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It’s All About the Ferns: A Literature Review of Species Concepts Referenced in New Pteridophyte Species Described Since 1989

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“The beginning of wisdom is to call things by their proper name.”

~ Confucius

Abstract

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Taxonomy is the field of science responsible for giving names to all living organisms. These names are given based on the data available or discovered, and the foundational knowledge about related organisms. All fields of science are theory-laden with testable hypotheses made atop, and taxonomy is no exception. However, trends in descriptions of new species point towards an implicit citation of the underlying theories (species concepts) and hypotheses (proposed species) rather than explicit statements that are common for other fields of science. Therefore, to assess the status of pteridophyte taxonomy, we conducted a literature review of all new pteridophyte species described since 1989 to holistically observe changes in how researchers carry out taxonomic investigations. Of the 130 articles reviewed, we found only nine (6.9%) explicitly cited a species concept and only twelve (9.2%) made an explicit taxonomic hypothesis. The morphological species concept was the most common (130 articles; 100%), followed by the evolutionary species concept (34 articles; 26.2%), then lastly the biological species concept (11.5%) based on the data types presented in the articles. We hope our review contributes to the strengthening of taxonomy and future outlooks of the entire field by encouraging taxonomists to explicitly cite the species concept(s) being prescribed to as well as the taxonomic hypothesis asserted. We believe these changes could allow for a broader audience to comprehend the field as well as provide a clearer path for future researchers to add to the existing field of knowledge.

Keywords and Phrases: species concepts, pteridophytes, hypothesis, literature review, taxonomy, ferns, monilophytes, clubmosses, lycophytes.

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Acknowledgements

As we trekked through the forest understory, we spotted a humble pteridophyte. Dr. Jennifer Koslow, Dr. Melanie Link-Pérez, and I went over to check it out. As we ran it through the key, we landed upon a species in the genus *Dendrolycopodium*. It was either *D. obscurum* or *D. hickeyi*. Both Dr. Koslow and Dr. Link- Pérez exclaim, “We must figure this out!” As I sat there a touch confused, they explain that *Dendrolycopodium hickeyi* was named in honor of Dr. Link-Perez’s dissertation mentor, R. James Hickey. Dr. Koslow states, “Nick, he’s like your fern grandfather.” We all laugh, but as we settle upon *D. obscurum* as the previously unidentified creature, I realize how science lies in the hands of people. It is the duty of all scientists, all biologists, and all pteridologists to pass along the bounty of knowledge they have accrued. With this, I fully realized how much I am indebted to all my mentors for entrusting me with this duty that I must fully carry out.

I deeply thank all my professional and personal mentors: Dr. Kelly Watson, Dr. Pat Calie, Dr. Jennifer Koslow, Dr. Brad Ruhfel, Robert Pace, Calvin Andries, and especially Dr. Melanie Link-Pérez. Each has given me knowledge and wisdom beyond belief. Lastly, I must thank the plant life, from the smallest of spores to the largest of trees. Each species has a unique story, and I hope to read as many as possible.

A Note to the Reader

Throughout the entirety of this thesis, the word “fern” is used interchangeably for the two clades (that is, lineages) traditionally called “pteridophytes,” which includes the monilophyte (fern) clade and lycophyte (clubmoss) clade. More specifically, the two classes under the umbrella term of “pteridophytes” include the Lycopodiopsida (lycophytes) and Polypodiopsida (ferns). The use of “fern” in this thesis was to reduce confusion for readers when trying to explain the complexities in pteridology. The clubmosses are fascinating and charismatic group of plants, but for the sake of simplicity are being lumped into the term “ferns”.

Introduction

What is Taxonomy?

The field of taxonomy is responsible for delineating and classifying organisms into “groups” called species. Taxonomists describe and name new species when observations are made that suggest the organism under study is different than the currently named species. Determination of a new species is influenced by taxonomists’ species concept(s), which impacts the type of data they collect to support their hypothesis (existence of a new species). There are various species concepts researchers can employ depending on the data they have available. Examples of the data taxonomists collect include measurements of plant parts (also known as morphological character traits), phenological attributes, ecological niches the species occupy, genomic data, and so forth. All of these data could be used by researchers to determine whether there is a new species present based on their own species concept. However, taxon authors (researchers who describe and name species that are new to science) frequently do not explicitly state their hypotheses and species concept(s) when describing a new species, although they do show the data with which they are testing those hypotheses. Because the underlying theory (species concept) and hypotheses of taxonomic studies describing new species tend to be implicit rather than explicit, taxonomy has been viewed somewhat negatively in science at-large. At times, taxonomy is undervalued as a field of science because the basis of science is hypothesis-testing and theory-validation; since taxonomists often do not explicitly reference their hypotheses and underlying theories, taxonomy has been impugned as merely a “descriptive” science (Agnarsson and Kuntner 2007).

Species Concepts

In 1989, the *American Fern Journal* published a special issue as a type of reflection and retrospective on the field of fern taxonomy, species concepts, and explanation of pteridophyte evolution. There are many complicated phenomena associated with fern reproduction and speciation. Many fern genera and families have formed reticulation complexes (merging of species to form a new species) and/or hybrid species. These have proved to be novel situations because of the question: "Are hybrids separate species?" Unlike most animal life, ferns have the capacity to interbreed with different species and create a living organism lacking the ability to reproduce (termed a sterile offspring). The collective genome of a fern can spontaneously duplicate (this is "polyploidy") which brings fertility back to the hybrid individual. If this new wildcard with double the chromosomal number can reproduce and continue into future generations, a new species can arise (termed an allopolyploid). Most interestingly, this is just one of the many ways fern species can come to be.

Researchers have demonstrated reticulation complexes in some example groups like the *Asplenium* complex (Barrington et al. 1989). By using phenolics, isozymes, spore abortion, chromosome number, and comparative morphology, Barrington and others were able to determine evolutionary relationships between species in these complexes. Along with the aforementioned techniques, the authors also used morphometrics when analyzing clades of fern species (analyses using both Principal Components Analysis and Discriminant Function Analysis). At the end, the authors present an argument for the three main species concepts useful in pteridophyte taxonomy (specifically for complex reticulate evolution or hybridization events) which includes the following:

- Morphological Species Concept
    - "Groups whose boundaries are diagnosed by discontinuities in critical, qualitatively or quantitatively definable features of the available specimens" (Haufler 1989).
- Biological Species Concept
    - "Groups that do not necessarily differ morphologically but do have barriers to interbreeding" (Haufler 1989).
- Evolutionary Species Concept
    - "Place a historical parameter on biological species and require definition of ancestral/descendent relationships" (Haufler 1989).

The authors determined that hybrid ferns are stable species with the lens of the morphological and biological species concepts as well as the evolutionary species concept, but this last one is harder to address because it requires more thought and logical arguments (Barrington et al. 1989).

Taxonomic Hypotheses

Dr. Christopher Haufler wrote broadly in 1989 about the main purpose and path taxonomists take when describing pteridophyte species and the species concepts on which they base their hypotheses (Haufler 1989). The author tackles the discernment of species concepts and techniques used when describing polyploid complexes and cryptic species. Agreeing with Barrington and others, the three main species concepts aforementioned are available for taxonomists to make assertations about what is a species and where the lines for delineation lie. Haufler clearly supported the usage of the evolutionary species concept; however, he recognized the utility of the other species concepts when the taxonomists do not have the data that are necessary to fully use the evolutionary species concept (potentially could include molecular data, fossil record, or biogeographical data). One of the main points made was that taxonomists must develop concrete hypotheses of new species based on significant character traits, life history, ecological conditions, genetic makeup, and biochemical processes. When crafting the framework for the literature review in the current study, which will be expounded in the methodology section below, we included if the author specifically stated the hypothesis for which they are carrying out their research (Haufler 1989).

Previous Pteridophyte Literature Review

In the field of pteridophyte taxonomy, there has been little research reviewing the taxonomic treatments leaving a gap for much work to be done. In 1989, Yatskievych and Moran carried out an analysis of 50 monographic works (complete synthesis of a group of organisms) for the status of species concepts, population differentiation, the taxonomic group being studied, level of classification and taxonomic work (i.e., species-level, subspecies, variety), the arguments used to support a proposed phylogeny (an evolutionary history of organisms), and the type of data the study used, if applicable (for example, molecular or morphological data). The authors found there are many liberties taken in pteridophyte taxonomy that should be addressed in the future. The authors also found that many taxonomists do not state the species concept they are prescribing to (24% stated), which could have drastic influence on the species they propose. Interestingly, the authors binned the monographs into the following major species concepts: biological, morphological, and "look-alike" concepts (unlike the three species concepts defined by Haufler – morphological, biological, and evolutionary). For the purposes of our study, we will not be using the "look-alike" species concept (similar to morphological but less structured). From Yatskievych and Moran, we will also be adopting the part of the analysis where they collected the data types used by the taxonomists. However, our analyses will be expanding out from monographs to include any peer-reviewed publication in which a new fern species (new to science) is described (Yatskievych and Moran 1989).

Herbaria

The backbone of all taxonomic work are herbaria, natural history museums specifically for documenting and preserving plant and fungal specimens. Herbaria and the specimens stored within are shifting from solitary museums to more dynamic and accessible resources for researchers to participate in larger networks of data exchange and collaboration. In 2019, Heberling and collaborators conducted a computational text analysis on 13,702 research articles published from 1923 to 2017 that included the word "herbarium" in the title, keywords, or abstract (Heberling et al. 2019). The purpose of that research was to holistically analyze the usage of herbarium records throughout time. More specifically, the authors used machine learning to quantitatively review the connections between various fields of research using herbarium specimens as well as the rates and trends of research publications utilizing herbarium specimens. The authors used automated text analysis because the volume/quantity of the articles that have used herbarium specimens in the past 100 years was immense. A complex network was created from the text analysis, providing a visual representation of the large dataset compiled. The major finding was that herbarium specimens have metamorphosed into a dynamic data source enriched from technological and genomic advances allowing for the mobilization of formerly static specimens (Heberling et al. 2019).

Pteridophyte Phylogeny Group

In 2016, a massive team of pteridologists published a landmark research article that outlines the current taxonomic classification of the living (or extant) lycophytes/clubmosses and monilophytes/ferns (PPG I 2016). All of the authors on the paper, collectively called the Pteridophyte Phylogeny Group, united to write a classification of all extant pteridophytes down to the genus-level. This serves as a baseline for other researchers to reference when delineating and researching in the framework of the pteridophyte clade. The Pteridophyte Phylogeny Group attempted to create monophyly among the classifications they were making, but respected and aimed to maintain pre-existing clades that are persistently recognized in the field and/or fall in line with the current understandings of proposed phylogenies (PPG I 2016).

Hybrization

In 2016, Sigel gave a broad overview of the changes and current stage of fern genomics specifically in regard to hybridization events and how researchers discern and interpret reticulate species complexes (Sigel 2016). Hybridization is a very common incident among ferns, but the interesting divergence in pteridophytes is that the fertile hybrids that result from allopolyploidy represent a unification of two different parental genomes. To discuss these hybridization events, Sigel used published research similarly to how we are. Sigel goes as far as to recommend that the time for asking research questions about fern hybrids is now due to exponential increases in extinction rates among all forms of life. Therefore, to prevent these lineages from disappearing forever, we should try to learn as much as we can about them to conserve their existence. More specifically, the author wishes for fellow researchers to look at the genome specifically to look at the molecular-level changes to the relatedness of parental genomes and their progeny. Our review will include hybrids if a taxonomist treats the hybrid as a unique, stable species with an accompanying species description of the allopolyploid (Sigel 2016).

Basis of Literature Review

Dr. Melanie Link-Pérez, my thesis mentor, for her PhD dissertation completed a treatment of the neotropical fern genus *Adiantopsis*. The dissertation is split into many chapters that include an analysis of the palmate species in the genus; a phylogenetic, morphological, and biogeographical study of the members in *Adiantopsis*; and a summary of the results found with the broader implications. However, the part of Dr. Link-Pérez’s dissertation that has sparked theoretical conversations among her friends and colleagues is the introduction and the “Note about Species Concepts.” In this section, she explicitly describes the theoretical underpinnings adopted in her taxonomic study and explicitly stated a null hypothesis as well as articulated a prediction associated with the hypothesis. Link-Pérez goes into detail about what species concept the dissertation research prescribed to (evolutionary species concept). The original and initial hypotheses were based upon the morphological species concept with further integration of a multitude of different data (i.e., ecological, biogeographical, and genomic). With the comprehensive data set, the initial hypotheses based on the morphological species concept were joined with other data that allowed for a final argument building on the evolutionary species concept. The value of this section is the whole reason for the start of our review. Since publication of the dissertation, Link-Pérez has been prompted by AJ Harris (who already has cited the dissertation in two of her own articles) to elaborate because explicit stating species concepts and hypotheses is relatively uncommon in taxonomic research but a mainstay of scientific methodology.

