

# **TAXONOMY OF ECONOMIC SEaweEDS**

**With reference to the  
Pacific and other locations  
Volume IX**

Isabella A. Abbott and Karla J. McDermid, Editors  
Results of an international workshop sponsored by the Hawaii Sea Grant  
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## Foreword

E. Gordon Grau

Director, University of Hawaii Sea Grant College Program

In May 2002, we proudly sponsored the ninth biennial Workshop on Taxonomy and Diversity of Economic Seaweeds in Hilo, Hawaii. The first workshop in this series on the taxonomy of commercially interesting seaweed species was held in Guam in 1985. For nearly twenty years, through the efforts of Dr. Isabella Abbott, international participants have come together to work to better understand the taxonomy of seaweeds that are important as sources of food, hydrocolloids, marine natural products, and aquacultured crops. The Hilo Workshop continued and expanded upon these valuable collaborations. With support from the University of Hawaii Sea Grant College Program, California Sea Grant, and the University of Hawaii, 26 seaweed experts from universities and scientific institutions in Australia, Chile, Guam, Japan, the People's Republic of China, South Korea, Thailand, the United States, and Vietnam gathered for the weeklong workshop. Participants focused on identification of species in selected economically useful genera, such as *Dictyota*, *Sargassum*, *Caulerpa*, *Codium*, *Gelidium*, *Gelidiella*, *Gracilaria*, *Halymenia*, *Hypnea*, and *Laurencia*. To encourage a successful future, the Workshop intended to train up-and-coming scientists while facilitating discussion about introducing more students to the fields of phycology and taxonomy. The results of this productive workshop are evident in these proceedings edited by Dr. Isabella Abbott and Dr. Karla McDermid. To achieve sustainable use and wise stewardship of marine resources, science-based information must be shared both within and beyond the scientific community through activities such as the May 2002 Workshop and associated proceedings. Our hope is that scientists will continue to build upon the legacy of this series.



Pioneer Participants of the First Workshop, Guam (1985),  
and the Ninth Workshop, Hilo (2002)

*left to right: Roy Tsuda, Jim Norris, Jim Sullivan, Isabella Abbott,  
Bernabé Santelices, Tadao Yoshida, Xia Bangmei*



## Preface

Isabella A. Abbott, Coeditor

Anyone who was at the Hilo Sea Grant Workshop would know that Karla McDermid planned the logistics of welcoming, transportation, housing, meals. These things don't happen by themselves but because someone was planning ahead and being thoughtful to the smallest details. I want everyone to know that, while I gave advice and help when asked, I didn't volunteer my person to be there to help her all along the way. Therefore, the great success and enjoyment of that Workshop (and please note the productivity published in the pages that follow) everyone owes to Karla. Should we be able to obtain funding to hold other future Workshops, she will be more than adequate at leading them, and I strongly recommend that you don't let her get away!

I did put in time on the Workshop papers, and we (Karla and I) are proud of the good product that we have turned out, but of course most of you have published with us previously, so you knew what to do. Thank you all for cooperating with us.

I plan to take a back seat from now on; 18 years has been long enough, and I need the time to finish two grants so that I can do some traveling and some things other than writing about seaweeds. But of course I will help Karla should the Workshops continue. I very much enjoy working with her.

It has been fun and a privilege to lead this Workshop. Its impact will be lasting, not the least getting our Asian colleagues to think and write in English so that westerners can see what is happening in algae in the western Pacific and adjoining seas. There is no question that if Jim Sullivan didn't have the vision to push this through, it would never have happened; it is too hard to raise funds plus run a big meeting and edit the writing of those whose first language is not English. It has been more rewarding for me than most of you know, and I want to thank all of you for good memories.

