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The Hardy Fern Foundation was founded in 1989 to establish a comprehensive collection of the world's hardy ferns for display, testing, evaluation, public education and introduction to the gardening and horticultural community. Many rare and unusual species, hybrids and varieties are being propagated from spores and tested in selected environments for their different degrees of hardiness and ornamental garden value.

The primary fern display and test garden is located at, and in conjunction with, The Rhododendron Species Botanical Garden at the Weyerhaeuser Corporate Headquarters, in Federal Way, Washington.

Satellite fern gardens are at the Stephen Austin Arboretum, Nacogdoches, Texas, Birmingham Botanical Gardens, Birmingham, Alabama, California State University at Sacramento, Sacramento, California, Coastal Maine Botanical Garden, Boothbay, Maine, Dallas Arboretum, Dallas, Texas, Denver Botanic Gardens, Denver, Colorado, Georgeson Botanical Garden, University of Alaska, Fairbanks, Alaska, Harry P. Leu Garden, Orlando, Florida, Inniswood Metro Gardens, Columbus, Ohio, Lewis Ginter Botanical Garden, Richmond, Virginia, New York Botanical Garden, Bronx, New York, and Strybing Arboretum, San Francisco, California.

The fern display gardens are at Bainbridge Island Library, Bainbridge Island, WA, Lakewold, Tacoma, Washington, Les Jardins de Metis, Quebec, Canada, University of Northern Colorado, Greeley, Colorado, and Whitehall Historic Home and Garden, Louisville, KY.

Hardy Fern Foundation members participate in a spore exchange, receive a quarterly newsletter and have first access to ferns as they are ready for distribution.

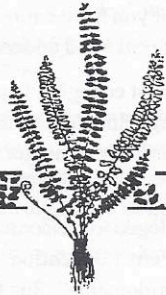
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HARDY FERN FOUNDATION QUARTERLY

THE HARDY FERN FOUNDATION

QUARTERLY

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The Spore Exchange Needs You!

Please continue to send spores to:

Shannon Toal
9843 41st AVE SW
Seattle, WA 98136

President's Message Winter 2002/2003

I hope all of you have enjoyed the happiest of holidays and will be able to welcome a New Year of peace and understanding.

One of the most engaging features of gardening is the anticipation of approaching seasonal offerings. In addition to the spring ritual of greeting newly unfurled fronds and grooming our fresh, reinvigorated specimens, one looks forward to coming events of the year.

We are privileged to welcome members of the British Pteridological Society along with our Hardy Fern Foundation members in mid summer 2003 for meetings, tours and general "Pteridomania". Sue Olsen has spent many hours these past months arranging and organizing events that will provide a varied and most interesting agenda. There are still a very, very limited number of spaces available. For further information please contact Sue directly at (425) 747-2998 or e-mail at Foliageg@juno.com.

The Northwest Flower and Garden Show will be held again at the Convention Center in Seattle, Washington, February 19–23, 2003. Board member Richie Steffen will lecture on the Great Plant Picks Program on Thursday, February 20 @ 9:45 A.M. and we're pleased to note that *Polystichum polyblepharum*, the tassel fern, has been honored as the first fern to make this select list.

We can always use help in set up and take down of our display as well as hosting the booth in shifts during the show. To volunteer please call Michelle Bundy at (206) 835-1290 or send her an e-mail at thebundys5@attbi.com. As in the past volunteers receive free admission to the show and can enjoy a breath of spring during our dreary February.

On behalf of the Board of Directors I would like to thank Ralph C. Archer for his dedicated efforts in conducting the Fern Frond Emergence Study these past two years. I know this requires a lot of time and energy and we are pleased to be publishing his collected data and analyses in this issue of the Quarterly. Thanks also go to those of you who have regularly contributed articles including John Scott whose research on forms of *Polystichum acrostichoides* continues in this issue, Catharine Guiles and Joan Gottlieb for their always well crafted and researched articles of interest and especially Jim Horrocks who has faithfully provided a fern profile for every issue since the first days of our publication. All articles have provided substance for our most informative publication and are truly appreciated.

We're pleased to learn of the garden renovation and renewed activity in establishing a comprehensive fern collection at our affiliate, Whitehall, in Louisville, KY. I thank Ralph Archer, again, for his efforts in organizing the planting and design of the new fern area, which includes a major donation from his personal plant collection. The work will continue and we look forward to a comprehensive report this spring. Whitehall's expansion includes a fern "stumpery" and Roger Hughes reports from our satellite in Nocadoches, TX that they too have a stumpery in the design stages. He promises to document the development with an illustrated article for an upcoming Quarterly. We look forward to the reports.

Locally we are pleased to have been given tentative approval from the administration at the Washington Park Arboretum in Seattle for developing a fern display garden and educational exhibit adjacent to their visitor center. This "signature garden" will provide a highly visible opportunity to increase public awareness of the great variety of hardy ferns and to promote their usefulness and beauty in our gardens.

After many years of devoted service Mayde Anderson has turned over the task of collecting and sorting our mail to yours truly. A gifted gardener and fern devotee, Mayde has provided many hours of help and support as well as generous donations of plants for our sales. We all thank you Mayde with a private but stirring round of applause!

Meanwhile, my appreciation goes out to all members for their cooperation and involvement on a continuing basis.

Best regards,
Pat Kennar
President

In Memoriam

We are sorry to report that Mareen S. Kruckeberg, a founding HFF board member passed away on Jan. 1, 2003. Our sincerest condolences to her family. She will be sorely missed.

Welcome New Members

David Andrews
Bob Check
John DeMarrais
James A. Duke
Danny Dunlap
Susan Ewalt
James Honeycutt
G. Joan Lawson
City of University Place
James Montgomery
Tom Pfeifer
Sharon and Michael Rosenthal
George Sanko
GPC Botanical Garden

On the Trail of the Galapagos Tree Fern

Alan Ogden - Birmingham, England

For an admirer of Charles Darwin a trip to the Galapagos Islands is an ambition to be fulfilled if at all possible. I was offered a trip with a "photographic safari" in the year 2,000 to share a cabin with a friend and to help make up numbers. I thought I knew enough about photography to bluff my way through but fortunately this wasn't necessary as several other members of the party were bird watchers, not photographers.

Before we went I tried to get some books and information about the wild-life there particularly ferns which are something of an obsession of mine. For such a famous place the Galapagos seem remarkably poorly provided with books and there wasn't much available on botany, never mind ferns.

Enquiries from the British Pteridological Society and from other enthusiasts were not very productive, indeed, one man wrote to say that his impression of the islands was that they were arid. Perhaps a short explanation of the climate might be helpful here. The archipelago is on the equator about 700 miles off the coast of Ecuador. The islands are volcanic in origin and there is hardly any rainfall except in the El Niño years when it may rain quite a lot. In the main the rainfall is pretty meagre. The islands are bathed in the Humboldt current which brings cold water from Antarctica and the result of this is that there are lots of clouds.

The low lying islands are very dry and the vegetation consists of cacti and spiny shrubs but on the mountainous islands the volcanoes have their heads in the clouds quite literally and this results in a good deal of condensation so that the upper regions are wetter. In some cases there may be enough water to form ponds or the water may percolate downwards to form oases where there are depressions. These can be small gardens of life in the midst of a sterile lava field which looks like a desert.

I did not appreciate these differences before my visit so when we went to the wild tortoise reserve on Santa Cruz, one of the largest inhabited islands, I was surprised to pass through farms where cows were grazing and to see bracken growing by the roadside. When we walked in the reserve I was surprised to find a large lake where the tortoises enjoyed a wallow in the mud. Even more surprising were the curtains of moss which hung from the trees (mentioned by Darwin) and the numbers of ferns which grew under the trees. There were some *Adiantums* of the pedate type and some others I could not identify.

I took photographs of these of course but still had the utmost difficulty in putting names to them. A year later I found a book called "Flowering Plants of the Galapagos" by Conley K. McMullen which, despite its title, contained pictures and descriptions of many ferns. Needless to say, I was delighted and, what was more, the book contained a description of the Galapagos tree fern, *Cyathea weatherbyana*. Two eminent members of the B.P.S., the chairman of the tree fern group and the owner of a famous nursery which sells tree ferns, had never heard of it.

This year I had the chance to visit the islands again so, as you can imagine, I jumped at the offer. I resolved to track down the Galapagos tree fern if I could. Fortunately we were having the same guide as on my previous visit, Santiago Bejarano, so I was able to

email him in Quito to ask if it would be possible to see the Galápagos tree fern during our visit.

Now I need to explain the system of guides in the Galápagos. In such a sensitive ecosystem tourists are not allowed to visit any site without an authorised guide. These are remarkable people who have to be able to speak several languages and who also have an extensive knowledge of the plants and animals. Visitors go to demarcated sites where they have to stay in special paths and not go outside the marker posts. One is not allowed to pick the plants, collect shells and driftwood or feed or touch the fauna. This is often very difficult because the birds and animals are ridiculously tame and will sometimes investigate your camera case or ruck-sack. Boobies will take nesting material from your hand and poke it into place while you watch.

Santiago replied that he didn't know where to find the tree fern but would ask at the Charles Darwin Research Institute which is at Puerto Ayora, the largest town on Santa Cruz. A few days later he wrote to say that he had the information and if I would be willing to pay about \$20 US for a taxi to take us from Puerto Ayora into the uplands we could go to see the tree ferns. Wonderful! I agreed.