Rationale & Research Objectives

Even though taxonomy is observational in nature, rather than experimental, there are still very concrete and solid underlying theories from which taxonomic hypotheses are asserted (Fig. 1). In the field of taxonomy, these underlying theories are the species concepts a plant author (researcher who names new plant species) chooses to prescribe to based on the data available. From the theories, data analysis is carried out to make hypotheses on which recognition of a new species or new rearrangements of clades can emerge (Fig. 2). Changing the underlying theory can change the outcome of what hypotheses can be supported or built upon the foundation. This is also greatly dependent on the type of data available to the researchers (i.e., the building material of the house). For example, in Figure 3, we can show in the house-foundation analogy how two different species concepts (for this purpose, the morphological and evolutionary species concepts) can give rise to differing taxonomic conclusions with two species able to be supported from the top foundation (representing, perhaps, a morphological species concept) and three from the bottom foundation (for example, representing an evolutionary species concept). To demonstrate other complexities, Figure 4 represents many of the biological phenomena that complicate fern taxonomy. In the top right corner, a two-story house represents a polyploidy event. In the bottom left corner, hybridization giving rise to a sterile hybrid is represented by the support of a house on two different houses. In the bottom right corner, an allopolyploid species resulting from hybridization followed by polyploidy is represented in a “simple” reticulation complex. In some fern genera, there are much more dynamic interactions in reticulation complexes that simply cannot be explained by the analogy of stacking of houses. To develop the analogy further, if a contractor does not consciously know the foundation she is building upon, the houses she builds could crumble (disagreement in science or falsification of the species hypothesis). However, if there is explicit statement of the species concept, when a new contractor wants to build a different house in a different location (taxonomist making a new hypothesis or taxonomic assertation), he can know exactly how previous contractors built certain structures (or how previous scientists interpreted that taxonomic group).

To bring this analogy back to the research at hand, we have conducted a literature review of new pteridophyte species described since the special issue of the *American Fern Journal* in 1989 in hopes of seeing what types of foundations are used in taxonomic treatments. We hypothesize three results from our research:

1. There will be a meager number of researchers explicitly stating the species concept they are using, seeing a similar trend from 1989 (Yatskievych & Moran 1989).
2. Few publications will include an explicitly stated hypothesis.
3. There will be a general increasing use of genomics and DNA data as there has been extensive technological innovations and discoveries since 1989.

Methods

Article Search

To gather the data for our study, we were originally going to use Web of Science (WOS) as a search engine. However, the EKU Libraries during the data collection stage eliminated access to WOS due to the COVID-19 pandemic. In leiu of WOS, we utilized EBSCO’s Academic Search Ultimate. Many initial tests were conducted to optimize search terms with combinations including “new species OR sp nov” AND “$aceae” AND “pteridophy$” as well as “plant species” AND “sp nov” AND “pteridophy$”. The search terms we settled upon were “new species OR sp nov” AND “fern OR pteridophy$” and the dates were set from 1989 to 2020, which yielded 431 articles. This specific Boolean search was used for a variety of reasons: produced a manageable number of articles to sift through while other search terms gave over 10,000 articles to search through, and this search also included a higher concentration of extant species when compared to other searches.

Article Screening

After looking through the titles of the articles, we removed any paper that was the description of an extinct pteridophyte species from the fossil record. For the purposes of our work, the analysis techniques for describing fossilized species is much different than living species, mainly in the genetic techniques available for researching extant species. This reduced the number of papers to 176. When carrying out the review, articles were removed as needed if the articles did not fall into the scope of the research (i.e., outside of the pteridophyte phylogeny, extinct species, no new species described). The final number of articles reviewed was 130 (Table 1). The articles that were initially included but were then removed once deeper into the text have also been included (Table 3).

Article Reviewing Methodology

A form was developed for collecting data (Appendix A). The articles were assessed for the following criteria:

1. Explicitly stated species concept:
    a. Present or absent?
    b. If present, where in the paper? (Abstract, introduction, methods, results, discussion, appendices, or other?)
2. Explicitly stated hypothesis:
    a. Present or absent?
    b. If present, where in the paper? (Abstract, introduction, methods, results, discussion, appendices, or other?)
3. Types of data used in the study:
    a. Morphological species concept data types? (macroscopic, microscopic, or other?)
    b. Biological species concept data types? (molecular data: isozymes, chromosome counts; non-molecular data: crossing, other?)
    c. Evolutionary species concept data types? (morphological: differences among related taxa; biogeographical: ecological and geographical range; phylogenetic: proposed phylogeny; geological: paleobotanical and geological data; other?)

4. Concept(s) used? (biological species concept, morphological species concept, evolutionary species concept, or other?)
5. Hybrid taxa? (yes, no, or other)

The data types associated with each of the underlying species concepts were derived from published expert taxonomists' descriptions of the type of data used in conjunction with certain species concepts (Haufler 1989; Link-Pérez 2010). To test the usability of the data-collection form, ten papers were evaluated using the form and small modifications were made to increase efficiency and repeatability by reducing the amount of detailed interpretation required by each paper (Table 2).

Data Analysis

We exported the articles from the EPSCO search into a .csv file format, and then bound the separate files using R and R Studio (R Core Team 2017; RStudio Team 2020). To analyze trends in the dataset, Google Sheets was used for creating charts/figures and the bar graphs were generated from Google Form or using Google Sheets.

Results

Species Concepts

From the literature review, 130 of the articles have been included in our final analyses. We found 121 (93.1%) of the articles did not explicitly state the species concept they were using and nine (6.9%) of the articles did explicitly state the species concept (Fig. 5).

When the species concept was stated explicitly in the paper, it was located in the discussion section in five (55.6%) of the articles, methods section in two (22.2%) of the articles, introduction section in four (44.4%) of the articles, and abstract in two (22.2%) of the articles (Fig. 6). Sometimes the species concept was explicitly stated in multiple places, hence percentages add to more than 100%.

When analyzing the articles, we determined of the 130 papers reviewed, 130 (100%) of the articles used the morphological species concept, 34 (26.2%) of the papers used the evolutionary species concept, and eleven (11.5%) of the papers used the biological species concept. The totals add up to more than 100% since an article can use multiple species concepts at a time. For example, when using the evolutionary species concept, the authors are simultaneously using the morphological species concept (Fig. 9).

Hypothesis Testing

For the hypothesis being tested, of the 130 articles reviewed, we found 118 (90.8%) of the articles did not explicitly state the hypothesis they were testing and twelve (9.2%) of the articles did state their hypothesis/hypotheses (Fig. 7). When the hypothesis was stated explicitly, it was in the discussion in ten (83%) of the articles, the introduction in three (25%) of the articles, the methods in one (8.3%) of the articles, and the abstract in one (8.3%) of the articles (Fig. 8). Again, sometimes the taxonomic hypothesis was explicitly stated in multiple places, hence percentages add to more than 100%.

Hybrization

When analyzing if the newly described species was a hybrid species or not, of the 130 articles reviewed, we found seven (5.4%) of the articles were descriptions of new species believed to be distinct species from hybrid origins, nine (6.9%) of the articles were believed to potentially have hybrid origins but the authors were not able to positively confirm or deny the idea, and 114 (87.7%) of the articles were not believed to be of hybridization events or the author did not explore this idea (Fig. 10).

Discussion

Species Concepts

As hypothesized, we found an overwhelming majority of the reviewed articles (121; 93.1%) did not explicitly state the species concept(s) they were prescribing to (Fig. 5). This could be a result of previous research not including the species concepts, which creates a culture in the pteridophyte community for a researcher to not include this. We understand most pteridologists and expert taxonomists would automatically pick up on the species concept being utilized; however, for both experts and novices, we believe including this step would strengthen the field of taxonomy by both increasing the understanding of the specific species concept being used and better representing the field of taxonomy as a scientific discipline.

When the species concept was specifically stated in a paper, there were a variety of locations (discussion, methods, abstract, and introduction) but we find this to be beneficial. Leaving this decision up to the author would be optimal due to the nature of where they think it should be included. The decision to discuss the scientific theories a paper is relying on and/or using as a foundation would be logical to include in the introduction or methods (four articles and two articles, respectively) but could also be justified to include in the discussion or abstract (five articles and two articles, respectively), according to which best fits the author’s flow of writing and logic (Fig. 6).

When analyzing the species concepts used in all of the articles, it was decided to allow for the possible selection of multiple species concepts for each article. This could be changed when conducting future studies; however, for this study, we wished to capture information about any of the three species concepts that could be supported by the data used in each article rather than forcing a selection of just one species concept. Enforcing a selection of just one species concept for each article when those concepts were overwhelmingly implicit would require a much closer examination of each publication, demanding additional expertise and more time than what was allocated for this thesis. We found all 130 (100%) of the articles used the morphological species concept at some point. This is not at all surprising as this is the least expensive and most easily accessible data available for analysis (Fig. 9). We also found fifteen (11.5%) of the articles used the biological species concept data types such as isozymes or chromosomal numbers or structure when describing a new pteridophyte species. The biological species concept is problematic to apply to ferns and most plant life because mating between distantly related species is possible in ferns/plants (Donoghue 1985), even occurring between genera separated by 60 million years (Rothfels et al. 2015). As more data become available through research of a specific species or taxonomic group, a researcher can expand into the evolutionary species concept. By using genomic data, biogeographical data, and/or geologic data, this adds to the arguments being made in the morphological differences in a phylogeny or shifts the phylogeny to a more informed argument. We saw that 34 (26.2%) of the articles were able to get to this point in their species descriptions and use an evolutionary species concept based on the data types the researchers included (Fig. 9). For example, in a publication by Sánchez and Labiak, the authors write, “In the future, these taxonomic hypotheses should be tested with molecular data” (Sánchez & Labiak 2019). The researchers were able to gather enough data to make a sound morphological taxonomic hypothesis but recognized the need for future studies pushing for a more comprehensive conclusion.

Hypothesis Testing

We think that explicitly stating a hypothesis in taxonomic studies would be valuable and could improve the status of taxonomy among other scientific fields. Certainly, in every taxonomic study there is a hypothesis being made; however, the hypothesis draped over the entire paper often is implicit and left to be understood (or not) by the reader. An expert taxonomist would have no trouble dissecting a publication to be able to discern the hypothesis being asserted, but this could be more difficult for a reader unfamiliar with the field. However, out of the 130 articles reviewed, only twelve (9.2%) gave the reader an explicit taxonomic hypothesis the researchers are testing (Fig. 8). This shows vast room for growth in the other 118 (90.8%) of the articles to allow for a clearer scientific investigation.

By clearly articulating the hypothesis and underlying theories, we hope the field of taxonomy could become an even stronger leader in the sciences for researchers to find species to use as model organisms, groups for evolutionary studies, or individuals for ecological analyses, to answer complex questions in plant biology. Regarding the location of the hypothesis being stated, similar to the species concepts, placing the hypothesis where deemed most appropriate by the author would enhance the paper the most.

Hybridization

When the articles were reviewed, the number of stable species with hybrid origins was much lower than hypothesized, however, these data could be deceiving and misleading. Whilst reviewing, an article was marked as "not hybrid" if there was no mention of hybridization, with 114 (87.7%) articles falling into this bin, or if the authors said confidently the distinct species was not of hybrid origins. The authors could have not included a hybrid origin hypothesis in their research thus not yielding a "Yes" or "Potentially" when asked where the species was of hybrid origin in the reviewing process. There were nine (6.9%) articles that mentioned a hybrid origin could be possible for the new species based on morphological blending of two related species, unusual chromosomal numbers, or other cytological inferences. However, it can be assumed the authors were not at far enough stage in their research to yet ask hybridization questions (Fig. 10).

Future Work

The authors are planning to expand greatly on the work completed by this thesis. Much of this thesis will be seen as preliminary work for larger research questions. While the authors recognize the limitations of a general literature search in missing pertinent articles, we will be searching individual articles that describe new species of pteridophytes to have more data points. Along with individual searches, we also hope to use Web of Science, the gold standard for scientific literature reviews, in combination with Academic Search Ultimate.