Aloha from Isabella Abbott  
October 28, 2003



## Introduction: Looking Back, Looking Forward

Karla J. McDermid, Workshop Convenor and Coeditor

In May 2002, phycologists from around the world discovered the University of Hawaii–Hilo. Each day started with early morning fieldtrips at low tide and ended with dinner at a different Hilo restaurant. A first priority was to provide a rich collaborative learning experience. Every day we worked on the selected genera, and the Marine Science Building labs and rooms were open twelve hours a day. The dual-head microscopes allowed true teamwork: two taxonomists could view the same slides at the same time! The teams examined hundreds of specimens including dried herbarium specimens and preserved material brought from their home countries, as well as fresh Hawaiian samples. Special presentations were made by Paul Silva, Bernabé Santelices, John Huisman, Anong Chirapart, and UH–Hilo students on a variety of topics including *Codium* taxonomy, red algal coalescence, the marine flora of Australia, seaweed research in Thailand, and nutritional composition of Hawaiian macroalgae. On the last afternoon, Group Summary Presentations were made. Some of this workshop’s accomplishments were discovery of new species, new regional records, and clarification of the characteristics of known species. At the farewell dinner, the Mayor of Hawaii County, who had always wanted to be a marine biologist, exhorted us to “keep doing what we do, because it is so important for the ocean and the world.”

An equally meaningful goal for this workshop was to discuss the challenges ahead in the field of seaweed taxonomy. At dinner one night, we all filled out questionnaires and talked about our answers. The first question was “How did you get interested in studying seaweeds?” An overwhelming majority of us answered that it was a special teacher or a class that “introduced us to the seaweed world.” Some of the responses were:

“I met a good teacher.”

“A professor with a grant invited me to join the group studying marine macroalgae.”

“A teacher who took us for collection of marine algae.”

“A field course where I was given an algal project.”

For others, what drew them to phycology was finding *Caulerpa* on the seashore, a gift of an algal guidebook, or the purchase of a mask and snorkel.

A second question asked was “How can we get more students involved in seaweed research, especially taxonomy?” “Money” was the most common response, including more money for thesis work, for training programs and research assistantships. One person outlined the solution: “Get more small grants, hire students; they work on seaweeds and become interested in whatever they know best.” Others talked about how to capture students’ interests:

“Encourage by example and select students who are ‘natural’ collectors.”

“Tell students how important taxonomy is and relate it to biotechnology.”

“Teach about the importance of seaweeds to world climate, marine ecology, etc.”

“Make better connections with the applied aspects of taxonomy.”

“Work with students and infect them with your enthusiasm.”

An excellent idea suggested more than once was that every participant of future workshops bring a student. Another common answer was that we need to publish more books that illustrate the importance of taxonomy—more floras, surveys, interactive keys, photo books, guidebooks. Each of us must try harder to show how taxonomy provides the basis for testing and answering questions in field ecology, population genetics, physiology, phylogenetics, aquaculture, natural products chemistry, biogeography, biotechnology, and conservation biology. One participant warned that we must act, because “when the present seaweed specialists are no longer here, there will be no one to identify the algae others are working on.” It was agreed that we must reach out to students as others in the past reached out and mentored us: through good teaching, memorable classes, research projects, student jobs, and personal inspiration.

Taxonomy, the science of classification of organisms, is part of human nature and our desire to sort and group things we observe. Aristotle and other ancient Greeks named and classified creatures, indigenous cultures worldwide developed their own working taxonomy systems, and about 250 years ago Linnaeus introduced binomial nomenclature, still used today. In an article in *Nature*, Godfray argued that taxonomy is facing a crisis because of reduced funding, poor distribution of information, lack of clearly achievable goals, and little attention paid to the non-specialists who use the information.<sup>1</sup> The author advised that, in order to survive, descriptive taxonomy must reinvent itself as a 21st-century web-based, information science under a single

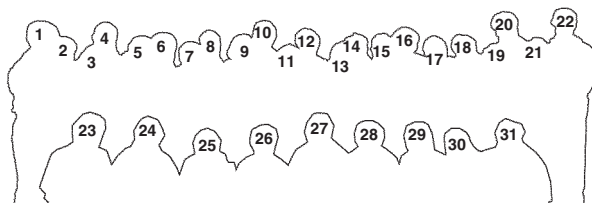
<sup>1</sup>H. Charles J. Godfray, Challenges for taxonomy, *Nature* 417:17–19, 2002.

administration. Others see the future of taxonomy primarily in molecular genetics, with species' identities determined more by gene sequences and much less by morphology or anatomy. However, even if taxonomy evolves into a DNA-dominated, web-based science, there will always be a need for scientists who can cut sections, make a microscope slide, and interpret anatomical features; for researchers who can recognize species in the ocean and on an herbarium sheet; and for holotypes, paratypes, and isotypes that document the ocean's biodiversity. A recently conducted search using the Web of Science found that articles in *Taxonomy of Economic Seaweeds* Volumes 1–7 had been cited 347 times. Clearly the results of the taxonomic workshops have been useful, not only to the participants but also to a wider audience. We must continue to provide high-quality information on the taxonomy and diversity of economical valuable seaweeds.