Our yacht came to Puerto Ayora a few days into our tour and while the rest of our party visited the Charles Darwin Research Institute Santiago and I went to the uplands. Our taxi was rather a venerable vehicle like most of the cars and buses on the island and our driver didn't mind waiting while we went exploring. There is one main road on Santa Cruz and it crosses the island from Puerto Ayora to Baltra on the other side, the site of the main airport. The road winds up the mountain through farmland, villages, and groves of bananas. The road surface is remarkably good having been built by the Americans who used the airport in the defence of the Pacific. After a few miles we came to a sign "Beware tortoises crossing" (in Spanish, of course) and then the road began to rise more steeply, the vegetation changed to scrub growing right down to the roadside and there were no more buildings.

A little further on there was a stopping place by the side of the road and we pulled over and parked. The light was very poor and rain was threatening but I took my camera gear - I would need pictures to prove I had found the tree fern.

Santiago led me off the road onto a narrow footpath which disappeared off into the trees. These *Scalesia* trees are very strange, being members of the daisy family. Under the trees grew various ferns but we pressed on until we came to an enormous crater which was almost circular and about quarter of a mile across. The sides were sheer as it was a collapsed vent of an ancient volcano. This crater was one of two and the road runs between them. Strange unidentified plants grew all around including a beautiful club moss which looked like a grove of dwarf pine trees. It was a botanical wonderland and I could have happily spent days there but we didn't have much time and we had to find the Galápagos tree fern.

We worked our way round the giant crater and I feverishly took photographs of all the plants - often having to use flash as the light was so poor. Eventually we found them, the tree ferns, growing out of the sides of the crater and quite inaccessible for collection of spores or samples of the fronds. I did get some nice pictures though. It isn't very

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On the Trail of the Galapagos Tree Fern continued from page 5

impressive as tree ferns go but it obviously is one! It was named after Charles Weatherby who worked at the Gray Herbarium and who was the mainstay of the American Fern Society for many years.

All too soon it was time to make our way back to the waiting taxi driver who probably thought I was mad. I dragged my feet, trying to get photographs of all the ferns on the way back. The *Doryopteris pedata* was the easiest to identify but I could only guess the genus of others. Elaphoglossum? Polypodium?

All too soon we were on our way back to the harbour where we had to meet the others and take the dinghy back to the yacht. After lunch we had another trip, in an ancient coach this time, to the tortoise reserve which was so much overgrown due to the El Niño rain that we were unable to get through to the lake. We visited a lava tunnel where I found another rare fern, a maidenhair, *Adiantum macrophyllum*, growing in semi-darkness.

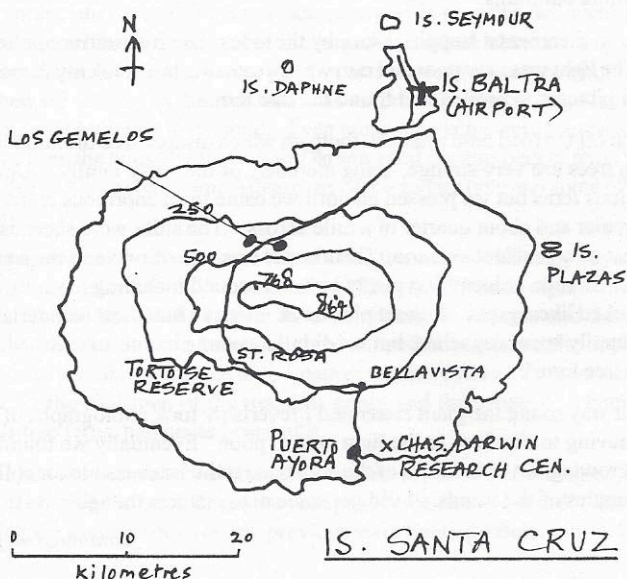
It would be wonderful if a fern expedition could be organised to visit the upper regions of the larger, mountainous islands in the Galápagos archipelago. There are many interesting plants up there apart from ferns and there is always the chance of finding new records.

References:

Flowering Plants of the Galapagos by Conley K. McMullen ISBN 0-8014-8621-1.

Pteridophyta of the Galapagos and Cocos Islands by H. K. Svenson. Bulletin of the Torrey Botanical Club. May 1938 Vol. 65, No. 5, p 303.

Charles Alfred Weatherby, 1875-1949 by H. K. Svenson. American Fern Journal Vol. 40.



Cheilanthes lanosa

Hairy Lip Fern

James R. Horrocks - Salt Lake City, Utah

Cheilanthes is a large genus of ferns in the Pteridaceae family and related to *Adiantum*, *Pellaea*, *Notholaena*, and *Pteris* among others. Edgar T. Wherry noted that the name refers to "a fancied lip-like aspect of the strips of reflexed indusoid tissue." The technical name was proposed by Swartz in 1806 from the Greek for marginal flowers. The species name, "lanosa", literally means "woolly", which is quite appropriate in its description. Being the easternmost member of the genus, *C. lanosa* occurs on rocky slopes of various rock types in the eastern, southern and midwestern portions of the United States and is considered frequent in its distribution. *C. lanosa* is found on open or half-shaded ledges of igneous trap rock or on metamorphic com-



Cheilanthes lanosa pinna

positions and also on rock slabs of shale or even sandstone. The soil is mostly acidic but can also be subacid or less commonly circumneutral. It has also been reported growing on limestone. This fern has been observed growing with *Polypodium virginianum* in acidic rock clefts and pockets on ledges.

Description: The rhizome is thick, short-creeping, but rarely branching, with linear-lanceolate scales that are bicolorous, being pale brown with a dark-brown wide central stripe. The stipes are two-thirds as long as the fronds and are dark brown with many long hairs having dark joints. The rachis is coarse-hairy as well. The fronds are dark green, erect and deciduous. They are narrowly elliptic to oblong and from 6 to 16 inches in length. The fronds are bipinnate-pinnatifid to almost tripinnate. The conspicuously hairy pinnae are acute to obtuse toward the base, while those at the apex are acute to acuminate. The pinnules are deeply cut into oblong, lobed segments. They are obtuse to rounded at the apex. There are few sori, being submarginal, and barely covered by the indusoid flaps, hence the name "lip". With the onset of dry, hot weather, the fronds tend to curl up, but revive with the first rain.

Cultivation: Wherry notes that the Hairy Lip Fern is "adaptable to a wide range of climate and soil conditions," and "is the easiest member of the genus to grow in the rock garden." Lellinger comments that its ease of cultivation is due to "its adaptability to many different rock types." It may be grown in the open ground and of course along ledges but it never grows on vertical cliff faces. It is charming in a desert garden where it can grow among large slabs of sandstone or shale. *Cheilanthes* species need good drainage and protection in winter from too much moisture. *C. lanosa* is an attractive fern and certainly can adapt to a variety of situations. It is hardy to Zone 5.

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A Report of the Emergence of Fern Species in the United States During the Spring of 2002

Ralph C. Archer - Louisville, KY

It was decided to continue the study of the time of emergence of ferns made in the spring of the year 2001 and reported in the HFF Quarterly, Vol. 12 No. 1. The intent of the study continuation during the spring of year 2002 was:

- (1) to determine if the average emergence dates reported in year 2001 were reasonable estimates for these dates and to determine what differences occurred from last year to this.
- (2) to try to shed additional light on cultural and climate factors which affect the timing of emergence at individual sites.
- (3) to update the fern species emergence order lists to include the additional data.
- (4) to further evaluate the differences in emergence time spans for populations of species at a location, between locations and for single species.

I would like to thank the following members who again participated in the study this year. Their time and effort are greatly appreciated. They contributed significantly to the study of fern emergence under a variety of growing conditions.

The six HFF members who continued to participate in the study are:

Joan Gottlieb of Pittsburgh, PA
Catharine Guiles of New Gloucester, ME
Tim Kessenich of Madison, WI
Sue Olsen of Bellevue, WA
John Schieber of Holland, PA
Mary Ellen Tonsing of Denver, CO

I would like to thank the new participant for her time and effort. Her participation provides valuable additional information and is greatly appreciated.

She is Ginny Remeika of Buckfield, ME

A number of conclusions have been drawn from the data reported for the spring of 2002. Each is stated in summary form in the conclusions section. A discussion section discusses the conclusions in some detail along with a comparison of the data for year 2001. For the benefit of those not familiar with last year's report, the following discussion of characteristics used to measure fern performance is included.

Two types of numerical measures offer useful criteria for evaluation of fern emergence.

The first is a measure of when the "average fern" emerges at a given location. The arithmetical average of all the individual emergence dates for the specific fern group under evaluation is used as a measure of the average emergence date. This date provides an estimate of the center date of the total time span for emergence of all of the fern species at each location or for populations of individual species under evaluation.

The second is a measure of the total time span required for all the individuals of the group of species or for all the members of a single species of ferns to emerge. The total

emergence time or range is the observed time period for all ferns in the specific group to emerge throughout the spring. A second measure has been added for this year. The standard deviation will be reported for the use of those familiar with statistical analysis, who are accustomed to standard deviations as a measure of variability. It is the normal measure of how a population is spread out. For the benefit of those not familiar with the concept of a standard deviation, six times a standard deviation listed below is the estimated range for 99.7 percent of the total population of items being described. Five times the standard deviation provides 99 percent and 3.3 times provides the estimate for 90 percent.