Along with the extended literature search, it would be fascinating to extend these research questions (if not asked yet) to other taxonomic groups such as angiosperms, bryophytes, and gymnosperms.

In terms of future analyses, we will be conducting more time analyses with the articles seeing if there are trends in time and the type of species concept(s) used by the authors or trends in time and the usage of genetic techniques (i.e., polymerase chain reaction and Next Gen Sequencing). We also hope to review the articles with a more fine-toothed comb when looking at the types of data researchers have deployed when describing pteridophyte species and comparing this to time. During the review process, we also noted the wide number of species described in each article ranging from sometimes only one new species to sometimes over eleven species. Additionally, analyzing the global distribution and trends in new pteridophyte species being described could shed light on where current research is being carried out as well as where new pteridophyte species remain to be discovered.

Lastly, the results from this thesis will be taken to the professional botanical and pteridological societies to report on the findings as well as to encourage taxonomists to be more explicit in the theories and hypotheses being researched and published.

References

Agnarsson, I., & Kunter, M. 2007. Taxonomy in a Changing World: Seeking Solutions for a Science in Crisis. *Systematic Biology*. 56(3): 531-539.

Barrington, D. S., Haufler, C. H., & Werth, C. R. 1989. Hybridization, Reticulation, and Species Concepts in the Ferns. *American Fern Journal*, 79: 55.

Cárdenas, G. G., Tuomisto, H., & Lehtonen, S. 2016. Newly discovered diversity in the tropical fern genus *Metaxya* based on morphology and molecular phylogenetic analyses. *Kew Bull*, 71: 5.

Chao, Y.-S., Ebihara, A., Chiou, W.-L., & Huang, Y. M. 2017a. *Pteris latipinna* sp. nov. (Pteridaceae), a new species segregated from *Pteris fauriei*. *PhytoKeys*, 85: 95–108.

Chao, Y.-S., Huang, Y.-F., Dong, S.-Y., Huang, Y.-M., & Liu, H.-Y. 2019. *Bolbitis lianhuachihensis* (Dryopteridaceae), a new species from Taiwan. *PhytoKeys*, 131: 69–81.

Chao, Y.-S., Mustapeng, A. M. A., Chen, C.-W., & Chiou, W.-L. 2017b. *Pteris borneensis* (Pteridaceae), a New Species from Borneo, with Re-circumscription of *Pteris decrescens* and *Pteris parviloba*. *Systematic Botany*, 42: 724-732.

Donoghue, M.J. 1985. A critique of the biological species concept and recommendations for a phylogenetic alternative. *Bryologist*. 88(3): 172-181.

Dubuisson, J.-Y., Bauret, L., Grall, A., Li, T., Ebihara, A., & Hennequin, S. 2016a. Discussion on the taxonomy of African fern *Abrodictyum rigidum* (Sw.) Ebihara & Dubuisson and description of two new *Abrodictyum* C.Presl species (Hymenophyllaceae, Polypodiidae) for the Afro-Malagasy region. *Phytotaxa*, 284: 151.

Dubuisson, J.-Y., Hennequin, S., Droissart, V., & Deblauwe, V. 2016b. *Hymenophyllum senterreanum* Dubuisson & Deblauwe, sp. nov. (Hymenophyllaceae) and its relatives in western Central Africa. *Phytotaxa*, 257: 287.

Fernandez-Hilario, R., & Arteaga, R. 2017. A new species of *Raputia* (Rutaceae) from the Selva Central of Peru. *PhytoKeys*, 89: 73–84.

Grusz, A. L. 2013. *Myriopteris windhamii* sp. nov., a New Name For *Cheilanthes villosa* (Pteridaceae). *American Fern Journal*, 103: 112–117.

Haufler, C. H. 1989. Species Concepts in Pteridophytes: Summary and Synthesis. *American Fern Journal*, 79: 90.

He, H., & Zhang, L.-B. 2010. *Pteris xiaoyingae* sp. nov. (sect. *Pteris*) from a Karst Cave in China Based on Morphological and Palynological Evidence. *Systematic Botany*, 35: 695–700.

Heberling, J. M., Prather, L. A., & Tonsor, S. J. 2019. The Changing Uses of Herbarium

Data in an Era of Global Change: An Overview Using Automated Content Analysis. *BioScience*, 69: 812–822.

Huiet, L., Lenz, M., Nelson, J. K., M. Pryer, K., & Smith, A. P. 2015. *Adiantum shastense*, a new species of maidenhair fern from California. *PhytoKeys*, 53: 73–81.

Jongkind, C., & Winter, W. de. 2015. *Blotiella confusa* Jongkind & W. de Winter, sp. nov. (Dennstaedtiaceae), a new species from lowland tropical West Africa, and its distinction from *B. reducta* (C.Chr) R.M.Tryon. *Adansonia*, 37: 7–12.

Link-Pérez, M. A. 2010. Revision and Molecular Systematics of the Neotropical Fern Genus *Adiantopsis* (Pteridaceae). *Miami University*, 2-9.

Lu, N. T., Peng, Y.-L., Gao, X.-F., & Zhang, L.-B. 2019. *Woodsia kungiana* sp. nov. (Woodsiaceae), a new fern from Sichuan, China. *Phytotaxa*, 397: 253.

Lu, N. T., Zhang, L., Nguyen, D. T., & Zhang, L.-B. 2016. *Polystichum quangbinhense* sp. nov. (subg. *Haplopolystichum*; Dryopteridaceae), the southernmost cave species of *Polystichum* from central Vietnam. *Phytotaxa*, 283: 295.

Padial, J., Miralles, A., De la Riva, I., & Vences, M. 2010. The integrative future of taxonomy. *Frontiers in Zoology*, 7: 16.

Patel, M., & Narsimha Reddy, M. 2019. Revealing a new species of *Ophioglossum*

(Ophioglossaceae Pteridophyta) from India with palynological and phylogenetic implications. *Botany Letters*, 166: 425–433.

Perrie, L., & Brownsey, P. 2012. *Lastreopsis kermadecensis* , a new fern species from Raoul Island in the Kermadec Islands, New Zealand, with notes on *L. pacifica*. *New Zealand Journal of Botany*, 50: 29–36.

Peters, M. D., Godfrey, C. M., Khalil, H., McInerney, P., Parker, D., & Soares, C. B. 2015. Guidance for conducting systematic scoping reviews. *International Journal of Evidence-Based Healthcare*, 13: 141-146.

PPG I. 2016. A community-derived classification for extant lycophytes and ferns. *Journal of Systematics and Evolution*, 6: 563-603.

R Core Team. 2017. R: A language and environment for statistical computing. R Foundation for Statistical Computing, Vienna, Austria.

Rakotondrainibe, F., Hemp, A., & Meyer, S. 2014. *Adiantum papilio* Rakotondr. & Hemp, sp. nov. (Pteridophyta, Pteridaceae), une nouvelle espèce endémique de Madagascar. *Adansonia*, 36: 15–20.

Rakotondrainibe, F., & Jouy, A. 2012. Quatre espèces et une variété nouvelles dans la famille des Thelypteridaceae à Madagascar -premier signalement du genre *Pronephrium* C.Presl dans la region africano-malgache. *Adansonia*, 34: 223–235.

Rothfels, C.J., Johnson, A.K., Hovenkamp, P.H., Swofford, D.L., Roskam, H.C., Fraser-Jenkins, C.R., Windham, M.D. and Pryer, K.M. 2015. Natural hybridization between genera that diverged from each other approximately 60 million years ago. *The American Naturalist*, 185(3): 433-442.

Roux, J. P. 2014. *Elaphoglossum nimbaense* J.P.Roux, sp. nov. (Pteridophyta: Dryopteridaceae), a new fern species from Liberia, West Africa. *Adansonia*, 36: 7-13.

RStudio Team. 2020. RStudio: Integrated Development for R. RStudio, PBC, Boston, MA.

Salino, A., Santos Fernandes, R., & Roberto Pietrobom, M. 2011. *Thelypteris amazonica* sp. nov. (Thelypteridaceae) from Amazonian Brazil. *Nordic Journal of Botany*, 29: 611–614.

Salino, A., & Smith, A. R. 2018. *Steiropteris alstonii* (Thelypteridaceae), a new species from Colombia, and some new combinations in the family. *Phytotaxa*, 340: 175.

Sánchez, C., & Labiak, P.H. 2019. *Parapolystichum villosissimum* (Dryopteridaceae): A new and threatened species from Cuba. Brittonia, 71: 235-241.

Sanín, D. 2014. *Serpocaulon obscurinervium* (Polypodiaceae), a new fern species from Colombia and Ecuador. *Plecevo*, 147: 127–133.

Schwartsburd, P. B., Miranda, C. V., & Prado, J. 2016. *Oleandra* (Oleandraceae) in the

Brazilian Atlantic Forest. *American Fern Journal*, 106: 191–205.

Sigel, E. M. 2016. Genetic and genomic aspects of hybridization in ferns. *Journal of Systematics and Evolution*, 54: 638-655.

Tsutsumi, C., Matsumoto, S., Yatabe-Kakugawa, Y., Hirayama, Y., & Kato, M. 2011. A New Allotetraploid Species of *Osmunda* (Osmundaceae). *Systematic Botany*, 36: 836–844.

Wang, C., Yang, W., Zhao, J., Zhang, D., & Zhang, G. 2019. Two new records of the fern genus *Coniogramme* (Pteridaceae) from Vietnam. *PhytoKeys*¸119: 137-142.

Xu, K.-W., Zhou, X.-M., Zhang, L.-B., & Liao, W.-B. 2018. *Hymenasplenium hastifolium* sp. nov. (Aspleniaceae) from a karst cave in western Guangxi, China. *Phytotaxa*, 333: 281.

Yatskievych, G., & Moran, R. C. 1989. Primary Divergence and Species Concepts in Ferns. *American Fern Journal*, 79: 36.

Zhang, L.-B., & He, H. 2010. *Polystichum speluncicola* sp. nov. (sect. *Haplopolystichum*, Dryopteridaceae) Based on Morphological, Palynological, and Molecular Evidence with Reference to the Non-Monophyly of *Cyrtogonellum*. *Systematic Botany*, 35: 13–19.

Zhang, L.-B., & He, H. 2011. *Polystichum fengshanense* , sp. nov. (sect.

Haplopolystichum, Dryopteridaceae) from Karst Caves in Guangxi, China based on Morphological, Palynological, and Molecular Evidence. *Systematic Botany*, 36: 854–861.

Figures

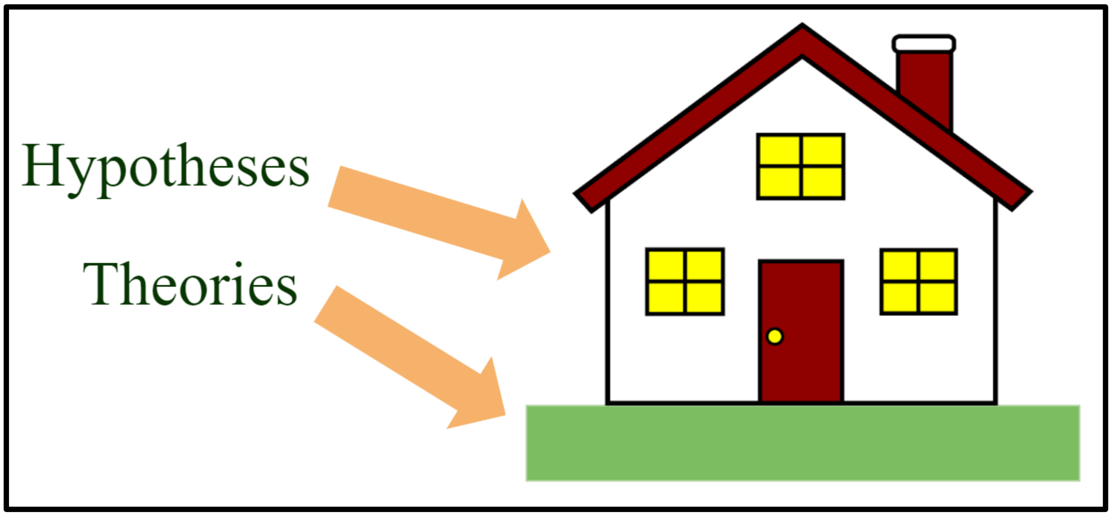

Figure 1. House-foundation analogy for scientific investigation demonstrating how hypotheses are built on theories.

