, 72 taxa were considered at least as, or more common, than they had previously been understood to be and, thus, were removed from the updated Flora Conservanda list (Appendix 1). Also, taxonomic changes in 13 taxa resulted in the lumping of these taxa, previously considered as distinct, into larger, more common groups, and they were subsequently removed from the list. *Achillea borealis* Bong., formerly Division IND., is a synonym of *Achillea millefolium* L. subsp. *lanulosa* (Nutt.) Piper. *Bidens hyperborea* Greene var. *svensonii* Fassett, formerly Division IND., was previously treated separately from *B. hyperborea* Greene, formerly Division 2. Now considered together as *B. hyperborea* Greene, the taxon is not rare enough to list. *Eupatorium perfoliatum* L. var. *colpophilum* Fernald & Griscom, formerly Division IND., was subsumed into *E. perfoliatum*. *Euthamia galetorum* Greene, formerly Division IND., is synonymous with the common species *Euthamia caroliniana* (L.) Greene *ex* Porter & Britton, although further study is warranted. *Solidago canadensis* L. var. *subserrata* (DC.) Cronquist, formerly Division IND., is a synonym of *Solidago altissima* L. *Carex foenea sensu* Fernald was misapplied to some EOs in New England and is now called *Carex siccata* Dewey, formerly Division 3. Now

considered to be *C. siccata*, the Chittenden County, VT, EO is no longer disjunct [*Carex foenea* Willd. (called *Carex aenea* by Fernald) occurs in New England]. *Cyperus engelmannii* Steud. has been subsumed into *Cyperus odoratus* L. Although these taxa were previously listed separately as Division IND., together they are too common to list. *Juncus alpinus* auct. non Vill., formerly Division 2, is a synonym of *Juncus alpinoarticulatus* Chaix *ex* Vill. subsp. *americanus* (Farw.) Hämet-Ahti. *Utricularia biflora* Lam. and *U. fibrosa* Walter (not *U. fibrosa* Britton), both formerly Division 2, are synonyms of *U. gibba* L. In addition, *Melampyrum lineare* Desr. varieties *lineare*, *latifolium* W.P.C. Barton, and *pectinatum* (Pennell) Fernald, each formerly Division IND., have been removed from the list pending taxonomic and genetic study to determine if the observed phenotypic variation represents real genetic variation.

Misidentifications. Eleven taxa were previously believed to occur in New England based on herbarium records or field observations, but these records were since determined to be misidentifications. *Artemisia campestris* L. subsp. *borealis* (Pall.) H.M. Hall & Clem. (Asteraceae) was reported from New England, but there are no valid collections; some collections are subsp. *canadensis* [*Pease 19455* (NEBC), *Sorrie 2244* (GH)]. A study of *Bidens heterodoxa* (Fernald) Fernald & H. St. John (Haines 2003; Roberts 1982) revealed that, in New England, the taxon was comprised of two different, previously described taxa. Collections from the Kennebec River in Maine refer to *B. eatonii* Fernald (GH), and collections from Pocotopaug Lake in Connecticut refer to *B. tripartita* L. [*Bidens heterodoxa* var. *agnostica*: 21 Sep 1910 *Woodward & Bissell s.n.* (GH); *Bidens heterodoxa* var. *monardifolia*: 21 Sep 1910 *Woodward & Bissell s.n.* (GH)]. A *Taraxacum ceratophorum* (Ledeb.) DC. record was based on an immature specimen that is likely *T. officinale* G.H. Weber *ex* Wigg. [*Pease 12154* (NEBC)]. *Carex woodii* Dewey (Cyperaceae) specimens have been annotated to other species [30 June 1946 *E.J. Palmer* (NEBC) is now *C. buxbaumii* Wahlenb.]. *Stachys tenuifolia* Willd. (Lamiaceae) specimens, such as 15 Aug 1974, *Campbell s.n.* (MAINE), were annotated as *S. hispida* Pursh due to synonymy listed in Gleason and Cronquist (1991) and other sources. Some specimens previously identified as *Dichanthelium polyanthes* (Schult.) Mohlenbr. (Poaceae; syn. *Panicum polyanthes* Schult.) were redetermined as *Dichanthelium sphaerocarpon* (Elliott) Gould, including: 4 Apr

Table 2. Recently described or separated taxa included in the updated Flora Conservanda list. Numbers in the 1996 and 2012 status columns represent the Flora Conservanda divisions to which each taxon was assigned.

Family	Scientific Name	Status		Reason For Change
		1996	2012	
Alliaceae	*Allium tricoccum* Aiton var. *burdickii* Hanes		4	Separated out from typical *A. tricoccum*
Apiaceae	*Sanicula canadensis* L. var. *grandis* Fernald	2: *S. canadensis* L.	4	Separated out from *S. canadensis*; *S. canadensis* var. *canadensis* is now considered too common to list
Asteraceae	*Artemisia campestris* L. subsp. *canadensis* (Michx.) Scoggan	2: *A. campestris* L. subsp. *borealis* (Pallas) Hall & Clem.	2	Was previously included as a synonym of subsp. *borealis*, which is no longer an accepted subspecies
Asteraceae	*Taraxacum latilobum* DC.	IND.	4	*T. latilobum* is not a synonym of *T. ceratophorum* as was indicated incorrectly in the 1996 edition of *Flora Conservanda*
Cyperaceae	*Carex capillaris* L. subsp. *fuscidula* (V.I. Krecz. *ex* Egorova) A. & D. Löve	2: *Carex capillaris* L.	2	Separated out from *C. capillaris*; *C. capillaris* L. subsp. *capillaris* is also Division 2
Cyperaceae	*Carex reznicekii* Werier		2	Newly described taxon
Cyperaceae	*Eleocharis aestuum* A. Haines		1	Newly described taxon, primarily limited to fresh tidal river shores
Cyperaceae	*Scleria pauciflora* Muhl. *ex* Willd. var. *caroliniana* (Willd.) Alph. Wood	2	2	Separated out from *S. pauciflora*; *S. pauciflora* Muhl. *ex* Willd var. *pauciflora* is also Division 2
Ericaceae	*Hypopitys lanuginosa* (Michx.) Nutt.		IND.	Only recently recognized as a taxon distinct from *H. monotropa* in New England

Table 2. Continued.

Family	Scientific Name	Status 1996	Status 2012	Reason For Change
Gentianaceae	*Bartonia iodandra* B.L. Rob.		IND.	Recently again raised to species status from *B. paniculata* subsp. *iodandra*. Range and status are unclear. *Bartonia paniculata* (Michx.) Muhl. is also IND.
Lamiaceae	*Stachys pilosa* L. var. *arenicola* (Britton) G.A. Mulligan & D.B. Munro	IND.: *S. pilosa* L.	2	Separated out from *S. pilosa*; *S. pilosa* L. var. *pilosa* is not considered to be native to New England
Onagraceae	*Oenothera fruticosa* L. ssp. *glauca* (Michx.) Straley	IND.: *Oenothera fruticosa* L.	IND.	Separated out from *O. fruticosa*; *O. fruticosa* L. ssp. *fruticosa* is also listed as IND.
Orchidaceae	*Corallorhiza odontorhiza* (Willd.) Poir. var. *pringlei* (Greenm.) Freudenst.	3: *Corallorhiza odontorhiza* (Willd.) Poir.	4	Separated out from *C. odontorhiza*. Variety *pringlei* is known only from CT and is of regional conservation concern; also reported from MA, ME, VT by Brown (1997), but specimens are unknown. Variety *odontorhiza* is Division 3(b) ME, NH
Poaceae	*Elymus villosus* Muhl. *ex* Willd. var. *arkansanus* (Scribn. & C.R. Ball) J.J.N. Campb.	2: *Elymus villosus* Muhl. *ex* Willd.	IND.	Separated out from *E. villosus*; *E. villosus* Muhl. *ex* Willd. var. *villosus* is also listed as IND.
Poaceae	*Phragmites americanus* (Saltonst., P.M. Peterson & Soreng) A. Haines		IND.	Recently described taxon
Poaceae	*Poa interior* Rydb.	2: *P. glauca* Vahl	2	Separated out from *Poa glauca* which is also Division 2
Poaceae	*Poa saltuensis* Fernald & Wiegand subsp. *languida* (Hitchc.) A. Haines		2	Separated out from *P. saltuensis*

Table 3. Taxa previously listed as Regionally Historic (Division 4) that, since 1996, have been found to be extant in New England.

Family	Scientific Name	Synonym	Status 1996	Status 2012	Reason For Change
Apocynaceae	*Asclepias viridiflora* Raf.	Asclepiadaceae	4	2	1 extant CT EO
Asteraceae	*Krigia biflora* Walter var. *biflora*	*Krigia biflora* (Walter) S.F. Blake	4	2	1 extant CT EO
Asteraceae	*Senecio suaveolens* (L.) Elliott	*Cacalia suaveolens* L.	4	2	1 extant CT EO
Asteraceae	*Symphyotrichum anticostense* (Fernald) G.L. Nesom	*Aster anticostensis* Fernald	4	1	2 extant ME EOs
Caprifoliaceae	*Triosteum angustifolium* L.		4	2	1 extant CT EO
Cyperaceae	*Carex atherodes* Spreng.		4	2	Several extant ME records
Cyperaceae	*Carex willdenowii* Schkuhr *ex* Willd.		4	2	4 extant CT EOs
Fabaceae	*Strophostyles umbellata* (Muhl. *ex* Willd.) Britton		4	2	1 extant RI EO
Juncaginaceae	*Triglochin gaspensis* Lieth & D. Löve		4	1	6 extant ME EOs
Melanthiaceae	*Anticlea elegans* (Pursh) Rydb. subsp. *glauca* (Nutt.) A. Haines	Liliaceae: *Zigadenus elegans* Pursh var. *glaucus* (Nutt.) Preece	4	2	Recently rediscovered in VT
Poaceae	*Calamagrostis canadensis* (Michx.) P. Beauv. var. *langsdorfii* (Link) Inman		4	2	1 extant NH EO
Poaceae	*Piptatherum canadense* (Poir.) Dorn [recently updated to *Piptatheropsis canadensis* (Poir.) Romasch., P.M. Peterson & Soreng; as presented in Flora Conservanda 2012]	*Oryzopsis canadensis* (Poir.) Torr.	4	2	2 extant NH EOs and 9 ME EOs
Poaceae	*Sporobolus clandestinus* (Biehler) Hitchc.		4	2	1 extant CT EO
Ulmaceae	*Ulmus thomasi* Sarg.		4	2	4 extant VT EOs

1882, *Dudley s.n.* (NEBC, YU), *Fernald & Long 16158* (NEBC), and *Parker 72.216* (CONN). New England records of *Puccinellia tenella* (Lange) Holmb. subsp. *alascana* (Scribn. & Merr.) Tzvelev and *P. tenella* (Lange) Holmb. subsp. *langeana* (Berlin) Tzvelev were actually *Puccinellia pumila* (Vasey) Hitchc. [17 Aug 1918, *Kidder* (MAINE); 3 Aug 1913, *Hill* (MAINE)]. *Potamogeton diversifolius* Raf. (Potamogetonaceae) specimens were annotated to *Potamogeton* ×*aemulans* Z. Kaplan, Hellq. & Fehrer, a rare hybrid (Kaplan et al. 2009). *Crataegus mollis* (Torr. & A. Gray) Scheele (Rosaceae) specimens were annotated to other species [17 Sep 1905, *Bissell s.n.* (GH); *Rajakaruna 17* (HCOA); and *Zebryk 7107* (NEBC)]. *Euphrasia disjuncta* Fernald & Wiegand was removed from the list because the very old specimen was unfortunately destroyed in a fire at the Portland Society of Natural History in 1866. The specimen had been collected along the St. John River, which is beyond the range of *E. disjuncta*. Instead, the specimen was likely to have been *E. suborbicularis* P.D. Sell & Yeo, not *E. disjuncta* (St. John River, collected by G. L. Goodale in 1860's and cited in Fernald and Wiegand 1915; *Rhodora* 17: 192).

