BOOK REVIEW

C. Leo Hitchcock and Arthur Cronquist. Edited by David E. Giblin, Ben S. Legler, Peter F. Zika, and Richard G. Olmstead. Illustrated by Jeanne R. Janish, John H. Rumely, Crystal Shin, and Natsuko Porcino. 2018. **Flora of the Pacific Northwest: An Illustrated Manual.** (ISBN-13: 978-0-295742-88-5, hbk). University of Washington Press, Box 359570, Seattle, Washington 98195-9570, U.S.A. (**Orders:** uwapress@uw.edu, 1-206-543-4050). $75.00 US, 936 pp., 7,505 illlus., 2 maps, 7" × 10".

Hitchcock & Cronquist's 1973 *Flora of the Pacific Northwest* was a one-volume derivative of their five-volume flora, the *Vascular Plants of the Pacific Northwest*. The 1973 volume was taxonomically updated from the five-volume set, and was streamlined for brevity, compacted into a single volume for use as a field manual. It has been a solid foundation for regional field and herbarium botany for over four decades. I carried the *Flora of the Pacific Northwest* in my backpack throughout my early years of botanical exploring and kept it close at hand when studying herbarium specimens. My many years worth of marginalia in the 1973 flora form my own "update." A published update was needed. It is now available as the second edition of the *Flora of the Pacific Northwest*.

Updating Hitchcock & Cronquist's *Flora of the Pacific Northwest* is a hefty responsibility. The 1973 volume carries authority. Any new addition would also by default have the look of authority. With use, will the second edition succeed or falter? It will succeed if the project was taken on by authors who know the region's plants very well, who could take the time to access to all the region's major herbaria, who adhere to nomenclatural rules, who have a clear understanding of geography and ecology, who can write clearly, and who could commission good-quality illustrations.

The second edition of the *Flora of the Pacific Northwest*, very thankfully, was printed similarly to the first edition. My copy of the second edition hasn't seen much use, but it does seem to have the durability of the first edition. It is not excessively large or heavy. Unlike so many manuals and floras, you can open this volume to any page and trust that it won't snap shut when let go. The text and illustrations are arranged as in the first edition, with each illustration fitting snugly into the left margins of the keys, as they should be. Unfortunately, the illustrations are pixilated and lacking clarity. For such a well-funded project, I find it surprising that better illustration reproduction wasn't possible.

As in the first volume, the keys double as brief descriptions. Thankfully, the keys are "artificial" rather than "natural" and are formatted as in the first edition (#a/#b dichotomous). The indenting is non-excessive, and the first of each couplet pair is consistently the smaller. These attributes help the user keep track of routes taken through the keys in case backtracking is necessary.

As in the first edition, families are arranged in a taxonomic order. This gives an erroneous impression of linear progression from "primitive" (ferns and other seedless vascular plants) to "advanced" (sympetalous eudicots and monocots). And this makes it necessary to use the index often. Alphabetic order of families would have avoided these problems. If the authors wished to use the volume to teach evolutionary relationships, then phylogenetic trees printed in the introduction would have sufficed.

How well do species key out in the second edition? Regardless of any taxonomic choices made by the authors, the keys mostly work well enough to take a first go at identification. But that "mostly" leaves many exceptions. For example, couplet 1 in *Angelica* makes it difficult to identify *A. genuflexa* and *A. lucida*, as both occur in "maritime" and interior regions, and the involucre character given does not differentiate these two species reliably. Couplet 17 in *Antennaria*, regarding leaf length:width ratios, will have users misidentifying *A. pulvinata* and some *A. parvifolia* as *A. densifolia*, and the illustration of *A. aromatica*, which immediately follows in couplet 18, shows a leaf that would key out in 17a as *A. densifolia*. There are similar problems throughout the volume, as with *Antennaria* couplets 13 and 21, *Eriophorum* couplet 5, *Festuca* couplet 11, *Platanthera* couplet 7, *Rosa* couplet 6, *Salix* couplet 14, *Selaginella* couplet 3, *Spiraea* couplet 5, and so forth. In many cases, some of the

best distinguishing characters are not mentioned in keys, as with the leaf fleshiness or gemma-production of *Hammarbya (Malaxis) paludosa*. Only geographical and elevational range and no morphological characters at all were given in *Downingia* couplet 5, which is troublesome, especially for plants in geographically intervening areas such as Klickitat County, Washington.