These are the normal statistics used to describe populations in general. They are the measures of the center of a distribution of individuals and how it is spread out. Conclusions and remarks apply only to initial emergence of the crozier or fiddlehead as first noted by the observer. The definition of emergence for a fern, given with the report sheet, was full emergence from ground or full separation from the crown of the first fiddlehead. The statement that the difference is statistically significant means that the observed difference is probably a result of an assignable cause and is not due to normal variation.

CONCLUSIONS:

1. The finding, in the previous report, that there is a statistically significant difference between southern and northern regions of the eastern United States for the average emergence date for groups of fern species, was confirmed by year 2002 data. The average emergence date was 20 days later for Maine than Kentucky in year 2002 compared to 21 days for year 2001. The average emergence date for year 2002 for the sample groups of ferns at four locations was different by one day or less from the average emergence date of identical groups of ferns for year 2001. Three sites (Bellevue, WA, Denver, CO and Holland, PA) reported significant weather events during the early spring. At Bellevue, WA, cold weather appeared to delay the average emergence date, while warm weather appeared to initiate earlier emergence at Denver, CO and Holland, PA.

Table I in the discussion section shows the average emergence date for each location:

- (1) as reported for 2001
- (2) for the fern species reported for year 2002 at the site for both 2001 and 2002 years
- (3) for the best estimate of an average date based on all data available.

The table also shows the weather conditions as reported by the observer and a discussion of the weather effect.

2. The statistically significant difference for total emergence time for fern species between Washington State west of the Cascade Range and the part of the country east of the Rocky Mountains was again present in year 2002 data. It took 2.8 times longer for a group of eighteen fern species to emerge in Bellevue, WA than for the same species in Louisville, KY. It took 2.6 times longer for a group of twenty-seven fern species to emerge in Bellevue, WA than for the same species in Pittsburgh, PA.

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A Report of the Emergence of Fern Species continued from page 9

Table II in the discussion section shows the emergence variability comparison for the fern species grown at Bellevue, WA, which were common to either Louisville, KY or Pittsburgh, PA for year 2002.

3. Data from Buckfield, ME confirmed the previous report from Coupeville, WA that two of the factors which effect fern emergences are moisture and exposure to sunlight the previous year. The data for year 2002 also confirms the idea that both are needed to promote early emergence. Ferns growing in beds that received intermittent light in moist conditions emerged six to seven days earlier than ferns growing in beds which were dry with intermittent light or were moist with shade. The difference between the early group of beds and the two later groups of beds was statistically significant.

Table III in the discussion section shows the average emergence date for the three different cultural conditions.

4. The 2001 year study suggested that the difference in total emergence time appears to depend on one or more of at least four factors. They are major climate differences, interruptions in emergence due to weather, significant growing condition differences between sites and the total number of ferns grown at a site.

As discussed in Item 2 above, there is a significant difference in average emergence time for Bellevue, WA compared to the eastern United States. At this point, the only suggestion for the cause is the major climate difference between these two areas.

It does not appear that the weather in the eastern US had a significant effect on total emergence time. Only one site (Holland, PA) reported a serious weather interruption in year 2002. While the emergence time was extended compared to year 2001, it was not statistically significant.

All of the sites from year 2001, which reported in year 2002, are those that appear to have relatively uniform cultural conditions. The total emergence time from the sample data for year 2002 was more uniform than that of the total species data for year 2001. No effects of a difference due to changes from location to location were seen. The only difference for total emergence time in year 2002 that was statistically significant was the difference between Louisville, KY and Madison, WI. This year the time for Madison, WI was longer, whereas it was shorter in year 2001.

The data showed that a large number of the fern species exhibited large fluctuations in their date of emergence from one year to next. The magnitude of this variability of specific fern species from year to year was totally unexpected. It does not appear to be related to a specific location, a small number of fern species, or whether the fern emerges early or late in spring. It resulted in significant change in the total emergence time at three sites.

As expected, the total emergence time is related to the number of fern species at a site. It appears that as the number of species increases, the total emergence time does also. It was especially evident in comparing total emergence time at Bellevue, WA when evaluating the difference between Bellevue, WA and Louisville, KY or Pittsburgh, PA.

This subject of fern emergence variability will be further discussed in a separate discussion section.

DISCUSSION

In year 2002 the emergence reporting was changed from a report on all fern species at a given site to only those ferns which represented the most common ferns as reported from all sites in year 2001. In order to make the most direct comparison, the data for ferns from year 2002 was compared to the data for the same ferns reported in year 2001. In addition, the data from the total number of fern species reported in year 2001 is included for comparison.

The following table shows the number of fern species reported at each site for the two years of the study.

	Holland Pittsburgh					N. Gloucester Buckfield		
	WA	KY	PA	PA	WI	CO	ME	ME
Number-2001	115	49	59	79	23	11	26	
Number- 2002	31	27	32	39	14	10	21	16

Table I below shows the comparison of the average emergence dates. Column one lists the average emergence date for all fern species reported in year 2001. The two center columns show a comparison of the average emergence date based on the sample data for year 2001 and 2002. The best estimate date, which is the average of the three reported dates, is also given for each site. The differences among the first three dates for each site are not statistically significant. All three are different estimates of the center date for fern emergence for the given location. The reported dates are for the first fern of each species to emerge at the site. As was discussed in the report for 2001, the date reported for that year for all species is a best estimate date using a variety of statistical measures of the central tendency for the emergence distribution. The Buckfield, ME date is based on other factors which are discussed later.

Table I

Average Emergence dates

	Allspecies Reported in 2001	Dates for Sample Ferns reported in Year 2002	Best Est. AllData	Weather 2002	
	2001	2002			
Bellevue, WA	07-Apr	04-Apr	11-Apr	07-Apr	Record setting cold spring
Louisville, KY	14-Apr	12-Apr	13-Apr	13-Apr	Very wet spring with normal temperatures
Holland, PA	19-Apr	18-Apr	15-Apr	18-Apr	Warm spring temperature in 90s around 4/17 Frost 4/23
Pittsburg, PA	18-Apr	19-Apr	18-Apr	18-Apr	Mild early spring-several cold nights Mid 80s 4/15 to 4/18
Madison, WI	24-Apr	23-Apr	23-Apr	23-Apr	No unusual conditions

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A Report of the Emergence of Fern Species continued from page 11

Denver, Co	01-May	29-Apr	26-Apr	29-Apr	Warm spring, cool latter part of April then warm
N. Gloucester	04-May	04-May	03-May	03-May	Warm winter and early spring until mid-April, then cool and wet
Buckfield, ME				25-Apr	Warm Winter and Spring until mid April, then cool and wet with freezes on 20-Apr and 28-Apr

The largest difference from year 2001 total species data and the year 2002 data was for Bellevue, WA, Denver, CO and Holland, PA which showed four to five day differences. The data for the remaining sites agreed within one day. The three major differences, although not statistically significant, were at sites that reported unusual weather events. Bellevue, WA reported a record cold spring and emergence was seven days later in year 2002 than year 2001 for the sample only data. Both Holland, PA and Denver, CO reported warm springs until the average date, and emergence was three days earlier, again comparing samples only data.

The data from the new site at Buckfield, ME shows an average emergence date that is not compatible with data from the other Maine site. It appears that some or perhaps all of the difference can be ascribed to differences in observation methods and/or the effect of samples taken from large populations. This subject will be discussed later in some detail as it raises interesting questions regarding the study of fern emergence.

Table II shows a comparison of the total emergence time span for fern species at Bellevue, WA compared to Louisville, KY and Pittsburgh, PA. "STD" is the standard deviation for the emergence data in days. "First" is the date of emergence for the first fern and "Last" is the date of emergence for the last fern. Range is the observed time or the total emergence time in days for all sample ferns to emerge. The Louisville-Bellevue comparison was for 18 identical fern species. The Pittsburgh-Bellevue comparison was for 27 identical fern species.

Table II

Year	2002	2002	2002	2002
Location	WA	KY	WA	Pittsburgh, PA
STD	13.8	4.98	17.8	6.9
First	20-Mar	04-Apr	28-Feb	10-Apr
Last	18-May	22-Apr	04-June	8-May
Range	59	18	96	28
Sample size	18	18	27	27

The difference of total emergence times for Louisville compared to Bellevue is statistically significant as is the difference for Pittsburgh compared to Bellevue. The ratio of

the standard deviation of Washington to that of Kentucky is 2.8 and is 2.6 for the same comparison with Pittsburgh. This is the basis for the estimate that the emergence time spans are 2.8 times longer for Washington than Kentucky and 2.6 for Washington longer than Pennsylvania. The reason for the longer time is not clear. It has been suggested that the climate provides for a longer, more uniform spring in western Washington which extends the emergence time for different species of plants.

It is interesting that this data clearly shows an increased total emergence time resulting from increased numbers of different fern species. The sample size was increased 50 percent for Bellevue, WA vs. Pittsburgh, PA to make a comparison using the maximum number of ferns at each location. The standard deviation for Bellevue, WA increased by 32 percent and the total emergence time for this larger group of ferns increased by 63 percent.

DATA FOR BUCKFIELD, ME

The site at Buckfield, Me had substantial differences between beds within the site as discussed in item three above. Table III shows the effects of water and sun from the previous year on emergence from the site at Buckfield, ME. The environmental conditions were based on the observer's descriptions of various beds. "STD" is the standard deviation for the data in days. "No." is the number of ferns in each combined bed.