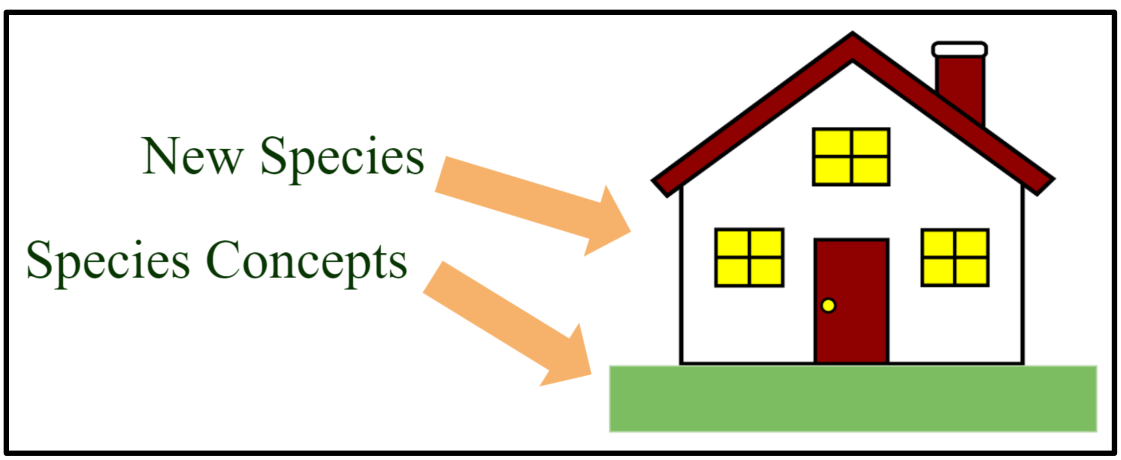

Figure 2. House-foundation analogy for taxonomic investigation demonstrating how new species are hypotheses, and those hypotheses emerge from the underlying theories, which are the species concepts adopted by the taxonomist proposing the species.

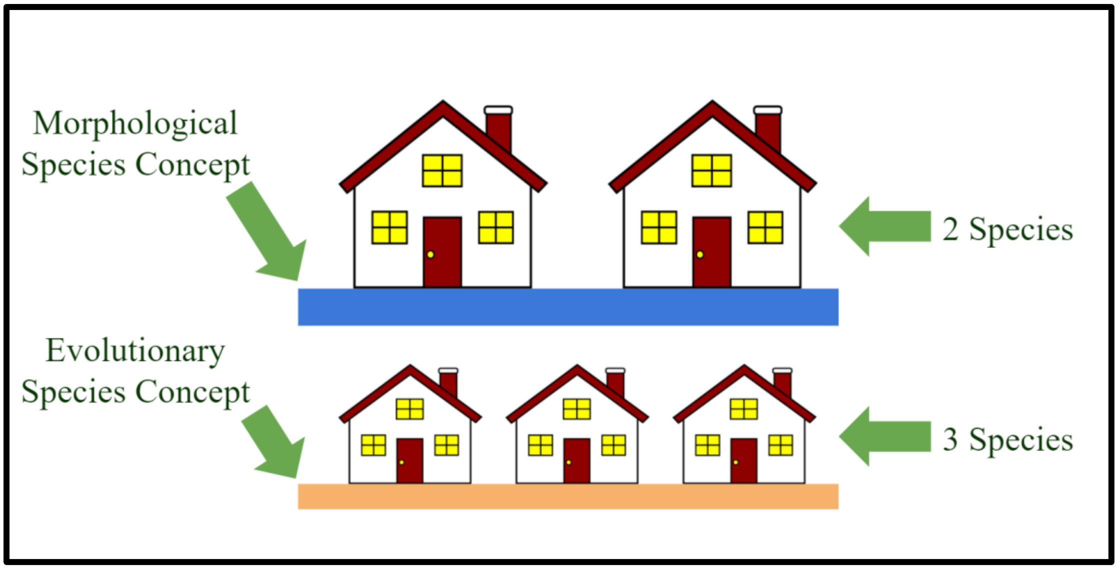

Figure 3. House-foundation analogy demonstrating how two different species concepts (for example, morphological, above, and evolutionary, below) can give rise to differing taxonomic conclusions. In the depiction above, a taxonomist subscribing to a morphological species concepts recognizes the existence of two species, whereas another taxonomist subscribing to an evolutionary species concept may propose the existence of three species even though the taxonomists are studying the same group of organisms.

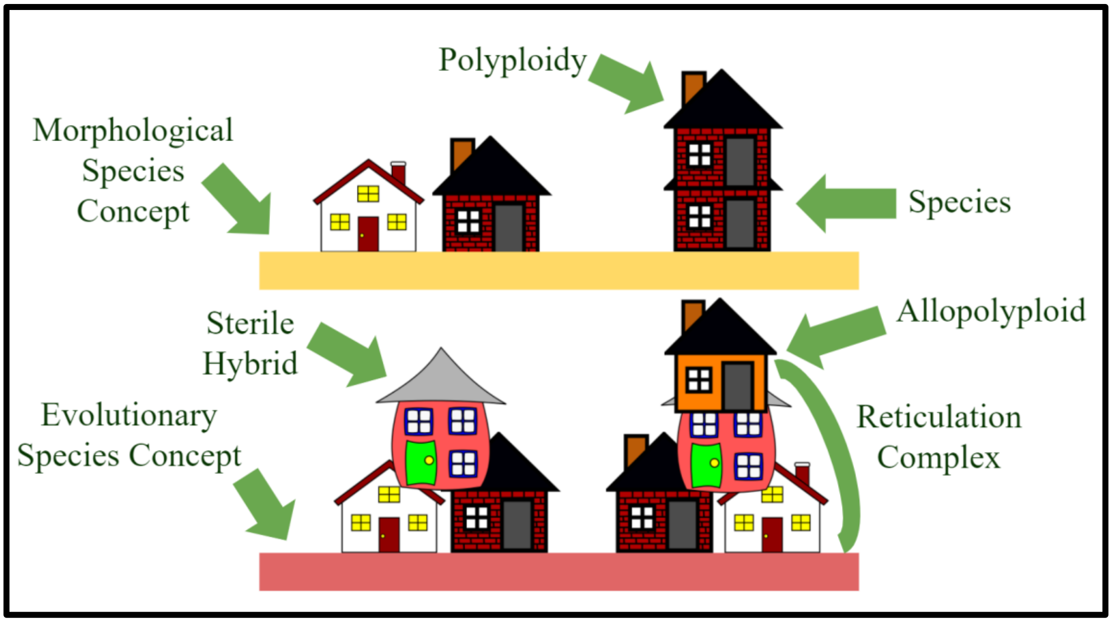

Figure 4. House-foundation analogy demonstrating the complexities that can come from using different species concepts in fern taxonomy. The two-story house represents a polyploidy event (top right corner), hybridization giving rise to a sterile hybrid is represented by the support of a house on two different houses (bottom left corner), and an allopolyploid species resulting from hybridization followed by polyploidy is represented in a "simple" reticulation complex (bottom right corner).

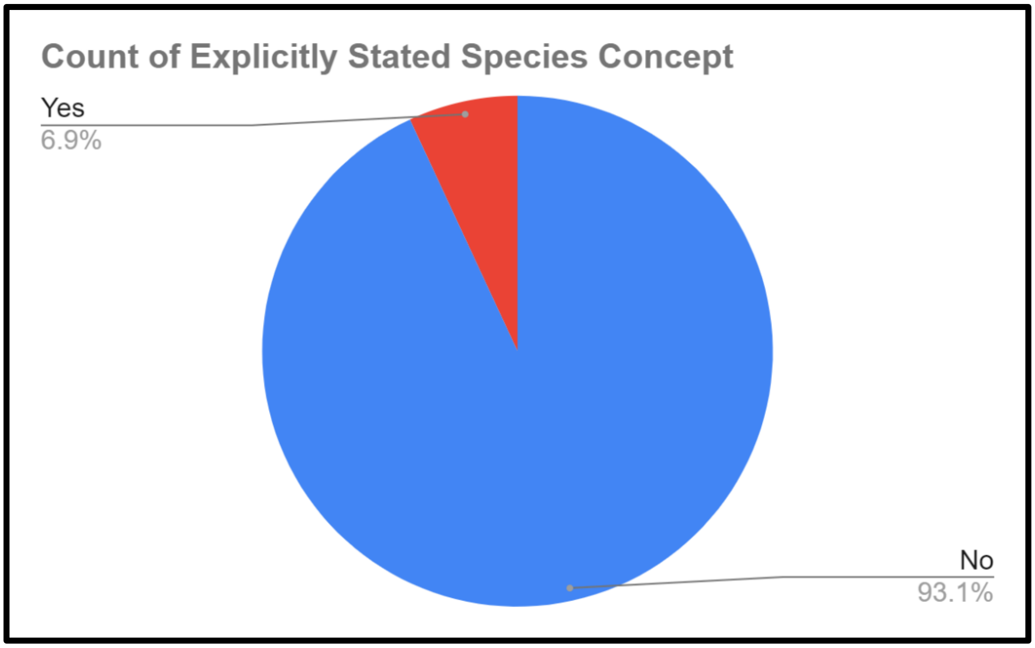

Figure 5. Pie chart of count of explicitly stated species concepts (Yes: n = 9 articles; No: n = 121 articles; Total: n = 130 articles).

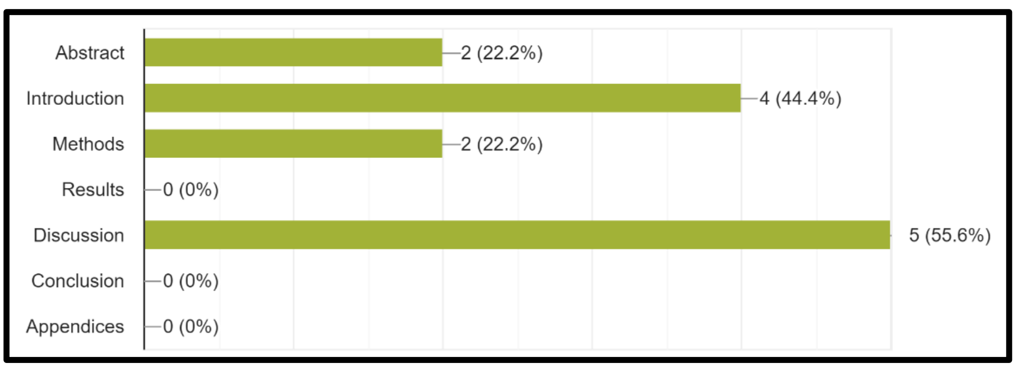

Figure 6. Location of explicitly stated species concept in journal article (Total: n = 9 articles). Exceeds 100% because options for reviewing were mutually inclusive.

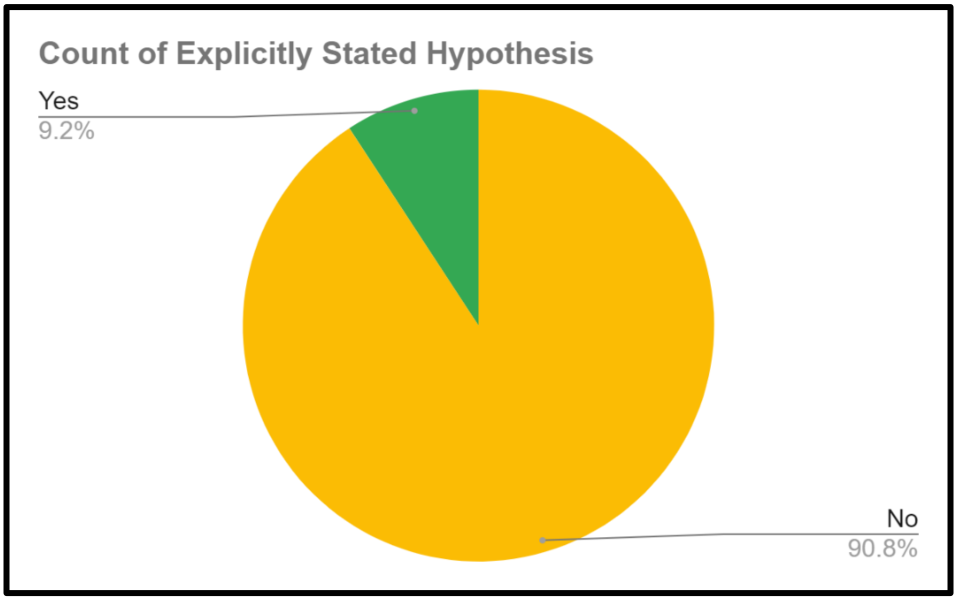

Figure 7. Pie chart of count of explicitly stated hypothesis (Yes: n = 12 articles; No: n = 118 articles, Total: n = 130 articles).