Introduced taxa. We found eight taxa, previously included in the Flora Conservanda list (1996), which, upon further study, led us to conclude that they had been more recently introduced to New England through human agency, perhaps over the last several hundred years. To verify the status of these taxa, we studied information available from herbarium labels, records of the EO(s), and observations of the habitats and habits of the taxa in New England, and/or considered their wider global ranges. The following taxa had been listed in Division IND. but are now considered introduced, or not-native, and are not included in the updated list: *Chenopodium leptophyllum* Nutt. and *C. standleyanum* Aellen (Amaranthaceae), *Sagina nodosa* (L.) Fenzl subsp. *nodosa* (Caryophyllaceae), *Stachys pilosa* Nutt. var. *pilosa* (Lamiaceae), *Utricularia inflata* Walter (Lentibulariaceae), *Rhinanthus minor* L. subsp. *minor* (Orobanchaceae syn. Scrophulariaceae: *Rhinanthus crista-galli* L.), *Physalis longifolia* Nutt. var. *subglabrata* (Mack. & Bush) Cronquist (Solanaceae), and *Viola striata* Aiton (Violaceae).

Changes in reported numbers of EOs between 1996 and 2012. An overall increase in reported numbers of EOs (Appendix 2) was noted for 118 taxa, 27 of which had increased sufficiently in numbers to be excluded altogether from the updated list. Forty taxa

had decreasing numbers of EOs, including two taxa that had been newly added to the updated list (Appendix 3). Ten taxa showed numbers of EOs that increased in some states and decreased in others (Table 4). Each state had some rare species for which the number of populations had increased between 1996 and 2012. Maine had 46 taxa (16.9% of the rare Maine flora on either the original or updated list) that had increased numbers of EOs, but 32 of these taxa remained on the list. In New Hampshire, 35 taxa (15.6% of the rare New Hampshire flora on either the original or updated list) had increased numbers of EOs, with 22 of these taxa remaining on the list. Forty-one taxa (14.2%) in Vermont had higher numbers of EOs, with 28 of these taxa remaining on the list. Massachusetts had 55 taxa (18.4%) with increased numbers of EOs, but 43 of these taxa remained on the list. Twenty-four taxa (13.5%) in Rhode Island showed increased numbers of EOs and 20 of these taxa remained on the list. Connecticut had 55 taxa (18.4%) with an increased number of populations, and 43 of these taxa remained on the list.

In terms of overall decreases in numbers of EOs since 1996, Massachusetts had the highest number of taxa (22) with observed declines in EOs, impacting 7.7% of the rare Massachusetts flora in 2012. Maine followed with declines for 20 taxa, or 8.3% of the state's rare taxa. In New Hampshire, 17 taxa showed EO declines, representing 8.4% of rare taxa in the state. Nine rare taxa in Vermont (3.5%) had fewer EOs in 2012. In Rhode Island, eight taxa had decreased numbers of EOs, impacting 4.7% of the state's rare plants. Connecticut had 14 rare taxa with decreased numbers of EOs, representing 4.8% of the state's rare plants.

Chi-square analyses indicated that distributions of both declining and increasing taxa did not differ significantly among states ($\chi^2 = 2.2$; d.f. = 5; $p = 0.82$).

Effects of range on changes in EOs. The taxa reaching the northern edges of their ranges in New England were more likely to display a decline in number of EOs (41% of taxa with decreased numbers of EOs were predominantly distributed south of New England) than a reported increase (only 17.8% of taxa with increasing population numbers had most of their ranges south of New England; Figure 1). Taxa reaching the southern edges of their ranges in northern New England were about equally likely to decrease (35.9% of taxa with decreases) as to increase (38.1% of

taxa with increases; Figure 1), although in absolute numbers there were many more taxa showing increased numbers of EOs (45) than decreased numbers (14). Taxa with New England at the centers of their ranges were also equally likely to show decreases in percentages of populations (10.3%) as to show increases (9.3%); but again, although the percentages were close, the absolute numbers of EOs differed, with 4 decreased and 11 increased. Taxa distributed predominantly west of New England were more likely to exhibit increases (34.7% of taxa) in numbers of EOs than decreases (12.8%). Chi-square analyses indicated significantly different distributions of geographic ranges between groups of taxa with declining and increasing numbers of EOs ($\chi^2 = 19.4$; d.f. = 3; $p < 0.01$); the comparison of declining taxa with the summed category of increasing and non-changing taxa showed the same trend ($\chi^2 = 8.5$; d.f. = 3; $p = 0.04$).

Habitat affinities. Habitat affinities differed somewhat among taxa exhibiting declines and those apparently increasing.Taxa displaying apparent increases in reported numbers of EOs were most frequently associated with banks and shores (33.9% of increasing taxa). Wetland habitat types (28.8%) and forests (28.6%) were habitats associated with increasing taxa, followed by anthopogenic sites (25.2%; Figure 2). Alpine (9.3%) and coastal (8.4%) habitat affinities were less frequently associated with increasing taxa. Taxa displaying overall decreases in EOs were associated most frequently with open fields (35.9%), followed by banks (28.2%), coastal (25.6%), and rocky habitats (25.6%; Figure 2); a significantly higher proportion of species of coastal habitats were declining relative to those increasing ($\chi^2 = 4.34$; d.f. = 1; $p = 0.04$). Chi-square analyses indicated significantly different distributions of habitat affinities among declining and increasing taxa ($\chi^2 = 15.9$; d.f. = 8; $p = 0.043$). However, the comparison of declining taxa with the summed category of increasing and non-changing taxa did not show a significant trend ($\chi^2 = 7.9$; d.f. = 8; $p = 0.44$). Species that spanned several habitat types did not differ in relative distributions of declining and increasing numbers of EOs compared to apparent habitat specialists ($\chi^2 = 0.3$; d.f. = 1; $p = 0.59$).

A higher proportion of declining taxa, compared to increasing taxa, were insect-pollinated, whereas a higher proportion of increasing taxa were wind- or self-pollinated (Figure 3). Chi-square

Table 4. Taxa that have increased in reported numbers of EOs in some states and decreased in others since the 1996 Flora Conservanda publication.

Family	Scientific name	Status 1996	Status 2012	Distribution	Habitat
Juncaceae	*Juncus debilis* A. Gray	2	2	EOs increased in MA from 1 to 5, but decreased in RI from 3 to historic. Still historic in CT	Low areas in fields, edges of pools, roadside ditches, damp coastal sands
Lamiaceae	*Agastache scrophulariifolia* (Willd.) Kuntze	2	2	EOs increased in MA from historic to 1 and in CT from 2 to 4. EOs decreased in VT from 1 to historic	Forests, frequently dry-mesic, rocky types, forest fragments, roadsides, river banks, riparian forests
Lamiaceae	*Blephilia hirsuta* (Pursh) Benth. var. *hirsuta*	2	2	EOs increased in VT from 2 to 3, but decreased in MA from 7 to 5 and CT from 1 to historic	Rich, sometimes rocky, upland and riparian forests, cliff bases, dry fields
Lamiaceae	*Lycopus rubellus* Moench	2	2	EOs increased in MA from 2 to 6, but decreased in RI from 1 to historic. The number of CT EOs is unknown - previously listed as 2. Does not occur in NH or VT	Swamps, pond shores, stream banks
Lamiaceae	*Trichostema brachiatum* L.	2	2	EOs increased in CT from historic to 2, but decreased in MA from 3 to 2. Still historic in VT	Ledges, fields, river banks, woodlands, forested hillsides
Orchidaceae	*Liparis liliifolia* (L.) L.C. Rich *ex* Lindl.	2	2	EOs increased in VT from 1 to 3 and CT from 2 to 5, but decreased in MA from 8 to 6 and RI from 2 to historic. Does not occur in NH	Dry-mesic to wet-mesic forests and woodlands

Table 4. Continued.

Family	Scientific name	Status 1996	Status 2012	Distribution	Habitat
Orchidaceae	*Malaxis monophyllos* (L.) Sw. ssp. *brachypoda* (A. Gray) A. & D. Löve		2(a)	Previously 27 EOs throughout CT, MA, ME, NH, and VT (13 in VT). Currently 26 EOs. Historic in ME and NH. 19 EOs in VT	Fens and evergreen swamps, usually in the shade of *Thuja occidentalis*, rarely on open ledges
Poaceae	*Calamagrostis stricta* (Timm) Koeler ssp. *stricta*	2	2	EOs increased in ME from 5 to 14, but decreased in NH from 5 to historic. Historic in VT	Mainly in boreal to alpine settings (CT and MA EOs excepted), such as streambeds, talus slopes, ridges, rock outcrops, ledges, ice-scoured river shores, lake shores, woodlands, and high-elevation cliffs and plateaus
Poaceae	*Phleum alpinum* L.	2	2	EOs increased in NH from 2 to 5, but decreased in ME from 13 to 8	Open, mesic sites in alpine areas, such as snowbank lawns, stream shores, and bases of headwalls; also northern, ice-scoured river shores in high-pH bedrock and/or till regions
Violaceae	*Viola palustris* L. var. *palustris*	2	2	EOs increased in NH from 4 to 7, but decreased in ME from 1 to historic	Brooks, mossy seeps, meadows, tarn shores, and ravines in alpine areas

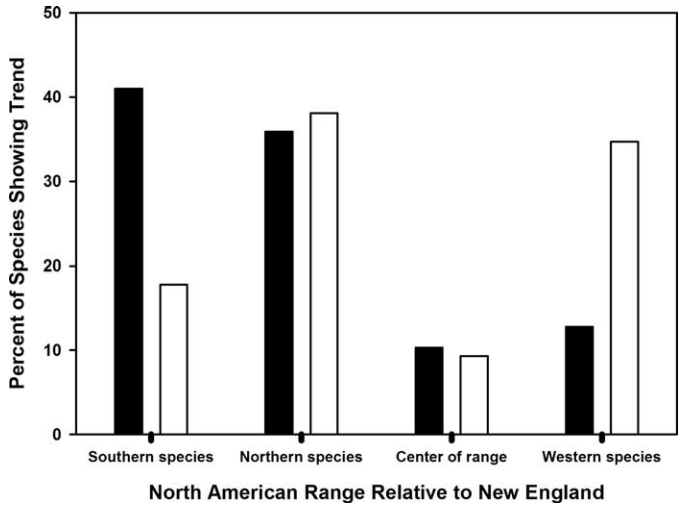

Figure 1. Relative percentages of species showing declining numbers of EOs between 1996 and 2012 (black bars) and species showing gains in EO numbers during the same time period (white bars), categorized by location of the heart of the species' range relative to New England. Species characterized as "southern" occurred most commonly in states south of New England, reaching an apparent range edge in the New England region. Those classified as "northern" were generally circumboreal or considered most secure in regions of North America north of New England. "Western" taxa hailed from the Midwest or western states reaching an eastern range boundary in New England. "Center of range" taxa have their stronghold in New England (and include some endemics), but are still regarded as regionally rare.

analyses indicated significantly different distributions of pollination syndromes among declining and increasing taxa ($\chi^2 = 12.1$; d.f. = 2; $p < 0.01$); the comparison of declining taxa with the summed category of increasing and non-changing taxa showed the same trend, with marginal significance ($\chi^2 = 5.7$; d.f. = 2; $p = 0.06$).