Table III

Moisture	Sun Exposure	Avg. Emergence Date	STD	No.
Moist to wet	intermittent	04/19	8.6	12
Fairly dry	intermittent	04/25	7.5	9
moist to wet	None to very little	04/26	7.7	16

The data from individual beds was combined into four categories for moisture and light. There was very limited data for the category of a dry bed with little light, so it was not considered. The data was for the first fern of each species to emerge in the various beds. It is interesting that the data shows a possible interaction between light and moisture. One without the other does not appear to be sufficient to promote early emergence. As mentioned above, the difference between the early bed and the two later beds was statistically significant. This same effect was observed in data reported for the year 2001 for the site in Coupeville, WA. The differences between beds were significantly longer for the Washington data, being 16 and 18 days compared to 6 and 7 for Maine.

The data from the site at Buckfield, ME showed an average emergence date that does not seem compatible with data from the other Maine site. It appears that some or perhaps all of the difference can be ascribed to differences in observation methods and/or the effect of samples taken from large populations. In discussing the difference with the two observers in Maine, both agreed that the difference probably was not related to significant geographical or weather differences as the sites are comparatively close together. Ms. Remeika commented:

continued on page 14

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“The only thing that occurs to me immediately is that, because I was using mostly wild sites, there were many (often hundreds) of individuals of each species at each ‘site’. So in looking for the first individual of a species in a site to emerge, I had so many individuals to choose from that maybe the odds made for an earlier emergence date average? Also I interpreted ‘emergence’ to be the day on which the crozier emerged from the ground, not from the duff. I moved the duff aside to check the ferns’ progress.”

Table IV below compares emergence data for Buckfield, ME using (1) dates of emergence of the last fern to emerge of each species, (2) the dates for the fern that represents the center date of the emergence range of each species and (3) the first fern to emerge of each species. This analysis was done to evaluate the effect of using samples from both ends of the emergence range as well as the center. It is uncertain how much of a time difference checking for frond emergence under the mulch will make. It was not envisioned, when the definition of emergence was first considered, that the mulch would be moved aside. But the definition is ambiguous as mulch was not mentioned, but emergence from the ground was. For this reason, the date in the average emergence date table (Table I) is the average date shown below. Some correction needs to be made, but it is not known how much of a correction.

Table IV

	Last	Avg.	First
Average emergence date	05/01	04/25	04/21
Standard Deviation (days)	11.74	8.68	8.73
First to emerge	11-Apr	11-Apr	10-Apr
Last to emerge	20-May	12-May	12-May
Number of ferns	16	16	16
Range (days)	39	31	32

This is the first site reporting on a significant number of ferns from the same species in various cultural conditions at the same geographic location. The data in the “Last” column included one fern which appears to differ significantly from the rest in time of emergence. The significant difference for the standard deviation and range for the “Last” fern’s column appears to be the result of the ferns from the end of the emergence time distribution of the individual species.

Table V shows the emergence data for twenty-four *Polystichum acrostichoides* ferns. There was a total of seven beds with various conditions of soil, available moisture and sun exposure. The first column labeled “Total” shows data for all ferns in all beds. The second column labeled “First” shows the data based on the first fern that emerged in each bed. The third column labeled “Last” shows the data based on the last fern that emerged in each bed. The last column shows the data for all ferns except for the last two that emerged on May 12 and May 20. These last two ferns emerged twelve and twenty days later than the next last. They biased the standard deviation and emergence range

shown in the "Last" column as well as in the "Total" column. This is an example of the possible effect of ferns whose dates significantly vary from the other ferns under consideration. In general, these are the tail end ferns from the emergence time distributions.

Table V

	Total	First	Last	Total without 2 last dates
Average emergence date	04/24	04/19	04/30	04/22
Standard Deviation (days)	7.61	3.06	10.93	4.14
First to emerge	16-Apr	16-Apr	18-Apr	16-Apr
Last to emerge	20-May	25-Apr	20-May	30-Apr
Number of ferns	24	7	7	22
Observed Range (days)	34	9	32	14

If these two last ferns were ignored in the analysis, the average emergence date of April 24 for all ferns would be changed to April 22, which is not significant. The effect of these two ferns is to increase the variance or total emergence time considerably. Removing them from the analysis reduces the total emergence time for the remaining twenty-two ferns to fourteen days for a reduction of twenty days. The effect on the standard deviation is statistically significant so there is justification to say that the distributions with and without these two ferns are not the same. There is a high probability that the emergence times for these two ferns is different from other ferns in the group because of some assignable cause. As examples of such a cause, errors in reporting dates, errors in transcribing data for analysis, damage to the fern by an external agent, disease, plant age, and a significant growing condition difference are a few that come to mind. Others not listed could also be the cause of variation. At this point the only known significant factor is that these two ferns come from beds that were wet but had high evergreen tree shade. These conditions are such that the ferns in these conditions emerged later than those with sun and moisture by an average of seven days. The site also had two freezes on April 20 and 28 that may have contributed to the late emergence. One question that comes to mind is why other ferns appear to show no effect since they emerged within two or three days after the freezes.

DISCUSSION OF VARIABILITY

Table VI below shows the standard deviations for the emergence data reported from the various sites. As described above, six times the standard deviation gives the estimated total emergence time or range for 99.7 percent of the total population of items being described. The estimated time in the table is for 90 percent of all ferns of the different sample groups at the sites to emerge. It is based on the best estimated standard deviation. The multiplier in this case is 3.3 times the standard deviation value in column four.

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Table VI

Standard Deviation-Days

	All species Reported in 2001	Data for Sample Ferns reported in Year 2002 for 2001	2002	Best Est.	Days for 90% of all Ferns to Emerge
Bellevue, WA	18.1	17.6	16.9	17.5	58
Louisville, KY	7.1	5.1	5.0	5.7	19
Holland, PA	7.4	6.1	7.5	7.0	23
Pittsburgh, PA	12.8	11.7	6.8	6.8	22
Madison, WI	4.5	4.0	8.8	5.8	19
Denver, CO	5.8	5.5	5.5	5.6	18
N. Gloucester, ME	2.9	3.0	7.8	7.8	26
Buckfield, ME				8.7	29
Average for East only	6.7	5.9	6.9	6.8	22

The above data shows the variability of ferns at the various locations. The total emergence time, as measured by the standard deviations for the year 2001 and 2002 sample groups of fern species, increased for year 2002 for Holland, PA, Madison, WI and New Gloucester, ME. The data from Pittsburgh, PA shows an opposite effect, as the total emergence time in year 2002 was shortened compared to year 2001. The net effect of all of these fluctuations was to reduce significantly the total emergence time at one location and to increase it at two others. The increase at Holland, PA was not statistically significant. It was the only continuing site which reported a frost during emergence. It occurred about eight days after the average emergence date, but did not appear to have a significant effect. The effect of the fluctuations at the other three sites was statistically significant.

Table VII shows the fluctuations for all sites for only those ferns which had ten or more day's emergence date difference from year 2001 to year 2002. A minus sign means that the fern emerged earlier in 2002 than 2001. No sign means the fern emerged later.

Table VII

Bellevue	Louisville	Holland	Pittsburgh	Madison	Denver	N. Gloucester
WA	KY	PA	PA	WI	CO	ME
-11	10	-13	-23	11		-17
-10		-11	-16	14		-13

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a date seven days later. The standard deviations in days for the sample ferns for the two years show an insignificant change from 17.6 for 2001 to 16.9 for 2002.

The data for Holland, PA and Denver, CO shows the effect of more ferns emerging earlier rather than later. The average emergence date shifted to three days earlier for both Holland and Denver than in year 2001. It is possible that the frost after the average emergence time caused the slight increase in total emergence time at Holland. At Denver, the fluctuations were mild and the only effect was a change to an earlier emergence date.

The Pittsburgh, PA, New Gloucester, ME and Madison, WI data shows the effect of the fluctuations to a greater extent than any of the other data. While the average emergence date changed a maximum of one day at these locations, the result of the fluctuations was to reduce the standard deviation by 40 percent at Pittsburgh and more than double it at the other two sites. This brought the total emergence time into general agreement at all eastern sites. It eliminated the significant shortening of total emergence time when moving from the southern to the northern sites seen in data from year 2001.

Table IX shows a listing of the fern species which had the greatest variation in emergence dates. These ferns are spread across the emergence time list, consist of native and nonnative species and come from a majority of the sites. The "Later" column is the maximum number of days later the ferns were reported to emerge in year 2002 compared to 2001 using the data from all of the sites. The "Earlier" column is the maximum number of days earlier the ferns were reported to emerge. "Range" is the total time span of the different emergence date changes from the earlier time difference to the later.

Table IX

		Later	Days Earlier	Range
Adiantum	venustum	2	-13	15
Dryopteris	celsa	5	-11	16
Dryopteris	erythrosora	6	-11	17
Matteuccia	struthiopteris	5	-13	18
Osmunda	regalis	16	-3	19
Polystichum	setiferum	15	-4	19
Athyrium	otophorum	3	-16	19
Polystichum	acrostichoides	3	-17	20
Adiantum	pedatum	2	-23	25
Dryopteris	cristata	14	-14	28
Dryopteris	intermedia	19	-10	29
Thelypteris	decursive-pinnata	25	-10	35

The standard deviation of the average time difference for all ferns at all sites was 7.5 days. This means that the emergence date changed more than plus or minus seven days

from one year to the next for more than 25 percent of all the ferns. The reasons why so many ferns at so many sites showed this degree of variability is not evident from the data.