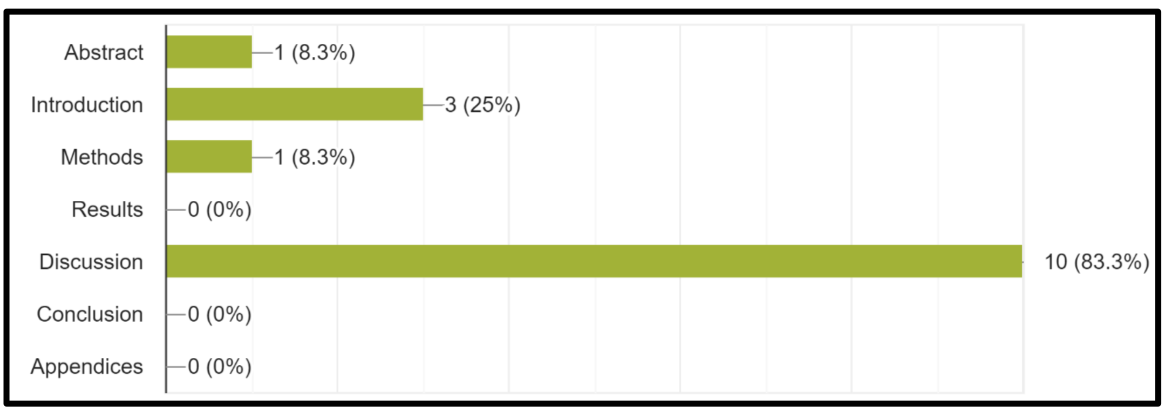

Figure 8. Location of explicitly stated hypothesis in journal article (Total: n = 12 articles). Exceeds 100% because options for reviewing were mutually inclusive.

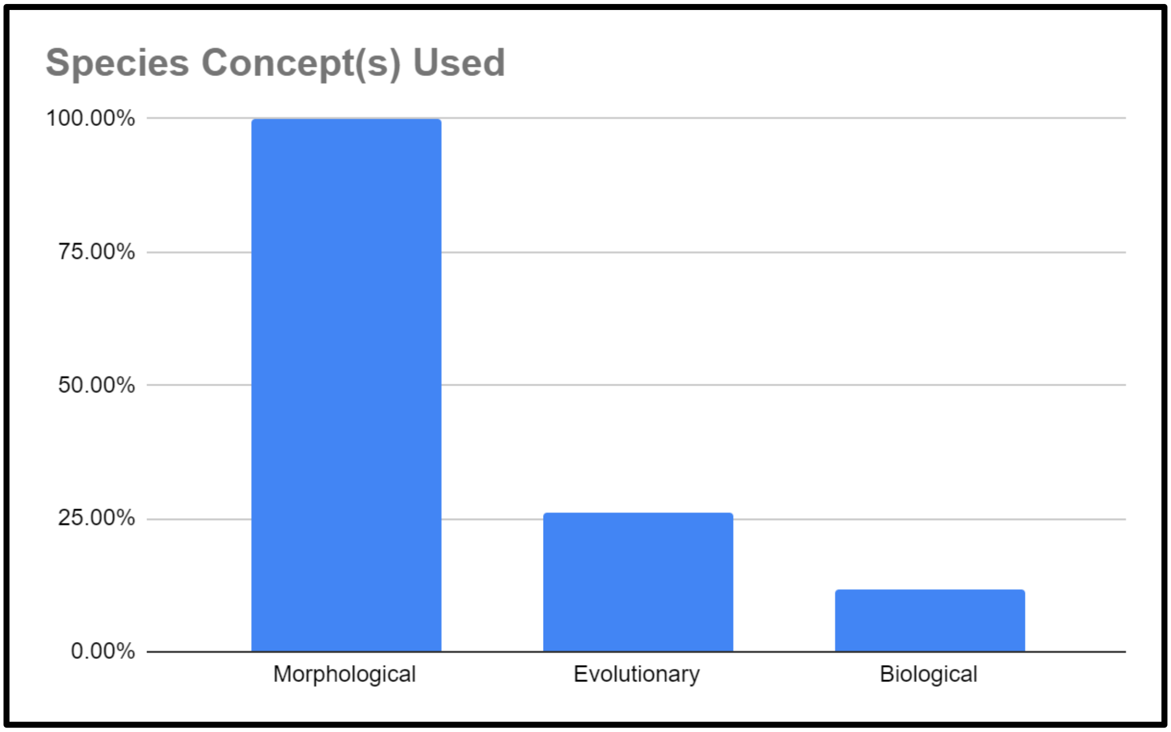

Figure 9. Species concept(s) used by journal articles (Morphological: 100 %, n = 130 articles; Evolutionary: 26.2%, n = 34 articles; Biological: 11.5%, n = 15 articles; Total: n = 130 articles). Exceeds 100% because options for reviewing were mutually inclusive.

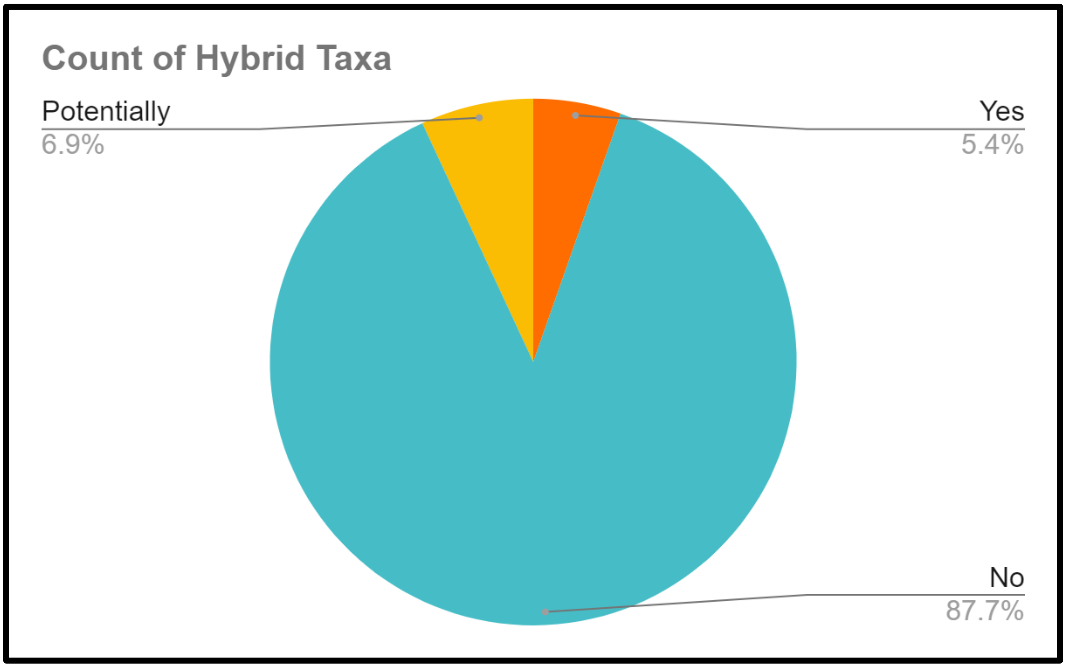

Figure 10. Pie chart of count of hybrid taxa described (No: n = 114 articles; Potentially: n = 9 articles; Yes: n = 7; Total: n = 130 articles).

Tables

Table 1. Reviewed articles with authors, journal titles, and publication dates.

Title of Reviewed Article	**Author(s)**	**Title of Journal**	**Year**
Ascogrammitis lehnertii (Polypodiaceae): A New and Dominant Understory-Species from a Diverse Community of Grammitid Ferns in the Andes of Ecuador.	Sundue, Michael; Olivares, Ingrid; Kessler, Michael	Systematic Botany	2018
Asplenium lepidotum, a new fern species from New Zealand allied to *Asplenium oblongifolium* and *Asplenium obtusatum*.	Perrie, LR; Brownsey, PJ	New Zealand Journal of Botany	2016
Asplenium serratifolium (Aspleniaceae), a New Fern Species from Central Vietnam Based on Morphological and Molecular Evidence.	Xu, Ke-Wang; Zhang, Liang; Lu, Ngan Thi; Zhang, Li-Bing	American Fern Journal	2018
Asplenium simaoense (Aspleniaceae), a New Fern Species from Yunnan, China,	Xu, Ke-Wang; Jiang, Lei; Liao,	Systematic Botany	2019

Based on Morphological and Molecular Data.	Wen-Bo; Zhang, Li-Bing		
A Monograph of the Fern Genus *Pteridrys* (Pteridryaceae).	Zhou, Xin-Mao; Zhang, Li-Bing	Systematic Botany	2019
Athyrium bipinnatum K.Hori (Athyriaceae), a new cornopteroid fern from Japan.	Kiyotaka Hori	PhytoKeys	2020
Athyrium haleakalae (Athyriaceae), a new rheophytic fern species from East Maui, Hawaiian Islands: with notes on its distribution, ecology, and conservation status.	Wood, Kenneth R.; Wagner, Warren L.	PhytoKeys	2017
Athyrium sessilipinnum: A new lady fern (Athyriaceae) from southern China.	Wei, Ran; Zhang, Xian-Chun	Brittonia	2016
Bolbitis lianhuachihensis (Dryopteridaceae), a new species from Taiwan.	Yi-Shan Chao; Yu-Fang Huang; Shi-Yong Dong; Yao-Moan Huang; Ho-Yih Liu	PhytoKeys	2019

Bolbitis moranii (Dryopteridaceae), a new species from southern Guatemala.	Jiménez, Jorge	Brittonia	2012
A New Allotetraploid Species of *Osmunda* (Osmundaceae).	Tsutsumi, Chie; Matsumoto, Sadamu; Yatabe-Kakugawa, Yoko; Hirayama, Yumiko; Kato, Masahiro	Systematic Botany	2011
Bolbitis occidentalis (Dryopteridaceae), a new species from the western side of the Andes of Ecuador.	Moran, Robbin	Brittonia	2016
Campyloneurum atrosquamatum (Polypodiaceae), a new species from Amazonia.	Labiak, Paulo H.; León, Blanca; Moran, R. C.	Brittonia	2020
Ceradenia spectabilis (Polypodiaceae), a New Species from Cerro del Torrá, Colombia.	Sundue, Michael A.	American Fern Journal	2017

A New Brazilian Species of the Genus *Asplenium* L. (Aspleniaceae).	Matos, Fernando B.; Labiak, Paulo H.; Sylvestre, Lana S.	American Fern Journal	2009
Cyathea atrocastanea, a New Tree Fern from the Atlantic Rain Forest of Southeastern Brazil.	Labiak, Paulo H.; Matos, Fernando B.	Systematic Botany	2009
Cyathea srilankensis Ranil (Cyatheaceae): A New Tree Fern Species From Sri Lanka.	Ranil, R. H. G.; Pushpakumara, D. K. N. G.; Janssen, T.; Wijesundara, D. S. A.; Dhanasekara, D. U. M. B.	American Fern Journal	2010
Danaea (Marattiaceae) revisited: biodiversity, a new classification and ten new species of a neotropical fern genus.	Christenhusz, M. J.	Botanical Journal of the Linnean Society	2010
Dicksonia utteridgei, a new species of hairy tree fern (Dicksoniaceae - Cyatheales) from New Guinea.	Lehnert, M.; Cámara-Leret, R.	Blumea	2018