DISCUSSION

Given extensive land conversion, succession, proliferation of non-native species, and climate change impacting the New England landscape, we expected that few taxa would have increased in numbers of EOs. Surprisingly, a considerable number of taxa (118) were reported to have increased by several EOs (Appendix 2). These increases may have resulted from new expansions of the taxa over the past 15 years, discovery of previously overlooked EOs, or

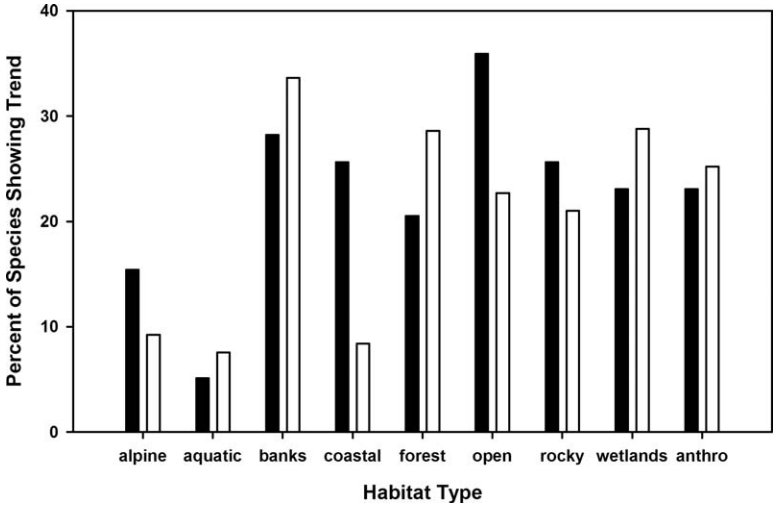

Figure 2. Relative percentages of species showing declining numbers of EOs between 1996 and 2012 (black bars) and species showing gains in EO numbers during the same time period (white bars), categorized by habitat affinity. Species were classified into one or more habitat types based on information from Haines (2011), herbarium records, and Natural Heritage element occurrence (EO) records. Habitats included: alpine and subalpine areas; aquatic (submerged in water); banks (riverbanks, pondshores, and floodplains); coastal (saltmarshes, beaches, and dunes); forests (and woodlands); open (fields, turf, meadows, and shrublands); rocky (balds, cliffs, and talus slopes); wetlands (marshes, swamps); and anthropogenic habitats ("anthro": e.g., roadsides, ditches, power lines).

annotation of older records. Conversely, the number of taxa obviously decreasing in numbers of EOs (40) was unexpectedly low (Appendix 3).

A significantly higher proportion of declining species relative to increasing taxa relied on entomophilous pollination, a pattern that has been noted in other studies of rare New England species (Farnsworth and Ogurcak 2008) and suites of insect-pollinated taxa elsewhere (Quinn et al. 1994). Large-scale pollinator decline has been documented globally (Biesmeijer et al. 2006; Potts et al. 2010), with serious implications for reciprocal mutualisms between plants and insects, and may be occurring in New England as well.

We had hypothesized that a higher proportion of species occurring in habitats vulnerable to anthropogenic disturbance would show declines in numbers of EOs relative to more generalist

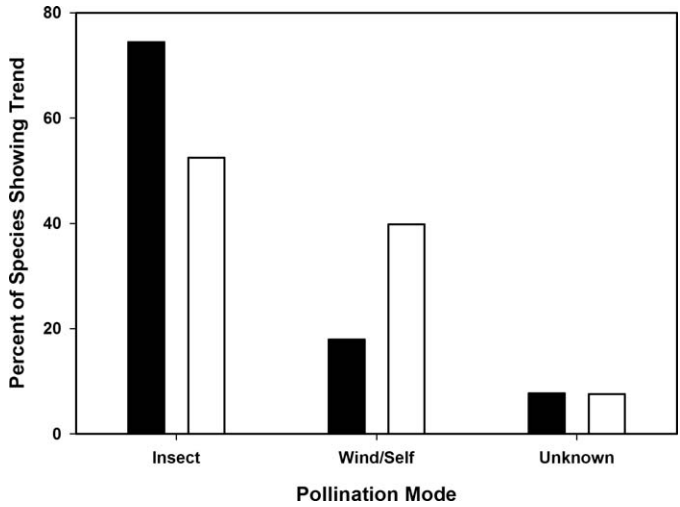

Figure 3. Relative percentages of species showing declining numbers of EOs between 1996 and 2012 (black bars) and species showing gains in EO numbers during the same time period (white bars), categorized by general pollination syndrome. Data on probable mode of pollination were gleaned from floral morphology and floras (Flora of North America Editorial Committee 1993+; Haines 2011). Members of the Poaceae, Cyperaceae, and Juncaceae, and other taxa with minute flowers were classified as wind-pollinated; species known to produce cleistogamous flowers were scored as selfing and combined with anemophilous species for the purposes of this analysis.

and disturbance-tolerant species associated with more common habitat types. We found that a higher proportion of declining taxa inhabited open areas, alpine, coastal, and exposed rocky habitats compared to taxa showing increasing numbers of EOs (Figure 2). A recent comparison of the current and historical flora of Worcester County (Bertin 2014) also found that species once associated with open fields showed disproportionate declines, at least partly due to afforestation. Our findings accorded with our hypothesis that taxa of habitats vulnerable to climatic change would show more frequent declines in numbers of EOs. Coastal habitats are likely to be affected negatively by rising sea levels, and plants adapted to alpine and drought-prone habitats may be stressed above their tolerances by warming temperatures and extreme drought—all conditions currently forecast by climate change models (Frumhoff et al. 2007). Redoubled *in situ* conservation and management efforts and *ex situ*

seedbanking may be warranted for taxa of these imperiled habitats. Although the distribution among habitats of declining and increasing species differed (Figure 2), the more conservative analysis incorporating both increasing and unchanging taxa did not show significant differences. This may reflect biases in sampling among different habitat types, and points to the need for more information on true species' trends across all habitats.

Further, we examined the geographical distributions of declining and apparently increasing taxa. When species were scored for the position of the heart of their range relative to New England, a higher proportion of declining species were southern taxa reaching their northern range edge in New England (Figure 1), which concurs with a previous regional comparison (Farnsworth and Ogurcak 2008). In the present study, a higher proportion of taxa with increasing numbers of EOs hailed from farther west of New England (Figure 2). Overall, more data are needed on the autecology of all these species—regarding their resilience, dispersal dynamics, and climatic affinities—in order to understand reasons for their changing biogeography and rarity status.

As a proportion of the number of taxa considered rare in a state, New Hampshire, Maine, and Massachusetts had the highest percentages of taxa exhibiting decreased numbers of EOs, whereas Connecticut, Rhode Island, and Vermont had the lowest. This finding may corroborate a recent latitudinal analysis of species increasing and declining in Worcester County, which found that a higher frequency of species with ranges centered north of the county showed declines, whereas species distributed farther south showed evidence of increase (Bertin 2014). That study included both common and rare species, and it may be instructive to focus on trends among rare taxa in that flora. On the other hand, in our study, Connecticut, Massachusetts, and Maine showed the largest proportions of apparently increasing taxa, and the data for all six New England states showed more species that were apparently increasing in EOs, than taxa that were declining in EOs. This finding may reflect increased sampling effort in those states during 1996–2012 and it underscores the need to consider increases in EOs very conservatively when interpreting trends.

The geographic and habitat distribution of observed changes in numbers of EOs across New England may be affected by the degree of historical and more recent botanical focus given to different sites. For example, continued study of historically well-botanized

Connecticut may result in less dramatic apparent shifts in numbers of EOs, whereas more recent studies in more remote, less well studied areas of Maine might reveal many "new" EOs. Also, the availability of man-hours for field work and record-keeping varies by state and thus influences the probability of detecting new EOs. We attempted to take into account these factors when very conservatively assigning a status of "increasing" to taxa. We also created a new category of taxa that combined those that we evaluated as "increasing" with those that were apparently unchanged in numbers of EOs. The fact that similar trends held (except for habitat distributions) in comparing this new category with declining taxa lends confidence to our conclusions that certain types of taxa are genuinely more vulnerable to decline. Ultimately, the only way to definitively characterize taxa as increasing or declining is to eliminate sampling bias and overcome limitations of presence-only data (Fitzpatrick et al. 2013) by systematically recording both presence and absence of each taxon in a series of targeted surveys across New England.

By comparing 1996 and 2012 Flora Conservanda lists, potential trends in rarity from the past 15 years can be identified, but determining significant temporal trends is problematic when each taxon is comprised of only a small number of populations in New England—20 or fewer for taxa in Divisions 1 and 2 (Regionally Rare), for example. Several taxa that have recently become Regionally Historic since the 1996 Flora Conservanda and are now listed as Division 4 were represented in New England by no more than one or two extant populations in the last 15 years (included in Appendix 3). Those taxa have either always been rare in New England or have been declining for a period longer than that represented in the Flora Conservanda studies. Further, the status of a number of taxa in Division IND. is uncertain. Conversely, many taxa newly included in the 2012 Flora Conservanda list had not been listed as rare by the individual states until after publication of the first Flora Conservanda, and reliable information on previous numbers of EOs has not been gathered. Data on both extant and historic EOs will be necessary to interpret future trends for these taxa.

Additional information is necessary to improve this analysis, in order to gain a more detailed understanding of changes in rarity. In particular, the creation of a quantitative time series of population size for each taxon for which data are available would provide information on how many EOs are extant at a given time, and could

be amenable to generating analyses of population viabilities (Bakker and Doak 2009; Beissinger and McCollough 2002).