The following listing of the order of emergence is given to update the previous list from year 2001. It should be used with care, and the fact that the emergence date for individual fern species fluctuates should be kept in mind. The individual dates are shown to give a sense of the time differences. The fern species are grouped into two-week ranges for the most part. In spite of the fluctuations, there is a good chance that the species listed as emerging earlier will emerge before those listed as later.

The date for each fern listed is calculated using the sample data for both year 2001 and 2002. Only ferns reported from at least three different sites are included for the eastern listing. The dates are an average of a minimum of six individual dates to a maximum of ten dates. The western data is an average of the two dates reported in year 2001 and 2002 for each fern species at the Bellevue, WA site.

East		West	
Week 1		Week 1 & 2	
Polystichum polyblepharum	04/08	Adiantum venustum	03/05
Dryopteris clintoniana	04/12	Matteuccia struthiopteris	03/15
Adiantum venustum	04/13	Week 3 & 4	
Matteuccia struthiopteris	04/14	Polystichum polyblepharum	03/23
Week 2 & 3		Cyrtomium macrophyllum	03/27
Dryopteris intermedia	04/16	Athyrium otophorum	03/27
Dryopteris celsa	04/16	Dryopteris clintoniana	03/29
Polystichum braunii	04/16	Arachniodes standishii	03/28
Dryopteris erythrosora	04/17	Dryopteris erythrosora	03/29
Polystichum acrostichoides	04/17	Dryopteris expansa	03/30
Dryopteris expansa	04/17	Cystopteris bulbifera	04/01
Dryopteris carthusiana	04/17	Week 5 & 6	
Onoclea sensibilis	04/18	Adiantum aleuticum	04/03
Cystopteris bulbifera	04/18	Dryopteris pycnopteroides	04/04
Phegopteris connectilis	04/19	Polystichum setiferum	04/04
Osmunda cinnamomea	04/19	Gymnocarpium dryopteris	04/07
Thelypteris decursive-pinnata	04/19	Dryopteris remota	04/07
Deparia acrostichoides	04/20	Dryopteris crassirhizoma	04/07

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Dryopteris complexa	04/21	Blechnum spicant	04/08
Athyrium* f-f var. angustum	04/21	Thelypteris decursive-pinnata	04/09
Adiantum pedatum	04/21	Dryopteris complexa	04/09
Gymnocarpium dryopteris	04/22	Onoclea sensibilis	04/10
Dryopteris championii	04/22	Polystichum braunii	04/11
Dryopteris x australis	04/22	Dryopteris x australis	04/11
Dryopteris goldian	04/22	Adiantum pedatum	4/12
Dryopteris filix-mas	04/23	Dryopteris filix-mas	04/13
Osmunda regalis	04/23	Week 7 & 8	
Dryopteris remota	04/24	Phyllitis scolopendrium	04/19
Dryopteris marginalis	04/24	Dryopteris pseudo-filix-mas	04/28
Arachniodes standishii	04/26	Osmunda regalis	04/28
Week 4		Week 9 & 10	
Athyrium otophorum	04/30	Dryopteris championii	05/08
Dryopteris cristata	04/30	Week 12	
		Dryopteris sieboldii	06/06

***A. filix-femina var. angustum**



THE HARDY FERN FOUNDATION
QUARTERLY

The Hardy Fern Foundation Quarterly is published quarterly by the Hardy Fern Foundation, P.O. Box 166, Medina, WA 98039-0166.

Articles, photos, fern and gardening questions, letters to the editor, and other contributions are welcomed!

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Newsletter:

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Graphics: Willanna Bradner
(cover design)
Karie Hess (inside design)

*"The green and graceful fern,
How beautiful it is.
There's not a leaf in all the land,
So wonderful, I wis.*

*Have ye e'er watched it budding,
With each stem and leaf wrapped small,
Coiled up within each other
Like a round and hairy ball?*

*Have ye watched that ball unfolding
Each closely nestling curl
Its fair and feathery leaflets
Their spreading forms unfurl?*

*Oh, then most gracefully they wave
In the forest, like a sea,
And dear as they are beautiful
Are these fern leaves to me."*

Twamley

Confessions of a Fernatic

By Ralph Archer

About twenty five years ago, my wife and I bought a home on two acres with lots of big trees. We landscaped it by fits and starts. We hired a landscaper who planted juniper bushes along with a small group of daylilies and Japanese iris on the clay bank along a creek. All the bushes, including some replacements, eventually died due to root rot as the creek flooded them regularly. My wife started dividing and re-planting the few daylilies and iris as the bushes died. This eventually became a large daylily-iris bed along the creek in a sunny area. I added a few trees, tried to improve the grass under a number of big trees, and raised roses and vegetables. In the fall, I mainly cleaned up the leaves and piled them along an old fence row as well as digging in some in the vegetable garden.

About twelve years ago, everything changed. We had a very wet spring with water puddles in places never before so wet. Several of the dogwoods I had planted died due to wet feet. I called in a new landscaper who sold me three crabapple trees which he assured me would stand the wet soil. I really don't know if they would or not since we have not had such weather since, but I hope so since two are still growing.

I then had a brilliant idea! I thought that a bed of plants around the new trees would look nice and so I asked the man to draw up something for consideration. He did so, showed it to me and said a price. I said eight hundred fifty you got to be kidding dollars, and he assured me that he was most serious. I decided that, since I was in the process of retiring, I could handle this program with no sweat and a lot fewer dollars. So I went to a nursery to buy the necessary plants. Since the area was shady, I went into the shade plant department. The first plants I bought were five Japanese painted ferns (*Athyrium niponicum* 'Pictum'). When I went to pay for them, I passed by a group of Hosta on sale and thinking that five ferns would not really be enough to fill up the bed in progress, I bought two blue and two green Hosta.

This was the start of a love affair with and addiction to plants that has become a real joy. It has also liberated me from the need to improve a stand of grass. If it grows grudgingly, the area becomes a prime candidate for a fern and plant bed which eliminates more of the grass cutting. As I had such an area on one side of the yard, I just had to start another bed while I was still working on filling up the original bed around the crabapples.

At first I bought and planted mainly locally native fern species. I tended to specialize in the ones that I thought were the easiest to grow and I learned how to successfully divide and grow some. I also learned how to kill some including some vigorous ones that many think of as pests like *Onoclea sensibilis* and *Dennstaedtia punctilobula*. I was also lucky. I became acquainted with a professional botanist about eighteen months into the program. I had started cleaning and planting along the old fence row, where I had dumped leaves for a number of years. He came by in late spring before I had time to go into my planned cleanup program in this new area. He became very excited when he saw the native sessile trillium, green dragon and Solomon seal that were coming up in several areas including along the fence row. After he left, I literally dropped everything, went to the store and bought the book on wild flowers he had recommended. Mercifully, I did

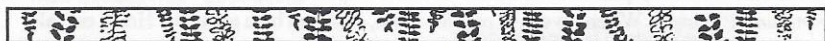
continued on page 22

Confessions of a Fernatic continued from page 21

not tell him what my original plans were as I think it might have caused a stroke. I had planned to weed out much of what gave him such a bust of excitement.

This sort of program requires plants in substantial number so propagating ferns from spores is a highly recommended practice. I learned that if you are successful, it is something like being the Sorcerers Apprentice. A few packets of spores make more ferns than most people have room for. However they make lovely gifts, especially if you help a fellow gardener deal with what many see as a problem -- SHADE!

While ferns are still my first love, the wild flowers along the fence row guided me to the belief that ferns need other plants for company and contrast. This led me to a wonderful world of plants, such as Arisaema, Arum, Asarum, Hosta, Pulmonaria, Trillium and all the rest, which shine in the darkness, and so, light up the shade garden. I have come to think that a large scale planting of ferns in the shade is like the Jeweler laying down a cloth of black velvet on which are displayed the individual gemstones, i.e., unusual forms of ferns, various variegated plants and wild flowers such as Wild Gingers, Bloodroot, Virginia Bluebells or Trillium. In addition to the beauty of color of variegated ferns, the color of non-variegated ones, which ranges from a pale yellow-green to a lustrous polished dark green, adds to the scene. The variety of fern frond forms makes for even more interest. It seems to me that this diversity from the world of plants is needed to make the most effective shade garden. I am constantly finding new plants to add, which makes for a wonderful life in my garden.



Alan Smith to Lead a Workshop on Ferns and Fern Allies

April 5-6, 2003

UC Botanical Garden, Berkeley

Topics to be covered will include overview and discussions of characters used in the identification and classification of ferns and fern allies in California and adjacent states. Living and pressed plants, with the UC Botanical Garden as our backdrop, will be used to illustrate many of the characters used in identification and to provide material for using keys (to be furnished). Other features to be discussed, at levels geared to the interests and backgrounds of the participants, will include fern life cycles, reproduction (vegetative, sexual) distribution, ecology, evolutionary relationships, and hybridization. Ruth Kirkpatrick, a graduate student at UC, will give insight from her research on adaptations to xeric environments and desiccation tolerance in ferns, especially in California *Pellaea* and relatives. There will be ample opportunity to ask questions, practice identification, and to go off on fern tangents. For further information contact Staci Markos at (510) 643-7008 or by e-mail smarkos@socrates.berkeley.edu.