## Acknowledgments

Many, many people helped make this workshop a success. We thank Chancellor Rose Tseng of UH–Hilo, Dr. Gordon Grau, Hawaii Sea Grant Director, and Dr. Russell Moll, California Sea Grant Director, for funding the workshop through three separate grants. We are grateful to the Research Corporation of the University of Hawaii staff for patiently guiding us through budget and fiscal details: thanks Doreen Koizumi, Keri Ann Tomita, Paula Gealon, and David Lovell. We appreciate the *aloha* (kindness, love) shown by Clifford Kaneshiro, UH–Hilo Bookstore Manager, and Miles Nagata, UH–Hilo Housing Director, as well as Auxiliary Service, College of Arts and Sciences, and College of Agriculture, Forestry and Natural Resources. Auntie Ulu Garmon, who gave the opening chant, and Pualani Kanaka’ole Kanahale and the Halau o Kekuhi, who performed *Ka’uluwehi o ke kai* (the lush vegetation of the sea), made the workshop *pono* (complete, right). The smoothness of daily operations of the workshop was largely due to the tireless student volunteers: Yumi Kamada, Sara McCutcheon, Marybeth Murphy, Jeremy Polloi, and especially to Brooke Stuercke, who organized their efforts. Words do not fully express our gratitude to John Thomas, editor extraordinaire. We thank the David and Lucile Packard Foundation, the Minority Biomedical Research Support Program, and Dr. Mary Donohue, Assistant Director of Hawaii Sea Grant for their financial support of the publication of this volume. Finally, we say *mahalo nui loa* (thank you very much) to all the participants of this workshop, who made it so much fun and so very productive.



- |                        |                             |
|------------------------|-----------------------------|
| 1. Ryuta Terada        | 17. Jim Sullivan            |
| 2. Roy Tsuda           | 18. Robin South             |
| 3. Yumi Kamada         | 19. Celia Smith             |
| 4. Jeremy Polloi       | 20. Chris Puttock           |
| 5. Pham Huu Tri        | 21. Isabella Abbott         |
| 6. Lu Baoren           | 22. Jack Fisher             |
| 7. Nguyen Huu Dai      | 23. Tadao Yoshida           |
| 8. Brooke Stuercke     | 24. Paul Silva              |
| 9. Rose Tseng          | 25. Lynn Hodgson            |
| 10. John Huisman       | 26. Khanjanapaj Lewmanomont |
| 11. Xia Bangmei        | 27. Shigeo Kawaguchi        |
| 12. Sara McCutcheon    | 28. Ki Wan Nam              |
| 13. Karla McDermid     | 29. Anong Chirapart         |
| 14. Jim Norris         | 30. Posa Skelton            |
| 15. Alan Millar        | 31. Ryan Okano              |
| 16. Bernabé Santelices |                             |



## Participants

### Editorial Team

Isabella A. Abbott  
Botany Department  
University of Hawaii–Manoa  
3190 Maile Way  
Honolulu, HI 96822 USA  
iabbott@hawaii.edu

Karla J. McDermid  
Marine Science Dept.  
University of Hawaii–Hilo  
200 W. Kawili St.  
Hilo, HI 96720 USA  
mcdermid@hawaii.edu

### Taxonomy and Nomenclature Team

Paul C. Silva  
University Herbarium  
University of California  
1001 Valley  
Life Science Building 2465  
Berkeley, CA 94720  
psilva@uclink4.berkeley.edu

### Caulerpa Team

Lynn M. Hodgson  
Natural Sciences  
University of Hawaii–West Oahu  
96-129 Ala-Ike  
Pearl City, HI 96782 USA  
hodgson@hawaii.edu

Khanjanapaj Lewmanomont  
Faculty of Fisheries  
Kasetsart University  
Bangkok 10900, Thailand  
ffiskpl@ku.ac.th

Pham Huu Tri  
Department of Marine Botany  
Institute of Oceanography  
Nha Trang, Vietnam  
triphram@vol.vnn.vn