A new *Dryopteris* (Pteropsida: Dryopteridaceae) species from south-central Africa.	Roux, J. P.	Botanical Journal of the Linnean Society	2003
Diplazium fimbriatum (Athyriaceae), a New Species from Brazil.	Mynssen, Claudine M.; Mato, Fernado B.	American Fern Journal	2012
Doryopteris mojestoso (Pteridaceae), a New Species from South America.	Yesilyurt, Jovita Cislinski	American Fern Journal	2007
Dryopteris damingshanensis (Dryopteridaceae): A New Fern in Subgenus *Nothoperanema* from Guangxi, China.	Li-Bing Zhang; Hong-Mei Liu	Novon	2014
Eight New Taxa of *Hypolepis* (Dennstaedtiaceae) from the Neotropics.	Schwartsburd, Pedro B.	American Fern Journal	2018
Elaphoglossum fendleri (Dryopteridaceae), a new species of *Elaphoglossum* sect. *Lepidoglossa* from Venezuela, and the identity of *Elaphoglossum ornatum*.	Matos, Fernando; Vasco, Alejandra	Brittonia	2015

Elaphoglossum mickeliorum (Dryopteridaceae), a new species of *Elaphoglossum* sect. *Polytrichia* from Peru.	Matos, Fernando; Moran, Robbin	Brittonia	2017
Elaphoglossum montanum, a New Species from Southern Brazil.	Kieling-Rubio, Maria A.; Windisch, Paulo G.	American Fern Journal	2012
Elaphoglossum nidusoides (Dryopteridaceae), a New Species of Fern from Madagascar with an Unusual Phylogenetic Position in the *Squamipedia* Group.	Rouhan, Germinal; Rakotondrainibe, France; Moran, Robbin C.	Systematic Botany	2007
Eleven New Scaly Tree Ferns (*Cyathea*: Cyatheaceae) from Peru.	Tejedor, Adrian; Calatayud, Gloria	American Fern Journal	2017
Eleven New Species in the Grammitid Fern Genus *Melpomene* (Polypodiaceae).	Lehnert, Marcus	American Fern Journal	2008
Eriosorus areniticolci (Pteridaceae), a New Species from Brazil.	Schwartsburd, Pedro Bond; Labiak, Paulo Henrique	American Fern Journal	2008

Four New Species of *Adiantum* (Pteridaceae) from the Guianas.	Boudrie, Michel; Hirai, Regina Y.; Prado, Jefferson	American Fern Journal	2017
Genetic Diversity in the Worldwide *Botrychium lunaria* (Ophioglossaceae) Complex, with New Species and New Combinations.	Stensvold, Mary; Farrar, Donald	Brittonia	2017
Gleichenia inclusisora , a new and uncommon tangle fern from New Zealand.	Perrie, LR; Shepherd, LD; Brownsey, PJ	New Zealand Journal of Botany	2012
Hymenophyllum paniense (Hymenophyllacea), A New Species of Filmy Fern from New Caledonia.	Atushi, E.; Iwatsuki, K.; Ohsawa, T.; Ito, M.	Systematic Botany	2003
Hymenophyllum pluviatile , a new and uncommon fern from New Zealand.	Perrie, LR; Shepherd, LD; de Lange, PJ; Batty, EL; Ohlsen, DJ; Bayly, MJ; Brownsey, PJ	New Zealand Journal of Botany	2013

Introducing a new species of the fern genus *Doryopteris* (Pteridaceae, Polypodiopsida) from the Neotropics.	Yesilyurt, Jovita C.	Botanical Journal of the Linnean Society	2008
Isoetes aroucaniana, a New Species from Southern South America.	Macluf, C. Cecilia; Hickey, R. James	American Fern Journal	2007
Isoëtes laosiensis, a New Species from Lao PDR.	Changkyun Kim; Bounphanmy, Somchanh; Byung-Yun Sun; Hong-Keun Choi	American Fern Journal	2010
Isoetes maxima, a New Species from Brazil.	Hickey, R. James; MacLuf, C. Cecilia; Link-Perez, Melanie	American Fern Journal	2009
Isoetes mourabaptistae, a New Species from Southern Brazil.	Pereira, J. B.; Windisch, P. G.; Lorscheitter, M. L.; Labiak, P.	American Fern Journal	2012
Isoëtes todaroana (Isoëtaceae, Lycopodiophyta), a New Species from Sicily (Italy).	Troia, Angelo; Raimond, Francesco M.	American Fern Journal	2009

Isoëtes viridimontana: A Previously Unrecognized Quillwort from Vermont, USA.	Rosenthal, Michael A.; Rosenthal, Sharon R.; Johnson, Gabriel; Taylor, W. Carl; Zimmer, Elizabeth A.	American Fern Journal	2014
Lastreopsis kermadecensis , a new fern species from Raoul Island in the Kermadec Islands, New Zealand, with notes on L. pacifica.	Perrie, LR; Brownsey, PJ	New Zealand Journal of Botany	2012
Lectotypification of *Adiantopsis alata* (Pteridaceae) and Descriptions of New Palmate Species in the Guiana Shield.	Link-Pérez, Melanie A.; Ludwig, Thomas G.; Ledford, Cody J.; Seabolt, Matthew H.; Sessa, Emily B.	Systematic Botany	2016
Megalastrum (Dryopteridaceae - Pteridophyta) in Bolivia, with Descriptions of Six New Species.	Kessler, Michael; Smith, Alan R.	American Fern Journal	2006

Megalastrum (Dryopteridaceae) in Andean South America, Part I.	Moran, Robbin C.; Prado, Jefferson; Sundue, Michael A.	American Fern Journal	2014
Melpomene anazalea, a New Species of Grammitid Fern (Polypodiaceae).	Sundue, Michael; Lehnert, Marcus	American Fern Journal	2008
A new scaly tree fern (*Cyathea*: Cyatheaceae) from Colombia.	Tejedor, Adrian; Calatayud, Gloria; Lehnert, Marcus; Duque, WDR; Wilson D.; Kessler, Michael	Brittonia	2018
Monograph of the West Indian fern genus *Polystichopsis* (Dryopteridaceae).	Prado, Jefferson; Moran, Robbin	Brittonia	2016
Myriopteris windhamii sp. nov., a New Name For *Cheilanthes villosa* (Pteridaceae).	Grusz, Amanda L.	American Fern Journal	2013
A new species and a new combination in *Ctenitis* (Dryopteridaceae) from South America.	Viveros, Raquel; Salino, Alexandre	Brittonia	2017

A New Species and a New Combination of *Thelypteris*, subgenus *Amauropelta*, section *Amauropelta* from Cuba.	Alvarez-Fuentes, Orlando; Sánchez, Carlos	American Fern Journal	2005
New pteridophyte records for Taveuni (Fiji) and a new species of *Chingia* (Thelypteridaceae).	Game, John C.; Fawcett, Susan E.; Smith, Alan R.	New Zealand Journal of Botany	2018
New pteridophyte species and combinations from the Marquesas Islands, French Polynesia.	Lorence, David H.; Wagner, Warren L.; Wood, Kenneth R.; Smith, Alan R.	PhytoKeys	2011
New Species and New Records in *Elaphoglossum* sect. *Polytrichia* subsect. *Hybrida* (Dryopteridaceae) from the Neotropics.	Rojas-Alvarado, Alexander Fco.	American Fern Journal	2010
New species and new records of the fern genus *Terpsichore* (Polypodiopsida: Polypodiaceae) from Bolivia	Sundue, Michael; Kessler, Michael	Organisms Diversity & Evolution	2008

New species and records of tree ferns (Cyatheaceae, Pteridophyta) from the northern Andes	Lehnert, Marcus	Organisms Diversity & Evolution	2006
A New Species and a New Hybrid in the Grammitid Fern Genus *Stenogrammitis* (Polypodiaceae).	Labiak, Paulo H.	American Fern Journal	2012
New Species of *Elaphoglossum* Schott ex J.Sm. (Dryopteridaceae) from Brazil.	Melo, Luciana C. Neves; Salino, Alexandre	American Fern Journal	2011
New species of grammitid ferns (Polypodiaceae, Polypodiopsida) from Bolivia	Kessler, Michael; Smith, Alan R.	Organisms Diversity & Evolution	2008
New Species of the Fern Genus *Lindsaea* (Lindsaeaceae) from New Guinea with Notes on the Phylogeny of *L.* sect. *Synaphlebium*.	Dong, Shi-Yong; Zuo, Zheng-Yu; Chao, Yi-Shan; Damas, Kipiro; Sule, Bernard	PLoS ONE	2016
Not so Neotropical After all: the Grammitid Fern Genus	Rouhan, Germinal; Labiak, Paulo H.;	Systematic Botany	2012

Leucotrichum (Polypodiaceae) is also Paleotropical, as Revealed by a New Species from Madagascar.	Randrianjohany, Emile; Rakotondrainibe, France; Hipp, Andrew		
Novel fern- and centipede-like *Selaginella* (Selaginellaceae) species and a new combination from South America.	Valdespino, I.A.	PhytoKeys	2017
Novelties in Costa Rican *Pityrogramma* (Pteridaceae): A New Species and a New Hybrid from the Osa Peninsula.	Test, Weston	American Fern Journal	2018
A New Species and Two New Records of the Fern Genus *Cheilanthes* (Pteridaceae) from Southwestern Brazil.	Ponce, M. Monica; Monteiro De Assis, Elton Lois; Labiak, Paulo Henrique	American Fern Journal	2008
On the identification of *Cyathea pallescens* (Sodiro) Domin (Cyatheaceae): typifications, reinstatements and new descriptions of	Lehnert, Marcus	Botanical Journal of the Linnean Society	2008

common Neotropical tree ferns.			
Parapolystichum villosissimum (Dryopteridaceae): A new and threatened species from Cuba.	Sánchez, Carlos; Labiak, Paulo H.	Brittonia	2019
A New Species of *Adiantum* (Pteridaceae) from Thailand.	Suksathan, Piyakaset	American Fern Journal	2004
Phegopteris excelsior (Thelypteridaceae): A New Species of North American Tetraploid Beech Fern.	Patel, Nikisha R.; Fawcett, Susan; Gilman, Arthur V.	Novon	2019
A New Species of *Adiantum* from Cuba.	Caluff, Manuel G.	American Fern Journal	2009
Phylogeny, divergence times, and historical biogeography of New World *Dryopteris* (Dryopteridaceae)	Sessa, Emily B.; Zimmer, Elizabeth A.; Givnis, Thomas J.	American Journal of Botany	2012
Pityrogramma opalescens (Pteridaceae), a New Species from Cerro del Torrá, Colombia.	Sundije, Michael A.	American Fern Journal	2011

Pneumatopteris pendens (Thelypteridaceae), a New Hawaii Endemic Species of *Pneumatopteris* from Hawaii.	Palmer, Daniel D.	American Fern Journal	2005
A new species of *Alsophila* (Cyatheaceae) from the Tucuman-Bolivian forest.	Martínez, Olga	Brittonia	2015
Polystichum cavernicola, sp. nov. (sect. *Haplopolystichum*, Dryopteridaceae) from a karst cave in Guizhou, China and its phylogenetic affinities.	He, Hai; Zhang, Li-Bing	Botanical Studies	2011
Polystichum fengshanense, sp. nov. (sect. *Haplopolystichum*, Dryopteridaceae) from Karst Caves in Guangxi, China based on Morphological, Palynological, and Molecular Evidence.	Li-Bing Zhang; Hai He	Systematic Botany	2011
Polystichum hubeiense (Dryopteridaceae), a new fern species from Hubei, China.	Liang Zhang; Zhang-Ming Zhu; Xin-Fen Gao; Li-Bing Zhang	Annales Botanici Fennici	2013