Book Review Book Review Book Review Book Review

Hawai'i's Ferns and Fern Allies, by Daniel D. Palmer. University of Hawai'i Press, 2840 Kolowalu Street, Honolulu, HI 96822-1888, USA; phone: 1-808-956-8255 (<http://www.uhpress.hawaii.edu.>); hardcover \$60.00. ISBN 0-8248-2522-5; 325 pp, 9.5 x 6.5; 100+ line illustrations.

This scholarly and eminently readable book is testament to the impact that dedicated "amateurs" have on fern systematics. Palmer, vocationally a dermatologist, devoted a big part of his life for the last 30 years to the study of Hawaiian ferns. Ultimately, he turned this passion into a first class book, suitable for both lay and professional audiences. It is a bit surprising that it has taken until the 21st century for someone to write a modern account on Hawaiian ferns, especially because of the high interest in, and visibility of, the Hawaiian fern flora. Perhaps it has been the inordinate, and still not fully explained, taxonomic difficulties one encounters with the ferns of these islands, and the uncommon breadth of variation one finds within many species. Or perhaps the enchantment of the ferns there has lulled botanists into a sense of reverie, rendering them incapable of coming to grips with the hard reality of a taxonomic hierarchy and the mechanics of actually producing a usable fern flora. Whatever the reasons, it has been worth the wait.

Palmer's love of Hawaiian ferns grew out a close collaboration with, and inspiration from, the late Warren "Herb" Wagner Jr., eminent pteridologist at the University of Michigan, who, with his wife Florence, were similarly passionate about the ferns of the Sandwich Isles. Although all floras build on the work of predecessors, colleagues, and friends, the present work is Palmer's own, as evidenced by the language, taxonomic decisions, and style employed. The approach Palmer has chosen is generally a conservative one, insofar as the circumscription of genera and species are concerned, an easily defensible choice in view of how much we still don't know about Hawaiian pteridophytes. Palmer has accepted some of the species recognized by Wagner, but treated others as varieties, or even synonyms, and in each case he gives his reasons.

The book contains just about everything you'd want in a fern flora, and more — scientific and vernacular names, synonymy (especially well cross-referenced to earlier important 19th and early 20th century works on Hawaiian ferns), etymology of names, keys to genera and species, descriptions, thorough discussions of variation and unresolved taxonomic problems, pertinent literature, and good illustrations (a combination of line drawings and silhouettes) for all 222 taxa. Genera and species are arranged alphabetically. There is also an exemplary statistical summary, which makes my job as reviewer much easier. At the end of the book is a descriptive summary of families, a key to Hawaiian genera within each family, and an illustrated glossary. Palmer based his work on years of extensive fieldwork on all of the major islands, studies in many herbaria, including careful examination of type specimens, and numerous discussions and interactions with fern specialists throughout the world.

One of the fascinating things about Hawaiian ferns and allies is that 114 of the species, 71% of the natives, occur nowhere else on the planet. This is a lower percentage than for
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Book Review continued from page 23

flowering plants, with their more cumbersome propagules, but still the highest for any fern flora in the world. As with other groups of organisms, ferns have not made it there easily, but when they have, the results are often evolutionarily intriguing, even spectacular, with notable radiations in the species-rich genera such as Asplenium and Dryopteris, and three endemic genera (Sadleria, Diellia, and Adenophorus). Molecular studies may eventually clarify relationships of these endemics, e.g., as part of some lineage within a broadly defined Asplenium (in the case of Diellia), but that would make them no less interesting to evolutionary biologists, and perhaps even more so. Of special concern are the 31 species and varieties that Palmer considers rare or endangered in Hawaii. Additionally, 5 species are categorized as probably extinct — not seen in the wild for 100+ years, despite intensive search.

To put the Hawaiian ferns in perspective for North American fern enthusiasts, Hawaii, with a land area only slightly larger than Connecticut, has 161 native species + 33 naturalized species (17%) for a total of 194 spp. This compares with the Flora of North America North of Mexico, Vol. 2 (1993), a land area more than a thousand times larger, which has 441 species, but only about 18 (4%) naturalized species. This bespeaks the suitability of the Hawaiian landscape for ferns, the ease with which ferns can naturalize there, the relative difficulty that fern spores have had in reaching the Hawaiian Islands without the hand of man (if it were easy, there would be a 1000 ferns in Hawaii!), and finally, the danger of introducing any non-native organism to remote island groups, like Hawaii. There are many instances in Hawaii where introduced species (both ferns and flowering plants) are outcompeting, and thus endangering, the more interesting and unique native flora. I recall spending 30 minutes or more with Palmer, a few years ago on Oahu, weeding out introduced ginger and other invasives to give a colony of the rare and beautiful Microsorium spectrum, with its hastate or trilobed blades, a fighting chance for a few more years. But then what, I wondered?

About the only quibble I have with the book is what I consider an overuse of boldface type, which is used to focus the reader's attention on diagnostically important details of a given species (or variety). Liberal use has been made of this diversionary device, so much so, that many pages have almost as much boldface and non-boldface print. For me, this defeats the whole purpose of the convention, and I found it sometimes visually distracting. But this point is trivial in comparison with all the good things about this book.

The ultimate measure of any flora is how well it stands the test of time, usage (in this case generations of botanists, with various interests and backgrounds), and future scientific investigations, which will no doubt utilize the latest analytical techniques — population genetic and hybridization studies, DNA sequence data analysis — in addition to cytological, biogeographic, and life cycle studies. I predict this book will be a survivor, a lasting contribution to our knowledge of ferns of the 50th state.

Alan R. Smith
Research Botanist and Curator of Ferns
University of California, Berkeley

Forms of the American Christmas Fern (*Polystichum acrostichoides*).

Part I: Shapes of individual pinnae.

John D. Scott - Rockland Botanical Garden

As previously mentioned ¹ fern books have mostly ignored the interesting varieties of this eastern American native. The Christmas fern is fairly common throughout its range and has two characteristics that make it easy to recognize — one, its evergreen dark green fronds and two, its discrete pinna form.



**Distribution of *Polystichum acrostichoides*,
Flora North America (1993)**

The Christmas fern was first described by Andre Michaux in 1803 as *Nephrodium acrostichoides*. It was placed in the genus *Polystichum* by Schott in 1834.

While most professional fern taxonomists tend to ignore forms, their study is interesting nonetheless, especially to fern gardeners and propagators looking for new and unusual forms. It should be noted that while some of the forms that I found during this study were located on only one herbarium sheet, many forms reoccurred in both space and time. Hopefully some of the more interesting forms can be rediscovered and propagated. In this and succeeding papers I will cover shapes/forms of individual pinnae, forms of entire fronds, and plants that merit attention. I will defer the presentation of any new form names to the final section of this series of papers—plants that merit attention. I will begin here with brief descriptions of the shapes/forms of individual pinnae.

This study is based on the examination of living specimens and hundreds of herbarium specimens, including all the *Polystichum acrostichoides* specimens at the Academy of Science, Philadelphia (ANSP); the New York Botanical Garden (NYBG); and the Smithsonian, D. C. (USNM). I've chosen to restrict the initial descriptions to single pinnae, as some of the type specimens of named forms are based on only a few pinnae on a single frond or only one frond on an entire plant. The pinnae forms may be conveniently divided into three groups — undissected flat pinnae, dissected flat pinnae, and three-dimensional pinnae. Each pinna will be referenced to a literature citation and type specimen if found. Those that have neither of the former will be referenced to a herbarium specimen or living specimen. Complete literature citations will be given at the conclusion of this series of papers.

¹HFFQ 12(2): 42-43 (2002)

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Forms of the American Christmas Fern continued from page 25

Except where noted, the figures for part 1 were taken from digital photos of herbarium sheets or live plants. The photos were taken with a 3.3 mega pixel Casio QV-3000EX camera that produces 1.2 megabyte jpeg files. To show more detail the single pinna figures were cropped from close-ups of a small area of the whole herbarium sheet. Close-up photos of single pinnae would have produced sharper images.

Part Ia: Undissected flat pinnae.

Figure 1. Type (typical)

Michaux's type specimen
Pennsylvania, Carolina, Tennessee.

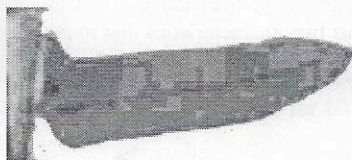


Figure 1 is taken from a photo of the type specimen (Herbarium of the Laborato de Phanérogam Muséum d'Hist. Naturelle, Paris. Michaux Herbarium *Nephrodium acrostichoides* Michaux, 1803. Fl. Bor. Am. 2: 267.) Photographed by Alice R. and Rolla M. Tryon. Prints distributed by the Gray Herbarium, Harvard University.



Figure 2. Blunt-lobed

ANSP: Bayard Long 55859
Old Etna Furnace, Atlantic Co., NJ
January 5, 1941

I have been unable to find completely blunt-lobed forms in the field. However, many typical plants have at least some pinnae tending toward a blunt pinna end.

Figure 3. Broad, overlapping

ANSP: Albert Commons 543451
Centerville, Del.
July 1873

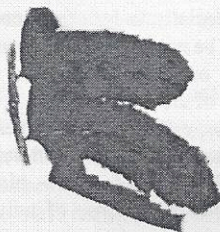


Figure 4. Ovate

ANSP: Edgar T. Wherry
Famington, Fayette Co., PA
September 3, 1950

Figure 5 *Orbiculatum*

TYPE: Gray Herbarium. no. 11.214
Darien, Fairfield County, CT.
8. October 1930
Harvard Bar Code: 00021932



E. H. Eames (1931) published this form as *Polystichum acrostichoides* (Mich.) Schott. f. *orbiculatum*. He described "Pinnae orbicular or nearly so, dentate. Typical fronds are 14-20 mm broad, 15-30 cm long. Most fronds show some more or less transitional pinnae, which usually are irregularly disposed."