Inaccurate descriptions are easily found by browsing the second edition. For example, under *Antennaria monocephala* subsp. *angustata* "upper leaf surface green, occ. less hairy than lower surface" describes only subsp. *monocephala*. The note under *Artemisia rigida* "Lvs rigid and brittle" belies the notably pliant leaves of that species (in contrast to stiffer-leaved related species). *Cardamine parviflora* is misleadingly noted to be similar in appearance to *C. hirsuta*. *Cirsium undulatum* is described as "caespitose," clearly a misuse of that term as there is usually only a single, unbranched root crown in that species. The description of *Delphinium sutherlandii* omits the key character of lower petal colour. Errors in identification may come from the description of *Hieracium piloselloides*: "lvs glabrous on upper surface, or nearly so," which is misleading as the leaf upper surface characteristically bears conspicuous setae. Also, the authors seem to be unaware of the presence of stoloniferous forms of *H. piloselloides* in the flora area. The flowers of *Lloydia serotina* var. *flava* are misdescribed as "yellow with yellow to green veins." As noted in the original description of that variety, the epithet refers to the yellow veins only; the tepals are white as in the nominal variety. The description (and illustration) of *Phlox caespitosa* applies to *P. douglasii*, which is listed in synonymy, but which is widely known to be sharply different from *P. caespitosa*. Even if the authors believe that *P. douglasii* is best combined with *P. caespitosa*, the description of the latter must include the characters of typical plants, and the illustration must be similar to the type specimen. The frequent occurrence of red petals of *Saxifraga aizoides* is not reflected in the description. Similar errors are unfortunately common in descriptions throughout the second edition.

In any work of taxonomy or floristics, authorities must be correctly reported. This is to avoid confusion in cases of homonyms, to make it easier to trace the publications of taxa to their original descriptions and any recombinations or validations, and to correctly attribute the work of authorship. I would never have expected to see a flora with so many incorrectly listed authors. For example, *Arnica angustifolia* subsp. *tomentosa* (Macoun) G.W. Douglas & Ruyle-Douglas should have "J.M. Macoun," not "Macoun" as the basionym author; those are two different authors. *Bromus sitchensis* var. *marginatus* (Nees ex Steud.) B. Boivin should not include any validating author in the basionym authority, and the species is given as *B. sitchensis* Trin, without a period as in Trinius' standard abbreviation. The genus *Kelloggia* is given as "*Kelloggia* Torr. ex Benth. & Hook.," followed after a gap of a few spaces by the vernacular name of "f. Kelloggia." The "f." notes the second recombining author (correctly cited as Hook. f.) as Joseph Dalton Hooker rather than Hook. (William Jackson Hooker). *Madia sativa* Mol. is not correct, the author's name in standard form is spelled out fully. "*Navarretia divaricata* (Torr. ex A. Gray) Greene" is incorrect; Greene is the basionym author of the species under *Navarretia*, as the basionym in *Gilia* is a later homonym of *Gilia divaricata* Nutt. Very commonly throughout the volume, authorities' names are correctly spelled in full, but with a period on the end, as under "*Aspidotis densa* Lellinger."