### ***Dictyota* Team**

Khanjanapaj Lewmanomont  
Faculty of Fisheries  
Kasetsart University  
Bangkok 10900, Thailand  
ffiskpl@ku.ac.th

Roy T. Tsuda  
Marine Lab, University of Guam  
UOG Station  
Mangilao, Guam 96913  
rtsuda@uog9.uog.edu

### ***Sargassum* Team**

Khanjanapaj Lewmanomont  
Faculty of Fisheries  
Kasetsart University  
Bangkok 10900, Thailand  
ffiskpl@ku.ac.th

Lu Baoren  
Institute of Oceanology  
Academia Sinica  
7 Nan Hai Road  
Qingdao, People's Republic of China  
brlu@ms.qdio.ac.cn

Nguyen Huu Dai  
Department of Marine Botany  
Institute of Oceanography  
Nha Trang, Vietnam  
nghuudai@dng.vnn.vn

Tadao Yoshida  
Suzaku 6-13-13  
Dazifu City  
Fukuoka, 818-0103 Japan  
yoshidata@nifty.com

### ***Gelidiales* Team**

Bernabé Santelices  
Facultad Ciencias Biologicas  
P. Universidad Catolica de Chile  
Casilla 114-D  
Santiago, Chile  
bsanteli@genes.bio.puc.cl

Posa A. Skelton  
International Ocean Institute  
Regional Centre for Australia & the  
Western Pacific  
P.O. Box 1539  
Townsville, Queensland,  
4810 Australia  
posa.skelton@impac.org.au

G. Robin South  
International Ocean Institute  
Regional Centre for Australia & the  
Western Pacific  
P.O. Box 1539  
Townsville, Queensland,  
4810 Australia  
robin.south@impac.org.au

### ***Hypnea* Team**

G. Robin South  
International Ocean Institute  
Regional Centre for Australia & the  
Western Pacific  
P.O. Box 1539  
Townsville, Queensland,  
4810 Australia  
robin.south@impac.org.au

### ***Halymenia* Team**

Isabella A. Abbott  
Botany Department  
University of Hawaii–Manoa  
3190 Maile Way  
Honolulu, HI 96822 USA  
iabbott@hawaii.edu

Shigeo Kawaguchi  
Faculty of Agriculture  
Department of Fisheries  
Kyushu University  
Fukuoka, Japan 812-8581  
skawaga@agr.kyushu-u.ac.jp

### ***Gracilaria* Team**

Isabella A. Abbott  
Botany Department  
University of Hawaii–Manoa  
3190 Maile Way  
Honolulu, HI 96822 USA  
iabbott@hawaii.edu

Anong Chirapart  
Faculty of Fisheries  
Kasetsart University  
Bangkok 10900, Thailand  
ffisanc@ku.ac.th

Khanjanapaj Lewmanomont  
Faculty of Fisheries  
Kasetsart University  
Bangkok 10900, Thailand  
ffiskpl@ku.ac.th

Karla J. McDermid  
Marine Science Dept.  
University of Hawaii–Hilo  
200 W. Kawili St.  
Hilo, HI 96720 USA  
mcdermid@hawaii.edu

Alan J. K. Millar  
Royal Botanic Gardens  
Mrs. Macquarries Rd.  
Sydney, NSW, 2000 Australia  
alan.millar@rbgsyd.nsw.gov.au

James N. Norris  
National Museum of Natural History  
Smithsonian Institution  
P.O. Box 37012  
Washington, D.C. 20013-7012 USA  
norris.james@nmnh.si.edu

Posa A. Skelton  
International Ocean Institute  
Regional Centre for Australia & the  
Western Pacific  
P.O. Box 1539  
Townsville, Queensland,  
4810 Australia  
posa.skelton@impac.org.au

G. Robin South  
International Ocean Institute  
Regional Centre for Australia & the  
Western Pacific  
P.O. Box 1539  
Townsville, Queensland,  
4810 Australia  
robin.south@impac.org.au

Brooke Stuercke  
Marine Science Dept.  
University of Hawaii–Hilo  
200 W. Kawili St.  
Hilo, HI 96720 USA  
stuercke@hawaii.edu

Ryuta Terada  
Faculty of Fisheries  
Kagoshima University  
4-50-20 Shimoarata, Kagoshima City  
890-0056 Japan  
terada@fish.kagoshima-u.ac.jp