Polystichum kungianum, sp. nov. (sect. *Mastigopteris*, Dryopteridaceae) from Chongqing, China.	Hai He; Li-Bing Zhang	Botanical Studies	2010
Polystichum perpusillum (sect. *Haplopolystichum*, Dryopteridaceae), a new fern species from Guizhou, China.	Li-Bing Zhang; Hai He	Annales Botanici Fennici	2012
Polystichum puteicola, sp. nov. (sect. *Haplopolystichum*, Dryopteridaceae) from a karst sinkhole in Guizhou, China based on molecular, palynological, and morphological evidence.	Li-Bing Zhang; Hai He; Qiang Luo	Botanical Studies	2010
Pteris carsei (Pteridaceae), a new endemic fern from New Zealand previously treated as *P. comans* G.Forst.	Brownsey, Patrick; Braggins, John; Perrie, Leon	New Zealand Journal of Botany	2020
Revision of *Adiantopsis radiata* (Pteridaceae) with Descriptions of New Taxa	Link-Pérez, Melanie A.; Hickey, R. James	Systematic Botany	2011

with Palmately Compound Laminae.			
A new species of *Asplenium* section *Thamnopteris* (Aspleniaceae) from Indonesia.	Dong, S. Y.; Mujahidin; Wei, L. L.; Chao, Y. S.	Blumea	2012
Revision of series *Gravesiana* (*Adiantum* L.) based on morphological characteristics, spores and phylogenetic analyses.	Wang, Fa-Guo; Zhang, Wan-Wan; Yi, Qi-Fei; Duan, Lei; Xing, Fu-Wu; Wang, Ai-Hua; Ma, Xiao-Dong; Li, Dong-Lin; Li, Xu-Wen; Yan, Yue-Hong	PLoS ONE	2017
Revision of the fern genus *Orthiopteris* (Saccolomataceae) in Malesia and adjacent regions.	Thien Tam Luong; Hovenkamp, Peter H.; Sosef, Marc S. M.	PhytoKeys	2015
Rumohra glandulosissima (Dryopteridaceae) a New Species from the Atlantic Rainforest, and Revision of	Sundue, Michael; Hirai, Regina Y.; Prado, Jefferson	Systematic Botany	2013

the Species Occurring in Brazil.			
Selaginella hyalogramma (Selaginellaceae - Lycopodiophyta): A New Species from Venezuela, South America.	Valdespino, I.A.	American Fern Journal	2017
A New Species of *Ceradenia* (Polypodiaceae) from Southern Brazil.	Labiak, Paulo H.; Pereira, Jovani B. S.	Systematic Botany	2016
Selliguea kachinensis (Polypodiaceae), a new fern species of uncertain affinity from Northern Myanmar.	Phyo Kay Khine; Lindsay, Stuart; Fraser-Jenkins, Christopher; Kluge, Jürgen; Kyaw, Myint; Hovenkamp, Peter	PhytoKeys	2016
Stenochlaena riauensis (Blechnaceae), A new fern species from Riau, Indonesia	Sofiyanti, N.; Iriani	Bangladesh Journal of Plant Taxonomy	2015
Studies on the Genus *Bolbitis* (Dryopteridaceae) from Vietnam and Laos.	Jian-Ying Xiang; Wu Su-Gong; Phan	American Fern Journal	2011

	Ke Loc; Onevilay Souliya		
Systematic revision of *Elaphoglossum* (Dryopteridaceae) in French Polynesia, with the description of three new species.	Rouhan, G.; Lorence, D. H.; Motley, T. J.; Hanks, J. G.; Moran, R. C.	Botanical Journal of the Linnean Society	2008
Systematics of *Hymenophyllum* subgenus *Mecodium* (Hymenophyllaceae) in Taiwan.	Hsu, Tian-Chuan; Huang, Yu-Fang; Chao, Yi-Shan	Systematic Botany	2019
Taxonomic and Ecological Notes on the *Alsophila hornei* Complex (Cyatheaceae-Polypodiopsida), with the Description of the New Species *A. phlebodes* from New Guinea.	Lehnert, Marcus; Coritico, Fulgent P.; Darnaedi, Dedy; Hidayat, Arief; Kluge, Jürgen; Karger, Dirk Nikolaus; Kessler, Michael	Systematic Botany	2013
Taxonomic revision of *Elaphoglossum* subsection *Muscosa* (Dryopteridaceae).		Blumea	2011

Taxonomic Revision of the Fern Genus *Osmolindsaea* (Lindsaeaceae).	Lehtonen, Samuli; Tuomisto, Hanna; Rouhan, Germinal; Christenhusz, Maarten J. M.	Systematic Botany	2013
Ten New Species and Two New Combinations of *Blechnum* (Blechnaceae, Pteridophyta) from Bolivia.	Kessler, Michael; Smith, Alan R.; Lehnert, Marcus	American Fern Journal	2007
The Brazilian species of *Elaphoglossum* section *Polytrichia* (Dryopteridaceae).	Matos, Fernando; Mickel, John	Brittonia	2014
The fern genus *Elaphoglossum* section *Lepidoglossa* (Dryopteridaceae) in Africa, Macaronesia, the mid-Atlantic and southern Indian Ocean Islands.	Roux, Jacobus P.	Botanical Journal of the Linnean Society	2011
The fern genus *Polybotrya* (Dryopteridaceae) in the Atlantic Forest of Brazil, with the description of a new species.	Canestraro, Bianca; Labiak, Paulo	Brittonia	2015

A new species of *Lindsaea* (Lindsaeaceae) from the Brazilian Amazon.	Martins, Marcos Benigno Silva; Lima, Bruno De Cássio Da Costa; Calliari, Ramon Batista; Moraes-Neto, Pedro Gonçalves; Costa, Jeferson Miranda; Pietrobom, Márcio Roberto	Brittonia	2020
Thelypteris tuxtiensis (Thelypteridaceae), a New Species in Subgenus *Goniopteris* from Los Tuxtias, Veracruz, Mexico.	Krömer, Thorsten; Acebey, Amparo; Smith, Alan R.	American Fern Journal	2007
Three new scaly tree fern species (*Cyathea*-Cyatheaceae) from the Amotape-Huancabamba Zone and their biogeographic context.	Lehnert, Marcus; Tejedor, Adrian	American Fern Journal	2016

Three New Species of Grammitid Ferns (Polypodiaceae) from the Fern Hunter's Paradise: Sierra Juárez, Oaxaca, Mexico.	Sundue, Michael A.	Systematic Botany	2017
A New Species of *Microlepia* (Dennstaedtiaceae) from Mt. Micangshan, China.	Xiao-Si Guo; Bin La	American Fern Journal	2006
Tmesipteris horomaka, a new octoploid species from Banks Peninsula.	Perrie, LeonR; Brownsey, PatrickJ; Lovis, JohnD	New Zealand Journal of Botany	2010
Two new *Diplazium* (Woodsiaceae) species from East Malesia	Hovenkamp, P.	Fern Gazette	2015
Two New Species of *Pleopeltis* (Polypodiaceae) from Andean South America.	Sundue, Michael A.	American Fern Journal	2007
Two New Species of the Fern Genus *Blechnum* with Partially Anastomosing Veins from Northern Brazil.	de Oliveira Dittrich, Vinícius Antonio; Salino, Alexandre; Almeida, Thais Elias	Systematic Botany	2012

Una nueva especie de *Pellaea* (Pteridaceae) del estado de San Luis Potosí, México	Mendoza, Aniceto; Windham, Mike; Pérez-García, Blanca; Yatskievych, George	Acta Botanica Mexicana	2001
A New Species of *Moranopteris* (Polypodiaceae) from Inaccessible Ledges in the High Andes of Peru.	Sundue, Michael; Sylvester, Steven Paul; Kessler, Michael; Lyons, Brendan; Ranker, Tom A.; Morden, Clifford W.	Systematic Botany	2015
A new species of *Odontosoria* (Lindsaeaceae) from New Guinea.	Lehtonen, S.	Blumea	2011
A New Species of *Thelypteris* subgenus *Amauropelta* (Thelypteridaceae) from Southeastern Brazil.	Salino, Alexandre; De Oliveira Dittrich, Vinícius Antonio	American Fern Journal	2008
A New Species, New Combinations in *Pecluma* and *Pleopeltis*, and New Records	Carvajal-Hernández, César I.; Guzmán-Jacob,	American Fern Journal	2018

for the State of Veracruz, Mexico.	Valeria; Smith, Alan R.; Krömer, Thorsten		
A New Vittarioid Fern Species, *Haplopteris heterophylla* (Pteridaceae).	Cheng Wei Chen; Yao Moan Huang; Li Yaung Kuo; Yi Han Chang; Yea Chen Liu; Wen Liang Chiou	Systematic Botany	2013
A revision of *Blechnum vulcanicum* (Blume) Kuhn and related taxa (Blechnaceae) in Malesia and Oceania.	Chambers, T. Carrick; Wilson, Peter G.	Telopea	2019
A Taxonomic and Biogeographic Reappraisal of the Genus *Dicksonia* (Dicksoniaceae) in the Neotropics.	Noben, Sarah; Kessler, Michael; Weigand, Anna; Tejedor, Adrian; Duque, Wilson D. RodrÃguez; Gallego, Luis Fernando Giraldo; Lehnert, Marcus	Systematic Botany	2018

A Unified Approach to Taxonomic Delimitation in the Fern Genus *Pentagramma* (Pteridaceae).	Schuettpelz, Eric; Pryer, Kathleen M.; Windham, Michael D.	Systematic Botany	2015
Actinostachys minuta, a new species of grass fern from Mindanao, Philippines.	Amoroso, Victor B.; Coritico, Fulgent P.; Fritsch, Peter W.	PhytoKeys	2020
Adiantum alan-smithii (Pteridaceae), a New Maidenhair Fern from Chiapas, Mexico.	Hirai, Regina Y.; Sundue, Michael A.; Prado, Jefferson	Systematic Botany	2014
Adiantum camptorachis (Pteridaceae), a New Species from South America with Notes on the Taxonomy of Related Species from the Southern Cone and Bolivia.	Sundue, Michael A.; Prado, Jefferson; Smith, Alan R.	American Fern Journal	2010
Adiantum lindsaeoides (Pteridaceae), a New Fern Species from the Atlantic Rain Forest, Brazil.	Prado, Jefferson; Hirai, Regina Y.	Systematic Botany	2013

Adiantum mariposatum (Pteridaceae), a New Species from Ecuador.	McCarthy, Mirabai R.; Hickey, R. James	American Fern Journal	2011
Adiantum shastense, a new species of maidenhair fern from California.	Huiet, Layne; Lenz, Martin; Nelson, Julie K.; Pryer, Kathleen M.; Smith, Alan R.	PhytoKeys	2015
Anemia brunnea (Anemiaceae), a new species from Central Brazil.	Prado, Jefferson; Hirai, Regina Y.	Brittonia	2020
Anemia paripinnata (Anemiaceae), a New Species from Central Brazil.	Labiak, Paulo H.; Mickel, John T.; MatosS, Fernando B.	American Fern Journal	2018
Anemia tabascana (Anemiaceae), a new species from southeastern Mexico.	Carvajal-Hernández, César I.; Córdova-Hernández, Ena E.; Krömer, Thorsten; Burelo-Ramos, Carlos M.	American Fern Journal	2020

Antrophyum nambanense, a New Vittarioid Fern (Pteridaceae; Polypodiales) from Vietnam.	Chen, Cheng-Wei; Dang, Minh Tri; Luu, Hong Truong; Kao, Tzu-Tong; Huang, Yao-Moan; Li, Chia-Wei	Systematic Botany	2020
Antrophyum solomonense (Pteridaceae), a New Species from the Solomon Islands, and Its Systematic Position Based on Phylogenetic Analysis.	Chen, Cheng Wei; Nitta, Joel Hamilton; Fanerii, Moffat; Yang, Tsung Yu Aleck; Pitisopa, Fred; Li, Chia Wei; Chiou, Wen Liang	Systematic Botany	2015

Table 2. Subset of articles used for verifying the reviewing form with authors, journal titles, and publication dates.

Title of Reviewed Article	**Author**	**Title of Journal**	**Year**
Anemia paripinnata (Anemiaceae), a New Species from Central Brazil.	Labiak, Pauol; Mickel, John T.; Matos, Fernando B.	American Fern Journal	2018

Antrophyum nambanense, a New Vittarioid Fern (Pteridaceae; Polypodiales) from Vietnam.	Chen, Cheng-Wei; Dang, Minh Tri; Luu, Hong Truong; Kao, Tzu-Tong; Huang, Yao-Moan; Li, Chia-Wei	Systematic Botany	2020
Athyrium haleakalae (Athyriaceae), a new rheophytic fern species from East Maui, Hawaiian Islands: with notes on its distribution, ecology, and conservation status.	Wood, Kenneth R.; Wagner, Warren L.	PhytoKeys	2017
Athyrium sessilipinnum: A new lady fern (Athyriaceae) from southern China.	Wei, Ran; Zhang, Xian-Chun	Brittonia	2016
Botrychium matricariifolium, a new fern species for the flora of Montenegro.	Stešević, Danijela; Berg, Christian	Acta Botanica Croatica	2015
Eriosorus areniticolci (Pteridaceae), a New Species from Brazil.	Schwartsburd, Pedro Bond; Labiak, Paulo Henrique	American Fern Journal	2008

New species and new records of the fern genus *Terpsichore* (Polypodiopsida: Polypodiaceae) from Bolivia	Sundue, Michael; Kessler, Michael	Organisms Diversity & Evolution	2008
Phylogeny, divergence times, and historical biogeography of New World *Dryopteris* (Dryopteridaceae)	Sessa, Emily B.; Zimmer, Elizabeth A.; Givnis, Thomas J.	American Journal of Botany	2012
Revision of series *Gravesiana* (*Adiantum* L.) based on morphological characteristics, spores and phylogenetic analyses.	Wang, Fa-Guo; Zhang, Wan-Wan; Yi, Qi-Fei; Duan, Lei; Xing, Fu-Wu; Wang, Ai-Hua; Ma, Xiao-Dong; Li, Dong-Lin; Li, Xu-Wen; Yan, Yue-Hong	PLoS ONE	2017
Rumohra glandulosissima (Dryopteridaceae) a New Species from the Atlantic Rainforest, and Revision of the Species Occurring in Brazil.	Sundue, Michael; Hirai, Regina Y.; Prado, Jefferson	Systematic Botany	2013

Table 3. Removed articles with authors, journal titles, and publication dates.