Basic rules of nomenclature are violated in some entries in the second edition. Taxonomy and floristics cannot work without adherence to those rules. As examples, *Arabidopsis lyrata* is listed in synonymy under *A. kamtschatica*, though the former is the older name. The range of *Callitriche fassettii* is given as "CA sp., reported from OR, but no specimens seen"; the type locality is in Oregon (*Suksdorf 2746*, "near Dalles City"), so Oregon is automatically within the species' range; a type cannot be excluded from the taxon it represents. *Lupinus lepidus* var. *lepidus* is given *L. minimus* in its synonymy, though the type locality and the rest of its reported range is not included, nor is the synonymy reflected in the description. Listed in synonymy under *Perideridia montana* is the non-existing name *P. gairdneri* subsp. *bolanderi*. *Phlox hoodii* is listed in synonymy under *P. caespitosa*, but the former is also treated as an accepted species. *Arenaria stricta* is listed in synonymy under *Sabulina macra*, though the geographical range of *A. stricta* (no authority given) is not included under that species, presuming they refer to *A. stricta* Michx. (which should be represented by the nomen nov. *Sabulina michauxii* (Fenzl)

Dillenb. & Kadereit). The authors treat *Selaginella densa* R. Sim, which is illegitimate as *S. densa* Rydb. is conserved. Autonyms are often given as the sole entry in synonymy; there is no need to do that when no infrataxa are accepted, as that automatically synonymizes the autonym. The spelling of epithets sometimes violates the rule of gender agreement, as with "*Anticlea occidentale,*" "*Lomatium fusiformis,*" "*Nasturtium sterilis,*" and "*Papaver radicatum* var. *kluanensis*."

The newly added illustrations in the second edition are of varying quality, but many were done in heavy, dense line that are obscure with reduction (*Castilleja victoriae*, for example). Some of the illustrations are unambitious, as with *Lomatium piperi*, *Symphyotrichum chilense*, *S. novi-angliae*, and *S. pilosum* (in the first and third of these, it isn't clear to me what exactly the illustrations are supposed to show). *Phacelia inconspicua*, *P. scopulina*, and *P. verna* are illustrated only by a single isolated flower, which is not particularly useful in this genus in which plant habit and leaf characters are key to identification.

Among the illustrations that did not appear in the first edition, many are inaccurate and misleading. The illustration of *Antennaria media* appears to be *A. microphylla* s. str. instead. *Antennaria monocephala* subsp. *monocephala* is shown with a hemispheric involucre (campanulate is correct), and the phyllaries are shown appressed (squarrose is correct). *Arnica gracilis* is illustrated as a plant that does not appear like that species. *Draba thompsonii* is shown without its characteristic twisted fruits (except one out of several that appears somewhat twisted). A long rhizome appears in the illustration of *Eriophorum callitrix*, which is incorrect for that caespitose species. *Erythranthe ptilota* is shown with corollas too small in relation to the size of the leaves. The illustrations of *Townsendia condensata*, *T. leptotes*, and *T. spathulata* are misleadingly unlike those species.

Some of the Janish and Rumely illustrations are misleading, sometimes due to transfer to a taxon different from the original intention, sometimes owing to non-typical plants having been illustrated in the first place. In the latter case, corrections should have been made, and in the former, new illustrations should have been commissioned. The illustration of *Alopecurus saccatus* appears to show an intermediate between that species and *A. carolinianus*. *Aphyllon purpureum* appears more like *A. uniflorum* by corolla shape and flare, and by one of the calyces. *Chrysosplenium tetrandrum* is incorrectly shown with long, sprawling stems. *Drymocallis arguta* is illustrated with *D. convallaria*. *Lysimachia europaea* is illustrated with *Trientalis arctica*, which would cause confusion were that taxon to be resurrected with a recombination in *Lysimachia*. The illustration of *Perideria montana* is a plant of *P. gairdneri* instead. *Salix petrophila* is illustrated with a plant that is clearly not that species.