Flora Conservanda is a tool for prioritizing conservation action. The taxa listed here may be targets for physical on-the-ground management or may more immediately benefit from further data collection in the field. The increased scrutiny of these taxa since the original publication has been vital for identifying the population changes used for this analysis and for providing data for the list update. Incidentally, almost 40% of the taxa for which detailed NEPCoP Conservation and Research plans have been produced are among those where a change in number of EOs had been noted, and these fell overwhelmingly (43 to 3) into the increased population-number category (data not shown). This is undoubtedly due to the increased search effort given these taxa by NEPCoP surveyors since the publication of the plans. It is hoped that the list will 1) continue to aid the development of priorities for research, protection, and recovery on a regional basis, and 2) help states to coordinate their individual species conservation efforts. The list is not static. Information and discussion on potential errors and omissions are welcomed and encouraged.

ACKNOWLEDGMENTS. We thank the many biologists and volunteers who have tirelessly surveyed and monitored rare plant populations in New England and supported conservation efforts, including members of the Flora Conservanda Committee, and New England Plant Conservation Program Task Forces, and the Plant Conservation Volunteer Corps New England Wild Flower Society. We thank Arthur Haines for much advice on the status of plants in the region. We are grateful to Robert Bertin for sharing data and offering comments that greatly improved the manuscript, and appreciate the very helpful suggestions of two anonymous reviewers.

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APPENDIX 1

Taxa delisted from the 2012 *Flora Conservanda* list because they are now known to be more common or secure in New England.

Family	Scientific Name	Synonym	1996 Status	Reason for Change
Alismataceae	*Sagittaria rigida* Pursh		3	Previously considered disjunct in Sagadahoc Co., Maine. Additional EOs have been found and Sagadahoc is no longer considered disjunct
Apiaceae	*Angelica lucida* L.		IND.	Sufficient EOs are known from ME, particularly Downeast, to not list
Apiaceae	*Lilaeopsis chinensis* (L.) Kuntze		3	ME EOs in York Co., previously considered disjunct, do not occur at significant distance from NH EOs
Apiaceae	*Osmorhiza berteroi* DC.	*Osmorhiza chilensis* Hook. & Arn.	2	Sufficient extant EOs are known from ME and NH to not list this taxon
Apiaceae	*Sanicula canadensis* L. var. *canadensis*		2	Currently 30+ EOs throughout CT, MA, RI, and VT; previously, 17 were listed in VT and MA. Still historic in NH
Apocynaceae	*Asclepias tuberosa* L.		3	Declining EOs have been stabilized through sandplain restoration projects
Asteraceae	*Eupatorium sessilifolium* L.		3	VT EOs in Rutland Co., previously considered disjunct, are not disjunct from Bennington Co. EOs
Asteraceae	*Iva frutescens* L. var. *oraria* (Bartlett) Fernald & Griscom		3	ME EOs in Sagadahoc Co. and Cumberland Co., previously considered disjunct, do not occur at significant distance from NH EOs
Asteraceae	*Nabalus racemosus* (Michx.) Hook.	*Prenanthes racemosa* Michx.	2	Currently 35 EOs in ME; previously 15 were listed
Asteraceae	*Omalotheca sylvatica* (L.) Sch.Bip. & F.W. Schultz	*Gnaphalium sylvaticum* L.	IND.	Sufficient extant EOs are known, particularly in ME, to not list this taxon

APPENDIX 1. Continued.

Family	Scientific Name	Synonym	1996 Status	Reason for Change
Asteraceae	*Symphyotrichum dumosum* (L.) G.L. Nesom	*Aster dumosus* L.	3	Previously considered disjunct in York Co. and Oxford Co., ME. The Oxford Co. EO was a misidentification, and the York Co., ME, EO does not occur at significant distance from NH EOs
Betulaceae	*Betula pumila* L.		3	Previously considered an ecological anomaly in NH, but EOs in similar conditions have been observed in ME
Brassicaceae	*Boechera stricta* (Graham) Al-Shehbaz	*Arabis drummondii* A. Gray	3	Previously considered disjunct in Addison and Rutland Co., VT, but the taxon has been found in additional VT counties
Brassicaceae	*Subularia aquatica* L. ssp. *americana* G.A. Mulligan & Calder	*S. aquatica* L.	2	Sufficient EOs have been identified in ME and NH to not list this taxon
Caprifoliaceae	*Lonicera dioica* L.		3	Previously considered disjunct in Cumberland Co., ME, but has since been observed in other ME counties
Caprifoliaceae	*Symphoricarpos albus* (L.) Blake ssp. *albus*		3	Previously considered disjunct in Franklin Co., MA, but does not occur at a sufficient distance from the Bennington Co., VT, EO
Ceratophyllaceae	*Ceratophyllum echinatum* A. Gray		3	Previously considered disjunct or even historic in ME, but sufficient EOs have been identified to not list this taxon
Chenopodiaceae	*Chenopodium rubrum* L.		3	Previously considered disjunct in Lincoln and Washington Co., ME, but has since been observed in other ME counties
Cornaceae	*Benthamidia florida* (L.) Spach	*Cornus florida* L.	3	Taxon is declining in New England, but not over a significant range

APPENDIX 1. Continued.

Family	Scientific Name	Synonym	1996 Status	Reason for Change
Cyperaceae	*Bolboschoenus maritimus* (L.) Palla		3	Previously considered disjunct in Addison Co., VT, but that EO was a misidentification
Cyperaceae	*Carex albicans* Willd. var. *emmonsii* (Dewey *ex* Torr.) Rettig		3	Previously considered disjunct in Chittenden Co., VT, but has since been observed in other VT counties
Cyperaceae	*Carex arcta* Boott		3	Previously considered disjunct in Grand Isle Co. and Franklin Co., VT, but EOs have been identified in NH so that the VT EOs no longer appear disjunct
Cyperaceae	*Carex backii* Boott		3	Previously considered disjunct in Penobscot Co., ME, but has since been observed in other ME counties
Cyperaceae	*Carex baileyi* Britton		3	Previously considered disjunct in Oxford, Co., ME, but there are now no extant records in ME. The taxon is otherwise too common in New England to list
Cyperaceae	*Carex buxbaumii* Wahlenb.		3	Previously considered disjunct in Addison Co., VT, but does not occur at sufficient distance from EOs in nearby New York State
Cyperaceae	*Carex lupuliformis* Sartw. *ex* Dewey		1	Global rank changed from G3? to G4, and the taxon is otherwise too common in New England to list
Cyperaceae	*Carex mackenziei* V.I. Krecz.	*C. norvegica* Retz.	2	Previously only one EO known from ME, but sufficient EOs have been identified to not list this taxon
Cyperaceae	*Carex muehlenbergii* Schkuhr *ex* Willd. var. *muehlenbergii*		3	Previously considered disjunct in Chittenden Co., VT, but numerous EOs occur in that county so the taxon cannot accurately be described as disjunct

APPENDIX 1. Continued.

Family	Scientific Name	Synonym	1996 Status	Reason for Change
Cyperaceae	*Carex prairea* Dewey *ex* Wood		3	Previously considered disjunct in Cumberland Co., ME, but does not occur at sufficient distance from EOs in adjacent Canada
Cyperaceae	*Carex tetanica* Schkuhr		2(a)	Currently 27+ EOs in CT and MA; previously, 21 were listed. Historic in NH
Cyperaceae	*Carex trichocarpa* Muhl. *ex* Willd.		2	Currently 27 EOs in CT, MA, NH, and VT; previously, 17 were listed
Cyperaceae	*Carex wiegandii* Mack.		1	Global rank has changed from G3 to G4. Previously 11 EOs in New England in ME and NH, now 24+ in ME, NH, and VT. Still historic in MA
Cyperaceae	*Eleocharis quinqueflora* (Hartmann) O. Schwarz ssp. *fernaldii* (Svenson) Hultén	*E. pauciflora* (Lightf.) Link var. *fernaldii* Svenson	2	Currently 23 EOs in ME, NH, VT, and MA (15 in ME); previously, 8 were listed
Cyperaceae	*Scirpus pendulus* Muhl.		3	Previously considered disjunct in Penobscot Co., ME, but has since been observed in other ME counties
Cyperaceae	*Scirpus polyphyllus* Vahl		2	Currently 21 EOs in CT, MA, and VT; previously, 7 were listed in MA and VT. Still historic in NH
Cyperaceae	*Scleria reticularis* Michx.		1	Global rank changed from G3G4 to G4 and the taxon is otherwise too common in New England to list
Ericaceae	*Vaccinium boreale* I.V. Hall & Aalders		1	Global rank changed from G3 to G4 and the taxon is otherwise too common in New England to list
Fabaceae	*Desmodium canescens* (L.) DC.		2	Currently 26 EOs in MA alone; previously, 13 were listed in CT and MA

APPENDIX 1. Continued.

Family	Scientific Name	Synonym	1996 Status	Reason for Change
Gentianaceae	*Gentianella quinquefolia* (L.) Small var. *quinquefolia*		2	Currently 43 EOs in CT, MA, and VT (34 in MA); previously, 16+ were listed. Still historic in ME and NH
Haloragaceae	*Myriophyllum verticillatum* L.		IND.	Sufficient EOs have been verified to not list this taxon
Iridaceae	*Sisyrinchium mucronatum* Michx.		2	Sufficient EOs have been verified to not list this taxon
Isoetaceae	*Isoetes riparia* Engelm. *ex* A. Braun var. *canadensis* Engelm. *ex* N. Pfeiff.	*I. riparia* Engelm. *ex* A. Braun	2	Sufficient EOs have been verified to not list this taxon. Previously, 8 extant EOs were listed in NH, VT, and RI
Juglandaceae	*Juglans cinerea* L.		IND.	Taxon may be declining in New England, but not over a significant range
Lentibulariaceae	*Utricularia resupinata* B.D. Greene *ex* Bigelow		2(a)	Sufficient EOs have been verified to not list this taxon. Previously, "about 20" EOs noted throughout New England
Najadaceae	*Najas guadalupensis* (Spreng.) Magnus		IND.	Sufficient EOs have been verified to not list this taxon
Nymphaeaceae	*Nymphaea tuberosa* Paine		IND.	This taxon is native and secure in VT and determined to be introduced elsewhere in New England
Orchidaceae	*Cypripedium parviflorum* Salisb. var. *pubescens* (Willd.) Knight		IND.	Sufficient EOs have been verified to not list this taxon
Orobanchaceae	*Aureolaria virginica* (L.) Pennell	Scrophulariaceae	3	Previously considered disjunct in Franklin Co., VT, but that EO was a misidentification

APPENDIX 1. Continued.