Xia Bangmei  
Institute of Oceanology  
Academia Sinica  
7 Nan Hai Road  
Qingdao, People's Republic of China  
bmxia@ma.qdio.ac.cn

### ***Laurencia Team***

Karla J. McDermid  
Marine Science Dept.  
University of Hawaii–Hilo  
200 W. Kawili St.  
Hilo, HI 96720 USA  
mcdermid@hawaii.edu

Ki Wan Nam  
Department of Marine Biology  
Pukyong National University  
Nam-gu, Pusan 608-737  
Korea  
kwnam@pknu.ac.kr

### **UH–Hilo Students**

Yumi Kamada  
Sara McCutcheon  
Marybeth Murphy  
Jeremy Polloi

### **Visitors**

Jack Fisher  
Botany Department  
Bernice Pauahi Bishop Museum  
1525 Bernice St.  
Honolulu, HI 96817 USA  
jfisher@bishopmuseum.org

John Huisman  
Biological Sciences and  
Biotechnology  
Murdoch University, Murdoch, WA 6150  
Australia  
J.Huisman@murdoch.edu.au

Ryan Okano  
Botany Department  
University of Hawaii–Manoa  
3190 Maile Way  
Honolulu, HI 96822 USA  
ryano@hawaii.edu

Chris Puttock  
Botany Department  
Bernice Pauahi Bishop Museum  
1525 Bernice St.  
Honolulu, HI 96817 USA  
cputtock@bishopmuseum.org

Celia Smith  
Botany Department UH Manoa  
3190 Maile Way  
Honolulu, HI 96822 USA  
celia@hawaii.edu

James Sullivan  
California Sea Grant  
P.O. Box 2065  
Del Mar, CA 92014 USA  
jamesjsull@aol.com

## Notes

### About Chinese Names

In accordance with the national change made in China in 1987, Chinese names are listed with surname first, no comma, and given name last, with a different spelling than before. A good example of old style and new style is Chang, C. F. (old), vs. Zhang Junfu (new). For another example, Lu Baoren's first name is Baoren. Because he is known in the West as C. K. Tseng, Dr. Tseng has asked us to list his name in this Western style.

### About Vietnamese Names

In this volume, we use whole names (all three pieces of the name) for Vietnamese authors at first mention in the text and in the Literature Cited (references) section. When we speak to them, we use the last of the three name pieces as their "familiar" name. The reason that many of our Vietnamese colleagues use their third name is that Vietnam has only a very few family names, and the "familiar" name is the one that distinguishes each individual. You would be surprised to find that Pham Hoang Ho is listed as Ho about as many times as he is listed as Pham in the literature. But he never explained what the order of names meant. Now, we know; so please observe this usage.

### Listing Species Names

In accordance with the practices of the international journal *Taxon* and the adoption of this practice in volume 4 of the workshop series, reference to place of publication follows author name(s) of nomenclature of species, basionyms, synonyms, types, and so forth and is not listed in the Literature Cited sections (references). On the other hand, if the species and author(s) are listed in the text, for example, in the discussion, this citation is listed in Literature Cited. An example is as follows:

*Sargassum ilicifolium* (Turner) C. Agardh, Sp. algarum, p. 11, 1820.

Basionym: *Fucus ilicifolius* Turner, Fuci...vol. 1, p. 113, pl. 51, 1808.

The order is species name, author name, place of publication (i.e., name of either book or journal), volume number, page number(s), plate or figure number(s), and date. If this style is followed, no one will ever create an illegitimate name, many of which occur because an author did not provide the exact reference in which the species are described. Article 33.2 of the International Code of Botanical Nomenclature states: "A new combination... for a previously and validly published name is not validly published unless its basionym...is clearly indicated and a full and direct reference given to its author and place of valid publication with page or plate reference and date."

## Literature Cited

In this volume, all references to volumes from the eight previous workshops are listed in nomenclature setups and in Literature Cited as “Tax. Econ. Seaweeds 1 (or 2, 3, 4, 5, 6, 7, or 8),” followed by page and figure numbers, instead of giving the whole citation including editor, place of publication, and so forth. Inasmuch as the entire citation for each volume takes five lines of type, it will save a lot of ink and paper if we shorten the references within the volume. The entire citations are given here for reference:

*Taxonomy of economic seaweeds:* with reference to some Pacific and Caribbean species, vol. 1. I. A. Abbott and J. N. Norris, eds. [i–ii] + iii–xv + 1–167, 1985. California Sea Grant College, University of California, La Jolla, Calif. Report No. T-CSGCP-011.