Title of Removed Article	Author(s)	Title of Journal	Year
A consistent taxonomic treatment for dimorphic variation in New Zealand *Adiantum* species.	Brownsey, Patrick J.; Shepherd, Lara D.; Perrie, Leon R.	New Zealand Journal of Botany	2019
A global plastid phylogeny uncovers extensive cryptic speciation in the fern genus *Hymenasplenium* (Aspleniaceae).	Xu, Ke-Wang; Zhou, Xin-Mao; Yin, Qian-Yi; Zhang, Liang; Lu, Ngan Thi; Knapp, Ralf; Luong, Thien Tam; He, Hai; Fan, Qiang; Zhao, Wan-Yi; Gao, Xin-Fen; Liao, Wen-Bo; Zhang, Li-Bing	Molecular Phylogenetics & Evolution	2018
A molecular phylogeny for the New Zealand Blechnaceae ferns from analyses of chloroplast tmL-trnF DNA sequences.	Shepherd, Lara D.; Perrie, Leon R.; Parris, Barbara S.; Brownsey, Patrick J.	New Zealand Journal of Botany	2007
A new Miocene fern (*Palaeosorum*: Polypodiaceae) from New Zealand bearing in situ	Kaulfuss, Uwe; Conran, John G.; Bannister, Jennifer M.; Mildenhall, Dallas C.; Lee, Daphne E.	New Zealand Journal of Botany	2019

spores of Polypodiisporites.			
A New Species of *Scutellospora* with a Coiled Germination Shield.	Kartini Kramadibrata; Christopher Walker; Daniel Schwarzott; Arthur Schüβler	Annals of Botany	2000
A new species of the marattialean fern *Scolecopteris* (Zenker) Millay from the uppermost Permian of Guizhou Province, south-western China.	He, Xiao-Yuan; Wang, Shi-Jun; Hilton, Jason; Zhou, Yi-Long	Botanical Journal of the Linnean Society	2006
A review of the fern genus *Sticherus* (Gleicheniaceae) in New Zealand with confirmation of two new species records.	Brownsey, PJ; Ewans, R; Rance, B; Walls, S; Perrie, LR	New Zealand Journal of Botany	2013
A revised classification of Chinese Davalliaceae based on new evidence from molecular phylogenetics and	Ma, Xiao-Dong; Wang, Ai-Hua; Wang, Fa-Guo; He, Chun-Mei; Liu, Dong-Ming; Gerstberger, Pedro; Xing, Fu-Wu	PLoS ONE	2018

morphological characteristics.			
A total-evidence phylogeny of the lady fern genus *Athyrium* Roth (Athyriaceae) with a new infrageneric classification.	Wei, Ran; Ebihara, Atsushi; Zhu, Yan-Mei; Zhao, Cun-Feng; Hennequin, Sabine; Zhang, Xian-Chun	Molecular Phylogenetics & Evolution	2018
An expanded phylogeny of the Dennstaedtiaceae ferns: Oenotrichia falls within a non-monophyletic *Dennstaedtia*, and *Saccoloma* is polyphyletic.	Perrie, Leon R.; Shepherd, Lara D.; Brownsey, Patrick J.	Australian Systematic Botany	2015
Arsenic hyperaccumulation by different fern species.	Zhao, F. J.; Dunham, S. J.; McGrath, S. P.	New Phytologist	2002
Botrychium simplex E. Hitchc. (Ophioglossaceae) -- a new species for the native flora of Ukraine.	Parnikoza, Ivan Yu.; Celka, Zbigniew	Biodiversity: Research & Conservation	2016

Chloroplast DNA sequences indicate the grammitid ferns (Polypodiaceae) in New Zealand belong to a single clade, *Notogrammitis* gen. nov.	Perrie, LR; Parris, BS	New Zealand Journal of Botany	2012
Chloroplast DNA sequences support the transfer of the New Caledonian endemic fern *Sphenomeris alutacea* to *Odontosoria*.	Perrie, LR; Shepherd, LD; Thouvenot, L; von Konrat, M	New Zealand Journal of Botany	2014
Clarification of Two Poorly Known Vittarioid Ferns (Pteridaceae): *Haplopteris angustissima* and *H. capillaris*.	Chen, Cheng-Wei; Lindsay, Stuart; Yong, Kien Thai; Mustapeng, Andi Maryani A.; Amoroso, Victor B.; Dang, Viet Dai; Huang, Yao-Moan	Systematic Botany	2019
Description and redescription of *Transeius* species (*Acari*: Phytoseiidae) from	Gonçalves, Dinarte; Ruffatto, Kettlin; Granich, Juliana; Ferla, Noeli J.	International Journal of Acarology	2017

arborescent ferns from Brazilian Mixed Ombrophylus Forest.			
ERRATA.		American Fern Journal	2009
Erratum to: The fern genus *Polybotrya* (Dryopteridaceae) in the Atlantic Forest of Brazil, with the description of a new species.	Canestraro, Bianca; Labiak, Paulo	Brittonia	2015
ERRATUM.		American Fern Journal	2007
Genetic and morphological identification of a recurrent *Dicksonia* tree fern hybrid in New Zealand.	Shepherd, Lara D.; Brownsey, Patrick J.; Stowe, Chris; Newell, Claire; Perrie, Leon R.	PLoS ONE	2019
The fern family Gleicheniaceae (Polypodiopsida) in Brazil	Lima, Lucas Vieira; Salino, Alexandre	Ciencia en Desarrollo	2017

High endemism and stem density distinguish New Caledonian from other high-diversity rainforests in the Southwest Pacific.	Ibanez, Thomas; Blanchard, E; Hequet, V; Keppel, G; Laidlaw, M; Pouteau, R; Vandrot, H; Birnbaum, P	Annals of Botany	2018
Lista Con Anotaciones De Los Pteridófitos Del Eastado De México, México	Tejero-Díez, J. Daniel; Arreguín-Sánchez, Ma. De La Luz	Acta Botanica Mexicana	2004
Madagascar sheds new light on the molecular systematics and biogeography of grammitid ferns: New unexpected lineages and numerous long-distance dispersal events.	Bauret, Lucie; Gaudeul, Myriam; Sundue, Michael A.; Parris, Barbara S.; Ranker, Tom A.; Rakotondrainibe, France; Hennequin, Sabine; Ranaivo, Jaona; Selosse, Marc-André; Rouhan, Germinal	Molecular Phylogenetics & Evolution	2017
Mycopteris, a new neotropical genus of grammitid ferns (Polypodiaceae).	Sundue, Michael	Brittonia	2014

New Combinations in *Serpocaulon* and a Provisional Key for the Atlantic Rain Forest Species.	Labiak, Paulo Henrique; Prado, Jefferson	American Fern Journal	2008
New insights into the phylogeny of *Pleopeltis* and related Neotropical genera (Polypodiaceae, Polypodiopsida)	Otto, Elisabeth M.; Janssen, Thomas; Kreier, Hans-Peter; Schneider, Harald	Molecular Phylogenetics & Evolution	2009
Phylogenetic relationships of the fern genus *Christiopteris* shed new light onto the classification and biogeography of drynarioid ferns.	Schneider, Harald; Kreier, Hans-Peter; Hovenkamp, Peter; Janssen, Thomas	Botanical Journal of the Linnean Society	2008
Phylogeny and classification of the Cuban species of *Elaphoglossum* (Dryopteridaceae), with description of	Lóriga, Josmaily; Vasco, Alejandra; Regalado, Ledis; Heinrichs, Jochen; Moran, Robbin	Plant Systematics & Evolution	2014

Elaphoglossum sect. *Wrightiana* sect. nov.			
Phylogeny of the fern family Aspleniaceae in Australasia and the south-western Pacific.	Ohlsen, Daniel J.; Perrie, Leon R.; Shepherd, Lara D.; Brownsey, Patrick J.; Bayly, Michael J.	Australian Systematic Botany	2015
Phylogeny of the fern subfamily Pteridoideae (Pteridaceae; Pteridophyta), with the description of a new genus: *Gastoniella*.	Zhang, Liang; Zhou, Xin-Mao; Lu, Ngan Thi; Zhang, Li-Bing	Molecular Phylogenetics & Evolution	2017
Ploidy level and genome size variation in the homosporous ferns *Botrychium* s.l. (Ophioglossaceae).	Dauphin, Benjamin; Grant, Jason; MrÃ¡z, Patrik	Plant Systematics & Evolution	2016
Reticulate evolution on a global scale: A nuclear phylogeny for New World Dryopteris (Dryopteridaceae)	Sessa, Emily B.; Zimmer, Elizabeth A.; Givnish, Thomas J.	Molecular Phylogenetics & Evolution	2012

Taxonomic notes on the New Zealand flora: lectotypes in Dryopteridaceae and Nephrolepidaceae.	Brownsey, Patrick J.; Perrie, Leon R.; Field, Ashley R.	New Zealand Journal of Botany	2019
Taxonomic Placement of Unassigned Species of Lastreopsid Ferns (Dryopteridaceae) Using Phylogeny.	Gardner, Jessica J. S.; Perrie, Leon; Shepherd, Lara; Nagalingum, Nathalie S.	Systematic Botany	2017
The Genus *Dryopteris* (Pteridophyta): Dryopteridaceae) in the Flora of the Repuplic of Madedonia – 30 Years After Micevski’s Flora	Melovski, Ljupco	Contributions. Section of Natural, Mathematical & Biotechnical Sciences	2016
The Genus *Hymencispienium* (Aspleniaceae) in Cuba, Including New Combinations for the Neotropical Species.	Gabancho, Ledis Regalaijo; Prada, Carmen	American Fern Journal	2011

Tryonia, a new taenitidoid fern genus segregated from Jamesonia and Eriosorus (Pteridaceae).	Cochran, Alyssa T.; Prado, Jefferson; Schuettpelz, Eric	PhytoKeys	2014

Appendix A: Journal Article Reviewing Form

Reviewer *

- ◯ Nick
- ◯ Dr. Link-Perez

Article (Format: #_First-Author_Year) *

Your answer ____________________

Explicitly Stated Species Concept

- ◯ Yes
- ◯ No

If explicit species concept, where in the paper

- ☐ Abstract
- ☐ Introduction
- ☐ Methods
- ☐ Results
- ☐ Discussion
- ☐ Conclusion
- ☐ Appendices
- ☐ Other: ____________________

Explicitly Stated Hypothesis

- ○ Yes
- ○ No

If an explicit hypothesis, where in the paper?

- ☐ Abstract
- ☐ Introduction
- ☐ Methods
- ☐ Results
- ☐ Discussion
- ☐ Conclusion
- ☐ Appendices
- ☐ Other: ____________________

Morphological Species Concept Data Types

- ☐ Macroscopic
- ☐ Microscopic
- ☐ Other: ____________________

Biological Species Concept Data Types

- ☐ Molecular Data (Isozymes, Chromosomes/DNA)
- ☐ Non-Molecular Data (Crossing)
- ☐ Other: ____________________

Evolutionary Species Concept Data Types

- [ ] Morphological (Differences Among Related Taxa)
- [ ] Biogeographical (Ecological and Geographical Range)
- [ ] Phylogenetic (Proposed Phylogeny)
- [ ] Geological (Paleobotanical and Geological Data)
- [ ] Other: ____________________

Concept(s) Used

- [ ] Biological Species Concept
- [ ] Morphological Species Concept
- [ ] Evolutionary Species Concept
- [ ] Other: ____________________

Hybrid Taxa?

- ○ Yes
- ○ No
- ○ Other: ____________________