Family	Scientific Name	Synonym	1996 Status	Reason for Change
Plantaginaceae	*Hippuris vulgaris* L.	Hippuridaceae	2	Previously 4 extant EOs were listed in NH and VT. Sufficient EOs have been verified in ME, making this taxon too common to list
Poaceae	*Agrostis mertensii* Trin.		2	Currently 27+ EOs in ME, NH, and VT (predominantly NH); previously, 18 were listed
Poaceae	*Aristida basiramea* Engelm. *ex* Vasey		IND.	Sufficient EOs have been verified to not list this taxon
Poaceae	*Calamagrostis pickeringii* A. Gray		2	Currently 27 EOs in ME, MA, and NH (21 in NH); previously, 11 were listed. Still historic in VT
Poaceae	*Dichanthelium sphaerocarpon* (Elliott) Gould	*Panicum sphaerocarpon* Elliott	IND.	Sufficient EOs have been verified to not list this taxon
Poaceae	*Graphephorum melicoides* (Michx.) Desv.	*Trisetum melicoides* (Michx.) Vasey *ex* Scribn.	2	Sufficient EOs have been verified in ME to not list this taxon; previously, 2 were listed,
Poaceae	*Leymus mollis* (Trin.) Hara var. *mollis*		IND.	Sufficient EOs have been verified to not list this taxon
Poaceae	*Muhlenbergia richardsonis* (Trin.) Rydb.		2	Currently 23 EOs extant in ME; previously, 2 were listed
Poaceae	*Sporobolus compositus* (Poir.) Merr. var. *compositus*		2	Sufficient EOs have been identified, particularly in CT, to not list this taxon
Poaceae	*Tripsacum dactyloides* (L.) L.		2	Sufficient EOs have been verified in CT to not list this taxon
Polygalaceae	*Polygala senega* L.		2	Currently 22 EOs in CT, MA, and VT (19 in VT); previously, 16 were listed. Still historic in MA

APPENDIX 1. Continued.

Family	Scientific Name	Synonym	1996 Status	Reason for Change
Polygalaceae	*Polygala verticillata* L.		IND.	Sufficient EOs have been verified to not list this taxon
Polygonaceae	*Polygonum douglasii* Greene		2	Currently 29 EOs in ME, NH and VT; previously, 12 were listed
Polygonaceae	*Polygonum tenue* Michx.		3	The previously disjunct EO in Chittenden, Co., VT is now historic, and the taxon is otherwise too common in New England to list
Potamogetonaceae	*Potamogeton confervoides* Rchb.		1	Global rank change from G3G4 to G4 and the taxon is otherwise too common in New England to list
Potamogetonaceae	*Potamogeton strictifolius* A. Benn.		IND.	Currently 26 EOs in CT, ME, MA and VT; previously, 2 verified EOs were listed
Potamogetonaceae	*Potamogeton vaseyi* J.W. Robbins		2	Currently 34 EOs in CT, ME, MA, NH, and VT; previously, 12 were listed
Ranunculaceae	*Ranunculus allegheniensis* Britton		2	Currently approximately 29 EOs in CT, MA, RI, and VT; previously, 16 were listed
Rosaceae	*Potentilla litoralis* Rydb.	*P. pensylvanica* L. var. *bipinnatifida* (Douglas) Torr. & A. Gray	IND.	Sufficient EOs have been verified to not list this taxon
Rubiaceae	*Galium kamtschaticum* Steller *ex* J.A. & J.H. Schultes		IND.	Sufficient EOs have been verified to not list this taxon
Salicaceae	*Salix eriocephala* Michx. ssp. *eriocephala* var. *eriocephala*	*S. cordata* Muhl.	IND.	Sufficient EOs have been verified to not list this taxon

APPENDIX 1. Continued.

Family	Scientific Name	Synonym	1996 Status	Reason for Change
Santalaceae	*Geocaulon lividum* (Richardson) Fernald		2	Currently 20 EOs in ME and NH; previously, 14 were listed. Still historic in VT
Tofieldiaceae	*Triantha glutinosa* (Michx.) Baker	Liliaceae *Tofieldia glutinosa* (Michx.) Pers.	3	EOs exist throughout potential habitat. No longer considered disjunct
Violaceae	*Viola palmata* L.		IND.	Sufficient EOs have been verified to not list this taxon

APPENDIX 2

Taxa that have increased in reported numbers of EOs in New England since the 1996 Flora Conservanda publication. Habitats described in Haines (2011) were used to score species' affinities for single or multiple habitat types. DIV = the NEPCoP division to which the species belonged in 1996 and 2012; – in DIV 2012 column indicates species is no longer rare in New England.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Apiaceae	*Osmorhiza berteroi* DC.	*Osmorhiza chilensis* Hook. & Arn.	2	–	Extant EOs (5) are known in NH and additional EOs are known from ME (>11). Not rare in New England	Mesic, deciduous, and mixed evergreen-deciduous forests in north-temperate and boreal areas
Apiaceae	*Sanicula canadensis* L. var. *canadensis*		2	–	Currently 30+ EOs total throughout CT, MA, RI, and VT; previously 17 total in VT and MA. Still historic in NH	Rich, mesic forests, dry-mesic forests on sandy soils
Apiaceae	*Taenidia integerrima* (L.) Drude		2	2	EOs increased in VT from 7 to 12	River banks, lake shores, and headlands, primarily in regions of high-pH bedrock
Apocynaceae	*Asclepias purpurascens* L.	Asclepiadaceae	2	2	EOs increased in CT from historic to 8 and in MA from 2 to 3	Forest edges, roadsides, dry fields
Aristolochiaceae	*Endodeca serpentaria* (L.) Raf.	*Aristolochia serpentaria*	2	2	EOs increased in CT from 6 to 10	Mesic to dry-mesic forests

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Aspleniaceae	*Asplenium montanum* Willd.		2	2	EOs increased in CT from 6 to 10, but decreased in MA from 3 to 2. VT and RI still have 1 EO each	Primarily noncalcareous cliffs. In MA, confined to western portion of state; in VT, confined to southern portion of state
Asteraceae	*Arnica lanceolata* Nutt. ssp. *lanceolata*		1	1	EOs increased in ME from < 6 to 13 and in NH from 2 to 7	Alpine ravines, gullies, and brooks, sometimes found on middle elevation stream banks whose waters drain high alpine areas; also known from northern, ice-scoured river shores. Northern portion of states
Asteraceae	*Bidens eatonii* Fernald		1	1	EOs increased in ME from 5 to 19 and in CT from 3 to 5. Still 2 in MA	Fresh to brackish-tidal river shores
Asteraceae	*Liatris novae-angliae* (Lunell) Shinners var. *novae-angliae*	*Liatris scariosa* var. *novae-angliae*	1	1	EOs increased in NH from 6 to 8, MA from 33 to 61, RI from 4 to 12, and CT from 11 to 14. Slight decrease in ME from 4 to 3	Woodlands, sandplains, dry fields, sandy sea beaches, roadsides, railroads, limestone outcrops

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Asteraceae	*Nabalus boottii* DC.	*Prenanthes boottii*	1	1	EOs increased in NH from 4 to 7 and VT from 2 to 3. ME still has 3	Alpine plateaus and ridges
Asteraceae	*Nabalus racemosus* (Michx.) Hook.	*Prenanthes racemosa* Michx.	2	–	EOs increased in ME from 15 to 35	Ice-scoured river shores in high-pH bedrock and/or till regions. Northern portion of state
Asteraceae	*Nabalus serpentarius* (Pursh) Hook.	*Prenanthes serpentaria*	2	2	EOs increased in MA from 5 to 10 and RI from historic to 3, but decreased in CT from 3 to 1. ME is still historic	Woodlands, rocky slopes, cliffs, roadsides, power line rights-of-way, sandplains, clearings
Asteraceae	*Symphyotrichum prenanthoides* (Muhl. *ex* Willd.) G.L. Nesom	*Aster prenanthoides*	2	2	EOs increased in MA from 8 to 16. VT also has 1 EO listed	In open areas and along edges of mesic to wet-mesic forests, often riparian types
Boraginaceae	*Cynoglossum virginianum* L. ssp. *boreale* (Fernald) A. Haines		1	2	ME was previously listed as '?' – there are now 5 EOs. EOs increased in NH from 1 to 2, VT from 2 to 3, and MA from historic to 1. Still historic in CT	Deciduous and mixed evergreen-deciduous forests

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Boraginaceae	*Hydrophyllum canadense* L.	Hydrophyllaceae	2	2	EOs increased in MA from 2 to 5. Still 1 in VT	Rich, mesic forests, high-terrace floodplain forests, usually in regions of high-pH bedrock, often associated with cliff bases and streams
Brassicaceae	*Cardamine longii* Fernald		1	1	EOs increased in ME from 9 to 14 and MA from 2 to 8. Still historic in NH and CT. Does not occur in RI	Fresh to brackish-tidal river shores
Brassicaceae	*Draba arabisans* Michx.		2	2(a)	EOs increased in ME from 3 to 5 and in VT from 10 to 22	Cliffs, talus, and headlands in high-pH bedrock regions, ascending to subalpine situations in northern VT
Brassicaceae	*Draba reptans* (Lam.) Fernald		2	2	EOs increased in CT from 4 to 7. Still historic in MA and RI	Sandy and rocky fields, ledges, balds
Brassicaceae	*Subularia aquatica* L. ssp. *americana* G.A. Mulligan & Calder	*S. aquatica* L.	2	–	Along with the EOs in ME (9), EOs have been identified in NH, some large. Not rare in New England	Shallow water of lakes, usually on sand substrate

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Caprifoliaceae	*Triosteum perfoliatum* L.		2	2	EOs increased in MA from 4–5 to 7. CT now lists 2 EOs. RI still has 4	Dry-mesic to mesic forests, woodlands, and forest borders
Caprifoliaceae	*Valeriana uliginosa* (Torr. & A. Gray) Rydb.	Valerianaceae	2	2	EOs increased in ME from 10 to 16, but decreased in NH from 1 to historic. There is still 1 in VT	Evergreen swamps dominated by *Thuja occidentalis*, fen woodlands
Caryophyllaceae	*Cerastium nutans* Raf. ssp. *nutans*		2	2	Previously listed as '?' in VT; now 1 EO. CT now lists '2?' and MA has increased from 1 to 3	Rocky woodlands and forests, balds, cliffs, streams, sandy banks, borrow pits; western New England
Caryophyllaceae	*Minuartia glabra* (Michx.) Mattf.		2(a)	3(b)	EOs increased in ME from 8 to 25 and NH from 4 to 5. Disjunct EOs increased in RI from 2 to 3, but decreased in CT from 7 to 4	Ledges, balds, rock slabs, usually on relatively low summits and ridges, occasionally near sea level on sandy gravel and slabs, typically on granite or soils derived from granite
Caryophyllaceae	*Silene stellata* (L.) W.T. Aiton		2	2	EOs increased in CT from 3 to 8. Still historic in VT and RI	Deciduous woodlands and rocky forests, river banks, roadsides