*Taxonomy of economic seaweeds:* with reference to some Pacific and Caribbean species, vol. 2. I. A. Abbott, ed. [i–ii] + iii–xv + 1–265, 1988. California Sea Grant College, University of California, La Jolla, Calif. Report No. T-CSGCP-018.

*Taxonomy of economic seaweeds:* with reference to some Pacific and Western Atlantic species, vol. 3. I. A. Abbott, ed. [i–ii] + iii–xiv + 1–241, 1992. California Sea Grant College, University of California, La Jolla, Calif. Report No. T-CSGCP-023.

*Taxonomy of economic seaweeds:* with reference to some Pacific species, vol. 4. I. A. Abbott, ed. [i–ii] + iii–xvii + 1–200, 1994. California Sea Grant College, University of California, La Jolla, Calif. Report No. T-CSGCP-031.

*Taxonomy of economic seaweeds:* with reference to some Pacific species, vol. 5. I. A. Abbott, ed. [i–ii] + iii–xx + 1–254, 1995. California Sea Grant College System, University of California, La Jolla, Calif. Report No. T-CSGCP-035.

*Taxonomy of economic seaweeds:* with reference to some Pacific species, vol. 6. I. A. Abbott, ed. [i–ii] + iii–xviii + 1–212, 1997. California Sea Grant College System, University of California, La Jolla, Calif. Report No. T-040; ISBN 1-888691-04-2.

*Taxonomy of economic seaweeds:* with reference to some Pacific species, vol. 7. I. A. Abbott, ed. [i–ii] + iii–xviii + 1–181, 1999. California Sea Grant College System, University of California, La Jolla, Calif. Report No. T-044; ISBN 1-888691-08-5.

*Taxonomy of economic seaweeds:* with reference to some Pacific species, vol. 8. I. A. Abbott and K. McDermid, eds. [i–ii] + iii–xviii + 1–332, 2002. California Sea Grant College System, University of California, La Jolla, Calif. Report No. T-048; ISBN 1-888691-07-7.

## Section I. Invited Paper: On Taxonomy and Nomenclature

### INTRODUCTION: DEFINING CURRENT TAXONOMY

Isabella A. Abbott

“Taxonomy of Economic Seaweeds” has been the short cut to describe what the past nine Workshops have been doing for 18 years. We all think we know how to define that word “taxonomy,” and we usually say it means to put a correct name, or give a correct name, to an organism, in our case an alga. At our first meeting in Guam, taxonomy meant writing up the species in our respective algal floras; it became clear almost immediately that many names we were using were incorrect (mostly superceded by studies in far-off places, or published in journals we never heard of). Sometimes the person we were sitting next to was a specialist in the group of algae under consideration, and we didn’t know that. We are all specialists in one degree or another. But as of the Vietnam Workshop (the 8th, held in 1999) we have been moved, perhaps because we weren’t paying too much attention, into the 21st century by papers that included molecular genetics, which is to say, quantitative phylogenetics, which is technically a step beyond phylogeny from a strictly morphological perspective.

Foreseeing this change for many of us is a giant step since we are still preoccupied with “old-fashioned” taxonomy based on morphology and anatomy. We can rather easily find new species in our floras, and we can always take an alga that has had an incorrect name when it was listed from our flora and give a correct name to it.

But things have changed rather precipitously: the morphological tools we know well are only part of the contribution to taxonomy that is concerned with naming taxa.

In the course of the Workshops, all of us have learned to acknowledge that there are rules of nomenclature we must adhere to, but we can't learn them all at once. (That's true, learn a few rules at a time—learn them so well that you can argue with others about them! That will give you courage to learn a few more!) Knowing the rules gives you a very strong bridge on which to stand—morphologically strong. Understanding them will give you the best foundation for being able to interpret and understand the impact of molecular studies upon “old-fashioned” taxonomy. As you will see when you read Dr. Silva's chapter, it took him a very long time to figure out all of this—he is a good leader to follow.