The herbarium sheet has three fronds. One has all the pinnae orbicular except one. The other two fronds are quite irregular with some typical pinnae and some very large incised pinnae.



Figure 6a *Lanceolatum*



Figure 6b *Lanceolatum* (with heel)
from same frond

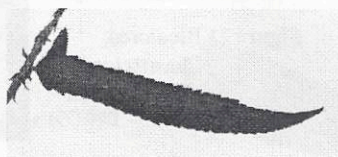
ANSP: 667689

Near Protor, Rutland Co., VT

Clute, W. N. (1912a) published figure 6a as forma *lanceolatum*. "It was found at Fairfield, Conn., E. H. Eames" in 1902. Clute specified "lack of the ear-like pinnule at the base of each pinna" and illustrated a frond from Mr. W. A. Poyser, presumably from the Fairfield plant. Specimens could not be located and are apparently missing from the Clute herbarium at Butler University. Unfortunately only two herbarium sheets of *Polystichum acrostichoides* remain. Figures 6a and 6b are from ANSP 667689. No collector is listed but notation states "transplanted in Mrs. Maude Chisholm's garden, September 1931." The three fronds all have some pinnae with the ear-like pinnule.

Figure 7 *Angustifolium*

USNM 2200222
Hampden, Mass.
9/10/1943
R. A. Doray



The herbarium sheet is labeled *Polystichum acrostichoides* f. *angustifolium* F. W. Gray ? I haven't found any publication of this form name!

Figure 8 *Demittens*



USNM #: 2083880 Holotype
Reed, C.F. 5454
21 Jul 1946
Laanna, Harlow Gardens, (Pike Co.)
Pennsylvania

This name was published by Reed (1951). The fertile frond, collected in Harlow's garden, July 21, 1946, was originally found by Harlow in the Pocono Mountains, Pennsylvania.

continued on page 28

Forms of the American Christmas Fern continued from page 27

Reed's Herbarium was purchased by the Missouri Botanical Garden in 2001 and was not available for study. There are several spellings of the location. Alternative correct spellings are Laanna and LaAnna.

Figure 9 Smooth

**ANSP: E. G. Harger #3766
Oxford, Conn.
July 19, 1997**



I've only seen this totally smooth form in this specimen. There is absolutely no serration and no bristles on this pinna.

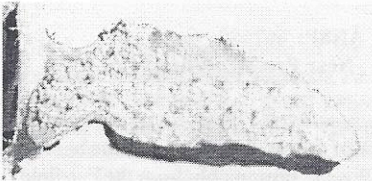


Figure 10 *Gymnosorum*

NYBG live specimen

Published by Neidorf (1949) as forma *gymnosorum*, the type specimen at the USNM is a photo. His description was "indusia none, the sporangia few, solitary or borne in small submarginal sori; fertile pinnae normally contracted". "Nedorf stated "indusia have never been observed at any stage during the development of the fertile fronds." Figure 11 is a fertile pinna from the New York Botanical Garden for a plant labeled asoriatae.

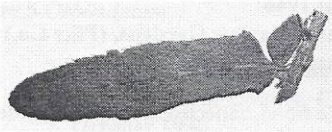
Figure 11 Bicolored
**Chanticleer
live specimen**



This specimen is growing at Chanticleer, Devon, PA. The gardeners thought the coloration is due to a herbicide. However, only one plant in the midst of several had this coloration. This plant will be followed. I only have a photo at this point.

Part Ib: Flat dissected pinnae.

Figure 12 Detached heel

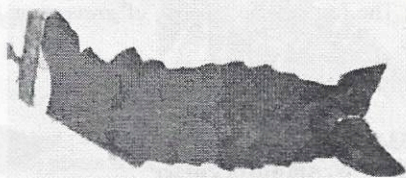


**ANSP: 578388
M. L. Fernald and Bayard
Long No. 17717
Barnstable Co., Mass.
August 9, 1919**

Occasionally there is a deep cleft separating the heel of the boot from the rest of the pinna.

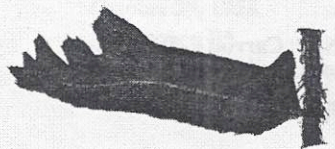
Figure 13. Fish-tailed

ANSP: G. L. Gruber
Wagenhorst's Hill
Kutztown, PA
July 4, 1936



This type of split of the end of pinnae is common in many fern species. It should be noted that Gruber's specimen has only a single 'fish-tailed' pinna. Gruber recorded the term on this herbarium sheet. This form has been seen in combination with other forms on the same frond. I have since found several specimens in the vicinity of the Rockland Botanical Garden. They had one to three 'fish-tailed' pinna on the fronds. They were potted up and the second year there were no 'fish-tailed' pinna. This seems to be in part, at least, a transient form.

Figure 14 Lacerated



ANSP: Mrs. C. Y. Tanger
Puseyville Narrows below
Quarryville, Lancaster Co., PA
August 7, 1933

This herbarium sheet was labeled f. *gravesii*, though I didn't notice any of the stiff bristles of *gravesii*. The ends of the pinnae look totally shredded!

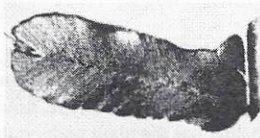
Figure 15 Bristle-tipped (*gravesii*)

ANSP: Miss E. M. Kittredge 657997
Vermont
September 4, 1928



The name *Polystichum acrostichoides* f. *gravesii* was published by Clute (1912b) based on a specimen collected by James A. Graves, Susquehanna, Pa. in 1893. Clute stated "type in the herbarium of Willard N. Clute; cotype in the herbarium of Alfred Twining, Scranton, Pa. Mr. Graves used the name *truncatum* (unpublished)." Specimens could not be located and are apparently missing from the Clute herbarium at Butler University.

Figure 16 *Ventropaefereris*



USNH #: 1918022 Holotype
Neidorf, C.
02 Sep 1936
New York

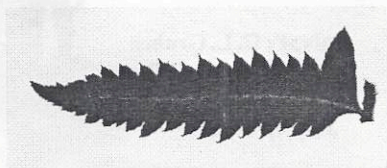
continued on page 30

Forms of the American Christmas Fern continued from page 29

This name, *Polystichum acrostichoides* f. *ventroperiferis*, was published by Neidorf, C. (1949) The form is the obverse of *gravesii* and wasn't considered a significant difference.

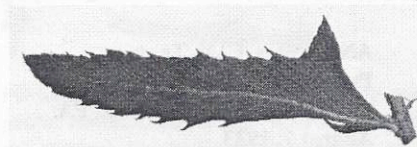
Figure 17 Incised

ANSP: 553460
Herbarium of W. Aldworth Poyser
Merrill
Hiram, Maine
1906



This form was first published by Beck (1833) as *Aspidium schweinitzii* with no diagram or type specimen. Eaton (1879) in "The Ferns of North America" illustrated the form as var. *incisum*. More on the name and nature of this interesting form later.

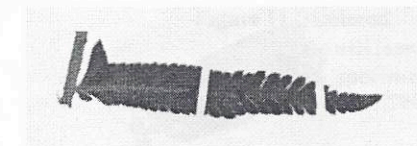
Figure 18 Sharp heel



ANSP: Carroll E. Wood, Jr.
2396 Roanoke Co., VA
June 21, 1942

This specimen (Figure 18) in addition to the sharp triangular heel, has extra long bristles which don't show up well in the photo.

Figure 19 Intermediate

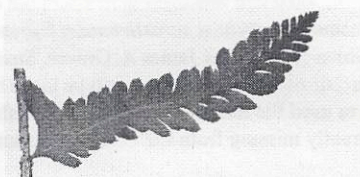


ANSP: Warren H. Wagner, Jr. #340
Fairfax Co., VA
January 26, 1942

This form is intermediate between the type and *multifidum*.

Figure 20 *Multifidum*

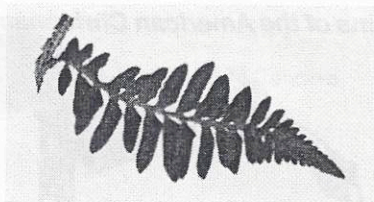
ANSP: Miss E. M. Kittredge
Old quarry, Florence, VT
September 25, 1924



Published by Clute, (1907) as *Polystichum acrostichoides* f. *multifida*, the spelling was later corrected to *multifidum*. "As early as 1867 it was reported from New Jersey and a pinnule of this find is illustrated in Eaton's 'Ferns of North America' (1879). Clute's type, now lost was discovered in Bristol, Conn. by Mr. W. A. Terry, "who now has the plant under cultivation and to whose kindness in sending specimens I am greatly indebted." Eaton illustrated this as a "pinnatifid" form of *incisum*.