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Convolvulaceae	*Calystegia spithamaea* (L.) Pursh ssp. *spithamaea*		2	2(a)	EOs increased in ME from 3 to 8, VT from 8 to 11, and MA from 2 to 5. Still historic in CT and decreased in NH from 2 to 1	Sandy fields, roadsides, and clearings, railroads, woodlands, sand plain grasslands
Cyperaceae	*Carex adusta* F. Boott		2	2	EOs increased in ME from 4 to 8. Still historic in NH	Sandy, often well-drained, soils of woodlands, road shoulders, old road beds, and borrow pits
Cyperaceae	*Carex alopecoidea* Tuck.		2	2	EOs increased in MA from 6 to 8 and CT from historic to 2. Decreased in ME from 1 EO to historic. Still 4 EOs in VT	Usually associated with riverine systems
Cyperaceae	*Carex atherodes* Spreng.		4	2	There are now 5 ME EOs and 1 in VT	Marshes and low, open rights-of-way in high-pH bedrock regions
Cyperaceae	*Carex bushii* Mack.		2	2(a)	EOs increased in MA from 3 to 6 and CT from 2 to ~16. Still historic in ME and VT	Mesic to dry-mesic, often sandy, fields, meadows, and open, human-disturbed areas

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Cyperaceae	*Carex davisii* Schwein. & Torr.		2	2	EOs increased in VT from 1 to 2 and CT from 2 to 7. Still 1 in MA	Riparian forests, meadows
Cyperaceae	*Carex glaucodea* Tuck.		2	2	EOs increased in NH from historic to 1 and CT from 1 to '8?'. Still historic in VT and 4 EOs in MA	Meadows, disturbed open soil, wetland borders, and woodlands
Cyperaceae	*Carex livida* (Wahlenb.) Willd.		2	2	EOs increased in ME from 5 to 13, but decreased in MA from 1 to historic. There is 1 EO in NH, and still 1 in VT and historic in CT	Fens
Cyperaceae	*Carex lupuliformis* Sartwell *ex* Dewey		1	–	EOs increased in CT from 2 to 20+	Swamps, lacustrine forests, stream banks, edges of marshes, vernal pools
Cyperaceae	*Carex mackenziei* Krecz.	*C. norvegica* Retz.	2	–	There was previously only 1 EO known from ME, but many additional EOs have been identified	Brackish and saline marshes

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Cyperaceae	*Carex mitchelliana* M.A. Curtis		1	2	EOs increased in MA from 5 to 11, and RI now lists 3	Swamps, both deciduous and evergreen types, stream banks, shorelines, and graminoid marshes
Cyperaceae	*Carex oligocarpa* Schkuhr		2	2	EOs decreased in VT from 4 to 2, but increased in MA from historic to 1 and CT from 1 to 10	Rich, mesic forests and woodlands in high-pH bedrock regions
Cyperaceae	*Carex polymorpha* Muhl.		1	1	EOs decreased slightly in ME from 5 to 3. EOs increased in NH from 1 to 3, MA from 2 to 7, RI from 1 to 2, and CT from 3 to 5	Sandy soils of woodlands, forest edges, borrow pits, and cleared rights-of-way
Cyperaceae	*Carex scirpoidea* Michx. ssp. *scirpoidea*		2	2(a)	EOs increased in ME from 2 to 14 and VT from 11 to 12, but in NH decreased slightly from 6 to 5	Boreal and subalpine ridges, cliffs, and basins, usually on high-pH substrate
Cyperaceae	*Carex sterilis* Willd.		2	3(b)	EOs increased in ME from 3 to 23 and CT from 9 to 14. There are now 2 EOs in VT, MA still has 7, and RI is historic	Fens, river shore seeps, and wet meadows

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Cyperaceae	*Carex tenuiflora* Wahlenb.		2	2	EOs increased in ME from 8 to 17, and there is now 1 in NH. Decreased in VT from 4 to 2	Fens, usually in the shade of *Thuja occidentalis*
Cyperaceae	*Carex tetanica* Schkuhr		2(a)	–	Currently 27+ EOs total in CT and MA, previously 21. Historic in NH	Circumneutral fens, meadows, and graminoid marshes
Cyperaceae	*Carex trichocarpa* Muhl. *ex* Willd.		2	–	Currently 27 EOs total in CT, MA, NH, and VT; previously 17	Wet meadows, ditches, lake shores, riverside marshes and fields, usually in high-pH bedrock regions
Cyperaceae	*Carex vaginata* Tausch		2	3(b)	EOs increased in ME from 3 to 37 and VT from 3 to 5	Evergreen swamps dominated by *Thuja occidentalis*, wooded fens
Cyperaceae	*Carex wiegandii* Mack.		1	–	Global rank has changed from G3 to G4. Previously 11 EOs in ME and NH, now 24+ total in ME, NH, and VT. Still historic in MA	Bogs, often in shade or partial shade of *Picea* or *Larix*, low areas in evergreen forests, and peaty meadows
Cyperaceae	*Carex willdenowii* Schkuhr *ex* Willd.		4	2	EOs increased in CT from historic to 4. Still historic in VT and MA	Woodlands and forests, usually on dry-mesic, rocky or ledgy slopes and ridge lines

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Cyperaceae	*Eleocharis quinqueflora* (Hartmann) O. Schwarz ssp. *fernaldii* (Svenson) Hultén	*E. pauciflora* (Lightf.) Link var. *fernaldii* Svens.	2	–	Currently 23 EOs total in ME, NH, VT, and MA (15 in ME), previously 8	Fens, river shore ledges and seeps, wet cliffs, and peaty lake shores in regions of high-pH bedrock or till
Cyperaceae	*Eleocharis tricostata* Torr.		2	2	EOs increased in MA from 2 to 3 and RI from historic to 1	Sandy or peaty pond shores of the coastal plain
Cyperaceae	*Scirpus ancistrochaetus* Schuyler		1	1	EOs increased in NH from 6 to 11, VT from 9 to 27, and MA from 1 to 2	Beaver flowages, temporary pools, wet depressions, near small ponds
Cyperaceae	*Scirpus longii* Fernald		1	1	EOs increased in NH from 1 to 2 and MA from 4 to 14. ME still has 9 EOs, RI 1, and CT is historic	Graminoid marshes, often adjacent to river channels, acidic fens, river oxbows
Cyperaceae	*Scirpus polyphyllus* Vahl		2	–	Currently 21 EOs total in CT, MA, and VT, previously 7 total in MA and VT. Still historic in NH	Low, riparian forests, stream and pond borders, swamp edges

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Cyperaceae	*Scleria triglomerata* Michx.		2	2	EOs increased in both MA and CT from 1 to 5 and RI from 2 to 3. Historic in VT	Openings in woodlands, moist sandy fields, and low, seasonally wet, sandy areas
Cyperaceae	*Trichophorum clintonii* (A. Gray) S.G. Sm.		2	2	EOs increased in ME from ~7 to 15	Circumneutral river shore outcrops
Dryopteridaceae	*Dryopteris filix-mas* (L.) Schott ssp. *brittonii* Fraser-Jenk & Widén		2	2	EOs increased in VT from 7 to 15. Still 2 in ME and 1 in NH	Rich, mesic, often rocky forests
Ericaceae	*Arctous alpina* (L.) Nied.	*Arctostaphylos alpina*	2	2	EOs increased in NH from 4 to 8. Still 1 EO in ME	Alpine plateaus and ridges
Ericaceae	*Phyllodoce caerulea* (L.) Bab.		2	2	EOs increased in NH from 8 to11, but decreased slightly in ME from 2 to 1	Alpine gullies, ravines, and snow bank communities
Fabaceae	*Desmodium canescens* (L.) DC.		2	–	Currently 26 EOs in MA alone, previously 13 total in CT and MA.	Dry-mesic forests, woodlands, roadsides, and fields

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Fabaceae	*Desmodium cuspidatum* DC. *ex* Loudon		2	2	EOs increased in MA from 3 to 10 and there is now 1 in RI. Still historic in NH and SU in CT, and has decreased in VT from 3 EOs to 1	Dry-mesic to mesic forests and woodlands, these usually on rocky slopes. Usually in southern portions of New England states in which it occurs
Fabaceae	*Desmodium glabellum* (Michx.) DC.		2	2	EOs increased in CT from 5 to 11	Woodlands, roadsides, open power line rights-of-way
Fabaceae	*Senna hebecarpa* (Fernald) Irwin & Barneby	Caesalpiniaceae	2	2	Was previously historic in NH and VT but each has 1 EO now. EOs increased in CT from 2 to 8. There are still 2 EOs in MA. Decreased in RI from1 EO to historic	Fields, roadsides, forest borders, riparian corridors
Gentianaceae	*Gentianella quinquefolia* (L.) Small var. *quinquefolia*		2	–	Currently 43 EOs total in CT, MA, and VT (34 in MA), previously 16+. Still historic in ME and NH	Fields, pastures, roadsides, banks, pond shores; commonly in regions of high-pH bedrock

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Hymenophyllaceae	*Crepidomanes intricatum* (Farrar) Ebihara & Weakley	*Trichomanes intricatum*	1	2	EOs increased in MA from 3 to 10, but decreased in NH from 1 to historic and CT from 3 to 2. VT lists 4 EOs	Growing on basic and acidic rock in sheltered caves, pockets, and crevices
Isoetaceae	*Isoetes acadiensis* Kott		1	1	EOs increased in ME from 1 to 4 and MA from 3 to 6, but decreased in NH from 1 to historic	Slightly acidic lakes and slow-moving streams of eastern New England
Isoetaceae	*Isoetes prototypus* D.M. Britton		1	1	EOs increased in ME from 1 to 4	Cold, clear lakes with mineral substrate
Isoetaceae	*Isoetes riparia* Engelm. *ex* A. Braun var. *canadensis* Engelm. *ex* N. Pfeiff.	*I. riparia* Engelm. *ex* A. Braun	2	–	Sufficient EOs have been verified to not list this taxon. Previously 8 total extant in NH, VT, and RI	Sandy and muddy margins of streams and lakes, including tidal shorelines
Juncaceae	*Juncus torreyi* Coville		2	2	EOs increased in VT from 2 to 10. Historic in ME, and MA now lists 1 EO	Stream shores and ditches in regions of high-pH bedrock, tidal river shores
Juncaceae	*Juncus vaseyi* Engelm.		2	2	EOs increased in ME from 1 to 6. Still 1 in VT	High-pH river shore outcrops, limestone headlands, low boggy fields and ditches

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Juncaginaceae	*Triglochin gaspensis* Lieth & D. Löve		4	1	There are now 6 extant ME EOs	Saline marshes with low vegetation. Eastern ME
Lamiaceae	*Scutellaria integrifolia* L.		2	2	EOs increased in CT from 1 to 3. Still historic in MA	Mainly along the coastal plain, Connecticut River Valley in CT. Mesic to hydric fields and pastures
Lentibulariaceae	*Utricularia resupinata* B.D. Greene *ex* Bigelow		2(a)	–	Sufficient EOs have been verified to not list this taxon. Previously 'about 20' EOs noted throughout New England	Shallow water of lakes and ponds, often associated with sandy substrate, though also occurring on mud and muck
Lycopodiaceae	*Lycopodiella alopecuroides* (L.) R. Cranfill		2	2	EOs increased in MA from 1 to 2, RI from 1 to 4, and CT from historic to 1. ME now lists 2 EOs	Wet, sandy and/or peaty soils along the coastal plain, often in disturbed sites such as abandoned borrow pits and power line rights-of-way. Southern and eastern New England
Lythraceae	*Rotala ramosior* (L.) Koehne		2	2	EOs increased in MA from 1 to 6, RI from 1 to 3, and CT from 5 to 6. NH now lists as historic	Mainly along the coastal plain. Pond shores, on mud, sand, and, rarely, ledge substrate, frequently in areas with drawdown in late season