The number of taxa omitted is surprisingly large. Some of those omitted are known to occur within the range covered by the second edition, others occur nearby and which are to be expected. If the authors reject these species taxonomically, they should have listed them in synonymy. Not accounting for them at all leaves the user of the manual wondering whether the authors studied and rejected the taxa, or just forgot to include them. I found no mention at all, even in synonymy, of *Alchemilla monticola*, *A. subcrenata*, *Amelanchier basalticola*, *A. humilis*, *A. lamarckii*, *Anchusa arvensis*, *Anemone nemorosa*, *Arnica louiseana*, *Artemisia ludoviciana* subsp. *gnaphaloides*, *A. tridentata* subsp. *xericensis*, *A. verlotiorum*, *Atriplex powellii* var. *powellii*, *Botrychium alaskense*, *Bromus riparius*, *B. squarrosus* infrataxa, *B. subvelutinus*, *Calamagrostis epigeios*, *Callitriche stenoptera*, *Carex adusta*, *Carex aquatilis* var. *substricta*, *C. brunnescens* var. *sphaerostachya*, *C. canescens* var. *disjuncta*, *Carex hindsii*, *C. rupestris* var. *drummondii*, *C. sitchensis*, *C. xerantica*, *Cicuta virosa*, the genera *Anemonastrum*, *Sinosenecio*, *Tomostima*, and so forth. Most of the recurrent hybrids occurring in the region are not mentioned, such as *Dryopteris* × *uliginosa*, *Elyleymus* × *uclueletensis*, *Erigeron* × *arthurii*, *Hieracium* × *fuscoatrum*, *Populus* × *hastata* and so forth. Conversely, some taxa are mistakenly included.

It is good to see the results of decades of work in systematics reflected in the delimitations of families and genera. But at the level of species, the authors retreated to a coarse taxonomy for many genera, such as *Amelanchier*, *Antennaria*, *Cirsium, Drymocallis, Fragaria,* and *Potentilla*. For other genera and species complexes that have long been known to need revision, no revision is given in the second edition. Some recent

taxonomic revisions that were already in widespread use in the region were disregarded in the second edition, generally without explanation. Why upend those decades of taxonomic progress? Why not retain those species that had already come into wide use, and let the users decide whether to lump or to split? It's more difficult for flora users to know what taxa could be resurrected from synonymy than it is to know what might be combined, if one chooses, into species aggregates.

Knowing species' habitats can help corroborate morphology-based identifications, but for that to work, habitat notes must be accurate and succinct. Listing habitat types instead of summarizing commonalities often fails to accomplish this, and it's a waste of space. For example, "lowl[and] to alp, talus, scree, rocky slopes and ridges, meadows, streambank, open damp for[est]" for *Androsace septentrionalis* could simply have been 'more or less open sites'. For *Carex hoodii,* the habitat description "dry or mesic meadows, rocky slopes, scree, talus, open for[est], sagebr[ush] des[ert]" could be put simply and accurately as "open sites." For *Antennaria pulcherrima,* "streams, wet thickets, peatlands" is inaccurate; it does not grow in streams, but rather in more or less open, calcareous wetlands (it is an obligate calciphile). Calciphily and other substrate requirements are generally omitted from the habitat descriptions, which is unfortunate since such a large percentage of species in the flora could be identified based in large part on their habitats.

Some of the habitat accounts are simply untrue, as with *Arctous rubra*: "wet spruce for[est], bogs and fens," whereas the species is largely limited to tundra, less often in the first of the habitats listed (which should have been listed as "muskeg"). *Carex vallicola* is described as growing in "dry to mesic grassy slopes, open for[est], riparian zones, sagebr[ush] des[erts]," but the species does not grow in riparian zones, or in deserts of any sort. When it grows with sagebrush, it is with *Artemisia tridentata* subsp. *vaseyana*, a montane species of forest clearings. *Erigeron lonchophyllus*: "meadows and other moist places, gen in mountains" does not describe its requirement for calcareous or saline soils. Likewise for *Eriophorum viridicarinatum*, which is another obligate calciphile in relatively warm microclimates compared with most other *Eriophorum* species, though the authors wrote of it "cold swamps and peatlands." *Erythronium idahoense* is given "grassland and ponderosa for[est]," though it is seldom found in those habitats.