Figure 21 Bipinnate

ANSP: Emma Groff,
Lancaster Co., PA
July 1923

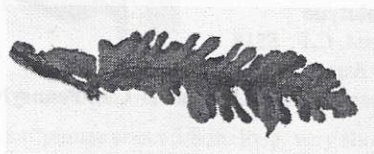


Wagner (1942) covers in detail bipinnate plants from Virginia, but he didn't introduce a name. Wherry (1963) illustrated this form (Figure 'f' upper figure) as a variant of multifidum. Figure 21 is from a frond with only the lower pinna pair bipinnate, Wagner's specimens intergrade from Figure 19 to Figure 21.

Part 1c: Three dimensional pinnae.

Figure 22 Crispum

ANSP: Wherry, E. T.
October 29, 1958
Glenmoore, PA
Photo: 09270104b



This fern was named var. *crispum* by Clute (1901) and later incorrectly listed as f. *crispum* by Gilbert (1901) and forma *crispum* by Broun (1938). The 1958 specimen (Figure 22) was described and illustrated in Wherry (1947).

Figure 23 Wrinkled

RBG

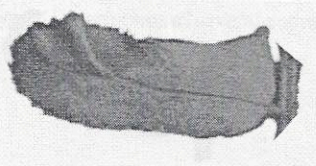
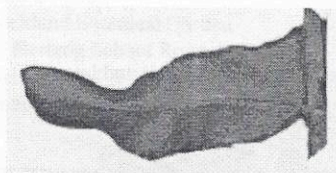
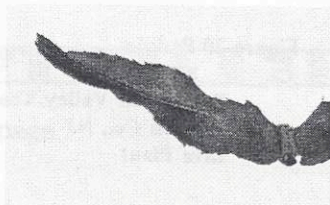


Figure 24 Pinched

RBG

Figure 25 Wavy

RBG



Figures 23-25 are from living plants at the Rockland Botanical Garden. The total effect on the entire plant creates three different forms quite pleasing in appearance.

continued on page 32

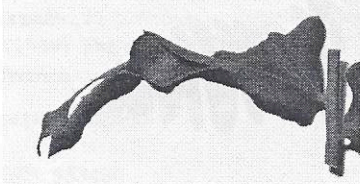


Figure 26 Twisted
RBG

Figure 26 twists completely around on itself. It has been described as “twisted like a corkscrew.”

Figure 27 Spathiforme

USNH #: 2083881

Holotype

Reed, C.F. 5518

04 August 1946

Peach Bottom, Lancaster Co., Pennsylvania

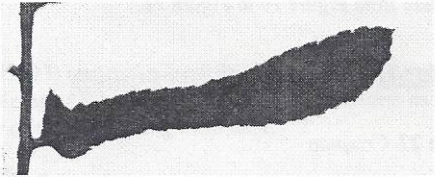


Figure 27 is taken from the holotype in the US National Herbarium. The name was published by Reed (1951) and described as having “very broad spatulate fertile pinnae, the terminal region of the fertile frond being sterile, and looking very much like the sterile frond.” Reed listed several localities in MD, NY, and KT.



Figure 28 *Recurvatum*

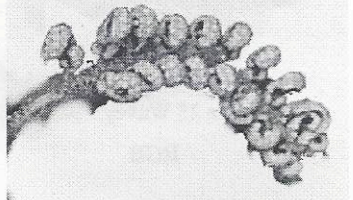
First named *Polystichum acrostichoides* forma *recurvatum* by Clute (1904) and later illustrated by Reed (1951), Figure 28 is from Reed’s page

Figure 29 Prolific

Paulinskill Valley Trail

Warren Co., NJ

Live Plant



This specimen was photographed on the Sussex Branch Trail in Sussex Co., NJ. Superficially it resembles *recurvatum* but neither Clute (1904) nor Reed (1951) mentions the recurved pinnae being fertile. Figure 29 is the fertile tip of a slightly incised frond. Unfortunately, I don’t have a close-up of the pinnae. In other species this form has often been named ‘Prolificum.’ More on this form in part III



Figure 30 Concave
RBG

This rolled form is from the Rockland Botanical Garden woods. Left figure is bottom view, right figure is the top view. Unlike recurvatum, the pinna is curved under making a more photogenic plant. Unlike Figure 29 these pinnae are the sterile lower ones.

Figure 31 *Lingulatum*

ANSP: Type.
Gruber, C. L.
August 29, 1937
Kutztown, Berks Co., PA



Gruber (1940) describes f. *lingulatum* as “pinnae about 3/8 in. long, very short-stalked, crowded, especially in upper part of frond, cleft lengthwise into two acute lobes which acute lobes which are strongly recurved, giving the frond a ruffled appearance; occasionally slightly auricled on the upper side; suborbicular in appearance on the growing and on the pressed frond (but if the pinnae would be flattened out they would measure at least 11 times the dimensions given and would be oblong-ovate in shape).”

This concludes the brief descriptions of pinnae types. Descriptions of several entire fronds follow.

(To be continued)

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Cheilanthes lanosa continued from page 7

References:

- The Fern Guide*, 1961, Edgar T. Wherry, Doubleday & Co., Inc. New York.
A Field Manual of the Ferns and Fern Allies of the United States and Canada, 1985, David B. Lellinger, Smithsonian Institute, Washington, D.C.
Fern Growers Manual (Revised), 2001, Barbara Joe Hoshizaki & Robbin C. Moran, Timber Press, Portland
Field Book of Common Ferns, 1949, Herbert Durand, G. P. Putnam's Sons, New York.

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Arachniodes simplicior		99	RSF
Arachniodes simplicior	'Variegata'	99	Bundy
Arachniodes standishii		00	Swell
Asplenium bilottii		00	Seibert
Asplenium foreziense		00	Seibert
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Athyrium niponicum		02	Olsen
Athyrium niponicum	'Pictum' tall form	99	Gottlieb
Athyrium niponicum	'Pictum'	00-02	Several
Athyrium otophorum		00-02	Several
Blechnum cordatum		00	RSF
Blechnum fluviatile		00	Olsen
Blechnum penna-marina		01	Steffen
Blechnum spicant	'Ramosum Piskowitz'	00	Seibert
Blechnum spicant	'Rickard's Serrate'	02	Steffen
Blechnum spicant		00	Several
Blechnum wattsii		00	RSF
Bommeria hispida		99	??
Botrychium multifidum		00	Olsen
Botrychium virginianum		02	Briegel
Ceterach officinarum		01	Duryee
Cheilanthes argentea		00	Seibert

Cheilanthes intertexta		99	Schwartz
Cryptogramma acrostichoides		??	Gassner
Cryptogramma crispa		01	Several
Cyrtomium caryotideum		01	Bundy
Cyrtomium falcatum		02	Briegel
Cyrtomium lonchitoides		01	Bundy
Cyrtomium macrophyllum		01	Bundy
Dennstaedia punctilobula		02	Briegel
Deparia acrostichoides		01	McGill
Diplazium pycnocarpon		03	Briegel
Doodia media		01	Bundy
Dryopteris celsa		03	Briegel
Dryopteris crassirhizoma		01	Bundy
Dryopteris cystolepidota		00	RSF
Dryopteris dilatata	'Jimmy Dyce'	00	Duryee
Dryopteris erythrosora		01	Several
Dryopteris filix-mas		02	Briegel
Dryopteris filix-mas	'Linearis Polydactyla'	00	Several
Dryopteris formosana		01	Bundy
Dryopteris goldiana		02	Olsen
Dryopteris ludoviciana		01	Mandeville
Dryopteris marginalis		02	Briegel
Dryopteris namegatae		01	Olsen
Dryopteris polylepis		00	McGill
Dryopteris remota		01	RSF
Dryopteris sacrosancta		00	Several
Dryopteris sieboldii		01	Bundy
Dryopteris tokyoensis		02	Olsen
Dryopteris wallichiana		01	Bundy
Gymnocarpium oyamense		00	Duryee
Lygodium scandens		02	Briegel
Matteuccia struthiopteris		02	Briegel
Notholaena standleyi		00	Schwartz
Onoclea sensibilis		02	Briegel
Pellaea breweri		00	Schwartz
Pellaea cordifolia		00	Schwartz
Pellaea viridis		01	McGill
Pentagramma pallida		00	Schwartz
Phyllitis scolopendrium		01	Bundy
Phyllitis scolopendrium	'Digitata'	01	Mandeville
Polypodium glycyrrhiza		01	Taylor
Polypodium scolieri		01	Bundy
Polystichum acrostichoides		01	McGill
Polystichum aculeatum		00	Olsen
Polystichum andersonii		02	Olsen

continued on page 36

Spore Exchange 2002 continued from page 35

Polystichum braunii		99	RSF
Polystichum imbricans	Siskiyou	00	Entz
Polystichum lobatum		??	Gassner
Polystichum lonchitis		00	Duryee
Polystichum luctuosum		02	Olsen
Polystichum mayebarae		00	Olsen
Polystichum munitum		00-02	Several
Polystichum neolobatum		01	Bundy
Polystichum richardii		00	Seibert
Polystichum scopulinum		01	Bundy
Polystichum setiferum		00	RSF
Polystichum setigerum		00	Olsen
Polystichum tripterum		00	Olsen
Polystichum tsus-simense		00	Several
Pteris gallinopes		00	Olsen
Pteris vittata		02	Briegel
Pyrrosia shearerii		02	Olsen
Thelypteris decursive-pinnata		00	McGill
Thelypteris palustris		00	NY
Thelypteris patens		02	Briegel
Thelypteris phegopteris		00	NY
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Woodsia obtusa		00	RSF
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Woodwardia fimbriata		02	Mandeville

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