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Moraceae	*Morus rubra* L.		2	2	EOs increased in MA from 3 to 5 and CT from 1 to 3. Still 2 EOs in VT and now 6+ in RI	Rocky forests, ridges, edge of talus slopes, base of ledges. Western New England
Nymphaeaceae	*Nymphaea leibergii* Morong		2	2	EOs increased in ME from 6 to 15	Circumneutral water of lakes and slow-moving streams. Northern portion of state.
Onagraceae	*Epilobium hornemannii* Rchb. ssp. *hornemannii*		2	2	EOs increased in ME from 3 to 5 and NH from 6 to 12	Boreal to alpine gullies, cliffs, stream banks, and seeps. Northern portion of states
Orchidaceae	*Amerorchis rotundifolia* Banks		2	2	EOs increased in ME from 6 to 11. Historic in NH and VT	High-pH swamps and fens, usually in the shade of *Thuja occidentalis*
Orchidaceae	*Goodyera oblongifolia* Raf.		2	2	EOs increased in ME from 5 to 12. Historic in VT	Evergreen or mixed evergreen-deciduous forests. Northern portions of state
Orchidaceae	*Triphora trianthophora* (Sw.) Rydb.		2(a)	1	Currently 32 EOs total in ME, MA, NH, and VT, previously 22. Still historic in CT	Deciduous forests, usually in association with *Fagus grandifolia* on slopes and benches in hilly terrain
Orobanchaceae	*Agalinis acuta* Pennell	Scrophulariaceae	1	1	EOs increased in MA from 3 to 7. Still 1 EO each in RI and CT	Sandy fields, roadsides, grasslands, and barrens

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Orobanchaceae	*Castilleja coccinea* (L.) Spreng.	Scrophulariaceae	2	2	EOs increased from 4 to 7 in CT. Still historic in ME, NH, MA, and RI	Wet-mesic to hydric meadows, swamps, boggy areas; slopes with seasonal seepage, open rights-of-way
Orobanchaceae	*Pedicularis furbishiae* S. Wats.	Scrophulariaceae	1	1	EOs increased in ME from 26 to 39	Ice-scoured river shores, meadows, and shrub thickets in high-pH bedrock and/or till regions. Northern portion of state
Orobanchaceae	*Pedicularis lanceolata* Michx.	Scrophulariaceae	2	2	EOs increased in CT from 3 to 6. Still 2 in MA	Swamps, stream banks, hydric meadows, fresh-tidal marshes, wet ditches
Oxalidaceae	*Oxalis violacea* L.		2	2	EOs increased in RI from 1 to 3 and CT from 5 to 11. Still 5 EOs in MA and historic in VT	Ridges and rocky slopes, usually associated with trap rock or marble bedrock
Papaveraceae	*Corydalis aurea* Willd.	Fumariaceae	2	2	EOs increased in VT from 6 to 13. Still historic in NH	Lakeshore headlands and cliffs, rocky woodlands
Phrymaceae	*Erythranthe moschata* (Douglas) G.L. Nesom	Scrophulariaceae *Mimulus moschatus* var. *moschatus*	2	2	EOs increased in VT from 6 to 11 and MA from 4 to 6. Now 1 EO in RI. EOs decreased in NH from 3 to 2. Still historic in CT	River and stream shores, seeps, stream-side meadows, low roadsides, ditches. Northern and western New England

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Phrymaceae	*Mimulus alatus* Aiton	Scrophulariaceae	2	2(a)	EOs increased in MA from 3 to 6 and CT from 1 to 18	Stream banks, river shores, fresh-tidal marshes, streamside meadows
Phrymaceae	*Mimulus ringens* L. var. *colpophilus* Fernald	Scrophulariaceae	1	2	EOs increased in ME from 12 to 17	Shorelines, marshes, including fresh-tidal marshes, swamps, wetland margins
Plantaginaceae	*Hippuris vulgaris* L.	Hippuridaceae	2	–	Sufficient EOs have been verified in ME to de-list this taxon. Previously 4 noted in NH and VT	Muddy or peaty shores and shallow, still or slow-moving water of streams, ponds, backwater sloughs, and pools
Plantaginaceae	*Veronica wormskjoldii* Roem. & Schult. var. *wormskjoldii*	Scrophulariaceae	2	2	EOs increased in NH from 2 to 4. Still 1 in ME	Alpine ravines, gullies, and snowbanks
Poaceae	*Agrostis mertensii* Trin.		2	–	Currently 27+ EOs total in ME, NH, and VT (predominantly NH), previously 18	High-elevation ridges and plateaus, boreal and alpine cliffs. Northern counties

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Poaceae	*Aristida purpurascens* Poir. var. *purpurascens*		2	2(a)	EOs increased in MA from 14 to 23 and CT from historic to 1, but RI decreased from 2 to 1	Sandy fields, roadsides, woodland openings, grasslands
Poaceae	*Bouteloua curtipendula* (Michx.) Torr. var. *curtipendula*		2	2	EOs increased in CT from 1 to 4	Dry-mesic to xeric open woodlands and balds, sandy fields, river banks in areas of high-pH bedrock. Western CT
Poaceae	*Calamagrostis pickeringii* A. Gray		2	–	Previously 2 EOs in ME and 9 in NH - historic in VT and MA. There are now 27 EOs	Bogs, gravel river shores, open alpine and subalpine areas, shores of small, usually mid- to high elevation, ponds, peaty meadows
Poaceae	*Calamagrostis stricta* (Timm) Koeler ssp. *inexpansa* (A. Gray) C. W. Greene		2	2(a)	EOs increased in NH from 7 to 8, VT from 2 to 5, and CT from 1 to 3. There is 1 in MA and still 3 in ME	Mainly in boreal to alpine settings

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Poaceae	*Coleataenia longifolia* (Torr.) Soreng ssp. *longifolia*	*Panicum rigidulum* var. *pubescens*	2	2	EOs increased in MA from 6 to 9 and CT from historic to 3. Historic in NH and RI	Sandy and/or peaty pond shores, meadows, edges of marshes, lacustrine and riparian flood plains
Poaceae	*Graphephorum melicoides* (Michx.) Desv.	*Trisetum melicoides* (Michx.) Vasey *ex* Scribn.	2	–	Sufficient EOs have been verified in ME, previously 2, to not list this taxon	Ice-scoured river shores, river shore ledges, inland cliffs, usually in regions of high-pH bedrock or till
Poaceae	*Muhlenbergia richardsonis* (Trin.) Rydb.		2	–	EOs increased in ME from 2 to 23	Ice-scoured river shores, river shore ledges and cobble pavement, in regions of high-pH bedrock or till
Poaceae	*Paspalum laeve* Michx.		2	2	EOs increased in CT from 2 to 5. Still historic in MA	Mesic to wet-mesic fields, shorelines, meadows, river banks
Poaceae	*Paspalum setaceum* Michx. var. *psammophilum* (Nash) D.J. Banks		2	2	EOs increased in MA from 7 to 13 EOs. There are 2 EOs in RI. Still historic in CT	Sandy fields, roadsides, and forest edges

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Poaceae	*Poa laxa* Haenke ssp. *fernaldiana* (Nannf.) Hyl.		1	1	EOs increased in NH from 2 to 7 EOs. Still historic in ME and there is 1 EO in VT	Alpine plateaus, ravines, and summits
Poaceae	*Sphenopholis nitida* (Biehler) Scribn.		2	2(a)	EOs increased in MA from 3 to 13, RI from historic to 3, and CT from historic to 7+. VT still has 1	Dry-mesic to mesic forests and woodlands, often on hillsides and rocky slopes
Poaceae	*Sphenopholis pensylvanica* (L.) Hitchc.		2	2	EOs increased in MA from 4 to 8, RI from not listed to 4, and CT from historic to 6	Open swamps, graminoid marshes, wet meadows, mossy seeps, and banks along streams
Poaceae	*Sporobolus compositus* (Poir.) Merr. var. *compositus*		2	–	Sufficient EOs have been identified, particularly in CT, to not list this taxon	River shores, banks, and outcrops, lakeshore headlands, sandy fields and coastal beaches, dry openings, and barrens
Poaceae	*Sporobolus neglectus* Nash		2	2	EOs increased in MA from 2 to 7 and CT from historic to 2. Still 1 EO in VT, but decreased in NH from 1 to historic. The EO number in ME is unknown	Ledges, river shore outcrops, dry sandy soil of roadsides and fields, often in regions of high-pH bedrock and/or till, more recently naturalizing along heavily salted roadsides

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Poaceae	*Tripsacum dactyloides* (L.) L.		2	–	Sufficient EOs have been identified, particularly in CT, to not list this taxon	Upper border of saline marshes, salt meadows, river shores and banks, dry fields near the coast
Polemoniaceae	*Polemonium vanbruntiae* Britton		1	1	EOs increased in ME from 1 EO to 2 and VT from 8 to 12	Swamps, pond shores, fens, stream-side meadows
Polygalaceae	*Polygala senega* L.		2	–	Currently 22 EOs total in CT, ME, and VT (19 in VT), previously 16. Still historic in MA	River banks and woodlands in limestone and marble bedrock regions, limestone headlands, also on northern, ice-scoured rivers, railroad embankments, roadside clearings in high-pH till regions. Western and northern New England
Polygonaceae	*Polygonum douglasii* Greene		2	–	Currently 29 EOs total in ME, NH, and VT, previously 12	Thin soil of ledges, cliff bases, and rocky woodlands
Potamogetonaceae	*Potamogeton ogdenii* Hellq. & R.L. Hilton		1	1	EOs increased in VT from 2 to 3, MA from 1 to 4, and CT from '?' to 3	Shallow, basic water of lakes

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Potamogetonaceae	*Potamogeton vaseyi* J.W. Robbins		2	–	Currently 34 EOs total in CT, ME, MA, NH, and VT, previously 12	Shallow, still or slow-moving, circumneutral water of lakes and rivers
Ranunculaceae	*Ranunculus allegheniensis* Britton		2	–	Currently approximately 29 EOs total in CT, MA, RI, and VT; previously 16	Mesic forests, woodlands, forest edges, fields, and roadsides, usually in regions of high-pH bedrock
Ranunculaceae	*Ranunculus ambigens* S. Watson		2	2	EOs increased in both NH and RI from historic to 1 and CT from 1 to 4. Still historic in ME and MA	Pond shores, stream shores, ditches, pools, hydric fields, marshes, swamps
Ranunculaceae	*Ranunculus gmelinii* DC.	*Ranunculus gmelinii* var. *hookeri*	2	2	EOs increased in ME from 4 to 7	Slow streams, evergreen swamps dominated by *Thuja occidentalis*, and ditches in regions of high-pH bedrock and/or till. Northern portion of state
Salicaceae	*Populus heterophylla* L.		2	2	EOs increased in CT from 4 to 7. There is 1 EO in MA and RI still has 1	Swamps, pond shores
Salicaceae	*Salix myricoides* Muhl.		2	2	EOs increased in ME from 2 to 17	Ice-scoured river shores in high-pH bedrock and/or till regions. Northern portion of state

APPENDIX 2. Continued.