Habitat terms are misused commonly. "Alkaline" is used for saline (saline habitats are not all necessarily alkaline, and alkaline habitats are commonly not saline). "Woodland" is often used for species that grow not in what most people would colloquially refer to as woodland, but rather in continuous conifer forest. The authors seem to be unaware of what a bog is. The habitat of the species *Rudbeckia alpicola* is given as "thickets, bogs, and along streams," though there are no bogs in the species' range. Similarly, the term "swamp" is misused, as for *Drosera* species that do not grow in swamps (i.e., flooded forests). Habitat notes are often not given at all, as for *Castilleja elmeri*, *Castilleja rhexiifolia*, *Galium boreale*, *Navarretia propinqua*, *Phlox kelseyi*, *Poa glauca*, *Polystichum kwakiutlii*, and for many infrataxa.

Geographical ranges, like habitats, can help corroborate identifications. As in the first edition, the authors generally captured the scope of geographical ranges on the scale of states, provinces, and territories, as known to them, in as few terms as possible, which is good. These range descriptions are sometimes confusing, as with "absent in ID, se BC, MT, s to NM" for *Carex inops* var. *heliophila*, which leaves one wondering whether the authors meant that the taxon is present or absent in se BC and MT. The geographical distributions for infrataxa are often left vague, especially for the grasses. No geographical range is given at all for many taxa.

For large numbers of species, major portions of the ranges were left out. This includes, for example, the omitted Canadian portion of the ranges of *Artemisia douglasiana*, *Lupinus sulphureus* var. *sulphureus*, and *Thermopsis rhombifolia*. *Carex aquatilis* var. *dives* is not, as the authors describe, disjunct in Montana, as there is a large area of interior British Columbia and northern Idaho where the taxon is common. *Cirsium flodmanii* is given the range description "Alta to MT, CO, e to GL; reported further w." Occurrences in BC and WA are documented. The authors seem to be unaware of the trans-Canada distribution of the range of *Eutrochium maculatum*. *Hordeum jubatum* var. *intermedium* is described as occurring in "n RM to n Gr Pl" (northern Rocky

Mountains to northern Great Plains, though the taxon is common in central British Columbia, far west of the Rocky Mountains. The type locality of *Lupinus argenteus* var. *depressus* is omitted from the geographical range given by the authors. *Lupinus lepidus* var. *aridus* is given the range description "sc WA to n CA and NV, e to sc ID," though it is well known to occur in northeastern Washington and further north in Idaho. The east-central Idaho portion of the range of *Paronychia sessilifolia* was left out. The well documented interior populations of *Fritillaria camschatcensis*, *Lupinus nootkatensis*, *Rubus spectabilis*, and *Vaccinium parvifolium* were omitted.

Some geographical ranges given by the authors should doubted, as with their claim of *Carex amplifolia* in Alaska. The statement "c BC s, mostly e Cas, to ID …" for *Antennaria parvifolia* is incorrect as the species was documented in coastal regions only from a horticultural specimen. *Artemisia cana* does not occur in British Columbia. *Artemisia spiciformis* and *Artemisia tridentata* subsp. *wyomingensis* do not occur in Washington; floristic botanists should know that *Artemisia* is very frequently misidentified, and that should prompt extra effort of verification. *Braya humilis* does not occur in "sw BC." *Erythronium grandiflorum* var. *grandiflorum* is attributed to interior CR [Columbia River] Basin; the region referred to as the Columbia Basin is the dry, sagebrush lands of central Washington and north-central Oregon, where the taxon is absent. The range of *Lupinus littoralis* is given as "c BC to CA," but it is strictly coastal and could not possibly occur in central British Columbia. *Pyrrocoma scaberula* is attributed to the "n SR Plains." [northern Snake River Plains], which presumably refers to southernmost reports, which are on the Cuddy Mountains, not part of the Snake River Plains. Further, the common name given for *P. scaberula* is "Palouse goldenweed," though it does not grow in the Palouse. *Woodsia ilvensis* in western North America is limited to the arctic and boreal, and almost certainly does not occur in the flora area.