Family	Scientific Name	Synonym	DIV 1996	DIV 2012	Distribution	Habitat (Haines 2011)
Salicaceae	*Salix planifolia* Pursh ssp. *planifolia*		2	2	EOs increased in NH from 4 to 6 EOs and VT from 1 to 2. ME still has 1	Tarns, brooksides, ravines, seeps, cliff bases, and talus in alpine areas
Santalaceae	*Geocaulon lividum* (Richards.) Fernald		2	–	Currently 20 EOs total in ME and NH, previously center14. Still historic in centerVT	Subalpine heaths, coastal peatlands, mossy openings in boreal and alpine, evergreen forests
Ulmaceae	*Ulmus thomasi* Sarg.		4	2	There are now 4 extant VT EOs	Woodlands and ledges in regions of high-pH bedrock, riparian forests, swamps
Verbenaceae	*Verbena simplex* Lehm.		2	2	EOs increased in MA from center1 to 3 EOs. Still historic in VT and CT	Dry fields, sandplains, ledges, quarries, road cuts

APPENDIX 3
Taxa that have decreased in reported numbers of EOs in New England since 1996 Flora Conservanda publication.

Family	Scientific Name	Synonym	Status 1997	Status 2012	Distribution	Habitat
Adoxaceae	*Viburnum nudum* L. var. *nudum*	Caprifoliaceae	2	4	Not observed since 1979 in RI. Also historic in CT	Swamps, wetland margins, wet-mesic forests
Alismataceae	*Sagittaria subulata* (L.) Buchenau		2	2	Does not occur in MA as previously noted. EOs decreased in CT from 14 to 9	Fresh to brackish-tidal river shores
Altingiaceae	*Liquidambar styraciflua* L.	Hamamelidaceae	2	2	EOs decreased in CT from 8 to '5?'	Swamps and swamp margins
Amaranthaceae	*Amaranthus tuberculatus* (Moq.) Sauer		2	2	Only 3 EOs in VT now considered native (instead of 6)	Fresh water wetlands and shores
Apocynaceae	*Asclepias variegata* L.		2	4	CT EO last observed in 1992	Dry slopes and thickets
Araceae	*Orontium aquaticum* L.		–	2	18 EOs total now in MA, RI, and CT; previously 28 total from MA and CT	Shallow water of lakes and rivers, river banks, including fresh tidal shorelines
Asteraceae	*Erigeron hyssopifolius* Michx.		–	2	16 EOs total now in ME and VT, previously 22+	Cliffs, gorges, and river shore ledges in regions of high-pH bedrock
Asteraceae	*Gamochaeta purpurea* (L.) Cabrera	*Gnaphalium purpureum*	2	4	Last observed 1993 in MA. Also historic in ME, RI, and CT	Sandy soils of fields, grasslands, woodland margins, and beaches

APPENDIX 3. Continued.

Family	Scientific Name	Synonym	Status 1997	Status 2012	Distribution	Habitat
Asteraceae	*Solidago leiocarpa* DC.	*Solidago cutleri*	2	2	EOs decreased in ME from 6 to 3 and NH from 9 to 7. VT still with 1 EO	Alpine ridges, plateaus, and ravines
Asteraceae	*Symphyotrichum concolor* (L.) G.L. Nesom ssp. *concolor*	*Aster concolor*	2	2	EOs decreased in MA from 9 to 5	Coastal plain. Grasslands, sand plains, woodlands
Asteraceae	*Tanacetum bipinnatum* (L.) Sch.Bip. ssp. *huronense* (Nutt.) Breitung		2(a)	2	EOs decreased in ME from 30 to 18	Ice-scoured river shores, usually on gravel substrate
Betulaceae	*Betula glandulosa* Michx.		2	2	EOs decreased in NH from 11 to 7. Still 1 EO in ME	Alpine plateaus, ravines, and snow bank communities
Boraginaceae	*Hackelia deflexa* (Wahlenb.) Opiz ssp. *americana* (A. Gray) A. & D. Löve		2	2	EOs increased in ME from 1 to 3, but decreased in VT from 16 to 9	Rocky forests and cliff bases, in regions of high-pH bedrock

APPENDIX 3. Continued.

Family	Scientific Name	Synonym	Status 1997	Status 2012	Distribution	Habitat
Brassicaceae	*Barbarea orthoceras* Ledeb.		2	4	NH EO last observed 1977. Also historic in ME	Ice-scoured river shores in high-pH bedrock and/or till regions, wet talus in subalpine setting
Caryophyllaceae	*Sagina nodosa* (L.) Fenzl ssp. *borealis* G.E. Crow		2	2	EOs decreased in ME from 10 to 2. Historic in NH	Open, coastal fields, headlands, turfs, and upper beaches, often on thin soils over ledge, in rock crevices, or among stones
Cistaceae	*Crocanthemum dumosum* E.P. Bicknell	*Helianthemum dumosum*	1	1	EOs decreased in MA from 92 to 47. Increased in RI from 5 to 6. Still historic in CT	Open, sandy soils of woodlands, roadsides, clearings, dry fields, and sandplains
Cyperaceae	*Carex gracilescens* Steud.		2	2	EOs decreased in MA from 1 to historic and CT from 5 to '1?'. VT has increased from historic to 2 EOs. Taxon does not occur in NH	Forests, woodlands, edges, and wetland margins
Cyperaceae	*Carex oronensis* Fernald		1	1	EOs decreased in ME from 51 to 29	Wet-mesic to xeric open places such as fields, roadsides, and abandoned paths

APPENDIX 3. Continued.

Family	Scientific Name	Synonym	Status 1997	Status 2012	Distribution	Habitat
Cyperaceae	*Rhynchospora torreyana* A. Gray		2	2	EOs decreased in MA from 10 to 4. Still 1 in RI	Coastal plain pond shores
Ericaceae	*Kalmia procumbens* (L.) Gift, Kron & P.F. Stevens	*Loiseleuria procumbens*	2	2	EOs decreased in NH from 10 to 2. Still 1 EO in ME	Alpine ridges, plateaus, and gullies
Ericaceae	*Rhododendron lapponicum* (L.) Wahlenb.		2	2	EOs decreased in ME from 2 to 1 and NH from 7 to 1	Alpine ridges and plateaus
Gentianaceae	*Lomatogonium rotatum* (L.) Fries		2	2	EOs decreased in ME from 9 to 5	Coastal islands, pools, turfs, and open, rocky areas
Gentianaceae	*Sabatia campanulata* (L.) Torr.		2	2	EOs decreased in MA from 5 to 2	Coastal plain pond shores
Hypericaceae	*Hypericum stragulum* W.P. Adams & N. Robson	Clusiaceae	2	2	EOs decreased in MA from 8 to 2	Coastal plain pond shores, sand plains
Lamiaceae	*Dracocephalum parviflorum* Nutt.		2	4	VT EO last observed 1983, considered exotic in other New England locations	Fields, railroads, yards, lawns, gardens, waste areas, woodlands

APPENDIX 3. Continued.

Family	Scientific Name	Synonym	Status 1997	Status 2012	Distribution	Habitat
Onagraceae	*Epilobium anagallidifolium* Lam.		2	2	EOs decreased in ME from 2 to 1 and NH from 1 to historic	Alpine gullies, slides, and ledges, borders of subalpine brooks
Orchidaceae	*Tipularia discolor* (Pursh) Nutt.		2	2	EOs decreased in MA from 7 to 3	Deciduous forests and woodlands on sandy soils, often near upland edge of swamps and ponds
Plantaginaceae	*Gratiola virginiana* L. var. *virginiana*	Scrophulariaceae	2	4	EOs last observed in RI in 1992 and 1993. Subsequent surveys have been unsuccessful	Shorelines, margins of pools, ditches
Poaceae	*Spartina cynosuroides* (L.) Roth		2	2	EOs decreased in MA from 8 to 7, RI from 3 to 2, and CT from <10 to 1	Saline and brackish marshes
Polygonaceae	*Polygonum glaucum* Nutt.		1	1	EOs decreased in MA from about 40 to 14. Still 3 EOs in RI and historic in CT	Sandy, Atlantic coast beaches
Portulacaceae	*Montia fontana* L.		2	2	EOs decreased in ME from 12 to 8	Rock crevices, peaty turf, stream margins, tidal marshes, pools, and forests near the Atlantic coast

APPENDIX 3. Continued.

Family	Scientific Name	Synonym	Status 1997	Status 2012	Distribution	Habitat
Potamogetonaceae	*Potamogeton hillii* Morong		1	1	EOs decreased in MA from 22 to 13, but increased in CT from 1 to 2. Still > 20 EOs in VT	Shallow, still or slow-moving, circumneutral to basic water of lakes and streams
Primulaceae	*Primula laurentiana* Fernald		2	2	EOs decreased in ME from 14 to 6	High-pH cliffs and ledges, coastal ledges, and turf
Pteridaceae	*Cryptogramma stelleri* (S.G. Gmelin) Prantl		3	2	EOs decreased in VT from > 20 to 4 and NH from 6 to 3. EOs increased in ME and CT, each, from 2 to 4. MA still has 5 EOs	High-pH rocks and cliffs
Ranunculaceae	*Ranunculus micranthus* Nutt.		2	2	EOs decreased in MA from 4 to 3 and CT from 6 to 2. RI still has 1 EO	Rich, rocky, deciduous forests, woodlands, and ridges
Rosaceae	*Amelanchier nantucketensis* E.P. Bicknell		1	1	EOs decreased in ME from 11 to 8 and MA from 50 to 17. RI now lists 1 EO, and the number of EOs in NH and CT are unknown	Fields, roadsides, sand plains, ledges, river shore outcrops, and ridges
Rosaceae	*Prunus maritima* Marshall var. *gravesii* Small		IND.	4	CT EO last observed, with very little live material, in 1998.	Fields, roadsides, dunes, forest borders, and sandy openings near the Atlantic coast

APPENDIX 3. Continued.

Family	Scientific Name	Synonym	Status 1997	Status 2012	Distribution	Habitat
Salicaceae	*Salix argyrocarpa* Andersson		2	2	EOs decreased in ME from 1 to historic and NH from 5 to 4	Alpine ravines, plateaus, and tarn shores
Selaginellaceae	*Selaginella eclipes* W. R. Buck		IND.	4	CT EOs (2) last observed in 1983. Also historic in MA	Mesic to hydric meadows and swamps, rarely on rock; habitat usually influenced by high-pH bedrock
Violaceae	*Viola brittoniana* Pollard		2	2	EOs decreased in MA from 6 to 4. Still 2 in CT	Fields, meadows, trail edges, and forest clearings; adjacent to rivers and coastal marshes, also peaty river shores