The authors of the second edition of the *Flora of the Pacific Northwest* seem not to know how to apply geographical terms accurately. Some would argue that including southern British Columbia and southwest Alberta in "the Pacific Northwest" is inappropriate for far southwestern Canada. Alberta should be abbreviated AB, not the obsolete "Alta." The Rocky Mountains do not extend west to Oregon. The Cascade Mountains extend north into British Columbia, but only barely. North of that, the mainland coastal Cordillera are called the Coast Ranges. So ranges given as "AK s in Cas to CA …" (*Arnica chamissonis*) and "ne BC s, e Cas to MT, CO, e to Atl" (*Antennaria neglecta*) make no sense.

As a field manual, the *Flora of the Pacific Northwest*, second edition should serve multiple purposes, just as its predecessor. It should allow the user to identify species in the field and in the herbarium, it should preserve a snapshot of taxonomic knowledge at the time of publication, it should be useful to extract species lists for biodiversity studies and conservation, and the illustrations and species descriptions should give reliable standards for taxon concepts. On these criteria, the second edition lives up to some expectations, but it also fails in some important ways.

While the second edition may suffice for field identifications, too many of the keys will either lead to incorrect identifications or to overly broad species concepts. Further confusion will come from the omission of so many taxa, or from the misleading geographical and habitat notes. More sources will have to be consulted after returning from field excursions. For herbarium identifications, I would recommend using original taxonomic literature or floras that were written with better care.

Should the second edition serve as a trustworthy source for building checklists? Correct concepts of taxa are communicated not just by their epithets, but also (for unambiguous clarity) by the authorities attached to those epithets. Therefore, both the epithets and the authorities must be given correctly. The second edition simply gives too many nomenclature errors to make it a reliable source. If the authors had taken the time to consult the recognized nomenclatural sources, they would have avoided this problem. Checklists may also rely on accurate reporting of geographical ranges of taxa—if a flora gives incorrect geography, the user will believe that they are making errors of misapplication in the omitted portion of the taxon's range. If I were to use the second edition to build a checklist of plants that grow in, for example, northern Idaho, I would derive a list

that would exclude many taxa and that would include taxa that are not present, and the taxonomy would be unsatisfying. The ecological accounts are so far off that I can't recommend using the second edition to learn, for example, what species can be expected in sagebrush steppe or in a certain wetland type. Aside from the problems of using the second edition for geographical distributions, the second edition presents a taxonomy that is too coarse for use in listing conservation-priority taxa, as too many rare taxa that are widely recognized are in the second edition synonymized or omitted.

Lastly, will the illustrations and species descriptions consistently give correct impressions of the key characters and general appearance of each plant? Certainly not consistently. Anyone using the second edition frequently will have to sketch in a lot of marginalia to correct the errors. I would have hoped that any update to Hitchcock & Cronquist 1973 would have been as useful in the year of its publication as the original was in 1973 in this regard.

Overall, the second edition of the *Flora of the Pacific Northwest* was an opportunity missed. Just by browsing, I have found an overwhelming number of errors and questionable taxonomic treatments (most of which I leave out in this review for brevity). For taxonomy, nomenclature, and for knowledge of individual plant taxa, the second edition is a detour from contemporary standards, or in other words, a lowering of the bar in regional botany at a time when the botanical culture of the northwest US and southwest Canada has needed that bar raised.—*Curtis R. Björk, UBC Herbarium, Beaty Biodiversity Museum, 2212 Main Mall, University of British Columbia, Vancouver, BC V6T 1Z4, CANADA*